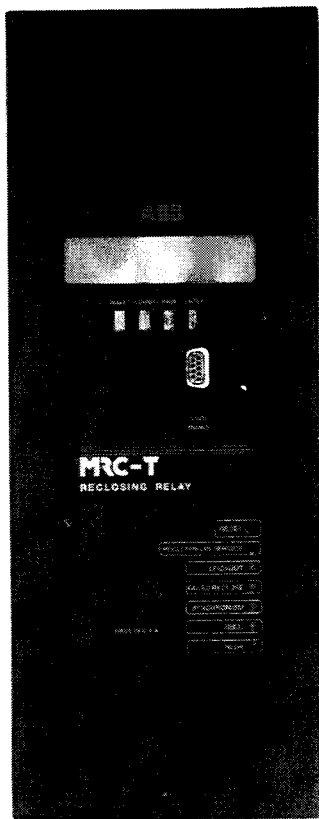


MRC-T

MRC-T



MRC-T

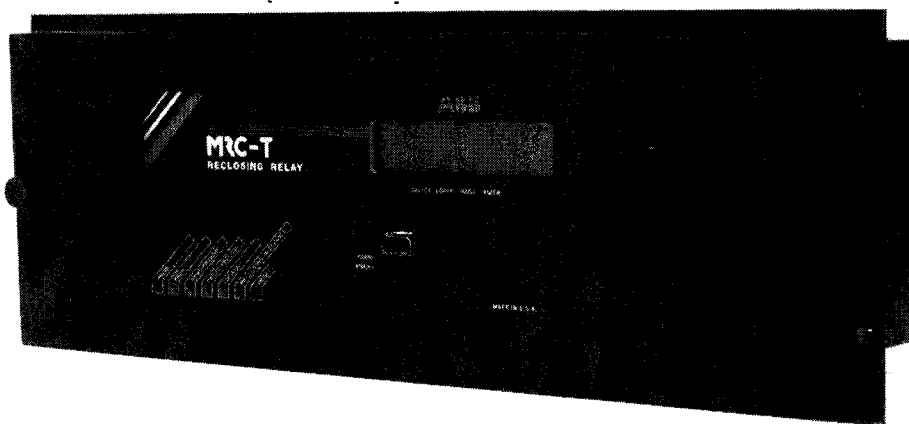


ABB Power T&D Company Inc.

Relay Division
4300 Coral Ridge Drive
Coral Springs, FL 33065

305 752-6700



800 523-2620

I.L. 41-669A

Version 1.0
May 1995

Section 1. Product Description

1. 1. INTRODUCTION

The MRC-T relay (Figure 1-1) is a numerical reclosing system, with internal synchronism check. All measurements and logic are performed by digital means, using a microprocessor. Self-checking, Reclosing and Synchronism check techniques are included. MRC-T is recommended for transmission or sub-transmission reclosing applications.

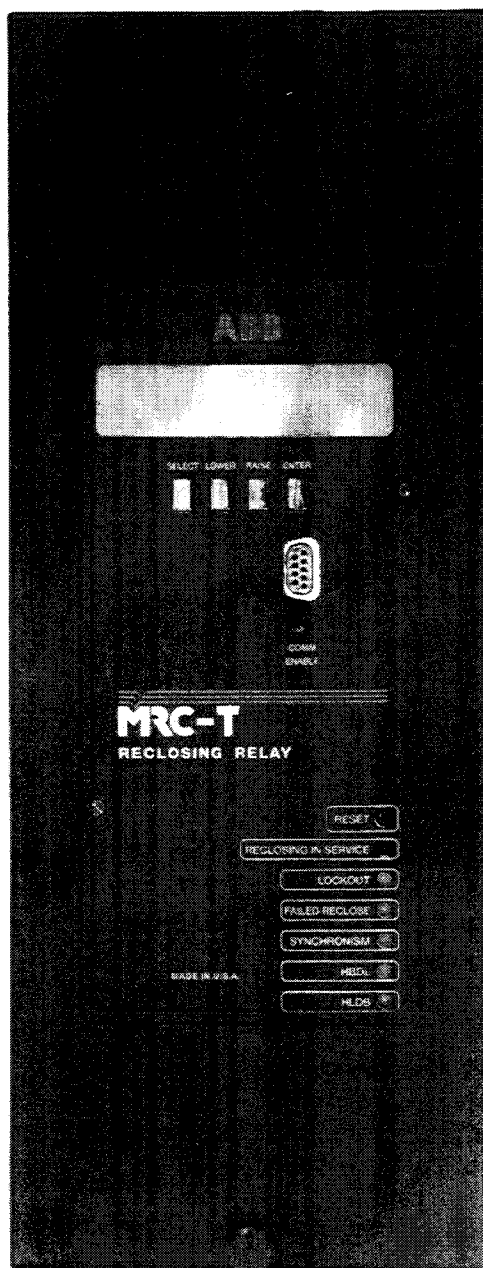


Figure 1-1.

1. 2. MRC-T FEATURES

1.2.1 Standard Features

- Multiple-Shot Reclosing
1 - 4 Instantaneous or time delay reclosures
- Reclosure dead time (settable for each reclose)
0.01 - 250 seconds
- Selectable reclosing initiate signal
52b only
Reclose Initiate (RI) only
52b or RI
52b and RI
- Reclosure block feature setting selectable
- Ac or dc control powered
- Close contact closure energizing time (reset by removal of 52b)
0.01 - 2 seconds
- Switched synchronism (enabled by external input) allow:
Hot Line Dead Bus (HLDB) voltage check and/or
Hot Bus Dead Line (HBDL) voltage check and/or
Synchronism (Sync) to be used with:
Maximum Wait Time for voltage check or Sync, - 990 seconds
Minimum Sync Condition Time Duration, 0.01 - 20 seconds
Within any reclose sequence
- Drive to Lockout input for manual trips and breaker failure or bus lockout relay input
- Reclosure skip input
- Hold input to freeze reclosing cycle
- Failed reclose timer:
1 - 250 seconds
- Maximum cycle timer:
1 - 990 seconds
- Follow Breaker function (52b status monitored during reclosing sequence)
- Breaker operation and maintenance monitoring:
Settable cumulative reclosures before alarm, 0 - 990 reclosures
Breaker limit operations:
Maximum reclosures (Max Count) in Duration time, 0 - 250 reclosures
Duration time limit, 1 - 250 minutes
Recovery time, after Max Count exceeded, 1 - 250 minutes
- Front panel LED indication:

RECLOSING IN SERVICE	LOCKOUT	FAILED RECLOSE
SYNCHRONISM	HBDL	HLDB (supplied with sync-check option)
- Recloser event records (recorded as targets)
Reclosure number
Number of attempts to completion
Result, successful or lockout
Time of event
Synchronism information (if synchronism used)
- Target data available through communications port
- Real time clock to time stamp reclosing events

- Four programmable inputs (any combination of OR's and AND's)
- Two programmable logic outputs (fed by the programmable inputs)
- Alarms for:
 - Relay Failure
 - Intermediate | LOCKOUT
 - Reclosure Failure
 - Reclosure LOCKOUT
 - Reclosing in progress

1.2.2 Optional Features

- Internal Sync/voltage checking logic including:
 - Settable "hot" voltage range
 - 30 - 70 volts for 70 volt input relay or
 - 50 - 120 volts for 120 volt input relay
- Settable "dead" voltage range
 - 0 - 30 volts for 70 volt input relay or
 - 0 - 50 volts for 120 volt input relay
- Settable HLDB and/or HB DL and/or Sync for each reclosure sequence
 - Settable maximum angle for synchronism, 0 - 60 degrees
 - Maximum Wait Time for voltage check or Sync, 0 - 990 seconds
 - Minimum Sync Condition Time Duration, 0.01 - 20 seconds
- Line and bus voltage input for either 70 volts or 120 volts
- Man-Machine Interface consisting of 2 X 16 character LCD display and four push-buttons to:
 - Review or change settings
 - Review two most recent targets
 - Review or reset breaker operations and other counters
 - Review results of self-checking test
 - Display status of relay, Ready, Disabled or Lockout
 - Display reason for relay being in Lockout state
 - Test output contacts, input circuit integrity and LED operation
- Front communications port, RS232C, 9 pin DCE connector, settable for 300 - 19,200 bits/second
- Choice of rear communications port, either RS232C or INCOM network type (default is RS232C)
- Horizontal or vertical mounting
- Choice of 48, 125 or 250 volts dc control power

1. 3. MRC-T CONSTRUCTION

The standard nomenclature for ABB relay protection equipment is as follows:

- Cabinet – contains fixed-racks, swing-racks, or open racks
- Rack – contains one or more chassis (e.g., the MRC-T)
- Chassis – contains several modules (e.g., Microprocessor or Power supply)
- Module – contains a number of functional circuits (on printed circuit board)
- Circuit – a complete function on a printed circuit board (e.g., analog-to-digital conversion)

The MRC-T relay assembly consists of an outer-chassis and an inner-chassis which slides into the outer-chassis. The MRC-T can be mounted either vertically (Figure 1-2) or horizontally where the only changes are the nameplate and the 19 inch adapter plate (Figure 1-3).

All of the relay circuitry, with the exception of the first-line surge protection, is mounted on the inner chassis, to which the front panel is attached. The outer chassis has a backplane, which is a receptacle for external connections, including the rear communication adaptor (Figure 1-4). The FT-10 switches allow convenient and safe disconnection of close contact output, ac and dc input circuits, and provide for injection of test signals.

1.3.1 MRC-T Outer Chassis

This is an FT-32 case, where all the input/output signals are surge protected. All external connections are made through the rear of the case.

The outer chassis (Figure 1-5) consists of 2 surge protection modules, a backplane surge protection module, a metal case, FT-switches and a communication interface consisting of a PONI box (INCOM or RS232C) mounted on the back of the case from the inside on the backplane module (Figure 1-4).

1.3.2 MRC-T Inner Chassis

- The inner chassis (Figure 1-7) consists of a frame, 2 switchjaws and the following modules:
- I/O Module (Bottom):
Consisting of 4 contact inputs and 2 contact outputs (Figure 1-8).
- I/O Module (Top):
Consisting of 4 contact inputs and 4 contact outputs (Figure 1-9).
- Microprocessor Module:
Consisting of a microcontroller (16 bits Intel 80C196 at 10 MHz), two EPROM program memory chips; two RAM chips, and EEPROM for data retention, a real time clock with a chip battery and indication LED's (Figure 1-10).
- Power Supply/I/O Module
This is an isolated switching power supply capable of supplying +5 Vdc for microcontroller and surrounding IC logic, 12 Vdc for reference voltages and +24 Vdc for communication. The two analog inputs for synchronism check, 4 contact inputs and 2 contact outputs for programmable logic are also contained in this module. (Figure 1-11).
- Three different styles of power supply boards are required to accommodate the input voltage ranges listed in **Table 1-1**:
- Man-machine interface/display module (Optional):
Consisting of a 2-line, 16 character per line Liquid Crystal Display (LCD), and four push-buttons for setting data entries (Figure 1-12).
- Front RS232C Communication Module (Optional):
providing front RS232C Communication interface to microprocessor module (Figure 1-13).

**Table 1-1:
Control Power Operating Range**

Nominal Battery (Vdc)	Input Range (Vdc)
48/60 110/125 220/250	38 - 70 88 - 145 176 - 290

1. 4. RECLOSE/SYNCHRONISM CHECK SOFTWARE

The reclose/synchronism check software includes the following functions:

- a. All the reclose and synchronism check functions.
- b. All the MMI functions.
- c. Programmable logic input/output function.
- d. Reclosing event recording.
- e. Test functions.

1. 5. SELF-CHECKING SOFTWARE

Self-checking software includes the following functions:

- a. Program Memory Check-sum
Immediately upon power-up, the relay does a complete EPROM check-sum of program memory. Afterwards, the MRC-T continually verifies the program memory check-sum.
- b. Power Up RAM Check:
Immediately upon power-up, the relay does a complete test of the RAM data memory.
- c. EEPROM Check:
Settings are stored in EEPROM in three identical arrays. These arrays are continuously checked by the program. If any of the three array entries disagree, an EEPROM failure is detected.

1. 6. UNIQUE REMOTE COMMUNICATION PROGRAM (RCP)

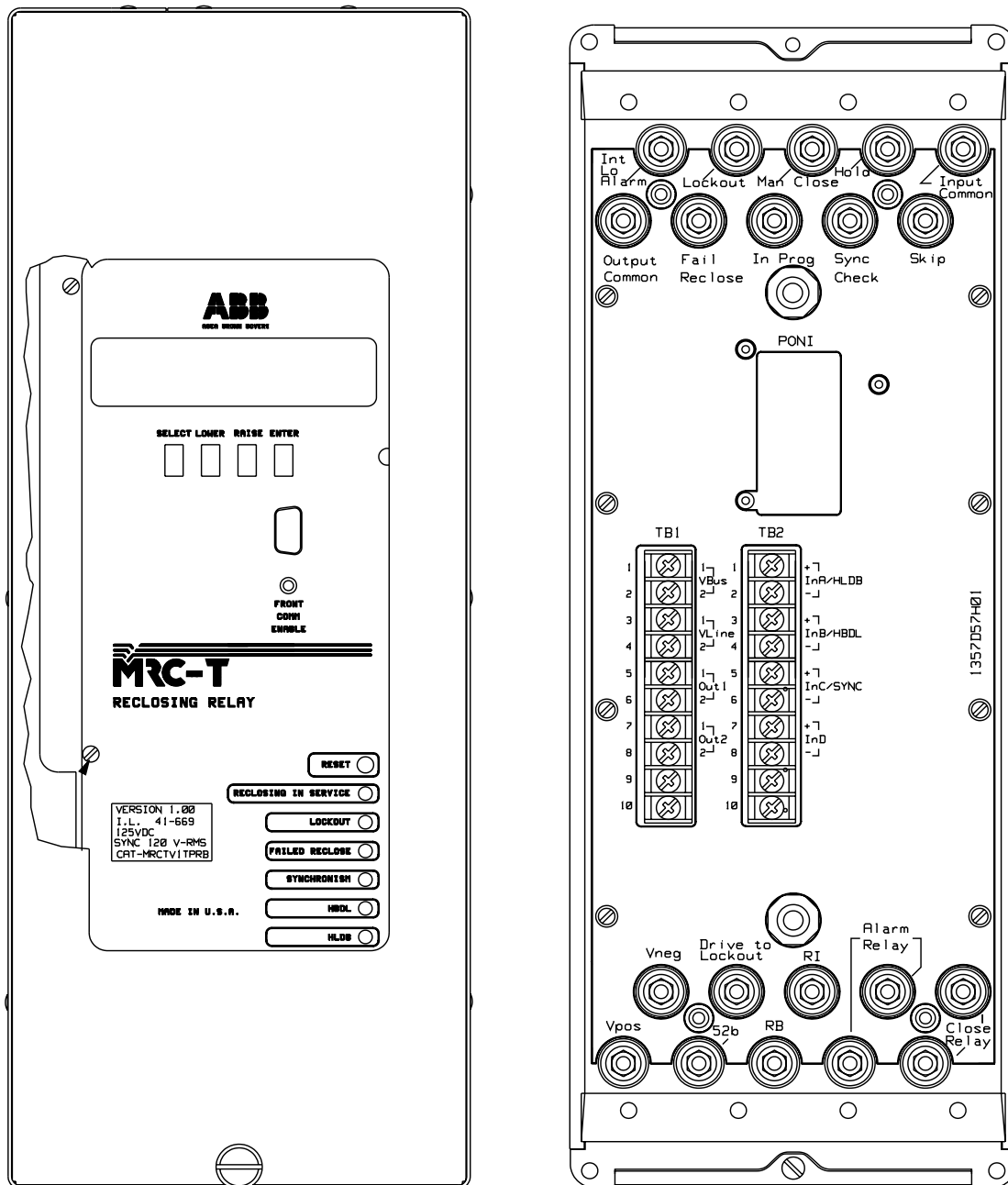
Special software, RCP, is provided for obtaining fault, metering and current settings data as well as sending data to the REL 301/302. RCP can best be described as a user friendly way of using a personal computer (PC) to communicate with ABB protective relays by way of pull-down menus. By coupling a computer with the appropriate communications hardware, it is possible to perform all relay setting and data interactions. RCP is required to communicate with the REL 301/302 via the communication port(s). Refer to the RCP Instruction Manual, I.L. 40-603, for detailed information. If you want to update your RCP, use the ABB bulletin board. More information about using the bulletin board is on following page.

ABB BULLETIN BOARD NOW ON LINE

To obtain the latest RCP communication software, please call the ABB Power T&D Company Inc., Relay Division bulletin board system via modem at:

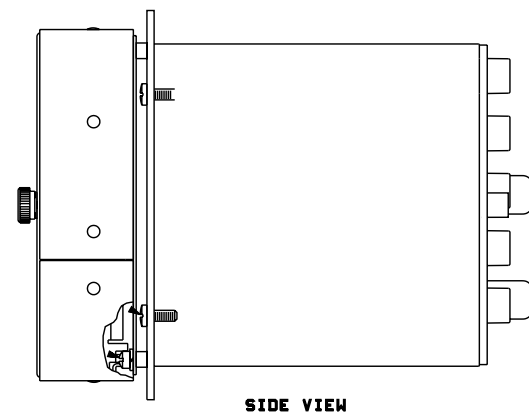
(800) 338-0581 or (305) 755-3250

Using configuration settings 300 - 14,400 bits/second, 8 data bits, 1 stop bit, no parity, and full duplex. Once the connection is established and login is completed, from the TOP menu choose L - Library of Files. Then from the Library of Files menu choose D - Down Load File, filename RCPxxxx.EXE (where xxxx is the most current version number e.g., 175D).



