ALSTOM

CTZ61, 62, 71, 72

Service Manual
R5902P

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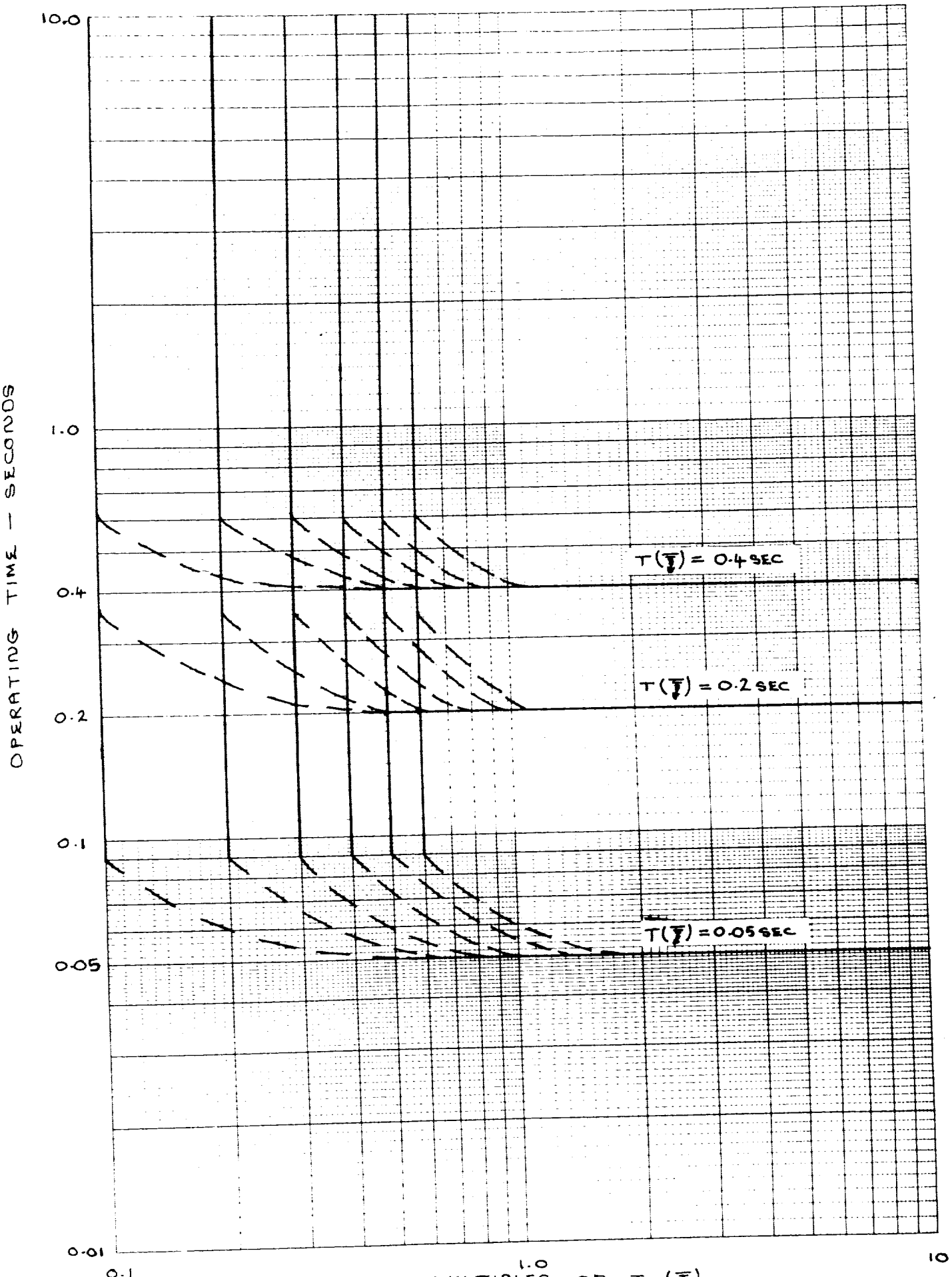

FIGURE 4 :- EARTH FAULT OVERCURRENT CHARACTERISTICS (CTZ 72)

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1.0 DESCRIPTION

The CTZ 61, 62, 71, 72 relays are overcurrent relays for phase or phase and earth fault protection. The model descriptions are as follows :-

CTZ61 Three phase overcurrent.

CTZ62 Three phase overcurrent suitable for the American market.

CTZ71 Three phase overcurrent and earth fault.

CTZ72 Three phase overcurrent and earth fault suitable for American market.

These relays have been designed for use on a wide variety of low voltage systems and are particulary suited for direct tripping applications as all power including the trip function derived from the current transformers.

The above relays offer the combined facilities of very inverse time overcurrent and independent time overcurrent characteristics and thus may provide maximum discrimination on complex low voltage systems having a variety of protective devices such as fuses, thermal type trips and induction disc type relays.

The CTZ62 and CTZ72 relays have an instantaneous high set function to provide protection against high fault levels and comply with the requirements of ANSI C37.17 - 1979.

The CTZ71 meets Lloyds requirements for marine generators.

The AC rated currents for the relays are 5A for the phase element and 100mA for the earth fault element.

2.0 SETTINGS

The relay settings are varied in positive steps by means of calibrated switches on the relay front panel.

2.1 PHASE OVERCURRENT PICK-UP SETTING

On all models the phase overcurrent pick-up is switch selectable to 0.5, 0.6, 0.7, 0.8, 0.9 or 1.0 times the relay rated phase current.

2.2 TRIP TIME SETTING FOR SIX TIMES OVERLOAD

The trip time setting provides a choice of six inverse time-overload characteristics of the form

$$t = \frac{K}{I-1}$$

where t is the time to trip
I is the input current as a multiple of setting
K is a constant

The trip time at six times overload on all models is switch selectable to 2, 4, 8, 12, 16 or 20 seconds giving K = 10, 20, 40, 60, 80 or 100 respectively.

Inverse time-overcurrent characteristics are shown in Figure 1 and Figure 2.

2.3 PHASE DEFINITE TIME DELAY PICK-UP

For CTZ61 and CTZ71 relays the phase definite time delay pick-up is switch selectable to 2, 3, 4, 5, 6 or 8 times the relay current setting. For CTZ62 and CTZ72 relays the phase definite time delay pick-up may be set to 2, 3, 4, 6, 8 or 10 times the relay current setting.

2.4 PHASE DEFINITE TIME DELAY

The phase definite time delay is switch selectable to 0.9, 0.4, 0.1 seconds or instantaneous on CTZ61/CTZ71 relays and to 50ms, 200ms or 400ms on CTZ62/CTZ72 relays. Phase definite time delay characteristics are shown in Figure 1 and Figure 2.

2.5 EARTH FAULT PICK-UP

On CTZ71/CTZ72 relays the earth fault pick-up is switch selectable to 0.5, 0.6, 0.7, 0.8, 0.9 or 1.0 times the rated earth fault current.

2.6 EARTH FAULT DEFINITE TIME DELAY

For CTZ71 relays the earth fault definite time delay is switch selectable to 0.9, 0.4, 0.1 seconds or instantaneous and for CTZ72 relays may be set to 50ms, 200ms or 400ms. Earth fault characteristics are shown in Figure 3 and Figure 4.

