Service Manual R8068
Type MCHD

General Purpose Thermal Replica Relay

GEC ALSTHOM
T&D

CONTENTS

Section 1. DESCRIPTION

The MCHD is a general purpose thermal replica relay intended for the thermal overload protection of generators, transformers and cables.

1.1 Thermal overload protection

The relay provides accurate thermal overload protection under all operating conditions by creating a thermal replica of the equipment being protected.

The relay has separate inputs for connection to the three phases of the supply circuit and contains one thermal replica and measuring circuit which responds to the largest phase current.

The MCHD may thus be applied for single or three phase overload protection.

The current setting (I) is adjustable from $0.4I_n$ to $1.175I_n$ and is set equal to the rated current of the protected equipment expressed as a current transformer secondary value.

The thermal replica is calibrated so that a continuous current of I_s will produce an indication of a temperature rise of 100% θ_s. The indicator reading has to be multiplied by two to give these actual θ. Thus the eventual value of θ seen by the replica is given by $(I/I_s)^2$ x 100% θ_s for any applied current I.

The time constant t (heating and cooling) of the thermal replica is adjustable from 5 to 160 minutes allowing the relay to be matched with the thermal overload withstand capability of a wide range of generators, transformers and cables.

The thermal overload protection is equipped with two stages, providing alarm (θ_{alarm}) and trip (θ_{trip}), both have settings available from 70% θ_s 147.5% θ_s.

The operating time/current characteristics for different time constants (t) and % θ_s settings are given on Figure 1.

The relay has separate output contacts for θ_{alarm} and θ_{trip} which operate in the times obtained from Figure 1.

Indication of θ_{trip} is given by a light emitting diode on the front plate which cannot be reset until the contacts have reset. The trip and alarm contacts reset when the indicated % θ_s is below the appropriate θ_{trip} and θ_{alarm} settings. The reset time constant is the same as the set operating time constant.

1.2 Short circuit protection

Protection against short circuit faults is provided by a highset overcurrent unit which has a setting range from $2I_n$ to $25I_n$. The trip time is adjustable from 0.05s to 2.05s.

Operation is indicated by another light emitting diode and the output contacts reset as soon as the fault current is removed.

1.3 Test feature

Pressing the test button causes the high set unit to operate after the set time (t), the trip and alarm contacts operate after a time depending on the time constant t.

The output contacts and resets function as described for a normal operation.

Section 2 INSTALLATION

2.1 Protective relays, although generally of robust construction, require careful treatment prior to installation and a wise selection of site. By observing a few simple rules the possibility of premature failure is elimated and a high degree of performance can be expected.

2.2 The relays are either despatched individually or as part of a panel/rack mounted assembly in cartons specifically designed to protect them from damage.

Relays should be examined immediately they are received to ensure that no damage has been sustained in transit. If damage due to rough handling is evident, a claim should be made to the transport company concerned immediately, and GEC ALSTHOM Measurements should be promptly notified. Relays which are supplied unmounted and not intended for immediate installation should be returned to their protective polythene bags.

2.3 Care must be taken when unpacking and installing the relays so that none of the parts are damaged or their settings altered, and must only be handled by skilled persons.

Relays should be examined for any wedges, clamps, or rubber bands necessary to secure moving parts to prevent damage during transit and these should be removed after installation and before commissioning.

Relays which have been removed from their cases should not be left in situations where they are exposed to dust or damp. This particularly applies to installations which are being carried out at the same time as constructional work.

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

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

The storage temperature range is –25°C to +70°C.

2.5 The installation should be clean, dry and reasonably free from dust and excessive vibration. The site should preferably be well illuminated to facilitate inspection.

An outline diagram is normally supplied showing panel cut-outs and hole centres. For individually mounted relays these dimensions will also be found in publication R6017.

Publication R7012, Parts Catalogue and Assembly Instructions, will be useful when individual relays are to be assembled as a composite rack or panel mounted assembly.

Publication R6001 is a leaflet on the modular integrated drawout system of protective relay.

Publication R6014 is a list of recommended suppliers for the pre-insulated connectors.

Section 3. COMMISSIONING

3.1 Commissioning Preliminaries

3.1.1 Electrostatic discharge

The relay uses components which are sensitive to electrostatic discharges. When handling the withdrawn module, care should be taken to avoid contact with components and electrical connections. When removed from its case for storage the module should be placed in an electrically conducting anti-static bag.

3.1.2 Inspection

Carefully examine the module and case to see that no damage has occurred during transit.

Check that the relay number on the module, case and cover are identical. also check that the rating information is correct for the system.

3.1.3 Wiring

Check that the external wiring is correct to the relevant relay diagram and/or scheme diagram. The relay internal connection diagram number is given on the rating label inside the case.

If a test block type MMLG is provided the connections should be checked to the scheme diagram particularly that the supply connections are to the 'LIVE' side of the test block (coloured orange) and with odd terminal numbers (1, 3, 5, 7, etc)

The auxiliary supply volts to the scheme are normally routed via test block terminals 13 and 15.

3.1.4 Earthing

Ensure that the case earthing connection, above the rear terminal block, is connected to the local earth bar.

