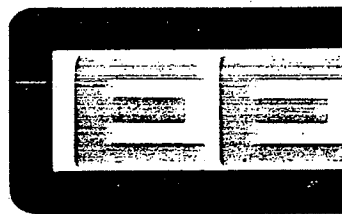
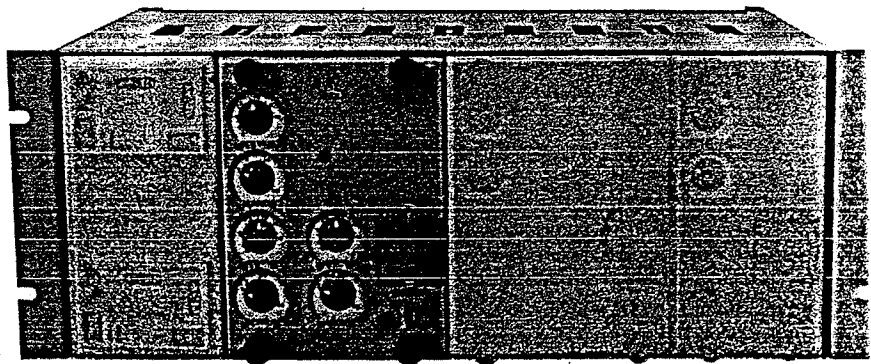


relais
de protection
différentielle
pour machines
tournantes

*machine
differential
protection
relay*

**DTM
7031**



**COMPAGNIE
CONTINENTALE
D'ÉQUIPEMENTS
ÉLECTRIQUES**

relais de protection
différentielle
pour machines tournantes
en boîtier modulaire
DTM 7031

machine differential
protection relay
in modular case
DTM 7031

GENERALITÉS

Le DTM 7031, relais différentiel triphasé à pourcentage, apporte une solution particulièrement satisfaisante à la protection des machines tournantes contre les défauts internes.

Ces défauts, généralement consécutifs à un vieillissement de l'isolation, nécessitent une détection sensible et une élimination rapide afin d'en limiter les conséquences.

Le relais DTM 7031 répond à ces exigences grâce à un seuil très faible, réglable de 2 à 15 % I_n , associé à un dispositif de retenue qui assure la stabilité de la protection en cas de défaut extérieur.

En pratique, le seuil de fonctionnement du DTM 7031 sera choisi en fonction de la précision des réducteurs de mesure, et permettra de protéger la quasi-totalité des enroulements statoriques d'un alternateur ou d'un moteur.

Le DTM 7031 est présenté en boîtier modulaire type R3 débrochable, qui peut indifféremment être monté :

- soit en relais séparé, en saillie ou en encastré,
- soit par insertion dans un panier rack au standard de 19"

La désignation du DTM 7031 répond au code suivant :

D : grandeur d'influence : courant différentiel
T : élément de mesure : transistorisé
M : utilisation : machines tournantes
7 : identification de la série en boîtier modulaire R
0 : caractéristique de temps : instantané
3 : nombre de mesures
1 : identification du type

GENERAL

The DTM 7031, three-phase percentage biased differential relay, provides a particularly satisfactory solution for the protection of rotation machines against internal faults.

These faults, generally caused by insulation ageing, require sensitive detection, and rapid elimination in order to minimise their consequences.

The DTM 7031 relay fulfils these requirements, having a very low pick-up level, adjustable from 2 to 15 % I_n , with a biasing device which ensure the stability of the protection in the event of an external fault.

In practice, the choice of operating level of the DTM 7031 is a function of the line transformer precision, and can provide protection for virtually the whole alternator or motor stator winding.

The DTM 7031 is supplied in a plug-in modular case type R3, which may be mounted :

- either as a separate relay, projecting or flush,*
- or by insertion into a standard 19" rack cradle.*

The designation DTM 7031 corresponds to the following code :

D : influencing factor : differential current
T : measuring element : transistorised
M : use : machines
7 : identification of the series in modular case type R
0 : time characteristic : instantaneous
3 : number of measurements
1 : type identification

PRINCIPAUX AVANTAGES

Ce relais bénéficie de l'expérience acquise par CEE depuis de nombreuses années en matière de relais de protection à éléments de mesure statiques pour tous types de réseaux et d'équipements électriques.

Il se caractérise par :

- des éléments de mesure statiques à faible consommation,
- une unité différentielle rapide et sensible, à seuil réglable sur chaque phase en pourcentage du courant nominal,

MAJOR ADVANTAGES

This relay benefits from CEE's experience, acquired over many years, on the subject of protective relays with static measuring elements for all types of network and electrical equipment.

Its principal characteristics are :

- low burden static measuring elements,*
- a sensitive high-speed differential unit, with pick-up adjustable on each phase as a percentage of nominal current,*

- des éléments de retenue réglables en pourcentage du courant nominal,
- une parfaite stabilité en cas de défaut extérieur,
- une capacité de surcharge très importante,
- un relais auxiliaire de sortie à deux contacts de forte puissance avec voyant mécanique de fonctionnement à réarmement manuel,
- son insensibilité aux secousses sismiques : tenue à 5 g selon norme IEEE 344,
- sa compacité : le DTM 7031 se présente en boîtier modulaire de très grande robustesse et d'encombrement particulièrement réduit,
- une protection pour environnement sévère : chaleur humide, air salin, termites, moisissures,
- sa capacité de stockage à très basse température (-57°C).
- Un voyant électroluminescent vert de contrôle de fonctionnement s'allume dès l'application de l'alimentation auxiliaire et tant que le seuil de la grandeur mesurée n'est pas atteint.

- restraint or bias elements, adjustable as a percentage of nominal current,
- a very high overload capacity,
- an output relay with two high-power contacts and a hand-reset mechanical operation indicator,
- insensitive seismic shock : 5 g withstand according to IEEE 344,
- compact : the DTM 7031 is supplied in a very robust and particularly small case,
- protection against severe environments : heat and humidity, saline atmosphere, termites, corrosion and mould,
- may be stocked at very low temperatures (-57°C).
- A green LED checking operation with lights when auxiliary supply is applied and the incasured quantity is below operating level.

