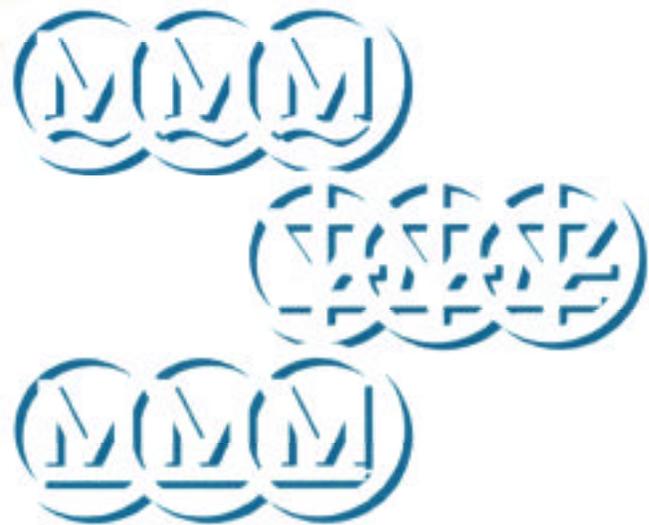


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SIMOREG® 6RA24

Instructions

Safety Installation Operation



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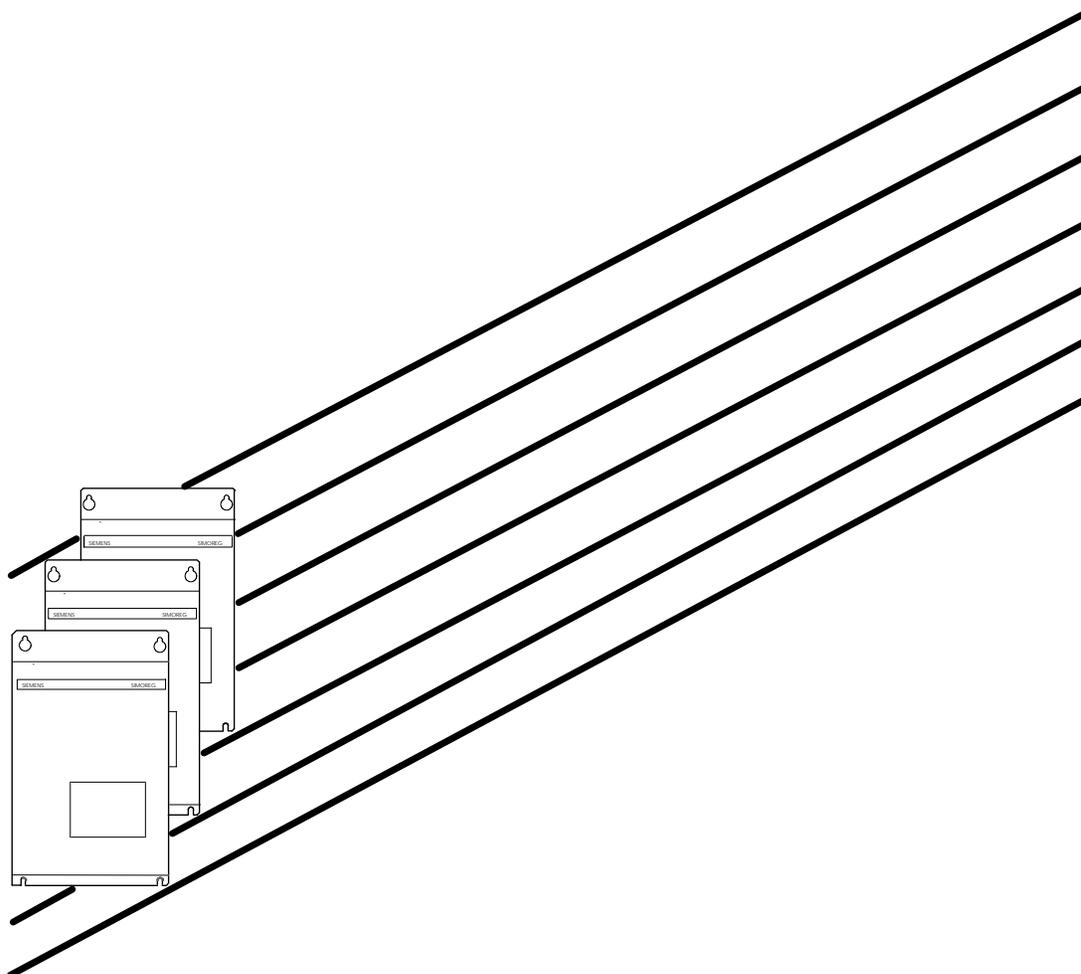
SIMOREG 6RA24

Instructions

Safety

Installation

Operation



NOTE These instructions do not purport to cover all details or variations in equipment, nor to provide for every possible contingency to be met in connection with installation, operation, or maintenance. Should further information be desired or should particular problems arise which are not covered sufficiently for the purchaser's purposes, the matter should be referred to the local Siemens sales office. The contents of this instruction manual shall not become part of or modify any prior or existing agreement, commitment, or relationship. The sales contract contains the entire obligation of the Motors and Drives Division. The warranty contained in the contract between the parties is the sole warranty of Siemens Motors and Drives Division. Any statements contained herein do not create new warranties or modify the existing warranty.

Documentation for the SIMOREG, 6RA24, DC drive. Software Version 2.00, 2.10, 2.20, 2.30.

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Siemens Energy & Automation, Inc
Motors and Drives Division
100 Technology Drive
Alpharetta, GA 30202

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1. Safety Information

**WARNING**

This equipment contains hazardous voltages and hazardous rotating mechanical parts.



Loss of life, severe personal injury or property damage can result if instructions contained in this manual are not followed.

Only qualified personnel should work on this equipment, and only after becoming familiar with all safety notices, installation, operation and maintenance procedures contained in this manual. The successful and safe operation of this equipment is dependent upon proper handling,

Definitions:**Qualified Person:**

For the purpose of this instruction manual and product labels, a QUALIFIED PERSON is one who is familiar with the installation, construction, operation and maintenance of the equipment, and the hazards involved. In addition, the person must have the following qualifications:

1. Is trained and authorized to energize, de-energize, clear, ground and tag circuits and equipment in accordance with established safety practices.
2. Is trained in the proper care and use of protective equipment such as rubber gloves, hard hat, safety glasses or face shields, flash clothing, etc., in accordance with established safety practices.
3. Is trained in rendering first aid.

DANGER:

For the purpose of this instruction manual and product labels, DANGER indicates loss of life, severe personal injury or substantial property damage WILL result if proper precautions are not taken.

WARNING:

For the purpose of this instruction manual and product labels, WARNING indicates loss of life, severe personal injury or substantial property damage CAN result if proper precautions are not taken.

CAUTION:

For the purpose of this instruction manual and product labels, CAUTION indicates minor personal injury or property damage can result if precautions are not taken.

NOTE:

For the purpose of this manual, NOTES merely call attention to information that is especially significant in understanding and operating the drive.



DANGER



Hazardous voltages are used in the operation of this equipment and will cause severe personal injury or loss of life. The following precautions should be followed to reduce risk of injury or death.

1. Only qualified personnel familiar with the equipment and the information supplied with it should be permitted to install, operate, troubleshoot or repair the apparatus.
2. Installation of the equipment must be done in accordance with the National Electric Code and any other state or local codes. Proper grounding, conductor sizing and short circuit protection must be installed for safe operation.
3. During normal operation keep all covers in place and cabinet doors shut.
4. When performing visual inspection and maintenance, be sure the incoming AC feed is turned off and locked out. The drive and motor will have hazardous voltages present until the AC feed is turned off. The drive contactor does not remove hazardous voltages when it is opened.
5. When it is necessary to make measurements with the power turned on, do not touch any electrical connection points. Remove all jewelry from wrist and fingers. Make sure test equipment is in good, safe operating condition.
6. While servicing with the power on, stand on some type of insulation, being sure not to be grounded.
7. Follow the instructions given in this manual carefully and observe all danger, warning, and caution notices.
8. This list does not represent an exhaustive survey of the steps necessary to insure safe operation of the equipment. Should further information be desired, or should particular problems arise which are not covered sufficiently for the purchaser's purposes, the matter should be referred to the local Siemens sales office.

2.1 Power Module Part Numbers: (5 to 300 HP @ 500 VDC)

RATING (Amps DC)	1Q PART NUMBER	1Q TYPE (MLFB)	4Q PART NUMBER	4Q TYPE (MLFB)
15	A1-116-110-503	6RA2413-1FS22	A1-116-150-503	6RA2413-1FV62
30	A1-116-110-504	6RA2418-1FS22	A1-116-150-504	6RA2418-1FV62
60	A1-116-110-505	6RA2425-1FS22	A1-116-150-505	6RA2425-1FV62
90	A1-116-110-506	6RA2428-1FS22	A1-116-150-506	6RA2428-1FV62
123	A1-116-110-508	6RA2471-1FS22	A1-116-150-508	6RA2471-1FV62
175	A1-116-110-509	6RA2474-1FS22	A1-116-150-509	6RA2474-1FV62
255	A1-116-110-511	6RA2477-1FS22	A1-116-150-511	6RA2477-1FV62
510	A1-116-110-513	6RA2483-1FS22	A1-116-150-513	6RA2483-1FV62

2.2 Base Drive Part Numbers: (5 to 500 HP @ 500 VDC)

RATING (Amps DC)	1Q PART NUMBER	1Q TYPE (MLFB)	4Q PART NUMBER	4Q TYPE (MLFB)
15	A1-116-210-503	6RA2413-2FS22	A1-116-250-503	6RA2413-2FV62
30	A1-116-210-504	6RA2418-2FS22	A1-116-250-504	6RA2418-2FV62
60	A1-116-210-505	6RA2425-2FS22	A1-116-250-505	6RA2425-2FV62
90	A1-116-210-506	6RA2428-2FS22	A1-116-250-506	6RA2428-2FV62
123	A1-116-210-508	6RA2471-2FS22	A1-116-250-508	6RA2471-2FV62
175	A1-116-210-509	6RA2474-2FS22	A1-116-250-509	6RA2474-2FV62
255	A1-116-210-511	6RA2477-2FS22	A1-116-250-511	6RA2477-2FV62
510	A1-116-210-513	6RA2483-2FS22	A1-116-250-513	6RA2483-2FV62
850 (60" Panel)	A1-116-210-516	6RA2487-2FS22	A1-116-250-516	6RA2487-2FV62
850 (78" panel)	A1-116-210-517	6RA2487-2FS22-Z	A1-116-250-517	6RA2487-2FV62-Z

2.3 6RA24 Field Supply Part Numbers: (For high power designs > 500 HP)

A separate field supply is required for all tripler designs.

The following single phase supplies are limited to 300 volt fields with 460 VAC input and 150 volt fields with 230 VAC input.

RATING (Amps DC)	1Q PART NUMBER
25/50	A1-116-180-502
85	A1-116-180-504

The following 3 phase field supplies are also available for use with the 6RA24 tripler designs.

Note: Since September 1996 standard power modules can also be used for field excitation requirements.

RATING (Amps DC)	1Q PART NUMBER	4Q PART NUMBER
15	A1-116-111-503	A1-116-151-503
30	A1-116-111-504	A1-116-151-504
60	A1-116-111-505	A1-116-151-505
90	A1-116-111-506	A1-116-151-506
123	A1-116-111-508	A1-116-151-508
175	A1-116-111-509	
255	A1-116-111-511	

2.4 Option Part Numbers:

Operator Panel: (Required when Z2006 is used)

Catalog Number LCD2401L (includes standard length interconnect cable)
(Siemens # 6RX1240-OAP20 SE&A # A1-108-101-802)

Operator Panel Extension Cables:

Catalog Number KPR241L (3 foot long shielded operator panel cable A1-116-009-804)
Catalog Number KPR242L (6 foot long shielded operator panel cable A1-116-009-805)

Z2006 Technology Board: (Requires Optional Operator Panel)

Catalog Number Z06240L (without software EPROM's A1-106-101-813)

Z2006 Technology Board EPROM's (Requires Optional Operator Panel)

Catalog Number Z06242L Sectional Drive Type 1
Catalog Number Z06243L CEMF Winder Type 3
Catalog Number Z06244L Armature Winder Type 4
Catalog Number Z06245L Drum surface Winder Type 5

CB24 Communications Board:

A1-116-101-051
(Siemens # 6RX1240-0AK01)

CB24 Communications Board Kit:

Catalog # CS5101L
Includes PC board, Z2006 Interconnect Cable, Shipping Box

Interconnect Cable Z2006 to CB24:

A1-108-031-501 Required for CB24 and Z2006 combination.

A1618 RS232 to RS485 Converter for Base Port 1:

Catalog # RX24502L (Siemens # 6RX1240-0AL01) (See sections 6.9.6 and 10.7)

Motor Interface:

Catalog # XM22401L (Siemens # 6RX1240-0AL00) (See section 6.9.7 and parameter P146)

2.5 Reference Drawings:

1Q Power Module Schematics	Drawing A1-316-110-401
1Q Base Drive Schematics	Drawing A1-316-210-401
1Q Power Interface Board Schematics	Drawing A1-316-100-401
4Q Power Module Schematics	Drawing A1-316-150-401
4Q Base Drive Schematics	Drawing A1-316-250-401
4Q Power Interface Board Schematics	Drawing A1-316-100-404

2.6 Technical Support:

Should you have problems with your SIMOREG 6RA24 drive equipment and have trouble locating the cause or resolving the situation, Siemens maintains a staff of trained drives personnel in our Product Service Group, who are ready to assist. The Product Service Group is a single point of contact for remote technical and field service support. See section 2.8 for more information.

2.7 Spare Parts & Repair/Return

Personnel in this group are trained to reduce the need for on-site service. Surveys indicate that as many as 70% of product questions can be resolved by telephone through the Product Service Group. However, when additional assistance is required, the Product Service Group will schedule equipment commissioning, coordinate on-site field service (emergency or routine maintenance), or arrange for spare parts shipments.

To expedite technical assistance, having some basic product information available when you call is extremely helpful. Typical information that is of value includes:

- Part number(s), Serial number(s), Date purchased
- Company that purchased the equipment (if not purchased directly from Siemens)
- For technical assistance or field service, a description of the problem or symptoms is of extreme value. This should include any fault codes that have appeared and any parameter values that have been observed.
- Know what options (if any) are being used. For example: CB24 Serial Communications, or Z2006 technology board options.

Should the need arise for the replacement of a part, Siemens is ready. Call your local Siemens sales office, your Siemens drives distributor, or the Drive Products Customer Service Group. Please have the following information available:

- a. Company name
- b. Part Number(s) of items you wish to order or return
- c. One of the following:
 - Serial Number of the SIMOREG drive controller
 - Siemens Energy & Automation Sales Order Number
 - Original P.O. Number (if ordered from Siemens).
- d. Reason for replacement (failure symptom, if applicable)
- e. Purchase order number
- f. If you wish to place an order directly with Siemens Energy & Automation, and you are a new customer of the Motors & Drives Division, you will also need to furnish the following information:
 - Company Billing Address
 - Company Contact
 - Company Telephone Number (and FAX Number, if available)
 - If you are presently a Siemens customer, with which companies or divisions?
 - Customer Type (Distributor, OEM, User, etc.)?
 - Approximate Expected Annual Business in Drives
 - Tax Exemption Status:

If tax exempt, we need a copy of your tax exemption certificate for our files. Please note that tax is charged on the "ship-to" address, according to applicable tax laws. If you will have shipping addresses in multiple states, we will need a copy of your tax exemption certificate for each state, otherwise tax will be charged.

A credit line will be established by our Credit Manager. Our Credit Department is located in Norwood, OH, telephone number (513) 841-3141.

Warranty Replacement - Emergency

If you are in an emergency situation and after your warranty is commercially validated, we will ship a replacement part to you, via "Next Day Air", initially at no charge.

Instructions for return of the failed part will be provided, separately, by your Customer Service Representative.

Warranty Replacement - Non-Emergency

Instructions for return of the failed part will be provided by your Customer Service Representative. Upon receipt and inspection of the failed part, we will immediately forward a replacement part to you.

Warranty Cost

Assuming technical validation of the warranty claim, no charge will be issued against your purchase order. If the failure of the part is due to causes not covered under the Siemens warranty, or if you fail to return the defective part within sixty (60) days from the date of receipt of return instructions, you will be invoiced in full for the replacement part.

Non-Warranty Spare Parts

If your warranty has expired, Siemens maintains an excellent supply of new parts, available for direct shipment. At your discretion, you are welcome to take advantage of our "Next Flight Out" or "Next Day" expedited shipment plans, subject to additional nominal published charges.

Exchange Program

The Drive Products Business Unit offers an excellent exchange program for repair of parts which are no longer under warranty. Highly trained technicians perform incoming tests to determine the exact cause of failure, effect repairs and fully test the equipment.

For many parts, SE&A offers an exchange from stock program at a substantial reduction in price, compared to a new part. Should you be in an emergency situation, we will supply a remanufactured part from stock. Your existing part must be returned, following our return goods authorization procedures. If for some reason your part is not returned to us within sixty (60) days, you will be billed an additional 20% of the price of the replacement part.

Remanufactured parts carry a ninety (90) day warranty. Please note, not all parts are available under this program.

2.8 Emergency Services**Spare Parts**

An excellent stock of drive products spare parts is maintained at Atlanta Hartsfield International Airport. Same day delivery and after hour shipments can be serviced from this stock, including on weekends and holidays. To activate Emergency/After Hours Service, simply call our Customer Service Group general phone number:

(770) 740-3535

Advise the operator there is an emergency and you would like to contact after hours personnel for the Drive Products Group (Account 3492). We will return your call and get the part on its way immediately!

Technical Assistance

Should you need technical assistance (other than ordering a part) and the Product Service Group is unavailable, a reliable answering service ensures that your request is relayed immediately to one of our engineers. Simply call any of the daytime Product Service telephone numbers to access this service:

(770) 740-3523

(770) 740-3585

If you prefer, a toll free number provides day and night access to our Field Service Operation:

(800) 241-4453

2.9 Standard Warranty

Company warrants that on the date of shipment to the Purchaser the goods will be of the kind and quality described in the initial contract, merchantable, and free of defects in workmanship and material.

If within one year from date of initial operation, but not more than eighteen months from date of shipment by Siemens Energy & Automation, of any item of the goods, Purchaser discovers that such item was not as warranted above and promptly notifies Company in writing thereof, Company shall remedy such defect by, at Company's option, adjustment, repair or replacement of the item and any affected part of the goods. Purchaser shall assume all responsibility and expense for removal, reinstallation and freight in connection with the foregoing remedy. The same obligations and conditions shall extend to replacement items furnished by Company hereunder. Company shall have the right of disposal of items replaced by it. Purchaser shall grant Company access to the goods at all reasonable times in order for Company to determine any defect in the goods. In the event that adjustment, repair or replacement does not remedy the defect, the Company and Purchaser shall negotiate in good faith an equitable adjustment in the contract price.

The Company's responsibility does not extend to any item of the goods which has not been manufactured and sold by the Company. Such item shall be covered only by the express warranty, if any, of the manufacturer thereof. The Company and its suppliers shall have no responsibility if the goods have been improperly stored, handled or installed, if the goods have not been operated or maintained according to their ratings or according to instructions in Company or supplier furnished manuals, or if unauthorized repairs or modifications have been made to the goods.

THIS WARRANTY IS EXPRESSLY IN LIEU OF ALL OTHER WARRANTIES (EXCEPT TITLE), INCLUDING BUT NOT LIMITED TO IMPLIED WARRANTIES OF MERCHANTABILITY AND FITNESS, AND CONSTITUTES THE ONLY WARRANTY OF COMPANY WITH RESPECT TO THE GOODS.

The foregoing states Purchaser's exclusive remedy against Company and its suppliers for any defect in the goods or for failure of the goods to be as warranted, whether Purchaser's remedy is based on contract, warranty, failure of such remedy to achieve its essential purpose, tort (including negligence), strict liability, indemnity or any other legal theory, and whether arising out of warranties, representations, instructions, installations or defects from any cause.

2.10 Reference Spare Parts List Chassis Designs (5 to 500 HP @ 500 VDC)

1. Printed Circuit Boards & Cables

DESCRIPTION	WHERE USED	PART NUMBER	RECOM SPARE
Main Microprocessor Board	all ratings	A1-116-101-801	1
EPROM Software Module	all ratings	A1-116-100-817	-
Power/Interface Board, 1-Quad armature	15 to 850 amp	A1-116-100-801	1
Power/Interface Board, 4-Quad armature	15 to 850 amp	A1-116-100-804	1
Power/Interface Board, 1-Quad field	15 to 255 amp	A1-116-100-511	1
Power/Interface Board, 4-Quad field	15 to 123 amp	A1-116-100-514	1
Snubber Board, 4-Quad only	15 to 510 amp	A1-116-100-502	-
Field Current Shunt Board, 2.5 Amps	15 amp	A1-116-100-507	-
Field Current Shunt Board, 5 Amps	30 amp	A1-116-100-508	-
Field Current Shunt Board, 10 Amps	60 to 123 amp	A1-116-100-509	-
Field Current Shunt Board, 15 Amps	175 & 255 amp	A1-116-100-510	-
Field Current Shunt Board, 20 Amps	510 amp	A1-116-100-512	-
Field Current Shunt Board, 35 Amps	850 amp	A1-116-100-513	-
Flat Cable assembly, 64 circuit	All	A1-216-031-501	-
Flat Cable Assembly, 26 circuit	All	A1-216-031-502	-

2. Thyristor & Diode Modules

Armature Converter Thyristor Modules (V1 - V6)

DESCRIPTION (CURRENT IS THE AVERAGE RATED AMPS)	WHERE USED	PART NUMBER	RECOM SPARE
Dual Thyristor Module, 18 A, 1400 V	15 amp	A1-116-001-002	1
Dual Thyristor Module, 56 A, 1400 V	30 amp & 60 amp	A1-116-001-004	1
Dual Thyristor Module, 105 A, 1400 V	90 to 175 amp	A1-116-001-006	1
Dual Thyristor Module, 162 A, 1400 V	255 amp	A1-116-001-008	1
Dual Thyristor Module, 425 A, 1400 V	510 amp	A1-116-001-010	1
Single Thyristor Module, 425 A, 1600 V	850 amp	A1-106-001-008	1

Field Converter Thyristor Modules (V7)

DESCRIPTION	WHERE USED	PART NUMBER	RECOM SPARE
Dual Thyristor Module, 18 A, 1400 V	15 amp	A1-116-001-002	1
Dual Thyristor Module, 56 A, 1400 V	30 to 850 amp	A1-116-001-004	1

Field Converter Diode Modules (D1)

DESCRIPTION	WHERE USED	PART NUMBER	RECOM SPARE
Dual Diode Module, 57 A, 1400 V	15 to 510 amp	A1-106-002-001	1
Dual Diode Module, 90 A, 1400 V	850 amp	A1-106-002-002	1

3. Power Fuses

Armature Converter AC Line Fuses (1PFU - 3 PFU)

DESCRIPTION	WHERE USED	PART NUMBER	RECOM SPARE
30 amp, 700 volt	15 amp	A1-FUF-END-CDH	2
60 amp, 500 volt	30 amp	A1-FUF-00D-013	2
100 amp, 500 volt	60 amp	A1-FUF-00D-017	2
150 amp, 500 volt	90 & 123 amp	A1-FUF-00D-019	2
200 amp, 500 volt	175 amp	A1-FUF-00D-021	2
300 amp, 500 volt	255 amp	A1-FUF-00D-025	2
600 amp, 500 volt	510 amp	A1-FUF-00D-031	2
1000 amp, 700 volt	850 amp	A1-FUB-FBC-045	2

Armature Converter DC Fuses, 4 Quad Only (4PFU)

DESCRIPTION	WHERE USED	PART NUMBER	RECOM SPARE
30 amp, 700 volt	15 amp	A1-FUF-END-CDH	2
60 amp, 700 volt	30 amp	A1-FUF-00E-013	2
100 amp, 700 volt	60 amp	A1-FUF-00E-017	2
150 amp, 700 volt	90 & 123 amp	A1-FUF-00E-019	2
200 amp, 700 volt	175 amp	A1-FUF-00E-021	2
300 amp, 700 volt	255 amp	A1-FUF-00E-025	2
600 amp, 700 volt	510 amp	A1-FUF-00E-031	2
1000 amp, 700 volt	850 amp	A1-FUB-FBC-045	2

Field Converter AC Line Fuses (1 & 2FSFU)

DESCRIPTION	WHERE USED	PART NUMBER	RECOM SPARE
30 amp, 700 volt	60 to 510 amp	A1-FUF-END-CDH	2
60 amp, 500 volt	850 amp	A1-FUB-HAA-JDP	2

4. Control Fuses

Control Transformer Primary Fuses (1CFU, 2CFU)

DESCRIPTION	WHERE USED	PART NUMBER	RECOM SPARE
2 amp, 600 volt, Class "CC"	15 to 90 amp	A1-FUF-AFA-009	2
3 amp, 600 volt, Class "CC"	123 to 255 amp	A1-FUF-AFA-013	2
5 amp, 600 volt, Class "CC"	510 & 850 amp	A1-FUF-AFA-016	2

Control Transformer Secondary Fuse (3CFU)

DESCRIPTION	WHERE USED	PART NUMBER	RECOM SPARE
2 amp, 250 volt, Type MDL	15 to 90 amp	A1-FUF-DKA-GBV	2
3 amp, 250 volt, Type MDL	123 to 255 amp	A1-FUF-DKA-GCD	2
6.25 amp, 250 volt, Type MDL	510 & 850 amp	A1-FUF-DKA-GCM	2

5. Control Transformer (1CTR)

DESCRIPTION	WHERE USED	PART NUMBER	RECOM SPARE
200 VA	15 to 90 amp	A1-TRC-Q0B-050	-
300 VA	123 to 255 amp	A1-TRC-Q0B-051	-
500 VA	510 & 850 amp	A1-TRC-Q0B-052	-

6. Main Contactor (M)

DESCRIPTION	WHERE USED	PART NUMBER	RECOM SPARE
3 Pole AC contactor, 120 VAC coil	15 amp	3TF4022-0AK6	-
3 Pole AC contactor, 120 VAC coil	30 amp	3TF4222-0AK6	-
3 Pole AC contactor, 120 VAC coil	60 amp	3TF4422-0AK6	-
3 Pole AC contactor, 120 VAC coil	90 amp	3TF4622-0AK6	-
3 Pole AC contactor, 120 VAC coil	123 amp	3TF4822-0AK6	-
3 Pole AC contactor, 120 VAC coil	175 amp	3TF5022-0AK6	-
3 Pole AC contactor, 120 VAC coil	255 amp	3TF5222-0AK6	-
1 Pole DC contactor, 125 VDC coil	510 amp	A1-CRD-CAC-007	-
1 Pole DC contactor, 125 VDC coil	850 amp	A1-CRD-CAC-007	-

Contactor Coil Suppressor (1SP)

DESCRIPTION	WHERE USED	PART NUMBER	RECOM SPARE
Suppressor, varistor type	15 to 60 amp	3TX7402-3J	-
Suppressor, varistor type	90 to 255 amp	3TX7462-3J	-

Contactor Auxiliary Relay (2MX) & Relay Coil Suppressor (2SP)

DESCRIPTION	WHERE USED	PART NUMBER	RECOM SPARE
Relay, 2-NO, 2-NC, 120 VAC coil (2MX)	123 to 850 amp	3TH2022-0AK6	-
Suppressor, varistor type (2SP)	123 to 850 amp	3TX4490-3J	-

DC Contactor Rectifier Bridge (MREC)

DESCRIPTION	WHERE USED	PART NUMBER	RECOM SPARE
Rectifier Bridge, 1 Phase, 800 V	510 & 850 amp	A1-116-002-001	-

7. Current Transformer (T2, T3)

DESCRIPTION	WHERE USED	PART NUMBER	RECOM SPARE
2000:1 ratio	15 to 90 amp	A1-116-010-002	-
2000:1 ratio	123 & 175 amp	A1-116-010-003	-
2000:1 ratio	255 & 510 amp	A1-116-010-004	-
1200:5 ratio	850 amp	A1-TRC-R0N-001	-

8. Blower Assembly & Capacitor**Blower (HSFAN)**

DESCRIPTION	WHERE USED	PART NUMBER	RECOM SPARE
36 CFM, 115 VAC	123 amp	A1-316-010-501	-
365 CFM, 115 VAC	175 to 510 amp	A1-308-010-508	-
710 CFM, 115 VAC	850 amp	A1-FAA-L00-018	-

Blower Capacitor (C1 or C7)

DESCRIPTION	WHERE USED	PART NUMBER	RECOM SPARE
7.5 MFD, 370 VAC (C1)	175 to 510 amp	A1-CCQ-VEM-001	-
16 MFD, 370 VAC (C7)	850 amp	A1-106-030-022	-

2.11 Reference Spare Parts List High Power Tripler Designs (> 500 HP @ 500 VDC)**1. Printed Circuit Boards**

DESCRIPTION	WHERE USED	PART NUMBER	RECOM SPARE
Main Microprocessor Board	all ratings	A1-116-101-801	1
EPROM Software Module	all ratings	A1-116-100-817	-
Power/Interface Board, 1 or 4 Quad	all ratings	A1-116-100-805	1
Snubber & Pulse Transformer Board	all ratings	A1-103-100-532	1
Attenuator / CT Board	all ratings	A1-116-100-516	-
Field Supply Control Board 25 / 50 A	25/50 A Field	A1-116-100-515	1
Field Supply Control Board 85 A	85 A Field	A1-116-100-525	

2. Tripler Part Numbers

DESCRIPTION	FUSES	WHERE USED	PART NUMBER	RECOM SPARE
Common Cathode	700 A / 700 V	830 Amp Drive	A1-106-106-501	-
Common Anode		230 to 575 VAC	A1-106-106-502	-
Common Cathode	1250 A / 700 V	1660 Amp Drive	A1-106-106-503	-
Common Anode		230 to 575 VAC	A1-106-106-504	-
Common Cathode	1250 A / 700 V	1660 Amp Drive	A1-106-106-505	-
Common Anode		460 to 650 VAC	A1-106-106-506	-
Common Cathode	1000 A / 1000 V	1330 Amp Drive	A1-106-106-511	-
Common Anode		460 to 650 VAC	A1-106-106-512	-

3. Thyristor Part Numbers

THYRISTOR DESCRIPTION	WHERE USED	PART NUMBER	RECOM SPARE
850 Amp RMS, 1600 Volt	830 Amp Drive 230 to 575 VAC	A1-103-001-020	2
1880 Amp RMS, 1600 Volt	1660 Amp Drive 230 to 575 VAC	A1-103-001-021	2
1880 Amp RMS, 2200 Volt	1660 Amp Drive 460 to 650 VAC	A1-103-001-025	2
1880 Amp RMS, 2200 Volt	1330 Amp Drive 460 to 650 VAC	A1-103-001-025	2

4. Thyristor Fuse Part Numbers

DESCRIPTION	WHERE USED	PART NUMBER	RECOM SPARE
700 Amp, 700 Volt	830 Amp Drive 230 to 575 VAC	A1-FUB-FBC-042	4
1250 Amp, 700 Volt	1660 Amp Drive 230 to 650 VAC	A1-FUB-FBC-048	4
1000 Amp, 1000 Volt	1330 Amp Drive 460 to 650 VAC	A1-FUB-FFP-010	4

5. Fans

DESCRIPTION	WHERE USED	PART NUMBER	RECOM SPARE
Tripler Fan	All Triplers	A1-FAA-L00-010	1
Cabinet Roof Fan	All Cabinet Designs	A1-FAA-L00-020	1
85 Amp Field Supply Fan	85 Amp Field Supply	A1-FAA-L00-002	

6. Assemblies

DESCRIPTION	WHERE USED	PART NUMBER	RECOM SPARE
Complete Control Module	All	A1-116-180-501	1
Field Supply 1 Phase, 25 or 50 amps DC	per application	A1-116-180-502	1
Field Supply 1 Phase 85 amps DC	per application	A1-116-180-504	

7. Main Contactor (M)

DESCRIPTION	WHERE USED	PART NUMBER	RECOM SPARE
1 Pole DC contactor, 125 VDC coil	All ratings	A1-CRD-CAC-009	

DC Contactor Rectifier Bridge (MREC)

DESCRIPTION	WHERE USED	PART NUMBER	RECOM SPARE
Rectifier Bridge, 1 Phase, 800 V	All ratings	A1-116-002-001	-

8. 1 Phase Field Supply Thyristors and Diodes All Designs 25 to 85 amps

DESCRIPTION	WHERE USED	PART NUMBER	RECOM SPARE
Dual Thyristor Module, 105 A, 1400 V	Field Supply	A1-116-001-006	1
Dual Diode Module, 80/90 A, 1400 V	Field Supply	A1-116-002-002	1

3. Introduction

This manual is intended to provide the user a quick and simple procedure to get a basic SIMOREG drive connected and running in a short time. Although the SIMOREG offers many features and a high level of configurability, many applications can be met using the built-in default settings. In order to get the SIMOREG up and running it is only necessary to make the required wiring connections and set a few application dependent parameters.

3.1 Applications

SIMOREG converters are fully-digital compact converters for connection to a three phase AC line to provide armature and field supplies for DC variable-speed motors with rated currents from 5 to 850 amps. Continuous currents up to 3600 amps, 6 pulse, and 7200 amps, 12 pulse, are possible through the use of high power SIMOREG tripler designs. The SIMOREG converters are available for both single and four quadrant applications.

3.2 Design

SIMOREG converters are extremely compact. Ratings up to 510 amps are available in either Power Module designs, (no contactor or fuses), or as complete Base Drive designs. Above 510 amps only complete Base Drive designs are offered.

The modular design provides a high level of service friendliness as the individual components are easily accessible. The electronic box, that contains the basic electronics as well as supplementary boards can be easily swung out and removed to gain full access to the power circuits. The drive software is provided in a plug-in EPROM module which can be easily replaced if required.

External signals (binary input/output, analog input/output, pulse tachometer, etc.) are normally connected to terminals provided on the power interface board where two ribbon cables make the interconnection between this board and the main microprocessor board in the electronic box. As an option, shielded cables up to 2 meters long can be used in conjunction with external terminal modules to move the connections outside the converter in a cubicle.

SIMOREG converters can be easily parameterized using three optional methods. The first uses the three keys and five 7-segment displays located on the microprocessor board. The second method uses a supplementary operator panel that fits in the SIMOREG cover. This operator panel provides clear English text descriptions on a 2 line 16 character display along with keys that allow the parameters to be changed and the drive to be operated. The third method uses an RS232 serial port on the microprocessor board to interface with a conventional PC. Using start-up software included with the drive, the PC can be used for start-up, maintenance, and for trouble shooting. Among other things the PC software allows all parameters to be up or down loaded from PC files.

For single quadrant converters, the armature is supplied using a fully controlled three phase bridge, and for four quadrant converters, using two fully controlled three phase bridges connected in a circulating current free back to back configuration.

For converters rated 15 to 850 amps, the power section for both armature and field uses isolated thyristor modules which makes the heatsink electrically isolated from the power source and at ground potential. All connecting terminals are accessible from the front with the power connections at the top and the control connections at the bottom. For ratings between 850 and 4500 amps, the power section consists of tripler modules each containing 3 thyristors. The structure includes the connections to configure the tripler modules as three phase bridges with up to three bridges in parallel.

3.3 Technical Data: *Power Modules 15 to 510 amp (5 to 300 HP @ 500 VDC)*

Armature Supply Voltage	3 PHASE 460 VAC or 230 VAC (+10%, -5%) Phase Insensitive								
Field Supply Voltage	1 PHASE, Phase Insensitive 460 VAC FOR 300 VOLT FIELDS, 230 VAC FOR 150 VOLT FIELDS,								
Control and Fan Supply Voltage	1 PHASE, 115 VAC ($\pm 10\%$) Phase Insensitive								
Rated Frequency	Hz	45 to 65 Hz, Automatic Adaption							
Rated Armature Voltage	VDC	500 or 240 VDC depending on armature supply voltage							
Rated Armature Current	ADC	15	30	60	90	123	175	255	510
Rated HP @ 500 VDC	Hp	7½	15	30	50	75	100	150	300
Rated HP @ 240 VDC	Hp	3	7½	15	25	30	50	75	150
Rated Field Current	ADC	2½	5	10	10	10	15	15	20
Control and Fan Supply Current	AAC	1.6	1.6	1.6	1.6	1.8	2.9	2.9	2.9
Power Loss (approximate)	Watts	125	140	230	320	420	500	800	1500
Weight (approximate)	lbs	24	24	30	30	35	45	50	55
Rated Field Voltage	VDC	300 or 150 VDC depending on field supply voltage							
Armature Overload	%	150% for 60 seconds							
Operational Ambient	°C	0°C to 50°C open panel, 40°C enclosed							
Storage Temperature	°C	-30°C to +85°C							
Installation Altitude	M (feet)	up to 1000 meters (3,300 feet)							
Ambient Humidity	%	Up to 95% noncondensing							
K1 Relay Contact Rating (used to operate a main contactor)		Maximum contactor coil load switchable with K1, at 115 VAC, is 20 VA closed, and 200 VA open. For larger contactors use an interposing relay such as Siemens 3TH2022-OAK6. For noise protection always provide an appropriate suppressor on contactor and relay coils.							
K3 and K4 Relay Contact Rating		Normally open relay contacts rated maximum 5A, 125VAC resistive. See section 6.9.3 for terminal information.							
Binary Output Rating Terminals 46, 48, 50, & 52		High signal: +16 to +30 VDC Low signal: 0 to +2 VDC Output Current: Internal 24 volt supply = 10 ma per output External 24 volt supply = 100 ma per output							
Package Design		Open Chassis							
Speed Regulation	%	With pulse encoder and digital reference $\pm 0.01\%$ of top speed average ¹ With analog tachometer $\pm 0.1\%$ of top speed average							
Dimensions		Refer to Dimension Drawings Section 5.2							
Recommended Pulse Encoder Pulses per Revolution		For best results a pulse encoder with a minimum of 1024 PPR should be selected.							

Table 3.1
Power Modules 15 to 510 amp

Note 1:

Steady state speed regulation of up to $\pm 0.01\%$ of top speed, when averaged over 2 seconds or greater, is possible for well balanced and aligned mechanical systems that do not contain significant torsional resonance's within the speed loop bandwidth.

3.4 Technical Data: *Base Drives 15 to 850 amp (5 to 500 HP @ 500 VDC)*

Armature and Field Supply Voltage	3 PHASE 460 VAC or 230 VAC (+10%, -5%) Phase Insensitive									
Control and Fan Voltage	Internally supplied 115 VAC									
Rated Frequency	Hz	45 to 65 Hz, Automatic Adaption								
Rated Armature Voltage	VDC	500 or 240 VDC depending on armature supply voltage								
Rated Armature Current	ADC	15	30	60	90	123	175	255	510	850
Rated HP @ 500 VDC	Hp	7½	15	30	50	75	100	150	300	500
Rated HP @ 240 VDC	Hp	3	7½	15	25	30	50	75	150	250
Power Loss (approximate)	Watts	125	140	230	320	420	500	800	1500	2500
Rated Field Current	ADC	2½	5	10	10	10	15	15	20	35
Weight (approximate)	lbs	45	45	55	75	85	95	110	175	500
Rated Field Voltage	VDC	300 or 150 VDC depending on field supply voltage								
Armature Overload	%	150% for 60 seconds								
Operational Ambient	°C	0°C to 50°C open panel, 40°C enclosed								
Storage Temperature	°C	-30°C to +85°C								
Installation Altitude	M (feet)	up to 1000 meters (3,300 feet)								
Main Contactor Auxiliary Contact	Normally open relay contacts rated maximum 5A, 125VAC resistive. See section 6.8.7 for terminal information.									
K3 and K4 Relay Contact Rating Terminals 66-67 & 69-70	Normally open relay contacts rated maximum 5A, 125VAC resistive. See section 6.9.3 for terminal information.									
Binary Output Rating Terminals 46, 48, 50, & 52	High signal: +16 to +30 VDC Low signal: 0 to +2 VDC Output Current: Internal 24 volt supply = 10 ma per output External 24 volt supply = 100 ma per output									
Ambient Humidity	%	Up to 95% noncondensing								
Package Design	Open Chassis									
Speed Regulation	%	With pulse encoder and digital reference ±0.01% of top speed average ¹ With analog tachometer ±0.1% of top speed average								
Dimensions	Refer to Dimension Drawings Section 5.2									
Recommended Pulse Encoder Pulses per Revolution	For best results a pulse encoder with a minimum of 1024 PPR should be selected.									

Table 3.2
Base Drives 15 to 850 amp

Note 1:

Steady state speed regulation of up to ±0.01% of top speed, when averaged over 2 seconds or greater, is possible for well balanced and aligned mechanical systems that do not contain significant torsional resonance's within the speed loop bandwidth.

Note 2:

The 850 amp base drive has been designed to operate with an armature supply voltage of up to 600 VAC. Refer to page 6-14 for wiring modification information.

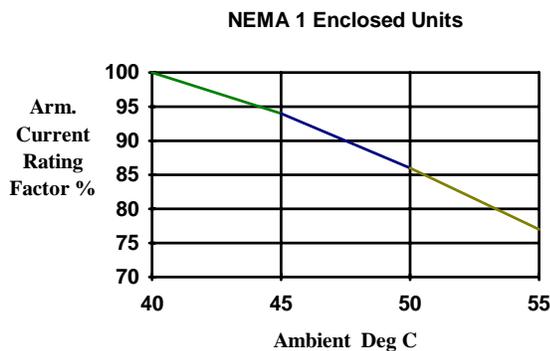
3.5 Technical Data: High Power Tripler Designs (>500 HP @ 500 VDC)

High power 6RA24 converters are built using tripler modules. Two tripler modules together form a three phase bridge. The tripler modules can be arranged in various configurations to provide ratings from 830 amps DC to 4500 amps DC. A summary of available ratings along with tripler part numbers is provided in the following table. Refer to the supplied job specific drawings for schematics and mechanical outline drawings.

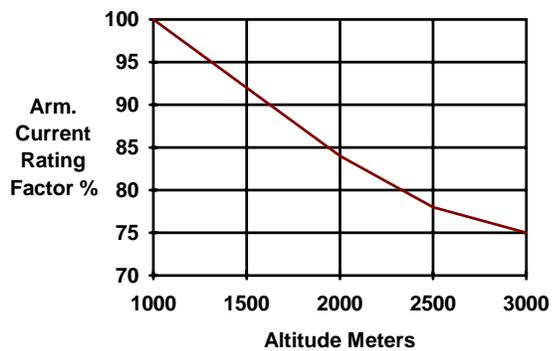
DC CURRENT	THYRISTOR TYPE	FUSE TYPE	(AC)/(DC) VOLTS	PATH	PART # C - Cathode	PART # C - Anode
830 A, 1/4 Q	T7SO, 1600 V	700 A / 700 V	(230 to 575 VAC) / (240 to 600 VDC)	1 PATH	A1-106-106-501	A1-106-106-502
1660 A, 1/4 Q	T9GO, 1600 V	1250 A / 700 V	(230 to 575 VAC) / (240 to 600 VDC)	1 PATH	A1-106-106-503	A1-106-106-504
1660 A, 1/4 Q	T9GO, 2200 V	1250 A / 700 V	(460 to 650 VAC) / (500 to 700 VDC)	1 PATH	A1-106-106-505	A1-106-106-506
1330 A, 1/4 Q	T9GO, 2200 V	1000 A / 1000 V	(460 to 650 VAC) / (500 to 700 VDC)	1 PATH	A1-106-106-511	A1-106-106-512
3100 A, 1Q	T9GO, 1600 V	1250 A / 700 V	(230 to 575 VAC) / (240 to 600 VDC)	2 PATH	A1-106-106-503	A1-106-106-504
3100 A, 1Q	T9GO, 2200 V	1250 A / 700 V	(460 to 650 VAC) / (500 to 700 VDC)	2 PATH	A1-106-106-505	A1-106-106-506
2600 A, 1Q	T9GO, 2200 V	1000 A / 1000 V	(460 to 650 VAC) / (500 to 700 VDC)	2 PATH	A1-106-106-511	A1-106-106-512
2600 A, 4Q	T9GO, 2200 V	1000 A / 1000 V	(460 to 650 VAC) / (500 to 700 VDC)	2 PATH	A1-106-106-511	A1-106-106-512
4500 A, 1Q	T9GO, 1600 V	1250 A / 700 V	(230 to 550 VAC) / (240 to 600 VDC)	3 PATH	A1-106-106-503	A1-106-106-504
4500 A, 1Q	T9GO, 2200 V	1250 A / 700 V	(460 to 650 VAC) / (500 to 700 VDC)	3 PATH	A1-106-106-505	A1-106-106-506
3600 A, 1Q	T9GO, 2200 V	1000 A / 1000 V	(460 to 650 VAC) / (500 to 700 VDC)	3 PATH	A1-106-106-511	A1-106-106-512
3600 A, 4Q	T9GO, 2200 V	1000 A / 1000 V	(460 to 650 VAC) / (500 to 700 VDC)	3 PATH	A1-106-106-511	A1-106-106-512

3.6 General Derating Information:

Ambient Derating:



Altitude Derating:



SIMOREG converters are packed at the manufacturing plant in protective containers suitable for shipping. Avoid dropping and shocks during unloading and moving the SIMOREG during receiving. Observe the instructions on the package for transport, storage, and correct handling.

The SIMOREG converter can be installed after it has been unpacked and inspected to make sure that the scope of supply is correct and that the unit was not damaged in transit.

4.1 Damage During Transit



WARNING



not be connected up without first being repaired and tested by a qualified repair person.

Loss of life, severe personal injury or property damage can result if instructions contained in this manual are not followed.

Only qualified personnel should work on this equipment, and only after becoming familiar with all safety notices, installation, operation and maintenance procedures contained in this manual. The successful and safe operation of this equipment is dependent upon proper handling,

Procedure for Shipping Damage

SIMOREG converters are normally shipped FOB factory making it the buyers responsibility to make sure the equipment is received undamaged. Carefully examine the equipment before accepting the shipment from the transport carrier. If you do not notify the carrier immediately of any damage you may lose your right to file a damage claim. If required you can request support from the local Siemens office.

- When received, examine the shipment to ensure that it is complete and not damaged.
- Damaged or missing items which are obviously visible should be specified in the shipping papers and must be countersigned by personnel from the transport company.
- Immediately notify the transport company in writing of any damage or missing items

Notes:

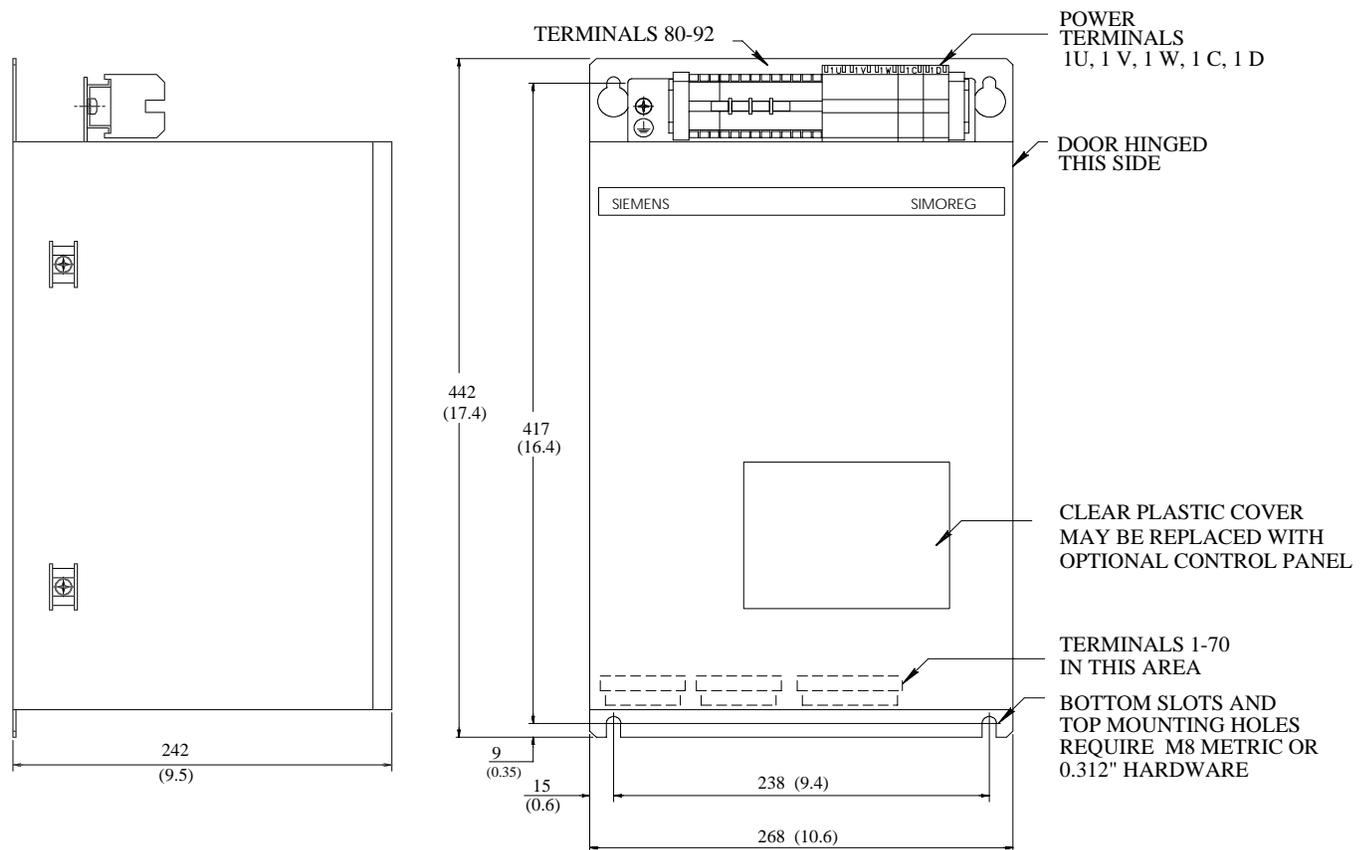
5. Installation

5.1 Mounting

SIMOREG drives up to 850 amps are designed as chassis units intended to be mounted inside a protective enclosure or inside a control room. The units are to be mounted vertically in cubicles with the power connections at the top and the control connections at the bottom. A 100 mm (4 inch) clearance must be kept above and below the converter in order to ensure unrestricted cooling air flow. The open chassis units are designed to operate in a 50°C ambient. When enclosed in a cubicle the ambient temperature outside the cubicle should not exceed 40°C which then allows for a 10°C temperature rise inside the cubicle. Care must be taken in the selection of the cubicle so that the internal temperature rise does not exceed 10°C.

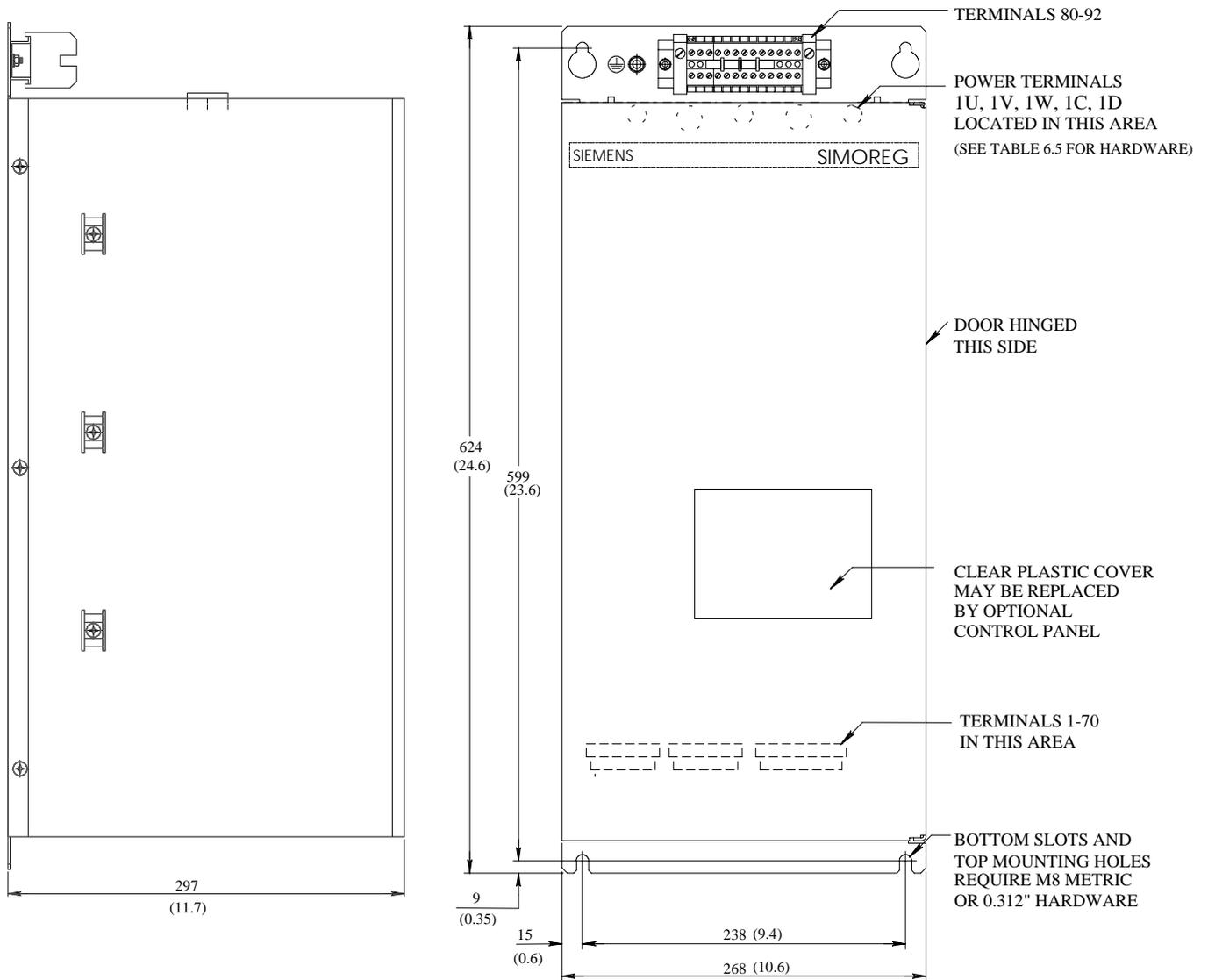
5.2 Dimension Drawings

NOTE: All dimensions are in mm and (inches).



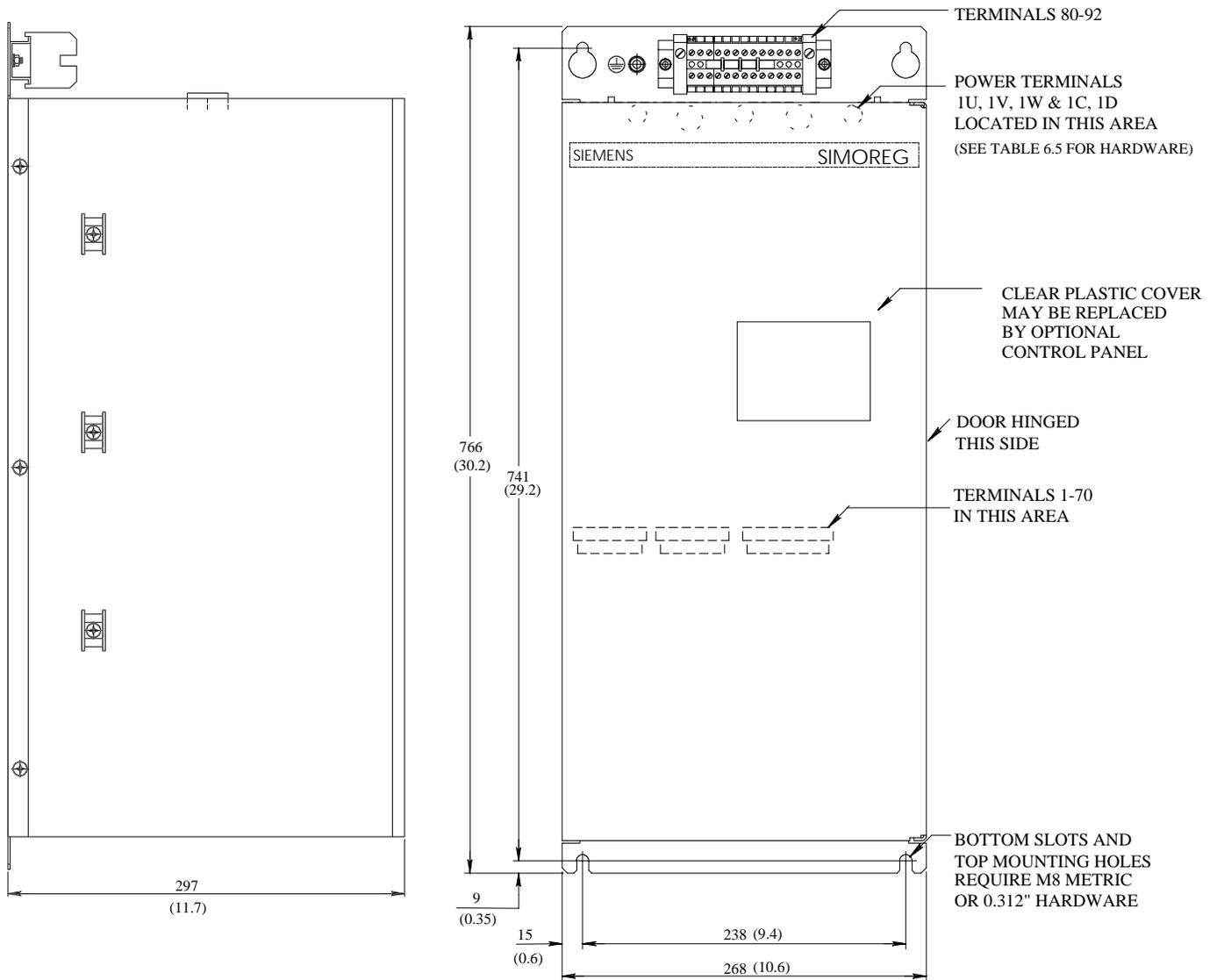
**15 to 90 Amp Power Modules (1 & 4Q)
(No Fuses or Contactor)**

NOTE: All dimensions are in mm and (inches).



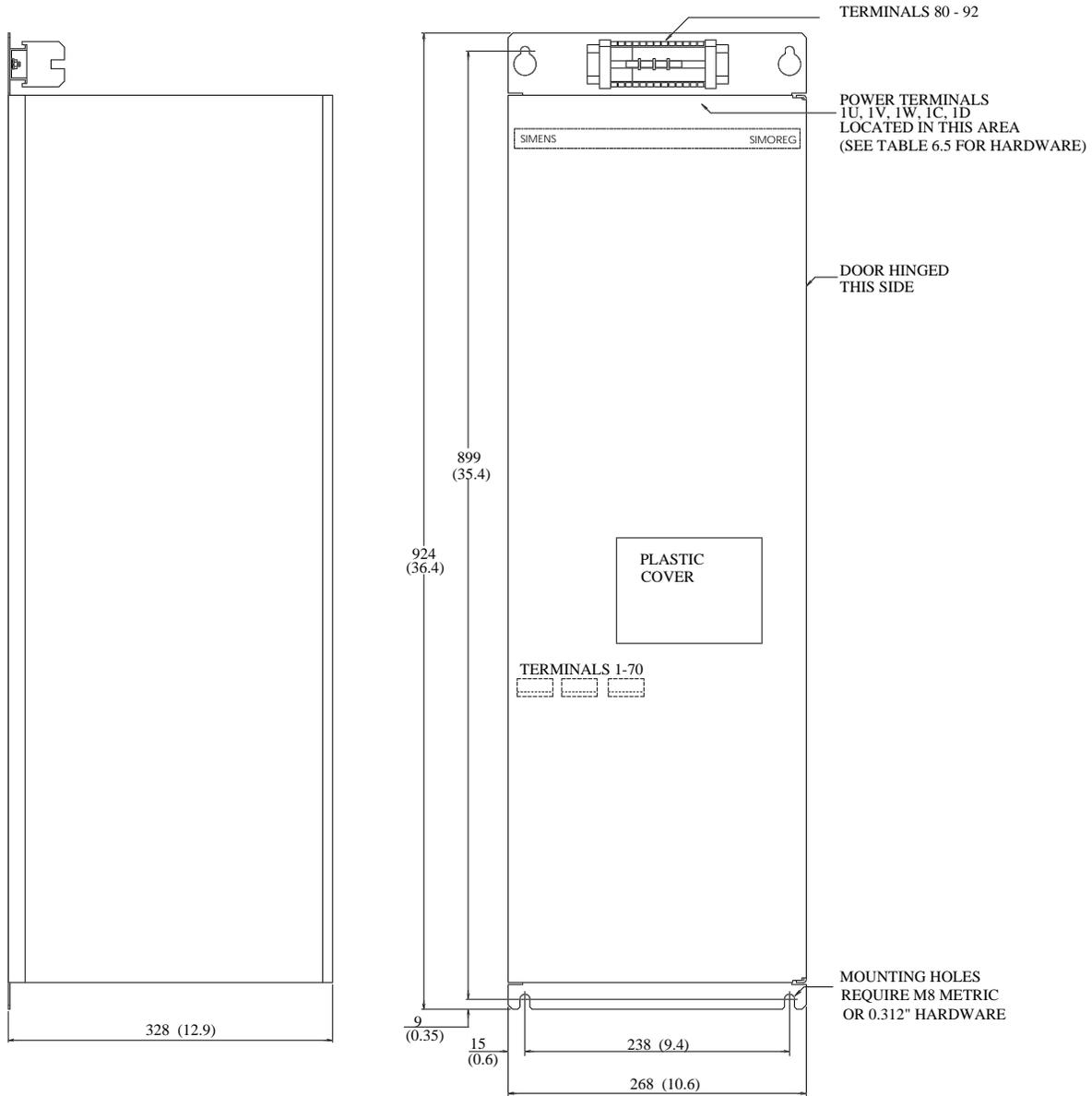
**123 AMP POWER MODULE (1 & 4Q)
(No Fuses or Contactor)**

NOTE: All dimensions are in mm and (inches).



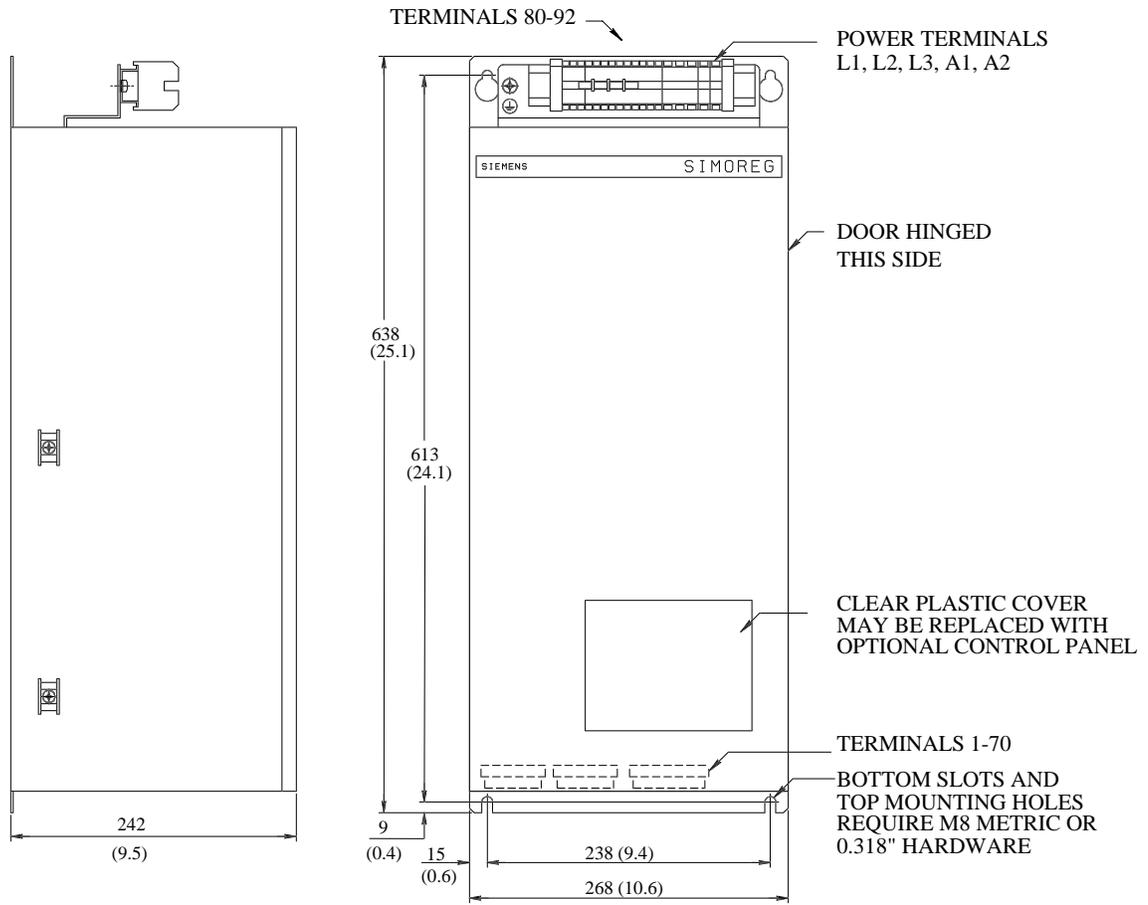
**175 AMP OR 255 AMP POWER MODULE (1 OR 4Q)
(No Fuses or Contactor)**

NOTE: All dimensions are in mm and (inches).



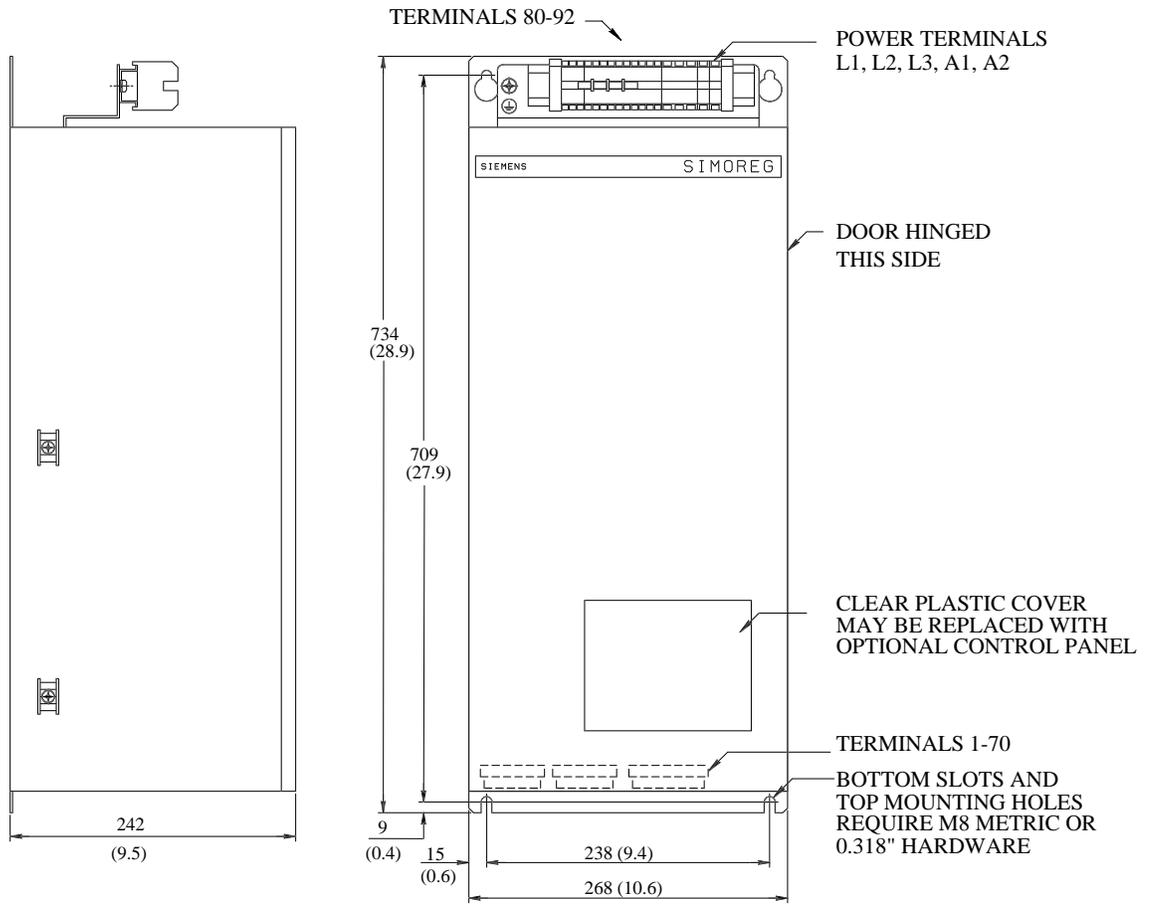
**510 AMP POWER MODULE (1 & 4Q)
(No Fuses or Contactor)**

NOTE: All dimensions are in mm and (inches).



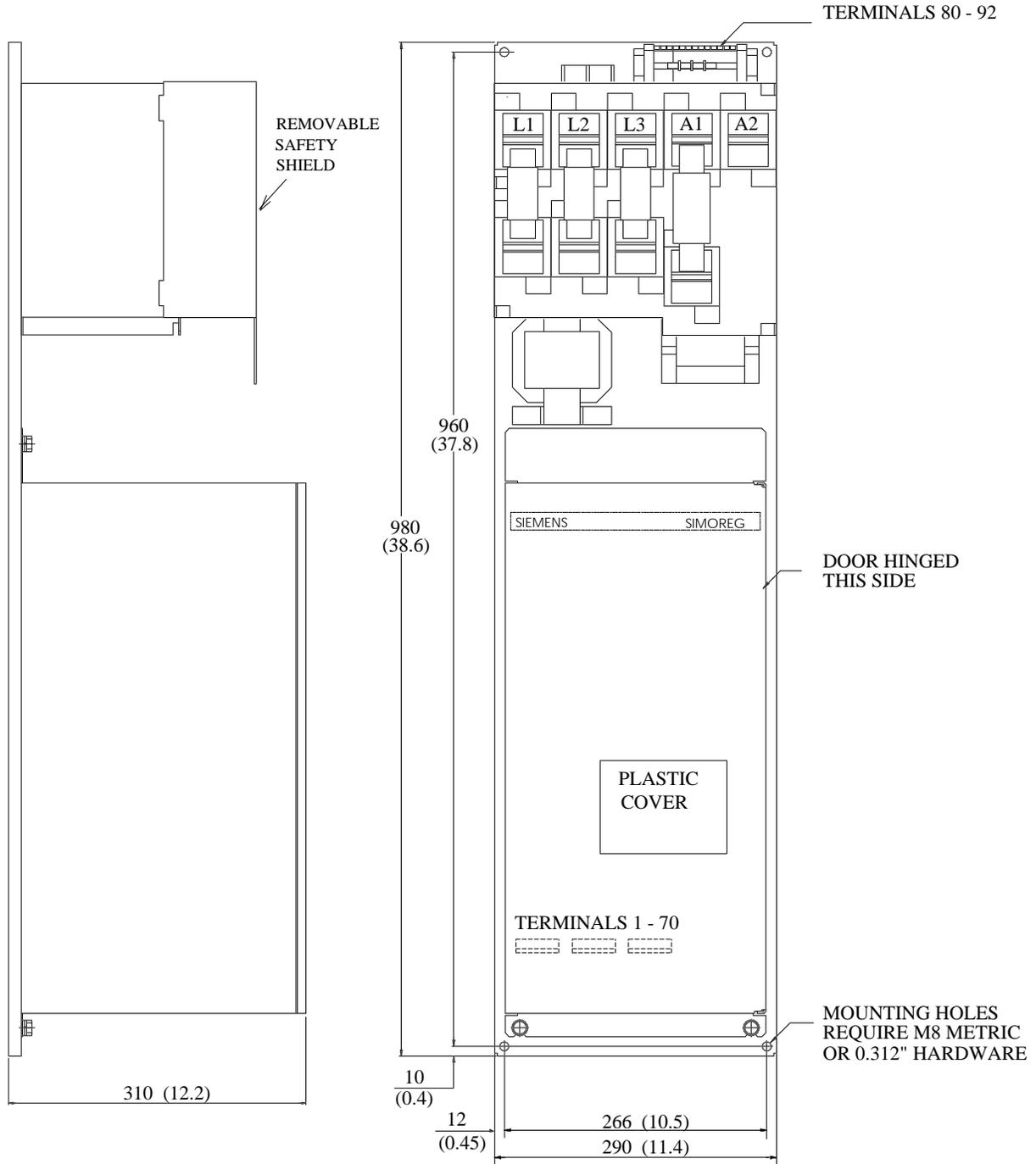
15 and 30 Amp Base Drives (1 & 4Q)

NOTE: All dimensions are in mm and (inches).



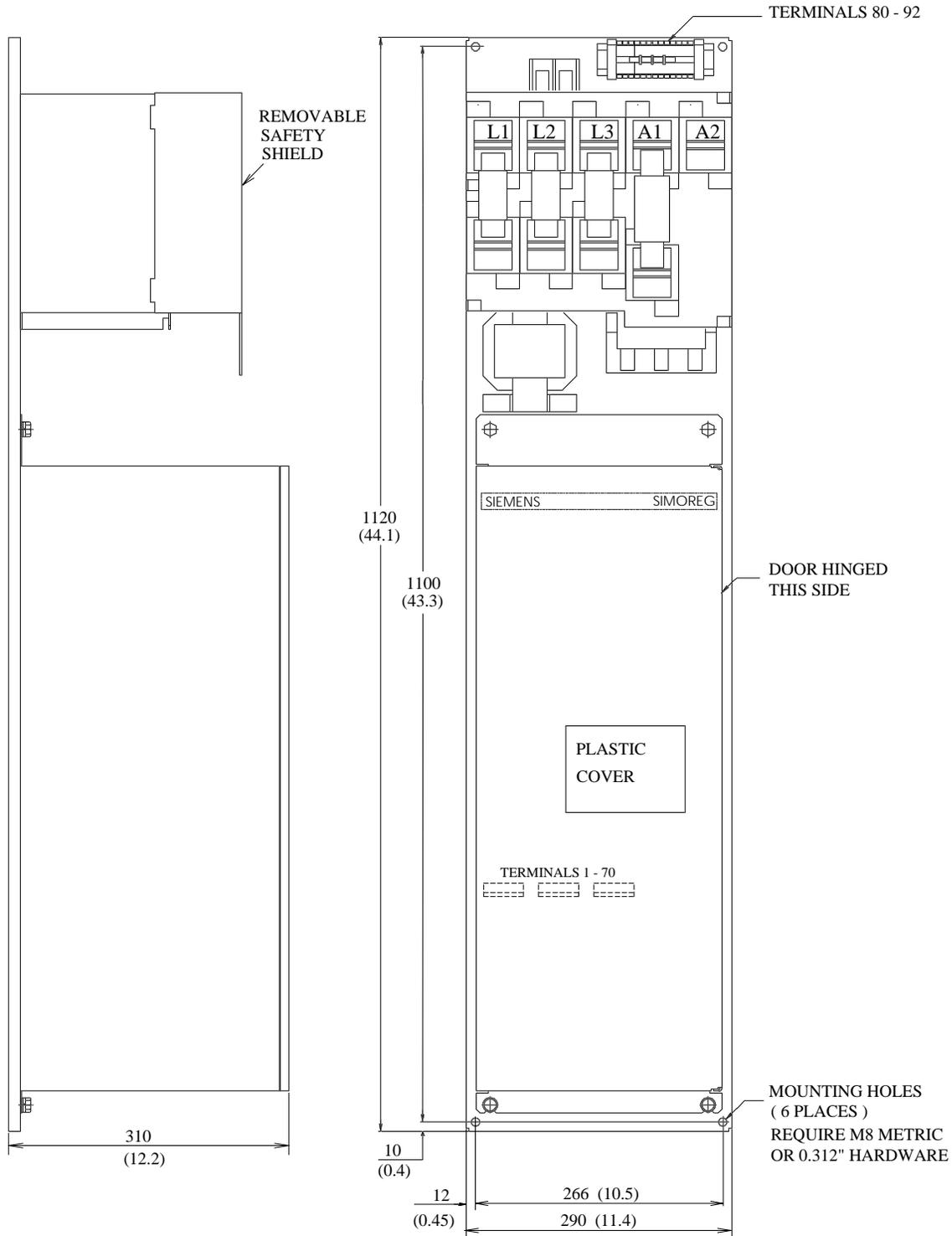
60 and 90 Amp Base Drives (1 & 4Q)

NOTE: All dimensions are in mm and (inches).



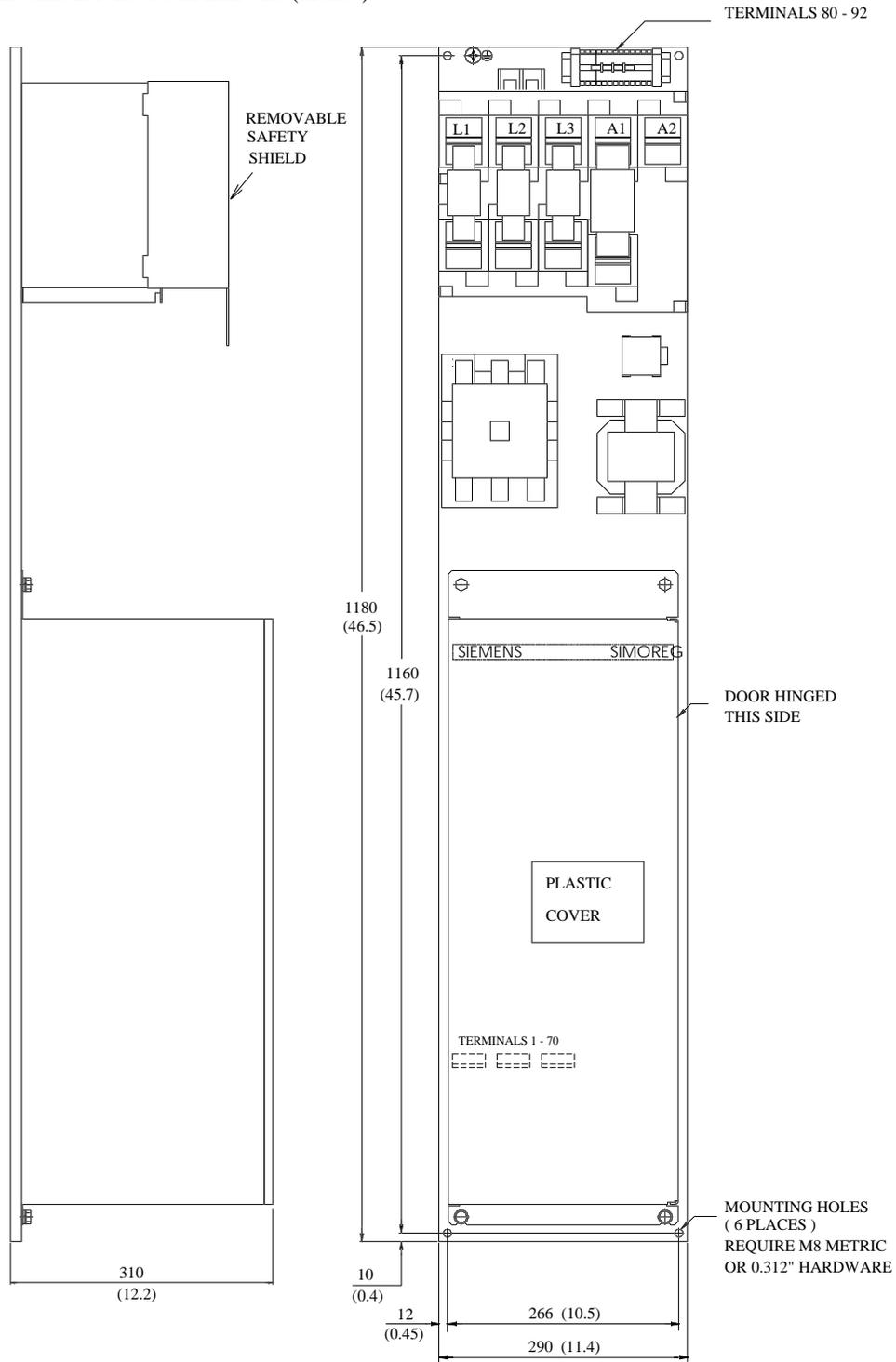
123 Amp Base Drive (1 & 4Q)

NOTE: All dimensions are in mm and (inches).



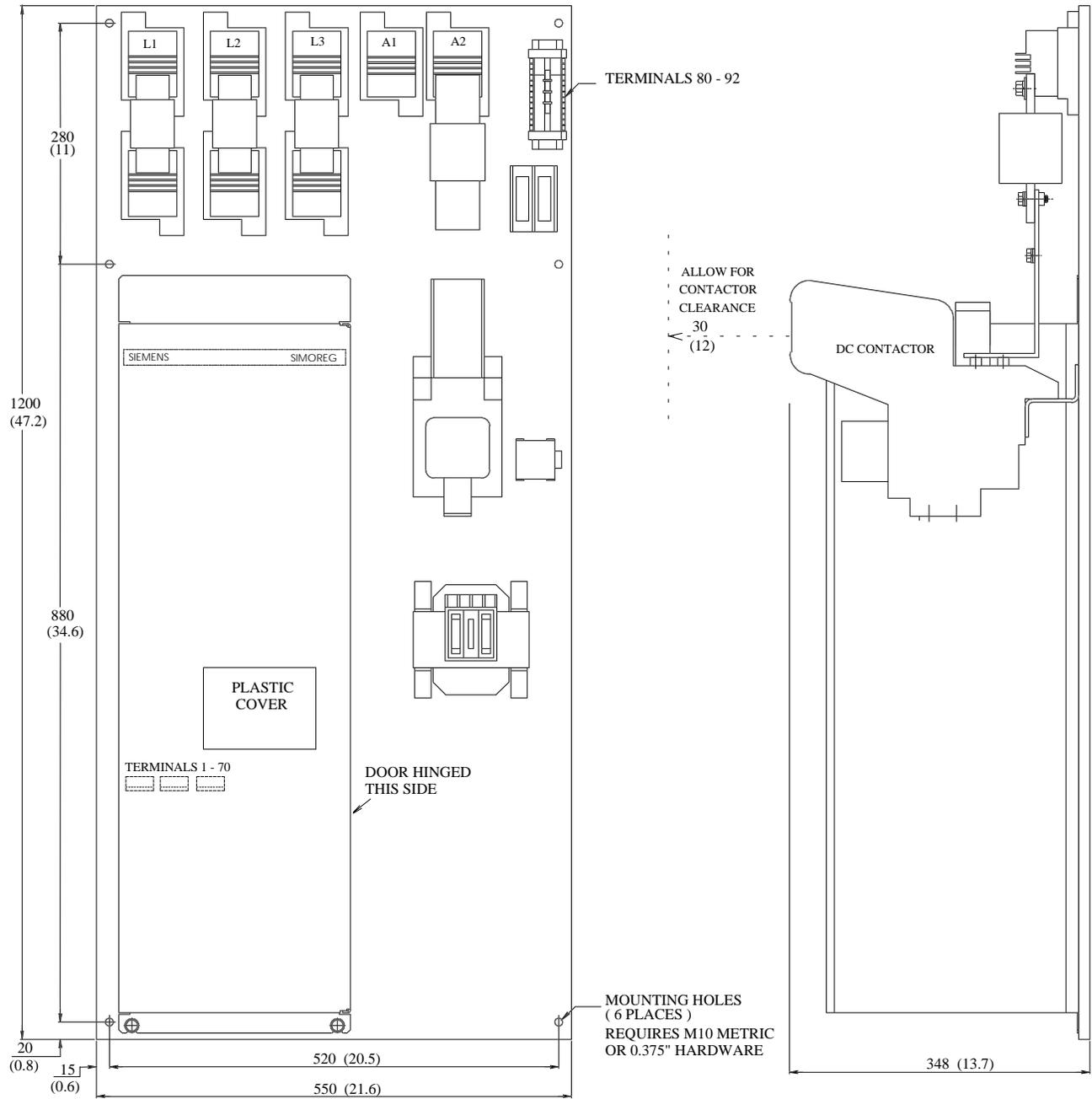
175 Amp Base Drive (1 & 4Q)

NOTE: All dimensions are in mm and (inches).



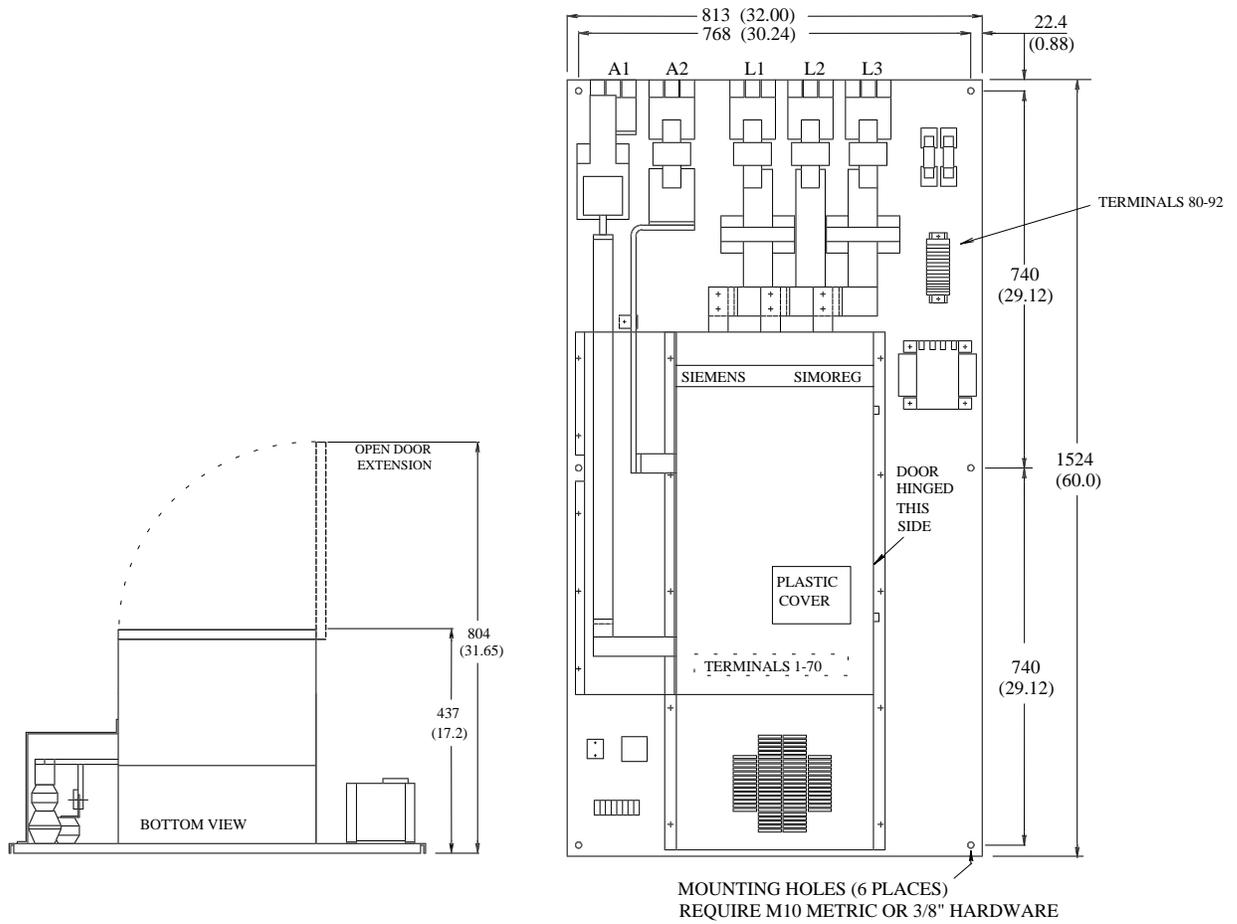
255 Amp Base Drives (1 & 4Q)

NOTE: All dimensions are in mm and (inches).



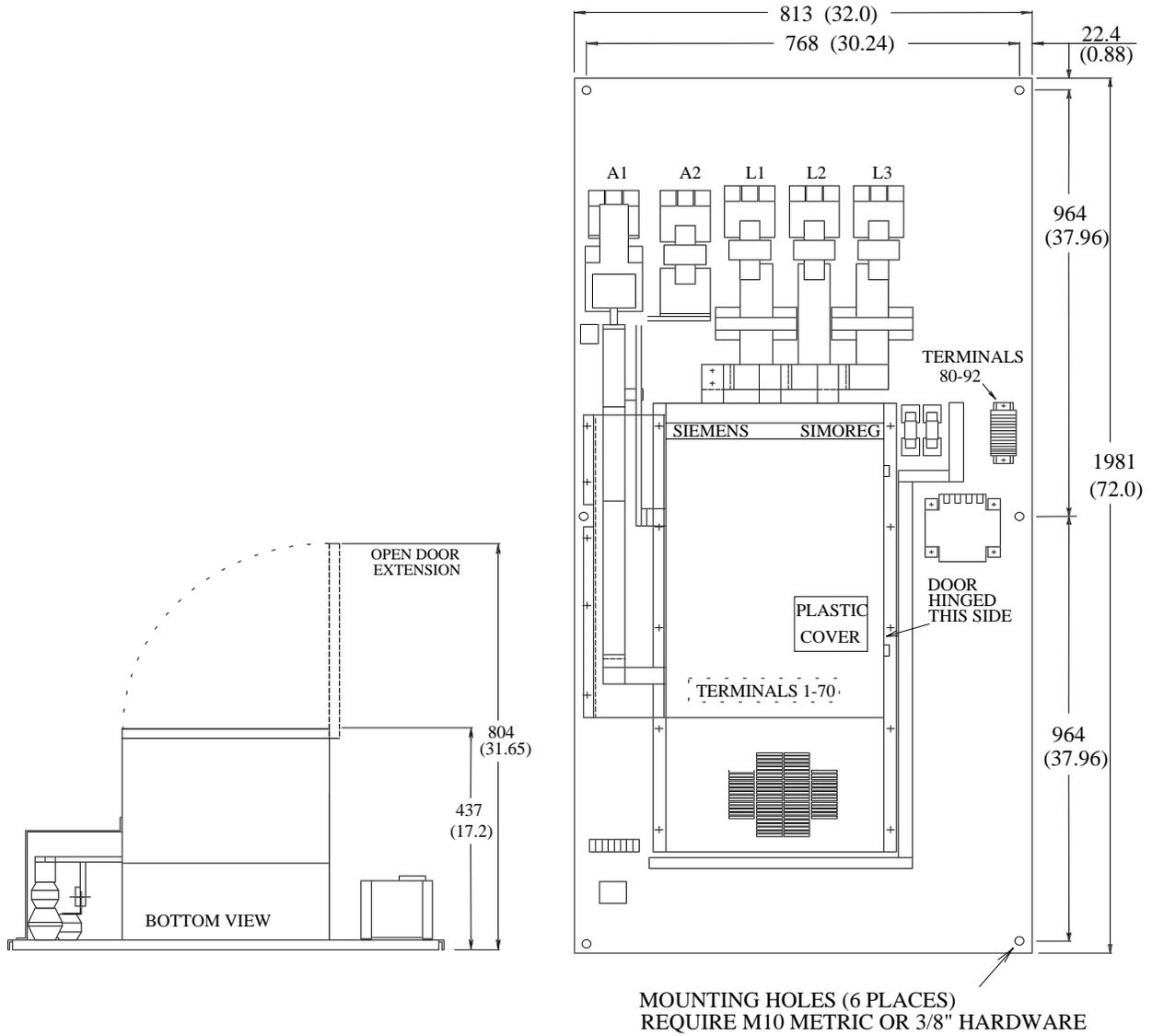
510 Amp Base Drives (1 & 4Q)

NOTE: All dimensions are in mm and (inches).



850 Amp Base Drives (SHORT PANEL 1 & 4Q)

NOTE: All dimensions are in mm and (inches).



850 Amp Base Drives (FULL PANEL 1 & 4Q)

5.3 Installation Instructions for Proper EMC Protection

In order for the 6RA24 to meet the EMC Directive as required by the European Economic Area (EEA) it is necessary that the following installation guidelines be followed when installing a 6RA24 drive.

5.3.1 EMC Basics

5.3.1.1 What is EMC

EMC stands for electromagnetic compatibility and defines the capability of a piece of equipment to operate satisfactorily in an electromagnetic environment without itself causing electromagnetic disturbances which would be unacceptable for other electrical equipment in this environment. Thus, the electrical equipment should not mutually disturb each other.

5.3.1.2 Noise Radiation and Noise Immunity

EMC is dependent on two characteristics of the equipment involved, namely, the radiated noise and noise immunity. Electrical equipment can either be a noise source (transmitter) and / or noise receiver. Electromagnetic compatibility exists if the noise sources do not negatively influence the function of the noise receivers. A piece of electrical equipment can be both a noise source and noise receiver at the same time. For example, the power section of a drive converter can be considered as noise source, and the control section (gating unit, etc.), as noise receiver.

5.3.1.3 Maximum Values

The Product Standard E DIN IEC 22G/21/CDV is now available in draft form for electric drives. According to this product standard, all EMC measures are not necessarily required for industrial supply networks, and a solution should be defined and adapted to the actual installation. In this way, it may be more cost effective to increase the noise immunity of a sensitive piece of equipment than implementing noise suppression measures for the drive converter. Thus, a solution is selected dependent on its cost-effectiveness.

Until the Product Standard E DIN IEC 22G/21/CDV comes into force, the basic EN 50081 and EN 50082 Standards are valid and these specify that EN 55011 must be maintained. These standards define maximum values for noise radiation in industrial and domestic environments. Cable carried noise at the supply connection point is measured under standardized conditions as radio interference noise voltage and electromagnetically radiated noise as radio interference (radiated noise). The standard defines maximum values "A1" and "B1", which are valid for radio interference voltage in the range between 150 kHz and 30 MHz and for radio interference radiation between 30 MHz and 2 GHz. "A1" levels are valid for industrial installations whereas "B1" levels are valid for residential installations. Because SIMOREG drive converters are used in industrial applications, limit value "A1" is valid. **To achieve value "A1", SIMOREG K drive converters must be installed per the following guidelines.**

Noise immunity defines the behavior of a piece of equipment subject to electromagnetic noise. For industrial applications, the EN50082-2 Standard defines the demands and evaluation criteria for the behavior of the equipment. **This standard is fulfilled by the 6RA24 converter family when properly installed.**

5.3.1.4 SIMOREG Drive Converters in Industrial Applications

In an industrial environment, equipment must have a high level of noise immunity whereas lower demands are placed on noise radiation. SIMOREG drive converters are components of an electric drive system, along with contactors and switches etc. Professionally trained personnel must integrate them to form a complete drive system. A drive system will typically involve as a minimum, the drive converter itself, motor feeder cables, motor, AC supply cable and disconnect. Limiting to the maximum allowed values can only be maintained if these components are installed and mounted in the correct way. **In order to limit the radiated noise from the drive converter, according to limit value “A1”, a radio interference suppression filter and a commutation reactor are required.** If SIMOREG drive converters are not equipped with radio interference suppression filters, the radiated noise will slightly exceed the limit value “A1”, specified in EN55011.

If the drive is part of an overall system, initially it does not have to fulfill any requirements regarding radiated noise. However, the EMC Law specifies that the system as a whole must be electromagnetically compatible with its environment. If all of the system control components (e.g. PLCs) have noise immunity for industrial environments, then it is not necessary that each drive maintains a limit value “A1”.

5.3.1.5 Non-Grounded AC Supplies

Non-grounded AC supplies (IT-supplies) are often used in various industrial sectors in order to increase the availability of the plant. If one ground fault occurs a fault current does not flow, and the plant can still produce. However, when a radio interference suppression filter is used on such a system and a ground fault should occur, a fault current path now exists through the filter. This can result in the drive being shutdown and possible damage to the radio interference suppression filter. Thus, the Product Standard does not define limit values for these non-grounded supplies. From a cost standpoint, if radio interference suppression is required, this should be implemented at the grounded primary of the supply transformer.

5.3.1.6 EMC Planning

If two units are not electromagnetically compatible, you can either reduce the noise radiated by the noise source, or increase the noise immunity of the noise receiver. Noise sources are generally power electronic units with a high current requirement. In order to reduce the radiated noise from these units, complex and somewhat costly filters are required. Noise receivers usually involve control units and sensors. It is sometimes less complex and less costly to increase the noise immunity of low-power equipment. Thus, in an industrial environment it is often more cost-effective to increase the noise immunity rather than reduce the radiated noise. For example, in order to maintain limit value Class “A1” of EN 55011, the radio interference voltage at the supply connection point between 150 kHz and 500 kHz, may not exceed 79 dB(μ V) and between 500 kHz and 30 MHz, 73 dB(μ V) (9 mV or 4.5 mV). In industrial environments, the EMC of the equipment used must be based on a well-balanced mixture of noise radiation (low level) and noise immunity.

The most favorably priced interference measure is to physically separate noise sources and noise receivers, assuming that this is taken into account when designing the machine or plant. The first step is to define whether each unit is a potential noise source (noise radiator) or noise receiver. Noise sources are, for example, drive converters, contactors. Noise receivers are, for example, PLCs, and sensors. The components must be physically separated in the cabinet (noise sources and noise receivers), using metal partitions or by mounting the components in individual metal enclosures. A possible component layout configuration in a typical 6RA24 cabinet is illustrated in Fig. 1.

5.3.2 EMC-Correct Installation of Drive Converters**5.3.2.1 General information**

As drives can be operated in a wide range of differing environments, and as the electrical components used (controls, switched-mode power supplies etc.) can widely differ regarding noise immunity and noise radiation, any mounting / installation guideline can only represent a typical general situation. Consequently, deviations can be made from the EMC regulations, under the assumption that they are checked-out on a case by case basis.

In order to guarantee electromagnetic compatibility (EMC) in cabinets in rugged electrical environments, and also fulfill the standards specified by the relevant legal bodies, the following EMC regulations must be observed when designing and manufacturing the drive cabinets.

Rules 1 to 10 illustrate good wiring practices and generally must be followed. In order to further comply with the radiated noise standards Rules 11 to 15 are mandatory.

5.3.2.2 Rules for EMC-Correct Installation**Rule 1:**

All of the metal cabinet components must be electrically connected with one another through the largest possible surface area (not paint on paint!). If required, use serrated washers and / or grounding straps to connect the cabinet parts. The cabinet door should be connected to the cabinet through a grounding strap which should be kept as short as possible.

Rule 2

Contactors, relays, solenoid valves, electromagnetic operating hour counters etc. in the cabinets should be provided with coil suppression devices such as RC elements, varistors, diodes etc. These devices must be connected directly at the coil with very short wires to be effective.

Rule 3

If possible, signal cables¹⁾ should enter the cabinet at only one level.

Rule 4

Non-shielded cables belonging to the same circuit (incoming and return conductors) should be twisted, or the distance between the two conductors kept as close as possible in order to prevent unnecessary coupling effects.

Rule 5

Connect reserve (spare) conductors to the cabinet ground at both ends. This offers an additional shielding effect.

Rule 6

Unnecessary cable / conductor lengths should be avoided so that coupling capacitance's and inductance's are kept low.

Rule 7

Crosstalk is kept low if cables are routed close to the cabinet ground. Thus, wiring shouldn't be routed freely in the cabinet, but as close as possible to the cabinet frame and mounting panels. This is also true for reserve (spare) cables.

Rule 8

Signal and power cables should be routed separately from one another (to avoid noise being coupled from one to another). **A minimum 20 cm (8 inches) clearance should be maintained.**

If it is not possible to physically separate encoder and motor cables, then the encoder cable must be routed either using a metal partition or in a separate metal conduit. The partition or metal conduit must be grounded at several locations along this length.

Rule 9

The shields of digital signal cables must be connected to ground at both ends (source and destination) through the largest possible surface area. If there is poor potential bonding between the equipment pieces where the shields connect, then an additional potential bonding cable of at least 10 mm² (AWG 6) must be connected in parallel to the shield. The shields can be grounded to the cabinet frame at several positions along the cable length. The shields can also be connected to ground at several locations outside the cabinet. Foil-type shields should be avoided if possible. They are not as effective as braided shields by a factor of at least 5.

Rule 10

The shields of analog signal cables can be connected to ground at both ends if potential bonding is good (through the largest possible surface area). Good potential bonding can be assumed, if all metal parts are well connected and all of the electronic components involved are supplied from one source.