3.1.5 Insulation tests

These tests may be done by the main plant contractor at an earlier date.

The relay and its associated wiring may be insulation tested between:

— all electrically isolated circuits

— all circuits and earth

An electronic or brushless insulation tester should be used giving a dc voltage not exceeding 1000V. Accessible terminals of the same circuit should first be strapped together. Deliberate circuit earthing links removed for the tests must subsequently be replaced.

3.2 Commissioning Tests

3.2.1 Equipment required

1 overcurrent test set with time internal meter.

1 multi-meter

3.2.2 Auxiliary Supply

The auxiliary supply should be checked at terminals 13 (+ if dc) and 14 with the module removed.

If a test block type MMLG is fitted, the auxiliary supply may be routed through it. Removal of the cover provides isolation of one connection. If the test plug type MMLB01 is to be used, the links to provide ct shorting must be in place before it is inserted. (Removal of the relay from the case automatically puts shorts on the appropriate relay terminals). Links can then be put on it to restore auxiliary supplies to the relay.

Refer to the scheme connection diagram.

For supplies greater than 125V ac or dc an external regulating device can be used giving about 110V dc at the relay. Alternatively an MSTZ may be used which has a nominal output of 30V dc for dc inputs up to 250V.

3.3 Commissioning

3.3.1 Test feature checks

This provides a quick confirmation that the relay is capable of operating. All external connections are shown on Figure 2. The following settings should be put on for these tests :

t = 1.05 second	$\theta_{alarm} = 70\%$	$\tau = 85$min
$\theta_{trip} = 100\%$	$I_s = 0.4I_n$	$I>> = 2I_n$

The settings are shown on Figure 4.

The settings of I_s and I >> will not however, affect the test feature results.

The θ_{trip} time when using the test feature is approximately

$\tau/4 \times \% \; \theta_s/100$ seconds

which for the above settings = 85/4 x 100/100

= 21s approx.

and the θ_{alarm} time would be 0.7 x θ_{trip} time = 15s approx.

Check the appropriate contacts for operation. These times should be checked using a stopwatch started when pressing the test button. but first it is essential to reset the thermal charateristic circuit and this is done as shown on Figure 3. ESD precautions should be taken when the relay is removed from its case.

The I >> light emitting diode and the appropriate contact should be checked for operation about 1 second after pressing the test button.

The indicator should show about 35% on its scale when the alarm is given and about 50% when the trip is given.

3.3.2 Secondary injection with example settings

Settings as for the test feature checks except $\tau = 5$.

Inject 4 x Is (1.6 amps for In = 1 and 8 amps for In = 5) into each phase in turn if used and check the θ_{alarm} time obtained is about 13 seconds and the θ_{trip} time obtained is about 19 seconds. The above times are obtained from Figure 1 (5 x 60 x 0.044 = 13 approximately and 5 x 60 x 0.064 = 19 approximately).

A check can be made on τ by obtaining an indication of 100% and checking the time until the indicated reading falls to 37%, the time should be about 5 minutes.

Determine the I >> trip value injecting 2In minus 10% for about 2 seconds. Check for no operation and then inject 2In + 10% for 2 seconds to check for operation. Check the operation time with at least 120% of setting applied.

3.3.3 Secondary injection with In Service settings

If the tests injecting each phase in 3.3.2 are satisfactory only one need be injected for these tests. The appropriate settings should now be put on the relay and recorded on the 'in service setting chart' if it has not already been done. The tests can now be done as in 3.3.2 having determined the new thermal trip times from Figure 1. If a high value of τ has been set, test time will be reduced by choosing to inject a current of say 7 x I_s rather than 4 x I_s.

If a high value of τ has been set it may be considered impracticable to check the reset. However, the operation time confirms correct selection of τ and the test done in 3.3.2 confirms the reset function. The correct setting of I_s is similarly confirmed by the operation times measured.

Tolerances on predicted values under commissioning conditions are $\pm 10\%$.

3.3.4 Thermal Reset

Ensure all temporary connections are removed and the thermal element is reset.

During testing of the relay, it is frequently necessary to reset the thermal feature between tests before proceeding with further tests. Failure to do so may result in the thermal feature operating when attempting to test another feature. It is essential before carrying out any thermal timing check.

The module must be removed to reset the thermal replica. The screen and insulating material on the right of the relay must be removed (unless the relay has a cut out especially arranged). A 1000 ohm resistor must then be temporarily shorted across connections 8 and 9 as shown in Figure 3.

Replace the insulating material and screen. Replace the module and check that the thermal indicator is reset. If not repeat and re-check. Note that the indicator is only functional when the auxiliary supply is connected and the thermal memory is not reset by removing the auxiliary supply.

