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INSTRUCTIONS FOR THE COMMISSIONING AND MAINTENANCE OF DIGITAL PROTECTIONS FOR SYNCHRONOUS MACHINES

GMS 7002

M.1813/AA.XE - 06/96

V - TESTING - COMMISSIONING

VI - ABNORMAL SITUATIONS

I - PRINCIPLES AND APPLICATIONS

GMSx7002 series relays are designed to protect synchronous motors, driving centrifugal or piston compressors, crushers, or any other type of mechanism connected to three phase 50 Hz or 60 Hz networks.

Using microprocessor technology, the GMSx7002 samples the applied signals and produces current and voltage vectors as a result of Fast Fourier Transform (F.F.T.): from the resulting values the relay derives the symmetrical components and the real power of the network supplying the motor.

The GMSx7002 is remarkable firstly because of its wide range of operating frequency (8 Hz - 70 Hz) making it particularly suitable to supervise machines of which the frequency can vary widely. Furthermore, the GMSx7002 has a high level of insensitivity to 3rd harmonic currents which enables low earth fault settings to be applied.

The GMSx7002 series is made up of two families :

- The GMS7002, used when the 3 phase voltages are available (3VTs/distributed neutral) and when the zero sequence voltage, manufactured by an internal summation, is used as a characteristic value in the operation of the relay.

- The GMSH7002, used when the 2 phase to phase voltages are available and when zero sequence current is used as a characteristic value in the operation of the relay.

The GMSx7002 groups together all of the protection functions normally required on a synchronous motor with the exception of the stator differential protection (kept separate in order to ensure redundancy in the protection system) and the detection of insulation faults in the rotor which uses special operating principles and measurement quantities.

The following table summarises the protection functions covered by the GMSx7002 family:

Functions	ANSI code	GMS 7002	GMSH 7002
Thermal Image Overload	49	x	x
Negative phase sequence over current	46	x	x
Over current	50	x	x
Over voltage	59	x	x
Over fluxing (v/f)	24	x	x
Under voltage	27	x	x
Under and over frequency	81	x	x
Under and over power	32	x	x
Neutral displacement over voltage	59G	x	
Earth fault	64		x
Loss of synchronism	55	x	x
Too long start over current/Locked rotor	51-LR	x	x

Thermal image overload (49)

The GMSx7002 produces a thermal image of the motor from an appropriate combination of the positive and negative phase sequence components of the stator current.

The equivalent thermal current I is given by the formula:

$$I = \sqrt{I_{Pos}^2 + K^2 I_{Neg}^2}$$

where I_{Pos}: positive phase sequence current,

I_{Neg}: negative phase sequence current,

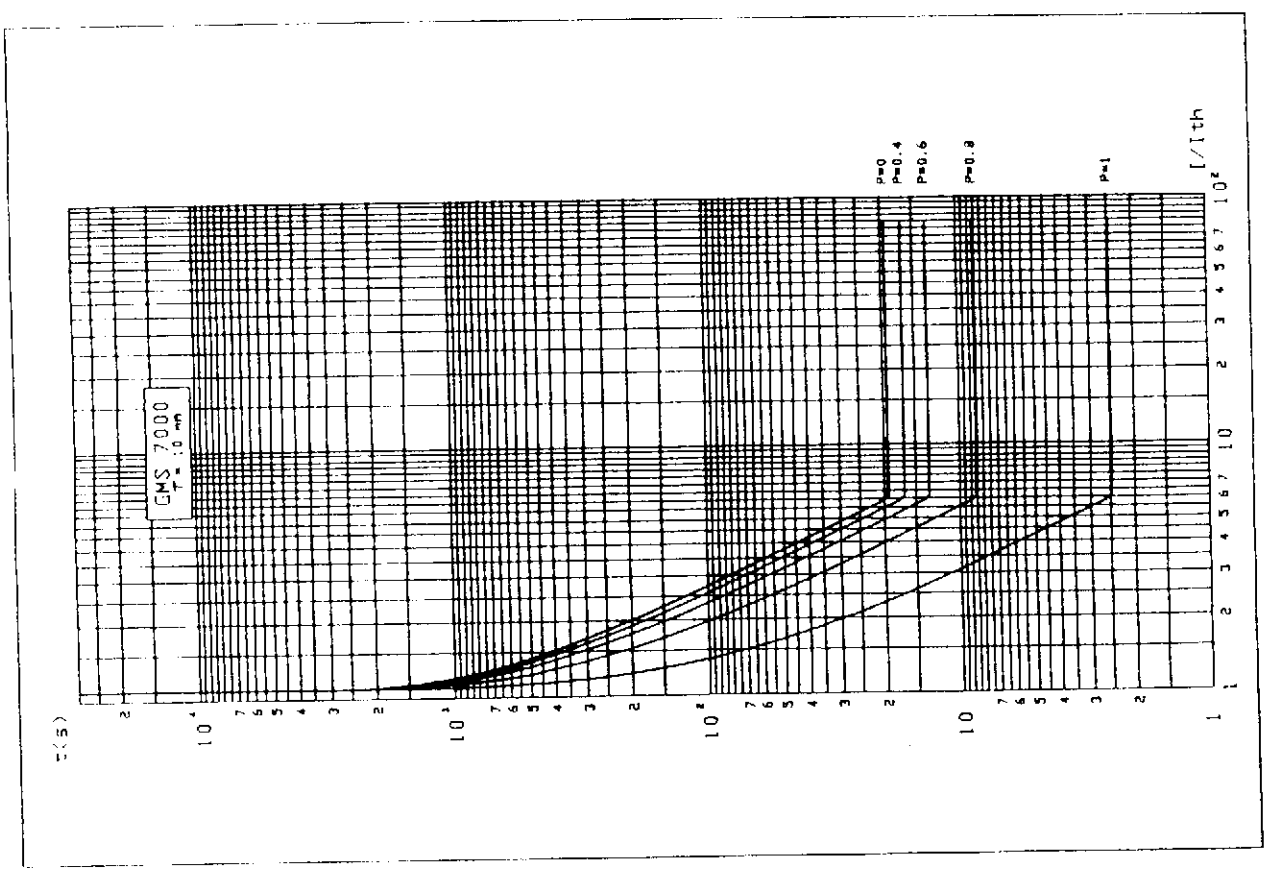
K^2: weighting factor for the negative phase sequence current heating effect, adjustable from 4 to 16.

The heat exchanges in the machine as well as pre-load conditions are allowed for in the form of a thermal time constant τ adjustable from 4 to 240 minutes.
A thermal alarm adjustable from 80 to 100% of the rated thermal state is provided.

See the thermal image operating curves in Fig 1.

Fig 1. - Thermal Image (49) - IEC 255-8 Thermal image operating curve

For other values of τ multiply the times given by the curves by $\tau/10$



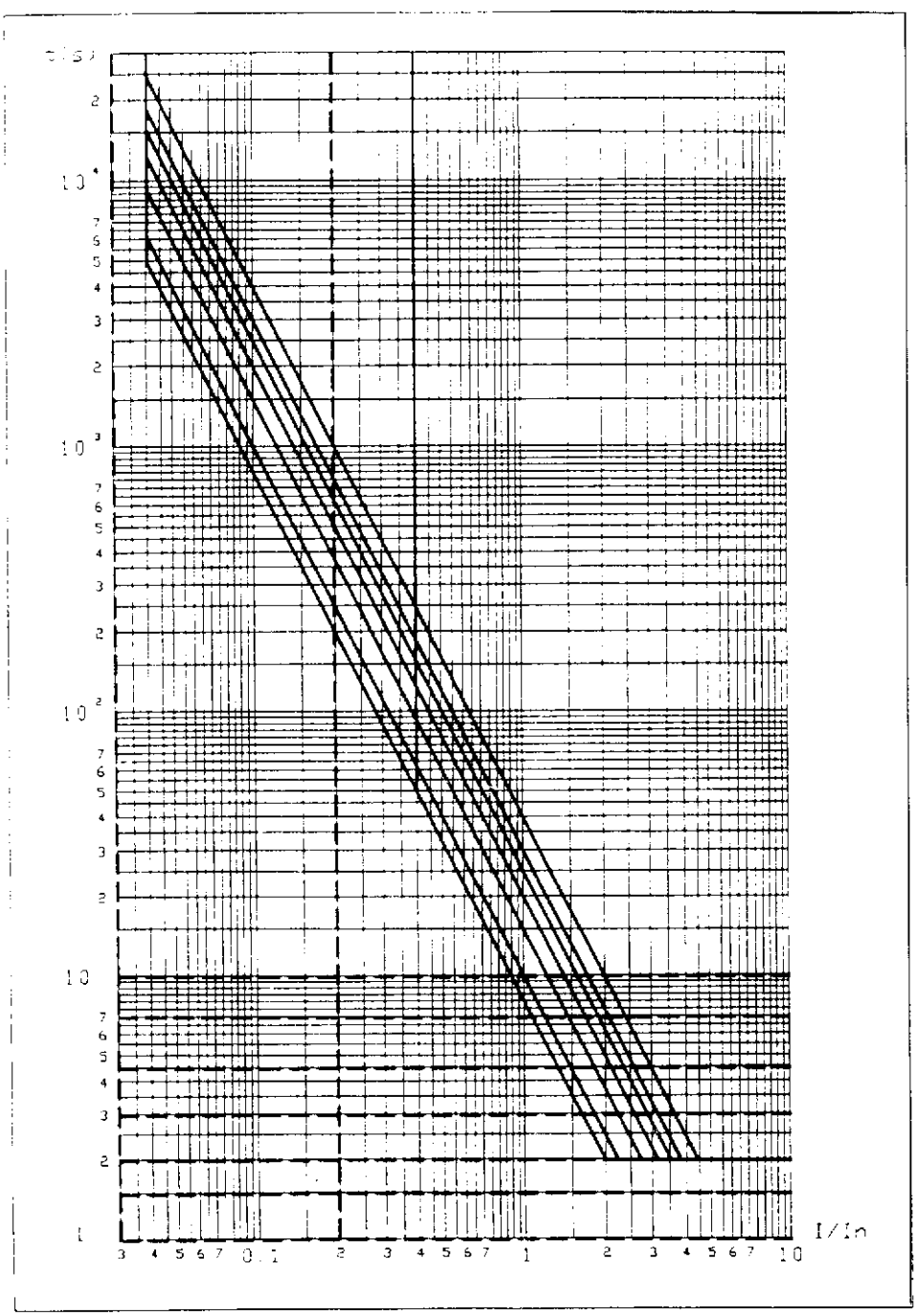
Negative phase sequence over current (46)

The GMSx7002 protects the rotor against these unbalanced conditions by an inverse time over current characteristic which follows the above law exactly with a constant C, adjustable from 8 to 40 seconds (See figure 2). This function is also equipped with a start operating level, adjustable from 4 to 40% In; and a definite time alarm level, adjustable from 3 to 20 % In, completes the protection.

Formula for the inverse time curve : $(I_{Neg} / In)^2 * t = C$

where : I_{Neg} : negative phase sequence currents
t : motor withstand (seconds)
C : constant related to the type of motor (seconds)

Figure N°2 - Negative phase sequence over current (46) - Current/time operating characteristic



Too long start over current [51-1LR]/Locked rotor [51-2LR]

The starting period is characterised by the flow of a current greater than rated current. Monitoring of the starting time and the associated current is needed to avoid overheating dangerous to the machines insulation and to the rotors mechanical withstand.

With this in mind, the GMSx7002 is equipped with a Too long a start element which uses an extremely inverse three-phase over current measuring unit [51-1 LR] (see curves, Fig.6). This unit is brought into operation by a circuit breaker auxiliary contact, connected to the relays V input and indicative that the motors starting sequence has commenced. If this sequence continues normally, this unit is inhibited after a time delay Td set by the user. If this is not the case, a trip command is sent to the circuit breaker.

A motor subject to a mechanical problem which causes the rotor to lock, must be disconnected as quickly as possible as the temperature of the rotor, when not forced cooled, can reach a destructive level. The GMSx 7002 has a definite time over current element [51-2LR] to trip the machine rapidly if it absorbs a current greater than its setting.

This unit [51-2LR] is automatically brought into operation at the end of the time delay Td.

For both units, the possible settings are as follows:

Td adjustable from 2 to 400s

- function [51-1LR]

IST>adjustable from 0.5 to 2IN

tIST>adjustable from 0.1 to 3s

-function [51-2LR]

ILR>adjustable from 2 to 10IN

tILR>adjustable from 1 to 5s

Over current (50)

Violent phase faults on synchronous motors have to be eliminated as quickly as possible. The GMSx7002 detects and eliminates these faults using a three phase high speed over current element. The current setting should be approximately 20% greater than the short circuit current generated by the machine for a solid fault at its terminals in order to avoid any unwanted operation for an external fault and during asynchronous starting.

This unit is adjustable from 2 to 12IN with a 100ms fixed operating time.

Over voltage (59)

The GMSx 7002 is equipped with an "Over voltage" function with two operating levels providing a time delayed protection for low levels of over voltages (limited to less than approximately 120/130% of the rated voltage) and a fast protection for higher over voltages (GMS 7002: three phase detection, GMSH7002: two phase detection).
The two voltage threshold settings V> and V>> are adjustable from 70 to 150% Vn.

Over fluxing (24)

These devices monitor the image of the flux density Φ by generating a U/f> threshold setting of 50 to 150% order to protect the motors against overfluxing.

Under and Over frequency (81)

The GMSx7002 supplement the mechanical protection with a 2 operating level frequency function, adjustable as "Over" or "Under" frequency between 44Hz and 66Hz.

Loss of synchronism (55)

When there is an increase in mechanical power, such that the maximum rotor angle cannot be compensated for, the machine loses synchronism.
The result is an increase in the stator current, increased heating in the rotor, severe over voltages in the field circuit and high levels of mechanical vibration. For these reasons, it is important to trip the machine.

GMSx7002 relays use the apparent power S = P + jQ, to protect synchronous motors against loss of synchronism (see Fig.3). The trip zone allows the synchronous motor to supply the real power P demanded by the motor load and, where necessary, allows positive or negative reactive power Q compensation.