2.7 PHASE INSTANTANEOUS HIGH SET PICK-UP

CTZ62 and CTZ72 relays have a single thumbwheel switch which may be set to positions 1, 2, 3 or 4 corresponding to instantaneous high set pick-up currents of 8, 12, 16 or 20 times the relay current setting. The instantaneous high set characteristics are shown in Figure 1 and Figure 2.

3.0 INSTALLATION

3.1 GENERAL CONSIDERATIONS

Protective relays, although generally of robust construction, require careful treatment prior to installation on site. Upon receipt, relays should be examined immediately to ensure no damage has been sustained in transit.

If damage has been sustained in transit a claim should be made to the transport contractors and the nearest branch office of GEC Measurements should be promptly notified.

3.2 UNPACKING

Care must be taken when unpacking and installing the relays so that none of the parts are damaged or their settings altered and they must at all times be handled by skilled persons only. The installation should be clean, dry and reasonably free from dust and excessive vibration.

3.3 STORAGE

If the relays are not installed immediately upon receipt they should be stored in a place free from dust and moisture in their original cartons. Where de-humidifier bags have been included they should be retained. The action of the de-humidifier crystals will be impaired if the bag has been exposed to ambient conditions and may be restored by gently heating the bag for about an hour, prior to replacing it in the carton.

Dust which collects on a carton may, on subsequent unpacking, find its way into the relay. In damp conditions the carton and packing may become impregnated with moisture and the de-humidifying agent will lose its efficiency.

Storage temperature $-25^{o}C$ to $+ 70^{o}C$.

4.0 COMMISSIONING

4.1 COMMISSIONING PRELIMINARIES

NOTE THAT BEFORE SECONDARY INJECTION IS CARRIED OUT IT IS IMPORTANT THAT THE CIRCUIT BREAKER IS OFF AND EARTHED DOWN.

4.1.1 INSPECTION

Carefully examine the relay to check that no damage has occurred since installation. Check that the model number and serial number on the case are correct.

4.1.2 WIRING

Check that the external wiring is correct to the relevant relay diagram or scheme diagram.

4.1.3 INSULATION

Isolate all wiring from earth and test the insulation of the external wiring with an electronic or brushless insulation tester at a DC voltage not exceeding 1000V. Terminals of the same circuit should be temporarily strapped together.

4.1.4 TERMINAL ALLOCATION

Reference should be made to the diagram supplied with every relay.

4.2 INSTRUCTIONS TO ENABLE COMMISSIONING AT THE SETTING CALCULATED FOR THE PARTICULAR APPLICATION

The following test equipment is required :-

a) Overcurrent test set (0-100A) with timer facilities
   30V DC follower relay
   Variable resistor
   Multi-meter
   Digital timer

   and/or

b) CZB portable test set and 5 pin DIN connector.

4.2.1 OPERATION OF OVERCURRENT TEST SET

For timing tests using the overcurrent test set the timer should be connected so that it starts when the fault current is transferred to the relay and stops when the thyristor output of the relay operates. The 2.0A AC current source is used to provide the 2.0A $\pm$ 5% pre-fault current required to establish the internal voltage rails. Once the relay output has operated it may only be reset by removing both pre-fault and fault currents.

4.2.2 OPERATION OF CZB TEST SET

Select the required input supply voltage and switch on the test set. Ensure that the output short switch is in the on position and then select either the overcurrent or earth fault mode. Connect the CZB to the relay using the 5 pin DIN connector. Pre-fault current is applied to the relay as soon as the CZB test set is energised. To set the fault current level hold the fault switch in the ON position and adjust the current setting to give the required reading on the digital ammeter using the coarse and fine current adjustments. Release the fault switch. To apply the fault current set the output short switch to the OFF position and then hold the fault switch in the ON position. Upon application of the fault current the digital timer display on some CZB test sets will remain blank. When the relay output operates the digital timer will display the operating time. Release the fault switch and set the output short switch to the ON position. The relay may be reset by means of the CZB reset switch. After resetting allow 4 to 5 seconds for the pre-fault current to establish the voltage rails.

4.2.3 ENERGISE RELAY

Isolate the trip circuits and connect either the CZB test set or overcurrent test set, pre-fault current source and timer to the relay. To energise the relay apply pre-fault current by either energising the CZB test set or, if the overcurrent test set is to be used, by applying 2.0A AC to one phase of the relay.

4.2.4 AC INPUT TESTS

This test must be carried out on all relay types using an overcurrent test set and pre-fault current source but not using a CZB. Connect the overcurrent test set to the red phase current inut (terminals 3 and 4) and set the test set to provide 20A $\pm$ 2%. Connect the 2.0 amp pre-fault current source to the blue phase current input (terminals 7 and 8). Inject the pre-fault current into the CTZ and wait 4 to 5 seconds for the internal voltage rails to establish. Transfer the fault current to the relay starting the timer at the same instant. The CTZ should operate in under 40 seconds. Record the operating time. Reset the relay by removing both the pre-fault and fault currents.

Repeat the above timing test with the fault current injected into the yellow phase current input (terminal 5 and 6) and check that the trip time for a fault current of 20A is as that previously recorded with an error of $\pm$ 10%. Reset the relay.

Connect the pre-fault current to the red phase current input (terminals 3 and 4) and the fault current to the blue phase input and check that the trip time for a fault current of 20A is as that previously recorded with an error margin of $\pm$ 10%. Reset the relay.

4.2.5 OVERCURRENT PICK-UP SETTING

Inject pre-fault current and after 4 to 5 seconds inject the fault currents shown below corresponding to the relay pick-up setting I_s.

The current levels correspond to 1.05 and 1.25 times the overcurrent pick-up setting for relay types CTZ61/71 and to 0.9 and 1.1 times the overcurrent pick-up setting for relay types CTZ62/72.

Check that the relay operates within the time limits shown for a given six times overload trip time setting. The relay must be reset after each test.

OVER-CURRENT PICK-UP I_s ($\times I_n$)	FAULT CURRENT				OPERATING TIME
	CTZ61/CTZ71		CTZ62/CTZ72		$t(6 \times I_s)$
	Over-Current Test Set (Amps)	CZB Test Set ($\times I_n$)	Over-Current Test Set (Amps)	CZB Test Set ($\times I_n$)	2 4 8 12 16 20
0.5	3.13	0.625	2.75	0.550	Relay operating time: <2 <4 <7 <11 <14 <17 (min)
	2.63	0.525	2.25	0.450	No operation during test interval of: 4 6 9 13 16 19 (min)
0.6	3.75	0.750	3.30	0.660	AS FOR OVERCURRENT PICK-UP OF 0.5 I_n
	3.15	0.63	2.70	0.540	
0.7	4.38	0.875	3.85	0.770	AS FOR OVERCURRENT PICK-UP OF 0.5 I_n
	3.68	0.735	3.15	0.630	
0.8	5.00	1.00	4.40	0.880	AS FOR OVERCURRENT PICK-UP OF 0.5 I_n
	4.20	0.840	3.60	0.720	
0.9	5.63	1.125	4.95	0.990	AS FOR OVERCURRENT PICK-UP OF 0.5 I_n
	4.73	0.945	4.05	0.810	
1.0	6.25	1.250	5.50	1.100	AS FOR OVERCURRENT PICK-UP OF 0.5 I_n
	5.25	1.050	4.50	0.900	

4.2.6 INVERSE OVERCURRENT TIME SETTING

Inject pre-fault current and after 4 to 5 seconds for the given overcurrent pick-up setting inject the fault current shown below. The fault current levels correspond to 2.00 x I_s. Check that the relay operates within the time limits shown for the given six times overload trip time setting. The relay must be reset after each test.