APPLICATION AND SELECTION OF SETTINGS

4.1 Example

Consider the case of a 30MVA, 33/11kV, DY11 power transformer fed from the 33kV side to which thermal overload protection needs to be applied. The power transformer details are :

Current transformer ratio 600/1

Power transformer perentage reactance 11%

Type of cooling ON

Maximum continuous overload 110%

Short time overload 130%

Time constant 60 minutes

4.2 Procedure for Relay Settings

4.2.1 Relay current setting I_s

Transformer full load current $= \dfrac{30 \times 10^3}{\sqrt{3} \times 33} = 525A$

CT full load secondary current = 525/600 = 0.875A

Relay current setting range = 0.4 - 1.175I_n in 0.025I_n steps

Corresponding to $I_s = (0.4 + \Sigma)_n$

In this application a relay with $I_n = 1$ would be ordered.

Σ settings are 0.4, 0.2, 0.1, 0.05, 0.025 selectable by switches.

Therefore select switch positions 0.4, 0.05, 0.025 to give the required current setting $I_s = (0.4 + 0.4 + 0.05 + 0.025) \times 1A = 0.875A$

4.2.2 Thermal Overload Settings

Recommended settings for alarm and trip overloads:

Alarm θA = 110% of θs

Trip θT = 130% of θs

Relay temperature settings 70 - 147.5% of θs in 2.5% steps corresponding to
$\theta = (0.7 + \Sigma)\ \theta s$

Σ settings are 0.4, 0.2, 0.1, 0.05, 0.025 selectable by switches. Therefore, select switch positions :

Alarm 0.4

Trip 0.4 and 0.2

To give us the required values of :

Alarm overload setting θA = 0.7 + 0.4 = 110% of θs.

Trip overlaod setting $\theta trip$ = 0.7 + 0.4 + 0.2 =130% of θs.

Time constant = 60 minutes

Relay time constant settings = 5 - 160 minutes in 5 minute steps.

Corresponding to = $(5 + \Sigma)$ minutes

Σ Settings are 80, 40, 20, 10, 5 selectable by switches.

Therefore, select switch Positions 40, 10, 5 to give the required value.

5 + 40 + 10 + 5 = 60 minutes

4.2.3 Short Circuit Protection

Transformer through fault current $= 525 \times \frac{100}{10}$

= 5250A

CT through fault secondary current = 5250/600 = 8.75A

If, we set the relay not to overreach the transformer low voltage side.

Recommended relay current setting = 1.5 x 8.75
= 13.12A

Relay current setting range = 2 - 25 I_n in 1I_n steps

Corresponding to I>> = $(2 + \Sigma)\ I_n$
settings are 8, 8, 4, 2, 1 selectable by switches.

Therefore, select switch positions 8, 2, 1, to give the required value of :

I>> = 2 + 8 + 2 + 1 = 13A

Assuming an $\frac{X}{R}$ ratio of 30/1.

Time constant of the fault current = $\frac{30}{2 \times 3.14 \times 50}$ = 0.0955 second

Timer setting range 0.05 - 2.05 seconds in 0.1 second steps.

Corresponing to t = (0.05 +Σ) seconds.

Σ settings are 1, 0.5, 0.2, 0.2, 0.1 selectable by switches.

Therefore, select switch position 0.1.

To give us an operating time $t = 0.05 + 0.1$
$= 0.15$ second.

COMMISSIONING TEST RECORD

GENERAL PURPOSE THERMAL REPLICAT RELAY TYPE MCHD

STATION ________________ DATE ________________

CIRCUIT ________________ SERIAL NO ________________

AUXILIARY SUPPLY Vx ________ Volts dc ________ ac ________

RATED CURRENT ________ amp ________

3.1.2 Visual inspection ________________

3.1.5 Insulation tests ________________

3.2.2 Auxiliary supply at terminals 13 and 14 ________________ volts

3.3.1 Test Feature Checks

θ alarm time ________________ seconds

θ trip time ________________ seconds

I>>operation obtained in about 1 second ________________

All contacts operated correctly ________________

Indicator percentage readings correct ________________

3.3.2 Secondary Injection Tests with Example Settings

Injecting terminals	23 to 24	25 to 26	27 to 28
θ alarm time			
θ trip time			
I>>no trip with 2In – 10%			
I>> trips with 2In + 10%			
I>>trip time		seconds	
Reset time constant measured		seconds	

