INTRODUCTION

1. SCOPE OF THIS MANUAL

This manual provides instructions for MOSCAD™ Remote Terminal Unit (RTU) installation and operation. It also provides on-site replacement instructions for RTU elements that do not necessarily require shop level assistance.

This manual covers the basic six-slot and optional three-slot RTUs and most of the communications and I/O options. Other manuals (available separately) contain additional information on the RTU, as follows:

68P02924C10	19” Rack Mounted RTU, Owner’s Manual
68P02991G90	MOSCAD RTU Service Manual
68P02995G10	MOSCAD Programming Tool Box, Operating Instructions

2. GENERAL DESCRIPTION

The MOSCAD RTU is a remotely located terminal used for monitoring and control of local equipment. The unit is intelligent and can operate in a stand alone mode as well as serve as an intelligent node in a distributed processing system.

The MOSCAD RTU is a modular unit, basically made up of plug-in modules installed in a multi-slot rack, power supply, radio and interface equipment. The chapters in this manual separately describe each of the RTU modular elements.

The *basic* model of the MOSCAD RTU is supplied with a chassis suitable for wall mounting, a six-slot Modular bus (motherboard), power supply, backup battery, radio, and a CPU module assembled by the manufacturer. The basic RTU model is enclosed in a NEMA4 metal housing. Figure 1 provides a general view of the basic Six-Slot RTU (shown without housing).

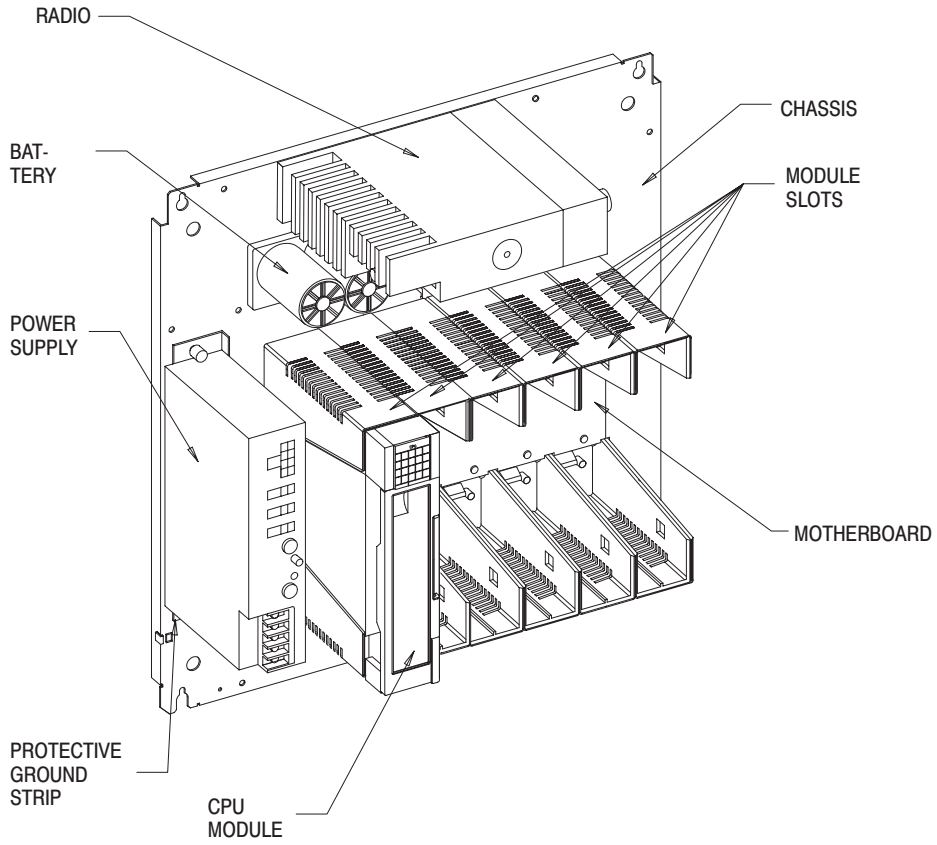

Figure 1. Six-Slot RTU - General View (without housing)

2.1 RTU BASIC MODELS

The basic RTU model is determined according to the prime communication channel used. These models are detailed in Table 1.

Table 1. RTU Basic Models

Model No.	Description
F6900A	No radio communication interface
F6909A	External radio (FSK)
F6953A	MT 2000 VHF radio, 5 W, 136-174 MHz, FSK
F6954A	MT 2000 UHF radio, 4 W, 403-470 MHz, FSK
F6956A	Darcom 9000-2 radio, 5 W, 928-960 MHz, 12.5 kHz, FSK
F6973A	MaxTrac VHF radio, 20 W, 136-174 MHz, DFM
F6974A	MaxTrac UHF radio, 20 W, 403-430, 449-470 MHz, DFM
F6975A	MaxTrac 800 conventional radio, 12 W, 800 MHz, FSK
F6984A	MaxTrac UHF trunked radio, 20 W, 403-430, 450-470 MHz, 1200 bps DPSK
F6985A	MaxTrac 800 trunked radio, 15 W, 800 MHz, DPSK
F6986A	MaxTrac 900 trunked radio, 12 W, 900 MHz, DPSK

2.2 MODULAR BUS AND HOUSING

The basic RTU includes a six-slot modular bus which houses a CPU module and up to five I/O modules. As an option, a three-slot Modular bus is supplied instead of the six-slot Modular Bus. In addition to the CPU, a three-slot modular bus houses up to two I/O modules.

The basic RTU is supplied in a NEMA 4 metal housing. Optionally, both the six-slot and three-slot RTUs can be ordered with a NEMA 4 stainless steel housing. The three-slot RTU can be ordered in a plastic housing.

Table 2 details the Modular Bus and Housing options.

Table 2. Modular Bus and Housing Options

V89	6-Slot Modular Bus, Stainless Steel Housing
V214	3-Slot Modular Bus, Metal Housing
V228	3-Slot Modular Bus, Plastic Housing
V229	3-Slot Modular Bus, Omit Housing
V231	6-Slot Modular Bus, Omit NEMA4 Metal Housing
V405	3-Slot Modular Bus, Stainless Steel Housing

2.3 CPU AND COMMUNICATION INTERFACES

The main element of the MOSCAD RTU is the CPU module. The standard CPU type is Series 200, which is suitable for most applications. For calculation intensive applications, the enhanced CPU Series 300 and math coprocessor options are available. Tables 3, 4 and 5 detail the CPU and communication interface options.

Table 3. CPU Options

V426	CPU 300
V445	Add Math Coprocessor

Table 4. Communications Interface Options

For all models (except for F6900)	
V356	Replace DFM or DPSK with FSK radio interface
V370	Replace DFM or FSK with DPSK radio interface
V390	Replace FSK with DFM radio interface
For F6900 model only	
V345	RS-232, asynchronous, via port 3
V340	RS-232, synchronous, via port 3
For F6956 model only	
V127	4800 bps Modem for Darcom Radio, Port 3, Synchronous
V360	4800 bps Modem for Darcom Radio, Port 3, Asynchronous
V387	9600 bps Modem for Darcom Radio, Port 3, Asynchronous
V388	9600 bps Modem for Darcom Radio, Port 2, Asynchronous
V430	9600 bps Modem for Darcom Radio, Port 3, Synchronous
V431	4800 bps Modem for Darcom Radio, Port 2, Asynchronous

Table 5. Modem Options (for F6900 model only)

V104	300/1200 bps Line Modem, Auto Answer
V219	1200 bps Line Modem, 2 Wire, Half Duplex, Multi-Drop
V226	300/1200/2400 bps Line Modem, Auto Answer
V285	1200 bps Line Modem, 2/4 wire, Full Duplex
V404	2400 bps Line Modem, 2/4 Wire, Full Duplex

2.4 I/O MODULES

The MOSCAD RTU provides a wide range of I/O modules for interfacing with the user equipment (see Table 6). The RTU can house up to either five or two I/O modules according to the Modular Bus option.

Table 6. RTU I/O Module Options

V118	4-AO Module (4 - 20 mA, 0 - 5 V)
V278	8-AI Module (4 - 20 mA)
V437	8-AI Module (±5 V)
V459	8-AI Module (±1 mA)
V460	8-AI Module (±2.5 V)
V461	8-AI Module (±2 mA)
V462	8-AI Module (±1 V)
V329	16 AC DI Module, input voltage range = 10 - 28 V
V379	16 AC DI Module, input voltage range = 20 - 56 V
V115	16-DI, 2-Counter Module
V516	16-DO Module (magnetically latched outputs)
V616	16-DO Module (electrically energized outputs)
V355	32 DC DI Module, input voltage range = 10 - 28 V
V480	32 DC DI Module, input voltage range = 20 - 56 V
V481	32 DC DI Module, input voltage range = 35 - 80 V
V314	32 DO Module (Transistorized Outputs)
V380	60 DI Module
V464	AC Analyzer System (Module and Termination Panel)
V245	Mixed I/O Module, 3ML+1EE, 8DI, 2AI (4 - 20 mA)
V436	Mixed I/O Module, 4EE, 8DI, 2AI (4 - 20 mA)

2.5 POWER SUPPLY AND BATTERY

The power supply provides DC power for the RTU operation and charges the RTU backup battery. The power supply and backup battery options are detailed in Table 7. The RTU can be ordered without the power supply and the battery, in which case the FKN5934A external power supply cable is provided.

Table 7. Power Supply Options

V251	220 V Power Supply (instead of 110 V)
V274	Omit Power Supply and Battery
V328	Battery expansion to 10 AH

The FLN4666A battery, consisting of six subunits, is rated for 5 AH operation. An optional field retrofit kit, FRN5528A, enables the installation of a second FLN4666A battery on top of the existing one. The two batteries are connected in parallel by means of an optional cable kit FKN5895A, providing 10 AH operation.

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INSTALLATION

1. GENERAL

This chapter covers the following installation procedures:

– Wall mounting (with metal, stainless steel or plastic housing, or without housing).

– Module preparation and installation.

– Electrical connections.

In addition, this chapter describes the RTU disassembly procedures and provides a list of the RTU parts that are field replaceable.

2. WALL MOUNTING WITH HOUSING

The following housing installation procedures refer to the NEMA4 type housings. The NEMA4 housing sizes are:

	Large (for 6-Slot RTUs)	**Small** (for 3-Slot RTUs)	**Plastic** (for 3-Slot RTUs)
Width:	50 cm (19.7”)	38 cm (15”)	41.5 cm (16.3”)
Height:	50 cm (19.7”)	38 cm (15”)	51.5 cm (20.3”)
Depth:	21 cm (8.26”)	21 cm (8.26”)	23 cm (9.05”)

Convenient installation of the MOSCAD RTU with the NEMA4 housing requires the following available space:

	Large (for 6-Slot RTUs)	**Small** (for 3-Slot RTUs)	**Plastic** (for 3-Slot RTUs)
Width:	56 cm (22”)	44 cm (17.5”)	47 cm (18.5”)
Height:	56 cm (22”)	44 cm (17.5”)	57 cm (22.5”)
Depth:	28 cm (11”)	28 cm (11”)	30 cm (11.8”)

Four mounting brackets are provided, one in each corner of the RTU, for wall mounting of the RTU (see Figures 1 to 5). To mount the RTU on the wall proceed as follows:

(1) Fasten the mounting brackets at the housing back corners. Use the brackets and the screws supplied in the plastic bag.

(2) Choose the mounting means (screws, etc.) appropriate for the site and mount the RTU on the wall using the mounting brackets.

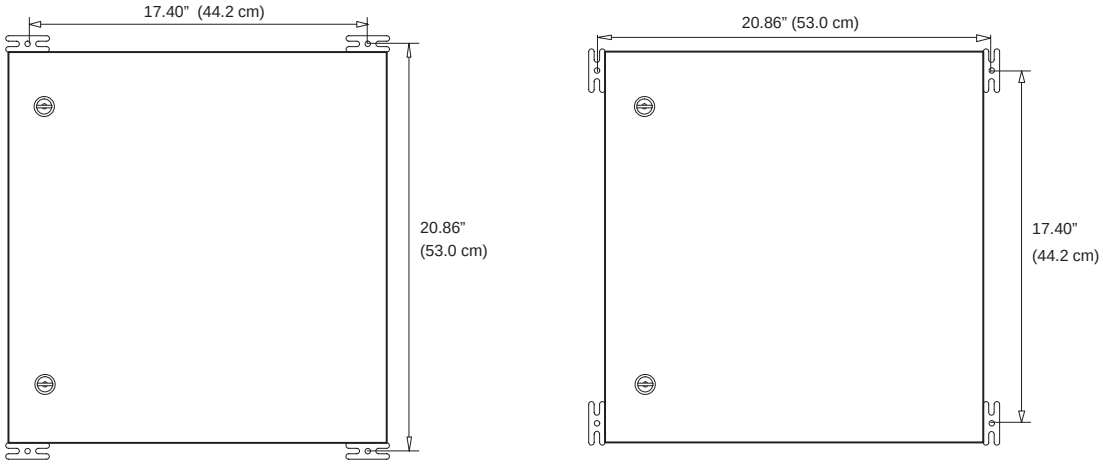

Figure 1. Large NEMA 4 Housing - Installation Dimensions

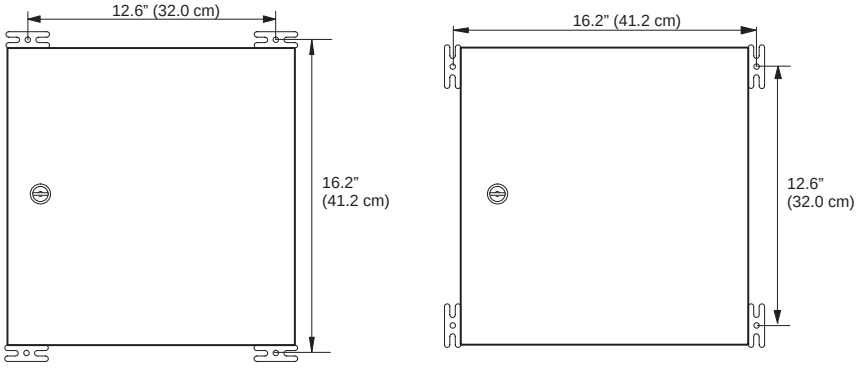

Figure 2. Small NEMA 4 Housing - Installation Dimensions

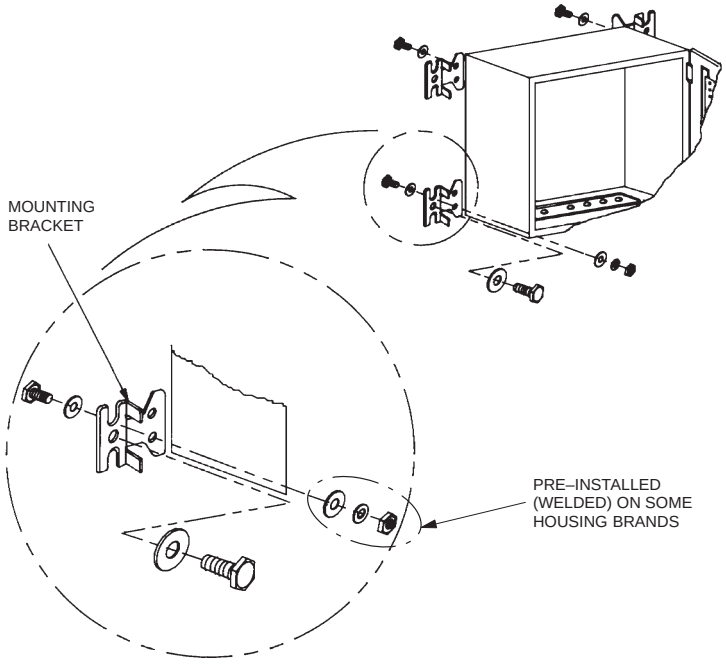

Figure 3. Mounting the NEMA 4 Housing

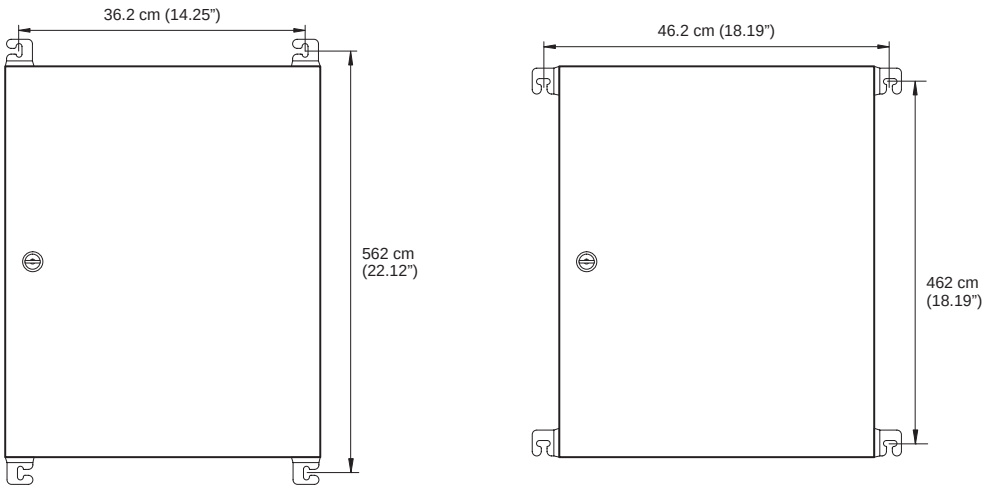

Figure 4. Plastic Housing - Installation Dimensions

Figure 5. Plastic Housing - Mounting Brackets Installation

3. WALL MOUNTING OF RTU WITHOUT HOUSING

Convenient installation of the MOSCAD RTU without housing requires the following available space:

	6-Slot RTU	3-Slot RTU
Width:	50 cm (20”)	35 cm (14”)
Height:	50 cm (20”)	38 cm (15”)
Depth:	10” (25 cm)	25 cm (10”)

Four holes are provided, one in each corner of the RTU, for wall mounting of the RTU. Figure 6 shows the distances between the holes.