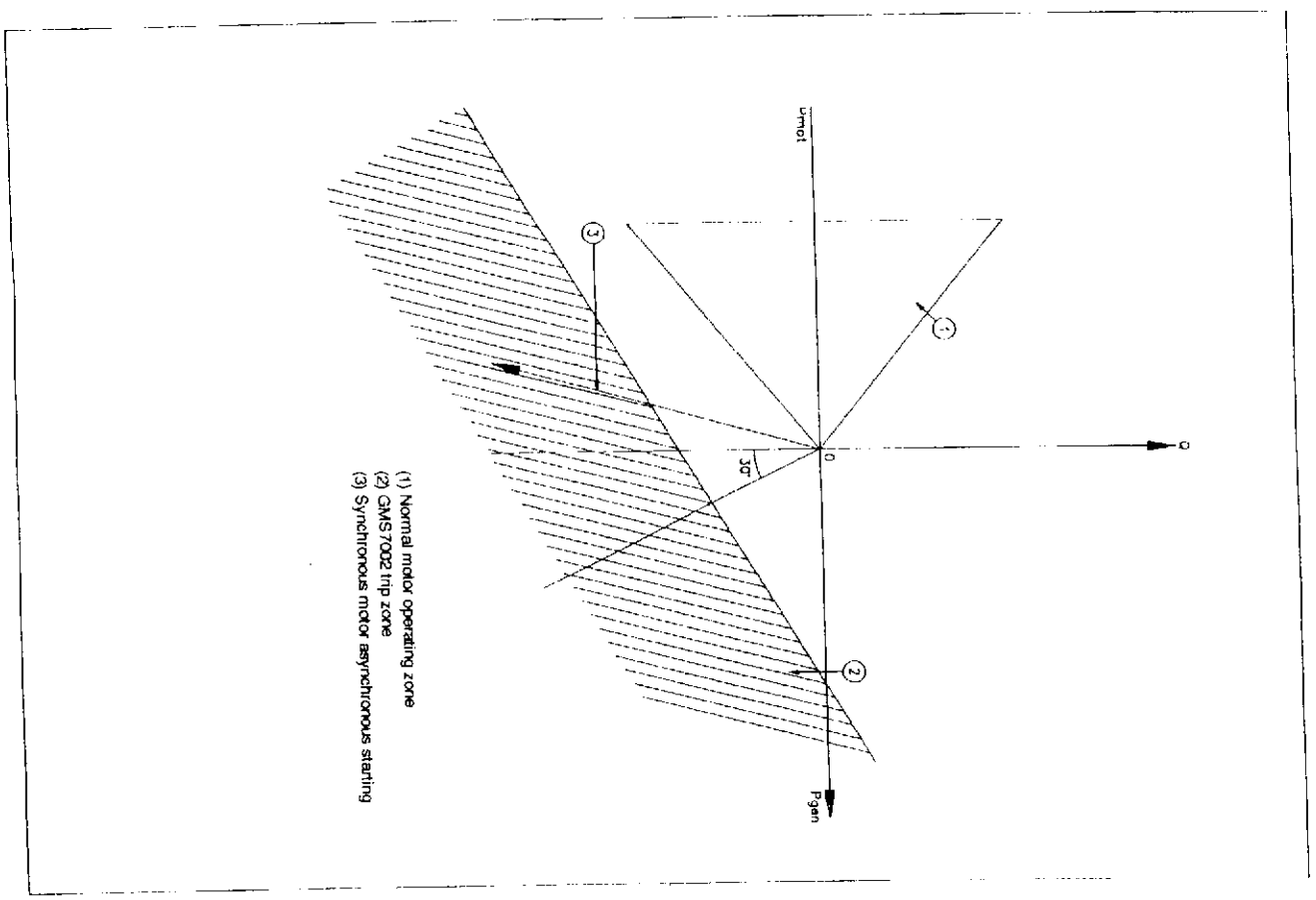
As with the loss of synchronism, the reactive power can swing (but in general is absorbed for the majority of time), the GMSx7002s time delay system integrates these successive passages into the trip zone.

Operating characteristics :

- operating level SY>, adjustable from 0.2 to 0.8SN,
- time delay following entry into the operating zone tSY> adjustable from 0.1 to 10s,

the reset time constant when outside the operating zone is equal to 10 times the chosen operating time.

Fig.3 - Operating zone of loss of synchronism protection (55) on a P/Q diagram



Under and Over power (32-2)

The GMSx7002 can send an alarm to the operator or can assist certain control sequences upon the real power exceeding a given operating level.
This function can be configured as "Over power" or "Under power" by the operator, with a setting range of 30 to 120% Sn.

Neutral displacement over voltage (59 G)

The GMS7002 recreates the zero sequence voltage by summing the 3 phase voltages supplied by voltage transformers connected to the motors terminals.
The "Neutral displacement over voltage" provided by these relays is equipped with two separate operating levels which can be used as alarm and trip functions.
Digital filtering enables the effect of 3rd harmonic voltages to be eliminated.
The operating levels are adjustable from 3 to 15% Vn and 6 to 30% Vn.

Earth fault (64)

The GMSH7002 protects the motors against phase to earth faults using its definite time or inverse time "Earth fault" function (see Figures 4, 5, 6). By using a toroid, the GMSH7002 can detect fault currents of 1 A, and remain insensitive to the influence of 3rd harmonic currents thanks to digital filtering techniques (setting range 1 to 20A).
When using the residual connection of 3 line cts, or the connection to a star point ct, the setting range is 5 to 100%IN.

Fig.4 - Over current (51) - IEC 255-4 Inverse time curve

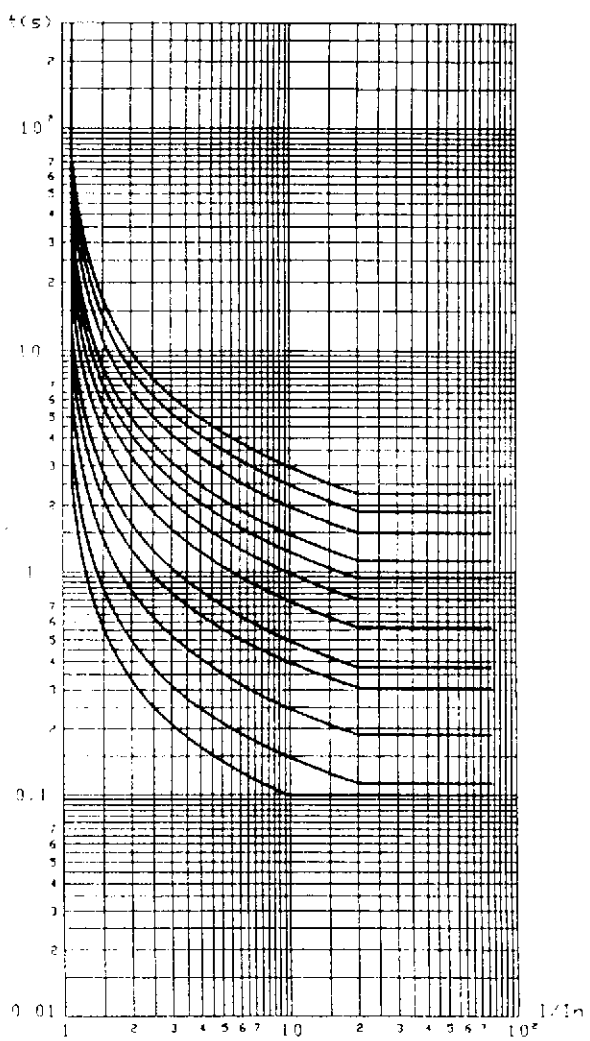
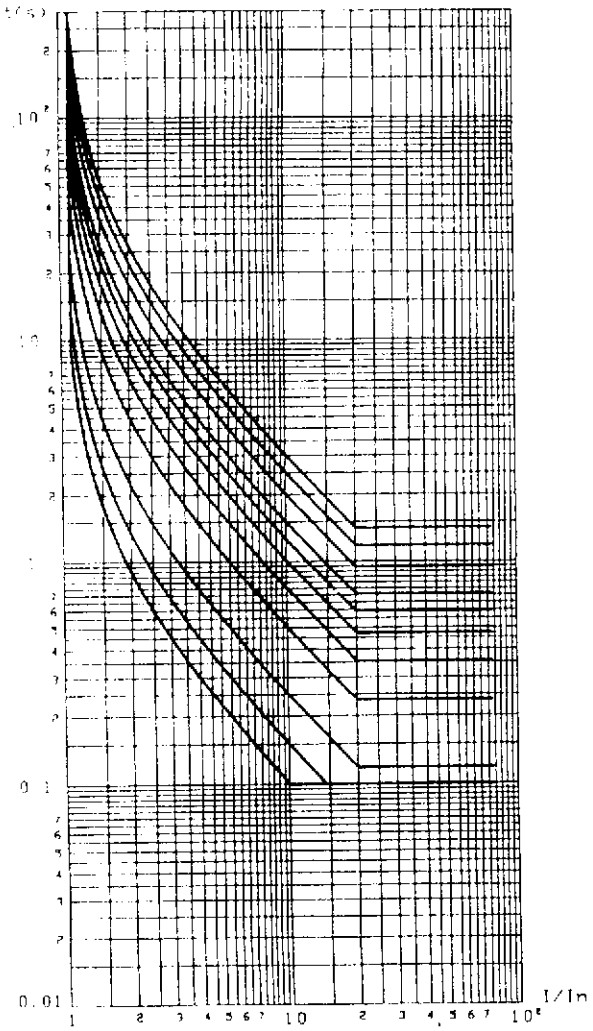


Fig.5 - Over current (51) - IEC 255-4 Very inverse time curve



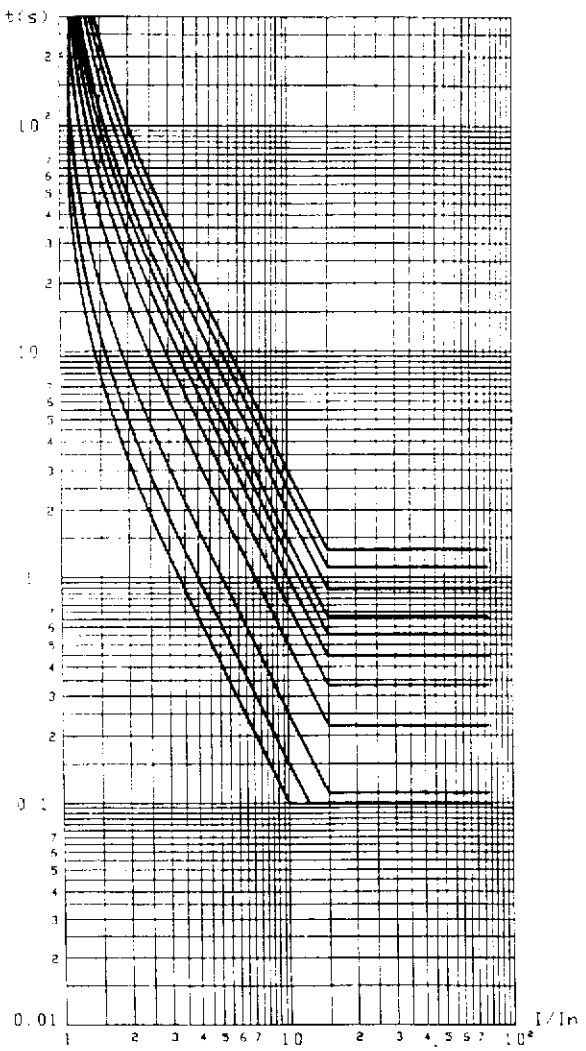


Fig.6 - Over current (51) - IEC 255-4 Extremely inverse time curve

Communications

.Local communication

Dialogue between the user and the equipment is ensured by means of a 16 key keyboard and a 16 digit display, which may be used to set up and read back all of the quantities, recorded, calculated or measured by the device.
Alarms and trip conditions are indicated by LEDs on the front plate, as well as on the display.

.Communication by digital channels

The GMSx7002 case is equipped with 2 types of serial communications channels:
-1 RS232-C/DB9 on the face plate enabling the relay to be directly connected to a PC
-1 (0-20mA) current loop (2 sockets) enabling the relays to be connected into a communications network.

.Communication by "all or nothing" channels

- Inputs : The GMSx7002 relays accept two volt free contact inputs which control the temporary inhibition of certain functions when this contact is closed (motor run up sequences, etc....) See § IV-3
-Outputs: The device is fitted with 3 trip output units (A-B-C) , 2 alarm and signal relays (D-E) and a watch-dog relay (W).

II - MECHANICAL INSTALLATION

II-1 Introduction

All parts necessary for the physical mounting of the relay (in the version ordered) are part of the package as supplied, including the screws for the terminals.

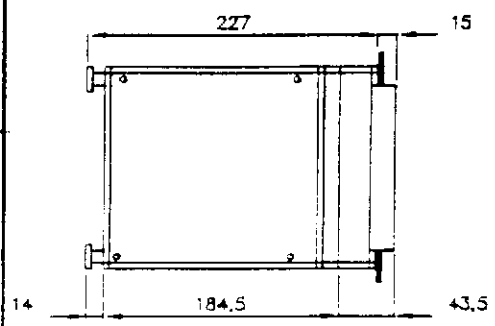
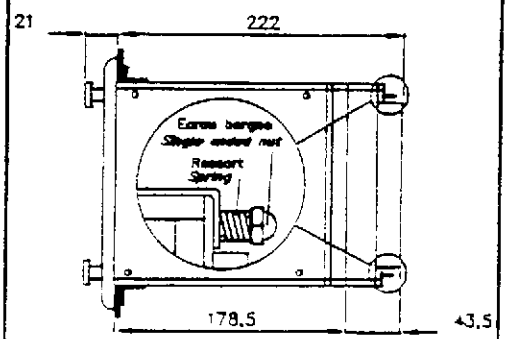
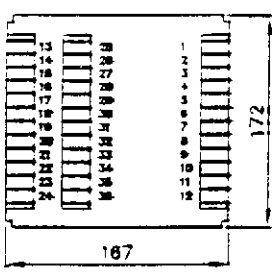
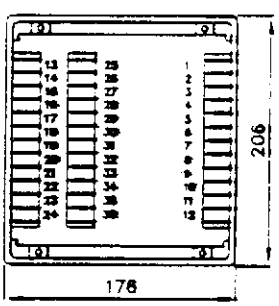
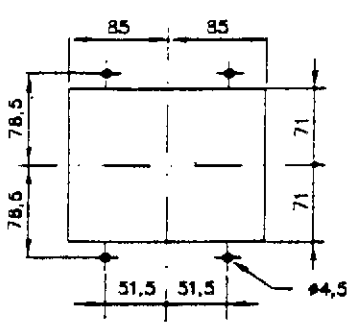
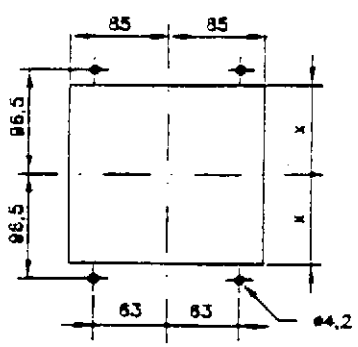
When plugging the relay in, check that the "current loop" plug locking clips are horizontal so as not to obstruct the operation.

After plugging in, it is important to fully screw home the fixing rods, which can be done by using a flat 3.5 mm screwdriver.

All relays are delivered complete with a lead-seal applied after the final factory inspection. The lead seals should only be broken when the units are put into service by personnel qualified for such an operation.

IMPORTANT:
We strongly advise against testing the relay without its base by using standard commercially-available plugs or leads directly into the female connectors of the relay.