OVER-CURRENT PICK-UP I_s ($\times I_n$)	FAULT CURRENT: Over-current test set (Amps)	FAULT CURRENT: CZB test set ($\times I_n$)	OPERATING TIME: $t(6 \times I_s)$ 2	4	8	12	16	20
0.5	5.00	1.00	9.00 to 11.00	18.00 to 22.00	36.00 to 44.00	54.00 to 66.00	72.00 to 88.00	90.00 to 110.00
0.6	6.00	1.20	As for overcurrent setting of 0.5 I_n					
0.7	7.00	1.40	As for overcurrent setting of 0.5 I_n					
0.8	8.00	1.60	As for overcurrent setting of 0.5 I_n					
0.9	9.00	1.80	As for overcurrent setting of 0.5 I_n					
1.0	10.00	2.00	As for overcurrent setting of 0.5 I_n					

4.2.7 SHORT TIME DELAY PICK-UP

Inject pre-fault current and after 4 to 5 seconds inject the fault currents shown below corresponding to the relay pick-up setting. The fault currents shown are 0.9 and 1.1 times the short time delay pick-up.

Check that the relay operates within the time limits shown for the given six times overload trip time setting. The relay must be reset after each test.

The short time delay pick-up is tested by first injecting a fault current below pick-up and checking that the relay operates in the inverse characteristic trip time. A fault current above pick-up is then injected and the relay should operate in the set short time delay.

Short Time Delay Pick-up (Setting I>)		Fault Current		Relay Operating Time Limits(Sec)					
		O/C Test Set	CZB Test Set	t(6 x Is)					
CTZ 61/71	CTZ 62/72			2	4	8	12	16	20
2	2	I>xIsxInx0.9	I>xIsx0.9	11.25 to 13.75	22.50 to 27.50	45.00 to 55.00	67.50 to 82.50	90.00 to 110.0	112.5 to 137.5
		I>xIsxInx1.1	I>xIsx1.1	< 2.00					
3	3	I>xIsxInx0.9	I>xIsx0.9	5.29 to 6.47	10.58 to 12.94	21.18 to 25.88	31.76 to 38.82	42.35 to 51.77	52.94 to 64.70
		I>xIsxInx1.1	I>xIsx1.1	< 2.00					
4	4	I>xIsxInx0.9	I>xIsx0.9	3.47 to 4.24	6.92 to 8.46	13.84 to 16.92	20.77 to 25.39	27.69 to 33.85	34.61 to 42.31
		I>xIsxInx1.1	I>xIsx1.1	< 2.00					
5	-	I>xIsxInx0.9	I>xIsx0.9	2.57 to 3.15	5.14 to 6.28	10.29 to 12.57	15.43 to 18.85	20.57 to 25.15	25.71 to 31.43
		I>xIsxInx1.1	I>xIsx1.1	< 2.00					
6	6	I>xIsxInx0.9	I>xIsx0.9	2.04 to 2.49	4.10 to 5.00	8.18 to 10.00	12.28 to 15.00	16.36 to 20.00	20.45 to 25.00
		I>xIsxInx1.1	I>xIsx1.1	< 2.00					
8	8	I>xIsxInx0.9	I>xIsx0.9	1.45 to 1.77	2.91 to 3.55	5.81 to 7.10	8.71 to 10.65	11.61 to 14.19	14.52 to 17.74
		I>xIsxInx1.1	I>xIsx1.1	< 2.00					
-	10	I>xIsxInx0.9	I>xIsx0.9	1.13 to 1.38 (*)	2.25 to 2.75	4.50 to 5.50	6.75 to 8.25	9.00 to 11.00	11.25 to 13.75
		I>xIsxInx0.9	I>xIsx1.1	< 2.00					

* Note on these settings it will be difficult to distinguish between the inverse trip time and the short time delay trip time. Hence it may be necessary to alter the t(6 x Is) setting to allow discrimination. It is important that after this test the relay settings be returned to those calculated for the particular application.

4.2.8 SHORT TIME DELAY

Inject pre-fault current and after 4 to 5 seconds inject a fault current of 1.5 times the short time delay pick-up setting using the overcurrent test set or inject the corresponding fault current in terms of multiples of rated current I_n using the CZB test set. Check that the relay operates with the time limits given. The relay must be reset after each test.

SHORT TIME DELAY SETTING		RELAY OPERATING TIME LIMITS
CTZ61/CTZ71	CTZ62/CTZ72	
0.9s	-	0.81s - 0.99s
0.4s	0.4s	0.36s - 0.44s
-	0.2s	0.18s - 0.22s
0.1s	-	0.09s - 0.11s
-	50ms	45ms - 55ms
INST	-	< 30ms

4.2.9 INSTANTANEOUS HIGH SET SETTING

The following tests apply to the CTZ62 and CTZ72 relays only. The relay settings must be changed as follows :-

$I > 10I_s$

$I >> 8I_s$

$t(6 \times I_s) = 20$ seconds

Inject pre-fault current and after 4 to 5 seconds inject the fault currents shown below that correspond to the relay pick-up setting I_s. The fault currents correspond to 0.9 and 1.1 times the instantaneous high set pick-up.

Check that the relay operates within the time limits shown. The relay must be reset after each test. Note that the relay operating times at 1.1 times pick-up do not include the operating time of the DC follower relay. It is important that upon completion of the instantaneous high set tests the relay settings should be returned to the settings calculated for the particular application.

OVERCURRENT PICK-UP I_s ($\times I_n$)	FAULT CURRENT		RELAY OPERATING TIME LIMITS
	Overcurrent test set (Amps)	CZB test set ($\times I_n$)	
0.5	18.00	3.60	14.52s - 17.74s
	22.00	4.40	< 20ms
0.6	21.60	4.32	14.52s - 17.74s
	26.40	5.28	< 20ms
0.7	25.20	5.04	14.52s - 17.74s
	30.80	6.16	< 20ms
0.8	28.80	5.76	14.52s - 17.74s
	35.20	7.04	< 20ms
0.9	32.40	6.48	14.52s - 17.74s
	39.60	7.92	< 20ms
1.0	36.00	7.20	14.52s - 17.74s
	44.00	8.80	< 20ms

4.2.10 EARTH FAULT PICK-UP

The following tests apply to the CTZ71 and CTZ72 relays only. If the overcurrent test set is to be used the fault current should be applied to terminals 9 and 10 of the relay. If the CZB test set is to be used the overcurrent/earth fault switch should be moved to the earth fault position.