APPLICATIONS

Utilisé en protection différentielle longitudinale de machines synchrones ou asynchrones (figure n° 1), le relais DTM 7031 protège la quasi-totalité des enroulements contre les court-circuits entre spires de phases différentes. En effet, les éléments de retenue autorisent un seuil de fonctionnement très sensible pouvant atteindre 2 % I_n (ce qui correspond à la protection de 98 % des enroulements) tout en assurant la stabilité du relais en cas de défaut extérieur.

Le DTM 7031 peut être également utilisé en protection différentielle transversale de machines possédant deux enroulements accessibles en parallèle par phase (figure n° 2), assurant dans ce cas la protection contre les court-circuits entre spires d'un même enroulement.

Même si l'équilibrage du courant entre les deux enroulements d'une phase n'est pas rigoureux, le dispositif de retenue permet de maintenir la stabilité du relais sur défauts extérieurs.

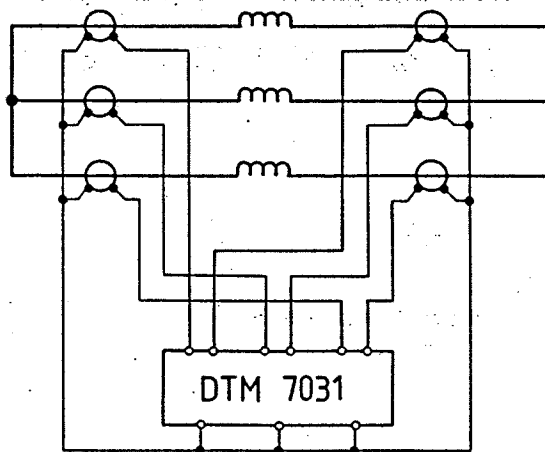


Fig. 1 — Protection différentielle longitudinale de machine
Machine longitudinal differential protection

APPLICATIONS

Used as a longitudinal differential protection for synchronous or asynchronous machines (figure n° 1), the DTM 7031 protects virtually the whole winding against short-circuits between turns on different phases. The bias elements allow a very sensitive setting, attaining as low as 2 % I_n (which corresponds to protection of 98 % of the winding) whilst ensuring stability of the relay in the event of an external fault.

The DTM 7031 may also be used as a transverse differential protection on machines having two accessible windings in parallel per phase (figure n° 2), in this event ensuring protection against short-circuits between turns on the same winding.

Even if current balance between the two windings on the same phase is not perfect, the restraint (or bias) circuit maintains relay stability for external faults.

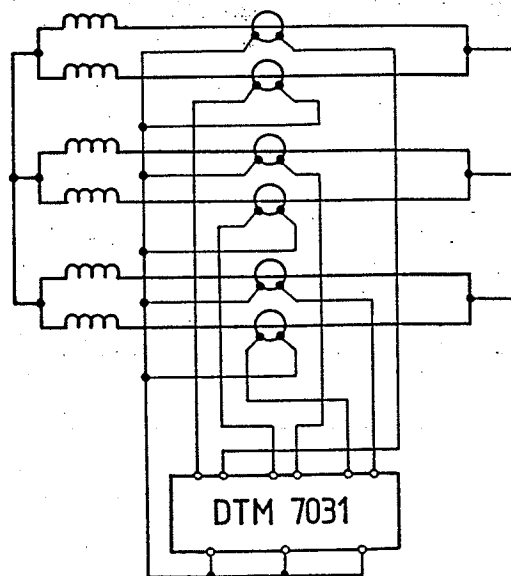


Fig. 2 — Protection différentielle transversale de machine à double enroulement
Transverse differential protection for split-winding machine

CARACTÉRISTIQUES GÉNÉRALES

1 Courant nominal I_n	1 A ou 5 A - 50 ou 60 Hz
2 Caractéristiques de fonctionnement	selon courbes figure 4
3 Domaine d'ajustement — Courant différentiel de déclenchement	$I_d = 2$ à 15% de I_n (gamme standard) ou 10 à 40% de I_n
— Pourcentage de retenue	$I_r = 2$ à 20%
4 Précision aux valeurs de référence des facteurs d'influence Seuil de déclenchement — à I traversant nul	$\pm 0,2\%$ de I_n ou 5% du réglage affiché
— à I traversant = I_n	5% de la valeur théorique
5 Dérive maximale à l'intérieur des domaines suivants: — Température	— 5 + 50°C
— Fréquence	45 à 65 Hz
— Tension auxiliaire	entre 80% et 110% de la tension nominale
Seuil de déclenchement — à I traversant nul	$\pm 0,3\%$ de I_n ou 5% du réglage affiché
— à I traversant = I_n	10% de la valeur théorique
6 Domaine de température à l'intérieur duquel le fonctionnement est garanti	— 10 à + 55°C
7 Pourcentage de dégagement	> 85% du seuil de fonctionnement
8 Temps de fonctionnement	40 ms à 5 fois la valeur du seuil de réglage selon courbes figure 5
9 Etendue de mesure du courant de retenue	0,5 à 10 I_n
10 Surcharge admissible (courant traversant) — Permanente	2 I_n
— Temporaire	80 I_n 1 s
11 Consommation des circuits retenue et différentiels — $I_n = 1$ A	0,2 VA
— $I_n = 5$ A	0,5 VA
12 Tension auxiliaire continue	48 V ou 60 V ou 110 V ou 125 VCC ou 220 V + 10% — 20%
— Consommation	125 VCC - en veille 8 W - en déclenchement 11 W
13 Voyants — Mécanique	à réarmement manuel
— Electrique	vert - allumé en permanence en l'absence de défaut et indiquant la présence de tension auxiliaire
14 Contacts de sortie	2 NO ou 2 NF ou 1 NO + 1 NF
	Alternatif Continu
— Pouvoir de fermeture	2500 VA avec max de 10 A ou 500 V 2500 W avec max de 10 A ou 500 V
— Pouvoir de coupure	1250 VA avec max de 5 A ou 500 V 100 W résistif ou 50 W inductif avec max de 3 A ou 500 V
— Courant maximum de service continu	5 A 5 A
15 Isolement — Tenue diélectrique Entre toutes les bornes réunies et la masse	2 kV - 50 ou 60 Hz pendant 1 mn
Entre les bornes entrées et toutes les autres bornes réunies	2 kV - 50 ou 60 Hz pendant 1 mn
— Tenue à la tension de choc en mode commun et en mode différentiel	5 kV crête - 1,2/50 μ s selon CEI 255 - 5
16 Insensibilité aux perturbations haute fréquence	2,5 et 1 kV - 1 MHz selon classe III CEI 255-6 annexe C
17 Boîtier	R 3
18 Masse	4,5 kg
19 Caractéristiques des transformateurs de courant, y compris la charge correspondant à une résistance de boucle de raccordement de 0,15 ohm (5 A) ou 3,5 ohm (1A)	5 VA - 5 P 10
20 Schéma d'identification à utiliser pour toute commande	9372