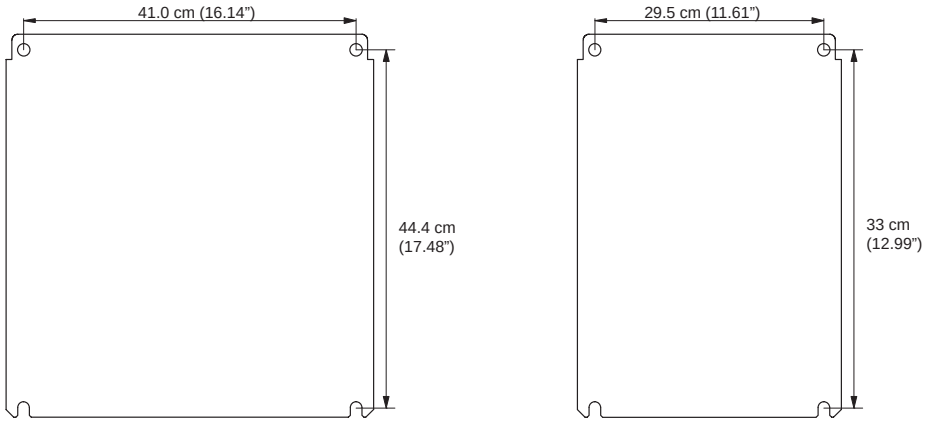

Figure 6. RTU Chassis Installation Dimensions

Choose the mounting means (screws, etc.) appropriate for the site and mount the RTU on the wall.

4. PLUG-IN MODULE INSTALLATION

There are six slots (or three slots, as an option) for plug-in module installation. The CPU module must be installed in the leftmost slot. The I/O modules are installed according to the site configuration instructions provided by the Programming Tool Box.

Refer to section 6, PLUG-IN MODULE REPLACEMENT, for the module insertion instructions.

NOTE

Turn off the DC power before installing a new module.

5. ELECTRICAL CONNECTIONS

NOTE

Make sure that all power and ground connections are made according to local standards and laws.

5.1 GROUND CONNECTION

Connect the line ground directly to the protective ground strip located under the power supply.

5.2 POWER CONNECTIONS

Different internal power supply models can be installed in the RTU. For instructions on how to connect the specific power supply refer to the separate chapter in this manual pertaining to the power supply installed.

If you are using an external power supply, refer to Appendix B.

5.3 RADIO CONNECTIONS

Different radio models can be installed in the RTU. For instructions on how to connect the specific radio refer to the separate chapter in this manual pertaining to the model installed.

5.4 USER CONNECTIONS TO I/O MODULES

For instructions regarding user connections to the I/O modules refer to the separate chapter in this manual pertaining to the specific module.

NOTES

1. Carefully read instructions for ensuring battery backup for RAM. These instructions are provided in the CPU MODULE chapter of this manual.

2. Turn off the power supply DC output before installing or removing of any plug-in module.

5.5 INTERCONNECTION DIAGRAM

The RTU is supplied with all internal electrical connections installed. For your convenience, the unit interconnection diagram is also provided (see Figure 7).

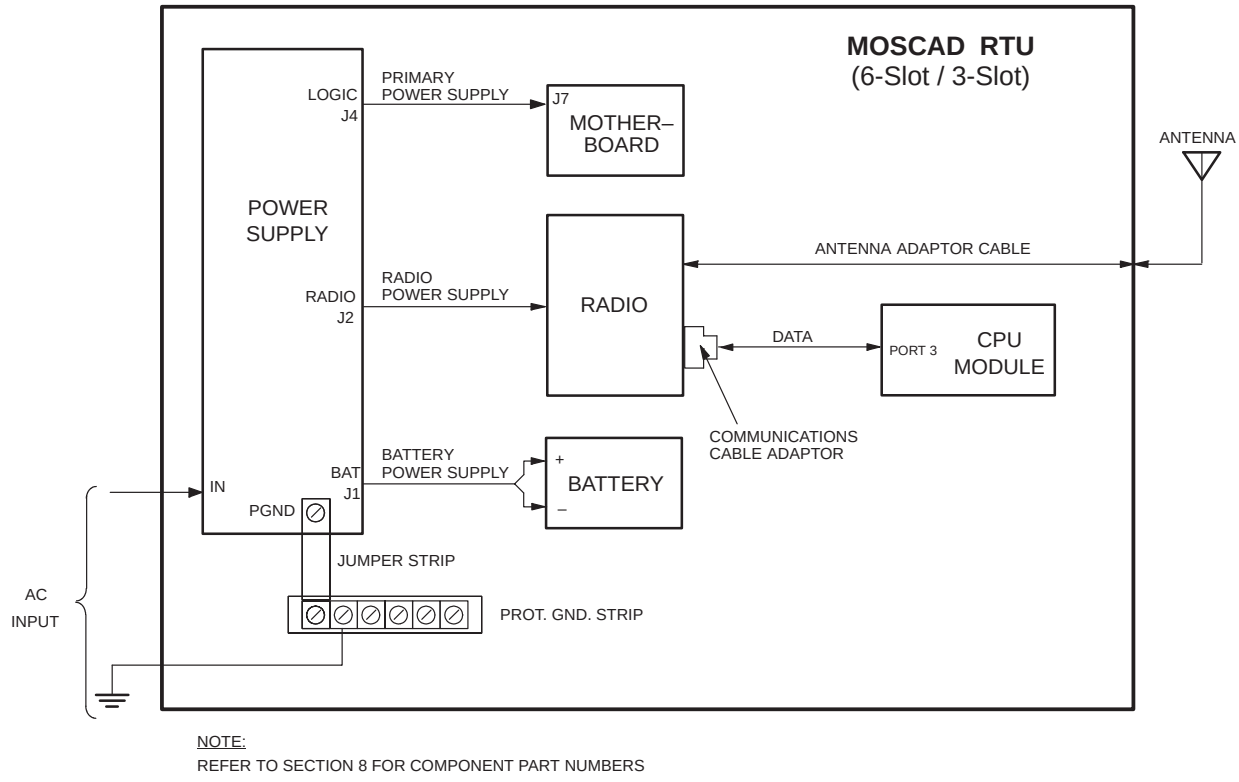

Figure 7. MOSCAD RTU - Interconnection Diagram

6. PLUG-IN MODULE REPLACEMENT

NOTE

Turn off the DC power before replacing a module.

6.1 MODULE REMOVAL FROM RTU

(1) Put your finger into the notch in the module front door and open the door.

(2) Disconnect all electrical connections from the module TBs and/or ports.

(3) Hold the door firmly at right angles to the module front panel and pull the door outwards - the door is drawn out with its hinge and the module lock is disengaged.

(4) Keep pulling the door until the module is extracted from the slot.

6.2 MODULE INSERTION INTO RTU

(1) Open the module door and pull the door with its hinge out (for about 1/2" [1 cm]).

(2) Slide the module into the appropriate RTU slot.

(3) While holding the door at right angles with the module front panel, push the door firmly in until you feel that the door lock is latched.

(4) Connect all electrical connections disconnected from TBs and/or ports while removing the module.

(5) Close the module door.

7. MODULAR BUS DISASSEMBLY

The modular bus includes a motherboard and module slots. A special design allows easy removal of the bus elements, as described below.

7.1 MOTHERBOARD REMOVAL

(1) Turn off the RTU power supply.

(2) Remove all modules (for removal procedure refer to paragraph 6.1).

(3) Disconnect the cable from connector J7 on the motherboard.

NOTE

The motherboard is attached to the module slots by the motherboard retaining clips (see Figure 8).

(4) Carefully bend one of the outermost clips away from the motherboard; slightly pull the motherboard edge adjacent to the clip outwards, until it is released from the clip (see Figure 8).

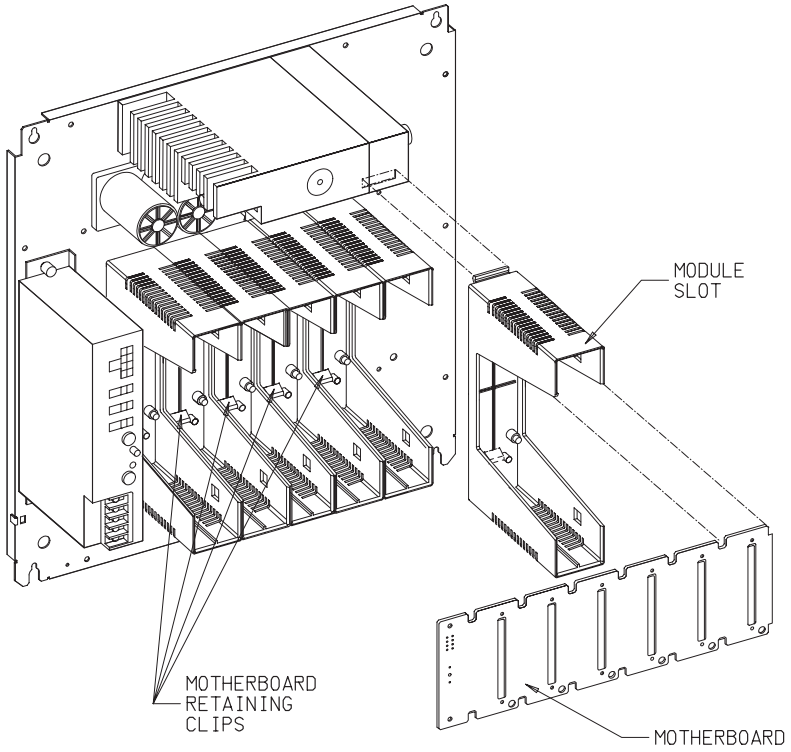

Figure 8. Modular Bus Disassembly

(5) Release the motherboard from all remaining clips and remove the motherboard.

7.2 REMOVAL OF MODULE SLOT

(1) Remove the motherboard (refer to paragraph 7.1).

(2) Press the slot retaining clip (see Figure 8) upwards and carefully pull the lower part of the slot. When the slot retaining clip is released from the chassis remove the slot.

8. FIELD REPLACEABLE SPARE PARTS

Description	Part No.
Antenna adaptor cable:	
for 6-slot housings	FKN5952A
for 3-slot housings	FKN4069A
Power supply to radio DC cable:	
for MaxTrac radio	FKN5932A
for Darcom radio	FKN4017A
for MT 2000 radio	FKN5933A
CPU to radio communication cable	FKN5953A
Communications cable adaptor:	
for MaxTrac radio	FLN6433B
for Darcom radio	FLN6594A
Power supply to battery DC cable:	
for 6-slot housing	FKN5930A
for 3-slot housing	FKN4047A
Power supply to motherboard cable	FKN5931A
External power supply DC cable	FKN5934A
Protective ground strip	3102811K01
Jumper strip	3102894K01
Motherboard:	
6-slot	FRN5547A
3-slot	FRN5659A
Plastic module slot	1508572S01
Fuse F1 (4A, slow-blow, located on the motherboard)	6500061688
Ejector	6602833G01

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CPU MODULE

1. OVERVIEW

The main element of the MOSCAD RTU is the CPU module. It controls the I/O modules, processes the gathered data and communicates with the outside world. The module is based on the Motorola 68302 microprocessor and includes an on-board memory, communications, I/O bus drivers and other circuits.

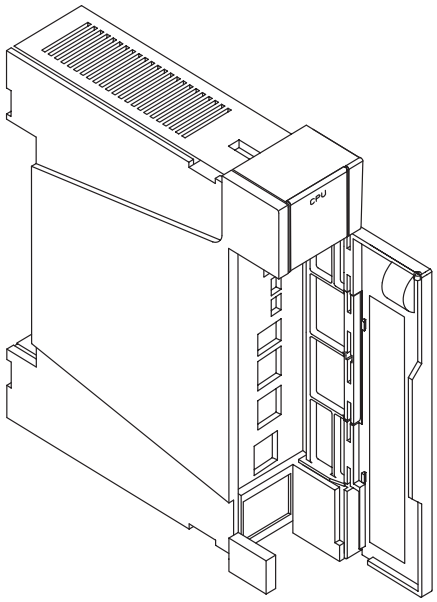

Figure 1. CPU Module - General View

The standard CPU type is Series 200, which is suitable for most applications. For calculation intensive applications, the enhanced CPU Series 300 and math coprocessor are available.

2. INSTALLATION

2.1 MODULE LOCATION

The CPU module must be installed in the leftmost slot (a corresponding label is printed on the chassis below the slot).

2.2 BATTERY BACKUP FOR RAM

The CPU module has a non-rechargeable lithium battery (6008261C04) that provides backup power for the RAM. The battery maintains data stored in the RAM when the power from the line and the main battery is lost. The lithium battery enables the CPU to continue operation after power restoration while maintaining the same state that was interrupted.

The lithium battery is located on the module front panel behind the door, as shown in Figure 2.

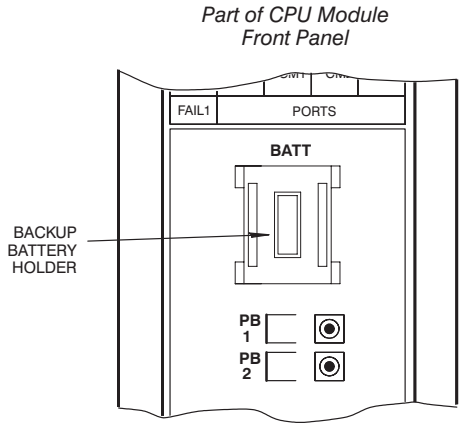

Figure 2. Backup Battery Location

The lithium battery is capable of preserving the data stored in the RAM for three months (accumulated time of power losses). In order to maximize the useful lifetime of the battery an insulating strip is inserted into the battery housing before shipment. The strip is easily removed by pulling it out.

IMPORTANT: We recommend that you remove the insulating strip only after connecting the RTU to the main power. We also recommend that you save the strip, and then reinstall it whenever the RTU is to be shipped for maintenance or will not be used for a prolonged period of time.

2.3 ELECTRICAL CONNECTION

The CPU module installed in the RTU is supplied with the FKN5953A cable connected between port 3 and the radio. Any other connections (to ports 1, 2 or 3) depend on the specific application.

3. CONTROLS, INDICATORS AND CONNECTORS

Tables 8 and 9 define the functions of the module diagnostic LEDs, controls and connectors.

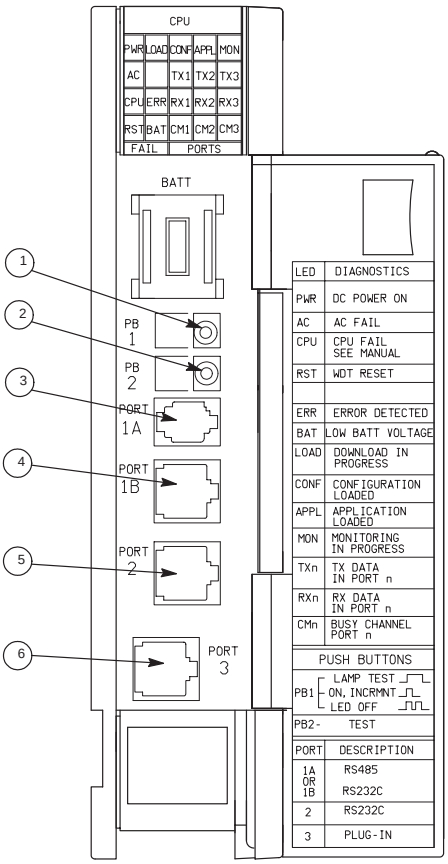

Table 8. CPU Module - Controls and Connectors

Item	Name	Function
1	PB1	Pushbutton. PB1 main function is to turn the LEDs of all modules on/off, as follows: • When the pushbutton is pressed *once* momentarily, the display is activated. Every consecutive short pressing of the pushbutton advances the display mode in those modules where more than one display mode is available. • When the pushbutton is pressed *twice* momentarily, the display immediately turns off. To conserve energy, the display turns off after two minutes even if it is not switched off manually. • When the pushbutton is *pressed and held* for a few seconds all the LEDs light simultaneously (for LED test). The LEDs extinguish when the switch is no longer pressed. In all modules there are several LEDs that do not turn off when all other LEDs do. These LEDs, including the four LEDs in the leftmost side of the CPU module, indicate malfunctions and important events.
2	PB2	Pushbutton. Used for additional tests to be performed by the service technician. **NOTE** Pressing simultaneously both PB1 and PB2 for about 10 seconds performs a CPU restart. This deletes the configuration and application that were loaded into the RTU and redefines the RTU to the default configuration. When the RTU is re-started the buzzer sounds.
3	PORT 1A	Data port (RS-485).
4	PORT 1B	Data port (RS-232).
5	PORT 2	Data port (RS-232).
6	PORT 3	Radio or line, according to the RTU model.

Table 9. CPU Module Diagnostic LEDs

Name	Function
PWR (Power)	Lights as long as the 12 V DC input power is applied to the RTU, indicating that the unit is operating.
AC (AC Fail)	Lights when the AC power supply to the unit fails (operates on the unit's 12 V battery).
CPU (CPU Fail)	Lights to indicate a malfunction in the CPU. The nature of the malfunction is indicated by the 16 LEDs situated in the four columns on the right, which light simultaneously with the CPU Fail LED.
RST (CPU Reset)	Flashes upon reset of the CPU, usually by the watchdog timer, indicating that the software is not running properly.
ERR (Error)	Lights to indicate one of the following: an illegal state has been detected in the software, a module/board is missing, or other malfunctions. These events are logged in a special error logger in the CPU. The contents of the error logger may be read via the Programming Tool Box.
BAT (Low voltage)	Lights to indicate that the voltage of the lithium battery (which backs up the CMOS RAM when the 12 V voltage is not supplied to the modules) is low. **The lithium battery must be replaced.**
LOAD	Lights to indicate that a Configuration definition or an Application program is being downloaded to the FLASH memory.
CONF (Configuration)	Lights to indicate that a Site Configuration definition has been loaded into the FLASH memory.
APPL (Application)	Lights to indicate that an Application program has been loaded into the FLASH memory. The APPL LED flashes in the following situations: • When the application program is in the "STOP SCAN" state for performing diagnostics via the monitoring program of the Tool Box's Application Programmer. • When the application run-time is too long, caused by a mistake in the Ladder diagram program, such as an infinite loop. • When the application program is in STOP state during hardware test performed by the Programming Tool Box.
MON (Monitor)	Lights when the monitoring program of the Application Programmer performs symbolic debugging of the ladder diagram function.
TX1	Lights when the RTU transmits data via Port 1.
TX2	Lights when the RTU transmits data via Port 2.
TX3	Lights when the RTU transmits data via Port 3.
RX1	Lights when the RTU receives data via Port 1.
RX2	Lights when the RTU receives data via Port 2.
RX3	Lights when the RTU receives data via Port 3.
CM1	Lights when the communications channel used by Port 1 is busy.
CM2	Lights when the communications channel used by Port 2 is busy.
CM3	Lights when the communications channel used by Port 3 is busy.