The single-ended shield ground connection prevents low-frequency, capacitive noise from being coupled into the analog signal (e.g. 60 Hz hum). In this case the shield should be connected to ground only in the receiving cabinet.

Rule 11

Always locate the radio interference suppression filter close to the assumed noise source. The filter must be mounted through the largest possible surface area at the cabinet housing or mounting panel etc. The input and output cables must be physically separated.

Rule 12

Radio interference suppression filters must be used ahead of the converter in order to maintain limit value class "A1". Additional loads must be connected to the line supply side of the filter. The type of control used and how the remaining cabinet is wired defines whether an additional line filter needs to be installed for auxiliary equipment.

Rule 13

A commutation reactor is required in the field circuit AC supply for controlled field supplies to limit filter discharge current through the converter thyristors.

Rule 14

A commutation reactor is required in the drive converter armature circuit AC supply to limit filter discharge current through the converter thyristors.

Rule 15

For SIMOREG drives, the motor cables can be unshielded. The line supply cable must be a minimum of 20 cm (8 inches) away from the motor cables (field, armature).

If required, use a metal partition or metal conduit.

Footnotes:

1) Signal cables are defined as:

Digital signal cables

Analog signal cables. (e.g. ± 10 V setpoint cable)

Pulse encoder cables

Serial interface cables, e.g. PROFIBUS-DP or USS

24 VDC Binary I/O circuits

2) Generally, all metallic conductive parts, which can be connected to a protective conductor, e.g. cabinet housing, motor frame, foundation ground, etc., are considered as ground.

5.3.2.3 Cabinet Design and Shielding

The cabinet design illustrated in **Fig. 1** is intended to make the user sensitive and aware of EMC-critical components and parts. The example does not claim to handle all possible cabinet components and their respective mounting possibilities but does give a good representation of a typical assembly that meets the EMC requirements.

Details which influence the noise immunity / noise radiation of the cabinet and which aren't absolutely clear in the overview diagram, are further described in detail **Figures 1a - 1c**.

Different shield connecting techniques are illustrated in detail **Figures. 2a - 2b**.

Mounting radio interference suppression filters and commutation reactors:

Radio interference suppression filter and commutation reactor mounting for SIMOREG drives is described in Section 2.3. The sequence when installing the reactor and filter must be maintained. The semiconductor protection fuses are selected according to the Instruction Manual of the drive converters or are included in the base drive chassis.

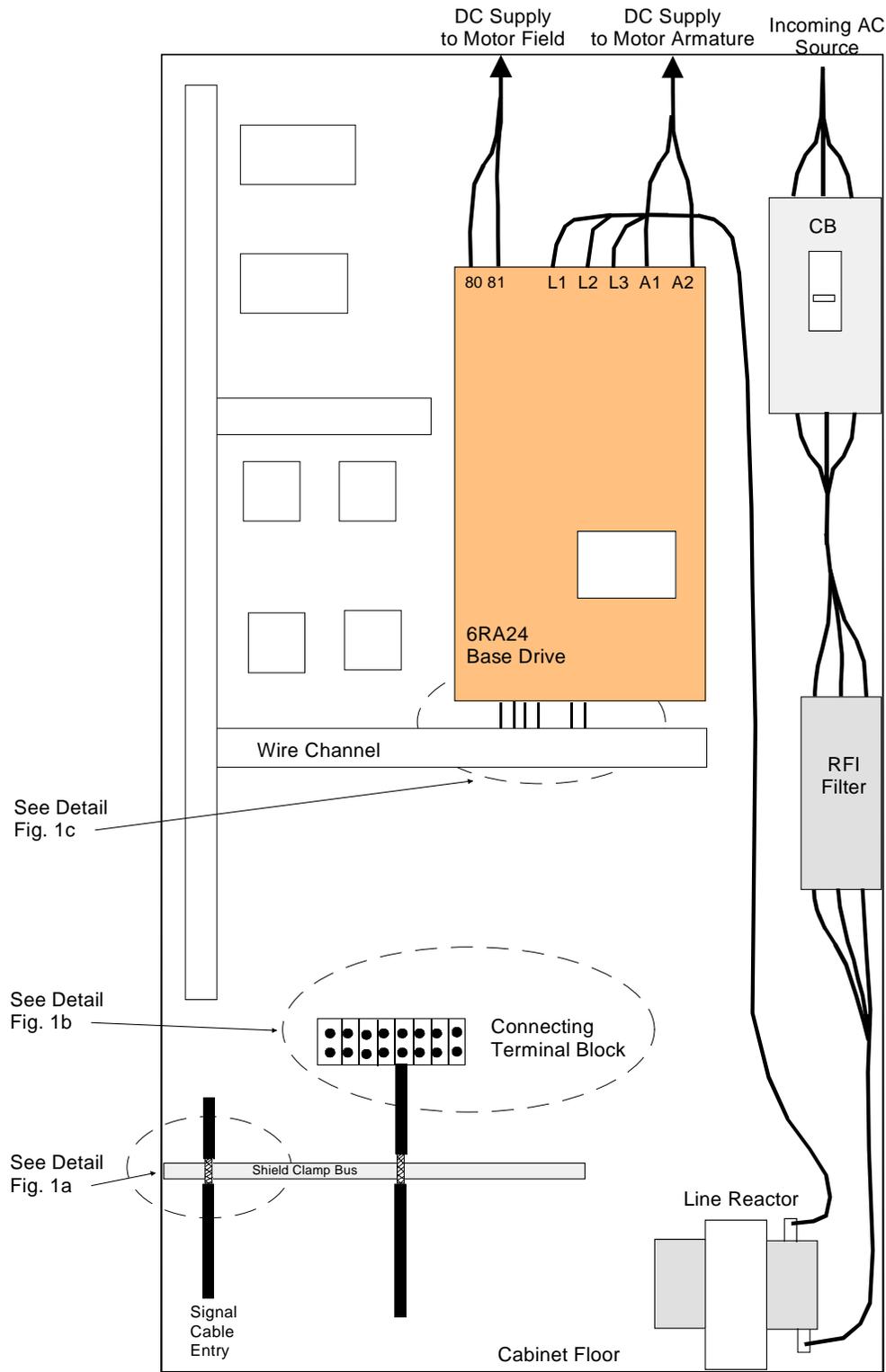


Fig. 1
Typical Cabinet Panel Layout

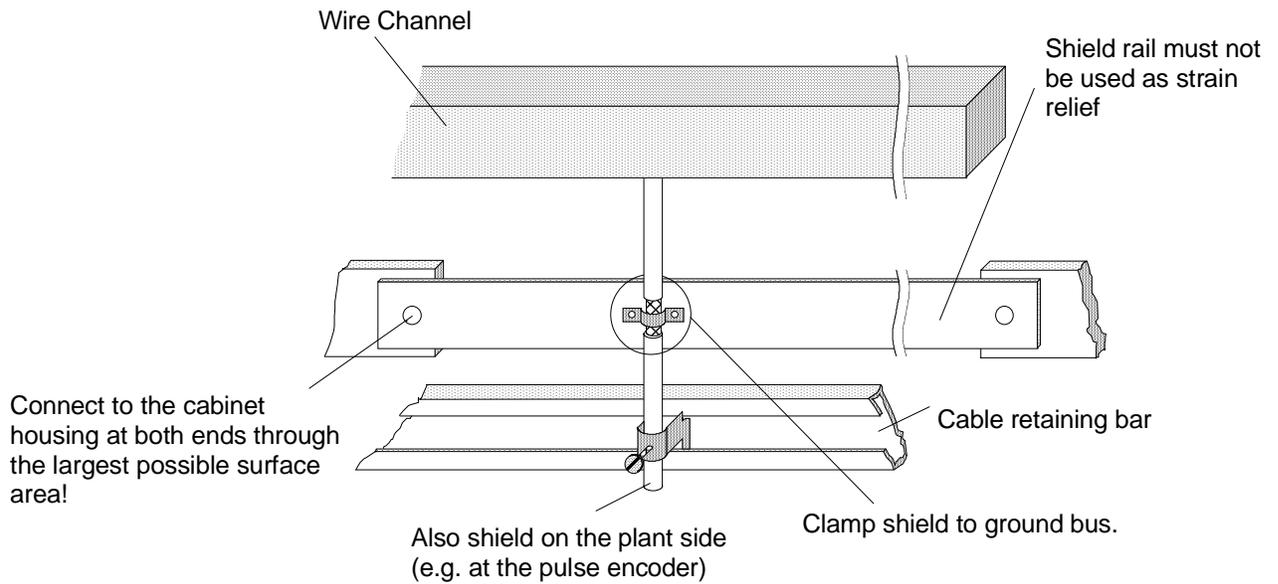


Fig. 1a Shielding Where the Cable Enters the Cabinet

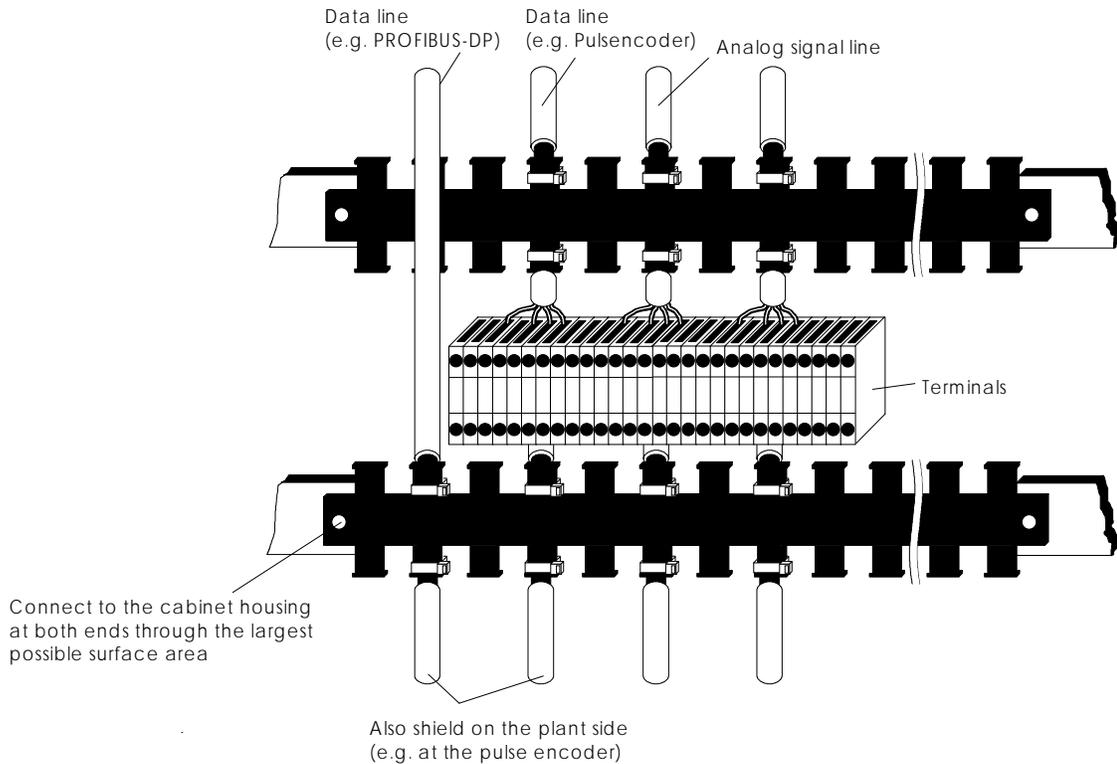


Fig. 1b: Shielding in the cabinets

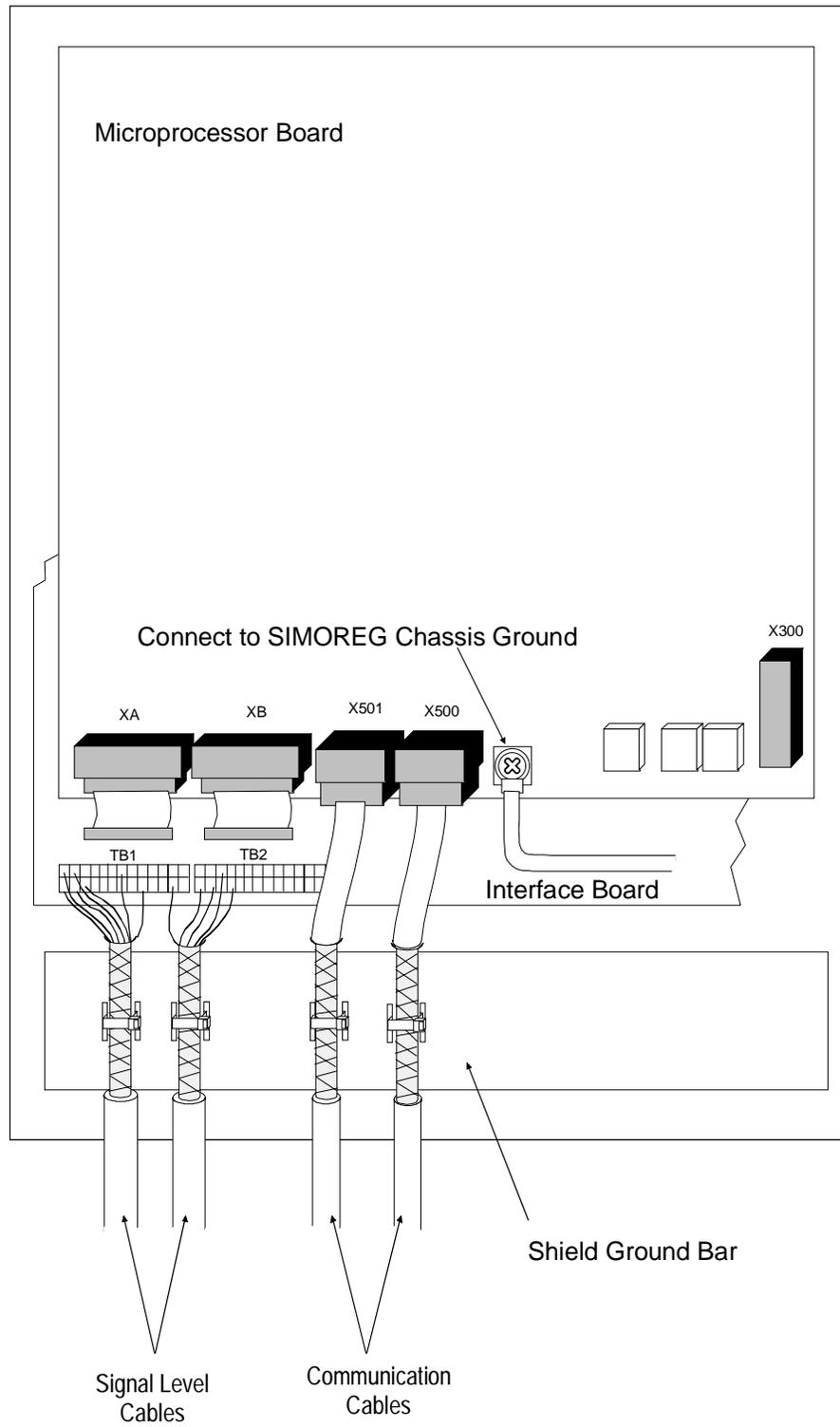


Fig. 1c Connecting Shields at the SIMOREG

Typical Shield connection methods:

Cable Tie:

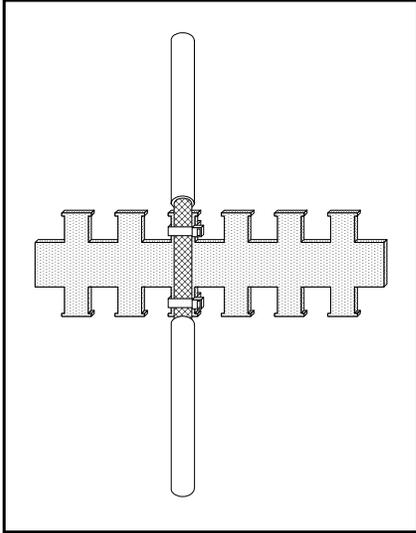


Figure 2a
Metalized tubing or cable ties on a bare metal serrated rail

Clamp:

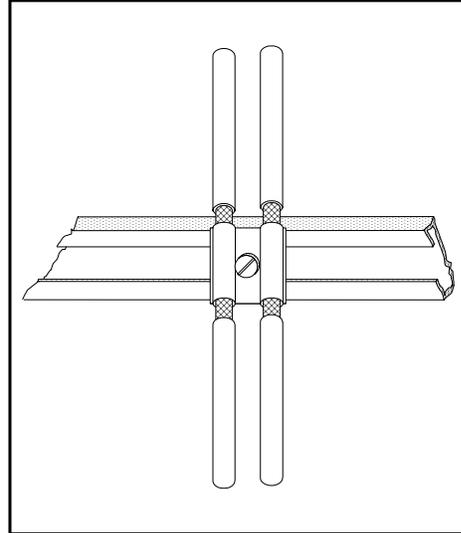
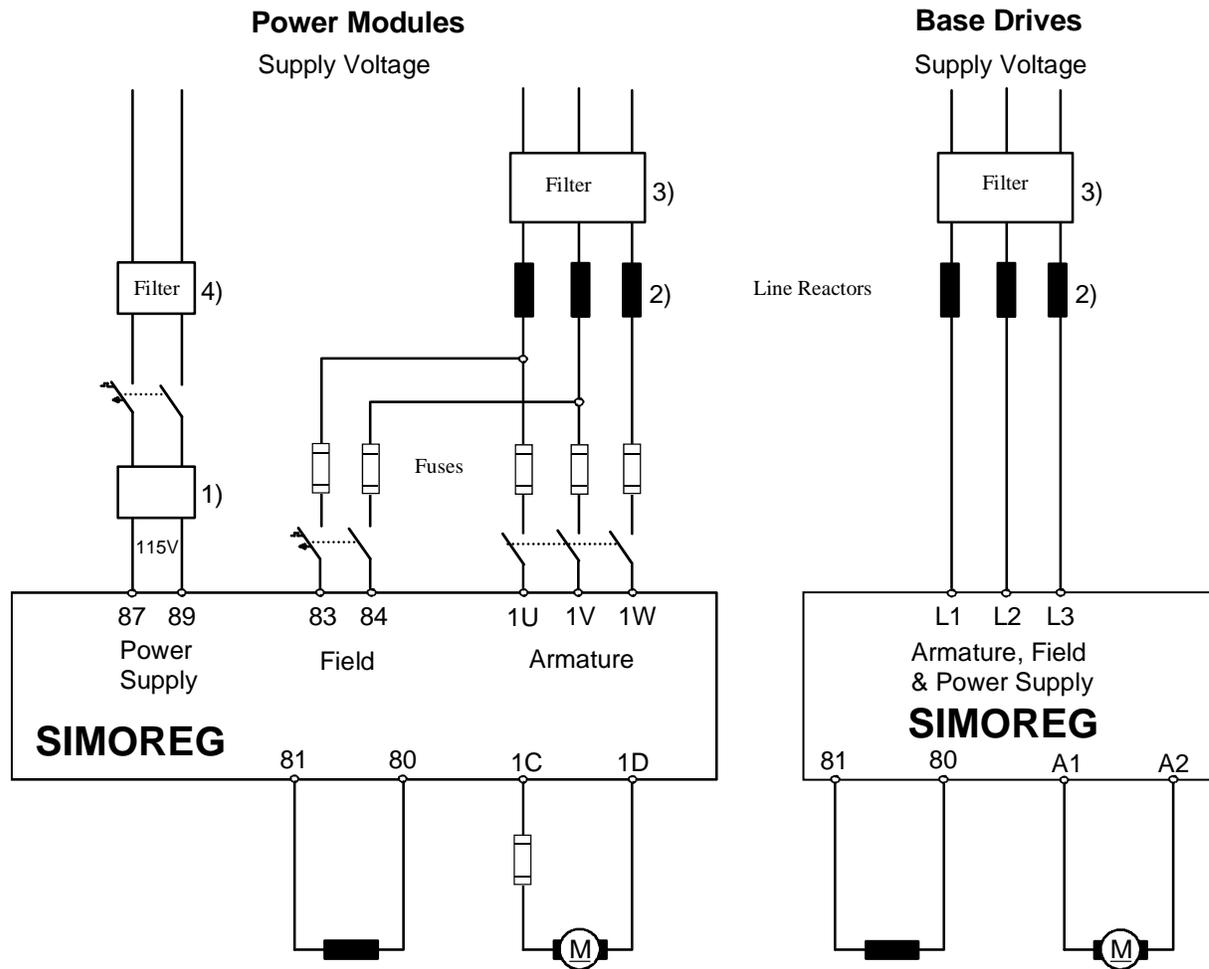


Figure 2b
Clamp and metallic mating piece on a cable support rail.

5.3.2.4 Drive converter component arrangement

**6RA24 SIMOREG K drive converter, US version (power modules & base drives):
Reactor and filter arrangement**



- 1) Power supply transformer (adapts the unit for 115 V supplies).
- 2) The commutating reactor for the armature- and field circuits is dimensioned for the nominal motor armature current (the line supply current is the DC current x 0.82) plus the nominal motor field current.
- 3) The filter for the armature and field circuits is dimensioned for the nominal motor armature current (the line supply current is the DC current x 0.82) plus the nominal motor field current.
- 4) Filter for power supply of SIMOREG

Note:

When filters are used, commutating reactors are always required at the drive converter input to decouple the filter circuitry. The commutating reactors are standard line reactors with 2 to 4% impedance based on the drive rating.

5.3.2.5 List of the recommended radio interference suppression filters

Nominal current, radio interference suppression filter (A)	Radio interference suppression filter Order No.	Terminal cross-section (mm ²)	Weight (kg)	Dimensions HxWxD (mm)
12	6SE7021-0ES87-0FB0	10 [*])	2,2	215x90x81
18	6SE7021-8ES87-0FB0	10 [*])	2,2	215x90x81
36	6SE7023-4ES87-0FB0	25	3,7	245x101x86
80	6SE7027-2ES87-0FB0	50	9,5	308x141x141
120	6SE7031-0ES87-0FA0	50	10	348x171x141
180	6SE7031-8ES87-0FA0	95	13	404x171x141
500	6SE7033-7ES87-0FA0	Connecting lug	49	590x305x154
1000	6SE7041-0ES87-0FA0	Connecting lug	90	840x465x204
1600	6SE7041-6ES87-0FA0	Connecting lug	130	870x465x204

^{*}) The filters generate discharge currents. VDE 0160 specifies a protective ground conductor connection using 10 mm² (AWG 6) cable.

For 6RA24 drive converters, the RMS AC line current (filter current) is equal to the DC current x 0.82.

Important technical data of the radio interference protection filter:

Nominal supply voltage	3-ph. 380-460 V AC (+/- 15%)
Rated frequency	50/60 Hz (+/- 6%)
Operating temperature	0° C to +40° C
Degree of protection	IP20 (EN60529) < 500A IP00 ≥ 500 A

Notes

6. CONNECTIONS

**WARNING**

This equipment contains hazardous voltages and hazardous rotating mechanical parts.



Loss of life, severe personal injury or property damage can result if instructions contained in this manual are not followed.

The user is responsible for installation of the motor, SIMOREG drive controller, transformer, and other devices in accordance with the National Electric Code and other applicable local codes that cover such items as wiring size and protection, grounding, disconnects, and overcurrent protection.

**WARNING**

Hazardous voltages may be present on external surfaces of ungrounded controllers and other devices.



Loss of life, severe personal injury or property damage can result if controllers and devices are not properly grounded.

If the SIMOREG drive cabinet or open chassis unit is mounted such that it is not grounded, a ground wire must be connected to the panel or enclosure frame for personnel safety. Also the motor frame, transformer enclosure, and operator station must be connected to earth ground. Consult the National Electric Code and other local codes for specific equipment grounding requirements.

Protective guards must be installed around all exposed rotating parts.

6.1 POWER MODULES



WARNING

Hazardous currents may be present as a result of wiring error or internal controller failure.



Loss of life, severe personal injury or property damage can result if Power Modules are not properly installed with external short circuit protection devices.

It is the users responsibility to install SIMOREG power modules with adequate short circuit protection per the National Electric Code or other local codes. SIMOREG power modules are designed to operate from ac lines that have a maximum symmetrical short circuit capacity of 18,000 ampers RMS at 480 volts.

Power modules contain the basic power conversion and control circuitry necessary for dc motor control systems. They **do not** contain the main contactor, control transformer, or any protective fusing. It is the users responsibility to select the appropriate external short circuit protective devices to work with the basic power module. In addition to short circuit protection, the equipment must also be installed with the appropriate disconnect devices as required by the National Electrical Code and other applicable local codes.

Recommended short circuit protective devices include high speed semiconductor fuses in the AC supply lines for the armature and field converters as well as an additional high speed semiconductor fuse installed in the motor armature circuit for regenerative 4 quadrant modules. A list of recommended fuses for the ac supply for the armature and field converters and for the dc motor circuit for 4 quadrant power modules is contained in tables 6.1, 6.2, and 6.3. These fuses and the appropriate fuse holder may be purchased directly from the recommended fuse vendor as noted in the tables.

6.1.1 Recommended Fuses For Power Modules:

Line Fuses For The Armature Converter (3 fuses required):

UNIT RATING	FUSE RATING	FUSE TYPE BUSSMAN	FUSE TYPE GOULD-SHAWMUT
15 AMP	30 A, 700 V	FWP-30	A70P30
30 AMP	60 A, 500 V	FWH-60A	A50P60
60 AMP	100 A, 500 V	FWH-100A	A50QS100-4
90 AMP	150 A, 500 V	FWH-150A	A50QS150-4
123 AMP	150 A, 500 V	FWH-150A	A50QS150-4
175 AMP	200 A, 500 V	FWH-200A	A50QS200-4
255 AMP	300 A, 500 V	FWH-300A	A50QS300-4
510 AMP	600 A, 500 V	FWH-600A	A50QS600-4

Table 6.1

Line Fuses For The Field Converter (2 fuses required):

UNIT RATING	FUSE RATING	FUSE TYPE BUSSMAN	FUSE TYPE GOULD-SHAWMUT
ALL	30 A, 700 V	FWP-30	A70P30

Table 6.2

Line Fuses For The Motor Armature DC Circuit (1 fuse required):

UNIT RATING	FUSE RATING	FUSE TYPE BUSSMAN	FUSE TYPE GOULD-SHAWMUT
15 AMP	30 A, 700 V	FWP-30	A70P30
30 AMP	60 A, 700 V	FWP-60A	A70P60
60 AMP	100 A, 700 V	FWP-100A	A70P100
90 AMP	150 A, 700 V	FWP-150A	A70P150
123 AMP	150 A, 700 V	FWP-150A	A70P150
175 AMP	200 A, 700 V	FWP-200A	A70P200
255 AMP	300 A, 700 V	FWP-300A	A70P300
510 AMP	600 A, 700 V	FWP-600A	A70P600

Table 6.3

6.1.2 Power Connection Information (Line and Armature Circuits)

Power connections must be made using cable with the proper rating as defined by the National Electric Code and other state or local codes. SIMOREG POWER MODULES can accommodate various cable sizes as indicated in tables 6.4, and 6.5 below.

Power modules from 15 to 90 amps include compression type terminal blocks for power connections whereas ratings from 123 amps to 510 amps use bolted connections and require that a compression ring tongue terminal be connected to the cable end.

Power Modules 15 to 90 amps

RATING	CABLE RANGE	RECOMMENDED TORQUE
15 & 30 AMP	#12 to #6 AWG	1.2 Nm (11 IN-LBS)
60 & 90 AMP	#10 to #2 AWG	3 Nm (27 IN-LBS)

Table 6.4
Power Module Line and Armature Power Connections
 (1U, 1V, 1W, 1C, 1D)

Power Modules 123 to 510 amps

RATING	TERMINALS	BOLT SIZE
123 & 175 AMP	1U, 1V, 1W (ac line)	M8 (metric), 5/16" (English)
255 & 510 AMP	1U, 1V, 1W (ac line)	M10 (metric), 3/8" (English)
123 to 510 AMP	1C, 1D (dc armature)	M10 (metric), 3/8" (English)

Table 6.5
Power Module Line and Armature Power Connections
 (1U, 1V, 1W, 1C, 1D)

6.2 BASE DRIVES

Base drives are complete drive assemblies that include all short circuit protective fusing, main contactor, and a control transformer, ready to be connected and operated. All external connections to base drives, including power connections are made with compression type terminals on the drive. The user is responsible for installation of the motor, SIMOREG drive controller, transformer, and other devices in accordance with the National Electric Code and other applicable local codes that cover such items as wire size, protective grounding, disconnects, and overcurrent protection. Depending on the rating, base drives can accommodate a range of cable sizes as indicated in table 6.6 below.

Base Drive Power Connections

RATING	CABLE RANGE	RECOMMENDED TORQUE
15 AMP	#12 to #6 AWG	1.2 Nm (11 IN-LBS)
30 AMP	#12 to #6 AWG	1.2 Nm (11 IN-LBS)
60 AMP	#10 to #2 AWG	3 Nm (27 IN-LBS)
90 AMP	#10 to #2 AWG	3 Nm (27 IN-LBS)
123 AMP	2 CABLES PER CONNECTION #6 AWG to 250 MCM	30 Nm (275 IN-LBS)
175 AMP	2 CABLES PER CONNECTION #6 AWG to 250 MCM	30 Nm (275 IN-LBS)
255AMP	2 CABLES PER CONNECTION #6 AWG to 250 MCM	30 Nm (275 IN-LBS)
510 AMP	2 CABLES PER CONNECTION #6 AWG to 500 MCM	41 Nm (375 IN-LBS)
850 AMP	3 CABLES PER CONNECTION #6 AWG to 500 MCM	41 Nm(375 IN-LBS)

Table 6.6
Base Drive Line and Armature Power Connections
(L1, L2, L3, A1, A2)

6.3 CONTROL CONNECTIONS TERMINALS 80 to 92 (All Ratings)

Terminals 80 to 92 contain circuits that are between 115 and 460 volts and should be treated like power circuits. They contain the motor field connections, 115 volt control power, and other auxiliary circuits. Wiring to these terminals should be separated from low voltage signal control wiring.

CONTROL TERMINAL INFORMATION:

TERMINAL #	WIRE RANGE	RECOMMENDED MAX TORQUE
80 to 92	#18 - #10 AWG	0.5 Nm, (4.5 IN-LBS)

Table 6.7

6.4 LOW VOLTAGE CONTROL CONNECTIONS TERMINALS 1 to 70 (All Ratings)

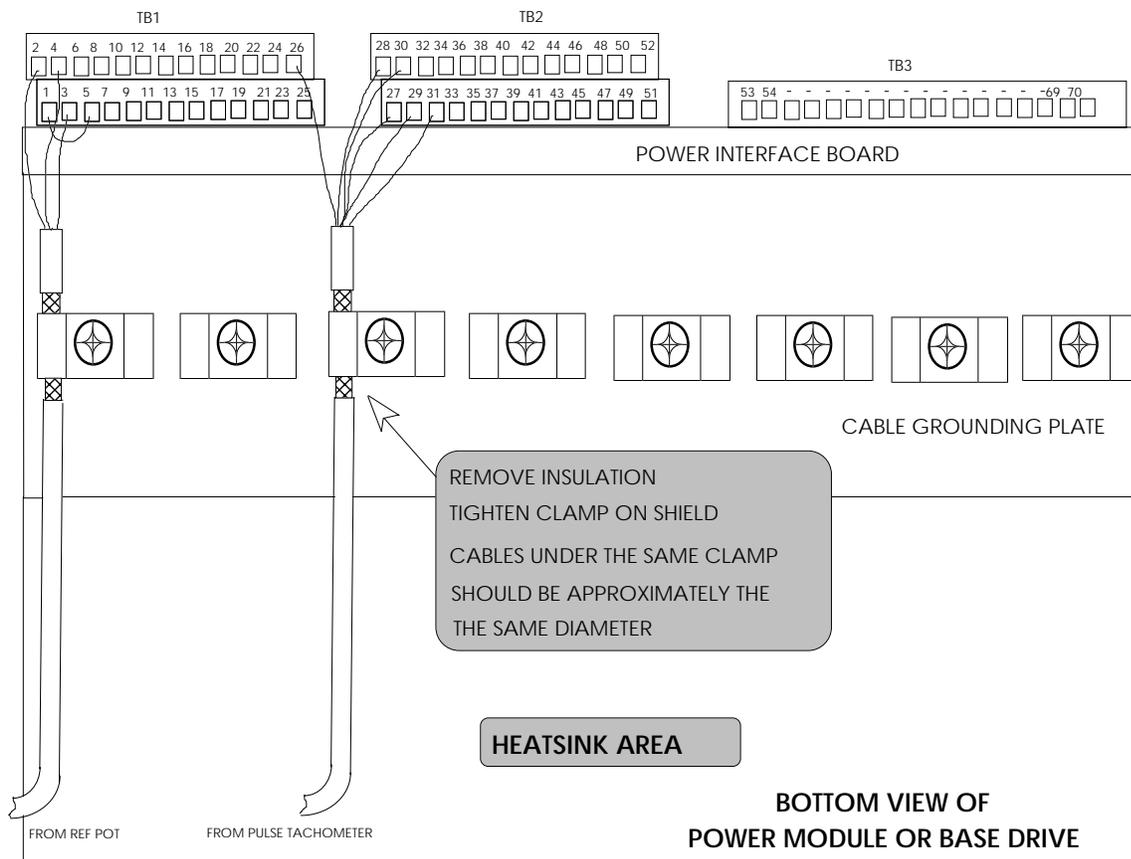
Terminals 1 to 70 are located on the power interface board near the bottom of the unit and contain low voltage analog and digital control functions. For best noise immunity all analog cables and tachometer cables must be properly shielded and run in dedicated conduits, separate from the binary control signals and power and motor wiring.

The cable shields must be connected to the shield chassis grounding point provided near terminals 1 to 70 as illustrated in Figure 6.1. Do not connect the shields of analog signal cables at the end away from the drive and avoid creating ground loops through multiple connection of shields or common connections.

CONTROL TERMINAL INFORMATION:

TERMINAL #	WIRE RANGE	RECOMMENDED MAX TORQUE
1 to 70	#12 AWG Maximum,	0.5 Nm, (4.5 IN-LBS)

6.4.1 Shielded Cable Instructions

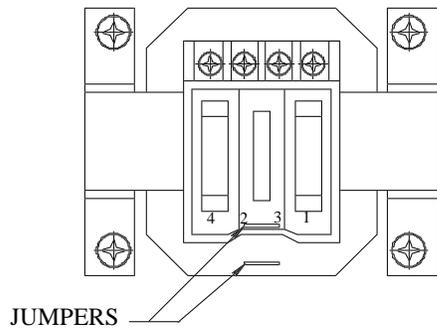


SHIELDED CABLE WIRING EXAMPLE

Figure 6.1

6.5 VOLTAGE CONFIGURATION 460 / 230 VAC

The control transformer 1CTR used in base drives, includes integral primary fuses, one secondary fuse, and jumper straps used to reconnect the primary for either 460 or 230 VAC. These components are located beneath a hinged plastic shield on top of the control transformer (hinge side opposite wire side). As shipped from the factory the transformer is configured for 460 VAC by placing one jumper in the middle jumper position at location 2-3. For 230 VAC application two jumpers are required that fit into positions 1-3 and 2-4. A second jumper for this purpose is stored on the side of the transformer next to the protective cover hinge.



CONTROL TRANSFORMER 1CTR

Figure 6.2

Power modules do not include the transformer and are automatically configured for 460 or 230 volts depending on the supplied ac line voltage. In all cases power modules must be supplied with 115 VAC for the control power supply and cooling fans if needed.

6.6 TYPICAL BASE DRIVE CONNECTIONS

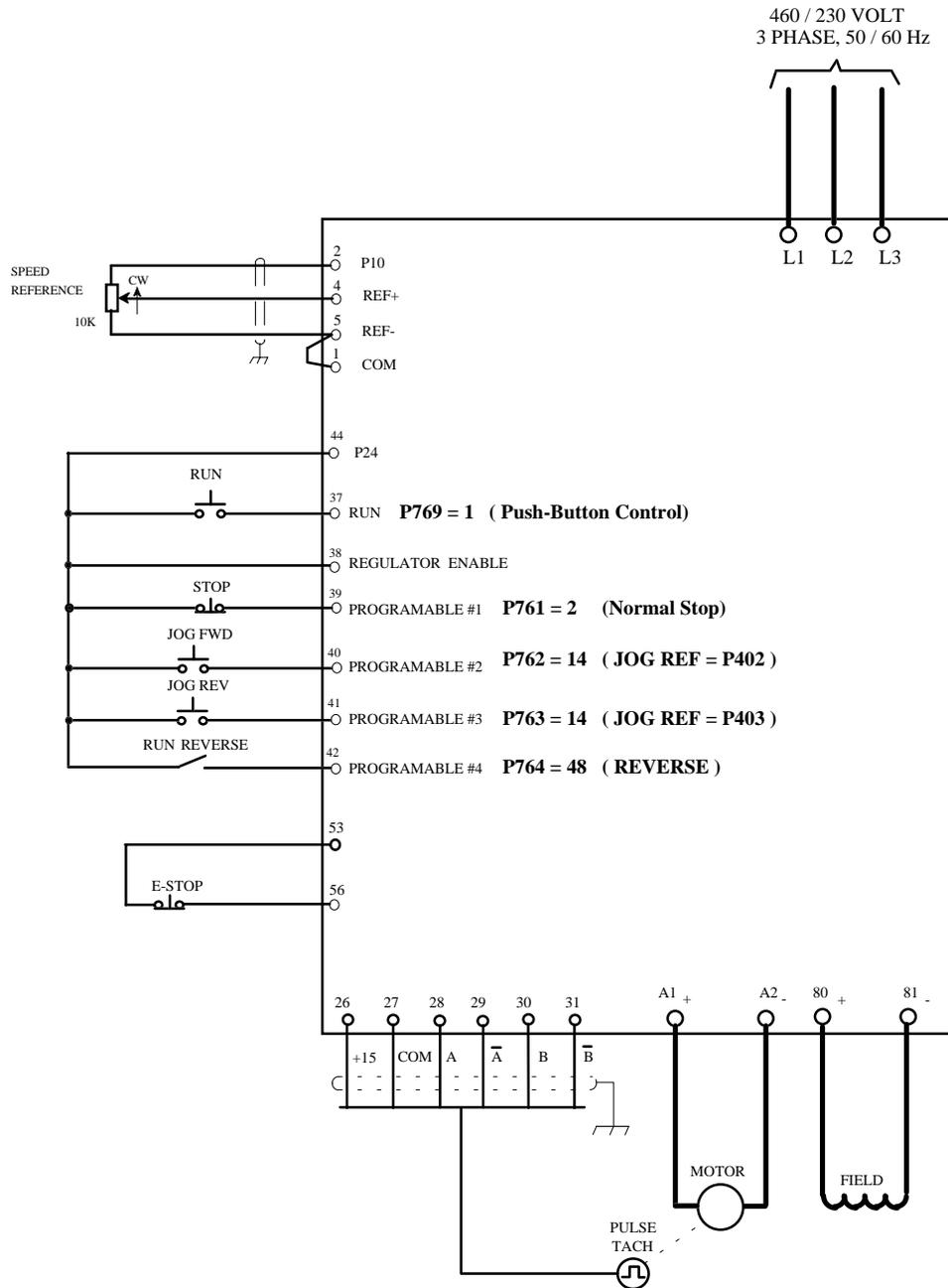


Figure 6.3
Typical Connection Diagram

NOTE:

All analog and tachometer cables must be properly shielded. The cable shields must be connected to the shield chassis grounding point provided near terminals 1 to 70. Refer to figure 6.1 for shield termination information. All control cables, including 24 volt logic circuits, analog circuits, and tachometer circuits should be run in dedicated separate conduits, separated from power and motor lines.

6.7 CONTROL BLOCK DIAGRAMS

6.7.1 Power Modules 15 to 510 Amps

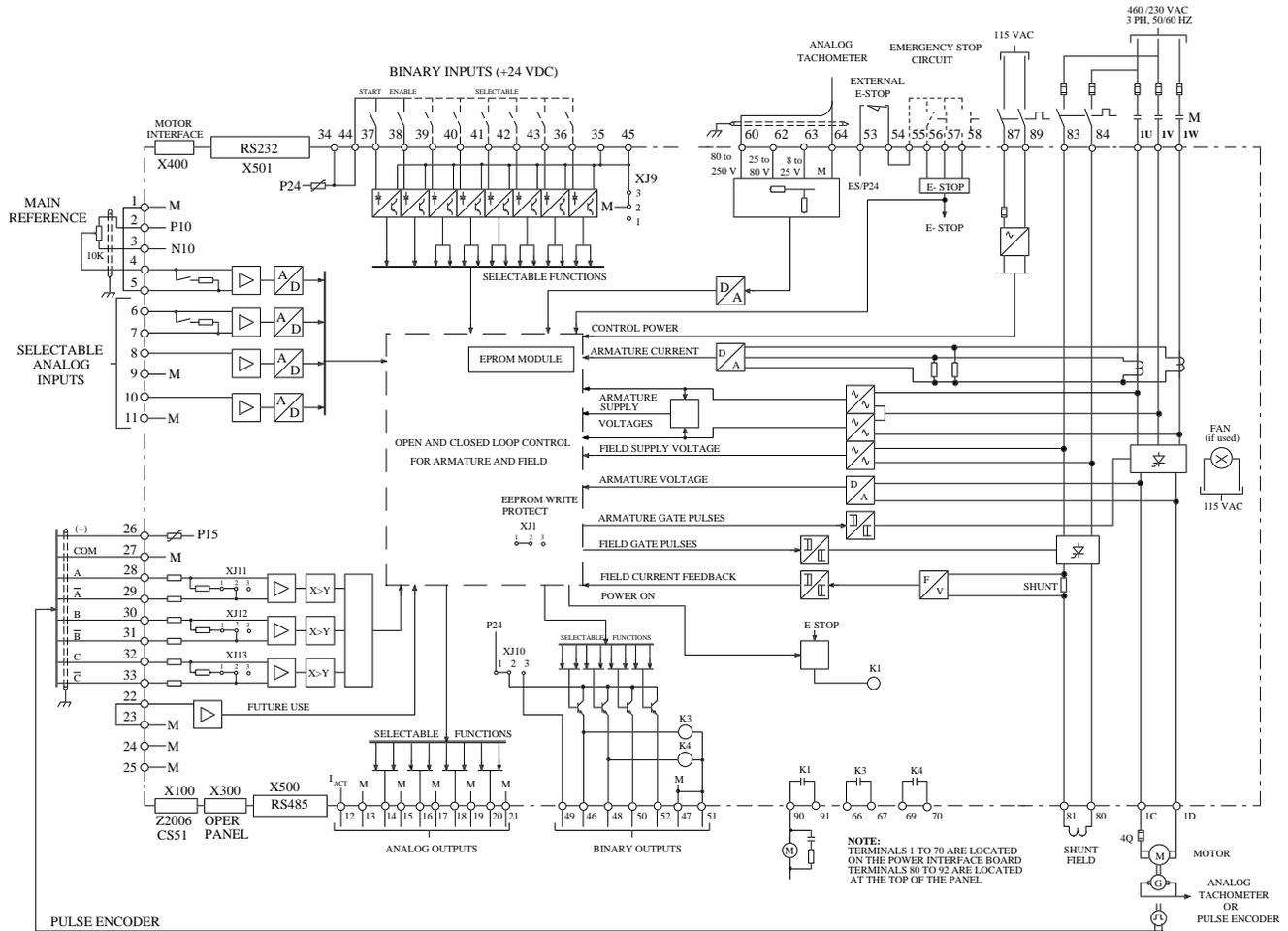


Figure 6.4
Power Modules 15 to 510 Amps

6.7.2 Base Drives 15 & 30 Amp

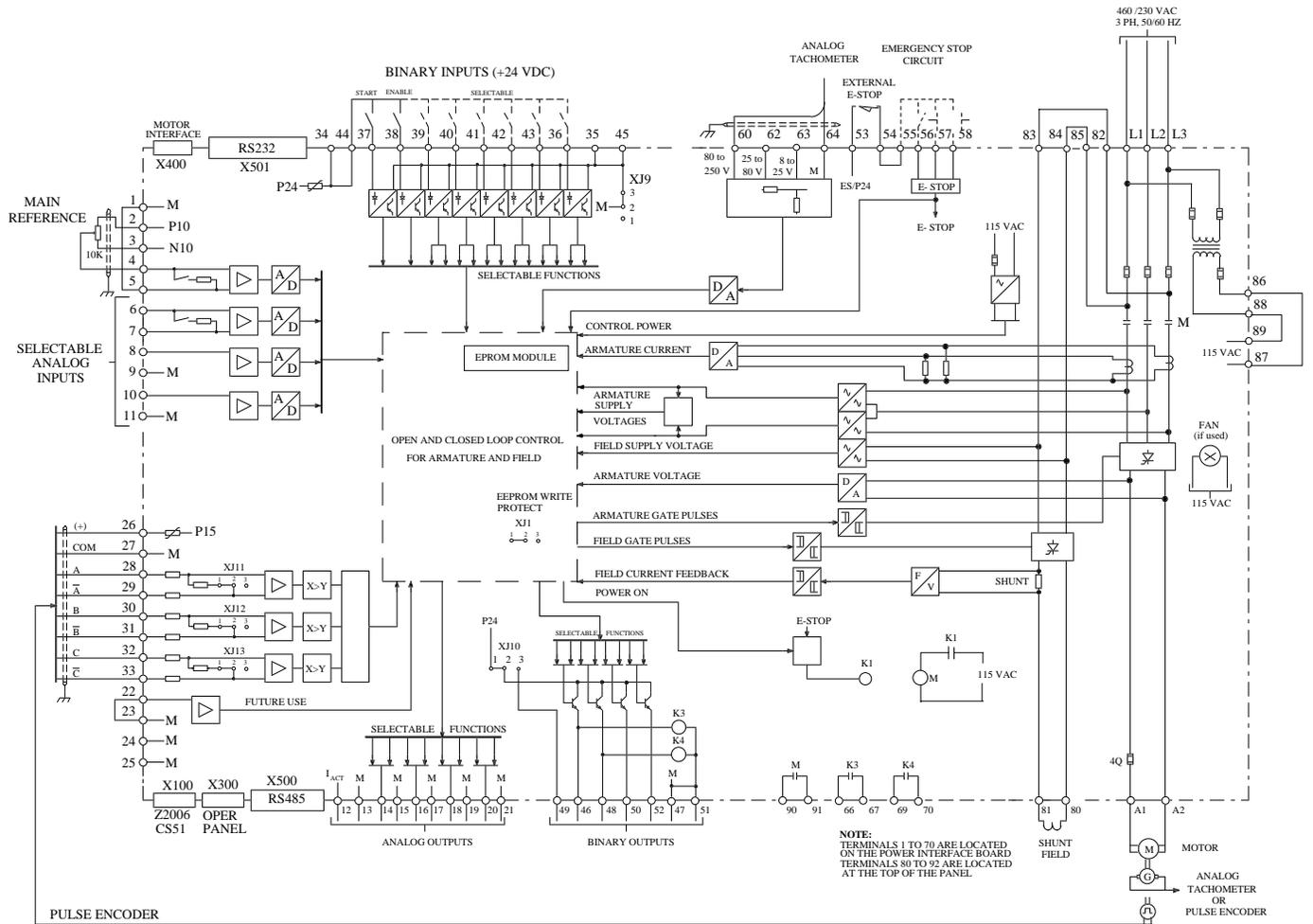


Figure 6.5
Base Drives 15 & 30 Amp

6.7.3 Base Drives 60 to 255 Amp

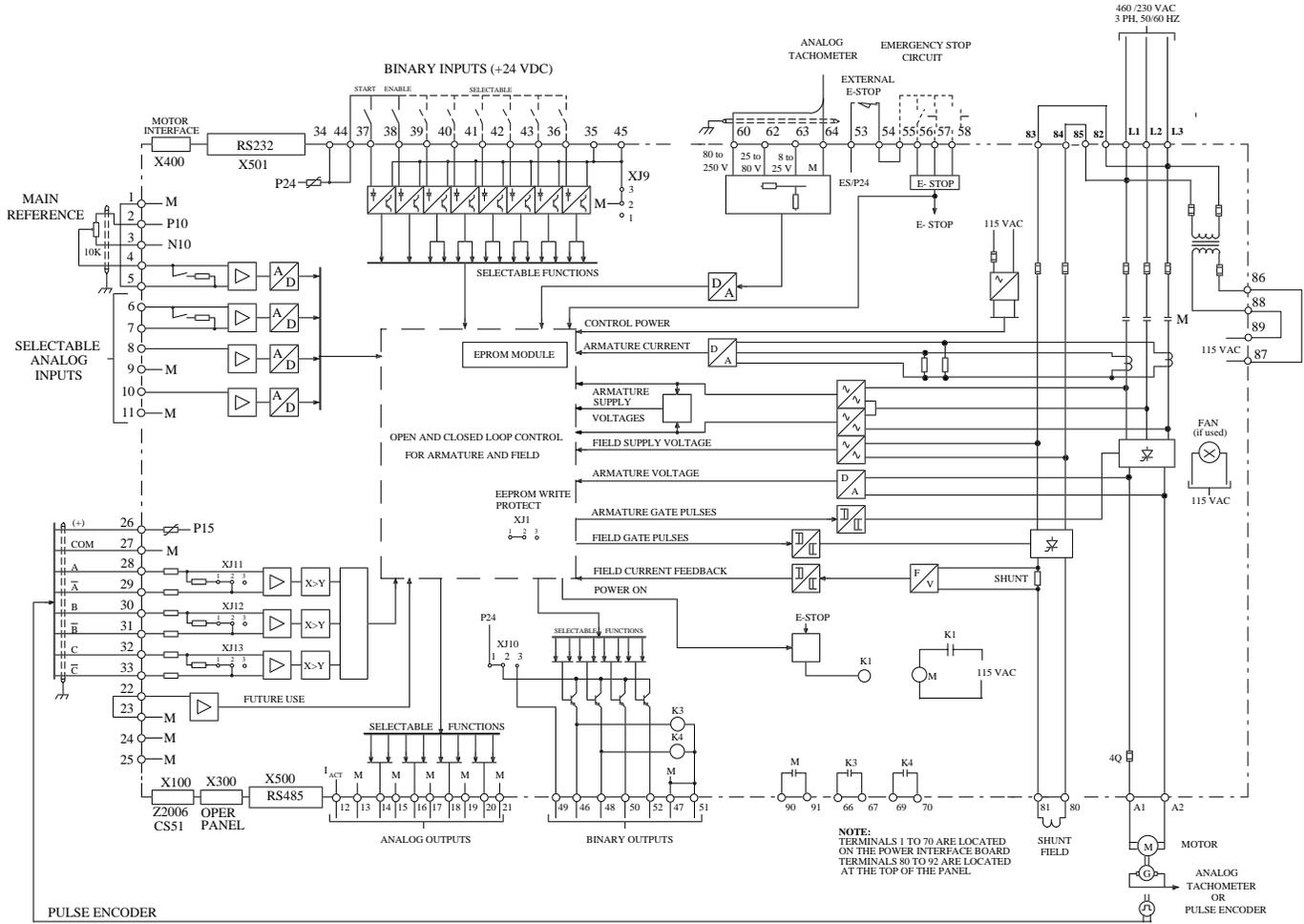


Figure 6.6
Base Drives 60 to 255 Amp

6.7.4 Base Drives 510 Amp

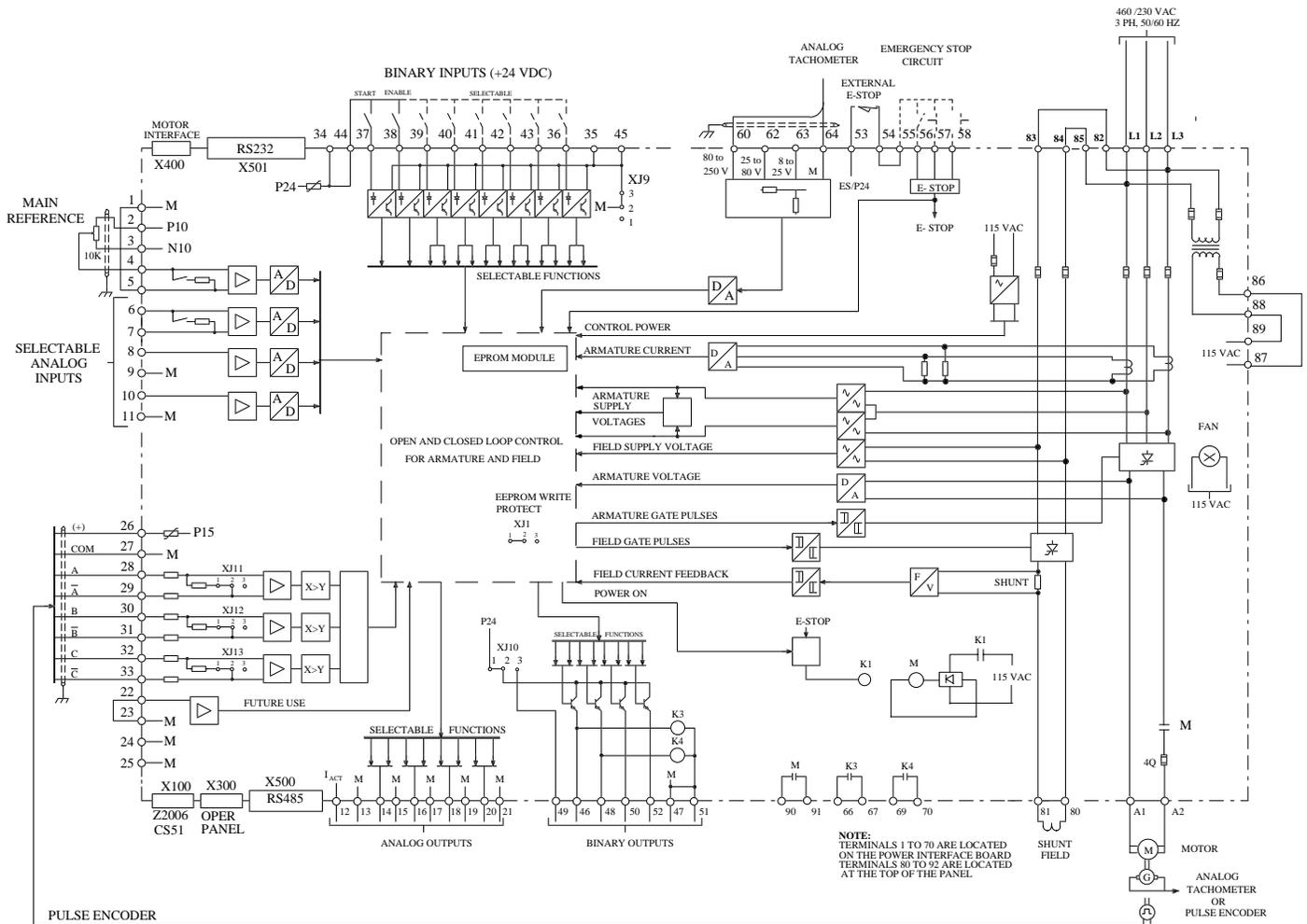


Figure 6.7
Base Drives 510 Amp

6.7.5 Base Drives 850 Amp

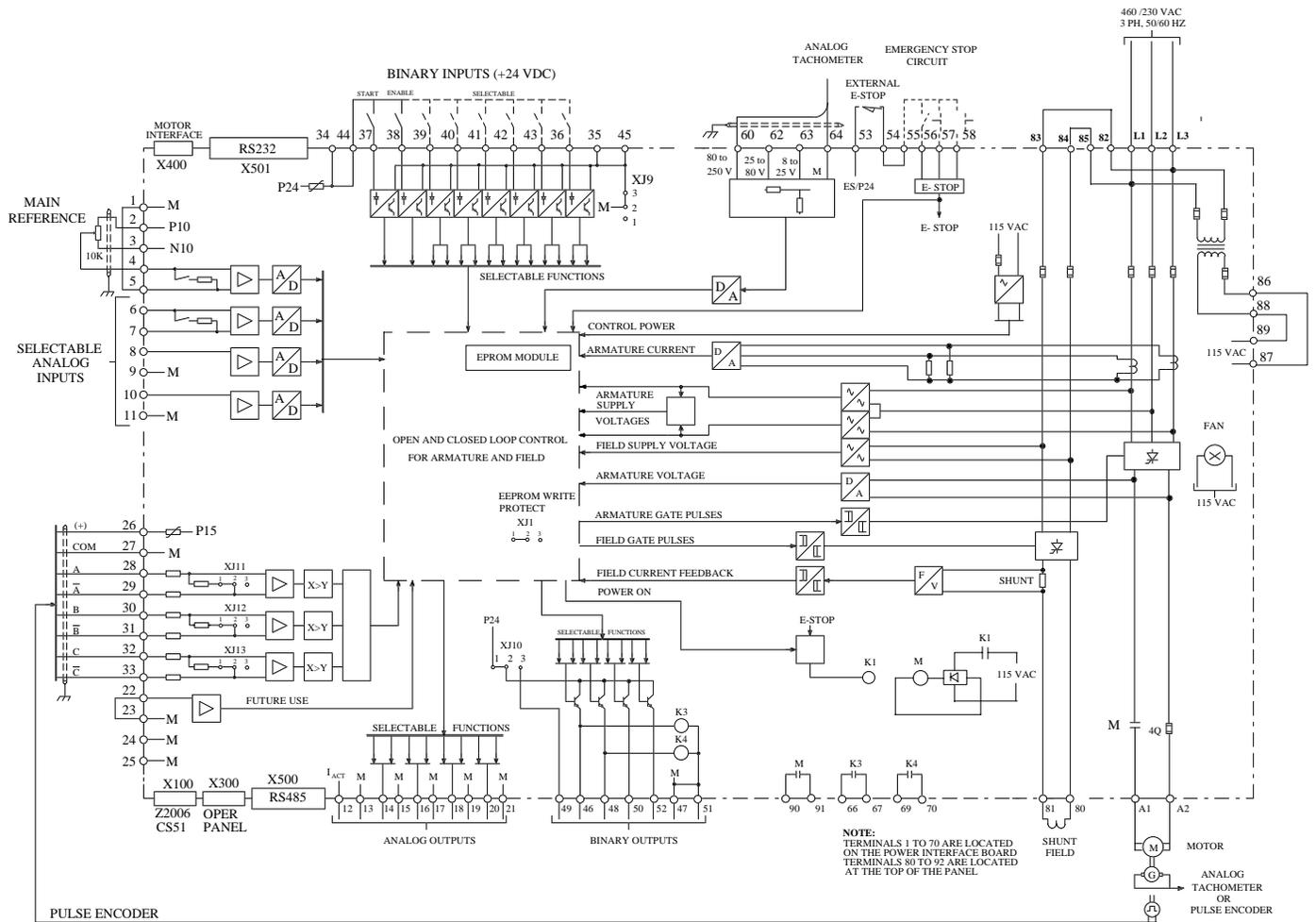


Figure 6.8
Base Drives 850 Amp

6.7.7 Base Drive Field and Armature Voltage Modifications:**6.7.7.1 Field AC Voltage:**

All base drives can be modified to use field ac voltages that are different than the armature supply voltage. In all cases the applied field ac voltage must not exceed the nominal 460 VAC level. To use a special field ac voltage remove the two strap jumpers between terminal blocks 82 - 83 and between 84 - 85. Apply the special ac field voltage between terminals 83 and 84. There is no phase relationship requirements for the single phase field ac supply voltage. Parameter P078 should be set to agree with the applied field voltage. The maximum rated dc field voltage available is approximately 0.8 times the RMS value of the applied ac field voltage.

6.7.7.2 Armature AC Voltage:

Base drives up to 510 amps are designed to operate from armature AC voltages of 230 or 460 VAC for dc motors rated at 250 or 500 volts dc. These base drives can not be operated at voltages above 460 volts +10%.

The 850 amp base drive has been designed to operate with armature supply voltages of up to 600 VAC allowing the use of 600 volt motors. When 575 / 600 VAC armature supply voltage is required the field and control circuits must be supplied from separate supplies as well. The following will describe the necessary modifications:

Field:

Modify the field ac supply as described in 6.7.6.1. For motors with 300 volt fields supply the field with 460 VAC, motors with 150 volt fields can be operated from 230 VAC.

Control Power:

A separate 115 VAC source rated at 500 VA is required for control power.

- Remove the control fuses on the primary of the internal control transformer ICTR so that it is not supplied from the 600 volt armature ac supply.
- Remove the strap jumpers between terminals 86 - 87 and between terminals 88 - 89.
- Connect the external 115 VAC source to terminals 87 (hot) and 89 (ground).

Armature Voltage:

Connect the 575 / 600 VAC armature supply to the normal terminals L1, L2, and L3.

6.8 POWER TERMINAL DESCRIPTIONS

6.8.1 Power Connections *Power Modules*

Function	Terminal	Connected Values / Comments	Related Parameters
Armature Supply Input	1U 1V 1W	Refer to technical data table 3.1 and Wiring data tables 6.4 and 6.5	P071
Safety Ground		Earth safety ground	
Armature Circuit Motor Connections	1C 1D	Refer to technical data table 3.1 and Wiring data tables 6.4 and 6.5	P072, P100, P101

6.8.2 Motor Field Connections *Power Modules*

Function	Terminal	Connected Values / Comments	Related Parameters
AC Supply Input	83 84	Refer to technical data table 3.1 and Wiring data table 6.7	
Motor Field Connections	80 (+) 81 (-)	Refer to technical data table 3.1 Wiring data table 6.7	P102

6.8.3 Control and Fan Supply *Power Modules*

Function	Terminal	Connected Values / Comments	Related Parameters
AC Supply Input	87 89 (gnd)	Single Phase 115 Vac Refer to technical data table 3.1	

6.8.4 Main Contactor Control Relay K1 *Power Modules*

Function	Terminal	Connected Values / Comments	Related Parameters
K1 Relay Contact for Driving the Main Contactor	90 91 92 ... NC	A normally open K1 relay contact is wired between terminals 90 and 91. This can be used to drive an external main contactor. Refer to technical data section 3.3 for rating information.	

NC is no internal connection

6.8.5 Power Connections *Base Drives*

Function	Terminal	Connected Values / Comments	Related Parameters
Armature Supply Input	L1 L2 L3	Refer to technical data table 3.2 and Wiring data table 6.6	P071
Safety Ground		Earth safety ground	
Armature Circuit Motor Connections	A1 A2	Refer to technical data table 3.2 and Wiring data table 6.6	P072, P100, P101

6.8.6 Motor Field Connections *Base Drives*

Function	Terminal	Connected Values / Comments	Related Parameters
AC Supply Input	83 84	Refer to technical data table 3.2 and Wiring data table 6.7	
Motor Field Connections	80 (+) 81 (-)	Refer to technical data table 3.2 and Wiring data table 6.7	P102

6.8.7 Main Contactor Auxiliary Contact *Base Drives*

Function	Terminal	Connected Values / Comments	Related Parameters
Auxiliary contact from the main contactor "M"	90 91 92 ... NC	A normally open auxiliary "M" contact is wired between terminals 90 and 91. Refer to technical data section 3.4 for rating information.	

NC is no internal connection

6.8.8 Auxiliary 115 volt Control Power *Base Drives*

Function	Terminal	Connected Values / Comments	Related Parameters
Auxiliary 115 volt control power for external customer use	87 89	115 volt AC auxiliary power 115 V return (chassis ground) A minimum of 75 VA is available for external customer use on all ratings.	

6.9 JUMPER, SWITCH, AND CONTROL TERMINAL DESCRIPTIONS

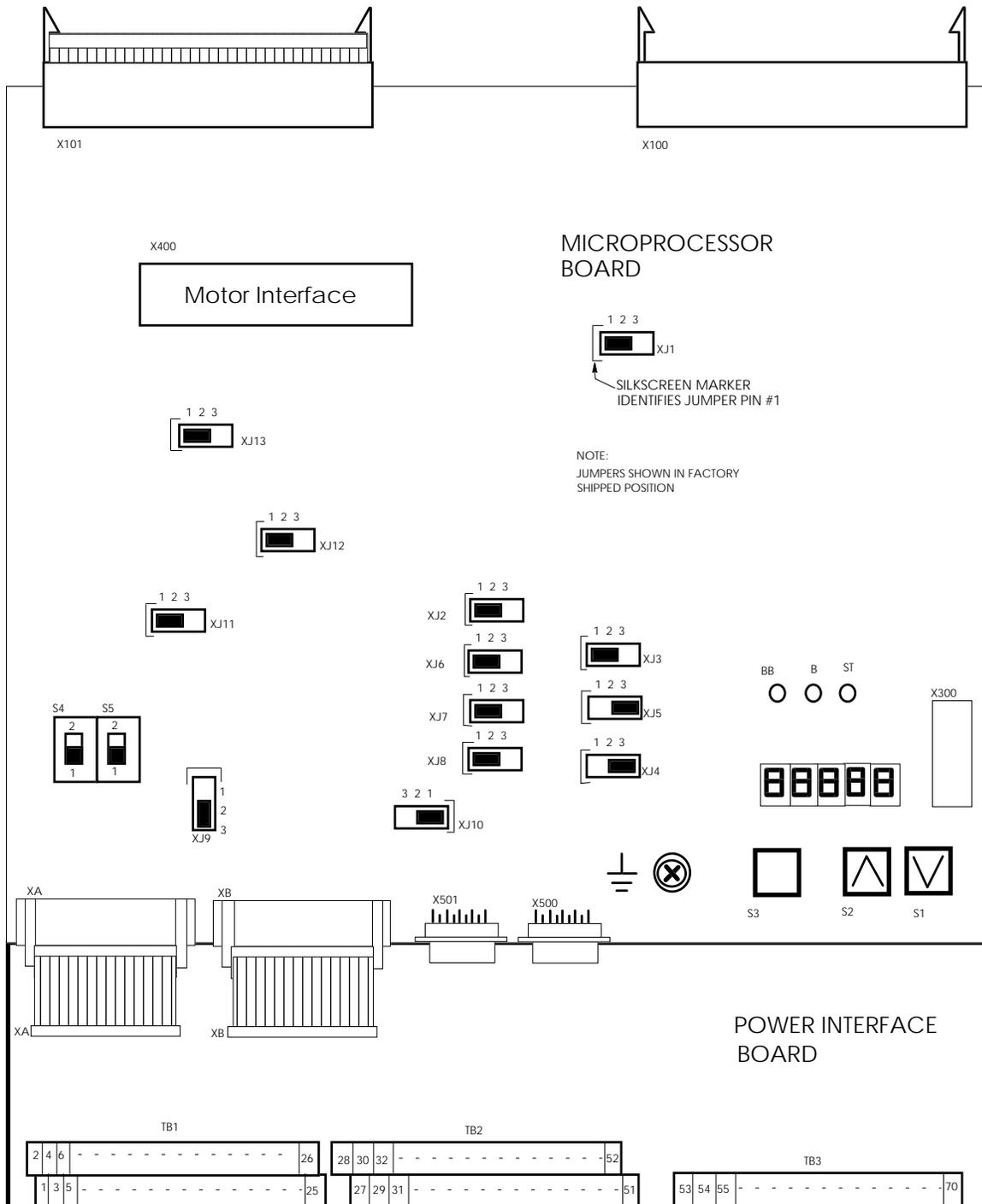


Figure 6.10
Device Location Diagram

6.9.1 Microprocessor Board Jumpers

The microprocessor board, located in the card file inside the front cover, contains 13 movable jumpers that can be set for different application requirements. Each jumper consists of 3 pins and a movable jumper link that connects the center pin with either of the end pins. Jumper pin #1 is identified with a silk-screen [symbol. Refer to figure 6.7 for approximate jumper locations. In the descriptions that follow the factory jumper setting is shown in **bold** and underlined.

JUMPER	FUNCTION	POSITION DESCRIPTION
XJ1	Hardware EEPROM write protect	<u>Position 1-2</u> Write active Position 2-3 Write de-activated
XJ2	5 volt power for RS232 to RS485 converter option board (X501)	<u>Position 1-2</u> Option not supplied Position 2-3 Option supplied
XJ3	RS485 bus termination resistor (X500 pin 3 to 8)	<u>Position 1-2</u> No termination resistor Position 2-3 150Ω resistor termination
XJ4	RS485 bus termination pulldown resistor (X500 pin 8 to M pin 5)	Position 1-2 390Ω resistor termination <u>Position 2-3</u> No termination resistor
XJ5	RS485 bus termination pullup resistor (X500 pin 3 to P5 pin 6)	Position 1-2 390Ω resistor termination <u>Position 2-3</u> No termination resistor
XJ6	Transmit signal for RS232 to RS485 converter option board (X501)	<u>Position 1-2</u> Not connected to X501 Position 2-3 connected to X501
XJ7	Receive signal for RS232 to RS485 converter option board (X501)	<u>Position 1-2</u> Not connected to X501 Position 2-3 connected to X501
XJ8	Driver enable signal for RS232 to RS485 converter option board (X501)	<u>Position 1-2</u> Not connected to X501 Position 2-3 connected to X501
XJ9	Common for binary input, terminals 35 & 45 connected internally to M or externally	Position 1-2 External common connection <u>Position 2-3</u> Internal connection to M
XJ10	24 volt power for binary outputs from internal source or external source	<u>Position 1-2</u> supplied from internal 24 vdc Position 2-3 supplied from external 24 vdc
XJ11	Pulse encoder track 1 voltage level	<u>Position 1-2</u> 15 volt encoder Position 2-3 5 volt encoder
XJ12	Pulse encoder track 2 voltage level	<u>Position 1-2</u> 15 volt encoder Position 2-3 5 volt encoder
XJ13	Pulse encoder marker track 1 voltage level	<u>Position 1-2</u> 15 volt encoder Position 2-3 5 volt encoder

6.9.2 Microprocessor Board Switches

The microprocessor board provides 5 switches that can be used to configure functions and operate the board level display. Refer to figure 6.7 for approximate switch locations.

SWITCH	FUNCTION	POSITION DESCRIPTION
S1	LOWER Parameter change push-button	
S2	RAISE Parameter change push-button	
S3	Parameter Mode push-button	
S4	Main reference terminals 4 and 5	Position 1 ±10 volt input range Position 2 0 to 20 ma input range
S5	Selectable analog input 1 terminals 6 and 7	Position 1 ±10 volt input range Position 2 0 to 20 ma input range

6.9.3 Terminal Descriptions Terminals 1 to 70

ANALOG INPUTS Reference Inputs

Terminal	Function	Comments	Related Setting
1 2 3	M P10 N10	Voltages source for potentiometers; ±0.5% at 25°C, 0.1% drift/10°C 10 ma short circuit proof; Recommended potentiometer resistance is 10kΩ	
4 5	Ref (+) Ref (-)	Differential input normally used as the main reference; Note: Terminal 5 must be connected when this input is used. S4 - position 1: ±10V; 515kΩ S4 - position 2: 0 - 20 ma; 300Ω Resolution approximately 2.4 mv (12 bit)	S4 P701 P702 P703 P704
6 7	analog 1 (+) analog 1 (-)	Differential input; used as a selectable analog input; Note: Terminal 7 must be connected when this input is used. S5 - position 1: ±10V; 515kΩ S5 - position 2: 0 - 20 ma; 300Ω Resolution approximately 2.4 mv (12 bit)	S5 P711 P712 P713 P714
8 9	analog 2 common	Single ended input used as a selectable analog input; ±10V; 52kΩ; resolution approximately 10.8 mv	P716 P717 P718 P719
10 11	analog 3 common	Single ended input used as a selectable analog input; ±10V; 52kΩ; resolution approximately 10.8 mv	P721 P722 P723 P724

ANALOG OUTPUTS

Terminal	Function	Comments	Related Setting
12 13	Arm current common	0 to ± 10 volts corresponds to 0 to $\pm 200\%$ of rated converter current maximum load 2 ma; short circuit proof	P739
14 15	Selectable analog output 1 common	Selectable analog output; 0 to ± 10 volts, maximum load 2 ma; short circuit proof; resolution ± 11 bits	P740 P741 P742 P743 P744
16 17	Selectable analog output 2 common	Selectable analog output; 0 to ± 10 volts, maximum load 2 ma; short circuit proof; resolution ± 11 bits	P745 P746 P747 P748 P749
18 19	Selectable analog output 3 common	Selectable analog output; 0 to ± 10 volts, maximum load 2 ma; short circuit proof; resolution ± 11 bits	P750 P751 P752 P753 P754
20 21	Selectable analog output 4 common	Selectable analog output; 0 to ± 10 volts, maximum load 2 ma; short circuit proof; resolution ± 11 bits	P755 P756 P757 P758 P759

OTHER ANALOG TERMINALS

Terminal	Function	Comments	Related Setting
22 23 24 25	Future use Future use common common	Terminals 24 and 25 are connected to the analog common signal.	

PULSE ENCODER CONNECTIONS

Terminal	Function	Comments	Related Setting
26 27	Tach supply Tach common	+15 volts nominal; 200 ma; short circuit proof Tachometer common	XJ11 XJ12
28 29	Channel A Complement A	Pulse encoder channel A and complement channel A; Load < 5 ma at 15 volts.	XJ13 P083
30 31	Channel B Complement B	Pulse encoder channel B and complement channel B; Load < 5 ma at 15 volts.	P140 P141
32 33	Channel C Complement C	Marker channel C and complement channel C. (not currently used)	P142 P143

ADDITIONAL PULSE ENCODER INFORMATION:**Input Pulse Level:**

Encoder signals up to 27 volts differential voltage can be processed by the pulse encoder input circuit. Two voltage ranges are defined with jumpers XJ11, XJ12, and XJ13.

Nominal 5 Volt range is selected with jumpers XJ11, XJ12, and XJ13 in position 2-3 and accepts signals with the following characteristics: (separate 5 Vdc supply required)

Low Level:	differential voltage < 0.8 volts
High Level:	differential voltage > 2.0 volts
Input Hysteresis:	> 0.2 volts
Common Mode:	± 10 volts maximum

Nominal 15 Volt range is selected with jumpers XJ11, XJ12, and XJ13 in position 1-2 and accepts signals with the following characteristics:

Low Level:	differential voltage < 5 volts
High Level:	differential voltage > 8.0 volts
Input Hysteresis:	> 1.0 volts
Common Mode:	± 10 volts maximum

Note: If the encoder does not provide complimentary signals then the encoder common must be connected to the complimentary terminals (i.e., terminals 29 and 31).

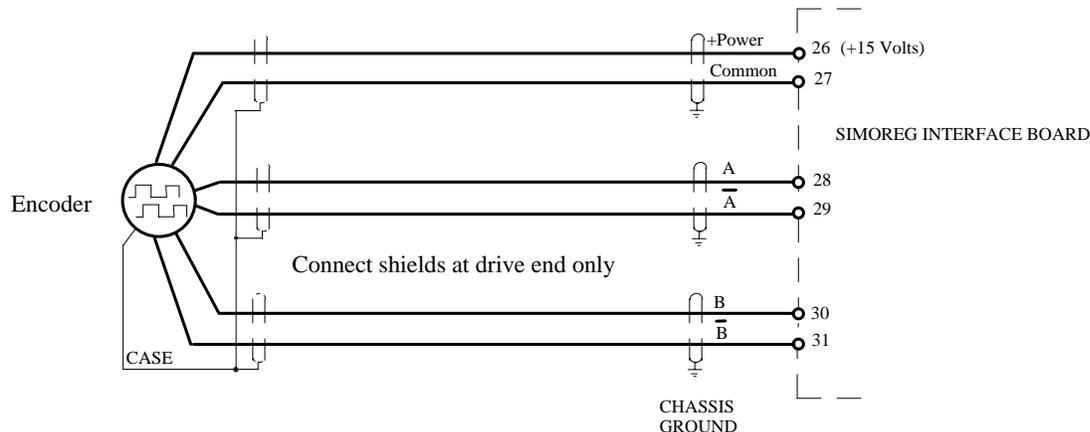
Encoder Pulse Frequency:

The encoder input circuit can accept input frequencies up to 300 kHz if the encoder voltage is 15 volts or less and the minimum time between pulse edges of the two channels A and B meets the limits shown below. For best results an encoder with at least 1024 PPR should be selected.

Differential Voltage at terminals	5 Volt Nominal		15 Volt Nominal		
	2V	> 2.5 V	8V	10V	>14V
Minimum Time between edges	630 ns	380 ns	630 ns	430 ns	380 ns

Encoder Cable:

The encoder cable capacitance must be charged and discharged with each encoder pulse. Cables with high capacitance will increase the load on the encoder and cause the pulse edges to round which limits high frequency operation. A low capacitance shielded cable such as Belden Type 9730 or equivalent should be used.



Recommended Pulse Encoder Wiring

BINARY INPUTS

Terminal	Function	Comments	Related Setting
34 44	24V Supply 24V Supply	Internal 24 Vdc; 100 ma maximum; Referenced to internal common at terminals 35 and 45 when jumper XJ9 is in position 2-3.	XJ9
35 45	Common Common	Binary input common; Connected to internal common when jumper XJ9 is in position 2-3.	XJ9
37	On / Off	H signal: ON. Refer to section 10.3. Closes main contactor and releases the regulators if terminal 38 is also on. L signal: OFF. Refer to section 10.3. Decelerates to zero speed, blocks regulators, and then opens main contactor.	P769
38	Enable	Regulator Enable. Refer to section 10.3.: H signal: Regulators Enabled Allows regulator to operate when terminal 37 is "ON". L signal: Regulators Blocked Blocks regulators by setting outputs to zero even if terminal 37 is "ON"	
39	Selectable 1	Selectable binary input; refer to Section 10.2 for choices	P761
40	Selectable 2	Selectable binary input; refer to Section 10.2 for choices	P762
41	Selectable 3	Selectable binary input; refer to Section 10.2 for choices	P763
42	Selectable 4	Selectable binary input; refer to Section 10.2 for choices	P764.ii
43	Selectable 5	Selectable binary input; refer to Section 10.2 for choices	P765.ii
36	Fault acknowledge	Selectable binary input; refer to Section 10.2 for choices; Factory default is binary input function 5, " Fault Acknowledge "	P766

H signal: +13Volts to +33 Volts

L signal: -3Volts to +5Volts or open terminal

Loading: 8.5 ma at +24 volts dc per input

BINARY OUTPUTS

Terminal	Function	Comments	Related Setting
49	External Supply	External +24 volt nominal supply for binary outputs if used. If an external supply is used jumper XJ10 must be in position 2-3. The external supply must be between +20 and +30 volts.	XJ10
47	Common	Common connection for binary outputs.	
51	Common	Common connection for binary outputs.	
46	"No Fault"	Selectable binary output 1. Refer to section 10.4 for binary output choices. As shipped terminal 46 is defaulted as " NO Fault ". H signal: No faults, L signal: Faults present	P771
48	Selectable 2	Selectable binary output 2. Refer to section 10.4 for binary output choices.	P772
50	Selectable 3	Selectable binary output 3. Refer to section 10.4 for binary output choices.	P773
52	Selectable 4	Selectable binary output 4. Refer to section 10.4 for binary output choices.	P774

H signal: +16Volts to +30 Volts

L signal: 0Volts to +2Volts

Loading: Internal supply = 10 ma max per output, External supply = 100 ma max per output

EMERGENCY STOP

Terminal	Function	Comments	Related Setting
53	Supply voltage	+24 volts dc, 50 ma, short circuit proof, for use with the hardwired EMERGENCY STOP function	
54	Ext E-STOP	Terminal for external circuits to be connected between terminal 53 and 54. As shipped a jumper is installed between terminals 53 and 54. Remove jumper if normally closed external E-STOP circuits are used.	
55	Voltage source	Voltage source after external E-STOP circuits. As shipped a jumper is installed between terminals 55 and 56.	
56	E-STOP function without manual reset	If a normally closed momentary push-button or a normally closed maintained E-STOP safety switch is used, it should be connected between terminals 55 and 56. The factory jumper between terminals 55 and 56 must be removed. If the run command is still on after the E-STOP is released the drive will wait in status o8 until the run command is removed.	
57	E-STOP function with manual reset	If a normally closed E-STOP push button or safety switch is required with a manual reset push-button, then the E-STOP function should be connected between terminals 55 and 57 and the factory jumper between terminals 55 and 56 should be removed. Terminal 56 should not be used when a manual reset is required.	See terminal 58
58	E-STOP manual reset	If an E-STOP function is used at terminal 57 a normally open push-button should also be connected between terminals 55 and 58. This will reset the internal E-STOP latch when all E-STOP situations have been cleared and the drive is ready to be started again.	See terminal 57

NOTE: Either terminal 56 **OR** 57 and 58 should be used for the E-STOP function. As shipped jumpers are installed between terminals 53 and 54, and between terminals 55 and 56. This allows the drive to operate without any hardwired E-STOP functions.

ANALOG INPUT Analog Tachometer Input

Terminal	Function	Comments	Related Setting
59	NC	NC .. no connection	P083
60	80 - 250 Volt	± 80 to ± 250 volt tachometer input range at top speed; 520k Ω	P706
61	NC	NC .. no connection	P707
62	25 - 80 Volt	± 25 to ± 80 volt tachometer input range at top speed; 138k Ω	P708
63	8 - 25 Volt	± 8 to ± 25 volt tachometer input range at top speed; 138k Ω	P709
64	Common	Tachometer common	

NC is no internal connection

CONTROL RELAY CONTACT OUTPUTS

Terminal	Function	Comments	Related Setting
65	NC	NC .. no connection	
66 - 67	K3 Relay	One normally open contact from relay K3 is connected between terminals 66 and 67. The contact can be used in 115 VAC or 24 VDC circuits. The relay is driven by binary output 1 at terminal 46 and has the same function as selected with P771	P771
68	NC	NC .. no connection	
69 - 70	K4 Relay	One normally open contact from relay K4 is connected between terminals 69 and 70. The contact can be used in 115 VAC or 24 VDC circuits. The relay is driven by binary output 2 at terminal 48 and has the same function as selected with P772	P772

6.9.4 RS232 Serial Interface Base Port 1.... X501 (Sub D 9 pin connector) Also refer to section 10.7

Terminal	Function	Comments	Related Setting
X501.1	RxD1-1 if XJ7 in position 2-3	Connection to optional interface expansion module RS232 to RS485 converter	P790 to P798 and XJ2 XJ6 XJ7 XJ8
X501.2	Received Data RxD	RS232 data	
X501.3	Transmitted Data TxD	RS232 data	
X501.4	TxD1-1 if XJ6 in position 2-3	Connection to optional interface expansion module RS232 to RS485 converter	
X501.5	Signal Common	Common for RS232	
X501.6	DE2-1 if XJ8 in position 2-3	Direction changeover for optional expansion module RS232 to RS485 converter	
X501.7	Driver Output	RTS (request to send)	
X501.8	Driver Output	CTS (clear to send)	
X501.9	P5-10 if XJ2 in position 2-3	+5 volt supply for expansion module RS232 to RS485 converter	

Note: For serial interfaces, use shielded twisted control cable and connect the shields at **BOTH** ends to chassis ground.

6.9.5 RS485 Serial Interface Base Port 0.... X500 (Sub D 9 pin connector) Also refer to section 10.7

Terminal	Function	Comments	Related Setting
X500.1	Protective chassis ground		P780 to P788 and XJ3 XJ4 XJ5
X500.2	No connection		
X500.3	RxD-P or RxD / TxD-P	For 4 wire or 2 wire RS485 connections	
X500.4	TxD-P	Used only for 4 wire connections	
X500.5	DGND	Common	
X500.6	+5 Volt supply	Used for cable termination	
X500.7	No Connection		
X500.8	RxD-PN or RxD / TxD-N	For 4 wire or 2 wire RS485 connections	
X500.9	TxD-N	Used only for 4 wire connections	

Notes

1. For serial interfaces, use shielded twisted control cable and connect the shields at **BOTH** ends to chassis ground.
2. The last drive on the end of the RS485 line must provide line termination using jumpers XJ3, XJ4, XJ5
3. Cable length up to 600 meters for transmission rates of 187.5 kBd and higher, up to 1200 meters for rates less than 187.5 kBd.
4. RS485 specifications require that the potential difference between commons at different equipment be no more than ± 7 volts. If this can not be guaranteed additional ground equalization wiring must be added.

6.9.6 Optional Serial Interface Expansion..X502... RS232 to RS485 Converter Also refer to section 10.7

The optional serial interface expansion module can be used to convert the RS232 channel at X501 into a second RS485 channel. The resulting RS485 channel can be operated with either 2 or 4 wire connections.

Terminal	Function	Comments	Related Setting
X502.1	No connection		P780 to
X502.2	No connection		P788
X502.3	RxD_P1 or RxD / TxD_P1	For 4 wire or 2 wire RS485 connections	XJ200 to
X502.4	TxD_P1	Used only for 4 wire connections	XJ202
X502.5	DGND	Common	XJ2
X502.6	+5 Volt supply	Used for cable termination	XJ6 to XJ8
X502.7	No Connection		
X502.8	RxD_PN1 or RxD / TxD_N1	For 4 wire or 2 wire RS485 connections	
X502.9	TxD_N1	Used only for 4 wire connections	

Notes

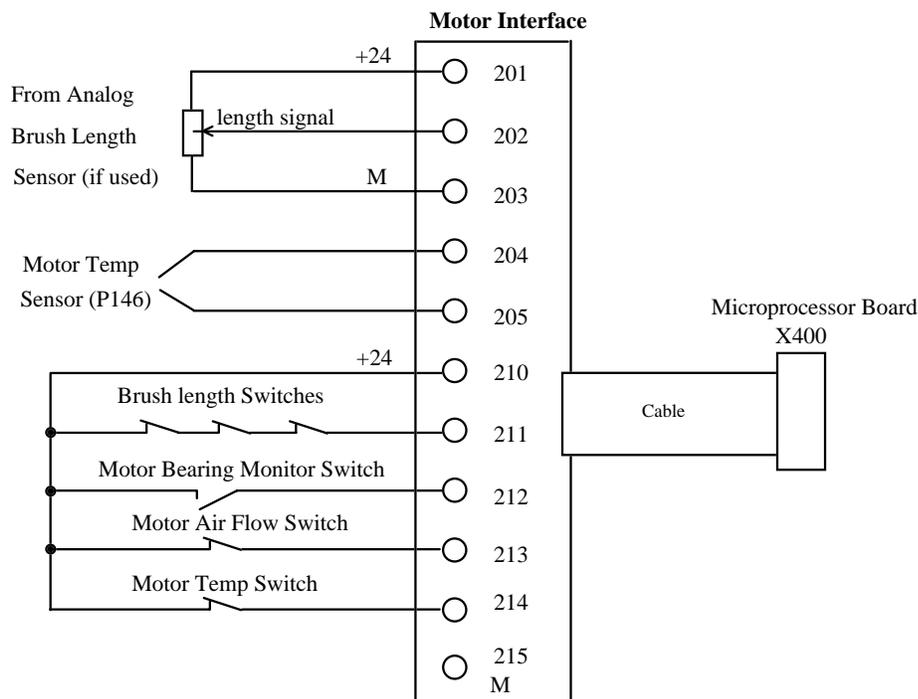
1. For serial interfaces, use shielded twisted control cable and connect the shields at **BOTH** ends to chassis ground.
2. The last drive on the end of the RS485 line must provide line termination using jumpers XJ200, XJ201, XJ202 located on the RS232 to RS485 converter module. **Refer to section 10.7 for jumper settings.**
3. Cable length up to 600 meters for transmission rates of 187.5 kBd and higher, up to 1200 meters for rates less than 187.5 kBd.
4. RS485 specifications require that the potential difference between commons at different equipment be no more than ± 7 volts. If this can not be guaranteed additional ground equalization wiring must be added.

See section 2.3 for ordering information.

6.9.7 Motor interface Option XM200

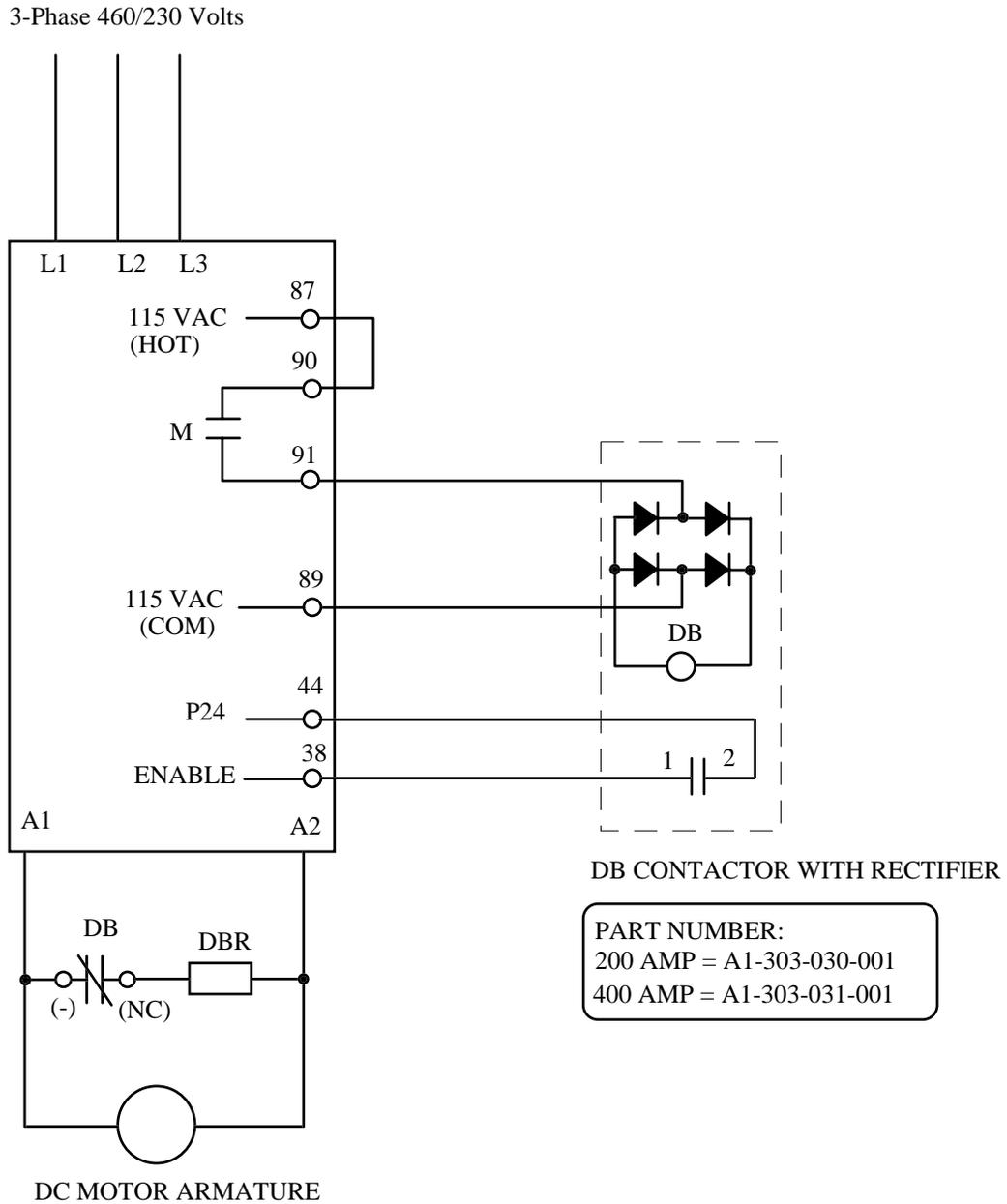
Function	Terminal	Comments	Related Setting
Brush length measurement supply	XM201	+24 VDC, maximum load capability is 100 ma	P145
Analog brush length signal	XM202	Brush signal 0 to 17 V, Rin > 100 kΩ	
Common for analog brush sensor	XM203	Common	
Motor temperature sensor positive	XM204	Sensor type selected with P146 & XJ101	P146
Motor temperature sensor negative	XM205		P147 P148
Supply for binary inputs	XM210	24 VDC, maximum load capability is 100 ma with respect to internal common if jumper XJ100 is in position 1-2.	P145
Brush length binary input	XM211	Refer to parameter P145 for details	
Bearing condition binary input	XM212	"	
Air flow monitor binary input	XM213	"	
Thermal switch binary input	XM214	"	
Common M5/3 for binary inputs	XM215	Can be disconnected from internal ground for use with an external supply if jumper XJ100 is in position 2-3.	XJ100

- Note:
- For binary inputs a HIGH signal is +13 to +33 volts; a LOW signal is _3 to +5 volts
 - Each binary input requires 8.5 ma at 24 VDC
 - If jumper XJ100 is in position 2-3, then the potential isolation to internal common is optically isolated to a voltage level of 50 volts peak.
 - Jumper XJ101 is set depending on the type of temperature sensor used. Refer to parameter P146 for information concerning the setting of XJ101.
 - See section 2.3 for ordering information.



6.9.8 Dynamic Braking

Dynamic braking can be used with 6RA24 drives through the addition of a dynamic braking contactor and resistor. The following schematic shows the required connections.



Notes:

7. START-UP

7.1 General Safety Information for Start-up

NOTE

Before starting-up the equipment, confirm that the software module is mounted on the microprocessor board

Before touching any board (especially the software module, A1-116-101-517) it is necessary to be electrically grounded in order to protect the electronic components from high voltages generated as a result of electrostatic charging. Boards must not come into contact with highly insulating materials (e.g. plastic objects, insulated desktops, clothing articles manufactured from man-made fibers) which can generate static electricity.

Boards removed from the drive must be placed on conductive surfaces.



WARNING

This equipment contains hazardous voltages and hazardous rotating mechanical parts.



Loss of life, severe personal injury or property damage can result if instructions contained in this manual are not followed.

Only qualified personnel should work on this equipment, and only after becoming familiar with all safety notices, installation, operation and maintenance procedures contained in this manual. The successful and safe operation of this equipment is dependent upon proper handling, installation, operation and maintenance of this equipment.

The SIMOREG drive controller has hazardous voltages present even when the main contactor is open. The power / interface board (bottom pc board) has many circuits that are at hazardous voltages. Turn off and lock out all power sources at the feeder to the drive before performing maintenance or repair.

This procedure does not represent an exhaustive survey of all steps necessary to ensure safe operation of equipment. Particular applications may require further information and procedures. Contact the nearest Siemens sales office should particular problems arise which are not covered sufficiently for the purchasers' purpose.

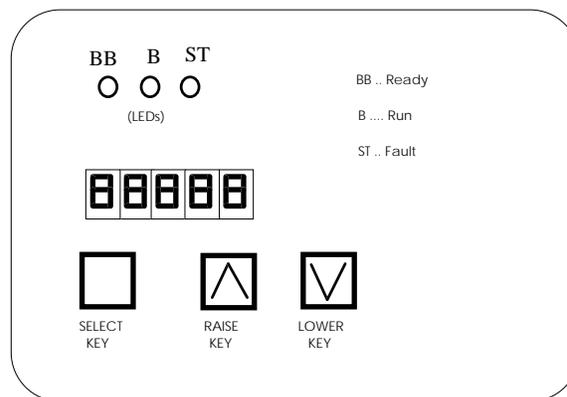
The use of unauthorized parts in the repair of this equipment or tampering by unqualified personnel will result in dangerous conditions which can cause death, severe personal injury or serious equipment damage. Follow all safety precautions contained in this manual and all safety warning labels on this product. *Refer to the full set of warning labels on pages 1.1 and 1.2 of this manual.*

7.2 Operator Control Panels

The basic drive controller comes equipped with a built-in simple operator panel. The drive controller can be optionally equipped with a LCD alpha-numeric operator panel. When the optional operator panel is installed the simple built-in operator panel is not operational except to display drive status. In this case, the optional panel is used to make all drive controller settings.

7.2.1 Built-in Operator Panel

The built-in operator control panel is located at the bottom right behind the drive controller front door on the microprocessor board. It consists of a 5 digit, 7 segment LED display unit, 3 LEDs used for status display, and 3 keys used to adjust the drive parameters. All configurations, adjustments, and measurements required for start-up of the base 6RA24 can be performed using the built-in operator panel. To gain access to Z2006 technology board parameters the optional operator control panel must be used.



Built-in Operator Panel Functions

SELECT key

- Changes the display between the parameter number (parameter mode), and the parameter value (value mode).
- Accelerates the rate of change when the raise or lower keys are used
- Used to acknowledge faults

RAISE key

- In parameter mode, increases the parameter number through the parameter list.
- In value mode, will increase the value of a parameter. When the highest parameter value is reached, a jump to the lowest value can be made by pressing the raise key again,
- Used to increase the index number for index parameters.
- Used to start a function selected with parameter P051 (e.g., self-tuning procedure)

LOWER key

- In parameter mode, decreases the parameter number through the parameter list.
- In value mode, will decrease the value of a parameter. When the lowest parameter value is reached, a jump to the highest parameter value can be made by pressing the lower key again,
- Used to decrease the index number for index parameters.
- Used to terminate a function started with the raise key and parameter P051.

LED Functions**Ready (BB)** green LED

When lit the drive controller is in the "wait for operating enable" status (o1). Refer to section 8.1 for additional information.

Run (B) yellow LED

When lit the drive controller is operating with torque direction I, II, or Zero. Refer to section 8.1 for additional information.

Fault (ST) red LED

When lit the drive controller has a fault condition present, status (o11).

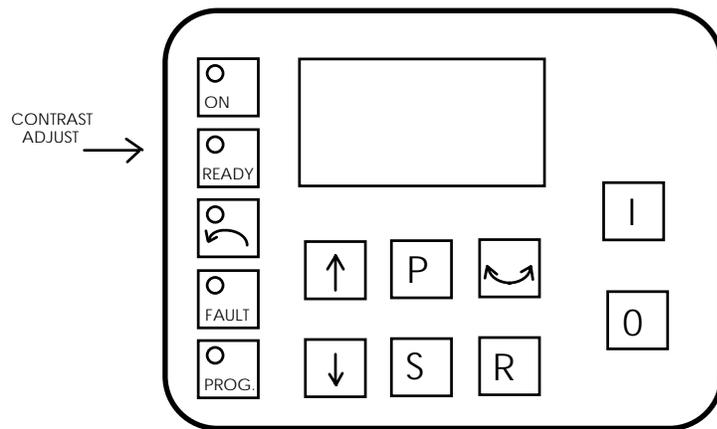
When flashing, the drive controller has a warning alarm present. Refer to section 8.1 for additional information.

7.2.2 Optional Operator Control Panel

The optional operator control panel is usually mounted in the drive controller door or as an option can be remotely mounted up to 5 feet from the drive controller. If remotely mounted, a flat cable will be required to connect the operator panel to the drive. Refer to section 2.4 for operator panel and cable part numbers.

The operator panel provides a plain text LCD display with 2 lines of 16 characters per line, 5 LEDs for status display and 8 keys.

When the operator panel is connected to the drive controller it is automatically detected and becomes active. The text display contrast can be adjusted with a screw potentiometer located on the back edge of the panel.



Optional Operator Control Panel

Control Panel Key Functions:**P key**

- Changes between OPERATING DISPLAY mode and PARAMETER CHANGE mode
- In parameter change mode either the parameter number or the parameter value can be selected for change
- When changes are made using the raise or lower keys, the rate of change can be increased by also pressing the P key.

RAISE key

- In parameter mode, increases the parameter number through the parameter list.
- In value mode, will increase the value of a parameter. When the highest parameter value is reached, a jump to the lowest value can be made by pressing the raise key again,
- Used to increase the index number for index parameters.

LOWER key

- In parameter mode, decreases the parameter number through the parameter list.
- In value mode, will decrease the value of a parameter. When the lowest parameter value is reached, a jump to the highest parameter value can be made by pressing the lower key again,
- Used to decrease the index number for index parameters.

R key

- Changes the display from parameter change mode to operating display mode
- Used to acknowledge faults
- In the operating display mode, the cause of the last warning alarm will be displayed. Pressing the R key again will return to the operating display mode.

I key

- Used to start the drive if selected with parameter P066

O key

- Used to stop the drive and is always active. The stopping method is selected using parameter P067.

OTHER keys

- All other keys have no function and are reserved for future use.

Control Panel LED Functions:**ON LED**

- When lit it indicated that the contactor is closed, the regulators are enabled, and the drive is operating (refer to section 8.1 for additional information)

READY LED

- When lit it indicated that the contactor is closed but the drive is waiting for the enable signal to transfer to the ON status.
(refer to section 8.1 for additional information)

ARROW LED

- When lit it indicated that the actual speed is in the defined reverse direction (bridge II torque for motoring)

FAULT LED

- **When lit** a fault signal is present (status o11)
(refer to section 8.1 for additional information)
- **When flashing** it indicated a warning alarm signal is present. The alarm can be displayed by pressing the "R" key.