GENERAL CHARACTERISTICS

1 Nominal current I_n	1 A or 5 A 50 or 60 Hz	
2 Operating characteristics	see curves figure 4	
3 Setting ranges :		
— Differential tripping level	$I_d = 2$ to 15% (standard range) or 10 to 40% of I_n	
— Percentage bias	$I_r = 2$ to 20%	
4 Accuracy class index at reference values of influencing factors :		
— Differential tripping level		
— at through current = 0	$\pm 0.2\%$ of I_n or 5% of differential setting	
— at through current = I_n	5% of theoretical value	
5 Maximum error within following ranges :		
— Temperature	— 5 to + 50°C	
— Frequency	45 to 65 Hz	
— Auxiliary supply	80 to 110% of nominal voltage	
— Operating level		
— at through current = 0	$\pm 0.3\%$ of I_n or 5% of differential setting	
— at through current = I_n	10% of theoretical value	
6 Temperature range over which operation is ensured	— 10 to 55°C	
7 Drop out percentage	$> 85\%$ of operating level	
8 Operating time	40 ms at 5 times differential setting see curves figure 5	
9 Measuring range of bias current	0.5 to 10 I_n	
10 Overload withstand (through current)		
— Permanent	2 I_n	
— Temporary	80 I_n for 1 sec	
11 Burden of restraint and differential circuits :		
— $I_n = 1$ A	0.2 VA	
— $I_n = 5$ A	0.5 VA	
12 Auxiliary supply voltages	48 V or 60 V or 110 V or 125 V or 220 VDC + 10% — 20%	
— Burden	at 125 VDC - standing drain 8 W - tripping 11 W	
13 Operation indicators		
— Mechanical	hand reset trip indicator	
— Electrical	green - lit in absence of fault, indicating presence of auxiliary supply	
14 Output contacts	2 NO or 2 NC or 1 NO + 1 NC	
— Closing capacity	Alternating current 2500 VA with max of 10 A or 500 V	Direct current 2500 W with max of 10 A or 500 V
— Breaking capacity	1250 VA with max of 5 A or 500 V	100 W resistive or 50 W inductive with max of 3 A 500 V
— Maximum continuous current	5 A	5 A
15 Insulation		
— Dielectric withstand		
— Between all terminals connected together and chassis	2 kV - 50 or 60 Hz for 1 min.	
— Between input terminals and all others connected together	2 kV - 50 or 60 Hz for 1 min.	
— Impulse voltage withstand in common and transverse modes	5 kV peak - 1.2/50 μ s to IEC 255-5	
16 Insensitivity to high frequency disturbance	2.5 and 1 kV - 1 MHz to class III of IEC 255-6 annex C	
17 Case	R 3	
18 Weight	4.5 kg	
19 Current transformer characteristics including a load equivalent to a loop wiring resistance of 0.15 ohm (5 A) or 3.5. ohm (1A)	5 VA - 5 P 10	
20 Identifying drawing number to be used when ordering	9372	