4. REMOVAL AND INSTALLATION

4.1 MODULE REPLACEMENT

Refer to the RTU INSTALLATION chapter in this manual.

4.2 LITHIUM BATTERY (6008261C04) REPLACEMENT

NOTE

The lithium battery can be replaced without interrupting the RTU's operation.

For easy removal and replacement, a battery holder is provided (see Figure 2).

To remove the used battery:

(1) Open the CPU module front door.

(2) Pull the battery holder handle and remove the battery holder.

(3) Pull the battery out of the battery holder.

To insert a new battery:

(1) Insert the battery into the battery holder with the positive side facing the ⊕ mark on the battery holder.

(2) Insert the battery holder into the CPU's front panel (see Figure 2), while ensuring that the battery is placed between the battery contacts.

(3) Press the battery holder until latched.

5. FIELD REPLACEABLE SPARE PARTS

Description	Part No.
Door label	5402853D01
Protective plastic strip for the door label	6108874S01
Lithium battery	6008261C04
Lithium battery holder	1502802E01

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16 DI, 2 COUNTERS MODULE

1. OVERVIEW

The 16 DI, 2 Counters module (DI = Digital Input) can receive up to 16 isolated status inputs and two isolated high speed counter inputs from the user equipment. The module transfers the data to the CPU module.

Figure 1 shows a general view of the 16 DI, 2 Counters module.

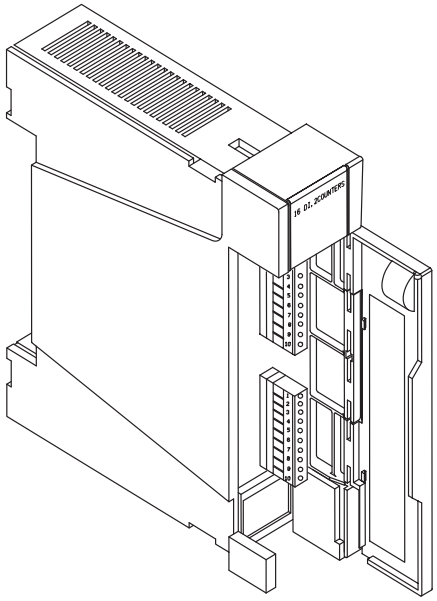


Figure 1. 16 DI, 2 Counters Module - General View

Each of the 16 discrete inputs withstands high line noise due to software controlled filters. The discrete inputs can also be utilized as slow speed counters (up to 500 Hz).

The high speed counter inputs can count pulses of up to 10 kHz rate with a minimum pulse width of 50 microseconds.

2. INSTALLATION

2.1 MODULE LOCATION

The module should be installed in a slot designated by the Programming Tool Box site configuration program.

2.2 ELECTRICAL CONNECTION

User connections are the wires originating from sensors and user relay controls. These wires are connected to the user interface TB located on the module front. For NEMA4 housing, thread the wires through the opening provided for this purpose at the bottom of the box.

TB pin definitions and complete connection instructions are provided by the Tool Box site configuration program following definition of the sensors, controls and the I/O module locations.

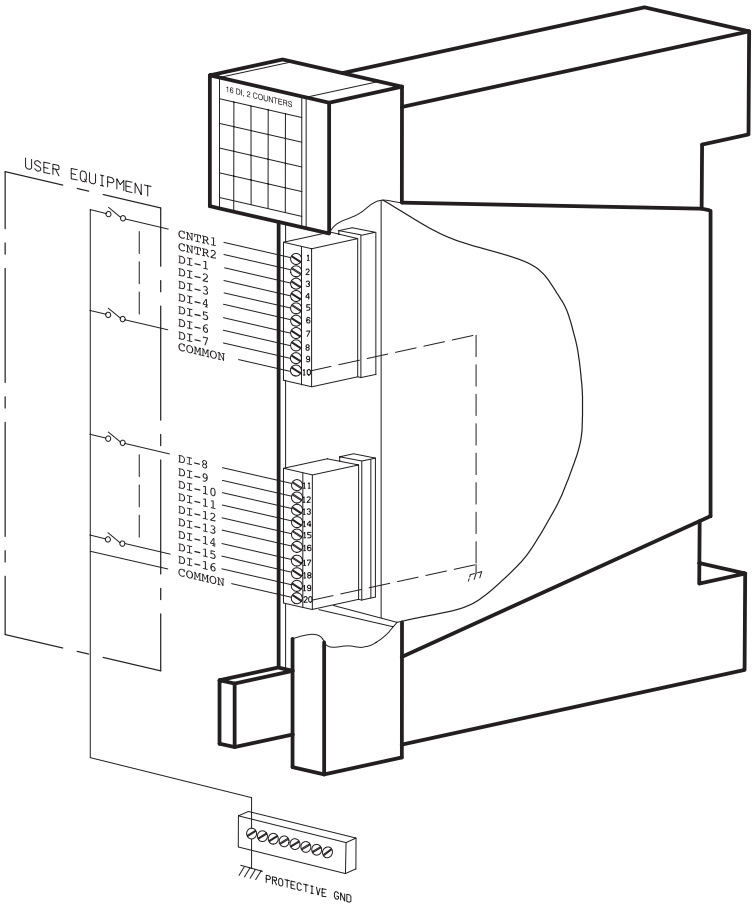
NOTE

Ensure that the plug with connections 1-10 is inserted into the upper TB and the plug with connections 11-20 is inserted into the lower TB.

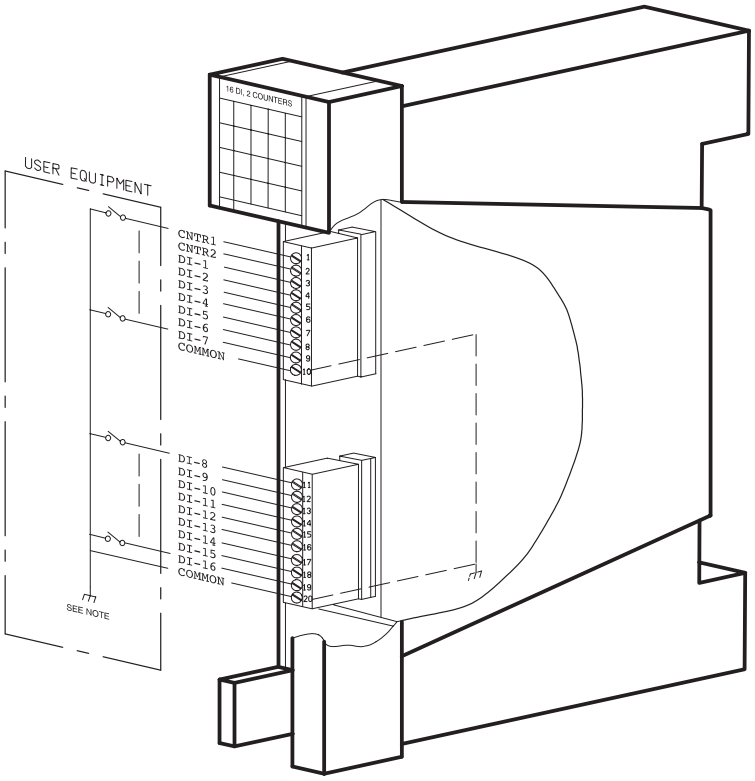
Figure 2 shows how to connect both the input devices protected by the RTU internal ground and devices protected or grounded externally.

2.3 MODULE REPLACEMENT

Refer to the RTU INSTALLATION chapter in this manual.



Internally Protected User Connections



Externally Protected User Connections

NOTE
The user protective potentials should be within ± 2.5 kV range relative to the MOSCAD protective ground.

Figure 2. 16 DI, 2 Counter Module - User Connections

3. DIAGNOSTIC LEDS

The module includes a LED panel (see Figure 3) composed of 20 LEDs. The LED functions are as follows:

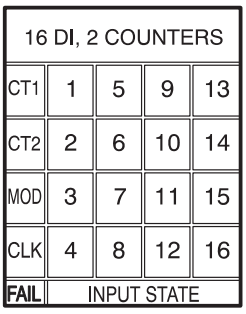


Figure 3. 16 DI, 2 Counter Module - LED Panel

CT1 - Displays the status of Counter-1 LSB: LED on = “1”, LED off = “0”.

CT2 - Displays the status of Counter-2 LSB: LED on = “1”, LED off = “0”.

MOD - When lit, indicates that the CPU cannot access the module. This happens when the module has either failed or was installed in a slot assigned for another module.

CLK - When lit, indicates absence of system clock.

1-16 LEDs - Display status of the corresponding input: LED lit = input closed, LED off = input open.

4. FIELD REPLACEABLE SPARE PARTS

Description	Part No.
User connections plug	3108509G18
Door label	5402853D03
Protective plastic strip for the door label	6108874S01
Numbering strips for the user connection plugs	5402831K01

16 DO MODULE

1. OVERVIEW

The 16 DO (Digital Output) module (see Figure 1) provides 16 relay outputs for controlling user devices. The upper four relays are Double Pole Double Throw (DPDT) and are referred to as the “Form C” relays; the remaining twelve relays are Single Pole Single Throw (SPST) normally open (NO) and are referred to as the “Form A” relays. The relay commands are received from the CPU module.

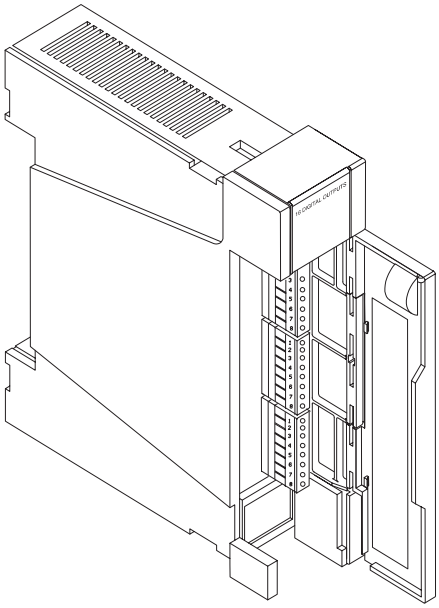


Figure 1. 16 DO Module - General View

The 16 DO module is available in the following configurations:

- FRN1492A Relay outputs are magnetically latched (the outputs maintain their state in case of power off or module failure).
- FRN1491A Relay outputs are electrically energized (the outputs return to the non-energized state in case of power off or module failure).

2. INSTALLATION

2.1 MODULE LOCATION

The module should be installed in a slot designated by the Programming Tool Box site configuration program.

2.2 ELECTRICAL CONNECTION

User connections are the wires originating from the controlled devices. These wires are connected to the user interface TBs located on the module front. For NEMA4 housing, thread the wires through the opening provided for this purpose at the bottom of the box.

Figure 2 shows how to connect the user inputs.

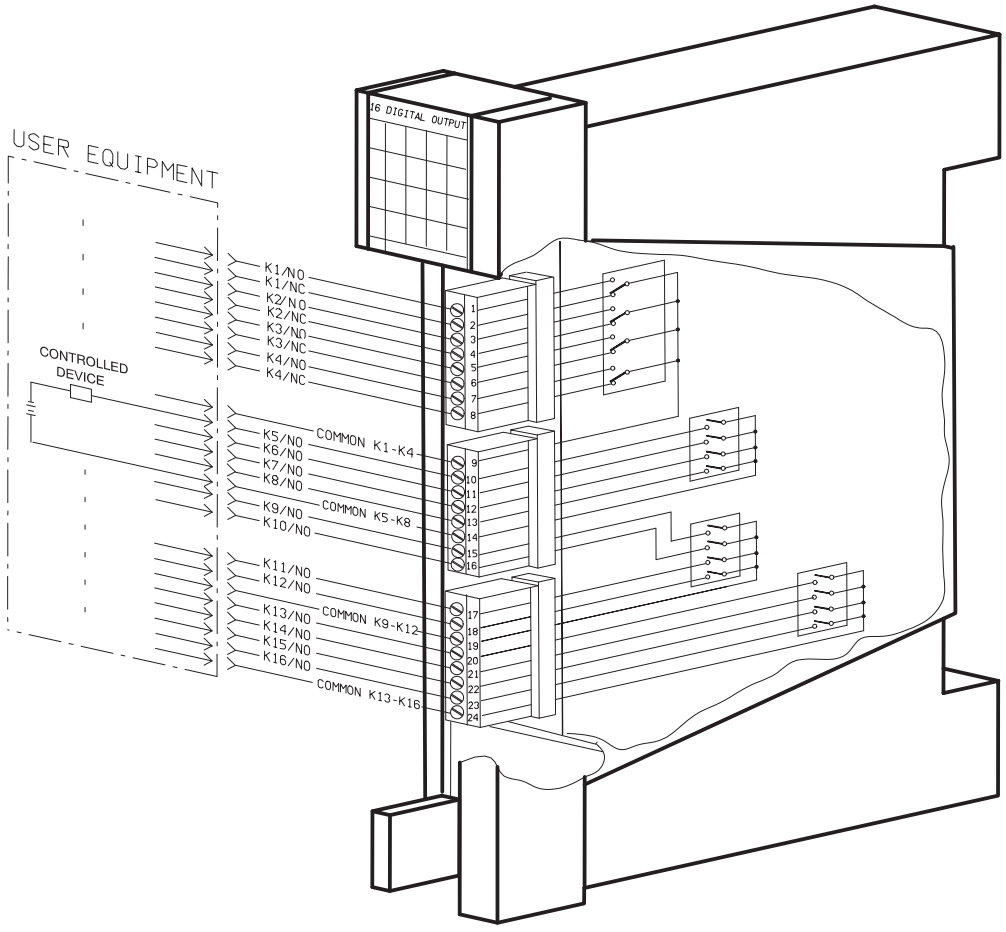


Figure 2. 16 DO - User Connections

TB pin definitions and complete connection instructions are provided by the Tool Box site configuration program following definition of the controlled devices and the I/O module locations.

NOTE

Ensure that the plug with connections 1-8 is inserted into the upper TB, the plug with connections 9-16 is inserted into the middle TB and the plug with connections 17-24 is inserted into the lower TB.

2.3 MODULE REPLACEMENT

Refer to the RTU INSTALLATION chapter in this manual.

3. DIAGNOSTIC LEDS

The module includes a LED panel (see Figure 3) composed of 20 LEDs. The LED functions are as follows:

MOD - When lit, indicates that the CPU cannot access the module. This happens either when the module has failed or was installed in a slot assigned for another module.

CLK - When lit, indicates absence of system clock.

1-16 LEDs - Display status of the corresponding output:
LED lit = relay is energized/set,
LED off = relay is not energized/reset.

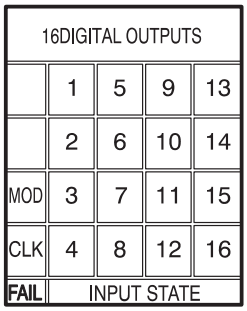


Figure 3. 16 DO Module - LED Panel

4. FIELD REPLACEABLE SPARE PARTS

Description	Part No.
User connections plug	3108509G19
Door label	5402853D02
Protective plastic strip for the door label	6108874S01
Numbering strips for the user connection plugs	5402831K02

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8 AI MODULE

1. OVERVIEW

The 8 AI module (AI = Analog Input) can receive up to 8 optically isolated analog inputs. The module converts the analog data into digital format and transfers the digital data to the CPU module.

The basic model of the 8 AI module meets the 4 - 20 mA Interface industry standard. The module is available in additional configurations with other input specifications, as detailed in Table 1.

Table 1. 8 AI Module - Field Add-On Types

Part No.	Description
FRN1421A	8 Analog Inputs, 4 – 20 mA, (Standard)
FRN1940A	8 Analog Inputs, ± 5 V
FRN1972A	8 Analog Inputs, ± 1 mA
FRN1973A	8 Analog Inputs, ± 1 V
FRN1980A	8 Analog Inputs, ± 2.5 V
FRN1981A	8 Analog Inputs, ± 2 mA

Figure 1 provides a general view of the 8 AI module.

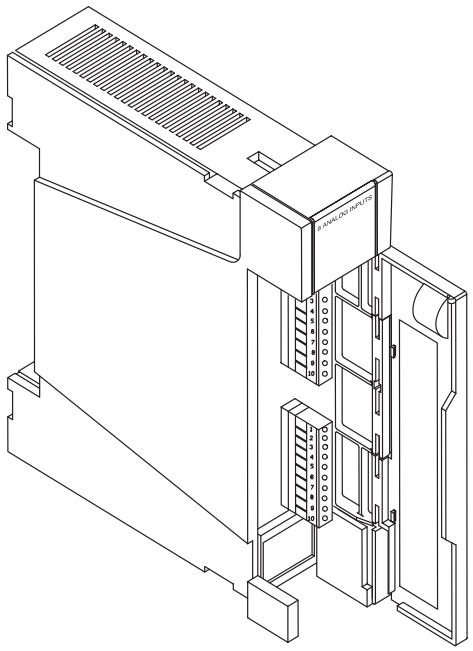


Figure 1. 8 AI Module - General View

2. INSTALLATION

2.1 MODULE LOCATION

The module should be installed in a slot designated by the Programming Tool Box site configuration program.

2.2 ELECTRICAL CONNECTION

User connections are the wires originating from sensors and user relay controls. These wires are connected to the user interface TB located on the module front. For NEMA4 housing, thread the wires through the opening provided for this purpose at the bottom of the housing.

TB pin definitions and complete connection instructions are provided by the Tool Box site configuration program following definition of the sensors, controls and the I/O module locations.