Sub 1
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Sheet 4 of 5

Figure 1-2. MRC-T Layout (Vertical)



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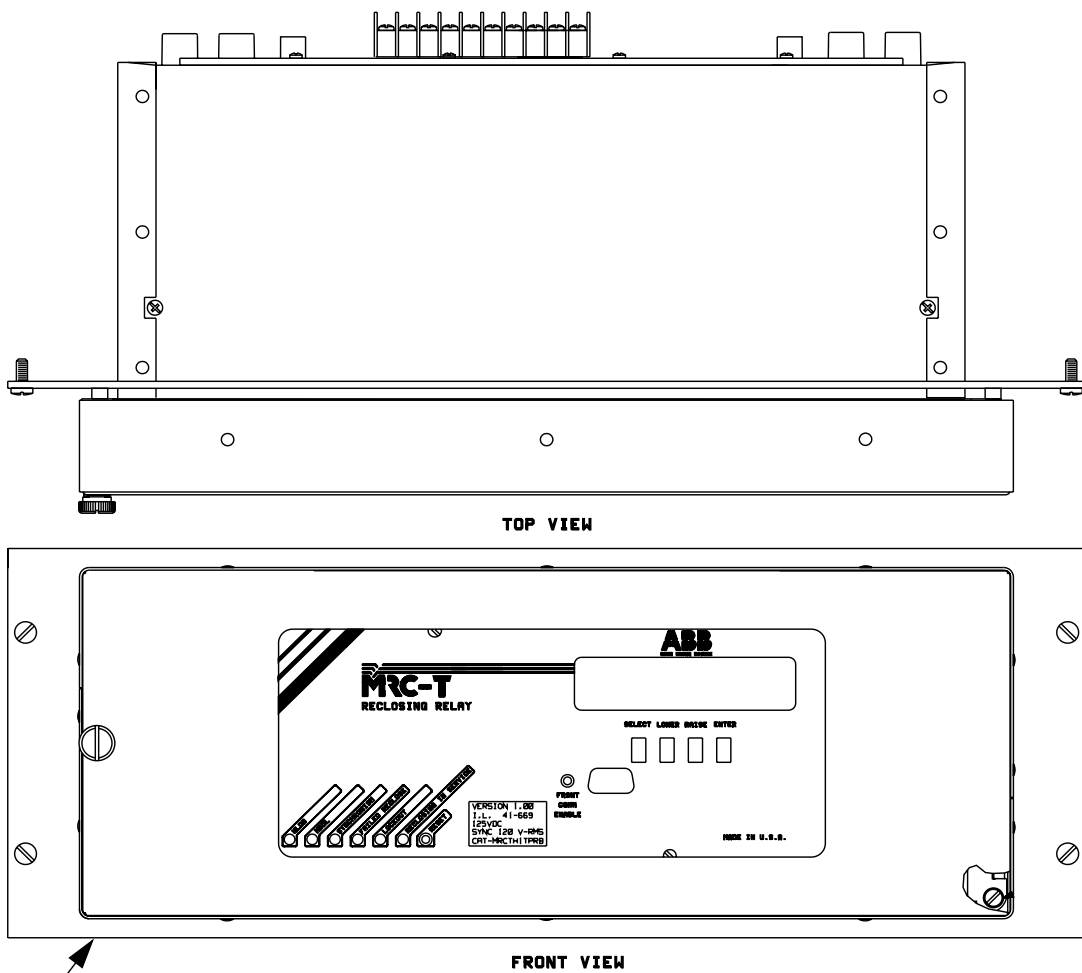


Figure 1-3. MRC-T Layout (Horizontal)

Horizontal Mounting Plate

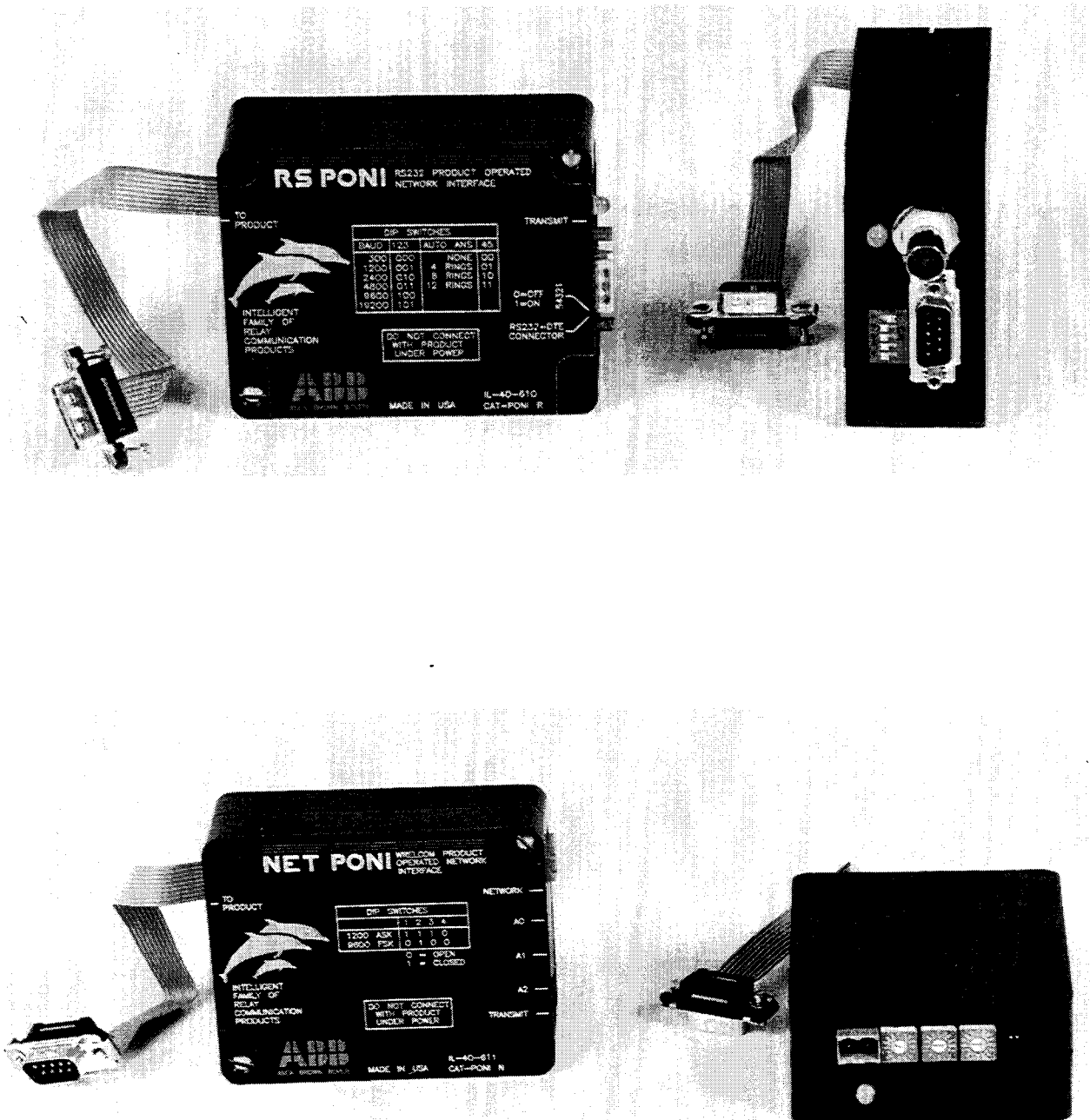


Figure 1-4. RS (232C) and NET (INCOM) PONI Communication Interface Devices

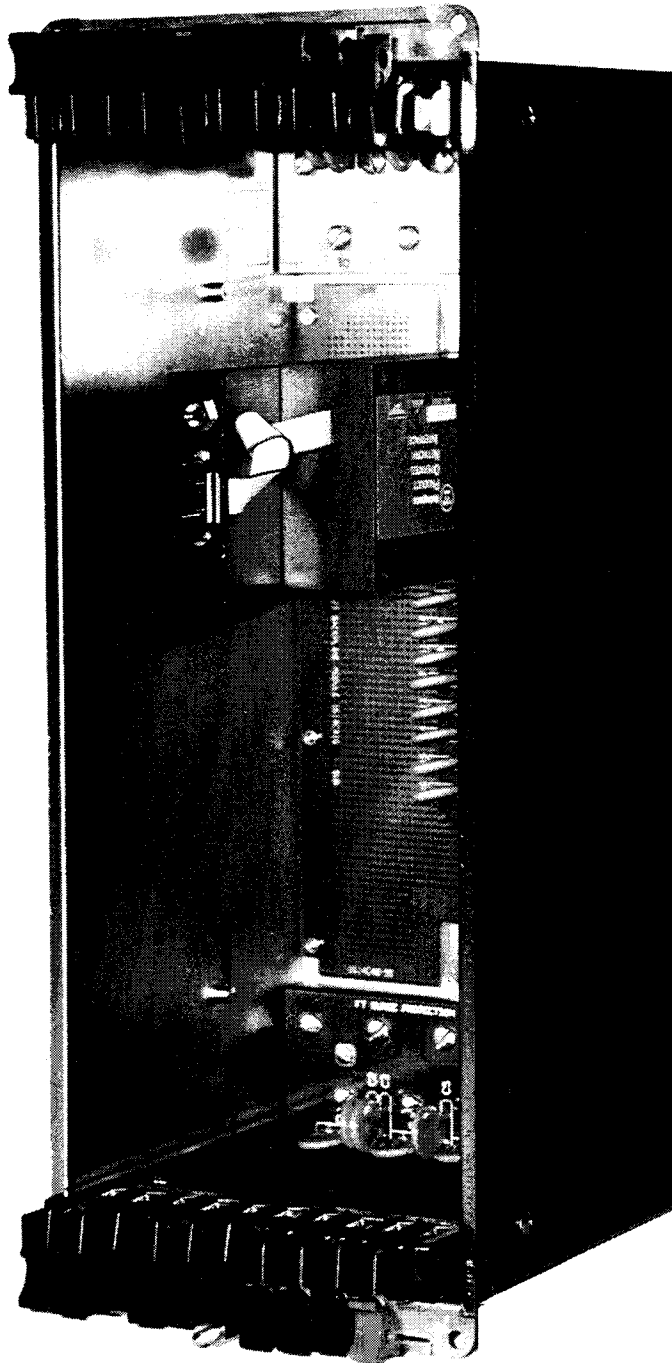


Figure 1-5. MRC-T Outer Chassis (Vertical Mounting)

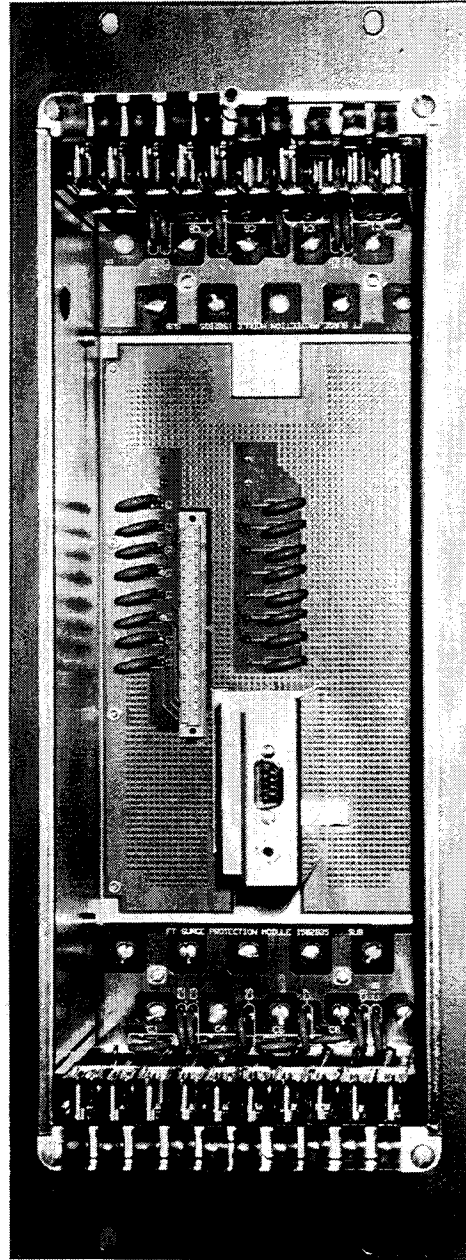


Figure 1-6. MRC-T Outer Chassis and 19" Adaptor Plate (Horizontal Mounting)