3.3.3 Secondary Injection with In Service Settings

In Service setting chart filled in ________

Current injected to determine θ alarm and θ trip times ________ x Is

Predicted times from Figure 1: θ alarm time ________ seconds

θ trip time ________ seconds

Measured times θ alarm time ________ seconds

θ trip time ________ seconds

I>>no trip with setting −10% ________

I>>trip with setting +10% ________

I>>trip time setting ________ seconds

I>>measured trip time ________ seconds

Time constant (if measured) Set ________ Minutes

Measured ________ Minutes

Commissioning Engineer

Customer Witness

Date

Date

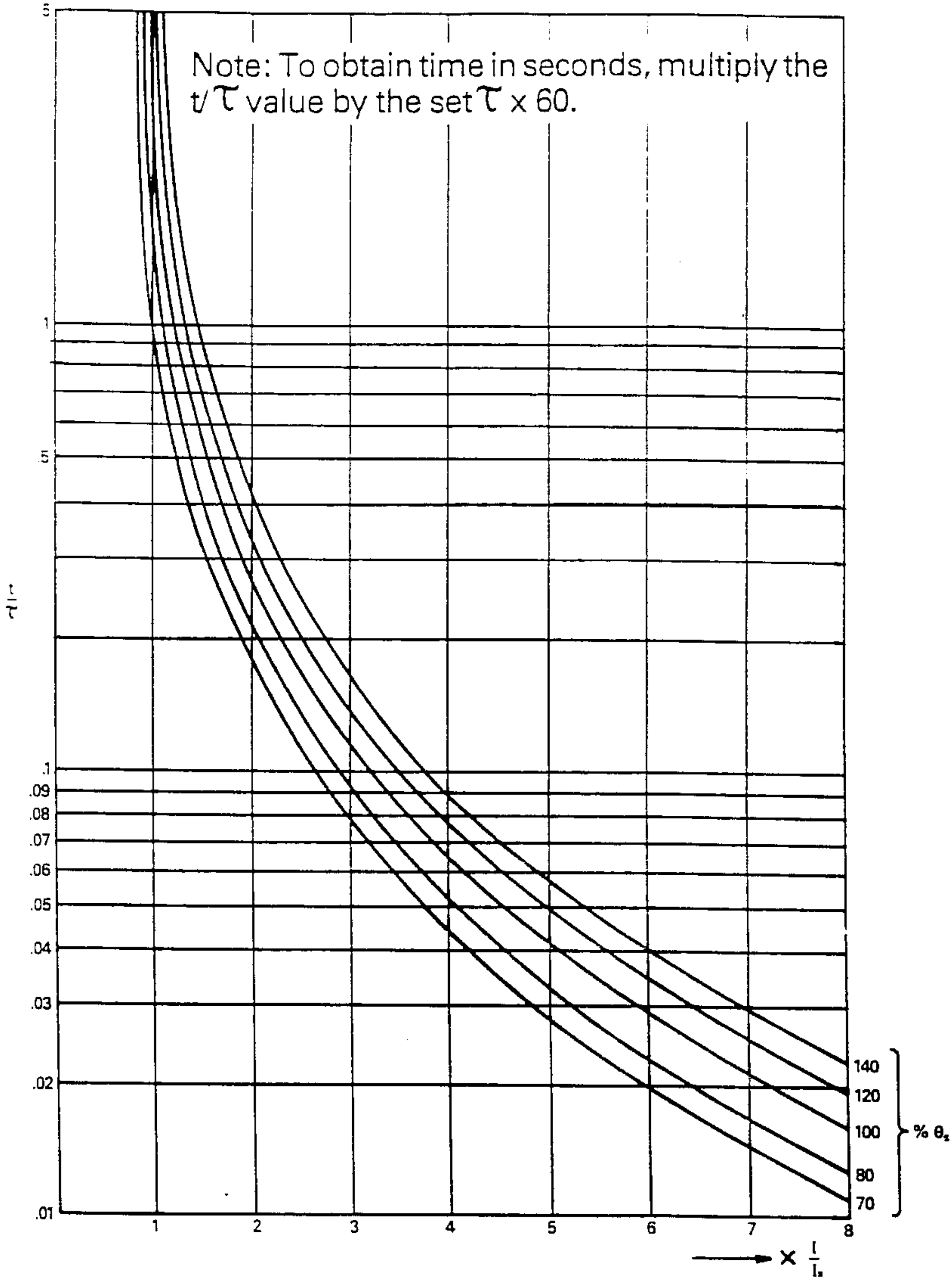
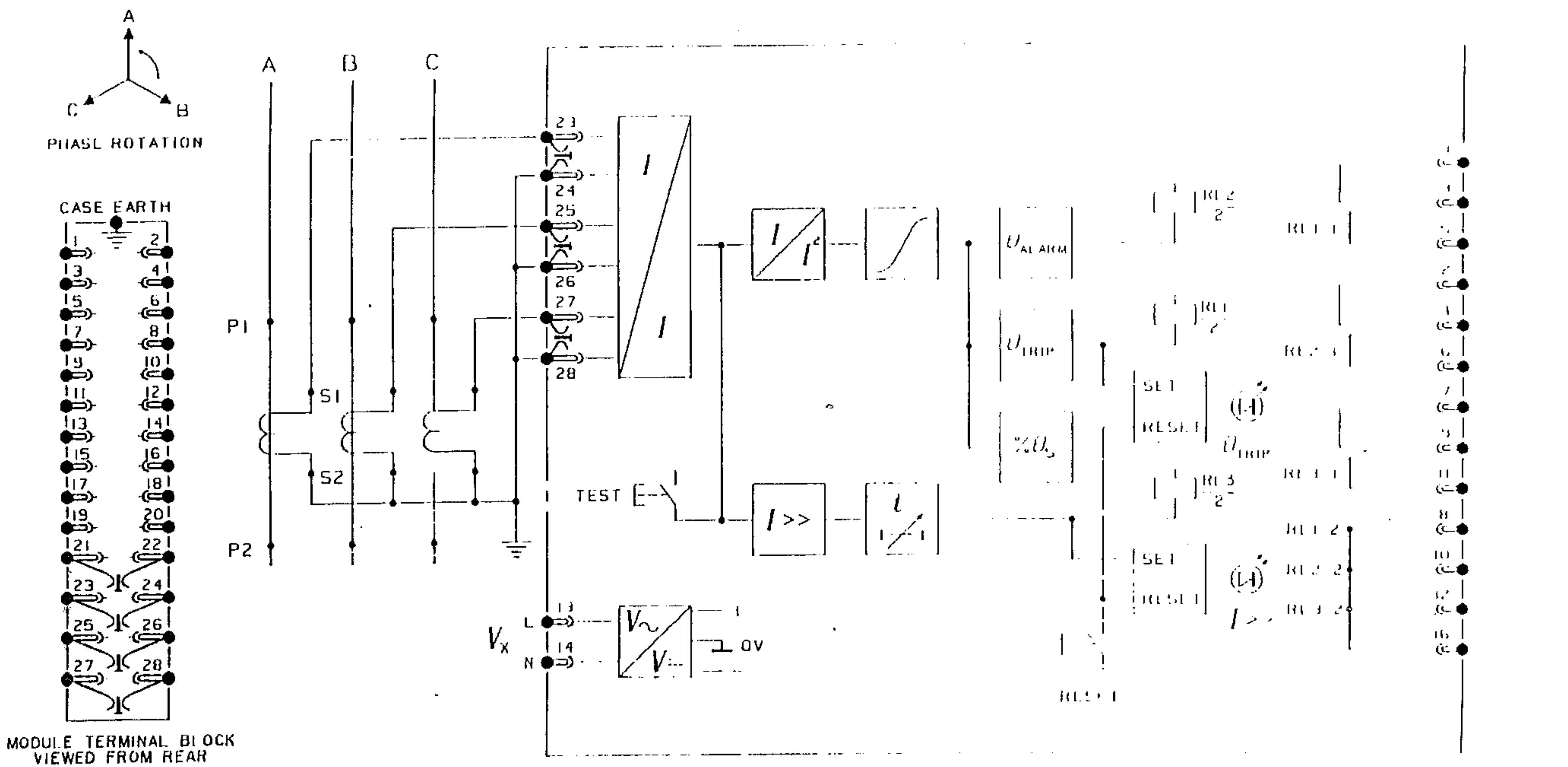