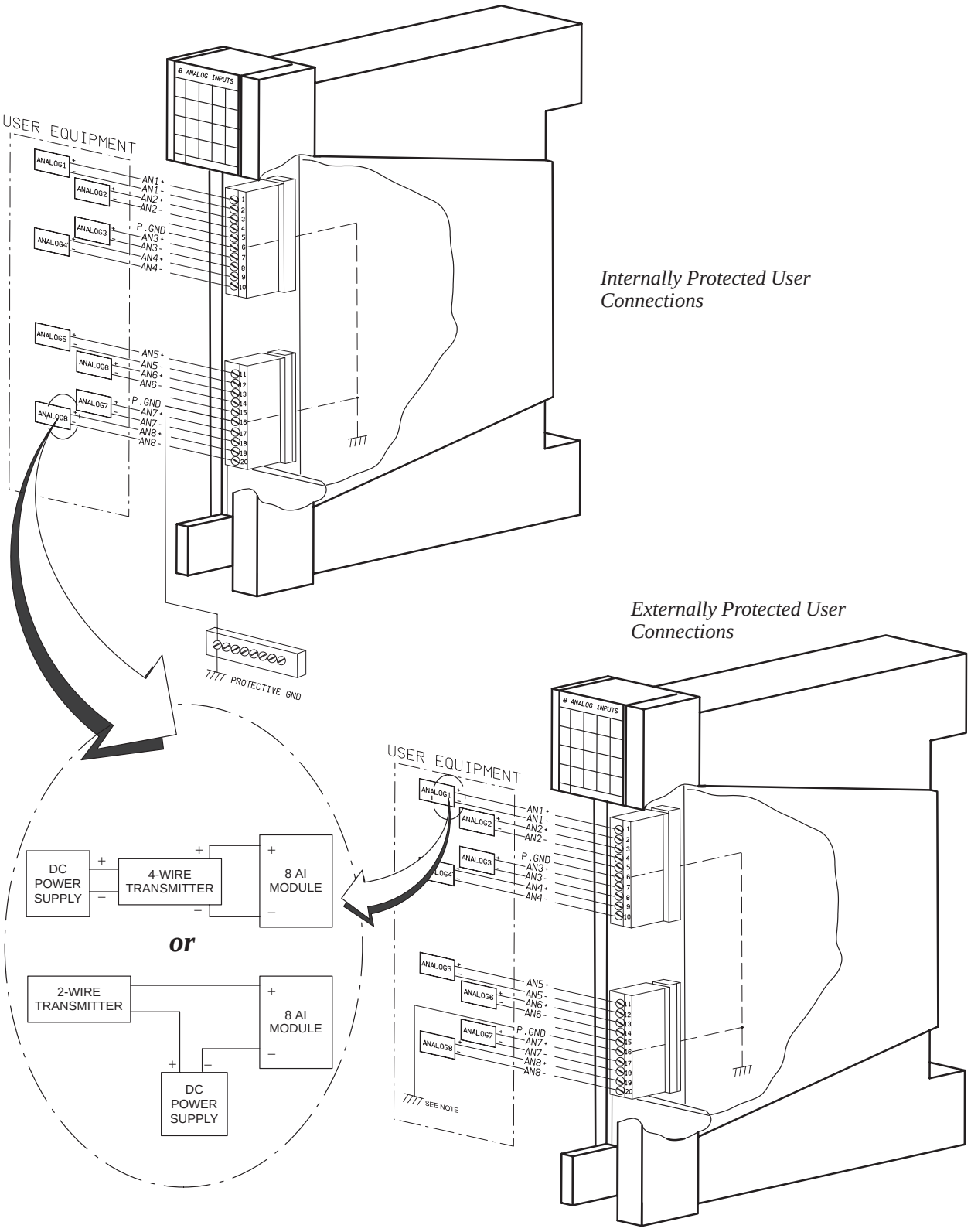
NOTE

Ensure that the plug with connections 1-10 is inserted into the upper TB and the plug with connections 11-20 is inserted into the lower TB.

Figure 2 shows how to connect both the input devices protected by the RTU internal ground and the input devices protected or grounded externally. External 2- or 4-wire transmitter and power supply should be connected to the user sensor as shown in Figure 2.

2.3 MODULE REPLACEMENT

Refer to the RTU INSTALLATION chapter in this manual.



NOTES

1. The user protective potentials should be within ± 2.5 kV range relative to the MOS-CAD protective ground.
2. For best performance, the wires connected to the user sensors should be shielded.

Figure 2. 8 AI Module - User Connections

3. DIAGNOSTIC LEDS

The module includes a LED panel (see Figure 3) composed of 20 LEDs. The LED functions are as follows:

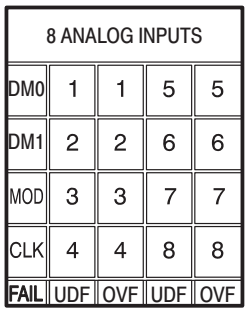


Figure 3. 8 AI Module - LED Panel

DM0, DM1 - Not used.

MOD - When lit, indicates that the CPU cannot access the module. This happens when the module has either failed or was installed in a slot assigned for another module.

CLK - When lit, indicates absence of system clock.

1-8 UDF LEDs - When lit, indicates that the signal level in the input, corresponding to the LED, is below the nominal range. The threshold for the underflow indication is 3.84 mA in the standard models, or 1.024 × (-Full Scale) in the non-standard models. If both the UDF and OVF LEDs of the same channel are lit, the channel is uncalibrated.

1-8 OVF LEDs - When lit, indicates that the signal level in the input, corresponding to the LED, is above the nominal range. The threshold for the overflow indication is 20.5 mA in the standard models, or 1.024 × (Full Scale) in the non-standard models. If both the UDF and OVF LEDs of the same channel are lit, the channel is uncalibrated.

4. FIELD REPLACEABLE SPARE PARTS

Description	Part No.
User connections plug	3108509G18
Door label	5402853D04
Protective plastic strip for the door label	6108874S01
Numbering strips for the user connection plugs	5402831K01

4 AO MODULE

1. OVERVIEW

The 4 AO (Analog Outputs) module provides four optically-isolated analog output channels for controlling user devices (see Figure 1). Each channel has two separate outputs: 4-20 mA Interface industry standard current output and 0-5 V Interface industry standard voltage output. Only one of the outputs can be enabled in a particular channel - either current or voltage.

The voltage outputs are self-powered by the RTU internal power supply. The current outputs must be externally powered - either by the user's or the internal power supply.

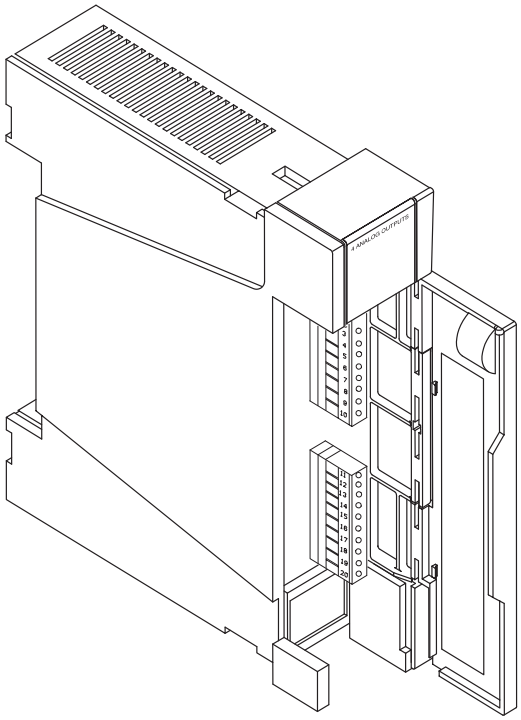


Figure 1. 4 AO Module - General View

2. INSTALLATION

2.1 MODULE LOCATION

The module should be installed in a slot designated by the Programming Tool Box site configuration program.

2.2 ELECTRICAL CONNECTION

User connections are the wires originating from the controlled devices. These wires are connected to the user interface TBs located on the front of the module. For NEMA4 housing thread the wires through the opening, located at the bottom of the housing. It is recommended to use 14 AWG gage wires.

TB pin definitions and complete connection instructions are provided by the Tool Box site configuration program following the definition of the controlled devices and the I/O module locations.

NOTE

Ensure that the plug with connections 1-10 is inserted into the upper TB and the plug with connections 11-20 is inserted into the lower TB.

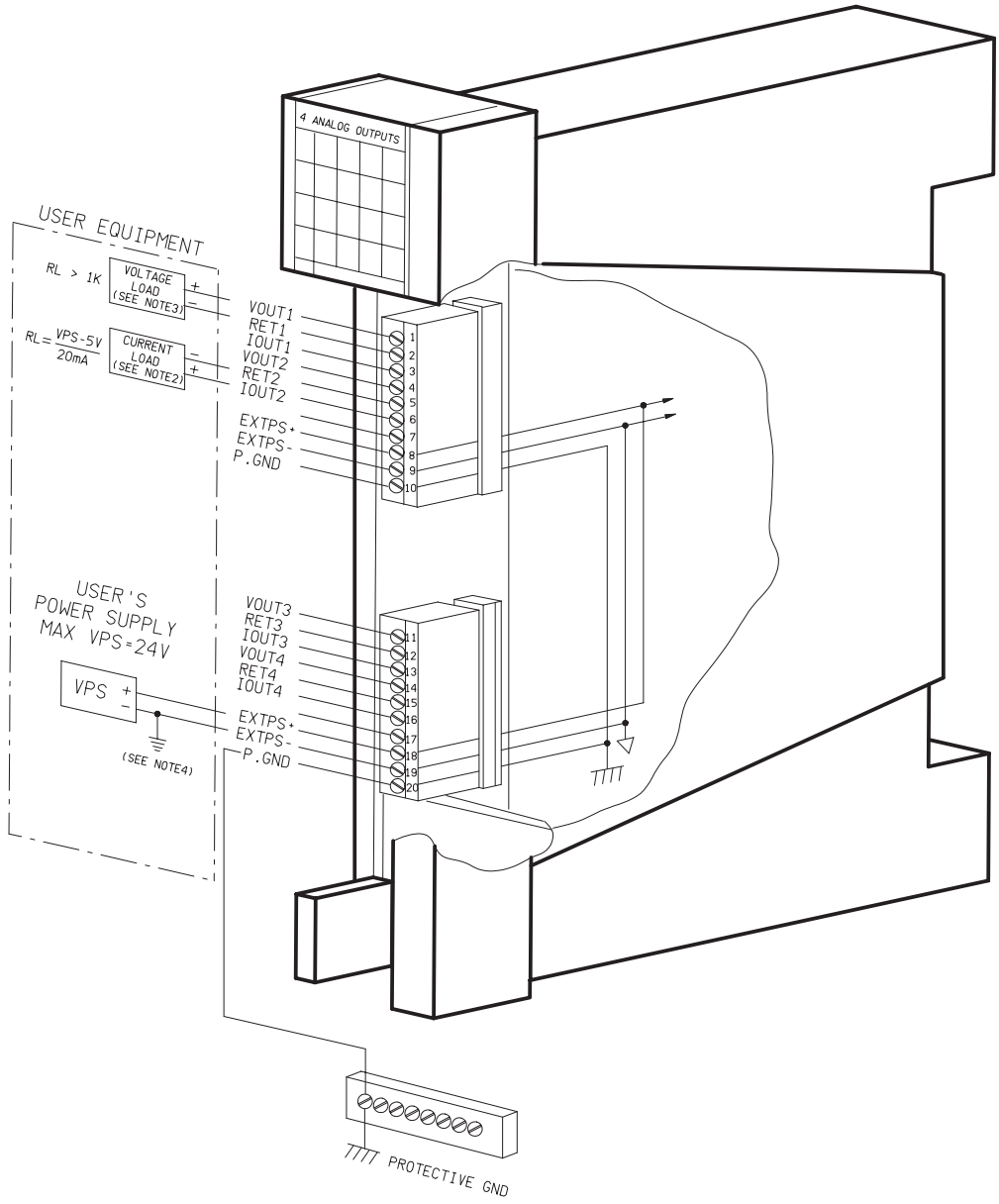
Figure 2 shows how the user connections to the 4 AO module are made, utilizing an external power supply for driving current outputs. Figure 3 shows how user connections to the 4 AO module are made, utilizing the RTU's power supply for driving current outputs.

2.3 CALIBRATION

The 4 AO module is calibrated at the factory by programming an internal E^2PROM. If another calibration is required, the Programming Tool Box should be used.

2.4 MODULE REPLACEMENT

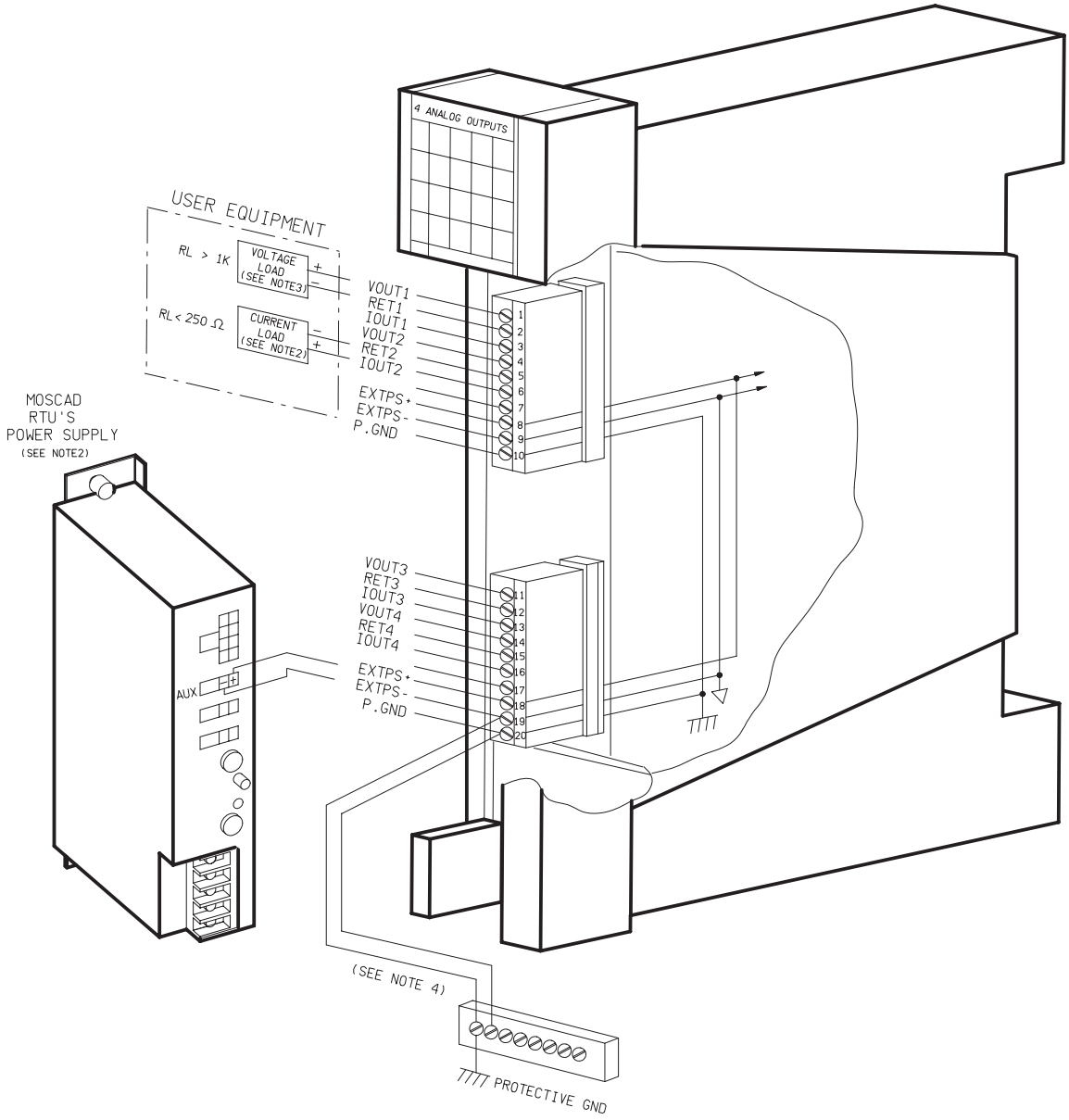
Refer to the RTU INSTALLATION chapter in this manual.



NOTE

1. An output can be defined as either current **or** voltage (not both).
2. An external power supply should be connected to the *ExtPS* terminals, when current outputs are used.
3. An external power supply is not required only when voltage outputs are used.
4. The user protective potential should be within ±60 V range relative to the MOSCAD protective ground.

Figure 2. 4 AO Module - User Equipment and User's Power Supply Connections



NOTE

1. An output can be defined as either current **or** voltage (not both).
2. An external power supply should be connected to the *ExtPS* terminals, when current outputs are used.
3. An external power supply is not required only when voltage outputs are used.
4. The *ExtPS* and *P. GND* outputs should be connected to the Protective Ground Strip directly and by separate wires.

Figure 3. 4 AO Module - User Equipment and RTU's Power Supply Connections

3. DIAGNOSTIC LEDS

The module includes a LED panel (see Figure 4) composed of 20 LEDs. The LED functions are as follows:

ROM - When lit, indicates a checksum error in the EEPROM. This signifies that all outputs are uncalibrated.

CAL - When lit, indicates that the channel, whose UCAL LED is lit, is uncalibrated. If none of the UCAL LEDs is lit, the uncalibrated channel is one of the channels that are not used.

MOD - When lit, indicates that the CPU cannot access the module. This happens when the module has either failed or was installed in a slot assigned for another module.

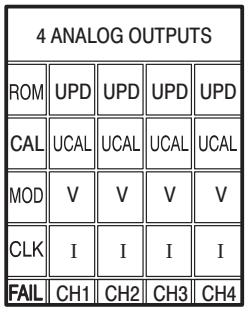


Figure 4. 8 AI Module - LED Panel

CLK - When lit, indicates an absence of the system clock.

UPD - When blinking indicates that the corresponding channel is being updated.

UCAL - When lit, indicates that the corresponding output is uncalibrated.

V - When lit, indicates that the voltage output is defined and used.

I - When lit, indicates that the current output is defined and used.

4. FIELD REPLACEABLE SPARE PARTS

Description	Part No.
User connections plug	3108509G19
Door label	5402853D08
Protective plastic strip for the door label	6108874S01
Numbering strips for the user connection plugs	5402831K01
RTU power supply to module TB DC cable	FKN4068A

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MIXED I/O MODULE

1. OVERVIEW

The Mixed I/O module is designed to provide a combination of different functions, as follows (see Figure 1):

– It can receive up to two optically isolated analog inputs (AI). The module converts the input analog data into digital format and transfers the digital data to the CPU module.

  Several model options are provided to meet the various interface industry standards (see section 2).

– It can receive up to eight isolated status inputs (DI). The data is transferred to the CPU module.