PROG LED

- **When lit** it indicated that the control panel is in the "program" mode or "index" mode. The parameter number or parameter index can be changed in this mode by pressing the raise or lower key.
- **When flashing** it indicates that the control panel is in the "value" mode and that parameter values can be changed by pressing the raise or lower keys.
- **When off** it indicated that the control panel is in the "value" mode but that the selected parameter can not be changed because the key code parameter has not been set or the parameter is not changeable (e.g., a display parameter)

7.3 Changing Parameters**7.3.1 General Information**

All drive controller adjustments, configuration settings, and measurements are performed by setting the appropriate parameter value using one of the operator control panels or a serial communications channel and a PC. Within the drive controller the parameters are arranged in the following manner:

PARAMETER NUMBER	PARAMETER FUNCTION
Parameters P000 to P050	<ul style="list-style-type: none"> • Display parameters
Parameters P051 to P099	<ul style="list-style-type: none"> • SIMOREG converter definition • Drive control definition
Parameters P100 to P599 Each parameter in this range has the possibility of having 4 values assigned in 4 parameter set groups. Parameter P054 determines which parameter set is active. Parameter set 1 is the normal default set while the other 3 sets can be activated with P054 or by binary input commands.	<ul style="list-style-type: none"> • Motor definition • Pulse encoder definition • Controller adjustments
Parameters P600 to P999	<ul style="list-style-type: none"> • Configuration of the closed loop controllers • Definition of converter hardware configuration • Configuration of the serial interfaces • Disabling fault signals • Configuration of optional hardware

Depending on the setting of parameter P052, *not all* parameters will be displayed. This allows the choice of displaying only the most used parameters needed to start-up typical applications or to display all of the parameters for more complex applications. If all of the parameters are not displayed and the raise or lower key is pressed, it may take up to 1 second for the next parameter to be located and displayed.

Parameter Sets

Parameter sets 1 to 4 of parameters P100 to P599 can be selected using parameter P054 or by binary input commands. When set 1 is selected only the normal parameter number will be displayed in the operator panel display. If sets 2 to 4 are selected, a number 2 to 4 will be displayed before the parameter number to indicate which parameter set is active. An example, parameter set 2 for parameter 100 would be displayed as shown below.

2	P	1	0	0
---	---	---	---	---

Parameter Set 2 For P100

Parameter Types

Display Parameters are used to display actual value quantities such as actual speed, speed setpoint, armature voltage and many more. The parameter values of display parameters can only be read and can not be changed from the operator control panel.

Decimal Parameters are used to display and set decimal values such as rated armature current, controller gain etc. The value of decimal parameters can be changed from the operator control panel.

Hexadecimal Parameters are used to display and change values of control words such as the control word for the pulse tachometer and the protocol for serial interfaces. In this case each digit has its own meaning.

Special Parameters are used to display in a special form values such as the status of the binary inputs and binary outputs.

Indexed Parameters are used to display and change several parameter values which are assigned to **one** parameter number. This allows one parameter number to have several layers of values assigned to it. This type of parameter is typically used to display the fault diagnostic memory, and as configuration parameters in the control section of the drive. Throughout the instruction manual, index parameters such as P607 are shown as P607.ii. The ".ii" refers to the index value of the parameter.

Access to Indexed Parameters:

When the desired parameter is displayed and the "select" or "P" key is pressed the parameter value is not displayed rather the parameter index is displayed. The index can then be changed using the raise or lower keys until the desired index is reached. Pressing the "select" or "P" key again will display the value of the parameter with the selected index. The value can now be changed using the raise or lower keys.

7.3.1 Changing Parameters Using The Built-in Operator Panel

The built-in operator panel can be used to set all drive controller parameters using the following procedure.

1. Press the "SELECT" key to change the display to the parameter mode. Normally parameter number P000 will be displayed or the last parameter selected if power has not been turned off.
2. Press the raise or lower keys to select the desired parameter in the display.
3. When the desired parameter number is displayed press the "SELECT" key again to switch to the value mode. The display will now show the value of the selected parameter. Use the raise or lower keys to change the parameter value.

The parameter value can only be changed if the correct key code is set with parameter P051 and the drive is in the correct operating state to allow parameter change. For example, some parameters can not be changed while the drive is running. As noted previously display and special parameters can not be changed.

If the parameter selected is an indexed parameter, pressing the "SELECT" key will display the parameter index number rather than a value. The raise or lower keys can then be used to select the desired index number. Once the desired index number is displayed press the "SELECT" key again. Now the display will show the value of the index and it can be changed using the raise or lower keys.

4. When done, press the "SELECT" key to switch back to the parameter mode to select a new parameter number to be changed.

Note:

When the raise or lower keys are pressed the SELECT key can be simultaneously pressed to accelerate the change rate by a factor of 10. If the raise key is pressed and then the lower key is simultaneously pressed the change rate will be accelerated by a factor of 100. The same holds true if the lower key is pressed and then the raise key is simultaneously pressed.

7.3.2 Changing Parameters Using The Optional Operator Panel

1. Press the "P" key to change the display to the parameter mode. Normally parameter number P000 will be displayed or the last parameter selected if power has not been turned off. An arrow will appear next to the parameter number which indicates that the parameter number can be changed.

	n	P	x	x	x	←		Description			
Value								Unit			

2. Press the raise or lower keys to select the desired parameter in the display.
3. When the desired parameter number is displayed press the "P" key again to switch to the value mode. The display will now show the value of the selected parameter. An arrow will appear next to the parameter value which indicates that the parameter value can be changed. Use the raise or lower keys to change the parameter value.

	n	P	x	x	x			Description			
Value							←	Unit			

The parameter value can only be changed if the correct key code is set with parameter P051 and the drive is in the correct operating state to allow parameter change. For example, some parameters can not be changed while the drive is running. As noted previously display and special parameters can not be changed.

If the parameter selected is an indexed parameter, pressing the "P" key will display the parameter index number rather than a value. The raise or lower keys can then be used to select the desired index number. Once the desired index number is displayed press the "P" key again. Now the display will show the value of the index and it can be changed using the raise or lower keys.

4. When done, press the "P" key to switch back to the parameter mode to select a new parameter number to be changed.

Note:

When the raise or lower keys are pressed the "P" key can be simultaneously pressed to accelerate the change rate by a factor of 10. If the raise key is pressed and then the lower key is simultaneously pressed the change rate will be accelerated by a factor of 100. The same holds true if the lower key is pressed and then the raise key is simultaneously pressed.

7.4 Factory Default Procedure

If the EPROM memory module is replaced, or a new microprocessor board is installed, the factory parameter default and offset adjustment procedure **must** be performed. The "reset to default" procedure can also be performed if it is necessary to return to a defined basic setting. This is highly recommended for a completely new start-up. **NOTE:** All application specific parameters are deleted and returned to the factory default value when the default procedure is performed. It is therefore recommended that a record of all of the old settings be printed out using P51 = 12, or stored in a PC using P51 = 16, prior to carrying out default procedure.

When the default procedure is performed a complete new start-up must be carried-out in order to start and operate the drive controller.

Default Procedure:

- If an analog tachometer is being used, remove any connections at terminals 60 to 64
- Set parameter P051 = 21
- Press the SELECT key on the built-in operator control panel, or press the "P" key on the optional operator control panel. The "dEF" text appears on the built-in operator control panel to indicate that when acknowledged, the default will be performed. Two key symbols, "∩", will flash as a prompt to press either the raise or lower keys. If the optional control panel is used, a prompt text appears on the display.
- The prompt is acknowledged and the default started by pressing the RAISE key. The default procedure is immediately aborted by pressing the LOWER key (all parameter values remain unchanged).
- After the default is started, several parameters related to the converter must be manually set. For this reason, after a default is started, **only the parameters listed below can be selected** and must be set before the default can proceed to other parameters.

P070 = 2	Gating board voltage type	Usual selection "230 - 500V"
P071 VAC	Rated converter supply voltage	Set per installation requirements
P072 ADC	Rated converter armature current	Set per converter nameplate
P073 ADC	Rated converter field current	Set per converter nameplate
P074	Control word for power section	001 = single quad, 002 = four quad
P076 = 2	European / US power section	For SE&A 2 = USA converter design

In order to complete this part of the default procedure, **each** of these parameters must be selected, and its parameter value either changed to the required value, or the recommended value confirmed by changing over into the value mode by pressing the "P" or "select" key. Once the parameter is acknowledged or confirmed, this is noted by the appearance of a point preceding the parameter number. The manual settings are completed by depressing the RAISE key in the parameter mode so that parameter P077 is displayed.

- The remaining parameter values are defaulted and permanently saved in the EEPROM memory so that they are available when the converter is powered off. This procedure takes about 35 seconds, and is indicated by displaying the currently processed parameter number.
- Next, parameters P884, P885 and P886 which are analog input offset adjustments for the field current feedback and the analog tachometer feedback are set. This takes about 10 seconds.

NOTE: If an external field is used fault F50 will be issued indicating that the field current feedback offset could not be set. This is normal. Press the fault reset and continue.

- Any connections removed from terminals 60 to 64 earlier should now be reconnected.

7.5 Start-up Step by Step Procedure

This converter has hazardous voltage levels present, even when the converter line contactor is open. The Power Interface board has many circuits at hazardous voltage levels.



WARNING



This equipment contains hazardous voltages and hazardous rotating mechanical parts.

Loss of life, severe personal injury or property damage can result if instructions contained in this manual are not followed.

Only qualified personnel should work on this equipment, and only after becoming familiar with all safety notices, installation, operation and maintenance procedures contained in this manual. The successful and safe operation of this equipment is dependent upon proper handling, installation, operation and maintenance of this equipment.

The SIMOREG drive controller has hazardous voltages present even when the main contactor is open. The power / interface board (bottom pc board) has many circuits that are at hazardous voltage levels. Turn off and lock out all power sources at the feeder to the drive before performing maintenance or repair.

Refer to the full set of warning labels on pages 1.1 and 1.2 of this manual.

To get a basic drive controller and motor operating only a few parameters need be set. The following step by step guide will allow the user to make the necessary settings to get the motor running.

7.5.1. Verify the Plug-in Jumpers on the Microprocessor Board

Refer to section 6, Figure 6.10 for jumper locations; jumper functions are described in section 6.9.1. Whenever it is necessary to move a jumper **make sure that power is turned off** to the drive.

Plug-in jumper XJ1, on the microprocessor board, must be in the 1-2 position which allows parameters to be changed in the RAM as well as the EEPROM for permanent use.

7.5.2 Access Authorization

P051 Key Parameter

P052 Selection of Parameters to be Displayed

Parameter changes are only possible when the appropriate access code has been set in key parameter P051. For most basic applications set P051 to 20 to get access to the required parameters. Refer to section 9 for more information on P051.

Parameter P052 is defaulted so that all parameters are displayed. Refer to section 9 for additional information on P052.

7.5.3 Drive Controller Armature and Field Current Rating**P072 Drive Controller Rated Nameplate Armature Current****P073 Drive Controller Rated Nameplate Field Current****P078 Field converter rated ac line voltage**

Parameters P072 and P073 represent the drive controller armature and field rated currents and not the motor rated currents. The correct values for P072 and P073 can be read from the drive controller nameplate and entered using the operator panel.

P078 is the ac line voltage used by the field converter. This is normally the same as the armature line voltage for 230 or 460 volt drives. P078 should be set to its maximum value (415 VAC) for 460 & 480 volt applications.

7.5.4 Motor Data**P100 Rated Motor Armature Current****P101 Rated Motor Armature Voltage****P102 Rated Motor Field Current**

Set these parameters to the motor nameplate values.

7.5.5 Speed Feedback Selection**P083 Source of the Speed Feedback****P083 = 0 Feedback has not been selected****P083 = 1 Analog Tachometer selected****P706 =** Tachometer voltage at maximum speed**P708 = 0x** No connections are made to terminals 60, 62, or 63**P708 = 1x** Tachometer connected to terminal 60 (voltage range 80 to 270 volts)**P708 = 2x** Tachometer connected to terminal 62 (voltage range 25 to 80 volts)**P708 = 3x** Tachometer connected to terminal 63 (voltage range 8 to 25 volts)**P083 = 2 Pulse Encoder selected****P140 =** Pulse encoder type (2 channel quadrature encoder P140 = 1)**P141 =** Encoder pulses per revolution (data on encoder nameplate)**P142 = 010** This provides the good operation with most encoders.**P143 =** Maximum motor speed for the application in RPM (coarse adjustment)**P452 =** Maximum motor speed for the application in RPM (fine adjustment)**P083 = 3 CEMF voltage is selected****P115 =** Selects maximum voltage as a % of rated line voltage at P071. Default is 100%.**P083 = 4 Feedback From an Other Source****P609 =** Selection of the connector that is the source for the speed feedback

7.5.6 Motor Field Control

P082 = Motor field control choices

P082 = xx0 Internal field converter is not used

P082 = xx1 Field ac power is switched on with the main contactor

P082 = xx2 Default setting. Automatic field economy after 10 seconds

P257 = Field economy setting as a % of full field

P258 = Delay time until field economy occurs (default 10 seconds)

P082 = xx3 Field economy is not used

P082 = x0x Speed dependent field weakening is not used

P082 = x1x Field weakening used to achieve operation above base speed

7.5.7 Current Limit Settings

P171 = torque direction I current limit in % of rated motor current (default = 100%)

P172 = torque direction II current limit in % of rated motor current (default = -100%)

7.5.8 Ramp Function Generator Times

P303 = Acceleration time

P304 = Deceleration time

P305 = Start rounding time

P306 = End rounding time

7.5.9 DC Contactor Closing Time (510 and 850 amp base drives only)

P087 = 0.2 (Allows 0.2 second for the DC contactor to close before the regulators are released)

7.5.10 Self-tuning Procedures

The following self-tuning procedures should be run in the sequence listed starting with the armature current loop. The drive must be stopped and in operating status o7 or higher in order for the self-tuning to be performed. The self-tuning procedures are selected with parameter P051.

P051 = 25 Self-tuning of the armature and field current loops. This procedure takes approximately 40 seconds and automatically sets parameters P110, P111, P112, P155, P156, P255, P256, P884 and P887. To proceed, first press the select key on the built-in operator panel or the "P" key on the optional operator panel then the raise key and then give the drive a start command.

Note: The adjusted current limits are not effective during the self-tuning of the armature current loop. Approximately 75% of rated armature current with individual pulses up to 120% will flow for approximately 500 ms.

P051 = 26 Self-tuning of the speed controller. This procedure takes approximately 6 seconds and sets parameters P225, P226, and P228.

Note: During the speed loop self-tuning, the motor will be accelerated to approximately 20% of maximum speed with a maximum of 45% of rated armature current.

Speed Controller Tuning:

The self tuning of the speed loop is based on a tight mechanical system with a minimum of backlash and torsional resonances. In some cases the self tuned values of the speed controller will be too responsive for the mechanical system. In these cases a filter should be added to the speed feedback using P200 before the self-tuning is performed. For most applications P200 should be set for 10 ms. The following recommendations for the filter time set at P200 should provide good tuning values and performance:

General application	P200 = 10 ms
High Inertia application	P200 = 50 ms

P051 = 27 Field weakening control tuning. This procedure is only necessary if field weakening operation above base speed was selected with P082 = 1x or if closed loop torque control is selected with P170 = 1, or if an independent field current setpoint is used. This procedure will take approximately 1 minute and will measure the motor field characteristics and set parameters P117 to P139.

Note: During the field weakening procedure the motor will be accelerated to approximately 80% of maximum speed.

P051 = 28 Friction and inertia compensation. This procedure can be performed if speed controller friction and inertia compensation is desired. Most basic drive applications do not require this function. If selected this procedure takes approximately 40 seconds and sets parameters P520 to P530, and P540.

Note: During this procedure the motor will be accelerated to maximum speed. When performing this procedure the speed controller must be operated proportional and integral gain and without speed droop. After the self-tuning for friction and inertia compensation the function must be activated manually using parameter P223 = 1.

7.5.11 Document the Parameter Settings

The parameter settings can be documented in several ways.

1. Set parameter P052 = 0. The display will now show only those parameters that are different from the factory default value.
2. Set P051 = 11 or 12 and print the parameter list on a connected printer. Refer to section 10.7.1 and P051 for additional information.
3. Set P051 = 15 or 16 and transfer the parameter values to a file on a connected PC. Refer to section 10.7.2 and P051 for additional information.
4. Use PC programs PCIN-USS to archive parameters
5. Use PC program SIMOVIS to archive parameters. Refer to section 14.

7.5.12 Verify Faults Disabled

Check parameter P850.00 to P850.09 to verify acceptance or to activate the faults that are defaulted off.

The drive is now ready for operation.

7.6 Optional Manual Tuning

Normally the self tuning procedure described in section 5.5 is the best method for tuning the drive. In some cases it may be desirable to check the tuning manually in which case the following procedure can be used.

7.6.1 Armature Current Controller Feed Forward Adjustments

The gain and time constant adjustments of the current PI controller and the feed forward controller require that the correct values for armature circuit resistance and inductance be entered in parameters P110 and P111.

Based on the values in P110 and P111 the gain, P155, and the time constant, P156, of the current controller can be set.

$$P155 = \left(\frac{P111 \times P072}{P071 \times 16.8} \right) \text{ for line frequency operation at 60 Hz}$$

$$P156 = \left(\frac{P111 \times 1.2}{P110} \right) \text{ ms}$$

The values of the circuit quantities P110 and P111 can be approximated by using motor design information if available, roughly calculated based on certain assumptions, or measured from the actual circuit.

a) Motor Design Data

If motor design data is available it can be used for the motor resistance and inductance. These values will be some what inaccurate since motor design data is based on calculations and not actual test information. This method will have additional errors since it does not include other circuit values such as cable and ac source resistance and inductance.

b) Calculation Method

This method is based on experience factors that are valid for many typical installations but are not as accurate as measured quantities.

The armature circuit resistance can be calculated using the following equation which is based on the experience factor that the circuit resistive voltage drop is approximately 10% of rated armature voltage when rated armature current flows.

$$P110 = \left(\frac{0.1 * \text{Rated Armature Voltage (P101)}}{\text{Rated Armature Current (P100)}} \right) \text{ ohms}$$

The armature circuit inductance can be calculated based on the experience factor that continuous current is first reached at approximately 28.6% armature current when the motor is at stall (i.e., no rotation or EMF voltage).

$$P111 = 1.4 * \left(\frac{\text{Rated Armature AC Supply Voltage (P071)}}{\text{Rated Armature DC Current (P100)}} \right) \text{ mH}$$

c) Measurement Method

Measure the armature circuit resistance by operating the drive as a current regulated motor at stall using the following procedure.

- Select current-controlled operation: P084 = 2 (bypasses the speed controller)
- Set parameter P153 = 0 (feed forward controller disabled)
- Set the field current to zero by using P082 = x0
- If the motor residual magnetism is high, the rotor must be blocked to prevent rotation
- Set the overspeed protection threshold P354 = 5%
- Set main setpoint = 0 (this is now the current reference)
- Start the drive and verify that the armature current is approximately zero.
- Slowly increase the main setpoint (displayed at P001) until the armature current is approximately 70% as read at P019 = 70.
- Read the value of armature current at P019 and the value of armature voltage at P038 and reduce the main reference to zero and stop the drive.
- Convert the P019 value into amps using

$$P019 = \left(\frac{P019\% * P100}{100} \right) \text{ amps}$$

- Calculating the armature circuit resistance P110 from the measured armature current and voltage

$$P110 = \left(\frac{\text{Armature Volts (P038)}}{P019 \text{ converted to amps}} \right) \text{ ohms}$$

Measure the armature circuit inductance using the following procedure.

- Use an oscilloscope to measure the armature current at terminal 12 of the power interface board.
- With the drive configured as it was for the resistance measurement, start the drive and slowly increase the main reference until the armature current just becomes continuous.
- Read the values of armature current at P019 and the value of AC line voltage at P015.
- Reduce the reference to zero and stop the drive.
- Convert the current reading at P019 into amps using:

$$P019 \text{ Amps} = \left(\frac{P019 * P100}{100} \right) \text{ amps}$$

- Calculate the armature circuit inductance from the following:

$$P111 = 0.4 * \left(\frac{P015}{P019 \text{ converted to amps}} \right) \text{ mH}$$

7.6.2 Armature Controller Tuning Manual Verification

The tuning of the armature current controller can be verified using the following test procedure.

- Use an oscilloscope to measure the armature current at terminal 12 of the power interface board.
- Select current-controlled operation: P084 = 2 (bypasses the speed controller)
- Set parameter P153 = 1 (feed forward controller enabled)
- Set the field current to zero by using P082 = x0
- If the motor residual magnetism is high, the rotor must be blocked to prevent rotation
- Set the overspeed protection threshold P354 = 5%
- Set main setpoint = 0 (this is now the current reference)
- Start the drive and verify that the armature current is approximately zero.
- Apply current reference steps while measuring the current response on the scope.
- Adjust the current controller gain, P155, and time constant, P156 to get the desired response
- Verify the responses for both discontinuous and continuous current operation.

8. Operating Status

8.1 Operating Status, Parameter P000

Parameter P000 provides information on the operating status of the drive. If the drive does not start, check parameter P000 to see what the cause of the problem is.

The following status codes will be displayed on the built-in operator panel or on the optional operator panel when P000 is selected.

TORQUE DIRECTION DISPLAY: (drive operating)

Ä Ä Contactor closed, regulators enabled, no torque direction selected

³ Contactor closed, regulators enabled, torque direction I selected

³³ Contactor closed, regulators enabled, torque direction II selected

o1 WAITING FOR REGULATOR ENABLE (ready mode):

o1.0 Brake release delay time is active

o1.1 Waiting for the enable signal at terminal 38

o1.2 Waiting for the enable signal via control word bit 3

o1.3 Delay time after jogging command has been removed is active

o1.4 Waiting for field current to return after a field reversal

o1.5 Delay time for the enable signal from the self-tuning run The self-tuning run only sets the enable signal at the end when $n < n_{min}$ has been reached and a STOP command has been entered

o1.6 Waiting for operate enable from a checkback signal "line contactor closed". This is BIF 55.

o2 RESERVED

o2.0 Reserved

o3 POWER UP SELF TEST

o3.0 Waiting for completion of thyristor diagnostics

o3.1 Waiting for completion of AC supply symmetry check

o3.2 Waiting for time set with P095 to pass (to allow time for a DC contactor to close) Version 2.3

o4 WAITING FOR ARMATURE AC VOLTAGE (AC voltage too high or P071 too low see P352)

o4.0 Waiting for voltage at the power connections L1, L2, L3 or 1U, 1V, 1W.

(threshold: $P071 * \left(\frac{P353}{100\%} \right)$)

o5 WAITING FOR FIELD CURRENT > 50% OF THE REFERENCE VALUE

o5.0 Waiting for the field current feedback to equal 50% of the field current reference.

o5.1 Waiting for voltage at terminals 83 and 84 (threshold: $P078 * \left(\frac{P353}{100\%} \right)$)

Note: Status's o4 and o5 have a time limit set by parameter P089. If the time is exceeded then the associated fault is issued (unless the fault is blocked with P850.ii).

o6 **WAITING STATUS BEFORE THE MAIN CONTACTOR IS CLOSED****o6.0** Waiting until the auxiliary equipment is started (delay time P093)**o6.1** Waiting until the setpoint at the ramp input is less than or equal to P091**o7** **WAITING FOR THE START COMMAND****o7.0** Waiting for start command at terminal 37**o7.1** Waiting for start command via control word bit 0**o7.2** Waiting for the external start command to toggled "off" to cancel an internally latched shutdown command.**o7.3** Waiting for completion of "reset to default"**o7.4** Waiting for an external start command to execute an action (e.g. "reset to default", "self tuning run", or waiting for completion of "offset compensation)**o7.5** Waiting for completion of "read-in parameter set"**o8** **WAITING for REMOVAL of the START COMMAND after an "E-STOP" or COAST STOP"****o8.0** Waiting for the removal of the start command at terminal 37 after an E-STOP or a Coast Stop has been initiated**o9** **QUICK STOP****o9.0** Quick stop was initiated via selectable binary input function 4**o9.1** Quick stop was initiated via control word bit 2**o9.2** Quick stop is internally latched (the latch is cleared by removing the quick stop command and the start command)**o10** **WAITING FOR "M" CONTACTOR TO OPEN****o10.0** Open M contactor was initiated via selectable binary input function 3**o10.1** Open M contactor was initiated via control word bit 1**o10.2** E-STOP initiated via terminal 56 or 57**o10.3** Waiting for reception of a valid Peer telegram from another drive if Peer-to-Peer is turned on.**o10.4** Waiting for valid telegrams from RS232, X501 (only if P797 is not = 0)**o10.5** Waiting for valid telegrams from RS485, X500 (only if P787 is not = 0)**o11** **FAULT FXXX FAULT MESSAGE IS DISPLAYED AND RED FAULT LED IS ON****o11.0** Fxxx flashing fault signal**o12** **ELECTRONICS IS INITIALIZED****o12.0** Waiting for the option board to be initialized (Verify P900 & P902 agree with option boards installed)**o12.1** Waiting for base electronics to be initialized)**o13** **ELECTRONICS NOT POWERED UP**

Display not lit, waiting for voltage at terminals 87 and 89

8.2 Fault Messages General Information

When a fault is detected in the drive the following actions are automatically taken:

- The BOF 3, "no fault", is set LOW and bit 3 of the status word ZSW is set high
- The drive is shutdown in the following manner:
 1. Ramp generator, process, speed and current regulators are disabled and set to zero
 2. Armature gating angle is set for maximum retard
 3. The armature gating pulses are disabled when zero armature current is detected
 4. "Close Operating Brake", BOF 14, is set to "on" if P080 has been set to 2.
 5. Operating status o11.0 is reached
 6. The K1 relay drops out which drops out the M contactor
 7. The drive coasts to a stop
 8. If selected, field economy occurs after the delay set with P258.
 9. If speed < minimum (P370, P371) the "Close Holding Brake", BOF 14 is set if P080 has been set to 1.
- The fault is displayed on the operator control panel
- The "ST" LED on the microprocessor board is lit
- The "Fault" LED on the optional operator panel is lit

Fault messages are only active when the drive is less than certain operating status's. The operating status is specified in the description of the individual fault codes.

A new fault message can only be displayed if the previous fault message has been acknowledged and cleared and the drive has been started or a function such as "parameter print-out", "self tune run" etc. was started by pressing the RAISE key.

The binary output function, "no fault", is issued independent of the fault display.

Automatic Restart after a Power Loss:

The automatic restart function is controlled by parameter P086. If P086 = 0 a restart after power loss is not allowed and the drive will trip on one of the power loss faults. If P086 is set to a time value up to 2 seconds, the power loss faults will not be issued unless they last longer than the time set with P086. If power returns before the time has elapsed an automatic restart will be performed. The automatic restart will not work if momentary edge triggered start commands are used.

The faults associated with P086 are:

F001	Electronics power supply failure
F003	SITOR set failure
F004	Armature supply phase failure
F005	Field supply phase failure
F006	Undervoltage Armature or Field supply
F007	Overvoltage Armature or Field supply

Fault Memory When Power is Lost

The fault memory, parameter P880, contains the numbers of the last 4 faults which were displayed. If P053 = 1x the faults in P880 are automatically stored when power is removed. If a fault is displayed when power is removed, then, when power is switched back on, the drive will power up with fault F040 displayed. If P053 = 0x the faults in P880 will not be stored on a power loss. In this case if a fault is displayed when power is removed, then, when power is switched back on, the drive will power up without any fault displayed in the ready mode.

Fault Diagnostic Memory

The fault diagnostic memory provides additional information on many faults by indicating which event triggered the particular fault. Parameter P047 is an indexed display parameter that shows the additional diagnostic information.

8.2.1 AC Supply Fault Messages

F001	Failure of Electronics Power Supply
Active:	All operating status's
Fault Condition:	The electronics power supply has failed or there is an undervoltage condition in the run mode for longer than the time set at parameter P086.
Fault Diagnostic Memory (P047):	Word 0 = 1 Electronics power supply is interrupted in the run mode longer than the time set in P086 Word 0 = 2 Supply failure pre-warning (alarm) responds periodically Word 0 = 3 Supply failure pre-warning (alarm) is present for longer than 1.28 seconds If Word 0 = 1, then Word 1 records the duration of the supply failure in 1/10 seconds
Possible Causes:	Line contactor opened in the run mode Brief supply failure Supply voltage too low

F003	Faults in Parallel SITOR Sets (Europe Units Only)
Active:	Active for operating status's $\leq o4$
Fault Condition:	At least one parallel SITOR set is connected and selected via parameter P074 and provides one of the following faults: phase failure, fan monitoring or undervoltage.
Fault Diagnostic Memory (P047):	Word 0 = 1 Fuse failure Word 0 = 2 Fan monitoring Word 0 = 3 Undervoltage Word 0 = 4 Undervoltage for a time longer than parameter P086
Possible Causes:	Undervoltage in the electronics power supply of a parallel SITOR assembly Sitor fan is not running Fuse failure in parallel SITOR assembly Cable connection between SIMOREG drive and parallel Sitor assembly is interrupted or faulty

F004	Phase Failure, Armature AC Supply
Active:	Active for operating status's $\leq o4$
Fault Condition:	The RMS value of armature supply voltage as calculated from the rectified average value times peak factor must be greater than $P071 \times P353 / 100\%$. The distance between two similar supply voltage zero crossings of a phase must not exceed 450 degrees. If either condition is not meet for a time longer than set with P086 the fault is issued.
Fault Diagnostic Memory (P047):	Word 0 = 1 Voltage failure in the armature supply L1, L2, L3, (1U, 1V, 1W) Word 0 = 2 Delay time, set with P089, has expired in operating status o4 Word 0 = 3 AC Armature supply fuse failure Word 0 = 4 Voltage failure longer than the time set in parameter P086 (if $P086 > 0$)
Possible Causes:	Parameter P353 incorrectly set Armature supply phase failed M contactor opened in run mode Fuse blown in the armature AC supply P086 time is set too short (especially on hi power 6RA24's)

F005	Phase Failure, Field AC Supply, Field Loss
Active:	Active for operating status's $\leq o5$ and $P082 > 000$
Fault Condition:	<p>The fault is initiated if one of the following conditions is present for longer than the time set with P086. The fault conditions are not evaluated if $P082 = 000$.</p> <p>1) The RMS value of the field supply voltage is calculated from the rectified average value times peak factor must be greater than $P078 \times P353/100\%$.</p> <p>2) The distance between two similar supply voltage zero crossings of a phase must not exceed 450 degrees.</p> <p>3) The field current feedback is less than 50% of the reference for more than 500 ms. This function is only active if the field current reference $> 2\%$ of the rated field current supply.</p> <p>4) The binary input $I_{field} < I_{min}$ (selectable binary input function) is LOW for more than 500 ms.</p>
Fault Diagnostic Memory (P047):	<p>Word 0 = 1 Voltage failure in the field supply (terminals 83 and 84) for $P086 = 0$</p> <p>Word 0 = 2 Delay time in operating status $o5.1$ has expired</p> <p>Word 0 = 3 Delay time of P089 has expired in operating status $o5.0$</p> <p style="padding-left: 40px;">OR when "ON" field current $< 50\%$ field current reference for more than 0.5 s</p> <p style="padding-left: 40px;">OR BIF59 is low for more than 0.5 s.</p> <p>Word 0 = 4 Voltage failure or field current $< 50\%$ field current reference for longer than the time in P086 if $P086 > 0$.</p>
Possible Causes:	<p>Threshold for the phase failure (P353) incorrectly set</p> <p>Field AC supply phase failed</p> <p>Fuse failure in the field AC supply circuit</p> <p>Field regulator and / or field feed forward controller not properly tuned</p> <p>check P112, P253 to P256; if required, run current regulator auto tuning)</p>

F006	AC Supply Undervoltage Armature or Field
Active:	Active for operating status's $\leq o4$
Fault Condition:	<p>Voltage at terminals L1, L2, L3 (1U, 1V, 1W), or 83 and 84 is below their threshold values for more than the time set at P086.</p> <p>Threshold for armature supply voltage: $= P071 \times (1 + P351 / 100)$</p> <p>Threshold for field supply voltage: $= P078 \times (1 + P351 / 100)$</p>
Fault Diagnostic Memory (P047):	<p>Word 0 = 1 Undervoltage condition</p> <p>Word 0 = 4 Undervoltage lasts longer than the time set with parameter P086 (if $P086 > 0$)</p> <p>If word 0 = 1 then word 1 will = Phase number which caused the fault message</p> <p>Word 1 = 0 Phase UV</p> <p>Word 1 = 1 Phase VW</p> <p>Word 1 = 2 Phase WU</p> <p>Word 1 = 3 Field phase</p> <p>Word 2 = Incorrect voltage value (normalized to 16384)</p>
Possible Causes:	<p>Supply undervoltage</p> <p>Monitoring set incorrectly (P351, P071 or P078)</p>

F007	AC Supply Overvoltage Armature or Field
Active:	Active for operating status's \leq o4
Fault Condition:	Voltage at terminals L1, L2, L3 (1U, 1V, 1W), or 83 and 84 is below their threshold for more than the time set at P086. Threshold for armature supply voltage: = $P071 \times (1 + P352 / 100)$ Threshold for field supply voltage: = $P078 \times (1 + P352 / 100)$
Fault Diagnostic Memory (P047):	Word 0 = 1 Overvoltage condition Word 0 = 4 Overvoltage lasts longer than the time set with parameter P086 (if P086 > 0) If word 0 = 1 then word 1 will = Phase number which caused the fault message Word 1 = 0 Phase UV Word 1 = 1 Phase VW Word 1 = 2 Phase WU Word 1 = 3 Field phase Word 2 = Incorrect voltage value (normalized to 16384)
Possible Causes:	Supply overvoltage Monitoring set too low or incorrectly (P352, P071)

Note: This monitoring function is disabled when supplied from the factory. The monitoring function is enabled with parameter P850 (refer to Section 8.2.10).

F008	Supply Frequency Less than 45 Hz
Active:	Active for operating status's \leq o5
Fault Condition:	Supply frequency less than 45 Hz for longer than the time set at P086.
Fault Diagnostic Memory (P047):	Word 0 = 1 Armature supply frequency < 45 Hz. Word 0 = 2 Field supply frequency <45 Hz.
Possible Causes:	Power system problem

F009	Supply frequency greater than 65 Hz
Active:	Active for operating status's \leq o5
Fault Condition:	Supply frequency greater than 65 Hz for longer than the time set at P086.
Fault Diagnostic Memory (P047):	Word 0 = 1 Armature supply frequency > 65 Hz. = 2 Field supply frequency > 65Hz.
Possible Causes:	Power system problem

8.2.2 Serial Communication Fault Messages

F010	Parity Error at RS485 Serial Port (X500)
Active:	Active for operating status's ≤ 01 if parameter P780 = xxx1 or xxx9
Fault Condition:	Bytes received at RS485 X500 have incorrect parity.
Fault Diagnostic Memory (P047):	None
Possible Causes:	Parity check parameter P780 set incorrectly Parity set incorrectly at transmitting unit EMC noise interference

F011	Framing Error at RS485 Serial Port (X500)
Active:	Active for operating status's ≤ 01 if parameter P780 = xxx1 or xxx9
Fault Condition:	Bits received at RS485 X500 have incorrect number of stop bits (P780).
Fault Diagnostic Memory (P047):	None
Possible Causes:	Parity data frame set with parameter P780 Incorrectly baud rate set at transmitting unit EMC noise interference

F012	Overrun error at RS485 Serial Port (X500)
Active:	Active for operating status's ≤ 01 if parameter P780 = xxx1 or xxx9
Fault Condition:	Each byte received at the RS485 port X500 must be removed from the receive buffer by the software before the next character has been completely received other wise a fault is issued.
Fault Diagnostic Memory (P047):	None
Possible Causes:	Incorrectly baud rate set at transmitting unit EMC noise interference

F013	Syntax error at RS485 Serial Port (X500)
Active:	Active for all status's if P780 = xxx1 and P051 = 23.
Fault Condition:	A syntax error occurred when reading in a parameter set from the X500 RS485 port. The error is first initiated at the end of a transmission and does not interrupt an actual transmission.
Fault Diagnostic Memory (P047):	Word 0 = 1 Invalid character received between two parameter transmissions Word 0 = 2 Invalid character received during a parameter transmission Word 0 = 3 Too many places after the decimal point were specified for the parameter Word 0 = 4 Too many digits were specified for nibble coded parameters Word 0 = 5 Parameter specified which is outside the parameter limits Word 0 = 6 Nibble coded parameter specified outside of the setting range Word 1: The last valid received parameter number of the complete transmission (hexadecimal number) Word 2: The last valid received parameter number before the last error occurred (hexadecimal number)
Possible Causes:	Errors in the transmitted data Error occurred during transfer

F014	USS Telegram failure at RS485 Serial Port (X500)
Active:	Active after the first valid telegram has been received in all operating status's
Fault Condition:	After a valid telegram had been received no further valid telegram was received for a time longer than set with P787.
Fault Diagnostic Memory (P047):	None
Possible Causes:	Cable interruption USS master not transmitting

F015	Peer to Peer error at RS485 Serial Port (X500)
Active:	Active for all operating status's
Fault Condition:	This fault is initiated if a valid telegram was not received within a time set with P788.
Fault Diagnostic Memory (P047):	None
Possible Causes:	P788 set too low Cable break EMC noise interference

F020	Parity Error at RS232 Serial Port (X501)
Active:	Active for operating status's ≤ 01 if parameter P790 = xxx1 or xxx9
Fault Condition:	Bytes received at RS232 X501 have incorrect parity.
Fault Diagnostic Memory (P047):	None
Possible Causes:	Parity check parameter P790 set incorrectly Parity set incorrectly at transmitting unit EMC noise interference

F021	Framing Error at RS232 Serial Port (X501)
Active:	Active for operating status's ≤ 01 if parameter P790 = xxx1 or xxx9
Fault Condition:	Bits received at RS232 X501 have incorrect number of stop bits (P790).
Fault Diagnostic Memory (P047):	None
Possible Causes:	Parity data frame set with parameter P790 Incorrectly baud rate set at transmitting unit EMC noise interference

F022	Overflow error at RS232 Serial Port (X501)
Active:	Active for operating status's ≤ 01 if parameter P790 = xxx1 or xxx9
Fault Condition:	Each byte received at the RS232 port X501 must be removed from the receive buffer by the software before the next character has been completely received otherwise a fault is issued.
Fault Diagnostic Memory (P047):	None
Possible Causes:	Incorrectly baud rate set at transmitting unit. Handshake is incompatible with host (see P798). EMC noise interference

F023	Syntax error at RS232 Serial Port (X501)
Active:	Active for all status's if P790 = xxx1 and P051 = 23.
Fault Condition:	A syntax error occurred when reading in a <u>parameter set</u> from the X501 RS232 port. The error is first initiated at the end of a transmission and does not interrupt an actual transmission.
Fault Diagnostic Memory (P047):	<p>Word 0 = 1 Invalid character received between two parameter transmissions Word 0 = 2 Invalid character received during a parameter transmission Word 0 = 3 Too many places after the decimal point were specified for the parameter Word 0 = 4 Too many digits were specified for nibble coded parameters Word 0 = 5 Parameter specified which is outside the parameter limits Word 0 = 6 Nibble coded parameter specified outside of the setting range</p> <p>Word 1: The last valid received parameter number of the complete transmission (hexadecimal number) Word 2: The last valid received parameter number before the last error occurred (hexadecimal number)</p>
Possible Causes:	Errors in the transmitted data Error occurred during transfer

F024	USS Telegram failure at RS232 Serial Port (X501)
Active:	Active after the first valid telegram has been received in all operating status's
Fault Condition:	After a valid telegram had been received no further valid telegram was received for a time longer than set with P798.
Fault Diagnostic Memory (P047):	None
Possible Causes:	Cable interruption USS master not transmitting

F025	Peer to Peer error at RS232 Serial Port (X501)
Active:	Active for all operating status's
Fault Condition:	This fault is initiated if a valid telegram was not received within a time set with P797.
Fault Diagnostic Memory (P047):	None
Possible Causes:	Cable interruption EMC noise interference

F028	Short circuit at a binary Output
Active:	Active for all operating status's
Fault Condition:	Hardware monitoring of the binary output has detected a short circuit
Fault Diagnostic Memory (P047):	None
Possible Causes:	Short circuit at a binary output at terminals 46, 48, 50, or 52

F029	Faulted Connection Between the Base Unit and an Option Board
Active:	Active for all operating status's ≤ 0.1
Fault Condition:	Data transmission between the base unit and an option board has failed. Refer to P911, P926 and P929.
Fault Diagnostic Memory (P047):	Word 0 = 1 Reference values channel 1 failed Word 0 = 2 Receive values channel 2 failed Word 0 = 3 Actual values channel 1 failed Word 0 = 4 Actual values channel 2 failed Word 1 = 1 Buffer still in the initialized status Word 1 = 2 Illegal value found in buffer status byte of REF VALUES channel Word 1 = 3 Illegal value found in buffer status byte of ACTUAL VALUES channel Word 1 = 4 No REF VALUES received for a time > P926/P929 Word 1 = 5 Actual Values not received for a time > P926/P929 Word 1 = 6 No Buffer Control Byte found after initialization
Possible Causes:	Defective ribbon cable connection between X100 and option board Defective option board Noise

8.2.3 Drive faults

F031	Speed Controller Monitoring
Active:	Active for operating status's \ddot{A} , I, II
Fault Condition:	The monitoring responds if the (reference-feedback) difference of the speed controller exceeds the value set in parameter P362 for a time set in parameter P363.
Fault Diagnostic Memory (P047):	None
Possible Causes:	Controller interrupted Controller not properly tuned

Note: This monitoring function is disabled when supplied from the factory. The monitoring function is enabled with parameter P850.

F032	Armature Current Controller Monitoring
Active:	Active for operating status's \ddot{A} , I, II
Fault Condition:	The monitoring responds if the (reference-feedback) difference of the current controller exceeds the value set in parameter P364 for a time set in parameter P365.
Fault Diagnostic Memory (P047):	None
Possible Causes:	Controller interrupted Controller not properly tuned

Note: This monitoring function is disabled when supplied from the factory. The monitoring function is enabled with parameter P850.

F033	EMF Voltage Controller Monitoring
Active:	Active for operating status's \ddot{A} , I, II
Fault Condition:	The monitoring responds if the (reference-feedback) difference of the EMF voltage controller exceeds the value set in parameter P366 for a time set in parameter P367.
Fault Diagnostic Memory (P047):	None
Possible Causes:	Controller interrupted Controller not properly tuned

Note: This monitoring function is disabled when supplied from the factory. The monitoring function is enabled with parameter P850.

F034	Field current Controller Monitoring
Active:	Active for operating status's \ddot{A} , I, II
Fault Condition:	The monitoring responds if the (reference-feedback) difference of the field current controller exceeds the value set in parameter P368 for a time set in parameter P369.
Fault Diagnostic Memory (P047):	None
Possible Causes:	Controller interrupted Controller not properly tuned

Note: This monitoring function is disabled when supplied from the factory. The monitoring function is enabled with parameter P850.

F035	Motor Stalled
Active:	Active for operating status's \ddot{A} , I, II
Fault Condition:	This fault is activated if the following conditions are fulfilled for a time longer than programmed in parameter P355: - Positive or negative torque or current limit reached - The armature current > 1% of the rated drive current - The speed feedback < 0.4% of the maximum speed
Fault Diagnostic Memory (P047):	None
Possible Causes:	Motor shaft torque too large Current Limits too low Motor field current too low

Note: This monitoring function is disabled when supplied from the factory. The monitoring function is enabled with parameter P850.

F036	No Armature Current
Active:	Active for operating status's \ddot{A} , I, II
Fault Condition:	This fault is activated if the armature gating angle is at the minimum gating limit for more than 500 ms and the armature current < 1% of the rated drive armature current.
Fault Diagnostic Memory (P047):	None
Possible Causes:	Open armature circuit, dc fuse blown, motor cable open, dc contactor open Minimum gating angle limit (P150) incorrectly set Drive at minimum gating angle limit (i.e. due to low supply voltage) CEMF too high due to maximum speed set too high (refer to P083, P115, P143, P608) CEMF too high due to not selecting field weakening (refer to P082) CEMF too high due to field current set too high (refer to P102) CEMF too high due rated motor voltage set too high (refer to P101 and P118)

Note: This monitoring function is disabled when supplied from the factory. The monitoring function is enabled with parameter P850.

F037	Motor I²t
Active:	Active for operating status's \ddot{A} , I, II
Fault Condition:	This fault is activated if the motor I ² t reaches a value that corresponds to operating the motor at 110% of rated current until the temperature has stabilized. $I^2t \text{ value} = (I/1.1)^2 \times (1 - e^{-t/T})$ where: T = P114, I = Iactual / Irated and t = time in minutes
Fault Diagnostic Memory (P047):	None
Possible Causes:	Parameter P114 set incorrectly Drive operated above 110% of rated motor current for too long

Note: This monitoring function is disabled when supplied from the factory. The monitoring function is enabled with parameter P850.

F038	Overspeed
Active:	Active for operating status's \ddot{A} , \ddot{A} , I, II
Fault Condition:	This fault is activated if the speed actual value exceeds the level set with parameter P354.
Fault Diagnostic Memory (P047):	None
Possible Causes:	Current regulated drive P354 set too low Intermittent tachometer cable connection

F039	Converter I²t
Active:	Active for operating status's \ddot{A} , \ddot{A} , I, II
Fault Condition:	This fault is activated if the calculated I ² t value of the power section has reached the max. value for that particular power section.
Fault Diagnostic Memory (P047):	None
Possible Causes:	Drive operated too long with an overload condition Parameter P075 set incorrectly

F040	Electronics Supply Disconnected With a Fault Present
Active:	Active for operating status's \ddot{A} , \ddot{A} , I, II
Fault Condition:	This fault is activated if the electronics power supply is switched off with a fault present.
Fault Diagnostic Memory (P047):	Word 0 = Fault which was present when power was switched off
Possible Causes:	Not all of the fault messages have been acknowledged prior to powering off the electronics

F041	Parameter Set or Ramp Rate Sets are Not Defined
Active:	Active for all operating status's
Fault Condition:	This fault is activated if more than one parameter set or ramp rate set is selected at the same time for more than 0.5 seconds.
Fault Diagnostic Memory (P047):	Word 0 = 1 More than 1 Parameter set selected Word 0 = 2 The selected parameter set has changed during a self tuning run Word 0 = 3 More than 1 ramp rate sets have been selected
Possible Causes:	Incorrect assignment of binary input functions (see P761 to P766) Incorrect activation of binary inputs (see P010 for binary input status) External short circuit of binary input wiring

F042	Tachometer Fault
Active:	Active for operating status's, Ä Ä, I, II
Fault Condition:	Every 20 ms a check is made to confirm that the (speed feedback / EMF feedback) > +105% This fault is activated if the above is not true for three consecutive checks and the motor EMF > P357 x 1.35 x P071 and the armature current is > 2% of the converter rated current. 100% speed = maximum speed 100% EMF = 1.35 * P071
Fault Diagnostic Memory (P047):	Word 0 = 1 Defective tachometer Word 0 = 2 Incorrect tachometer or pulse encoder polarity
Possible Causes:	Tachometer or pulse encoder cable interrupted Tachometer or pulse encoder cable incorrectly connected; Pulse encoder power supply failed P224 set incorrectly (speed feedback polarity) Incorrectly set armature circuit data (P110 and P111 causing incorrect EMF value) (execute current controller self tuning); Defective tachometer or pulse encoder, Plug-in jumpers XJ11, XJ12, XJ13 set incorrectly.

F043	Motor EMF for Braking Operation is too High
Active:	Active for operating status's, Ä Ä, I, II
Fault Condition:	This fault message is initiated if the following five conditions are met when a torque direction change is demanded: <ul style="list-style-type: none"> • P082 = 0xx • An additional torque free time set with P160 has expired • A parallel drive is ready for a new torque direction to be selected (if BIF 60 is active) • The absolute value of the armature current demand in the new torque direction is > 0.5% of P072 • The calculated gating angle (K101) for the armature current in the new direction is > 165°
Fault Diagnostic Memory (P047):	Word 0 = calculated armature gating angle before limiting @ K101 (hexadecimal Value) Word 1 = Instantaneously measured EMF @ K287 (hexadecimal Value) Word 2 = Armature current controller reference (K118) (hexadecimal Value)
Possible Causes:	<ul style="list-style-type: none"> • Field current too high because speed dependent field weakening, P082 = x0x, has not been set but is required to reach top speed • P101 set too high • Line voltage too low • EMF or field current controller has not been tuned which can lead to excessive EMF during fast acceleration through base speed. • Armature current controller "P" gain too high

F046	4 - 20 ma Reference Low at Terminals 4 & 5
Active:	Active for operating status's, o6 or less
Fault Condition:	The 4 - 20 ma reference at terminals 4 & 5 is less than 3 ma. When the drive is off this will give a warning message W16.
Fault Diagnostic Memory (P047):	None
Possible Causes:	4 - 20 transmitter defective or calibrated incorrectly, broken wire, P703 set incorrectly

F047	4 - 20 ma Reference Low at Terminals 6 & 7
Active:	Active for operating status's, o6 or less
Fault Condition:	The 4 - 20 ma reference at terminals 6 & 7 is less than 3 ma. When the drive is off this will give a warning message W17.
Fault Diagnostic Memory (P047):	None
Possible Causes:	4 - 20 transmitter defective or calibrated incorrectly, broken wire, P713 set incorrectly

F048	Fault in the Pulse Encoder Input Channel
Active:	Active for all operating status's
Fault Condition:	1) Noise on the pulse encoder cables or defective pulse encoder. This fault is initiated if ten encoder evaluations identify a direction change at a speed ≥ 48 RPM and EMF $> 10\%$ Note: (EMF $> 10\%$ added in version 2.2 software). 2) Defective encoder (frequent direction changes, edges too close together, encoder cable shorted). To eliminate nuisance trips near zero speed, the defective encoder fault is only initiated if EMF $> 10\%$ of $1.35 \times P071$
Fault Diagnostic Memory (P047):	Word 0 = 1 Noise on the encoder signals Word 0 = 2 Defective encoder
Possible Causes:	Noise induced onto the pulse encoder cables; Defective pulse encoder; P110 or P11 set incorrectly causing EMF to be incorrect; Pulse encoder shorted cable Pulse encoder cable connection intermittent

8.2.4 Start up Faults

F050	Self Tuning Unsuccessful
Active:	Active for all operating status's
Fault Condition:	A fault has occurred during an self tune run.

Fault Diagnostic Memory (P047) and Possible Causes:

Word 0 = 1 Fault occurred during the self tune run for the current controller and feed forward control for the armature and field (selected using P051 = 25).

Word 0 = 2 Fault occurred during the speed controller self tune run (selected using P051 = 26).

Word 0 = 3 Fault occurred during the field weakening self tune run (selected using P051 = 27).

Word 0 = 4 Fault occurred during the offset adjustments (selected using P051 = 21 or 22).

Word 0 = 5 Fault occurred during the self tune run for friction and inertia compensation (selected using P051 = 28).

Word 1 = 1 With a gating angle of 60 degrees and EMF = 0, the armature current was too low. Average armature current less than 75% of rated motor current.

Possible causes: Armature circuit opened

Word 1 = 2 The armature resistance (P110) cannot be determined.

Possible cause: Armature resistance $R_a > 32.767 \Omega$
Armature current of 37.5% of rated motor current not possible

Word 1 = 3 With a firing angle of 30 degrees and EMF = 0, the armature current was too low. Peak armature current less than 50% of rated motor current.

Possible causes: Armature inductance too large

Word 1 = 4 The armature inductance (P111) cannot be determined.

Possible causes: Armature inductance $L_A > 327.67 \text{ mH}$
Motor rated armature current much less than drive rated current
Armature shorted

Word 1 = 5 Not able to adjust the offset of the field current feedback sensing. Value determined for P884 exceeds permitted value range.

Possible causes: Field current is not zero during offset adjustment. Fault in the field current feedback (defective PIB or μP board)

Word 1 = 6 Not able to adjust the offset for the main speed feedback value channel. The value for P885 or P886 exceeds the permitted value range.

Possible causes: Voltage not equal to zero at terminals 60 to 64 (remove any connections to these terminals before setting P051 = 22), Defective μP board

Word 1 = 7 The field resistance (P112) cannot be determined

Possible causes: Field resistance $R_f > 3276.7 \Omega$
Fault in the field current feedback sensing (defective PIB or P board)
The field economizing command has been entered (binary input function 56)

F050 continued:

F050 continued:

- Word 1 = 8** 80% of the rated EMF (P101 - P100 x P110) cannot be reached within 15 seconds (or maximum of the three selected ramp acceleration times).
- Possible causes:** Acceleration time set too low (P303, P307, P311)
P101 does not match the selected maximum speed (armature voltage at max speed < P101)
- Word 1 = 9** Field current controller not stable enough for recording field characteristics.
- Possible causes:** Field current controller or feed forward controller unstable (run current controller self tuning)
- Word 1 = A_H** Field characteristic not stable enough to measure.
- Possible causes:** Significant armature reaction and widely varying load while the field characteristic is being recorded
Field current controller or feed forward controller unstable (run current controller self tune)
- Word 1 = B_H** A field current lower limit 50% of I_f, motor has been requested.
- Word 1 = C_H** The drive has reached the positive torque limit with the field current reference 50% of rated motor field current.
- Word 1 = D_H** The drive has reached the positive current limit with the field current reference 50% of rated motor field current.
- Word 1 = E_H** With a fixed speed reference the speed feedback has changed by more than 12.5% with the field current reference 50% of rated motor field current.
- Word 1 = F_H** The EMF reference is too low to record the field characteristic (EMF reference < 0.135 x P071).
- Word 1 = 10_H** Field weakening operation not allowed for operation without tachometer selected (P083 = 3).
- Word 1 = 11_H** Field current controller cannot be optimized because the field time constant cannot be determined.
- Possible causes:** Motor field inductance too large
Faulty field current feedback (defective PIB or μ P board)
- Word 1 = 12_H** Field weakening range too large (speed reference of 10% results in EMF > 77% of rated EMF)
- Possible causes:** Maximum speed incorrectly set
Pulse encoder parameters incorrectly set (P140 to P143)
Incorrect parameter for tach adaptation (P706, P708)
Rated EMF incorrect (P100, P101, P110)

F050 continued:

F050 continued:

- Word 1 = 13_H** A steady-state speed, speed error must be < 0.1% of 10%, 20%, ..., 100% of maximum speed cannot be reached within 180 seconds (or max. of the three ramp rate sets)
- Possible causes:** Acceleration time too low (P303, P307, P311)
Stalled motor
Current or torque limit too low
Incorrect speed controller settings (P225, P226, P228)
The speed controller is programmed as a Proportional controller or has droop active
Speed feedback has too much filtering (P201, P202, P203, P204)
- Word 1 = 14_H** Current limit too low
- Word 1 = 15_H** Field weakening range too large (with speed < 7% the resulting EMF > 54% of rated EMF)
- Possible causes:** Maximum speed incorrectly set
Pulse encoder parameters incorrect (P140 to P143)
Tachometer adaptation set incorrectly (P706, P143)
Incorrect EMF reference (P101, P100, P110 incorrectly set)
- Word 1 = 16_H** The required speed was not reached in 45 seconds
- Possible causes:-** Load inertia too large
Load too large or load is highly dependent on speed
- Possible remedy:** Increase P100 for the duration of the self tune to reduce acceleration time during the run.
- Word 1 = 17_H** The required EMF was not reached in 90 seconds
- Possible causes:-** Load inertia too large
Load too large or load is highly dependent on speed
- Possible remedy:** Increase P100 for the duration of the self tune to reduce acceleration time during the run.
- Word 1 = 18_H** The actual speed has not dropped below 2% of maximum speed in 2 minutes if word 0 = 2 or 5 minutes if word 0 = 5.
- Possible causes:-** Single quadrant drive with inertial load takes too long to coast to a stop.
- Word 1 = 19_H** The armature current required to operate from 7 to 13% of maximum speed for overcoming friction and steady-state load torque can not be calculated.
- Possible causes:-** Drive has extremely low friction
Drive has a very low speed controller integration time
Noisy or incorrect speed feedback
- Possible remedy:** Reduce P100 for the duration of the self tune so that the current can be better reduced during the run.

F050 continued:

Word 1 = 1A_H Load torque is too large. Nref = 0% results in Nact \geq 40% of Nmax. The speed actual value is averaged over 90 firing cycles. The speed monitoring begins 1 second after the speed reference reaches 0%. Diagnostic signals can be seen in words 2 to 14 as:
Word 2 = K167, Word 3 = K168, Word 4 = K287, Word 5 = K132, Word 6 = K117
Word 7 = K119, Word 8 = K131, Word 9 = K265, Word 10 = K304, Word 11 = K301
Word 12 = K302,
Word 13 = K167 averaged over 90 firing cycles
Word 14 = K117 averaged over 90 firing cycles

Possible causes:-

- Excessive driving load torque
- The armature current or torque limit has been set too low
- Motor field is too low
- Maximum speed has been set incorrectly
- Pulse encoder parameters P140 to P143 are set incorrectly
- Incorrect setting for tachometer adaptation parameters P706 or P708

Word 1 = 1B_H Load torque too large. Setting Nref = 0% results in |EMF| \geq 100% of the reference EMF. The EMF monitoring for EMF \geq (P101-P100*P110) begins 1 second after the speed reference reaches 0%. Diagnostic signals can be seen in words 2 to 14 as indicated for word 1 = 1A.

Possible causes:-

- Same causes as word 1 = 1A
- Reference EMF set incorrectly (P101, P100, P110)

Word 1 = 1C_H A steady state zero speed cannot be achieved within 30 seconds. The load torque is too large. Setting Nref = 0% results in |EMF| \geq 100% of the reference EMF. The EMF monitoring for EMF \geq (P101-P100*P110) begins 1 second after the speed reference reaches 0%. Diagnostic signals can be seen in words 2 to 14 as indicated for word 1 = 1A.

Possible causes:-

- Same causes as word 1 = 1A

Word 1 = 1D_H The armature inductance (P111) is greater than 327.67 mh.

Possible causes:-

- Converter is being used as a field supply.

F051	Self Tuning Not Possible
Active:	Active for all operating status's
Fault Condition:	If a self tune run is started a check is made to see if it is permitted to store parameter values in the EEPROM (P053 must equal x1). If parameters can not be stored in EEPROM the fault is issued
Fault Diagnostic Memory (P047):	None
Possible Causes:	Parameter P053 = x0
Possible Remedy:	Acknowledge fault Power off drive Set jumper XJ1 on the microprocessor board into position 1-2 Power on drive Set P053 = x1 Re-start self tune run

F052	Self Tuning Run Externally Interrupted
Active:	Active for all operating status's
Fault Condition:	This fault is initiated if during an self tune run: - the start command is removed - the enable command is removed - a "quick stop" command is entered - an E-STOP command is entered - a "forced field economy" command is entered Only those parameters which were optimized prior to a fault will be changed.
Fault Diagnostic Memory (P047):	Word 0 = 1 Fault occurred during the current controller tuning Word 0 = 2 Fault occurred during the speed controller tuning Word 0 = 3 Fault occurred during the field weakening tuning Word 0 = 5 Fault occurred during the friction and inertia tuning Word 1 = 1 Run status was removed by start or enable command Word 1 = 2 Quick stop command active Word 1 = 3 E-Stop command active Word 1 = 4 Field economy active

F055	Field Characteristics Were Not Recorded
Active:	Active for operating status's Ä Ä, I, II
Fault Condition:	This fault is initiated if "speed dependent field weakening" is selected using P082 = 1x and valid field characteristics have still not been recorded (P117 = 0).
Fault Diagnostic Memory (P047):	None
Possible causes	Self tune run for field weakening (P051 = 27) has not been executed.

F056	Important Parameters Not Set
Active:	Active for operating status's ≤ o6
Fault Condition:	This fault is activated if specific parameters are still set to 0.
Fault Diagnostic Memory (P047):	Word 0 = 1 P083 still at 0 Word 0 = 2 P100 still at 0.0 Word 0 = 3 P102 still at 0.00
Possible causes	Speed controller feedback source selection (P083) not set Rated motor armature current (P100) not set Rated motor field current (P102) not set

F057	Option Selection Incorrect
Active:	Active for operating status's ≤ o6
Fault Condition:	This fault is activated if a parallel sitor assembly is connected but P074 = 0x
Fault Diagnostic Memory (P047):	None
Possible causes	Parallel sitor assembly present but not selected with P074

F058	Parameter Settings Not Consistent
Active:	Active for operating status's ≤ o6
Fault Condition:	A check is made per software as to whether associated values are set in mutually dependent parameters.
Fault Diagnostic Memory (P047):	Word 0 = 1 The nominal input voltage value for the analog speed feedback set at parameter P706 lies outside the range specified by parameter P708 Word 0 = 2 Parameters are incorrectly set for speed dependent current limiting. P105 must be > P107 and P104 must be < P106 Word 0 = 3 Field characteristics not stable Word 0 = 4 The first threshold for the speed controller adaptive proportional gain (P556) is greater than the second threshold (P559) Word 0 = 5 The first threshold for the speed controller adaptive integral gain (P557) is greater than the second threshold (P560) Word 0 = 6 The first threshold for the speed controller adaptive droop (P558) is greater than the second threshold (P561) Word 0 = 7 If P083 = 1 (analog tachometer) then P708 cannot be 0x (analog speed feedback not used) Word 0 = 8 If P083 = 2 (digital tachometer) then P140 cannot be 0 (no digital tachometer selected) Word 0 = 9 If P083 = 3 (CEMF feedback) then P082 cannot be 1x (field weakening selected) Word 0 = A P090 (supply voltage stabilizing time) P086 (time for automatic restart) Word 0 = B P090 (supply voltage stabilizing time) P089 (waiting time in status o4 & o5) Word 0 = C P769 =1 and P761 ≠ 2
Possible causes	See above information

F059	Self Tuning Run Externally Interrupted
Active:	Active for all operating status's
Fault Condition:	A check is made in software as to whether the function selection for the serial interfaces at X500 and X501 is correct. The check is made in all operating status's as soon as the value mode has been exited during parameter setup.
Possible causes:	The one's digit of parameter P790 and P790 cannot be the same (i.e., the same functions cannot be simultaneously selected at both interfaces) Exception: Setting 2 (USS protocol)

F060	Software Version Does Not Match
Active:	Active as soon as control supply voltage is applied to the microprocessor board
Fault Condition:	When the microprocessor board is powered on the EPROM software version is compared with the version number in the EEPROM (permanent memory)
Fault Diagnostic Memory (P047):	Word 0 = 1 Version number of the actual EPROM Word 1 = Valid version number before the microprocessor was powered off the previous time
Possible causes:	- EPROM module on microprocessor board was replaced. Use procedure for software replacement (refer to P051 = 21 and Section 7.4).

8.2.5 Thyristor Diagnostics Fault Messages

Active for operating status o3

This fault message group can only occur if the thyristor diagnostics function is activated via parameter P860. The thyristor diagnostics check to determine if all thyristors can block and be gated on.

Possible fault causes: The appropriate thyristor module should be replaced if "thyristor defective" or "thyristor unable to block" is indicated. Although intermittent thyristor failure is possible, a re-occurring intermittent fault message indicates a possible problem in another area.

Possible causes of thyristor failure:

- Interruption in the snubber circuitry
- Current controller and / or current feed forward not optimized causing excessive current spikes
- Insufficient cooling (fan not running or running in wrong direction, ambient temperature too high, air intake too low, heatsink dirty)
- Excessive AC line supply voltage spikes
- External short circuits or ground fault (check armature circuit)

If "thyristor cannot be triggered" is indicated then the problem could be a defective thyristor or a gate circuit problem or an open gate cable.

Possible causes of gating problems:

- Gating pulse cable to the associated thyristor interrupted
- Ribbon cable X804, X805, X806, or X807 incorrectly inserted or interrupted
- Defective PIB or microprocessor board
- Open gate of thyristor module

The firing cables and associated thyristors should always be identified using the appropriate equipment circuit diagram (refer to Section 4).

Notes:

1. If thyristor diagnostics are turned on, they will only be executed if the motor speed is below 1% when speed feedback is selected or below 10% when EMF voltage feedback is selected.
2. To detect that a thyristor is conducting at least 1.35% of rated converter current is required when the gate angle is at 90°. On high inductive loads or motors that are much smaller than the converter rating it may not be possible to reach 1.35% of converter current during the thyristor test. In this case a false detection of thyristors that cannot be triggered will be issued.

The following are the possible thyristor faults:

F061	Defective thyristor (short circuit in module V1)
F062	Defective thyristor (short circuit in module V2)
F063	Defective thyristor (short circuit in module V3)
F064	Defective thyristor (short circuit in module V4)
F065	Defective thyristor (short circuit in module V5)
F068	Armature circuit ground fault P047 word 1 = gate angle where the fault occurred
F066	Defective thyristor (short circuit in module V6)
F069	I = 0 signal defective- (defective microprocessor board)

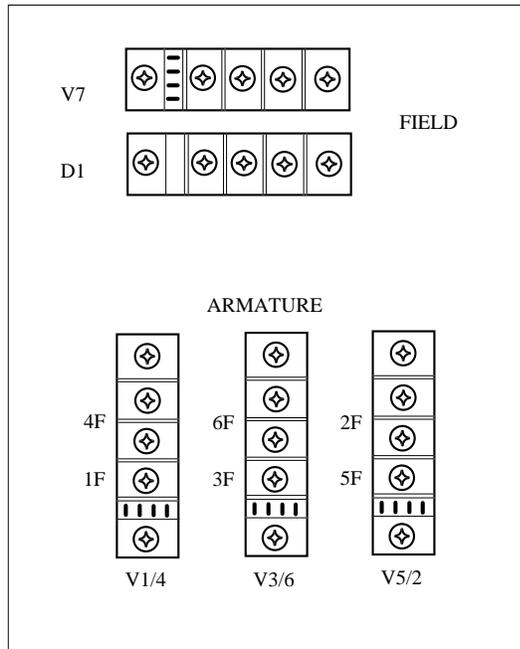
F071	Thyristor unable to be triggered (V1F)
F072	Thyristor unable to be triggered (V2F)
F073	Thyristor unable to be triggered (V3F)
F074	Thyristor unable to be triggered (V4F)
F075	Thyristor unable to be triggered (V5F)
F076	Thyristor unable to be triggered (V6F)
F077	2 or more thyristors (MI) unable to be triggered probably because of an open armature circuit

F081	Thyristor unable to be triggered (V1R)
F082	Thyristor unable to be triggered (V2R)
F083	Thyristor unable to be triggered (V3R)
F084	Thyristor unable to be triggered (V4R)
F085	Thyristor unable to be triggered (V5R)
F086	Thyristor unable to be triggered (V6R)
F087	2 or more thyristors (MII) unable to be triggered probably because P074 is set incorrectly

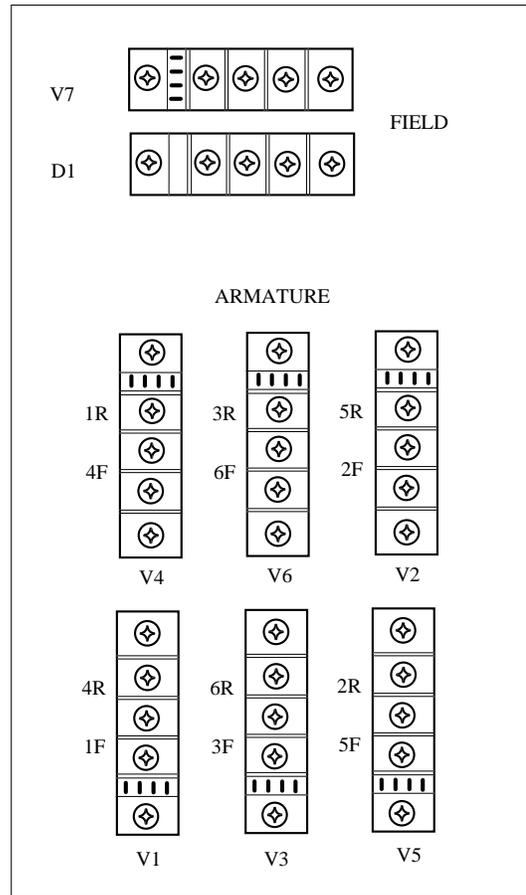
F091	Thyristor unable to block (V1F or V1R)
F092	Thyristor unable to block (V2F or V2R)
F093	Thyristor unable to block (V3F or V3R)
F094	Thyristor unable to block (V4F or V4R)
F095	Thyristor unable to block (V5F or V5R)
F096	Thyristor unable to block (V6F or V6R)

Thyristor Location 15 to 510 Amp Modules and Base Drives

1 QUADRANT

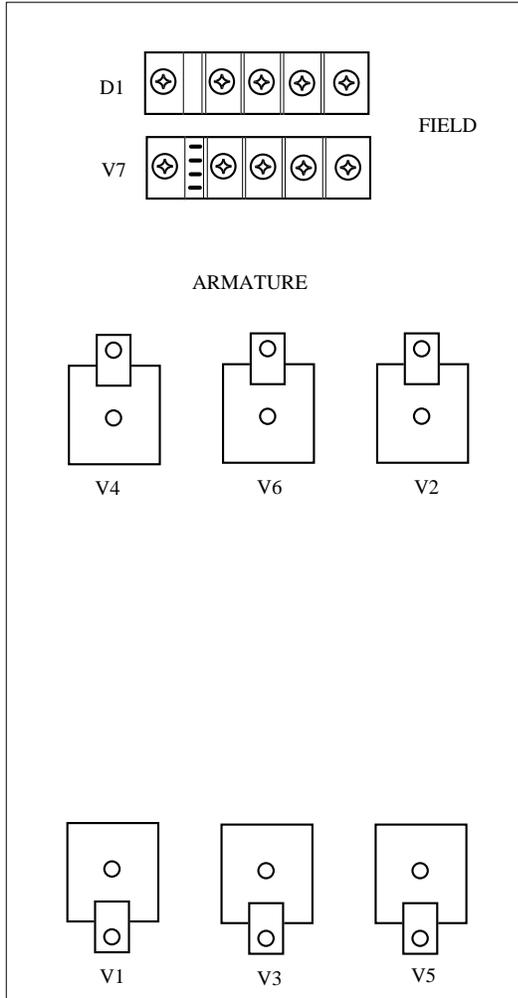


4 QUADRANT

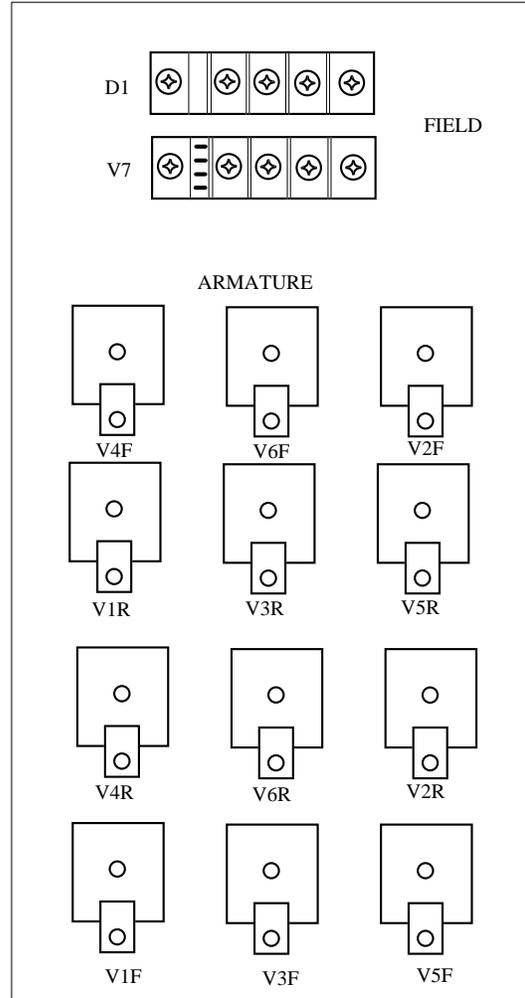


Thyristor Location 850 Amp Base Drives

1 QUADRANT



4 QUADRANT



8.2.6 Internal faults

F100	Illegal Microprocessor Statuses
Active:	Active in all operating status's
Fault Condition:	Internal hardware monitors the microprocessor for illegal operating status's.
Fault Diagnostic Memory (P047):	None
Possible causes:	Defective microprocessor board Excessive noise interfering with microprocessor board (i.e. as a result of unsuppressed contactors, unshielded cables, loose shield connections)

F101	Watchdog timer has initiated a reset
Active:	Active in all operating status's
Fault Condition:	An internal microprocessor hardware counter monitors to see that the program for calculating the gating pulses is executed at least every 14 ms (the average execution time is 2.7 to 3.3 ms). If this is not the case the counter initiates a reset (F101 is displayed).
Fault Diagnostic Memory (P047):	None
Possible causes:	Defective microprocessor board Excessive noise interfering with microprocessor board (i.e. as a result of unsuppressed contactors, unshielded cables, loose shield connections)

F102	EEPROM fault
Active:	Active in all operating status's
Fault Condition:	The correct functioning of the EEPROM chip on the microprocessor board is monitored in software. The EEPROM contains values which must not be lost even with a voltage failure (i.e. parameter values, Fault Diagnostic Memory (P047): and the operating hours counter). Immediately after the electronics power supply is energized the contents of the EEPROM are copied into the RAM. All programs access this RAM parameter image. This parameter image is also the only image changed via the parameter changes. A program continuously modifies the EEPROM contents to follow the contents of the RAM. Every 20 ms 1 byte is checked and if the values in RAM and EEPROM are not equal the RAM cell value is written into the appropriate EEPROM cell. At the same time the written value is stored in an additional RAM cell. The EEPROM requires a maximum of 10 ms to process the value which was written into it and during this time it can neither be written into nor read out of. The previously written memory cell is read from the EEPROM and compared with the additional stored cell in the next background program cycle (i.e. after approx. 20 ms). F102 is activated if they don't match indicating a EEPROM failure. Using P053 = x0 the parameter value changed in RAM but is not stored in the EEPROM (permanent memory inhibited). F102 is disabled in this case.
Fault Diagnostic Memory (P047):	None
Possible causes:	Determine the position of jumper XJ1 on the microprocessor board Determine the value of parameter P053 Defective EEPROM An attempt was made to change a parameter while jumper XJ1 in the write protect position (XJ1 should be in position 2-3) and parameter P053 is set for write protect

F103	Parameter value outside the permitted range
Active:	Active in all operating status's
Fault Condition:	Immediately after the electronics power supply has been switched on the parameter values from the EEPROM are loaded into the operating memory (RAM). A check is simultaneously made as to whether the values are within their permissible range. F103 is displayed if this is not the case.
Fault Diagnostic Memory (P047):	Word 0 = number of the bad parameter Word 1 = Index of the bad parameter Word 2 = Bad parameter value
Possible causes:	Default procedure was never executed with this software (i.e. after software replacement) Excessive noise (i.e. as a result of unsuppressed contactors, unshielded cables, loose shield connections) Acknowledge the fault, default and re-commission the drive!

F104	Incorrect EEPROM check sum
Active:	Active in all operating status's
Fault Condition:	A check sum of the parameter values stored in the EEPROM is cyclically generated and compared with a check sum which is saved with the non-volatile process data. F104 is displayed if the last calculated check sum does not coincide with the saved check sum.
Fault Diagnostic Memory (P047):	None
Possible causes:	Defective EEPROM The write protect jumper XJ1 on the microprocessor board was moved with power still applied to the board A parameter value was changed with jumper XJ1 in the write protect position and P053 not set for write protect (P053 = x1) Parameter P053 was changed with jumper XJ1 in the write protect position and previously P053 = x1 (write protect) (software always attempts to store the value of P053 in the EEPROM) Excessive noise (i.e. as a result of unsuppressed contactors, unshielded cables, loose shield connections) Default procedure was never executed with this software Acknowledge the fault, default and re-commission the drive! Check for proper noise suppression If F104 still occurs even with adequate noise suppression then replace the microprocessor board.

F105	Defective RAM
Active:	Active in all operating status's
Fault Condition:	The correct functioning of the RAM module (data memory) on the microprocessor board is monitored in software. A specific bit pattern is written into the complete RAM immediately after the power is applied. It is then read again. F105 is displayed if the data contents don't match.
Fault Diagnostic Memory (P047):	None
Possible causes:	Defective RAM (replace microprocessor board)

F106	EPROM Checksum Incorrect
Active:	Active in all operating status's
Fault Condition:	The EPROM checksum does not match the value stored in EEPROM.
Fault Diagnostic Memory (P047):	None
Possible causes:	Software version has been changed and the drive has not been defaulted; defective EPROM; defective microprocessor board.

F107	Internal buffer overflow
Active:	Active in all operating status's
Fault Condition:	The various software buffers are monitored per software.
Fault Diagnostic Memory (P047):	None
Possible causes:	Excessive noise (i.e. as a result of unsuppressed contactors, unshielded cables, loose shield connections)

F109	Defective supply voltage sensing
Active:	Active in all operating status's ≤ 0.4
Fault Condition:	An offset of greater than 5% was determined during the attempt to adjust the supply voltage sensing offset in software.
Fault Diagnostic Memory (P047):	None
Possible causes:	Defective voltage circuit on the PIB or microprocessor board

F110	Drive Cooling Failed
Active:	Active in all operating status's ≤ 0.4
Fault Condition:	A check is made on the status of a normally closed thermal contact. The monitoring function is activated 3 s after the drive is in operating status ≤ 0.4 . If the contact is open for more than 10 seconds F110 is issued (V2.3).
Fault Diagnostic Memory (P047):	Word 0 = 1 Thermal contact open (for drives greater than 90 ADC) Jumper missing on X800 1-2 (for drives 90 ADC or less) Word 0 = 2 or 3 For European 6RA24 > 640 amps
Possible causes:	Missing jumper on X800 1-2 for drives without fans (90 ADC or less) Thermal contact open for drives with fans (for drives greater than 90 ADC) Word 0 = 2 or 3 → Electrical Noise

F111	Defective Measuring Channel for the Main Input (terminals 4 and 5)
Active:	Active in all operating status's
Fault Condition:	Hardware monitoring of the analog input circuit
Fault Diagnostic Memory (P047):	None
Possible causes:	Defective microprocessor board or PIB Main reference input voltage on terminals 4 and 5 is greater than approximately 11.3 Volts

F112	Defective Measuring Channel Selectable Analog Input # 1 (terminals 6 and 7)
Active:	Active in all operating status's
Fault Condition:	Hardware monitoring of the analog input circuit
Fault Diagnostic Memory (P047):	None
Possible causes:	Defective microprocessor board or PIB Voltage on terminals 6 and 7 is greater than approx. 11.3 V

F113	Defective Measuring Channel for the Analog Speed Feedback (terminals 60 to 64)
Active:	Active in all operating status's
Fault Condition:	Hardware monitoring of the analog input circuit
Fault Diagnostic Memory (P047):	None
Possible causes:	Defective microprocessor board or PIB Tachometer connected to the wrong input range terminals

8.2.7 Fault Messages From the Motor Sensor System

These faults are only active with the motor sensor option board. The motor sensor option board is designed to operate with Siemens European manufactured dc motors and is not usually supplied with SE&A supplied motors.

F115	Brush Length too Low
Active:	Active in all operating status's ≤ 03
Fault Condition:	Hardware monitoring of the motor brush length For parameter P145 = xxx2 (binary sensing of the brush length): Fault message with log "0" signal at terminal strip X12 terminal 211. For parameter P145 = xxx3 (analog sensing of the brush length): Fault message for brush length 12 mm or if the voltage at terminal X12 terminal 202 < 1.7 volts.
Fault Diagnostic Memory (P047):	None
Possible causes:	For parameter P145 = xxx2, Brush length sensor responded or sensor cable opened For parameter P145 = xxx3, Brush length 12 mm or sensor cable opened

F116	Poor Bearing Condition
Active:	Active in all operating status's ≤ 06
Fault Condition:	Hardware monitoring of the motor bearing condition For parameter P145 = xx2x; Fault message for a logic "1" signal at terminal strip X12 terminal 212.
Fault Diagnostic Memory (P047):	None
Possible causes:	Bearing sensor responded

F117	Air Flow Monitoring
Active:	Active in all operating status's ≤ o6
Fault Condition:	Hardware monitoring of the motor air flow For parameter P145 = x2xx: Fault message if a logic "0" signal is present at terminal strip X12 terminal 213 for at least 40 seconds.
Fault Diagnostic Memory (P047):	None
Possible causes:	The fan monitoring sensor has responded or the sensor cable is opened

F118	Motor Overtemperature (binary sensing)
Active:	Active in all operating status's ≤ o6
Fault Condition:	Hardware monitoring of the motor temperature For parameter P145 = 2xxx: Fault message for a logic "0" signal at terminal strip X12 terminal 214.
Fault Diagnostic Memory (P047):	None
Possible causes:	The thermal switch for motor temperature monitoring has responded or the sensor cable has opened

F119	Motor Overtemperature (analog sensing)
Active:	Active in all operating status's --, I, II
Fault Condition:	Hardware monitoring of the motor temperature For parameter P146 = 1 or 2: The fault message is initiated if the motor temperature reaches or exceeds the value selected using parameter P148. For parameter P146 = 4, 6, 8 or 10: The fault message is initiated if the motor temperature reaches or exceeds the response value of the selected PTC.
Fault Diagnostic Memory (P047):	None
Possible causes:	Motor overloaded or cooling air ambient is too high

8.2.8 External Faults

F121	Fault Signal at Terminal 39
Active:	Active in all operating status's
Fault Condition:	This fault is activated if terminal 39 is programmed for external fault and an external fault is sensed at terminal 39 for a time longer than the time set in P767.
Fault Diagnostic Memory (P047):	None
Possible causes:	External fault

F122	Fault Signal at Terminal 40
Active:	Active in all operating status's
Fault Condition:	This fault is activated if terminal 40 is programmed for external fault and an external fault is sensed at terminal 40 for a time longer than the time set in P767.
Fault Diagnostic Memory (P047):	None
Possible causes:	External fault

F123	Fault Signal at Terminal 41
Active:	Active in all operating status's
Fault Condition:	This fault is activated if terminal 41 is programmed for external fault and an external fault is sensed at terminal 41 for a time longer than the time set in P767.
Fault Diagnostic Memory (P047):	None
Possible causes:	External fault

F124	Fault Signal at Terminal 42
Active:	Active in all operating status's
Fault Condition:	This fault is activated if terminal 42 is programmed for external fault and an external fault is sensed at terminal 42 for a time longer than the time set in P767.
Fault Diagnostic Memory (P047):	None
Possible causes:	External fault

F125	Fault Signal at Terminal 43
Active:	Active in all operating status's
Fault Condition:	This fault is activated if terminal 43 is programmed for external fault and an external fault is sensed at terminal 43 for a time longer than the time set in P767.
Fault Diagnostic Memory (P047):	None
Possible causes:	External fault

F126	Fault Signal at Terminal 36
Active:	Active in all operating status's
Fault Condition:	This fault is activated if terminal 36 is programmed for external fault and an external fault is sensed at terminal 36 for a time longer than the time set in P767.
Fault Diagnostic Memory (P047):	None
Possible causes:	External fault

F128 to F255	Technology Board Faults
Active:	Active in all operating status's
Fault Condition:	Faults for the technology board are displayed, as for all other faults, using their fault number. If several faults are simultaneously indicated in the PT fault channel the first fault entered into the buffer will be displayed. Possible additional fault numbers can be seen in the Fault Diagnostic Memory (P047):.
Fault Diagnostic Memory (P047):	Word 0 = Number of occurred faults (can exceed 3) Word 1 = Fault number 1 Word 2 = Fault number 2 Word 3 = Fault number 3
Possible causes:	Technology board fault--- refer to the Technology board instruction manual

8.2.9 Acknowledging Fault Messages

The fault message is acknowledged by:

- Depressing the SELECT key on the built-in operator control panel
- or
- Depressing the R key on the optional operator control panel
- or
- A positive transition at a binary selectable input which has been programmed as "fault reset"

The drive goes into operating status o8 if the start command is still present and into operating status o7 if the start command is not present. After the fault has been acknowledged the "no fault" output function goes HIGH (i.e. no fault).

8.2.10 Disabling / Activating Monitoring Functions

Monitoring functions can be disabled using index parameter P850.xx in any sequence (i.e. under any index). Indices of P850.xx which are not used should be set to 0. Several monitoring functions (specifically F007, F028, F030 to F037, F040) are disabled when shipped from the factory. If these are to be activated the appropriate P850.xx must be set to 0.

Example: F042 (tachometer fault) is to be disabled
Set P850.11, or any other P850 index value which is 0, to 42

Example: F035 (stall protection) is to be activated
Set P850.07 to 0 (as shipped, P850.07 is set to 35 which disables the stall fault)

8.3 Warnings

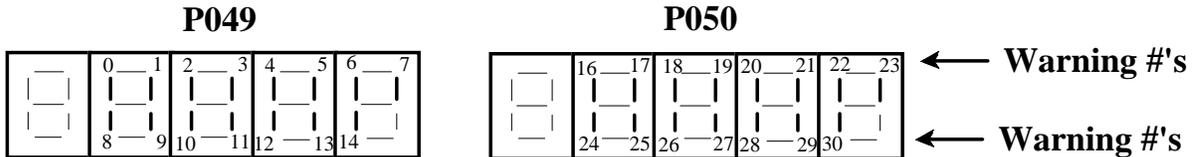
When an warning function is activated the following occurs:

- The binary "no warning" output function is set LOW (selectable function).
- The warning is indicated by the "ST" LED flashing on the microprocessor board or by the "FAULT" LED flashing on the optional control panel.

8.3.1 Warning Displays

When a warning is active as indicated by the above indicators, the actual warning number or warning numbers if more than one warning is present at the same time, can be seen at display parameters P049 and P050. Warnings W00 to W14 are displayed on P049 and warnings W16 to W30 are displayed on P050. The built-in operator panel presents the warnings by assigning specific segments of the display to each warning. The optional operator panel likewise displays the warnings in a coded manner.

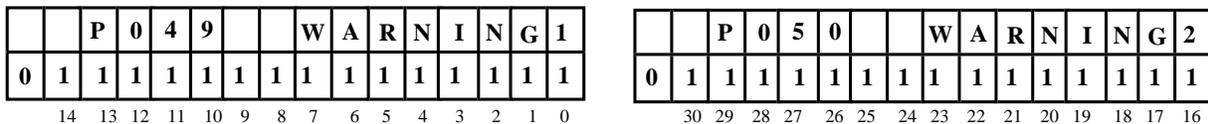
The built-in display indicates the warnings by assigning a unique segment to each warning. The assignment of the segments for parameters P048 and P050 are shown below:



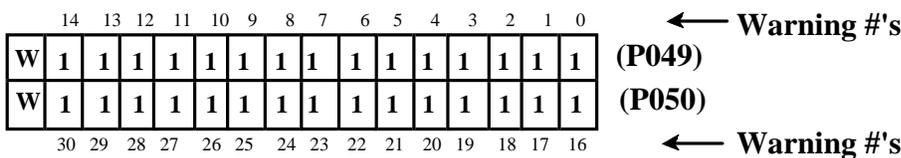
If the segment is lit then the indicated warning number is active.

The optional operator panel indicates the presence of warnings by displaying "0" or "1" in assigned positions in the second line of the display. In this case when P049 or P050 is displayed the active warnings can be seen.

The displays for P049 and P050 are shown below. If the warning position indicates a "1" then that warning is active whereas a "0" indicates no warning present.



If the "R" key is pressed on the optional operator panel while the panel is in the operating display mode, the display will switch to the dual parameter display mode and both P049 and P050 will be displayed and all warning will be indicated at a glance.



8.3.2 Warning Alarm List

W01 Motor Over temperature

The warning is initiated if the calculated I^2t reaches a value that corresponds to the final temperature of the motor if rated motor current were flowing continuously.

W02 Brush Length

If parameter P145 = xxx1, (binary length sensing) then a warning is initiated if a logic "0" signal is present at terminal strip X12, terminal 211 on the motor interface optional module or if the cable between the motor and module is broken.

If parameter P145 = xxx3, (analog length sensing), then the warning is initiated when the length ≤ 14 mm.

W03 Bearing Condition

If parameter P145 = xx1x, then a warning is initiated if a logic "1" signal is present at terminal strip X12, terminal 212 on the motor interface optional module.

W04 Motor Fan

If parameter P145 = x1xx, then a warning is initiated if a logic "0" signal is present at terminal strip X12, terminal 213 on the motor interface optional module or if the cable between the motor fan sensor and module is broken.

W05 Motor Temperature, Binary Sensor

If parameter P145 = 1xxx, then a warning is initiated if a logic "0" signal is present at terminal strip X12, terminal 214 on the motor interface optional module or if the cable between the motor sensor and module is broken.

W06 Motor Temperature, Analog Sensor

If parameter P146 = 1 or 2, then a warning is initiated if the motor temperature reaches or exceeds the value set with parameter P147.

If parameter P146 = 3,5,7, or 9, then a warning is initiated if the motor temperature PTC temperature switching level is reached.

W07 Short Circuit at the Binary Outputs

If binary output hardware short circuit monitor operates the warning is initiated.

W08 Drive Stalled

The warning is issued if the following conditions are true for a time longer than set with parameter p355:

- Positive or negative torque or current limit reached
- The armature current is greater than 1% of the drive controller rated current
- The actual value of speed is $< 0.4\%$ of maximum speed

W09 Open Armature Circuit

The warning is initiated when the armature gating angle is at the minimum limit for more than 500 ms and the armature current is $< 1\%$ of rated drive controller rated armature current.

W10 Pt of the Converter is too Large

This warning is initiated if the permissible I^2t value for the particular converter is reached. Simultaneously the current limit is automatically reduced to 100% of the converter rated current. The warning is canceled if the current reference falls below 100% of rated converter current. Refer also to F039 and parameter P075.

W12 Automatic field current reduction (if motor EMF is too high)

The warning is only active if P082 = 1xx and is initiated if the following is valid for the armature gating angle before limiting at K101:

Gate angle $\alpha > P151 - 5^\circ$ (for continuous current operation)

Gate angle $\alpha > 165^\circ - 5^\circ$ (for discontinuous current operation)

The field is automatically reduced if P082 = 11x and a warning, W12, is issued if the armature gate angle is greater than the limit values shown above. The field is reduced by using a proportional armature gate angle controller. The reference to the controller is the gate values values shown above for either continuous or discontinuous current and the feedback is the actual gate angle at K101. The output of the controller is used to reduce the EMF reference.

If a torque direction change is requested both torque directions are inhibited until the calculated gate angle at K101 is less than 165° in the new torque direction.

W16 Analog input main reference (terminals 4 and 5) faulted

The warning is initiated if P703 = 1x (4 to 20 ma input), and if the input current is less than 3 ma. Also refer to F046.

W17 Analog selectable input reference (terminals 6 and 7) faulted

The warning is initiated if P713 = 1x (4 to 20 ma input), and if the input current is less than 3 ma. Also refer to F047.

W21 Warning Signal at Selectable Binary Input 1

The external warning signal selected at binary input 1 (terminals 39) is active.

W22 Warning Signal at Selectable Binary Input 2

The external warning signal selected at binary input 2 (terminals 40) is active.

W23 Warning Signal at Selectable Binary Input 3

The external warning signal selected at binary input 3 (terminals 41) is active.

W24 Warning Signal at Selectable Binary Input 4

The external warning signal selected at binary input 4 (terminals 42) is active.

W25 Warning Signal at Selectable Binary Input 5

The external warning signal selected at binary input 5 (terminals 43) is active.

W26 Warning Signal at Selectable Binary Input 6

The external warning signal selected at binary input 6 (terminals 36) is active.

W28 Connection between the base unit and an option board is faulty

The warning is present if process data transfer between the basic converter and the option board is faulted. Also refer to P911, P926, and P929.

W29 Warning on the Technology Board**W30 Warning on the Serial Interface Board**

9. Parameter List

The parameter list provides a description of all of the converter parameters. Parameters required for option boards are described in separate documentation provided with the specific option board.

9.1 Parameter Summary Overview

Depending on the setting of parameter P052 different parameters will be displayed as shown in the following summary overview tables.

DISPLAY PARAMETERS:

P052 =1	P052 =2	P052 =3	Function
P000	P000	P000	Operating status display
P001	P001	P001	Main reference terminals 4 and 5
P002	P002	P002	Main analog feedback terminals 60 to 64
P003	P003	P003	Selectable analog input terminals 6 and 7
	P004	P004	Selectable analog input terminal 8
	P005	P005	Selectable analog input terminal 10
P006	P006	P006	Selectable analog output terminal 14
	P007	P007	Selectable analog output terminal 16
	P008	P008	Selectable analog output terminal 18
	P009	P009	Selectable analog output terminal 20
P010.ii	P010	P010	Binary input and control word display
P011.ii	P011	P011	Binary output and status word display
	P012	P012	Temperature measured at terminals 22 and 23
	P013	P013	Motor temperature (for optional motor interface)
	P014	P014	Brush length (for optional motor interface)
P015	P015	P015	AC Supply voltage after main contactor, armature phase (L2-L1) (V-U)
P016	P016	P016	AC Supply voltage, field
P017	P017	P017	AC supply frequency
	P018	P018	Gating angle, armature converter
P019	P019	P019	Armature DC current
P020	P020	P020	Armature DC current reference
	P021	P021	Torque reference after torque limiter
	P022	P022	Torque reference before torque limiter

cont'd

DISPLAY PARAMETERS: cont'd

P052 =1	P052 =2	P052 =3	Function
P023	P023	P023	Speed controller (reference - feedback) error
P024	P024	P024	Speed feedback from the pulse encoder
P025	P025	P025	Speed feedback at the speed controller
P026	P026	P026	Speed controller reference
P027	P027	P027	Ramp function generator output
	P028	P028	Ramp function generator input after limiting
	P029	P029	Ramp function generator input before limiting
	P030	P030	Technology controller output
	P032	P032	Technology controller feedback
	P033	P033	Technology controller reference
	P034	P034	Gating angle, field converter
P035	P035	P035	Field current controller feedback
P036	P036	P036	Field current controller reference
	P037	P037	Motor EMF actual value
P038	P038	P038	Motor armature voltage
	P039	P039	EMF controller reference
P040	P040	P040	Status of all limit functions
		P041	Connector number selected at parameter P861.01
		P042	Connector number selected at parameter P861.02
		P043	Selectable display parameter 1
		P044	Display value assignment for P043
		P045	Selectable display parameter 2
		P046	Display value assignment for P045
P047.ii	P047.ii	P047.ii	Fault diagnostic memory
P048	P048	P048	Operating hours
P049	P049	P049	Warning display for W00 to W14
P050	P050	P050	Warning display W16 to W30

ACCESS AUTHORIZATION and PARAMETER DISPLAY:

P052 =1	P052 =2	P052 =3	Function
P051	P051	P051	Key code parameter
P052	P052	P052	Selection of which parameters will be displayed
P053	P053	P053	Parameter storage selection method
P054	P054	P054	Parameter "set" selection to be displayed
P055	P055	P055	Parameter page copy
P056	P056	P056	Display of the active parameter set

OPERATOR PANEL CONFIGURATION:

P052 =1	P052 =2	P052 =3	Function
P060	P060	P060	Software version number
P064	P064	P064	Optional operator control panel: Operating display 1st line
P065	P065	P065	Optional operator control panel: Operating display 2nd line
P066	P066	P066	Starting using the optional operator panel "I" key
P067	P067	P067	Stopping using the optional operator panel "O" key

DRIVE CONTROLLER RATING:

P052 =1	P052 =2	P052 =3	Function
P070	P070	P070	Interface board voltage rating
P071	P071	P071	Rated armature converter AC supply voltage
P072	P072	P072	Rated armature converter DC current
P073	P073	P073	Rated field converter DC current
P074	P074	P074	Power section control word
P075	P075	P075	Control word for armature converter I^2t
P076	P076	P076	Select European or USA power section
P077	P077	P077	Thermal reduction factor based on P075 (sets the maximum current limit value)
P078	P078	P078	Rated field converter AC supply voltage

DRIVE CONTROL SELECTIONS:

P052 =1	P052 =2	P052 =3	Function
	P080	P080	Control word for the brake function
P082	P082	P082	Field control mode
P083	P083	P083	Speed feedback source
P084	P084	P084	Speed, current, torque control selection
		P085	Delay time after JOG command is removed
	P086	P086	Automatic restart delay time
	P087	P087	Brake release time
	P088	P088	Brake closing time
		P089	Maximum wait time for voltage at the power section
		P090	Supply voltage stabilization time
	P091	P091	Main reference threshold for status o6
		P092	Delay for field reversal (to allow for field decay before reversing the field)
	P093	P093	Delay for drive starting when BOF 7 is used to start auxiliary equipment first
	P094	P094	Delay to turn off auxiliary equipment using BOF 7
	P095	P095	Delay time waiting in status o3.2 for the dc contactor to close.