Figure 1 Operating time/current characteristics.

DRG NO F10 MCHD01 501

SYMBOLS GENERALLY TO BS 3939



NOTE 1

(a) C.T. SHORTING LINKS MAKE BEFORE (b) & (c) DISCONNECT

(b) SHORT TERMINALS BREAK BEFORE (c).

(c) LONG TERMINALS

ORIGINAL DRG FRAME SIZE 277 x 400

A	B	C	TEST PUSH BUTTON ADDED
DATE	13 2 87	11 1 88	

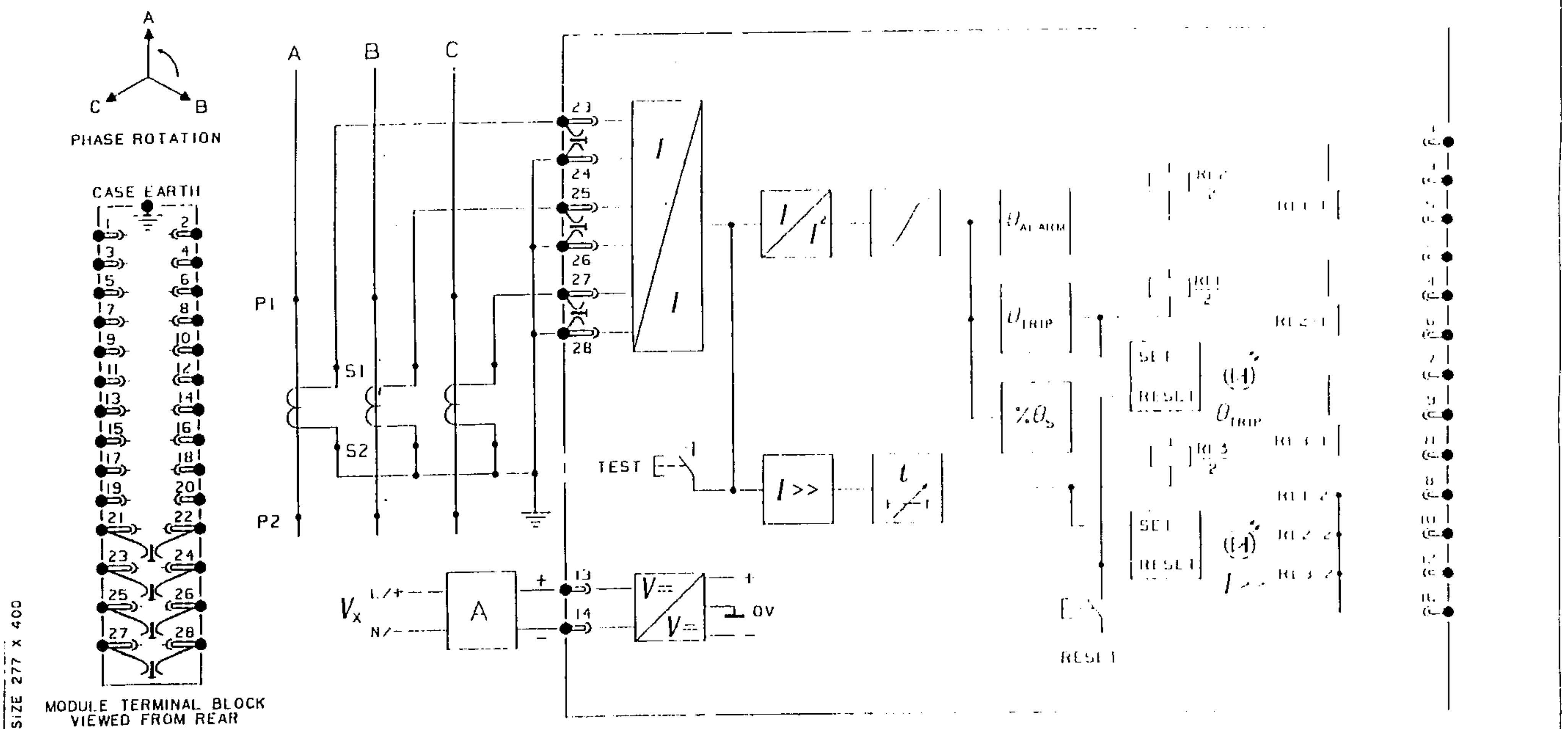
Fig. 2(a)