– It can provide four relay outputs (K1 - K4) for controlling user devices. Relays K1 and K2 are Double Pole Double Throw (DPDT) and are referred to as the "Form C" relays; relays K3 and K4 are Single Pole Single Throw (SPST) normally open (NO) and are referred to as "Form A" relays. One of the poles is used for user connections, while the other pole is used internally.

  The outputs of relays K1 - K3 are either magnetically latched (ML) or electrically energized (EE), depending on the model option (see section 2). The outputs of the magnetically latched relays maintain their state in case of power off or module failure, while the outputs of the electrically latched relays return to the non-energized state in case of power off or module failure. Relay K4 output is electrically energized in all model types.

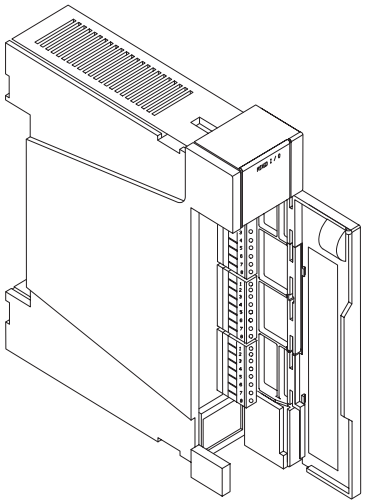


Figure 1. Mixed I/O Module - General View

2. MODEL OPTIONS

Table 1 lists the available Mixed I/O module standard options. Table 2 lists additional options that can be supplied upon special order.

Table 1. Mixed I/O Module - Standard Model Options

Part No.	Description
FRN1484A	3ML + 1EE, 8DI, 2AI (4 - 20 mA)
FRN1490A	4EE, 8DI, 2AI (4 - 20 mA)

Table 2. Mixed I/O Module - Non-Standard Model Options

Part No.	Description
FRN1997A	4EE, 8DI, 2AI (±1 V)
FRN1995A	4EE, 8DI, 2AI (±5 V)
FRN1996A	4EE, 8DI, 2AI (±1 mA)
FRN1994A	3ML + 1EE, 8DI, 2AI (±1 V)
FRN1992A	3ML + 1EE, 8DI, 2AI (±5 V)
FRN1993A	3ML + 1EE, 8DI, 2AI (±1 mA)

3. INSTALLATION

3.1 MODULE LOCATION

The module should be installed in a slot designated by the Programming Tool Box site configuration program.

3.2 ELECTRICAL CONNECTION

User connections are wires that originate from sensors and user relay controls. These wires are connected to the user interface TB located on the module front. For NEMA4 housing, thread the wires through the opening provided at the bottom of the box.

TB pin definitions and complete connection instructions are provided by the Tool Box site configuration program following definition of the sensors, controls and I/O module locations.

NOTE

Ensure that the plug with connections 1-8 is inserted into the upper TB, the plug with connections 9-16 is inserted into the middle TB and the plug with connections 17-24 is inserted into the lower TB.

Figures 2 and 3 show how to make user connections. Figure 2 shows connections of input devices protected by the RTU internal ground, while Figure 3 shows connections of input devices grounded externally.

3.3 MODULE REPLACEMENT

Refer to the RTU INSTALLATION chapter in this manual.

NOTES

1. Relay Contact Ratings:
   - Max switching power = 60 W, 120 VA
   - Max switching voltage = 220 VDC, 250 VAC
   - Max switching current = 2 A DC/AC
2. Relays are shown in the normal (non-activated) state.
3. For best performance, the wires from user analog sensors should be shielded.

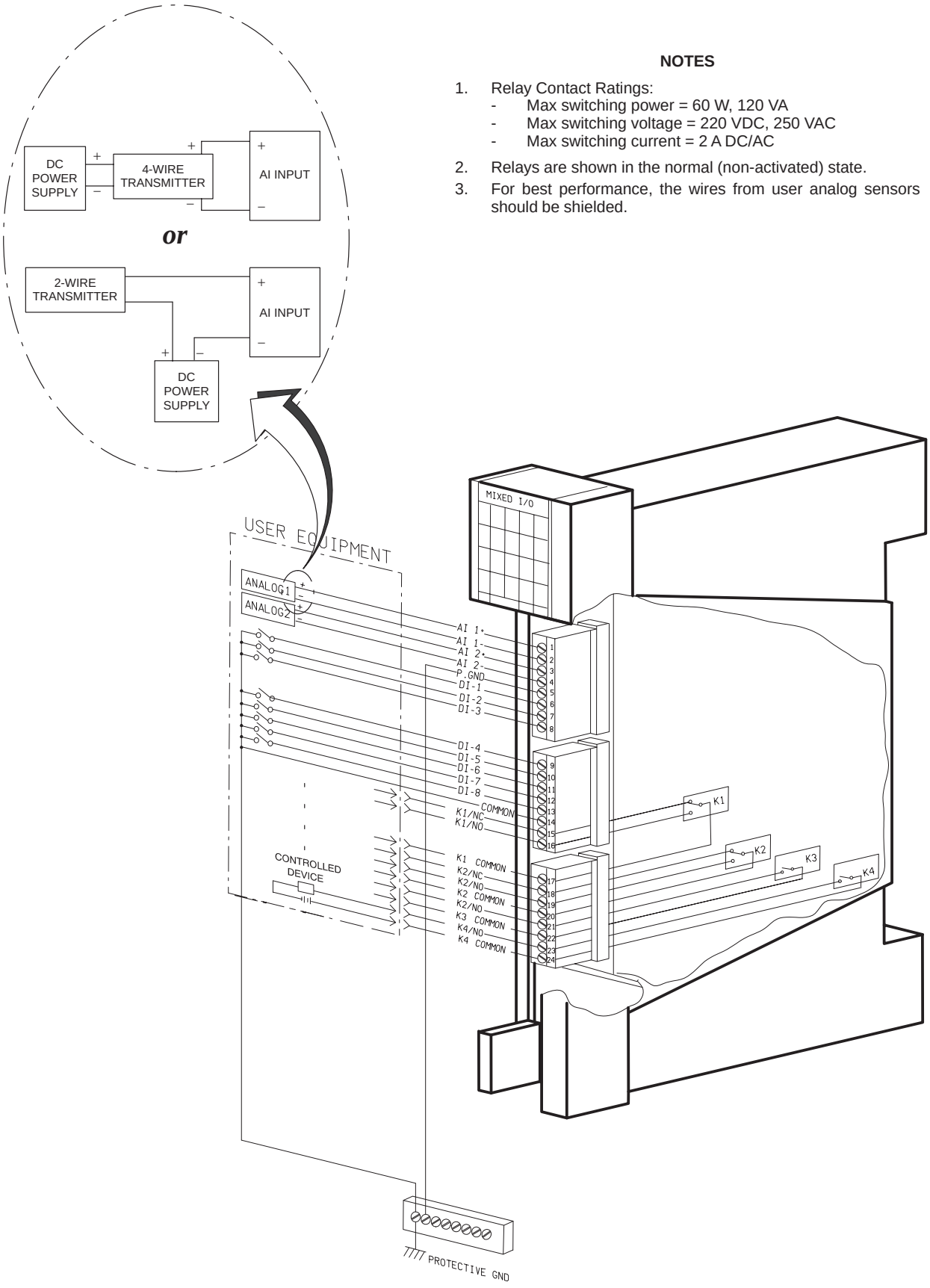
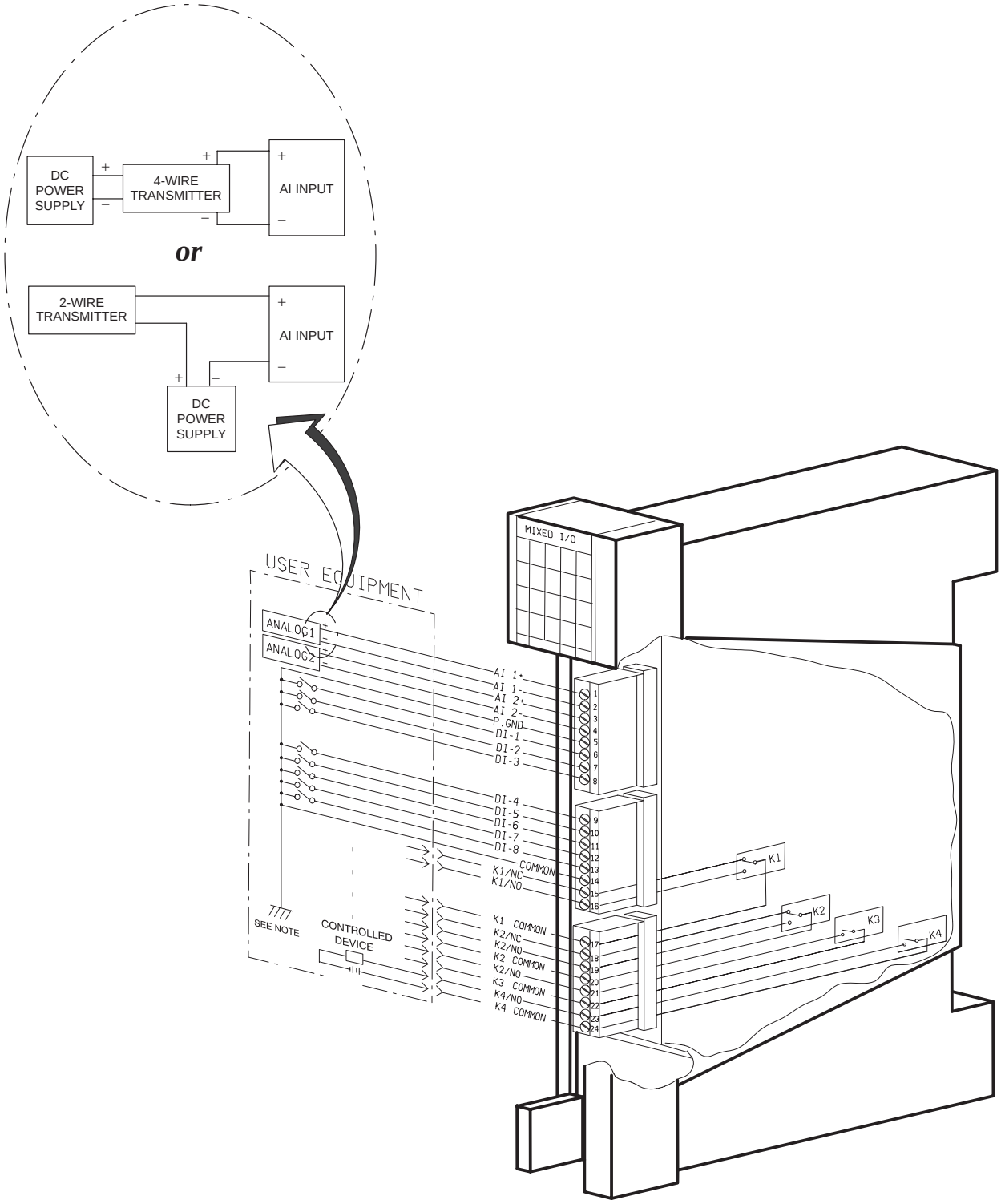


Figure 2. Mixed I/O Module - Internally Protected User Connections



NOTES

1. The user protective potentials should be within ± 2.5 kV range relative to the MOSCAD protective ground.
2. For best performance, the wires from user analog sensors should be shielded.

Figure 3. Mixed I/O Module - Externally Protected User Connections

4. DIAGNOSTIC LEDS

The module includes a LED panel (see Figure 4) composed of 20 LEDs. The LED functions are as follows:

MOD - When lit, indicates that the CPU cannot access the module. This happens when either the module has failed or was installed in a slot assigned for another module.

CLK - When lit, indicates absence of system clock.

1 - 8 DI LEDs - Display status of the corresponding input: LED lit = input closed, LED off = input open.

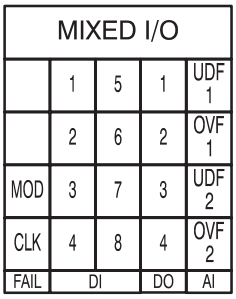


Figure 4. Mixed I/O - LED Panel

1 - 4 DO LEDS - Display status of the corresponding output: LED lit = relay is energized/set, LED off = relay is not energized/reset.

UDF1, UDF2 - When lit, indicates that the signal level in the input, corresponding to the LED, is below the nominal range. The threshold for the underflow indication is 3.84 mA in the standard models, or $1.024 \times (-\text{Full Scale})$ in the non-standard models. If both the UDF and OVF LEDs of the same channel are lit, the channel is uncalibrated.

OVF1, OVF2 - When lit, indicates that the signal level in the input, corresponding to the LED, is above the nominal range. The threshold for the overflow indication is 20.5 mA in the standard models, or $1.024 \times$ (Full Scale) in the non-standard models. If both the UDF and OVF LEDs of the same channel are lit, the channel is uncalibrated.

5. FIELD REPLACEABLE SPARE PARTS

Description	Part No.
User connections plug	3108509G19
Door label	5402853D09
Protective plastic strip for door label	6108874S01
Numbering strips for user connection plugs	5402831K02

16 AC DI MODULE

1. OVERVIEW

The 16 AC DI (DI = Digital Input) can receive up to 16 isolated ac and dc inputs. The module transfers the data to the CPU module.

Figure 1 shows a general view of the 16 AC DI module.

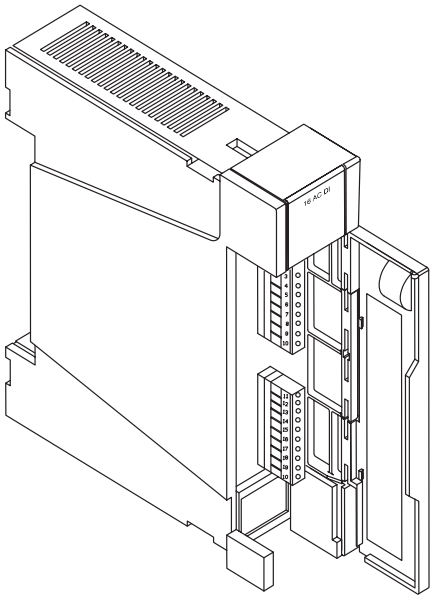


Figure 1. 16 AC DI Module - General View

Each of the 16 discrete inputs withstands high line noise, which is effectively suppressed by hardware and software controlled filters.

The 16 AC DI module is available in the following configurations:

- FLN2006A Input Voltage range is 10 to 28 V.
- FLN2007A Input Voltage range is 20 to 56 V.

2. INSTALLATION

2.1 MODULE LOCATION

The module should be installed in a slot designated by the Programming Tool Box site configuration program.

2.2 ELECTRICAL CONNECTION

User equipment is connected to the user interface TB, which is located on the front of the module. For NEMA4 housing, thread the wires through the opening provided at the bottom of the box.

TB pin definitions and complete connection instructions are provided by the Tool Box site configuration program following definition of the sensors, controls and I/O module locations.

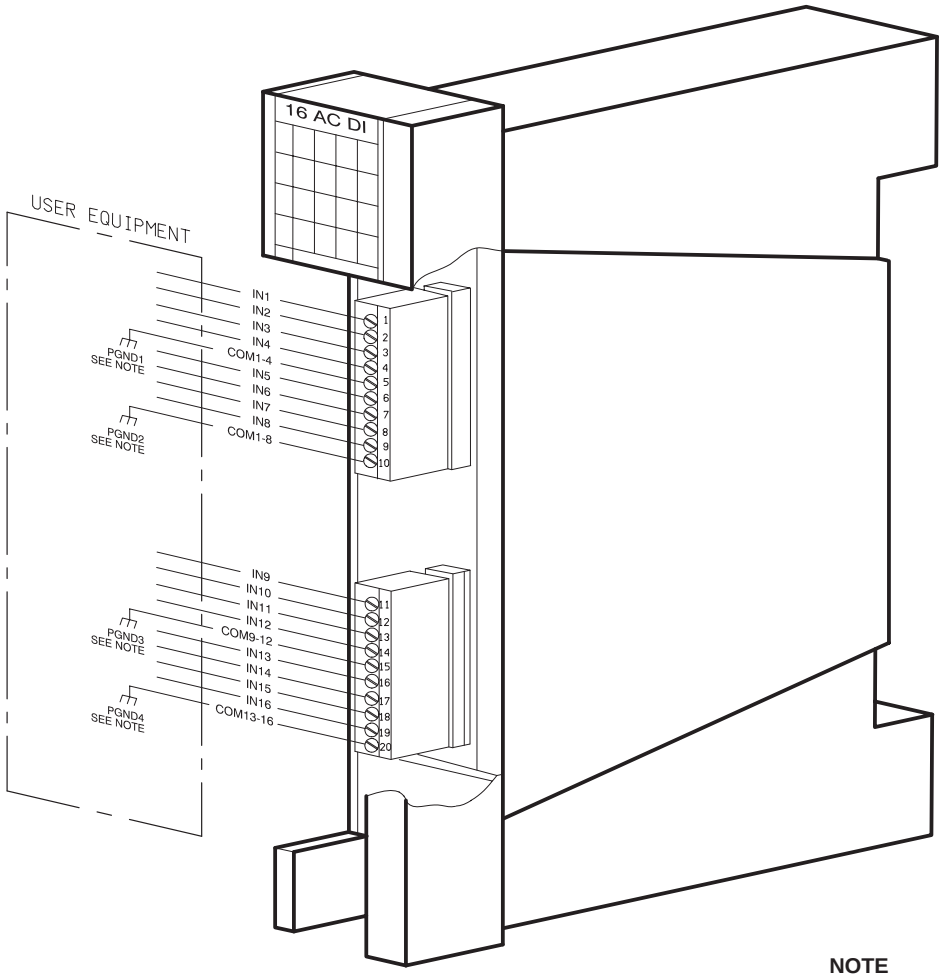
NOTE

Ensure that the plug with connections 1-10 is inserted into the upper TB and the plug with connections 11-20 is inserted into the lower TB.

Figure 2 shows how to make user connections of input devices, which are grounded externally.

2.3 MODULE REPLACEMENT

Refer to the RTU INSTALLATION chapter in this manual.



NOTE
The user protective potentials can differ but should be within ±2.5 kV range relative to the MOSCAD protective ground.

Figure 2. 16 AC DI Module - Externally Protected User Connections

3. DIAGNOSTIC LEDS

The module includes a LED panel (see Figure 3) composed of 18 LEDs. The LED functions are as follows:

MOD - When lit, indicates that the CPU cannot communicate with the module. This happens when either the module has failed or was installed in a slot assigned for another module.