H-2 Physical dimensions

	ENCOMBREMENTS / *CASE DIMENSIONS*	
	Saillie prises arriere / *Projecting rear connection*	Encastre prises arriere / *Flush rear connection*
RACCORDEMENT par vis ⌀M4 / *SCREW CONNECT. M4*		
R4		
	PERCAGES ET DECOUPES / *DRILLING AND CUT-OUTS*	
R4	 VUE DE FACE / *FRONT VIEW*	 X= 89 pour panneau epr ≤ 2 *89 for panel thh. ≤ 2* X= 90,5 pour panneau epr > 2 *90,5 for panel th. > 2*
Ind.A 21.10.92		

III- ELECTRICAL INSTALLATION

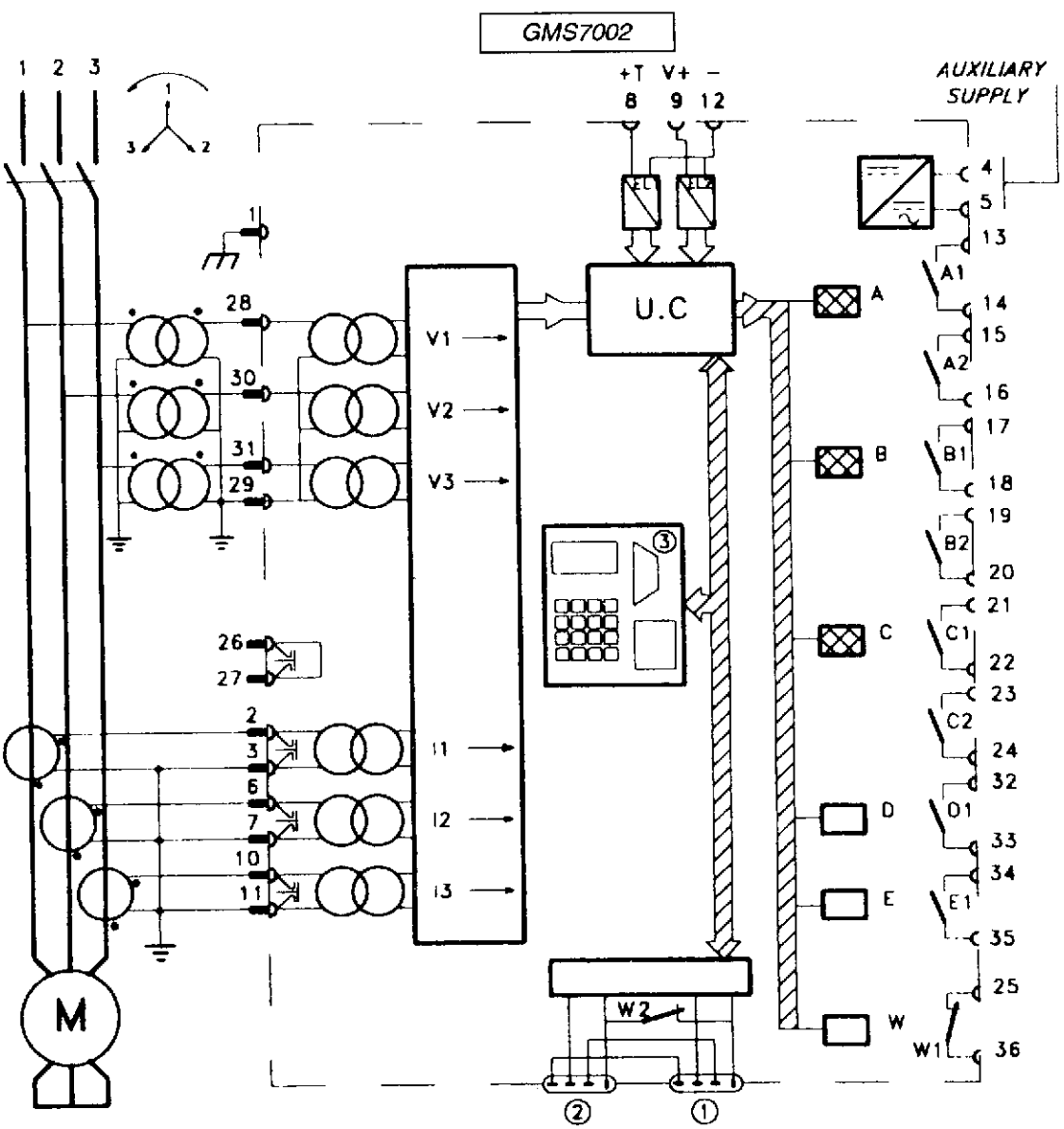
III-1 Introduction

Using the connection diagram in § III-2 (and the communications network diagram where appropriate), make the various connections using the terminal references given in § III-3.

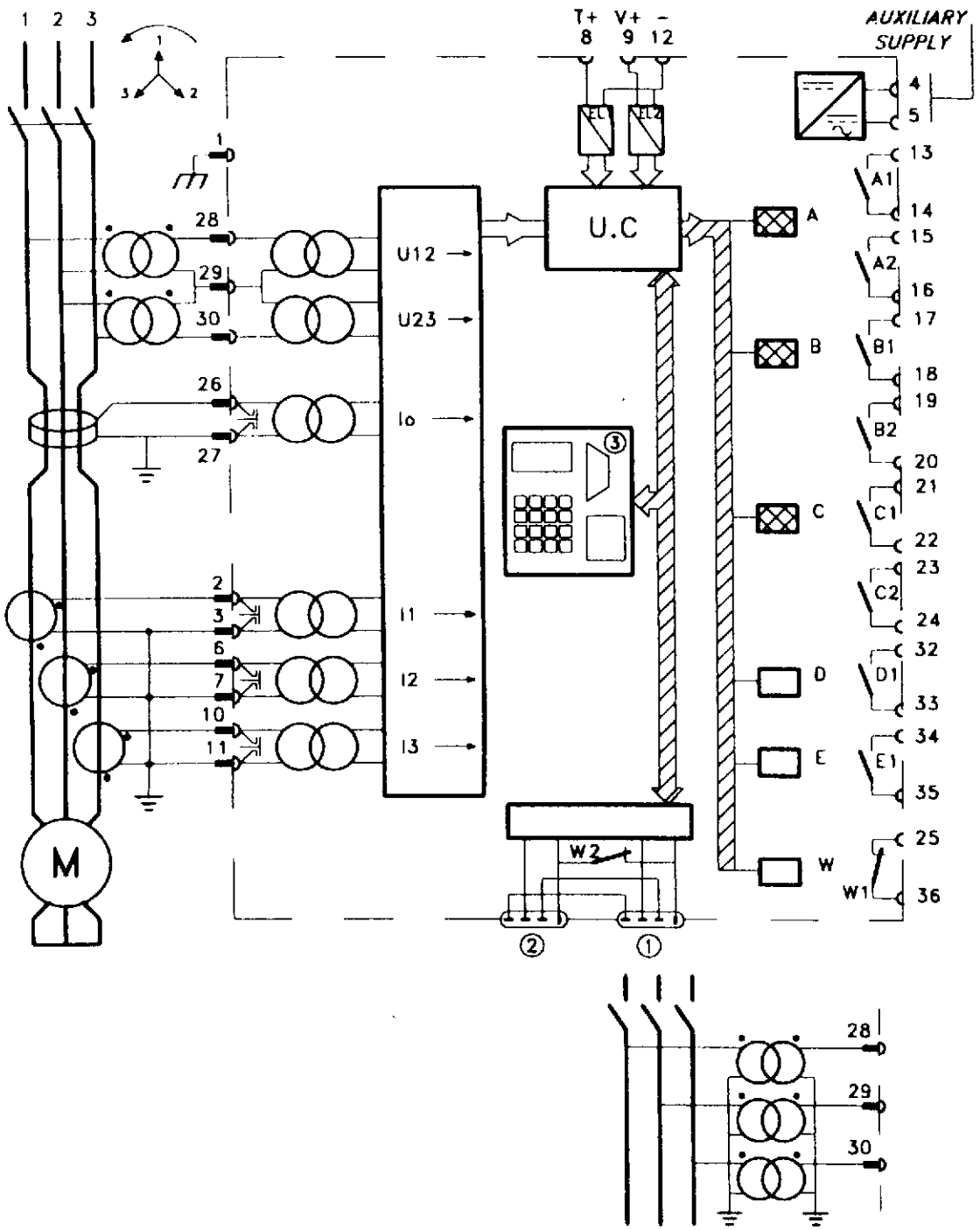
RECOMMENDATIONS

Before commissioning, it is important to check that:
- the potential transformers have a secondary rated voltage the same as that indicated on the relay rating plate,
- the current transformers have a secondary rated current the same as that indicated on the relay rating plate,
- the frequency of the network is identical to that indicated on the rating plate,
- the wiring connections agree with the diagram,
- the auxiliary voltage and its operating range are well within the range indicated on the rating plate,
- the relay is correctly plugged in, and that the fixing rods are fully screwed in.

III-2 Wiring diagrams



GMSH7002


1 2 3
T+ V+ -
8 9 12
AUXILIARY SUPPLY
4
5
13
A1
14
15
A2
16
17
B1
18
19
B2
20
21
C1
22
23
C2
24
32
D1
33
34
E1
35
25
W1
36
U.C
A
B
C
D
E
W
U12
U23
Io
I1
I2
I3
28
29
30
26
27
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3
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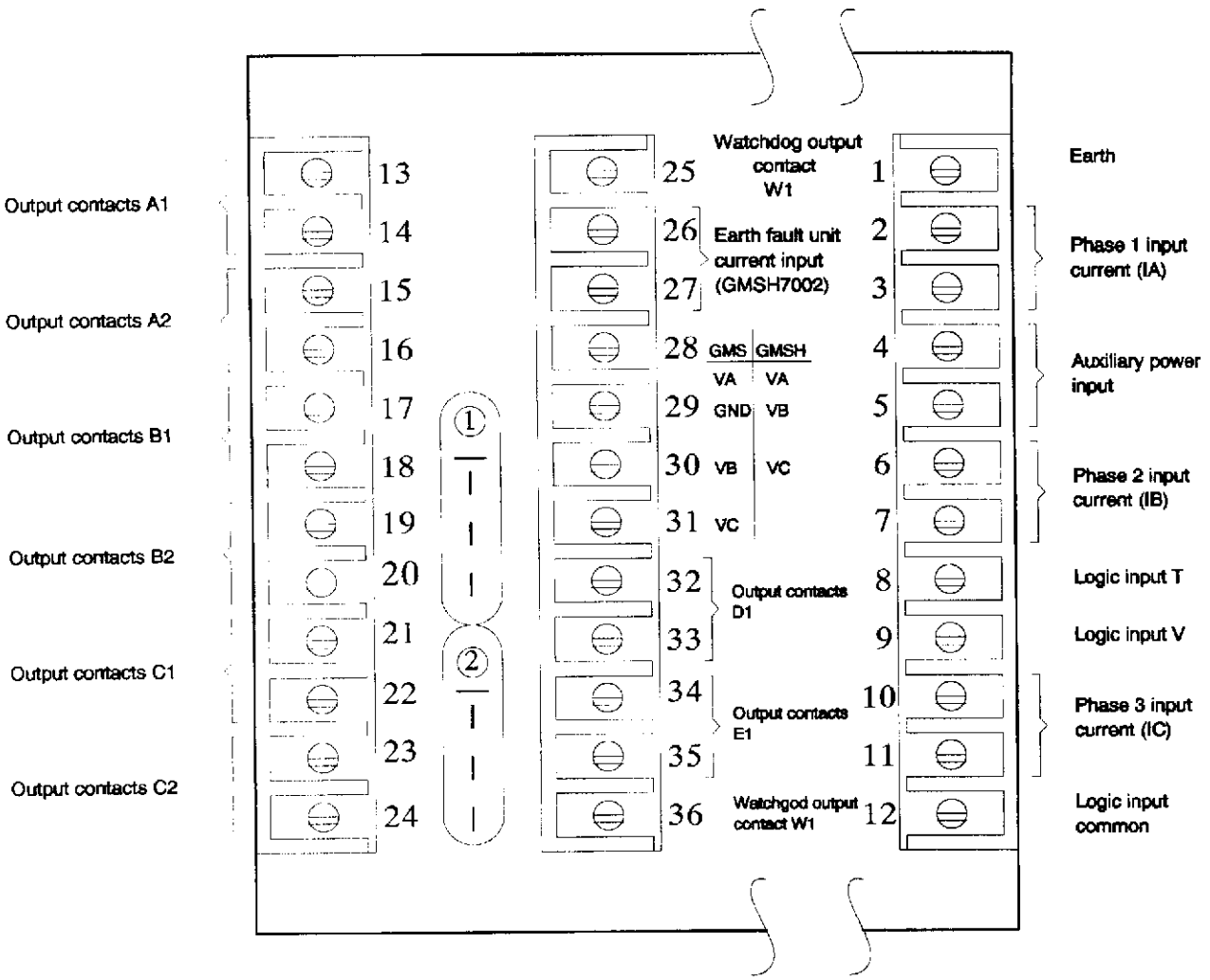
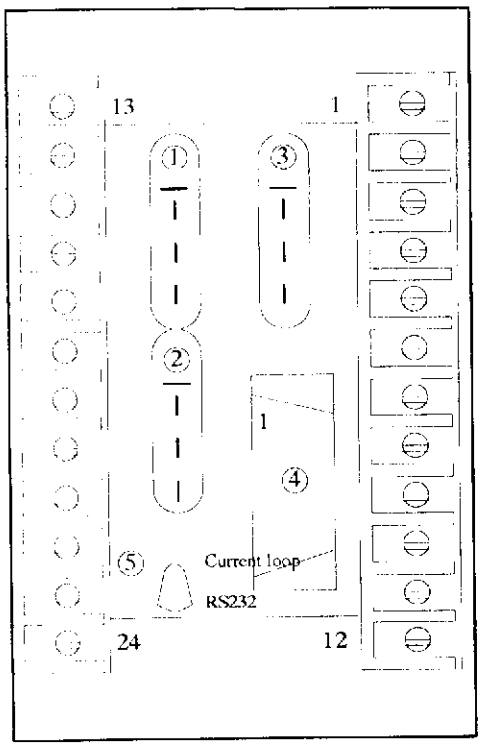
11
1
M
W2
EL1
EL2
③
②
①

III-3 Terminal block layout



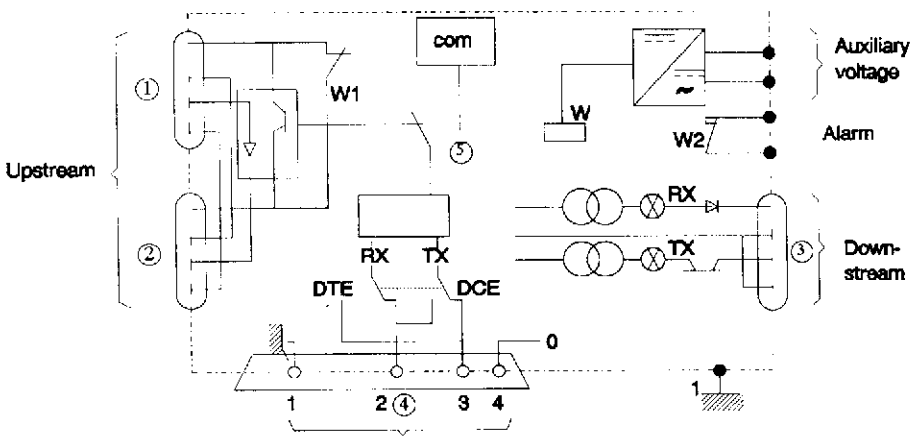
Connectors 1 and 2 are dedicated to upstream current loop communication (slave)
-Plug 1: Input from the master or the upstream device
-Plug 2 : Output to the downstream device or end-of-loop plug