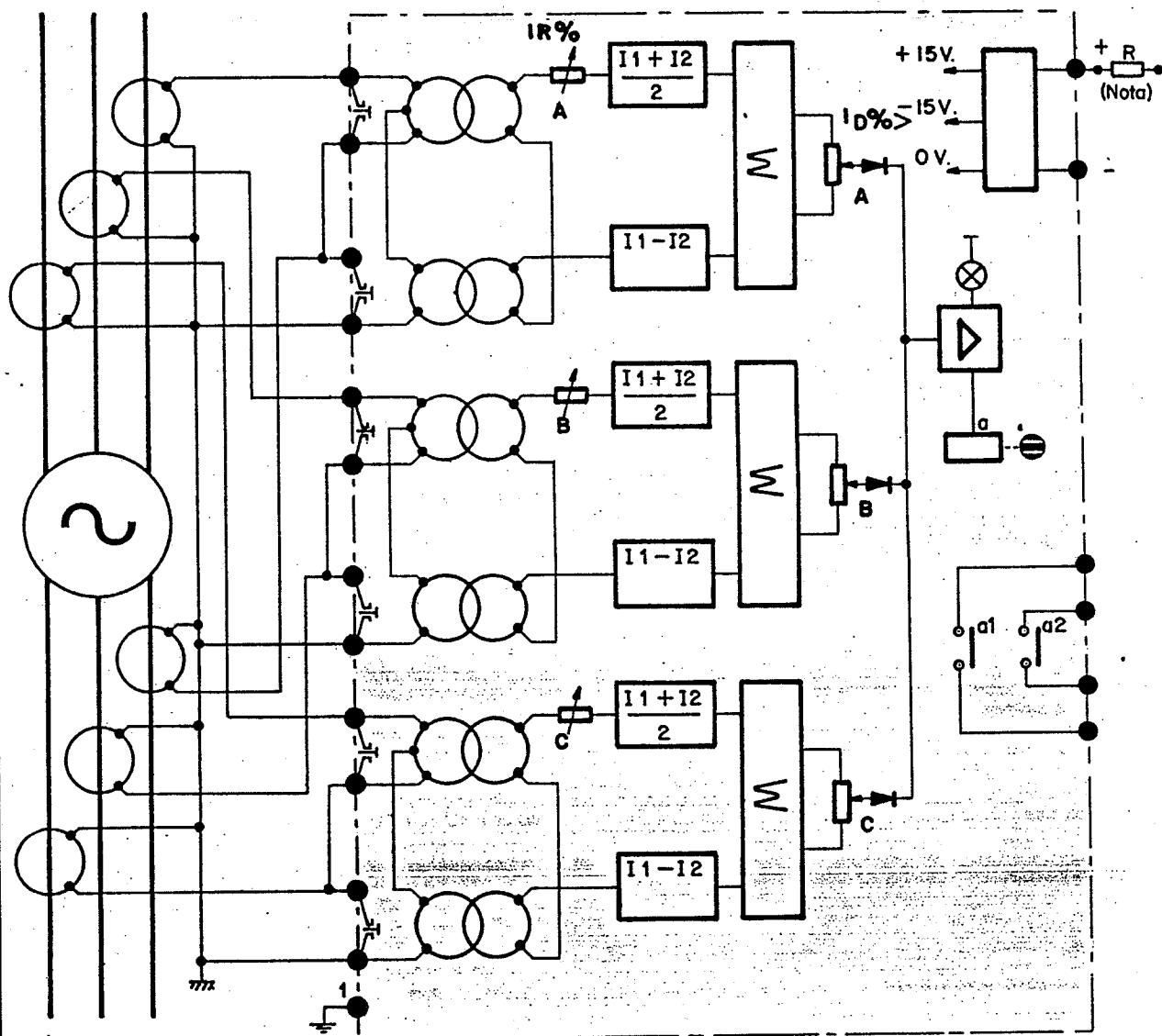


Fig. 3 — Schéma de fonctionnement simplifié et de raccordement /
 Simplified operating and connection diagram