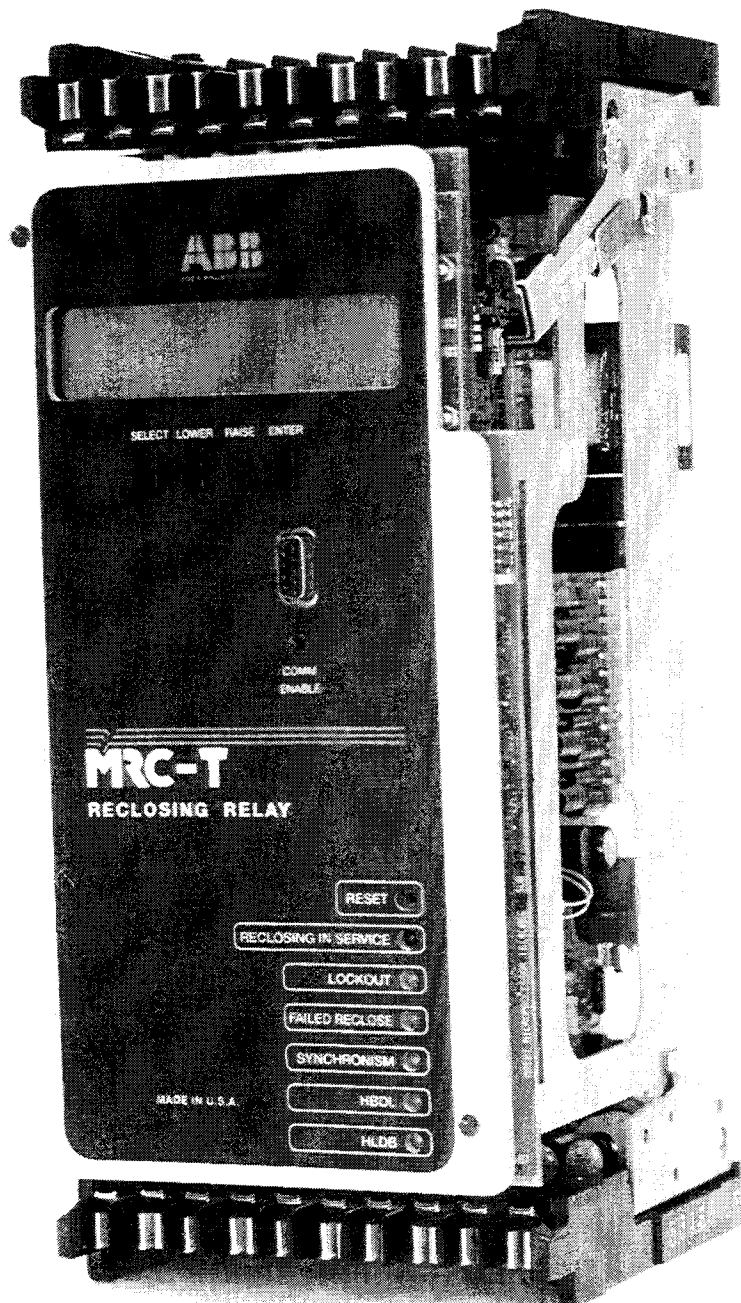


Figure 1-7. MRC-T Inner Chassis

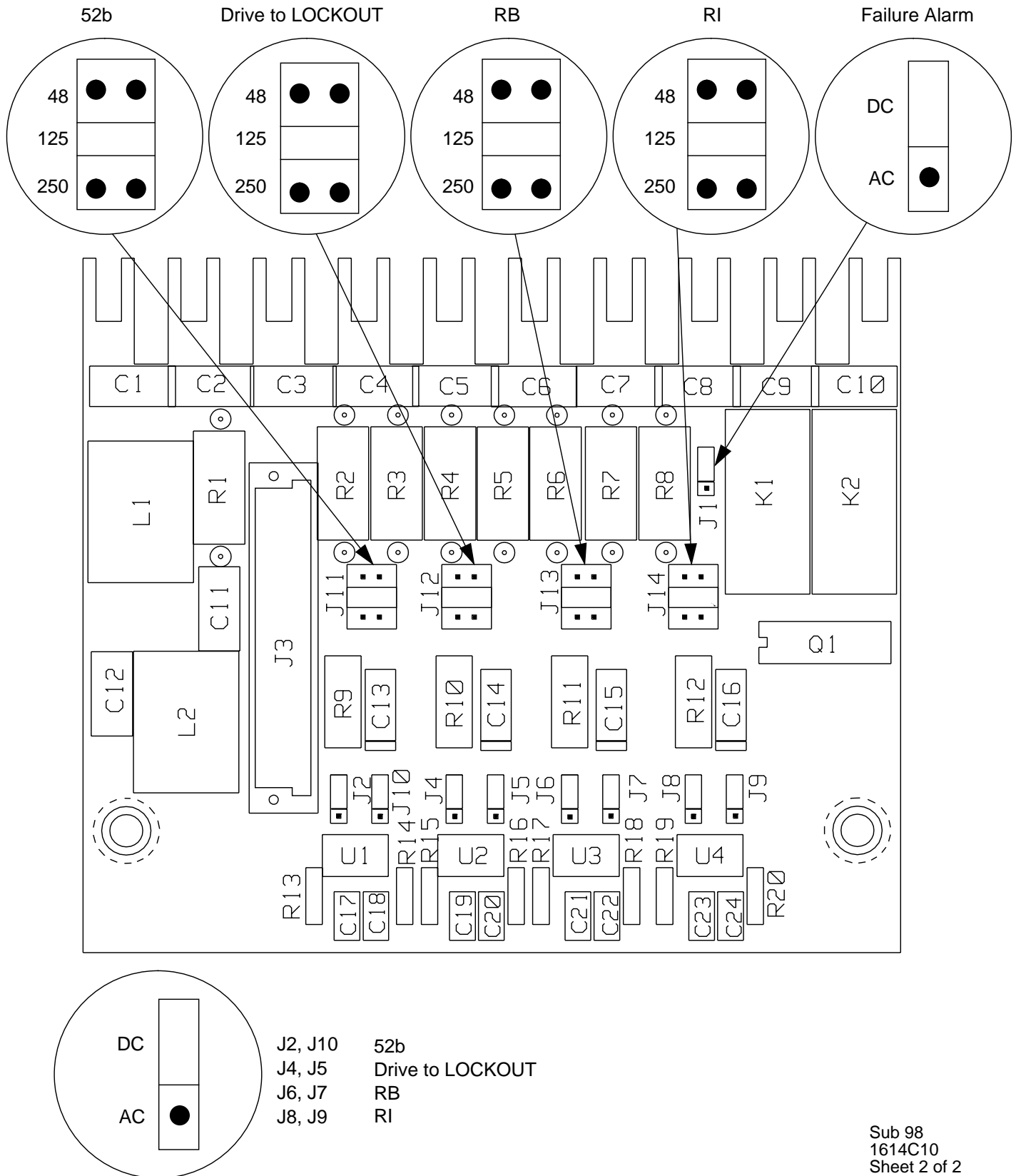


Figure 1-8. Bottom I/O Module

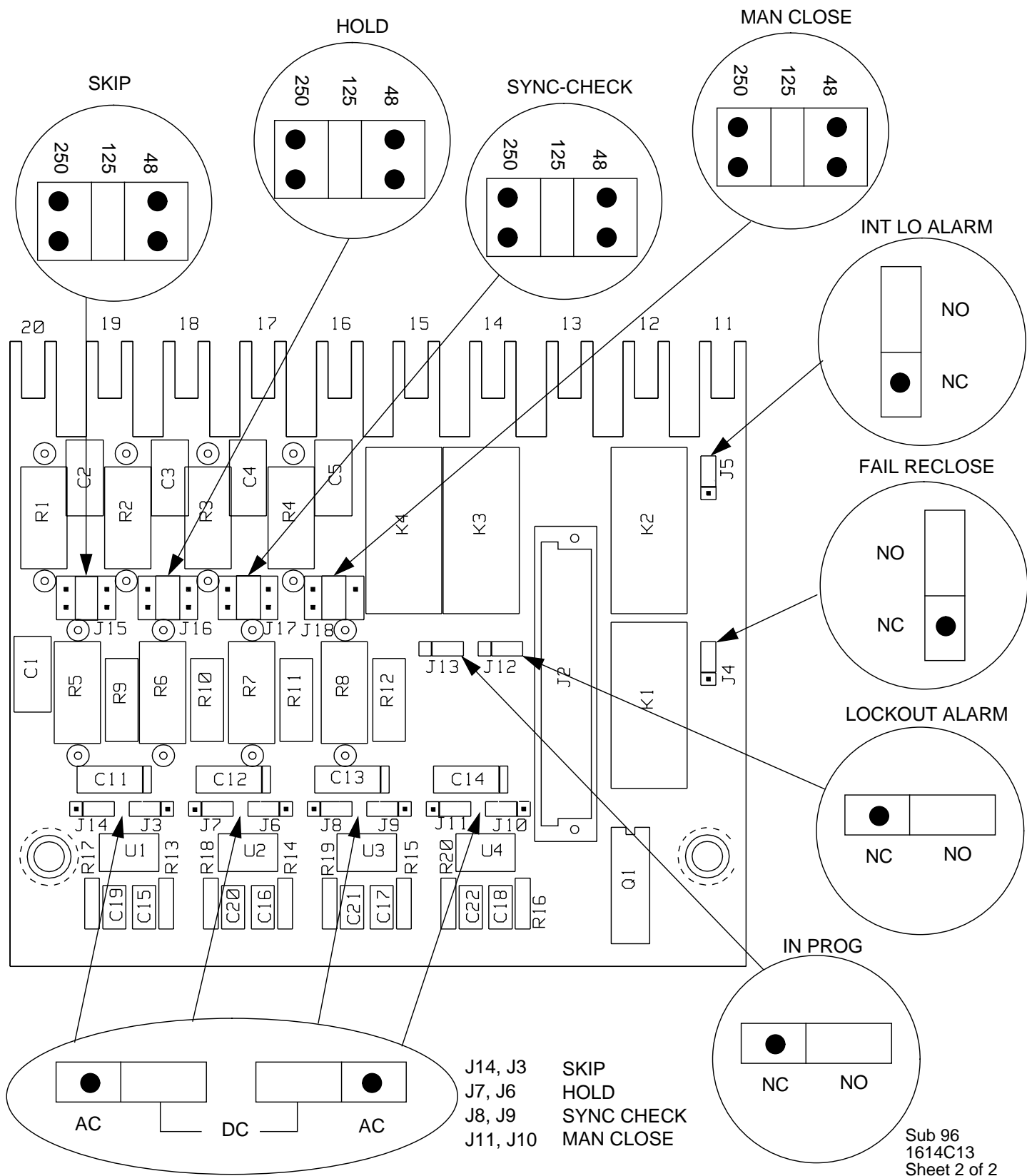
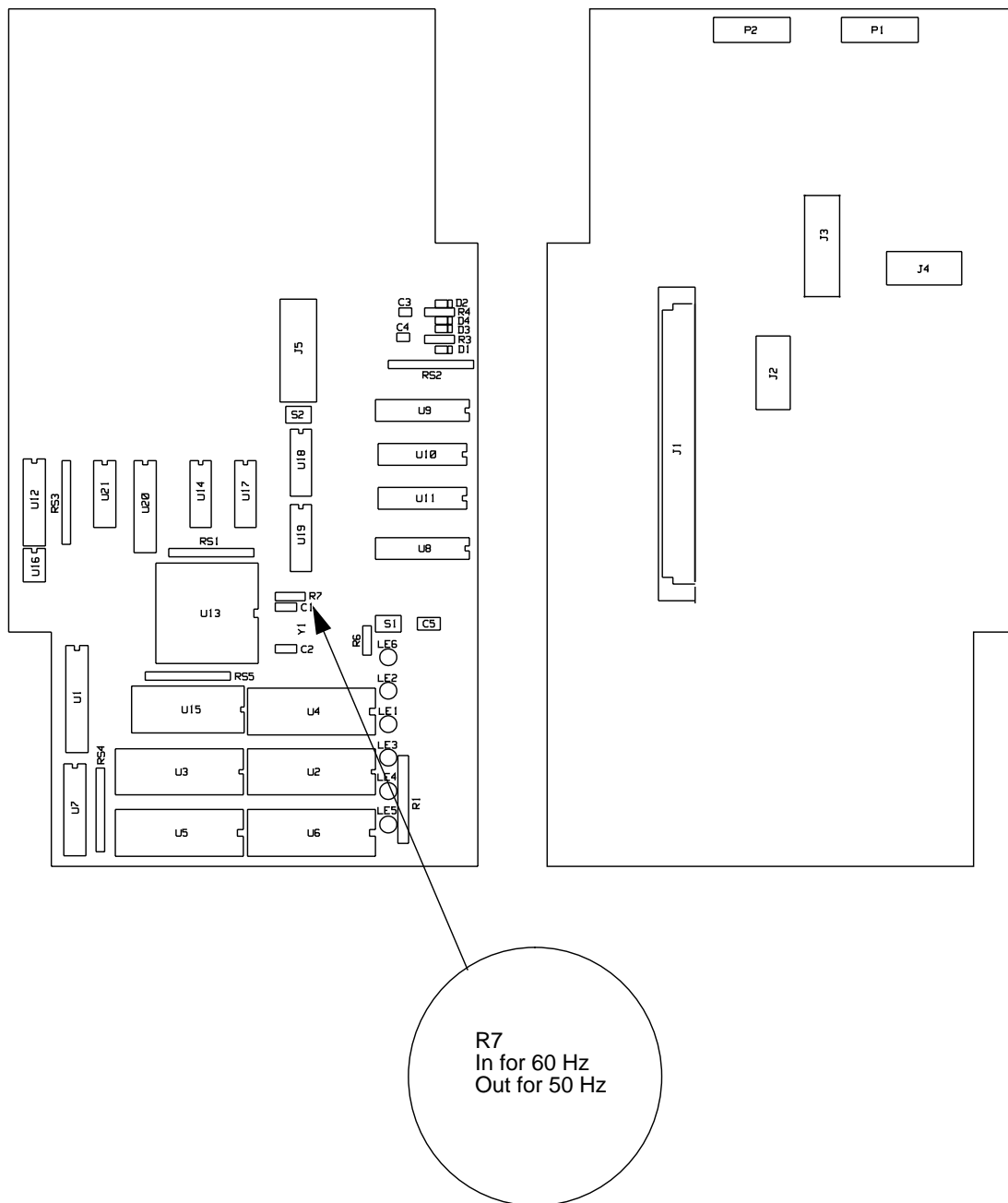
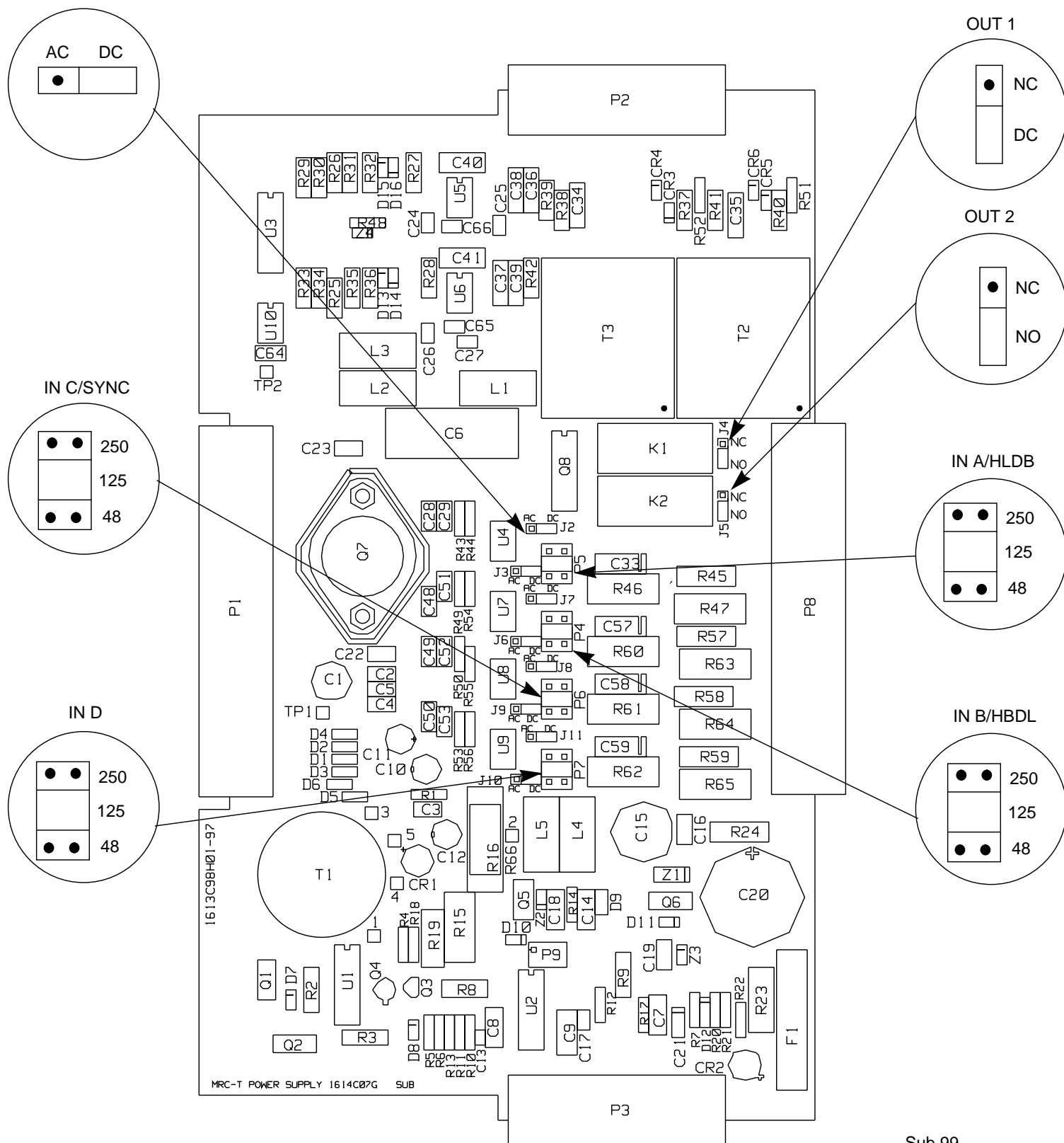


Figure 1-9. Top I/O Module



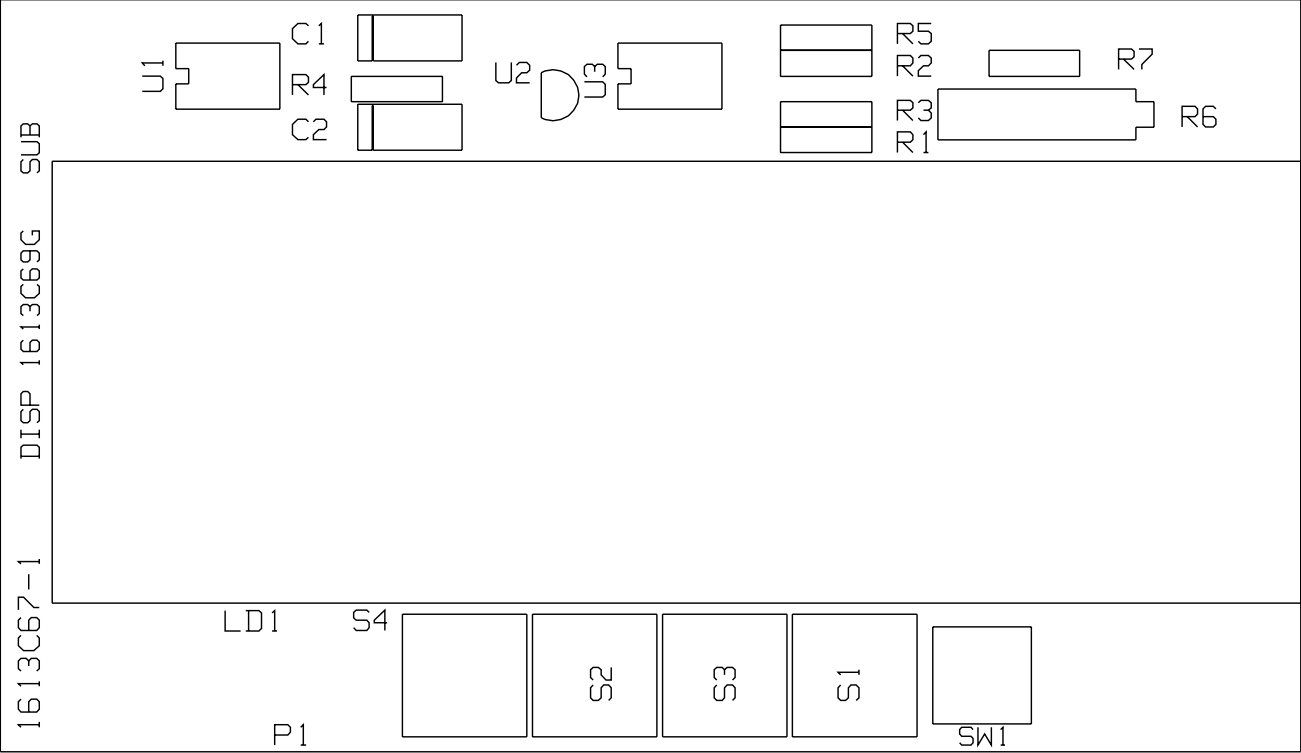
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Figure 1-10. Microprocessor Module



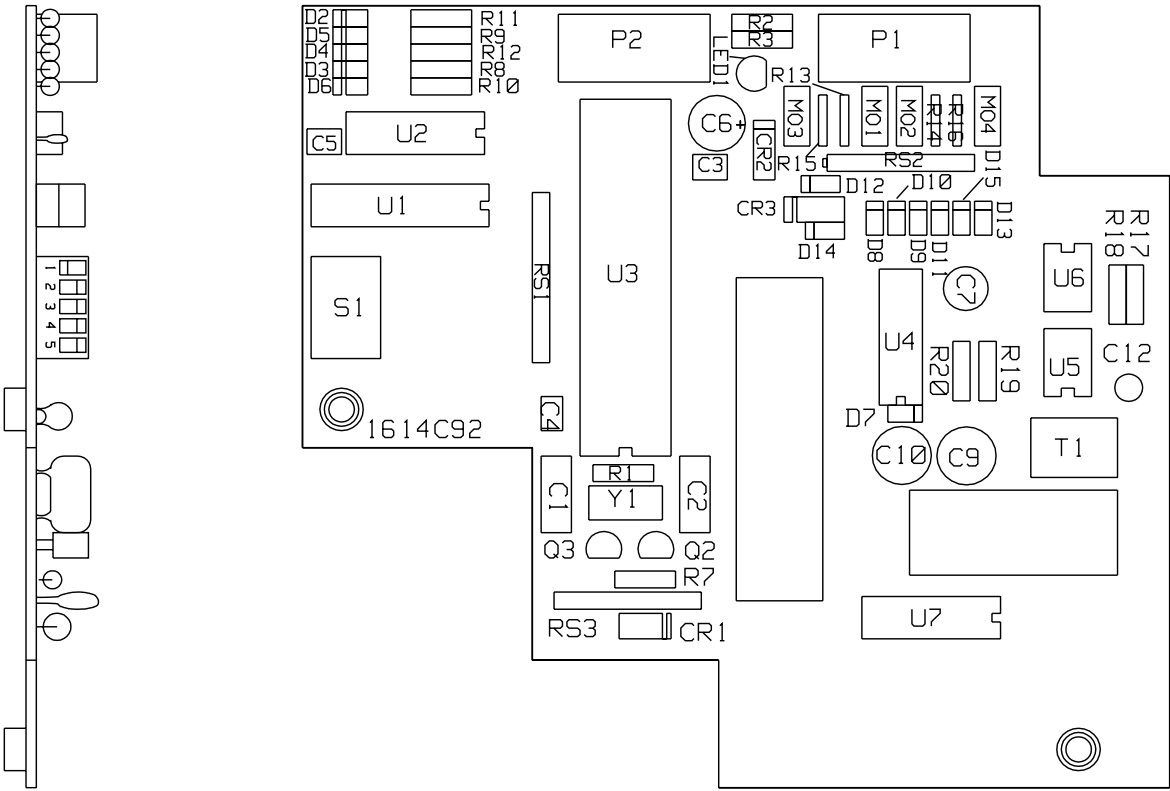
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Figure 1-11. Power Supply Module



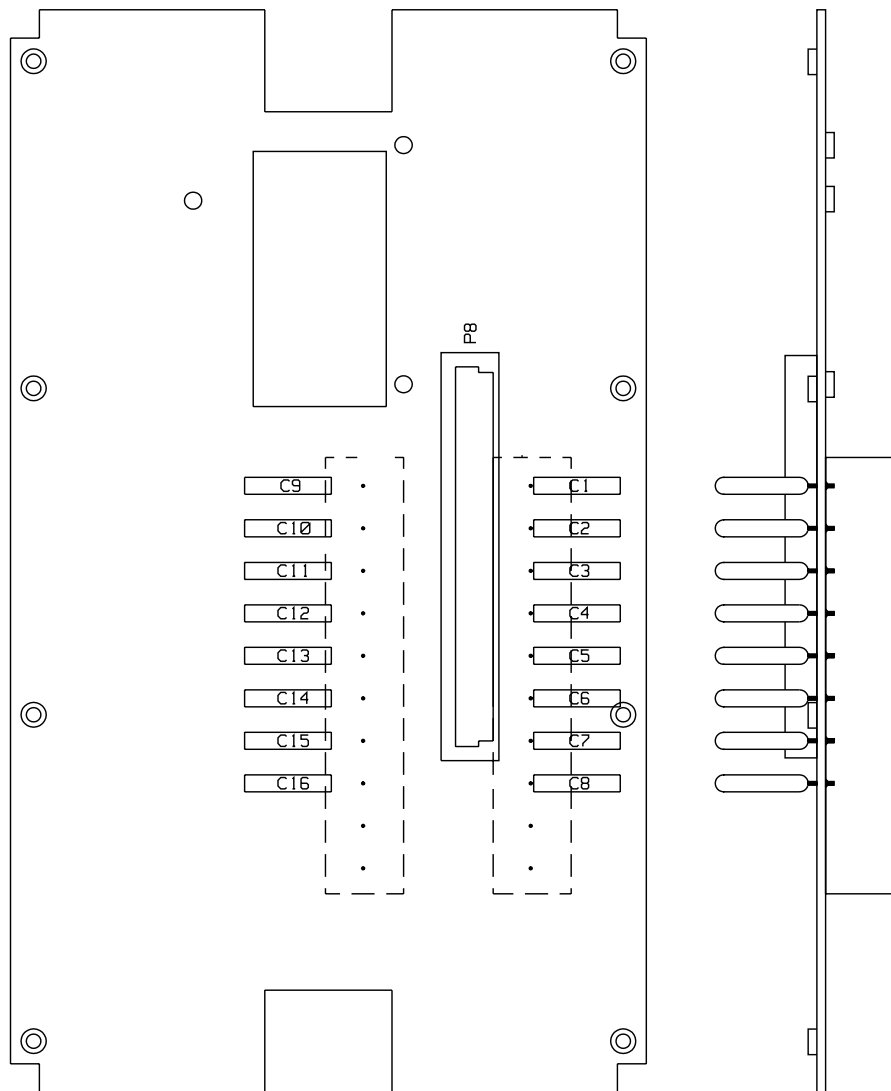
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Figure 1-12. Man-Machine Interface (display) Module (Optional)



Sub 99
1614C94

Figure 1-13. Front RS232 Communication Module (Optional)
Mounted on rear of Microprocessor Module



Sub 98
1614C41
Sheet of

Figure 1-14. Backplane Module



It is recommended that the user of MRC-T equipment become acquainted with the information in this instruction leaflet before energizing the system. Failure to do so may result in injury to personnel or damage to the equipment, and may affect the equipment warranty. If the MRC-T relay system is mounted in a cabinet, the cabinet must be bolted to the floor, or otherwise secured before MRC-T installation, to prevent the system from tipping over.

All integrated circuits used on the modules are sensitive to and can be damaged by the discharge of static electricity. Electrostatic discharge precautions should be observed when handling modules or individual components.