III-4 Communications installation

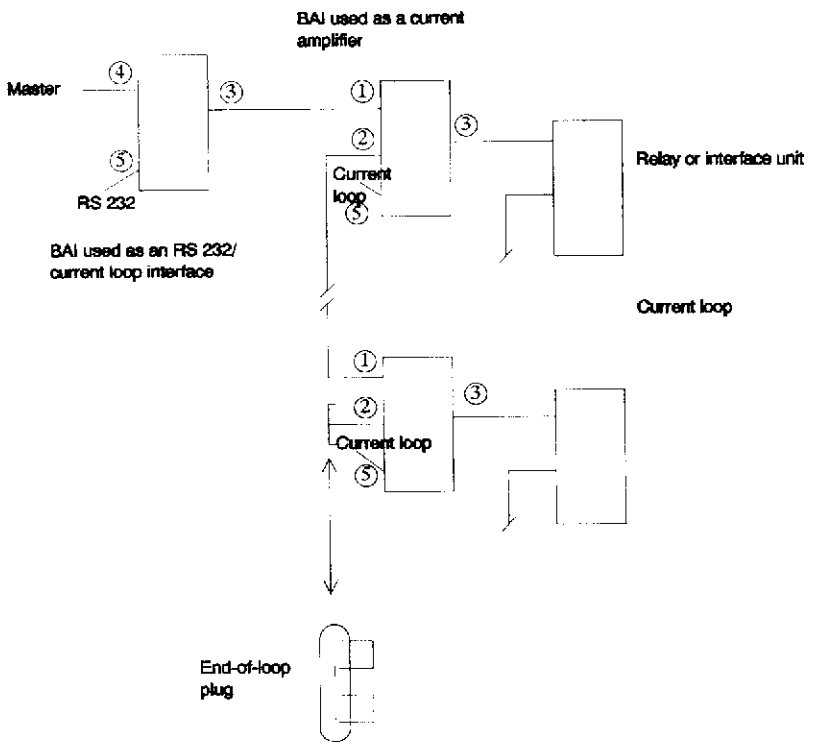


Rear view

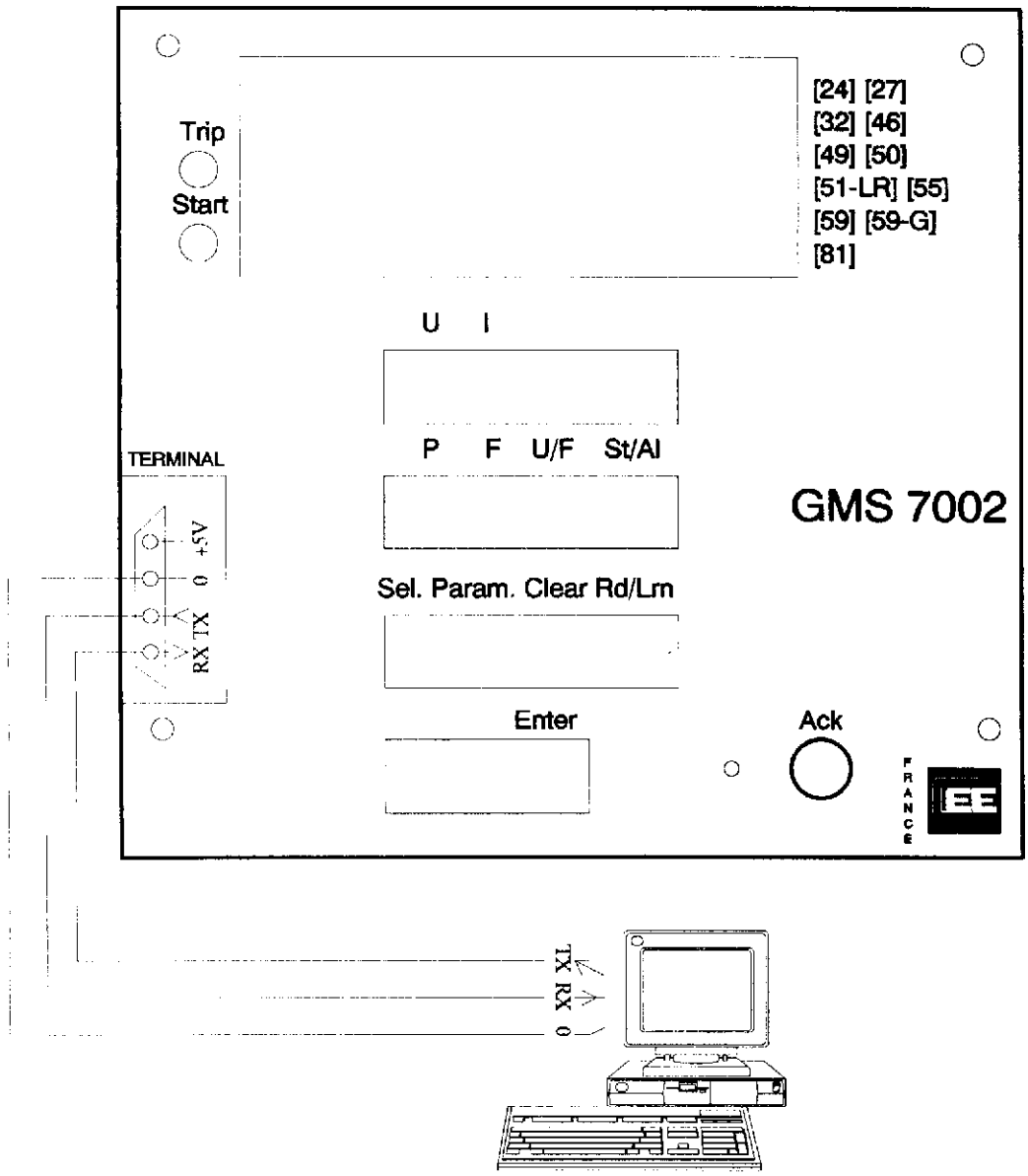
BAI 7001



RS 232



III-5 Connection to a terminal



IV - OPERATOR INTERFACE

IV-1 Local operator interface

The GMS parameters can be read and set locally in two ways :

- by directly using the keys and the display on the unit
- by using an alphanumeric display or a PC computer running a terminal emulation software program via the RS232 - 9 pin on the front plate.

IV.1.1 Reading and setting using the keys and the display

The keys can be used in two modes :
- Read (READING MODE) or Setting (SETTING MODE)

Repeated use of the [*](Rd/Lrn) key moves from one mode to the other.

When the unit is switched on, the relay is in the read mode and the display selects the average voltage VMEAN.

IV.1.1.1 Reading using the keys

The data related to the rated values, measurements and programmed functions are grouped together under 6 headings in order that they can be selected and read quickly.

List of the 6 headings

Group	Key	Data		
		rated	measurement	functions
Voltage	V	x	x	U>,U>>,U<,Vo>,Vo>>
Current	I	x	x	ITHA>,ITH>,IST>,ILR>, I>>,I2>,I2>>, Io>(GMSH7002)
Power, loss of synchronism	P		x	P< or P>,SY>
Frequency	F	x	x	F1</F1>,F2<,F2>
Flux	U/F			U/F>
General parameters	Param.	rated values and general parameters		

Data selection operating mode

- A group is selected by pressing the corresponding key. The first value under the group appears on the display.
- by using the keys [+] or [-], the list of all the values under the group can be scrolled in either direction

IV.1.1.2 Setting parameters using the keys and the display

Setting mode is selected by pressing the [Rd/Lrn] key. The display shows the message [LEARNING MODE].

In this position, the user may or may not be able to change settings depending upon whether or not a three figure general password has previously been declared (see chapter IV-5 Passwords).

In this mode, the selection or modification of settings is carried out as follows :
-Choose the characteristic value using the key [U/I/....]
The relay displays the selected group(ex : [U] ---->[VOLTAGE SETTINGS]).
-Choose a sub group using the [+] and [-] keys. After each operation the relay displays a new subheading.
-Select the subgroup using the [sel] key. The relay displays the first value in this subheading.
-Choose a parameter using the [+] and [-] keys. After each operation the relay displays a new parameter. It is possible to exit the subgroup without changing anything by using the [Clear] key.
-Delete the selected parameter using the [Enter] key.
-Use the keys to enter the new value. The figures entered are right justified in the format reserved for the parameter and the decimal point is automatically added if required.
-The new value is confirmed by using the [Enter] key.
-Return to the sub group selection by using the [Clear] key, then to the read mode by the [Clear] and [Rd/Lrn] keys.

The following example illustrates the method.

This relay setting method is really only of interest when a specific setting needs to be changed. When all the functions of a relay need to be set, it is better to use a terminal as this is easier and provides assistance to the operator.

The following example shows the sequence of operations to change the first over voltage threshold from 1.3 UN to 1.1 UN :

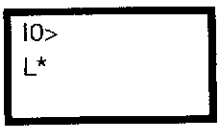
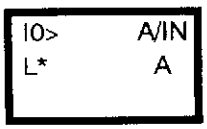
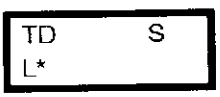
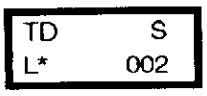
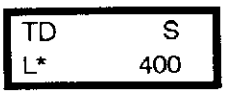
KEYS USED	DISPLAY
[Rd/Lrn]	[LEARNING MODE]
[U]	[VOLTAGE SETTINGS]
[+]	[U> 59-1 SETTINGS]
[Sel]	[U> Un L* 1.30]
[Enter]	[U> Un L -.--]
[1] [1] [0]	[U> Un L 1.10]
[Enter]	[U> Un L* 1.10]
[Clear]	[U> 59-1 SETTINGS]
[Clear]	[VOLTAGE SETTINGS]
[Rd/Lrn]	[READING MODE]

SETTING TABLES

The following tables summarise the allowable settings from the keyboard (limits, setting steps, procedure summaries.....).

SETTING OF RATED VALUES AND GENERAL FUNCTIONS

LEARNING MODE	PARAM MODE		Param , + or - keys , access then confirm using the Enter key
	minimum	**maximum**	comments
UN KV L*	UN KV L* 0.10	UN KV L* 100.00	Setting the primary rated voltage (in steps of 0.01 Kv)
IN A L*	IN A L* 10	IN A L* 10000	Setting the primary rated current (in steps of 1 A)
FN HZ L*	FN HZ L* 50	FN HZ L* 60	Setting the rated frequency Press + or -
F1 L*	F1> L*	F1< L*	Setting the F1 under and over frequency function. Press + or -
DF1 HZ L*	DF1 HZ L* 0.20	DF1 HZ L* 0.40	Setting the F1 pick-up/drop off ratio (in steps of 0.05Hz)
F2 L*	F2> L*	F2< L*	Setting the F2 under and over frequency function. Press + or -
DF2 HZ L*	DF2 HZ L* 0.20	DF2 HZ L* 0.40	Setting the F2 pick-up/drop off ratio (in steps of 0.05Hz)
U[59] L*	U[59] L* PH/N	U[59] L* PH/PH	Setting the [59] function use of either phase to neutral or phase to phase voltages. Press + or -.
U[27] L*	U[27] L* PH/N	U[27] L* PH/PH	Setting the [27] function use of either phase to neutral or phase to phase voltages. Press + or -.
P[32-2] L*	P[32-2] L* P<	P[32-2] L* P>	Setting the [32-2] function (under or over power). Press + or -.

	minimum	maximum	comments
			Setting the [64] function with connection to a toroid or to three CTs : IN (GMSH) . Press + or -.
			Setting the start time used with the 51-1 LR function and the V input (in steps of 1s.)
			Setting the unit address (in steps of 1).
			Setting the communication transmission speed. Press + or -.
			Setting the communication parity: NONE, EVEN, ODD.. Press + or -.
			Setting the password option: Press + or -.
			Setting the 3 digit password. Enter a number.

PROTECTION FUNCTION SETTING

THERMAL IMAGE OVERLOAD : trip function [49-2]

LEARNING MODE	CURRENT SETTINGS	ITH 49-2 SETTINGS	I , + or - keys Sel , + or - keys. Access then confirm using the Enter key

group	minimum	maximum	comments
IB K/2 L*	IB K/2 L* 4	IB K/2 L* 16	Setting the coefficient K^2 controlling the influence of negative phase sequence currents on the current IB in the thermal state calculation; (in steps of 2)
ITH> IN L*	ITH> IN L* 0.50	ITH> IN L* 1.20	Setting the threshold in multiples of the ct rated current ; (in steps of 0.05)
TITH MN L*	TITH MN L* 4	TITH MN L* 240	Setting the thermal time constant expressed in minutes (in steps of 1 minute).
ITH ABCDE L*	ITH ABCDE L* 00000	ITH ABCDE L* 11111	Configuration of the output relays A, B, C, D or E (0 = not connected to the output relay, 1 = connected to the output relay).
ITH PTV L*	ITH PTV L* 000	ITH PTV L* 110	Condition of the trip logic switches P, T and V; V switch non operational.

THERMAL IMAGE OVERLOAD : thermal alarm function [49-1]

LEARNING MODE	PARAM MODE	ITH 49-1 SETTINGS	I , + or - keys Sel , + or - keys. Access then confirm using the Enter key

group	minimum	maximum	comments
ITHA ITH L*	ITHA ITH L* 0.80	ITHA ITH L* 1.00	Setting the thermal overload alarm in multiples of the thermal current (or the thermal state); in steps of 0.01
ITHA ABC L*	ITHA ABC L* 000	ITHA ABC L* 111	Configuration of the output relays A, B or C (0 = not connected to the output relay, 1 = connected to the output relay).
ITHA DE L*	ITHA DE L* 00	ITHA DE L* 11	Configuration of the output relays D or E (0 = not connected to the output relay, 1 = connected to the output relay).
ITHA PTV L*	ITHA PTV L* 000	ITHA PTV L* 110	Condition of the trip logic switches P, T and V; V switch non operational.

UNDER AND OVER FREQUENCY function F1 threshold [81-1]

LEARNING MODE	FREQ. SETTINGS	F1 81-1 SETTINGS	F , + or - keys Sel , + or - keys. Access then confirm using the Enter key
group	**minimum**	**maximum**	comments
F1< HZ L*	F1< HZ L* 44.00	F1< HZ L* 66.00	Setting the F1 under frequency function threshold (in steps of 0.05 Hz).
TF1< S L*	TF1< S L* 0.20	TF1< S L* 99.99	Setting the definite time delay for the F1 threshold. (in steps of 0.01 s).
F1< ABCDE L*	F1< ABCDE L* 00000	F1< ABCDE L* 11111	Configuration of the output relays A, B, C, D or E (0 = not connected to the output relay, 1 = connected to the output relay).
F1< PTV L*	F1< PTV L* 000	F1< PTV L* 110	Condition of the trip logic switches P, T and V; V switch non operational.
		OR	
F1> HZ L*	F1> HZ L* 44.00	F1> HZ L* 66.00	Setting the F1 over frequency function threshold (in steps of 0.05 Hz).
TF1> S L*	TF1> S L* 0.20	TF1> S L* 99.99	Setting the definite time delay of the F1 threshold.(in steps of 0.01 s).
F1> ABCDE L*	F1> ABCDE L* 00000	F1> ABCDE L* 11111	Configuration of the output relays A, B, C, D or E (0 = not connected to the output relay, 1 = connected to the output relay).
F1> PTV L*	F1> PTV L* 000	F1> PTV L* 110	Condition of the trip logic switches P, T and V; V switch non operational.