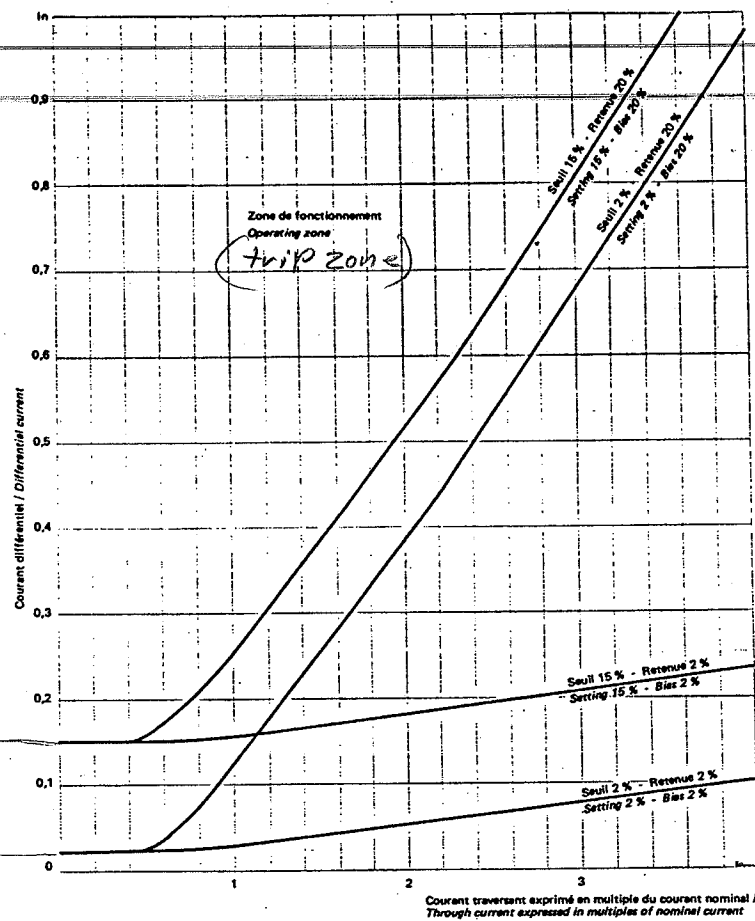


Fig. 4 — DTM 7031 - Courbes de fonctionnement / Operating characteristics

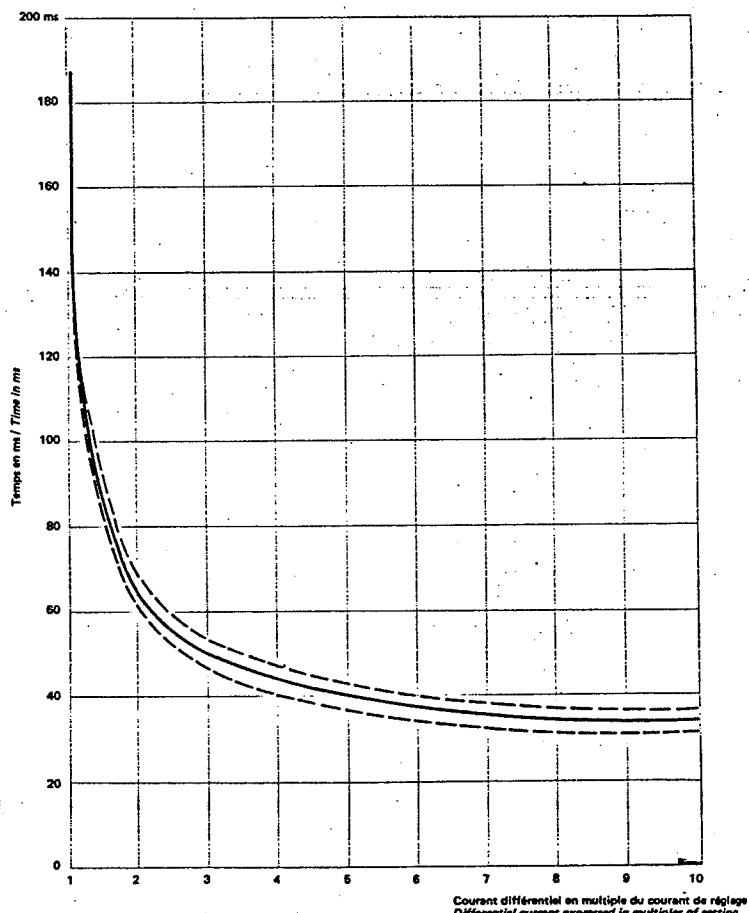
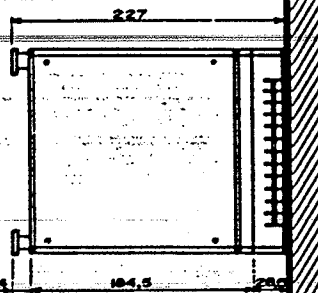
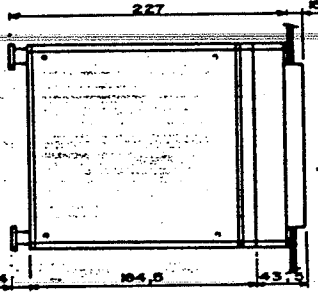
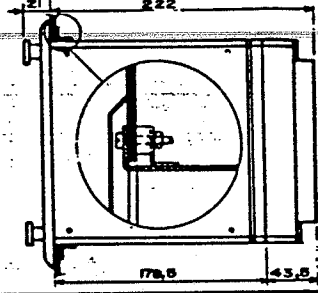
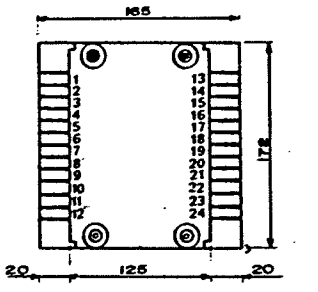
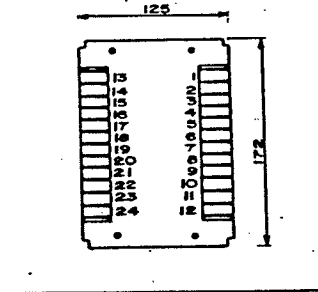
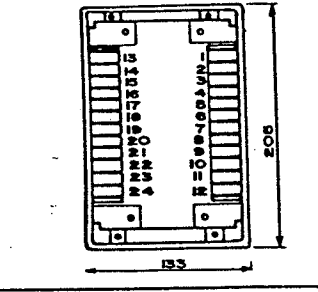
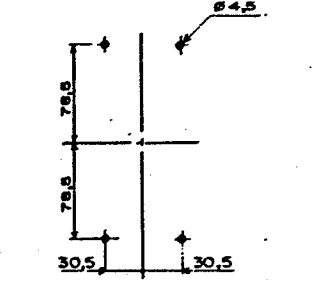
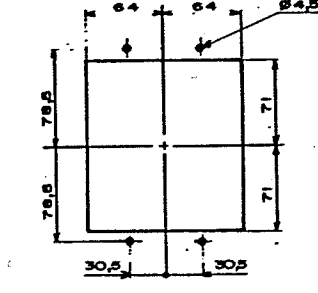
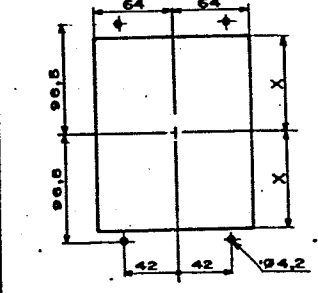


Fig. 5 — DTM 7031 - Temps de réponse / Operating time

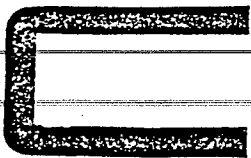
		saillie prises avant <i>projecting front connection</i>	saillie prises arrière <i>projecting rear connection</i>	encastré prises arrière <i>flush rear connection</i>
ENCOMBREMENTS CASE DIMENSIONS	RACCORDEMENT PAR VIS ØM4 CONNECTING SCREWS ØM4			
		$x = 89$ pour panneau epr ≤ 2 $x = 90,5$ pour panneau epr > 2 $x = 89$ for panel th. ≤ 2 $x = 90,5$ for panel th. > 2		
R3	ENCOMBREMENTS CASE DIMENSIONS			
	PERÇAGES ET DECOUPES DRILLING AND CUT OUT			

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SETTING, COMMISSIONING AND MAINTENANCE

OF MACHINE DIFFERENTIAL PROTECTION

DTM 7031

S U M M A R Y

I - DESCRIPTION OF THE DTM 7031 RELAY

- 1.1 - Identifying label
- 1.2 - Potentiometers
- 1.3 - Mechanical operation indicator

II - COMMISSIONING OF THE DTM 7031 RELAY

- 2.1 - Relay connections
- 2.2 - Setting

III - TESTS

- 3.1 - Important recommendations
- 3.2 - Preliminary checks
- 3.3 - Checking the relay itself
- 3.4 - Electrical tests on the relay
 - 3.4.1 - General
 - 3.4.2 - Checking differential operating level
 - 3.4.3 - Checking operating time
 - 3.4.4 - Checking restraint setting
- 3.5 - Testing the breaker trip

IV - ANALYSIS OF ABNORMAL SITUATIONS

I - DESCRIPTION OF THE DTM 7031 RELAY

The general publication n° 1745 describes the characteristics and application of this relay.