ADJUSTABLE FIXED SETPOINTS:

P052 =1	P052 =2	P052 =3	Function
	P096	P096	General digital fixed value on connector K096
	P097	P097	General digital fixed value on connector K097
	P098	P098	General digital fixed value on connector K098
	P099	P099	General digital fixed value on connector K099

MOTOR DEFINITION:

P052 =1	P052 =2	P052 =3	Function
P100	P100	P100	Rated motor nameplate armature current
P101	P101	P101	Rated motor nameplate armature dc voltage
P102	P102	P102	Rated motor nameplate field current at base speed
P103	P103	P103	Minimum motor nameplate field current at maximum speed
P104	P104	P104	Tapered current limit speed point 1
P105	P105	P105	Tapered current limit current point 1
P106	P106	P106	Tapered current limit speed point 2
P107	P107	P107	Tapered current limit current point 2
P108	P108	P108	Tapered current limit maximum speed point
P109	P109	P109	Control word for tapered current limit
	P110	P110	Armature circuit resistance
	P111	P111	Armature circuit inductance
	P112	P112	Field circuit resistance
P114	P114	P114	Motor thermal time constant
P115	P115	P115	Maximum speed for operation without a tachometer (EMF voltage control)
		P117	Control word for the field characteristic
		P118	Motor rated EMF
		P119	Rated motor speed (base speed)
		P120	Field current at 0% motor flux
		P121	Measured motor field characteristics
		to	↓
		P139	Measured motor field characteristics

PULSE ENCODER DEFINITION:

P052 =1	P052 =2	P052 =3	Function
P140	P140	P140	Pulse encoder type (usually type 1)
P141	P141	P141	Pulses per revolution
P142	P142	P142	Control word for the pulse encoder (recommended setting is 010)
P143	P143	P143	Maximum motor speed (see P452 for fine adjustment)
P144	P144	P144	Control word for positioning sensing

OPTIONAL MOTOR INTERFACE DEFINITION:

P052 =1	P052 =2	P052 =3	Function
	P145	P145	Control parameter for the motor interface option
	P146	P146	Motor temperature sensor selection (at terminals XM-204 & XM-205)
	P147	P147	Warning temperature
	P148	P148	Shutdown temperature

ARMATURE CURRENT CONTROL ADJUSTMENTS:

P52 =1	P052 =2	P052 =3	Function
		P150	Armature gate angle advance limit
		P151	Armature gate angle retard limit
		P152	Filtering of the supply frequency for gate tracking
		P153	Control word for armature current controller feed forward
		P154	Control word for the armature current controller
P155	P155	P155	Armature current controller proportional gain
P156	P156	P156	Armature current reference rate of change time constant
		P157	Operating method for armature current reference rate of change integrator
		P158	Time constant for the current reference integrator
		P159	Threshold for the reversing logic of the armature converter (4q drives)
		P160	Reversing logic dead time (4q drives)

ARMATURE CURRENT and TORQUE LIMITING:

P52 =1	P052 =2	P052 =3	Function
	P170	P170	Torque or current control selection
P171	P171	P171	Positive Current limit bridge I (forward)
P172	P172	P172	Negative Current limit bridge II (reverse)
P180	P180	P180	Positive torque limit 1
P181	P181	P181	Negative torque limit 1
	P182	P182	Positive torque limit 2
	P183	P183	Negative torque limit 2
	P184	P184	Changeover speed for torque limits 1 and 2

SPEED CONTROLLER FEEDBACK CONDITIONING:

P52 =1	P052 =2	P052 =3	Function
P200	P200	P200	Speed feedback smoothing filter time constant
	P201	P201	Resonant frequency for the first band-stop filter
	P202	P202	Quality of the first band-stop filter
	P203	P203	Resonant frequency for the second band-stop filter
	P204	P204	Quality of the second band-stop filter
	P205	P205	Derivative adjustment of the speed controller feedback

SPEED CONTROLLER ADJUSTMENTS:

P52 =1	P052 =2	P052 =3	Function
		P220	Speed controller integration time preset except for jog operations
		P222	Changeover threshold between PI and P control
	P223	P223	Control word for speed control feed forward
	P224	P224	Control word for the speed controller
P225	P225	P225	Speed controller proportional gain
P226	P226	P226	Speed controller integration time constant
P227	P227	P227	Speed controller droop
P228	P228	P228	Speed reference filter time constant
P229	P229	P229	Control word for master - slave operation

FIELD CURRENT CONTROLLER ADJUSTMENTS:

P52 =1	P052 =2	P052 =3	Function
		P250	Field gate angle advance limit
		P251	Field gate angle retard limit
		P252	Filtering of the supply frequency for gate tracking
		P253	Control word for field control feed forward
		P254	Control word for the field controller
P255	P255	P255	Field current controller proportional gain
P256	P256	P256	Field current controller integral time constant
P257	P257	P257	Field economy current setting
	P258	P258	Delay time for automatic field economy

EMF VOLTAGE CONTROLLER ADJUSTMENTS:

P52 =1	P052 =2	P052 =3	Function
		P273	Control word for field control feed forward
		P274	Control word for the field controller
P275	P275	P275	EMF current controller proportional gain
P276	P276	P276	EMF current controller integral time constant
		P277	EMF controller droop

RAMP FUNCTION GENERATOR ADJUSTMENTS:

P52 =1	P052 =2	P052 =3	Function
		P300	Positive limit for the ramp output
		P301	Negative limit for the ramp output
	P302	P302	Control word for the ramp generator

RAMP GENERATOR PARAMETER SET 1 ADJUSTMENTS:

P52 =1	P052 =2	P052 =3	Function
P303	P303	P303	Ramp up time 1
P304	P304	P304	Ramp down time 1
P305	P305	P305	Ramp start rounding time 1
P306	P306	P306	Ramp end rounding time 1

RAMP GENERATOR PARAMETER SET 2 ADJUSTMENTS:

P52 =1	P052 =2	P052 =3	Function
	P307	P307	Ramp up time 2
	P308	P308	Ramp down time 2
	P309	P309	Ramp start rounding time 2
	P310	P310	Ramp end rounding time 2

RAMP GENERATOR PARAMETER SET 3 ADJUSTMENTS:

P52 =1	P052 =2	P052 =3	Function
		P311	Ramp up time 3
		P312	Ramp down time 3
		P313	Ramp start rounding time 3
		P314	Ramp end rounding time 3

SPEED REFERENCE LIMITING ADJUSTMENTS:

P52 =1	P052 =2	P052 =3	Function
		P315	Positive limit at the ramp generator input
		P316	Negative limit at the ramp generator input
P317	P317	P317	Speed limit "maximum speed"
P318	P318	P318	Speed limit "minimum speed"
	P319	P319	Speed reference reduction, positive direction
	P320	P320	Speed reference reduction, negative direction

MONITORING ADJUSTMENTS:

P52 =1	P052 =2	P052 =3	Function
	P351	P351	Threshold for the undervoltage trip
	P352	P352	Threshold for the overvoltage trip
		P353	Threshold for the phase failure trip
P354	P354	P354	Threshold for the overspeed trip
P355	P355	P355	Stall protection time
	P357	P357	Threshold for tachometer loss fault
	P362	P362	Threshold for speed controller monitoring
	P363	P363	Time for the speed controller dynamic error
		P364	Threshold for armature current controller monitoring
		P365	Time for the current controller dynamic error
		P366	Threshold for the EMF controller monitoring
		P367	Time for the EMF controller dynamic error
		P368	Threshold for the field current controller monitoring
		P369	Time for the field current controller dynamic error

LIMIT VALUE ADJUSTMENTS:

P52 =1	P052 =2	P052 =3	Function
P370	P370	P370	Speed threshold for minimum speed (contactor drop out speed)
P371	P371	P371	Hysteresis for speed < minimum speed signal
P373	P373	P373	Speed threshold reference Nx1
P374	P374	P374	Hysteresis for speed < Nx1 signal
	P376	P376	Speed threshold reference Nx2
	P377	P377	Hysteresis for speed < Nx2 signal
	P379	P379	Speed threshold reference Nx3
	P380	P380	Hysteresis for speed < Nx3 signal
		P382	Speed threshold reference Nx4
		P383	Hysteresis for speed < Nx4 signal
		P385	Speed threshold reference Nx5
		P386	Hysteresis for speed < Nx5 signal
P391	P391	P391	Armature current reference I _x
P392	P392	P392	Hysteresis for current > I _x signal
		P394	Field current threshold reference for minimum field current I _{fmin}
		P395	Hysteresis for field current < I _{fmin} signal
		P396	Hysteresis for actual speed direction detection

REFERENCE INPUT ADJUSTMENTS:

P52 =1	P052 =2	P052 =3	Function
P401	P401	P401	Digital reference for terminal 39
P402	P402	P402	Digital reference for terminal 40
	P403	P403	Digital reference for terminal 41
	P404	P404	Digital reference for terminal 42
	P405	P405	Digital reference for terminal 43
	P406	P406	Digital reference for terminal 36
	P409	P409	Jog (inching) reference for the control word
	P410	P410	Jog (inching) reference by-pass the ramp for the control word
	P411	P411	Thread (crawl) reference for the control word
	P412	P412	Thread (crawl) reference by-pass the ramp for the control word
	P413	P413	Fixed reference for the control word
	P414	P414	Fixed reference by-pass the ramp for the control word
	P415	P415	Additional reference before the Technology regulator for the control word
	P416	P416	Additional reference before the ramp generator for the control word
	P417	P417	Additional reference before the speed controller for the control word
	P418	P418	Additional reference before the torque limiter for the control word
	P419	P419	Additional reference before the current controller for the control word

TECHNOLOGY CONTROLLER ADJUSTMENTS:

P52 =1	P052 =2	P052 =3	Function
	P420	P420	Feedback filter time constant
	P421	P421	Derivative gain
	P422	P422	Technology controller reference filter time constant
	P424	P424	Control word for the Technology controller
	P425	P425	Proportional gain
	P426	P426	Integral time constant
	P427	P427	Controller droop
	P428	P428	Scaling factor for the Technology controller output
	P430	P430	Positive Technology controller output
	P431	P431	Negative Technology controller output
	P432	P432	Positive limit for Technology controller droop
	P433	P433	Negative limit for Technology controller droop

MAXIMUM SPEED CALIBRATION:

P52 =1	P052 =2	P052 =3	Function
		P450	Maximum RPM of gear output (coarse)
		P451	Maximum RPM of gear output (fine)
	P452	P452	Maximum RPM of the motor (fine adjustment for the pulse encoder) ... see P143

MOTOR POTENTIOMETER ADJUSTMENTS:

P52 =1	P052 =2	P052 =3	Function
	P460	P460	MOP operating mode
	P461	P461	MOP setpoint
	P462	P462	MOP ramp up time
	P463	P463	MOP ramp down time
	P464	P464	MOP output scaling
	P465	P465	MOP time scaling (x1 or x60)
	P466	P466	MOP preset source for BIF 68

DRAW (TENSION) / RATIO CONTROL ADJUSTMENTS:

P52 =1	P052 =2	P052 =3	Function
	P470	P470	Speed Draw (tension) or Speed Ratio mode
	P471	P471	Draw or Ratio value

"OSCILLATION" or "STEP" SPEED REFERENCE FUNCTION:

P52 =1	P052 =2	P052 =3	Function
P480	P480	P480	Reference 1 value for the time set with P481
P481	P481	P481	Time that reference 1 is active
P482	P482	P482	Reference 2 value for the time set with P483
P483	P483	P483	Time that reference 2 is active

MASTER / SLAVE CURRENT REFERENCE SELECTION:

P52 =1	P052 =2	P052 =3	Function
	P500	P500	Reference source for the slave current / torque slave drive

SPEED CONTROLLER FRICTION COMPENSATION ADJUSTMENTS:

P52 =1	P052 =2	P052 =3	Function
	P520	P520	Friction at zero speed (break away)
	P521	P521	Friction at 10% speed
	to	to	to
	P529	P529	Friction at 90% speed
	P530	P530	Friction at 100% speed and faster

SPEED CONTROLLER INERTIA COMPENSATION ADJUSTMENTS:

P52 =1	P052 =2	P052 =3	Function
	P540	P540	Accelerating time scaling
	P541	P541	Accelerating proportional gain
	P543	P543	Threshold for compensation based on speed controller speed error
	P544	P544	Selection of an alternate acceleration rate
	P545	P545	Selecting the acceleration source
	P546	P546	Acceleration compensation filter time constant

SPEED CONTROLLER ADAPTATION FUNCTION ADJUSTMENTS:

P52 =1	P052 =2	P052 =3	Function
	P550	P550	Proportional gain adaptation below the lower threshold
	P551	P551	Integral time adaptation below the lower threshold
	P552	P552	Droop adaptation below the lower threshold
	P553	P553	Source of proportional adaptation signal
	P554	P554	Source of integral time adaptation signal
	P555	P555	Source of droop adaptation signal
	P556	P556	Lower proportional gain threshold
	P557	P557	Lower integral time threshold
	P558	P558	Lower droop threshold
	P559	P559	Upper proportional gain threshold
	P560	P560	Upper integral time threshold
	P561	P561	Upper droop threshold

CONFIGURING THE CURRENT / TORQUE FUNCTIONS:

P52 =1	P052 =2	P052 =3	Function
		P600	Armature gate angle reference source
		P601.ii	Armature current controller reference source before the current limiter
		P602	Armature current controller feedback source selection
		P603.ii	Variable current limit selection for torque direction I
		P604.ii	Variable current limit selection for torque direction II
		P605.ii	Variable torque limit selection for torque direction I
		P606.ii	Variable torque limit selection for torque direction II
		P607.ii	Torque reference source selection

CONFIGURING THE SPEED CONTROLLER FUNCTION:

P52 =1	P052 =2	P052 =3	Function
	P608.ii	P608.ii	Speed controller reference source selector
		P609	Speed controller feedback source selector

CONFIGURING THE FIELD and EMF CONTROL FUNCTIONS:

P52 =1	P052 =2	P052 =3	Function
		P610	Field gate angle reference source selection
		P611.ii	Field current controller reference source selection
		P612	Field current controller feedback source selection
		P613.ii	Field current controller reference positive limit selection
		P614.ii	Field current controller reference negative limit selection
		P615.ii	EMF voltage controller reference source selection
		P616	EMF voltage controller feedback source selection

CONFIGURING THE RAMP GENERATOR:

P52 =1	P052 =2	P052 =3	Function
		P620.ii	Positive limit source for the ramp output
		P621.ii	Negative limit source for the ramp output
		P622.ii	Source selection of the speed controller reference before the limiter
		P623.ii	Selection of the ramp input source
		P624	Selection of the ramp time reduction signal
		P625.ii	Selection of the positive limit source for the ramp
		P626.ii	Selection of the negative limit source for the ramp
		P627.ii	Selection of the reference input after the enable function
		P628.ii	Selection of the reference input before the enable function
		P629	Ramp generator preset value selector

CONFIGURING THE TECHNOLOGY CONTROLLER:

P52 =1	P052 =2	P052 =3	Function
	P630.ii	P630.ii	Technology controller reference source
	P631.ii	P631.ii	Technology controller feedback source
	P632	P632	Maximum output limit selector
	P633	P633	Scaling factor at the Technology controller output
	P634	P634	Minimum output limit selector

CONFIGURING THE ACCELERATION COMPENSATION SOURCE

P052 =1	P052 =2	P052 =3	Function
	P635.ii	P635.ii	Selection of acceleration torque compensation source

CONFIGURING THE CONVERTER CONTROL WORD

P052 =1	P052 =2	P052 =3	Function
	P640	P640	Control word selection
	P641	P641	Source selection of the assignable control word STWF
	P642.ii	P642.ii	Assignment of bits within the assignable control word STWF

FREELY DEFINED FUNCTION BLOCK PARAMETERS

P052 =1	P052 =2	P052 =3	Function
		P650.ii	Input selector for adder 1
		P651.ii	Input A selector for multiplier / divider 1
		P652	Input B selector for multiplier / divider 1
		P653.ii	Input A selector for divider function
		P654	Input B selector for divider function
		P655	Input selector for inverter 1
		P656.ii	Input A selector for switch 1
		P657	Input B selector for switch 1
		P658	Input selector for absolute value 1 function
		P659	Input A selector for limit detector 1
		P660	Input B selector for limit detector 1
		P661.ii	Input selector for adder 2
		P662.ii	Input A selector for multiplier / divider 2
		P663	Input B selector for multiplier / divider 2
		P664	Input selector the general function generator
		P665	Input selector for inverter 2
		P666.ii	Input A selector for switch 2
		P667	Input B selector for switch 2
		P668	Input selector for the limiter function
		P669	Input selector for absolute value 2 function
		P670	Input A selector for limit detector 2
		P671	Input B selector for limit detector 2

FREELY DEFINED FUNCTION BLOCK PARAMETERS cont'd

P052 =1	P052 =2	P052 =3	Function
		P672	Input selector for adder 3
		P673	Input A selector for multiplier / divider 3
		P674	Input B selector for multiplier / divider 3
		P675	Input selector for inverter 3
		P676	Input A selector for switch 3
		P677	Input B selector for switch 3
		P679	Deadband adjustment
		P680	Multiplication factor for multiplier 1
		P681	Multiplication factor for multiplier 2
		P682	Multiplication factor for multiplier 3
		P683	Minimum diameter adjustment
		P684	Control word for divider / diameter compensated speed calculator
		P686	Positive limit value for the limiter
		P687	Negative limit value for the limiter
		P688	Control word for the absolute value function 1
		P689	Filter time constant for absolute value function 1
		P690	Control word for the absolute value function 2
		P691	Filter time constant for absolute value function 2

FREELY DEFINED FUNCTION BLOCK PARAMETERS cont'd

P052 =1	P052 =2	P052 =3	Function
		P692	Control word for limit detector 1
		P693	Hysteresis for limit detector 1
		P694	Control word for limit detector 2
		P695	Hysteresis for limit detector 2
		P696	Line speed range adjustment
		P697	Diameter range adjustment
		P698.ii	X axis function generator points
		P699.ii	Y axis function generator points

ANALOG INPUTS:

P052 =1	P052 =2	P052 =3	Function
		P700	Resolution of the main reference at terminals 4 and 5
P701	P701	P701	Scaling main reference terminals 4 and 5
P702	P702	P702	Offset of main reference terminals 4 and 5
P703	P703	P703	Control word for the main reference terminals 4 and 5
P704	P704	P704	Filter time for the main reference terminal 4 and 5
P706	P706	P706	Scaling main feedback terminals 60 to 64
P707	P707	P707	Offset of main feedback terminals 60 to 64
P708	P708	P708	Control word for the main feedback terminals 60 to 64
P709	P709	P709	Filter time for the main feedback terminals 60 to 64
		P710	Resolution of analog input 1 at terminals 6 and 7
P711	P711	P711	Scaling analog input terminals 6 and 7
P712	P712	P712	Offset of analog input terminals 6 and 7
P713	P713	P713	Control word for the analog input terminals 6 and 7
P714	P714	P714	Filter time for the analog input terminal 6 and 7
	P716	P716	Scaling analog input terminal 8
	P717	P717	Offset of analog input terminal 8
	P718	P718	Control word for the analog input terminal 8
	P719	P719	Filter time for the analog input terminal 8
	P721	P721	Scaling analog input terminal 10
	P722	P722	Offset of analog input terminal 10
	P723	P723	Control word for the analog input terminal 10
	P724	P724	Filter time for the analog input terminal 10

ANALOG OUTPUTS:

P052 =1	P052 =2	P052 =3	Function
P739	P739	P739	Control word for armature current output at terminal 12
P740	P740	P740	Selecting the function of terminal 14 output
P741	P741	P741	Control word for terminal 14 output
P742	P742	P742	Filter time constant for terminal 14 output
P743	P743	P743	Offset for terminal 14 output
P744	P744	P744	Scaling for terminal 14 output
	P745	P745	Selecting the function of terminal 16 output
	P746	P746	Control word for terminal 16 output
	P747	P747	Filter time constant for terminal 16 output
	P748	P748	Offset for terminal 16 output
	P749	P749	Scaling for terminal 16 output
	P750	P750	Selecting the function of terminal 18 output
	P751	P751	Control word for terminal 18 output
	P752	P752	Filter time constant for terminal 18 output
	P753	P753	Offset for terminal 18 output
	P754	P754	Scaling for terminal 18 output
	P755	P755	Selecting the function of terminal 20 output
	P756	P756	Control word for terminal 20 output
	P757	P757	Filter time constant for terminal 20 output
	P758	P758	Offset for terminal 20 output
	P759	P759	Scaling for terminal 20 output

BINARY INPUTS:

P052 =1	P052 =2	P052 =3	Function
P761	P761	P761	Selecting the function of terminal 39
P762	P762	P762	Selecting the function of terminal 40
	P763	P763	Selecting the function of terminal 41
	P764.ii	P764.ii	Selecting the function of terminal 42
	P765.ii	P765.ii	Selecting the function of terminal 43
	P766	P766	Selecting the function of terminal 36
	P767	P767	Delay time for the external fault input
	P769	P769	Control word for start, stop, and thread commands (momentary or maintained)

BINARY OUTPUTS:

P052 =1	P052 =2	P052 =3	Function
P771	P770	P770	Control word for binary outputs
	P771	P771	Selecting the function of terminal 46
	P772	P772	Selecting the function of terminal 48
	P773	P773	Selecting the function of terminal 50
	P774	P774	Selecting the function of terminal 52
	P775	P775	Delay time for binary output at terminal 46
	P776	P776	Delay time for binary output at terminal 48
	P777	P777	Delay time for binary output at terminal 50
	P778	P778	Delay time for binary output at terminal 52

DRIVE CONTROLLER SERIAL INTERFACES:

P052 =1	P052 =2	P052 =3	Function
P790	P780	P780	RS485 protocol selection at X500
	P781	P781	RS485 number of process data words in the telegram
	P782	P782	RS485 number of parameter data words in the telegram
	P783	P783	RS485 Baud rate
	P784.ii	P784.ii	RS485 process data value assignments
	P786	P786	RS485 bus address
	P787	P787	RS485 telegram failure time for USS protocol on X500
	P788	P788	RS485 telegram failure time for Peer to Peer protocol on X500
	P790	P790	RS232 protocol selection at X501
	P791	P791	RS232 number of process data words in the telegram
P973	P792	P792	RS232 number of parameter data words in the telegram
	P973	P973	RS232 Baud rate
	P794.ii	P794.ii	RS232 process data value assignments
P798	P796	P796	RS232 bus address
	P797	P797	RS232 telegram failure time
	P798	P798	RS232 control word

DIAGNOSTIC TRACE BUFFER PARAMETERS:

P052 =1	P052 =2	P052 =3	Function
		P840	Number of recorder data lines
		P841.ii	Recorded values for diagnostic buffer 1
		P842.ii	Recorded values for diagnostic buffer 2
		P843.ii	Recorded values for diagnostic buffer 3
		P844.ii	Recorded values for diagnostic buffer 4
		P845.ii	Recorded values for diagnostic buffer 5
		P846.ii	Recorded values for diagnostic buffer 6
		P847.ii	Recorded values for diagnostic buffer 7
		P848.ii	Recorded values for diagnostic buffer 8
		P849	Trigger location

DISABLE FAULTS AND SPONTANEOUS MESSAGES:

P052 =1	P052 =2	P052 =3	Function
	P850.ii	P850.ii	Disable fault monitoring
		P855	Control word for parameter change reports (spontaneous messages)

DIAGNOSTIC TRACE BUFFER FUNCTIONS:

P052 =1	P052 =2	P052 =3	Function
		P860	Control word for thyristor diagnostics
		P861.ii	Number of the connectors used in diagnostic tracing
		P862	Connector number of diagnostic trigger
		P863	Diagnostic trigger condition
		P864	Percentage value for the diagnostic trace trigger condition
		P865	Sampling interval for the diagnostic trace
		P866	Trigger delay for diagnostic tracing
		P867	Control bit for diagnostic tracing
		P868	Recording speed of the analog output
		P869	Mode of the analog output for trace buffer output
		P870	Output mode of the trace buffer
		P871	Number of write accesses to the EEPROM
		P872	Number of page write accesses to the EEPROM
P880.ii	P880.ii	P880.ii	Fault parameter
		P881	Segment number of the basic address
		P882	Segment offset of the basic address
		P883.ii	Contents of the specified address

INTERNAL CONVERTER ADJUSTMENTS:

P052 =1	P052 =2	P052 =3	Function
		P884	Offset adjustment for the field current feedback analog channel
		P885	Offset adjustment for the main feedback analog channel 1
		P886	Offset adjustment for the main feedback analog channel 2
		P887.ii	Correction of the measured time instants for the supply zero crossings

OPTION BOARD SETUP PARAMETERS:

P052 =1	P052 =2	P052 =3	Function
		P900 to P971.ii	Setup parameters for optional communications boards (CS51) and technology boards (Z2006 and PT1). Refer to the specific option board manual for parameter details.

9.2 Parameter Description

Display Parameters P000 to P050

- P000** Operating status displays (refer to section 8.1)
- P001** Display of main reference (terminals 4 and 5)
Nominal display range: -100.00 to 100.00% of the nominal input voltage scaled using P701.
Value range (steps): -200.0 to 199.99% (0.01%)
- P002** Display of analog tachometer (terminals 60 to 64)
Nominal display range: -100.00 to 100.00% of the nominal input voltage scaled using P706.
Value range (steps): -200.0 to 199.99% (0.01%)
- P003** Display of analog input 1 (terminals 6 and 7)
Nominal display range: -100.00 to 100.00% of the nominal input voltage scaled using P711.
Value range (steps): -200.0 to 199.99% (0.01%)
- P004** Display of analog input 2 (terminals 8 and 9)
Nominal display range: -100.00 to 100.00% of the nominal input voltage scaled using P716.
Value range (steps): -200.0 to 199.99% (0.01%)
- P005** Display of analog input 3 (terminals 10 and 11)
Nominal display range: -100.00 to 100.00% of the nominal input voltage scaled using P721.
Value range (steps): -200.0 to 199.99% (0.01%)
- P006** Display programmable output 1 (terminal 14)
Nominal display range: -100.00 to 100.00% of the analog value selected using P740, P741 (sign, absolute value, inverted), and P742 (filtering).
Value range (steps): -200.0 to 199.99% (0.01%)
- P007** Display programmable output 2 (terminal 16)
Nominal display range: -100.00 to 100.00% of the analog value selected using P745, P746 (sign, absolute value, inverted), and P747 (filtering).
Value range (steps): -200.0 to 199.99% (0.01%)
- P008** Display programmable output 3 (terminal 18)
Nominal display range: -100.00 to 100.00% of the analog value selected using P750, P751 (sign, absolute value, inverted), and P752 (filtering).
Value range (steps): -200.0 to 199.99% (0.01%)
- P009** Display programmable output 4 (terminal 20)
Nominal display range: -100.00 to 100.00% of the analog value selected using P755, P756 (sign, absolute value, inverted), and P757 (filtering).
Value range (steps): -200.0 to 199.99% (0.01%)

- P012 Display of the temperature measured at terminals 22 and 23**
 Nominal display range: 0 to 97°C (using sensor type KTY84)
 Value range (steps) 0 to 250°C (1°C)
- P013 Motor temperature display (optional motor interface)**
 Nominal display range: 0 to 250°C for P146 = 1
 13 to 240°C for P146 = 2
 Value range (steps) 0 to 250°C (1°C)
- P014 Brush length display (optional motor interface)**
 Nominal display range: 0 to 80% → 100%
 0% is approximately 12 mm; lengths > 80% are displayed as 100%
 Steps: 0.1%
- P015 Supply voltage display; phase V-U (armature supply after the main contactor)**
 Nominal display range: 60.0 to 750.0 volts RMS
 Value range (steps): 0.0 to 1500.0 (0.1V)
- P016 Supply voltage display (field)**
 Nominal display range: 100.0 to 477.0 V
 Value range (steps): 0.0 to 477.0 V (0.1 V)
Note: P016 will not display voltages greater than approximately 477 volts.
- P017 Supply frequency display**
 Nominal display range: 40.00 to 65.00 Hz
 Value range (steps): 0.00 to 100.00 Hz (0.01 Hz)
- P018 Firing angle display (armature)**
 Nominal display range: 0.00 to 180.00 degrees
 Value range (steps): 0.00 to 180.00 degrees (0.01 degrees)
- P019 Armature current feedback display**
 Nominal display range: -100.0 to 100.0% of the motor armature current based on P100.
 Value range (steps): -400.0 to 400.0% (0.1%)
- P020 Armature current reference display**
 Nominal display range: -100.0 to 100.0% of the motor armature current based on P100.
 Value range (steps): -400.0 to 400.0% (0.1%)
- P021 Display of the torque reference after torque limiting**
 Nominal display range: -100.0 to 100.0% of the motor rated torque(rated torque = motor rated armature current(P100) x flux at rated motor field current(P102))
 Value range (steps): -400.0 to 400.0% (0.1%)
- P022 Display of the torque reference before torque limiting**
 Nominal display range: -100.0 to 100.0% of the motor rated torque(= motor rated armature current(P100) x flux at rated motor field current(P102))
 Value range (steps): -400.0 to 400.0% (0.1%)

- P023 Speed controller (reference-feedback) difference display**
Nominal display range: -100.00 to 100.00% of maximum speed
Value range (steps): -200.0 to 199.99% (0.01%)
- P024 Display of the pulse encoder speed feedback**
Nominal display range: -100.00 to 100.00% of maximum speed
Value range (steps): -200.0 to 199.99% (0.01%)
- P025 Display of the speed feedback**
Nominal display range: -100.00 to 100.00% of maximum speed
Value range (steps): -200.0 to 199.99% (0.01%)
- P026 Display of speed reference**
Nominal display range: -100.00 to 100.00% of maximum speed
Value range (steps): -200.0 to 199.99% (0.01%)
- P027 Display of the ramp generator output**
Nominal display range: -100.00 to 100.00% of maximum speed
Value range (steps): -200.0 to 199.99% (0.01%)
- P028 Display of the ramp generator input after limiting**
Nominal display range: -100.00 to 100.00% of maximum speed
Value range (steps): -200.0 to 199.99% (0.01%)
- P029 Display of the ramp generator input before limiting**
Nominal display range: -100.00 to 100.00% of maximum speed
Value range (steps): -200.0 to 199.99% (0.01%)
- P030 Display of the technology controller output**
Nominal display range: -100.00 to 100.00% of maximum speed
Value range (steps): -200.0 to 199.99% (0.01%)
- P032 Display of the technology controller feedback**
Nominal display range: -100.00 to 100.00% of maximum speed
Value range (steps): -200.0 to 199.99% (0.01%)
- P033 Display of the technology controller reference**
Nominal display range: -100.00 to 100.00% of maximum speed
Value range (steps): -200.0 to 199.99% (0.01%)
- P034 Firing angle display (field)**
Value range (steps): 0.00 to 180.00 degrees (0.01 degrees)
- P035 Display of the field current feedback**
Nominal display range: 0.0 to 100.0% of the rated motor field current (P102)
Value range (steps): 0.0 to 199.9% (0.1%)
- P036 Display of the field current reference**
Nominal display range: 0.0 to 100.0% of the rated motor field current (P102)
Value range (steps): 0.0 to 199.9% (0.1%)
- P037 Display of the EMF controller feedback**
Value range (steps): -1500.0 to 1500.0 V (0.1 V)
- P038 Display of the armature voltage**
Value range (steps): -1500.0 to 1500.0 V (0.1 V)

P039 Display of the EMF controller reference

This parameter indicates the EMF reference which is controlled in the field weakening range. This value is obtained from: $(V_{\text{motor rated}} - I_{\text{motor rated}} \times R_a)$ so that EMF reference = P101 - P100 x P110

Value range (steps): 0.0 to 1500.0 V (0.1 V)

P040 Display of limits

This parameter displays the status of the controller limit functions;

Built-in Display

□	□	0	□	1	2	□	3	4	□	5	6	□	7
□	□	□	□	□	□	□	□	□	□	□	□	□	□
□	□	8	□	9	10	□	11	12	□	13	14	□	15

Optional Display

		P	0	4	0			L	I	M	.	B	I	T	S
		1	1	1	1	1	1	0	1	1	1	1	1	1	1
		14	13	12	11	10	9	8	6	5	4	3	2	1	0

Optional Display (Two line mode)

B	1	1	1	1	1	1	1	0	1	1	1	1	1	1	1
		14	13	12	11	10	9	8	6	5	4	3	2	1	0

If one or more of the segments is lit or if a bit is = "1", then the indicated limit has been reached.

Segment or Bit	Function
0	Positive ramp generator reference reached
1	Positive speed controller reference reached
2	Positive torque limit reached
3	Positive armature current limit reached
4	Armature gate angle advance limit reached
5	Positive field current limit reached
6	Field gate angle advance limit reached
7	not used
8	Negative ramp generator reference reached
9	Negative speed controller reference reached
10	Negative torque limit reached
11	Negative armature current limit reached
12	Armature gate angle retard limit reached
13	Negative field current limit reached
14	Field gate angle retard limit reached

- P041 Display of the connector selected at parameter P861.01 (diagnostic trace)**
Nominal display range: -100.0 to 100.0%
Value range (steps): -199.9 to 199.9% (0.1%)
- P042 Display of the connector selected at parameter P861.02 (diagnostic trace)**
Nominal display range: -100.0 to 100.0%
Value range (steps): -199.9 to 199.9% (0.1%)
- P043 Assignable display parameter 1**
Displays the value of the connector selected at parameter P044
Nominal display range: -100.0 to 100.0%
Value range (steps): -199.9 to 199.9% (0.1%)
- P044 Selects the connector to be displayed for assignable display parameter P043**
This is the connector number whose value will be displayed at P043. This value is not stored in permanent memory and will be lost when power is turned off.
Factory setting: 0 Value range: 0 to 399
Access: 10 Change: on-line
- P045 Assignable display parameter 2**
Displays the value of the connector selected at parameter P046
Nominal display range: -100.0 to 100.0%
Value range (steps): -199.9 to 199.9% (0.1%)
- P046 Selects the connector to be displayed for assignable display parameter P045**
This is the connector number whose value will be displayed at P045. This value is not stored in permanent memory and will be lost when power is turned off.
Factory setting: 0 Value range: 0 to 399
Access: 10 Change: on-line
- P047.ii Fault diagnostic memory**
Nominal display range: Hexadecimal number 0000 to FFFF
P047.00 word 0
P047.01 word 1
to
P047.15 word 15
- P048 Operating hours display**
Time that the drive was in operating status's I, II, or --
All times > 0.1 seconds are added to the accumulated time
Factory setting: 0 Value range (steps): 0 to 65535 hours (1 hour)
- P049 Display of warning messages W00 to W14**
Refer to section 8.3
- P050 Display of warning messages W16 to W30**
Refer to section 8.3

Key Parameter and Parameter Output

P051 Key parameter

Used to gain access to parameter change and to initiate various actions.

0 No access authorization

10 Access authorization to parameter values for operating personnel

11 Print out parameters changed from the default value (see sections 10.7, 10.7.1)

12 Print out the complete parameter list (see sections 10.7, 10.7.1)

13 Print out the fault diagnostic after a fault has occurred (see sections 10.7, 10.7.1)

14 Print out the trace buffer (refer to parameters P861 to P867) (see sections 10.7, 10.7.1)

15 Parameter output for changed parameters to a PC (see sections 10.7, 10.7.2)

16 Complete parameter output to a PC (see sections 10.7, 10.7.2)

17 Fault diagnostic to a PC after a fault (see sections 10.7, 10.7.2)

18 Output of the trace buffer to a PC (see parameters P861 to P867 and section 10.7.2)

19 Trace buffer analog output (see sections 10.11)

20 Access authorization to parameter values for technical personnel

21 Reset all parameters to the factory default value

22 Perform internal analog offset adjustments (**must be performed if PIB is changed**)

23 Read in a parameter set from a PC

24 Select "Step Function" reference

25 Perform self-tuning for the armature and field current controllers

26 Perform self-tuning for the speed controller

27 Perform self-tuning for field weakening applications

28 Perform self-tuning for friction and acceleration compensation of the speed controller

30 Access for service personnel

40 Access for authorized service personnel

Factory setting: 0 Value range: 0 to 40

Access: always Change: on-line

Note 1: For functions that are executed from the serial interface such as P51 = 11, the control parameters for the serial interface must be set correctly. Refer to parameters P780 for RS485 and P790 for RS232.

Note 2: P051 can not be changed from the serial ports.

P052 Select the parameters to be displayed on the operator panel

0 Only parameters whose values deviate from the factory settings are displayed.

Note: In this mode, longer response times of up to 2 seconds can occur when depressing the raise or lower keys due to the search time to get from one parameter to a distant parameter.

1 Only parameters needed for simple applications are displayed

2 Additional parameters are displayed for medium complex applications

3 All parameters are displayed

Factory setting: 3 Value range: 0 to 3

Access: 10 Change: on-line

P053 Control word for the parameter memory

- x0 Only store parameter P053 in EEPROM
- x1 Store all parameters in EEPROM
- 0x Do not store process data
- 1x Store all process data that is non-volatile
- 2x Store only the contents of the fault memory (only for \geq version 2.2)

Note: If the non-volatile process data is not stored (P053 = 0x), then the following data is lost when the drive controller is switched off:

- Last operating status
- Reserved process data
- Operating time
- EEPROM check sum
- Thyristor temperature rise
- Contents of the fault memory
- Reserved process data
- Number of write accesses to the EEPROM
- Motor temperature rise

A hardware write protect feature is also available using microprocessor board jumper XJ1.

Factory setting: 11 Value range: 00 to 21

Access: 20 Change: on-line

P054 Select the parameter set to be displayed and changed

- 1 Standard parameter set 1
- 2 - 4 Alternate parameter sets 2 to 4

There are 4 parameter sets for parameters P100 to P599. Parameter sets 2 to 4 are identified in the display by a "number" in front of the "P" (e.g., **3P102** for parameter P102 in the 3rd parameter set).

Only the parameters in the set selected with P054 can be changed. P054 does not select the active parameter set but rather the parameter set to be displayed and allowed to be changed. BIF's 33, 34, and 35 select the active parameter set.

Factory setting: 1 Value range: 1 to 4

Access: 10 Change: on-line

P055 Page copy parameter

This parameter allows the 4 parameter sets for parameters P100 to P599 to be copied one to another or exchanged between one another. The copy or exchange takes place after the parameter sets have been selected, and the drive off line or stopped, and the parameter mode key is pressed. P055 is not stored in the EEPROM and is initially set to 012. After a copy or exchange the control power must remain on for at least 3 minutes to assure that the parameter values are stored in EEPROM.

0xy Copy or exchange is not allowed. P055 is automatically returned to this value after the copy or exchange is completed.

1xy Parameter set "x" (1, 2, 3, or 4) is copied to parameter set "y" (1, 2, 3, or 4). Parameter set y is overwritten with parameter set x.

2xy Parameter sets x and y are exchanged.

Factory setting: 012 Value range: 011 to 244 (1)

Access: 20 Change: off-line

P056 Active parameter set selection display

This is a display parameter that shows the active parameter set being used. The active parameter set is selected with BIF 33, 34, or 35 using terminal inputs or serial link commands.

SIMOREG Converter Definition

P060 Software version number

Access: can only be read

P064 Optional operator control panel: Operating display, 1st line

Parameter number which should be displayed in the first line of the operating display.

Factory setting: 0 Value range: 0 to 48

Access: 10 Change: on-line

P065 Optional operator control panel: Operating display, 2nd line

0 The parameter set at P064 is displayed in two lines.

1 to 48 Parameter number which is to be displayed in the second line of the operating display.

Factory setting: 0 Value range: 0 to 48

Access: 10 Change: on-line

P066 Start with the "I" key on the optional operator panel

0 "I" key is not used

1 "I" key is used to start the drive but doesn't provide regulator enable

2 "I" key starts the drive and also provides drive enable

Factory setting: 0 Value range: 0 to 2

Access: 20 Change: off-line

P067 Stop with the "O" key on the optional operator panel

1 "O" key is used to provide a normal stop command

2 "O" key is used to provide a coast stop command

3 "O" key is used to provide a quick stop command

The stop key is always functional using the selected stop method.

Factory setting: 1 Value range: 1 to 3

Access: 20 Change: off-line

SIMOREG Power Section Definition

P070 Power Interface board type

Defines the voltage rating of the power interface board. All standard SE&A chassis designs through 850 A use the 230 to 500 volt design. Hi-Power tripler designs will use either the 230 to 500 volt setting or the 750 volt setting depending on the voltage used in the application.

1 PIB modified for operation with very low voltage (Special applications only)

2 PIB for 230 V to 500 V converters (range 85 to 500 volts including triplers connected for 500 volts)

3 PIB for 750 VDC converters (tripler designs with attenuator board connected for 750 volts)

Factory setting: When initializing a sub-menu appears where this value has to be manually set.

Value range: 1 to 3

Access: 20 Change: off-line

P071 Rated armature converter AC supply voltage

The armature supply voltage must be specified with P071 for the nominal voltage that the power section is to be operated at. This is used to set the threshold level for under voltage, over voltage, and phase loss monitoring (P351, P352, P353).

Factory setting: When initializing a sub-menu appears where this value needs to be manually set.

Value range (steps): 10 to 1000 V (1 V)

Access: 20 Change: off-line

P072 Rated converter armature current

This is the rated DC output current of the power converter for the armature circuit. This value is located on the drive controller nameplate.

Factory setting: When initializing a sub-menu appears where this value has to be manually set.

Value range (steps): 1.0 to 6553.0 A (0.1 A)

Access: 20 Change: off-line

P073 Rated converter field current

This is the rated DC output current of the field power converter at power terminals 80 and 81. This value is located on the drive controller nameplate.

Factory setting: When initializing a sub-menu appears where this value has to be manually set.

Value range (steps): 1.00 to 100.00 A (0.01 A)

Access: 20 Change: off-line

P074 Control word for the power section

xx1 1-quadrant converters

xx2 4-quadrant converters

x0x No parallel sitor assemblies

x1x to x5x Number of parallel sitor assemblies (European design only)

0xx Short gate pulses for armature converters (pulse train 0.89 ms)

1xx Long gate pulses for high inductive loads

Factory setting: When initializing a sub-menu appears where this value is manually set.

Value range (steps): 001 to 152 (1 Hex)

Access: 20 Change: off-line

P075 Control word for the power section I²t monitoring (European units only)

Note: For SE&A converters the setting of P075 has no significance since P076 = 2 acts like P075 = x1 and P076 = 3 results in limiting to P077 * 1.8 * P072.

x0 The I²t monitoring for the power section is disabled and the armature current is limited to the rated converter current * P077.

x1 The I²t monitoring for the power section is disabled and the maximum armature current is limited to 150% of rated drive controller current * P077.

x2 The I²t monitoring for the power section is active and the maximum armature current is limited to 150% of rated drive controller current * P077.

02 When the I²t monitoring for the power section responds, warning W10 is issued and the limit for the armature current is automatically lowered to the rated converter current until the calculated equivalent junction temperature drops below the specific converter response threshold.

12 Fault F039 is issued and the converter is shutdown when the I²t monitoring for the power section responds.

Factory setting: 00 Value range (steps): 00 to 12 (1 Hex)

Access: 20 Change: on-line

P076 Select EU/US power section

1 European converter

2 US converter max overload = 150% of P072

3 US converter max overload = 180% of P072 (used only for 2600 and 3600 amp 4Q converters)

Factory setting: When initializing a sub-menu appears where this value has to be manually set. When P076 = 2 or 3, then the I²t monitoring of the power converter is disabled even if P075 = x2.

Value range (steps): 1 to 3 (1 Hex)

Access: 20 Change: off-line

P077 Thermal reduction factor

This parameter is used to adjust the overload factor of the armature converter depending on the selection at P075. The maximum current limit will be $P077 * P072$ or $1.5 * P077 * P072$.

Factory setting: 1.00 Value range (steps): 0.50 to 1.00 (0.01)

Access: 20 Change: off-line

P078 Rated field converter AC supply voltage

The field AC supply voltage must be specified with P078 for the nominal voltage that the power section is to be operated at.

For 460 or 480 volt field operation set P078 = 415. For 230 volt field operation set P078 = 230.

Factory setting: 400 V

Value range (steps): 85 to 415 V (1 V)

Access: 20 Change: off-line

Converter Control Settings

P080 Control word for the brake logic

1 Holding (brake closes at zero speed to hold the load still)

2 Safety or Stopping (brake closes when stop command is issued regardless of the speed using BOF 14)

Factory setting: 1 Value range (steps): 1 to 2 (1 Hex)

Access: 20 Change: off-line

P082 Field mode

xx0 Internal field and field regulators are not used (e.g. for permanently-excited motors)

xx1 The field AC supply voltage is switched on and off with the line contactor (field pulses are enabled with terminal 37).

xx2 Field economizing, set using P257, is enabled after a time delay, set using P258, after status o7 or higher has been reached.

xx3 Field economizing is disabled. The field is always set to full field when the speed is below the field cross over speed. Depending on the motor this could cause excessive field heating at zero speed.

x0x No speed dependent field weakening.

x1x Field current reference is set from the EMF controller (field weakening above base speed requires the motor EMF be held constant and that field self tuning using P051 = 27 be performed).

0xx Fault message F043 is active (EMF for braking is too high). If the calculated gating angle required for a reversal in torque is $>165^\circ$ then both torque directions are inhibited and if the armature current reference in the new torque direction is $> 0.5\%$ of the rated converter current (P072) then a fault F043 is be issued.

1xx Warning W12 and automatic field reduction if the EMF is too high for braking is active. Warning W12 is issued if the calculated gate angle at connector K101 is $> (P151 - 5^\circ)$ for continuous current or $> (160^\circ)$ for discontinuous current operation. The field is automatically reduced to control the gate angle using a proportional controller whose output reduces the EMF reference to the motor EMF controller. Field weakening operation must be selected with P082 = 11x for this feature to be active. If a torque direction change is requested and the EMF is too high the field will automatically be reduced and both torque directions will be inhibited until the calculated gate angle is less than the limits noted above.

Factory setting: 002 Value range (steps): 000 to 113 (1 Hex)

Access: 20 Change: off-line

P083 Selecting the speed feedback source

- 0 Speed feedback is still not selected
 - 1 Speed feedback comes from analog input (terminals 60 to 64)
 - 2 Speed feedback comes from pulse encoder (terminals 26 to 33)
 - 3 Speed feedback is calculated motor EMF based on measured motor armature voltage and is scaled with P115 (P115 is based on rated supply voltage).
 - 4 Speed feedback sourced from selector P609
- Factory setting: 0 Value range: 0 to 4
Access: 20 Change: off-line

P084 Speed controller enable

- 1 Speed controller enabled
 - 2 Speed controller disabled, speed reference becomes current/torque reference
- Factory setting: 1 Value range: 1 to 2
Access: 20 Change: off-line

P085 Delay time after removing the "JOG" (inching) command

After a jog command has been removed the drive remains in operating status o1.3 with the "M" contactor remaining closed and with the controllers inhibited for a time which can be set using this parameter. If a jog command is input again within this time, the drive goes into the next operating status (o1.2 or less). However, if the time expires without a new jog command having been entered, the "M" contactor drops out and the drive goes into operating status o7.

Factory setting: 10.0 s Value range (steps): 0.0 to 60.0 s (0.1 s)
Access: 10 Change: on-line

P086 Voltage failure time for supply line faults F001 to F009

If the voltage fails at one of the terminals L1, L2, L3, 87, 89, 83, or 84 (F001, F003, F004, F005), or if the voltage is too low (F006) or too high (F007), or if the frequency is too low (F008) or too high (F009) or if the field current is less than 50% of the field current reference for more than 0.5 seconds (F005), then the fault is released if the condition is not corrected within the time set with P086.

During the fault condition but within the P086 time, the gating pulses and controllers are inhibited and the drive waits in status o4, o5 or o13 depending on which voltage has failed.

If the fault is cleared before the P086 time has elapsed, the drive will be automatically re-started.

The "automatic restart" function is disabled if the time is set to 0.0 sec..

Factory setting: 0.4 s Value range (steps): 0.0 to 2.0 s (0.1 s)
Access: 10 Change: on-line

P087 Brake release time

When entering the commands "run", "jog", "thread" or "enable", a time delay is set with this parameter before the internal controller enable signal becomes effective and enables the thyristor firing pulses. During this time the drive remains in operating status o1.0 in order to allow a holding brake to open. This can also be used to allow time for slow operating DC contactors to close before the controllers are enabled.

For 510 and 850 amp base drives set this time to 0.5 seconds to allow for the DC contactor to close.

If negative times are entered, then the drive will be enabled immediately and the brake will be released after the time delay. This allows for torque proving before the brake is released for overhauling loads.

Factory setting: 0.00 s Value range (steps): -10.00 to +10.00 s (0.01 s)
Access: 10 Change: on-line

P088 Brake closing time

When the commands "run", "jog" or "thread" are withdrawn or when the "fast stop" command is entered and after $n < n_{min}$ (P370) has been reached, the drive will still generate a torque command for a short time set with this parameter to allow a holding brake to close. After the time delay, the internal controller enable is disabled and the thyristor firing pulses are inhibited.

Factory setting: 0.00 s Value range (steps): 0.00 to 10.00 s (0.01 s)

Access: 20 Change: on-line

P089 Time delay while waiting for voltage at the power section

This is the total time that the drive can remain in operating status's o4 and o5 waiting for line voltage after any start command. If voltage isn't sensed at the power section within the time set using this parameter, then the appropriate fault signal is activated. See parameter P353.

Factory setting: 2.0 s Value range (steps): 0.0 to 60.0 s (0.1 s)

Access: 30 Change: on-line

P090 Supply voltage stabilizing time

The supply voltage amplitude, frequency and phase symmetry are checked to be in the permissible tolerances for a time longer than programmed with this parameter after any start command is issued while in operating status's o4 and o5. This parameter is for both the armature and field power supplies.

Note: A smaller value must be set in P090 than in P089 and in P086 (except if P086=0.0).

Factory setting: 0.02 s Value range (steps): 0.01 to 1.00 s (0.01 s)

Access: 30 Change: on-line

P091 Main reference threshold to allow starting (P000 status o6)

The reference at the input to the ramp must be less than P091 to allow the drive to start. If the drive tries to start when the reference is higher than P091, then the drive will wait in operating status o6 until the reference at the ramp input is less than P091.

Factory setting: 199.9% Value range (steps): 0.0 to 199.9% (0.1 %)

Access: 20 Change: on-line

P092 Time delay for field decay at field reversal

This is the time delay that occurs before the field reversing contactors are switched. When a field reversal is started and after the field current is less than minimum field current (P394) the delay time set with P092 is started. When the time has expired the contactors will be switched.

Factory setting: 3.0 s Value range (steps): 0.0 to 3.0 s (0.1 s)

Access: 20 Change: off-line

P093 Time delay for drive starting while waiting for auxiliary equipment to start

This is the time that the drive waits after the start command is issued before it actually starts. The delay allows auxiliary equipment such as fans or pumps to be started first using **BOF 7**.

Factory setting: 0.0 s Value range (steps): 0.0 to 120.0 s (0.1 s)

Access: 20 Change: on-line

P094 Time delay before auxiliary equipment is stopped after the drive is stopped

This is the time that auxiliary equipment such as fans or pumps continue to run after the drive has been stopped when **BOF 7** is used.

Factory setting: 0.0 s Value range (steps): 0.0 to 120.0 s (0.1 s)

Access: 20 Change: on-line

P095 Time delay in status o3.2 before controllers are enabled (version 2.3)

Time that must pass before regulators are enabled (operating status o3.2) to allow a DC contactor to close.

Factory setting: 0.00 s Value range (steps): 0.00 to 1.00 s (0.01 s)

Access: 20 Change: on-line

Adjustable Fixed Reference Parameters

P096 Digital fixed value

This digital fixed value can be addressed as connector K096 and is used for making adjustments.

Factory setting: 0.00% Value range (steps): -200.0 to 199.99% (0.01%)

Access: 20 Change: on-line

P097 Digital fixed value

This digital fixed value can be addressed as connector K097 and is used for making adjustments.

Factory setting: 0.00% Value range (steps): -200.0 to 199.99% (0.01%)

Access: 20 Change: on-line

P098 Digital fixed value

This digital fixed value can be addressed as connector K098 and is used for making adjustments.

Factory setting: 0.00% Value range (steps): -200.0 to 199.99% (0.01%)

Access: 20 Change: on-line

P099 Digital fixed value

This digital fixed value can be addressed as connector K099 and is used for making adjustments.

Factory setting: 0.00% Value range (steps): -200.0 to 199.99% (0.01%)

Access: 20 Change: on-line

Motor Definition

P100 Rated motor armature current (according to the motor nameplate)

Factory setting: 0.0 A Value range (steps): 0.0 to 6553.0 A (0.1 A)

Access: 20 Change: off-line

P101 Rated motor armature voltage (according to the motor nameplate)

Factory setting: Dependent on P071:

If P071 = 230 V then P101 = 240 V

If P071 = 460 V then P101 = 500 V

Otherwise P101 = 400 V

Value range (steps): 10 to 1000 V (1 V)

Access: 20 Change: off-line

P102 Rated motor field current (according to the motor nameplate)

Factory setting: 0.00 A Value setting (steps): 0.00 to 100.00 A (0.01 A)

Access: 20 Change: on-line

P103 Minimum motor field current

To operate the self tune run with P051 = 27 the minimum field current must be set less than 50% of P102.

Factory setting: 0.00 A Value range (steps): 0.00 to 100.00 A (0.01 A)

Access: 20 Change: off-line

P104 Tapered current limit speed point 1 (n1)

Factory setting: 5000 RPM Value range (steps): 1 to 10000 RPM (1 RPM)

Access: 20 Change: off-line

- P105 Tapered current limit I1 at speed point 1** (see section 10.12)
Current limit @ speed point 1
Factory setting: 0.1 A Value range (steps): 0.1 to 6553.0 A (0.1 A)
Access: 20 Change: off-line
- P106 Tapered current limit speed point 2 (n2)** (see section 10.12)
Factory setting: 5000 RPM Value range (steps): 1 to 10000 RPM (1 RPM)
Access: 20 Change: off-line
- P107 Tapered current limit I2 at speed point 2** (see section 10.12)
Current limit @ speed point 2
Factory setting: 0.1 A Value range (steps): 0.1 to 6553.0 A (0.1 A)
Access: 20 Change: off-line
- P108 Maximum speed for tapered current limit function (n3)** (see section 10.12)
When using tapered current limit the maximum speed must be set at this parameter. This will be used to scale the taper current limit speed values. Set P108 depending on the selection of speed feedback at P083 as follows.
P083 = 1: RPM corresponding to the tach voltage at P706
P083 = 2: RPM equal to P143 + P452
P083 = 3: RPM corresponding to the maximum voltage set with P115
Factory setting: 5000 RPM Value range (steps): 1 to 10000 RPM (1 RPM)
Access: 20 Change: off-line
- P109 Enable tapered current limit** (see section 10.12)
0 Tapered current limit not active
1 Tapered current limit enabled
Factory setting: 0 Value range: 0 to 1
Access: 20 Change: off-line
- P110 Motor armature resistance**
This parameter is automatically set during the self-tuning run for the armature and field current controllers (P051 = 25).
Factory setting: 0.000 Value range (steps): 0.000 to 32.767 (0.001)
Access: 30 Change: off-line
- P111 Motor armature inductance**
This parameter is automatically set during the self-tuning run for the armature and field current controllers (P051 = 25).
Factory setting: 0.00 mH Value range (steps): 0.00 to 327.67 mH(0.01 mH)
Access: 30 Change: off-line
- P112 Motor field resistance**
This parameter is automatically set during the self-tuning run for the armature and field current controllers (P051 = 25).
Factory setting: 0.0 Value range (steps): 0.0 to 3276.7 (0.1)
Access: 30 Change: off-line
- P114 Thermal time constant (motor)**
0.0 Disables I²t motor protection. Refer to section 10.9 for more information.
Factory setting: 10.0 min Value range (steps): 0.1 to 80.0 min (0.1 min)
Access: 20 Change: on-line

P115 Maximum speed for operation without tachometer

For operation using the internal motor EMF voltage feedback.

Maximum speed is adjusted using this parameter when the internal EMF is used as the speed feedback.

EMF (max.) = P071 x P115

Factory setting: 100.00% Value range (steps): 1.00 to 140.00% (0.01%)

Access: 20 Change: on-line

P117 Control word for the field characteristics

0 Valid field characteristic measurement not complete

1 Valid field characteristic measurement complete (P118 to P139)

This parameter is automatically set during the self-tuning for the field weakening control (P051 = 27)

Factory setting: 0 Value range: 0 to 1

Access: for authorized service Change: off-line

P118 Rated motor EMF

This parameter is automatically set during the self-tuning for the field weakening control (P051 = 27). This parameter is the EMF controller reference and is defined by P101 - (P100 x P110).

Note:

When the maximum speed is changed it is not mandatory that the field weakening control self-tuning be repeated. However, P118 no longer represents the EMF controller reference in the field weakening range.

Factory setting: 340 V Value range (steps): 0 to 1000 V (1 V)

Access: for authorized service Change: off-line

P119 Rated motor speed (% of the maximum speed)

This is the base speed of the motor and is the speed at which field weakening begins (P118 = actual motor EMF). This parameter is automatically set during the self-tuning for the field weakening control (P051 = 27).

Note:

When the maximum speed is changed it is not mandatory that the field weakening control self-tuning be repeated. However, P119 no longer represents the speed at which field weakening begins.

Factory setting: 100.0% Value range (steps): 0.0 to 200.0% (0.1%)

Access: for authorized service Change: off-line

P120 Field current at 0% motor flux (as a % of P102)

Factory setting: 0.0% Value range: 0.0%

Access: can only be read

P121 Field current for 5% motor flux (field characteristic point No. 1) (as a % of P102)**P122 to P138 (field current value for each 5% flux step)****P139 Field current for 95% motor flux (field characteristic point No. 19) (as a % of P102)**

These parameters are automatically set during the self-tuning for the field weakening control (P051 = 27) and provide the motor flux based on the actual value of motor field current. If rated motor field current P102 is changed then the self tuning must be run again.

Factory Settings in % of rated field current are:

P120 = 0.0% P121 = 3.7% P122 = 7.3% P123 = 11.0% P124 = 14.7% P125 = 18.4%

P126 = 22.0% P127 = 25.7% P128 = 29.4% P129 = 33.1% P130 = 36.8% P131 = 40.6%

P132 = 44.6% P133 = 48.9% P134 = 53.6% P135 = 58.9% P136 = 64.9% P137 = 71.8%

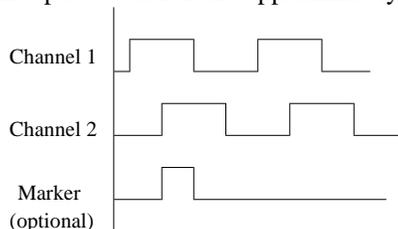
P138 = 79.8% P139 = 89.1%

Value range (steps): 0.0 to 100.0% of motor rated field current (P102) (0.1%)

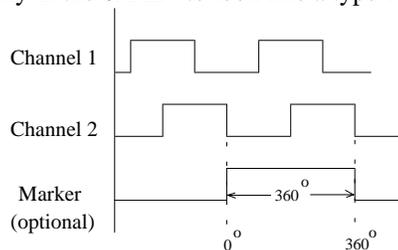
Access: 40 Change: off-line

P140 Pulse Encoder Type

- 0 Pulse encoder not used
- 1 Pulse encoder with 2 channels shifted 90° (quadrature encoder) with or without a marker pulse. Marker pulse is once per revolution and approximately 90° wide.



- 2 Pulse encoder with 2 channels shifted 90° (quadrature encoder) with or without a marker pulse. Marker pulse is once per revolution and 220 to 360 electrical degrees wide. The marker pulse is converted internally in the 6RA24 to look like a type 1 marker pulse.



- 3 Special 2 channel encoder with direction. Channel 1 is active for the forward direction and channel 2 is active for the reverse direction.
- 4 Special 2 channel encoder with direction. Channel 1 is active for both the forward and reverse directions and channel 2 is high for the forward direction and low for the reverse direction.

P141 Pulse encoder pulses per revolution

Note: For best results an encoder with at least 1024 PPR should be selected.

The lowest measurable speed is calculated as:

$$\text{min speed} = 14648 * \frac{V}{X * P141} \text{ (RPM)}$$

Where:

X = 1 for P142 = xx0, **X = 2** for P142 = xx1, **X = 4** for P142 = xx2.

V = 1 if P142 = 0xx

V = 1, 0.5, or 0.25 if P142 = 1x0 (V is automatically changed as the speed is reduced).

Speeds less than the minimum are evaluated as zero.

The highest measurable speed is calculated as:

$$\text{max speed} = \frac{18,000,000}{P141} \text{ (RPM)}$$

The pulse frequency from the encoder must not exceed 300 kHz.

The encoder pulses per revolution (PPR) must be within the following range:

$$\frac{14648 * V}{X * \text{min RPM}} < \text{PPR} < \frac{18,000,000}{\text{max RPM}}$$

Factory setting: 500 PPR

Value range (steps): 1 to 32767 PPR (1 PPR)

Access: 20

Change: off-line

P142 Control word for the pulse encoder

Pulse encoder measurement method selection. **For best results using general purpose pulse encoders, times 1 resolution should be selected. For best low speed operation automatic changeover to count frequency should be turned on.** For these functions set **P142 = 0010**.

xxx0 Pulse encoder with times 1 resolution

xxx1 Pulse encoder with times 2 resolution (for pulse encoder types 1, 1a, and 2)

xxx2 Pulse encoder with times 4 resolution (for pulse encoder types 1 and 1a)

xx0x Automatic changeover to count frequency OFF

xx1x Automatic changeover to count frequency ON (see P141)

x0xx Automatic changeover, multiple pulse encoder signal evaluation OFF

x1xx Automatic changeover to multiple pulse encoder signal evaluation ON. If P142 = 1x0, then as the speed reduces to low speeds, the pulse evaluation method will automatically switch from times 1 to times 2 to times 4.

0xxx Nominal encoder sample time = 1 ms (most dynamic setting; factory default) Ver 2.2

1xxx Nominal encoder sample time = 2 ms (steadier speed actual value than setting "0") Ver 2.2

2xxx Nominal encoder sample time = 4 ms (best for high inertia loads, also P200 = 5ms min) Ver 2.2

Factory setting: 0002 Value range (steps): 0000 to 2112 (1 Hex)

Access: 20 Change: off-line

P143 Maximum speed for operation with pulse encoder

This is the coarse setting for maximum speed when a pulse encoder is used. The fine adjustment is made using parameter P452. The effective maximum speed is then equal to the value of P143 + P452.

Factory setting: 500 RPM Value range (steps): 1 to 10000 RPM (1 RPM)

Access: 20 Change: on-line

P144 Control word for position sensing

xx0 Positioning counter reset OFF

xx1 Positioning counter reset using zero mark

xx2 Positioning counter reset using zero mark if signal at terminal 39 is LOW

xx3 Positioning counter reset when terminal 39 is LOW

x0x Hysteresis for direction of rotation reversal OFF

x1x Hysteresis for direction of rotation reversal ON

After a direction change, the first pulse encoder input pulse is not counted.

0xx Pulse encoder monitoring OFF (F048 is not initiated due to a defective pulse encoder)

1xx Pulse encoder monitoring ON (F048 faults can be initiated due to a defective encoder or noise)

Factory setting: 111 Value range (steps): 000 to 113 (1 Hex)

Access: 20 Change: off-line

The individual pulses from one track of the encoder are counted in a ± 23 bit counter. The contents of the counter are available at connectors K013 and K014. Connector K014 shows the lower 16 bits of the counter and K013 shows the upper 8 bits. In the forward speed direction the value at K014 will count up from 0 to 65,535 pulse counts and then reset to zero as the next pulse is counted. When K014 is reset to zero the value at K013 will be incremented by 1 count. The value at K013 is represented as a word of data by extending the sign of the lower byte into the upper byte and has a range of ± 127 . Since the scaling of 6RA24 display parameters is based on signed integers (± 15 bits), use of the available position information at the display parameters requires interpretation of the data. When evaluating the data by serial link, the values should be interpreted as a 32 bit integer value in 2's complement form. K014 should be loaded into the lower 16 bits and K013 should be loaded into the high 16 bits. The value of this 32 bit integer can vary from $\pm 8,388,608$ pulse counts. When the drive speed is reversed the counting direction is also reversed.

Motor Interface Option P145 to P148

P145 Brush length sensing

- xxx0 No brush length sensing
- xxx1 Binary brush length sensing (terminal XM-211).
Alarm at 0 signal (W02)
- xxx2 Binary brush length sensing (terminal XM-211).
Fault at 0 signal (F115)
- xxx3 Analog brush length sensing (terminal XM-202)
Alarm at brush length ≤ 14 mm (W02)
Fault at brush length ≤ 12 mm (F115)

Bearing condition

- xx0x No bearing condition sensing (terminal XM-212 is not interrogated)
- xx1x Bearing status sensing (terminal XM-213 is interrogated)
Alarm at HIGH signal (W03)
- xx2x Air flow monitoring (terminal XM-213 is interrogated)
Fault at HIGH signal (F116)

Air flow monitor

- x0xx No air flow monitoring
- x1xx Air flow monitoring (terminal XM-213 is interrogated)
Alarm at 0 signal (W04)
- x2xx Air flow monitoring (terminal XM-213 is interrogated)
Fault at 0 signal (F117)

Thermo switch

- 0xxx Thermo switch not connected (terminal XM-214 is not interrogated)
 - 1xxx Thermo switch connected (terminal XM-214 is interrogated)
Alarm at 0 signal (W05)
 - 2xxx Thermo switch connected (terminal XM-214 is interrogated)
Fault at 0 signal (F118)
- Factory setting: 0000 Value range (steps): 0000 to 2223 (1 Hex)
Access: 20 Change: off-line

**P146 Select the temperature sensor for the "motor interface" option
(at terminals X12-204 and X12-205)**

	Temperature sensor	Plug-in XJ101 jumper in position: (on motor interface bd)	Action when the nominal response temperature is exceeded
0	None	any	Terminal is not interrogated
1	KTY84 ²⁾	1 - 2	Alarm W06 at temperature >P147 Fault F119 at temperature >P148
2	PT100	2 - 3	Alarm W06 at temperature >P147 Fault F119 at temperature >P148
3	PTC thermistor ¹⁾ with R = 600Ω	1 - 2	Alarm W06
4	PTC thermistor ¹⁾ with R = 600Ω	1 - 2	Fault F119
5	PTC thermistor ¹⁾ with R = 1200Ω	1 - 2	Alarm W06
6	PTC thermistor ¹⁾ with R = 1200Ω	1 - 2	Fault F119
7	PTC thermistor ¹⁾ with R = 1330Ω	1 - 2	Alarm W06
8	PTC thermistor ¹⁾ with R = 1330Ω	1 - 2	Fault F119
9	PTC thermistor ¹⁾ with R = 2660Ω	1 - 2	Alarm W06
10	PTC thermistor ¹⁾ with R = 2660Ω	1 - 2	Fault F119

1) PTC thermistor where R = resistance at nominal response temperature

2) KTY84 is a positive temperature coefficient silicon temperature sensor with a nominal resistance of 1000 ohms at 100°C.

Factory setting: 0
Access: 20

Value range: 0 to 10
Change: off-line

P147 Alarm temperature

Only effective if the analog motor temperature is selected (P146 in setting 1 or 2).

Factory setting (steps): 0°C Value range (steps): 0 to 200°C(1°C)

Access: 20 Change: on-line

P148 Shutdown temperature

Only effective if the analog motor temperature measuring is selected (P146 in setting 1 or 2).

Factory setting: 0C Value range (steps): 0 to 200°C(1°C)

Access: 20 Change: on-line

Note: A setting of zero turns the monitor function off

Closed Loop Control Settings: Armature Current Control

P150 Gating angle minimum limit (armature)

Factory setting: 5° for 1Q converters; 30° for 4Q converters

Value range (steps): 0 to 165 degrees (1 degree)

Access: 30 Change: on-line

P151 Gating angle maximum limit (armature)

Factory setting: 150 degrees

Value range (steps): 120 to 165 degrees (1 degree)

Access: 30 Change: off-line

P152 Filtering of the supply frequency tracking (armature)

Value = 0 no filtering; values 1 to 9 use the average zero crossing time from the previous 1 to 9 cycles.

Even values from 10 to 200 ms provide line filtering for weak power systems. Usually the filter time must be reduced in order to achieve faster frequency tracking for the gating system on weak systems. **For weak systems only set P152 to even numbered values.**

Odd values from 11 to 199 ms provide special additional line filtering for stiff systems. This can allow operation through short power interruptions that might occur when the AC power is supplied through slip ring collectors or if commutation notches are present

Factory setting: 200 ms Value range (steps): 0 to 200 mS (1 mS)

Access: 40 Change: on-line

P153 Control word for armature current feed forward controller

xx0 Armature current feed forward controller inhibited (output = 180)

xx1 Armature current feed forward controller active

xx2 Armature current controller feed forward is calculated with EMF = 0.

This setting should be selected when the load is a high inductance field.

Method of EMF Calculation for Current Feed Forward Control Version 2.3

x0x The EMF at K122 is used for the feed forward control. $EMF = (U_a - I_a * R_a - L_a * di_a/dt)$ filtered according to P153.left digit with $U_a = \text{measured}$ armature voltage

x1x The EMF at K122 is used for the feed forward control. $EMF = (U_a - I_a * R_a - L_a * di_a/dt)$ filtered according to P153.left digit with $U_a = \text{calculated}$ armature voltage.

The EMF at K122 is only used for the feed forward controller. The measured vale at K287 is used for voltage feedback. In some cases the calculated value at K122 can provide smoother armature current control by reducing low frequency oscillations.

P153 continued:

P153 continued:

EMF Filtering at K122 Version 2.3

0xx First order filter with a time constant of 8.3 ms @ 60 Hz

1xx No Filter

2xx Use EMF average of last two samples instead of filtered value

3xx Use EMF average of last three samples instead of filtered value

Factory setting: 001 Value range: 000 to 312

Access: 20 Change: off-line

P154 Control word, armature current controller

x0 Set controller integral part to 0 (i.e., pure proportional controller)

x1 Controller integral part is active

0x Set controller proportional part to zero (i.e., pure integral control)

1x Controller proportional part is active

Factory setting: 11 Value range (steps)S 00 to 11 (1 Hex)

Access: 20 Change: off-line

P155 Armature current control proportional gain

The parameter is automatically set during the self-tuning run for the feed forward and current controller for armature and field (P051 = 25).

Factory setting: 0.10 Value range (steps): 0.01 to 200.00 (0.01)

Access: 20 Change: on-line

P156 Armature current controller integral-action time

The parameter is automatically set during the self-tuning run for the feed forward and current controller for armature and field (P051 = 25).

Factory setting: 0.200s Value range (steps): 0.001s to 10.000 s (0.001s)

Access: 20 Change: on-line

P157 Control word for the armature current reference integrator

0 di/dt limiting set with P158 is active only during torque reversal

1 di/dt limiting set with P158 is active all the time

Factory setting: 0 Value range (steps): 0 to 1 (1 Hex)

Access: 20 Change: off-line

P158 Time for the current reference integrator (di/dt limiting)

Time for current to change from zero to rated converter current.

Factory setting: 0.000s Value range (steps): 0.000 to 1.000s (0.001s) (range increase ver 2.10)

Access: 20 Change: on-line

P159 Changeover threshold for the auto-reversing stage (armature)

Factory setting: 0.01%

Value range (steps): 0.00 to 100.00% of the speed controller output (0.01%)

Access: 30 Change: on-line

P160 4 Quadrant armature current reversing logic dead time

This parameter is usually used when supplying a high inductive load such as a field.

Factory setting: 0.000s Value range (steps): 0.000 to 2.000s (0.001s)

Access: 20 Change: off-line

Current and Torque Limit Settings

P170 Torque control/current control selection

x0 Torque control disabled (= current control)

x1 Torque control active

0x "Torque limit" acts as current limits

1x Torque limit active

Factory setting: 10

Value range (steps): 00 to 11 (1 Hex)

Access: 20

Change: off-line

P171 System current limit in torque direction I

Factory setting: 100.0%

Value range (steps): 0.0 to 300.0% of the rated motor armature current (0.1%)

Access: 20

Change: on-line

P172 System current limit in torque direction II

Factory setting: -100.0%

Value range (steps): -300.0 to 0.0% of the rated motor armature current (0.1%)

Access: 20

Change: on-line

P180 Positive torque limit 1

Factory setting: 300.0%

Value range (steps): -300.0 to 300.0% of the rated motor torque (0.1%)

Access: 20

Change: on-line

P181 Negative torque limit 1

Factory setting: -300.0%

Value range (steps): -300.0 to 300.0% of the rated motor torque (0.1%)

Access: 20

Change: on-line

P182 Positive torque limit 2

A changeover is made from torque limit 1 to torque limit 2 if the torque limit changeover is selected (i.e., BIF 42 = 1) and the speed is greater than the changeover speed set in P184.

Factory setting: 300.0%

Value range (steps): -300.0 to 300.0% of the rated motor torque (0.1%)

Access: 20

Change: on-line

P183 Negative torque limit 2

A changeover is made from torque limit 1 to torque limit 2 if the torque limit changeover is selected (i.e., BIF 42 = 1) and the speed is greater than the changeover speed set in P184.

Factory setting: -300.0%

Value range (steps): -300.0 to 300.0% of the rated motor torque (0.1%)

Access: 20

Change: on-line

P184 Changeover speed for the torque limits

A changeover is made from torque limit 1 to torque limit 2 if the torque limit changeover is selected (i.e., BIF 42 = 1) and the speed at K166 is greater than the changeover speed set in P184.

Factory setting: 0.00%

Value range (steps): 0.00 to 120.00% of the maximum speed (0.01%)

Access: 20

Change: on-line

Speed Feedback Conditioning

P200 Filtering time for the speed controller feedback

The speed actual value is filtered through a first order delay element.
Factory setting: 0 ms Value range (steps): 0 to 10000 ms (1 ms)
Access: 20 Change: on-line

P201 Resonant frequency of the first band rejection filter

The actual value, after the P200 first order filter element, is further filtered by two adjustable band rejection filters. P201 is the resonant frequency of the first band rejection filter.
0 Band rejection filter switched off
1 to 140 Resonant frequency in Hz.
Factory setting: 0 Hz Value range (steps): 0 to 140 Hz (1 Hz)
Access: 20 Change: on-line

P202 Quality of the first band rejection filter

The actual value, after the P200 first order filter element, is further filtered by two adjustable band rejection filters. P202 is the quality factor of the first band rejection filter.
0 Quality = 0.5
1 Quality = 1
2 Quality = 2
3 Quality = 3
Factory setting: 0 Value range: 0 to 3
Access: 20 Change: on-line

P203 Resonant frequency of the second band rejection filter

The actual value, after the P200 first order filter element, is further filtered by two adjustable band rejection filters. P203 is the resonant frequency of the second band rejection filter.
0 Band rejection filter switched-off
1 to 140 Resonant frequency in Hz.
Factory setting: 0 Hz Value range (steps): 0 to 140 Hz (1 Hz)
Access: 20 Change: on-line

P204 Quality of the second band rejection filter

The actual value, after the P200 first order filter element, is further filtered by two adjustable band rejection filters. P204 is the quality factor of the second band rejection filter.
0 Quality = 0.5
1 Quality = 1
2 Quality = 2
3 Quality = 3
Factory setting: 0 Value range: 0 to 3
Access: 20 Change: on-line

P205 Derivative action time for the D component for the speed feedback

After filtering the speed feedback signal can be fed through a derivative component which can be set with parameters.
Factory setting: 0 ms Value range (steps): 0 to 1000 ms (1 ms)
Access: 20 Change: on-line

Speed Controller Settings

P220 Initial integrator value for the speed controller

Before the controller enable signal is set ON the integrator of the speed controller is initially set to the value programmed in P220.

Factory setting: 0.0%

Value range (steps): -100.0 to 100.0% of the speed controller output (0.1%)

Access: 20 Change: off-line

P222 Changeover threshold for PI to P of the speed controller

0.00 Automatic changeover from PI to P disabled (speed controller always a PI controller).

> 0.00 Speed at which the integral part of the PI speed controller is disabled (set to zero). When the actual speed is less than P222 the speed controller becomes a P only controller. The integrator is only enabled again if the actual speed > P222 + 2% nmax. This function allows the drive to be smoothly held at zero speed with the controllers enabled. If BIF 38 has been selected, then the changeover is only effective if BIF 38 is energized.

Factory setting: 0.00%

Value range (steps): 0.00 to 10.00% of the maximum speed (0.01%)

Access: 20 Change: on-line

P223 Control word for the speed controller feed forward

0 Speed controller feed forward controller inhibited

1 Speed controller feed forward controller output is added to the speed controller output as an additional torque reference.

Factory setting: 0 Value range: 0 to 1

Access: 20 Change: off-line

P224 Control word, speed controller

xxx0 Set controller integral part to zero (i.e., pure proportional controller)

xxx1 Integral component active but stops when torque or current limit is reached

xxx2 Integral component active but stops when torque limit is reached (Version 2.3)

xxx3 Integral component active but stops when it reached +199.99% (Version 2.3)

xx0x Set the controller proportional part to zero (i.e., pure integral controller)

xx1x Controller proportional component active

x0xx The reference is not inverted

x1xx The reference is inverted

0xxx The actual value is not inverted

1xxx The actual value is inverted

Factory setting: 0011 Value range (steps): 0000 to 1113 (1 Hex)

Access: 20 Change: off-line

P225 Speed controller, proportional gain

The parameter is automatically set during the speed controller self-tuning run (P051 = 26).

Factory setting: 3.00 Value range (steps): 0.10 to 200.00 (0.01)

Access: 20 Change: on-line

Also refer to the settings for the speed controller adaptation function (P550 to P563).

P226 Speed controller, integral-action time

The parameter is automatically set during the speed controller self-tuning run (P051 = 26).

Factory setting: 0.650s Value range (steps): 0.010 to 10.000s (0.001s)

Access: 20 Change: on-line

Also refer to the settings for the speed controller adaptation function (P550 to P563).

P227 Speed controller, droop

An internal feedback element is connected from the controller output to the input summing point, in parallel to the I and P component of the speed controller. If the "droop" function is set with BIF 37 this feedback can be enabled and disabled by energizing the function. If BIF 37 is not selected, then the droop feedback is always effective (disabled using parameter value = 0). A 10% droop setting means that the speed actual value deviates from the reference by 10% at rated converter torque.

Factory setting: 0.0%

Value range (steps): 0.0 to 10.0% of the rated converter torque (0.1%)

Access: 20 Change: on-line

P228 Speed reference filter

The reference is filtered through a first order filter element. This parameter is automatically set during the speed controller self-tuning run (P051 = 26).

Factory setting: 0 mS Value range (steps): 0 to 10000 mS (1 mS)

Access: 20 Change: on-line

P229 Control word for Master / Slave operation

0 For P084 = 2 or when slave operation is selected by BIF 41, the speed controller is inhibited.

1 For P084 = 2 or when slave operation is selected by BIF 41, the speed controller is enabled.

Factory setting: 0 Value range (steps): 0 to 1 (1 Hex)

Access: 20 Change: off-line

Field Current Controller Settings**P250 Gating angle minimum limit (field)**

Factory setting: 0 degrees Value range (steps): 0 to 180 degrees (1 deg)

Access: 30 Change: off-line

P251 Gating angle maximum limit (field)

Factory setting: 180 degrees Value range (steps): 0 to 180 degrees (1 deg)

Access: 30 Change: off-line

P252 Filtering of the supply frequency tracking (field)

When operating from weak power lines such as generators the filter time must be reduced in order to achieve faster frequency tracking for the gating system. **For weak systems only set P252 to even numbered values.**

An additional feature has been added when P252 is set to odd numbered values. This allows additional filtering on stiff frequency systems to allow operation through short power interruptions that might occur when the AC power is supplied through slip ring collectors. This feature can not be used on systems where the frequency is changing.

Factory setting: 200 ms Value range (steps): 0 to 200 ms (1 ms)

Access: for authorized service Change: on-line

P253 Control word for field feed forward control

x0 Field feed forward controller inhibited

x1 Field feed forward controller enabled

0x Motor flux calculated from field current from K265 (Compensated motors factory default)

1x Motor flux calculated from EMF feed forward controller output K293 (non-compensated motor)

2x Motor flux calculated from field current reference K268 (Smooth calculation for compensated motors)

Factory setting: 1 Value range: 00 to 21

Access: 20 Change: off-line

P254 Control word, field current controller

x0 Set the controller integral part to zero (i.e., pure proportional controller)
x1 Controller integral part active
0x Set the controller proportional part to zero (i.e., pure integral controller)
1x Controller proportional part active
Factory setting: 11 Value range (steps): 00 to 11 (1 Hex)
Access: 20 Change: off-line

P255 Field current controller, proportional gain

The parameter is automatically set during the self-tuning run for feed forward and current controller for armature and field (P051 = 25)
Factory setting: 5.00 Value range (steps): 0.01 to 100.00 (0.01)
Access: 20 Change: on-line

P256 Field current controller, integral-action time

The parameter is automatically set during the self-tuning run for feed forward and current controller for armature and field (P051 = 25)
Factory setting: 0.200s Value range (steps): 0.001 to 10.000s (0.001s)
Access: 20 Change: on-line

P257 Standstill field

Value to which the field current is reduced when the automatic field economy (P082 = xx2) or "standstill field" (BIF 56) function is selected.
Factory setting: 0.0% Value range (steps): 0.0 to 100.0% of the rated motor field current P102 (0.1%)
Access: 20 Change: on-line

P258 Delay time for automatic field current reduction

Time, in which the field current is reduced when the "automatic field current reduction" function is selected after the drive has been shutdown after reaching operating status o7.0 or higher.
Factory setting: 10.0s Value range (steps): 0.0 to 60.0s (0.1s)
Access: 20 Change: on-line

Motor EMF Controller Settings

P273 Control word for the EMF feed forward controller

0 EMF feed forward controller inhibited
 1 EMF feed forward controller enabled
 Factory setting: 1 Value range: 0 to 1
 Access: 20 Change: off-line

P274 Control word for the EMF controller

xxx0 Set controller integral part to zero
 xxx1 Enable integral part of the controller

 xx0x Set controller proportional part to zero
 xx1x Enable proportional part of the controller

 x0xx The EMF reference is not inverted
 x1xx The EMF reference is inverted

 0xxx The EMF feedback is not inverted
 1xxx The EMF feedback is inverted
 Factory setting: 0011 Value range (steps): 0000 to 1111 (1 Hex)
 Access: 20 Change: off-line

P275 Proportional gain of the EMF controller

Factory setting: 0.60 Value range (steps): 0.10 to 100.00 (0.01)
 Access: 20 Change: on-line

P276 Integral gain of the EMF controller

Factory setting: 0.200 S Value range (steps): 0.010 to 10.000 S (0.001S)
 Access: 20 Change: on-line

P277 EMF controller droop

Factory setting: 0.0% Value range (steps): 0.0 to 10.0% (0.1%)
 Access: 20 Change: on-line

Ramp function generator parameters:

P300 Positive limit for the ramp-function generator output

The speed reference is limited with sign (a negative limit can be set)
 Factory setting: 100.00%
 Value range (steps): -200.0 to 199.99% of the max. speed (0.01%)
 Access: 20 Change: on-line

P301 Negative limit for the ramp-function generator output

The speed reference is limited with sign (a positive limit can be set)
 Factory setting: -100.00%
 Value range (steps): -200.0 to 199.99% of the max. speed (0.01%)
 Access: 20 Change: on-line

P302 Control word, ramp-function generator

- xx0 Ramp tracking during current or torque limit is not active
- xx1 Ramp tracking during current or torque limit is active. The ramp tracking function is used to assure that the ramp does not integrate too far away from the actual speed when current or torque limiting is reached. When ramp tracking is used it is best to set the speed reference filter time to a low value.
- x0x Standard ramp function generator operation using ramp set 1 parameters P303 to P306. When a binary input is used with BIF 31 ramp set 2 parameters P307 to P310 are used. If BIF 33 is selected then ramp set 3 parameters P311 to P314 are used.
- x1x Ramp-up integrator: After the reference is reached for the first time the ramp times change from set 1 values to zero.
- x2x Ramp-up integrator: After the reference is reached for the first time the ramp times change from set 1 values to set 2 values (P307 to P310).
- x3x Ramp-up integrator: After the reference is reached for the first time the ramp times change from set 1 values to set 3 values (P311 to P314).
- 0xx The ramp output is not preset when a stop command is issued.
- 1xx The ramp output is preset to the actual speed value at K167 when a stop command is issued.
- 2xx The ramp output is preset to the filtered speed feedback at K165 when a stop command is issued.

Ramp-up integrator function:

The ramp-function generator parameters are automatically changed over from ramp set 1 to the specified parameter set when the reference is first reached after any "ON" command. This allows the drive to start on one rate and after reaching the set speed operate with another rate for the rest of the operation. The drive is always stopped using parameter set 1. The P302 = x1x, x2x, x3x function can be selectively controlled using BIF69 as described in section 10. The binary input function ramp-function generator setting 2 and ramp-function generator setting 3 have priority over the ramp-up integrator function.

Setting 1xx or 2xx allows the ramp output to be preset to the speed actual value when a stop command is issued. Since the ramp output limiter is not effective during stopping this will prevent a momentary increase in speed if the ramp were at limit when the stop command was issued. Setting 2xx should not be used if derivative compensation using P205 is used.

For operating condition ≥ 0.1 parameter P629 can be used to preset the ramp output.

Factory setting: 00 Value range (steps): 000 to 231 (1 Hex)
Access: 20 Change: off-line

Ramp function generator parameter set 1:**P303 Ramp-up time 1**

Factory setting: 0.00s Value range (steps): 0.00 to 650.00s (0.01s)
Access: 20 Change: on-line

P304 Ramp-down time 1

Factory setting: 0.00s Value range (steps): 0.00 to 650.00s (0.01s)
Access: 20 Change: on-line

P305 Initial rounding 1

Factory setting: 0.00s Value range (steps): 0.00 to 10.00s (0.01s)
Access: 20 Change: on-line

P306 Final rounding 1

Factory setting: 0.00s Value range (steps): 0.00 to 10.00s (0.01s)
Access: 20 Change: on-line

Ramp function generator parameter set 2 (selected with BIF 31):

P307	Ramp-up time 2 Factory setting: 0.00s Access: 20	Value range (steps): 0.00 to 650.00s (0.01s) Change: on-line
P308	Ramp-down time 2 Factory setting: 0.00s Access: 20	Value range (steps): 0.00 to 650.00s (0.01s) Change: on-line
P309	Initial rounding 2 Factory setting: 0.00s Access: 20	Value range (steps): 0.00 to 10.00s (0.01s) Change: on-line
P310	Final rounding 2 Factory setting: 0.00s Access: 20	Value range (steps): 0.00 to 10.00s (0.01s) Change: on-line

Ramp function generator parameter set 3 (selected with BIF 32):

P311	Ramp-down time 3 Factory setting: 0.00s Access: 20	Value range (steps): 0.00 to 650.00s (0.01s) Change: on-line
P312	Ramp-down time 3 Factory setting: 0.00s Access: 20	Value range (steps): 0.00 to 650.00s (0.01s) Change: on-line
P313	Initial rounding 3 Factory setting: 0.00s Access: 20	Value range (steps): 0.00 to 10.00s (0.01s) Change: on-line
P314	Final rounding 3 Factory setting: 0.00s Access: 20	Value range (steps): 0.00 to 10.00s (0.01s) Change: on-line

Speed Limiting:

P315	Positive limit for the ramp generator input The speed reference is limited with sign (a negative limit can be set) Factory setting: 100.00% Value range (steps): -200.0 to 199.99% of the maximum speed (0.01%) Access: 20	Change: on-line
P316	Negative limit for the ramp generator input The speed reference is limited with sign (a positive limit can be set) Factory setting: -100.00% Value range (steps): -200.00 to 199.99% of the maximum speed (0.01%) Access: 20	Change: on-line

P317 Maximum speed

The main reference is evaluated with parameters P317 and P318. Parameter P317 defines the speed when the main reference = 100%.

Factory setting: 100.00%

Value range (steps): 0.00 to 100.00% of the maximum speed (0.01%)

Access: 20 Change: on-line

P318 Minimum speed

The main reference is evaluated with parameters P317 and P318. Parameter P318 defines the speed when the main reference = 0%.

Factory setting: 0.00%

Value range (steps): 0.00 to 100.00% of the maximum speed (0.01%)

Access: 20 Change: on-line

P319 Speed reference reduction, positive direction

If the reference reduction command, BIF 24, is input the ramp function generator input is limited in the positive direction to the value set with P319 and in the negative direction to the value set with P320.

Factory setting: 100.00%

Value range (steps): -100.0 to 100.00% of the maximum speed (0.01%)

Access: 20 Change: on-line

P320 Speed reference reduction, negative direction

If the reference reduction command, BIF 24, is input the ramp function generator input is limited in the positive direction to the value set with P319 and in the negative direction to the value set with P320.

Factory setting: -100.00%

Value range (steps): -100.0 to 100.00% of the maximum speed (0.01%)

Access: 20 Change: on-line

Settings for Monitoring and Limit Values

Monitoring settings:

P351 Threshold for the undervoltage trip

If the supply voltage deviates by a larger value than set in P351 for a time longer than set at P086, then fault F006 is activated. The drive will be in operating status o4 during the P086 time.

Factory setting: -20%

Value range (steps): 0 to -90% [armature = % of P071; field = % of P078] (1%) (range increase ver 2.10)

Access: 30 Change: on-line

P352 Threshold for the overvoltage trip

If the supply voltage deviates by a larger value than set in P352 for a time longer than set at P086, then fault F007 is activated. The drive will be in operating status o4 during the P086 time.

Factory setting: +20%

Value range (steps): 0 to +99% [armature = % of P071; field = % of P078] (1%) (range increase ver 2.10)

Access: 30 Change: on-line

P353 Response threshold for phase failure monitoring

If the supply voltage, in operating status $\leq o4$, falls below the set value and does not recover within the restart time set at P086 fault message F004 or F005 is activated.

During starting in operating status's $o4$ and $o5$, a delay set with P089 is inserted to allow all phase voltages to exceed the threshold to avoid false F004 and F005 faults.

Factory setting: 40%

Value range (steps): 10 to 100%;[armature = % of P071; field = % of P078] (1%)

Access: 30 Change: on-line

P354 Threshold for overspeed protection

Fault message F038 is activated if the speed at connector K166 exceeds the set value by more than 0.5%.

Factory setting: 120.00%

Value range (steps): 0.00 to 120.00% of the maximum speed (0.01%)

Access: 20 Change: on-line

P355 Stall protection time

F035 is activated, if the conditions for the "stall protection" fault signal are present for a time longer than that set at parameter P355. **If P355 = 0.0 then fault F035 and warning W08 are suppressed.**

Factory setting: 0.5s Value range (steps): 0.0 to 60.0s (0.1s)

Access: 20 Change: on-line

P357 Threshold for the tachometer loss monitoring

F042 is suppressed, if the EMF actual value is less than the value set at parameter P357.

Factory setting: 10%

Value range (steps): 10 to 70% of the ideal average DC voltage at $\alpha = 0$, i.e., % of P071 x 1.35 (1%)

P362 Threshold for the speed controller monitoring

Refer to the description for fault message F031 in section 8.

Factory setting: 2.00%

Value range (steps): 0.00 to 100.00% of the maximum speed (0.01%)

Access: 20 Change: on-line

P363 Time for the dynamic control deviation of the speed controller

Refer to the description for fault message F031 in section 8.

Factory setting: 0.1s Value range (steps): 0.00 to 10.00s (0.01s)

Access: 20 Change: on-line

P364 Threshold for the armature current controller monitoring

Refer to the description for fault message F032 in section 8.

Factory setting: 2.00% Value range (steps): 0.00 to 100.00% (0.1%)

Access: 20 Change: on-line

P365 Time for the dynamic control deviation of the armature current controller

Refer to the description for fault message F032 in section 8.

Factory setting: 0.10s Value range (steps): 0.00 to 10.00s (0.01s)

Access: 20 Change: on-line

P366 Threshold for the EMF controller monitoring

Refer to the description for fault message F033 in section 8.

Factory setting: 2.00% Value range (steps): 0.00 to 100.00% (0.01%) of the ideal average DC voltage at $\alpha = 0$, i.e., % of P071 x 1.35 (1%)

Access: 20 Change: on-line

- P367 Time for the dynamic control deviation of the EMF controller**
Refer to the description for fault message F033 in section 8.
Factory setting: 0.10s Value range (steps): 0.00 to 10.00s (0.01s)
Access: 20 Change: on-line
- P368 Threshold for the field current controller monitoring**
Refer to the description for fault message F034 in section 8.
Factory setting: 2.00% Value range (steps): 0.00 to 100.00% (0.01%)
Access: 20 Change: on-line
- P369 Time for the dynamic control deviation of the field current controller**
Refer to the description for fault message F034 in section 8.
Factory setting: 0.10s Value range (steps): 0.00 to 10.00s (0.01s)
Access: 20 Change: on-line

Settings for the limit value monitor:

- P370 Speed threshold n_{\min}**
Speed threshold for the limit value monitor $n < n_{\min}$.
Determines the contactor drop out speed; also see BOF 21 in section 10.
Factory setting: 0.50%
Value range (steps): 0.00 to 120.00% of the maximum speed (0.01%)
Access: 20 Change: on-line
- P371 Hysteresis for the $n < n_{\min}$ signal**
This value is added to the response threshold, if $n < n_{\min}$.
Factory setting: 0.50%
Value range (steps): 0.00 to 100.00% of the maximum speed (0.01%)
Access: 20 Change: on-line
- P373 Speed threshold n_{x1}**
Speed threshold for limit value monitors $n < n_{x1}$ (also see BOF 16 in section 10)
Factory setting: 0.50%
Value range (steps): 0.00 to 120.00% of the maximum speed (0.01%)
Access: 20 Change: on-line
- P374 Hysteresis for the $n < n_{x1}$ signal**
This value is added to the response threshold, if $n < n_{x1}$ (also see BOF 16 in section 10)
Factory setting: 0.50%
Value range (steps): 0.00 to 100.00% (0.01%)
Access: 20 Change: on-line
- P376 Speed threshold n_{x2}**
Speed threshold for limit value monitor $n < n_{x2}$ (also see BOF 17 in section 10)
Factory setting: 0.50%
Value range (steps): 0.00 to 120.00% (0.01%)
Access: 20 Change: on-line

- P377 Hysteresis for the $n < n_{x2}$ signal**
 This value is added to the response threshold, if $n < n_{x2}$ (also see BOF 17 in section 10)
 Factory setting: 0.50%
 Value range (steps): 0.00 to 100.00% (0.01%)
 Access: 20 Change: on-line
- P379 Speed threshold n_{x3}**
 Speed threshold for limit value monitor $n < n_{x3}$ (also see BOF 18 in section 10)
 Factory setting: 0.50%
 Value range (steps): 0.00 to 120.00% (0.01%)
 Access: 20 Change: on-line
- P380 Hysteresis for the $n < n_{x3}$ signal**
 This value is added to the response threshold, if $n < n_{x3}$ (also see BOF 18 in section 10)
 Factory setting: 0.50%
 Value range (steps): 0.00 to 100.00% (0.01%)
 Access: 20 Change: on-line
- P382 Speed threshold n_{x4}**
 Speed threshold for limit value monitor $n < n_{x4}$ (also see BOF 19 in section 10)
 Factory setting: 0.50%
 Value range (steps): 0.00 to 120.00% (0.01%)
 Access: 20 Change: on-line
- P383 Hysteresis for the $n < n_{x4}$ signal**
 This value is added to the response threshold, if $n < n_{x4}$ (also see BOF 19 in section 10)
 Factory setting: 0.50%
 Value range (steps): 0.00 to 100.00% (0.01%)
- P385 Speed threshold n_{x5x}**
 Speed threshold for limit value monitor $n < n_{x5}$ (also see BOF 20 in section 10)
 Factory setting: 0.50%
 Value range (steps): 0.00 to 120.00% (0.01%)
 Access: 20 Change: on-line
- P386 Hysteresis for the $n < n_{x5}$ signal**
 This value is added to the response threshold, if $n < n_{x5}$ (also see BOF 20 in section 10)
 Factory setting: 0.50%
 Value range (steps): 0.00 to 100.00% (0.01%)
- P391 Armature current threshold I_x**
 Threshold for limit value monitor $I_A > I_x$ (also see BOF 15 in section 10)
 Factory setting: 100%
 Value range (steps): 0.00 to 200.00% of the rated converter armature current (0.01%)
 Access: 20 Change: on-line
- P392 Hysteresis for the $I_A > I_x$ signal**
 Hysteresis for the limit value monitor $I_A > I_x$ (also see BOF 15 in section 10)
 This value is added to the response threshold, if $I_A > I_x$.
 Factory setting: 10%
 Value range (steps): 0.00 to 100.00% of the rated converter armature current (0.01%)
 Access: 20 Change: on-line

- P394 Field current threshold $I_{f<I_{fmin}}$**
Threshold for the limit value monitor $I_{f<I_{fmin}}$ (also see BOF 28 in section 10)
Factory setting: 5.00%
Value range (steps): 0.00 to 100.00% of the rated converter field current (0.01%)
Access: 20 Change: on-line
- P395 Hysteresis for the $I_{f<I_{fmin}}$ signal**
This value is added to the response threshold, if $I_{f<I_{fmin}}$ (also see BOF 28 in section 10)
Factory setting: 1.00%
Value range (steps): 0.00 to 100.00% of the rated converter field current (0.01%)
Access: 20 Change: on-line
- P396 Hysteresis for the actual speed direction detector**
The direction of rotation signal BOF 13 changes direction if the speed at connector K167 less than -P396 or greater than +P396.
Factory setting: 0.01%
Value range (steps): 0.01 to 10.00% of maximum speed (0.01%)
Access: 20 Change: on-line

Settings for the Basic Converter Technology Functions

Setting for the digital references (e.g. "JOG" or "THREAD")

- P401 Digital reference 1**
The reference at this parameter is switched-in, if the select function "fixed reference, BIF 17 to 23", "jog, BIF 13 or 14" or "thread, BIF 15 or 16" is requested at binary input 1, terminal 39.
Factory setting: 0.0% Value range (steps): -199.9 to 199.99% (0.01%)
Access: 20 Change: on-line
- P402 Digital reference 2**
The reference at this parameter is switched-in, if the select function "fixed reference, BIF 17 to 23", "jog, BIF 13 or 14" or "thread, BIF 15 or 16" is requested at binary input 2, terminal 40.
Factory setting: 0.0% Value range (steps): -199.9 to 199.99% (0.01%)
Access: 20 Change: on-line
- P403 Digital reference 3**
The reference at this parameter is switched-in, if the select function "fixed reference, BIF 17 to 23", "jog, BIF 13 or 14" or "thread, BIF 15 or 16" is requested at binary input 3, terminal 41.
Factory setting: 0.0% Value range (steps): -199.9 to 199.99% (0.01%)
Access: 20 Change: on-line
- P404 Digital reference 4**
The reference at this parameter is switched-in, if the select function "fixed reference, BIF 17 to 23", "jog, BIF 13 or 14" or "thread, BIF 15 or 16" is requested at binary input 4, terminal 42.
Factory setting: 0.0% Value range (steps): -199.9 to 199.99% (0.01%)
Access: 20 Change: on-line
- P405 Digital reference 5**
The reference at this parameter is switched-in, if the select function "fixed reference, BIF 17 to 23", "jog, BIF 13 or 14" or "thread, BIF 15 or 16" is requested at binary input 5, terminal 43.
Factory setting: 0.0% Value range (steps): -199.9 to 199.99% (0.01%)
Access: 20 Change: on-line
- P406 Digital reference 6**

The reference at this parameter is switched-in, if the select function "fixed reference, BIF 17 to 23", "jog, BIF 13 or 14" or "thread, BIF 15 or 16" is requested at binary input 6, terminal 36.

Factory setting: 0.0% Value range (steps): -199.9 to 199.99% (0.01%)

Access: 20 Change: on-line

P409 Reference for "jog" from the control word

The reference at this parameter is switched-in when the "jog" command, BIF 13, is entered using a bit in the freely-definable control word STWF.

Factory setting: 0.0% Value range (steps): -199.9 to 199.99% (0.01%)

Access: 20 Change: on-line

P410 Reference for "jog and bypass ramp-function generator" from the control word

The reference at this parameter is switched-in if the command "jog and bypass ramp-function generator" is entered, BIF 14, using a bit in the freely definable control word STWF.

Factory setting: 0.0% Value range (steps): -199.9 to 199.99% (0.01%)

Access: 20 Change: on-line

P411 Reference for "thread" from the control word

The reference at this parameter is switched-in if the command "thread" is entered, BIF 15, using a bit in the freely-definable control word STWF.

Factory setting: 0.0% Value range (steps): -199.9 to 199.99% (0.01%)

Access: 20 Change: on-line

P412 Reference for "thread and bypass ramp-function generator" from the control word

The reference at this parameter is switched-in if the command "thread and bypass ramp-function generator" is entered, BIF 16, using a bit in the freely-definable control word STWF.

Factory setting: 0.0% Value range (steps): -199.9 to 199.99% (0.01%)

Access: 20 Change: on-line

P413 Reference for "fixed reference" from the control word

The reference at this parameter is switched-in if the command "fixed reference" is entered, BIF 17, using a bit in the freely-definable control word STWF.

Factory setting: 0.0% Value range (steps): -199.9 to 199.99% (0.01%)

Access: 20 Change: on-line

P414 Reference for "fixed reference and bypass ramp-function generator" from the control word

The reference, set at this parameter, is switched-in if the command "fixed reference and bypass ramp-function generator" is entered, BIF 18, using a bit in the freely-definable control word STWF.

Factory setting: 0.0% Value range (steps): -199.9 to 199.99% (0.01%)

Access: 20 Change: on-line

P415 Reference for "optional reference before the Technology controller" from the control word

The reference set at this parameter is switched-in if the command "optional reference before the Technology controller" is entered, BIF 19, using a bit in the freely-definable control word STWF.

Factory setting: 0.0% Value range (steps): -199.9 to 199.99% (0.01%)

Access: 20 Change: on-line

- P416 Reference for "optional reference before the ramp-function generator" from the control word**
The reference set at this parameter is switched-in if the command "optional reference before the ramp-function generator" is entered, BIF 20, using a bit in the freely-definable control word STWF.
Factory setting: 0.0% Value range (steps): -199.9 to 199.99% (0.01%)
Access: 20 Change: on-line
- P417 Reference for "optional reference before the speed controller" from the control word**
The reference set at this parameter is switched-in if the command "optional reference before the speed controller" is entered, BIF 21, using a bit in the freely-definable control word STWF.
Factory setting: 0.0% Value range (steps): -199.9 to 199.99% (0.01%)
Access: 20 Change: on-line
- P418 Reference for "optional reference before torque limiting" from the control word**
The reference set at this parameter is switched-in if the command "optional reference before torque limiting" is entered, BIF 22, using a bit in the freely-definable control word STWF.
Factory setting: 0.0% Value range (steps): -199.9 to 199.99% (0.01%)
Access: 20 Change: on-line
- P419 Reference for "optional reference before the current controller" from the control word**
The reference set at this parameter is switched-in if the command "optional reference before the current controller" is entered, BIF 23, using a bit in the freely-definable control word STWF.
Factory setting: 0.0% Value range (steps): -199.9 to 199.99% (0.01%)
Access: 20 Change: on-line

Setting for the "technology controller" function:

- P420 Filtering time, technology controller actual value**
Factory setting: 0 ms Value range (steps): 0 to 10000 ms (1 ms)
Access: 20 Change: on-line
- P421 Derivative action time, technology controller actual value**
Factory setting: 0 ms Value range (steps): 0 to 1000 ms (1 ms)
Access: 20 Change: on-line
- P422 Filtering time, technology controller reference value**
Factory setting: 0 ms Value range (steps): 0 to 10000 ms (1 ms)
Access: 20 Change: on-line

P424 Technology controller control word

xxx0 Set controller integral part is set zero (i.e. pure proportional controller)

xxx1 Controller integral part is active

xx0x Set controller proportional part is set to zero (i.e. pure integral controller)

xx1x Controller proportional component active

x0xx The reference is not inverted

x1xx The reference is inverted

0xxx The feedback is not inverted

1xxx The feedback is inverted

Factory setting: 0011 Value range (steps): 0000 to 1111 (1 Hex)

Access: 20 Change: off-line

P425 Technology controller proportional gain, P

Factory setting: 3.00 Value range (steps): 0.10 to 200.00 (0.01)

Access: 20 Change: on-line

P426 Technology controller integral gain, I

Factory setting: 0.650 s Value range (steps): 0.010 to 10.000 s (0.001s)

Access: 20 Change: on-line

P427 Technology controller droop

If the "droop" function is selected with BIF 36 then it can be enabled and disabled by this function. If the BIF is not selected as "droop" then the droop function is always active (disabled by setting P427=0.0%).