UNDER AND OVER FREQUENCY function F2 threshold [81-2]

LEARNING MODE	FREQ. SETTINGS	F2 81-2 SETTINGS	F , + or - keys Sel , + or - keys. Access then confirm using the Enter key

group	minimum	maximum	comments
F2< HZ L*	F2< HZ L* 44.00	F2< HZ L* 66.00	Setting the F2 under frequency function threshold (in steps of 0.05 Hz).
TF2< S L*	TF2< S L* 0.20	TF2< S L* 99.99	Setting the definite time delay of the F2 threshold.(in steps of 0.01 s).
F2< ABCDE L*	F2< ABCDE L* 00000	F2< ABCDE L* 11111	Configuration of the output relays A, B, C, D or E (0 = not connected to the output relay, 1 = connected to the output relay).
F2< PTV L*	F2< PTV L* 000	F2< PTV L* 110	Condition of the trip logic switches P, T and V; V switch non operational.
		OR	
F2> HZ L*	F2> HZ L* 44.00	F2> HZ L* 66.00	Setting the F2 over frequency function threshold (in steps of 0.05 Hz).
TF2> S L*	TF2> S L* 0.20	TF2> S L* 99.99	Setting the definite time delay of the F2 threshold.(in steps of 0.01 s).
F2> ABCDE L*	F2> ABCDE L* 00000	F2> ABCDE L* 11111	Configuration of the output relays A, B, C, D or E (0 = not connected to the output relay, 1 = connected to the output relay).
F2> PTV L*	F2> PTV L* 000	F2> PTV L* 110	Condition of the trip logic switches P, T and V; V switch non operational.

OVER VOLTAGE low-set threshold function [59-1]

LEARNING MODE	VOLTAGE SETTINGS	U> 59-1 SETTINGS	U , + or - keys Sel , + or - keys. Access then confirm using the Enter key

group	minimum	maximum	comments
U> UN L*	U> UN L* 0.70	U> UN L* 1.50	Setting the low-set threshold (in steps of 0.01Vn or Un).
TU> S L*	TU> S L* 0.10	TU> S L* 10.00	Setting the low-set threshold definite time delay.(in steps of 0.01 s).
U> ABCDE L*	U> ABCDE L* 00000	U> ABCDE L* 11111	Configuration of the output relays A, B, C, D or E (0 = not connected to the output relay, 1 = connected to the output relay).
U> PTV L*	U> PTV L* 000	U> PTV L* 110	Condition of the trip logic switches P, T and V; V switch non operational.

OVER VOLTAGE high-set threshold function [59-2]

LEARNING MODE	VOLTAGE SETTINGS	U>> 59-2 SETTINGS	U , + or - keys Sel , + or - keys. Access then confirm using the Enter key

group	minimum	maximum	comments
U>> UN L*	U>> UN L* 0.70	U>> UN L* 1.50	Setting the high-set threshold (in steps of 0.01Vn or Un).
U>> ABCDE L*	U>> ABCDE L* 00000	U>> ABCDE L* 11111	Configuration of the output relays A, B, C, D or E (0 = not connected to the output relay, 1 = connected to the output relay).
U>> PTV L*	U>> PTV L* 000	U>> PTV L* 110	Condition of the trip logic switches P, T and V; V switch non operational.

UNDER VOLTAGE function [27]

LEARNING MODE	VOLTAGE SETTINGS	U> 27 SETTINGS	U , + or - keys Sel , + or - keys. Access then confirm using the Enter key

group	minimum	maximum	comments
U< UN L*	U< UN L* OR	U< UN L* AND	Setting the logic control of the three voltages. Press + or - for OR or AND .
U< UN L*	U< UN L* 0.20	U< UN L* 1.20	Setting the threshold (in steps of 0.01Vn or Un).
TU< S L*	TU< S L* 0.10	TU< S L* 10.00	Setting the definite time delay. (in steps of 0.01 s).
U< ABCDE L*	U< ABCDE L* 00000	U< ABCDE L* 11111	Configuration of the output relays A, B, C, D or E (0 = not connected to the output relay, 1 = connected to the output relay).
U< PTV L*	U< PTV L* 000	U< PTV L* 110	Condition of the trip logic switches P, T and V; V switch non operational.

EARTH FAULT function [64] - (GMSH 7002 ONLY)

LEARNING MODE	CURRENT SETTINGS	I0> 64 SETTINGS	I , + or - keys Sel , + or - keys. Access then confirm using the Enter key

group	minimum	maximum	comments
I0> L*	I0> A L* 1.0	I0> A L* 20.0	Setting the earth fault current in Amps when connected to a 100 turn toroid (in steps of 0.5A).
	OR		
I0> L*	I0> IN L* 0.050	I0> IN L* 1.000	Setting the earth fault current in multiples of IN when connected to the residual of 3 cts (in steps of 0.025 IN).
I0> CURVE L*	I0> CURVE L* DT	I0> CURVE L* EI	Setting the curve type. Press + or - to select curve types DT, NI, VI, EI.
TI0> S L*	TI0> S L* 0.10	TI0> S L* 10.00	Setting the time delay for definite time curves DT (1).(in steps of 0.01s).
	OR		
TI0> S L*	TI0> S L* 0.10	TI0> S L* 3.00	Setting the time delay at 10 Ir for dependent time (inverse) curves. (in steps of 0.05s).
I0> ABCDE L*	I0> ABCDE L* 00000	I0> ABCDE L* 11111	Configuration of the output relays A, B, C, D or E (0 = not connected to the output relay, 1 = connected to the output relay).
I0> PTV L*	I0> PTV L* 000	I0> PTV L* 110	Condition of the trip logic switches P, T and V; V switch non operational.

NEGATIVE PHASE SEQUENCE OVER CURRENT - Alarm function [46-1]

LEARNING MODE	CURRENT SETTINGS	I2> 46-1 SETTINGS	i , + or - keys Sel , + or - keys. Access then confirm using the Enter key

group	minimum	maximum	comments
I2> IN L*	I2> IN L* 0.03	I2> IN L* 0.20	Setting the alarm threshold (in steps of 0.01 IN).
TI2> F/A L*	TI2> F/A L* F	TI2> F/A L* A	Setting the type of time delay for the alarm threshold I2>. Press + or - for fixed or adjustable.
TI2> A S L*	TI2> A S L* 1.0	TI2> A S L* 10.0	Setting the adjustable definite time delay for the alarm threshold I2> (in steps of 1s).
I2> ABCDE L*	I2> ABCDE L* 00000	I2> ABCDE L* 11111	Configuration of the output relays A, B, C, D or E (0 = not connected to the output relay, 1 = connected to the output relay).
I2> PTV L*	I2> PTV L* 000	I2> PTV L* 110	Condition of the trip logic switches P, T and V; V switch non operational.

NEGATIVE PHASE SEQUENCE OVER CURRENT trip function [46-2]

LEARNING MODE	CURRENT SETTINGS	I2>> 46-2 SETTINGS	i , + or - keys
			Sel , + or - keys. Access then confirm using the Enter key

group	minimum	maximum	comments
I2 C S L*	I2 C S L* 8	I2 C S L* 40	Setting the operating curve time constant C (in steps of 1s). Alarm and trip thresholds.
I2>> IN L*	I2>> IN L* 0.04	I2>> IN L* 0.40	Setting the trip threshold (in steps of 0.01 IN).
I2>> ABC L*	I2>> ABC L* 000	I2> ABC L* 111	Configuration of the output relays A, B, or C (0 = not connected to the output relay, 1 = connected to the output relay).
I2>> DE L*	I2>> DE L* 00	I2>> DE L* 11	Configuration of the output relays D or E (0 = not connected to the output relay, 1 = connected to the output relay).
I2>> PTV L*	I2>> PTV L* 000	I2>> PTV L* 110	Condition of the trip logic switches P, T and V; V switch non operational.

NEUTRAL DISPLACEMENT OVER VOLTAGE alarm function [59-G1]

LEARNING MODE	VOLTAGE SETTINGS	V0>59-G1 SETTINGS	U, + or - keys
			Sel , + or - keys. Access then confirm using the Enter key

group	minimum	maximum	comments
V0> VN L*	V0> VN L* 0.03	V0> VN L* 0.15	Setting the alarm threshold (in steps of 0.01 Vn).
TV0> S L*	TV0> S L* 0.10	TV0> S L* 10.00	Setting the definite time delay for the alarm threshold (in steps of 0.01s).
V0> ABCDE L*	V0> ABCDE L* 00000	V0> ABCDE L* 11111	Configuration of the output relays A, B, C, D or E (0 = not connected to the output relay, 1 = connected to the output relay).
V0> PTV L*	V0> PTV L* 000	V0> PTV L* 110	Condition of the trip logic switches P, T and V; V switch non operational.

NEUTRAL DISPLACEMENT OVER VOLTAGE trip function [59-G2]

LEARNING MODE	VOLTAGE SETTINGS	V0>>59-G2 SETTINGS	U, + or - keys Sel , + or - keys. Access then confirm using the Enter key

group	minimum	maximum	comments
V0>> VN L*	V0>> VN L* 0.06	V0>> VN L* 0.30	Setting the trip threshold (in steps of 0.01 Vn).
TV0>> S L*	TV0>> S L* 0.10	TV0>> S L* 10.00	Setting the definite time delay for the trip threshold (in steps of 0.01s).
V0>> ABC L*	V0>> ABC L* 000	V0>> ABC L* 111	Configuration of the output relays A, B, or C (0 = not connected to the output relay, 1 = connected to the output relay).
V0>> DE L*	V0>> DE L* 00	V0>> DE L* 11	Configuration of the output relays D or E (0 = not connected to the output relay, 1 = connected to the output relay).
V0>> PTV L*	V0>> PTV L* 000	V0>> PTV L* 110	Condition of the trip logic switches P, T and V; V switch non operational.

UNDER AND OVER POWER function [32]

LEARNING MODE	POWER SETTINGS	P 32 SETTINGS	P, + or - keys Sel , + or - keys. Access then confirm using the Enter key
group	**minimum**	**maximum**	comments
P< SN L*	P< SN L* 0.30	P< SN L* 1.10	Setting the under power threshold in multiples of Sn (in steps of 0.01 Sn).
TP< S L*	TP< S L* 0.20	TP< S L* 99.99	Setting the definite time delay (in steps of 0.01s).
P< ABCDE L*	P< ABCDE L* 00000	P< ABCDE L* 11111	Configuration of the output relays A, B, C, D or E (0 = not connected to the output relay, 1 = connected to the output relay).
P< PTV L*	P< PTV L* 000	P< PTV L* 110	Condition of the trip logic switches P, T and V; V switch non operational.
		OR	
P> SN L*	P> SN L* 0.30	P> SN L* 1.10	Setting the over power threshold in multiples of Sn (in steps of 0.01 Sn).
TP> S L*	TP> S L* 0.20	TP> S L* 99.99	Setting the definite time delay (in steps of 0.01s).
P> ABCDE L*	P> ABCDE L* 00000	P> ABCDE L* 11111	Configuration of the output relays A, B, C, D or E (0 = not connected to the output relay, 1 = connected to the output relay).
P> PTV L*	P> PTV L* 000	P> PTV L* 110	Condition of the trip logic switches P, T and V; V switch non operational.

OVER CURRENT too long start function [51-1 LR]

LEARNING MODE	CURRENT SETTINGS	IST> 51LR SETTINGS	I , + or - keys Sel , + or - keys. Access then confirm using the Enter key

group	minimum	maximum	comments
IST> IN L*	IST> IN L* 0.50	IST> IN L* 2.00	Setting the too long start function threshold (in steps of 0.1 IN).
IS> CURVE L*	IS> CURVE L* EI	IS> CURVE L* EI	Inverse time delay curve, extremely inverse time (EI) only.
TIST> S L*	TIST> S L* 0.10	TIST> S L* 3.00	Setting the inverse time delay (extremely inverse curve, EI) at 10 times the threshold (in steps of 0.05s).
IS> ABCDE L*	IS> ABCDE L* 00000	I> ABCDE L* 11111	Configuration of the output relays A, B, C, D or E (0 = not connected to the output relay, 1 = connected to the output relay).
IST> PTV L*	IST> PTV L* 001	IST> PTV L* 101	Condition of the trip logic switches P, T and V; T=0 and V=1.are mandatory

If P = 1, the function is operational and may only operate during the starting time delay TD. This time delay is initiated when the logic input V is activated (monostable function cannot be reactivated).

OVER CURRENT locked rotor function [51-2 LR]

LEARNING MODE	CURRENT SETTINGS	ILR> 51LR SETTINGS	I , + or - keys Sel , + or - keys. Access then confirm using the Enter key

group	minimum	maximum	comments
ILR> IN L*	ILR> IN L* 2.00	ILR> IN L* 10.00	Setting the locked rotor function (in steps of 0.25 IN).
TILR> S L*	TILR> S L* 1.00	TILR> S L* 5.00	Setting the definite time delay for the IL> threshold (in steps of 0.1s).
IL> ABCDE L*	IL> ABCDE L* 00000	IL> ABCDE L* 11111	Configuration of the output relays A, B, C, D or E (0 = not connected to the output relay, 1 = connected to the output relay).
ILR> PTV L*	ILR> PTV L* 000	ILR> PTV L* 100	Condition of the trip logic switches P, T and V; T and V switches non operational.

NB : this protection function is automatically inhibited during the starting time TD

OVER CURRENT external short circuits [50]

LEARNING MODE	CURRENT SETTINGS	I>> 50 SETTINGS	I , + or - keys Sel , + or - keys. Access then confir m using the Enter key

group	minimum	maximum	comments
I>> IN L*	I>> IN L* 2.00	I>> IN L* 12.00	Setting the short circuit function threshold (in steps of 0.25 IN).
I>> ABCDE L*	I>> ABCDE L* 00000	I>> ABCDE L* 11111	Configuration of the output relays A, B, C, D or E (0 = not connected to the output relay, 1 = connected to the output relay).
I>> PTV L*	I>> PTV L* 000	I>> PTV L* 110	Condition of the trip logic switches P, T and V; V switch non operational.

LOSS OF SYNCHRONISM function [55]

LEARNING MODE	POWER SETTINGS	SY> [55] SETTINGS	P , + or - keys Sel , + or - keys. Access then confirm using the Enter key

group	minimum	maximum	comments
SY> SN L*	SY> SN L* 0.20	SY> SN L* 0.80	Setting the SY> threshold in multiples of Sn (in steps of 0.05 Sn).
TSY> S L*	TSY> S L* 0.10	TSY> S L* 10.00	Setting the integration time constant for the initiation of the SY> function (in steps of 0.01s).
SY> ABCDE L*	SY> ABCDE L* 00000	SY> ABCDE L* 11111	Configuration of the output relays A, B, C, D or E (0 = not connected to the output relay, 1 = connected to the output relay).
SY> PTV L*	SY> PTV L* 000	SY> PTV L* 110	Condition of the trip logic switches P, T and V; V switch non operational.