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PREFACE

Scope

This manual describes the functions and features of the MRC-T. It is intended primarily for use by engineers and technicians involved in the installation, testing, operation and maintenance of the MRC-T system.

Equipment Identification

The MRC-T equipment is identified by the Catalog Number on the MRC-T chassis nameplate. The Catalog Number can be decoded by using Catalog Number Table 3-1 (see Section 3). MRC-T can be either vertically or horizontally mounted.

Production Changes

When engineering and production changes are made to the MRC-T equipment, a revision notation (SUB #) is reflected on the appropriate schematic diagram, and associated parts information.

Equipment Repair

Repair work is done most satisfactorily at the factory. When returning equipment, contact your field sales representative for RMR authorization. All equipment should be returned in the original packing containers if possible. Any damage due to improperly packed items will be charged to the customer.

Document Overview

SECTION 1 provides the Product Description. **SECTION 2** presents the Specifications. **SECTION 3** presents the Applications and Ordering Information. MRC-T Installation and Operation are described in **SECTION 4**. Engineering Evaluation Tests are described in **Appendix A**; Acceptance Tests in **Appendix B**; Maintenance in **Appendix C**; Calibration in **Appendix D**; and Index in **Appendix E**.

Contents of Relay System

The MRC-T Relay System includes the style numbers, listed below,

Module	Style Number
FT-10 Surge Protection	1502B35
Backplane Surge Protection	1614C41
Microprocessor	1614C06
Display (Optional)	1613C69
Power Supply	1614C07
Bottom I/O	1614C10
Top I/O	1614C13
Front RS232 Communication (Optional)	1614C94

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Section 2. SPECIFICATIONS

2. 1. TECHNICAL

ac Voltage	(VLN) at 60 Hz	70	Vrms
	(VLL) at 60 Hz	120	Vrms
	(VLN) at 50 Hz	63.5	Vrms
Rated Frequency	50 or 60 Hz		
Maximum Permissible ac Voltage			
• Continuous	1.5 x nominal voltage		
• 10 Second	2.5 x nominal voltage		
dc Battery Voltages			
Nominal	Operating Range		
48/60 Vdc	38 - 70 Vdc		
110/125 Vdc	88 - 145 Vdc		
220/250 Vdc	176 - 290 Vdc		
dc Burdens: Battery	7 W normal		
ac Burdens: Voltage input	0.02VA at 70 Vac / phase		

2. 2. EXTERNAL CONNECTIONS

Terminal blocks located on the rear of the chassis suitable for #14 square tongue lugs.

Wiring to FT-10 switches suitable for #12 wire lugs.

2. 3. CONTACT DATA

Close Contact - make & carry 30 A for 1 second, 10 A continuous capability, break 50 watts resistive or 25 watts with L/R = .045 seconds.

All other contacts are "Non-trip" rated.

- 3A Continuous
- 0.1A Resistive Interrupt Capability

Supports 1000 Vac across open contacts

contacts also meet IEC - 255-6A, 1EC - 255-12, IEC -255-16, BS142-1982.

2. 4. CONTACT INPUT VOLTAGE RATINGS

All contact inputs listed below are rated for ac or dc operation

- | | | |
|--------------------|--------------------|---------------------------|
| • Reclose Initiate | • Freeze Reclosing | • Reclosure Block |
| • Skip Reclosure | • Drive to Lockout | • Programmable Inputs 1-4 |
| • 52b | • Manual Close | • External Sync-Check |

2. 5. CHASSIS DIMENSIONS AND WEIGHT

Height:	15.125"	* 7.00"
Width:	5.876"	* 19.00"
Depth:	6.626"	* 6.626"
Weight:	19 lb.	

* For Horizontal Mount: 19 inch adapter plate

2. 6. ENVIRONMENTAL DATA**Ambient Temperature Range**

- For Operation -20°C to +55°C
- For Storage -40°C to +80°C

Dielectric Test Voltage 2.8 kV, dc, 1 minute (ANSI C37.90.0, IEC 255-5)

Impulse Withstand Level 5 kV peak, 1.2/50 msec, 0.5 joule (IEC 255-5)

Fast Transient Surge Withstand Capability 4 kV, 5/50 nsec (IEC 801-4); 5kV 10/150 nsec (ANSI C37.90.1)

Oscillatory Surge Withstand Capability 2.5 kV, 1 MHz (ANSI C37.90.1, IEC 255-6)

EMI Volts/Meter Withstand 25 MHz-1GHz, 10V/m withstand (Proposed ANSI C37.90.2).

Section 3. APPLICATIONS AND ORDERING INFORMATION

3. 1. THEORY OF OPERATION

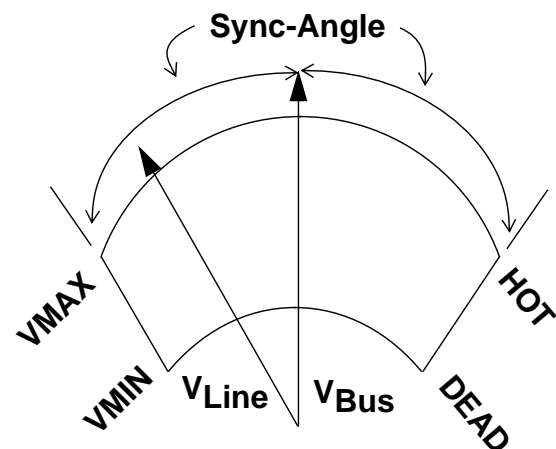
The following is an explanation of MRC-T relay synchronism measurements and operation.

3.1.1 Synchronism Checking

MRC-T can be supplied with internal synchronism-check/voltage check (**Hot Bus Dead Line** or **Hot Line Dead Bus**) logic or can be supervised with external synch/**HBDL/HLDB** inputs. For relays supplied with internal synchronism checking logic, supervision of MRC-T reclosing is settable for synchronism and/or **HBDL** and/or **HLDB** for each reclosing attempt.

MRC-T synchronism checking logic utilizes a “windshield wiper” characteristic (see Figure 3-1). This is, a combination of synchronism voltage, magnitude measurement and voltage, angle difference measurement. Both magnitude and angle difference measurement must be within the user's set range to produce synchronism check permission of reclosing.

If the MRC-T is not supplied with internal synchronism checking logic, reclosing can be supervised by an external source of synchronism and/or voltage check. Three inputs, **HLDB**, **HBDL** and **Sync** can be used, similar to the quantities produced by the internal synchronism logic, to supervise reclosing. MRC-T checks the inputs for the presence of rated voltage to determine if the corresponding reclosing permission is present. Selection of external synchronism input use is via the setting “**Sync Set?**” being set to “**Switches**”.



WINDSHIELD WIPER CHARACTERISTIC

Figure 3-1

3.1.2 Intermediate Lockout

With either synchronism check logic (internal or external) in use, an Intermediate Lockout condition, and alarm output, can be achieved to “wait” for the synchronism and/or voltage check condition to be met. Intermediate Lockout (“Int. Lo”) is a state which can only be selected on the last reclosure of the set reclose sequence. “Int. Lo” state exists indefinitely and MRC-T will return to the Ready Mode or Lockout Mode only if sync and/or voltage check condition set is met.

3. 2. APPLICATION

The MRC-T relay is used for automatic reclosure of an ac or dc electrically operated circuit breaker after it has been opened by a protective relay action. The basic style operates with 48, 125, or 250 Vdc or 120 or 240 Vac (50 or 60 Hz) input control voltage. The relay may be adjusted to provide several reclosures at predetermined intervals, so that in case the breaker does not remain closed after the first reclosure, additional reclosures can be made. The first reclosure usually is an immediate reclosure. System operation experience has shown that the majority of faults are of a temporary nature, such as lightning, flashovers, and will not be reestablished after an interruption of the fault current. Consequently, service interruption can be minimized by the use of an immediate reclosure. However, the first reclosure may be delayed (by setting) if desired.

In case the protective relay operates again after the first reclosure, the reclosing relay will close the breaker at selected intervals. The relay may be adjusted to make any number of reclosures up to a total of four. If the breaker does not remain closed after the final reclosure, the relay goes to **"LOCKOUT"**. The breaker must then be closed manually or by control switch. However, if the breaker remains closed after any automatic reclosure, the relay will, after the reset time, advance to and stop at the **"READY"** position, where the relay is in readiness to repeat the cycle.

For any automatic reclosing application, the underlying factors for breaker interrupting ability should be checked when choosing any particular reclosing cycle. Also, when using immediate first reclosure, it is necessary that the protective relays open their contacts before the breaker contacts make again and that sufficient delay exists to assure that the arc has become deionized.

The MRC-T relay is intended for use in transmission or subtransmission applications and may optionally be equipped with internal synchronism-check (including voltage supervision **HBDL** and **HLDB**). It will contain:

1. Multi-shot reclosing.
2. Reclose initiate and block features.
3. Intermediate **LOCKOUT** to allow remote line test and final close with synchronism check supervision.
4. External synchronism input.
5. **"LOCKOUT"** input for bus faults, breaker failure manual trips, etc.
6. **"LOCKOUT"** input to freeze all timing.
7. **"LOCKOUT"** input to skip reclosure.
8. "Manual Close" input for closing during LOCKOUT.
9. 8 programmable inputs (any combination of OR's and AND's).
10. 2 programmable outputs (fed by the programmable inputs).
11. Alarms for:
 - Check failure
 - Intermediate LOCKOUT
 - Reclose failure
 - Reclose LOCKOUT
 - Reclosing in progress
12. RS232C/PONI or INCOM/PONI Communications.

3. 3. MRC-T CATALOG NUMBERS

Table 3-1

MRCT	1 – 4	MRCT	V	1	S	P	R	L	
<u>MOUNTING</u>									
Horizontal	5	H							
Vertical		V							
<u>BATTERY VOLTAGE</u>									
48 Vdc	4								
125 Vdc	6	1							
250 Vdc		2							
<u>RECLOSING</u>									
Multi-shot Reclosing		R							
Multi-shot Reclosing w/sync-check (70 V input)	7	S							
Multi-shot Reclosing w/sync-check (120 V input)		T							
<u>PROGRAMMABLE LOGIC (I/O)</u>									
2 Relays w/(1) Form-C Contact	8	P							
<u>COMMUNICATIONS PORT (Rear)</u>									
Flexible (PONI-rear mounted)									
INCOM Network		C							
RS232C (Default)	9	R							
RS232C with IRIG-B/Input		B							
<u>FRONT PANEL INTERFACE</u>									
LCD Display		L							
RS232C Port (9-Pin DCE Connector)	10	R							
Both		B							
None		N							
<u>RELAY COLOR</u>									
Black (Default Color)	11								
Beige		E							
FT Test Plug-Item ID #13B8453G05									
Communication Cable Kit Item ID #1504B78G01									

Section 4. INSTALLATION AND OPERATION

4. 1. SEPARATING THE INNER AND OUTER CHASSIS

It is recommended that the user of this equipment becomes acquainted with the information in these instructions before energizing the MRC-T and associated assemblies. Failure to observe this precaution may result in damage to the equipment.

All integrated circuits used on the modules are sensitive to and can be damaged by the discharge of static electricity. Electrostatic discharge precautions should be observed when operating or testing the MRC-T.



Use the following procedure when separating the inner chassis from the outer chassis; failure to observe this precaution can cause personal injury, undesired tripping of outputs and component damage.

- a. Unscrew the front cover knob and remove cover.
- b. Open all FT switches.



Do Not Touch the outer contacts of any FT-10 switch; they may be energized.

- c. Release frame latches by pushing the top and bottom latches inward towards the center of the relay.
- d. Slide out the inner chassis.
- e. Reverse procedures above when replacing the inner chassis into the outer chassis.

4. 2. TEST PLUGS AND FLEXITEST (FT) SWITCHES

Test Plugs are available as accessories. They are inserted into the FT-10 switches for the purpose of System Function Tests.

4. 3. EXTERNAL WIRING

All electrical inputs/outputs are made through the back of the MRC-T. Table 4-1 illustrates where the various input/output signals are located. The vertical MRC-T is used as a reference in the Connection Specification Chart (similarly for the horizontal MRC-T).

4. 4. FRONT PANEL OPERATION

4.4.1 LED Indicator Functions

The MRC-T comes with LEDs on the front panel. They indicate the state of reclosing operation and synchronism check. The function of each LED is described in Table 4-2.

4.4.1.1 LED and Display Reset

The push-button labeled RESET is used to reset the latched “FAILED RECLOSE” LED, fail reclose contact output and send the display to “READY” mode, or “LOCKOUT” mode.

4.4.2 Front Communications Port (Optional) Enable Push-button

This pushbutton will activate the RS 232 front communication module. When communicating with the relay via 9 pin front panel connector, the rear INCOM or RS 232 communication will be inoperative. *See section 4.9 for further details regarding front communication.*

4.4.3 Man-Machine-Interface (MMI) (Optional)

The MMI consists of a 2-line 16-character per line **LCD** display, 4 push-buttons (SELECT, LOWER, RAISE, ENTER).

4.4.3.1 MMI Modes of Operation

The MMI provides a convenient means of checking the settings, targets, counter status and relay operations during a reclosing cycle.

The LCD display is divided into three fields: Function, Value, and Mode.

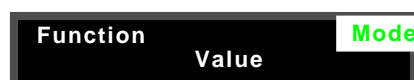


TABLE 4-1
CONNECTION SPECIFICATION CHART
FOR MRC-T

INPUT/OUTPUTS	LOCATION
SIGNAL INPUTS	(+, -)
RI RB DRIVE TO LOCKOUT 52b MAN CLOSE SYNC CHECK HOLD SKIP IN A/HLDB IN B/HBDL IN C/SYNC IN D	FT-5, FT-9 FT-6, FT-9 FT-7, FT-9 FT-8, FT-9 FT-16, FT-20 FT-17, FT-20 FT-18, FT-20 FT-19, FT-20 TB2-1, TB2-2 TB 2-3, TB2-4 TB2-5, TB2-6 TB2-7, TB2-8
ANALOG INPUTS	
POWER SUPPLY LINE VOLTAGE (VLINE) BUS VOLTAGE (VBUS)	FT-10, FT-9 TB1-3, TB1-4 TB1-1, TB1-2
CONTACT OUTPUTS	
CLOSE RELAY ALARM RELAY INT LO ALARM FAILED RECLOSE LOCKOUT IN PROG OUT 1 OUT 2	FT-1, FT-2 FT-3, FT-4 FT-11, FT-12 FT-11, FT-13 FT-11, FT-14 FT-11, FT-15 TB1-5, TB1-6 TB1-7, TB1-8
COMMUNICATION CONNECTION The INCOM or RS-232 PONI (Product Operated Network Interface) Communication box is mounted on the inside of the case to the backplane module. The RS-232 or INCOM cable is connected to the PONI from the back of the case (located in the upper section of the backplate).	
FRONT COMMUNICATION (OPTIONAL) The front RS-232 communication DB-9 connector is located on the front name plate directly below the MMI (display).	

The seven modes of operation, are shown at the top right of the display. The 4 push-buttons labeled SELECT, LOWER, RAISE, and ENTER, are used to interface with the MRC-T relay menu and settings.

The default mode (Ready, Lockout or Disabled) is automatically returned to when no push-button has been depressed for 2 minutes. By keeping the SELECT push-button depressed, the list of modes is scrolled in the sequence shown in Table 4-3, at approximately a one second rate. For each selected mode, the corresponding functions can be scanned (also every second) with the LOWER and RAISE push-buttons.

A. Ready Mode

In normal condition, the relay is in "READY" mode, ready to start a reclosing sequence as soon as the reclosure 1 initiation condition is detected.

When a reclosing cycle starts, the MRC-T goes through the selected logic until either back to "READY" mode, in case of successful reclosing, or to "LOCKOUT" mode, if for any reason, no further reclosing can be attempted.

B. Settings Mode [SET]

Change the mode to [SET] using the SELECT push-button. The list of available functions (see Table 4-5) can then be scrolled through forwards and backwards using the LOWER and RAISE push-buttons. The Function appears on the upper left of the display, and the Value on the second line.



TABLE 4-2
FRONT PANEL LED INDICATOR CHART

RECLOSING IN SERVICE	ON	when dc power is on, and relay is not disabled.
LOCKOUT	ON	when reclosing logic is in LOCKOUT state. Associated with LOCKOUT output contact.
FAILED RECLOSE	ON	after a FAILED RECLOSE. Can be cleared by depressing "RESET" push-button or via remote communication reset LED. Associated with fail reclose contact output.
SYNCHRONISM (*)	ON	when Bus & Line voltages are in Synchronism.
HBDL (*)	ON	when Bus is Live and Line is Dead.
HLDB (*)	ON	when Line is Live and Bus is Dead.
(*) The 3 lower LEDs are present only with the Synch-Check Option and the "SYNC SET" setting has been enabled.		

TABLE 4-3
MMI DISPLAY MODES

MODE	DESCRIPTION	AS DISPLAYED
READY	System ready to start a reclosing sequence. The MRC-T must be in this display mode in order to operate. When in the READY state, the default mode is the READY mode.	READY MRC-T VX.XX
SETTINGS	Check and/or change settings	[SET]
TARGETS	Lists the data related to the two last reclosing cycles.	[L-TR] or [P-TR]
STATISTIC	List the status of the different counters.	[MEM]
TEST	Shows selftest status and allows the testing of output contacts and LEDs.	[TEST]
LOCKOUT	Displays the reason for being in lockout state. When in the LOCKOUT state, the default mode is the LOCKOUT mode.	LOCKOUT Reason for Lockout
DISABLED	MRC-T disabled from "MRC-T" setting. When in the DISABLED state, the default mode is the DISABLED mode.	MRC-T DISABLED

The corresponding value can be changed by pressing the ENTER push-button once. An underscore dash will then flip alternatively between the first and last characters on the second line. At this point, other values for the same function can be scrolled



through by depressing the LOWER or RAISE push-button. When the desired value is reached, select it by pressing ENTER until VALUE UPDATED shows on the display. After the value is updated the system then returns to the Function scroll state.

Scrolling proceeds at a faster rate after having continuously held down either button for about 3 seconds. At the end of a setting session, return to “READY” mode by pushing the SELECT push-button until the ready mode appears on the display.

In order to restore the original value while in the middle of the scrolling values, press SELECT instead of ENTER, the system returns to the Function scroll state, without updating the setting. In the function scroll state, a jump to the next mode is performed by pressing SELECT.

Settings Description

Refer to Table 4-5 for the complete list of settings with ranges. It is advised to adjust the settings in the order given in the list (i.e. using the RAISE push-button to move to the next setting) since some settings might be disabled by certain values. For example, selecting 2 reclosures disables the display of settings for reclosures 3 and 4. Likewise, when a function works in conjunction with a timer, disabling the function hides the timer setting.

C. Targets Mode [L-TR or P-TR]

Change the mode to Targets using the SELECT push-button. The relay saves the reclosing events that have taken place during the last 2 reclosing sequences for front display purpose.

The last reclosing sequence is referred to as “L-TR”, and the previous one as “P-TR” in the mode field of the display. Internally, the 16 last targets are recorded and can be checked remotely via one of the communication port interfaces.

For each of the sequences, the function field displays the reclosure number, the value field displays the corresponding event. The list of the possible messages or causes for successful and unsuccessful reclosures is shown in Table 4-4.

To scroll the list of targets, depress the LOWER or RAISE push-buttons.

With the Synch-check option, each target is accompanied with the line and bus voltages, and the angle between them at the time the target was recorded (at reclosing in case of a closure, or at the time the reclosure was skipped for the given reason).

