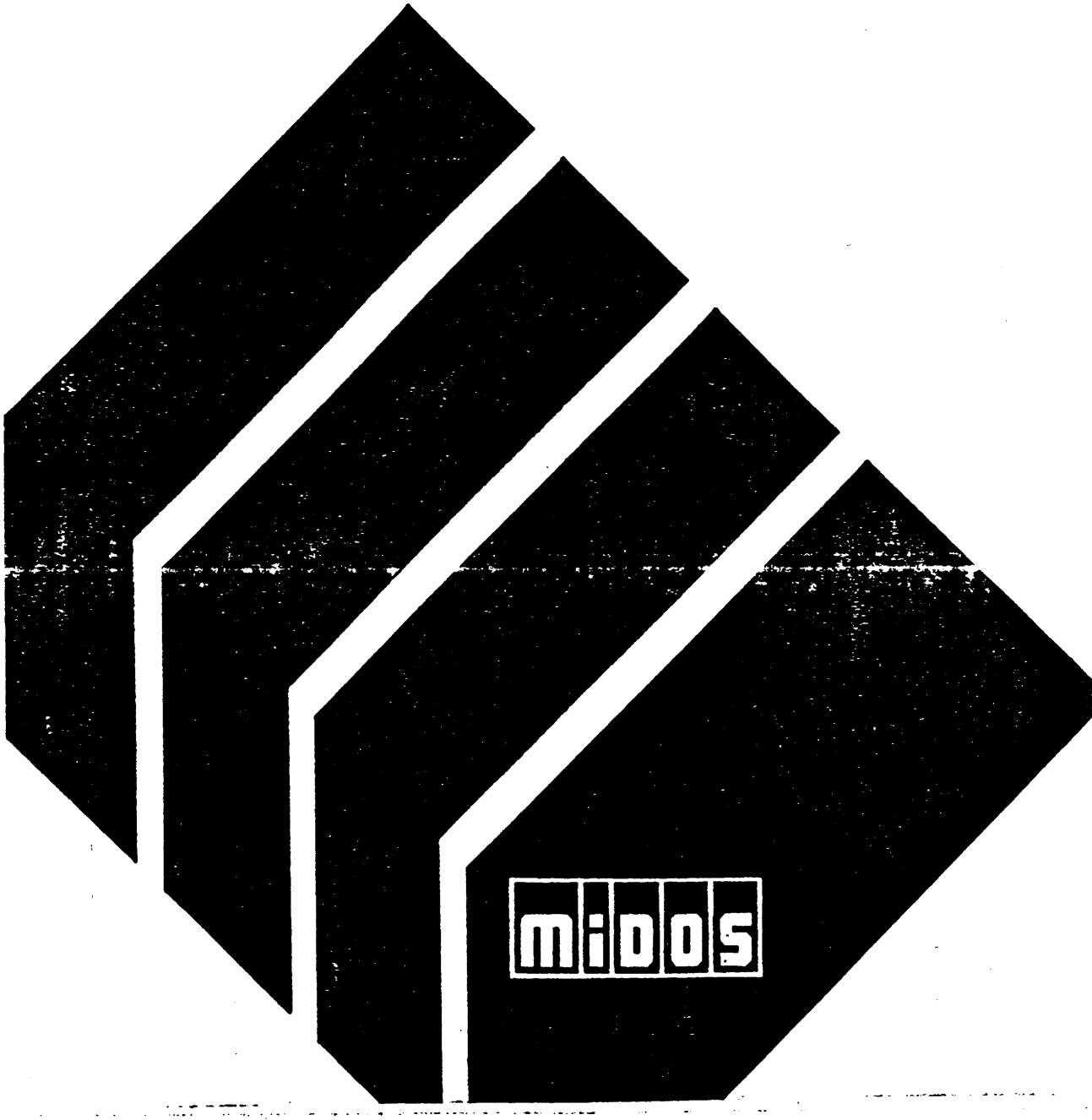
GEC Measurements

SERVICE MANUAL R-8038

MCTD

SILICON RECTIFIER AND FILTER PROTECTION



CONTENTS

1. SETTINGS

Relay type MCTD features both instantaneous and inverse time overcurrent protection.

The inverse time/current setting is adjustable by means of a plug bridge in equal steps of 25% from 50% to 200% of rated current.