CLK - When lit, indicates absence of system clock.

1 - 16 LEDs - Display status of the corresponding input: LED lit = voltage is present at the input, LED off = no voltage present at the input.

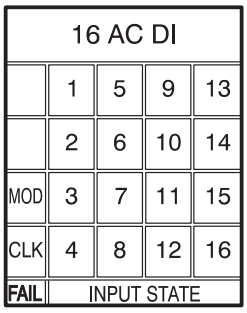


Figure 3. 16 AC DI - LED Panel

4. FIELD REPLACEABLE SPARE PARTS

Description	Part No.
User connections plug	3108509G18
Door label	5402853D10
Protective plastic strip for the door label	6108874S01
Numbering strips for the user connection plugs	5402831K01

32 DC DI MODULE

1. DESCRIPTION

1.1 OVERVIEW

The 32 DC DI (Digital Input) can receive up to 32 isolated dc status inputs from user equipment. The module transfers the data to the CPU module.

Figure 1 provides a general view of the 32 DC DI module.

Each of the digital inputs withstands high line noise due to software controlled filters.

The digital inputs can also be utilized as slow speed counters. The counter speed can be as follows:

– Up to 500 Hz for all inputs which are defined by the Tool Box as both serial inputs and counters.

– Up to 500 Hz in interrupt application mode.

– Up to 50 Hz, according to the application software, for all other inputs.

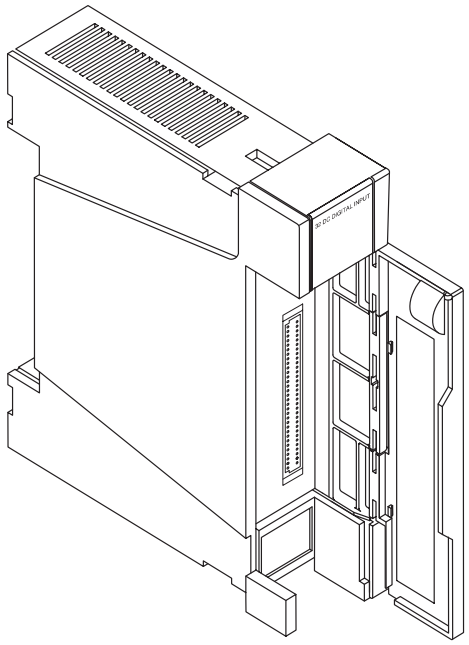


Figure 1. 32 DC DI Module - General View

1.2 MODULE CONFIGURATIONS

The 32 DC DI module is available in the following configurations:

- FLN2021A Input Voltage range: 10 to 28 V.
- FLN2022A Input Voltage range: 20 to 56 V.
- FLN2023A Input Voltage range: 35 to 80 V.

1.3 MOSCAD RTU AND TOOL BOX SOFTWARE VERSION COMPATIBILITY

Programming Tool Box

The 32 DC DI module is supported by Programming Tool Box versions 2.1 and higher.

MOSCAD RTU

The 32 DC DI module is supported by MOSCAD RTU software versions 2.0 and higher.

2. INSTALLATION

2.1 MODULE LOCATION

The module should be installed in a slot designated by the Programming Tool Box site configuration program.

2.2 ELECTRICAL CONNECTION

The user wires are connected to the 64-pin DIN input connector located on the module front. For NEMA4 housing, thread the wires through the opening provided for this purpose at the bottom of the box. Motorola FKN4162 kit (available separately) allows for convenient user connections and includes a 64-pin plug, that fits the module input connector, and hood.

I/O connector pin definitions and complete connection instructions are provided by the Programming Tool Box site configuration program following definition of the sensors, controls and I/O module locations.

Figure 2 shows the 64-pin DIN connector pinout (similar data is shown on the module door label). Figures 3 and 4 show how to connect input devices.

2.3 MODULE REPLACEMENT

Refer to the RTU INSTALLATION chapter in this manual.

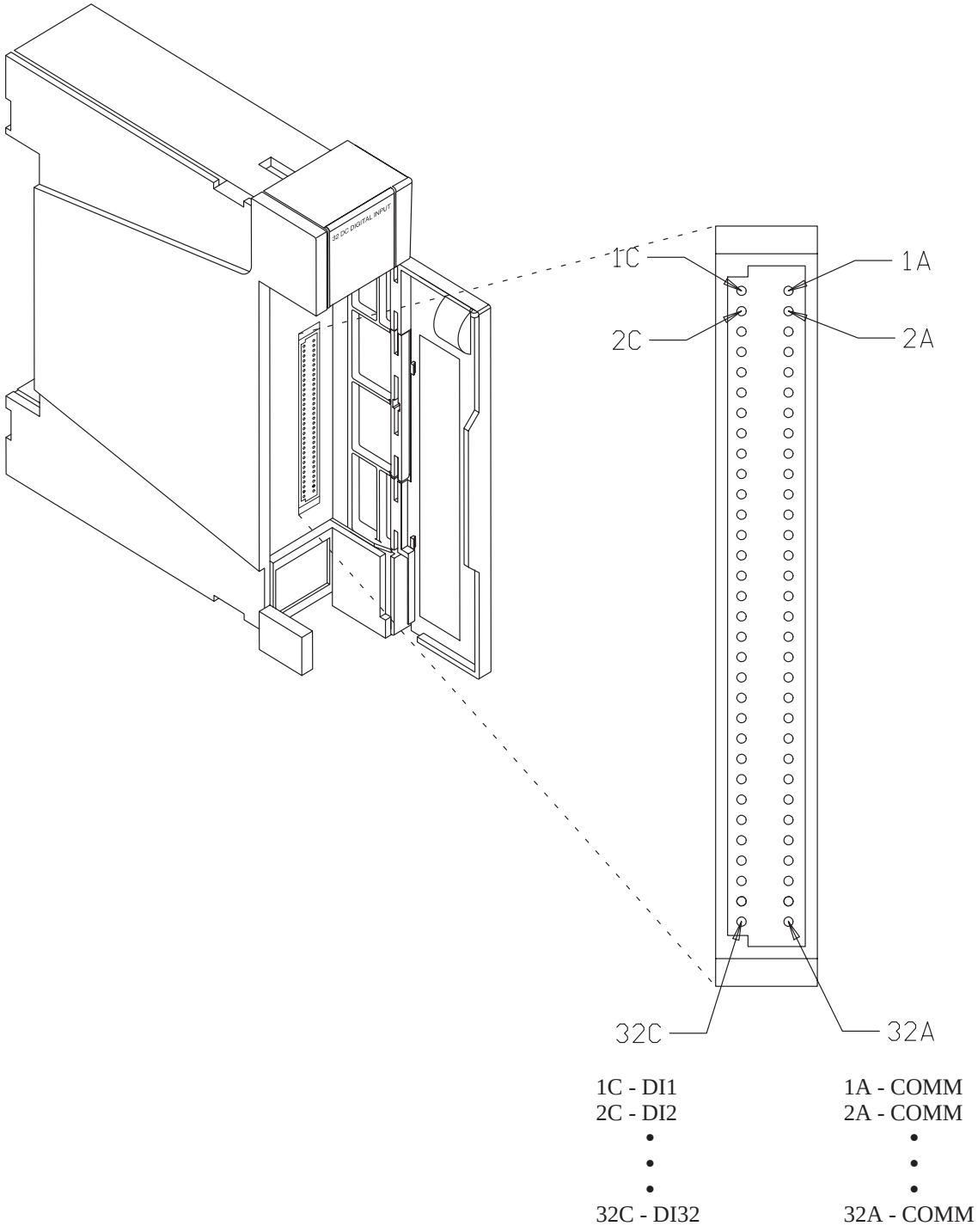


Figure 2. 32 DC DI Module - Output Connector Pinout

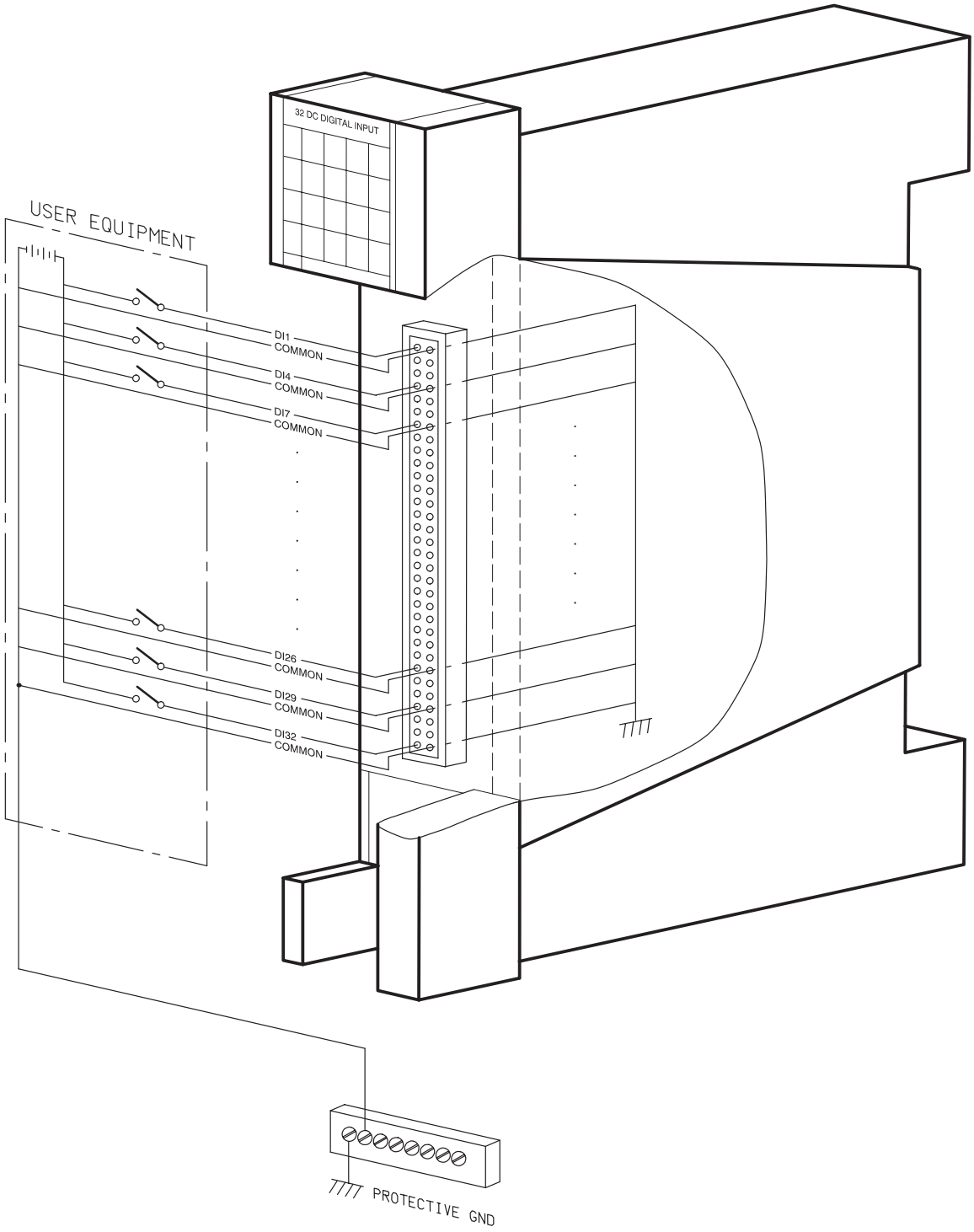
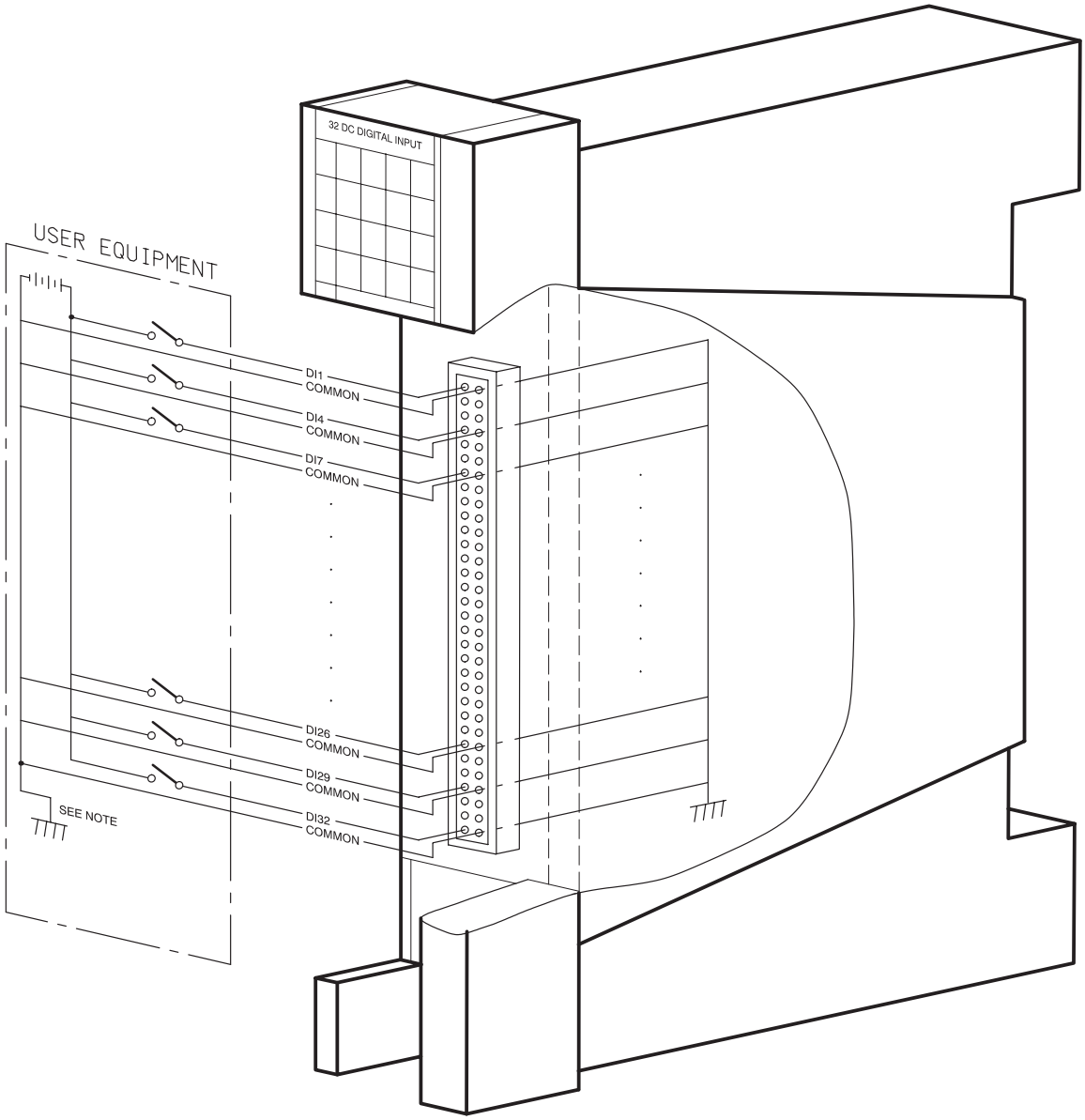


Figure 3. 32 DC DI Module - Internally Protected User Connections



NOTE

The user protective potential should be within ±2.5 kV range relative to the MOSCAD protective ground.

Figure 4. 32 DC DI Module - Externally Protected User Connections

3. DIAGNOSTIC LEDS

The module includes a LED panel (see Figure 4) composed of 19 LEDs. The LED functions are as follows:

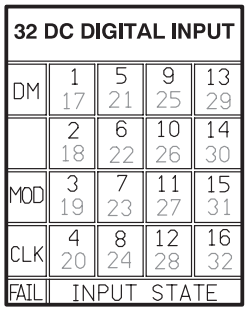


Figure 5. 32 DC DI Module - LED Panel

MOD - When lit, indicates that the CPU cannot access the module. This happens when the module has failed, or was installed in a slot assigned for another module, or the input polarity has been inverted.

CLK - When lit, indicates absence of system clock.

DM - Display Mode. When off, Input Status LEDs show the status of inputs 1–16. When lit, Input Status LEDs show the status of inputs 17–32.

1-16/17-32 LEDs - Display status of the corresponding input:
LED lit = input is ON,
LED off = input is OFF.

4. FIELD REPLACEABLE SPARE PARTS

Description	Part No.
Door label	5402853D11
Protective plastic strip for the door label	6108874S01

32 DO MODULE

1. OVERVIEW

1.1 GENERAL DESCRIPTION

The 32 DO (Digital Output) module provides 32 open drain FET outputs for controlling user devices. The output commands are received from the CPU module.

Figure 1 provides a general view of the 32 DO module.

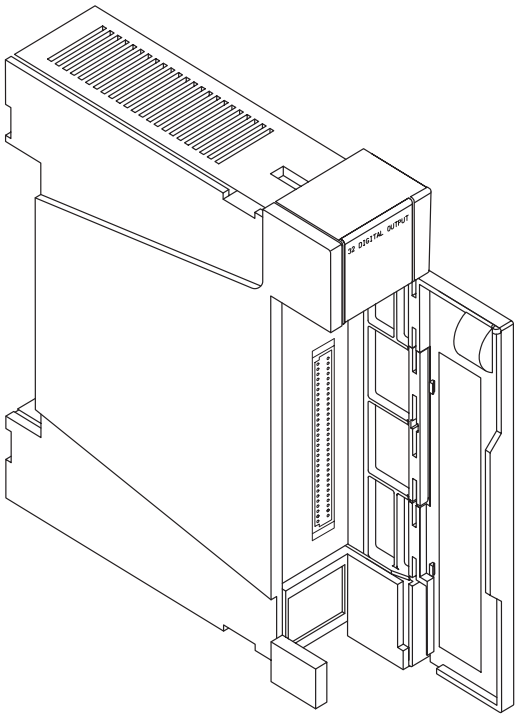


Figure 1. 32 DO Module - General View

For direct user connections the 32 DO module outputs have the following maximum ratings: voltage - 30 Vdc, current - 0.5 A. If a higher output rating is required, external relays should be used. Interpose Relay Panels (IRPs), available separately from Motorola, provide the interface required for connecting the controlled devices to the 32 DO module.