Factory setting: 0.0% Value range (steps): 0.0 to 60.0% (0.1%)

Access: 20 Change: on-line

P428 Technology controller output scaling

Factory setting: 100.0% Value range (steps): -100.0 to 100.0% (0.1%)

Access: 20 Change: on-line

P430 Technology controller output positive limit

Factory setting: 100.0% Value range (steps): 0.0 to 199.9% (0.1%)

Access: 30 Change: on-line

P431 Technology controller output negative limit

Factory setting: -100.0% Value range (steps): 0.0 to -199.9% (0.1%)

Access: 30 Change: on-line

P432 Technology controller droop positive limit

Factory setting: +100.00% Value range (steps): 0.00 to 199.99% (0.01%)

Access: 30 Change: on-line

P433 Technology controller droop negative limit

Factory setting: -100.00% Value range (steps): 0.00 to -199.99% (0.01%)

Access: 30 Change: on-line

P450 Maximum gear output RPM (coarse adjustment)

The fine maximum speed adjustment P451 is added to this value to set the maximum output shaft speed.

Factory setting: 500 RPM Value range (steps): 0 to 10,000 RPM (1 RPM)

Access: 20 Change: off-line

P451 Maximum gear output RPM (fine adjustment)

This is the fine adjustment for the maximum output shaft speed and it is added to P450 to set the maximum speed.

Factory setting: 0.00 RPM Value range (steps): 0.00 to 0.99 RPM (0.01 RPM)

Access: 20 Change: off-line

P452 Maximum motor RPM when pulse encoder is used (fine adjustment, see P143 for main adjustment)

This value is added to the value set with P143 to determine the maximum speed.

Factory setting: 0.00 RPM Value range (steps): 0.00 to 0.99 RPM (0.01 RPM)

Access: 20 Change: on-line

Settings for the motorized potentiometer function:**P460 Selecting the motorized potentiometer operating mode**

xxx1 Motorized potentiometer operation

xxx2 Ramp-function generator operation

xx0x The motorized potentiometer reference is set to zero for operating status's > o5

xx1x The motorized potentiometer reference remains stored in all operating status's (even when the electronics voltage is disconnected)

x0xx The motorized potentiometer - ramp-function generator is bypassed in the automatic mode (P462 and P463 ineffective)

x1xx Motorized potentiometer - ramp-function generator effective in the manual and automatic modes

0xxx Setting the range of the "MOP" by the raise/lower button is 0 to 100%.

Forward / reverse operation is determined by BIF 28, 29, or 30.

1xxx Setting the range of the "MOP" by the raise/lower button is -100% to 100%.

Forward / reverse operation by BIF 28, 29, or 30 is not allowed.

Factory setting: 0101 Value range (steps): 0001 to 1112 (1 Hex)

Access: 20 Change: off-line

P461 Selecting the motorized potentiometer reference

0 Fixed value 0% (= connector K000)

1 Fixed value 100% (= connector K001)

2 0%

3 Connector K003

to

399 Connector K399

Factory setting: 2 Value range (steps): 0 to 399 (connector number)

Access: 20 Change: on-line

P462 Motorized potentiometer ramp-up time

Factory setting: 10.00s Value range (steps): 0.00 to 300.00s (0.01s)

Access: 20 Change: on-line

- P463 Motorized potentiometer ramp-down time**
Factory setting: 10.00s Value range (steps): 0.00 to 300.00s (0.01s)
Access: 20 Change: on-line
- P464 Motorized potentiometer output scaling factor**
Factory setting: 100% Value range (steps): -100% to 100% (1%)
Access: 20 Change: on-line
- P465 Motorized potentiometer time adjustment multiplier**
0 Times set with P462 and P463 are multiplied by a factor 1
1 Times set with P462 and P463 are multiplied by a factor 60
Factory setting: 0 Value range (steps): 0 to 1 (1 Hex)
Access: 20 Change: on-line
- P466 Selecting the MOP preset source for BIF 68**
0 0%
1 100%
2 0%
3 to 399 supplemental connectors
Factory setting: 2 Value range: 0 to 399 (connector number)
Access: 20 Change: off-line

Settings for the Draw and Ratio control function:

- P470 Selecting the operating mode for the draw/ratio control**
0 Draw/ratio control inhibited
1 Draw control enabled
2 Ratio control enabled
3 to 399 supplemental connectors
Factory setting: 0 Value range: 0 to 399 (connector number)
Access: 20 Change: off-line
- P471 Selection of the draw/ratio factor**
Number of the connector which is multiplied with the draw/ratio value.
Factory setting: 0 Value range: 0 to 399 (connector number)
Access: 20 Change: off-line

Settings for the "oscillation" and "step" reference function:**P480 Oscillation reference value 1**

Reference value used for the oscillation reference function, BIF 12, or the step reference function, P051 = 24. This reference value is used for the time selected with P481.

Factory setting: 0.5% Value range: -199.9 to 199.9 % of top speed (0.1% of top speed)

Access: 20 Change: on-line

P481 Oscillation reference 1 time duration

Time duration for the reference 1 value, P480, used for the oscillation function, BIF 12, or the step reference function, P051 = 24. Reference 1 will be active for the duration of this time and then reference 2 will become active for the time set with P483.

Factory setting: 0.1 sec Value range: 0.1 sec to 300.0 sec (0.1 sec)

Access: 20 Change: on-line

P482 Oscillation reference value 2

Reference value used for the oscillation function, BIF 12, or the step reference function, P051 = 24. This reference value is used after the time set with P481 has expired and will last for the time set with P483.

Factory setting: -0.4% Value range: -199.9 to 199.9 % of top speed (0.1% of top speed)

Access: 20 Change: on-line

P483 Oscillation reference 2 time duration

Time duration for the reference 2 value, P482, used for the oscillation function, BIF 12, or the step reference function, P051 = 24. Reference 2 will be active for the duration of this time and then reference 1 will become active for the time set with P481.

Factory setting: 0.1 sec Value range: 0.1 sec to 300.0 sec (0.1 sec)

Access: 20 Change: on-line

Settings for "master / slave drive" function:**P500 Selection of the reference source for the slave drive**

Number of the connector which provides the current reference for the slave drive.

Factory setting: 2 Value range: 0 to 399 (connector number)

Access: 20 Change: off-line

Settings for the "friction compensation" function:

P520 Friction at 0% speed

P521 Friction at 10% speed

to Parameter

P529 Friction at 90% speed

P530 Friction at 100% speed and higher

Parameters P520 to P530 are the armature current or torque references required for steady-state speed operation of 0%, 10% to 100% of the maximum speed in 10% speed steps. These parameters are points along the friction and windage characteristic. They are either a current or torque value as determined by the setting of P170 and are automatically set during the self tuning run with P051 = 28. P520 is set to 0.0%.

The characteristic is interpolated between the points dependent on the speed controller feedback at connector K165. The output of the friction compensation has the same sign as the speed controller feedback. The value from P530 is also used for any speed overshoot values that exceed 100% speed. for operation in both directions it is recommended that P520 be set at 0.05 in order to prevent armature current oscillations at 0% speed.

Factory setting: 0.0%

Value range (steps): 0.0 to 100.0%

Rated converter current and rated converter torque (0.1%)

Access: 20

Change: on-line

Settings for the "moment of inertia compensation" function

P540 Accelerating time

The "accelerating time" is the time necessary to accelerate the drive from 0% to 100% of the maximum speed (friction neglected), at 100% rated converter armature current and 100% rated motor field current. This is a direct measure of the motor and load moment of inertia.

This parameter is automatically set during the self tune run for the friction and moment of inertia compensation (P051 = 28).

Factory setting: 0.00s

Value range (steps): 0.00 to 650.00s (0.01s)

Access: 20

Change: on-line

P541 Acceleration P gain

Proportional gain for the function "acceleration dependent on the reference-actual value difference" or "freely-connectable acceleration" (also refer to parameters P543 to P545).

Factory setting: 0.00

Value range (steps): 0.00 to 300.00 (0.01)

Access: 20

Change: on-line

P543 Threshold deadband for acceleration dependent on the (reference-actual value) difference

When acceleration dependent on the (reference - actual value) difference function is selected, only that component of the speed controller (reference - actual value) difference that exceeds the value in P543 is allowed to pass through (also refer to parameters P541 and P545).

Factory setting: 0.00%

Value range (steps): 0.00 to 100.00% of the maximum speed (0.01%)

Access: 20

Change: on-line

P544 Selecting the freely-connectable acceleration

Number of the connector to be used as input for the freely-connectable acceleration (also refer to parameters P541 and P545).

Factory setting: 2 Value range: 0 to 299 (connector number)

Access: 20 Change: on-line

P545 Source of the speed controller compensation signal

1 Calculated dv/dt from the speed controller reference at K168

Scaling: $K150 = \frac{d(K168 \text{ in } \% \text{ max speed})}{dt} * P540$ in % rated base unit torque

2 Ramp generator dv/dt from K191

Scaling: $K151 = \frac{K191 \text{ in } \% \text{ max speed}}{AC \text{ Line Period} * 6} * P540$ in % rated base unit torque

3 Speed error signal from K163

Scaling:

$K152 = \pm (|K163| \text{ in } \% \text{ max speed} - P543) * P541$ if $|K163| > P543$, otherwise zero

4 Freely selectable signal selected using P544

Factory setting: 2 Value range: 1 to 4

Access: 20 Change: off-line

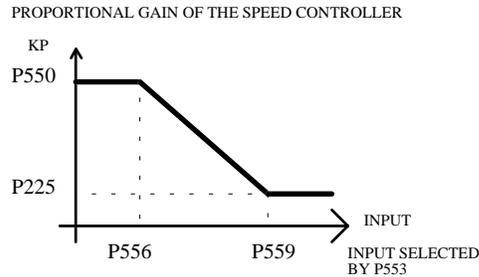
P546 Time constant for acceleration compensation smoothing filter

Factory setting: 0.0 Value range: 0.0 to 10,000 ms (1 ms)

Access: 20 Change: on-line

Settings for the "speed controller adaptation" function

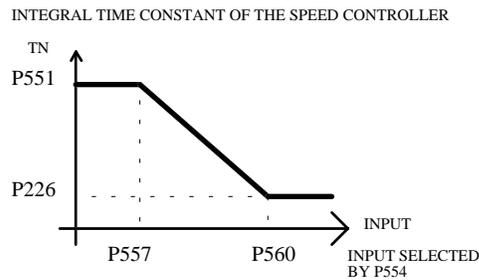
P550 Speed controller proportional adaptive gain



Factory setting: 3.0
Access: 20

Value range (steps): 0.10 to 200.00 (0.01)
Change: on-line

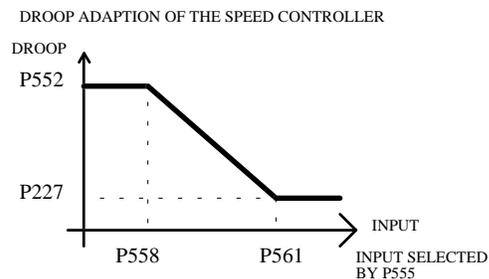
P551 Speed controller integral adaptive gain



Factory setting: 0.65 s
Access: 20

Value range(steps): 0.010 to 10.000 s (0.001 s)
Change: on-line

P552 Speed controller adaptive droop



Factory setting: 0.0%

Value range (steps): 0.0 to 10.0% of the rated drive torque (0.1%)
Access: 20

Change: on-line

P553 Input source selection for the speed controller adaptive proportional gain

- 0 Fixed value 0%
- 1 Fixed value 100%
- 2 Fixed value 0%
- 3 to 399 connector number

If the value from the selected connector is > the value of P559, P225 is used as the proportional gain.

Factory setting: 2

Value range: 0 to 399 (connector number)

Access: 20

Change: off-line

P554 Input source selection for the speed controller adaptive integral time

- 0 Fixed value 0%
- 1 Fixed value 100%
- 2 Fixed value 0%
- 3 to 399 connector number

If the value from the selected connector is > the value of P560, P226 is used as the integral time.

Factory setting: 2 Value range: 0 to 399 (connector number)

Access: 20 Change: off-line

P555 Input source selection for the speed controller adaptive droop

- 0 Fixed value 0%
- 1 Fixed value 100%
- 2 Fixed value 0%
- 3 to 399 connector number

If the value from the selected connector is > the value of P561, P227 is used as the droop gain.

Factory setting: 2 Value range: 0 to 399 (connector number)

Access: 20 Change: off-line

P556 Threshold 1 for speed controller proportional adaptive gain

When the input selected by P553 is less than P556 the speed controller proportional gain is equal to P550. When the input selected by P553 is greater than P556 and less than P559 the proportional gain varies linearly between P550 and P225.

Factory setting: 0.00% Value range (steps): 0.00 to 100.00% (0.01%)

Access: 20 Change: on-line

P557 Threshold 1 for the speed controller integral adaptive gain

When the input selected by P554 is less than P557 the speed controller integral gain is equal to P551. When the input selected by P554 is greater than P557 and less than P560 the integral gain varies linearly between P551 and P226.

Factory setting: 0.00% Value range (steps): 0.00 to 100.00% (0.01%)

Access: 20 Change: on-line

P558 Threshold 1 for the speed controller adaptive droop

When the input selected by P555 is less than P558 the speed controller proportional gain is equal to P552. When the input selected by P555 is greater than P558 and less than P561 the speed droop varies linearly between P552 and P227.

Factory setting: 0.00% Value range (steps): 0.00 to 100.00% (0.01%)

Access: 20 Change: on-line

P559 Threshold 2 for speed controller proportional adaptive gain

When the input selected by P553 is greater than P559 the speed controller proportional gain is equal to P225. When the input selected by P553 is greater than P556 and less than P559 the proportional gain varies linearly between P550 and P225.

Factory setting: 0.00% Value range (steps): 0.00 to 100.00% (0.01%)

Access: 20 Change: on-line

P560 Threshold 2 for speed controller integral adaptive gain

When the input selected by P554 is greater than P560 the speed controller integral gain is equal to P226. When the input selected by P554 is greater than P557 and less than P560 the integral gain varies linearly between P551 and P226.

Factory setting: 0.00% Value range (steps): 0.00 to 100.00% (0.01%)

Access: 20 Change: on-line

P561 Threshold 2 for speed controller adaptive droop

When the input selected by P555 is greater than P561 the speed controller droop is equal to P227. When the input selected by P555 is greater than P558 and less than P561 the integral gain varies linearly between P552 and P227.

Factory setting: 0.00% Value range (steps): 0.00 to 100.00% (0.01%)
Access: 20 Change: on-line

Structure for armature current or torque control:**P600 Selecting the gating input source (armature)**

0 fixed value 0%
1 fixed value 100%
2 armature current controller output
3 to 399 connector number
Factory setting: 2 Value range(steps): 0 to 399 (connector number)
Access: 30 Change: off-line

P601.ii Selection of the armature current controller reference (before current limits)

0 fixed value 0%
1 fixed value 100%
2 torque limit output
3 to 399 connector number
Factory setting: 2 Value range(steps): 0 to 399 (connector number)
Access: 30 Change: off-line Index ii = 00 to 03

P602 Selection of the armature current controller feedback

Number of the connector for sourcing the current feedback
Factory setting: 2 (internal current feedback)
Value range: 0 to 399 (connector number)
Access: 30 Change: off-line

P603.ii Selection of positive current limit scaling

The active positive current limit equals P171 times the minimum value sourced by P603.ii.
Factory setting: 2 (100%) Value range: 0 to 399 (connector number)
Access: 30 Change: off-line Index ii = 00 to 03

P604.ii Selection of negative current limit scaling

The active negative current limit equals the absolute value of P172 times maximum value sourced by P604.ii.
Factory setting: 2 (negative value of the P603.ii selection)
Value range: 0 to 399 (connector number)
Access: 30 Change: off-line Index ii = 00 to 03

P605.ii Additional positive torque limits

The active positive torque limit is the minimum value of P605.ii and (P180 or P182).
Factory setting: 2 (200%) Value range: 0 to 399 (connector number)
Access: 30 Change: off-line Index ii = 00 to 03

P606.ii Additional negative torque limit

The active negative torque limit is the maximum value of P606.ii and (P181 or P183).

Factory setting: 2 (200%) Value range: 0 to 399 (connector number)

Access: 30 Change: off-line Index ii = 00 to 03

P607.ii Torque reference selection

Factory setting: 2 (speed controller output)

Value range: 0 to 399 (connector number)

Access: 30 Change: off-line Index ii = 00 to 03

Structure for the Speed Controller:**P608.ii Selection of the speed reference**

Factory setting: 2 (output of the reference limiting)

Value range: 0 to 399 (connector number)

Access: 30 Change: off-line Index ii = 00 to 03

P609 Selection of the speed feedback

Factory setting: 2 (analog input from terminals 60 to 64)

Value range: 0 to 399 (connector number)

Access: 30 Change: off-line

Structure for the Field and EMF Controllers:**P610 Selection of the field gating unit input**

Factory setting: 2 (output from the field current controller and the field feed forward controller)

Value range: 0 to 399 (connector number)

Access: 30 Change: off-line

P611.ii Field current reference selection

Factory setting: 2 (EMF controller output)

Value range: 0 to 399 (connector number)

Access: 30 Change: off-line Index ii = 00 to 03

P612 Field current feedback selection

Factory setting: 2 (internal field current feedback)

Value range: 0 to 399 (connector number)

Access: 30 Change: off-line

P613.ii Scaling for maximum field current reference

P102 is multiplied by the smallest value selected by P613.ii.

Factory setting: 2 (100%) Value range: 0 to 399 (connector number)

Access: 30 Change: off-line Index ii = 00 to 03

P614.ii Scaling for the minimum field current reference

P103 is multiplied by the largest value selected by P614.ii.

Factory setting: 2 (100%) Value range: 0 to 399 (connector number)

Access: 30 Change: off-line Index ii = 00 to 03

P615.ii EMF reference selection

Factory setting: 2 (P101 - P100 x P110)

Value range: 0 to 399 (connector number)

Access: 30

Change: off-line

Index ii = 00 to 03

P616 EMF feedback selection

Factory setting: 2 (internal EMF feedback)

Value range: 0 to 399 (connector number)

Access: 30

Change: off-line

Structure of the Ramp Function Generator:**P620.ii Ramp generator output additional positive limits**

The ramp generator output is limited to the lesser value of P620 and P300.

If the selected connector has a negative value, this results in a negative minimum speed reference being entered.

Factory setting: 2 (200%) Value range: 0 to 399 (connector number)

Access: 30

Change: off-line

Index ii = 00 to 03

P621.ii Ramp generator output additional negative limits

The ramp generator output is limited to the larger value of P621 and P301.

If the selected connector has a positive value, this results in a positive minimum speed reference being entered.

Factory setting: 2 (negative value selected by P620.ii)

Value range: 0 to 399 (connector number)

Access: 30

Change: off-line

Index ii = 00 to 03

P622.ii Selection of speed reference before limiting

Factory setting: 2 (output of ramp generator)

Value range: 0 to 399 (connector number)

Access: 30

Change: off-line

Index ii = 00 to 03

P623.ii Ramp generator input selection

Factory setting: 2

Value range: 0 to 399 (connector number)

Access: 30

Change: off-line

Index ii = 00 to 03

P624.ii Ramp generator rate and rounding scaling selection

Scales P303, P304, P305, and P306.

Factory setting: 2

Value range: 0 to 399 (connector number)

Access: 30

Change: off-line

Index ii = 00 to 01

P624.00 selects the signal to modify the ramp up and down rates. P624.01 selects the signal to modify the ramp rounding times.

P625.ii Ramp generator input additional positive limits

The ramp generator input is limited to the lesser value of P625 and (P315 or P319).

Factory setting: 2 (200%) Value range: 0 to 399 (connector number)

Access: 30

Change: off-line

Index ii = 00 to 03

P626.ii Ramp generator input additional negative limits

The ramp generator input is limited to the larger value of P626 and (P316 or P320).

Factory setting: 2 (negative value per P625.ii)

Value range: 0 to 399 (connector number)

Access: 30

Change: off-line

Index ii = 00 to 03

P627.ii Speed reference selection after reference enable

Factory setting: 2 Value range: 0 to 399 (connector number)

Access: 30

Change: off-line

Index ii = 00 to 03

P628.ii Speed reference selection before reference enable

Factory setting: 2 Value range: 0 to 399 (connector number)

Access: 30

Change: off-line

Index ii = 00 to 03

P629 Ramp generator initial value selection

The value of P629 is used to set the output of the ramp generator when:

- the operating status is ≥ 01.1

- P500 is not = 2 and P084 = 2

(slave reference doesn't come from the speed reference and current or torque operation selected)

- P500 is not = 2 and BIF 41 = 1

(slave reference doesn't come from the speed reference and slave operation selected)

Factory setting: 2 (speed feedback - K167)

Value range: 0 to 399 (connector number)

Access: 30

Change: off-line

Structure for the Technology Controller:**P630.ii Technology controller reference selection**

Factory setting: 2 (0%) Value range: 0 to 399 (connector number)

Access: 30

Change: off-line

Index ii = 00 to 03

P631.ii Technology controller feedback selection

Factory setting: 2 (0%) Value range: 0 to 399 (connector number)

Access: 30

Change: off-line

Index ii = 00 to 03

P632 Technology controller output positive limit scaling

The technology controller output is limited by P632 x P430.

Factory setting: 2 (100%) Value range: 0 to 399 (connector number)

Access: 30

Change: off-line

P633 Technology controller scaling selection

The technology controller output is scaled by P633 x P428.

Factory setting: 2 (100%) Value range: 0 to 399 (connector number)

Access: 30

Change: on-line

P634 Technology controller output negative limit scaling

The technology controller output is limited by P634 x P431.

Factory setting: 2 (negative value per P632)

Value range: 0 to 399 (connector number)

Access: 30

Change: off-line

Structure for Acceleration Compensation

P635.ii Inertia compensation selection

Factory setting: 2 Value range: 0 to 399 (connector number)
 Access: 20 Change: off-line Index ii = 00 to 03

Structure for the control words:

P640 Selection of the standard control word STW source

Connector which supplies the STW control word with data. The functions specified with STW are logically combined with the terminal functions and the functions selected with the variable control word STWF.
 Factory setting: 19 (disabled) Value range: 0 to 399 (connector number) (range increase ver 2.10)
 Access: 30 Change: off-line

P641 Freely definable control word STWF selection

Connector which supplies the STWF control word with data. The functions defined for the STWF word with P642.11 logically combined with the terminal functions and the functions specified for the STW control word.
 Factory setting: 19 (disabled) Value range: 0 to 399 (connector number) (range increase ver 2.10)
 Access: 30 Change: off-line

P642.ii Defines the function of the bits in the STWF control word

The values of P642 at the individual indices , ii = 0 to 15, are the numbers of the binary input functions, (BIF), which are assigned to the corresponding bits 0 to 15 of the STWF control word.

P642.00 defines the function of bit 0

P642.01 defines the function of bit 1

to

P642.15 defines the function of bit 15

Factory setting: 0 (undefined) Value range: 0 to 69 (binary input function)

Access: 30 Change: off-line Index ii = 00 to 15



WARNING

When changing parameters P640 to P642 undesirable structure changes or start commands can occur that can unexpectedly start the motor.

Loss of life, severe personal injury or property damage can result if instructions contained in this manual are not followed.

To prevent the motor from starting unexpectedly make sure that the operate enable function at terminal 38 is de-energized when changing these parameters.



Settings for the freely Definable Function Blocks:**P650.ii Input selection for adder 1**

Factory setting: 2 (0%) Value range: 0 to 399 (connector number)
Access: 20 Change: off-line Index ii = 00 to 01

P651.ii Input A selection for multiplier/divider 1

Factory setting: 2 (0%) Value range: 0 to 399 (connector number)
Access: 20 Change: off-line Index ii = 00 to 01

P652 Input B selection for multiply/divide 1

Factory setting: 2 (0%) Value range: 0 to 399 (connector number)
Access: 20 Change: off-line

P653.ii Input A selection for the diameter/divider function

Factory setting: 2 (0%) Value range: 0 to 399 (connector number)
Access: 20 Change: off-line Index ii = 00 to 01

P654 Input B selection for the diameter/divider function

Factory setting: 2 (0%) Value range: 0 to 399 (connector number)
Access: 20 Change: off-line

P655 Input selection for inverter 1

Factory setting: 2 (0%) Value range: 0 to 399 (connector number)
Access: 20 Change: off-line

P656.ii Input A selection for switch 1

Factory setting: 2 (0%) Value range: 0 to 399 (connector number)
Access: 20 Change: off-line Index ii = 00 to 01

P657 Input B selection for switch 1

Factory setting: 2 (0%) Value range: 0 to 399 (connector number)
Access: 20 Change: off-line

P658 Input selection for absolute value function 1

Factory setting: 2 (0%) Value range: 0 to 399 (connector number)
Access: 20 Change: off-line

P659 Input A selection for limit detector 1

Factory setting: 2 (0%) Value range: 0 to 399 (connector number)
Access: 20 Change: off-line

P660 Input B selection for limit detector 1

Factory setting: 2 (0%) Value range: 0 to 399 (connector number)
Access: 20 Change: off-line

P661.ii Input selection for adder 2

Factory setting: 2 (0%) Value range: 0 to 399 (connector number)
Access: 20 Change: off-line Index ii = 00 to 01

P662.ii Input A selection for multiplier/divider 2

Factory setting: 2 (0%) Value range: 0 to 399 (connector number)
Access: 20 Change: off-line Index ii = 00 to 01

P663 Input B selection for multiply/divide 2

Factory setting: 2 (0%) Value range: 0 to 399 (connector number)
Access: 20 Change: off-line

P664 Input for X-Y function generator

Factory setting: 2 (0%) Value range: 0 to 399 (connector number)
Access: 20 Change: off-line

P665 Input selection for inverter 2

Factory setting: 2 (0%) Value range: 0 to 399 (connector number)
Access: 20 Change: off-line

P666.ii Input A selection for switch 2

Factory setting: 2 (0%) Value range: 0 to 399 (connector number)
Access: 20 Change: off-line Index ii = 00 to 01

P667 Input B selection for switch 2

Factory setting: 2 (0%) Value range: 0 to 399 (connector number)
Access: 20 Change: off-line

P668 Input selection for the limiter function

Factory setting: 2 (0%) Value range: 0 to 399 (connector number)
Access: 20 Change: off-line

P669 Input selection for absolute value function 2

Factory setting: 2 (0%) Value range: 0 to 399 (connector number)
Access: 20 Change: off-line

P670 Input A selection for limit detector 2

Factory setting: 2 (0%) Value range: 0 to 399 (connector number)
Access: 20 Change: off-line

P671 Input B selection for limit detector 2

Factory setting: 2 (0%) Value range: 0 to 399 (connector number)
Access: 20 Change: off-line

P672.ii Input selection for adder 3

Factory setting: 2 (0%) Value range: 0 to 399 (connector number)
Access: 20 Change: off-line Index ii = 00 to 01

P673.ii Input A selection for multiplier/divider 3

Factory setting: 2 (0%) Value range: 0 to 399 (connector number)
Access: 20 Change: off-line Index ii = 00 to 01

P674 Input B selection for multiplier/divider 3

Factory setting: 2 (0%) Value range: 0 to 399 (connector number)
Access: 20 Change: off-line

P675 Input selection for inverter 3

Factory setting: 2 (0%) Value range: 0 to 399 (connector number)
 Access: 20 Change: off-line

P676.ii Input A selection for switch 3

Factory setting: 2 (0%) Value range: 0 to 399 (connector number)
 Access: 20 Change: off-line Index ii = 00 to 01

P677 Input B selection for switch 3

Factory setting: 2 (0%) Value range: 0 to 399 (connector number)
 Access: 20 Change: off-line

P679 Deadband adjustment for adder 3 function block

Factory setting: 1.00% Value range: 0.00 to 100.00% (0.01%)
 Access: 20 Change: on-line

P680 Multiply / Divide 1 Scaling

If set to 0.0, the block operates as a divider:
$$\text{output} = \frac{\text{input 1}}{\text{input 2}} * 100\%$$

If set > 0.0, the block operates as a multiplier:
$$\text{output} = \frac{\text{input A}}{100\%} * \text{input B} * \text{P680}$$

Input A is selected with P651 and input B is selected with P652.
 Factory setting: 1.0 Value range (steps): -1000 to 1000 (0.1)
 Access: 20 Change: on-line

P681 Multiply / Divide 2 Scaling

If set to 0.0, the block operates as a divider:
$$\text{output} = \frac{\text{input A}}{\text{input B}} * 100\%$$

If set > 0.0, the block operates as a multiplier:
$$\text{output} = \frac{\text{input A}}{100\%} * \text{input B} * \text{P681}$$

Input A is selected with P662 and input B is selected with P663.
 Factory setting: 1.0 Value range (steps): -1000 to 1000 (0.1)
 Access: 20 Change: on-line

P682 Multiply / Divide 3 Scaling

If set to 0.0, the block operates as a divider:
$$\text{output} = \frac{\text{input A}}{\text{input B}} * 100\%$$

If set > 0.0, the block operates as a multiplier:
$$\text{output} = \frac{\text{input A}}{100\%} * \text{input B} * \text{P682}$$

Input A is selected with P673 and input B is selected with P674.
 Factory setting: 1.0 Value range (steps): -1000 to 1000 (0.1)
 Access: 20 Change: on-line

P683 Minimum diameter limit

Only active when P684 = 3.

Factory setting: 10,000 mm Value range (steps): 1 to 10,000 mm (1 mm)

Access: 20 Change: on-line

P684 Control word for the diameter/ divider function

$$1 \quad \text{functions as a divider} \quad \text{output} = \frac{\text{input A}}{\text{input B}} * 100\%$$

Where input A is the sum of the values selected with P653.ii and input B is selected with P654. Parameters P683, P696, P697 have no effect.

2 speed reference calculation based on line speed (in mm/s) and diameter (in 0.1 mm).

$$\text{speed ref} = \frac{\text{line speed} * 10}{\text{diameter}} * \frac{100\%}{\pi * \frac{\text{nP450} + \text{nP451}}{60}}$$

where:

speed ref = motor speed reference in % of maximum speed (K245)

line speed = line speed reference in mm/s, range -32768 to +32767 mm/s (selected with P653).

diameter = diameter in 0.1 mm units, range 0.1 to 6553.5 mm, selected with P654.

nP450 + nP451 = the maximum roll RPM where n = the active parameter set number (1 to 4). Parameters P696 and P697 have no effect.

3 speed reference calculation based on line speed % scaled by P696 and diameter scaled by P697.

$$\text{speed ref} = \frac{\text{line speed} * \frac{\text{P696}}{100}}{\text{diameter} * \frac{\text{P697}}{100}} * \frac{100\%}{\pi * \frac{\text{nP450} + \text{nP451}}{60}}$$

where:

speed ref = motor speed reference in % of maximum speed (K245)

line speed = line speed reference in % of P696 where 16384 = 100%. (selected with P653).

diameter = diameter in % of P697 where 16384 = 100% (selected with P654).

nP450 + nP451 = the maximum roll RPM where n = the active parameter set number (1 to 4).

Factory setting: 1 Value range: 1 to 3

Access: 20 Change: off-line

P686 Positive limit for the limiter function

Factory setting: 100.00% Value range (steps): -200.0 to 199.99% (0.01%)

Access: 20 Change: on-line

P687 Negative limit for the limiter function

Factory setting: -100.00% Value range (steps): -200.0 to 199.99% (0.01%)

Access: 20 Change: on-line

P688 Control word for absolute value 1 function

0 Value selected by P658 input to K241 without a polarity change

1 The absolute value selected by P658 input to K241

2 Value selected by P658 input to K241 with a polarity change

3 The negative of the absolute value selected by P658 input to K241

Factory setting: 0 Value range: 0 to 3

Access: 20 Change: off-line

P689 Filter for absolute value 1 function

Factory setting: 0 ms Value range (steps): 0 to 10,000 ms (1 ms)
Access: 20 Change: on-line

P690 Control word for absolute value 2 function

0 Value selected by P669 input to K232 without a polarity change
1 The absolute value selected by P669 input to K232
2 Value selected by P669 input to K232 with a polarity change
3 The negative of the absolute value selected by P669 input to K232
Factory setting: 0 Value range: 0 to 3
Access: 20 Change: off-line

P691 Filter for absolute value 2 function

Factory setting: 0 ms Value range (steps): 0 to 10,000 ms (1 ms)
Access: 20 Change: on-line

P692 Control word for limit detector 1 (BOF 34)

1 binary output function 34 is energized for A<B
2 binary output function 34 is energized for A=B
Factory setting: 1 Value range: 1 to 2
Access: 20 Change: off-line

P693 Hysteresis for limit detector 1

Factory setting: 0.00% Value range (steps): 0.00 to 199.99% (0.01%)
Access: 20 Change: on-line

P694 Control word for limit detector 2 (BOF 35)

1 binary output function 35 is energized for A<B
2 binary output function 35 is energized for A=B
Factory setting: 1 Value range: 1 to 2
Access: 20 Change: off-line

P695 Hysteresis for limit detector 2

Factory setting: 0.00% Value range (steps): 0.00 to 199.99% (0.01%)
Access: 20 Change: on-line

P696 Scaling for main input of diameter/divider function block

Only active if P684 = 3.
This parameter specifies the line speed in mm/s that corresponds to 100% speed.
Factory setting: 100 mm/s Value range (steps): 1 to 32,767 mm/s (1 mm/s)
Access: 20 Change: off-line

P697 Scaling for diameter input of diameter/divider function block

Only active if P684 = 3.
This parameter specifies the diameter in mm that corresponds to 100% diameter.
Factory setting: 10,000 mm Value range (steps): 1 to 32,767 mm (1 mm)
Access: 20 Change: off-line

P698.ii X values for the X-Y function generator

The points of the function generator should be set in associated x,y pairs in parameters P698 and P699.

The x values must be set in increasing values such as P698.01 must be greater than P698.00.

Factory setting: 0.00% Value range (steps): -200.0 to 199.99% (0.01%)
Access: 20 Change: on-line Index ii = 00 to 09

P699.ii Y values for the X-Y function generator

The points of the function generator should be set in associated x,y pairs in parameters P698 and P699.

Factory setting: 0.00% Value range (steps): -200.0 to 199.99% (0.01%)
Access: 20 Change: on-line Index ii = 00 to 09

Settings for the Converter Hardware Interfaces:

Analog Inputs:

P700 Main analog reference resolution, terminals 4 & 5

The main reference, connected at terminals 4 and 5, is averaged over a specified measuring time. This parameter specifies the minimum achievable resolution of the A/D converter in bits as well as the measuring time.

The main reference A/D conversion is performed cyclically. The duration of the conversion cycle is dependent on the measuring time and is therefore a measure of the delay time when placing an analog step input until the earliest availability of a digital value is present. This parameter therefore defines the dynamic performance of this analog input. It should be noted however that the converted A/D value can only be read once per gating cycle (2.77 ms at 60 Hz.) and that the A/D conversion cycle is asynchronous to the gating cycle. A hardware filter of 1 ms is provided before the A/D conversion.

P700	Minimum Resolution	Measuring Time	Maximum Conversion Time
10	±10	0.1422 ms	0.4164 ms
11	±11	0.2844 ms	0.7009 ms
12	±12	0.5689 ms	1.2698 ms
13	±13	1.1378 ms	2.4076 ms
14	±14	2.2756 ms	4.6831 ms

Factory setting: 12 bit Value range (steps): 10 to 14 bits (1 bit)
Access: 20 Change: on-line

P701 Main reference scaling (terminals 4 and 5)

This parameter defines the main reference as a % for a 10 volt input (or a 20 ma input).

For voltage input:

$$\text{P701 \%} = \% \text{ required for a specified input voltage} \times \frac{10 \text{ volts}}{\text{specified input voltage}}$$

For 20 ma current input:

$$\text{P701 \%} = \% \text{ required for a specified input current} \times \frac{20 \text{ ma}}{\text{specified input current}}$$

Factory setting: 100% Value range (steps): -1000 to 1000% (1%)
Access: 20 Change: on-line

P702 Main reference offset (terminals 4 and 5)

Value which is added to the main reference. 1 count equals 0.0061% reference.

Factory setting: 0 Value range (steps): -9999 to 16384 * 0.0061% (1)

Access: 20 Change: on-line

P703 Main reference control word

x0 signal input without changing polarity

x1 the absolute value is input

x2 signal input with polarity change

x3 the negative of the absolute value is input

0x operation as voltage input ($\pm 10V$) (switch S4 on μ processor board in position 1)

1x operation as current input (4 to 20 ma) (switch S4 on μ processor board in position 2)

2x operation as current input (0 to 20 ma) (switch S4 on μ processor board in position 2)

Factory setting: 00 Value range (steps): 00 to 23 (1 Hex)

Access: 20 Change: off-line

P704 Main reference filter

Factory setting: 0 ms Value range (steps): 0 to 10,000 ms (1 ms)

Access: 20 Change: on-line

P706 Analog speed feedback scaling (terminals 60 to 64)

Value of the tachometer input voltage at maximum speed.

For P083 = 1 this defines the maximum motor speed.

Factory setting: 60.00 V Value range (steps): -270.00 to 270.00V (0.01V)

Access: 20 Change: on-line

P707 Analog feedback offset (terminals 60 to 64)

Value which is added to the analog speed feedback. 1 count equals 0.0061% speed.

Factory setting: 0 Value range (steps): -9999 to 16384 * 0.0061%(1)

Access: 20 Change: on-line

P708 Analog speed feedback control word (terminals 60 to 64)

x0 signal input without changing polarity

x1 the absolute value is input

x2 signal input with polarity change

x3 the negative of the absolute value is input

0x nothing connected to terminals 60 to 63

1x Analog tachometer connected to terminal 60 (range = 80 to 250 V)

2x Analog tachometer connected to terminal 62 (range = 25 to 80 V)

3x Analog tachometer connected to terminal 63 (range = 8 to 25 V)

Factory setting: 20 Value range (steps): 00 to 33 (1 Hex)

Access: 20 Change: off-line

P709 Analog speed feedback filter (terminals 60 to 64)

This filter time is included in the speed loop self tuning run, P051 = 26.

Factory setting: 0 ms Value range (steps): 0 to 10,000 ms (1 ms)

Access: 20 Change: on-line

P710 Analog reference 1, terminals 6 & 7, A/D resolution

The voltage, connected at terminals 6 and 7, is averaged over a specified measuring time. This parameter specifies the minimum achievable resolution of the A/D converter in bits as well as the measuring time.

The A/D conversion is performed cyclically. The duration of the conversion cycle is dependent on the measuring time and is therefore a measure of the delay time when placing an analog step input until the earliest availability of a digital value is present. This parameter therefore defines the dynamic performance of this analog input. It should be noted however that the converted A/D value can only be read once per gating cycle (2.77 ms at 60 Hz.) and that the A/D conversion cycle is asynchronous to the gating cycle. A hardware filter of 1 ms is provided before the A/D conversion.

P710	Minimum Resolution	Measuring Time	Maximum Conversion Time
10	±10	0.1422 ms	0.4164 ms
11	±11	0.2844 ms	0.7009 ms
12	±12	0.5689 ms	1.2698 ms
13	±13	1.1378 ms	2.4076 ms
14	±14	2.2756 ms	4.6831 ms

Factory setting: 12 bit
Access: 20

Value range (steps): 10 to 14 (1 unit)
Change: on-line

P711 Analog input 1 scaling (terminals 6 and 7)

This parameter defines the input value as a % for a 10 volt input (or a 20 ma input).
For voltage input:

$$\text{P711 \%} = \% \text{ required for a specified input voltage} \times \frac{10 \text{ volts}}{\text{specified input voltage}}$$

For 20 ma current input:

$$\text{P711 \%} = \% \text{ required for a specified input current} \times \frac{20 \text{ ma}}{\text{specified input current}}$$

Factory setting: 100%
Access: 20

Value range (steps): -1000 to 1000% (1%)
Change: on-line

P712 Analog input 1 offset (terminals 6 and 7)

Value which is added to analog input 1. 1 count equals 0.0061% reference.

Factory setting: 0

Value range (steps): -9999 to 16384 * 0.0061% (1)

Access: 20

Change: on-line

P713 Analog input 1 control word

x0 signal input without changing polarity

x1 the absolute value is input

x2 signal input with polarity change

x3 the negative of the absolute value is input

0x operation as voltage input (±10V) (switch S5 on A1-116-101-501 board in position 1)

1x operation as current input (4 to 20 ma) (switch S5 on A1-116-101-501 board in position 2)

2x operation as current input (0 to 20 ma) (switch S5 on A1-116-101-501 board in position 2)

For operation as a current input the polarity can be reversed using BIF 50.

Factory setting: 00

Value range (steps): 00 to 23 (1 Hex)

Access: 20

Change: off-line

P714 Analog input 1 filter

Factory setting: 0 ms Value range (steps): 0 to 10,000 ms (1 ms)
 Access: 20 Change: on-line

P716 Analog input 2 scaling (terminal 8)

This parameter defines the input value as a % for a 10 volt input.

$$\text{P716 \%} = \% \text{ required for a specified input voltage} \times \frac{10 \text{ volts}}{\text{specified input voltage}}$$

Factory setting: 100% Value range (steps): -1000 to 1000% (1%)
 Access: 20 Change: on-line

P717 Analog input 2 offset (terminal 8)

Value which is added to analog input 2. 1 count equals 0.0061% reference.

Factory setting: 0 Value range (steps): -9999 to 16384* 0.0061% (1)
 Access: 20 Change: on-line

P718 Analog input 2 control word (terminal 8)

0 signal input without changing polarity
 1 the absolute value is input
 2 signal input with polarity change
 3 the negative of the absolute value is input
 Factory setting: 0 Value range: 0 to 3
 Access: 20 Change: off-line

P719 Analog input 2 filter (terminal 8)

Factory setting: 0 ms Value range (steps): 0 to 10,000 ms (1 ms)
 Access: 20 Change: on-line

P721 Analog input 3 scaling (terminal 10)

This parameter defines the input value as a % for a 10 volt input.

$$\text{P721 \%} = \% \text{ required for a specified input voltage} \times \frac{10 \text{ volts}}{\text{specified input voltage}}$$

Factory setting: 100% Value range (steps): -1000 to 1000% (1%)
 Access: 20 Change: on-line

P722 Analog input 3 offset (terminal 10)

Value which is added to analog input 3. 1 count equals 0.0061% reference.

Factory setting: 0 Value range (steps): -9999 to 16384 * 0.0061%(1)
 Access: 20 Change: on-line

P723 Analog input 3 control word

0 signal input without changing polarity
 1 the absolute value is input
 2 signal input with polarity change
 3 the negative of the absolute value is input
 Factory setting: 0 Value range (steps): 0 to 3 (1 Hex)
 Access: 20 Change: off-line

P724 Analog select input 3 filter

Factory setting: 0 ms Value range (steps): 0 to 10,000 ms (1 ms)
 Access: 20 Change: on-line

Settings for Analog Outputs:

P739 Control word for terminal 12 (current feedback display output)

- 0 output without polarity change
(positive voltage for torque direction I, negative voltage for torque direction II)
 - 1 output the absolute value
 - 2 output with opposite polarity
(i.e., negative voltage for torque direction I positive voltage for torque direction II)
 - 3 output the negative of the absolute value
- Factory setting: 0 Value range: 0 to 3
Access: 20 Change: on-line

P740 Function selection for terminal 14 (analog output 1)

- Number of the connector whose value is to be output at terminal 14 with respect to terminal 15.
- 0 Fixed value of 0%
 - 1 Fixed value of 100%
 - 2 0%
 - 3 connector K003
to
399 connector K399
- Factory setting: 0 Value range: 0 to 399 (connector number)
Access: 20 Change: on-line

P741 Control word for analog output 1 (terminal 14)

- 0 output without polarity change
 - 1 output the absolute value
 - 2 output with opposite polarity
 - 3 output the negative of the absolute value
- Factory setting: 0 Value range: 0 to 3
Access: 20 Change: on-line

P742 Filter time for analog output 1

- Factory setting: 0 ms Value range: 0 to 10,000 ms (1 ms)
Access: 20 Change: on-line

P743 Analog output 1 offset

- 1 count equals 5.33 mv.
Factory setting: 0 Value range: -2000 to 2000 * 5.33 mv
Access: 20 Change: on-line

P744 Analog output 1 scaling

- Output voltage = $\frac{\text{connector\%}}{100\%} * P744$**
- Factory setting: 10.00 V Value range (steps): -200.0 to +200.00 V (0.01 V)
Access: 20 Change: on-line
The maximum output voltage is limited to approximately 11 volts.

P745 Function selection of analog output 2 (terminal 16)

Number of the connector whose value is to be output at terminal 16 with respect to terminal 17.

- 0 Fixed value of 0%
- 1 Fixed value of 100%
- 2 0%
- 3 connector K003

to

399 connector K399

Factory setting: 0 Value range: 0 to 399 (connector number)

Access: 20 Change: on-line

P746 Control word for analog output 2 (terminal 16)

- 0 output without polarity change
- 1 output the absolute value
- 2 output with opposite polarity
- 3 output the negative of the absolute value

Factory setting: 0 Value range: 0 to 3

Access: 20 Change: on-line

P747 Filter time for analog output 2 (terminal 16)

Factory setting: 0 ms Value range: 0 to 10,000 ms (1 ms)

Access: 20 Change: on-line

P748 Analog output 2 offset (terminal 16)

1 count equals 5.33 mv.

Factory setting: 0 Value range: -2000 to 2000 * 5.33 mv (1)

Access: 20 Change: on-line

P749 Analog output 2 scaling

$$\text{Output voltage} = \frac{\text{connector\%}}{100\%} * \text{P749}$$

Factory setting: 10.00 V Value range (steps): -200.00 to +200.00 V (0.01 V)

Access: 20 Change: on-line

The actual maximum output voltage is limited to approximately 11 volts.

P750 Function selection for analog output 3 (terminal 18)

Number of the connector whose value is to be output at terminal 18 with respect to terminal 19.

- 0 Fixed value of 0%
- 1 Fixed value of 100%
- 2 0%
- 3 connector K003

to

399 connector K399

Factory setting: 0 Value range: 0 to 399 (connector number)

Access: 20 Change: on-line

P751 Control word for analog output 3 (terminal 18)

- 0 output without polarity change
- 1 output the absolute value
- 2 output with opposite polarity
- 3 output the negative of the absolute value

Factory setting: 0 Value range: 0 to 3

Access: 20 Change: on-line

P752 Filter time for analog select output 3

Factory setting: 0 ms Value range: 0 to 10,000 ms (1 ms)

Access: 20 Change: on-line

P753 Analog output 3 offset

1 count equals 5.33 mv.

Factory setting: 0 Value range: -2000 to 2000 * 5.33 ms (1)

Access: 20 Change: on-line

P754 Analog output 3 scaling

$$\text{Output voltage} = \frac{\text{connector}\%}{100\%} * \text{P754}$$

Factory setting: 10.00 V Value range (steps): -200.00 to +200.00 V (0.01 V)

Access: 20 Change: on-line

The actual maximum output voltage is limited to approximately 11 volts.

P755 Function selection for analog output 4 (terminal 20)

Number of the connector whose value is to be output at terminal 20 with respect to terminal 21.

0 Fixed value of 0%

1 Fixed value of 100%

2 0%

3 connector K003

to

399 connector K399

Factory setting: 0 Value range: 0 to 399 (connector number)

Access: 20 Change: on-line

P756 Control word for analog output 4 (terminal 20)

0 output without polarity change

1 output the absolute value

2 output with opposite polarity

3 output the negative of the absolute value

Factory setting: 0 Value range: 0 to 3

Access: 20 Change: on-line

P757 Filter time for analog output 4

Factory setting: 0 ms Value range: 0 to 10,000 ms (1 ms)

Access: 20 Change: on-line

P758 Analog output 4 offset

1 count equals 5.33 mv.

Factory setting: 0 Value range: -2000 to 2000 * 5.33 mv (1)

Access: 20 Change: on-line

P759 Analog output 4 scaling

$$\text{Output voltage} = \frac{\text{connector}\%}{100\%} * \text{P759}$$

Factory setting: 10.00 V Value range (steps): -200.0 to +200.00 V (0.01 V)

Access: 20 Change: on-line

The actual maximum output voltage is limited to approximately 11 volts.

Settings for the Binary Inputs:

P761 Function selection for binary input 1 (terminal 39)

0 disabled
 1 reserved
 2 binary input function 2 as described in Section 10.2
 x selectable binary input functions as described in Section 10.2
 Factory setting: 0 Value range: 0 to 69
 Access: 20 Change: off-line

P762 Function selection for binary input 2 (terminal 40)

0 disabled
 1 reserved
 2 binary input function 2 as described in section 10.2
 x selectable binary input functions as described in section 10.2
 Factory setting: 0 Value range: 0 to 69
 Access: 20 Change: off-line

P763 Function selection for binary input 3 (terminal 41)

0 disabled
 1 reserved
 2 binary input function 2 as described in section 10.2
 x selectable binary input functions as described in section 10.2
 Factory setting: 0 Value range: 0 to 69
 Access: 20 Change: off-line

P764.ii Function selection for binary input 4 (terminal 42)

Up to three functions can be activated at the same time from terminal 42 by selecting them using the 3 parameter indices.

0 disabled
 1 reserved
 2 binary input function 2 as described in section 10.2
 x selectable binary input functions described in section 10.2
 Factory setting: 0 Value range: 0 to 69
 Access: 20 Change: off-line index ii = 00 to 02

P765.ii Function selection for binary input 5 (terminal 43)

Up to three functions can be activated at the same time from terminal 43 by selecting them using the 3 parameter indices.

0 disabled
 1 reserved
 2 binary input function 2 as described in section 10.2
 x selectable binary input functions described in section 10.2
 Factory setting: 0 Value range: 0 to 69
 Access: 20 Change: off-line index ii = 00 to 02

P766 Function selection for binary input 6 (terminal 36)

0 disabled
 1 reserved
 2 binary input function 2 as described in section 10.2
 x selectable binary input functions as described in section 10.2
 Factory setting: 5 (fault reset) Value range: 0 to 69
 Access: 20 Change: off-line

P767 Delay of the external fault

If a binary input or a bit of the STWF control word is assigned the "external fault" function, BIF 53, a fault message is only displayed at the drive when the assigned input is set LOW for a time longer than programmed with P767.

Factory setting: 0 ms

Value range (steps): 0 to 10,000 ms (1 ms)

Access: 20

Change: on-line

P769 Control word for selection the starting method using push buttons or switches

This parameter selects the method of starting for normal start and thread using the terminals so that either momentary push buttons or maintained switches can be used.

0 Level sensing is used for a maintained start switch (energized → start, de-energized → stop)

1 Positive Edge sensing is used for starting using momentary push-button control. If push-button starting is selected then push-button stopping must also be selected using negative edge sensing with a terminal assigned to BIF 2.

Factory setting: 0

Value range (steps): 0 to 1 (1 Hex)

Access: 20

Change: off-line

Settings for the Binary Outputs:

P770 Control word for the binary outputs

xxx0 binary output 1 (terminal 46) is not inverted

xxx1 binary output 1 (terminal 46) is inverted

xx0x binary output 2 (terminal 48) is not inverted

xx1x binary output 2 (terminal 48) is inverted

x0xx binary output 3 (terminal 50) is not inverted

x1xx binary output 3 (terminal 50) is inverted

0xxx binary output 4 (terminal 52) is not inverted

1xxx binary output 4 (terminal 52) is inverted

Factory setting: 0000

Value range (steps): 0000 to 1111 (1 Hex)

Access: 20

Change: off-line

P771 Function selection for binary output 1 (terminal 46)

0 logic "0"

1 logic "1"

2 logic "0" or set by binary input function, BIF 61.

3 Fault H: No fault

L: Fault

X binary output function number ... see section 10.4

Factory setting: 3

Value range: 0 to 35

Access: 20

Change: on-line

P772 Function selection for binary output 2 (terminal 48)

0 logic "0"
 1 logic "1"
 2 logic "0" or set by binary input function, BIF 62.
 3 Fault H: No fault
 L: Fault

X binary output function number ... see section 10.4
 Factory setting: 0 Value range: 0 to 35 (BOF number)
 Access: 20 Change: on-line

P773 Function selection for binary output 3 (terminal 50)

0 logic "0"
 1 logic "1"
 2 logic "0" or set by binary input function, BIF 63.
 3 Fault H: No fault
 L: Fault

X binary output function number ... see section 10.4
 Factory setting: 0 Value range: 0 to 35 (BOF number)
 Access: 20 Change: on-line

P774 Function selection for binary output 4 (terminal 52)

0 logic "0"
 1 logic "1"
 2 logic "0" or set by binary input function, BIF 64.
 3 Fault H: No fault
 L: Fault

X binary output function number ... see section 10.4
 Factory setting: 0 Value range: 0 to 35 (BOF number)
 Access: 20 Change: on-line

P775 Binary output 1 delay (terminal 46)

The logic signal selected for output is only passed to the output if the internal signal is constant for a time longer than set with P775.

Factory setting: 0 ms Value range (steps): 0 to 10,000 ms (1 ms)
 Access: 20 Change: on-line

P776 Binary output 2 delay (terminal 48)

The logic signal selected for output is only passed to the output if the internal signal is constant for a time longer than set with P776.

Factory setting: 0 ms Value range (steps): 0 to 10,000 ms (1 ms)
 Access: 20 Change: on-line

P777 Binary output 3 delay (terminal 50)

The logic signal selected for output is only passed to the output if the internal signal is constant for a time longer than set with P777.

Factory setting: 0 ms Value range (steps): 0 to 10,000 ms (1 ms)
 Access: 20 Change: on-line

P778 Binary output 4 delay (terminal 52)

The logic signal selected for output is only passed to the output if the internal signal is constant for a time longer than set with P778.

Factory setting: 0 ms Value range (steps): 0 to 10,000 ms (1 ms)
 Access: 20 Change: on-line

Settings for the Serial Interfaces:

P780 Protocol selection for PORT 0 (RS485) at X500

Refer to section 10.7 for details on the serial interface.

xxx0	No function		
xxx1	Function can be selected via P051 (4-wire operation)		
xxx2	USS protocol (2-wire operation)		
xxx3	free		
xxx4	"Peer-to-peer" communication (2-wire operation)		
xxx5	"Peer-to-peer" communication (4-wire operation)		
xxx6	free		
xxx7	free		
xxx8	free		
xxx9	Diagnostics monitor (4-wire operation)		
xx8x	8-bit date frame ("8 data bits" or "7 data bits + parity bit")		
xx9x	9-bit date frame ("9 data bits" or "8 data bits + parity bit")		
x0xx	No parity check and generation		
x1xx	Checking for even parity and transmitting a corresponding parity bit		
1xxx	1 stop bit		
2xxx	2 stop bits		
Factory setting:	1180	Value range (steps):	1080 to 2199 (1 Hex)
Access:	20	Change:	off-line

Note:

A new serial interface setting with parameters P780 and P783 only becomes active when the value of P780 is changed. If both P780 and P783 are to be changed then P783 must be changed before P780 is changed. If only P783 is to be changed, it will be necessary to also change P780 initially and then reset P780 to the desired value after P783 has been set. Alternately the power can be cycled after the parameters have been changed.

P781 Number of PROCESS DATA (PZD) words for PORT 0 (RS485) at X500

This parameter is only effective if P780 = xxx2 (USS protocol).

0	No process data is expected in the USS protocol, and none is sent
1 to 16	Number of process data words in the USS protocol

The received process data values are available at connectors K020 to K035. The process data values to be sent in the USS telegram are assigned using parameter P784.00 to P784.15.

Factory setting:	0 words	Value range:	0 to 16 words
Access:	20	Change:	off-line

P782 Number of parameter handling (PKW) words for PORT 0 (RS485) at X500

This parameter is only effective if P780 = xxx2 (USS protocol).

0 to 2	<u>No PKW data</u> is expected in the USS protocol and none is sent		
3 to 127	<u>3 PKW data words</u> are expected in the USS protocol, and 3 PKW data words are sent		
Factory setting:	0	Value range:	0 to 127
Access:	20	Change:	off-line

P783 Baud rate for PORT 0 (RS485) at X500

- 1 300 baud
- 2 600 baud
- 3 1200 baud
- 4 2400 baud
- 5 4800 baud
- 6 9600 baud
- 7 19200 baud
- 8 38400 baud
- 9 93750 baud
- 10 187500 baud

Factory setting: 10

Value range: 1 to 10

Access: 20

Change: off-line

Note:

This parameter only becomes effective if parameter P780 is changed, and then the SELECT key or the P key is depressed (i.e., when the parameter mode is selected) or if power is cycled off and on.

P784.ii Send PROCESS DATA (PZD) assignment for PORT 0 (RS485) at X500

This parameter is only effective if P780 = xxx2 (USS protocol) or P780 = xxx4(peer-to-peer bus communication) or P780 = xxx5 (peer to peer communications).

Selects the actual values to be sent out in each of the process data words on port 0. The values are chosen by their associated connector number. Index 0 assigns a connector to output word 0, index 1 assigns a connector to output word 1, etc.

Factory setting: 0

Value range: 0 to 399 (connector number)

Access: 20

Change: off-line

Index = 00 to 15

P786 Bus address for PORT 0 (RS485) at X500

This parameter is only effective if P780 = xxx2 (USS protocol).

Selects the bus address of the drive for USS protocol.

Factory setting: 0

Value range: 0 to 30

Access: 20

Change: off-line

P787 Telegram failure time for PORT 0 (RS485) at X500

This parameter is only effective if P780 = xxx2 (USS protocol).

0 No time monitoring

1 to 32 Time which can expire between the reception of 2 telegrams addressed for the converter before a fault F014 signal is output.

Factory setting: 1

Value range (steps): 0 to 32s (1s)

Access: 20

Change: off-line

P788 Peer to Peer time out for PORT 0 (RS485) at X500

This parameter sets the time out for peer to peer telegrams when P780 = xxx4 or xxx5. This is the time which can expire between the reception of 2 telegrams before a fault F015 or F025 is issued. The following minimum settings as a function of baud rate are recommended.

Baud Rate	Minimum Time
300 baud	520 ms
600 baud	260 ms
1200 baud	140 ms
2400 baud	80 ms
≥4800 baud	40 ms

Factory setting: 40 ms
Access: 20

Value range: 40 to 10,000 ms (1 ms)
Change: off-line

P790 Protocol selection for PORT 1 (RS232) at X501

Refer to section 10.7 for details on the serial interface.

xxx0 No function
 xxx1 Function can be selected with P051 for Port 1
 (RS232 or RS485 with optional converter using 4-wire operation)
 xxx2 USS protocol (RS232 or for RS485 option: 2-wire operation)
 xxx3 free
 xxx4 "peer to peer" bus communications only with RS485 optional A1618 converter: 2-wire operation
 xxx5 "peer-to-peer" communication RS232 or RS485 with optional A1618 converter: 4-wire operation
 xxx6 free
 xxx7 free
 xxx8 free
 xxx9 Diagnostics monitor (for option RS485: 4-wire operation)
 xx8x 8-bit data frame ("8 data bits" or "7 data bits + parity bit")
 xx9x 9-bit data frame ("9 data bits" or "8 data bits + parity bit")
 x0xx No parity check and generation
 x1xx Checking for even parity and transmitting a corresponding parity bit
 1xxx 1 stop bit
 2xxx 2 stop bits

Factory setting: 1192
Access: 20

Value range (steps): 1080 to 2199 (1 Hex)
Change: off-line

Note:

A new serial interface setting with parameters P790 and P793 only becomes active when the value of P790 is changed. If both P790 and P793 are to be changed then P793 must be changed before P790 is changed. If only P793 is to be changed, it will be necessary to also change P790 initially and then reset P790 to the desired value after P793 has been set. Alternately the power can be cycled after the parameters have been changed.

P791 Number of PROCESS DATA (PZD) words for PORT 1 (RS232) at X501 (or RS485 with optional board A1618)

This parameter is only effective if P790 = xxx2 (USS protocol).

0 No process data is expected in the USS protocol, and none is sent
 1 to 16 Number of process data words in the USS protocol

Factory setting: 3

Value range: 0 to 16

Access: 20

Change: off-line

P792 Number of parameter handling (PKW) words for PORT 1 (RS232) at X501 (or RS485 with optional board A1618)

This parameter is only effective if P790 = xxx2 (USS protocol).

0 to 2 No PKW data is expected in the USS protocol, and none is sent

3 to 127 3 PKW data words are expected in the USS protocol, and 3 PKW data words are sent

Factory setting: 3 Value range: 0 to 127

Access: 20 Change: off-line

P793 Baud rate for PORT 1 (RS232) at X501 (or RS485 with A1618 optional board)

1 300 baud

2 600 baud

3 1200 baud

4 2400 baud

5 4800 baud

6 9600 baud

7 19200 baud

8 38400 baud

9 93750 baud

10 187500 baud

Factory setting: 6 Value range: 1 to 10

Access: 20 Change: off-line

Note:

This parameter only becomes effective if parameter P790 is changed, and then the SELECT key or the P key is depressed (i.e., when the parameter mode is selected).

P794.ii Send PROCESS DATA (PZD) assignment for PORT 1 (RS232) at X501 (or RS485 with optional board A1618)

This parameter is only effective, if P790 = xxx2 (USS protocol) or P790 = xxx4 (peer-to-peer bus communication) or P790 = xxx5 (peer to peer communications).

Selects the actual value to be sent out in each of the process data words on port 1. The values are chosen by their associated connector number. Index 0 assigns a connector to output word 0, index 1 assigns a connector to output word 1, etc.

Factory setting: 0 Value range: 0 to 399 (connector number)

Access: 20 Change: off-line Index = 00 to 15

P796 Bus address for PORT 1 (RS232) at X501 (or RS485 with optional board A1618)

This parameter is only effective if P790 = xxx2 (USS protocol).

Selects the bus address of the drive for USS protocol.

Factory setting: 0 Value range: 0 to 30

Access: 20 Change: off-line

P797 Telegram failure time for PORT 1 (RS232) at X501 (or RS485 with optional A1618 board)

This parameter is only effective if P790 = xxx2 (USS protocol).

0 No time monitoring

1 to 32 Time which can expire between the reception of 2 telegrams addressed for the converter before a fault F024 signal is output.

Factory setting: 0 Value range (steps): 0 to 32s (1s)

Access: 20 Change: off-line

P798 Control word for PORT 1 (RS232) at X501 (or RS485 with optional A1618 board)

This parameter is only effective at P790 = xxx1 and P790 = xxx9.

1 Software handshake XON/OFF

Received character:

XOFF (13H): The drive is not allowed to transmit telegrams
 XON (11H): The drive is allowed to transmit telegrams
 other characters: are ignored

2 Hardware handshake

CTS input (X501 pin 8): Clear to send
 Low signal (= + 10V): The drive transmit
 High signal (= - 10V): The drive is not allowed to transmit

RTS output (X501 Pin 7): Request to send
 Low signal (= + 10V): The drive is ready to receive
 High signal (= - 10V): The drive is not ready to receive

Caution:

The receiving device (printer, PC, etc.) must switch the CTS signal to high before its receive buffer reaches a minimum reserve capacity (refer to the following table), or buffer overflow will occur with an associated data loss (printer ignores characters).

Baud rate	Required buffer reserve in the receiving device
300 to 4800	1 byte
9600	2 bytes
19200	3 bytes
38400	5 bytes
93750	11 bytes
187500	20 bytes

Factory setting: 1

Access: 20

Value range: 1 to 2

Change: off-line

NOTE

Hardware handshake is not possible when using the optional board A1618.

Parameter P798 must be set to 1.

Settings for the Diagnostic Trace Monitor Function:

P840 Number of lines recorded by the diagnostic monitor

Each of the 8 trace buffers can accommodate up to 128 values. This parameter displays the number of valid points recorded.

Value range: 0 to 128 Access: Can only be read.

P841.ii Trace display values for trace buffer 1 (for display on the optional operator panel)

P841 displays of the contents of the first 100 points in trace buffer 1.

Index .00 to Index .99 Show 100 trace values for buffer 1

Value range: 0000 to FFFF (hex) or -200.0% to 199.00% as selected with P870.

P842.ii Trace display values for trace buffer 2 (for display on the optional operator panel)

P841 displays of the contents of the first 100 points in trace buffer 2.

Index .00 to Index .99 Show 100 trace values for buffer 2.

Value range: 0000 to FFFF (hex) or -200.0% to 199.00% as selected with P870.

P843.ii Trace display values for trace buffer 3 (for display on the optional operator panel)

P841 displays of the contents of the first 100 points in trace buffer 3.

Index .00 to Index .99 Show 100 trace values for buffer 3.

Value range: 0000 to FFFF (hex) or -200.0% to 199.00% as selected with P870.

P844.ii Trace display values for trace buffer 4 (for display on the optional operator panel)

P841 displays of the contents of the first 100 points in trace buffer 4.

Index .00 to Index .99 Show 100 trace values for buffer 4.

Value range: 0000 to FFFF (hex) or -200.0% to 199.00% as selected with P870.

P845.ii Trace display values for trace buffer 5 (for display on the optional operator panel)

P841 displays of the contents of the first 100 points in trace buffer 5.

Index .00 to Index .99 Show 100 trace values for buffer 5.

Value range: 0000 to FFFF (hex) or -200.0% to 199.00% as selected with P870.

P846.ii Trace display values for trace buffer 6 (for display on the optional operator panel)

P841 displays of the contents of the first 100 points in trace buffer 6.

Index .00 to Index .99 Show 100 trace values for buffer 6.

Value range: 0000 to FFFF (hex) or -200.0% to 199.00% as selected with P870.

P847.ii Trace display values for trace buffer 7 (for display on the optional operator panel)

P841 displays of the contents of the first 100 points in trace buffer 7.

Index .00 to Index .99 Show 100 trace values for buffer 7.

Value range: 0000 to FFFF (hex) or -200.0% to 199.00% as selected with P870.

P848.ii Trace display values for trace buffer 8 (for display on the optional operator panel)

P841 displays of the contents of the first 100 points in trace buffer 8.

Index .00 to Index .99 Show 100 trace values for buffer 8.

Value range: 0000 to FFFF (hex) or -200.0% to 199.00% as selected with P870.

P849 Trigger location

This parameter marks the index of parameters P841.ii to P848.ii that corresponds to the first value after the trigger event. The value can be between 0 and 127 and can only be read.

Settings to disable faults and parameter change reports:



WARNING



If monitoring functions are disabled and an actual fault does occur loss of life, severe personal injury or property damage can result.

Only qualified personnel should work on this equipment, and only after becoming familiar with all safety notices, installation, operation and maintenance procedures contained in this manual should monitoring functions be disabled.

P850.ii Disabling monitoring functions

The numbers of all monitoring functions, which are to be disabled, are entered in this parameter. The fault number sequence can be random. 0 should be written into indices of parameter P850 which are not used.

Factory Settings:

P850.00 = 7 (overvoltage)
 P850.01 = 28 (Short-circuit at the binary outputs)
 P850.02 = 30 (Not Used)
 P850.03 = 31 (Controller monitoring, speed controller)
 P850.04 = 32 (Controller monitoring, armature current controller)
 P850.05 = 33 (Controller monitoring, EMF controller)
 P850.06 = 34 (Controller monitoring, field current controller)
 P850.07 = 35 (Drive stalled)
 P850.08 = 36 (No armature current can flow)
 P850.09 = 37 (I²t motor monitoring has responded)
 P850.10 to P850.99 = 0

Value range: 0 to 127

Access: 30

Change: on-line

Index ii = 00 to 99

P855 Control word for spontaneous messages

If a parameter value has been changed, (operator panel, base serial ports, or option board DPR interface), the new value is sent to other nodes such as USS serial ports 0 and 1 or the DPR using the change report (spontaneous message) mechanism. This function can be enabled or disabled for every interface.

Caution:

When changing the control word, parameter change buffers can be deleted!

000 No change report messages are sent
 xx1 Change reports to USS protocol to PORT 0 (X500)
 x1x Change reports to USS protocol to PORT 1 (X501 or X502)
 1xx Reserved (change reports to the dual port RAM is not implemented in version 2.00)
 Factory setting: 000 Value range (steps): 000 to 111 (1 Hex)
 Access: 30 Change: off-line

Settings for Diagnostic Aids

Thyristor diagnostics:

P860 Control word for thyristor diagnostics

- 0 Thyristor check disabled
- 1 Thyristors are only checked once after the first RUN or JOG command.
- 2 Thyristors are checked at each RUN or JOG command.
- 3 Thyristors are checked at the next RUN or JOG command.

If no faults occur, parameter P860 is set to 0.

Note: The thyristor diagnostics can not be used when the converter is supplying a high inductive load such as a motor field or if BIF 60 is used. For more information see section 8.2.5.

Factory setting: 0 Value range: 0 to 3

Access: 20 Change: off-line

Settings for Diagnostic Recording:

P861.ii Number of the connectors to be used for diagnostic tracing

Selecting the connectors which are to be recorded during diagnostic tracing

- 00 Reserved
- 01 Number of the 1st connector
- 02 Number of the 2nd connector
- 03 Number of the 3rd connector
- 04 Number of the 4th connector
- 05 Number of the 5th connector
- 06 Number of the 6th connector
- 07 Number of the 7th connector
- 08 Number of the 8th connector

Factory setting: 0 Value range: 0 to 399 (connector number)

Access: 10 Change: on-line Index ii = 00 to 08

P862 Connector number used for the trigger condition

Number of the connector that will be sensed for the trigger point.

Factory setting: 0 Value range: 0 to 399 (connector number)

Access: 20 Change: on-line

P863 Trigger condition for diagnostic tracing

The value of the connector selected in P862 will be checked against the condition selected with P863 to determine the trigger point.

- 0 Trigger condition "<"
- 1 Trigger condition "="
- 2 Trigger condition ">"
- 3 Triggered when a fault occurs (P862 and P864 are then not used)

Factory setting: 0 Value range: 0 to 3

Access: 20 Change: on-line

P864 Percentage value in the trigger condition for diagnostic tracing

Threshold value for the connector value defined with parameter P862 which causes a trigger and starts the trace command.

Factory setting: 0.0% Value range (steps): -200.0 to 199.9% (0.1%)

Access: 20 Change: on-line

P865 Sampling interval for diagnostic tracing

This parameter selects the sample time for the trace buffer and determines if the selected connectors are recorded every pulse, every 2nd, ... up to every 99th gating pulse cycle. A gating pulse cycle is 1/6 of the supply frequency period or 2.77 ms at 60 Hz.

Factory setting: 1 Value range: 1 to 99 * 2.77 ms
Access: 20 Change: on-line

P866 Trigger delay for diagnostic tracing

Number of record cycles where tracing is active after the trigger event.

Factory setting: 1 Value range: 1 to 99
Access: 20 Change: on-line

P867 Control bit for diagnostic tracing

The trigger is armed with P867 = 1.

0 No tracing is executed, or tracing has already been completed.

1 Tracing when the trigger condition is met. When complete P867 is reset to zero.

Factory setting: 0 Value range: 0 to 1
Access: 20 Change: on-line

P868 Output speed when using the analog output for reporting the trace buffer contents

The values of the first four traced connectors can be output on the analog outputs 1 to 4 as voltages between ± 10 volts. The output speed is 300/P869 values per second.

Factory setting: 1 Value range: 1 to 300
Access: 20 Change: on-line

P869 Output mode for the analog output of the trace buffer

1 Single output (used with plotters)

2 Continuous output (for strip chart recorders and oscilloscopes)

Factory setting: 1 Value range: 1 to 2
Access: 20 Change: on-line

P870 Trace buffer display mode

This parameter determines how the contents of the trace buffer will be displayed.

0 Hexadecimal

1 Percent (100% = 16384 counts)

Factory setting: 1 Value range: 0 to 1
Access: 20 Change: on-line

Number of write accesses to the permanent EEPROM memory**P871 Number of write accesses to the EEPROM**

Display indicating how often an individual byte has been written into the EEPROM.

Factory setting: 0

Access: can only be read

Note:

Each time a parameter is changes in the EEPROM the number of write accesses displayed at P871 is updated. Only a limited number of write accesses are guaranteed (10,000) in the life time of the EEPROM. For this reason frequent parameter changes should be made only in the RAM if possible. Changing parameters from the serial interface allows the parameter to be changed in only RAM or in both RAM and EEPROM. If the parameter change is not required to be permanent then it should be changed only in the RAM.

P872 Number of page-write accesses to the EEPROM

Display indicating how often non-volatile process data were written into the EEPROM when power is turned off or lost.

Value range: 0 to 65535 Access: can only be read

Fault Memory:**P880.ii Fault parameter**

This parameter displays the numbers of the 4 faults which last occurred.

- 00 Number of the last fault
- 01 Number of the next to last fault
- 02 Number of the third from last fault
- 03 Number of the fourth from last fault

Factory setting: 0 Value range: 0 to 255

Access: can only be read Index ii = 00 to 03

Reading out Memory Locations:**P881 Segment number of the basic address**

0 to 3

The contents of any memory location can be displayed using parameters P881 to P883.ii.

P881 defines the segment number (5th digit) of the basic address, whose contents are displayed at P883.

Example:

The contents of address 2468A_{hex} are to be displayed => P881 = 2

Factory setting: 0

Access: 40 Change: on-line

P882 Segment offset of the basic address

P882 defines the segment offset of the basic address, whose contents are to be displayed at P883. Using the index from P883, the data words following this basic address, can be displayed.

Example:

Contents of address 2468A_{hex} are to be displayed => P882 = 468A.

Caution:

Only even addresses are permitted, as the contents of one data word are displayed using P883.ii. When an uneven address is entered, the contents of the next lowest, even address, are displayed (e.g., instead of

123_{hex}, address 122_{hex} is used).

Factory setting: 0 Value range: 0000 to FFFF

Access: 40 Change: on-line

P883.ii Contents of the specified address

P883.00 displays the contents of the basic address, specified with P881 and P882. By increasing the index value, the data words, following this basic address, can be displayed. Parameter P870 can be used to determine if the display is in hex or a % of 16384.

Example:

P881 = 2 and P882 = 468A.

The contents of the following addresses

246C_{hex}, 246E_{hex}, etc. are displayed by increasing the index value, i.e., using P883.00, the contents of basic address 246A_{hex} are displayed, P883.01, 2468C_{hex}, etc.

Caution:

When the maximum address 3FFFF_{hex} is exceeded by increasing the index value of P883, the addresses from 00000_{hex} are displayed again.

Value range: 0000 to FFFF (Hex)

Access: Can only be read Index ii = 00 to 99

Settings for Internal Converter Adjustments:**P884 Offset adjustment for the field current actual value channel**

$$\text{Parameter value} = \frac{18000}{f_o \text{ (kHz)}}$$

Where: f_o is the frequency at which field current actual value 0% is generated.

The nominal value 1.128 kHz and corresponds to a parameter value of 15957.

P884 is automatically set during the current controller self tuning run (P051 = 25), or when an offset run is performed (P051 = 22), or at the end of the default procedure.

Value range: 12418 to 20000 Nominal value: 15957

Access: 20 Change: off-line

P885 Offset adjustment for the main actual value channel 1

Each bit of the parameter value corresponds to approx. 0.012% of the nominal value of the main actual value provided the nominal value of the input quantity lies within the voltages specified for terminals 60 to 64 (8 - 25V, 25 - 80V, 80 - 250V).

P885, together with P886, are automatically set during the automatic offset adjustment (P51 = 22), or at the end of the default procedure.

Value range: -1000 to 1000 Nominal value: 0

Access: 20 Change: off-line

P886 Offset adjustment for the main actual value channel 2

Each bit of the parameter value corresponds to approx. 0.012% of the nominal value of the main actual value provided the nominal value of the input quantity lies within the voltages specified for terminals 60 to 64 (8 - 25V, 25 - 80V, 80 - 250V).

P885, together with P886, are automatically set during the automatic offset adjustment (P51 = 22), or at the end of the default procedure.

Value range: -1000 to 1000 Nominal value: 0

Access: 20 Change: off-line

P887.ii Correction of the measured time instants for the AC supply zero crossings

If a different armature current peak occurs from pulse to pulse in spite of having a constant gating angle, the appropriate AC supply line voltage phase can be corrected using P887.ii by shifting the reference time instant of the gating angle. Each parameter index, 00 to 05, is assigned to a supply phase such as UV, UW, VW, VU, WU, WV.

When the parameter is increased by a value 1, this corresponds to a gating angle increase of $1.777778 \mu\text{s}$ or 0.038 degrees at 60 Hz and this will cause a reduction in the associated armature current peak. Parameter P887 is automatically set during the self tuning run of the armature current controller with P051 = 25.

Value range: (steps): -100 to 100 * $1.77\mu\text{s}$ (1 * 1.77μ)

Access: 20

Change: on-line

Index ii = 00 to 05

9.3 Global converter parameters

The global converter parameters, in the P900 series, are defined and described for the DPR data transfer between SIMOVERT P and SIMOREG converters and are used with optional expansion boards. The following information describes 6RA24 specific variations to the P900 series parameters. The key parameter required to change the P900 series is P051 = 20.

Parameter Number	Designator	Factory Setting
P900	HW_conf	1
P901*		
P902	CBP1 Sel	1
P903	CBP1 Lng	2
P904	CBP1 Adr	0
P905	CBP1 Bdr	1
P906	CBP2 Sel	1
P907	CBP2 Lng	8
P908	CBP2 Adr	0
P909	CBP2 Bdr	1
P910	ParChEna	4
P911	PrDaEnab	1
P912*	see parameter P880.ii	
P913*	see parameters P049, P050	
P914*	see parameter P880.ii	
P915*	see the connector list in section 10	
P916	CBP1 TDat	0
P917*		
P918*		
P919*		
P920*		
P924	CBP1PDNo	0
P925	CBP1PENo	0
P926	CBP1MoTm	1
P927	CBP2PDNo	0
P928	CBP2PENo	0
P929	CBP2MoTm	1
P930	SDRminTm	1
P931	SlotTime	1
P932	AutRefTm	0
P933		
P970*	see the connector list in section 10	
P971.ii	CBP2TDat	0

Note: * parameters not implemented in the 6RA24

P900 Hardware Options Selector

This parameter specifies the option boards that are installed on the base unit.

- | | | |
|---|------------|---|
| 1 | "NoOption" | No option boards are installed on the base unit. |
| 2 | "CS5 Only" | Only a CB24 or CS51 communication board is installed on the base unit. |
| 3 | "ThBdOnly" | Only a Z2006 technology board is installed on the base unit (Also P902 must = 1). |
| 4 | "CS5&ThBd" | A Z2006 board and a communication board are installed on the base unit. |
- Factory setting: 1 Value range (steps): 1 to 4 (1)
Access: 20 Change: off-line

P901 Test mode serial ports RS232 and RS485

This feature is not implemented in the SIMOREG at this time.

P902 Protocol for communications board port 1 (CBP1 or SST1)

For the CB24, this parameter must be set to "9" which selects Profibus DP protocol. If only a technology board is used P902 **must** be set to "1" otherwise the drive will remain in status o12.0.

P904 Bus Address for communications board port 1 (CBP1 or SST1)

The bus address must be set in the range of 3 to 124.

P905 Baud Rate for communications board port 1 (CBP1 or SST1)

The baud rate is set as following:

- 1 = 9.6 kBd
- 2 = 19.2 kBd
- 3 = 93.75 kBd
- 4 = 187.5 kBd
- 6 = 500 kBd
- 9 = 1.5 Mbd
- 10 = Automatic baud rate recognition

P906 Protocol for communications board port 2 (CBP2 or SST2)

Note: The CB24 only supports CBP1 so P906 must be set to 1 (not used).

P910 Parameter source selector

For 6RA24 converters, P910 only defines whether the technology parameters (PT001 to PT999) can be changed. At the basic converter all interfaces always have parameter change rights, i.e., basic converter parameters can be changed from every interface. However to change parameters on the technology board, the appropriate change rights must be selected.

- | | | |
|---|----------------|--|
| 1 | "Operator Pnl" | Optional operator panel can change PT parameters (not built-in keys) |
| 2 | "Reserved" | |
| 3 | "Tech Bd" | Technology board can change PT parameters |
| 4 | "CBP1" | CB24 or CS51 serial port 1 can change PT parameters |
| 5 | "CBP2" | CS51 serial port 2 can change PT parameters |
- Factory setting: 1 Value range: 1 to 5
Access: 20 Change: on-line

P911 Process Data Control (PZD Control)

For 6RA24 converters, a differentiation is made between local control (i.e., local control by continuous signals at the terminals of the basic converter; settings 1, 2 or 3) and control from an optional expansion board (technology or interface board; setting 4 or 5). As soon as the control data is missing for approximately 1.5 times P926 or P929, an alarm (setting 4) or a fault (setting 5) is displayed.

For "local control" (setting 1 to 3), parameter P926 and P929 must be set to 0 to prevent the PZD failure monitor from issuing a fault.

1	"Local"	Control is from the base drive terminals or serial interfaces
2	"Local"	Control is from the base drive terminals or serial interfaces
3	"Local"	Control is from the base drive terminals or serial interfaces
4	"autm/War"	Status word bit 9 is on. Warning W028 is enabled and fault F029 is disabled
5	"autm/Flt"	Status word bit 9 is on. Warning W028 is enabled and fault F029 is enabled. W028 is issued if the drive is not running and F029 is issued if the drive is running at the time the control data is missing.

Factory setting: 1 Value range: 1 to 5
 Access: 20 Change: off-line

P912 Display fault memory

Not implemented (refer to basic converter parameter P880.ii).

Processing the PT (optional technology boards) fault channel

The 6RA24 converter does processes the PT fault channel. PT fault 1 is read-out and the fault number is entered in the fault channel. The PT fault numbers must be ≥ 128 and ≤ 255 and are displayed as fault number at the converter operator panel. Fault handling (basic converter response) and fault reset are implemented the same as for a basic converter fault. If the technology process demands controlled shutdown, before the fault is entered in the fault message channel, the drive must be shutdown by the control word.

P913 Display warning memory

Not implemented (refer to basic converter parameters P049 and P050).

Processing the PT (optional technology boards) warning channel

The basic converter processes the PT warning channel. If a warning status (bits 0 to 10) is equal to 1 in warning words 1 to 7, then warning W29 is initiated at the basic converter (group PT warning).

Processing the Serial warning Channel

This is the same at PT warnings, however, warning W30 (group serial alarm) is activated.

P914 Diagnostics memory

Not implemented (refer to basic converter parameter P880.ii).

P915 DPR data target selector channel 1

Not implemented. Process data assignment is made by the connector numbers and the basic converter select parameters.

P916.ii DPR process data assignment, actual value channel 1

The actual values are assigned to channel 1 DPR words using the connector numbers and parameter P916. Indexes 0 to 15 correspond to DPR words 0 to 15. For example, index word 0 should be designated as the status word, index word 1 is actual value 1, index 2 is actual value 2, etc. Refer to the block diagram in section 15 sheet 5 for more information.

P917 to P919 Normalization parameters

Not implemented.

P920 Control word expansion

Not implemented. The converter-specific, freely-definable control word STWF is used for control word expansion.

P924 CB24 Profibus PPO type (number of PZD words)

This parameter must be set with parameter P925 for the desired PPO type.

2 = PPO1 and PPO3

6 = PPO2 and PPO4

10 = PPO5

P925 CB24 Profibus PPO type (number of PKW words)

This parameter must be set with parameter P924 for the desired PPO type.

0 = PPO3 and PPO4

4 = PPO1, PPO2 and PPO5

P926 and P929 Telegram failure time

The basic converter software monitors process data transfer from a communication interface board or technology board. If there is no PROCESS DATA transfer for longer than approx. 1.5 times P926 or P929, either an alarm W028 (P911 = 4) or fault F029 (P911 = 5) is activated. W028 and F029 are disabled if P926 = 0. If a faulted control word is detected in the PZD word 1, then W028, F029 is issued immediately independent of the time value set at P926 provided P926 > 0.

Note: the CB24 only supports port CBP1 so P929 must always be set to 0.

P926 Factory setting: 1 Value range: 0 to 32 sec (1 sec)

P929 Factory setting 0 (effective version 2.3)

Access: 20 Change: on-line

P933 Converter identification

Not implemented

P970 DPR data target selector channel 2

Not implemented. PROCESS DATA assignment is implemented by the connector numbers and the basic converter selection parameters.

P971.ii DPR process data assignment, actual value channel 2

The actual values are assigned to channel 2 DPR words using the connector numbers and parameter P971. Indexes 0 to 15 correspond to DPR words 0 to 15. Channel 2 is only implemented for use when the CS51 is used without a technology board (P900 = CS5 Only). Refer to the block diagram in section 15 sheet 5 for more information. The CB24 does not support channel 2.

Notes

10.1 List of Connectors

All connectors without specific scaling, use standard scaling. Standard scaling: 16384 counts = 100%. All connectors without information are referred to the rated (nominal) drive quantities (for example, for K131: 100% = 16384 = rated drive current).

- K000 Fixed value of 0%
- K001 Fixed value of 100% (for negative limiting: -100%)
- K002 Parameter-specific standard connector (factory default setting)

Analog inputs

- K003 Main reference (terminals 4 and 5, parameters P701 to P704)
- K004 Main analog speed feedback (terminals 60 to 64, P706 to P709)
- K005 Analog select input 1 (terminals 6 and 7, P711 to P714)
- K006 Analog select input 2 (terminals 8 and 9, P716 to P719)
- K007 Analog select input 3 (terminals 10 and 11, P721 to P724)
- K008 Measuring sensor temperature terminals 22 and 23 (in °C)
- K009 Motor temperature (in °C)
- K010 Brush length

Pulse Encoder

- K011 Absolute value of the speed feedback from the pulse encoder
- K012 Speed feedback value from pulse encoder with sign
- K013 Position counter from pulse encoder (scaling 0 to 65,535 counts)
refer to parameter P144
- K014 Position counter from pulse encoder (scaling 0 to ±127 counts)
refer to parameter P144

Analog outputs

- K015 Analog select output 1 (terminal 14, P741 to P744)
- K016 Analog select output 2 (terminal 16, P746 to P749)
- K017 Analog select output 3 (terminal 18, P750 to P754)
- K018 Analog select output 4 (terminal 20, P755 to P759)

Serial interfaces of the base drive

- K019 Control word pre-assignment (value: 0000 0000 0111 1111)
- K020 Received data word 0 at RS485 PORT, X500
- K021 Received data word 1 at RS485 PORT, X500
to
- K035 Received data word 15 at RS485 PORT, X500

- K036 Received data word 0 at RS232 PORT, X501
- K037 Received data word 1 at RS232 PORT, X501
to
- K051 Received data word 15 at RS232 PORT, X501

Process data channels in the dual port RAM from the CS51 or technology board

Note: If only a CS51 option board is connected, then Channel 1 is from serial board port 1 and channel 2 is from serial board port 2.

K052	Received data word 0 channel 1
K053	Received data word 1 channel 1
	to
K067	Received data word 15 channel 1
K068	CS51 received data word 0 channel 2
K069	CS51 received data word 1 channel 2
	to
K083	CS51 received data word 15 channel 2

Connectors for the MOP

K090	MOP output
K091	Scaled MOP output

Auxiliary free function block connectors

K093	Connector after selectable dead-band function
K096	Connector for general fixed value parameter P096
K097	Connector for general fixed value parameter P097
K098	Connector for general fixed value parameter P098
K099	Connector for general fixed value parameter P099

Armature Gating unit

K100	Armature firing angle (16384 = 0°, 0 = 90°, -16384 = 180°)
K101	Armature firing angle before limiting (16384 = 0°, 0 = 90°, -16384 = 180°)
K102	Input to armature gating unit. (This equals the output of the feed forward controller + current controller; 16384 = 0°, 0 = 90°, -16384 = 180°)
K105	Code of the gated thyristors

Armature current controller

K109	Armature current averaged over the last 6 samples
K110	Armature current controller output
K111	Armature current controller output, P component
K112	Armature current controller output, I component
K113	Armature current controller reference-feedback difference
K114	Average armature current (averaged over one firing cycle)
K115	Armature current feedback
K116	Absolute value of armature current feedback
K117	Internal armature current feedback with sign
K118	Armature current reference at current controller input
K119	Armature current reference before absolute value function
K120	Armature current reference before torque change filter
K121	Output of armature feed forward controller (16384 = 0, 0 = 90, -16384 = 180)
K122	Filtered EMF for the feed forward control of the armature current controller (scaling see K287)
K123	EMF = $U_a - I_a * R_a - L_a * di_a/dt$ with U_a .. <u>measured</u> armature voltage (scaling see K287)
K124	EMF = $U_a - I_a * R_a - L_a * di_a/dt$ with U_a .. <u>calculated</u> armature voltage (scaling see K287)

Current limiting

K131	Lowest positive armature current limit
K132	Lowest negative armature current limit
K133	Armature current reference before limiting

Torque limiting

K140	Torque reference
K141	Torque reference after limiting
K142	Torque feedback (armature current feedback/motor flux)
K143	Lowest positive torque limit
K144	Lowest negative torque limit
K145	Torque reference before limiting
K147	Output of speed controller and feed forward controller
K148	Speed feedback after speed regulator filters
K149	Speed actual value after speed feedback filters

Speed controller torque compensation function

K150	Calculated dv/dt signal after scaling ($d(K168)/dt * P540$)
K151	Ramp dv/dt signal after scaling ($K191 * P540 / (0.00277 \text{ sec})$) @ 60 Hz.
K152	Speed error after dead-band and scaling ($K163 * P541$)
K153	Freely selectable compensation signal after selector P544 and P541 scaling

Programmable free function block connectors

K154	Output of switch function 3
K155	Input A for switch 3
K156	Output of freely selectable inverter 3
K157	Output of programmable multiply / divide function block 3
K158	Input A of programmable multiply / divide function block 3
K159	Output of adder 3

Speed controller connectors

K160	Speed controller output
K161	Speed controller proportional part
K162	Speed controller integral part
K163	Speed controller speed error (reference - feedback)
K164	Speed controller speed error (reference - feedback after droop)
K165	Speed controller actual feedback at the speed controller
K166	Absolute value of speed controller feedback before filters
K167	Speed controller feedback before filters
K168	Speed controller reference before the reference filter
K169	Derivative part of the speed controller feedback
K170	Speed controller reference at the speed controller
K171	Feed forward part of the speed controller
K172	Friction compensation part of the speed controller feed forward
K173	Filtered inertia compensation part of the speed controller feed forward
K174	Speed reference after speed reference filter
K175	Speed controller effective proportional gain (in 0.01)
K176	Speed controller effective integral time (in 0.001s)
K177	Speed controller effective droop (in 0.1% of rated motor torque)
K178	Inertia compensation part of the speed controller feed forward before filtering

Speed reference limiting

- K181 Effective positive reference limit after the ramp
- K182 Effective negative reference limit after the ramp
- K183 Speed reference before limiting (after the ramp)

Ramp function generator

- K185 Effective ramp up time (in 0.01 s)
- K186 Effective ramp down time (in 0.01 s)
- K187 Effective starting rounding (in 0.001 s)
- K188 Effective ending rounding (in 0.001 s)
- K190 Ramp generator output
- K191 Ramp acceleration rate (output steps per gating pulse)
- K192 Ramp generator input
- K193 Ramp generator input after addition of Draw / ratio signals
- K194 Ramp generator input after limiting

Ramp function generator reference limiting

- K196 Effective ramp input reference positive limit
- K197 Effective ramp input reference negative limit
- K198 Ramp generator input before limiting

Digital setpoint input connectors

- K200 Self tuning speed reference
- K201 Self tuning reference
- K202 Self tuning reference
- K203 Self tuning reference
- K204 Self tuning reference
- K205 Additional speed reference from P416 before ramp generator limiting
- K206 Thread reference
- K207 Jog reference
- K208 Oscillation function stepped reference
- K209 Internal fixed preset speed reference
- K211 Speed reference after min / max reference limiting
- K212 Speed reference before min / max reference limiting
- K213 Speed reference before reference enable switch

Technology controller connectors

K216	Technology controller reference after reference filter
K217	Technology controller active positive output limit
K218	Technology controller active negative output limit
K219	Technology controller output after scaling
K220	Technology controller output before scaling
K221	Technology controller proportional part
K222	Technology controller integral part
K223	Technology controller error (reference - feedback)
K224	Technology controller error (reference - feedback after droop)
K225	Technology controller feedback at the controller
K226	Technology controller absolute value of the feedback at P032 before filtering
K227	Technology controller feedback before filtering
K228	Technology controller reference
K229	Technology controller Derivative part of the controller feedback

Draw / Ratio connectors

K230	Ramp generator reference input to P470 selector
K231	Draw / Ratio additional speed reference

Freely selectable function block connectors

K232	Output of absolute value generator 2
K233	Output of limiter function
K234	Output of switch function 2
K235	Input A of switch function 2
K236	Output of inverter 2
K237	Output of programmable function generator
K238	Output of programmable multiply / divide function block 2
K239	Input A of programmable multiply / divide function block 2
K240	Output of adder 2
K241	Output of absolute value generator 1
K242	Output of switch 1
K243	Input A of switch 1
K244	Output of inverter 1
K245	Output of diameter / divider function related to P653 and P654
K246	Input A of diameter / divider function
K247	Output of programmable multiply / divide function block 1
K248	Input A of programmable multiply / divide function block 1
K249	Output of adder 1

Field gating connectors

K250	Field gating angle (16384 = 0°, 0 = 90°, -16384 = 180°)
K251	Field gating angle before limiting (16384 = 0°, 0 = 90°, -16384 = 180°)
K252	Gate angle reference (current controller output + feed forward part)

Field current control

K260	Current controller output
K261	Current controller proportional part
K262	Current controller integral part
K263	Current controller error (reference - feedback)
K265	Current controller feedback at the controller
K266	Current controller internal feedback before selector P612
K268	Current controller reference
K271	Output of the field current control feed forward

Field current reference limiting

K273	Effective positive field current reference limit
K274	Effective negative field current reference limit
K275	Current controller reference
K276	current controller reference before limiting
K277	EMF controller output + Feed forward control output

EMF voltage controller connectors

K280	EMF controller output
K281	EMF controller proportional part
K282	EMF controller integral part
K283	EMF controller error (reference - feedback)
K284	EMF controller error (reference - feedback after the droop)
K285	EMF controller feedback at the controller $16384 = P071 * \frac{3\sqrt{2}}{\Pi}$
K286	Absolute value of EMF feedback (scaling the same as K285)
K287	Internal value of EMF feedback (scaling the same as K285)
K288	EMF controller reference (scaling the same as K285)
K289	Absolute value of the EMF reference (scaling the same as K285)
K290	Motor flux (100% = 16384 = flux at rated motor field current)
K291	Absolute value of measured armature voltage (scaling the same as K285)
K292	Measured value of armature voltage (scaling the same as K285)
K293	Output of the feed forward control

General connectors

- K300 Operating status (code number)
- K301 Supply voltage U-V (armature)(16384 = P071)
- K302 Supply voltage V-W (armature)(16384 = P071)
- K303 Supply voltage W-U (armature)(16384 = P071)
- K304 Supply voltage (field)(16384 = 400 Volts)
- K305 Average supply voltage (armature)(16384 = P071)
- K306 Supply frequency (16384 = 60.0 Hz)
- K307 Motor output at the shaft (16384 = P100 x (P101 - (P100 x P110))
- K309 Calculated motor temperature rise
- K310 Calculated thyristor temperature rise
- K311 Operating hours (in hours)
- K315 Control word STW
- K316 Freely-definable control word STWF
- K317 Control word after terminal status is blended in
- K318 Freely definable control word after terminal status is blended in
- K325 Status word ZSW
- K326 Status word ZSW1
- K327 Status word ZSW2
- K330 Limiting bits (refer to P040 in section 9.2)
- K331 Warning memory 1 (refer to parameter P049)
- K332 Warning memory 2 (refer to parameter P050)
- K335 Status of the binary inputs (refer to Section 9.2, parameter P010)
- K336 Status of the binary outputs (refer to Section 9.2, parameter P011)
- K337 Number of the last fault from P880.00
- K338 Number of the second last fault from P880.01
- K339 Number of the third last fault from P880.02
- K340 Number of the fourth last fault from P880.03
- K350 Program step number displayed at the left of the operator panel during self tuning.
- K351 Number of operations of the self tuning run step for the step number specified at K350.
- K352 Program step number displayed at the right of the operator panel during self tuning.
- K353 Number of operations of the self tuning run step for the step number specified at K352.
- K355 $I_a * R_a + L_a * di_a/dt$ (same scaling as EMF at K287)
- K356 Calculated current sample at the time of the gate pulse
(calculated of the last 2 real current samples) (818 = +100% of unit current)
- K359 T1-value of last I=0-entry or T1-value of last gate pulse if no I=0-entry found
- K360 to K364 Factor diagnostic use
- K380 Positive supply zero crossing, phase U-V
- K381 Negative supply zero crossing, phase W-U
- K382 Positive supply zero crossing, phase V-W
- K383 Negative supply zero crossing, phase U-V
- K384 Positive supply zero crossing, phase W-U
- K385 Negative supply zero crossing, phase V-W
- K386 Last used supply zero crossing
- K387 Armature firing instant
- K388 Difference to the previous armature firing instant (in T1 increments)
- K389 Duration of most recent armature current pulse, in 1.778 us units
- K390 Actual total processor utilization
- K391 Interpolated total processor utilization at maximum supply frequency of 65 Hz
- K392 Actual total processor utilization by the background programs
- K393 Actual total processor utilization by programs in synchronism with field firing pulses
- K394 Actual total processor utilization by programs in synchronism with armature firing pulses

10.2 Binary Input Functions (BIF)

Introduction:

The binary input functions can be controlled as follows:

- by connecting a low or high voltage level at the binary input terminals
- by supplying control words with data by a serial interface
- by depressing a key on the operator control panel.

A terminal (39, 40, 41, 42, 43, 36) or a bit (0 to 15) of the freely defined control word STWF can be assigned a specific binary input function (BIF 0 to BIF 68) by setting the appropriate parameter.

The start / stop and operate enable functions are permanently assigned to terminals 37 and 38 and the bits of the standard control word STW are permanently assigned to specific binary input functions.

The function of the selectable binary input terminals can be assigned using parameters P761 to P766. To assign a binary input function to a terminal, the parameter associated with the terminal needs to be set to the desired binary input function number from the table below.

Terminal 39 assigned with parameter P761	Associated Reference Parameter = P401
Terminal 40 assigned with parameter P762	Associated Reference Parameter = P402
Terminal 41 assigned with parameter P763	Associated Reference Parameter = P403
Terminal 42 assigned with parameter P764.ii	Associated Reference Parameter = P404
Terminal 43 assigned with parameter P765.ii	Associated Reference Parameter = P405
Terminal 36 assigned with parameter P766	Associated Reference Parameter = P406

If P144 = xx2 or xx3, terminal 39 has the "reset position counter" function in addition to the function assigned with P761.

Terminal 40 has the "reset zero mark counter" function in addition to the function assigned with P762.

Terminals 42 and 43 can be assigned up to 3 different binary input functions using index parameters P764.ii and P765.ii. This allows up to 3 functions to be simultaneously switched with one control signal.

Index parameter P642.ii defines the binary input function assigned to the individual bits of the STWF control word.

Selector parameter P641 defines the connector that is to supply the freely definable STWF control word with data. STWF is ineffective if P641 = 19.



WARNING

When changing parameters P640 to P642 undesirable structure changes or start commands can occur causing the motor to start if the appropriate bit is set.



Loss of life, severe personal injury or property damage can result if instructions contained in this manual are not followed.

Make sure that the operate enable signal at terminal 38 is off when changing these parameters or remove power from the armature converter terminals while changing these parameters.

Selector parameter P640 defines the connector that supplies control word STW with data. The control word STW is ineffective if P640 = 19.

In addition to the specified binary control selection possibilities there are the **O** and **I** keys on the optional operator control panel. These keys can be assigned specific functions using parameters P066 and P067.