The setting for the high set instantaneous unit is continuously adjustable from 2x to 8x the time delayed setting by means of a calibrated potentiometer mounted on the relay frontplates.

The time/current characteristic is as follows:-

Multiple of current setting	2x	3x	4x	5x	6x	7x	8x
Nominal operating time (sec)	230	50	11.6	3.2	1.0	0.22	0.072

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 possiblity of premature failure is eliminated 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 the nearest GEC Measurements Branch Office should be promptly notified. Relays which are supplied unmounted and not intended for immediate installation should be returned to their prospective 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 they must at all times be handled by skilled persons only.

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 effeciency.

Storage temperature -25 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 R-6038.

Publication R-7012 is a Parts Catalogue and Assembly Instructions. This document will be useful when individual relays are to be assembled as a composite rack or panel mounted assembly.

3. COMMISSIONING

3.1 Commissioning Preliminaries

Electrostatic Discharges (ESD)

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

Inspection

Carefully examine the module and case to see that no damage has occurre during transit. Check that the relay serial number on the module, case and cover are identical and that the model number and rating informatio are correct.

Carefully remove any elastic bands/packing fitted for transportation purposes.

Carefully actuate the armature of each unit in turn with a small screwdriver/probe. Note that immediately after the point where the normally open contacts just make there is a small further movement of t armature. This ensures that contact follow through and wiping action i present.

On units fitted with hand reset flag indicators, check the flag is free fall before, or just as, the normally open contacts touch.

Wiring

Check that the external wiring is correct to the relevant relay diagram or scheme diagram. The relay diagram number appears inside the case.

Particular attention should be paid to the correct wiring and value of any external resistors indicated on the wiring diagram/relay rating information.

Note that shorting switches shown on the relay diagram are fitted internally across the relevant case terminals and close when the module is withdrawn. It is essential that such switches are fitted across all C.T. circuits.

If test block type MMLG is providd, 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 terminals allocated with odd numbers (1, 3, 5, 7, etc.). The auxiliary supply voltage to the scheme should be routed via test block terminals 13 and 15.

Earthing

Ensure that the case earthing connection above the rear terminal block, is used to connect the relay to a local earth bar.

Insulation

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

a) all electrically isolated circuits.

b) all circuits and earth.

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

3.2 Secondary Injection Testing

Test Equipment Required

1 - Variable current source
1 - Electronic timer
1 - Two pole switch
1 - A.C. ammeter
1 - Variable D.C. supply
1 - D.C. voltmeter

An overcurrent test set with timing facilities may be used if preferred.

3.2.1 General

If the relay is wired through an MMLG test block it is recommended that all secondary injection tests should be carried out using this block.

Ensure that the main system current transformers are shorted before isolating the relay from the current transformers in preparation for secondary injection tests.

DANGER

DO NOT OPEN CIRCUIT THE SECONDARY CIRCUIT OF A CURRENT TRANSFORMER SINCE THE HIGH VOLTAGE PRODUCED MAY BE LETHAL AND COULD DAMAGE INSULATIO

When type MMLG test block facilities are installed, it is important that the sockets in the type MMLB 01 test plug which correspond to the curren transformer secondary windings, are LINKED BEFORE THE TEST PLUG IS INSERTED INTO THE TEST BLOCK. Similarly, a MMLB 02 single finger test plug must be terminated with an ammeter BEFORE IT IS INSERTED to monitor C.T. secondary currents.

It is assumed that the initial preliminary checks have been carried out.

3.2.2 Relay C.T. Shorting Switches

With the relay removed from its case, check that the C.T. shorting switc is closed by injecting rated current into the current circuit.

The rated current of the relay (I_n) is either 1 A or 5 A and appears on the bottom handle strip of the relay module.

3.2.3 Auxiliary Supply

With the relay removed from its case, the incoming supply should be checked at the relay case terminals. The incoming voltage must be withi the range specified on the rating strip and terminal 13 should be positi with respect to terminal 14.

For secondary injection testing using test block type MMLG, insert test plug type MMLB 01 with the required main C.T. shorting links fitted. Isolate the relay trip and alarm circuits, insert the module and connect the auxiliary supply to the relay. It may then be necessary to link across the front of the test plug to restore the auxiliary supply to the relay.

3.2.4 Operational Tests

Energise the relay at the rated auxiliary supply voltage.