OVER FLUXING U/F> function [24]

LEARNING MODE	FLUX SETTINGS	U/F [24] SETTINGS	U/F , + or - keys Sel , + or - keys. Access then confirm using the Enter key

group	minimum	maximum	comments
U/F> [N] L*	U/F> [N] L* 0.50	U/F> [N] L* 1.50	Setting the trip threshold (in steps of 0.05 Un/Fn)
TU/F> S L*	TU/F> S L* 0.20	TU/F> S L* 99.99	Setting the definite time delay for the trip threshold (in steps of 0.01s).
U/F> ABC L*	U/F> ABC L* 000	U/F> ABC L* 111	Configuration of the output relays A, B or C (0 = not connected to the output relay, 1 = connected to the output relay).
U/F> DE L*	U/F> DE L* 00	U/F> DE L* 11	Configuration of the output relays D or E (0 = not connected to the output relay, 1 = connected to the output relay).
U/F> PTV L*	U/F> PTV L* 000	U/F> PTV L* 110	Condition of the trip logic switches P, T and V; V switch non operational.

IV.I.2 Use of a terminal to display and set parameters via the RS232 port on the front plate

IV.1.2.1 Hardware and software required

GMS 7002 relays have an RS232/9 pin socket on the front plate, identical to that used on the AMS7001/7002, used to connect to and to configure the relay.

The relay parameters may be set using a simple alphanumeric terminal or PC type computer running a terminal emulation software program.

The serial port is configured as follows :

- connection : see GMS wiring diagrams
- speed : 1200 bauds
- parity : even
- number of bits : 7
- stop bit : 1
- character echo by the relay
- type of terminal : VT100

The following software is recommended :

- LAMSTEL : C.E.E. software for communicating with AMS, GMS, ... relays

IV.1.2.2 Parameter reading and setting

A three-figure password can be set via the keyboard in order to protect the settings *(see chapter IV-5 : password)*.

When a terminal is first connected, and an [Enter] sequence is sent, a message is displayed, showing :

- the GMS software type and version
- the date and time
- the command awaited characters [?>].

Commands are chains of characters validated by [Enter].
A command is completed or cancelled using the [ESCAPE] key
Parameters are displayed in response to commands beginning V
(VG-VU-VI...).
Parameters are set in response to commands beginning P (PG-PU-PI...).
The carriage return key [↵] deletes the last character.
Simultaneous use of the control and X keys [^X] deletes the line.

There is a help function for general commands and for each setting value. This help function is activated by the [?] command.

The following pages illustrate the setting and display options provided by the GMS operating software.
NB : the PTV settings of any group must be programmed as follows:

- P : indicates a permanent activation of the function
- T : indicates a temporary deactivation of the function when the logic input EL1 is activated.
- V : this parameter linked to the EL2 logic input (V input - 51-LR function) is not programmable

**** Command awaited message**

GMS_7002 V2.02
Thursday 14/09/1995
02:05:32
?>

**** Display help : command [?]**

?>?
****Help****

VG	: Displays rated values
VU	: Displays voltages
VI	: Displays currents
VP	: Displays powers
VF	: Displays frequencies
VUF	: Displays flux
JBUSAV	: Switches to JBUS on the front plate
PASS	: Changes the access level
M	: Displays measurements
ETAT	: Displays the state octet
TS	: Displays *the digital inputs*
VC	: Displays the configuration
RST	: Resets the application
PG	: Rated values and general functions settings
PU	: Voltage settings
PI	: Current settings
PP	: Power settings
PF	: Frequency settings
PUF	: Flux settings
PC	: Communication settings
PTB	: Active setting table setting
PDATE	: Date setting
PTIME	: Time setting
PW	: Password setting
EXIT	: Exits supervisor mode
?	: Displays the help function
ESC	: Cancels the command
←	: Deletes the last character
^X	: Deletes the line
?	: Setting specific help
CR	: Validates the command

**** Display function configuration : command [vc]**

The configuration of the output relays for all functions and their associated PTV switches can be displayed using this command.

```
?>vc
**Configuration**
Funct.      Relay      Switch
U>          :C
I>          :A

GMS_7002 V2.02
Thursday 14/09/1995
02:05:44
```

****Display settings by group: commands [vu/vi/...]**

```
?>vu
**Voltages**
U>          Threshold       : 130
            Time delay      : 2.00
            Relay           : C
            PTV             : P
U>>         Threshold       : 140
            Relay           :
            PTV             :
U<          Threshold       : 80
            Time delay      : 2.00
            Funct.          : OR
            Relay           :
            TV              :
V0>         Threshold       : 10
            Time delay      : 2.00
            Relay           :
            PTV             :
V0>>        Threshold       : 20
            Time delay      : 0.20
            Relay           :
            PTV             :
GMS_7002 V2.02
Thursday 14/09/1995
02:06:02

?>vi
**Current**
ITHA>       Threshold       :  90
            Relay           :
            PTV             :
ITH>        Adjust          :  100
            K^2             :  8
            Cste            :  4
            Relay           :
            PTV             :
IST>        Threshold       :  100
            Time delay      :  2.00
            Type            :  EI
            Relay           :  A
            PTV             :  V
```

ILR>	Threshold	:	200
	Time delay	:	0.20
	Relay	:	
	PTV	:	
I2>	Threshold	:	10
	Time delay	:	2.00
	Type	:	AJUS
	Relay	:	
	PTV	:	
I2>>	Threshold	:	20
	Cste	:	10
	Relay	:	
	PTV	:	
I>>	Threshold	:	400
	Relay	:	
	PTV	:	

GMS_7002 V2.02
Thursday 14/09/1995
02:06:11

?>vp
****Powers****

SY>	Threshold	:	10
	Time delay	:	2.00
	Relay	:	
	PTV	:	
P>/P<	Threshold	:	50
	Time delay	:	2.00
	Relay	:	
	PTV	:	

GMS_7002 V2.02
Thursday 14/09/1995
02:06:27

?>vf
****Frequencies****

F1>/F1<	Threshold	:	48.00
	Time delay	:	2.00
	Relay	:	
	PTV	:	
F>/F2<	Threshold	:	52.00
	Time delay		2.00
	Relay	:	
	PTV	:	

GMS_7002 V2.02
Thursday 14/09/1995
02:06:32

```
?>vuf
**Flux**
U/F>        Threshold        : 120
            Time delay       : 2.00
            Relay            :
            PTV              :
GMS_7002 V2.02
Thursday 14/09/1995
02:06:36

?>vg
**General settings**
UN          : 17320
IN          : 1000
FN          : 50
F[81-1]     : F1<
Reset F1    : 30
F[81-2]     : F2>
Reset F2    : 30
U[59]       : PH/N
U[27]       : PH/N
P[32]       : P>
TD          : 100
Password    : OFF
GMS_7002 V2.02
Thursday 14/09/1995
02:06:43
```

****Display states : commands(ts/etat/m/..]**

Displays the condition of the 2 inputs, T and V (all or nothing inputs-ETOR), the activation of the various thresholds (TS) and the condition of the output units (Relays).

```
?>ts
**TS**
Digital inputs  :
Thres           :
Relays          :
                        **The [enter] key updates the display
Digital inputs  :
Thres           :
Relays          :
                        **The [escape] key exits the command

GMS_7002 V2.02
Thursday 14/09/1995
02:07:17
```

?>m

****Display measurements****

IMean	:	254
IA	:	257
IB	:	243
IC	:	261
I2	:	10
V0(V)	:	0
UMean	:	20016
VA	:	11576
VB	:	11521
VC	:	11535
UAB	:	20028
UBC	:	20017
UCA	:	20003
Theta(%)	:	80
F(1/100Hz)	:	4999
P(KW)	:	8800
Q(KVAR)	:	349
S(KVA)	:	8807

****The [enter] key updates the display**

IMean	:	254
IA	:	251
IB	:	240
IC	:	262
I2	:	13
V0(V)	:	0
UMean	:	20016
VA	:	11576
VB	:	11521
VC	:	11535
UAB	:	20028
UBC	:	20017
UCA	:	20003
Theta(%)	:	81
F(1/100Hz)	:	4999
P(KW)	:	8800
Q(KVAR)	:	+360
S(KVA)	:	8807

**** The [escape] key exits the command**

GMS_7002 V2.02
Thursday 14/09/1995
02:07:33

?>etat
****Overall condition****
Event to be processed
Reboot relay
Fault present
Trace blocked
Modified settings
** The [escape] key exits the command
GMS_7002 V2.02
Thursday 14/09/1995
02:07:59

****Setting functions : commands [pu/pi/...]**

?>pu
****Voltages****

U>	Threshold	:	130
	Time delay	:	2.00
	Relay	:	C
	PTV	:	P
U>>	Threshold	:	140
	Relay	:	
	PTV	:	
U<	Threshold	:	80
	Time delay	:	2.00
	Function	:	OR

****for help use [?] after having deleted the setting

****P : Permanently active function/ T : Temporary

****The [escape] key exits from the command

GMS_7002 V2.02
Thursday 14/09/1995
02:08:24
?>

IV-2 Remote operation

The GMS7002 relays are equipped with a communications channel (2 x 0-20mA current loop sockets) at the rear of the relay case.

Using these sockets, the relay may be inserted into a communications network supervised by a PC or other device (please consult us).

All information needed to implement remote communication is given in the document: User Manual - GMS communications tables.

IV-3 Operation of P.T.V. switches

The P, T and V switches provided for all protection elements operate as follows:

- The **P** setting indicates a permanent **activation** of the function
- The **T** setting indicates a temporary **deactivation** of the function.
This deactivation comes into effect when the logic input EL1 is activated (terminals 8 - 12)
- The **V** setting **is not programmable**. This switch is not operational and is locked at 0 for all functions except for the [51-1LR] (too long start) function, where it is automatically switched to 1. This unit signifies that only the [51-1LR] is connected to the EL2(V) input (terminals 9-12) (see 51-1LR programming table and operational tests).

The following table summarises how the P and T switches are programmed using the keyboard or a terminal.

	Relay keyboard/display	Terminal
Function out of service	P = 0	-
Function in service	P = 1	P
Function not deactivated by logic input EL1	T = 0	-
Function deactivated by logic input EL1	T = 1	T

IV-4 Fault mode

IV.4.1 Indication that a threshold has been crossed

When a threshold on a pre-programmed function is crossed, the orange Start LED to the left of the display comes on.

This LED signal is not latched and the Start light goes out if the value falls below the threshold value again.

On the terminal, there is a permanent record of function thresholds that have been crossed which may be referred to using the [TS] command.

IV.4.2 Alarm or trip display

When a relay operates, the red Trip LED comes on and ALARM or TRIP is displayed, followed by the function which gave rise to the alarm or trip, This information is latched (memorised). If a new event (alarm or trip) occurs, the preceding indication is replaced by the new one.

On the terminal, the function causing the trip, as well as the output relay, can be consulted by using the [TS] command, but in this case the information is not memorised.

NB : 3 functions are defined as alarms (thermal image overload ITHA>, neutral displacement over voltage Vo>, earth fault Io>), the other functions are trips.

IV.4.3 Display of the electrical value at moment of an alarm or trip

A single operation of the Ack key, accessible with the front plate on, displays th e value which caused the alarm or trip to operate (except for the SY> loss of synchronism, U/F> over fluxing and I>> over current functions).

In the case of a trip, the displayed value corresponds to the electrical value at the instant of the trip. In the case of an alarm, the displayed value corresponds to the instantaneous value of the electrical quantity that is being monitored (THETA, I2, Vo) *(see chapter IV-4-4).*

Using the Ack key a second time returns the display to the read mode for the last valu e consulted.

If another relay element operates before the display has been acknowledged, the new function replaces the previous one.

IV.4.4 Alarm memorisation

If several trips occur in succession, it is the last which is memorised. In the case of multiple alarms, information relating to the nature of the intervening alarms is memorised and may be referred to using the Ack key.

The 3 alarms (ITHA, I2> and Vo>) are memorised until they are acknowledged by the Ack key or by a trip. If the latter applies, the trip replaces the displayed alarm.
The corresponding electrical value (THETA, I2 and Vo) may be consulted without removing the front plate.

Example : 2 alarms occur at different moments (I2> alarm, then an ITHA alarm)

the display reads : ALARM followed by I2>
then the display reads : ALARM followed by ITHA

By repetitively pressing the Ack key, we see :

	ALARM ITHA	Alarm display
Ack	THETA 0.95	Continuous display of value associated with fault
Ack	ALARM I2>	Alarm display
Ack	I2> A 123	Continuous display of value associated with fault
Ack	UMEAN KV 12.00	Return to the READ mode value displayed before the alarm

IV.4.5 Looking up the most recent events (starts, alarms and trip) using the St/Al key accessible with the front plate removed

By using the St/AL key and the [+] key, the 5 most recent events can be consulted (starts, alarms or trips). There are 3 lists comprising 5 possible events.

No 1 corresponds to the first event on the list, the last number to the most recent event.

Here the electrical value displayed for the alarms is the value memorised at the instant of the alarm

IV-5 Password

The operator may choose to install a password restricting any setting function. This is a three figure password.

When a password has been installed, access is only authorised in read mode and the password must be known in order to put the password function out of service.

ATTENTION: if the password is lost, it will no longer be possible to gain access to settings and to put this function out of service.
Only by returning the relay to the factory may this function be changed.

Programming and de-programming the password via the keyboard

In read mode, the Param group informs the operator as to whether or not a password is in use. (PASSWORD = ON or OFF)

Programming

In programming mode, the Param heading, proceed as follows:

PASSWORD = OFF (Choose ON)

\+ key

PASSWORD = *** (key in the password from 000 to 999)

Return to read mode

Access to settings

To gain access to the LEARN mode, type in the password after pressing the Rd/Lrn key.

Suppressing the password

To suppress the password, choose
PASSWORD = OFF then return to read mode

Programming and de-programming the password via the terminal

The VG command informs the operator whether or not the password is in use (PASSWORD = ON or OFF). Without a password (PASSWORD = OFF), or after having entered the password, the opening message is preceded by the number 1, with a password it is preceded by a 0.

Programming

PG command : enter PASSWORD = ON
then after entry
PW command : type in the PASSWORD with 3 figures (000 to 999) then enter.

Access to parameters

Type in the PASS command followed by the password: 3 successive attempts are allowed. Access to different settings is authorised. When the terminal keyboard has been inactive for about 20 minutes, or after the EXIT command, the password must be entered once more to gain access to settings.

Suppressing the password

PG command : enter PASSWORD = OFF

IV-6 Setting tables

Two separate tables of settings (tables 1 and 2) are available in the GMSx7002 relays.

It is possible to change between tables via the terminal and via the current loop rear communications network, but not via the unit keyboard.

Reading the active setting table

The active table may be read directly on the relay under the settings group(Param. key) and on the terminal under the general settings group (Vg command).

Changing the settings table

The settings table may be changed from the terminal using the PTB command.

Changing the table switches all the settings from one table to the other.

V - TESTING - COMMISSIONING

V-1 Introduction

These tests are intended to ensure that the equipment has not suffered any damage during transport or storage and confirms correct operation at the set values.

In addition to electrical tests, the equipment should also be physically examined to ensure it is in sound mechanical condition.