1.1 - Identifying label

This carries the following information :

- the type of relay, followed by a letter indicating the type of contacts on the output unit, then the number of the wiring and operation diagram
- the nominal value of current (50 or 60 Hz),
- the nominal auxiliary voltage,
- the serial number preceded by a letter referring to the year of manufacture (eg. U for 1981) and followed by a letter indicating the model 115 index at the time of manufacture.

1.2 - Potentiometers

The potentiometers, accessible after removing the faceplate, provide continuous adjustment of the different operating and restraint levels.

Their references on the faceplate are as follows :

- | | | |
|-------|---|---|
| - ID% | A |) settings, as a percentage of nominal current |
| - ID% | B |) of the differential level for phases A, B and |
| - ID% | C |) C. |
| | | |
| - IR% | A |) settings, as a percentage of nominal current, |
| - IR% | B |) of the restraint for phases A, B and |
| - IR% | C |) C. |

1.3 - Mechanical operation indicator

A mechanical operation indicator, whose position is visible through window, indicates operation of the output unit. It may be reset using a push-button close to the window, and which acts only on the operation indicator. If the operation indicator is not reset, this does not prevent the network being put back into service, nor further operation of the relay or its output unit.

II - COMMISSIONING THE DTM 7031 RELAY

2.1 - Relay connections

The relay connections must be in accordance with the connection diagram supplied with the relay, and whose number is given on the identifying label.

2.2 - Setting

Set the potentiometers for the operating level and bias for each phase to the values calculated in the study of the corresponding network. In the absence of any particular restrictions, for use at the nominal operation of the machine, and with identical current transformers at each extremity, an efficient and sensitive protection may be achieved using an operating level of 3% and a bias of 5%.

III - TESTS

3.1 - Important recommendations

WE STRONGLY ADVISE AGAINST TESTING THE RELAY WITHOUT ITS BASE BY PLUGGING STANDARD COMMERCIALY AVAILABLE PLUGS OR LEADS DIRECTLY INTO THE FEMALE SOCKETS OF THE RELAY TERMINALS.

In the event of an auxiliary voltage higher than 125V, an external resistor must be connected in series with the auxiliary supply circuit. This resistor is supplied with the relay, and its value is indicated on the identifying label.

All our relays are supplied sealed after calibration and final inspection in our works. These seals should be broken for commissioning by a qualified person.

3.2 - Preliminary checks

Check that :

- the nominal current of the relay (1A or 5A) corresponds to the current transformer nominal secondary current,

- the auxiliary supply is that given on the identifying label on the relay. Remember that relay operation is ensured for any auxiliary voltage value in the range ± 10 to $\pm 20\%$ of the nominal voltage.

3.3 - Checking the relay itself

Check systematically that :

- the relay has not apparently been mechanically damaged during transportation, mounting or handling,

- the relay has not been stocked for a long period in humid or dusty conditions without the cover correctly fitted,

- the relay is correctly plugged in, and that the four fixing rods are screwed tight home in order to ensure that the short-circuits are removed from the current input circuits.

After having removed the faceplate, check that :

- the mechanical operation indicator falls when the armature of the electromagnetic output unit is pressed home using a pointed tool,

- the contacts on the electromagnetic output unit are apparently in good condition.

3.4 - Electrical tests on the relay

3.4.1 - General

In order to test this relay, it is necessary to have available a single phase current source to check the differential levels, and also two sources capable of recreating the line currents and the differential current to check the percentage bias.

NOTE : The test set type T/D available from C.E.E. is suitable for all tests.

3.4.2 - Checking the differential operating level

The differential operating level of this relay should be checked on each phase by injecting successively into terminals 2 and 15, 6 and 19, 10 and 23 using the current source. The output unit should pick up for a value of current equal to that set on the 10% potentiometers, with a tolerance of $\pm 5\%$. (or $\pm 2\text{mA}$ for a differential level set between 2 and 4% for a 1A relay, or $\pm 10\text{mA}$ under the same conditions for a 5A relay).

3.4.3 - Checking the operating time

Preset the current source, on one of the phases, at 5 times setting

Inject this current, simultaneously starting the timer. This latter must be stopped by the change of state of the contacts on the output unit. The time should be $40\text{ ms} \pm 10\%$.

3.4.4. - Checking the restraint setting

3.4.4.1 - If two current sources are available, connect up the circuit shown in fig. 1, successively on each of the three phases.

- the two current sources must be in phase,
- the directions of circulation of the currents I_1 and I_2 must be respected,
- if necessary, add a resistor in series with the I_2 current source in order to avoid one source forcing a current into the other.

Adjust current I_1 at twice nominal current, then vary the current I_2 until the output unit operates. The value of I_2 determined is :

$$I_2 = IN \left[ID + IR (I_1 - 0.5) \right]$$

where IN = relay nominal (1A or 5A)

ID = differential setting in percent.

IR = Restraint setting in percent.

I_1 is set to twice nominal current, therefore

$$I_1 - 0.5 = 2 - 0.5 = 1.5.$$

For a through current I_1 different from twice nominal current, this formula can also be applied, although accuracy will not be as high (see the operating curves given in the general publication n° 1745, which illustrate that the restraint curve tends progressively towards the differential setting, but is not a perfectly straight line).

3.4.4.2 - If a T/D test set is available, set up the circuit shown in fig. 2, successively on each phase.

Adjust currents I_1 and I_2 (D Case) at twice the relay nominal current. Vary the differential current ID using the T/D case until operation of the output unit is attained. In this case, the currents will have varied in opposite directions, and the tripping level obtained is :

$$ID : IN \left[ID + IR \left(\frac{I_1 + I_2}{2} \right) - 0.5 IR \right]$$

where IN = relay nominal (1 or 5A)...