(i) Plug Bridge Test

Set I_{INST} to 2 X I_s and for each plug bridge setting (I_s) including the condition when the plug is removed (in this condition the top tap 200% I_n is internally selected to ensure that the C.T. is not open circuited) check that the instantaneous unit operates when a current equal to 300% I_s is injected into the relay and does not operate when a current equal to 150% I_s is injected.

(ii) Instantaneous Unit Calibration Check

Select any convenient plug bridge setting I_s. Inject current equal to 90% I_{INST} and 110% I_{INST} for the following settings of I_{INST} 2, 5 and 8. Check that the instantaneous unit does not operate when 90% I_{INST} is injected and operates when 110% I_{INST} is injected.

WARNING

Ensure that the thermal rating of the relay is not exceeded whe the higher currents are injected. Remove the injected current soon as possible.

(iii) Relay Characteristic Check

Select any convenient plug bridge setting I_s, turn the instantaneous setting to maximum, i.e. fully clockwise.

Inject current equal to 2 I_s, 5 I_s and 8 I_s into the relay and record the operating times.

APPLIED CURRENT X I_s	NOMINAL OPERATING (SECONDS)	*ALLOWABLE LIMITS (SECONDS)
2	230	187 to 273
3	50	40.7 to 59.3
4	11.6	9.52 to 13.68
5	3.2	2.7 to 3.7
6	1.0	0.89 to 1.11
7	0.22	0.203 to 0.237
8	0.072	0.057 to 0.087

* IMPORTANT

The above times do not take into account any instrument error or variation in current during timing. The relay has an extremely inverse time/current characteristic which will produc large timing errors for small instrument errors or variations in current amplitudes. Figure 1 shows how the operating time can vary with 1%, 5% and 10% errors in current measurement alone.

3.2.5 Final Setting Checks

Time Delay Unit

Select the required final plug bridge setting I_S and turn the instantaneous setting to maximum, i.e. fully clockwise. Inject current equal to 2 I_S, 5 I_S and 8 I_S into the relay and record the operating times.

Instantaneous Unit

Select the required final instantaneous setting I_{INST}. Inject curent equal to 2 I_{INST} into the relay and record the operating time (typically less than 25 mS). Replace the relay cover and check that the flags reset with the facilities provided.

Final Checks

Operate the relay with the trip and alarm links restored to ensure the necessary trip and alarm circuits are energised according to the relevant schematic diagram.

Disconnect test circuits, test plugs and remove any main C.T. short circuits.

CAUTION

If a MMLG test block has been used it is essential that the test block cover is replaced to put the relay in service.

4. MAINTENANCE

Periodic maintenance is not necessary. However, periodic inspection and test is recommended.

4.1 Visual Inspection

Isolate all supplies and withdraw the module from the case using the two black handles on the relay. Inspect the printed circuit board for any sign of loose components or connections.

Note that the flag mechanism should not be disturbed unless found to be operating incorrectly during the routine function tests.

Your attention is drawn to the fact that the relay can be damaged by electrostatic discharges. The PCB should not be touched unless precautions have been taken.

4.2 Functional Checks

Periodic function tests should be carried out using the test procedures shown in the commissioning section.

The operation of the flag and the reset mechanism should be checked during these functional tests.

5. PROBLEM ANALYSIS

It is recommended that faulty printed circuit boards are replaced as a unit and no attempt is made to remove or change components on them.

This is because the protective coating on the board is degraded by attempting to solder through it. These instructions do not, therefore, go into sufficient detail to permit the identification faulty components at printed circuit board level.

5.1 Removal of the Relay from its case

To remove the relay from its case, loosen the cover screws and remove the cover. The relay may now be withdrawn from its case by pulling on the handles. Inspect the wiring and components visually for signs of damage or poor connections.

5.2 Current Transformer and Plugbridge check

Disconnect the CT secondary (red and black wires) from PCB terminals 1 and 2. Connect an A.C. milliammeter across the CT secondary and measure the secondary current, with rated current flowing in the primary (relay terminals 27 and 28), for each plugbridge setting. The currents measured should be within 10% of those given in the following table.

Tap	Secondary Current (mA)
0.5	37
0.75	24.6
1.0	18.5
1.25	14.8
1.5	12.3
1.75	10.5
2.0	9.25

5.3 VAA Output elements

Check the mechanical action of each unit by carefully pushing the armature in with a small screwdriver or similar tool.