Inject pre-fault current and after 4 to 5 seconds inject the fault currents shown below corresponding to the earth fault pick-up setting. The current levels correspond to 0.9 and 1.1 times the earth fault pick-up setting. Check that the relay operates within the time limits shown. The relay must be reset after each test.

EARTH FAULT PICK-UP ($\times I_n$ ($\frac{\Sigma}{=}$))	FAULT CURRENT		RELAY OPERATING TIME LIMITS
	Overcurrent test set (mA)	CZB test set ($\times I_n$)	
0.1	9.00	0.090	Relay should not operate
	11.00	0.110	< 2.0s
0.2	18.00	0.180	Relay should not operate
	22.00	0.220	< 2.0s
0.3	27.00	0.270	Relay should not operate
	33.00	0.330	< 2.0s
0.4	36.00	0.360	Relay should not operate
	44.00	0.440	< 2.0s
0.5	45.00	0.450	Relay should not operate
	55.00	0.550	< 2.0s
0.6	54.00	0.540	Relay should not operate
	66.00	0.660	< 2.0s

4.2.11 EARTH FAULT TIME DELAY

The following tests apply to the CTZ71 and CTZ72 relays only. Inject pre-fault current and after 4 to 5 seconds inject the fault current shown below corresponding to the earth fault pick-up setting. The current level corresponds to 4 times the earth fault pick-up setting. Check that the relay operates within the time limits shown. The relay must be reset after each test. Note that the operating time on the instantaneous setting does not include the operating time of the DC follower relay.

E/F P.U. SETTING I_s ($\frac{\Sigma}{=}$)	FAULT CURRENT	
	OVERCURRENT test set (mA)	CZB test set ($\times I_n$)
0.1	40	0.4
0.2	80	0.8
0.3	120	1.2
0.4	160	1.6
0.5	200	2.0
0.6	240	2.4

EARTH FAULT TIME DELAY (seconds)		RELAY OPERATING TIME LIMITS (seconds)
CTZ71	CTZ72	
0.9	-	0.810 - 0.990
0.4	0.4	0.360 - 0.440
-	0.2	0.180 - 0.220
0.1	-	0.090 - 0.110
-	0.05	0.045 - 0.055
INST	-	< 0.020

TEST RESULTS

OVERCURRENT RELAY TYPES CTZ61/62/71/72

SITE _____ CIRCUIT _____

MODEL _____ SERIAL NO. _____

RATING _____ DIAGRAM _____

SETTINGS I_s _____ xI_n E/F P.U. I_s (⏚) _____ xI_n (⏚)

O/C P.U. _____ Secs E/F time _____ Secs

6 x I_s curve I> _____ xI_s Inst. H/S P.U. _____ xI_s

t> _____ xI_s

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OPERATIONAL CHECKS

NOTE :- I_n refers to the rated current of the protection. I_n is 5.0A for phase protection. The setting current I_s is a multiple of rated current I_n and is expressed in Amperes.

4.2.3 AC input test

A phase _____ Secs

B phase _____ Secs

C phase _____ Secs

4.2.5 Overcurrent pick-up

O/C P.U. SETTING I_s	FAULT CURRENT			OPERATING TIME
	LEVEL (Amps)	CFB (Amps)	CZB (xI_n)	t(6 x I_s) 2 - 20 secs setting _____
	1.25 I_s			operate _____ mins
	1.05 I_s			Non operate _____ mins

4.2.6 Inverse overcurrent time setting

O/C P.U. SETTING I_s	FAULT CURRENT			OPERATING TIME
	LEVEL (Amps)	CFB (Amps)	CZB (xI_n)	$t(6 \times I_s)$ setting 2 - 20 secs _____
	2 I_s			_____ mins

4.2.7 Short time delay pick-up

Short Time Delay P.U. Setting I >	FAULT CURRENT			OPERATING TIME
	LEVEL (Amps)	CFB (Amps)	CZB (xI_n)	$t(6 \times I_s)$ setting 2 - 20 secs _____
	0.9 I >			
	1.1 I >			

4.2.8 Short time delay

Short Time Delay P.U. Setting I >	FAULT CURRENT			OPERATING TIME			
				t > (secs)			
	LEVEL (Amps)	CFB (Amps	CZB (xI_n)	0.9	0.4	0.1	INST
	1.5 I >						

4.2.9 Instantaneous high set

O/C P.U. SETTING I_s	FAULT CURRENT			OPERATING TIME	
	LEVEL (Amps)	CFB (Amps)	CZB (xI_n)	14.52 - 17.74 seconds	< 20 secs
	7.2 I_s				
	8.8 I_s				

4.2.10 Earth fault pick-up

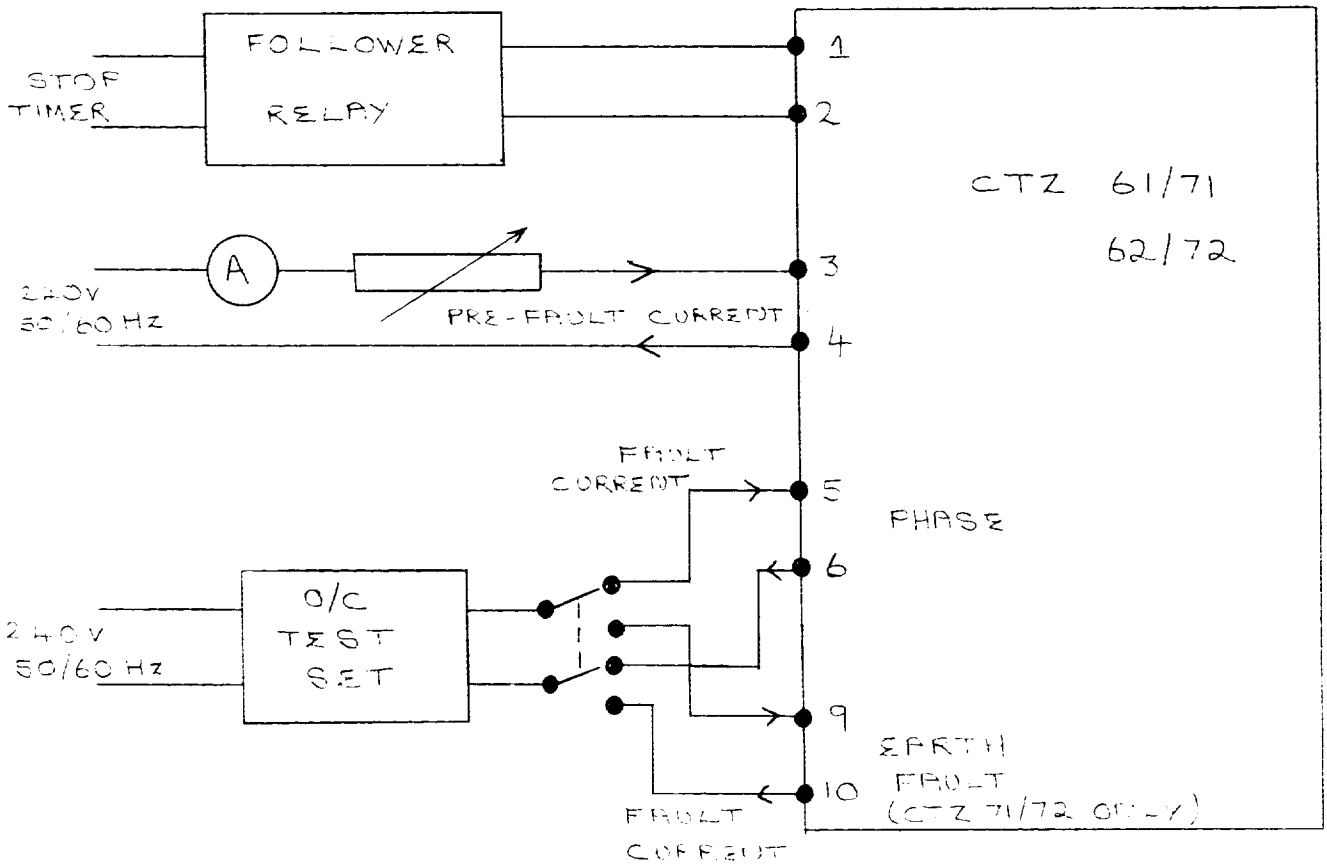
O/C P.U. SETTING I_s (⏚)	FAULT CURRENT			OPERATING TIME	
	LEVEL (Amps)	CFB (Amps)	CZB (xI_n)	non operate	< 2.0 seconds
	0.9 I_s (⏚)				
	1.1 I_s (⏚)				