**TABLE 4-4
Target Displays**

Target Event	As displayed
Close	Close
Follow Breaker	Follow Br
Reclose Block Input	Recl Block
No HLDB, No HBDL or	
No Synch-check	No Sync
Skip Input Present	Skip
Manual Close	Close
Manual Close	No Sync

**TABLE 4-5
SETTING DISPLAY**

Setting	Function Displayed	Values Displayed	Factory Default
Synchronism Functions Enable	Sync Set?	No/Yes/Switches	No
* “Hot” Voltage Threshold	VMax	30-70 in 1 Volt Steps 50-120 in 1 Volt Steps ⁺	53 Volts 92 Volts
* “Dead” Voltage Threshold	VMin	0-30 in 1 Volt Steps 0-50 in 1 Volt Steps ⁺	13 Volts 23 Volts
* Maximum Angle For Synchronism	Sync Angle	0-60 in 1 ^O Steps	20^O
* Present Sync / HLDB /HBDL Minimal Condition Duration	Sync Time	0.01-0.99 in 0.01 Second Steps 1.0-9.9 in 0.1 Second Steps 10-20 in 1 Second Steps	2.0 sec
Number of Reclosures	Reclosures	0-4 recl	4 recl
Reclosure 1, 2, 3 and 4 parameters Reclosure 1 parameters -Reclosure Initiation	Recl 1	52b Only/ RI Only/ 52b and RI/ 52b or RI	52b Only
-Reclose Block	Recl1 RB	No / Yes	No
-Reclose Dead Time	Recl1 Time	0.01-0.99 in 0.01 second steps 1.0-9.9 in 0.1 second steps 10-250 in 1 second steps	0.50 sec
* -Reclose on HLDB	Recl1 HLDB	No / Yes	No
* -Reclose on HBDL	Recl1 HBDL	No / Yes	No
* -Reclose if Synchronism	Recl1 Sync	No / Yes	No
* -Max Wait Time for a HBDL, HLDB or Synchronism Condition (only available when Recl1 Sync set to Yes).	Recl1 Wait	0-99 in 1 Second steps 100-990 in 10 Second steps No time limit (Infinite Time)	60 sec

* Available only with Sync-check Option or when using external sync input (**Sync Set ? = Switches**).
+ Ranges of 120 volt synchronism voltage, style relay only.

TABLE 4-5
SETTING DISPLAY (Continued)

Setting	Function Displayed	Values Displayed	Factory Default
Reclosure 2 parameters - Reclosure Initiation	Recl 2	52b Only / RI Only / 52b and RI / 52b or RI	52b Only
-Reclose Block	Recl2 RB	No / Yes	No
-Reclose Dead Time	Recl2 Time	0.01-0.99 in 0.01 second steps 1.0-9.9 in 0.1 second steps 10-250 in 1 second steps	3.0 sec
-Reclose on HLDB	Recl2 HLDB	No / Yes	No
-Reclose on HBDL	Recl2 HBDL	No / Yes	No
-Reclose if Synchronism	Recl2 Sync	No / Yes	No
-Max Wait Time for a HBDL, HLDB or Synchronism Condition (only available when Recl2 Sync set to Yes).	Recl2 Wait	0-99 in 1 Second steps 100-990 in 10 Second steps No time limit (Infinite Time)	60 Sec
Reclosure 3 parameters - Reclosure Initiation	Recl 3	52b only / RI only / 52b and RI / 52b or RI	52b Only
-Reclose Block	Recl3 RB	No / Yes	No
-Reclose Dead Time	Recl3 Time	0.01-0.99 in 0.01 second steps 1.0-9.9 in 0.1 second steps 10-250 in 1 second steps	10 sec
-Reclose on HLDB	Recl3 HLDB	No / Yes	No
-Reclose on HBDL	Recl3 HBDL	No / Yes	No
-Reclose if Synchronism	Recl3 Sync	No / Yes	No
-Max Wait Time for a HBDL, HLDB or Synchronism Condition (only available when Recl3 Sync set to Yes).	Recl3 Wait	0-99 in 1 Second steps 100-990 in 10 Second steps No time limit (Infinite Time)	60 sec
* Available only with Sync-check Option or when using external sync input (Sync Set ? = Switches). + Ranges of 120 volt synchronism voltage, style relay only.			

TABLE 4-5
SETTING DISPLAY (Continued)

Setting	Function Displayed	Values Displayed	Factory Default
Reclosure 4 parameters - Reclosure Initiation	Recl 4	52b only / RI only / 52b and RI / 52b or RI	52b Only
- Reclose Block	Recl4 RB	No / Yes	No
-Reclose Dead Time	Recl4 Time	0.01-0.99 in 0.01 second steps 1.0-9.9 in 0.1 second steps 10-250 in 1 second steps	30 sec
* -Reclose on HLDB	Recl4 HLDB	No / Yes	No
* -Reclose on HBDL	Recl4 HBDL	No / Yes	No
* -Reclose if Synchronism	Recl4 Sync	No / Yes	No
* -Max Wait Time for a HBDL, HLDB or Synchronism Condition (only available when Recl4 Sync set to Yes).	Recl4 Wait	0-99 in 1 Second Steps 100-990 in 10 Second steps No time limit (Infinite Time)	60 sec
Fail Reclose Enable	FailRecl ?	No / Yes	Yes
Fail Reclose Max Close Duration (only available when FailRecl ? is set to Yes)	Fail Time	1-99 in 1 Second steps 100-250 in 10 Second steps	10 sec
Close Contact Duration (only available when FailRecl ? is set to No) Reset by 52b removal	ClosePulse	0.01-0.99 in 0.01 Second steps 1.0-2.0 in 0.1 Second steps	0.50 sec
Successful Reclose Reset Duration	Reset Time	1-99 in 1 Second steps 100-250 in 10 Second steps	15 sec
Check Hold Input	Hold ?	No / Yes	No
Maximum Cycle Enable (only available when Sync Set? is set to No)	MaxCycle ?	No / Yes	No
Maximum Cycle Time (only available when MaxCycle ? is set to Yes)	MaxTime	1-99 in 1 Second steps 100-990 in 10 Second steps	990 Second
Follow Breaker Enable	FollowBr ?	No / Yes	No
Cumulative Reclosure Alarm	Cum. Recl?	No / Yes	No
* Available only with Sync-check Option or when using external sync input (Sync Set ? = Switches). + Ranges of 120 volt synchronism voltage, style relay only.			

TABLE 4-5
SETTING DISPLAY (Continued)

Setting	Function Displayed	Values Displayed	Factory Default
Number of Cumulative Reclosures (only available when Cum. Recl? is set to Yes)	Cum Recl	0-99 Step 1 100-990 Step 10	990 recl
Breaker Limit Operations: -Breaker Operation Enable -Breaker Limit Number (only available when Br Oper. ? is set to Yes) -Breaker Limit Duration (only available when Br Oper. ? is set to Yes) -Breaker Recovery Time (only available when Br Oper. ? is set to Yes)	Br Oper. ? Max Count Duration Recovery	No / Yes 0-99 Step 1 100-250 Step 10 1-99 Step 1 min 100-250 Step 10 min 1-99 Step 1 min 100-250 Step 10 min	No 250 Recl 250 min 1 min
Programmable Logic Output Enable	Prog IO ?	No / Yes	No
Logic Equation 1 (only available when Prog IO ? is set to Yes)	Output 1		ABCD =
Pick up Time 1 (only available when Prog IO ? is set to Yes)	PkUp Out 1	0.01 - 0.99 in 0.01 Second steps 1.0 - 9.9 in 0.1 Second steps 10 - 250 in 1 Second steps	2.0 sec
Drop Out Timer 1 (only available when Prog IO ? is set to Yes)	Drop Out 1	0.01 - 0.99 in 0.01 Second steps 1.0 - 9.9 in 0.1 Second steps 10 - 250 in 1 Second steps	1.0 sec
Output 1 Enable (only available when Prog IO ? is set to Yes)	Out 1 ?	No / Yes	Yes
Logic Equation 2 (only available when Prog IO ? is set to Yes)	Output 2		abcd =
Pick up Timer 2 (only available when Prog IO ? is set to Yes)	PkUp Out 2	0.01 - 0.99 in 0.01 Second steps 1.0 - 9.9 in 0.1 Second steps 10 - 250 in 1 Second steps	2.0 sec
Drop Out Timer 2 (only available when Prog IO ? is set to Yes)	Drop Out 2	0.01 - 0.99 in 0.01 Second steps 1.0 - 9.9 in 0.1 Second steps 10 - 250 in 1 Second steps	1.0 sec
Output 2 Enable (only available when Prog IO ? is set to Yes)	Out 2 ?	No / Yes	Yes
Remote Setting Change Enable	Remote Set	No / Yes	Yes
* Available only with Sync-check Option or when using external sync input (Sync Set ? = Switches). + Ranges of 120 volt synchronism voltage, style relay only.			

TABLE 4-5
SETTING DISPLAY (Continued)

Setting	Function Displayed	Values Displayed	Factory Default
Real Time Clock Settings: - Time Setting Change Enable - Year - Month - Day - Day of Week - Hour - Minute	Time Set Year Month Day Weekday Hour Minute	No / Yes 1900 - 2099 Step 1 01 - 12 Step 1 01 - 31 Step 1 Monday through Sunday 00 - 23 Step 1 00 - 59 Step 1	No
Manual Close (settings below available when Man Close set to Yes) - Manual Close on HLDB - Manual Close on HBDL - Manual Close if Synchronism - Max Wait Time for a HLDB, HBDL or Synchronism Condition	Man Close Man HLDB Man HBDL Man SYNC Man Wait	No / Yes No / Yes No / Yes 0-99 in 1 Second steps 100-990 in 10 Second steps Infinite Time (No Time Limit)	No No No 60 sec
MRC-T Reclosing Enable/Disable	MRC-T	Disable/Enable	Enabled
* Available only with Sync-check Option or when using external sync input (Sync Set ? = Switches). + Ranges of 120 volt synchronism voltage, style relay only.			

D. Statistic Mode [MEM]

Change the mode to [MEM] (Statistical) using the SELECT push-button. The following counter information can be scrolled through using the LOWER and RAISE push-buttons.

- 1st recl
- 2nd recl
- 3rd recl
- 4th recl
- Recl left (if Cumulative Reclosure enabled)
- Lockout Nr

NOTE: In order to reset the above counters, select the [MEM] mode and press together the LOWER and ENTER push-buttons until the text “Reset Counters” appears on the display.

E. Test Mode [TEST]

Change the mode to [TEST] using the SELECT push-button. The test display provides diagnostic and testing capabilities for the MRC-T.



Open FT Switch FT-1 and FT-2 before performing any test.

Output Contacts, LEDs and Input Circuit Verification Testing

a. Contact outputs

Press the SELECT push-button and scroll to the “TEST” mode. The display should read “STATUS” “OK” indicating the self-checking/startup/initialization routine was completed successfully and the system is continuously passing the self-checking routine. Press the RAISE push-button and scroll to contact output to be tested. All contact outputs can be tested. See the “CONNECTION SPECIFICATION CHART”, Table 4-1, for contact listing and terminal references.

After scrolling to the contact output to be tested, for example “CLOSE” “RELAY”, pressing the “ENTER” push-button will cause the close relay to operate and hence the close contacts to close. A similar procedure is used to test any contact output.

b. LEDs

In the case of “Lockout” and “Failed Reclose” the corresponding LED will light during the contact test described above. Again, the contact will remain closed and the LED will remain lit while pressing the ENTER push-button. With the Sync-check option, the 3 associated synchronization LEDs can be checked by pressing the ENTER push-button after scrolling to the “Bus/Line” “LED” display.

c. Input Circuit Test

The following input circuits can be tested, in the “TEST” mode, by applying voltage to each input and observing “Inputs” display. Scroll to the “Inputs” display, apply rated voltage and as each input is energized, the associated display segment changes from a “-” to a “|”. Table 4-6 give details of input circuit testing displays.

**TABLE 4-6
INPUT CIRCUIT TEST DETAILS**

Input Under Test	Display	Input Under Test	Display
In A	--- ---	Manual Close	---- - -
In B	- -- ---	Hold	---- - ---
In C	-- - ---	Skip	---- - - ---
In D	--- ---	52b	---- - - --
Drive to Lockout	---- ---	Reclose Block	---- - - - -
Sync Check	---- - --	Reclose Initiate	---- - - -

Self-Check status Relay Self-Check Status

The MRC-T continuously performs self-checking. The results of the self-check are displayed in the VALUE FIELD of the Status Function. They can be accessed using the following procedure:

- a. Continually depress the SELECT push-button until the TEST mode is displayed. Then, depress the RAISE or LOWER key until the word status appears in the FUNCTION FIELD.
- b. The VALUE FIELD will display the status of the relay.

The relay status may be one of the following:

OK
RAM Failure
EEPROM Warning
EPROM Failure
EEPROM Failure
CPU Failure

If more than one failure is detected the display will automatically step through the different messages.

F. Lockout Mode

The relay goes to "LOCKOUT" for any of the following reasons:

- Drive to lockout
- Maximum number of reclosure reached for this sequence without successful reclose
- Failed to close after the fail close timer ran out (when selected)
- Maximum cycle reached (when selected) without successful reclose
- Wait timer expired with no SYNC/HBDL/HLDB condition

G. Disabling The MRC-T

The MRC-T can be enabled or disabled through the "Setting" mode. When the MRC-T is set to "Disabled", the MRC-T goes to the "standby" state and the display shows the text "MRC-T Disabled, Check Setting", and the "Reclosing in Service" LED will turn off.

Settings, Targets, Statistics and Test modes can still be accessed when the MRC-T is disabled. To re-enable the MRC-T, set the setting "MRC-T" back to "Enabled". The MRC-T returns to "Ready" mode after resetting from LOCKOUT.

4.5 RECLOSING/SYNC-CHECK OPERATION

Upon power-up, the MRC-T performs self-diagnostic routines. Detection of a continuing problem will cause the alarm relay ALARM to operate, and the MRC-T will be locked out. If no problem was encountered, the MRC-T goes to READY mode.

In the READY mode, the MRC-T continuously monitors the input(s) selected to initiate the first reclosure. The initiation setting can be the following:

TABLE 4-7
RECLOSE INITIATION SIGNALS

As Displayed	Initiation Condition
52b only	Looks only at 52b to initiate a new reclosure
RI only	Looks only at RI to initiate a new reclosure
52b and RI	Both signals 52b and RI must be present within one second to initiate a new reclosure
52b or RI	Either signal will initiate a new reclosure

When a reclosing sequence is initiated for any of the above conditions, the MRC-T goes through different stages; MRC-T dead time countdown, waiting for synchronism/HBDL/HLDB (if selected with the sync-check option), closing of contacts and reset. If in the reset phase the condition to initiate the next reclosure appears, the MRC-T proceeds to the next reclosure. Otherwise, at the end of the reset time, the MRC-T returns to READY mode, which marks the end of the sequence.

The sequence can also end in the LOCKOUT mode for any of the reasons detailed in Section 4.4.3.1, Paragraph F (Lockout Mode).

During the reclosing sequence, the different stages are displayed with the corresponding countdowns and set timers.

This basic sequence can be affected by supervisory or control functions (i.e., Max Cycle, Drive to Lockout...). For description of the functions refer to Section 4.8.

4.6 PROGRAMMABLE LOGIC OUTPUT

Programmable logic outputs 1 and 2 work in conjunction with the contact inputs A, B, C and D. The following synchronism logic values can also be used E = HLDB, F = HBDL, G = sync and H = external sync input. They can be set to respond to any given combination of A, B, C, D, E, F, G, and H. The inputs (active low or active high) can be ANDed or ORed together for the desired result.

4.6.1 Entering Logic Equations

Logic equations consist of terms ORed together. It can have a maximum of 15 characters. A term consists of input variables which are ANDed together. The equation has to end with an '='. The following is an example:

$$ABCD + abcd =$$

The lower case characters represent active low inputs. The upper case characters represent active high inputs.

Logic equation can be entered using the push-buttons at front panel following the steps below:

- a.** In the [SET] mode change the display using LOWER or RAISE to Out 1 and Out 2 for the desired programmable output. (PROG IO setting must be “enabled”). The current equation is displayed.
- b.** Follow the same procedure until the entire equation is entered. When the “=” operator is entered, the new equation is confirmed and the “Value Updated!” display appears.
- c.** Press ENTER and the first character of the equation blinks. Select the new character using the LOWER or RAISE push-buttons (A, a, B, b, C, c, D, d, E, e, F, f, G, g, H, h, + or = can be chosen) and press ENTER. The character is retained and the next character blinks.
- d.** Select an input (A, a, B, b, C, c, D, d, E, e, F, f, G, g, H, h) for a term, a “+” after a term, and an “=” for end of equation using LOWER and RAISE push-buttons.

4.6.2 Programmable Logic Output Operation

When the programmable logic output function setting (Prog IO) is enabled, the four contact inputs are used as variables in logic equations set by the user. For example, output 1 could be programmed to energize when inputs A and B were active and input C was inactive, or when C and D were active. In equation form:

$$ABC + CD =$$

Unique logic equation can be entered for each output using virtually any combination of terms.

Each programmable output has a pick-up delay and a drop-out delay that can be set by the user, with values between 0.01-250 seconds.

When a output's logic equation is satisfied by the proper input combination, the output will activate after the user-specified pick-up delay for that output. If the pick-up delay is set for two seconds, then two seconds after the output logic equation becomes true, the output will energize.

The output will remain energized until its equation becomes false; at that point, the output will begin counting down the user-specified drop-out delay and then de-energize. If the equation becomes true again before the output is de-energized, this count down is aborted and the output will remain energized until the equation becomes false and the drop-out timer starts again.

The programmable logic output function can be disabled by setting Programmable logic output enable setting (“Prog IO”) to “No”. Also each individual output can be disabled by setting the corresponding output enable (“Out 1?” or “Out 2?”) setting to “No”.

4.6.3 External Synchronism Inputs

When “Sync Set?” is set to “Switches” the external inputs A, B, and C are used to enable HLDB, HBDL and SYNC respectively. If the synchronism, voltage supervision setting Reclx (x=1,2,3 or 4), of HLDB, HBDL or Sync and the corresponding external input

agree, the reclose will be supervised by the HLDB, HBDL, or Sync condition. If the external inputs are de-energized the Line-Bus conditions setting will be ignored.