To check the electrical operation of the units disconnect the black wires from PCB terminals 7 (time delayed unit) and 9 (instantaneous unit).

The appropriate VAA element should operate when 30V d.c. is connected between the floating black wire (-ve) and PCB terminal 10 (+ve).

5.4 Instantaneous setting pot, RV1 (frontplate mounted)

If the IDMT relay operate correctly and the Inst. relay maloperates then the wiper of RV1 may be faulty.

To check this disconnect the wiper connection to PCB terminal 5 and check that the resistance between the free wire and either end of the potentiometer (PCB terminals 3 and 4) varies from zero ohms to a maximum of about 3K3 as RV1 is rotated.

If both IDMT and Inst. relays maloperate then perform the above test and also check that the resistance between the fixed ends of the potentiometer (after disconnecting one end from the PCB) is approximately 3K3.

5.5 Printed Circuit Boards

5.5.1 If the relay is a 30V version and the preceeding tests do not uncover a fault lies on the PCB in which case the relay should be returned for repair.

5.5.2 If the relay is a higher voltage version (i.e. with dropping resistors fitted on a separate rear mounted, PCB), then energise the relay with 30V d.c. applied between case terminal 14 (-ve) and PCB terminal 10 (+ve). If the relay now operates correctly the dropping resistor PCB is faulty, if not then the main PCB is faulty.

5.6 Spares

When ordering any spares the serial number and model number of the relay should be quoted.

If any component is replaced the calibration of the relay should be checked and the relay re-calibrated if necessary.

It is recommended that this work is carried out by a competant service centre or that the relay is returned to GEC Measurements.

Main PCB	ZJ 0067 001
Rear Ventilated enclosure	GJ 0024 pts 018(48V), 019(110V), 020(220V)
5A C.T./Plugbridge assy.	GJ 0102 001
1A C.T.	FW 0169 047
1A Plugbridge	FW 0001 011
Inst setting pot. RV1	ZB 9021 676