4.2.11 Earth fault time delay

E/F P.U. Setting I_s (⏚)	FAULT CURRENT			OPERATING TIME (seconds)			
	LEVEL (Amps)	CFB (Amps	CZB [xI_n (⏚)]	0.9	0.4	0.1	INST
	4 I_s (⏚)						

TESTED BY _____ DATE _____

TEST CIRCUIT FOR O/C TEST SET



5.0 MAINTENANCE

Periodic maintenance is not required. However, the general condition of the relay should be monitored by periodic visual inspection and general operational tests should be performed.

6.0 PROBLEM ANALYSIS

6.1 GENERAL

Before fault finding on the relay is commenced, all connections to the relay should be checked to ensure that the fault lies within the relay. The following instructions allow a fault to be identified at sub-assembly level. Fault finding at component level is not recommended for the following reasons :-

(1) Fault finding on printed circuit boards requires specialised knowledge and equipment.

(2) Components used in manufacture are subjected to strict quality control procedures and in certain cases selected for particular characteristics. Static sensitive components are used which require very careful handling.

(3) Damage can be caused to printed circuit board track unless extreme care is used in replacement of components.

(4) Replacement of certain components will require recalibration of the relay.

In the event of a fault being found, it is recommended that the relay is returned to GEC Measurements or sent to a competent service centre for the work to be carried out.

6.2 PROCEDURE

The following test equipment is required :-

a) Overcurrent test set (0 - 100A) with timer facilities. 30V DC follower relay.
Variable resistor.
Multimeter
Digital timer

and/or

b) CZB portable test set and 5 pin DIN connector.

6.2.1 OPERATION OF OVERCURRENT TEST SET

For timing tests using the overcurrent test set the timer should be connected so that it starts when the fault current is transferred to the relay and stops when the thyristor output of the relay operates. The 2.0A AC current source is used to provide the 2.0A $\pm$ 5% pre-fault current required to establish the internal voltage rails. Once the relay output has operated it may only be reset by removing both pre-fault and fault currents.

6.2.2 OPERATION OF CZB TEST SET

Select the required input supply voltage and switch on the test set. Ensure that the output short switch is in the ON position and then select either the overcurrent or earth fault mode. Connect the CZB to the relay using the 5 pin DIN connector. Pre-fault current is applied to the relay as soon as the CZB test set is energised. To set the fault current level hold the fault switch in the ON position and adjust the current setting to give the required reading on the digital ammeter using the coarse and fine current adjustments. Release the fault switch. To apply the fault current set the output short switch to the OFF position and then hold the fault switch in the ON position. Upon application of the fault current the digital timer display will remain blank. When the relay output operates the digital timer display on some CZB test sets will display the operating time. Release the fault switch and set the output short switch to the ON position. The relay may be reset by means of the CZB reset switch. After resetting allow 4 to 5 seconds for the pre-fault current to establish the voltage rails.

6.2.3 AC INPUT TESTS

Set the relay switches as follows :-

$I_s = 0.5\ I_n$

$t(6 \times I_s) = 12$ seconds

$I > 2 \times I_s$

$t > 0.9$s (CTZ61/CTZ71 only)

$t > 400$ms (CTZ62/CTZ72 only)

I_s (⏚) $= 0.6 I_n$ (⏚) (CTZ71/CTZ72 only)

t (⏚) $= 400$ms (CTZ72 only)

t (⏚) $= 0.9$s (CTZ71 only)

$I >> 20\ I_s$ (CTZ62/CTZ72 only)

Note that all the tests make no allowance for errors in the measurement of the AC current amplitude.

The AC input tests must be performed on all relay types. Connect the overcurrent test set to the red phase current input (terminals 3 and 4) and set the test set to provide 15A rms ± 2%. Connect the 2.0 amp pre-fault current source to the blue phase current input (terminals 7 and 8). Inject the pre-fault current into the CTZ and wait 4 to 5 seconds for the internal voltage rails to become established. Transfer the fault current to the relay starting the timer at the same time. The CTZ should operate after 0.9s ± 10% (CTZ61/CTZ71 only) or 400ms ± 10% (CTZ62/CTZ72 only). Reset the relay after each test.

6.2.5 INVERSE OVERCURRENT TIME TESTS

Change the relay settings as follows :-

$$I_s = 0.5\ I_n$$

With the trip time at $6 \times I_s$ switch set to the positions shown below inject pre-fault current and after 4 to 5 seconds inject the corresponding fault current levels. Check that the relay operates within the time limits given. If the relay does not conform to these limits it should be returned to GECM. The relay must be reset after each test.

$t(6 \times I_s)$ (seconds)	FAULT CURRENT		RELAY OPERATING TIME LIMITS (SECONDS)
	Overcurrent setting (Amps)	CZB setting ($\times I_n$)	
2	15.00	3.00	1.80 - 2.20
	5.00	1.00	9.00 - 11.00
4	15.00	3.00	3.60 - 4.40
	5.00	1.00	18.00 - 22.00
8	15.00	3.00	7.20 - 8.80
	5.00	1.00	36.00 - 44.00
12	15.00	3.00	10.80 - 13.20
	5.00	1.00	54.00 - 66.00
16	15.00	3.00	14.40 - 17.60
	5.00	1.00	72.00 - 88.00
20	15.00	3.00	18.00 - 22.00
	5.00	1.00	90.00 - 110.00

6.2.6 SHORT TIME DELAY PICK-UP TESTS

Change the relay settings as follows :-

$$I_s = 0.5\ I_n$$

$$t(6 \times I_s) = 20 \text{ seconds}$$

$$t > 0.4 \text{ seconds}$$

With the short time delay pick-up set as shown below inject pre-fault current and after 4 to 5 seconds inject the corresponding fault current levels. Check that the relay operates within the time limits given. If the relay does not conform to these limits it should be returned to GECM. The relay must be reset after each test.