GEC Measurements (c) THE GENERAL ELECTRIC COMPANY, p.l.c. OF ENGLAND
ST LEONARDS WORKS STAFFORD

TITLE	BLOCK DIAGRAM THERMAL REPLICA RELAY			A.C.
CUSTOMER		SHEET NO	NEXT SHT	DRAWN R.PARNELL CHECKED
DRG NO	F10 MCHD01 501	1		

DRG NO F10.MCHD01 502

SYMBOLS GENERALLY TO BS 3939



A: AUXILIARY SUPPLY UNIT ONLY REQUIRED FOR A.C. AND D.C. SUPPLIES FOR V_x >125 VOLTS AND IS FOR USE WITH 110 VOLT D.C. RELAY

NOTE 1

(a) C.T. SHORTING LINKS MAKE BEFORE (b) & (c) DISCONNECT

(b) SHORT TERMINALS BREAK BEFORE (c).

(c) LONG TERMINALS

A	B	C	
DATE	13 2 87	11 1 88	TEST PUSH BUTTON ADDED

Fig. 2(b)

GEC Measurements

© THE GENERAL ELECTRIC COMPANY p.l.c. [illegible]

ST. LEONARDS WORKS [illegible]

TITLE BLOCK DIAGRAM THERMAL REPLICA RELAY

CUSTOMER

DRG NO F10 MCHD01 502

SHEET NO 1 | NEXT SHT | DRAWN | CHECKED

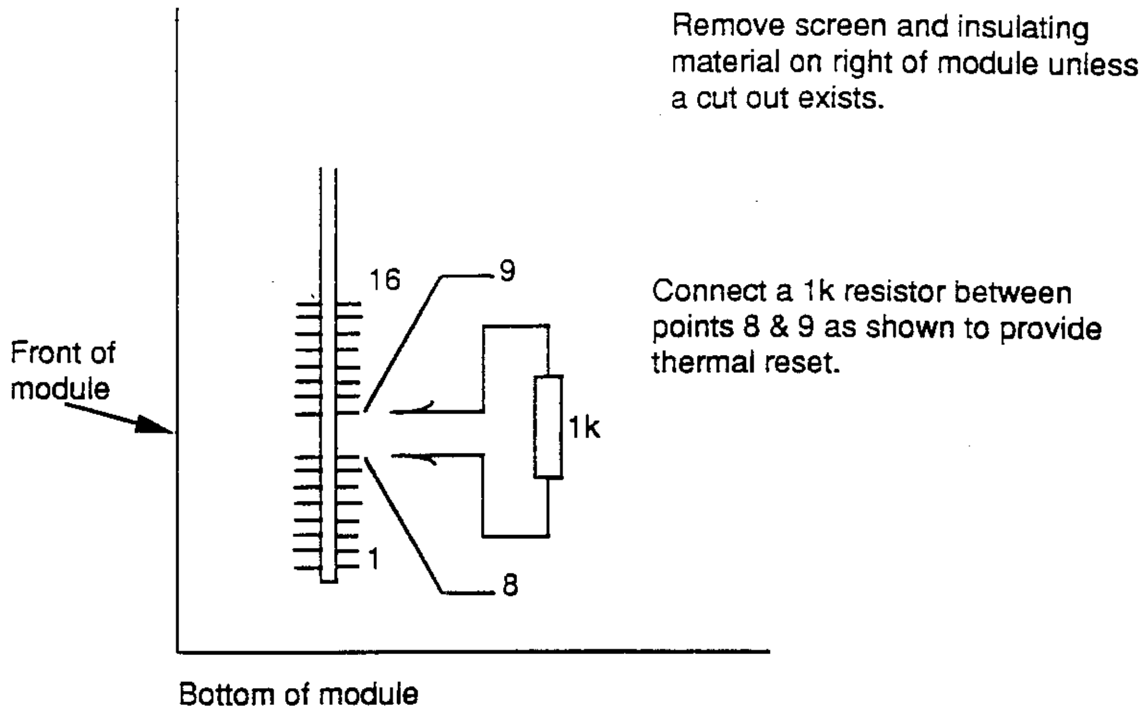


FIGURE 3 THERMAL CHARACTERISTIC RESET

Σ = The sum of numbers selected by switches.