ID = differential setting in per unit

IR = restraint setting in per unit

$$\frac{I_1 + I_2}{2} \text{ is set to twice nominal, therefore } \frac{I_1 + I_2}{2} - 0.5 = 2 - 0.5 = 1.5$$

3.5 - Testing the breaker trip

During such tests as those above, the trip circuit of the breaker may be checked by putting the latter into its test position.

Close the breaker electrically, and then check that the contact on the electromagnetic output unit cause a breaker trip.

IV - ANALYSIS OF ABNORMAL SITUATIONS

If, during the above tests, the relay has not operated, check :

- that the auxiliary voltage supplies the relay correctly. This may be done by inserting a milliammeter in series with the auxiliary supply circuit

- that the relay is correctly plugged in (the four fixing rods must be screwed tight home). If the relay is not completely plugged in, the current transformer shorting links will not be opened.

- that the wiring on the measuring inputs is continuous (terminals correctly crimped, screws tightened, etc ...).

If, when commissioning the installation, the relay causes spurious tripping, check :

- that the relay is correctly plugged in,
- that the wiring is continuous,
- that the relay connection is correct, and that there is no inversion between the restraint inputs (2-3, 6-7, 10-11) and the differential inputs (15, 19, 23).

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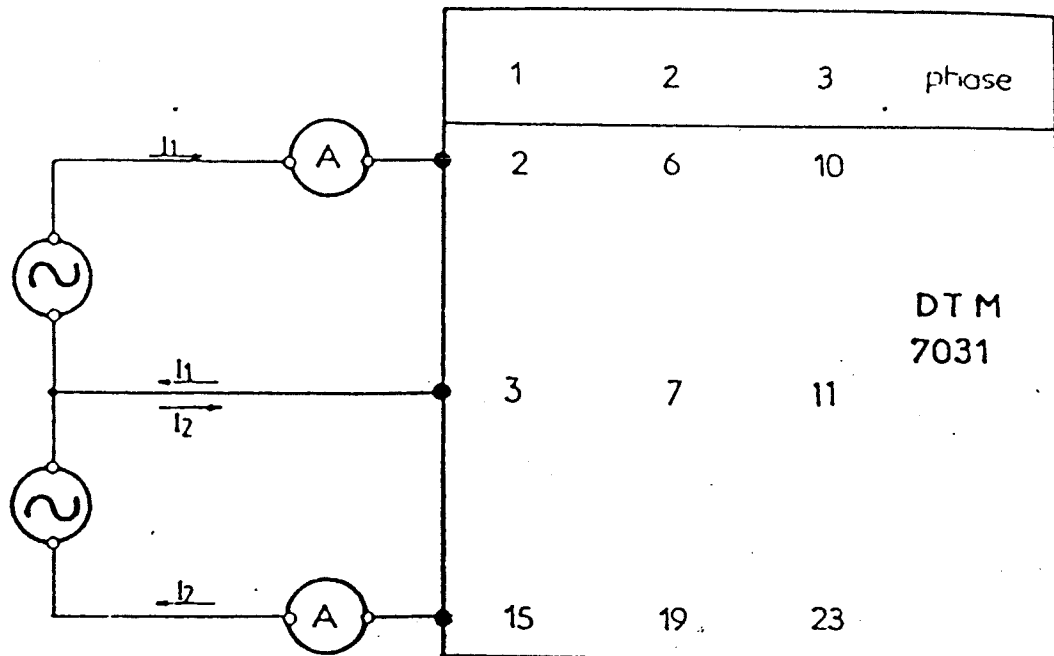