The selected binary input functions are controlled by low or high signal levels at the binary input terminals or by supplying the control word with data. The logical status of the binary input terminals or the control word is displayed at parameter P010.ii and is available at connectors K315 to K318 and K335.

The terminal signal level is defined as:	Terminal open	Logic 0
	Terminal energized	Logic 1

If several inputs from terminals or bits of the control word are assigned the same binary input function, then the control inputs involved are logically combined so that any one signal can activate the function but all must be off the turn the function off.

Binary Input Function Summary

#	FUNCTION	#	FUNCTION
0	No function	37	Enable speed controller droop
1	Reserved for future use	38	Switch from PI to P speed controller
2	Normal Stop if P769 = 1 (low active) (push-button start / stop commands)	39	Enable inertia compensation
3	Coast Stop (low active)	40	Speed feedback polarity reversal
4	Quick stop (low active)	41	Master / slave selection
5	Fault reset	42	Torque limit set selection
6	Technology controller enable	43	Selecting main reference (terminals 4 and 5)
7	Speed controller enable	44	Selecting main analog speed feedback (terminals 60 to 64)
8	CEMF controller enable	45	Selecting analog input 1 (terminals 6 and 7)
9	Ramp generator enable	46	Selecting analog input 2 (terminals 8 and 9)
10	Ramp generator hold	47	Selecting analog input 3 (terminals 10 and 11)
11	Reference enable	48	Main reference polarity (terminals 4 and 5)
12	Oscillation	49	Main analog speed feedback polarity (terminals 60 to 64)
13	Jog	50	Analog input 1 polarity (terminals 6 and 7)
14	Jog and bypassing ramp generator	51	Analog input 2 polarity (terminals 8 and 9)
15	Thread	52	Analog input 3 polarity (terminals 10 and 11)
16	Thread and bypassing ramp generator	53	External fault (low active)
17	Fixed reference	54	External alarm (low active)
18	Fixed reference and bypassing ramp generator	55	M contactor status signal
19	Additional ref before Technology controller	56	Forced field economizing
20	Additional reference before ramp generator	57	Speed direction change by field reversal
21	Additional reference before speed controller	58	Dynamic braking by field reversal
22	Additional reference before torque limiting	59	Field current less than minimum field current (low active)
23	Additional reference before current controller	60	Torque direction change interlock (example: 12 pulse interlock)
24	Selection of second set of main reference limits	61	Set binary select output 1 if P771 = 2
25	MOP manual/automatic	62	Set binary select output 2 if P772 = 2
26	MOP increase	63	Set binary select output 3 if P773 = 2
27	MOP decrease	64	Set binary select output 4 if P774 = 2
28	MOP reverse polarity (switch)	65	Switch between P656 and P657 at K242
29	MOP positive polarity (push-button)	66	Switch between P666 and P667 at K234
30	MOP negative polarity (push-button)	67	Switch between P676 and P677 at K154
31	Ramp generator settings 2 (P307 to P310)	68	Preset MOP
32	Ramp generator settings 3 (P311 to P314)	69	Ramp-up Integrator Changeover Enable
33	Use parameter set #2		
34	Use parameter set #3		
35	Use parameter set #4		
36	Enable Technology controller droop		

BINARY INPUT FUNCTION DESCRIPTION:**BIF 1 Reserved for future use****BIF 2 Normal Stop**

This function is only effective if parameter P769 = 1 (start by momentary push-button control). If the input terminal is open then the run or thread commands will not function. If the input terminal is energized then the run or thread commands will start the drive. If the drive is running and the input terminal changes from energized to open the drive will follow a normal stop sequence.

Signal level: Terminal open or logical 0	normal stop
Terminal energized or logic 1	operation allowed

BIF 3 Coast stop command

Signal level: Terminal open or logical 0	coast stop
Terminal energized or logic 1	operation allowed

Coast stop can be activated from the terminals, from the STWF control word, from the STW control word and from the "O" key on the optional control panel.

Sequence when a coast stop command is issued:

1. Input "coast stop" command
2. Disable Technology controller, ramp generator, speed controller and current controller
3. Set gate angle to full retard limit
4. Gating pulses are disabled when current feedback reaches zero
5. The M contactor control relay (K1) drops out
6. The drive coasts to a stop
7. Operating status o8.0 or higher is displayed
8. After delay time, set with P258, the field is reduced to the value programmed by P257

Sequence when the "coast stop" command is removed

1. Reset the coast stop command to the operate condition
2. **After** the "start" command is set to the stop condition, status o7 is displayed and the drive can be started again.

All "coast stop" commands (i.e. from terminals, control words, etc.) are logically AND'd by the drive controller software. This means that all commands must be energized or logical 1, indicating that it is OK to operate, before the drive will be allowed to start.

BIF 4 Quick stop

Signal level: Terminal open or logical 0 Quick stop
 Terminal energized or logic 1 Operation allowed

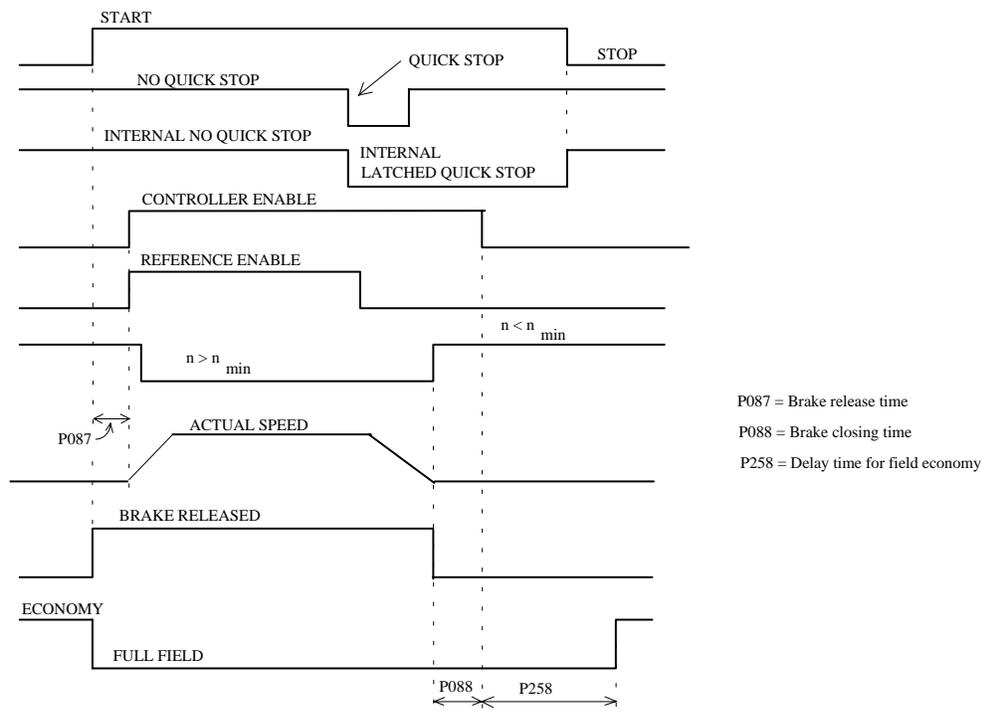
Quick stop can be activated from the terminals, from the STWF control word, from the STW control word and from the "O" key on the optional control panel.

Sequence when entering "quick stop":

1. Input "quick stop" command
2. Technology controller and ramp generator are disabled and speed reference is set to zero
3. Drive decelerates in current limit until speed is less than min. speed (P370 to P372)
4. Drive wait for brake closing time (P088), and then sets the current reference to zero.
5. The speed controller is then disabled and when the current feedback equals 0 gating pulses are disabled
6. The M contactor relay drops out and operating status o9.0 or higher is displayed
7. After delay time (P258) the field is reduced to the value programmed by P257

Sequencing when recovering from a "quick stop":

1. Reset the "quick stop" command to the operate condition
2. Remove the start command
3. Operating status o7 is displayed



Quick Stop Sequence Logic Diagram

Quick Stop continued:

Quick Stop continued:

The "quick stop" command is a momentary pulse that must last for at least 10 ms. The quick stop is latched internally and is reset after the drive has reached zero speed and the normal run / stop command has been switched to the stop condition.

All of the "quick stop" commands (i.e. from terminals, control words, etc.) are logically AND'd by the drive controller software. This means that all commands must be energized or logical 1, indicating that it is OK to operate, before the drive will be allowed to start.

When the speed is less than n_{\min} (P370 to P372) for the first time after a quick stop, an internal interlock function is enabled that prevents the drive from attempting to brake again if the motor is turned by external forces causing the drive speed to exceed n_{\min} .

While braking during quick stop, until the speed is less than minimum speed, all torque limits are ineffective. Only the system current limit, P171 and P172 and the speed dependent current limits are effective.

BIF 5 Fault reset (assigned to terminal 36 as supplied from factory)

Signal level: Positive transition resets the fault (signal must be present for at least 10 ms)

Fault reset can be activated from the terminals, from the STWF control word, and from the STW control word.

A fault is reset by a positive going edge (corresponds to depressing the SELECT key on the simple operator panel or the R key on the optional operator control panel). If several inputs are programmed as "fault reset" the function is executed by the rising edge of any of the terminals.

BIF 6 Enable Technology controller

Signal level: Terminal open or logic 0 Inhibit Technology controller
Terminal energized or logic 1 Enable Technology controller

If several inputs are programmed as "Technology controller enable" all of the terminals must be energized for the Technology controller to be enabled. The controller is always inhibited in all operating status's ≥ 01

BIF 7 Enable speed controller

Signal level: Terminal open or logic 0 Inhibit speed controller
Terminal energized or logic 1 Enable speed controller

If several inputs are programmed as "speed controller enable" all of the terminals must be energized for the speed controller to be enabled. The controller is always inhibited in all operating status's ≥ 01 . If none of the selectable inputs are programmed as "speed controller enable" the speed controller will be enabled by terminal 38 (drive enable).

BIF 8 Enable CEMF controller

Signal level: Terminal open or logic 0 Inhibit CEMF controller
Terminal energized or logic 1 Enable CEMF controller

If several inputs are programmed as "CEMF controller enable" all of the terminals must be energized for the CEMF controller to be enabled. If none of the selectable inputs are programmed as "CEMF controller enable" the CEMF controller will be enabled by terminal 38 (drive enable).

BIF 9 Enable ramp generator

Signal level: Terminal open or logic 0	Inhibit ramp generator
Terminal energized or logic 1	Enable ramp generator

This function can be activated from the terminals, from the STWF control word, and from the STW control word.

The ramp generator is enabled when the assigned terminal, programmed as "enable ramp", is energized. If none of the terminals are programmed as "enable ramp generator" then the ramp generator is enabled by terminal 38 (drive enable).

If the terminal programmed as "enable ramp generator" is opened the ramp is inhibited and the output of the ramp generator is set to 0. The drive decelerates in current limit to zero speed but the M contactor does not open. When the ramp generator is enabled again, it ramps up to the incoming reference along the active ramp.

If several inputs are programmed as "enable ramp generator" all of the terminals must be energized for the ramp generator to be enabled.

BIF 10 Ramp generator stop

Signal level: Terminal open or logic 0	Enable ramp generator
Terminal energized or logic 1	Ramp generator hold

This function can be activated from the terminals, from the STWF control word, and from the STW control word. When using STW bit 5 for control, the logic level noted above is reversed

If the terminal programmed as "ramp generator stop" is energized the ramp is interrupted and the output of the ramp generator is held at its last instantaneous value. When the terminal is opened again the ramp generator is enabled and continues to ramp with the selected ramp-up or ramp-down time.

If several inputs are programmed as "ramp generator stop" only one of the terminals needs to be energized for the ramp generator to be held.

BIF 11 Reference enable

Signal level: Terminal open or logic 0	Inhibit reference
Terminal energized or logic 1	Enable reference

This function can be activated from the terminals, from the STWF control word, and from the STW control word bit 6.

If the terminal programmed as "reference enable" is energized, the external reference is connected to the input of the ramp generator. When the terminal is opened the external reference is disconnected from the input of the ramp generator. All internal references and additional references remain active.

If several inputs are programmed as "reference enable" all inputs must be energized for the external references to be connected to the ramp generator.

BIF 12 Oscillation Function

Signal level: Terminal open or logic 0	Oscillation reference is not enabled
Terminal energized or logic 1	Oscillation reference is enabled

To assist in gear changing the oscillation function can be enabled which disconnects the normal speed reference and injects a programmable stepping reference from K208 to allow smoother meshing of the new gears. When the terminal is open the normal reference is once again active.

BIF 13 Jog

Signal level: Terminal open or logic 0	No jog
Terminal energized or logic 1	Jog

Each of the binary input terminals can be programmed as "jog" and each has a separate jog reference using parameters P401 to P406. The "jog" function is only allowed if the "drive enable" signal is present and the drive is not running. When jogging using the STWF control word, parameter P409 sets the jog reference.

Sequencing when selecting jog:

If the terminal programmed as "jog" is energized, the M contactor is closed, the regulators are enabled, and the jog reference is connected to the ramp generator input.

Sequencing when removing jog:

If all of the terminals programmed as "jog" are opened, the drive will be inhibited after the speed drops below minimum speed then the M contactor will be opened after a delay programmed by P085.

If two or more terminals programmed as "jog" are simultaneously energized, then a reference of 0 is applied to the ramp generator.

BIF 14 Jog and bypass the ramp generator

Signal level: Terminal open or logic 0	No jog
Terminal energized or logic 1	Jog

This function is the same as "jog" except when this command is selected the ramp generator operates with ramp-up and ramp-down times set to zero. When jogging using the STWF control word, parameter P410 sets the jog reference.

BIF 15 Thread

Signal level: Terminal open or logic 0	No thread
Terminal energized or logic 1	Thread

Each of the binary input terminals can be programmed as "thread" and each has a separate thread reference using parameters P401 to P406. The "thread" function is only allowed if the "drive enable" signal is present. When using thread with the STWF control word, parameter P411 sets the reference.

Thread is possible in operating status o7. and in the "run" status and with operating enable present.

Sequencing when selecting thread:

If a terminal programmed as "thread" is energized in operating status o7, the M contactor is closed, the regulators are enabled, and the thread reference is connected to the ramp generator input. If one of the terminals programmed as "thread" is energized while the drive is in the "run" status, the drive ramps from the run speed to the thread speed following the ramp generator.

Sequencing when withdrawing thread:

If all of the terminals programmed as "thread" are opened and the start command is not present, the drive will be turned off and the M contactor will be opened when the speed drops below minimum speed.

If the drive is operating in thread and all of the terminals programmed as "thread" are opened, and the start command is present, the drive ramps from the thread speed to the run speed by following the ramp generator.

If thread is selected using momentary inputs (refer to P769 in section 9.2) then a terminal or bit in the STWF control word must be assigned as the normal stop command BIF 2.

If two or more terminals are programmed as "thread" are simultaneously energized then the sum of the selected references is applied to the ramp generator input.

BIF 16 Thread and bypass the ramp generator

Signal level: Terminal open or logic 0	No thread
Terminal energized or logic 1	Thread

This function is the same as "Thread" except when this command is selected the ramp generator operates with ramp-up and ramp-down times equal to zero. When using thread with the STWF control word, parameter P412 sets the reference.

BIF 17 Fixed reference setpoint

Signal level: Terminal open or logic 0 Main reference selected
 Terminal energized or logic 1 Fixed reference selected

The fixed reference setpoint can be selected when the drive is running at which time the main reference is switched off and the fixed reference is applied to the ramp generator input. The fixed references associated with the terminals are P401 to P406. The fixed reference for the STWF control word is P413.

Sequence when selecting a fixed reference:

If one or more terminals are programmed (max. of 6) as "fixed reference setpoint", and one of the terminals is energized, the speed reference is switched from the main reference to the fixed reference parameter P401 to P406 before the ramp generator. If several terminals are simultaneously energized the selected fixed references are added.

Sequence when withdrawing the fixed reference:

If all of the terminals programmed as "fixed reference setpoint" are opened the speed reference ramps from the fixed reference(s) to the main reference.

BIF 18 Fixed reference setpoint bypassing the ramp generator

Signal level: Terminal open or logic 0 Main reference selected
 Terminal energized or logic 1 Fixed reference selected

This function is the same as "Fixed reference setpoint" except when this command is selected the ramp generator operates with ramp-up and ramp-down times equal to zero. The fixed references associated with the terminals are P401 to P406. The fixed reference for the STWF control word is P414.

BIF 19 Additional reference before the Technology controller

Signal level: Terminal open or logic 0 Main reference only
 Terminal energized or logic 1 Additional reference added

The "additional reference" function is possible when the start and drive enable commands are present.

Sequence when selecting a additional reference:

If one or more terminals (max. 6) are programmed as "additional reference before the Technology controller" and one of the terminals is energized, then the additional reference(s), P401 to P406, are added to the main Technology controller reference. If the STWF control word is used the added reference is from P415. If more than one terminal is energized then the selected fixed references and main reference are added.

BIF 20 Additional reference before the ramp generator

Signal level: Terminal open or logic 0 Main reference only
 Terminal energized or logic 1 Additional reference added

The "additional reference" function is possible when the start and drive enable commands are present.

Sequence when selecting a additional reference:

If one or more terminals (max. 6) are programmed as "additional reference before the ramp generator", and one of the terminals is energized, then the additional reference(s), P401 to P406, are added to the main reference before the ramp generator. If the STWF control word is used the added reference is from P416.

BIF 21 Additional reference before the speed controller

Signal level: Terminal open or logic 0 Main reference only
 Terminal energized or logic 1 Additional reference added

The "additional reference" function is possible when the start and drive enable commands are present.

Sequence when selecting a additional reference:

If one or more terminals (max. 6) are programmed as "additional reference before the speed controller", and one or more of the terminals is energized, then the additional reference(s), P401 to P406, are added to the main speed controller reference. If the STWF control word is used the added reference is from P417.

BIF 22 Additional reference before torque limiting

Signal level: Terminal open or logic 0 Main reference only
 Terminal energized or logic 1 Additional reference added

The "additional reference" function is possible when the start and drive enable commands are present.

Sequence when selecting a additional reference:

If one or more terminals (max. 6) are programmed as "additional reference before torque limiting", and one or more of the terminals is energized, then the additional reference(s), P401 to P406, are added to the main torque limiting input. If the STWF control word is used the added reference is from P418.

BIF 23 Additional reference before the current controller

Signal level: Terminal open or logic 0 Main reference only
 Terminal energized or logic 1 Additional reference added

The "additional reference" function is possible when the start and drive enable commands are present.

Sequence when selecting a additional reference:

If one or more terminals (max. 6) are programmed as "additional reference before the current controller", and one or more of the terminals is energized, then the additional reference(s), P401 to P406, are added to the main current reference. If the STWF control word is used the added reference is from P419.

BIF 24 Selection of second set of main reference limits

Signal level: Terminal open or logic 0 P315 & P316 set limits
 Terminal energized or logic 1 P319 & P320 set limits

This function is possible when the start and drive enable commands are present.

Sequence when changing main reference limits:

If terminals are programmed for "selection of second set of main reference limits", and when one of the terminals are energized, then the positive reference limit switches from P315 to P319 and the negative limit switches from P316 to P320.

BIF 25 MOP manual / automatic

Signal level: Terminal open or logic 0	MOP manually controlled by raise / lower inputs
Terminal energized or logic 1	MOP automatically follows the value selected with P461

If one or more terminals are programmed as "MOP manual / automatic", then automatic operation is effective when one of the terminals is energized.

BIF 26 MOP increase

Signal level: Terminal open or logic 0	MOP reference is not increased
Terminal energized or logic 1	MOP reference is increased

If one or more terminals are programmed as "MOP increase", and one of the terminals is energized, the MOP reference will increase if the MOP is in the manual mode.

BIF 27 MOP decrease

Signal level: Terminal open or logic 0	MOP reference is not decreased
Terminal energized or logic 1	MOP reference is decreased

If one or more terminals are programmed as "MOP decrease", and one of the terminals is energized, the MOP reference will decrease if the MOP is in the manual mode. If both a raise and lower command is present the MOP will decrease.

BIF 28 MOP reverse polarity direction switch

Signal level: Terminal open or logic 0	MOP reference is not inverted
Terminal energized or logic 1	MOP reference is inverted

If one or more terminals are programmed as "MOP reverse polarity", and one of the terminals is energized, the MOP reference will be inverted if the MOP is in the manual mode, and the MOP output will ramp to the inverted reference value. If BIF 29 or BIF 30 is selected then this function, BIF 28 is ineffective.

BIF 29 MOP positive polarity direction push-button

Signal level: Terminal open or logic 0	MOP existing reference polarity is maintained
Terminal energized or logic 1	MOP reference becomes positive polarity

If one or more terminals are programmed as "MOP positive polarity", and one of the terminals is energized, the MOP reference will become positive polarity if the MOP is in the manual mode. If BIF 29 or BIF 30 is selected then function BIF 28 is ineffective.

BIF 30 MOP negative polarity direction push-button

Signal level: Terminal open or logic 0	MOP existing reference polarity is maintained
Terminal energized or logic 1	MOP reference becomes negative polarity

If one or more terminals are programmed as "MOP negative polarity", and one of the terminals is energized, the MOP reference will become negative polarity if the MOP is in the manual mode. If BIF 29 or BIF 30 is selected then function BIF 28 is ineffective.

BIF 31 Ramp generator set 2

Signal level: Terminal open or logic 0 Ramp generator set 1 is used (P303 to P306)
Terminal energized or logic 1 Ramp generator set 2 is used (P307 to P310)

If one or more terminals is programmed as "ramp generator set 2", and one of the terminals is energized, then ramp generator parameter set 2 is selected. This function has priority over parameter P302.

The drive will trip on fault F041 if "ramp generator set 2" and "ramp generator set 3" are selected simultaneously.

BIF 32 Ramp generator set 3

Signal level: Terminal open or logic 0 Ramp generator set 1 is used (P303 to P306)
Terminal energized or logic 1 Ramp generator set 3 used (P311 to P314)

If one or more terminals is programmed as "ramp generator set 3", and one of the terminals is energized, then ramp generator parameter set 3 is selected. This function has priority over parameter P302.

The drive will trip on fault F041 if "ramp generator set 2" and "ramp generator set 3" are selected simultaneously.

BIF 33 Parameter set #2 active parameters 2P100 to 2P599

Signal level: Terminal open or logic 0 Parameter set 1 is used
 Terminal energized or logic 1 Parameter set 2 is used (2P100 to 2P599)

If one or more terminals is programmed as parameter set 2, and one of the terminals is energized, then parameter set #2 will be the active parameters used.

BIF 34 Parameter set #3 active parameters 3P100 to 3P599

Signal level: Terminal open or logic 0 Parameter set 1 is used
 Terminal energized or logic 1 Parameter set 3 is used (3P100 to 3P599)

If one or more terminals is programmed as parameter set 3, and one of the terminals is energized, then parameter set #3 will be the active parameters used.

BIF 35 Parameter set #4 active parameters 4P100 to 4P599

Signal level: Terminal open or logic 0 Parameter set 1 is used
 Terminal energized or logic 1 Parameter set 4 is used (4P100 to 4P599)

If one or more terminals is programmed as parameter set 4, and one of the terminals is energized, then parameter set #4 will be the active parameters used.

Notes concerning BIF 33, BIF 34, and BIF 35

From BIF 33, 34, and 35 only one of these functions can be active at any given time. If more than one function is active for more than 0.5 seconds fault F041 is issued and the last used parameter set is maintained. The parameter sets must not be changed during the self tuning runs. It can take up to 25 ms for a new parameter set to become active.

Parameter set change over is possible while the drive is running making it possible to change gains etc. on-line. Care must be exercised when changing parameter sets since normally off-line parameters can effectively be changed when going to the new parameter set.

**WARNING**

When changing parameter sets some parameters that define the control structure are changed. This can lead to undesirable and unpredictable operation if these parameters are not initially set correctly.

Loss of life, severe personal injury or property damage can result if instructions contained in this manual are not followed.

When using parameter sets, make all of the basic settings in parameter set 1 and then copy these values to the other parameter sets. When this is done the specific parameters can be modified in each parameter set. P055 allows parameter sets to be copied and to interchange the values of different parameter sets.



BIF 36 Technology controller droop

Signal level: Terminal open or logic 0	Droop not enabled
Terminal energized or logic 1	Droop enabled

If one or more terminals is programmed as "Technology controller droop", and one of the terminals is energized, then the droop function is effective. If none of the terminals are programmed as "Technology controller droop", then the droop function is active and controlled with parameter P427.

BIF 37 Enable speed controller droop

Signal level: Terminal open or logic 0	Droop not enabled
Terminal energized or logic 1	Droop enabled

If one or more terminals is programmed as "speed controller droop", and one of the terminals is energized, then the droop function is effective. If none of the terminals are programmed as "speed controller droop", then the droop function is active and controlled with parameter P227. If several terminals are assigned to BIF 37 then all terminals must be energized to make droop active.

BIF 38 Switch the speed controller from PI to P controller

Signal level: Terminal open or logic 0	PI speed controller
Terminal energized or logic 1	P speed controller

If one or more terminals is programmed as "switch from PI to P speed controller", then when all of the terminals are energized, and the speed is below the value in P222, the speed controller switches from a PI controller to a P controller.

BIF 39 Enable inertia compensation

Signal level: Terminal open or logic 0	Inertia compensation not enabled
Terminal energized or logic 1	Inertia compensation enabled

If one or more terminals is programmed as "enable inertia compensation", and all of the terminals are energized and P223 = 1, then the inertia compensation is added to the output of the speed controller.

BIF 40 Speed feedback polarity reversal

Signal level: Terminal open or logic 0	Speed feedback polarity not reversed
Terminal energized or logic 1	Speed feedback polarity reversed

If one or more terminals is programmed as "speed feedback polarity reversal", and one of the terminals is energized, then the speed feedback polarity is reversed.

BIF 41 Master / Slave selection

Signal level: Terminal open or logic 0	Master drive
Terminal energized or logic 1	Slave drive

If one or more terminals is programmed as "Master / Slave selection", and one of the terminals is energized, then the slave drive mode is selected. When the slave mode is selected the torque reference comes from the source defined by P500 and the slave speed controller is disabled.

If 2 wire peer to peer is used, BIF 41 will be used to enable the transmit function on the master and inhibit the slaves from transmitting.

Signal level: Terminal open or logic 0	Master drive will transmit on the bus and its receiver will be disabled.
Terminal energized or logic 1	Slave drive receivers will be active and their transmitters will be disabled.

BIF 41 together with the peer to peer bus protocol allows a multi-motor drive system to be implemented where several drives operate on the same shaft (printing applications). Any particular drive can be the master and all others will be torque slaves. Any slave drive can be disabled using normal or quick stop commands, using the drive enable function, or by removing the peer to peer cable. All drives receive the same reference.

One drive can be selected as master with BIF 41 = 0. This drive is then speed controlled. The RS485 master will transmit on the bus and its receiver will be disabled.

All other drives will be selected as slaves with BIF 41 = 1. Every slave drive is then operated in either closed loop torque or current control and will receive the torque or current reference from the master on the peer to peer bus. The slave RS485 transmitters are disabled and the receivers are enabled.

When changing roles of the drives, the original master should first be changed to a slave and then within 0.5 seconds the slave that is to be the master should be changed to the master. This prevents two masters from trying to transmit on the same bus and prevents any peer to peer time out faults from being issued.

Parameter Setting:

P780 = xxx4	Peer to peer bus protocol BBP0 (X500)
P783 = 10	187.5 kbaud (or select an other baud rate)
P500 = 20	1st received data on BBP0 is used as the torque/current reference
P784.00 = 147	Torque reference is sent to BBP0 as the 1st process data value
P761 = 41	Terminal 39 is assigned the changeover between master and slave function

BIF 42 Torque limit set selection

Signal level: Terminal open or logic 0	Torque limit set 1 used (P180 & P181)
Terminal energized or logic 1	Torque limit set 2 used (P182 & P183) if speed is greater than the value of P184.

If one or more terminals is programmed as "torque limit set selection", and one of the terminals is energized, and the speed is greater than the value in P184, then torque limit set 2 is selected.

BIF 43 Selecting the main reference (terminals 4 and 5)

Signal level: Terminal open or logic 0 Main reference not selected
 Terminal energized or logic 1 Main reference selected

If one or more terminals is programmed as "selecting the main reference", and **all** of the terminals are energized, then the software switch in the main reference path before P001 is closed. If any one terminal is open then the main reference is switched off. If none of the terminals are programmed as "selecting the main reference" then the main reference switch is automatically closed.

BIF 44 Selecting the main analog speed feedback (terminals 60 to 64)

Signal level: Terminal open or logic 0 Main speed feedback not selected
 Terminal energized or logic 1 Main speed feedback selected

If one or more terminals is programmed as "selecting the main analog speed feedback", and all of the terminals are energized, then the software switch in the main analog speed feedback path before P002 is closed. If none of the terminals are programmed as "selecting the main analog speed feedback", then the main analog speed feedback switch is automatically closed.

BIF 45 Selecting the analog input 1 (terminals 6 and 7)

Signal level: Terminal open or logic 0 Analog input 1 is not selected
 Terminal energized or logic 1 Analog input 1 is selected

If one or more terminals is programmed as "selecting the analog input 1" and all of the terminals are energized then the analog input 1 switch is closed. If none of the terminals are programmed as "selecting the analog input 1" then the analog input 1 switch is automatically closed.

BIF 46 Selecting the analog input 2 (terminals 8 and 9)

Signal level: Terminal open or logic 0 Analog input 2 is not selected
 Terminal energized or logic 1 Analog input 2 is selected

If one or more terminals is programmed as "selecting the analog input 2" and all of the terminals are energized then the analog input 1 switch is closed. If none of the terminals are programmed as "selecting the analog input 2" then the analog input 2 switch is automatically closed.

BIF 47 Selecting the analog input 3 (terminals 10 and 11)

Signal level: Terminal open or logic 0 Analog input 3 is not selected
 terminal energized or logic 1 Analog input 3 is selected

If one or more terminals is programmed as "selecting the analog input 3" and all of the terminals are energized then the analog input 3 switch is closed. If none of the terminals are programmed as "selecting the analog input 3" then the analog input 3 switch is automatically closed.

BIF 48 Main reference polarity

Signal level: Terminal open or logic 0 Main reference polarity is not reversed
 Terminal energized or logic 1 Main reference polarity is reversed

If one or more terminals is programmed as "main reference polarity", and if one of the terminals is energized, then the main reference polarity is reversed.

BIF 49 Main analog speed feedback polarity

Signal level: Terminal open or logic 0	Main analog speed feedback polarity is not reversed
Terminal energized or logic 1	Main analog speed feedback polarity is reversed

If one or more terminals is programmed as "main analog speed feedback polarity", and if one of the terminals is energized, then the main analog speed feedback polarity is reversed.

BIF 50 Analog input 1 polarity

Signal level: Terminal open or logic 0	Analog input 1 polarity is not reversed
Terminal energized or logic 1	Analog input 1 polarity is reversed

If one or more terminals is programmed as "analog input 1 polarity", and if one of the terminals is energized then the analog input 1 polarity is reversed.

BIF 51 Analog input 2 polarity

Signal level: Terminal open or logic 0	Analog input 2 polarity is not reversed
Terminal energized or logic 1	Analog input 2 polarity is reversed

If one or more terminals is programmed as "analog input 2 polarity", and if one of the terminals is energized, then the analog input 2 polarity is reversed.

BIF 52 Analog input 3 polarity

Signal level: Terminal open or logic 0	Analog input 3 polarity is not reversed
Terminal energized or logic 1	Analog input 3 polarity is reversed

If one or more terminals is programmed as "analog input 3 polarity", and if one of the terminals is energized, then the analog input 3 polarity is reversed.

BIF 53 External fault (low active)

Signal level: Terminal open or logic 0	Fault message initiated
Terminal energized, or logic 1	Fault message not initiated

This function can not be controlled from the STWF control word.

The external fault is handled the same as the internal fault (see section 8.2). Fault messages F121 to F126 are initiated depending on which programmed terminal indicates a fault. The fault message will be initiated if the programmed terminal stays open for a time longer than the value in P767.

BIF 54 External warning (low active)

Signal level: Terminal open or logic 0	Warning message initiated
Terminal energized, or logic 1	Warning message not initiated

This function can not be controlled from the STWF control word.

The external warning is handled the same as the internal warning. Warning messages W21 to W26 are initiated depending on which programmed terminal indicates an warning .

BIF 55 M contactor status signal

Signal level: Terminal open or logic 0	M contactor not closed
Terminal energized, or logic 1	M contactor closed

This input is used for evaluating an auxiliary contact of the M contactor. If one or more terminals are programmed as "M contactor status signal", then all of the terminals must be energized for the drive to exit operating status o1.6

BIF 56 Forced field economizing

Signal level: Terminal open or logic 0 Full field reference
 Terminal energized, or logic 1 Forced field economizing

If one or more terminals are programmed as "forced field economizing", and one of the terminals is energized, then the field reference is reduced to the value in P257.

BIF 57 Speed direction change by field contactor reversal for 1Q converters

Signal level: Terminal open or logic 0
 Positive field direction is selected. Field contactor 1 closed (BOF 30 = 1) and field contactor 2 is open (BOF 31 = 0).

 Terminal energized, or logic 1
 Negative field direction is selected. Field contactor 1 open (BOF 30 = 0) and field contactor 2 is closed (BOF 31 = 1)..

This function requires the use of external field reversing contactors:

If one or more terminals are programmed as speed direction change by field contactors, and one of the terminals is energized, then the motor will automatically brake to zero speed following the selected ramp rate and accelerate up to speed in the other direction.

Once the reversal is started with a change in logic state at BIF 57, the operation will be latched until the reversal is completed at which time a new reversal can be commanded. For either direction of rotation the speed reference will be positive.

Control sequence for reversing by field contactors (direction 1 to direction 2):

1. The drive is operating in direction 1
2. The BIF 57 logic state changes to logic 1
3. Internal field reversing sequence is active
 - o The armature current is controlled to zero and gate pulses are blocked
 - o The field gate pulses are blocked and field current reference is set to zero.
 - o When zero field current is detected, BOF 30 will open the main field contactor after a time delay, set with P092.
 - o After an additional 100 ms BOF 31 will close the field reversing contactor.
 - o The speed feedback polarity is reversed (unless EMF feedback is selected P083 = 3)
 - o The field current is re-established and armature gating is enabled.
4. The drive will brake to zero speed following the ramp rate and accelerate in the reverse direction to the set speed. For either direction of operation the speed reference will remain positive.

BIF 58 Regenerative braking Stop by field contactor reversal for 1Q converters

Signal level: Terminal open or logic 0	Has no meaning
Terminal energized, or logic 1	Braking active

This function requires the use of external field reversing contactors:

This is a momentary push button function that will initiate a field reversal brake until the speed is less than the minimum speed. When the motor is stopped the original field direction is re-established. Once initiated the drive will brake to zero following the selected ramp rate and stop. To start the drive again the brake command must be removed and the start command must be cycled off and then on.

Control sequence when entering "brake with field reversal"

1. The drive is running in the forward direction
2. The brake to stop command is momentarily issued with BIF 58 for at least 30 ms.
3. Internal field reversing sequence is active
 - o The armature current is controlled to zero and gate pulses are blocked
 - o The field gate pulses are blocked.
 - o When zero field current is detected, BOF 30 will open the main field contactor after a time delay, set with P092.
 - o After an additional 100 ms BOF 31 will close the field reversing contactor.
 - o The speed feedback polarity is reversed (unless EMF feedback is selected P083 = 3)
 - o The field current is re-established and armature gating is enabled.
4. Internal brake sequence:
 - o The speed reference at the input to the ramp is set to zero.
 - o When the speed and armature current is zero the armature pulses are blocked.
 - o The drive will brake to zero speed following the selected ramp rate and stop in operating status o7.0 or o7.2 if BIF 58 remains on..
5. Internal sequence for changing to the original field direction:
 - o The armature current is controlled to zero and gate pulses are blocked
 - o The field gate pulses are blocked.
 - o When zero field current is detected, BOF 31 will open the reverse field contactor after a time delay, set with P092.
 - o After an additional 100 ms BOF 30 will close the main field contactor.
 - o The speed feedback polarity is reversed (unless EMF feedback is selected P083 = 3)
6. The drive is in operating status o7.2
The drive can accelerate in the original direction of rotation by cycling the start command off and then back on.

BIF 59 Field current less than minimum field current

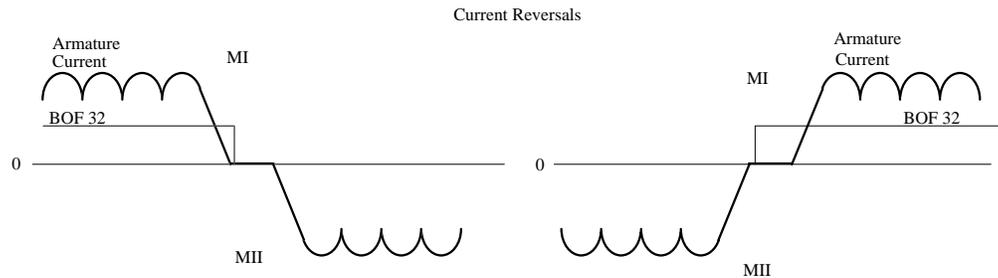
Signal level: Terminal open or logic 0	Field current < min field
Terminal energized, or logic 1	Field current > min field

If one or more terminals are programmed as "field current less than minimum field current", and one of the terminals is not energized, then the drive acts the same as an internal field loss. This signal is used to evaluate an external field current monitoring function and has the same effect as an internal drive field loss signal. If this signal goes LOW for at least 500 ms then a fault message F005 will be initiated unless this fault is disabled.

BIF 60 Torque Reversal Interlock

Signal level: Terminal open or logic 0	A torque direction change from MI to MII is permitted but a torque direction change from MII to MI is prevented and results in no torque direction being selected (Ä Ä).
Terminal energized, or logic 1	A torque direction change from MII to MI is permitted but a torque direction change from MI to MII is prevented and results in no torque direction being selected (Ä Ä).

This function is used when parallel converters are connected such as in 12 pulse systems. When the function is used, and a torque direction change is requested by the converter, the armature current will be controlled to zero. At this point the armature current will be held at zero until the parallel converter indicates it is also ready for reversed torque using BIF 60. At this time both converters will develop torque in the reversed direction. This function is used with BOF 32 to cross tie the two converters to assure that they always operate in the same torque direction. BOF 32 from one converter will be used as BIF 60 on the other converter.



BIF 61 Set binary output 1

Signal level: Terminal open or logic 0	Binary output 1 (terminal 46) is set to logic 0
Terminal energized, or logic 1	Binary selectable output 1 is set to logical 1

If one or more terminals are programmed as "set binary output 1", and one of the terminals is energized, then selectable output 1 is set to logical 1.

BIF 69 Ramp-up Integrator Changeover Enable

Signal level: Terminal open or logic 0 Changeover per P302 = x1x, x2x, x3x is inhibited.
Terminal energized or logic 1 Changeover per P302 = x1x, x2x, x3x is allowed.

Terminal open: The changeover according to the setting of P302 ten's digit is inhibited and the ramp continues to use ramp rate 1 or the ramp rate selected with BIF33-35.

Terminal Energized: The changeover according to the setting of P302 ten's digit is allowed as soon as the ramp output reached the required setpoint for the first time after BIF69 = 1.

If BIF69 is not selected by any input selector then this function is not evaluated and the ramp changeover is according to the setting of P302.

If one or more terminals are programmed for BIF69, and one of the terminals is energized, then the ramp changeover will occur per P302 ten's digit as soon as the ramp output reached the required setpoint for the first time after BIF69 = 1. If BIF69 subsequently changes from 1 to 0 then ramp rate 1 or the ramp-function generator setting 2 or 3 as selected with BIF31 or BIF32 is again used. The changeover enable is re-activated when BIF69 changes from 0 to 1 so that when the required setpoint is reached the next time the ramp-function generator setting, corresponding to P302, is again selected.

10.3 Fixed Input Terminal Functions

Terminal 37 Start / Stop command

Signal level: Terminal open or logic 0 Stop
 Terminal energized, or logic 1 Start

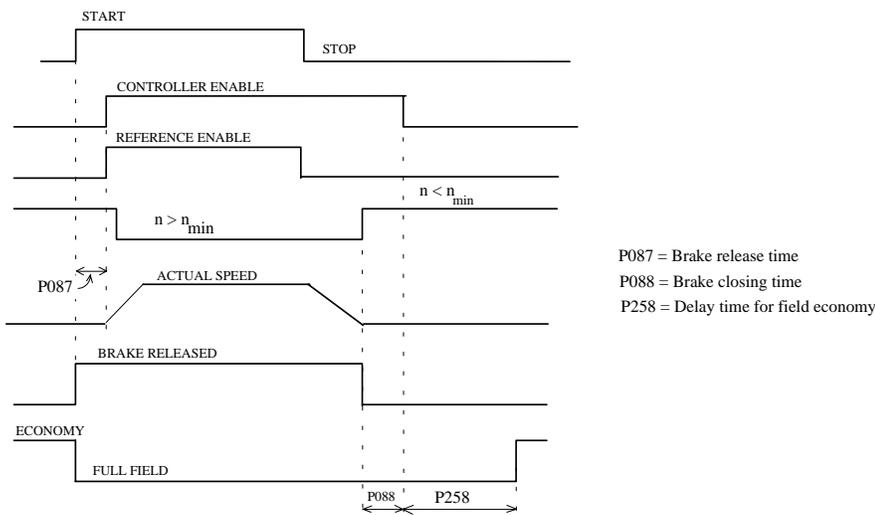
The drive can also be started using the "I" key on the optional operator control panel by setting P066 to the appropriate value. The "O" key on the optional operator control panel can be used to stop the drive using various methods set using P067.

Sequence when starting the drive:

1. Provide the drive enable signal by terminal 38 or control word bit
2. Initiate the start command by terminal 37 or control word bit
3. Operating status o7 is exited
4. M contactor relay is energized,
5. Field economizing command is removed
6. If the brake release time is a positive value, output BOF 14 = 1 to release the brake and then wait for the brake release time delay (set by P087) and proceed to step 7. If the brake time is negative BOF 14 remains zero and the brake is set and the sequence proceeds to step 7.
7. Drive is enabled and running and after the negative brake time has expired BOF 14 = 1 to release the brake..

Sequence when stopping the drive:

1. Remove the start command
2. Drive decelerates using the ramp generator
3. Wait for speed < minimum speed signal (P370 to P372)
4. Issue the set brake command (BOF 14 = 0) and wait for brake to close time delay (set by P088)
5. Set current reference to 0
6. Technology controller, ramp generator and speed controller are inhibited
7. When current feedback reaches 0% the gate pulses are inhibited
8. The M contactor relay drops out
9. Operating status o7.0 or higher is displayed
10. Waiting for field economizing delay time (set by P258) to expire
11. Field reference is reduced to the value programmed in P257



Typical Start / Stop Sequence

NOTE ON STARTING AND STOPPING:

When removing the start command, the reference limiting at the speed controller input is not effective.

During stopping, when the speed feedback becomes less than the minimum speed (P370 to P372) for the first time, an internal interlocking function becomes effective which prevents the drive from braking again if the motor is rotated by external forces causing the removal of the signal speed feedback less than minimum speed.

All start commands, by terminals or control words are logically AND'd by the software which means that all start commands must be in the "start" condition before the drive will actually start.

If start is set for a momentary command then a terminal or bit of the STWF control word must be set to stop the drive using BIF 2.

If started using momentary signals then automatic restart is not possible.

Terminal 38 Drive enable

Signal level:	Terminal open or logic 0	Drive disabled
	Terminal energized, or logic 1	Drive enabled

If the optional operator panel is used and P066 = 2, then "I" key will both enable the drive and provide the start command. In this case terminal 38 is ineffective.

Sequence when entering the drive enable command when "start" is already present:

1. Enter drive enable command
2. Output the brake release signal BOF 14 = 1 and wait for brake release time delay if P087 is set to a positive value. The contactor is already picked up at this time. If the brake time is a negative value BOF 14 will remain zero and the sequence will proceed immediately to the next step.
3. Enable ramp generator, speed controller and current controller
4. Operating status I, II or -- is reached and after a negative brake time has expired the brake release command BOF 14 = 1.

Sequence when withdrawing drive enable:

1. Remove drive enable command
2. The ramp generator and speed controller are blocked
3. Set current reference to 0%
4. When current feedback reaches 0% disable gating pulses
5. Drive coasts to a stop (or is braked by the stopping brake).
6. When the speed is less than the minimum speed the holding brake is set with BOF 14 = 1

All "drive enable" commands by terminals or control words are logically AND'd by the software. This means that all "drive enable" commands must be energized before the drive can be operated.

Field economizing**a) Automatic field economizing**

Automatic field economy is controlled by parameter P082 (i.e., P083 = xx2).

Sequence when drive is stopping:

1. Remove the start command (by terminal 37 or control word bit)
2. When the drive stops, operating status o7.0 or higher is displayed
3. Wait for the delay time programmed in P258 to expire
4. The field current reference is reduced to the value set in P257

Sequence when starting the drive:

1. Enter start command
2. Operating status I, II or -- is reached
3. Field economizing command is simultaneously removed and the normal field current reference is applied

b) Forced field economizing by selectable binary input

Signal level: Terminal open or logic 0	Full field reference
Terminal energized, or logic 1	Forced field economizing

If one or more terminals are programmed as "forced field economizing", using BIF 56, and one of the terminals is energized, then the field reference is immediately reduced to the value in P257. The forced field economy function is disabled during self tuning runs.

Emergency stop (E-STOP)**a) Operation by a maintained E-Stop Switch**

E-STOP is initiated by opening a switch between terminals 53 and 56. For operation with a maintained E-Stop switch, there should be no connections to terminals 57 or 58.

b) Momentary Push-button operation

When a normally closed push-button is used for E-Stop it should be connected between terminals 53 and 56. An E-Stop is initiated by depressed the E-STOP button.

If a normally closed E-STOP button is connected between terminals 53 and 57 then a reset push-button with normally open contacts must be connected between terminals 53 and 58. In this case there should be no connection to terminal 56.

Sequence when entering E-STOP:

1. Enter the "E-STOP" command
2. Inhibit Technology controller, ramp generator, speed and current controllers
3. Set gate angle to full retard limit
4. Gating pulses are inhibited when current feedback reaches 0%
5. M contactor relay drops out
6. The drive coasts to a stop
7. Operating status o8.0 or higher is displayed
8. Wait for time delay programmed in P258 to expire
9. Field reference is reduced to value programmed in P257

NOTE: The E-Stop is a hard wired stop function. In parallel and independent to the above sequence, the main contactor will be dropped out a short time after the E-Stop command is given. Normally the above controlled sequence occurs first assuring that the contactor opens under no load.

10.4 Binary Output Functions

The binary output functions can be assigned to terminals by setting the terminal assignment parameter to the desired binary output function number.

- terminal 46 assigned with parameter P771.
- terminal 48 assigned with parameter P772.
- terminal 50 assigned with parameter P773.
- terminal 52 assigned with parameter P774.

The operation of the selected function can be inverted using parameter P770 and a response delay time can be set with parameters P775 to P778 for each terminal. Most of the BOF's can be assigned to the status words ZSW, ZSW1, or ZSW2 (refer to section 10.6 for status word descriptions).

Binary Output Functions Summary:

BOF	Description
0	Logical "0" or "OFF"
1	Logical "1" or "ON"
2	Logical "0" or according to binary input functions 61, 62, 63, 64
3	Fault (low is a fault)
4	Ready to start (waiting for the start command)
5	Ready to operate (waiting for the enable)
6	Run
7	Turn auxiliary equipment "ON".
8	AC supply voltage available (armature and field)
9	Line contactor control OFF = switch-on inhibit (low active)
10	Line contactor OFF (= E-Stop) (low active)
11	Status signal from BIF 55 "line contactor closed" (low active)
12	Ramp-function generator active
13	Reverse direction of rotation
14	Switch-on command for the holding or operating brake (low active)
15	$I_A > I_x$ (I_x is set using P391, hysteresis P374)
16	$n < n_{x1}$ (n_{x1} is set using P373, hysteresis P374)
17	$n < n_{x2}$ (n_{x2} is set using P376, hysteresis P377)
18	$n < n_{x3}$ (n_{x3} is set using P379, hysteresis P380)
19	$n < n_{x4}$ (n_{x4} is set using P382, hysteresis P383)
20	$n < n_{x5}$ (n_{x5} is set using P385, hysteresis P386)
21	$n < n_{min}$ (n_{min} is set using P370, hysteresis P371)
22	Reference speed reached ((setpoint-feedback) < P362)
23	Speed < maximum speed
24	Warning (low active)
25	Warning, motor overload, i.e., W01 or W05 or W06 (low active)
26	Warning, converter overload (low active)
27	Converter cooling faulted (refer to fault message F110, message also comes when the fault message is suppressed) (low active)
28	$I_{field} < I_{fmin}$ (low active) (I_{fmin} is set using P394, hysteresis P395)
29	$I_A = I_{limit}$ (actual current limit reached)
30	Field reversing contactor 1 "ON" (main contactor)
31	Field reversing contactor 2 "ON" (reversing contactor)
32	Torque direction change signal
33	Power section warm (European design only)
34	Output of general purpose limit detector 1
35	Output of general purpose limit detector 2

Binary Output Function Descriptions

BOF 3 Fault (low active)

As supplied from the factory, the fault output is assigned to terminal 46 although the function can be assigned at any of the outputs or not selected at all.

Signal level: H signal	No fault
L signal	Fault, the drive is in operating status o 11.

Note:

The fault status bit in status word ZSW3 has inverted logic levels (bit = 1 means Fault)

BOF 4 Ready to start

Signal level: H signal	Ready to start. The drive is in operating status o7, the power supply is on, electronics are initialized, the line contactor is open, gate pulses are inhibited, waiting for a start command.
------------------------	---

L signal	The drive is not in operating status o7.
----------	--

BOF 5 Ready to operate

Signal level: H signal	Ready to operate The drive is in operating status o 1, the line contactor is closed, waiting for the operating enable command.
------------------------	--

L signal	The drive is not in operating status o 1.
----------	---

BOF 6 Run

Signal level: H signal	Operation, the drive is in operating status I, II or --
------------------------	---

L signal	The drive is not in operating status I, II or --
----------	--

BOF 7 Switch auxiliary equipment "ON"

Signal level: H signal	Auxiliary equipment is started
L signal	Auxiliary equipment is stopped

When the drive start command is given, auxiliary equipment such as fans or lubrication pumps can be immediately started using BOF 7. The drive waits in operating status o6.0 and will not start until a time delay set with P093 has elapsed. When the drive is stopped the auxiliary equipment will continue to run for a time set with P094.

BOF 8 Supply voltage available (armature and field)

Signal level: H signal	Supply voltage available and the drive is in an operating status <o4.
------------------------	---

L signal	The drive is in an operating status ≥ o4.
----------	---

BOF 9 Line contactor control OFF (low active)

Signal level: H signal	The line contactor can be closed by the converter control
------------------------	---

L signal	The contactor has been opened for safety reasons by the converter control and the drive is in operating status o8.0 or higher.
----------	--

Note:

The BOF 9 bit in status word ZSW has inverted logic levels with respect to the above.

BOF 10 Line contactor OFF (low active)

Signal level: H signal E-Stop has not been activated
L signal E-Stop has been activated and the operating status is o 10 20

BOF 11 Status signal of the binary input function "line contactor energized,"

Signal level: H signal The binary input signal, BIF 55, "line contactor energized," is low
L signal The binary input signal, BIF 55, "line contactor energized," is high

BOF 12 Ramp function generator active

Signal level: H signal The ramp is active. The ramp output is not equal to the ramp input
L signal The ramp is not active. The ramp output is equal to the ramp input.

BOF 13 Reverse rotation

Signal level: H signal Reverse direction of rotation
L signal Forward direction of rotation

Note: Direction hysteresis is set with P396.

BOF 14 Switch on command for the "operating" or "holding" brake

Signal level: H signal Release the brake
 L signal Set the brake

The following parameters control the function of the brake signal:

- P080 = 1** The brake is a holding brake that is set when the speed < minimum speed (P370, P371).
- P080 = 2** The brake is an operating or stopping brake that is set when the drive is running.

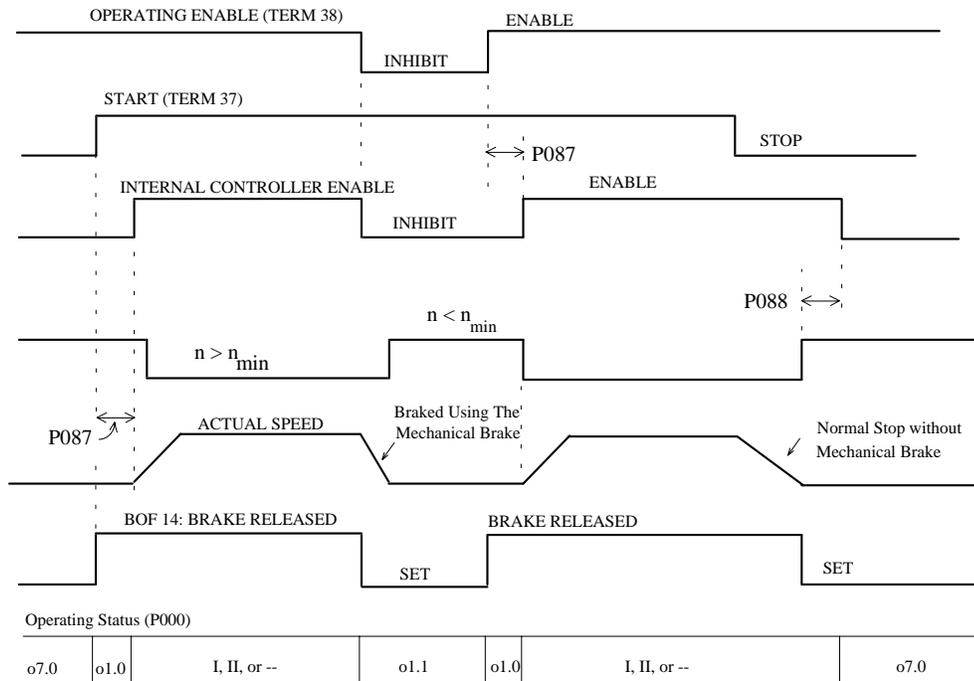
P087 Brake opening time; A positive value prevents the motor from producing torque when the brake is set. A negative value allows the motor to produce torque when the brake is set.

P088 Brake closing time; The motor continues to develop torque while the brake is closing.

The following diagrams illustrate the brake control sequence for signal level changes to the "operate enable" and "start/stop" signals. As far as the brake control is concerned "jog", "thread", and "quick stop" are treated like start or stop commands.

The close brake signal is output during the armature current self tuning run.

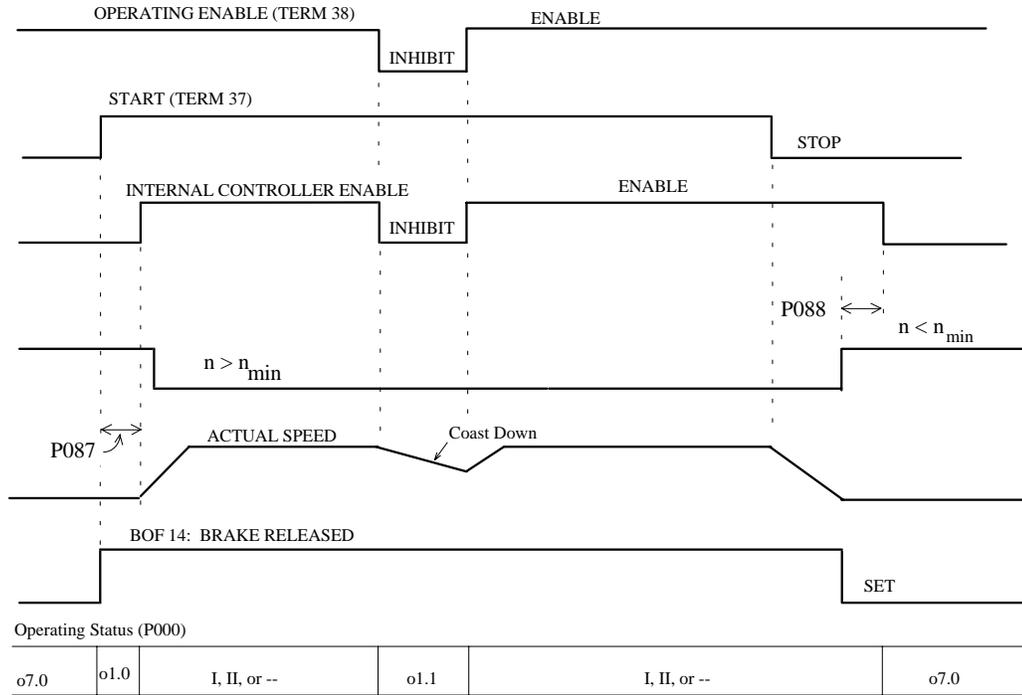
**Operating Brake (P080 = 2), brake opening time P087 is positive
 Reaction to "operating enable" and "stop" commands**



P087 = Brake release time

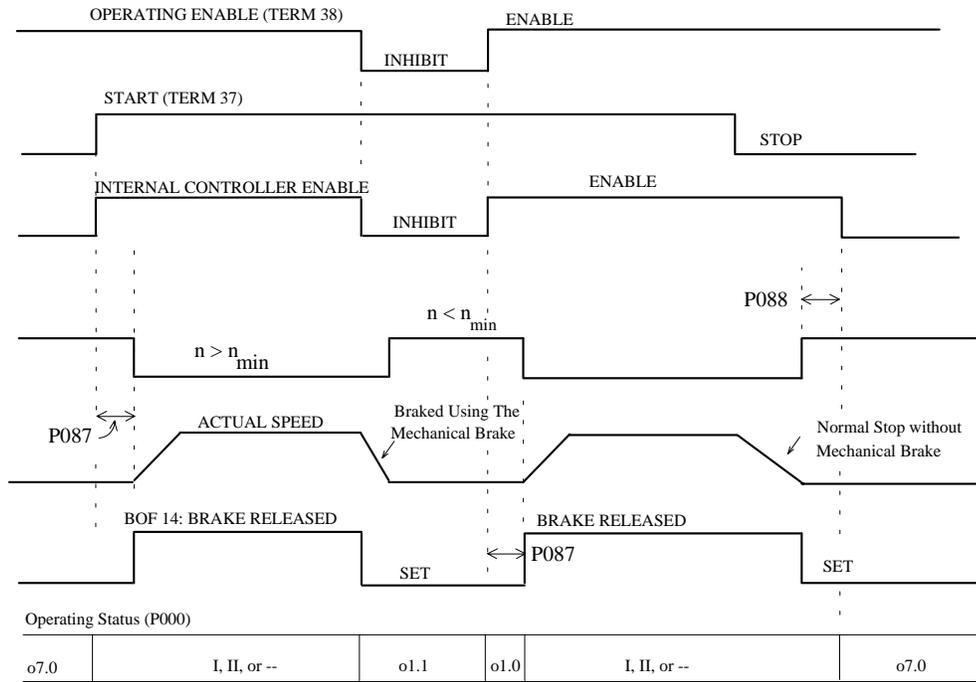
P088 = Brake closing time

**Holding Brake (P080 = 1), brake opening time P087 is positive
Reaction to "operating enable" and "stop" commands**



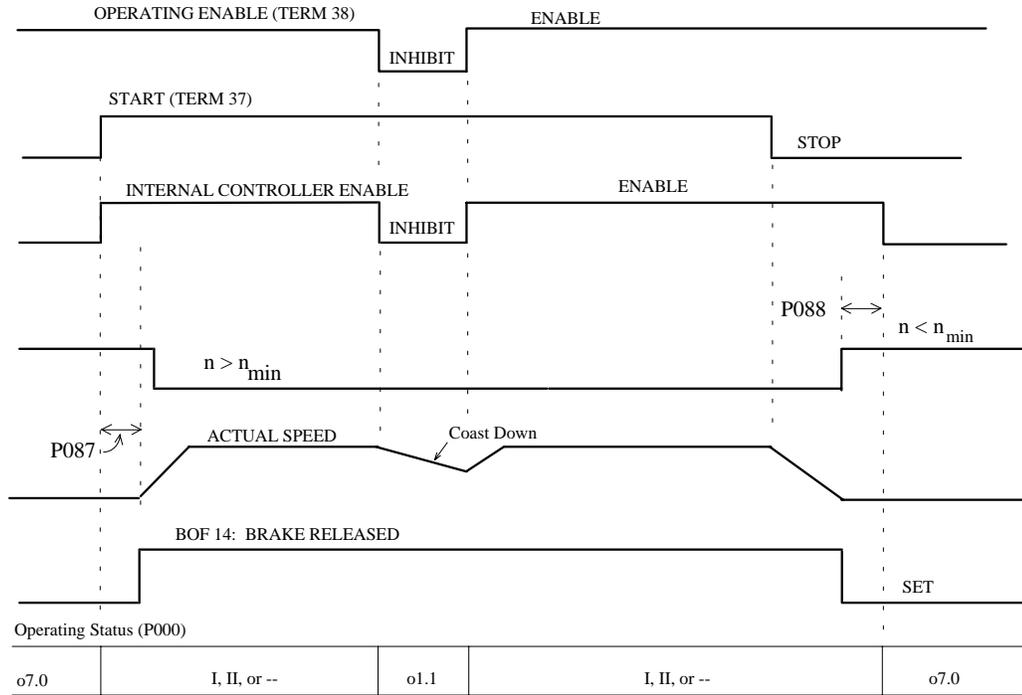
P087 = Brake release time
P088 = Brake closing time

Operating Brake (P080 = 2), brake opening time P087 is negative
Reaction to "operating enable" and "stop" commands



P087 = Brake release time
 P088 = Brake closing time

**Holding Brake (P080 = 1), brake opening time P087 is negative
Reaction to "operating enable" and "stop" commands**

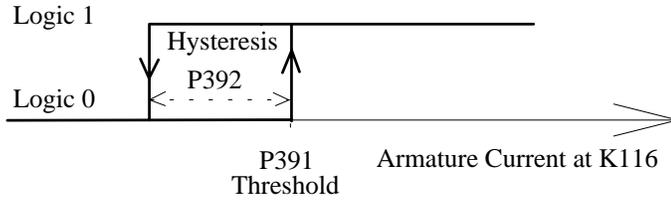


P087 = Brake release time
P088 = Brake closing time

BOF 15 $I_A > I_X$ (current value monitor)

Signal level: H signal Switch to logic level 1 when armature current at K116 is greater than the threshold value P391.
 L signal Switch to logic level 0 when armature current at K116 is less than the threshold value minus the hysteresis value.

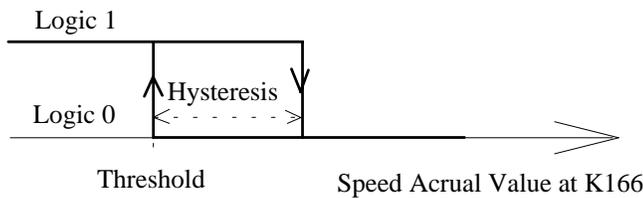
Threshold value = P391 in % of rated **converter current**
 Hysteresis value = P392 in % of rated **converter current**



BOF 16 to 21 Speed value monitor

Signal level: H signal Switch to logic level 1 when the |actual speed| at K166 is less than the threshold value
 L signal Switch to logic level 0 when the |actual speed| at K166 is greater than the threshold plus the hysteresis values.

		Threshold	Hysteresis
BOF 16	$n < n_{base}$	$n_{base} = P373$	Hysteresis = P374
BOF 17	$n < n_{x2}$	$n_{x2} = P376$	Hysteresis = P377
BOF 18	$n < n_{x3}$	$n_{x3} = P379$	Hysteresis = P380
BOF 19	$n < n_{x4}$	$n_{x4} = P382$	Hysteresis = P383
BOF 20	$n < n_{x5}$	$n_{x5} = P385$	Hysteresis = P386
BOF 21	$n < n_{min}$	$n_{min} = P370$	Hysteresis = P371



Note: The n_{min} value, set with P370, is also used when stopping to determine the speed when the contactor is dropped out.

BOF 22 Reference speed reached

Signal level: H signal	The deviation of the speed error at the input of the speed controller is lower in magnitude than the value set with P362 or has exceeded the value of P362 but for a shorter time than the time set with P363.
L signal	The deviation of the speed error at the input of the speed controller is greater in magnitude than the value set with P362 and lasts longer in time than the time set with P363.
Threshold	Set with P362 in % of maximum speed
Time	Set with P363 in seconds

BOF 23 Speed less than maximum speed

Signal level: H signal	The speed actual value at K166 is lower than the maximum speed threshold set with P354.
L signal	The speed actual value at K166 is greater than the maximum speed threshold set with P354 plus 5% hysteresis. A fault F038 is issued for overspeed. This monitor signal is active even if fault F038 is suppressed.

BOF 24 Warning (active low)

Signal level: H signal	No warnings are present
L signal	Warning present (see P049 and P050)

Note: The warning status bit of status word ZSW bit 7 has inverted logic (bit = 1 means a warning is present).

BOF 25 Warning Motor overload W01, W05, W06 (active low)

Signal level: H signal	No warning is present
L signal	Warnings W01, W05, or W06, motor over temperature, are present

BOF 26 Warning converter overload (active low)

Signal level: H signal	No warning present
L signal	Warning W10 (converter I ² t) present

BOF 27 Converter cooling fault (active low)

Signal level: H signal No fault present
 L signal Fault F110 present

This monitor function is active even if fault F110 is disabled.

BOF 28 $I_{\text{field}} < I_{\text{field min}}$ (active low)

Signal level: H signal The field current actual value at K265 is greater than the minimum threshold set with P394 plus hysteresis set with P395.

L signal The field current actual value is less than the minimum threshold set with P394.

Threshold Set with P394 in % of rated drive controller field current

Hysteresis Set with P395 in % of rated drive controller field current

The hysteresis is effective when the transition from low to high is made.

BOF 29 $I_A = I_{\text{limit}}$

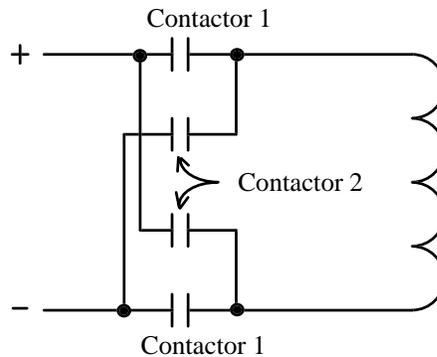
Signal level: H signal Armature current limit is reached (either + or - limit at K131 & K132).
 L signal Armature current is less than current limit

BOF 30 Field circuit contactor 1 "ON"

Signal level: H signal Field circuit contactor 1 is picked up to provide positive field current.
 L signal Field circuit contactor 1 is dropped out

This function requires the use of external field reversing contactors:

This signal along with BOF 31 is used to control a reversing contactor for changing the field current direction on 1-Q converters. This allows for direction of rotation changes and braking for larger 1-Q converters. Two contactors in the field circuit are used to reverse the applied field voltage to get reversed field current. The internal sequence automatically supervises the operation of the contactors. **Refer to BIF 57 and BIF 58 for additional information.**

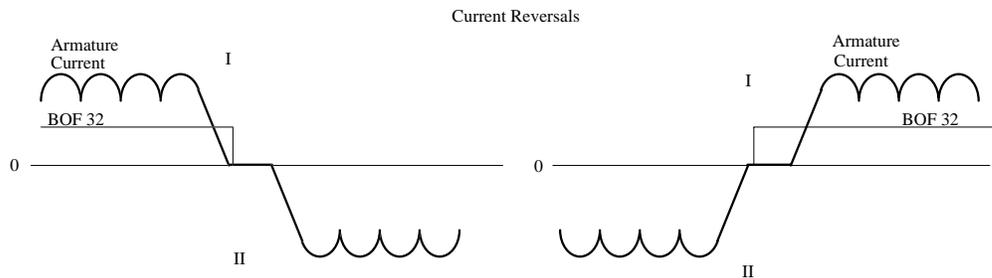
**BOF 31 Field circuit contactor 2 "ON"**

Signal level: H signal Field circuit contactor 2 is picked up to provide negative field current.
 L signal Field circuit contactor 2 is dropped out

Refer to BIF 57 and BIF 58 for additional information.

BOF 32 Ready for torque direction change

Signal level: H signal The drive is in operating status "I" or "--" waiting to go to "I"
 L signal The drive is in operating status "II" or "--" waiting to go to "II"

**BOF 33 Power section is warm (European design only)**

Signal level: H signal The calculated thyristor junction temperature exceeds the desired value and the converter is considered "warm".
 L signal The calculated thyristor junction temperature is less than the warm value and the converter is considered "cool".

BOF 34 General Purpose Limit Detector 1

Signal level: H signal The selected comparator condition is true.
 L signal The selected comparator condition is false.
 Refer to P693, P659, P660, and P692 for information on how to use the detector.

BOF 35 General Purpose Limit Detector 2

Signal level: H signal The selected comparator condition is true.
 L signal The selected comparator condition is false.
 Refer to P693, P659, P660, and P692 for information on how to use the detector.

BOF 36 Coast Stop (Stop 2) is Active (Version 2.3)

Signal level: H signal Coast Stop is active.
 L signal Coast Stop is not active.

BOF 37 Quick Stop (Stop 3) is Active (Version 2.3)

Signal level: H signal Quick Stop is active.
 L signal Quick Stop is not active.

10.5 Control Words

The control words have the individual bits assigned to various converter binary functions. The specific operation of the converter depends on how the control word has been defined and in many cases the same definition of the control word applies to several Siemens drive families. By setting bits on or off the functions of the converter can be controlled. The control word can come from the converter binary input terminals or from the serial port. The information from these two sources is blended together to form the control word. The 6RA24 SIMOREG has two control words. The first is the standard control word STW. It has the bits defined for converters in general and applies to other converter families as well as the 6RA24. The second control word, STWF, is definable and is used for converter specific functions.

10.5.1 Control Word STW (connector K315)

The following table shows the meaning of each bit in the standard control word.

Bit	State	Name	Function
0	0	OFF1	Normal Stop
	1	ON	Start
1	0	OFF2	Coast Stop
	1		Operation allowed
2	0	OFF3	Quick Stop
	1		Operation allowed
3	0		Drive not enabled
	1		Drive operating enabled
4	0		Ramp generator not enabled
	1		Ramp generator enabled
5			Note: bit 5 has two different senses depending on the source of the control word.
	0		For the basic serial ports of the 6RA24 with USS protocol:
	1		Ramp generator is held
			Ramp generator is not held
	0		For the option board dual port ram interfaces:
	1		Ramp generator is not held
6	0		Reference not enabled
	1		Reference enabled
7	0		No significance
	1		Fault reset or acknowledged
8			Not used for 6RA24 converters
9			Not used for 6RA24 converters
10	0		Serial control lost; operation is from old data still in the DPR
	1		Control by serial interface; process data is valid
11			Not used for 6RA24 converters
12			Not used for 6RA24 converters
13			Not used for 6RA24 converters
14			Not used for 6RA24 converters
15			Not used for 6RA24 converters

Parameter P640 is used to select the connector that supplies the STW control word with data. As an example, if P640 = 20, then the control word data comes from the first word of the base board port 0 (BBP0) serial interface.

The status of the STW bits is available at connector K315 and is indicated at parameter P010.01.

The individual control word bits are logically combined with the terminal functions and the STWF control word. The logical status of the binary input terminals is available at connector K335 and indicated at parameter P010.00. The status of the control word after combining the various bits is available at connector K317 and displayed at P010.03.

10.5.2 Converter Specific Control Word STWF (connector K316)

Parameter P642 is used to assign a binary input function to each bit in the STWF control word. Parameter P642 is an index parameter with indices from zero to 15 corresponding to the control word bits zero to 15. As an example, index 0 of P642 is used to assign a binary function to bit 0 in the STWF control word.

Parameter P641 is used to define the connector number to be used as the source for the STWF control word in addition to the terminal source. The choices of P641 include all of the words available from the 2 base serial ports and the words available from the dual port ram interface to an option board. As an example, if P641 = 52, then the control word would come from the first word in the dual port ram interface. The individual bits of the source word selected with P641 are logically combined with the binary input terminal functions to create the STWF control word.

The status of the bits of the STWF control word is available at connector K316 and is indicated at parameter P010.02. The status of the bits of the STWF control word after combining with the binary input terminals is available at connector K318 and is indicated at parameter P010.04.

The following table shows the possible sources for the control function and the logic operation used to blend the terminal data with the other selected source data. If the source cell in the following table is shaded with a check mark or bit number, that indicates that the binary input function could originate from that source.

BIF #	FUNCTION	Possible Source			LOGIC
		TERMINAL	STW	STWF	
0	No function	✓		✓	OR
1	Reserved for use later				
2	Normal Stop (active low)				
3	Coast stop	✓	Bit 1	✓	AND
4	Quick Stop	✓	Bit 2	✓	AND
5	Fault reset	✓	Bit 7	✓	OR
6	Technology controller enable	✓		✓	AND
7	Speed controller enable	✓		✓	AND
8	EMF controller enable	✓		✓	AND
9	Ramp generator enable	✓	Bit 4	✓	AND
10	Ramp generator hold	✓	Bit 5	✓	OR
11	Reference enable	✓	Bit 6	✓	AND
12	Reserved for use later	✓		✓	OR
13	Jog	✓		✓	OR
14	Jog bypass the ramp	✓		✓	OR
15	Thread	✓		✓	OR
16	Thread bypass the ramp	✓		✓	OR
17	Fixed reference	✓		✓	OR
18	Fixed reference bypass the ramp	✓		✓	OR
19	Additional reference before Technology controller	✓		✓	OR
20	Additional reference before ramp generator	✓		✓	OR
21	Additional reference before speed controller	✓		✓	OR
22	Additional reference before torque limiting	✓		✓	OR
23	Additional reference before current controller	✓		✓	OR
24	Reference reduction	✓		✓	OR
25	MOP manual / automatic	✓		✓	OR
26	MOP raise	✓		✓	OR
27	MOP lower	✓		✓	OR
28	Forward / Reverse switch	✓		✓	OR
29	Forward push-button	✓			
30	Reverse push-button	✓			

cont'd

BIF #	FUNCTION	Possible Source			LOGIC
		TERMINAL	STW	STWF	
31	Ramp generator setting 2	✓		✓	OR
32	Ramp generator setting 3	✓		✓	OR
33	Use parameter set 2	✓		✓	OR
34	Use parameter set 3	✓		✓	OR
35	Use parameter set 4	✓		✓	OR
36	Enable Technology controller droop	✓		✓	AND
37	Enable speed controller droop	✓		✓	AND
38	Switch speed controller P /PI	✓		✓	AND
39	Enable speed controller inertia compensation	✓		✓	AND
40	Reverse polarity of speed controller feedback	✓		✓	OR
41	Switch drive function Master / Slave	✓		✓	OR
42	Switch torque limits	✓		✓	OR
43	Switch "on" main reference terminals 4 & 5	✓		✓	AND
44	Switch "on" main analog feedback term 60 to 64	✓		✓	AND
45	Switch "on" analog input terminals 6 & 7	✓		✓	AND
46	Switch "on" analog input terminal 8	✓		✓	AND
47	Switch "on" analog input terminal 10	✓		✓	AND
48	Main reference polarity change terminals 4 & 5	✓		✓	OR
49	Analog feedback polarity change term 60 to 64	✓		✓	OR
50	Polarity change analog input terminals 6 & 7	✓		✓	OR
51	Polarity change analog input terminal 8	✓		✓	OR
52	Polarity change analog input terminal 10	✓		✓	OR
53	External fault active low	✓		✓	AND
54	External warning active low	✓		✓	AND
55	Main contactor status	✓		✓	AND
56	Forced field economy	✓		✓	OR
57	Direction reversal using field reversing	✓		✓	OR
58	Braking using field reversal	✓		✓	OR
59	External field loss	✓		✓	AND
60	Reserved for use later	✓		✓	
61	Set binary output 1 at terminal 46 if P771 = 2	✓		✓	OR
62	Set binary output 2 at terminal 48 if P772 = 2	✓		✓	OR
63	Set binary output 3 at terminal 50 if P773 = 2	✓		✓	OR
64	Set binary output 4 at terminal 52 if P774 = 2	✓		✓	OR
65	Switch between P656 and P657 at K242	✓		✓	OR
66	Switch between P666 and P667 at K234	✓		✓	OR
67	Switch between P676 and P677 at K154	✓		✓	OR
68	Preset MOP	✓		✓	OR
	Start / Stop	37	Bit 0		AND
	Operating enable	38	Bit 3		AND
	Control from serial source		Bit 10		

Assignments of the fixed references of the converter specific control word STWF.

BIF	Function	Parameter
13	Jog ¹⁾	P409
14	Jog bypass the ramp ¹⁾	P410
15	Thread ¹⁾	P411
16	Thread bypass the ramp ¹⁾	P412
17	Fixed reference ²⁾	P413
18	Fixed reference bypass the ramp ²⁾	P414
19	Additional reference before Technology controller ²⁾	P415
20	Additional reference before ramp generator ²⁾	P416
21	Additional reference before speed controller ²⁾	P417
22	Additional reference before torque limiting ²⁾	P418
23	Additional reference before current controller ²⁾	P419

- 1) If the function is requested from 2 sources, i.e., terminals and the STWF control word, the references is set to zero.
- 2) If the function is requested from 2 sources, i.e., terminals and the STWF control word, the references set at the parameters are added.

10.6 Status Word

The standard status word has been defined for all of the Siemens converters and is used to provide operating status information about the drive controller. The standard status word, ZSW, has all of the bits assigned. Two converter specific status words, ZSW1 and ZSW2, are also available to provide additional status information. All of the bits in these two words have been pre-assigned.

10.6.1 Standard status word ZSW (K325)

The ZSW status word is available at connector K325 and is displayed at parameter P011.01.

The following table shows the bits of the standard status word and their meaning.

Bit	State	Function	BOF
0	0	Not ready to start	4
	1	Ready to start (operating status o7)	
1	0	Not ready, waiting for the operate enable signal (status o1)	5
	1	Operate enable is present	
2	0	Drive not running	6
	1	Drive running; torque direction I, II, or --	
3	0	No faults present	3
	1	Faults present Logic is inverted compared to BOF 3	
4	0	Coast stop command present (active low)	
	1	Coast stop is not active (allows drive to be started)	
5	0	Quick stop command present (active low)	
	1	Quick stop is not active (allows drive to be started)	
6	0	Drive not inhibited from running	9
	1	Drive blocked (operating status o8) Logic is inverted compared to BOF 9	
7	0	No warning	24
	1	Warning present Logic is inverted compared to BOF 24	
8	0	Speed controller speed error is not within the tolerance band	22
	1	Speed controller speed error is within the tolerance band	
9	0	Local operation; control is only possible at the converter	
	1	The automation system is requested to take control (monitor signal by bit 10 in the STW control word)	
10	0	speed < nbase (P373) + hysteresis (P374)	16
	1	speed > nbase (P373) Logic is inverted compared to BOF 16	
11		Not used for 6RA24 converters	
12		Not used for 6RA24 converters	
13		Not used for 6RA24 converters	
14		Not used for 6RA24 converters	
15		Not used for 6RA24 converters	

10.6.2 Converter specific status word ZSW1 (K326)

The ZSW1 status word is available at connector K326 and is displayed at parameter P011.02.

The following table shows the bits of the converter specific status word and their meaning.

Bit	State	Function (refer to binary output functions for descriptions)	BOF
0	0	Auxiliaries OFF	7
	1	Auxiliaries ON	
1	0	Armature and field supply voltage not present; Status \geq o4	8
	1	Supply voltage present; Status $<$ o4	
2		Reserved for use later	
3	0	E-Stop present; Statue 8.2	10
	1	E-Stop not present	
4	0	Binary input signal "contactor energized" is present (BIF 55)	11
	1	Binary input signal "contactor energized" is not present	
5	0	Ramp not active; output = input	12
	1	Ramp active; output \neq output	
6	0	Forward rotation (hysteresis set with P396)	13
	1	Reverse rotation (hysteresis set with P396)	
7	0	Close brake	14
	1	Open brake	
8	0	IA $<$ Ix (P391 plus P392)	15
	1	IA $>$ Ix (P391)	
9	0	Speed $>$ nx1 (P373 + P374)	16
	1	Speed $<$ nx1 (P373)	
10	0	Speed $>$ nx2 (P376 + P377)	17
	1	Speed $<$ nx2 (P376)e	
11	0	Speed $>$ nx3 (P379 + P380)	18
	1	Speed $<$ nx3 (P379)	
12	0	Speed $>$ nx4 (P382 + P383)	19
	1	Speed $<$ nx4 (P382)	
13	0	Speed $>$ nx5 (P385 + P386)	20
	1	Speed $<$ nx5 (P385)	
14	0	Speed $>$ nmin (P370 + P371)	21
	1	Speed $<$ nmin (P370)	
15		Not used for 6RA24 converters	

10.6.3 Converter specific status word ZSW2 (K327)

The ZSW2 status word is available at connector K327 and is displayed at parameter P011.03.

The following table shows the bits of the converter specific status word and their meaning.

Bit	State	Function (refer to binary output functions for descriptions)	BOF
0	0	Speed is greater than nmax (P354). Fault F038 is issued.	23
	1	Speed is less than nmax	
1		Reserved for use later	
2	0	Warning motor overload present; W01, W05, or W06	25
	1	No warning present	
3	0	Warning converter overload; W10 converter I _t	26
	1	No warning present	
4	0	Fault F110 converter cooling failure	27
	1	No fault	
5	0	I _{field} is less than the minimum field current (P394)	28
	1	I _{field} is greater than minimum field current	
6	0	Actual armature current limit has not been reached	29
	1	Actual armature current limit has been reached	
7	0	Field contactor 1 is open	30
	1	Field contactor 1 is closed	
8	0	Field contactor 2 is open	31
	1	Field contactor 2 is closed	
9	0	Drive is in operating status II or -- and ready to go to II	32
	1	Drive is in operating status I or -- and ready to go to I	
10	0	Power section considered cool	33
	1	Power section considered hot	
11	0	Output of Limit Detector 1 is Low	34
	1	Output of Limit Detector 1 is High	
12	0	Output of Limit Detector 2 is Low	35
	1	Output of Limit Detector 2 is High	
13		Reserved for use later	
14		Reserved for use later	
15		Reserved for use later	

10.7 Serial Interfaces

The drive controller is equipped with two serial interfaces: RS485 (X500) and RS232 (X501).

	Base Board Port 0		Base Board Port 1	Base Board Port 1 ¹⁾	
Type	RS485		RS232	RS485 ¹⁾	
Connector	X500		X501	X502 ¹⁾	
Operating Mode ²⁾	4 wire bus	2 wire bus	Point to Point	4 wire bus	2 wire bus
Base Board Jumpers			XJ2, XJ6, XJ7, XJ8 in position 1-2	XJ2, XJ6, XJ7, XJ8 in position 2-3	
Cable Termination ³⁾	yes: XJ3 in position 2-3 XJ4 in position 1-2 XJ5 in position 1-2 no: XJ3 in position 1-2 XJ4 in position 2-3 XJ5 in position 2-3		none	yes: XJ201 in position 2-3 XJ200 in position 1-2 XJ202 in position 1-2 no: XJ201 in position 1-2 XJ200 in position 2-3 XJ202 in position 2-3	

- 1) Port 1 for RS485 requires the optional RS232 to RS485 converter board A1618 and is referenced as X502.
- 2) Interface functions with P51 = 11, 12, 13, 14, 15, 16, 17, 18 and 23 as well as the diagnostic monitor and the peer to peer (P780 or P790 = xxx5) are not 2 wire bus capable and automatically switch the interface to 4 wire operation. The peer to peer 2 wire operation, P780 or P790 = xxx4 automatically switch the RS485 to 2 wire. USS protocol automatically uses 2 wire operation.
- 3) 2 wire operation: Cable termination should be provided at both ends of the cable
 4 wire operation: Cable termination should be provided at the master receiver and at the slave receiver located at the end of the transmit cable.

To activate an interface set the following parameters:

	Base Board Port 0 RS485	Base Board Port 1 RS232
Transmission rate	P783	P793
Transmission protocol	P780	P790
For P780 and P790 = xxx1, the required Function must be set and started using P051.	P051	P051

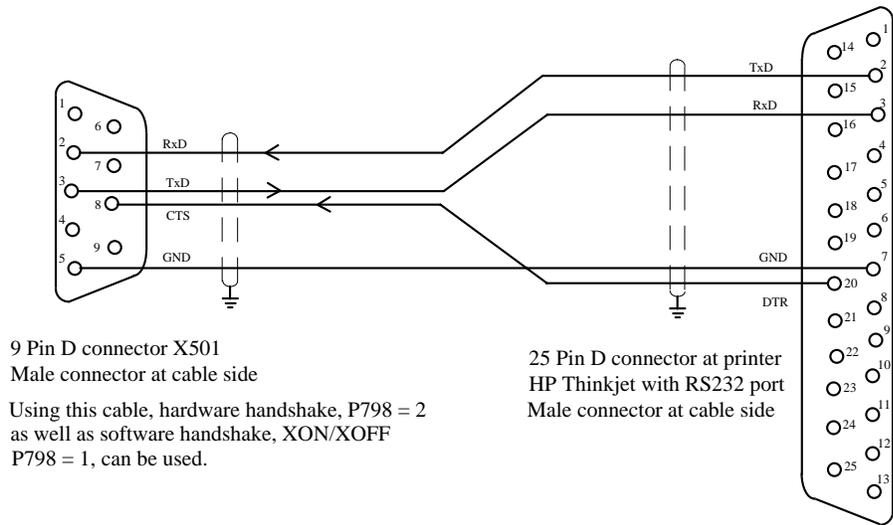
10.7.1 Print the Parameter List, Diagnostics Memory, and Trace Buffer

The parameter list, diagnostic buffer, and the trace buffer can be printed directly on a printer equipped with a serial port or output to a PC using either serial ports X500 or X501. The following procedure describes the necessary steps to make a print out of the desired data using either of the base board serial ports.

Output to a Printer:

The transmission rate and transmission protocol parameters in the 6RA24 must be set to match the particular printer being used. Check the printer instruction manual to determine this data.

STEP	DESCRIPTION	BASE BOARD PORT 0 RS485 (X500)	BASE BOARD PORT 1 RS232 (X501)
1	Set transmission rate to match printer	P783	P793
2	Set transmission protocol; the "xxx" digits of P780 or P790 must be set to match the printer protocol.	P780 = xxx1	P790 = xxx1
3	Set the handshake mode	automatic XON/XOFF	P798
4	Select the desired print function at P051:		
4.1	Print-out changed parameters	P051 = 11	P051 = 11
4.2	Print-out all parameters	P051 = 12	P051 = 12
4.3	Print-out diagnostic buffer after a fault	P051 = 13	P051 = 13
4.4	Print-out the trace buffer	P051 = 14	P051 = 14
5	Press the "SELECT" or "P" key to get the operator prompt message		
6	Press the "RAISE" key to start the print-out. The print-out can be aborted by pressing the "LOWER" key.		



Typical Cable Connection X501 to Printer
Connection Shown is for a HP Thinkjet Printer with an RS232 Port

10.7.2 Transfer the Parameter List, Diagnostic Buffer, and Trace Buffer to a PC

A personal computer, using transfer software, can be used to transfer the parameter, diagnostic, and trace buffer data to computer files for archiving or later use. The following procedure describes the necessary steps to make a transfer from the 6RA24 to the computer using the standard Windows Terminal Program and the base RS232 serial port at X501.

6RA24 Settings:

Set P793 = 6	Sets transmission rate to 9600 baud
Set P790 = 1181	Sets transmission protocol
Set P798 = 1	Sets software handshake on

Windows Terminal Program Settings:

From the Windows "Accessories" menu select "Terminal". Under the Terminal pull down menu "Settings" set the following data:

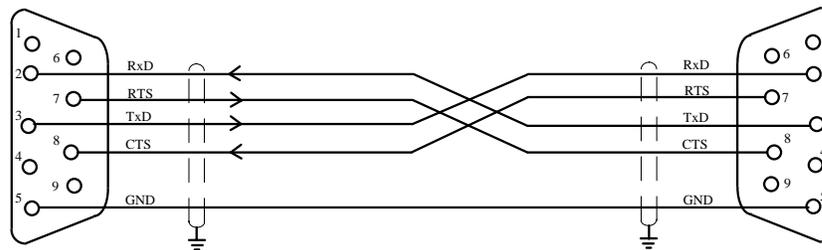
Terminal Emulation	DEC VT-100 (ANSI)
Terminal Preferences	Terminal Modes = Line Wrap Columns = 80 Terminal font = Fixedsys Cursor = Block & Blink Translations = None Show Scroll Bars = on Use Function, Arrow etc. keys = on Buffer Lines = 100 CR > CR/LF = none selected
Text Transfers	Flow Control = Line at a Time Transfer a Line at a Time = delay between lines 0/10 Sec
Communications	Baud Rate = 9600 Data Bits = 7 Stop Bits = 1 Parity = Even Flow Control = Xon/Xoff Connector = COM1 (or can also be COM2) Parity Check = on Carrier Detect = off
Modem Commands	Commands = Set all fields to blanks Modem Defaults = None

After the settings are made they can be saved to a file with a "TRM" extension and used the next time the program is to be used. In this case the file should be opened from the Terminal file menu.

Transfer 6RA24 Data to a PC File:

To send data from the 6RA24 to a PC file, the Windows Receive Text File selection of the Transfer menu should be chosen. After entering the desired file name, the OK button should be selected.

To begin the transfer, parameter P051 should be set to 15, 16, 17, or 18 depending on the information to be transferred, and the raise key should be pressed. After the data has stopped scrolling in on the PC screen, the Stop button should be selected to end and store the file. The file is an ASCII text file and can be modified using a text editor program.



9 Pin D connector X501
Male connector at cable side

9 Pin D connector at PC RS232 port
Female connector at cable side

Using this cable, software handshake, P798 = 1
is used.

Typical Cable Connection X501 to PC RS232 Port

10.7.3 Reading-in Parameters from a PC to the 6RA24

A personal computer, using transfer software, can be used to transfer a parameter file from the PC to a 6RA24. The following procedure describes the necessary steps to make a transfer from the PC to a 6RA24 using the standard Windows Terminal Program and the base RS232 serial port at X501.

6RA24 Settings:

Set P793 = 6	Sets transmission rate to 9600 baud
Set P790 = 1181	Sets transmission protocol
Set P798 = 1	Sets software handshake on

Windows Terminal Program Settings:

Refer to 10.7.2 for the Windows Terminal Program Settings.

Transfer Parameter File from PC to a 6RA24:

Saved parameter files can be transferred from the PC back to a 6RA24. To send a parameter file from the PC to the 6RA24, parameter P051 should be set to 23 and the raise key pressed. Next the Windows Send Text File selection from the Transfer menu should be chosen.

Turn the Strip LF box off, select the file name to be sent, and then select OK.

Refer to 10.7.2 for the required RS232 cable.

10.7.4 "Peer to Peer" Protocol

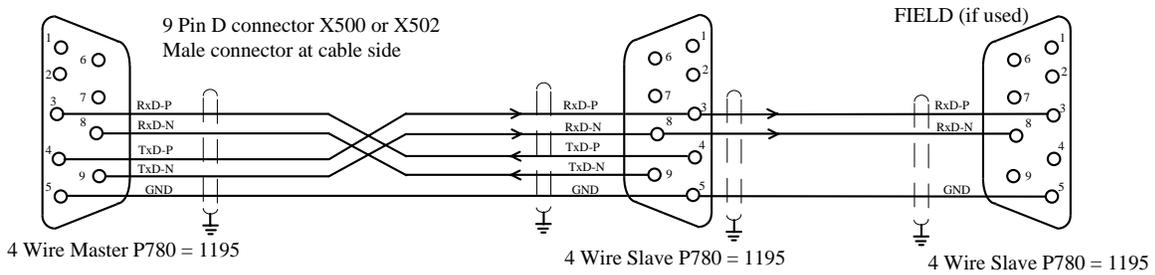
"Peer to Peer " protocol permits a serial bus connection to be made between several drives that allows data to be exchanged between drives. The data sent in the peer to peer telegram can be assigned with parameters depending on the particular application. Port 1 can be operated as Peer to Peer using either RS232 or RS485 with the A1618 converter (see page 2-2 for order number). When used as RS232 only point to point connections are possible. The following procedure describes how to set up the peer to peer protocol.

Four wire operation means that the drive can both transmit and receive data simultaneously on the peer to peer port. If 4 wire operation is selected then the drive must receive valid telegrams before being allowed to run. See operating status o10.3 in section 8. If the drive is only intended to transmit data, then 2 wire operation should be selected.

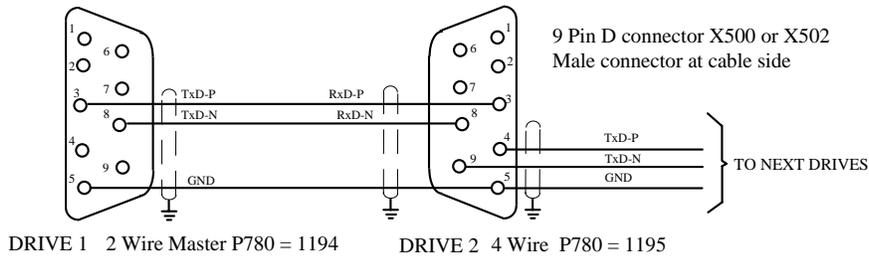
A. Peer to Peer communications (4 wire operation)

	Base Board Port 0 X500 RS485	Base Board Port 1 X501 / X502 RS232 / RS485
Baud Rate P783, P793	P783 = 1 to 10 for baud rates of 300 to 187500 baud.	P793 = 1 to 10 for baud rates of 300 to 187500 baud.
Protocol Selection P780, P790	P780 = 1195: selects Peer, with 1 stop bit, even parity, 9 bit data frame (8 bit data + 1 bit parity)	P790 = 1195: selects Peer, with 1 stop bit, even parity, 9 bit data frame (8 bit data + 1 bit parity)
Number of Process Data Words	5 data words are always sent	5 data words are always sent
Assignment of Process Data Words	Incoming data words can be assigned using the word connector numbers, K020 to K024. The control word is assigned with P640 (STW) OR P641 (STWF)	Incoming data words can be assigned using the word connector numbers, K036 to K040. The control word is assigned with P640 (STW) OR P641 (STWF)
Number of Parameter Data Words	No parameter data is transferred.	No parameter data is transferred.
Assignment of Actual Value Words	Actual value connectors are assigned to words with P784ii Factory setting = 0	Actual value connectors are assigned to words with P794ii Factory setting = 0
Telegram Failure Time (P788)	Time monitoring is dependent on P788 (see fault F015).	Time monitoring is dependent on P788 (see fault F025).
Node Address	No address. All connected receivers get data.	No address. All connected receivers get data.
Wire Method	4 wire operation is automatically selected when P780 = 1195. See connections below.	4 wire operation is automatically selected when P790 = 1195. See connections below.

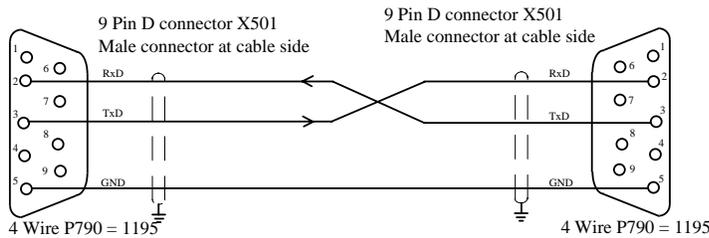
Typical Peer to Peer Cables (4 wire operation and 2/4 Wire Combinations):



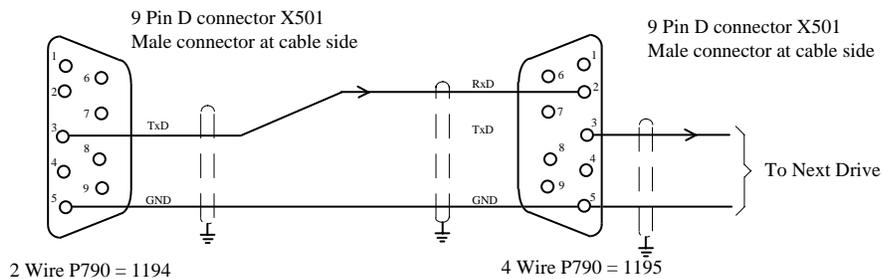
RS485 Peer to Peer 4 Wire Cable Connection
(Example: 12 Pulse Converter with a 3φ Field Supply)



RS485 Peer to Peer Combination 2 and 4 Wire Operation Cable Connections
Cascaded Peer Connection



RS232 Peer to Peer 4 Wire Operation Cable Connections
Point to Point Only



RS232 Peer to Peer Combination 2 and 4 Wire Operation Cable Connections
Cascaded Peer Connection

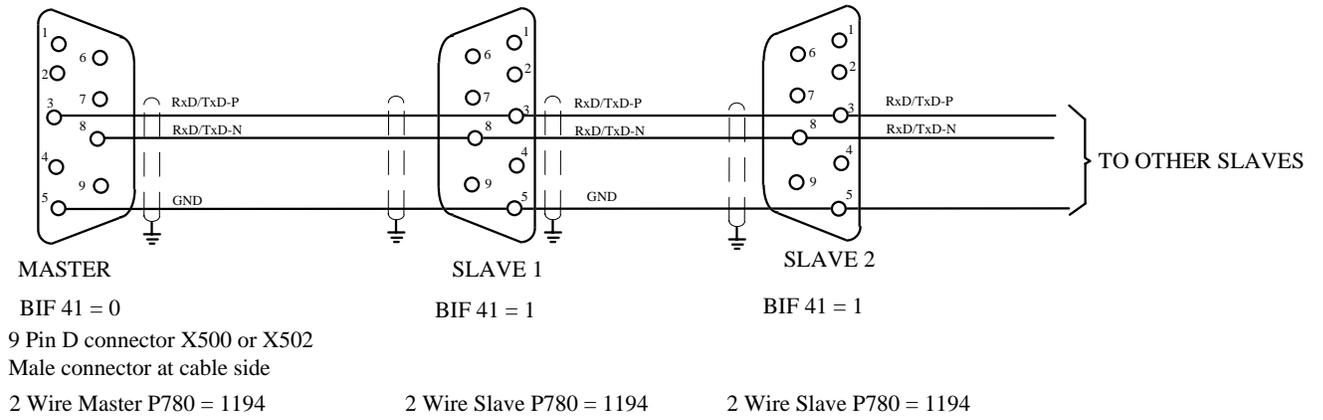
B. Peer to Peer communications (2 wire operation)

The Peer to Peer bus protocol permits a serial link to be established with several converters through a common 2 wire bus cable in conjunction with the binary input function "change over master / slave", (BIF 41) which defines the data transfer direction of each drive. Only one drive can be a master and all other drives must be slaves.

With 2 wire operation the master can only transmit on the wire pair and the slaves can only receive data.

	Base Board Port 0 X500 RS485	Base Board Port 1 X501 / X502 RS232 / RS485
Baud Rate P783, P793	P783 = 1 to 10 for baud rates of 300 to 187500 baud.	P793 = 1 to 10 for baud rates of 300 to 187500 baud.
Protocol Selection P780, P790	P780 = 1194: selects Peer, with 1 stop bit, even parity, 9 bit data frame (8 bit data + 1 bit parity)	P790 = 1194: selects Peer, with 1 stop bit, even parity, 9 bit data frame (8 bit data + 1 bit parity)
Number of Process Data Words	5 data words are always sent	5 data words are always sent
Assignment of Process Data Words	Incoming data words can be assigned using the word connector numbers, K020 to K024. The control word is assigned with P640 (STW) OR P641 (STWF)	Incoming data words can be assigned using the word connector numbers, K036 to K040. The control word is assigned with P640 (STW) OR P641 (STWF)
Number of Parameter Data Words	No parameter data is transferred.	No parameter data is transferred.
Assignment of Actual Value Words	Actual value connectors are assigned to words with P784ii Factory setting = 0	Actual value connectors are assigned to words with P794ii Factory setting = 0
Telegram Failure Time (P788)	Time monitoring is dependent on P788 (see fault F015).	Time monitoring is dependent on P788 (see fault F025).
Node Address	No address. All connected receivers get data.	No address. All connected receivers get data.
Wire Method	2 wire operation is automatically selected when P780 = 1194. See connections below.	2 wire operation is automatically selected when P790 = 1194. See connections below.
Signal level of BIF 41 Low (master drive) High (slave drive)	Master Send only Slave Receive only	Master Send only Slave Receive only

Peer to Peer Cables (2 wire):



**RS485 Peer to Peer 2 Wire Cable Connections
Parallel Master to Slaves**

10.7.5 USS Protocol Summary

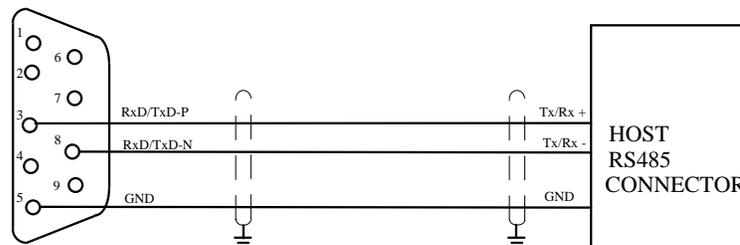
USS protocol has been developed for use with Siemens converters and offers a simple effective communications link to a master device. On the 6RA24 the USS protocol can be operated on both of the base board serial ports at the same time. The protocol can operate as a bus system using RS485 at X500 or point to point using RS232 at X501. If the RS232 base board port 1 is to be used for USS bus protocol, the optional A1618, RS232 to RS485 converter, is required.