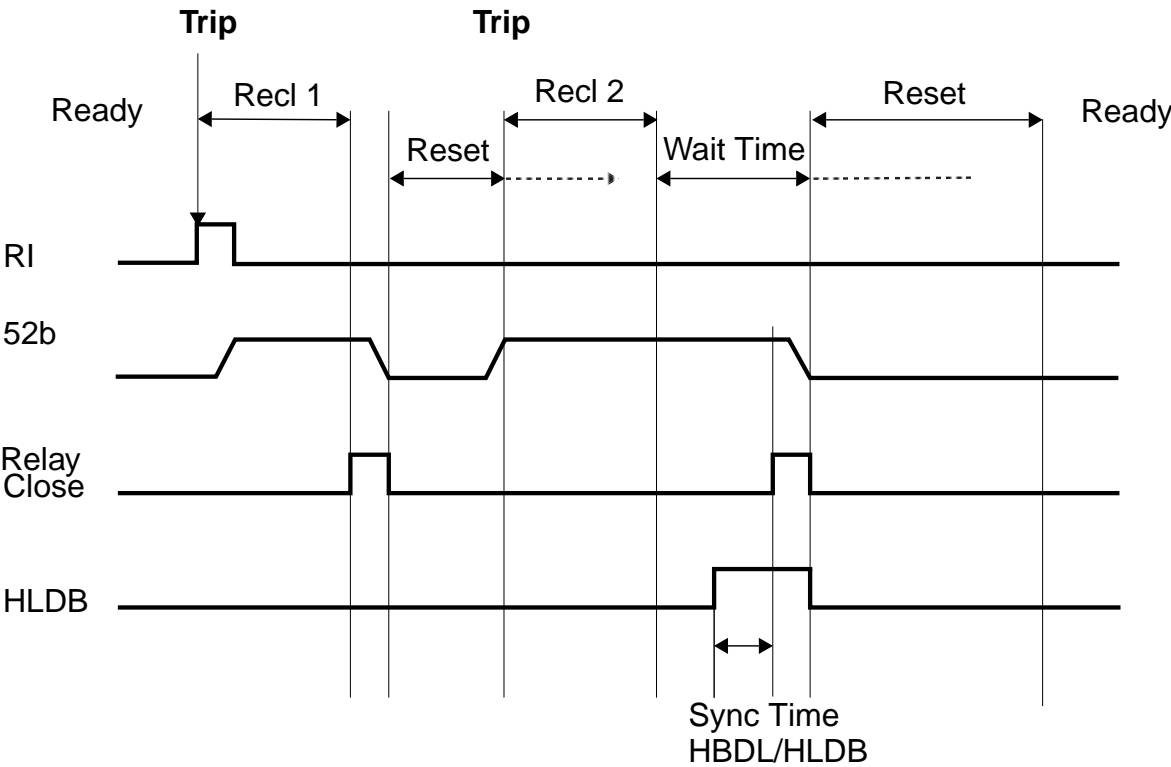
4.7 TIMING DIAGRAM FOR A TYPICAL RECLOSING SYNC-CHECK SEQUENCE

Timing Diagram showing a typical Reclosing/Sync-check sequence according to the following enabled settings and conditions.

Relevant Settings for this example:

TABLE 4-8
SETTINGS FOR TIMING DIAGRAM

Sync Set ?	Yes	Recl 2	52b Only
Recl1	RI Only	Recl2 HLDB	Yes
Recl1 HLDB	No	Recl2 HBDL	Yes
Recl1 HBDL	No	Recl2 Sync	No
Recl1 Sync	No	Recl2 Wait	No Time Limit



Note: The above information, 2 reclosures were selected: Reclosure 1 (RECL 1) was initiated by RI only. Reclosure 2 (RECL 2) was initiated by 52b only with HLDB condition enabled and a RECL 2 Wait Time set indefinitely, i.e., “No Time Limit”.

4.8 RECLOSING/SYNC-CHECK FUNCTION DESCRIPTIONS

PROGRAMMABLE	DESCRIPTION FUNCTION
Reclosures	This function selects the maximum number of reclosures in a sequence (0 to 4). The settings relating to the non-selected reclosures don't appear on the display.
Recl x	Selects the input(s) that will initiate the next reclosure "52b only" will look only at the 52b (x being the reclosure number)input and "RI only" will look at RI. "52b and RI" needs both signals (52b and RI) within one second, and "52b or RI" allow either signal to initiate a reclosure.
Reclx RB	If RI was in the selection for the reclose initiation, a Reclose Block signal will prevail (x being the reclosure number)over a RI in case this setting was selected.
Reclx Time	This is the reclose time or "dead time" from the initiation until the MRC-T verifies sync (x being the reclosure number)conditions if set, then energizes the close output contacts.
Fail Recl? and Fail Time	When selected, the Fail Recl? setting enables the function that keeps the close output contact energized until 52b is detected open, in which case the system releases the close contacts and proceeds to the reset phase. When enabled, the next setting Fail Time sets the maximum time the close contact is energized. If the breaker hasn't closed after this time, the system enters the lockout state, activating the failed reclose contact and LED. If not selected, Close Pulse is the next setting.
Close Pulse	Active only when Fail Recl? was not selected. ClosePulse sets a fixed time the output close contacts remain energized. After this time, if the breaker has closed the system proceeds to reset, if not, the relay goes to next reclosure.
Reset Time	Sets the duration of the reset phase, starting when the breaker has closed (52b open). If during this time the breaker opens again, the system proceeds to the next reclosure. Otherwise, at the end of reset time, the system returns to ready mode.
Hold?	When selected, reclose and reset operations are "frozen" when hold input is present. The operations are resumed as soon as hold input is removed.
Max Cycle? and Max Time	When selected, this function limits the total duration of a reclosing sequence. The relay enters "LOCKOUT" state if 52b is closed past this time limit. The function is reset when returning to "READY" mode. When selecting Max Cycle, move to the next setting (Max Time) to adjust the maximum duration.
Follow Breaker	This function is to prevent sustained pumping action of a circuit breaker as a result of a permanent fault, for example, and any mechanical malfunction which causes the breaker to be closed by some means other than the designed reclosing relay action through the full cycle of reclose shots that have been set on the MRC-T. This function allows the relay to follow the 52b contacts action. While the relay is timing a reclosure, it checks the 52b contact for openings. If the 52b contact opens within a

Cum. Recl? and Cum. Recl	When selected, this function allows the relay to be set for a maximum number of reclosures before the breaker maintenance warning. This condition will activate the alarm relay and display "Br. Maintenance" when the relay returns to the ready mode. To reset the alarm relay change the value of "Cum. Recl" or disable the function.
Br. Oper.?	Br Oper? selects the breaker limit functions, comprising Max Count, Duration and Re-Max Countcover. The breaker limit functions operate as follows: Duration
Recovery	Within the time Duration, the relay can perform up to Max Count number of reclosures. If the count is exceeded, the relay goes to lockout and remains in this mode for the Recovery time period set.
Prog IO	When selected, enables programmable logic output function.
Output X	Selects logic equation for programmable logic output X.
PkUp Out X	Selects pick up delay time for programmable logic output X.
Drop Out X	Selects drop out delay time for programmable logic output X.
Out X	When selected, enables output of programmable logic output X.
Remote Set	When selected, Remote changes requiring the password are allowed via remote communication.
Time Set	When selected, enables changing real time clock settings.
Year, Month, Day,	Selects year, month, day, weekday, hour and minute settings for real time clock Weekday, Hour, Minute
Man Close	When selected, this function allows manual close input to initiate a closure when the relay is in lockout. This closure can be controlled by synchronism check (HLDB, HBDL or synchronism).
MRC-T	This function allows one to disable/enable the entire MRC-T Relay.

 ADDITIONAL FUNCTIONS WITH THE SYNCH-CHECK OPTION

* Sync Set?	When selected, enables all synchronization, HBDL and HLDB related settings.
VMax	The voltage threshold above which the bus or line is considered "live".
* VMin	The voltage threshold under which the bus or line is considered "dead".
Sync Time	The minimum time required for one of the selected conditions (HBDL, HLDB, SYNC) to allow reclosure to occur.
Sync Angle	Selects the maximum angle for which Line and Bus are considered in synchronism.
Reclx HLDB (X being the reclosure number)	When selected, permits a reclosure when the line is "live" and the bus is "dead".
Reclx HBDL (X being the reclosure number)	When selected, permits a reclosure when the bus is "live" and the line is "dead".
* Reclx Sync (x being the reclosure number)	<p>When selected, permits a reclosure when the synchronism condition is fulfilled (line "live", bus "live" and the difference of angle is lower or equal to the Sync angle).</p> <p>If Reclx (x=1,2,3 or 4), sync is set to "Yes" for the last reclosure, (see "Reclosures" setting) MRC-T will enter the Intermediate Lockout ("Int. Lo") state, will display "Int. Lo" and the Int. Lo alarm relay will be energized while waiting for synchronism. If synchronism is achieved before the "Reclx Wait" timer expires, MRC-T will display "Timing Sync", then time out, reset and return to Ready State.</p>
* Reclx Wait (x being the reclosure number)	This function is used to set a maximum waiting time for the condition for HLDB, HBDL or synchronism to occur. If the Recl x wait time expires, the reclosure goes to lockout. An infinite Recl x wait time is selected by choosing "No Time Limit."
Man HLDB	When selected, permits a manual closure when the line is "live" and the bus is "dead".
Man HBDL	When selected, permits a manual closure when the bus is "live" and the line is "dead".
* Man SYNC	When selected, permits a manual closure when the synchronism conditions is fulfilled. (Line "live", bus "live" and the difference of angle is lower or equal to the Sync angle.)
* Man Wait	This function is used to set a maximum waiting time for the condition for HLDB, HBDL or synchronism to occur. If the manual wait time expires, the manual closure goes to Lockout. An infinite wait time is selected by choosing "No Time Limit".
* These features are available with out sync-check option, but will only respond to external "sync check" signal input FT-17 & FT-20.	

HARD WIRED FUNCTIONS	DESCRIPTION
Drive to Lockout [DR LOCK]	This is an optically isolated input. When present it will drive the relay to lockout from anywhere in the sequence. The relay will stay in "LOCKOUT" until the drive to lockout input is removed. Then the relay will continue the sequence before ending in the "READY" mode (after a reset in "LOCKOUT").
Manual Close	This is an optically isolated input, used for manual close Initiate
Hold	This is optically isolated input. When present the reclosing relay "freezes". All timing and all sequencing shall stop until the "HOLD" input is removed. It will then continue from the point at which action was suspended.
Sync Check	This is an optically isolated input, used for external synchronism input.
Skip	This is an optically isolated input, used for reclosure skip.
In-Progress	This is an output relay with N.O. or N.C. contacts selectable through a jumper. This output is energized during the reclosing sequence and de-energized in "READY" and "LOCKOUT" modes.
Lockout	This is an output relay with N.O. or N.C. contacts selectable through a jumper. This output is energized when the relay is in the "LOCKOUT" mode.
FAILED RECLOSE	This is an output relay with N.O. or N.C. contacts selectable through a jumper. This output is energized when the relay is in the "FAILED RECLOSE" state.
52b	This is an optically isolated input, used to determine breaker status
RI	This is an optically isolated input, which when enabled can initiate a reclosure sequence.
RB	This is an optically isolated input, which when enabled will block a reclosure initiated by RI input.
ALARM	This is an output relay with N.O. or N.C. contacts selectable through a jumper. This output is deenergized when the relay has self-tests error or loses power. It is energized when the relay operates normally.
INT LO Alarm	This is an output relay with N.O. or N.C. contacts selectable through a jumper. This output is energized when the relay is in intermediate lockout.
IN A/HLDB	This is an optically isolated input, used for programmable I/O input A or switched synchronism HLDB.
IN B/HBDL	This is an optically isolated input, used for programmable I/O input B or switched synchronism HBDL.
IN C/SYNC	This is an optically isolated input, used for programmable I/O input C or switched synchronism SYNC.

IN D	This is an optically isolated input, used for programmable I/O input D
OUT 1	This is an output relay with N.O. or N.C. contacts selectable through a jumper. This relay is energized when the logic value of OUT1 calculated according to the logic equation 1 selected in the settings is true during the certain time selected using the pick up timer 1 setting.
OUT 2	This is an output relay with N.O. or N.C. contacts selectable through a jumper. This relay is energized when the logic value of OUT 2 calculated according to the logic equation 2 selected in the settings is true during the certain time selected using the pick up timer 2 setting.

4. 9. COMMUNICATION PORT(S) USE

4.9.1 Introduction

MRC-T can be communicated with for target data, settings, etc., through the man-machine interface (MMI), if supplied, or via one of the communication (comm.) ports. Comm. port communications, provides the user with more information than is available with the MMI. For example, all 16 targets are available and more friendly user interface for settings can be accessed (all settings are displayed on a single screen on the user's PC). This section will provide the details of the comm. port options, personal computer requirements, connecting cables and all information necessary to communicate with and extract data from the relay. Additional communications details are contained in I.L. 40-603, "RCP Remote Communication Program".

4.9.2 Communication Port Options

MRC-T is supplied with a rear communications port. If the network interface is not specified, a RS-232C [hardware standard] communications port is supplied. Network interface comm. port option allows the connection of the relay with many other devices to a 2-wire network. A detailed discussion of networking capabilities can be found in AD 40-600, "Substation Control and Communications Application Guide".

RS-232C, rear comm. ports are of the removable, Product Operated Network Interface (PONI) type and are available in two styles. One is identified by a 25 pin [DB-25S] female connector, it is usually black in color, and has a single data comm. rate of 1200 bps. The second style is identified by a 9 pin [DB-9P] male connector and externally accessible dip switches (next to the connector) for setting the comm. data rate. This port option is always black in color, can be set for speeds of 300, 1200, 2400, 4800, or 9600 bps and offers an option for IRIG-B time clock, synchronization input.

Front communications is another comm. port option. The front panel RS-232C communications port, is supplied with a 9 pin [DB-9S] female connector and can be configured for 300, 1200, 2400, 4800, 9600 or 19200 bps. Data comm. rate choice is made by dip switch settings which will be discussed later in this chapter.

4.9.3 Personal Computer Requirements

Communication with the relay requires the use of Remote Communication Program (RCP) regardless of the comm. port option. RCP is supplied by ABB Relay Division and is run on a personal computer (PC).

To run the program requires an IBM AT, PS/2 PC (or greater) true compatible with a minimum of 640 kilobytes of RAM, 1 hard disk drive, a RS-232C comm. port and a video graphics adapter card. The PC must be running Version 3.3, or higher, MS-DOS.

4.9.4 Connecting Cables

With each comm. port option the connecting cable requirement can be different. Also, connecting directly to a PC or connecting to a modem, for remote communication, affects the connecting cable requirements. Table 4-9 provides a summary of plug pin assignments, pins required and cable connectors.

**TABLE 4-9
COMMUNICATIONS CABLE REQUIREMENTS**

Connection Type (From Relay Comm Port)	Cable (Straight = no null modem)	Pins Req'd. (All pins not required)	Cable Connectors (Comm Port to PC or Modem)	Notes
DB-25S, RS-232C connected to PC*	Straight	2,3,7	To port: 25 pin DTE To PC: 9 or 25 pin DCE	
DB-25S RS-232C connected to Modem	Null Modem	2,3,7	To port: 25 pin DTE To Modem: 25 pin DTE	
DB-9P, RS-232C con- nected to PC*	Null Modem	2,3,5	To port: 9 pin DCE To PC: 9 or 25 pin DCE	See IL 40-610 for settings
DB-9P, RS-232C connected to Modem*	Straight	2,3,5	To port: 9 pin DCE To Modem: 25 pin DTE	See IL 40-610 for settings
DB-9S, RS-232C connected to PC*	Straight	2,3,5,7,8	To port: 9 pin DTE To PC: 9 or 25 pin DCE	See Table 4-10 for settings
DB-9S, RS-232C connected to Modem	Null Modem	2,3,5,7,8	To port: 9 pin DTE To Modem: 25 pin DTE	See Table 4-10 for settings

Some terminology will be defined to aid the user in understanding cable requirements in Table 4-9. Reference is often made to the "RS-232C" standard, for data communication. The RS-232C standard describes mechanical, electrical, and functional characteristics. This standard is published by the Electronics Industry Association, (EIA) and use of the standard is voluntary but widely accepted for electronic data transfer. ABB relay communications follows the RS-232C standard for non-network data communication.

Although the RS-232C standard does not specify a connector shape, the most commonly used is the "D" shape connector. As stated in Section 4.9.2 above, all ABB relay communication (except network communications) connectors are of the "D" shape (such as DB-25S).

Data Communication devices are categorized as either Data Terminal Equipment [DTE] or Data Communication Equipment [DCE]. A DTE is any digital device that transmits and/or receives data and uses communications equipment for the data transfer. DCEs are connected to a communication line (usually a telephone line) for

the purpose of transferring data from one point to another. In addition to transferring the data, DCE devices are designed to establish, maintain, and terminate the connection. As examples, a computer is a DTE device and a modem is a DCE device.

By definition the connector of a DCE is always female (usually DB-9S or 25S). Similarly, DTEs are always male (usually DB-9P or 25P). These definitions apply to the equipment being connected and to the connectors on the interconnecting cables.

One additional piece of hardware that is required, in some applications, is a “null” modem. Null modem’s function is to connect the transmit line [TXD], pin 2 by RS-232C standard, to the receive line [RXD], pin 3. A null modem is required when connecting like devices. This is DTE to DTE or DCE to DCE. A DCE to DCE for example, where a null modem is required, is the connection of a 25 pin, PONI to a modem.

A null modem function can be accomplished in the connecting cable or by separate null modem package. That is, by using a conventional RS-232C cable plus a null modem. One type of null modem, available from electronics suppliers is B&B Electronics Type 232MFNM.

4.9.5 Setting Change Permission and Relay Password

To gain access to certain communication port(s) functions, the MRC-T must have the remote setting capability permission “Remote Set”, set to “Yes” and knowledge of the relay password is required. To perform any of the following communication port functions, the “Remote Set”, setting must be set to “Yes”:

- Update/Change Settings
- Update Programmable Contact Settings
- Enable Local Settings (capability)
- Disable Local Settings (capability)
- Set Relay Password
- Activate output Relays (contact testing function)

Access control, both setting permission and password knowledge is required for all communications port options.

Before attempting any of the above functions, the setting of “Remote Set”, must be verified via the front panel MMI. Using the setting change procedure in Section 4.4.3.1, verify or change “Remote Set”, such that it is set to “Yes”.

During communications, via one of the comm. ports, the ability to change settings from the front of the relay (by way of the MMI), can be disabled. The RCP, Password Menu choice “Disable Local Settings”, when selected, will block setting changes from the relay front panel. Blocking local front panel setting changes, may be useful for situations in which the access to the relay cannot be secured from tampering by unauthorized persons.

PASSWORD:

When the MRC-T is received from factory or if the user loses the relay password, a new password can be assigned with the following procedure:

1. Turn the relay off, for a few seconds, by removing the dc supply voltage.

2. Re-apply dc supply voltage to re-energize the relay.
3. Using RCP, perform the Password Menu choice “Set Relay Password”. Use the word “password” for the “current relay password” and then select a new password.

The password setting procedure must be completed within 15 minutes of energizing the relay.

4.9.6 Setting up the Front Communications Port

The front RS-232C comm. port, on the relay, consists of a printed circuit board that plugs flat into the rear of the microprocessor module. On the front panel, of the relay, is the 9-pin [DB-9S] DCE connector with it's associated enabling push-button, next to the connector. As described above, communications with the relay requires a serial cable from the comm. port to the communicating device (usually a local PC).

The front comm port data rate must match the comm. port data rate of the device connected to the port. This data rate is set when configuring communications on the communicating device. If the communicating device is a PC, the data rate is set by RCP either when setting up RCP or by changing settings while running RCP.

To set the data rate on the front comm. port the five dip switch poles of switch S1 (see Figure 1-13) must be set according to Table 4-10. When the relay is viewed from the front, (front cover removed) the switch S1 is located on the right side of the front panel near the top (on the top of the front panel and on the left for horizontally mounted relays). Only the first three poles, #1, #2 and #3, of the switch, are used to set the communications bit rate. Refer to Table 4-10 for the correct position of the switch poles. Note that settings 110 and 111 result in the default bit rate of 1200 bps.

4.9.6.1 Front Port Operations

When the communication hardware is in place, communicating with the front requires pressing of the push-button beside the connector in order to switch from the rear to front port. There after, the communication will remain with the front until no data transfer has taken place for two minutes. The push-button can be pressed again to toggle from front to rear or reverse.