Indicate numbers selected by [x |]

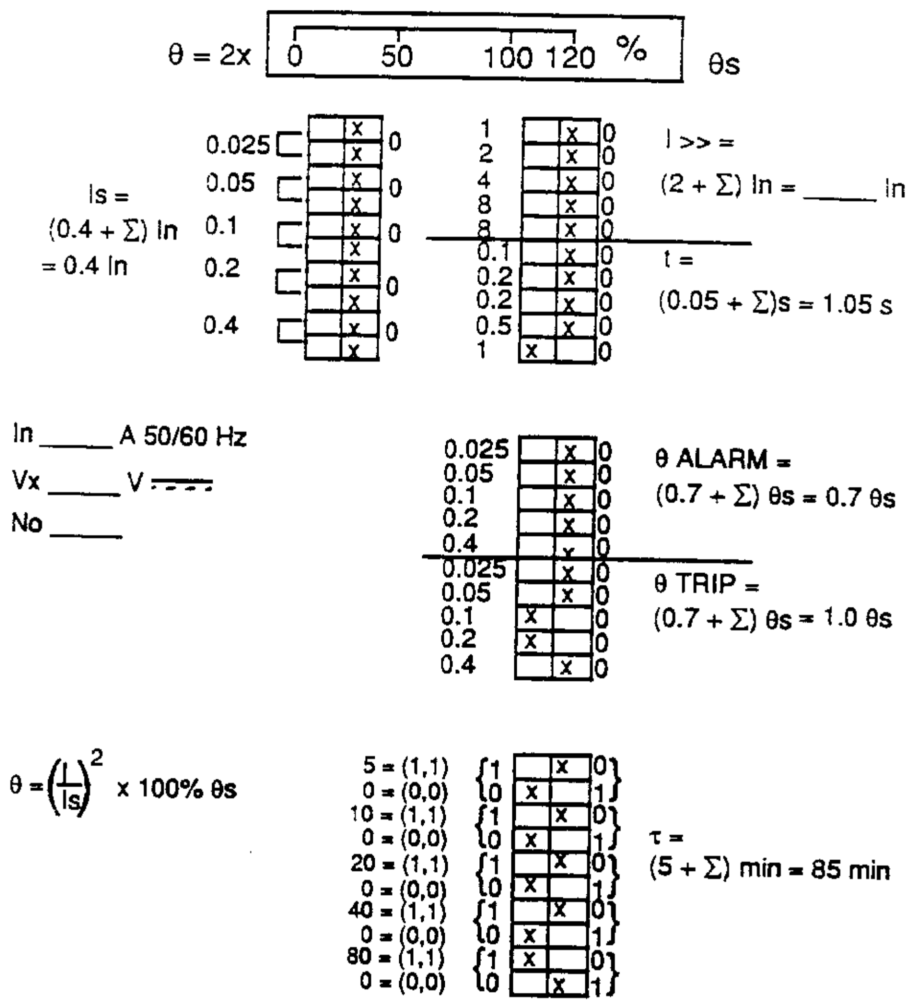


FIGURE 4 CHART OF SETTINGS FOR TEST FEATURE CHECKS

Σ = The sum of numbers selected by switches.

Indicate numbers selected by [X|]