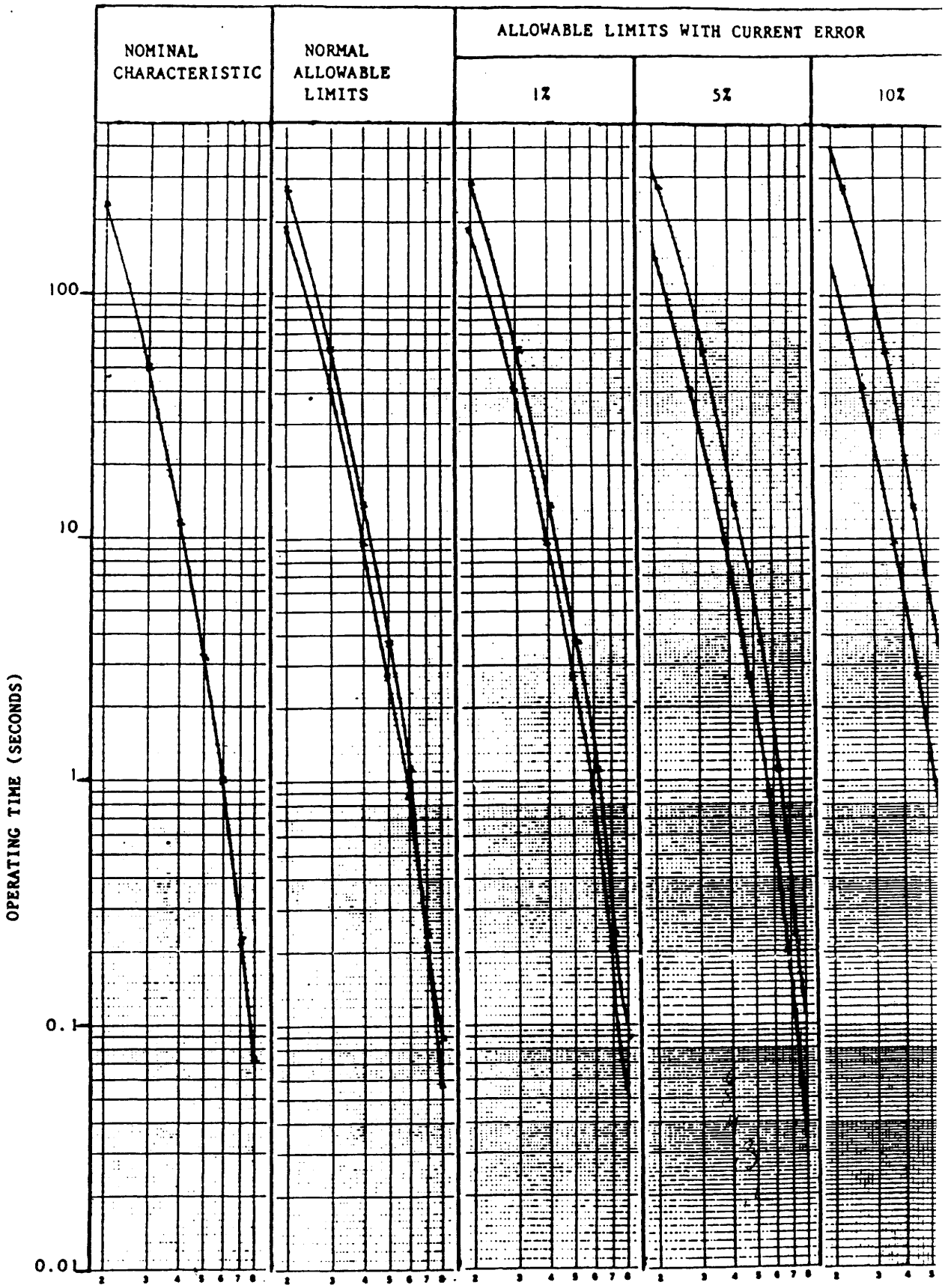

NOMINAL CHARACTERISTIC
NORMAL ALLOWABLE LIMITS
ALLOWABLE LIMITS WITH CURRENT ERROR
1%
5%
10%
100
10
1
0.1
0.01
OPERATING TIME (SECONDS)
2 3 4 5 6 7 8
APPLIED CURRENT (x Is)

FIGURE 1

ADDENDUM Publication R8038

COMMISSIONING TEST RECORD DATE _____

SILICON RECTIFIER PROTECTION RELAY TYPE MCTD 01

STATION [ ] CIRCUIT [ ]

RELAY MODEL NO. MCTD _____ SERIAL NO. _____

RATED CURRENT In 1 A ☐ 5 A ☐ FREQUENCY 50 Hz ☐ 60 Hz ☐

AUXILIARY SUPPLY VOLTAGE Vx [ ] / [ ] V D.C.

TEST RESULTS

3.1 VISUAL INSPECTION ☐ 3.2.2 RELAY C.T. SHORTING SWITCHES ☐

3.2.3 AUXILIARY SUPPLY [ ] V D.C.

3.2.4 OPERATIONAL TESTS

(i) PLUG BRIDGE TEST $I_{INST} = 2 \times I_S$

SETTING I_S (%In)	50	75	100	125	150	175	200	PLUG REMOVED
OPERATION (300% I_S APPLIED)	☐	☐	☐	☐	☐	☐	☐	☐
NO OPERATION (150% I_S APPLIED)	☐	☐	☐	☐	☐	☐	☐	☐

(ii) INSTANTANEOUS UNIT CHECK I_S = [ ] A

SETTING I_{INST} ($\times I_S$)	2	5	8
OPERATION (110% I_{INST} APPLIED)	☐	☐	☐
NO OPERATION (90% I_{INST} APPLIED)	☐	☐	☐

(iii) RELAY CHARACTERISTIC CHECK I_{INST} 8 X I_S I_S = A

APPLIED CURRENT ($\times I_S$)	2	5	8
OPERATING TIME (SECONDS)	[ ]	[ ]	[ ]

3.2.5 FINAL SETTING CHECKS I_S = [ ] A

TIME DELAY UNIT

APPLIED CURRENT ($\times I_S$)	2	5	8
OPERATING TIME (SECONDS)	[ ]	[ ]	[ ]

INSTANTANEOUS UNIT

I_{INST} = X I_S

OPERATING TIME WITH 2 X I_{INST} APPLIED [ ] mS

FLAG OPERATION/RESET ☐

CONTACT OPERATION ☐

COMMISSIONING ENGINEER _____ CUSTOMER WITNESS _____