USS Protocol Parameter Summary:

	Base Board Port 0 X500 RS485	Base Board Port 1 X501 / X502 RS232 / RS485
Baud Rate P783, P793	P783 = 1 to 10 for baud rates of 300 to 187500 baud.	P793 = 1 to 10 for baud rates of 300 to 187500 baud.
Protocol Selection P780, P790	P780 = 1192: selects USS, with 1 stop bit, even parity, 9 bit data frame (8 bit data + 1 bit parity)	P790 = 1192: selects USS, with 1 stop bit, even parity, 9 bit data frame (8 bit data + 1 bit parity)
Number of Process Data Words P781, P791	P781 = 0 to 16; the number of process data words + the control word. Factory setting = 0	P791 = 0 to 16; the number of process data words + the control word. Factory setting = 3
Assignment of Process Data Words	Incoming data words can be assigned using the word connector numbers, K020 to K035. The control word is assigned with P640	Incoming data words can be assigned using the word connector numbers, K036 to K051. The control word is assigned with P640
Number of Parameter Data Words	P782 < 3 means no parameter data P782 = 3 to 126 variable length Factory setting = 0	P792 < 3 means no parameter data P792 = 3 to 126 variable length Factory setting = 3
Assignment of Actual Value Words	Actual value connectors assigned to words with P784ii Factory setting = 0	Actual value connectors assigned to words with P794ii Factory setting = 0
Telegram Failure Time P787, P797	Set with P787; 0 to 32 sec Zero disables the time monitor Factory setting = 0	Set with P797; 0 to 32 sec Zero disables the time monitor Factory setting = 0
Node Address P786, P796	P786 = 0 to 30 Factory setting = 0	P796 = 0 to 30 Factory setting = 0
Wire Method	2 wire operation is automatically selected for USS protocol	2 wire operation is automatically selected for USS protocol

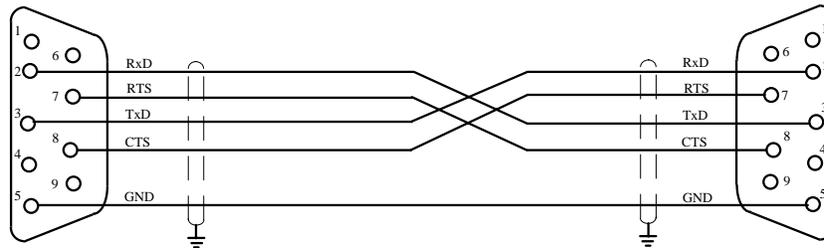
USS Protocol Summary for 6RA24 Drive Controllers

- All data transmitted is word length
- The first byte of the word data transmitted is always the high byte then followed by the low byte
- The process data from the received telegram at the 6RA24 can be freely assigned to drive functions
- The actual value signals sent from the 6RA24 to the master can be freely assigned to the data words
- Any active serial interface can change parameters at any time. There is no parameter change rights
- Bit 10 of the control word from the Host is not evaluated
- Two converter specific error codes are implemented:
 - error code 101 Function not implemented
 - error code 102 Parameter is the index type
- A request for text will result in an error code 101



9 Pin D connector X500 or X502
Male connector at cable side

RS485 USS Protocol Cable



9 Pin D connector X501
Male connector at cable side

9 Pin D connector at PC RS232 port
Female connector at cable side

Using this cable, hardware handshake, P798 = 2
as well as software handshake, XON/XOFF
P798 = 1, can be used.

Typical USS Cable Connection X501 to PC RS232 Port

10.8 USS Protocol Details

10.8.1 Introduction

USS Protocol can be used to implement communications with a host system using a bus channel with one host (master) and a maximum of 31 slaves. Either of the base board serial ports can be used with the USS protocol.

The information in the telegram allows the drive to be sequenced on and off, allows the drive speed to be controlled, and allows parameters to be interrogated and changed from the host system.

The length of USS protocol telegrams is variable and is normally set to a fixed length at commissioning. Rigid cyclic telegram transfer is required for automation tasks in drive technology, which can only be realized if the telegrams are restricted to a fixed length. "Host to drive" and "drive to host" must always be the same length. The selected telegram length (set with parameters P781 and P782 or P791 and P792) must not be changed during operation. A fixed telegram length limits the number of characters in the telegram's net data block.

The control data and the parameter data are separated in the telegram. The parameter data (PKW) makes up the first part of the net data of the telegram, and the control or process data (PZD) makes up the last part of the net data of the telegram. The length of the PKW section in words is set with parameter P782 or P792 and the length of the PZD section in words is set with parameter P781 or P791. The total of PKW words + PZD words is the number of net data words in the telegram.

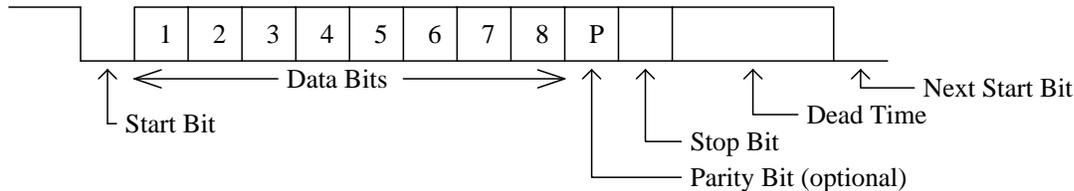
The advantage of being able to use or not use parameter (PKW) data and to custom tailor the number of process (PZD) data words (references to the drive and actual values from the drive) results in the shortest telegrams possible for each specific application. The shorter the telegrams, the greater the data throughput on the bus; with all other factors remaining the same.

When drives are connected in the RS485 bus mode, each drive can be addressed individually or broadcast messages can be sent by the host and received by all of the drives.

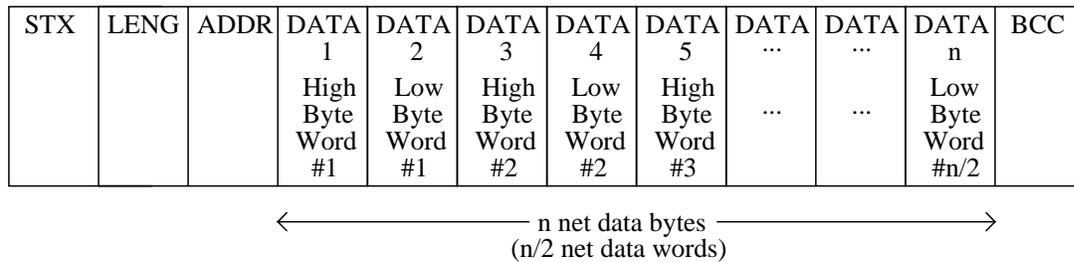
When not in the broadcast mode each valid telegram received by the drive is answered with an appropriate length telegram back to the host system. The communications take place on a strictly master slave basis where the drive will only respond to a request from the master. A drive cannot be the master.

10.8.2 USS Protocol Character Frame

Each transferred character begins with a start bit followed by 8 data bits, an optional parity bit, and a stop bit for a total of 11 bits per character (10 bits per character if parity is not used). If parity is selected (parameter P780 or P790), even parity is used (i.e., the number of logic "1's" must be an even number including the parity bit).



10.8.3 USS Protocol Telegram Structure



Each telegram begins with the start character STX (= 02H), which is followed by the length specification byte (LENG), which is followed by the address byte (ADDR) and the net data bytes. The telegram is ended with the calculated BCC (block check character).

For word information (16 bit) in the net data, the first byte transmitted is always the high byte and then the low byte is transmitted.

The length byte of the telegram contains the telegram length as a binary number. The telegram length is variable and is automatically set based on the selections for the PZD and PKW lengths.

The quantity n is the number of net characters (bytes).

$$n = (\text{value of parameter P781} + \text{value of parameter P782}) * 2 \text{ for the RS485 port at X500}$$

or

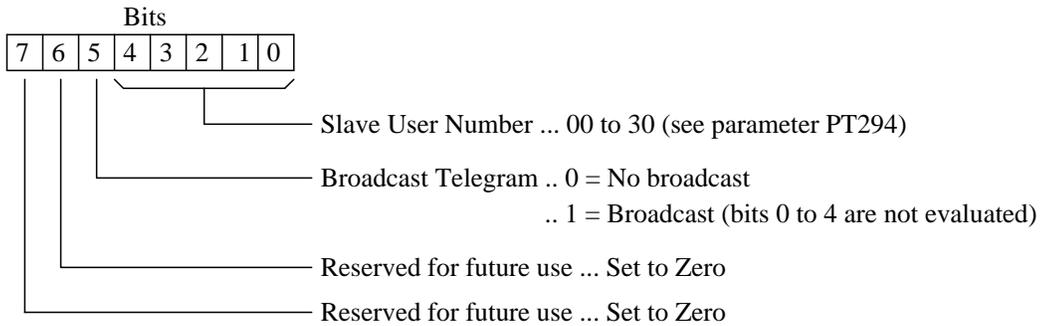
$$n = (\text{value of parameter P791} + \text{value of parameter P792}) * 2 \text{ for the RS232 port at X501}$$

A maximum of n = 38 net data bytes can be transmitted per telegram.

The telegram length includes the net characters (quantity n), the address byte (ADDR) and the block check character (BCC).

$$\text{LENG} = n + 2 \text{ bytes}$$

The address byte of the telegram contains the following information:



The block check character is formed by calculating the "exclusive or" of each character in sequence, beginning with the STX character, with the result of the previous calculations. In this procedure the STX will be exclusive or'd with the address byte, and the result will be exclusive or'd with data character 1 and so on to the last data character is used. The final result will be placed in the BCC location. The BCC parity bit is calculated solely from the BCC value.

10.8.4 USS Protocol Transmission Procedure

The host (master) transmits the telegram defined for the drive with ADDR = X, including the start delay. Drive X only responds after a valid telegram with ADDR = X is received.

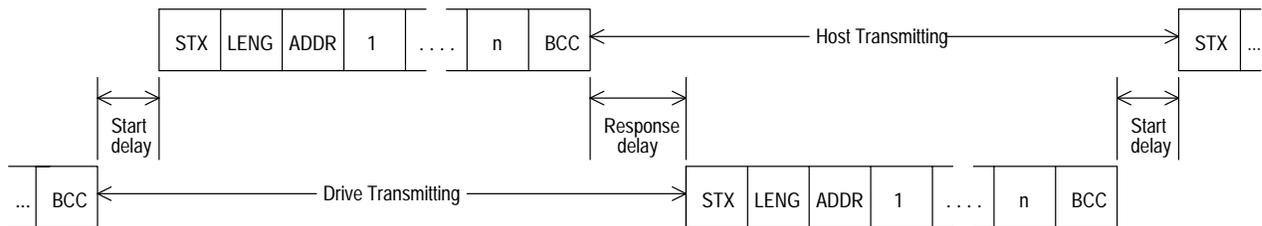
10.8.5 USS Protocol Data Transfer Administration

The start character STX ("02") is not by itself sufficient for the slaves to clearly identify the start of a telegram, because the bit combination "02" can also occur in the net bytes. Thus, before the STX, a character-less start delay of a least 2 character run times is specified for the host. This start delay is part of the task telegram.

A valid telegram start is only identified with an STX with a start delay in front of it.

The sequence in which the individual drives (slaves) are to be addresses can be defined in a circulating list, for example by entering the drive number. A **point-to-point connection** can be realized using the circulating list with only one drive number in the circulating list.

Data transfer is always realized as illustrated below (half-duplex operation).



10.8.6 USS Protocol Monitoring Mechanisms and Error Responses

The **host** must monitor the following times:

- Response delay time (processing time for the drive)
- Residual run time of the drive to host telegram (refer to section 10.8.8)

The **drive** monitors the following times:

- Start delay
- Residual run time of the host to drive telegram (refer to section 10.8.8)

10.8.7 USS Protocol Response Delay Time

The time interval between the last character of the host to drive telegram (the BCC) and the start of the first character of the drive to host telegram (the STX) is known as the response delay time. The response delay of the 6RA24 is approximately 1.5 milliseconds. The maximum permissible response delay is 20 milliseconds. If the drive does not respond within the maximum permissible response delay time, the "drive X does not transmit" error message is stored in the host. The host then transmits the telegram for the next drive.

The "drive X does not transmit" error message is only deleted after an error-free telegram from drive X. Drive X is not deleted from the circulating list.

10.8.8 USS Protocol Telegram Residual Run Time

The monitoring of the telegram residual run time is dependent on the agreed telegram length. For a fixed telegram length, the maximum residual run time is always the same.

10.8.9 USS Protocol Processing Received Telegrams

Only telegrams which have been received error-free are processed. The following errors are identified:

- Parity error
- Character frame error
- BCC incorrect
- Telegram residual run time exceeded
- Connection interrupted
 - **Drive:**
 - Start delay
 - Monitoring of bus activity (see parameter P787 or P797).
 - **Host:**
 - Drive does not respond within the maximum permissible processing time after the host to drive telegram has been sent (response delay time).

The drive does not transmit a drive to host telegram to a erroneous telegram.

USS Protocol Definitions

10.8.10 USS Protocol Character Run Time

The character run time is the time which is required to transmit one character (10 or 11 bit character frame). This time depends on the baud rate.

10.8.11 USS Protocol Compressed Telegram Residual Run Time

The compressed telegram residual run time is defined as the run time which is required in order to consecutively transmit LENG, ADDR, the n net bytes and BCC as a block (that is the stop bit of a character is immediately followed by the start bit of the next character).

The compressed telegram residual run time is obtained as follows:

$$(n + 3) * \text{character run time}$$

10.8.12 USS Protocol Maximum Telegram Residual Run Time

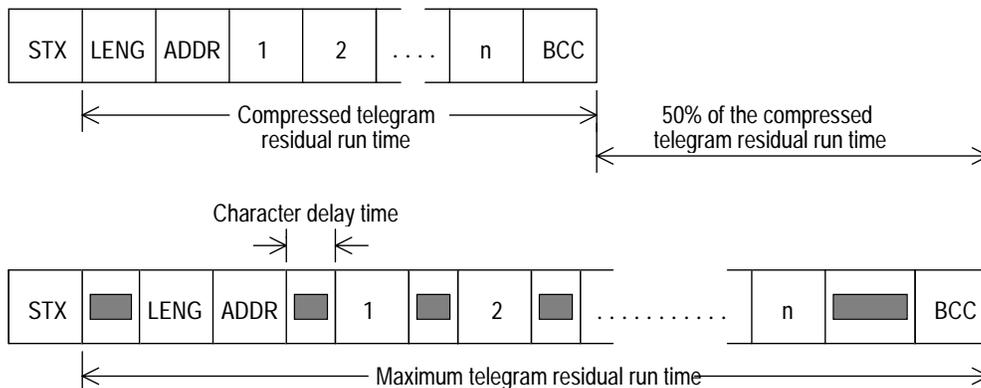
The maximum telegram residual run time includes character delay times in addition to the compressed telegram residual run time. See the illustration below. The sum of the character delay times is equal to 50% of the compressed telegram residual run time.

The maximum telegram residual run time is obtained as follows:

$$1.5 * \text{compressed telegram residual run time}$$

which corresponds to:

$$1.5 * (n + 3) * \text{character run time}$$



The delay time between two characters (character delay time) must be less than the start delay and can be distributed as required between the characters. It is not necessary to monitor the character delay times.

10.8.13 USS Protocol Communications Monitoring Considerations

In normal operation, the 6RA24 monitors the serial ports for valid incoming telegrams from the host. Once the reception of valid telegrams has begun, if the serial port does not receive a valid telegram for the number of seconds set by parameter P787 or P797, the drive will trip out, displaying a F014 or F024 fault number. Setting P787 or P797 to zero will suppress these faults.

A valid telegram is defined to be one that follows the telegram structure and transmission procedure described in sections 10.8.3 and 10.8.5. A valid telegram does not have to address the particular slave address in parameter P786 to P796. Thus, valid telegrams addressed to other slaves on the bus will reset the monitoring time.

10.8.14 USS Protocol Host Control Suppression

In certain installations, the serial link between the Host and the drive is intended to be only used for monitoring of the operation of the drive and reading and/or changing of parameters. All control of the drive is performed locally, including start/stop, thread, jogs and speed reference. Various drive parameters allow this type of operation by not using the serial link as a source for commands or references. With the use of these parameters and parameters P787 or P797 (described in the previous section), the base unit will operate from local control, disregarding whether the serial link is operating or not. In this mode, the Host system may be started and stopped with no effect on the drive.

10.8.15 USS Protocol EEPROM Memory Function

At power-up, the RAM of the base drive microprocessor board is always initialized to the values stored in its non-volatile EEPROM memory. The RAM copy is used by all functions of the drive.

A decision can be made in the request code portion of the first word of the Host to drive telegram (word E1) as to whether the parameter change from the serial port is used to change the value only in the RAM, or in both the RAM and the non-volatile EEPROM memory of the drive. The Host to Drive telegram is described in section 10.8.17.

There is a practical limit to the number of times information can be erased and re-stored in the EEPROM memory. If the host system is normally changing a specific parameter while the process is running, it is recommended that the changes be made in only the RAM.

10.8.16 USS Protocol Parameter Types

Presently there are three types of parameters supported by the base unit microprocessor board.

Types X2 and O2 Most parameters are one of these two types. Each parameter is used to read and/or set only one (1) value.

These parameters are read using a command 1H in the request code portion of PKW word 1. These parameters are changed using a command of 2H or EH in the request code portion of PKW word 1 with the desired parameter value placed in PKW word 3.

If a parameter does not have a type designation, it is a type X2 or O2.

Type OF These parameters are called indexed parameters and are used to display and to change several parameter values which are assigned to one parameter number. Each parameter value has a specific index value (referred to as INDEX if using the serial link), from 0 to the maximum specified for each parameter.

Parameters P100 to P599 are considered indexed parameters for USS. Refer to section 7.3.1.

Parameter Set 1 is accessed with index 0

Parameter Set 2 is accessed with index 1

Parameter Set 3 is accessed with index 2

Parameter Set 4 is accessed with index 3

These parameters are read using a command 6H in the request code portion of PKW word 1 with the index value of the desired parameter value placed in PKW word 2. These parameters are changed using a command of 7H or CH in the request code portion of PKW word 1 with the index value placed in PKW word 2 and the desired parameter value placed in PKW word 3.

10.8.17 USS Protocol Parameter Access Code

The access code shown for each parameter in section 9 does not apply to parameters that are changed through the serial port.

10.8.17 USS Protocol Telegram ... Host to Drive**Complete Telegram Overview:**

The following telegram is valid for either the RS485 (X500) or RS232 (X501) interface. The PZD data words are used by assigning associated connector number using other base drive selector parameters. Generally PZD Word 1 will be used as the standard control word STF and PZD word 3 is used as the auxiliary control word STWF although the assignment of the words within the 6RA24 is totally flexible through the use of the connectors.

PKW TELEGRAM SECTION:

PKW Word 1 ⇒ Parameter No. + Request Code
 PKW Word 2 ⇒ Parameter Index
 PKW Word 3 ⇒ Parameter Value

PZD TELEGRAM SECTION: (refer to block diagram section 15 sheet 5)

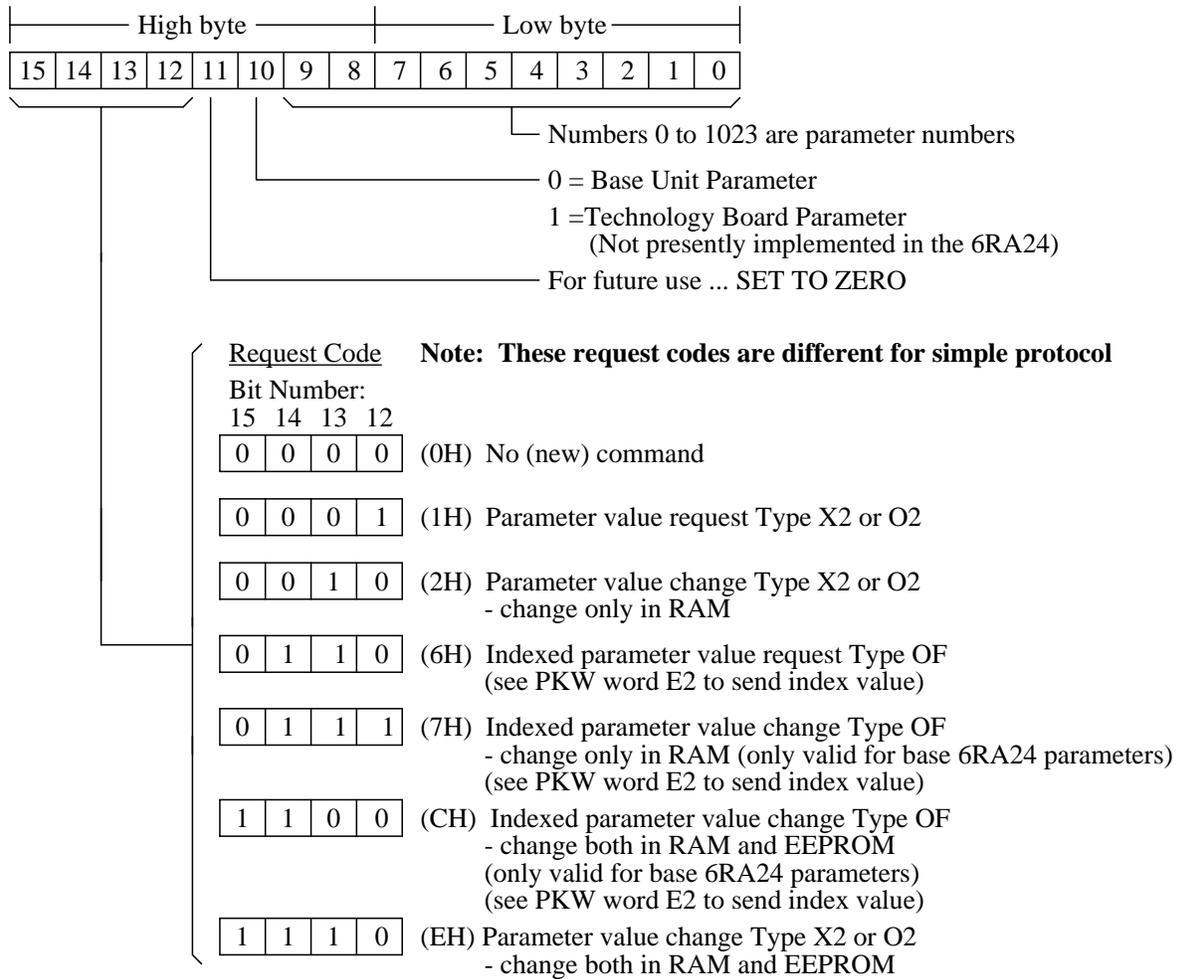
			Associated Connector	
			<u>X500</u>	<u>X501</u>
PZD Word 0	⇒	CntlWd1	K020	K036
PZD Word 1	⇒	Ref. 1	K021	K037
PZD Word 2	⇒	Ref. 2	K022	K038
PZD Word 3	⇒	Ref. 3	K023	K039
PZD Word 4	⇒	Ref. 4	K024	K040
PZD Word 5	⇒	Ref. 5	K025	K041
PZD Word 6	⇒	Ref. 6	K026	K042
PZD Word 7	⇒	Ref. 7	K027	K043
PZD Word 8	⇒	Ref. 8	K028	K044
PZD Word 9	⇒	Ref. 9	K029	K045
PZD Word 10	⇒	Ref. 10	K030	K046
PZD Word 11	⇒	Ref. 11	K031	K047
PZD Word 12	⇒	Ref. 12	K032	K048
PZD Word 13	⇒	Ref. 13	K033	K049
PZD Word 14	⇒	Ref. 14	K034	K050
PZD Word 15	⇒	Ref. 15	K035	K051

The PKW portion of the telegram can be 0 or 3 words in length. See parameters P782 or P792.

The PZD portion of the telegram can be 0 to 16 words in length. See parameters P781 or P791.

PKW Word 1: Parameter Number and Request Code

This word is only used if parameter P782 or P792 is set to a 3 or higher.



All other combinations of the request code (bits 12 to 15) are not implemented and will result in a fault indication

Only the base drive parameters (not technology board parameters) can be addressed by the base serial links. Although the parameter numbers are displayed on the drive as an alphanumeric number they must be addressed by the serial link using their appropriate parameter number. The parameter numbers are:

Parameter Name	Parameter Type	Parameter Number
P0000 to P1023	Base Unit	0 to 1023 (with bit 10 = 0)

Only parameters in the above ranges should be used. Any others can cause abnormal operation.

PKW Word 2: Index for Parameter Number

This word is only used if parameter P782 or P792 is set to a 3 or higher.

This word contains the index if PKW word 1 contains an indexed parameter (type OF). If PKW word 1 does not contain an indexed parameter, this word should be set to zero. (For Profibus, the index is an 8 bit value located in the high byte)

PKW Word 3: Parameter Value

This word is only used if parameter P782 or P792 is set to a 3 or higher.

If the request code of PKW word 1 is equal to 0H or 1H or 6H, PKW word 3 is not evaluated.

If the request code of PKW word 1 is equal to 2H or 7H or CH or EH, PKW word 3 contains the value to be placed in the parameter identified in PKW word 1 at the index in PKW word 2 (if applicable).

In the parameter descriptions in section 9, many parameters have both a number and a phrase describing each selection. When the parameter is read or changed using the serial link, the numbers are used for each selection. When the parameter is changed using the optional operator panel, the number and the phrase will be displayed.

Quick Stop Function [STOP3] (PZD word 0, bit 2)

This bit is only used if $P640 = 20$ or 36 . This bit must normally be turned on to allow the drive to operate. When this bit is turned off, the main reference of the base unit is immediately switched to zero, causing the motor to decelerate in current limit to zero speed. To restart the drive, this bit must be turned on again and the start command must be cycled off and then on.

Base Unit Regulators Enable Function (PZD word 0, bit 3)

This bit is only used if $P640 = 20$ or 36 . The base unit regulator enable function allows applications with their own external logic to disable the base unit regulators. This can be thought of as the last step before allowing current to flow in the controlled motor. The start command can be turned on earlier resulting in the performance of all base unit diagnostics and the application of voltage to the thyristors. Turning on this bit then results in immediate current to the motor, without any delays.

If this bit is turned off while the motor is running, the base unit thyristors are immediately turned off and the motor will coast to a stop.

Base Unit Ramp Enable Function (PZD word 0, bit 4)

This bit is only used if $P640 = 20$ or 36 . This bit must normally be turned on to allow the base unit to operate. When this bit is turned off, the main reference is immediately switched to zero, causing the motor to decelerate in current limit to zero speed. If this bit is then turned back on without any other changes, the motor will accelerate to the main reference using the active ramp settings.

Base Unit Ramp Released (PZD word 0, bit 5)

This bit is only used if $P640 = 20$ or 36 . When this bit is off, the output of the base unit ramp generator is held at its current value. When this bit is on, the ramp is released and will continue to its final value in the normal manner.

Base Unit Reference Enable Function (PZD word 0, bit 6)

This bit is only used if $P640 = 20$ or 36 . When this bit is on, the normal reference is applied to the input of the base unit ramp. When this bit is off, the input to the ramp is set to zero, and the motor will decelerate to zero following the selected ramp. When the speed reaches zero, the drive will continue to operate holding zero speed and ready to respond to any reference change.

Fault Reset (PZD word 0, bit 7)

This bit is only used if $P640 = 20$ or 36 . When this bit is turned on (rising edge triggered), the drive fault memory will be reset. The action is the same as pressing the "Select" or "R" key on the base unit operator panel if the panel is displaying a fault.

PZD Word 1: Reference 1

This word is only used if the PZD section is set greater than 1. This word contains reference value #1.
Scaling: +100.0% = 16384 and -100.0% = -16384.

PZD Word 2: Reference 2 or Control Word 2

This word is only used if the PZD section is set greater than 2. This word may be used as STWF control word #2 or as a regular reference word like reference #1. The function of the word depends on how the associated connector is assigned. When used as the STWF control word the connector is selected with P641 and the individual meaning of the bits is assigned with parameter P642.ii. When used as a reference the scaling is +100.0% = 16384 and -100.0% = -16384.

PZD Word 3: Reference 3 to PZD Word 15: Reference 15

These words are only used if the PZD section is set large enough to include them.
Scaling: +100.0% = 16384 and -100.0% = -16384.

USS Protocol Telegram ... Drive to Host

Each valid telegram received by the drive is answered after a 1.5 millisecond delay with a same length telegram back to the host system. The drive never initiates a telegram and will only send one in response to a telegram from the host system.

Since the serial port immediately sends a telegram after it receives a valid telegram from the host system, the parameter number, index, and parameter value contained in PKW return words 1, 2, and 3 (see next page for description of the telegram words) will usually contain information requested in a previous telegram. All other information in the telegram will be the latest available. The only delay is in the parameter information.

The time required to process a new parameter request is approximately 100 milliseconds, so if the next host telegram is 100 milliseconds or more later, the response telegram should include the parameter information requested in the previous telegram.

It is a requirement that the host system wait for a verification that the drive has processed the last host parameter request before the host sends a different parameter request.

- In the case of "REQUEST TELEGRAMS", this verification consists of waiting until PKW return word 1 contains the same value that has been sent in PKW word 1, and PKW return word 2 contains the same value that has been sent in PKW word 2. When PKW return word 1 matches PKW word 1 and PKW return word 2 matches PKW word 1, then the parameter value received in PKW return word 3 is valid.
- In the case of "CHANGE TELEGRAMS", this verification consists of waiting until PKW return words 1, 2, and 3 contain the same values that have been sent in PKW words 1, 2, and 3 and the response code of PKW return word 1 contains 1H or 4H. If received PKW word 1 contains the parameter number sent in PKW word 1 and PKW return word 2 contains the parameter index sent in PKW word 2 but the response code of PKW return word 1 contains 7H, the parameter value received in PKW word 3 may differ from the requested host value sent in PKW word 3 for any of the following reasons:
 - a) An undefined parameter number was sent in PKW word 1.
 - b) The parameter value requested in PKW word 3 is beyond the minimum or maximum limits of acceptable values.
 - c) The request code sent in PKW word 1 is not implemented.

If received PKW word 1 contains the parameter number sent in PKW word 1 and PKW returned word 2 contains the parameter index sent in PKW word 2 but the response code of PKW returned word 1 contains 8H, the serial port is not allowed to change the parameter.

These differences must be programmed into the host's verification procedure.

Broadcast telegrams are not verified.

Complete Telegram Overview:

The following telegram is valid for either the RS485 (X500) or RS232 (X501) interface. The PZD data words are assigned to the sending telegram using connector numbers and parameters P784.ii and P794.ii. Generally PZD Word 1 will be used as the standard status word ZSW. PZD words 3 and 4 may be used for drive specific status words ZSW1 and ZSW2 although they could just as well be used for additional drive data words. The assignment of the words to the sending telegram is totally flexible through the use of the connectors and needs only be coordinated with the Host.

PKW TELEGRAM SECTION:

PKW Word 1 ⇒ Parameter No. + Response Code
PKW Word 2 ⇒ Parameter Index
PKW Word 3 ⇒ Parameter Value

PZD TELEGRAM SECTION

PZD Word 1 ⇒ Status word ZSW
PZD Word 2 ⇒ Actual value 1
PZD Word 3 ⇒ Actual value 2 or Status word ZSW1
PZD Word 4 ⇒ Actual value 3 or Status word ZSW2
PZD Word 5 ⇒ Actual value 4
PZD Word 6 ⇒ Actual value 5
PZD Word 7 ⇒ Actual value 6
PZD Word 8 ⇒ Actual value 7
PZD Word 9 ⇒ Actual value 8
PZD Word 10 ⇒ Actual value 9
PZD Word 11 ⇒ Actual value 10
PZD Word 12 ⇒ Actual value 11
PZD Word 13 ⇒ Actual value 12
PZD Word 14 ⇒ Actual value 13
PZD Word 15 ⇒ Actual value 14
PZD Word 16 ⇒ Actual value 15

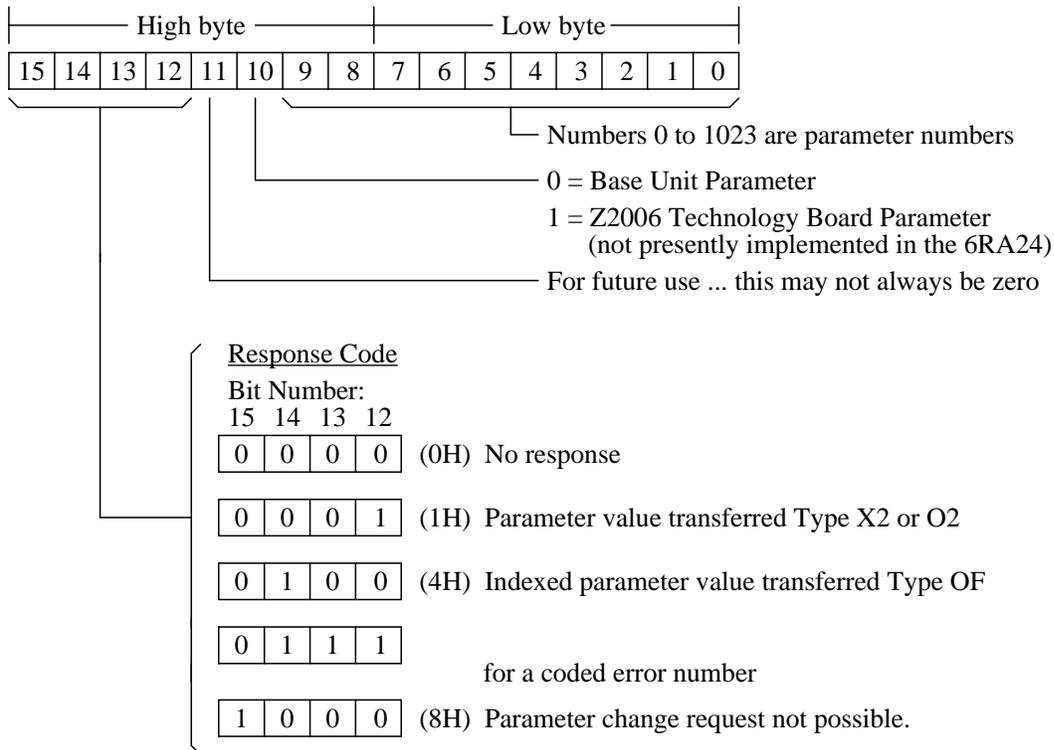
The PKW portion of the telegram can be 0 or 3 words in length.

The PZD portion of the telegram can be 0 to 16 words in length.

PKW Word 1: Parameter Number and Response Code

This word is only used if the PKW section, P782 or P792 is set to a 3.

PZD word 1 contains the parameter number requested in a previous host to drive telegram.



PKW Word 2: Index for Parameter Number

This word is only used if the PKW section , P782 or P792 is set to a 3.

This word contains the index if PKW word 1 contains an indexed parameter (type OF). If PKW word 1 does not contains an indexed parameter, this word will be zero.

PKW Word 3: Parameter Value or Error Code

This word is only used if the PKW section , P782 or P792 is set to a 3.

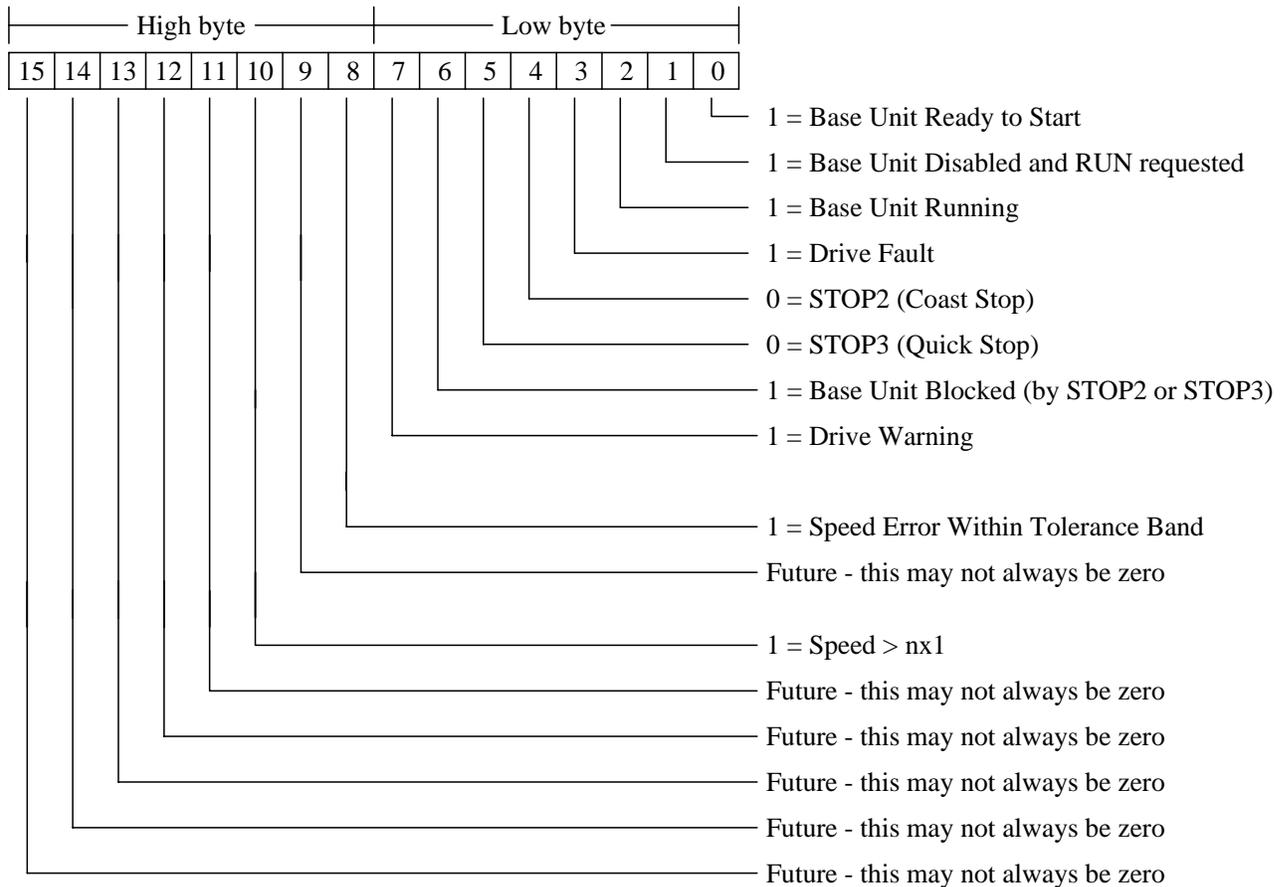
If the response code of PKW word 1 is equal to 1H or 4H, this word contains the value of the parameter whose number is located in the PKW word 1 and whose index is located in PKW word 2 (if applicable). This is the value requested by the host in the PKW word 3 of the host to drive telegram.

If the response code of PKW word 1 is equal to 7H, this word contains a coded error number explaining why the parameter whose number is located in the PKW 1 and 1 words could not be read and/or changed.

Coded Error Number	Explanation	Word 1 Request Code
0	Undefined parameter number in PKW word 1	all valid
1	Parameter cannot be changed	2H, 7H CH, EH
2	The parameter value requested in PKW word 3 is beyond the minimum or maximum limits of acceptable values	2H, 7H CH, EH
3	The index sent in PKW word 2 is undefined	6H, 7H CH
11	The request code sent in PKW word 1 is not implemented	--
101	The request code function sent in PKW word 1 is not implemented	--
102	The parameter is an indexed parameter	--

PZD Word 1: Serial Port Status Word 1

This word is only used if the PZD section, P781 or P791, is set to a number greater than 0 and P784.00 or P794.00 is set to (connector) 325. This is the standard status word 1, ZSW, that contains the status and fault information of the drive. Each bit of this word has a pre-defined meaning.



Refer to section 10.6 for additional information about the status word.

Base Unit Ready to Start Status (PZD word 1, bit 0)

This bit is set to a 1 when the base unit is ready to start. In this drive condition, the operating status will be o7.0. When start is requested, this bit is set to a 0.

Base Unit Disabled Status (PZD word 1, bit 1)

This bit is set to a 1 when the drive is disabled (see PZD word 1, bit 3) and start is requested. The operating status will be o1.0.

Base Unit Running Status (PZD word 1, bit 2)

Refer to word 3, bit 3.

Drive Fault Status (PZD word 1, bit 3)

When this bit is set to a 1, a fault condition exists on the drive. To find out the specific fault number, the host system must read parameter P0912 (FAULT-MEMORY) using PKW word 1 with a request code of 6H and PKW word 2 with an index value of 0. In the response telegram from the drive, the value of P0912 (sent in PKW word 3) is the fault number. The received fault number may be used as an index for a text table in the host system.

STOP2 (coast stop) Status (PZD word 1, bit 4)

This bit indicates the actual status of STOP2 (see PZD word 1, bit 1) at the base unit.

STOP3 (quick stop) Status (PZD word 1, bit 5)

This bit indicates the actual status of STOP3 (see PZD word 1, bit 2) at the base unit.

Base Unit Blocked Status (PZD word 1, bit 6)

When this bit is set to a 1, the turn on of the base unit is blocked. This can be caused by the absence of several permissives. If start is not requested, this bit is set to a 1 if STOP2 (see PZD word 1, bit 1) or STOP3 (see PZD word 1, bit 2) is not set.

Drive Warning Status (PZD word 1, bit 7)

When this bit is set to a 1, a warning condition exists on the drive. To find out the specific warning number, the host system must read parameter P0913 (WARNING) using PKW word 1 with a request code of 6H and PKW word 2 with an index value of 0. In the response telegram from the drive, the value of P0913 (sent in PKW word 3) is the warning number. The received warning number may be used as an index for a text table in the host system.

Speed Error within Tolerance Band Status (PZD word 1, bit 8)

This bit is set to a 1 when the speed error is within the tolerance band. The speed error is the difference between the active speed reference and the actual speed feedback. Normally this bit is on. This bit may go off during acceleration, deceleration, and times when the load changes.

PZD Word 2: Actual Value 1 to PZD Word S16: Actual Value 15

These words are only used if the PZD section is set large enough to include them.
Scaling: +100.0% = 16384 and -100.0% = -16384.

If words are to be used to send status word 2 or 3 to the master, then the connectors K326 and K327 must be assigned to two of the actual value words using parameter P784.ii or P794.ii. Refer to sections 10.6.2 and 10.6.3 for additional information about the status words.

Similarly, if words are to be used to send other actual values to the master, then the connector number of each specific actual value must be assigned to an unused actual value output word using parameter P784.ii or P794.ii.

10.9 DC Motor Thermal Overload Protection (I^2t motor monitoring)

Parameter P100 and P114 are used for setting the motor I^2t monitoring. With the proper setting, the motor will be protected against excessive overloads.

Settings:

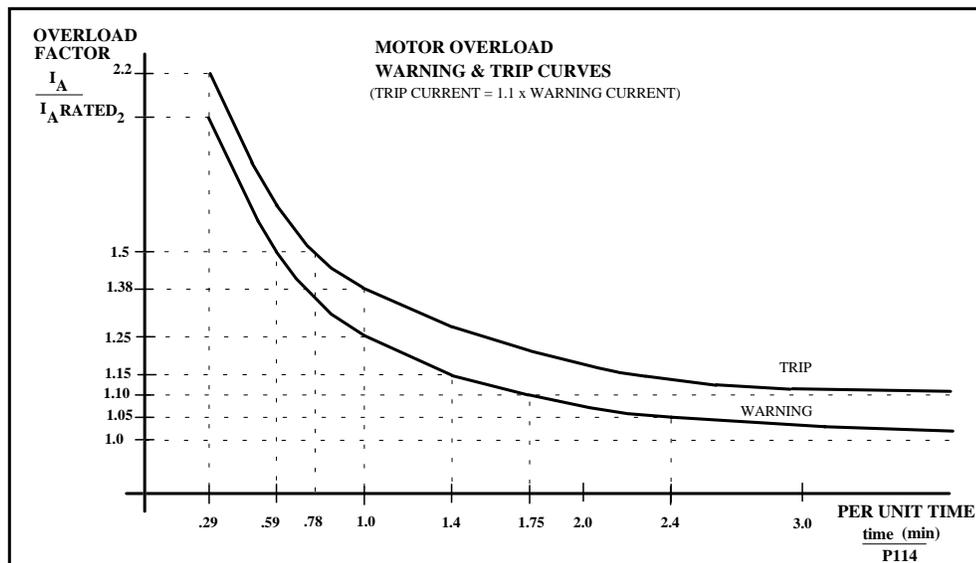
P114 The thermal time constant in minutes used to scale the warning and trip functions.

P100 Motor rated nameplate armature current entered in amperes

Warning and Shutdown Characteristics

If the motor armature current exceeds 100% of rated, the warning I^2t monitor begins to operate. When the I^2t reaches the warning level a warning message, W01, is issued. If the overload is greater than 110% of rated motor current the fault monitor is also operating. If the I^2t reaches the fault level then the drive is stopped with a F037 fault.

As an example, if the time constant at P114 is set 1.69 minutes, then the warning message will be issued if the armature current is at 150% of rated motor current for 60 seconds. If the current remains at 150%, then the drive will trip at 1.3 minutes, or approximately 20 seconds after the warning.



NOTE:

- The calculated I^2t is lost if power is turned off for more than 2 seconds.
- The I^2t monitoring is turned off if P114 is set to zero.

10.10 Armature Converter Overload Capability

Armature converters designed by SE&A can be operated at full nameplate rated current continuously followed by an infrequently applied overload of 150% for 1 minute. The converter can then operate at rated current again but should not be overloaded until the temperature has stabilized. The time for the temperature to stabilize will depend on the ambient temperature, the actual overload condition, and the actual normal current level. Generally a 150% overload for 1 minute at a 40°C ambient should not be repeated within 15 minutes.

10.11 Operation of the Trace Buffer

The trace buffer can be used to collect operational data from the converter based on a trigger condition. Up to 8 trace channels can be recorded and each channel will contain 128 data values. The trace buffer has the following features:

Trace buffer size:	128 values x 8 channels
Connectors to be Recorder:	Set with P861.ii
Trigger Condition	Adjustable using P862, P863, P864
Sample Time:	Set with P865 (in 60° steps; 2.77 ms @ 60 Hz)
Record length after the trigger event:	Set using P866 (in lines of data)
Trace enable:	Enabled with P867 = 1 and disabled with P867 = 0
Trace stop:	The trace stops when the trigger condition is fulfilled and the samples have been recorder or if P867 = 0.

The contents of the trace buffer can be output on either base board serial ports directly to a printer where the data is printed in table form, to the operator control panel, or to the analog outputs.

The procedure to record values is to:

1. Set all conditions for recording (P861.ii to P866)
2. Start recording using P867 = 1
When the trigger condition is fulfilled the recording will be started. when completed P867 is automatically reset to 0.

Note: If this sequence is not followed the trigger instant is not calculated and data will not be recorded. If the recording is manually terminated by setting P867 to 0 the trigger point saved in P849 will be incorrect.

Example 1:

P862	P863	P864	P865	P866
123 (K123)	2 (>)	10.0 (10.0%)	1 (60° samples)	10 (10 lines after trigger)

In this example P862 has selected connector K123 to be recorded. P863 has selected a "greater then" trigger function and P864 has selected a 10.0% trigger value. P865 has selected a 60° sample time (2.77 ms on 60 Hz systems) and P866 has selected 10 lines to be recorded after the trigger event. In this case the trace is triggered when the value of connector K123 is greater that 10.0 %. A value is recorded every 60° for 128 samples with 118 samples before the trigger and 10 samples after the trigger event.

Example 2:

P862	P863	P864	P865	P866
any	3 (Fault)	any	6 (360° samples)	5 (5 lines after trigger)

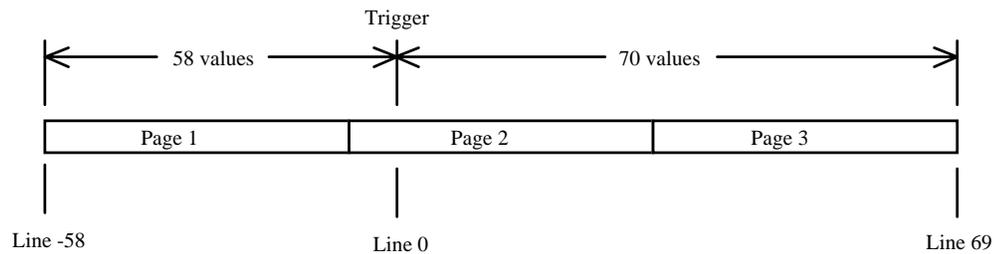
In this example P862 can select any connector to be recorded. P863 is selected to trigger on any fault message. P865 has selected a 360° sample time (6 x 60° or 16.67 ms on 60 Hz systems) and P866 has selected 5 lines to be recorded after the trigger event. In this case the trace is triggered when a fault is issued. A value is recorded every 360° with 5 values recorded after the fault message has been issued.

Output the trace buffer to a serial printer:

The values are output in 128 lines, each with 8 columns that correspond to the 8 recorded connector values. The line with line number 0 corresponds to the point where the trigger condition was fulfilled for the first time.

Example:

In this example, P866 is set to 70 so that 58 lines of data is recorded before the trigger event and 70 lines of data recorded after the trigger event (128 lines total). The trigger event starts the line number sequence at 0 and in the example the last line will be numbered 69. A total of 2½ pages will be printed.



Refer to section 10.7.1 for the procedure for output to a printer.

Output the trace buffer to the operator panel:

If the values are to be read out using the operator control panel, it should be noted that only 100 values can be seen located at index parameters P841.ii to P848.ii from index 0 to index 99. By judiciously selecting P866 (trigger delay) and P865 (sample interval), the values of interest can be made to fall within the 100 values accessible from the operator panel.

For example, P866 = 77 can be selected and in this case the trigger instant will lie at index = 50 (i.e., $127 = 77 = 50$). Now for each recorded connector selected with P861.ii, 50 values can be read out before the trigger instant and another 50 values after the trigger event. After the recording is complete the trigger instant can be read at parameter P849. If the recording time period is too short it can be extended using P865 set to a larger sample interval.

At the end of recording when P867 = 0, parameter P840 indicated how many values per connector were recorded. If the trigger condition is already fulfilled when the recording is started with P867 = 1, then all the recorded values will be from the starting instant onward since the trigger instant was not clearly defined.

When reading the values parameter P870 can be used to define whether the display is in hexadecimal or a percentage of 16384 (nominal 100% value).

Output the trace buffer to the analog outputs:

The values of the first 4 recorded connectors can be output to the 4 selectable analog output channels as voltages between ± 10 volts. Parameter P868 and P869 control the output.

P868 Output speed to the analog output (300 / P868) values per second

P869 Output Mode:

- 1 Just one output (for output to a plotter)
- 2 Continuous output (for output to an oscilloscope)

Assignment of recorded values to the analog outputs:

Analog output 1	Terminal TB1 14	Output 128 values of connector selected with P861.01
Analog output 2	Terminal TB1 16	Output 128 values of connector selected with P861.02
Analog output 3	Terminal TB1 18	Output 128 values of connector selected with P861.03
Analog output 4	Terminal TB1 20	Output 128 values of connector selected with P861.04

Data transfer is started by setting P051 to 19 and then pressing the Select or P key and acknowledging using the Raise key. The output can be stopped by pressing the Lower key.

When using an oscilloscope to observe the data it is recommended that P868 = 1 and P869 = 2. In this case a complete trace buffer output cycle will last for $128 * (1/300) = 0.427$ seconds. If the scope is set with a time base of 50 ms/division the complete contents of one or several trace buffers can be displayed.

10.12 Speed Dependent Current Limit (Tapered Current Limit)

The speed dependent current limit is used to protect the commutator and brushes of DC motors operating at high speeds. As the motor speed increases above base speed some motors reach their commutation limit and can only operate safely with reduced current limit.

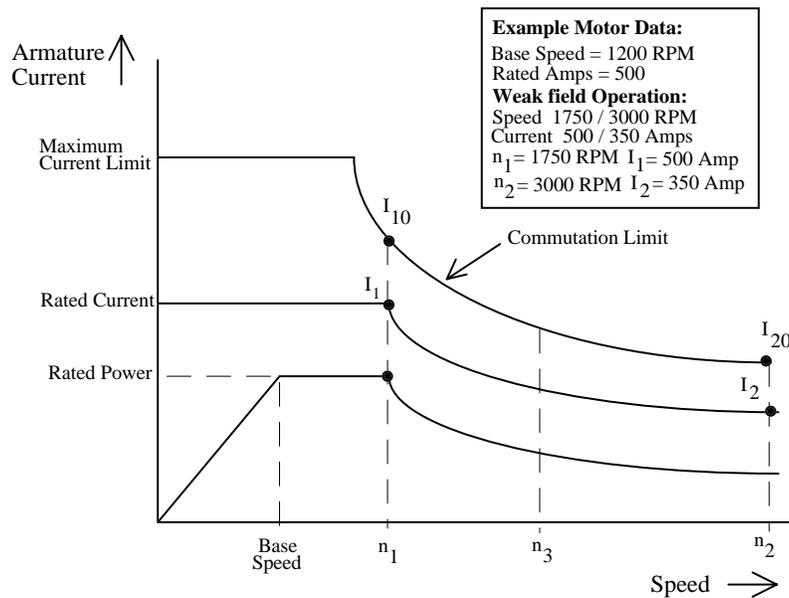
To use speed dependent current limit parameters P104 to P107 must be set according to the motor nameplate data. In addition the maximum operating speed must be set at parameter P 108 and this must agree with the maximum operating speed set for the overall drive. The drive maximum speed is set by various parameters depending on the type of speed feedback selected.

The maximum drive speed is set by:

- o P143 for pulse encoder feedback
- o P606 and P608 for analog tachometer feedback
- o P115 for EMF voltage feedback

Speed Dependent Current Limit

For a motor with reduced rated current at high speed



Where:

n_1 = speed that rated current begins to be reduced

n_2 = maximum possible operating motor speed

n_3 = maximum drive operating speed

$$I_{10} = 1.4 * I_1$$

$$I_{20} = 1.2 * I_2$$

$$P104 = n_1$$

$$P105 = \text{Rated armature current at low speed, } I_1$$

$$P106 = n_2$$

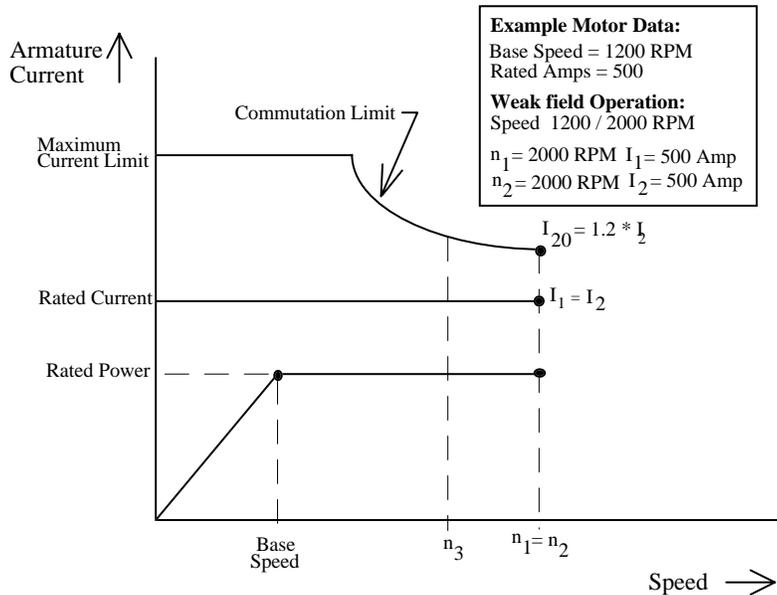
$$P107 = \text{Rated armature current at maximum motor speed, } I_2$$

$$P108 = n_3, \text{ maximum drive operational speed}$$

$$P109 = 0 \quad \text{Speed dependent limit disabled}$$

$$P109 = 1 \quad \text{Speed dependent limit enabled}$$

Speed Dependent Current Limit For a motor with full rated current at high speed



Where:

$n_1 = n_2 =$ maximum possible operating motor speed

$n_3 =$ maximum drive operating speed

$I_{20} = 1.2 * I_2$ Maximum motor commutation current at maximum motor speed

P104 = n_1

P105 = Rated armature current at low speed, I_1

P106 = n_2

P107 = Rated armature current at maximum motor speed, I_2

P108 = n_3 , maximum drive operational speed

P109 = 0 Speed dependent limit disabled

P109 = 1 Speed dependent limit enabled

10.13 Forcing Function (P051 = 24)

The forcing function injects a square wave signal that can be set with parameters for use in diagnostics and manual tuning of the drive controllers. Forcing uses the same parameters as the oscillation function used to aid smooth gear changing with BIF 12. The square wave function is also shown with the adjustment parameters on the block diagram on sheet 12.

To use the forcing function do the following:

1. Connect the forcing function to the desired injection point using connector K208.
2. Set P051 = 24
3. Press the "select" or "P" key to enter the program mode
4. Briefly press the Raise key to start the square wave forcing function
5. Briefly press the lower key to stop the forcing function
If the "select" or "P" key is pressed it will also stop the forcing function.

10.14 Automatic Restart

The automatic restart function is controlled by parameter P086. If P086 = 0 automatic restart is disabled otherwise P086 sets the allowable restart time from 0.1 to 2.0 seconds.

If automatic restart is used, the drive will not go immediately to a fault condition if the AC supply voltage is momentarily lost, low, high, or if the frequency is too low or too high, or if the field current is too low. If the abnormal condition recovers within the time set with P086 then the drive will immediately go back to the run condition. If the fault condition last longer than the time set with P086 then the fault will be issued and the drive will be shut down.

The faults included in the automatic restart procedure include the following:

- F001 Control power supply failure
- F003 Undervoltage condition
- F004 Phase failure for the armature supply
- F005 Field phase failure or field loss fault
- F006 Undervoltage armature or field
- F007 Overvoltage armature or field
- F008 Supply frequency less than 45 Hz.
- F009 Supply frequency greater than 65 Hz.

If the AC supply voltage for the control power supply fails, the power supply can only operate for 0.1 to 0.2 seconds. If the AC supply returns before the control power supply fails then the drive is restarted in the run condition otherwise an automatic restart is not possible. To extend the operation of the control power supply it can be supplied from a "UPS" system for critical applications.

Automatic restart is not possible if the start commands are selected as momentary input commands. The start commands must be maintained functions for automatic restart to work.

11.1 EMC basics

11.1.1 What is EMC

EMC stands for electromagnetic compatibility and defines the capability of a piece of equipment to operate satisfactorily in an electromagnetic environment without itself causing electromagnetic disturbances which would be unacceptable for other electrical equipment in this environment. Thus, the electrical equipment should not mutually disturb each other.

11.1.2 Noise radiation and noise immunity

EMC is dependent on two characteristics of the equipment involved, namely, the radiated noise and noise immunity. Electrical equipment can either be noise sources (transmitters) and / or noise receivers. Electromagnetic compatibility exists, if the noise sources do not negatively influence the function of the noise receivers. A piece of electrical equipment can also be both a noise source and noise receiver at the same time. For example, the power section of a drive converter can be considered as noise source, and the control section (gating unit, etc.), as a noise receiver.

11.1.3 Maximum values

The Product Standard E DIN IEC 22G/21/CDV is now available in draft form for electric drives. According to this product standard, all EMC measures are not necessarily required for industrial supply networks, and a solution should be defined and adapted to the actual environment. In this way, it may be more cost effective to increase the noise immunity of a sensitive piece of equipment than implementing noise suppression measures for the drive converter. Thus, a solution is selected dependent on its cost-effectiveness.

Until the Product Standard E DIN IEC 22G/21/CDV comes into force, the basic EN 50081 and EN 50082 Standards are valid and these specify that EN 55011 must be maintained. These standards define maximum values for noise radiation in industrial and domestic environments. Cable carried noise at the supply connection point is measured under standardized conditions as radio interference noise voltage and electromagnetically radiated noise as radio interference (radiated noise). The standard defines maximum values "A1" and "B1", which are valid for radio interference voltage in the range between 150 kHz and 30 MHz and for radio interference radiation between 30 MHz and 2 GHz. Because SIMOREG drive converters are used in industrial applications, limit value "A1" is valid. To achieve value "A1", SIMOREG drive converters must be installed with external radio interference suppression filters.

The noise immunity defines the behavior of a piece of equipment subject to electromagnetic noise. For industrial applications, the EN50082-2 Standard defines the demands and evaluation criteria for the behavior of the equipment. This standard is fulfilled by the SIMOREG drive converters listed in Section 11.2.4.

11.1.4 SIMOREG Drive Converters in Industrial Applications

In an industrial environment, equipment must have a high level of noise immunity whereas lower demands are placed on noise radiation. SIMOREG drive converters are components of an electric drive system, along with contactors and switches etc. Professionally trained personnel must integrate them to form a complete drive system, which comprises, as a minimum, the drive converter itself, motor feeder cables and motor. Generally, commutation reactors and fuses are also required. Limiting to the maximum allowed values can only be maintained if these components are installed and mounted in the correct way. In order to limit the radiated noise from the drive converter, according to limit value "A1", a radio interference suppression filter and a commutation reactor are required. If SIMOREG drive converters are not equipped with radio interference suppression filters, the radiated noise will exceed the limit value "A1", specified in EN55011.

If the drive is part of an overall system, initially it does not have to fulfill any requirements regarding radiated noise. However, the EMC Law specifies that the system as a whole must be electromagnetically compatible with its environment. If all of the system control components (e.g. PLCs) have noise immunity for industrial environments, then it is not necessary that each drive maintains a limit value "A1".

11.1.5 Non-Grounded Supplies

Non-grounded AC supplies (IT-supplies) are often used in various industrial sectors in order to increase the availability of the plant. If one ground fault occurs a fault current does not flow, and the plant can still produce. However, when a radio interference suppression filter is used on such a system and a ground fault should occur, a fault current path now exists through the filter. This can result in the drive being shutdown and possible damage to the radio interference suppression filter. Thus, the Product Standard does not define limit values for these non-grounded supplies. From a cost standpoint, if radio interference suppression is required, this should be implemented at the grounded primary of the supply transformer.

11.1.6 EMC Planning

If two units are not electromagnetically compatible, you can either reduce the noise radiated by the noise source, or increase the noise immunity of the noise receiver. Noise sources are generally power electronic units with a high current requirement. In order to reduce the radiated noise from these units, complex, costly filters are required. Noise receivers usually involve control units and sensors, including their evaluation circuitry. It is less complex and costly to increase the noise immunity of low-power equipment. Thus, in an industrial environment it is often more cost-effective to increase the noise immunity rather than reduce the radiated noise. For example, in order to maintain limit value Class "A1" of EN 55011, the radio interference voltage at the supply connection point between 150 kHz and 500 kHz, may not exceed 79 dB(μ V) and between 500 kHz and 30 MHz, 73 dB(μ V) (9 mV or 4.5 mV). In industrial environments, the EMC of the equipment used must be based on a well balanced mixture of noise radiation (low level) and noise immunity.

The most favorably priced interference measure is to physically separate noise sources and noise receivers, assuming that this is taken into account when designing the machine or plant. The first step is to define whether each unit is a potential noise source (noise radiator) or noise receiver. Noise sources are, for example, drive converters, contactors. Noise receivers are, for example, PLCs, transmitters and sensors. The components must be physically separated in the cabinet (noise sources and noise receivers), using metal partitions or by mounting the components in individual metal enclosures. A possible component layout configuration in a cabinet is illustrated in Fig. 1.

11.2 EMC-Correct Installation / Mounting Instructions for Drive Converters

11.2.1 General information

As drives can be operated in a wide range of differing environments, and as the electrical components used (controls, switched-mode power supplies etc.) can widely differ regarding noise immunity and noise radiation, any mounting / installation guideline can only represent a typical general situation. Consequently, deviations can be made from the EMC regulations, under the assumption that they are checked-out on a case by case basis.

In order to guarantee electromagnetic compatibility (EMC) in cabinets in rugged electrical environments, and also fulfill the standards specified by the relevant legal bodies, the following EMC regulations must be observed when designing and manufacturing the drive cabinets.

Rules 1 to 10 illustrate good wiring practices and generally must be followed. In order to further comply with the radiated noise standards Rules 11 to 15 are mandatory.

11.2.2 Rules for EMC-Correct Installation

Rule 1

All of the metal cabinet components must be electrically connected with one another through the largest possible surface area (not paint on paint!). If required, use serrated washers and or bonding ground cables. The cabinet door should be connected to the cabinet through grounding straps (top, center, bottom) which should be kept as short as possible.

Rule 2

Contactors, relays, solenoid valves, electromagnetic operating hour counters etc. in the cabinets should be provided with coil suppression devices such as RC elements, varistors, diodes etc. These devices must be connected directly at the coil with very short wires.

Rule 3

Signal cables¹⁾ should enter the cabinet, if possible, at only one level.

Rule 4

Non-shielded cables belonging to the same circuit (incoming and outgoing conductor) should be twisted, or the distance between the two conductors kept as close as possible in order to prevent unnecessary coupling effects.

Rule 5

Connect spare conductors to the cabinet ground at both ends. This offers an additional shielding effect.

Rule 6

Unnecessary cable / conductor lengths should be avoided. Thus, coupling capacitance's and inductance's are kept low.

Rule 7

Crosstalk is kept low if cables are routed close to the cabinet ground. Thus, wiring shouldn't be routed freely in the cabinet, but as close as possible to the cabinet frame and mounting panels. This is also true for spare cables.

Rule 8

Signal and power cables should be routed separately from one another (to avoid noise being coupled from one to another). A minimum 20 cm (8 inches) clearance should be maintained.

If it is not possible to physically separate encoder and motor cables, then the encoder cable must be routed either using a metal partition or in a separate metal pipe or conduit. The partition or metal pipe must be grounded at several locations along this length.

Rule 9

The shields of digital signal cables must be connected to ground at both ends (source and destination) through the largest possible surface area. If there is poor potential bonding between the shield connections, then to reduce the shield current an additional potential bonding cable of at least 10 mm² (AWG 6) must be connected in parallel to the shield. The shields can be grounded to the cabinet frame at several positions along the cable length. The shields can also be connected to ground at several locations outside the cabinet. Foil-type shields should be avoided if possible. They are not as effective as braided shields by a factor of at least 5.

Rule 10

The shields of analog signal cables can be connected to ground at both ends if potential bonding is good (through the largest possible surface area). Good potential bonding can be assumed, if all metal parts are well connected and all of the electronic components involved are supplied from one source.

The single-ended shield ground connection prevents low-frequency, capacitive noise from being coupled in to the analog signal (e.g. 60 Hz hum). In this case the shield should be connected to ground in the receiving cabinet.

Rule 11

Always locate the radio interference suppression filter close to the assumed noise source. The filter must be mounted through the largest possible surface area at the cabinet housing or mounting panel etc. The input and output cables must be physically separated.

Rule 12

Radio interference suppression filters must be used ahead of the converter in order to maintain limit value class "A1". Additional loads must be connected to the line supply side of the filter. The type of control used and how the remaining cabinet is wired defines whether an additional line filter must be installed.

Rule 13

A commutation reactor is required in the field circuit AC supply for controlled field supplies to limit filter discharge current.

Rule 14

A commutation reactor is required in the drive converter armature circuit AC supply to limit filter discharge current.

Rule 15

For SIMOREG drives, the motor cables can be unshielded. The line supply cable must be a minimum of 20 cm (8 inches) away from the motor cables (field, armature).

If required, use a metal partition.

Footnotes:

- 1) Signal cables are defined as:
 - Digital signal cables, Analog signal cables. (e.g. ± 10 V setpoint cable)
 - Pulse encoder cables, Serial interface cables, e.g. PROFIBUS-DP or USS
- 2) Generally, all metallic conductive parts, which can be connected to a protective conductor, e.g. cabinet housing, motor frame, foundation ground, etc., are considered as ground.

Cabinet Design and Shielding

The cabinet design illustrated in **Fig. 1** is intended to make the user sensitive and aware of EMC-critical components and parts. The example does not claim to handle all possible cabinet components and their respective mounting possibilities.

Details, which influence the noise immunity / noise radiation of the cabinet and which aren't absolutely clear in the overview diagram, are further described in **Figs. 1a - 1d**. Different shield connecting techniques with reference source information are illustrated in detail in **Figs. 2a - 2c**.

Mounting Radio Interference Suppression Filters and Commutation Reactors:

Radio interference suppression filter and commutation reactor mounting for SIMOREG drives is described in Section 2.3. The sequence when installing the reactor and filter must be maintained. The semiconductor protection fuses are selected according to the Instruction Manual of the drive converters.

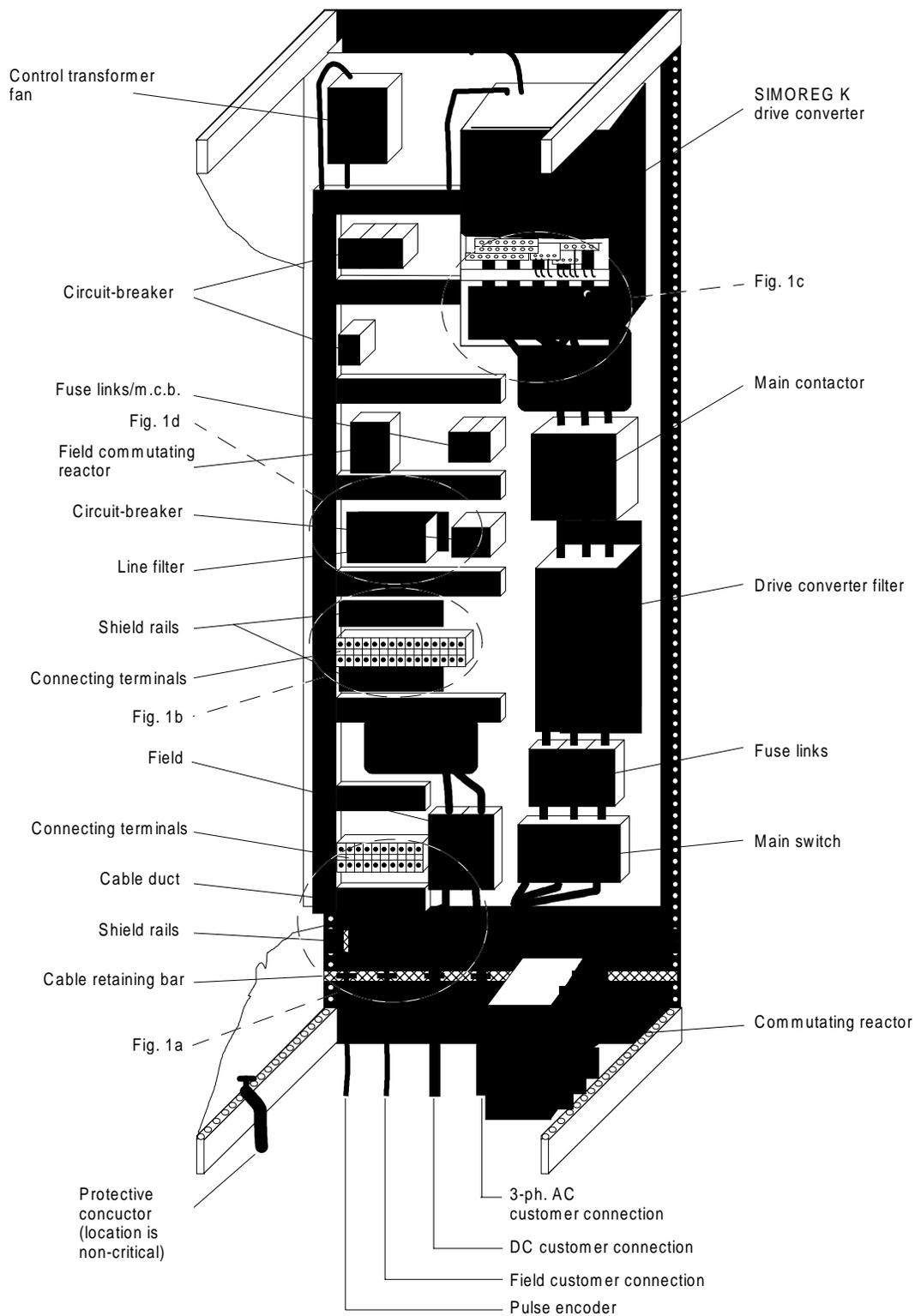


Fig. 1: Example of a cabinet design with a SIMOREG K

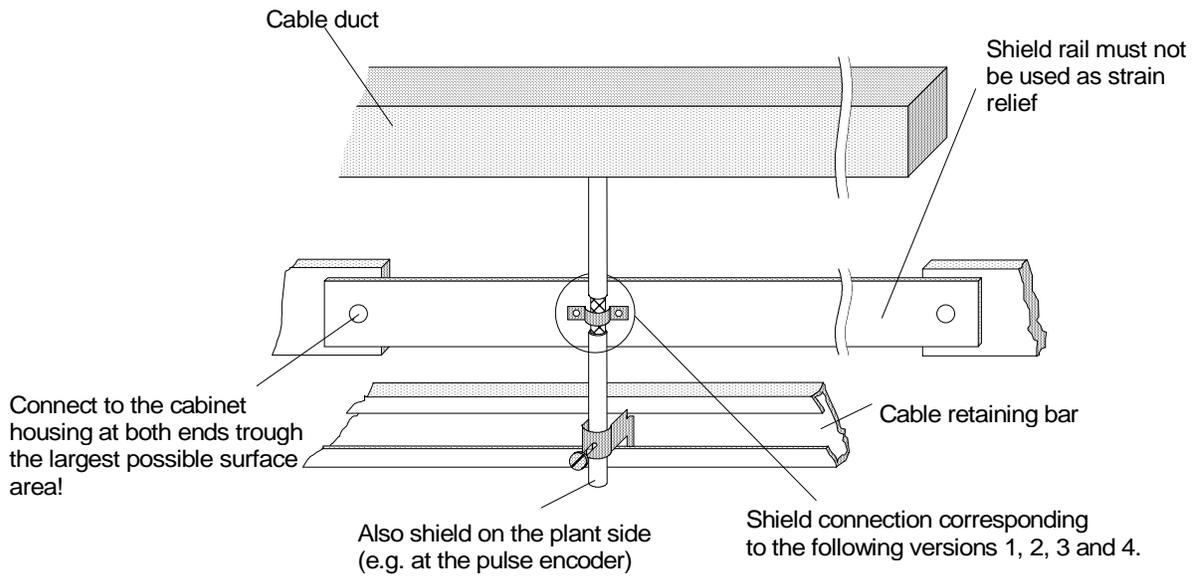


Fig. 1a: Shielding Where the Cable Enters the Cabinet

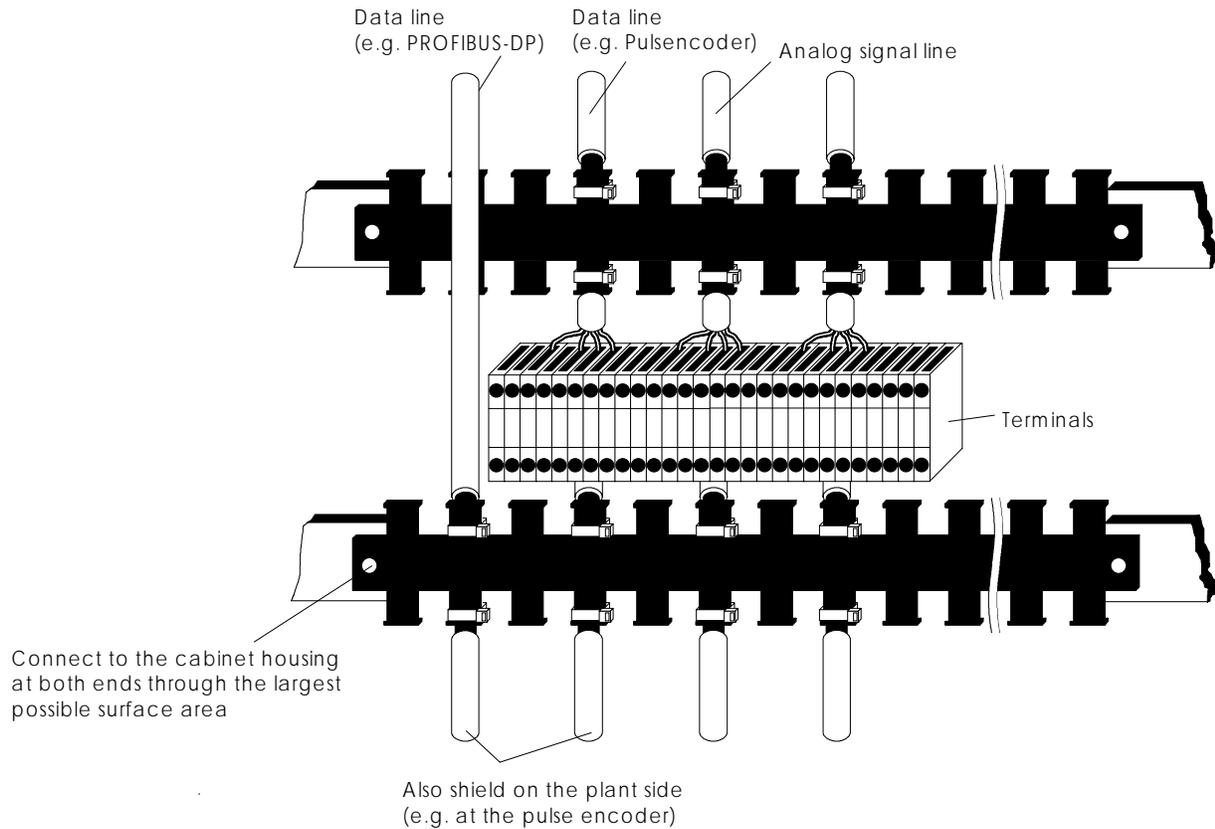


Fig. 1b: Shielding in the cabinets

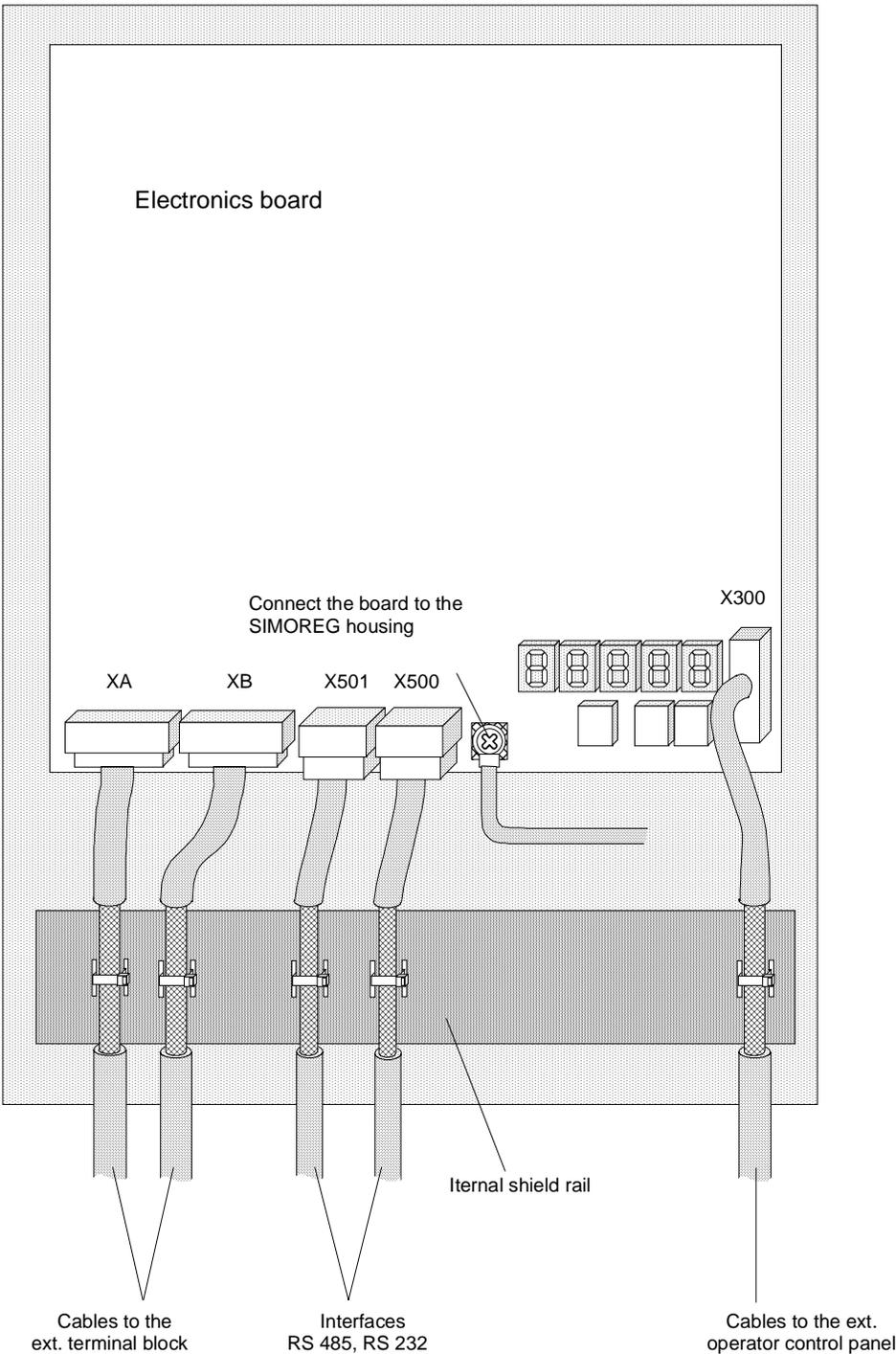


Fig. 1c: Connecting the shields at the SIMOREG K 6RA24

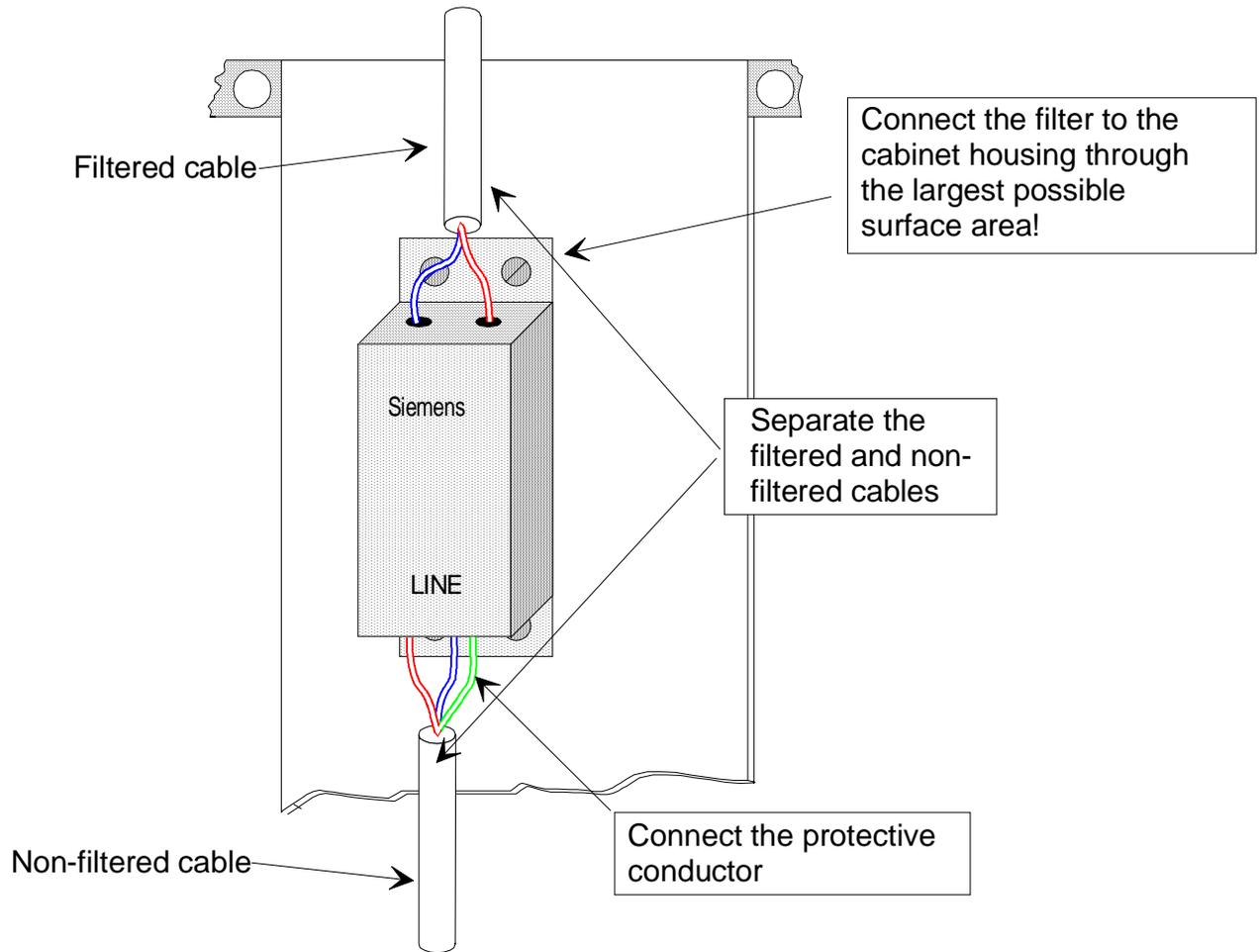


Fig. 1d: SIMOREG 6RA24 Power Module Line Filter for the Electronic Power Supply

11.2.3 Shield Connection Methods:

Method 1:

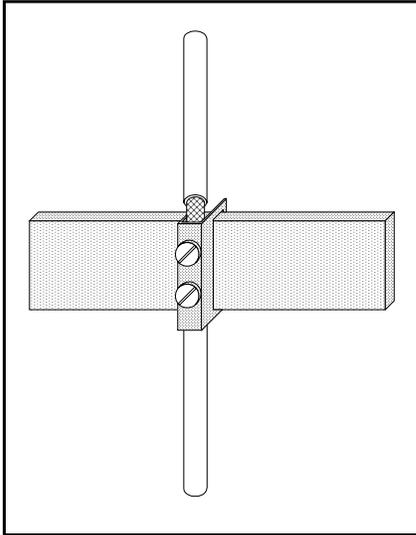


Fig. 2a: Connecting terminal mounted on a copper busbar, max. cable / cable diameter = 15 mm

Method 2:

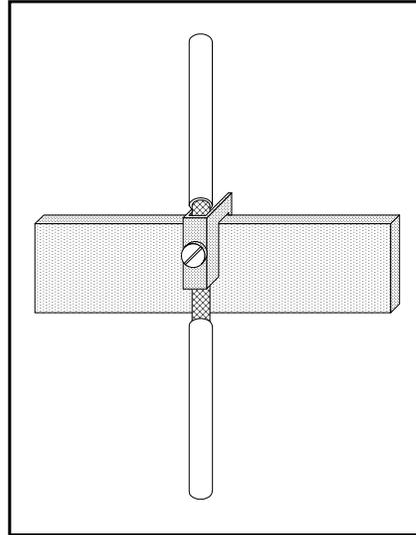


Fig. 2b: Terminal mounted on a copper busbar, max. cable / cable diameter 10 mm.

Caution!

The conductor could be damaged if the terminal screw is over-tightened

Note:

Terminals:
5 mm busbar thickness,
Order No. 8US1921-2AC00
10 mm busbar thickness,
Order No. 8US1921-2BC00

Note:

Terminals:
Order No. 8HS7104, 8HS7174, 8HS7164

Method 3:

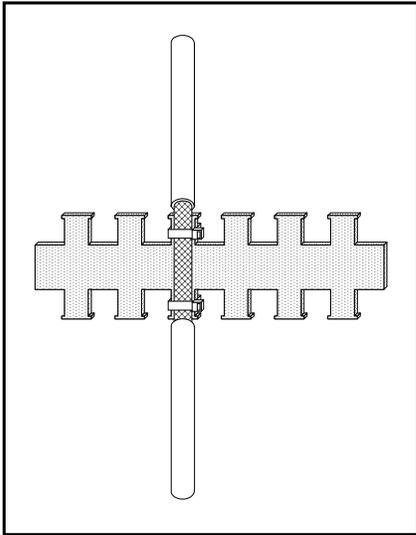


Fig. 2c: Metalized tubing or cable ties on a bare metal serrated rail

Note:

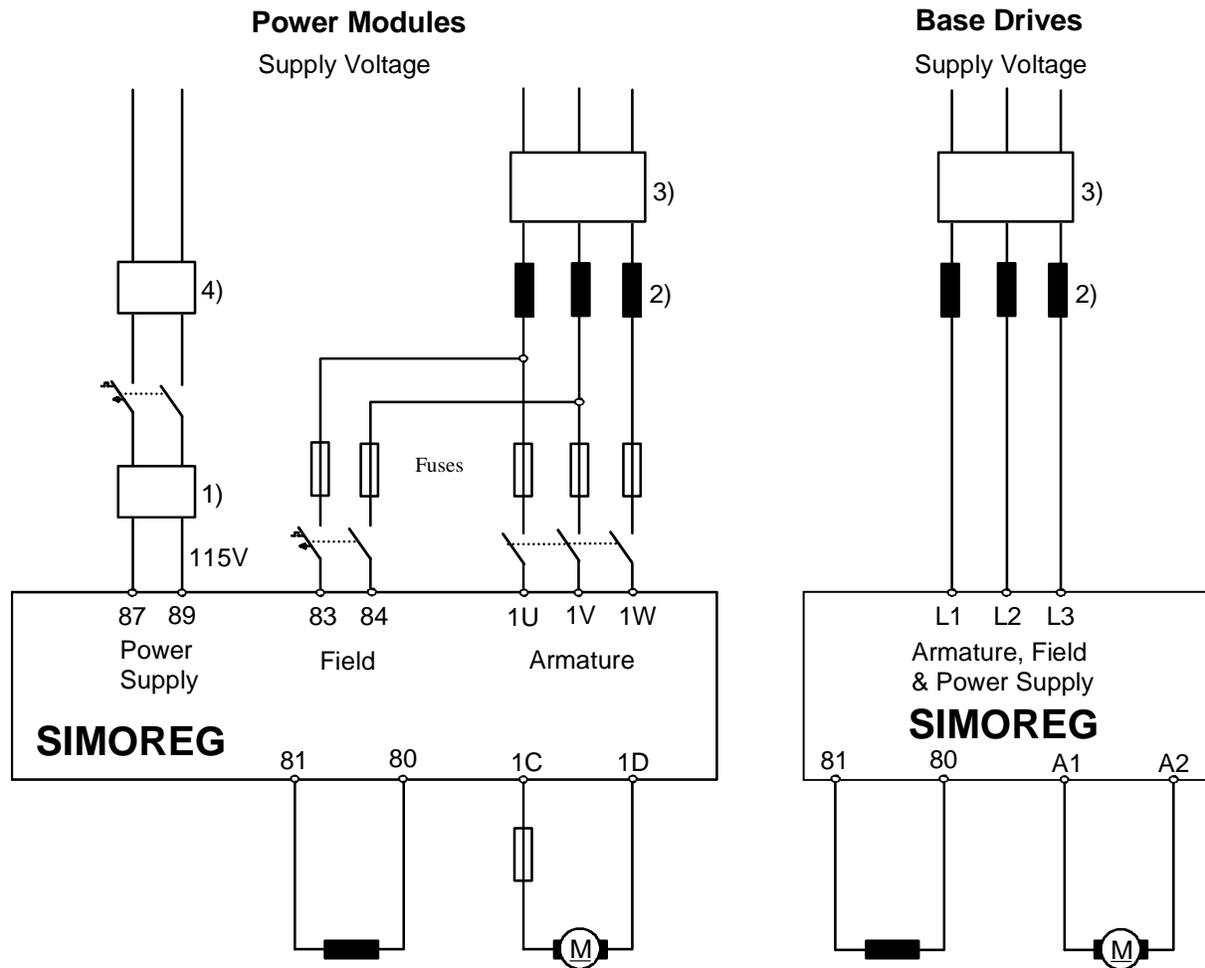
Serrated rail:
Item No. J48028

Can be ordered from:

SIEMENS AG ANL A443 KA
Günther-Scharowsky-Str. 2
Betriebe Süd
91058 Erlangen

11.2.4 Drive converter component arrangement

6RA24 SIMOREG Drive Converter, US Version
Reactor and filter arrangement
(Power Modules & Base Drives):



- 1) Power supply transformer (adapts the unit for 115 V supplies).
- 2) The commutating reactor for the armature- and field circuits is dimensioned for the nominal motor armature current (the line supply current is the DC current x 0.82) plus the nominal motor field current.
- 3) The filter for the armature and field circuits is dimensioned for the nominal motor armature current (the line supply current is the DC current x 0.82) plus the nominal motor field current.
- 4) Filter for power supply of SIMOREG

Note:

When filters are used, commutating reactors are always required at the drive converter input to decouple the snubber circuitry.

The commutating reactors are selected according to the information specified in Catalog DA93.1.

13. SOFTWARE UP-DATE HISTORY

13.1 Version 2.00 Initial SE&A release August 1993

13.2 Version 2.10 Up-Dated software release June 1995

Version 2.10 New Functions

1. New connectors:

Connectors K337, K338, K339, K340 have been added. These connectors show the fault code of the last 4 faults saved at P880.00 to P880.03 respectively. When a fault is acknowledged the value of the last displayed fault remains in K337

Version 2.10 Changes

1. Operation with high or low AC line voltages

Adjustment range of parameter of P352 (threshold for AC line-over-voltage)

With version 2.00 (and version 2.10), the fault "over voltage", F007, is blocked at parameter P850 for the default condition. If the drive is started when an overvoltage condition is present the drive will remain in operating status o4.0 even though the F007 fault is blocked. In this case the drive can not be started until the voltage is reduced.

Version 2.10 increases the range of adjustment of P352 from 0 to 20% to 0 to 99% of the value in P071. This allows operation with high line voltages that are otherwise not a problem for the drive.

Adjustment range of parameter of P351 (threshold for AC line-under-voltage)

Version 2.10 increases the range of adjustment of P351 from 0 to -20% to 0 to -90% of the value in P071. This allows operation with low line voltages that are otherwise not a problem for the drive.

2. Adjustment range of parameter of P158 (di/dt ramp time)

The range of adjustment of P158 has been increased from 0.000 to 0.100 seconds to 0.000 to 1.000 seconds. This allows more flexibility in applying the 6RA24 to older motors or to installations with high backlash gearboxes.

3. Adjustment range of parameters P640 and P641 (selection of STW & STWF)

The selection of the control word source with P640 and the freely defined control word source with P641 has been limited to connectors 19 to 83 in version 2.00. Version 2.10 has extended the allowable range to cover all connector numbers 0 to 399. This provides more application flexibility for the 6RA24.

4. New text for P781, P782, P791, P792

The text on the optional operator panel for parameters P781, P782, P791, P792 has been changed from Prt0PDNo, Prt0PrNo, Prt1PDNo, Prt1PrNo respectively to Port0PZD, Port0PKW, Port1PZD, Port1PKW. This brings the text in-line with commonly used terms from the USS and Profibus protocols.

Version 2.00 Problems Fixed in Version 2.10**1. Operating status o1.3 (contactor delay for "jog" using P085)**

There are operating conditions following an active "jog" function where the drive will instead of going to drive status o7 it will go to o1.3 at which time the main contactor will close until the time at P085 has elapsed. This has been corrected in V2.10.

2. Change the Off-line parameter P642.ii:

When setting the STWF bits with P642.ii the drive may start when BIF13 to BIF16 are passed over. The main contactor may close and the drive will hold in drive status o1.3 for a time set with P085 and then go to status o1.1 (enable not present). It is also possible to reach drive status o8.0. This is now corrected.

3. Control word for position sensing (P144)

The position sensing function doesn't work when power is first applied to the drive since P144 in RAM is always automatically set to a value of 100. If any parameter is changed then P144 assumes the correct value and position sensing will be active. This has been corrected in V2.10.

4. Speed regulator integrator limit-bits

Normally, if current or torque limit is reached, the speed regulator integrator is stopped to prevent regulator windup. If the positive *and* negative torque limits are set to exactly zero an error allowed the integrator to continue to operate. This has been corrected in V2.10.

5. Field reversal using an external field supply

Using the internal field supply, the gate pulses are blocked to bring the field current to zero, however, the field current reference at connector K268 is not clamped to zero and is still active. Consequently, an external field supply could not be used for field reversal since there was no way to bring the field current to zero. In version 2.10 the field current reference at K268 is clamped to zero during the period when the internal gate pulses are blocked so that even an external supply will regulate for zero field current.

6. Speed regulator reference filter P228

The value of P228 for parameter set 1 was used for all parameter sets even though different values were entered for parameter sets 2, 3, & 4. This has been corrected in V2.10.

7. Diagnostic monitor

The memory read feature using parameters P881, P882, and P883 has been extended to allow reading of dual port ram locations. The memory read feature is a factory use only function that requires detailed knowledge of the software memory map

8. Current regulator self tuning (P051= 25)

The field current regulator self tuning, done when P051 = 25, is only correct when the minimum field current, set with P103, is zero. If P103 > 0, then the self tuning will generate either fault F050 with word 1 = 17 or the field current regulator proportional gain setting, P225, will be too large. This has been corrected in V2.10

9. Armature current regulator self tuning (P051= 25) using an external field supply

During the time when armature current flows the field current is held at zero by gate blocking the internal field supply. When an external field supply is used the internal blocking is ineffective in bringing the field current to zero and the external field must be turned off during this part of the procedure.

In version 2.10 the field current reference, at connector K268, is held at zero in addition to internal gate blocking. This allows an external field supply to regulate the field current to zero when armature current tuning is in progress.

10. Clarification of the "normal stop" & "coast stop" function

There are no changes to this function. The following description clarifies the transition from normal stop to coast stop. If the drive has been given a normal stop (ramp to stop) and is in the process of decelerating towards zero speed and a subsequent coast stop command is then applied and held, the drive will block armature current, open the contactor, and coast to a stop. If the coast stop command is then removed while the drive is still coasting, the drive will revert to the original normal stop (ramp to stop) and continue to stop following the ramp.

11. Missing gate pulse at the pulse retard limit (current suppression)

When armature current is being forced to zero, the gate angle is phased back to the gate angle retard limit to get maximum negative voltage. When using the drive as a field supply it was possible that the gate angle could be temporarily phased past the retard limit. During this temporary time gate pulses are not released. If a 4 quadrant drive is being used in a DC generator field exciter application for example, the missing gate pulses can lead to inversion faults and AC line fuse loss. Version 2.10 has solved this problem by allowing the gate pulses to be released up to 15° after the angle limit has been reached.

12. Storing parameters in RAM using USS protocol

The USS protocol allows parameters to be changed only in RAM or in RAM and EEPROM. If a parameter was changed only in RAM from the USS protocol and then within 2 minutes was subsequently changed from the operator panel, it would still only be changed in RAM and would be lost when power is cycled off. Version 2.10 has corrected this problem.

13. Fault F004 (phase failure threshold P353)

The phase loss threshold set with P353 was affected by the AC line-frequency. This has been corrected in version 2.10

14. External fault message time delay (P767)

External faults can be delayed using P767 to avoid nuisance faults. When power was first turned on to the drive, the time delay set with P767, was not effective. This has been corrected.

15. External fault message time delay (P767)

The time delay for external faults set with P767 is approximately 2 times the value actually selected with P767. This has been corrected in V2.10.