SHORT TIME DELAY PICK-UP ($\times I_s$)		FAULT CURRENT		RELAY OPERATING TIME LIMITS (SECONDS)
CTZ61/71	CTZ62/72	Overcurrent setting (Amps)	CZB setting ($\times I_n$)	
2	2	4.50	0.90	112.5 - 137.5
		5.50	1.10	< 1.0
3	3	6.75	1.35	52.94 - 64.70
		8.25	1.65	< 1.0
4	4	9.00	1.80	34.61 - 42.31
		11.00	2.20	< 1.0
5	-	11.25	2.25	25.71 - 31.43
		13.75	2.75	< 1.0
6	6	13.50	2.70	20.46 - 25.00
		16.50	3.30	< 1.0
8	8	18.00	3.60	14.52 - 17.74
		22.00	4.40	< 1.0
-	10	22.50	4.50	11.25 - 13.75
		27.50	5.50	< 1.0

6.2.7 SHORT TIME DELAY TESTS

Change the relay settings as follows :-

$I_s = 0.5\ I_n$

$t(6 \times I_s) = 20$ seconds

$I > 2 \times I_s$

With the short time delay set as shown below inject pre-fault current and after 4 to 5 seconds inject 15A fault current using the overcurrent test set or 3.00 x I_n using the CZB test set and check that the relay operates within the time limits given. Note that the operating time on the instantaneous setting does not include the operating time of the DC follower relay.

If the relay does not conform to these limits it should be returned to GECM. The relay must be reset after each test.

SHORT TIME DELAY SETTING		RELAY OPERATING TIME LIMITS
CTZ61/CTZ71	CTZ62/CTZ72	
0.9s	-	0.81s - 0.99s
0.4s	0.4s	0.36s - 0.44s
-	0.2s	0.18s - 0.22s
0.1s	-	0.09s - 0.11s
-	50ms	45ms - 55ms
INST	-	< 20ms

6.2.8 INSTANTANEOUS HIGH SET TESTS

The following tests apply to the CTZ62 and CTZ72 relays only. Change the relay settings as follows :-

$I_s = 0.5\ I_n$

$I > 10\ I_s$

$t = 400ms$

$I >> 8\ I_s$

Inject pre-fault current and after 4 to 5 seconds inject the fault current levels shown below. Check that the relay operates within the time limits given. If the relay does not conform to these limits it should be returned to GECM The relay must be reset after each test. Note that the relay operating time at 4.4 I_n does not include the operating time of the DC follower relay.

FAULT CURRENT		RELAY OPERATING TIME LIMITS
Overcurrent setting (Amps)	CZB setting (x I_n)	
18.00	3.60	14.52s - 17.74s
22.00	4.40	< 20ms

6.2.9 EARTH FAULT PICK-UP TESTS

The following tests apply to the CTZ71 and CTZ72 relays only. Change the relay settings as follows :-

$I_s = 0.5\ I_n$

$t(6 \times I_s) = 20$ seconds

$I > 8\ I_s$

$t > 0.9$ seconds (CTZ71 only)

$t > 0.4$ seconds (CTZ72 only)

t (⏚) $= 0.4$ seconds

$I >> 20\ I_s$ (CTZ72 only)

If the overcurrent test set is to be used the fault current should be applied to terminals 9 and 10 of the relay. If the CZB test set is to be used the overcurrent earth fault switch should be moved to the earth fault position. With the earth fault pick-up set as shown below inject pre-fault current and after 4 to 5 seconds inject the corresponding fault current levels. Check that the relay operates within the time limits given. If the relay does not conform to these limits it should be returned to GECM. The relay must be reset after each test.

EARTH FAULT PICK-UP CURRENT ($\times I_n$ (⏚))	FAULT CURRENT		RELAY OPERATING TIME LIMITS
	Overcurrent setting (mA)	CZB setting ($\times I_n$)	
0.1	9.00	0.090	Relay should not operate
	11.00	0.110	< 1.0 secs
0.2	18.00	0.180	Relay should not operate
	22.00	0.220	< 1.0 secs
0.3	27.00	0.270	Relay should not operate
	33.00	0.330	< 1.0 secs
0.4	36.00	0.360	Relay should not operate
	44.00	0.440	< 1.0 secs
0.5	45.00	0.450	Relay should not operate
	55.00	0.550	< 1.0 secs
0.6	54.00	0.540	Relay should not operate
	66.00	0.660	< 1.0 secs

6.2.10 EARTH FAULT TIME DELAY TESTS

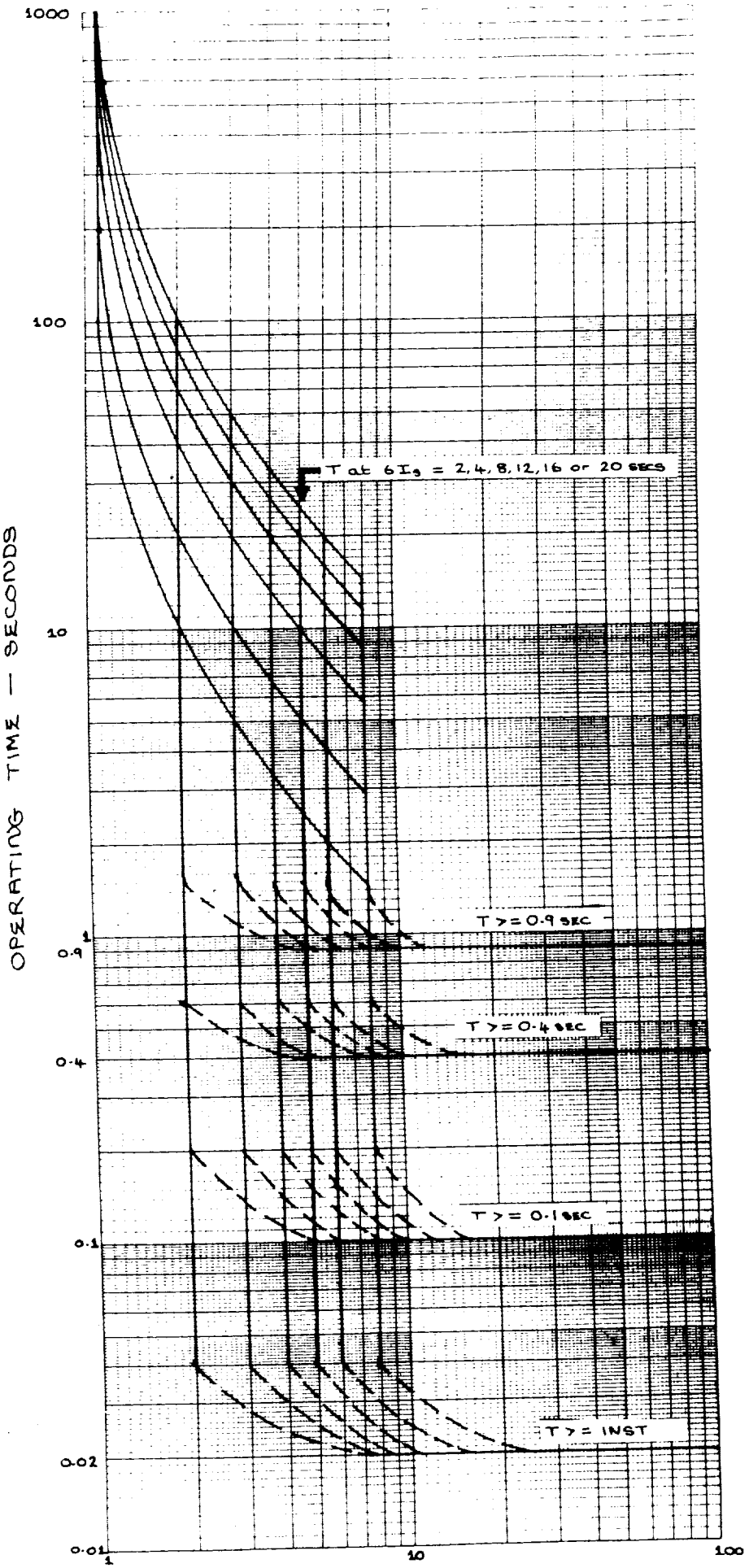
The following tests apply to the CTZ71 and CTZ72 relays only. Change the relay settings as follows :-