1.2 MOSCAD RTU AND TOOL BOX SOFTWARE VERSION COMPATIBILITY

Programming Tool Box

The 32 DO module is supported by Programming Tool Box versions 2.10 and higher.

MOSCAD RTU

The 32 DO module is supported by MOSCAD RTU software versions 2.0 and higher.

2. INSTALLATION

2.1 MODULE LOCATION

The module should be installed in a slot designated by the Programming Tool Box site configuration program.

2.2 ELECTRICAL CONNECTION

The user wires are connected to the 64 pin DIN connector located on the 32 DO module front. The connections may be made either directly or via an IRP. Motorola FKN4162 kit (available separately) allows for convenient user connections to the module 64-pin connector and includes a 64-pin plug and hood.

Pin definitions and complete connection instructions are provided by the Programming Tool Box site configuration program following definition of the sensors, controls and I/O module locations.

2.2.1 Direct Connection

For direct connection refer to Figure 2 which shows the 64 pin DIN connector pinout (similar data is shown on the module door label). The controlled device load should not exceed the following ratings:

– Switching Voltage: 30 V dc

– Switching Current: 0.5 A dc

2.2.2 Connection Via an IRP

An IRP contains a control connector to the 32 DO module, Terminal Blocks (TBs) for user connections and sockets for user control relays. The IRP also provides the means to interconnect several IRPs to a single 32 DO module.

For using an IRP, refer to your IRP Installation Manual for detailed information on connecting the IRP to the 32 DO module and the user control devices.

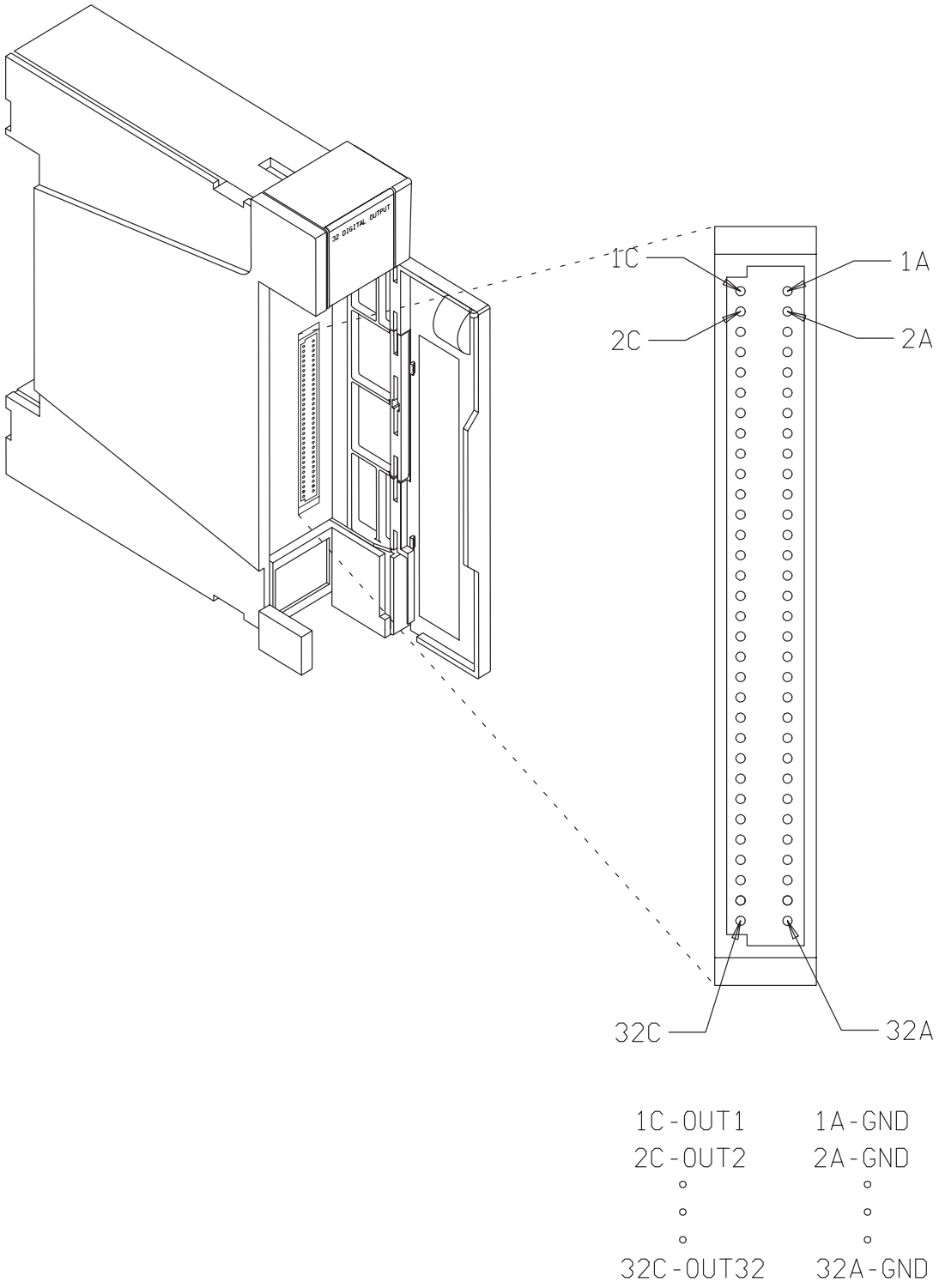


Figure 2. 32 DO Module - Output Connector Pinout

2.3 MODULE REPLACEMENT

Refer to the RTU INSTALLATION chapter in this manual.

3. DIAGNOSTIC LEDS

The module includes a LED panel (see Figure 3) composed of 19 LEDs. The LED functions are as follows:

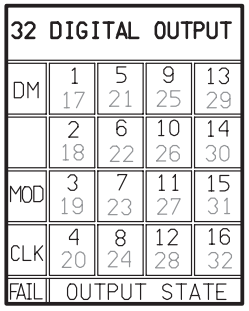


Figure 3. 32 DO - LED Panel

MOD - When lit, indicates that the CPU cannot access the module. This happens when either the module has failed or was installed in a slot assigned for another module.

CLK - When lit, indicates absence of system clock.

DM - Display Mode. When off, Output Status LEDs show the status of outputs 1–16.When lit, Output Status LEDs show the status of outputs 17–32.

1-16/17-32 LEDs - Display status of the corresponding output:
LED lit = output is ON,
LED off = output is OFF.

4. FIELD REPLACEABLE SPARE PARTS

Description	Part No.
Door label	5402853D13
Protective plastic strip for the door label	6108874S01

60 DI MODULE

1. DESCRIPTION

1.1 OVERVIEW

The 60 DI (Digital Input) can receive up to 60 isolated status inputs from user equipment (dry contacts). The module transfers the data to the CPU module.

Figure 1 provides a general view of the 60 DI module.

Each of the digital inputs withstands high line noise due to software controlled filters.

The digital inputs can also be utilized as slow speed counters. The counter speed can be as follows:

– Up to 500 Hz for all inputs which are defined by the Tool Box as both serial inputs and counters.

– Up to 500 Hz in interrupt application mode.

– Up to 50 Hz, according to the application software, for all other inputs.

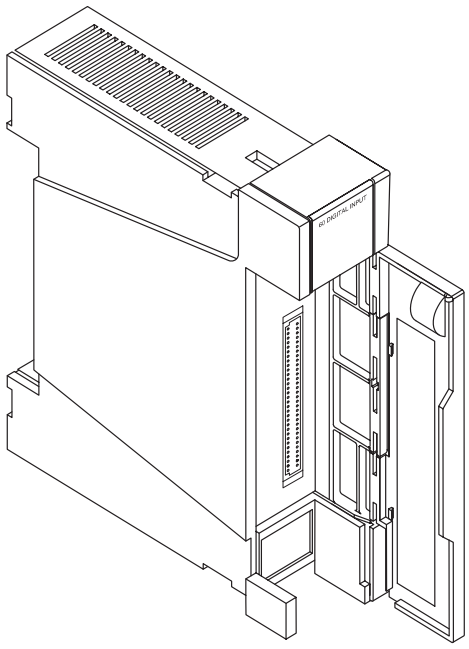


Figure 1. 60 DI Module - General View

1.2 MOSCAD RTU AND TOOL BOX SOFTWARE VERSION COMPATIBILITY

Programming Tool Box

The 60 DI module is supported by Programming Tool Box versions 2.1 and higher.

MOSCAD RTU

The 60 DI module is supported by MOSCAD RTU software versions 2.0 and higher.

2. INSTALLATION

2.1 MODULE LOCATION

The module should be installed in a slot designated by the Programming Tool Box site configuration program.

2.2 ELECTRICAL CONNECTION

The user wires are connected to the 64-pin DIN I/O connector located on the module front. For NEMA4 housing, thread the wires through the opening provided for this purpose at the bottom of the box. Motorola FKN4162 kit (available separately) allows for convenient user connections to the module 64-pin connector and includes a 64-pin plug and hood.

I/O connector pin definitions and complete connection instructions are provided by the Programming Tool Box site configuration program following definition of the sensors, controls and I/O module locations.

Table 1 details the module I/O connector pin definitions.

Figures 2 and 3 show how to connect input devices.

2.3 MODULE REPLACEMENT

Refer to the RTU INSTALLATION chapter in this manual.

Table 1. Module I/O Connector - Pin Definitions

Pin No.	Signal Name		Pin No.	Signal Name
1A	DI2		1C	DI1
2A	DI4		2C	DI3
3A	DI6		3C	DI5
4A	DI8		4C	DI7
5A	DI10		5C	DI9
6A	DI12		6C	DI11
7A	DI14		7C	DI13
8A	DI16		8C	DI15
9A	DI17		9C	COMMON
10A	DI19		10C	DI18
11A	DI21		11C	DI20
12A	DI23		12C	DI22
13A	DI25		13C	DI24
14A	DI27		14C	DI26
15A	DI29		15C	DI28
16A	DI31		16C	DI30
17A	COMMON		17C	DI32
18A	DI34		18C	DI33
19A	DI36		19C	DI35
20A	DI38		20C	DI37
21A	DI40		21C	DI39
22A	DI42		22C	DI41
23A	DI44		23C	DI43
24A	DI46		24C	DI45
25A	DI48		25C	DI47
26A	DI49		26C	COMMON
27A	DI51		27C	DI50
28A	DI53		28C	DI52
29A	DI55		29C	DI54
30A	DI57		30C	DI56
31A	DI59		31C	DI58
32A	COMMON		32C	DI60

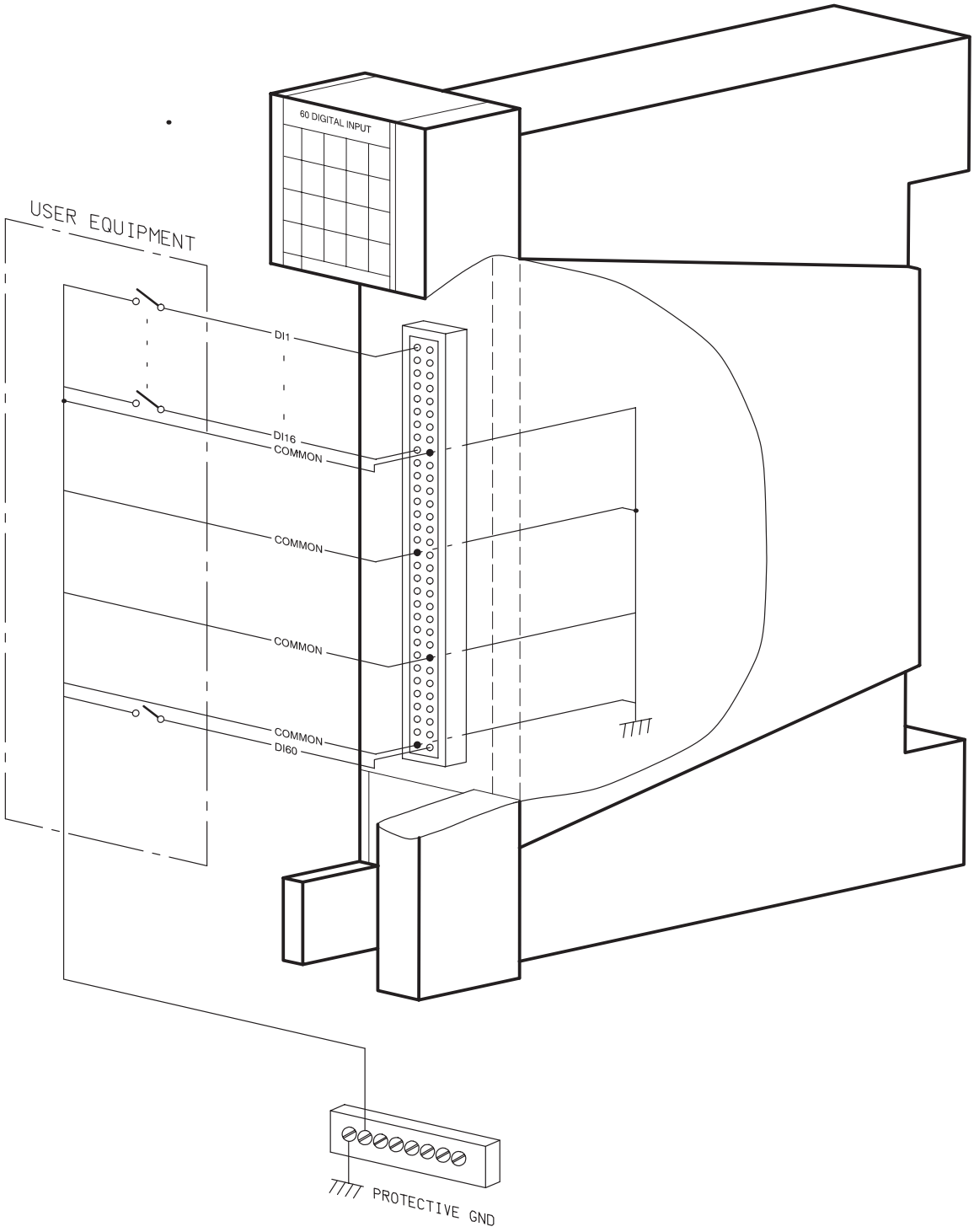
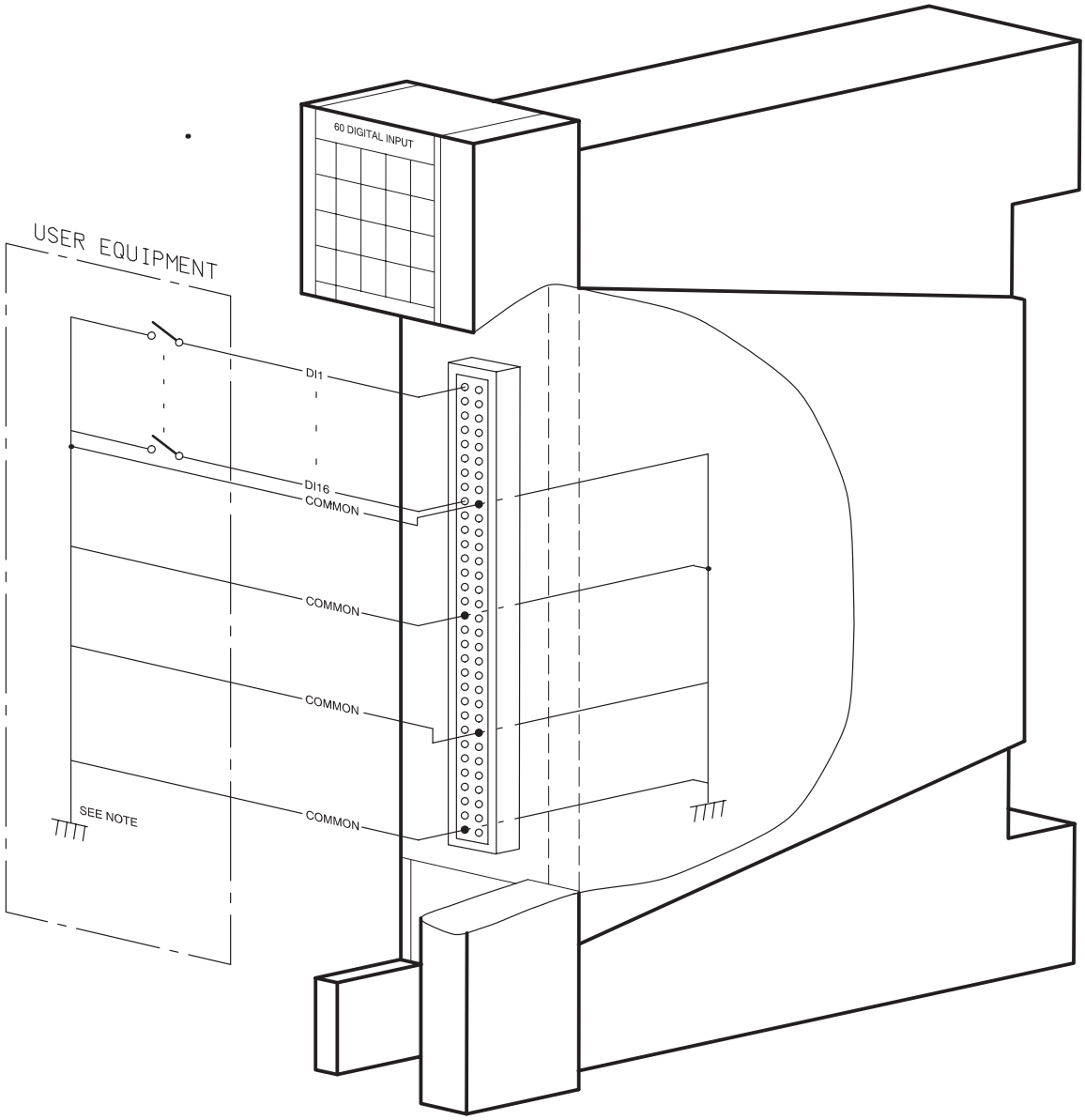


Figure 2. 60 DI Module - Internally Protected User Connections



NOTE

The user protective potential should be within ± 2.5 kV range relative to the MOSCAD protective ground.