V-2 Preliminary checks

Before commissioning, it is important to check :
- the correct polarity of the current and voltage transformers. On the connection diagrams, the dots marked next to the transformers represent the P1 or S1 sides.
- the communication plugs, at the rear of the unit, are correctly in place.

V-3 Switching on the auxiliary supply

When the auxiliary supply is switched on, the device goes through the following sequences :

- sequence of microdiagnostics : DIAG
- start-up period : INIT
- display of device name and its version : GMS-7002 V-2.02
- display of the mean voltage : U MEAN V

At the end of these sequences, the self-monitoring system and the associated W relay are active (W1 contact open).

The self-monitoring system operates in 3 modes:

- detection of the loss of the auxiliary voltage
- detection of the failure of the microprocessor by the watch-dog
- detection of the failure of a peripheral device by the microprocessor by the execution of micro-diagnostic routines

The self-monitoring system warns the operator of a fault by closing the W1 contact - device terminals 25 and 36 and displays, if the display is operating, the type of fault (RAM - CAN - PROM fault - etc...).

NB : During the micro-diagnostics phase [DIAG], the watch-dog relay is activated (W1 contact open), during the start-up phase [INIT], the watch-dog relay is deactivated (W1 contact closed).

V-4 Setting the device

Having determined the settings of the various protection functions, taking into account the characteristics of the machine and instrument transformers, follow the procedure outlined in chapter IV.
Also to be determined :
- the configuration of the trip matrix connecting the protection functions to the output relays
- any operational restrictions during the starting period (< under functions especially): T input
- the control of over current protection [51LR] during and following the starting period :
V input and TD time delay

Before carrying out any tests, it is preferable to block all functions (switch P = 0) and to perform tests function by function.

To make things easier, it is advisable to program the device using the terminal, as programming using the keyboard is usually only used to modify certain values.

V-5 Testing the device, necessary test equipment

These tests require a minimum amount of test equipment, namely :
- a single phase voltage source, frequency variable from 45 to 65 Hz,
- a single phase current source,
  - the phase difference between the two sources should be adjustable from 0 to 360 degrees,
  - the voltage/current injection set needs to have a timer and automatic supply cut-off system,
  - an auxiliary power supply,
  - an ammeter, a voltmeter and a frequency meter.

All tests are carried out single phase.

Testing closer to actual normal operating conditions would involve using a three-phase injection system (test quantities free of negative phase sequence or earth fault components etc...).

A high level of measurement accuracy may only be achieved when using test sources having good electrical characteristics and accurate measurement devices.

IMPORTANT : It is absolutely prohibited to test this equipment without its base by plugging standard commercially available plugs or leads into the female sockets at the rear of the relay.

Before disconnecting the current inputs to the device, the current transformer secondaries must be short-circuited.

Remark concerning the display of alarm and trip conditions:

The most recent alarm or trip condition only replaces the preceding one on the GMS display if a new output relay is brought into action.

Remark concerning the duration of current injection:

In order to avoid dangerously overloading of the current inputs, the test current must be switched off automatically when the corresponding output relay operates.

V-5-1 TESTING THE TOO LONG START [51-1LR] and LOCKED ROTOR [51-2LR] OVER CURRENT FUNCTION

CONNECTIONS

Current source connected to 2-3, 6-7, or 10-11 depending upon the phase being tested (or the three phases in series)

Steps to be taken	Expected results
The IST> too long start function is operational during the starting time delay TD. The ILR> blocked rotor function is automatically put out of service during this time delay. The TD time delay is initiated when the EL2 (V) logic input is activated (monostable function non repeatable). The locked rotor function is operational when the starting time delay is completed. The too long start function is then put out of service. - Program the functions IST> and ILR> respectively to one of the output relays. - Connect a switch between the EL2 (V) logic input terminal 9 and terminal 4, connect terminal 12 to terminal 5 of the device. IST> - Close the switch ; - Progressively increase the current until the chosen current threshold is reached. tIST> - Preset the current to 10 times the IST> threshold (extremely inverse time EI curve only), - Cut the current and then switch it back on. **NB :** - even though the Start LED comes on at 100% of the setting, the effective point at which timing commences is 110%. - other points on the curve can be checked against those on Fig.6 or calculated given that :	The IST> protection function is operational during the TD time delay The Start LED comes on at 100% of the setting At the end of the set time delay : -the programmed relay should pick up -the trip LED should come on -the message TRIP followed by the function under test appears -the fault current value is available (Ack key)

V-5-1 TESTING THE TOO LONG START [51-1LR] and LOCKED ROTOR [51-2LR] OVER CURRENT FUNCTION cont..

CONNECTIONS

Current source connected to 2-3, 6-7, or 10-11 depending upon the phase being tested (or the three phases in series)

Steps to be taken	Expected results
$ts = \frac{100}{(I/IST>)^2 - 1}$ x the tIST> setting - Testing tIST is only possible during TD : the condition of TD may be consulted using a terminal and the TS command. ILR> - When the TD time delay is over, progressively increase the current until the chosen current threshold is reached. tILR> - Preset the injected current to at least 1.5 times the setting. - Cut the current and then switch it back on	The Start LED lights up at 100% of the setting At the end of the set time delay : -the selected relay should pick up -the trip LED should come on -the message TRIP fol lowed by the function under test appears -the fault current value is available (Ack key)

V-5-2 TESTING THE OVER CURRENT FUNCTION [50]

CONNECTIONS

Current source connected to 2-3, 6-7, or 10-11 depending upon the phase being tested (or the three phases in series)

Steps to be taken	Expected results
The I>> protection function is not time delayed. Its operating time is of the order of 100ms. I>> - Program the I>> function to one of the output relays.	
- Progressively increase the current I until the chosen current threshold is reached. - Preset the injected current to at least 1.5 times the I>> threshold.	The Start LED lights up at a current I equal to 100% of the setting
- Cut the current and then switch it back on.	After a delay of approximately 100ms : -the selected relay should pick up -the trip LED should come on -the message TRIP followed by the function under test appears -the fault current value is not available.

V-5-3 TESTING THE NEGATIVE PHASE SEQUENCE OVER CURRENT FUNCTION (46)

CONNECTIONS

Current source connected to one of the phases 2-3, 6-7, or 10-11 in order to generate negative phase sequence.
In this case the negative phase sequence current I_2 is equal to 1/3 of the injected current I

Steps to be taken	Expected results
$I_2>$ -Program the $tI_2>$ function to one of the output relays -Progressively increase the current I	The Start LED lights up at a an injected current of 3 times the $I_2>$ setting
$tI_2>$ (fixed or adjustable) -Preset the injected current to at least 1.5 times the setting -Cut the current and then switch it back on	At the end of the set time delay : -the selected relay should pick up -the trip LED should come on -the message ALARM followed by the function under test appears
$I_2>>$ -Program the $tI_2>>$ function to one of the output relays -Progressively increase the current I	The Start LED lights up at a an injected current of 3 times the $I_2>>$ setting
$tI_2>>$ -Temporarily set the I> threshold to 2IN in order that this function does not operate during the test -Check the C constant setting in seconds. -Preset the injected current I to 3 x 0.5IN -Cut the current and then switch it back on $t = \frac{C}{(0.5)^2} = C \times 4^*$ * consult the curves on fig. 2	At the end of the time delay t=Cx4 (C= set time constant in s) : -the selected relay should pick up -the trip LED should come on -the message TRIP followed by the function under test appears -the negative phase sequence fault current is available (Ack key)

V-5-4 TESTING THE THERMAL IMAGE FUNCTION (49)

CONNECTIONS

Current source connected to one phase 2-3, 6-7, or 10-11 in order to generate equal positive and negative phase sequence currents equal to 1/3 of the injected current

Steps to be taken	Expected results
Formula for the thermal current : $ITH = \sqrt{(IPOS^2 + K^2 INeg^2)}$ For a single phase injection : IPOS = INEG = 1/3I (I = current to be injected) $ITH = \sqrt{((1/3)^2 + K^2(1/3)^2)} = 1/3\sqrt{(1 + K^2)}$ $I = \frac{3}{\sqrt{1 + K^2}} ITH$ <u>ITHA> (alarm threshold) and ITH> (trip threshold)</u> A test at 3ITH is recommended. Taking into account the threshold setting coefficient of the thermal unit (ITH/IN) and of the relays rated current, the current to be injected is : $I = \frac{3}{\sqrt{1 + K^2}} \times 3 \times \frac{ITH}{IN} \times IN$ <u>NB 1</u> : if $K^2 = 8$ and ITH/IN = 1, I to be injected = 3IN - Program the ITHA> function to one of the output relays - Program the ITH> function to one of the output relays other than that chosen for ITHA> - Preset the I current to be injected according to the above formula - Cut the current, then switch off the auxiliary supply in order to reset the thermal image to zero. - Switch back on the auxiliary supply and then the injected current - Monitor the thermal state displayed on the unit	- The ITHA> function should trip when the thermal state equals the setting (80 to 100%) -The message ALARM followed by the name of the function being tested should appear -The Start and Trip LEDs should come on simultaneously The ITH> function should trip when the thermal state reaches 114%

V-5-4 TESTING THE THERMAL IMAGE FUNCTION (49) **Cont.**

CONNECTIONS

Current source connected to one phase 2-3, 6-7, or 10-11 in order to generate equal positive and negative phase sequence currents equal to 1/3 of the injected current

Steps to be taken	Expected results
- Measure the time delay tITH> for a zero pre-load current (cold condition) (consult the curves on fig. 1)	The measured time delay should be equal to: $t(s) = \tau Ln \frac{3^2}{3^2 - 1.07^2}$ $t(s) = \tau Ln\ 1.145$ Example : if τ = 10min or 600s t=81s
NB 2 : If a time delay measurement for the ITHA> alarm device is desired (0.8 to 1), at 3ITH, the time equation becomes :	$t(s) = \tau Ln \frac{3^2}{3^2 - ITHA>}$

V-5-5 TESTING THE EARTH FAULT OVER CURRENT FUNCTION (64) (GMSH7002 ONLY)

CONNECTIONS

Current source connected to 26 - 27 (residual connection), or to the primary of the toroid connected to terminals 26 - 27 (connection to a toroid)

Steps to be taken	Expected results
The earth fault input can be connected in two ways : -residually connected to three line cts (range 5 to 100%IN with IN = 1 or 5A) -to the secondary of a 100 turn toroid (range 1 to 20A) These different configurations, even if they are adjustable, involve different equipment (different earth fault input cts)	
Io> -Program the tIo> function to any of the output relays -Progressively increase the current until the chosen threshold is reached **Caution** : with the toroid connection, if the injection is done directly into terminals 26 - 27 the injected current has to be divided by 100, i.e. a range of 10mA to 200mA.	The Start LED lights up at 100% of the setting
tIo> -Preset the injected current to 10 times the setting for inverse time (NI, VI, EI curves) and at least 1.5 times the setting for definite time (DT curve) -Cut the current and then switch it back on **NB:** - even though the Start LED comes on at 100% of setting for inverse time curves, the effective point at which timing commences is 110%. -other points on the inverse time curves can be checked against those on Fig 4, 5 and 6 or calculated given that : $t(s) = \frac{T}{(I/Io>)^{\alpha} - 1}$ x the tIo> setting where T=0.046 α=0.02 (NI) inverse T=9 α=1 (VI) very inverse T=100 α=2 (EI) extremely inverse *Note : if type of curve is changed (definite time to inverse time), always set tIo>(0.1 to 3s) before the curve type.*	At the end of the set time delay : -the selected relay should pick up -the trip LED should come on -the message TRIP followed by the function under test appears -the fault current value is available (Ack key)

V-5-6 TESTING THE UNDER AND OVER VOLTAGE FUNCTIONS [59] , [27]

CONNECTIONS

Voltage source connected between 28 - 30 - 31 together and 29 (GMS7002), connected between 28 - 30 together and 29 (GMSH7002)

Steps to be taken	Expected results
Depending upon the model, 3 or 2 voltage inputs are connected in parallel in order to conveniently test the OR function of the under voltage element [27]. This test is carried out by applying phase to neutral voltages to the GMS7002. With the GMSH7002 it is obligatory to use phase to phase voltages.	
U> -Program only the function under test to any of the output relays -Progressively increase the voltage until the chosen threshold is reached	The Start LED lights up at 100% of the setting
tU> -Preset the injected voltage to at least 1.2 times the setting -Cut the voltage and then switch it back on	At the end of the set time delay : -the selected relay should pick up -the trip LED should come on -the message TRIP followed by the function under test appears The fault voltage is available (Ack key)
U>> -Program only the function under test to any of the output relays -Progressively increase the voltage until the chosen threshold is reached	The Start and trip LEDs should come on at 100% of the setting The selected relay should pick up
U< -Program only the function under test -Apply a voltage higher than the threshold and then progressively decrease the voltage until the chosen threshold is reached	The Start LED lights up at 100% of the setting
tU< -Preset the injected voltage to UN and then switch off the voltage	At the end of the set time delay : -the selected relay should pick up -the trip LED should come on -the message TRIP followed by the function under test appears The fault voltage value is available (Ack key)
Note: if the AND function is used with the under voltage element it is possible to check each phase individually	

V-5-7 TESTING THE NEUTRAL DISPLACEMENT OVER VOLTAGE FUNCTIONS [59G]

CONNECTIONS

Voltage source connected between 28 - 30 - 31 together and 29 (GMS7002 only)

Steps to be taken	Expected results
The 3 voltage inputs are connected in parallel in order to generate a zero sequence voltage 3Vo proportional to the Vo> and Vo>> thresholds.	
Vo> -Program only the function under test to any of the output relays -Progressively increase the voltage until the chosen threshold is reached	The Start LED lights up at 100% of the setting
tVo> -Preset the injected voltage to at least 1.5 times the setting -Cut the voltage and then switch it back on	At the end of the set time delay : -the selected relay should pick up -the trip LED should come on -the message ALARM followed by the function under test appears
Vo>> -Program only the function under test to any of the output relays -Progressively increase the voltage until the chosen threshold is reached	
tVo>> -Preset the injected voltage to at least 1.5 times the setting -Cut the voltage and then switch it back on	At the end of the set time delay : -the selected relay should pick up -the trip LED should come on -the message TRIP followed by the function under test appears The zero sequence fault voltage is available (Ack key)

V-5-8 TESTING THE UNDER AND OVER FREQUENCY FUNCTIONS [81]

CONNECTIONS

Variable frequency voltage source connected between 29 - 30 or 29 - 31 GMS7002 (VB or VC), connected between 29 - 28 or 29 - 30 GMSH7002

Steps to be taken	Expected results
The frequency is only measured using the phase 1 (VA) voltage applied to the GMS7002. The programming of the F1 and F2 thresholds as either over or under functions as well as the setting of the hysteresis is carried out under the general parameter heading. Note how these have been programmed before starting the testing. F1/2>/< -Program only the function under test -Apply rated voltage at rated frequency -Progressively increase or decrease the frequency until the chosen threshold is reached	The Start LED lights up when the setting is reached
tF1/2>/< -If the test set can handle it, this test is carried out by instantaneously switching the frequency from rated frequency to a frequency outside the confirmed threshold -Apply FN and then F outside the confirmed threshold	At the end of the set time delay : -the selected relay should pick up -the Trip LED should come on -the message TRIP followed by the function under test appears
-When the output relay has operated, check the programmed reset hysteresis	The value of the frequency during the fault is available (Ack key)