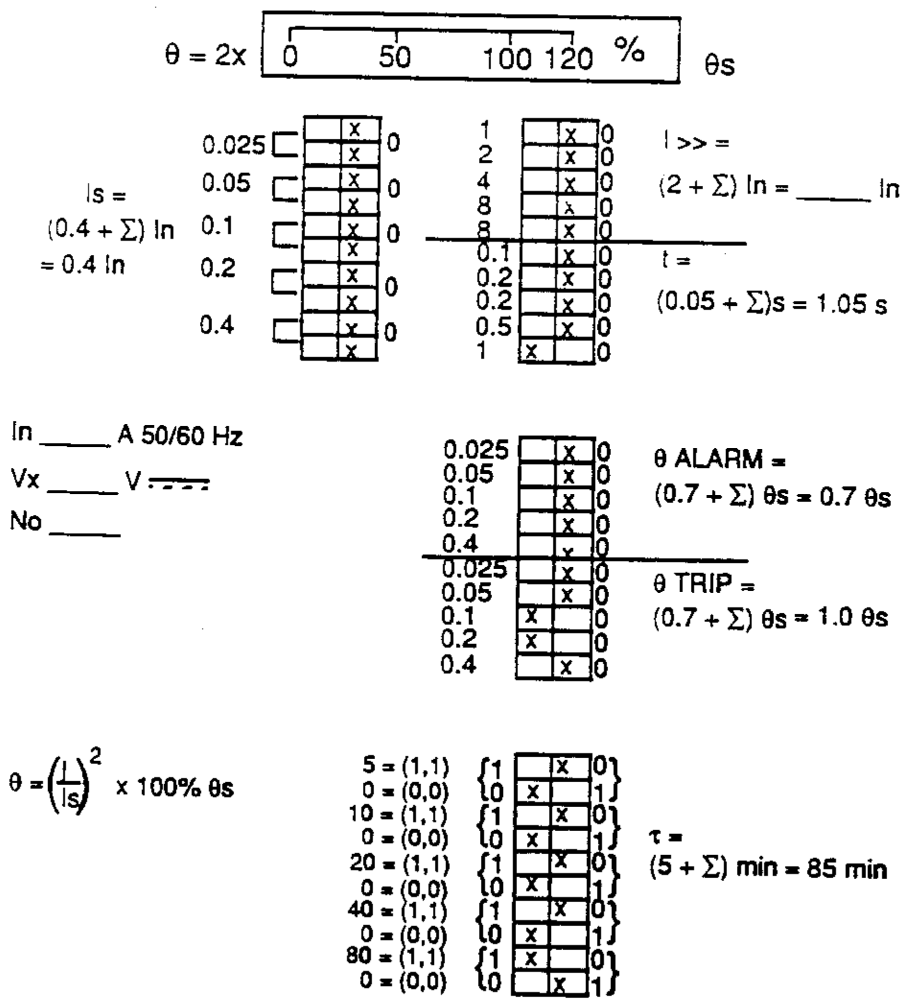


FIGURE 4 CHART OF SETTINGS FOR TEST FEATURE CHECKS

Σ = The sum of numbers selected by switches.

Indicate numbers selected by [X]

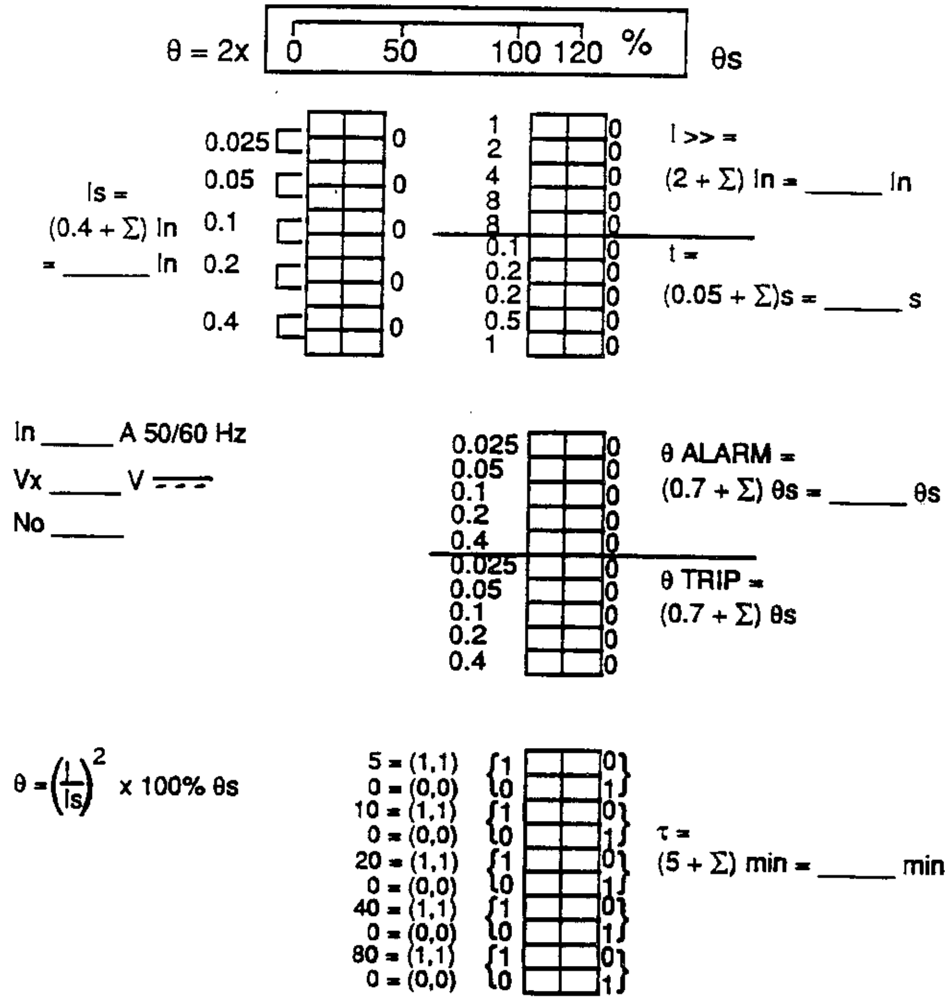


FIGURE 5 CHART OF IN SERVICE SETTINGS FOR MCHD RELAY