RCP operations are identical for front and rear communication [RS-232 or INCOM]. It is possible that the communication is unsuccessful the first time after a relay power-up or switching between protection and recloser. In this case, a second attempt should prove successful.

4.9.6.2 Troubleshooting

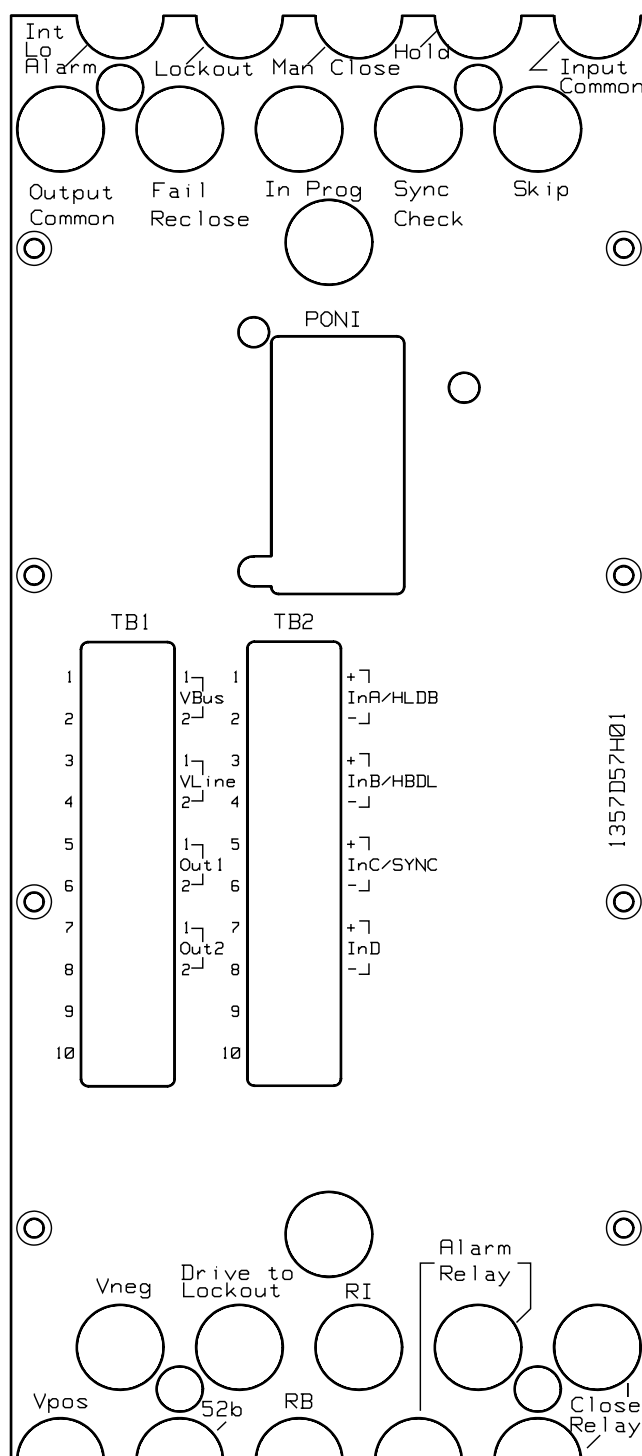
In the event the communication remains unsuccessful, first make sure that the front communication push-button has been depressed, the relay is powered and the connection is good.

For further test, remove the front cover and check that the bit rate on the communication board (dip switches; refer to Table 4-10) is set to correspond to the one displayed at the bottom right of the RCP screen

TABLE 4-10
COMMUNICATIONS PORT
DIP SWITCH SETTINGS
 (See Figure 1-13 for location of dip switch S1)

Dip Switch			Bps
#1	#2	#3	
0	0	0	300
0	0	1	1200
0	1	0	2400
0	1	1	4800
1	0	0	9600
1	0	1	19200
1	1	0	1200
1	1	1	1200
Logic 1 is towards printed circuit board			
Dip position 4 & 5 are not used			

If after these verifications the problem remains, try to remove the power from the relay and apply it again. If the communication still fails (several attempts), the communication board may need to be serviced.



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Figure 4-1. MRC-T Backplate

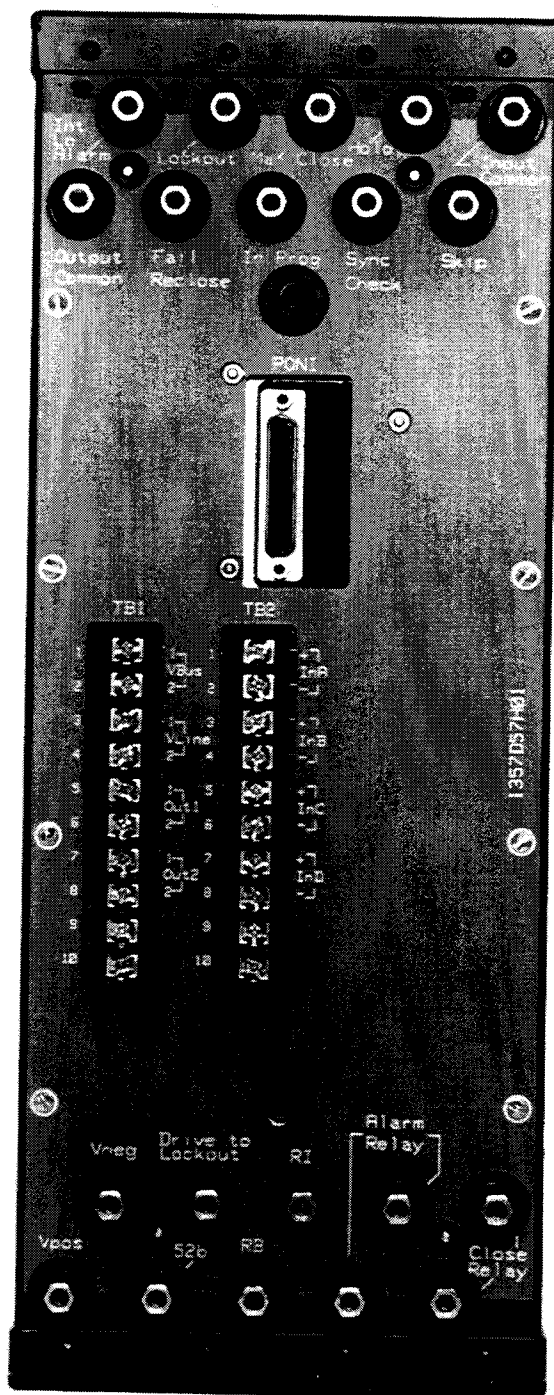
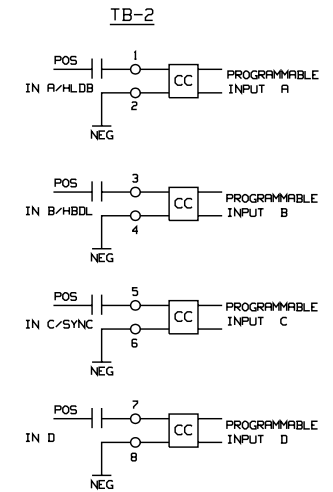
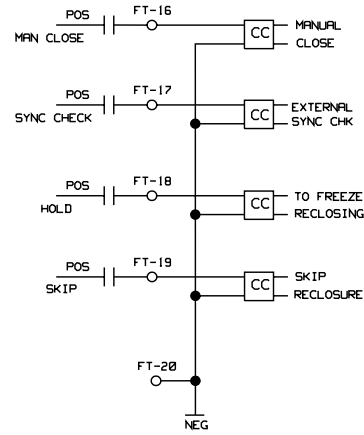
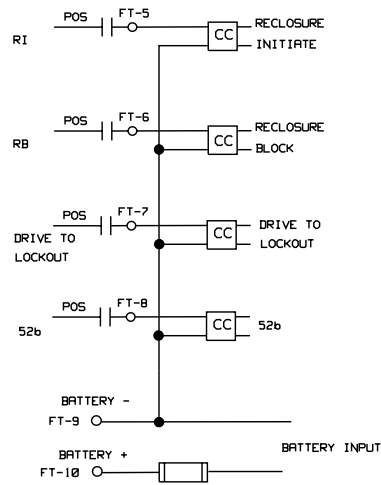
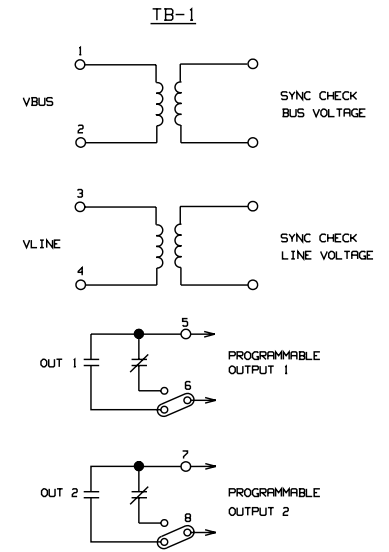
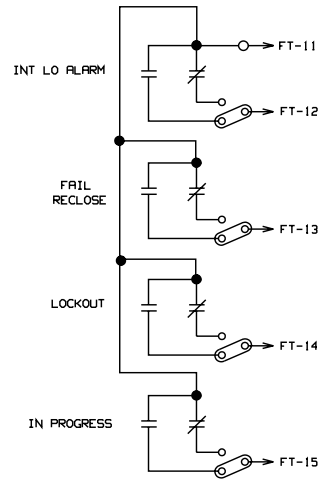
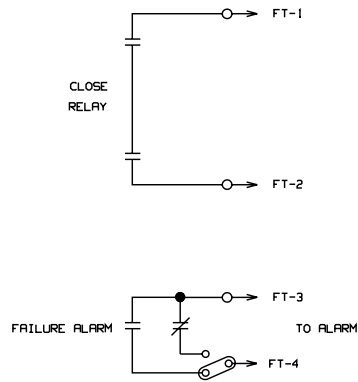


Figure 4-2. MRC-T Rear View



sub 1
1617C05

Figure 4-3. MRC-T System External Connection

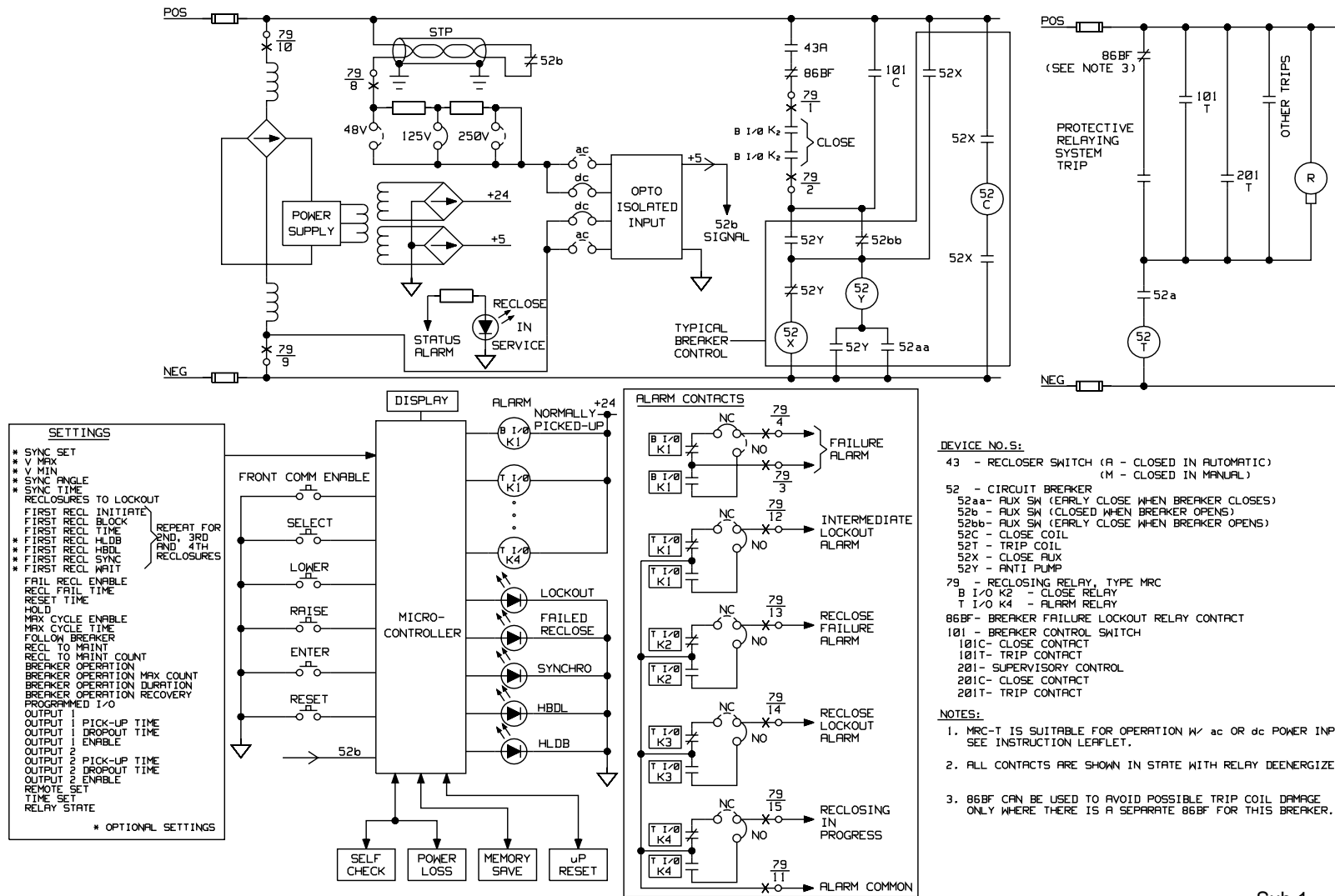


Figure 4-4a MRC-T System Connections

Sub 1
1617C07

Sheet 1 of 3

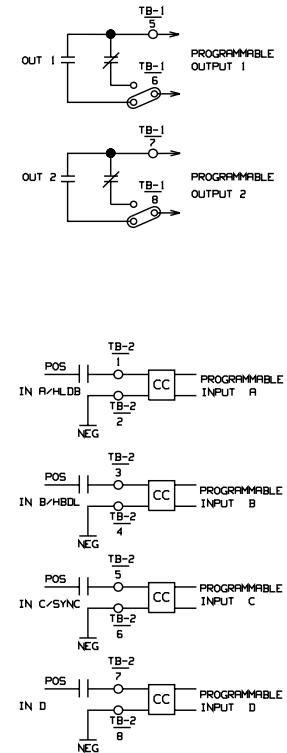
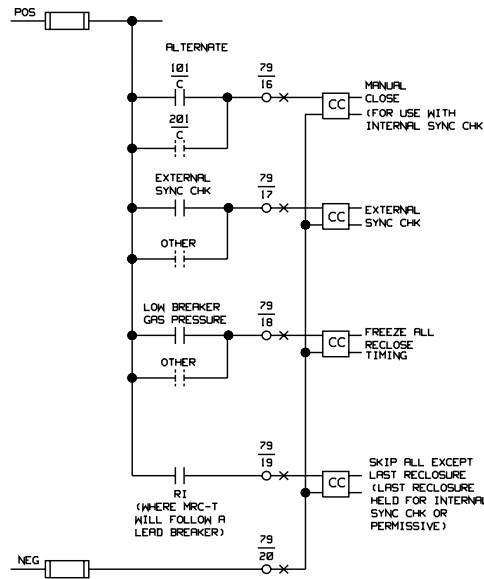
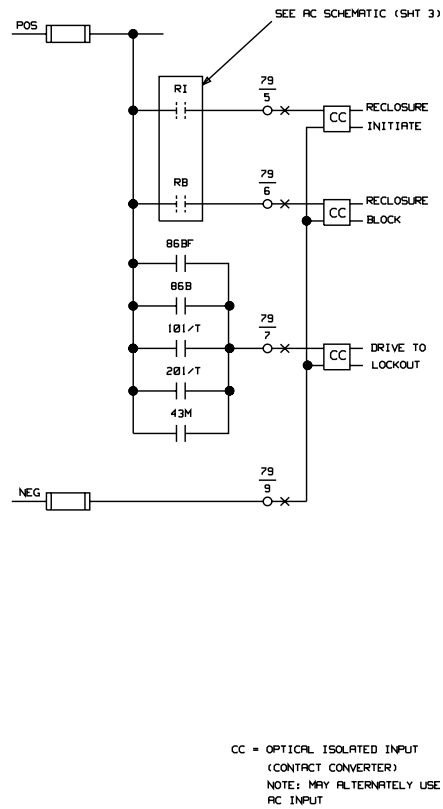


Figure 4-4b MRC-T System Connections

Sub 1
1617C07
Sheet 3 of 3

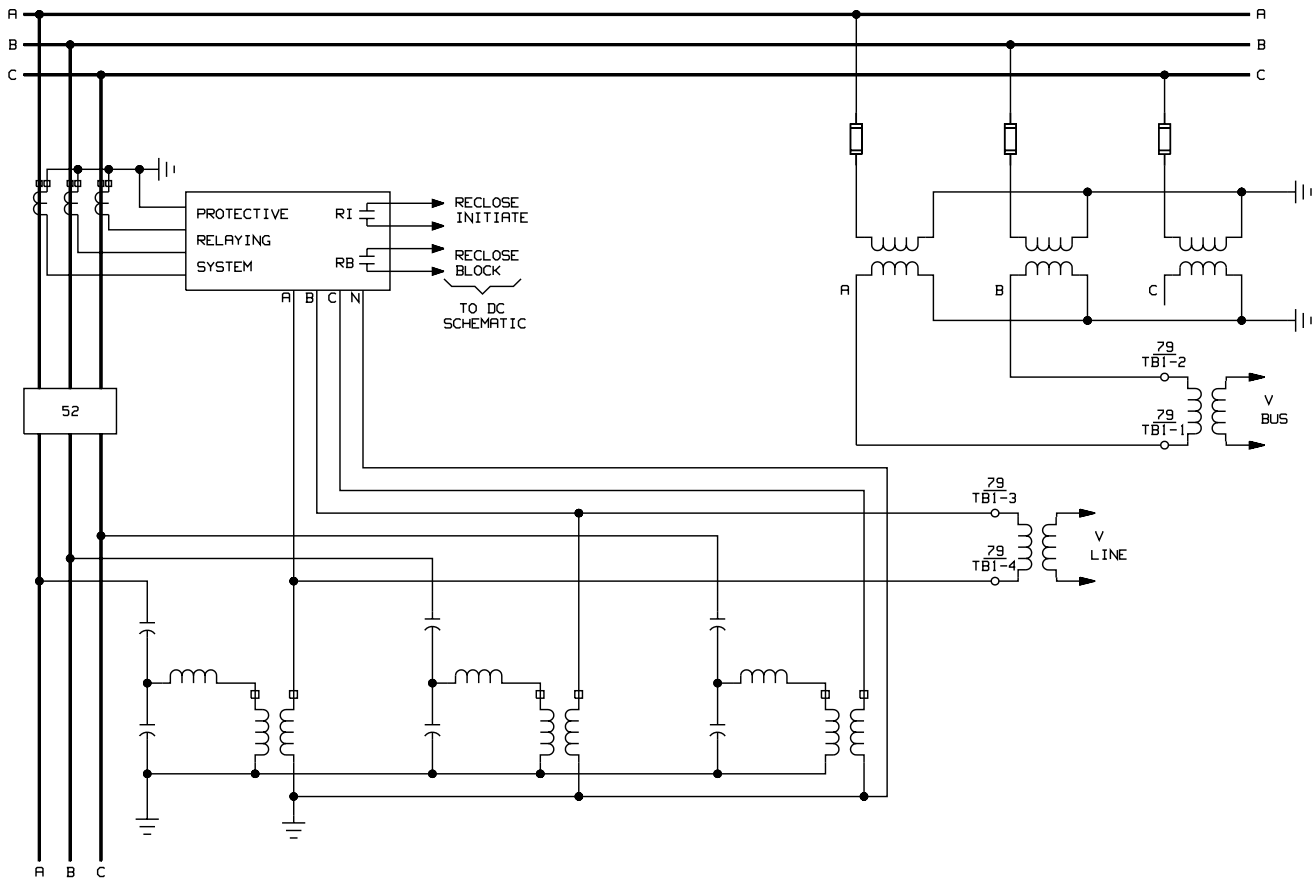


Figure 4-4c MRC-T System Connections

APPENDIX A. ENGINEERING EVALUATION TEST

THIS PROCEDURE PROVIDES AN IN DEPTH TEST OF MRC-T FUNCTIONALITY. IT IS NOT REQUIRED TO PERFORM THE ENGINEERING EVALUATION TEST FOR ACCEPTANCE TESTING. FOR ACCEPTANCE TEST, SEE APPENDIX B. IF YOU HAVE A RELAY WITHOUT SYNC-CHECK OPTION ONLY COMPLETE SECTIONS 1 & 2.