$$I_s \text{ (}\lightning\text{)} = 0.2\ I_n \text{ (}\lightning\text{)}$$

With the earth fault time delay set as shown below inject pre-fault and after 4 to 5 seconds inject either 80mA AC using the overcurrent test set or $0.80 \times I_n$ using the CZB test set and check that the relay operates within the time limits given. Note that the operating time on the instantaneous setting does not include the operating time of the DC follower relay.

If the relay does not conform to the operating limits it should be returned to GECM. The relay must be reset after each test.

EARTH FAULT TIME DELAY		RELAY OPERATING TIME LIMITS (SECONDS)
CTZ71	CTZ72	
0.9s	-	0.810 - 0.990
0.4s	0.4s	0.360 - 0.440
-	0.2s	0.180 - 0.220
0.1s	-	0.090 - 0.110
-	50ms	0.045 - 0.055
INST	-	< 0.020



CURRENT — MULTIPLES OF Ig

FIGURE 1 :- PHASE OVERCURRENT CHARACTERISTICS (CTZ 61 / CTZ 71)

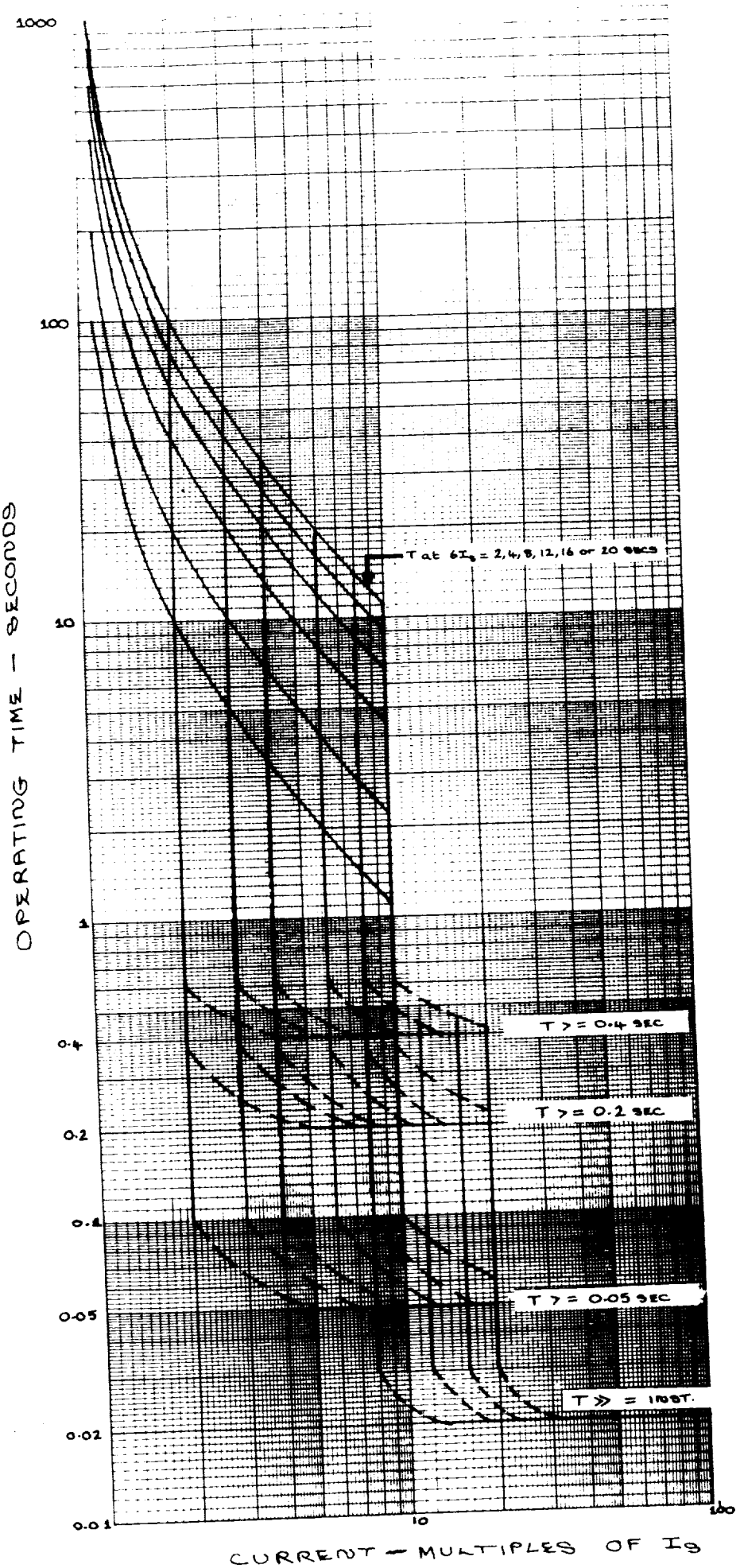


FIGURE 2 :- PHASE OVERCURRENT CHARACTERISTICS (CTZ 62/CTZ 72)