V-5-9 TESTING THE OVER FLUX FUNCTION [24]

CONNECTIONS

Variable frequency voltage source connected between 29 - 30 or
29 - 31 GMS7002 (VB or VC), connected between 29 - 30 GMSH7002

Steps to be taken	Expected results
The relay takes the ratio U/F where the value for U is taken as the phase to phase voltage UBC or U23 = V2 - V3 With the GMS7002, in the single phase mode, the injected voltage is the phase to neutral voltage and the ratio U/F = V2/F or V3/F. This means that it is necessary to inject a phase to neutral voltage V2 or V3 multiplied by √3 in order to simulate a three phase connection. For the GMSH7002, the injected voltage is the phase to phase voltage and no correction is required. U/F> -Program only the function under test Voltage operation -Inject a low level of voltage Ue at the devices rated frequency (F=FN) -Progressively increase the voltage Ue* until the chosen threshold is reached $Ue = U> \times \frac{F}{FN} = U> \times 1 = U>$ Frequency operation -Inject a voltage with a frequency of, for example, 10% below the rated frequency (45Hz for 50Hz) -Progressively increase the voltage Ue* until the threshold, which has been reduced by 10%, is reached $Ue = U> \times \frac{F}{FN} = U> \times \frac{45}{50} = 0.9U>$ * multiply the injected voltage Ue by √3 for the GMS7002	The Start LED lights up at the calculated setting The Start LED lights up at the calculated setting
tU/F> -Use the rated frequency -Preset a voltage Ue1 of at least 15%UN -Preset a voltage Ue2 at a value above the threshold -Change from Ue1 to Ue2 **Note** : if the change from Ue1=0 to Ue2 is used, the measured time will be higher than the set time because the frequency tracking function (at approximately 5% of UN) takes a certain amount of time to come into operation.	At the end of the set time delay : -the selected relay should pick up -the Trip LED should come on -the message TRIP followed by the function under test appears

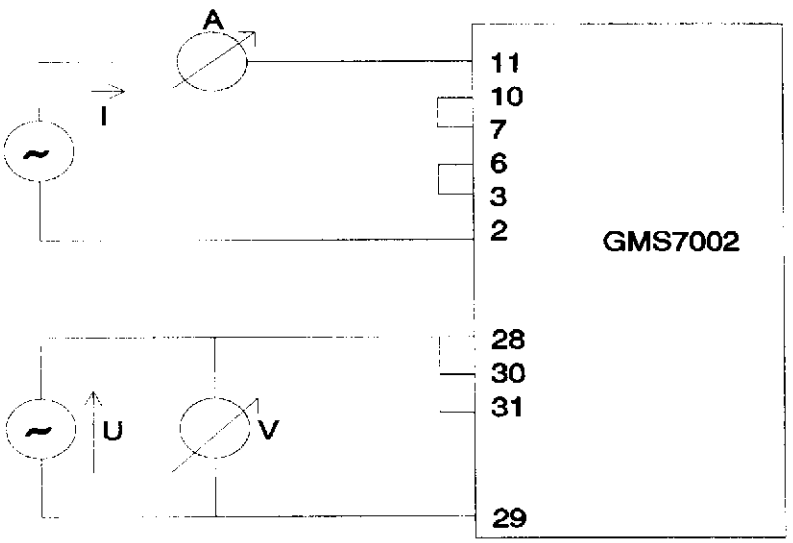
V-5-10 TESTING THE OVER AND UNDER POWER FUNCTIONS [32]

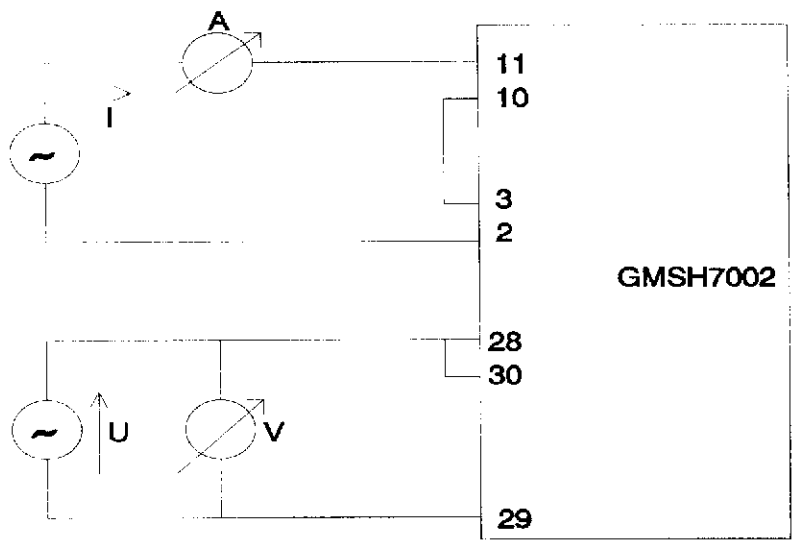
CONNECTIONS

Use the connection given in figure a. (currents in series, voltages in parallel)
Connected in single phase, the 2 quantities U and 1 are in phase.

Steps to be taken	Expected results
With the GMS7002, which uses the 3 wattmeter power measurement method, single phase injection (currents in series, voltages in parallel) is the same as three phase injection. With the GMSH7002, which uses the 2 wattmeter power measurement method, single phase injection is not the same as three phase injection and it is necessary to use a correction factor K=√3/2 such that P single phase threshold = √3/2 P three phase. P> or P< -Program only the function under test -Apply rated voltage U=VN or UN depending upon the GMS -Progressively increase or decrease the current until the chosen threshold with : I trip = x% Pn x In (GMS7002) I trip = x% Pn x In x √3/2 (GMSH7002)	The Start LED lights up at the setting
tP> or tP< -Preset the injected current to at least 1.5 the current threshold -Switch off the injection and then switch it back on	At the end of the set time delay : -the selected relay should pick up -the Trip LED should come on -the message TRIP followed by the function under test appears The value of the fault power is available (Ack key)
Note : the under power function is allowed to operate for all levels of power less than P< (zero or negative active power). The P< function will operate for reverse power conditions.	

-over or under power : U and I in phase





P single phase threshold = √3/2 three phase
2 wattmeter method

- Figure a - Connection for testing the over or under power protection [32]

V-5-11 TESTING THE LOSS OF SYNCHRONISM FUNCTION [55]

CONNECTIONS

Use the connection given in figure b. (currents in series, voltages in parallel)
Single phase connection, the current I lags the voltage U by 120°

Steps to be taken	Expected results
The [55] protection functions when the apparent power vector is in the operating zone (see Fig.3). This zone has a characteristic angle of 120° between the current and voltage. At this phase angle, the operating level of the protection is equal to SY> (apparent power threshold). On entering into the operating zone, the relay functions according to an adjustable integration time constant TSY>. On leaving the zone, this time constant is multiplied by 10. In this way, the system memorises the successive entries into the operating zone until it trips. With the GMS7002, which uses the 3 wattmeter measurement method for real and reactive power, single phase injection (currents in series, voltages in parallel) gives the same result as three phase injection. With the GMSH7002, which uses the 2 wattmeter measurement method for real and reactive power, single phase injection does not produce the same result as three phase injection and it is necessary to use a correction factor K = √3/2, such that : S single phase threshold = √3/2 S three phase threshold SY> -Program only the function under test -Apply rated voltage U=VN or UN depending upon if it is for a GMS or GMSH -Apply current I at 120° lag with respect to the voltage. Progressively increase this current until the SY> threshold is reached with : I trip = SY> x IN (GMS7002) I trip = SY> x IN x √3/2 (GMSH7002) NB 1 : the reset percentage is important for this function. It is set to approximately 50% of the operating threshold.	The Start LED comes on at the current setting.

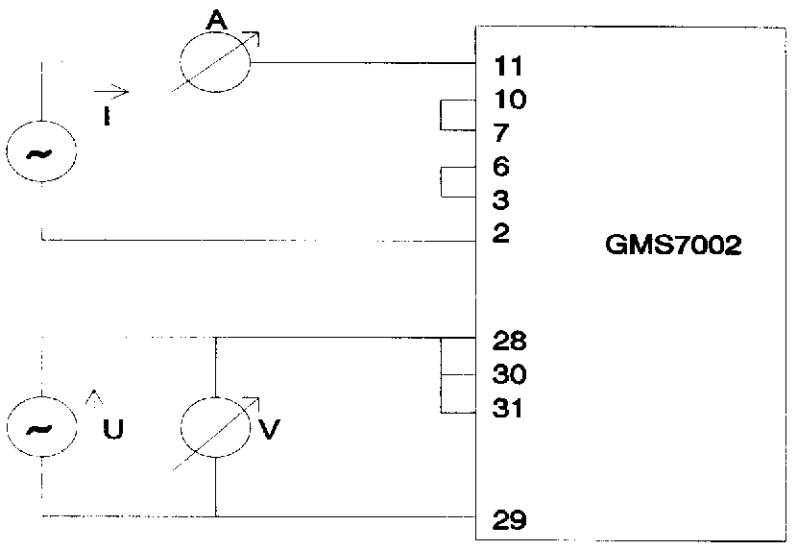
V-5-11 TESTING THE LOSS OF SYNCHRONISM FUNCTION [55] continued

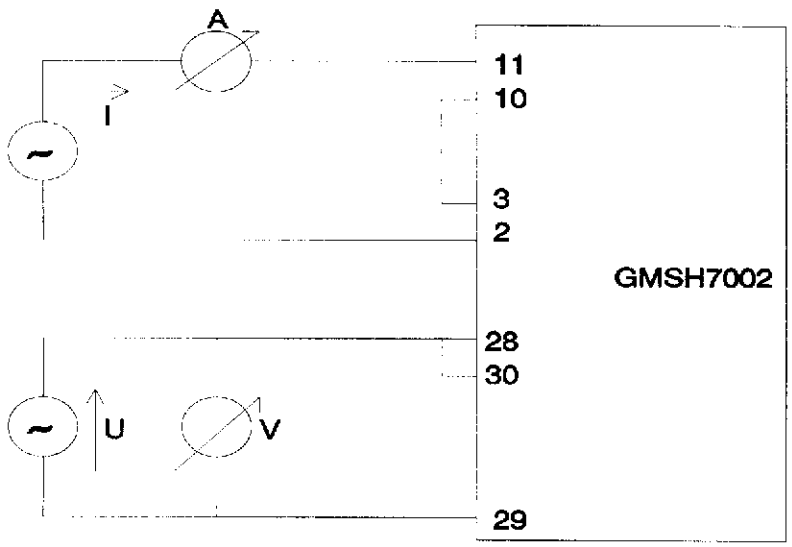
CONNECTIONS

Use the connection given in figure b. (currents in series, voltages in parallel)
Single phase connection. the current I lags the voltage U by 120°

Steps to be taken	Expected results
tSY> -Preset the injected current I to at least 1.5 the threshold calculated above -Switch off the injection and wait at least for a time equal to 10tSY>, then switch it back on	The trip time recorded is equal to a response time of a starting relay (approximately 80ms) plus the tSY> time setting. At the end of the set time delay : -the selected relay should pick up -the Trip LED should come on -the message TRIP followed by the function under test appears
NB 2 : If a new time delay test is carried out immediately afterwards, the measured time delay will be reduced, the shorter the interval between tests the greater the reduction. Wait for a time longer than 10tSY> before attempting to get a test result equal to the tSY> time delay setting.	

- current I lagging 120° with respect to U





S single phase threshold = √3/2 three phase GMSH7002
2 wattmeter method

- Figure b - Connection for testing the loss of synchronism protection [55]

V-5-12 TESTING THE DIGITAL INPUTS

CONNECTIONS

Terminal 12 to the -ve of the auxiliary supply. Terminal 8 (EL1 : T input) to terminal 9 (EL2 : V input) temporarily connected to the +ve of the auxiliary supply.
Note: the allowable variation in the voltage on the 2 inputs is the same as for the auxiliary supply. These two inputs are not polarised, they can be connected to an ac supply.

Steps to be taken	Expected results
EL1 logic input : T input	
When the T parameter is programmed for a given function, this function is inoperative whilst EL1 (T input) is live.	
-Permit the operation of a protection function (P parameter active)	
- Program the T temporary inhibition parameter connected to the T input (P and T parameters active)	
-Activate the selected protection by crossing the threshold	
-Connect terminal 8 of the T input to +ve of the auxiliary supply	The associated output relay operates The function is instantaneously deactivated and the associated output relay drops off.
When using an ac auxiliary supply, terminal 12 (common) should be connected to one side of the supply, terminals 8 and 9 to the other side.	
EL2 logic input : V input	
This input is only related to the [51-LR] function.	
-Connect terminal 9 of the V input to +ve of the auxiliary supply	The starting time delay TD is initiated.
NB : the V input initiation may be transient (30ms minimum)	

V-6 Commissioning using primary values

All secondary injection test equipment must be removed before commissioning the relay.

To start with, all of the protective functions, except for the over current protection which can not be deactivated, must be put out of service. During primary tests, the protective functions will be activated one after the other.

Before proceeding with commissioning it is important to check that :

- the current transformers have a rated current the same as that indicated on the relay rating plate, and have a minimum power of 5 VA;5P10,

- the frequency of the network is identical to that indicated on the relay rating plate;

- the auxiliary voltage is the same as that indicated on the rating plate (20 to 66V or 48 to 250V),

- the relay is correctly plugged in, and that the 4 fixing rods are fully screwed in,

- the rear connected communications sockets are correctly plugged in,

- the trip, control and signalling wiring are correct.

Checking the current connections

It is possible to read the 3 line currents IA, IB and IC. Compare the magnitude of these currents against those actually circulating.

The level of negative phase sequence current I2 can be read. Its value depends upon the correct connection of the line current transformers. If the three line currents have the same value consult the values below :

-normal connection	I2 ≈ 0
-two phases crossed or correctly wired but incorrect phase sequence	I2 = I
-one phase missing	I2 = I/3
-two phases missing	I2 = I/3
-one or two transformers reversed	I2 = 2/3I

Checking the voltage connections

It is possible to read the measured voltages (GMS7002 : 3 phase to neutral voltages VA, VB and VC, GMSH7002 : 2 phase to phase voltages VAB and VBC). Compare the magnitude of these voltages against those actually present.

The phase sequence voltage values are not available and so the active power (display) and reactive and apparent powers (terminal) need to be read when the machine is on load in order to confirm that the connections are correct.

If the values appear incorrect when they are read, it is necessary to check the phase sequence of the transformers.

VI - ABNORMAL SITUATIONS

-The display does not light up : check the drain given that P = approx 10W or 15VA.

-The relay operates but the circuit breaker does not trip : check the trip circuit wiring

-Threshold will not operate or is too high : check that the relay is fully plugged in and that the fixing rods are screwed in.

-Continuous operation of the residually connected earth fault element (GMSH7002) : check the wiring and the polarity of the cts.

-Toroid (GMSH7002) connected earth fault element will not operate : check the wiring of the cable sheath

-Poor communications . Check : the plugs, the switch position, the slave number.

[PAGES 67 - 68 ARE BLANK]