1 RECLOSER W/O SYNC-CHECK OPTION

Check that all jumpers of the output relays are in the N.O. (Normally Open) position except the Alarm Relay (J1 Bottom I/O module, Figure 1-8) which should be in the N.C. (Normally Closed) position. Check that all voltage jumpers are set to dc and rated voltage. Hereafter the rated dc voltage will be referred to as dc. (See Figures 1-8 through 1-11 for jumper locations.)

1.1 FRONT PANEL CHECK

STEP 1: Power Up Initialization

Connect dc to FT-9 (-), FT-20 (-) and FT-10 (+) and turn on power. The display will show "LOCKOUT" condition and the LOCKOUT LED will be on. After the reset timer times out, the LCD on the MRC-T should change from "Lockout Reset" to "READY MRC-T V1.xx" where "xx" is the last two digits of the installed firmware version. The Reclosing-in-Service LED and Alarm Relay (FT-3 & FT-4 contact-open) should be energized to indicate successful self-check on power up and the LOCKOUT LED will turn off.

STEP 2: Default Settings Check

Press the select push-button to access the settings mode. Scroll through the settings by pressing raise or lower to verify that settings are as in Table 4-5 "Factory Default". Change settings if necessary (see Installation & Operations section for details). Press select until the test mode appears. The "Status" display should read "OK". Return the relay to the Ready Mode by either pressing the Select push-button or the Reset push-button once.

1.2 RECLOSE BREAKER CHECK

STEP 1: 52b RECLOSE INITIATION FUNCTION

Momentarily apply (+)dc to the 52b terminal (FT-8) and remove. The relay will start a reclose sequence with RECL1 Dead Time. While the MRC-T is timing the RECL1 Dead Time, the LCD will display the timing "count down" and the In-Progress relay (FT-15 & FT-11) will energize. Once the RECL1 timer times out the Close Relay (FT-1 & FT-2) will energize to reclose the breaker. After the Reset Time Delay times out, the relay will return to ready and the In-Progress relay will drop out. The In-Progress relay will be energized during all relay operations other than READY and LOCKOUT modes.

STEP 2: FAILED RECLOSE AND MANUAL CLOSE**FAILED RECLOSE**

Change the MRC-T “MAN CLOSE” setting to “YES”. Press the select push-button as necessary to return the MRC-T to the “READY” mode. Apply dc (+) to the 52b terminal (FT-8). While the MRC-T is timing, the Recl1 Dead Time, the LCD will display the timing “count down” and the In-Progress relay (FT-15 & FT-11) will energize. Once the RECL1 timer times out, the MRC-T will attempt to issue a reclose however, since the 52b contact input is still present, the Reclose Fail timer begins timing. Once the Reclose Fail timer has timed out, the “FAILED RECLOSE” & “LOCKOUT” LED’s will light. The close and in progress contacts will drop out at this point in time. The display on the MRC-T should show “LOCKOUT, Failed Reclose”. Remove the dc from terminal FT-8.

MANUAL CLOSE

Apply dc (+) to the Manual Close terminal (FT-16). The “LOCKOUT” reset timer will begin timing. After the LOCKOUT reset timer times out, the “LOCKOUT” LED on the MRC-T front panel will go out. Remove the dc from terminal FT-16. The “FAILED RECLOSE” LED on MRC-T front panel will remain lit until reset push-button on MRC-T front panel is pushed. Push reset push-button and “FAILED RECLOSE” LED should go out.

STEP 3: RECLOSE INITIATE AND RECLOSE BLOCK**RECLOSE INITIATE FUNCTION**

Change the “Recl1” setting to “RI Only” and verify the “Recl1 RB” setting is set to “No”. Press the select push-button as necessary to return the MRC-T to the “READY” mode. Momentarily apply dc (+) to the 52b terminal (FT-8). The recloser should not begin timing since the 52b contact should have no effect on reclose initiation with the current test settings.

Momentarily apply dc (+) to the “Reclosure Initiate” terminal (FT-5). MRC-T will start a reclose sequence with the “Recl1 Dead Time”. While the MRC-T is timing the Recl1 Dead Time, the LCD will display the timing “count down” and the In-Progress relay (FT-15 & FT-11) will energize. After the RECL1 dead timer times out the Close contact (FT-1 & FT-2) will close. the reset timer should then begin timing out. Once the reset timer has timed out, the MRC-T should return to the “READY” mode.

RECLOSE BLOCK FUNCTION

Change the “Recl1 RB” setting to “Yes”. Press the select push-button as necessary to return the MRC-T to the “READY” mode. Apply dc (+) to the “Reclosure Block” terminal (FT-6). Momentarily apply dc (+) to the “Reclosure Initiate” terminal (FT-5). The MRC-T should skip “Recl1 Dead Time” (due to the Reclosure block input), jump to “Recl2”, reclose after the Recl2 dead time expires, reset, and return to “READY” mode. Change MRC-T settings as follows: “Recl1 RB” setting to “NO”, “Recl1” setting to “52b Only”.

**STEP 4: INTERMEDIATE LOCKOUT (Int LO)
ALARM EXTERNAL (Ext) SYNC-CHECK**

Change the MRC-T synchronism functions enable setting “Sync Set?” to “Yes”, the “Recl4 Sync” setting to “Yes”, and the “Recl4 Wait” setting to “No time limit”. Press select push-button on MRC-T front panel as necessary to return to the “READY” mode. Momentarily apply dc (+) to the 52b terminal (FT-8). MRC-T will start a reclose sequence with the “Recl1 Dead Time”. While the MRC-T is timing the Recl1 Dead Time, the LCD will display the timing “count down” and the In-Progress relay (FT-15 & FT-11) will energize. After the RECL1 dead timer times out, and while the reset timer is in the process of timing out, again momentarily apply dc (+) to the 52b terminal (FT-8), which will now start the Recl2 dead timer. Repeat this process until the Recl4 dead timer begins timing out. Once the Recl4 timer times out, the “WAIT BUS/LINE”, “No Time Limit” display will appear on the MRC-T front panel and the “INT LO” alarm contacts (FT-11 & FT-12) will close. Momentarily apply dc (+) to the Sync-Check input terminal (FT-17). The MRC-T display will change to “TIMING SYNC” then time-out after 2 seconds, reset, and return to “READY” mode. The Int LO alarm should drop out once the MRC-T returns to the “READY” mode. Change MRC-T settings as follows: “Recl4 Sync” setting to “NO”.

STEP 5: SKIP INPUT

Momentarily apply 52b signal, the relay will begin a reclose sequence with RECL1 dead time. During the dead time momentarily apply dc to the SKIP Input (FT-19). This will cause the relay to skip to RECL2 dead time without attempting the RECL1 closure. The relay then times out, energizes the close relay, resets and returns to “READY” mode.

2 INPUT OPTO-COUPLER CHECK

STEP 1: DRIVE TO LOCKOUT

(For a complete input circuit integrity test, see MMI Modes of Operation Part Ein Section 4.4.3.1).

Apply dc to the drive to LOCKOUT input (FT-7). The relay will display “LOCKOUT” DRIVE TO LOCKOUT”. The LOCKOUT LED and relay will be energized. Remove dc voltage from the input and the relay will return to “READY” mode after the Timer Reset times out.

STEP 2: HOLD

Change the “HOLD” setting to “YES”. Apply rated dc to the drive to LOCKOUT input then remove it. During the reset time apply dc to the hold input (FT-18). The reset timer will freeze at that time and only resume when the voltage is removed. Remove the voltage and the relay will return to the ready state after the remaining reset time, times out.

STEP 3: PROGRAMMABLE INPUTS/OUTPUTS

Change “PROG IO setting” to “YES” and the output 2 relay (TB1-7 & TB1-8) will energize 2 seconds after the “VALUE ENTERED” message is displayed. Then press the reset button to return to the ready mode. Apply dc to the programmable input A [TB2-1(+) & TB2-2(-)] the output 2 relay will drop out after 1 second. (For a complete input circuit integrity test, see MMI Modes of Operation parts in Section 4).

Apply dc to the following: Input B [TB2-3(+) & TB2-4(-), Input C [TB2-5(+) & TB2-6(-), and Input D [TB2-7(+) & TB2-8(-)]. Output 1 [TB1-5(+) & TB1-6(-), will energize 2 seconds after the last input is connected. Remove all programmable input voltages, output 1 will dropout 1 second after the first input is removed. Return "PROG IO" and "HOLD" settings to "NO".

This completes the Acceptance test for relays without Sync-Check.

3 SYNC-CHECK OPTION TESTS

A dual variable voltage source is required, the source must provide 70 Vac (or 120 Vac for 120 volt relay), with adjustable phase angle. Check R7 on the Microcontroller module, if present the input frequency is 60 Hz and 50 Hz if removed. Connect the VBUS to (TB1-1 & TB1 -2) and the VLINE to (TB1-3 & TB1-4). change "SYNC-SET" to "YES".

STEP 1: SYNCHRONISM CHECK

Apply rated ac voltage to VBUS and VLINE with the phase angle difference of 18 degrees. The synchronism LED should be on. Increase the phase angle to 22 degrees and the synchronism LED will then turn off.

STEP 2: METERING CHECK

Scroll the display to the test mode then push the lower button to verify that "BUS-LINE" "ANGLE", "V LINE" and "V BUS" are reading the correct values.

STEP 3: HBDL & HLDB LED CHECK

Reduce the line voltage to 10 Vac and check that the HBDL LED is on. Increase line voltage to 55 Vac and reduce BUS Voltage to 10 volts. This should cause the "HLDB" LED to turn on and the "HBDL" LED to turn off.

This completes the SYNC-Check Tests for the MRC-T Relay.

APPENDIX B. ACCEPTANCE TESTS

THIS IS A BASIC PROCEDURE TO DETERMINE IF A PARTICULAR MRC-T UNIT IS OPERATING CORRECTLY. MORE EXTENSIVE TESTS FOR OUTPUTS AND INPUTS CAN BE PERFORMED IF DESIRED BY FOLLOWING THE ENGINEERING EVALUATION TESTS IN APPENDIX A. IF YOU HAVE A RELAY WITHOUT SYNC-CHECK OPTION COMPLETE ONLY SECTION 1.

1. RECLOSER W/O SYNC-CHECK OPTION

Before beginning the Acceptance Test verify that all jumpers are set to dc and for the correct, rated voltage (see Appendix A, Section 1.) See Figures 1-8 through 1-11 for jumper locations and designations. Connect rated dc voltage to FT-9 (-), FT-20 (-) and FT-10 (+).

STEP 1: FRONT PANEL CHECK

Turn on the dc power to the relay. The display will show "LOCKOUT" condition and the LOCKOUT LED will turn on. The relay will then reset after the reset timer times out and return to the Ready Mode, display the software version and the LOCKOUT LED will turn off. The Reclosing-in-Service LED should light and Alarm Relay (FT-3 & FT-4) should be energized to indicate successful self check on power-up.

STEP 2: OUTPUT RELAY AND STATUS CHECK

Press the Select push-button to access the Test mode. Check that the "STATUS" display reads "OK". Press the RAISE push-button to access Test for Output relays and LEDs (See Section 4.4.3.1 part E for details). For each Output relay or LED, press the Enter push-button to determine that it energizes, except the Alarm relay which will de-energize. Return the relay to the Ready mode by pressing the Reset push-button.

2. SYNC-CHECK OPTION TESTS

Remove front faceplate and check for the presence or absence of R7 on the Microcontroller module, the input frequency is 60 Hz if present, 50 Hz if absent. Change "SYNC SET" to "YES".

STEP: 1 SYNCHRONISM AND METERING CHECK

Apply a single 70 Vac source to both VBUS (TB1-1 & TB1-2) and VLINE (TB1-3 & TB1-4). at the rated frequency. The synchronism LED should be on. Scroll the display to Test Mode then push the "Lower" button to verify that "BUS-LINE" "ANGLE", "V LINE" and "V BUS" are reading the correct values.

STEP 2: LED CHECK

While in the Test Mode, press the "lower" push-button until the "BUS/LINE" "LEDs" is displayed. Press the Enter push-button to turn on the "SYNCHRONISM", "HBDL" and "HLDB" LEDs.

This completes the Acceptance Test. Return all settings to values in Table 4-3 or to desired service settings.

Appendix C. PERIODIC MAINTENANCE TESTS

NOTE

It is **NOT RECOMMENDED TO PERFORM** any type of invasive periodic maintenance test (requiring relay disassembly).

1. PERIODIC MAINTENANCE TESTS

1. 1. Using Data Communication Port

- Read Metering Values
- Read Diagnostic Information
- Monitor Relay Failure Indication
- Remotely test Output Relay (Trip, Close, etc.)
- Check for Failure Alarm via annunciator or network

1. 2. Using Man-Machine Interface

- Use the front display, and push-buttons to manually perform the tests described in Section 1.1 above.

1. 3. Routine Visual Inspection

With the exception of routine visual inspection, the MRC-T relay assembly should be maintenance free for one year. A program of routine visual inspection should include:

- Condition of cabinet or other housing
- Tightness of mounting hardware
- Proper seating of subassemblies
- Condition of external wiring
- Appearance of printed circuit boards and components
- Signs of overheating in equipment

1. 4. Perform the Acceptance Test

Performing this test is optional if all other test results are acceptable.

Appendix D. CALIBRATION

The MRC-T has been calibrated at the factory; adjustments by the customer are not required. The following information is for reference only.

The power supply trim pot P9 is to adjust the +12 Vdc A/D reference. The voltage can be measured between TP1 and inductor L2. Clockwise rotation of the pot screw will decrease the reference voltage.

The display module option has a trim pot R6 which allows slight adjustment of the viewing angle. This adjustment can be made without removing the front panel.

CAUTION

Excessive adjustment of this pot could cause the display to go blank.

Numerics

52b -----1-2, 4-2, 4-5, 4-6, 4-7, 4-8, 4-10, 4-12, 4-14, 4-15, 4-16, A-1, A-2

A

ALARM -----4-7, 4-18

ALARM RELAY -----4-1, 4-11, 4-16, 4-17

B

BUS -----A-4

BUS-LINE -----A-4

C

CLOSE RELAY -----4-1, 4-10

D

DRIVE TO LOCKOUT -----3-1, 4-1, 4-10, 4-11, 4-12, 4-18, A-3

E

EEPROM -----1-3, 4-11

EPROM -----1-3, 4-11

F

FAILED -----4-11, A-1

FAILED RECLOSE -----1-2, 4-2, 4-3, 4-10, 4-15, 4-18, A-1

H

HBDL -----1-2, 3-1, 4-2, 4-3, 4-4, 4-5, 4-6, 4-7, 4-9, 4-11, 4-12, 4-13, 4-14, 4-16, 4-17, 4-18, A-4, B-1

HLDB -----1-2, 3-1, 4-2, 4-3, 4-4, 4-5, 4-6, 4-7, 4-9, 4-11, 4-12, 4-13, 4-14, 4-16, 4-17, 4-18, A-4, B-1

HOLD -----3-1, 4-2, 4-7, 4-10, 4-15, 4-17, 4-18

I

IN PROG -----4-2

IN A -----4-2, 4-14, 4-10, 4-18

IN B -----4-2, 4-14, 4-10, 4-18

IN C -----4-2, 4-14, 4-10, 4-18

INCOM -----1-2, 1-3, 2-1, 3-2, 4-2, 4-22

IN D -----4-2, 4-14, 4-10, 4-19

INT -----A-2

INT LO ALARM -----4-2, 4-18, A-2

L

LCD -----1-2, 1-3, 3-2, 4-2, A-1, A-2

LED -----1-2, 1-3, 4-2, 4-3, 4-10, 4-11, 4-15, A-1, A-2, A-3, A-4

LOCKOUT -----1-2, 3-1, 4-2, 4-3, 4-9, 4-10, 4-11, 4-12, 4-15, 4-16, 4-17, 4-18, A-1, A-2, A-3, B-1

LOCKOUT LED -----4-3, A-1, A-2, A-3, B-1

M

Man Close -----4-2, 4-9, 4-16
MAN SYNC -----4-9, 4-17
MULTI-SHOT RECLOSING -----3-2

O

OUT 1 -----4-2, 4-8, 4-13, 4-19
OUT 2 -----4-2, 4-8, 4-13, 4-19

P

PONI -----1-2, 1-3, 2-1, 4-1, 4-3, 4-18
PROG IO -----4-6, 4-9, 4-12, A-2

R

RB -----4-2, 4-5, 4-6, 4-7, 4-15, 4-18, A-1
RCP -----4-19, 4-21, 4-22, 4-23
READY -----3-1, 4-2, 4-3, 4-4, 4-11, 4-12, 4-14
RECL -----4-4, 4-5, 4-6, 4-7, 4-9, 4-14, 4-15, 4-16, 4-18
RECL1 -----4-5, 4-14, A-1, A-2
RECL2 -----4-6, 4-14, A-2
RECL3 -----4-6
RECL4 -----4-7, A-2
RI -----1-2, 4-5, 4-6, 4-7, 4-12, 4-14, 4-15, 4-18, A-1

S

SKIP -----3-1, 4-2, 4-4, 4-10, 4-18
SYNC -----1-2, 4-5, 4-6, 4-7, 4-9, 4-10, 4-12, 4-13, 4-14, 4-17
SYNC ANGLE -----4-17
SYNC CHECK -----4-2, 4-10, 4-17, 4-18, A-4
SYNC SET -----4-3, 4-4, 4-5, 4-6, 4-7, 4-13, 4-17, A-4, B-1
SYNC TIME -----4-5, 4-14, 4-17
SYNCHRONISM -----1-1, 1-2, 4-2, 4-3, 4-5, 4-6, 4-7, 4-9, 4-12, 4-13, 4-16, 4-17, 4-18, B-1

T

TIMING SYNC -----4-17, A-2

V

VBUS -----4-2, A-2
VLINE -----4-2
VMax -----4-4, 4-5, 4-17
VMin -----4-4, 4-5, 4-13, 4-17