FIG. 1

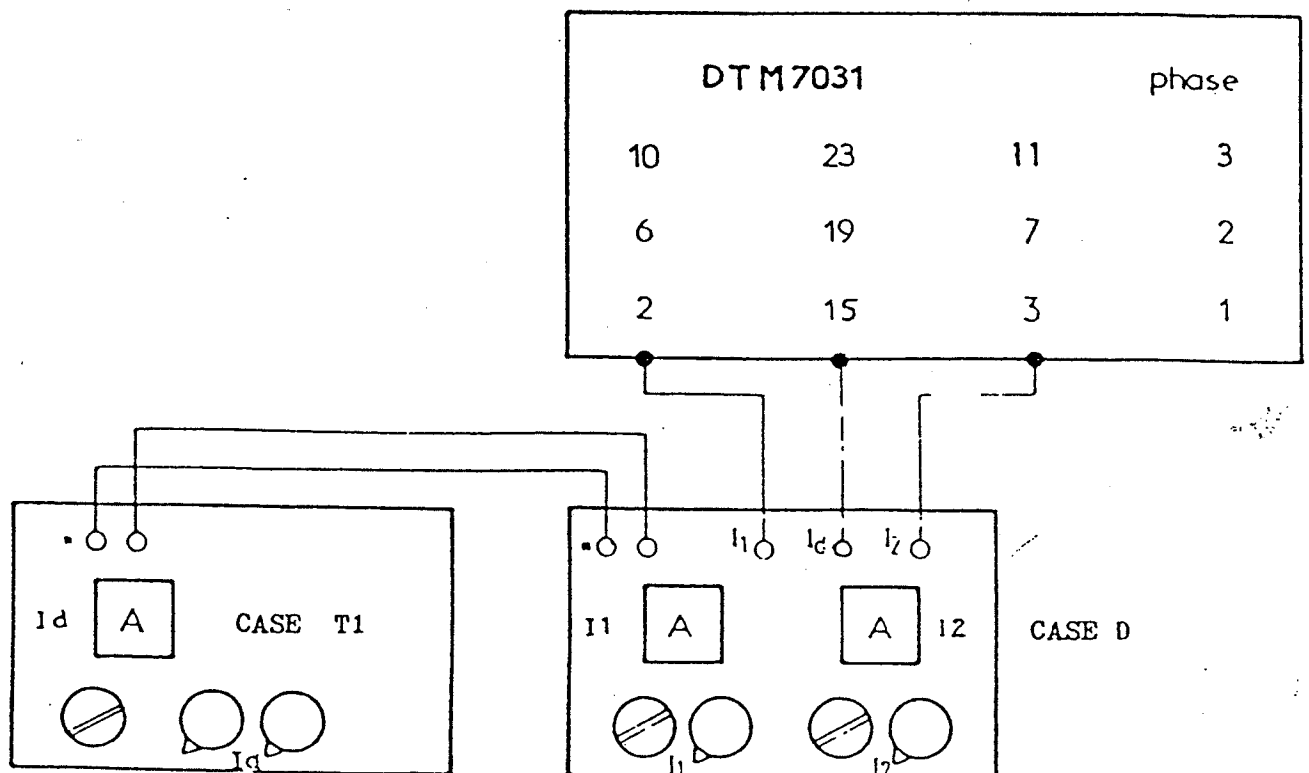
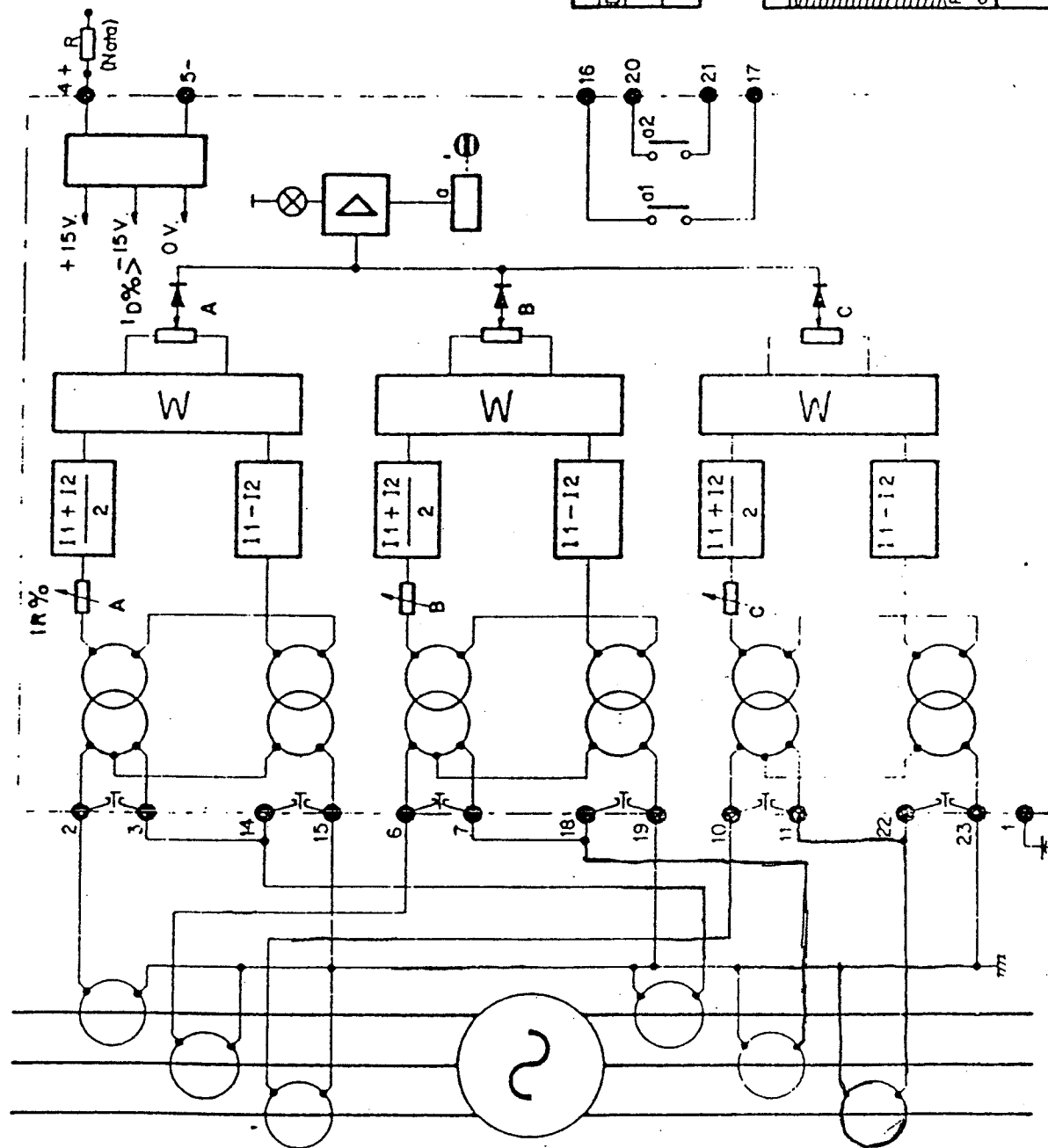


FIG. 2

ENSITE MINALE		RATED CURRENT
1 A.		a
5 A.		b
SEUIL		SETTING
2 - 15% In		a
10 - 40% In		b
TENUE		RESTRAINT
2 - 20% In		a

DTM7031

(87)



CONTACTS	
DTM7031A	DTM7031B
01	01
02	02

BOITIER R3 / CASE R3	
SD	SD
PAV	PAV
Project front connect	Project rear connect
Flush rear connect	Flush rear connect

D.9372

B 3.7800	D 13081	DESSINE	VERIFIE	APPROUVE
C1236A		H D		

NOTA: R - résistance extérieure fournie par nos soins (plan n° 8609)
R - external resistor of our supply (drawing n° 8609)

NSION XILIAIRE		AUXILIARY SUPPLY
48 V.		a
60 V.		b
110 V.		c
125 V.		d
220 V.		e