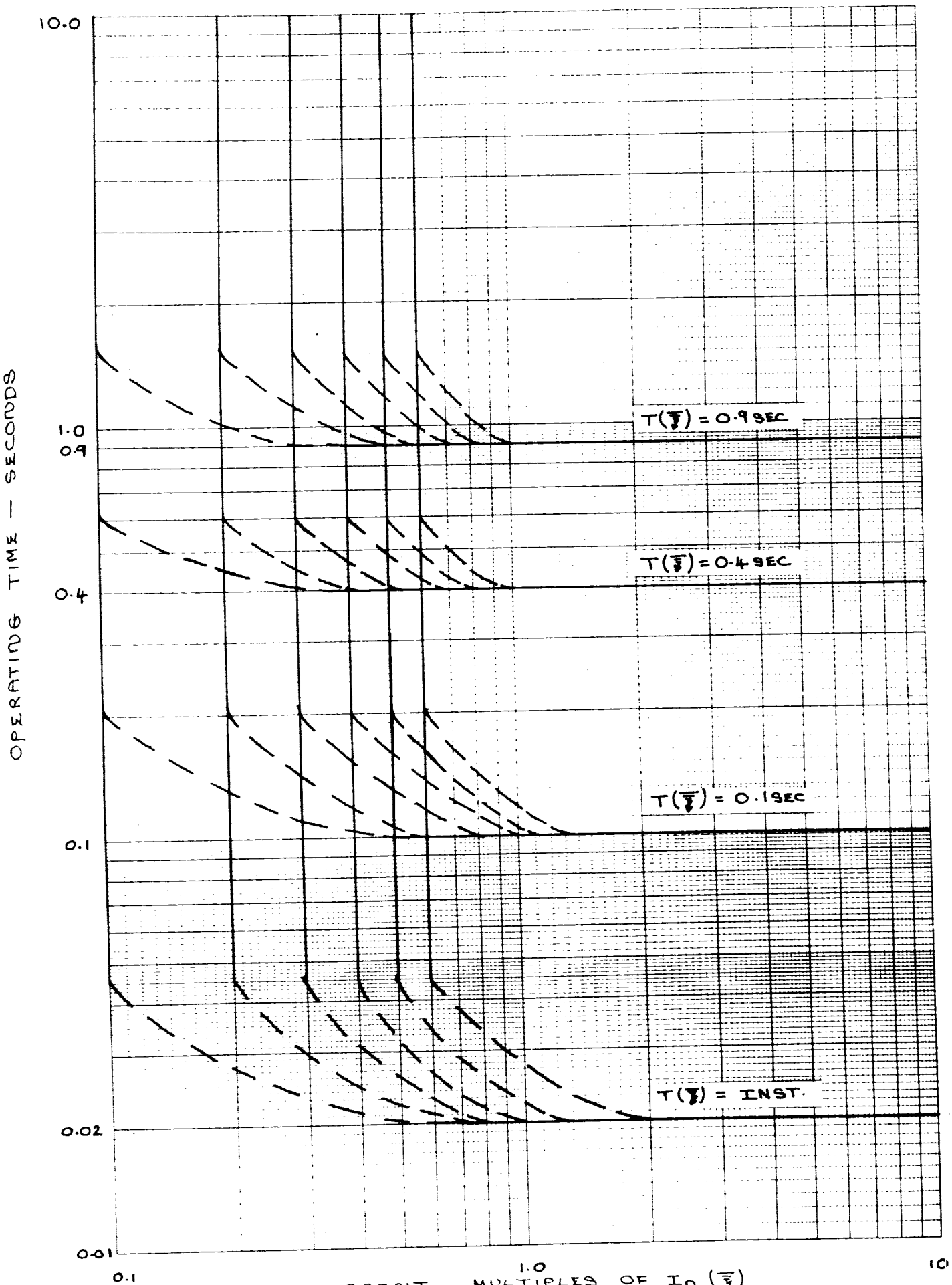


FIGURE 3 :- EARTH FAULT CHARACTERISTICS (CTZ 71)

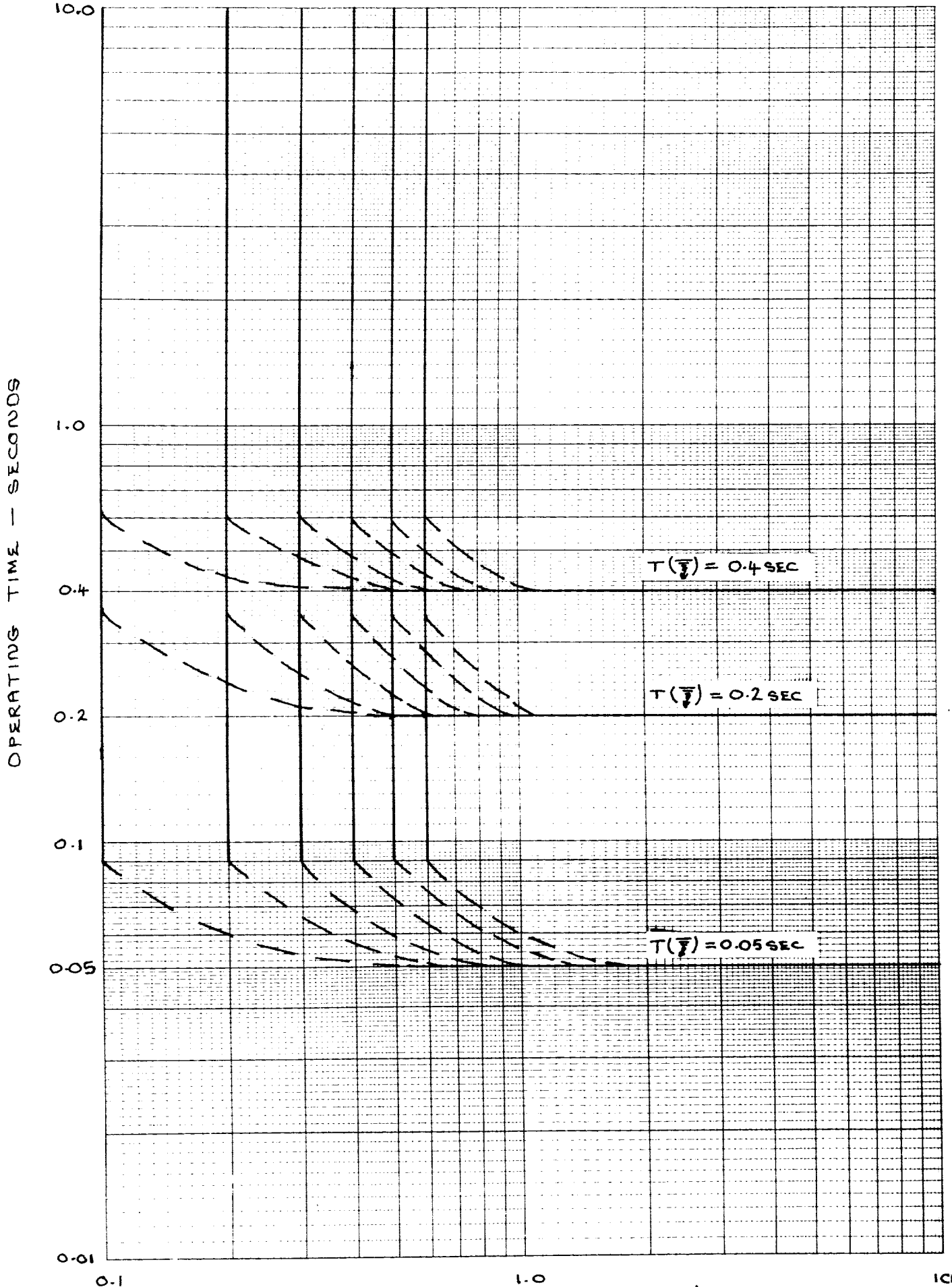


FIGURE 4 :- EARTH FAULT OVERCURRENT CHARACTERISTICS
(CTZ 72)