16. Current regular operating (P084= 2) or Current slave operation with BIF41 = 1

When current regulation is selected with P084 = 2 or BIF41 = 1, the speed regulator related function blocks for friction and inertia compensation torque's was not calculated. This has been corrected in V2.10.

17. Current regular operation (P084= 2) or Current slave operation with BIF41 = 1

If current regulation is selected with P084 = 2 or BIF41 = 1 and if P229 = 1, the speed regulator is enabled and can be used for some other unrelated regulation function if desired. It was found that in this case with P229 = 1 that current regulation was canceled and the drive operated again in the speed mode. Version 2.10 has corrected this problem.

18. Ramp generator:

With a normal stop (ramp stop) command it is possible that a speed increase can occur if ramp tracking is on, P302 = x1, and a limit condition is effective. This has been corrected in version 2.10 by making the ramp follow the actual speed when P302 = x1 and a limit condition is effective.

19. Dual Port Ram Accesses

Dual Port Ram accesses now use a longer "ALE" (address latch enable) so that even under worst case conditions there can not be a timing problems

20. Binary input-functions for the control word STW and STWF

Bits 1 and 2 at connector K317 (P010.03) for “coast stop” and “quick stop” are not up-dated from the control word selected with P640. Also, if “coast stop” and “quick stop” are selected using P641 and P642.ii, the corresponding bits at connector K318 (P010.04) are not up-dated. This has been corrected in V2.10.

21. Effect of the speed regulator reference filter (P228) when BIF41 is used

When P229= 0, speed regulator disabled during current regulation, and current regulation operation is selected with BIF41, the output of the speed reference filter (K174) stays at the last value prior to selecting current regulation. If P228 is set to a large time constant it is possible that when speed control is again selected the drive may run at the wrong speed or even in the wrong direction as the filter output slowly changes to the present speed reference value. Version 2.10 has corrected this potential problem by presetting the output of the speed reference filter to the value of the actual speed when current regulation is selected. Now when speed regulation is selected the initial condition of the filter will be correct for the true actual speed.

22. USS protocol; time between STX and LGE (between start and the length byte)

If the time between the STX byte and the LGE byte is larger than 1.5 times the character run time the telegram is rejected. This is a problem when operating at 187.5 kbaud with certain masters since they can not achieve the required time space. Version 2.10 has increased the allowable time up to the equivalent of 3 times the character run time.

23. Optional operator panel text correction for P109 Taper Current Limit

It was found that the text on the optional operator panel for parameter P109 was reversed. The correct text should be P109 = 0 is “off” and P109 = 1 is “on”. The instruction manual correctly describes parameter P109.

13.3 Version 2.20 Up-Dated software release November 1996

(Note: SE&A SIMOREG drives went directly from Version 2.10 to 2.30 software. Version 2.3 includes all of the changes described in version 2.2)

Version 2.20 New Functions

Binary input function, BIF69: Enabling the ramp-up integrator changeover

This binary input function, BIF69, is selected with setting 69 of the particular select parameter. If BIF69 is selected then the changeover according to P302 can be selectively activated using BIF69. If BIF69 is not selected then the ramp changeover takes place according to the P302 selection.

BIF69 Selected:

- Level: 0 When the ramp-up integrator function is selected with P302= x1x, x2x or x3x, refer to Section 9.2, the changeover from ramp generator setting 1 to the setting according to P302 is not allowed. Ramp-function generator setting 1 or the ramp-function generator setting 2 or 3 as selected with BIF31 or BIF32 is used.
- 1 When the ramp-up integrator function is selected with P302= x1x, x2x or x3x, refer to Section 9.2, there is an automatic changeover from ramp-up function generator setting 1 to the setting according to the tens location of P302 as soon as BIF69 changes from "0" to "1" and the ramp-function generator output reaches the required setpoint for the first time.

If the logical signal level of BIF69 changes from 1 to 0 after an automatic ramp-function generator setting changeover, ramp-function generator setting 1 or the ramp-function generator setting 2 or 3 as selected with BIF31 or BIF32 is again used. The changeover enable is re-activated when the signal level of BEF69 changes from 0 to 1, so that when the required setpoint is reached the next time the ramp-function generator setting, corresponding to P302, is again selected.

Version 2.20 Changes

P053: Value range increased: 00 to 21 (previously of 00 to 11)

- 2x Only the contents of the fault memory P880 (numbers of the last 4 faults that have occurred) are stored in the permanent memory. All other process data will be lost when power is removed from the drive.

P142: Value range increased: 0000 to 2112 (previously 000 to 112)

The measuring time for the speed actual value sensing using a pulse encoder can be changed as follows using the thousands position of P142:

- 0xxx nominal measuring time = 1 ms (factory setting)
- 1xxx nominal measuring time = 2 ms (results in a "steadier" speed actual value than for 0xxx)
- 2xxx nominal measuring time = 4 ms (for drives with a high moment of inertia this results in a "steadier" speed actual value than for 0xxx, P200 should be set at least to a value of 5 ms)

P152 (armature), P252 (field):

The line supply gate synchronizing function has been improved to provide better operation when the AC lines contain commutation notches or short interruptions:

Uneven number provides additional filtering of the line supply zero crossovers sensing for line supply synchronization. This can improve operation for situations with short line supply interruptions (e.g. for current feed via slip rings) or lines with commutation notches. This feature can only be used for supply networks with a stiff supply frequency since the additional filter will not allow the function to track fast changing frequency deviations. If operation is from a system with frequency deviations then even numbers must be used.

P253 (motor flux): Value range increased: 00 to 21 (previously 0 to 1)

The tens locations defines the input quantity used to determine the motor flux:

- 0x Input quantity to determine the machine flux is the field current actual value according to P612 at K265. This is for operation with a fully-compensated DC motor (factory setting).
- 1x The feed-forward output for the EMF controller at K293 is the input quantity to determine the machine flux. This is for operation of an uncompensated DC motor. For this setting, the EMF controller must be active since the EMF controller output compensates for the motor armature reaction. (**Exception:** The field current controller setpoint (K268) is used when field economy is active or for field pulse inhibit.)
- 2x The field current controller setpoint at K268 is the input quantity to determine the machine flux. This is also for operation with a fully-compensated DC motor. The advantage of this method is that quantities derived from the setpoint are generally steadier than quantities derived from the actual value. This can result in smoother control of motor torque.

P302: Value range increased: 000 to 231 (previously 00 to 31)

The hundreds location controls the initial ramp-function output at the start of a “shutdown” command:

- 0xx The ramp-function generator output is not preset at the start of “shutdown” (setting corresponds to software version ≤ 2.00) (factory setting)
- 1xx At the start of “shutdown”, the ramp-function generator output is preset to the speed actual value at K167 (setting corresponds to software release 2.10 for P629 = 2)
- 2xx At the start of “shutdown”, the ramp-function generator output is preset to the speed controller actual value at K165 (feedback filters are included). This setting should not be used if derivative control is activated when P205 > 0.

During “shutdown” the ramp-function generator output limiting is not effective. P302 should be set to 1xx or 2xx, so that a momentary speed increase does not occur when the ramp-function generator output is limited at shutdown.

P355: Value range increased: 0.0 to 600.0 s (previously 0.0 to 60.0 s)

With software release 2.20 if P355= 0.0, the “drive stalled” monitoring (F035) is disabled and now alarm W08 cannot occur. This is useful for special applications that do not use the speed controller.

P642, P761, P762, P763, P764, P765, P766: Value range increased: 0 to 69 (previously 0 to 68)
The range has been increased to allow for new BIF 69.

13.3 Version 2.30 Up-Dated software release March 1997

Version 2.30 Problems Fixed:

1. A problem that prevented fault F029 from being issued if a technology board failed has been corrected.
2. A problem that prevented thyristor diagnostics from working when a DC contactor was used in conjunction with voltage feedback has been corrected. See new parameter P095.
3. During thyristor diagnostics, detection of thyristor conduction when small motors are used on larger converters has been improved.
4. A problem that resulted in an erroneous fault F052 at the end of motor field weakening measurements, caused by long field time constants, has been corrected.
5. The armature current feed forward control has been improved (see parameter P153)
6. The gate synchronizing filtering has been improved (see parameter P152)
7. New choices have been added to P224 for special application requirements
8. Nuisance F110 faults have been resolved. An F110 is not processed unless it is present for at least 10 seconds.

New Parameters Added

Parameter P095 has been added. This parameter is used to set a wait time to allow a dc contactor to close before the regulators are enabled. The drive will wait in status o3.2 for this time before proceeding.

New Connectors Added (Intended for diagnostic use by factory personnel)

K109 Average value of the last 6 armature current samples.
 K122 filtered EMF for the pre-control of the armature current controller
 K123 $EMF = U_a - I_a * R_a - L_a * di_a/dt$ with U_a .. measured armature voltage
 K124 $EMF = U_a - I_a * R_a - L_a * di_a/dt$ with U_a .. calculated armature voltage
 K355 $I_a * R_a + L_a * di_a/dt$ (same scaling as EMF)
 K356 Calculated current sample at the time of the gate pulse
 (calculated of the last 2 real current samples) (818 = +100% of unit current)
 K359 T1-value of last I=0-entry or T1-value of last gate pulse if no I=0-entry found
 K360 to K360 are factor diagnostic connectors
 K389 Duration of most recent armature current pulse, in 1.778 us units

New Binary Output Functions Added

BOF 36 and 37 have been added. These indicate if Coast Stop or Quick Stop are active.

Notes

14. SIMOVIS for the 6RA24

14.1 Capabilities of SIMOVIS

SIMOVIS is a software program that runs on a PC and interfaces to a 6RA24 drive using one of the drive serial interfaces. Using SIMOVIS it is possible to perform the following functions:

- o Menu prompted drive start-up
- o UPREAD and DOWNLOAD parameters
- o Menu prompted setup of drive analog and binary inputs and outputs
- o Prompted settings for all open loop and closed loop control functions
(Technology controller, MOP, ramp generator, speed controller, reference generation, armature current controller, EMF voltage controller and the field current controller.)
- o Prompted settings for option boards
- o Operating mask to input control commands and reference points for drive operation.
- o Trace buffer recording, read-out, and graphic display.

Some of the text used in the SIMOVIS program uses slightly different words or abbreviations as compared with the rest of the instruction manual. The following list will show the correlation between the two.

FUNCTION	SIMOVIS
Binary Input Function BIF	BEF
Binary Output Function BOF	BAF
Reference value	Setpoint value
Scale or scaling	normalize
Feedback value	Actual value
Base Board Port 0, BBP0 (X500)	G-SST0 (X500)
Base Board Port 1, BBP1 (X501)	G-SST1 (X501)

14.2 Loading and Running SIMOVIS

For operation SIMOVIS must be installed on the hard disk of a computer with the following features:

- o PC with a 386 or 486 processor
- o MS-DOS version 5.0 or later
- o 10 Mbytes of free memory on the hard disk
- o 552 Kbytes of free working RAM
- o VGA graphics

The installation floppy disk includes a batch file that generates the required directory structure on the hard drive and copies all of the files to the correct directory. The master directory can be selected as desired (e.g., C:\6RA24\ or C:\SIMOVIS\). The installation program can then be started from the floppy drive and installed to the master directory.

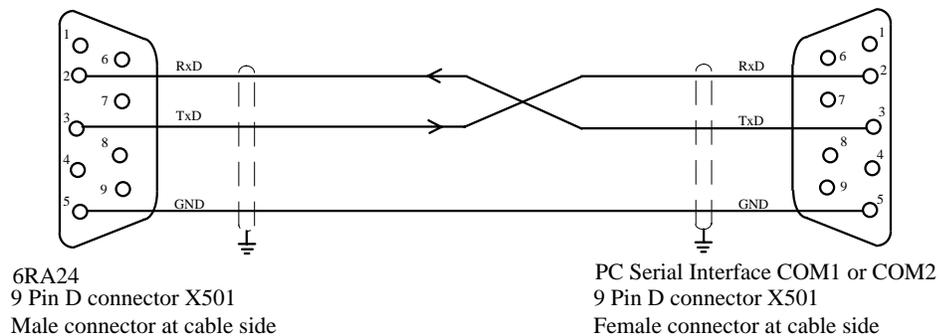
To install the SIMOVIS program:

1. Create a master directory on C: drive where you want SIMOVIS to be stored.
For example from the root directory type "MKDIR SIMOVIS" and enter.
Change to the SIMOVIS directory by typing: CD\SIMOVIS and enter
2. Insert the floppy disk into either A or B drive and type:
A:INSTALL and enter if drive "A" is used or
B:INSTALL and enter if drive "B" is used.

When the display "please insert the second floppy disk ..." appears, insert disk 2 and press any key.

3. After the installation is complete SIMOVIS can be started by typing "START" and then pressing enter.

The 6RA24 drive is connected to the PC using a cable as shown below and the RS232 port at X501.



RS232 Connections

The XJ2, XJ6, XJ7, and XJ8 jumpers on the 6RA24 microprocessor board should be in the factory shipped position 1-2.

Normally SIMOVIS is operated with a mouse however if a mouse is not present the pointer can be moved using keys.

KEY	ACTION
Alt cursor right	one position right
Alt cursor left	one position left
Alt cursor up	one position higher
Alt cursor down	one position lower
Ctrl cursor right	several positions right
Ctrl cursor left	several positions left
Ctrl cursor up	several positions higher
Ctrl cursor down	several positions lower

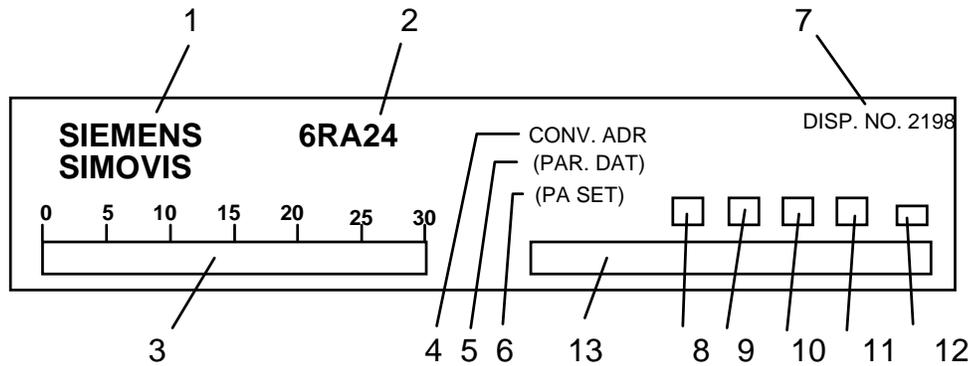
The mouse buttons are simulated from the key board as follows:

Alt end	Press the left mouse button
Alt page down	Release the left mouse button
Alt home	Press the right mouse button
Alt page up	Release the right mouse button

14.3 Operator control

All SIMOVIS displays have a defined display structure. The display is sub-divided into header, footer, and working zones.

The header remains the same for all displays, and includes the following information:



- 1 SIEMENS logo
- 2 6RA24 product logo
- 3 Bars where the current status of all drives connected to the bus is shown:

Dark Blue	Drive not logged on
Gray flashing	Drive logged on but presently not connected
Green	Connection established
Red	Connection established, drive has a fault
Yellow	Connection established, drive has a warning
- 4 Drive address for the drive active in the working zone
- 5 Name of the data file which is executed in off-line operations. This line remains empty when the drive is on-line.
- 6 Number of the displayed parameter set for parameters from P100 to P599.
- 7 Mask number
- 8 Display box for an existing fault (flashes red)
- 9 Display box for an existing warning (flashes yellow)
- 10 Display box for a received parameter change message
- 11 Display box for a communications fault (flashes yellow)
- 12 Symbol for displaying whether a write command is presently being executed in the RAM, ("R") or being permanently stored in the EEPROM ("E").
- 13 Window for message output

The footer indicates the actually assigned function keys. The function keys can be executed by pressing the function key or by clicking on the appropriate field using the mouse.

- F1 Calls up a help screen for the associated display
- F2 Indicates the last 10 internal SIMOVIS messages
- F11 Generally branches to the previous screen
- F12 Branches back to the main menu

The working zone displays the controller structures and parameter values and can be modified by the used using the mouse or key board.

The following display elements respond to a mouse click:

- o red boxes with white arrows (generally for changing a parameter value)
- o texts with a blue background (generally for sending a specific parameter)
- o function blocks with a blue boarder (generally to get to a more detailed display mask)
- o the footer area and the function keys
- o the number after CONV. ADR (for selecting the converter address)
- o the number after PA.SET in the header (for selecting the parameter set to be displayed)

The following actions are possible using the key board:

- o Display changes using the function keys noted in the footer
- o UPREAD/DOWNLOAD functions only operate using the function keys
- o Parameter values are set in the pop-up windows using the number and decimal keys. The number to the left of the cursor is set when the enter key is pressed.
- o Some masks have input fields that can be stepped through using the TAB key.
- o The cursor keys or F3/F4 are used to scroll through a list of connector numbers for parameters that allow connector numbers to be assigned. When the connector has been selected it is sent to the 6RA24 using F8.

14.4 UPREAD/DOWNLOAD Mask (display No. 3999)

UPREAD:

The UPREAD function is used to read the 6RA24 parameters and save them in a file on the PC hard drive. To select the UPREAD screen press F3. By specifying the parameter and index number for each parameter, a parameter definition file can be made which allows the parameters to be read from the 6RA24 using the UPREAD function.

The INITALL.UPR file is supplied with SIMOVIS and it includes all of the parameters in used in the 6RA24 software release 2.00 or 2.10.

If it is desired to UPREAD only specific parameters rather than all of the parameters, a new definition file can be made by coping INITALL.UPR to a new file name and editing it using the F5 edit function. When editing a file the parameter number is located in the left field and the index number is located in the right field.

When using the UPREAD (F4) function, the file name the parameters will be stored to is checked and then UPREAD is started. The INITALL.UPR definition file includes 1404 parameters including all indices and therefore the time to read them will take several minutes at 19,200 baud. The resulting parameter data file created has the extension .UPD and is saved in sub-directory SIMO_P. By pressing F10 the UPREAD/DOWNLOAD screen will return.

DOWNLOAD:

The DOWNLOAD screen is selected using F4. The following functions are available here:

F4 DOWNLOAD	The selected parameter data file is transferred to the 6RA24
F5 EDIT	The selected parameter data file can be edited
F6 COPY	A parameter data file can be copied to a new file name
F7 DELETE	Deletes a parameter data file
F8 Diff.dru	Compares two parameter data files. Prints out parameters and marks those that are different with a "*". This process can take up to 15 minutes.
F9 PRINT	A parameter data file is printed

Toggling between on-line / off-line operation

Generally SIMOVIS operates with a permanent link to the 6RA24 drive through the serial interface. In off-line operation, actual values are not supplied from the 6RA24 drive but rather from a parameter data file on the computer hard disk drive that was previously generated by an UPREAD operation from the 6RA24 or copied from the factory default file WERKSEIN.UPD.

The file name of a parameter data file (*.UPD) can be entered in the header in the UPREAD/DOWNLOAD screen (3999). In the entry field a list of available data files is displayed. ON-LINE operation can only be selected by pressing F7 in screen 3999.

To create a file to use with SIMOVIS go to the UP / Down load screen #3999 and press F4 to get the down load menu. Press copy F6 and enter the file name to be used (no extension required) and press the enter key. The file WERKSEIN.UPD which has all the parameters with values set at the factory default will be copied to the new file and show up in the list of down load data files.

Press return key F10 to get to back to the base screen #3999. Click the mouse on the PAR. DAT box at the top of the screen and enter the file name to be used (no file extension) and press the enter key. SIMOVIS will use this file from now on and it will be displayed at the top of each screen.

To return to an on-line condition return to screen #3999 and press key F7 which will clear the file name from the top box.

Drive Address

The drive to be addressed by SIMOVIS is also set on the Up / Down load screen #3999. To change to a different drive connected on the RS485 bus used by SIMOVIS click the mouse on the GER.ADR box at the top of the screen and enter the drive address number and press enter. The new drive address will be used by SIMOVIS from now on and will be displayed at the top of each screen.

14.5 Trace Buffer Graphics (display screen 2165)

For this function, an internal 6RA24 drive function is used which records over time up to 8 connectors each with 128 points at a maximum resolution of 2.77 ms per point. The diagnostic recording can be displayed on an oscilloscope screen where either the first 4 channels or the last 4 channels can be displayed.

Screen 2165 is first displayed and is used to set-up the trace buffer parameters as described in section 10.11. On this screen the following items are selected for the trace buffer:

- The first 4 trace channels are selected in the upper right window by clicking on the red selection arrow. "F10" can be used to select the second set of 4 trace channels if required. this sets the connector numbers for parameter P861.ii.
- The trigger condition line in the lower right window is used to select the signal to trigger on (P862), the trigger condition (P863), and the trigger value (P864).
- The "Sampling interval" is entered as an integer and is a multiplier times 2.77 ms (P865).
- The "Trigger delay" is entered as an integer and is the number of sample points after the trigger condition has been met (P866).

By clicking on the oscilloscope screen or by pressing "F3", display screen 3998 is selected and the trace buffer of the 6RA24 drive can be read and transferred to the PC.

Five parameter input lines appear on screen 3998 and **must** be set before the trace buffer can be transferred to the PC. The values to be sent are entered in the right-hand column starting with the first entry "Slave-No". A small cursor box indicates which field can be changed. Type the required value and press "enter" to move to the next field or move to the next field using the arrow keys on the PC.

Slave-No.	Drive address that has the recording
Trace-Channel	11 should always be entered here
First Parameter Nr.	P841 is trace buffer channel 1, P842 is trace buffer channel 2, etc., up to P848.
Last Parameter Nr.	P841 is trace buffer channel 1, P842 is trace buffer channel 2, etc., up to P848.
No. of valid samples	1 to 128 depending on the requirement (128 is the complete trace buffer)

The transfer can be started after all entries have been made by pressing the F4 key. As soon as the "No. of valid samples" number in the left-hand column has returned to zero, data transfer is complete and the values can be graphically displayed using F3.

When F3 is pressed, a menu appears with 4 choices that are used to select the scale for the graphics. Highlight the desired choice using the arrow keys and press enter to select it. Normally choice 3, $\pm 120\%$ with interpolation between the sample values, gives good results.

The choices are:

- Mode 1. $\pm 200\%$ with interpolation between the sample values
- Mode 2. $\pm 200\%$ without interpolation between the sample values
- Mode 3. $\pm 120\%$ with interpolation between the sample values
- Mode 4. $\pm 120\%$ without interpolation between the sample values

In all cases 16384 counts = 100%.

Up to 4 curves can be shown on one display. The display is sub-divided if more than four curves are transferred from the 6RA24 and the curves are shown in two windows.

By clicking on the top left window "set/win", followed by "1" or "2" and "start", one of the two small displays can be blanked out and the other zoomed up in size.

By clicking the right mouse button on "trace buffer #" in the large left window, the selected curve is toggled on or blanked out.

The time axis scaling is one second for 128 recorded values. If less than 128 values are transferred from the 6RA24, then the curve is displayed right justified. The actual time scaling is obtained from the selected "sample interval" in cycles. One second of the time axis labeling corresponds to $(128 * 2.77 \text{ ms} * \text{sampling interval})$.

14.6 Troubleshooting SIMOVIS

If SIMOVIS does not function properly check the following points.

Problem:

The connection to the 6RA24 is not established.

Possible Causes:

1. The interconnecting cable is faulty or connected to the wrong serial port (X501 for RS232 communications)
2. The interface used at the PC, COM1 or COM2, is not defined in the USS.INI file in the SIMO_D sub-directory on the hard drive. (set operation = 0 for COM1 and operation + 1 for COM2)
3. The baud rate set in the USS.INI file and the 6RA24 are not the same.
In USS.INI, set operation = 0, **9600**, E, 8, 1, p, 1, 1
In the 6RA24 set P793 = **6 for 9600 baud.**
4. The process data, PZD, length definition is incorrect:
In USS.INI, set slave = 0, 6RA24.00, 3, F, **3**, 3, 8, 101, 0C7E, 0000, 0000
In the 6RA24 set P791 = **3**
5. The parameter data, PKW, length definition is incorrect:
In USS.INI, set slave = 0, 6RA24.00, 3, F, **3**, 3, 8, 101, 0C7E, 0000, 0000
In the 6RA24 set P792 = **3**
6. The plug-in jumpers XJ2, XJ6, XJ7, XJ8, at the 6RA24 are not in setting 1-2.

Problem:

The hard disk is continuously accessed and the response time is very slow.

Possible Causes:

1. This can be improved by installing a hard drive cache memory (e.g., SMART DRIVE).
2. This can also be caused by an incorrect PZD value in USS>INI or P791. (see 4. above)

Problem:

Errors and alarms are not displayed.

Possible Causes:

1. The 6RA24 status word is not being transferred to the SIMOVIS program. Define the status word as the first PZD data with P794.00 = 325 or P784.00 = 325, for the 6RA24 serial interfaces.

Problem:

The trace buffer graphic display appears only briefly when changing to the graphic display and then jumps back to screen 3999.

Possible Causes:

1. There is no saved graphic files in the SIMO_A sub-directory. Transfer the trace buffer contents in display 3999 (refer to section 10.11)

14.7 SIMOVIS for 6RA24 Version 2.20

WHAT IS NEW FOR SIMOVIS V2.2 ?

a) Start SIMOVIS

- START1 and START2 are not required (COM1 and COM2 are selected in the bus configuration).
Start with bus configuration: START
Start without bus configuration: RUN

b) Bus configuration

- new function key F10 DOS (return to DOS).
- An individual number of process data words can be set for every bus node (0 to 16, pre-setting = 3)
- Improving the handling of the select field for the baud rate (click on the field and enter a new value).
- New select field to select COM1 or COM2.
- F10 Save not required; F8 Continue now includes a check, as to whether the bus configuration was changed: If yes, then a prompt is made to save.

c) Upreading / Downloading

- Only the file names of upread- or download files which match the selected basic drive are listed in the overview windows. This has required a format change in both the upread and download files and requires older files to be converted to the new format. These files can also be read and printed under DOS.
- **Old Upread and Download Files** can be converted to the new V2.2 format using UMWAND24.EXE located in SIMO_P.

Command lines:

<u>Old File Type</u>	<u>New File Type</u>
UMWAND24 filename1.UPD (Download-File) -->	filename1.R4D
UMWAND24 filename1.UPR (Upread-File) -->	filename1.R4U

- The possibilities of manipulating files has been expanded: e.g. when two download files are compared, this directly results in an additional download file, which only includes the differences between the comparison files.
- Faster upreading/downloading if many nodes are connected to the USS bus: Preferential handling of the actual unit (upreading/downloading hardly takes any longer than for point-to-point data transfer).
- The file names for the upread files, supplied on the SIMOVIS floppy disks, no longer start with "INIT...". Thus, these files can also be freely edited.

d) New Functions

- Trace Buffer Curve graphics - zoom facility added.

e) Operator control interface

- New graphic design of the function keys.
- Faults and alarms can be directly called-up from the main menu.
- Hexadecimal numbers are also now used for SIMOVIS.

f) Problems:

- Trace-Graphics will not work properly with SHARE.EXE.

15. Functional Block Diagrams

BLOCK DIAGRAM INDEX (diagrams are at the end of this section)

Sheet 1	Overview
Sheet 2	Analog Inputs
Sheet 3	Analog Outputs; Armature Voltage Sensing; Pulse Encoder Interface
Sheet 4	Binary Outputs; Drive Status Words
Sheet 5	Dual Port Ram and Serial Interfaces
Sheet 6	Control Word and Terminal Interface
Sheet 7	Selectable Functions
Sheet 8	Selectable Functions
Sheet 9	Selectable Functions
Sheet 10	Technology Controller
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Sheet 17	Torque and Current Limiting
Sheet 18	Armature Current Controller
Sheet 19	Motor EMF Voltage Controller
Sheet 20	Motor Field Current Controller

15.1 Functional Block Diagram Introduction

A large portion of the available converter functions, especially the open and closed loop control structures can be seen in the function block diagrams that follow. The function blocks have been implemented digitally as software modules and are shown as function blocks which allows the diagrams to be read similar to circuit diagrams of analog equipment.

In addition to the function blocks used for basic converter functions such as the ramp function generator, speed controller etc., there are also technology controllers and many freely configurable function blocks such as adders, multipliers, dividers, inverters, changeover switches, and limiting functions etc., which can be used to implemented custom complex functions.

The function blocks of the converter can be freely structured by the user to implement special or custom functions required for a particular application. The ability to freely structure means that the connections between individual function blocks can be selected by parameter setting.

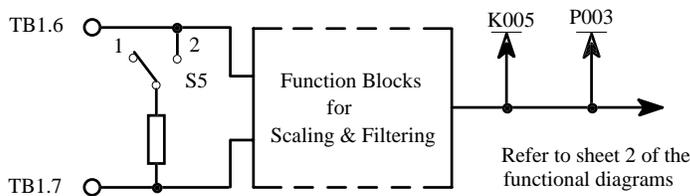
15.2 Connectors:

All important signals that are available within the software as digital values in memory locations are available as "connectors". The signals accessible using connectors correspond to the measuring points of an analog circuit and are therefore designated with their own particular "connector number". It is through the use of these connector numbers that the function blocks are structured.

Examples:

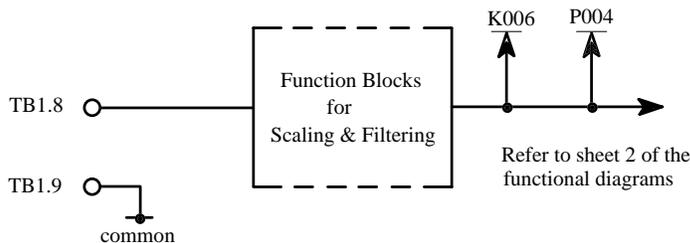
The differential analog signal applied at terminals TB1.6 and TB1.7 ($\pm 10\text{ V}$ or $4 - 20\text{ ma}$) is available after A/D conversion, scaling, and filtering at connector K005. The following diagrams show that this signal is also available for display at parameter P003.

ANALOG SELECT INPUT 1

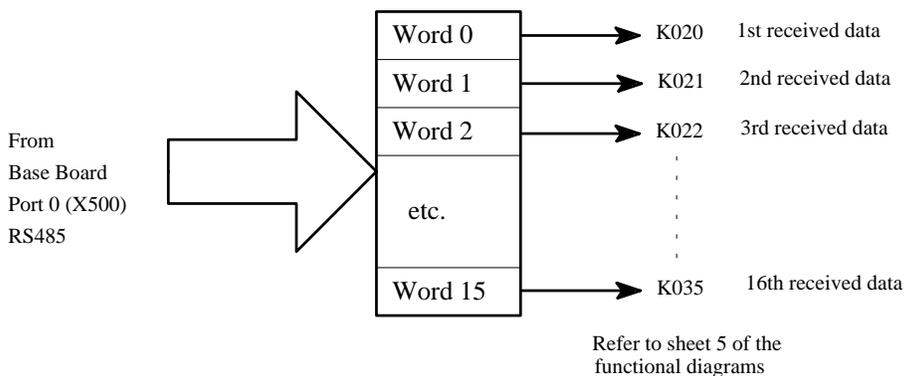


The analog signal (0 to $\pm 10\text{V}$) applied at terminal TB1.8 with respect to TB1.9 is available after A/D conversion, scaling, and filtering at connector K006 and is also available for display at parameter P004.

ANALOG SELECT INPUT 2



Receive data of the basic converter serial interface port 0 (X500) is available at connectors K020 to K035:



In addition to the available signal quantities (e.g., main reference (K003), main analog actual value (K004), armature current actual value (K117), etc.), there are other digital quantities that are available at connectors that are mainly used for diagnostics (e.g., overall processor utilization (K390), code of the triggered thyristor pair (K105), etc.).

Connectors K000, K001 are used to establish signal levels of 0% and 100% for diagnostic use or setting input values to a predetermined value. K000 is a fixed value with a 0% signal level and K001 is a fixed value with 100% signal level.

Connector K002 is different from other connectors in that it is assigned many different signal quantities depending on the function block and is used as the factory default setting. When defaulted the selector parameters are set to connector K002 which provides a system structure used for most applications. This makes start-up simpler since these selections are made automatically.

The list of available connectors is provided in Section 10.1.

The values, identified by their connector numbers, can be used within the converter, for example, to serve as reference values for a controller, as input values for a specific function block, or as variable values of a limiter.

The values of the individual connectors can also be displayed on the operator control panel, output by the analog outputs, transmitted by the serial interfaces, used for diagnostics, and recorded in the internal converter tract buffers.

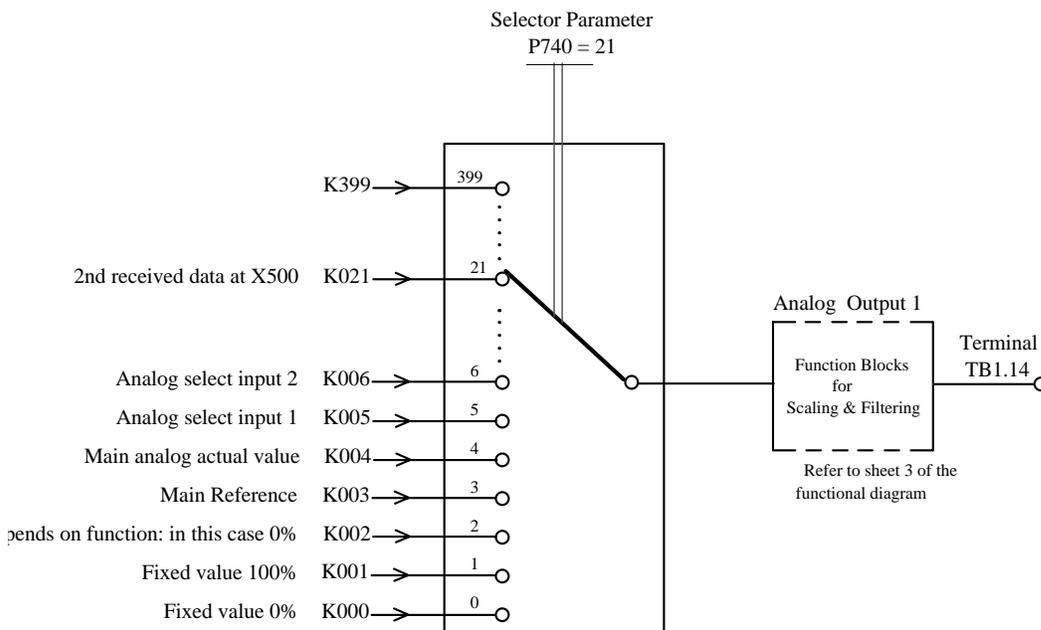
15.3 Selector Parameters and Connections

The inputs of function blocks are defined at "selector parameters". To implement this, the connector number of the required signal quantity is entered at the particular selection parameter to complete the connection.

The selector parameters are represented in the form of a selection switch in the function diagrams, whereby all available connectors (corresponding to the connector numbers), are connected to the individual switch contacts. The value given to the particular selector parameter controls the switch position of the selection switch, and therefore defines which connector signal is available at the switch output.

Using this selection switch, controlled by the selector parameter value, connections can be established between the individual function blocks.

The following diagram illustrates the use of connectors and selector parameters using the analog output 1 function block.

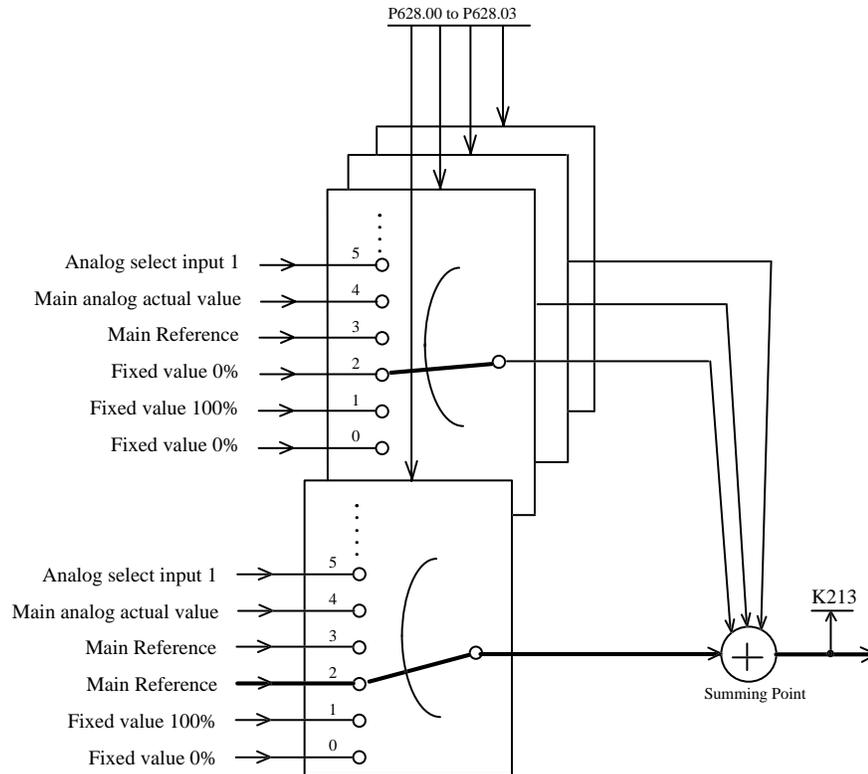


The selector parameter, P740, for analog select output 1, defines which signal quantity is output at terminal TB1.14 as an analog voltage. All of the available connectors are listed to the left of the selection switch controlled by P740.

For the example, to output the 2nd data word received at base board serial port 0, (X500), as an analog voltage at analog select output 1, it is necessary to set parameter $P740 = 21$. This means, that a connection is established from word 2 of the receive channel from base board serial port 0 (K021), to analog select output 1. In this case the default setting of $P740 = 2$ assigns a fixed value of 0% to the output.

15.4 Indexed Selector Parameter and Summing Points

This example shows how indexed selector parameters work to form summing points at function block inputs.



P628 defines the input of the ramp-function generator and the signal at connector K213. P628 is an indexed parameter, whereby all four signal quantities, selected with the individual indices of this parameter, are added at a summing point. The sum of the selected connectors is available at K213. The 4 selection switches are shown symbolically staggered to make the diagram easier to read.

All indices of P628 have the value 2 according to the factory default setting. The setting $P628.00 = 2$, means, that the main setpoint, available at connector K003 (refer to Sheet 2 of the function diagrams) is switched through. Factory setting $P628.01 = 2$, $P628.02 = 2$, and $P628.03 = 2$ means that a fixed value 0% is added (i.e., no influence).

As an example if the 2nd data word of the process data (which is available at K021, refer to Sheet 5 of the function diagrams) and the value from analog input 2 are to be added to the main setpoint (K003), then the following parameter setting must be made:

$P628.00 = 2$	The main setpoint (K003) is switched-through (factory setting)
$P628.01 = 21$	The quantity of the 2nd data word from base board port 0 (K021) is added
$P628.02 = 6$	The quantity of analog select input 2 (K006) is added
$P628.03 = 2$	Fixed value 0% (K001) is added (factory setting, no influence)

The connector which is used for setting 2 of a selection parameter is dependent on the particular selection parameter for the given function block.

15.5 Computation Cycles & Time Delay

The functions associated with analog inputs, analog outputs, binary outputs and serial interfaces (illustrated on Sheets 2 to 5 of the function diagrams), and the function blocks associated with the technology controller, motorized potentiometer, reference generation, ramp-function generator and speed and armature current controller (illustrated on Sheets 10 to 18 of the function diagrams), are calculated in synchronism with the armature firing pulses (i.e., every 2.777 ms for a 60 Hz supply frequency).

The binary inputs (Sheet 6 of the function diagrams) and the free function blocks are calculated in every second armature firing pulse cycle (i.e., every 5.55 ms for a 60 Hz supply frequency).

The function blocks associated with the closed-loop EMF and field current control (shown in Sheets 19 and 20 of the function diagrams) are calculated in synchronism with the field firing pulses (i.e., every 8.33 ms at a 60 Hz supply frequency).

Parameter handling is executed in a fixed 20 ms computation cycle. The self tuning run is also controlled in this cycle time.

When transferring parameter values by serial interfaces, it should be observed, that some of the transferred parameters must first be converted to this 20 ms cycle, before they can be used, for example, in the armature firing pulse cycle.

When "connecting" the freely-configurable function blocks, it should be observed, that the software modules are sequentially processed in a specific sequence:

The calculation order is:

Adder 1, multiplier / divider 1, general diameter divider (refer to Sheet 7, upper row)

Inverter 1, changeover switch 1 (refer to Sheet 8, upper row)

Absolute value 1 generator with filtering, limit detector 1 (refer to Sheet 9, upper row)

Adder 2, multiplier / divider 2, function generator (refer to Sheet 7, middle row)

Inverter 2, changeover switch 2, limiter (refer to Sheet 8, middle row)

Absolute value 2 generator with filtering, limit detector 2 (refer to Sheet 9, lower row)

Adder 3 + dead band, multiplier / divider 3 (refer to Sheet 7, lower row)

Inverter 3, changeover switch 3 (refer to Sheet 8, lower row)

In order to avoid unnecessary signal delays, the specified sequence should be taken into account when using these function blocks.

The processing sequence for all of the other modules of the appropriate computation cycle, essentially corresponds to the sequence that they are illustrated in the function diagrams.

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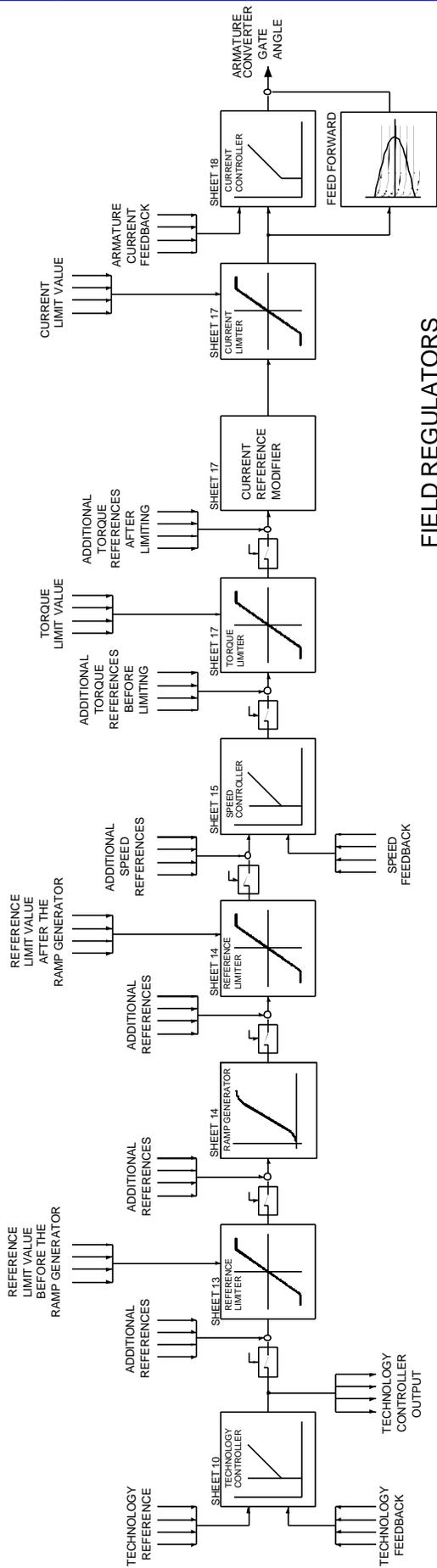
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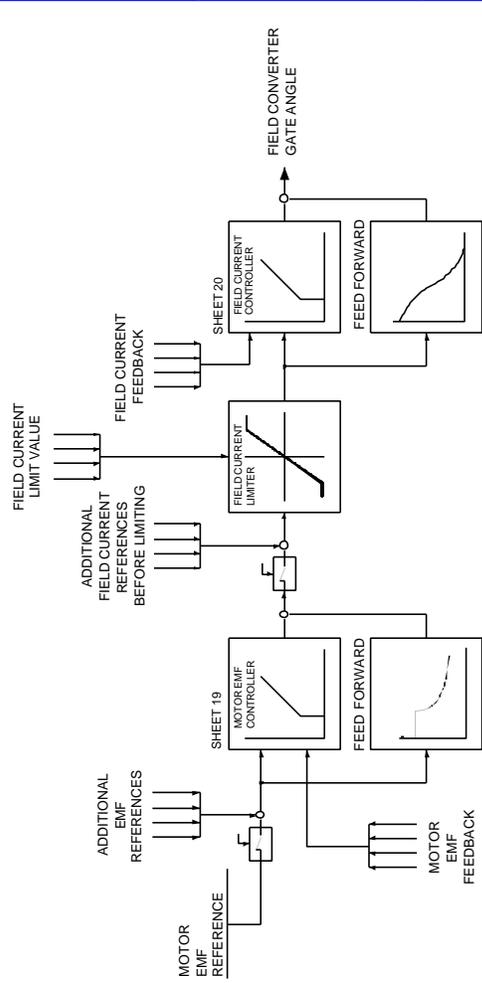
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X500 Port - RS485 Protocol Selector	P780				
X500 Port: RS485 Bus Address	P786				
X500 Port: No. of RS485 Parameter Words	P782				
X500 Port: No. of RS485 Process Data Words	P781				
X500 Port: RS485 Baud Rate	P783				
X500 Port: RS485 Failure Time	P787				
X500 Port: RS485 Peer Failure Time	P788				

ARMATURE REGULATORS



FIELD REGULATORS



LEGEND

a b c d

REPRESENTS

BIF = BINARY INPUT FUNCTION
BOF = BINARY OUTPUT FUNCTION

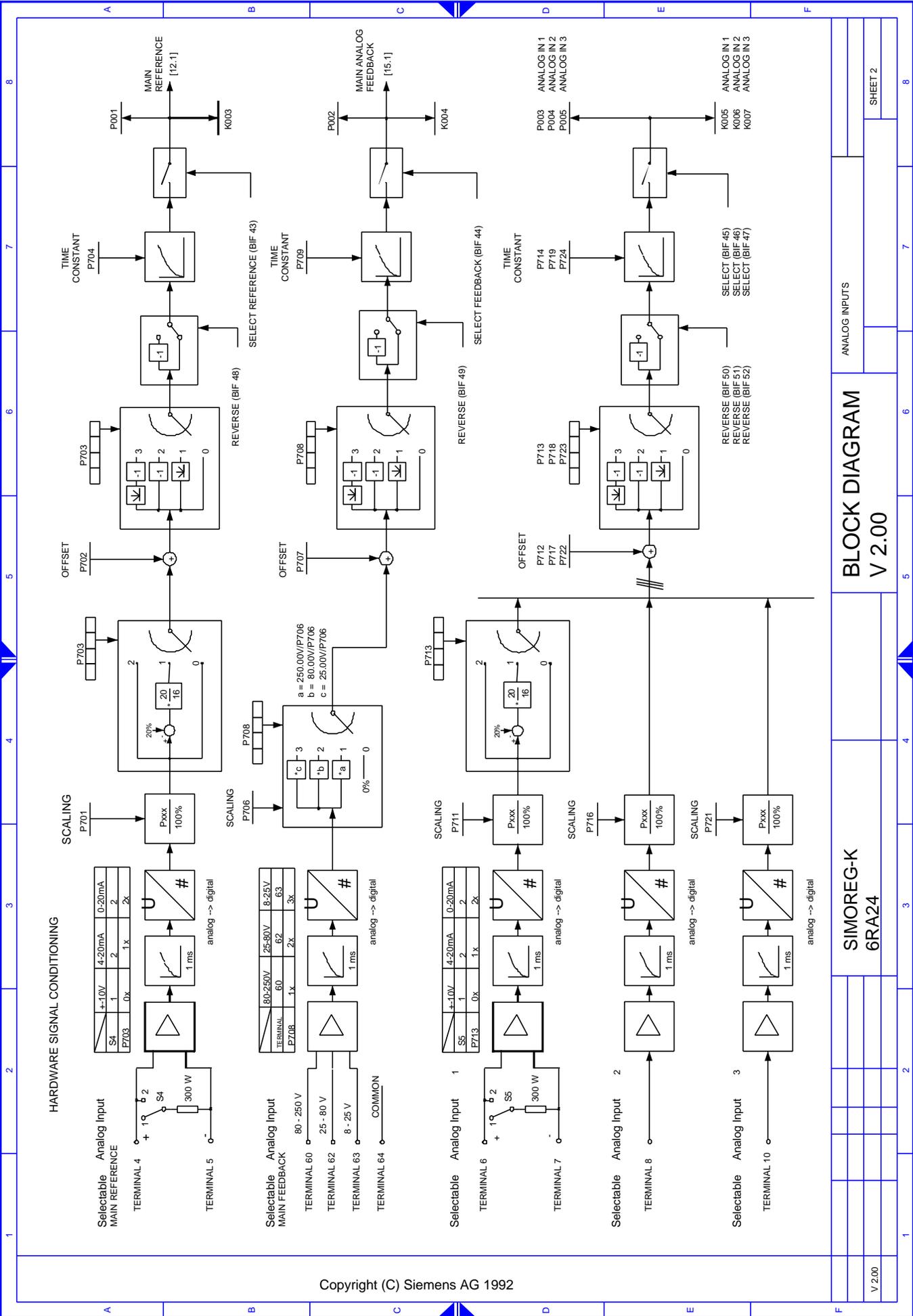
a = ANALOG INPUT SOURCE
b = SERIAL INPUT SOURCE
c = BASE UNIT FUNCTION INPUT
d = OPTION BOARD INPUT SOURCE

SHEET CROSS REFERENCE:
SHEET NUMBER
↓
VERTICAL COLUMN
[x.x]

BLOCK DIAGRAM V 2.00

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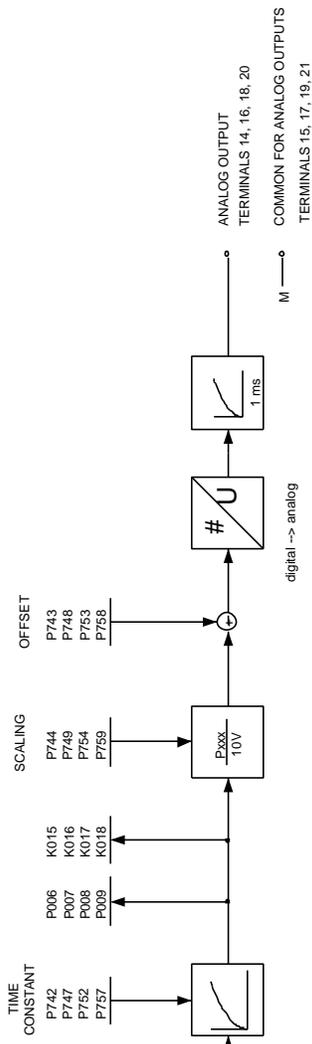
BLOCK DIAGRAM REGULATOR OVERVIEW



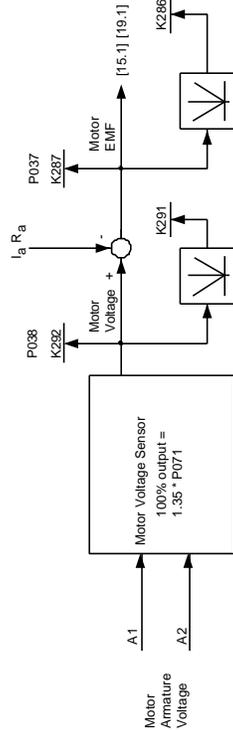
BLOCK DIAGRAM
V 2.00

SIMOREG-K
6RA24

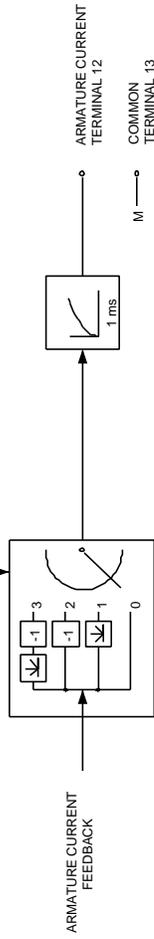
SELECTABLE ANALOG OUTPUTS



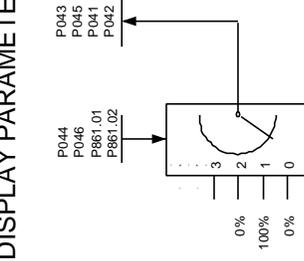
MOTOR VOLTAGE SENSOR



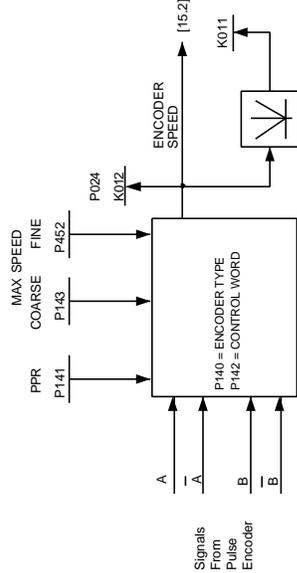
ARMATURE CURRENT OUTPUT



SELECTABLE DISPLAY PARAMETERS



PULSE ENCODER PROCESSING

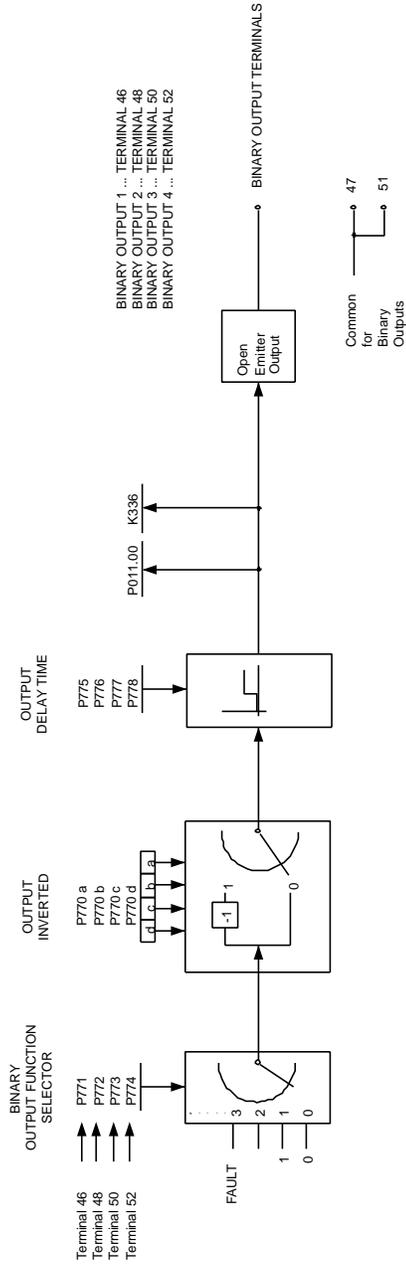


BLOCK DIAGRAM
V 2.00

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6RA24

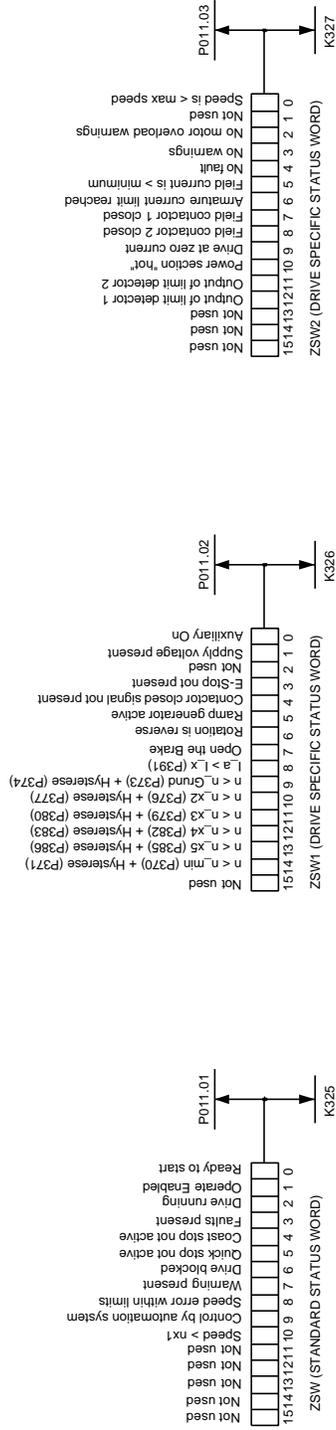
SELECTABLE ANALOG OUTPUT,
ARMATURE CURRENT OUTPUT

SELECTABLE BINARY OUTPUTS



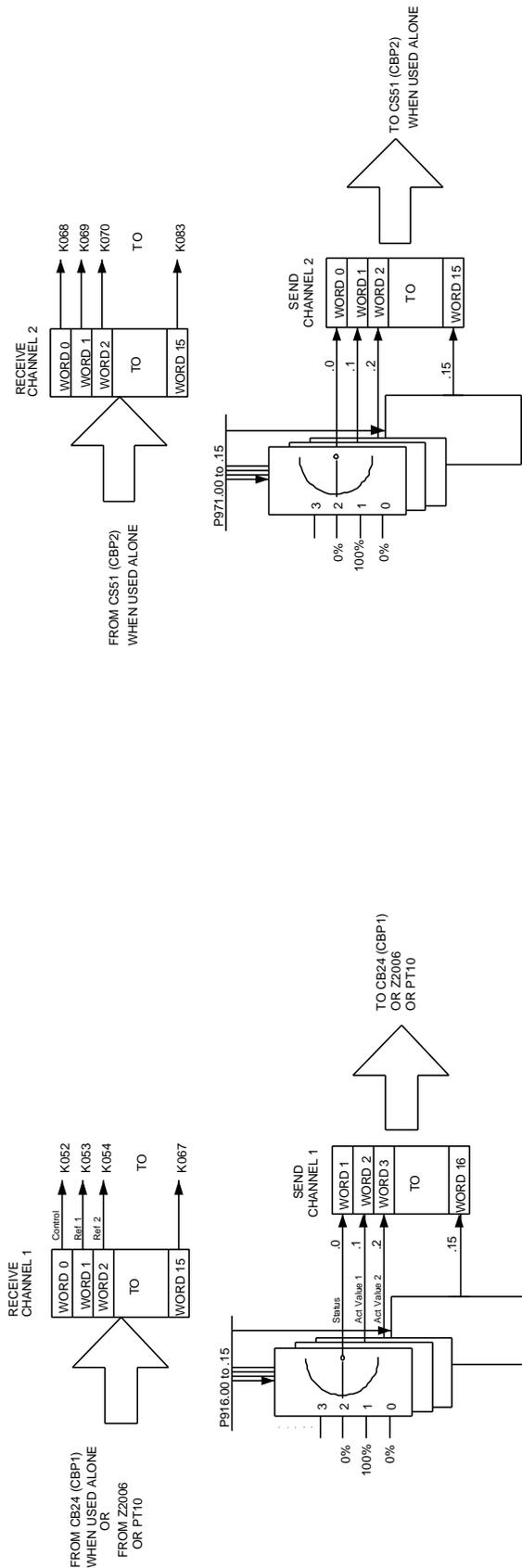
- COMMON BINARY OUTPUT SELECTIONS**
- 3 FAULT
 - 4 READY TO START
 - 5 READY TO RUN
 - 6 RUNNING
 - 14 SET THE BRAKE COMMAND
 - 15 Ia > Ix
 - 16 N < Nmin
 - 21 N < Nmin
 - 24 WARNING

DRIVE STATUS WORDS

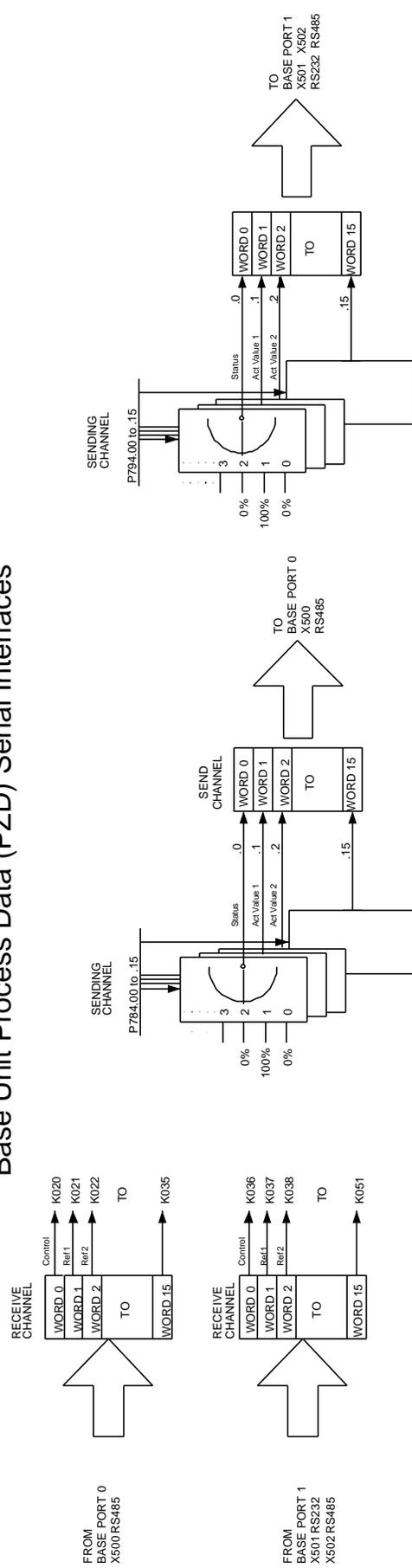


SIMOREG-K 6RA24		BLOCK DIAGRAM V 2.00		BINARY OUTPUTS AND CONVERTER STATUS WORDS	
V.2.00					
1	2	3	4	5	6
7	8	9	10	11	12
					SHEET 4

Communication and Technology Board DPR (Dual Port Ram) Interfaces



Base Unit Process Data (PZD) Serial Interfaces



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BLOCK DIAGRAM
V 2.00

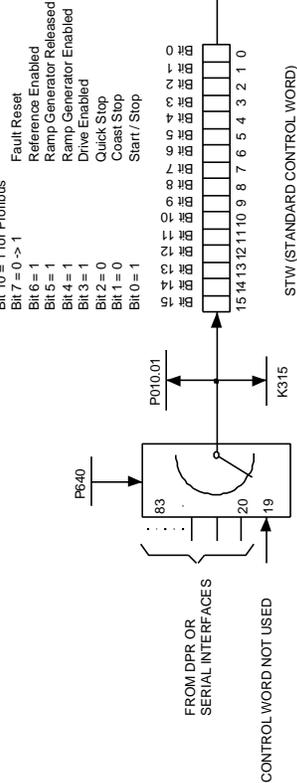
BASE UNIT SERIAL INTERFACES AND
OPTION BOARD DPR INTERFACES

SHEET 5

STANDARD CONTROL WORD BIT DEFINITIONS (Serial Interfaces)

- Bit 10 = 1 for Profibus
- Bit 7 = 0 → 1
- Bit 6 = 1
- Bit 5 = 1
- Bit 4 = 1
- Bit 3 = 1
- Bit 2 = 0
- Bit 1 = 0
- Bit 0 = 1

Note: If DPR interfaces are selected at P640, then Bit 5 = 0 releases the ramp generator

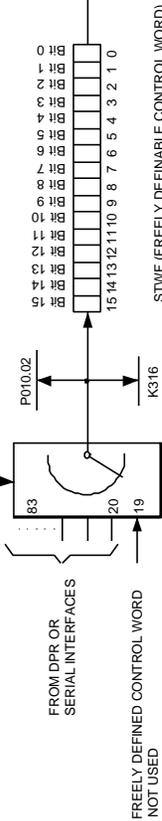


STW (STANDARD CONTROL WORD)

DEFINABLE CONTROL WORD BIT DEFINITIONS SET BY P642

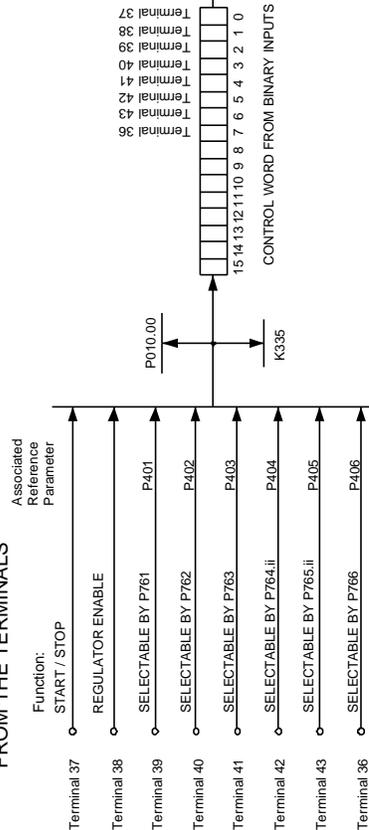
- Bit 15: BIF set by P642.15
- Bit 14: BIF set by P642.14
- to
- Bit 1: BIF set by P642.01
- Bit 0: BIF set by P642.00

Bit-by-bit logically combined using 'AND' & 'OR' logic functions



STWF (FREELY DEFINABLE CONTROL WORD)

BINARY CONTROL FUNCTIONS FROM THE TERMINALS



TERMINAL CONTROL WORD BIT DEFINITIONS SET BY P766

- Bit 7: BIF set by P766
- Bit 6: BIF set by P765.00 to .02
- Bit 5: BIF set by P764.00 to .02
- Bit 4: BIF set by P763
- Bit 3: BIF set by P762
- Bit 2: BIF set by P761
- Bit 1 = 1 Enable Regulators
- Bit 0 = 1 Start & Close Contactor

REFERENCE PARAMETERS FOR STWF FUNCTIONS

- Jog (Through the ramp) P409
- Jog (By-Pass the ramp) P410
- Thread (Through the ramp) P411
- Thread (By-Pass the ramp) P412
- Fixed (Through the ramp) P413
- Fixed (By-Pass the ramp) P414
- Additional Ref before process controller .. P415
- Additional Ref before the ramp P416
- Additional speed reference P417

COMMON SELECTIONS FOR P642

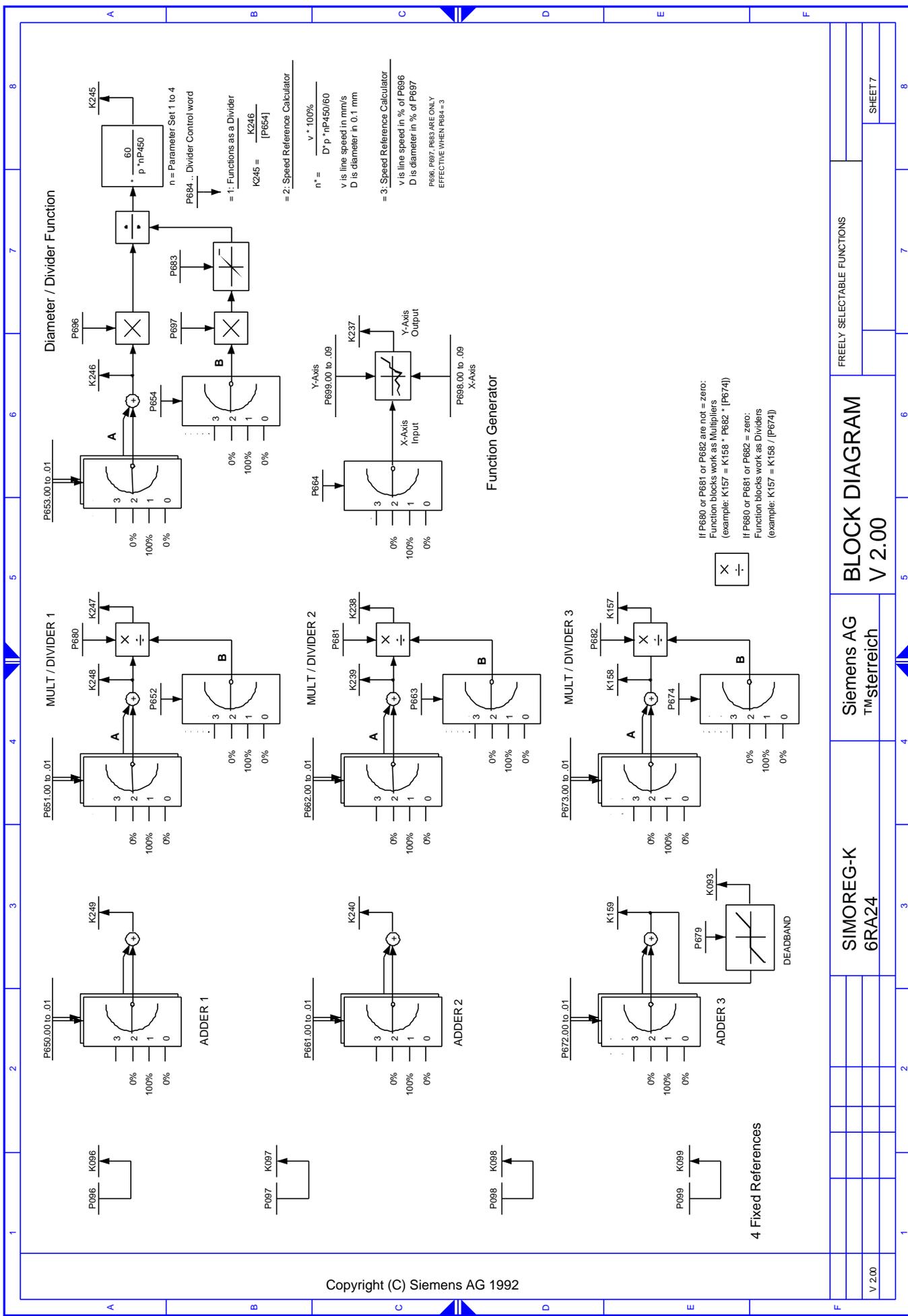
- 3 Coast Stop (Active Low)
- 4 Quick Stop (Active Low)
- 5 Fault Reset
- 9 Ramp Generator Enable
- 10 Ramp Hold
- 11 Reference Enable
- 13 Jog Using the Ramp
- 14 Jog Bypassing the Ramp
- 15 Thread using the Ramp
- 16 Thread Bypassing the Ramp
- 17 Fixed (Preset) Reference using the Ramp
- 18 Fixed (Preset) Reference Bypassing the Ramp
- 53 External Fault (Active Low)
- 54 External Warning (Active Low)
- 56 Forced Field Economy

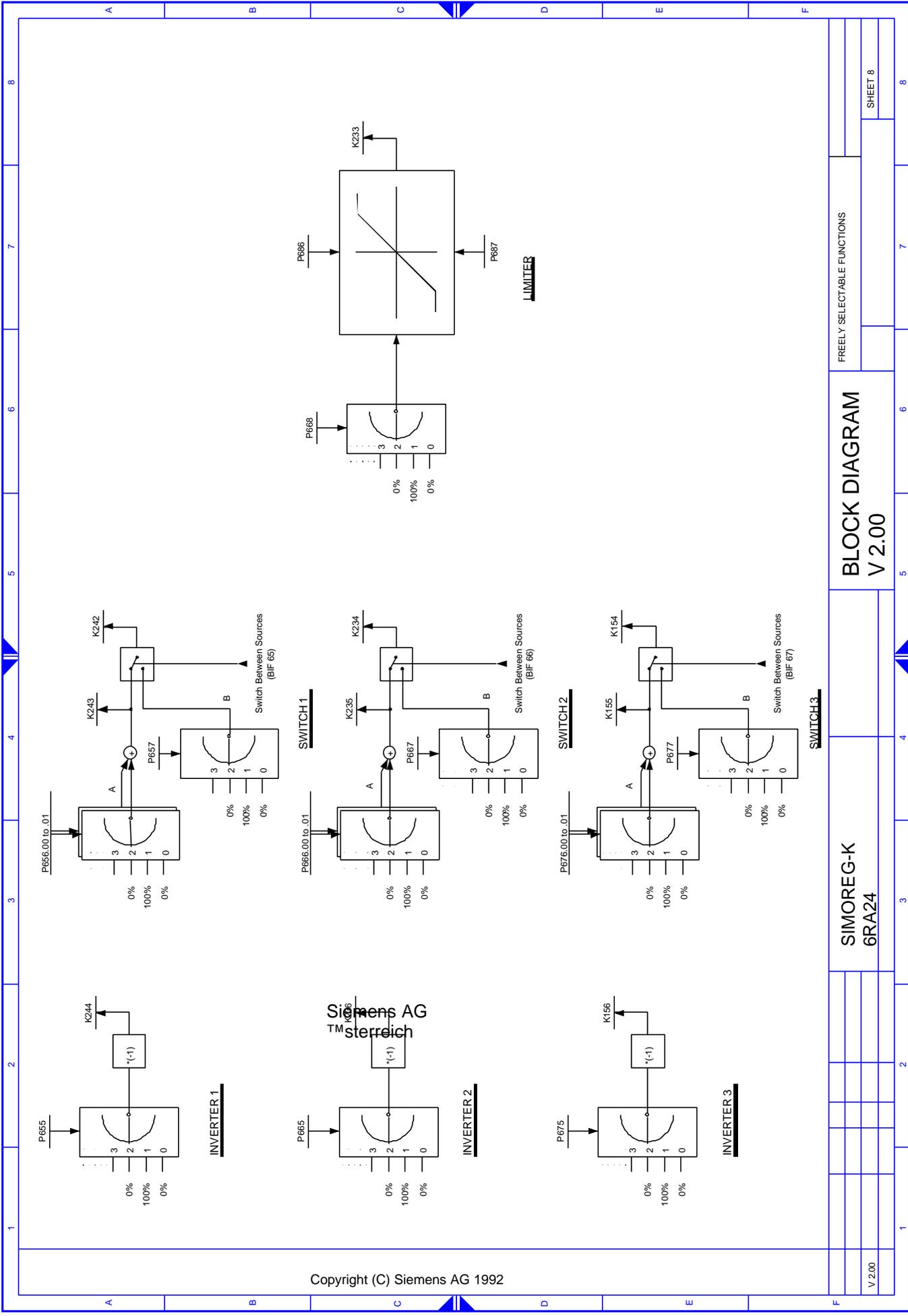
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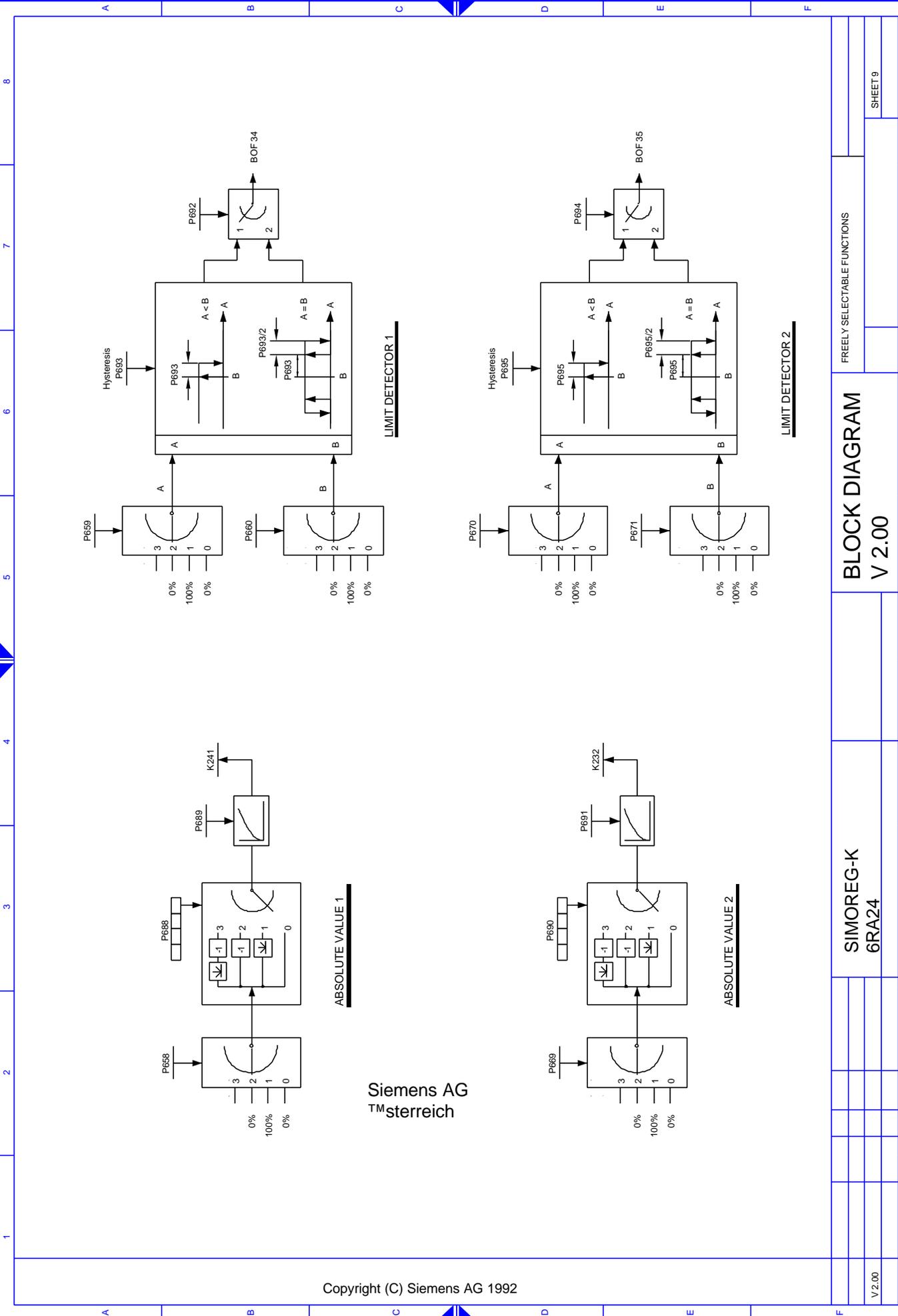
BLOCK DIAGRAM
V 2.00

CONTROL WORD DEFINITION AND
BINARY INPUT SELECTION

SHEET 6





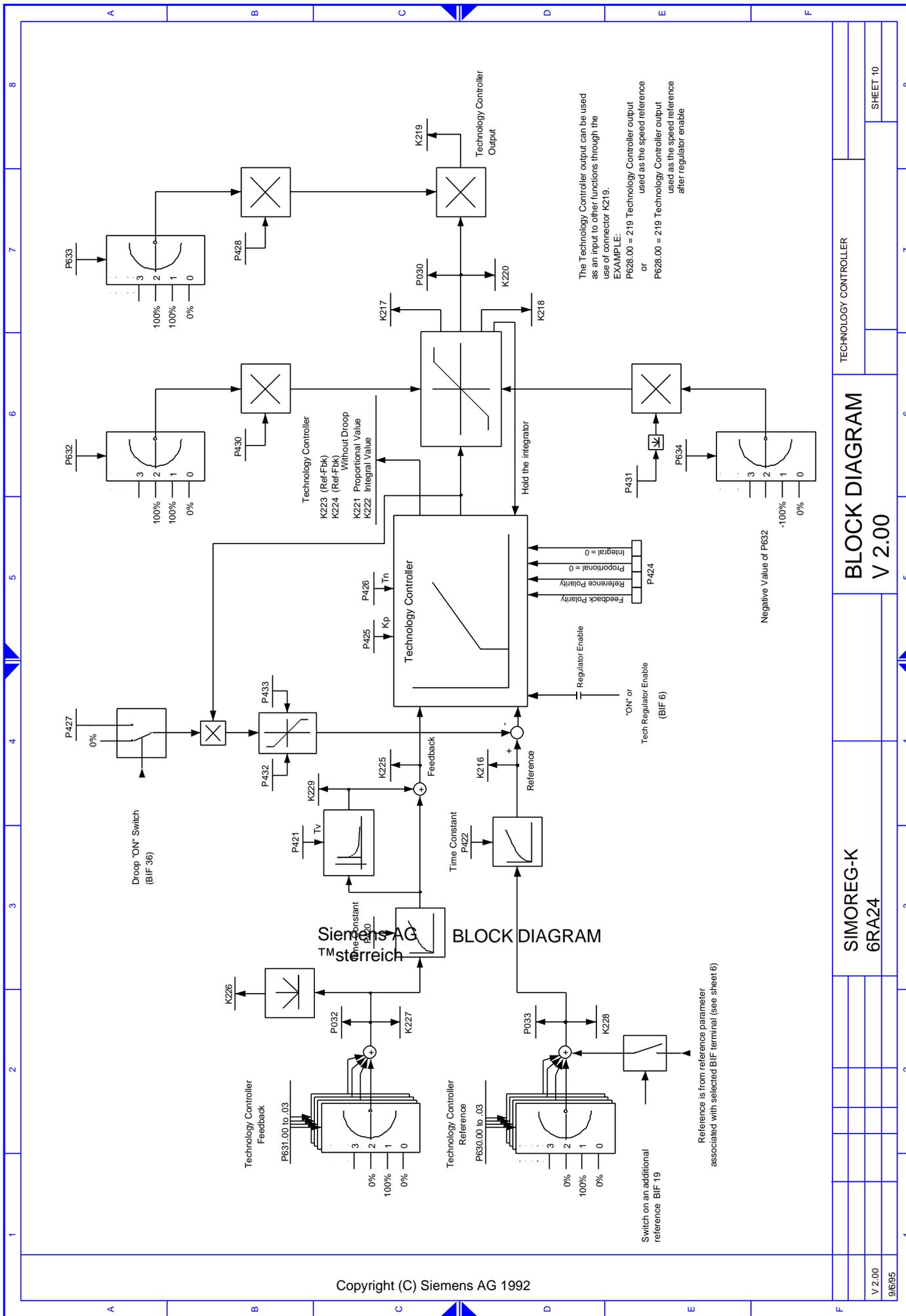


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 TMsterreich

BLOCK DIAGRAM
V 2.00

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FREELY SELECTABLE FUNCTIONS



The Technology Controller output can be used as an input to other functions through the use of connector K219.
 EXAMPLE:
 P628.00 = 219 Technology Controller output used as the speed reference
 or
 P628.00 = 219 Technology Controller output used as the speed reference after regulator enable

Reference is from reference parameter associated with selected BIF terminal (see sheet 6)

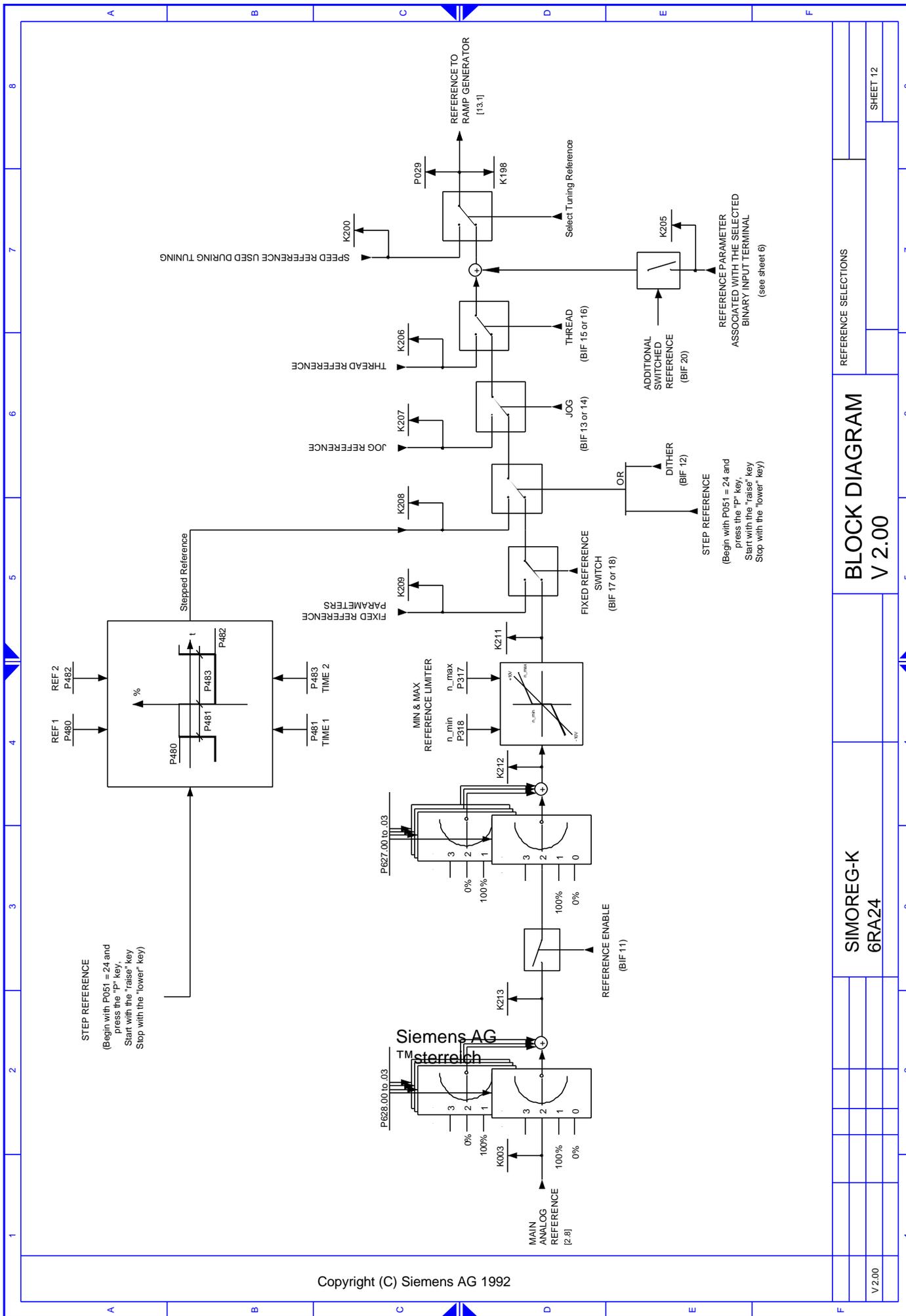
Switch on an additional reference BIF 19

BLOCK DIAGRAM V 2.00

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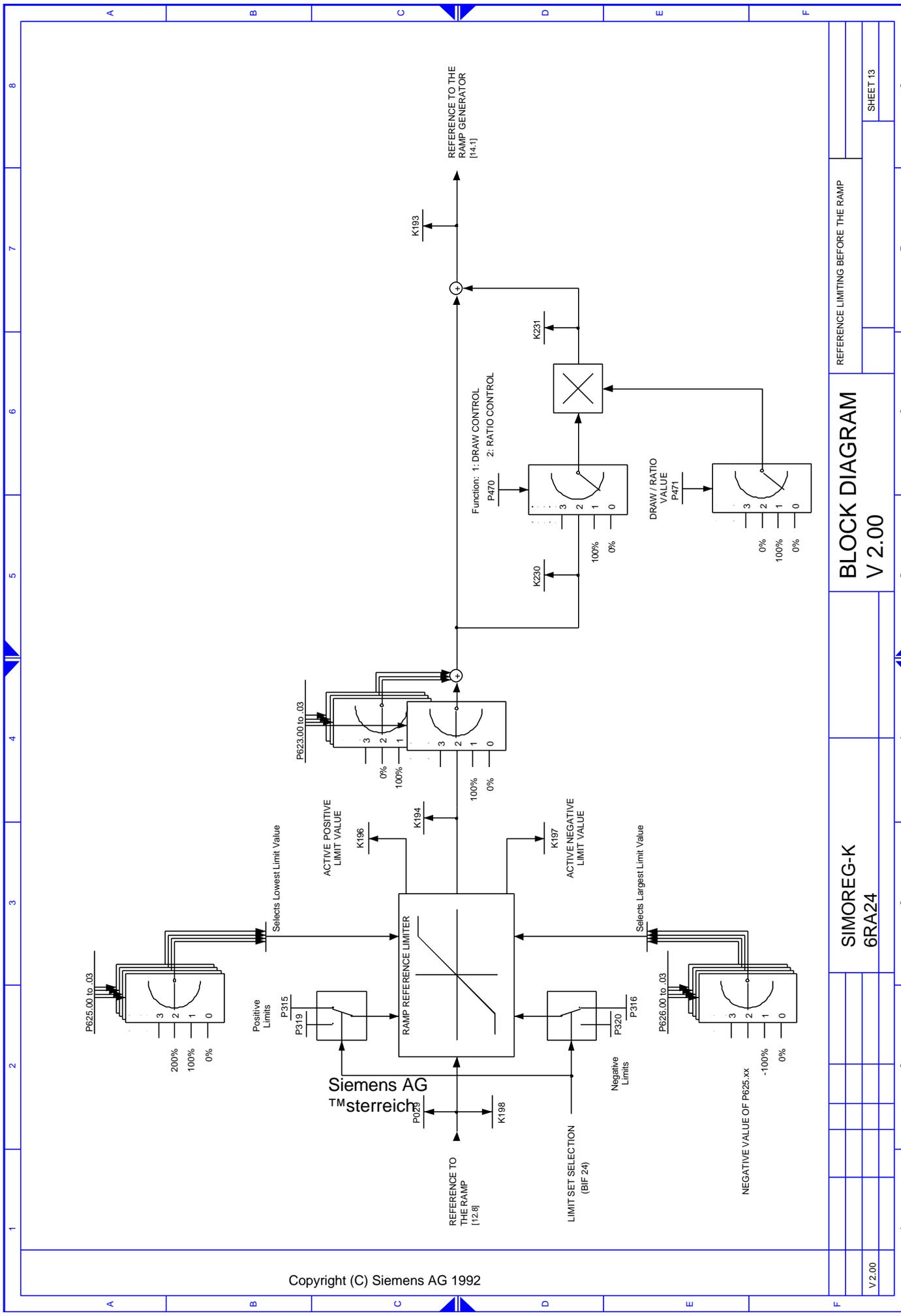
TECHNOLOGY CONTROLLER

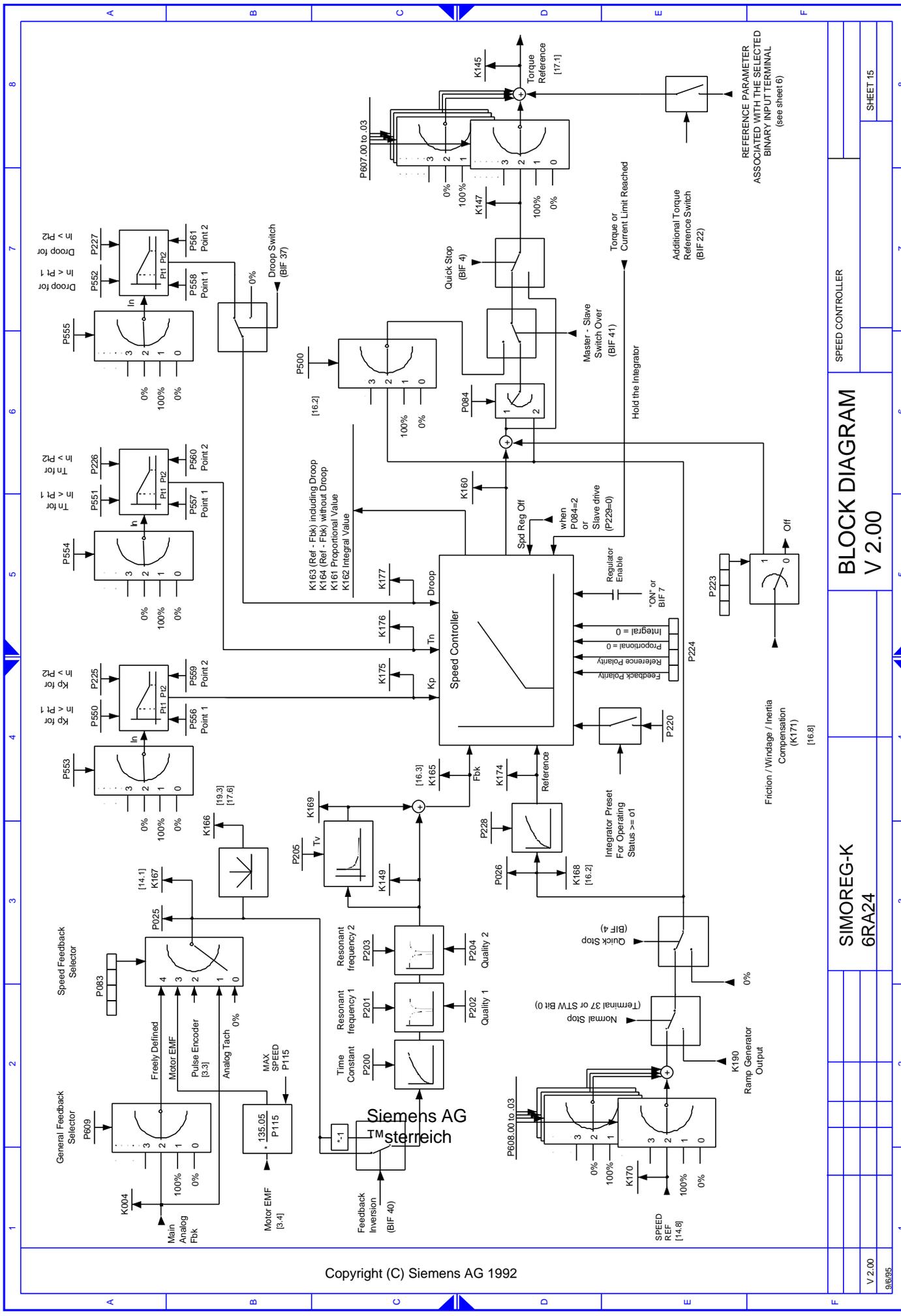
SHEET 10



BLOCK DIAGRAM
V 2.00

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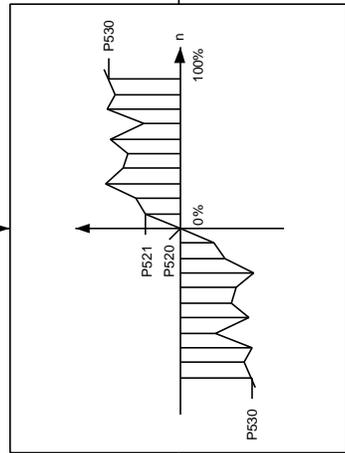
**BLOCK DIAGRAM
V 2.00**

**SIMOREG-K
6RA24**

SPEED CONTROLLER

Speed Controller Feed Forward

Friction & Windage Compensation Compensation Values (at 10% speed increments) P520 bis P530

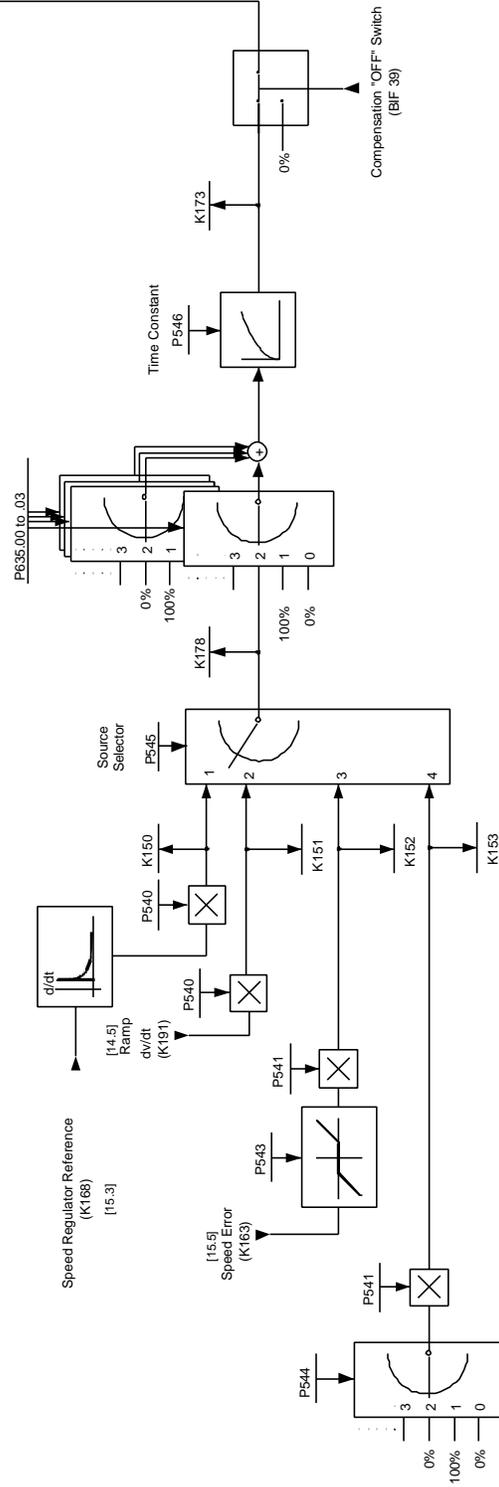


Speed Actual Value
(K166)
[15:4]

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TMsterreich

Inertia Acceleration Torque Compensation

TORQUE
COMPENSATION
[15:4]



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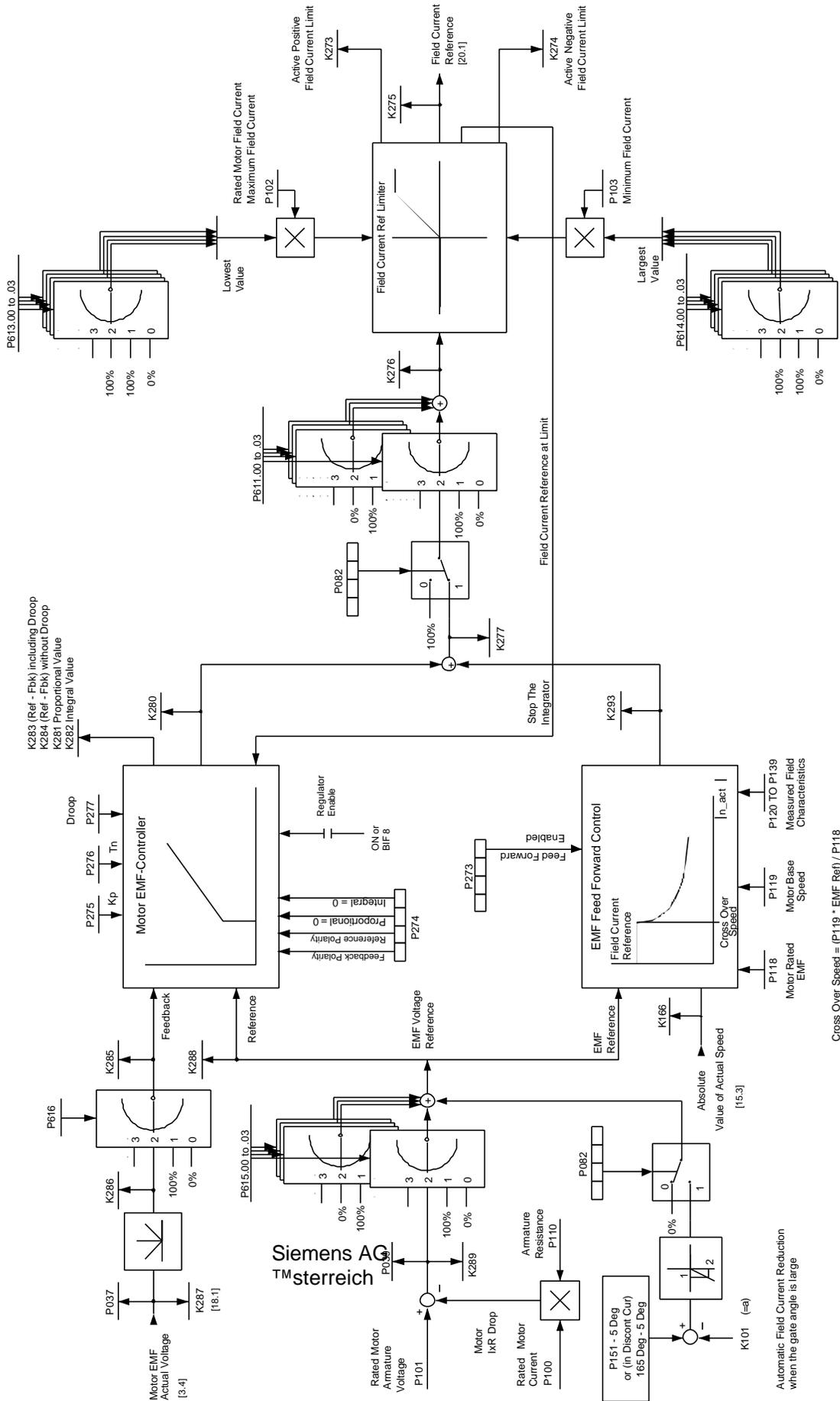
BLOCK DIAGRAM
V 2.00

FRICION, WINDAGE, AND INERTIA
COMPENSATION

V 2.00

SHEET 16

Armature Voltage Controller



BLOCK DIAGRAM
V 2.00

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MOTOR EMF VOLTAGE CONTROLLER

SHEET 19