Figure 3. 60 DI Module - Externally Protected User Connections

3. DIAGNOSTIC LEDS

The module includes a LED panel (see Figure 4) composed of 20 LEDs. The LED functions are as follows:

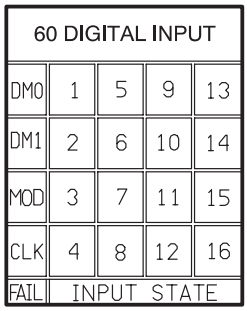


Figure 4. 60 DI Module - LED Panel

DM0, DM1 - Indicates Display Mode of the status LEDs, according to the table below:

Display Mode		Status LEDs 1 - 16 Indicate Inputs:
DM1	DM0	
0	0	1 – 16
0	1	17 – 32
1	0	33 – 48
1	1	48 – 60*

* Status LEDs 13 - 16 are not used in this Display Mode.

MOD - When lit, indicates that the CPU cannot access the module. This happens when the module has failed, or was installed in a slot assigned for another module.

CLK - When lit, indicates absence of system clock.

1-16 LEDs - Display status of the corresponding input (see definition of DM0 and DM1 LEDs):
LED lit = closed input, LED off = open input.

4. FIELD REPLACEABLE SPARE PARTS

Description	Part No.
Door label	5402853D12
Protective plastic strip for the door label	6108874S01

LINE INTERFACE UNIT

1. OVERVIEW

The Line Interface Unit provides the interface required to connect the internal line modem (installed in the CPU) to various types of communication lines.

Figure 1 provides a general view of the Line Interface Unit.

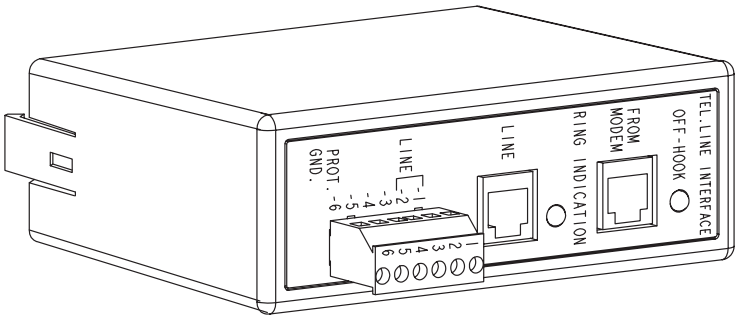
The unit transmitting level is -10 dBm into 600 Ω impedance. The receiving dynamic range is -3 dbm to -47 dBm. The unit's line impedance is 600 Ω in both the receiving and transmitting states.

2. OPTIONS

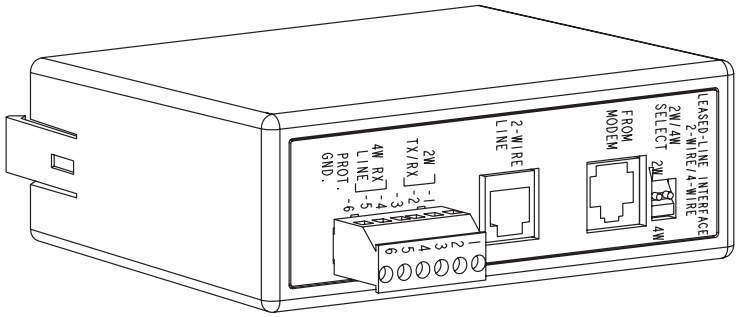
The Line Interface Unit has several options, each of which supports a different type of communication line. Table 1 details the available options.

Table 1. Line Interface Unit Options

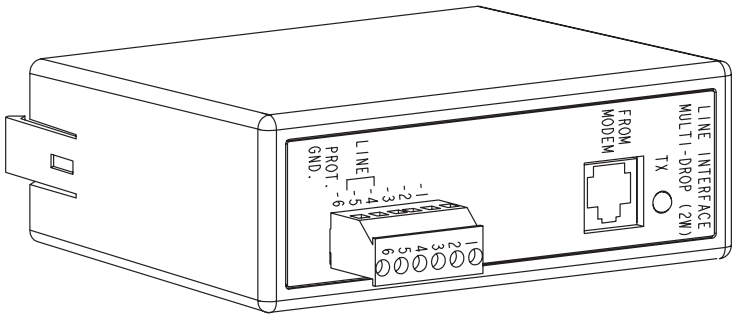
Type	Description
FRN1985A Telephone Line	Interfaces the internal line modem to a telephone line. The telephone line interface operates in full-duplex mode.
FRN1986A Multi-Drop	This option allows the CPU internal line modem to communicate with several modems in other RTUs using a single pair of wires. The multi-drop interface operates in half-duplex mode. **NOTE** Only the 1200 BPS internal line modem is supported by the multi-drop option.
FRN1987A Leased Line	This option allows for the connection of the CPU internal line modem to a communication line using a dedicated pair or two pairs of wires. The leased line interface operates in full-duplex mode.



Telephone Line Option



Leased Line Option



Multi Drop Option

Figure 1. Line Interface Unit - General View

3. INSTALLATION

NOTE

The Line Interface Unit can only be operated when the Internal Modem board (FRN5669A or FRN5639A) is installed in the CPU module.

3.1 UNIT INSTALLATION

The unit is easily installed by snapping it into the various RTU chassis. The installation locations are shown in Figures 2 and 3 (for 19" rack mounted RTU and 6-slot RTU, respectively). For installation instructions refer to section 3.3.2.

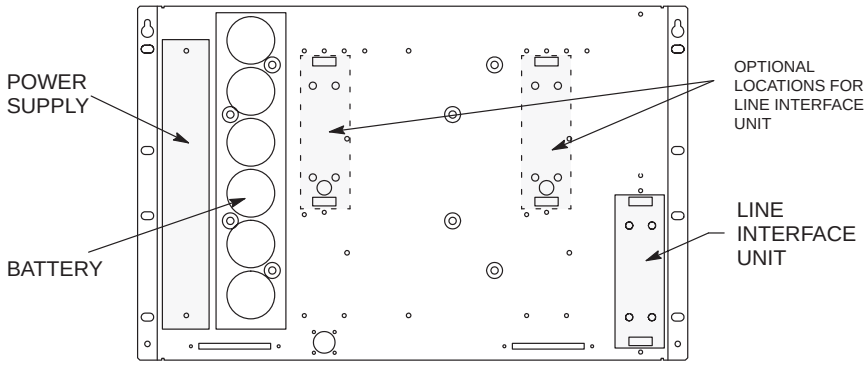


Figure 2. Line Interface Unit - Installation Location
(For 19" Rack Chassis)

3.2 ELECTRICAL CONNECTION

Perform the instructions given in section 3.2.1 and in the subsection of 3.2.2 that corresponds to the option installed.

3.2.1 Internal Connections

(1) Connect communication cable FKN5953 between port FROM MODEM on the line interface unit and port 3 on the CPU.

NOTE

Several installation locations are provided (see Figure 2). In some cases, the length of cable FKN5953 may not be sufficient and another cable might be required.

(2) Connect a grounding wire between terminal 6 of the TB connector located on the Line Interface Unit and the protective ground strip located below the power supply on the RTU chassis.

3.2.2 External Connections

NOTE

For NEMA4 housing, thread the wires through the opening at the bottom of the box.

3.2.2.1 Telephone Line Option

See Figure 3.

There are two options for connecting the line wire to the Line Interface Unit:

– If the telephone line has an RJ11 connector, plug it into the LINE connector on the unit's front panel.

or:

– If the telephone line is made of two wires, connect the wires to terminals 1 and 2 of the unit's front panel TB. The polarity is insignificant.

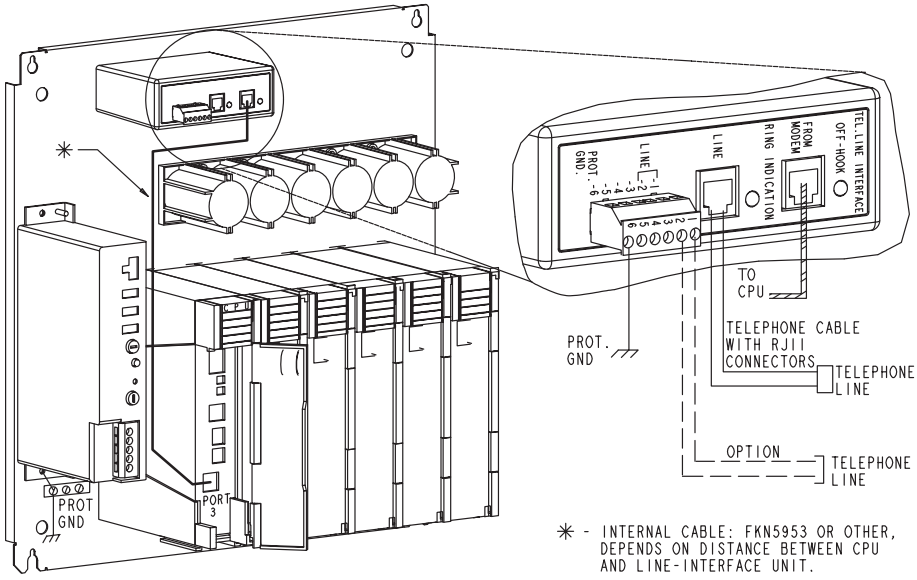


Figure 3. Line Interface Unit - Telephone Line Option Electrical Connections (For 6-Slot Chassis)

3.2.2.2 Multi-Drop Option

See Figure 4.

Connect the line wires to terminals 4 and 5 of the unit's front panel TB.

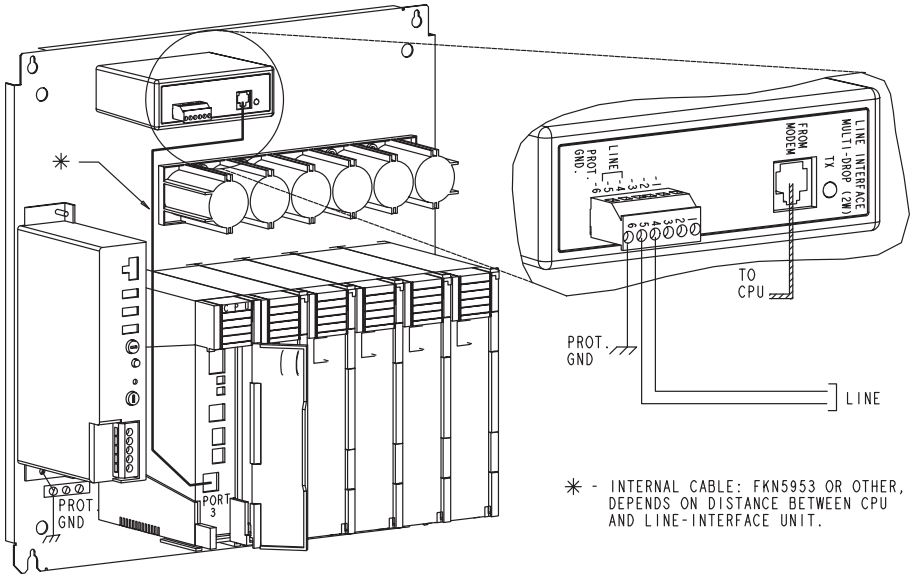


Figure 4. Line Interface Unit - Multi-Drop Option Electrical Connections (For 6-Slot Chassis)

3.2.2.3 Leased Line Option

See Figure 5.

This option supports both two- and four-wire connections. Perform the instructions from either section *a* or *b* below.

a. Two-Wire Line Connection

(1) Set both switches of dip-switch 2W/4W SELECT on the unit's front panel to position 2W.

(2) There are two options to connect the line wire to the unit:

– If the line has an RJ11 connector, plug it into the 2-WIRE LINE connector on the unit front panel.

or:

– If the line does not have an RJ11 connector, connect the wires to terminals 1 and 2 of the unit's front panel TB. The polarity is insignificant.

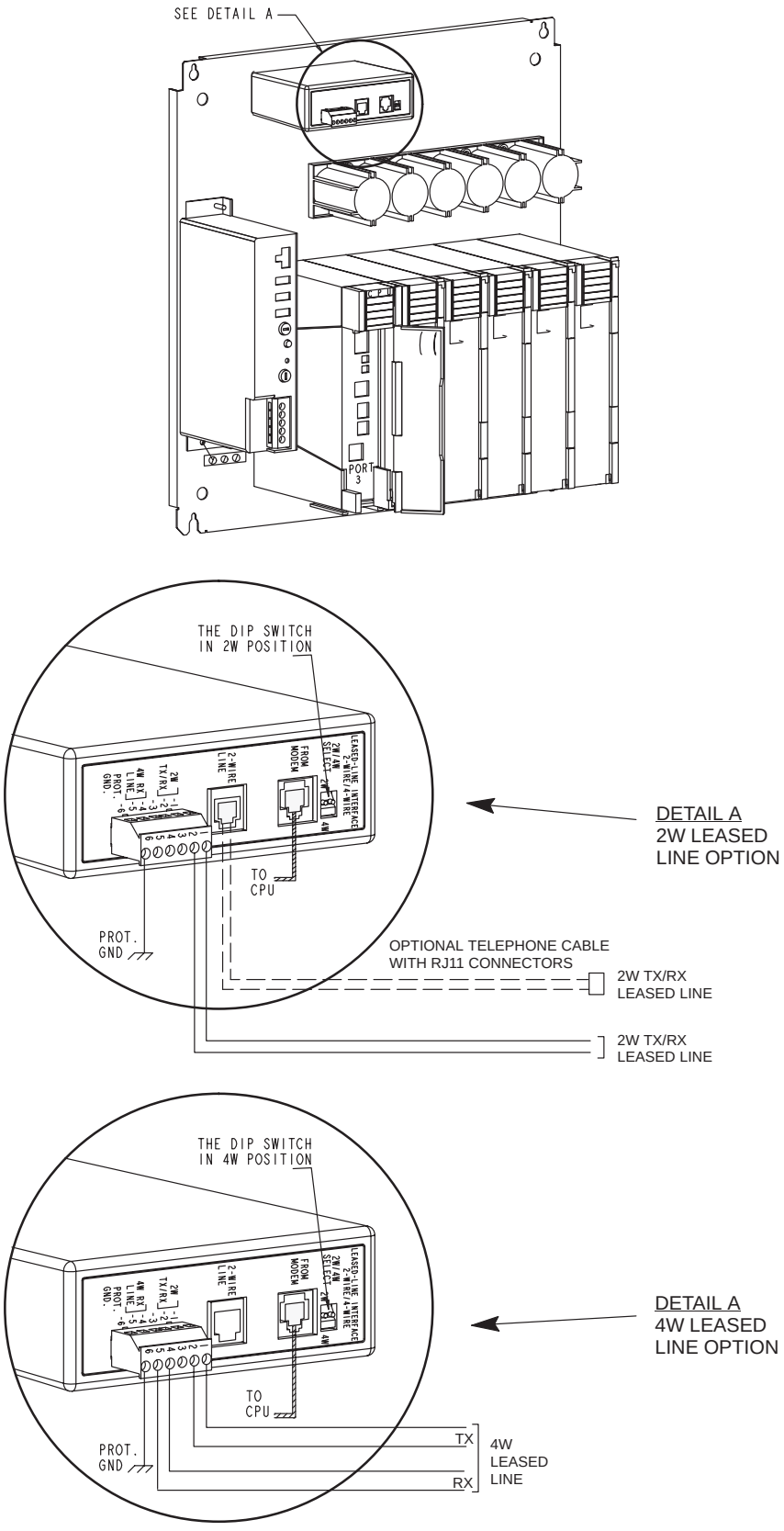


Figure 5. Line Interface Unit - Leased Line Option Electrical Connections
(For 6-slot chassis)

b. Four-Wire Line Connection

(1) Set both switches of dip-switch 2W/4W SELECT on the unit's front panel to position 4W.

(2) Connect the TX line wires to terminals 1 and 2 of the unit's front panel TB. The polarity is insignificant. Note that this line should be connected to the line interface's (modem's) RX input on the other end of the line (see Figure 6).

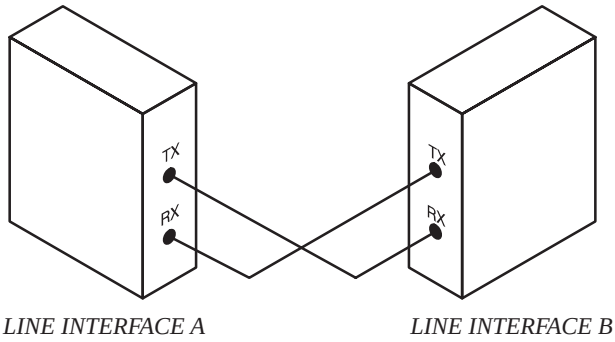


Figure 6. Typical 4-Wire Line Modem Interconnection

(3) Connect the RX line wires to terminals 4 and 5 of the TB on the unit front panel. The polarity is insignificant. Note that this line should be connected to the line interface's (modem's) TX input on the other end of the line.

3.3 LINE INTERFACE UNIT REPLACEMENT

The following paragraphs provide instructions for replacing the entire Line Interface Unit and for replacing only the Line Interface circuit board installed in the unit.

3.3.1 Line Interface Unit Removal

Insert a screwdriver into the notch located in the snap securing the unit to the chassis. Slightly bend the snap outwards to release it from the chassis's slot, and carefully pull the unit out.

3.3.2 Line Interface Unit Installation

(1) Insert the hook, located on the unit's back panel, into the appropriate slot on the chassis.

(2) Insert the two guiding pins and the snap into the appropriate slots on the chassis and snap the unit into the chassis.

3.3.3 Line Interface Board Removal

(1) Remove the connectors connected to the Line Interface Unit.

(2) Press the snap securing the front panel to the unit housing and pull out the front panel.

(3) Pull out the board.

3.3.4 Line Interface Board Installation

Perform the instructions in paragraph 3.3.3 in reverse order.

NOTE

The Line Interface board can be installed in either of the two available slots on the unit housing, with the front panel positioned accordingly. However, in some installations only one of the above-mentioned orientations is convenient, due to the communication cable length.

4. DIAGNOSTIC LEDS

The LED indicator operation of the various Line Interface Unit options is described below.

a. Telephone Line Option

Off Hook - When lit, indicates that the modem is in the off-hook state.

Ring Indication - When lit, indicates incoming call ring indication.

b. Multi-Drop Option

Tx - When lit, indicates transmission from modem.

5. FIELD REPLACEABLE SPARE PARTS

Description	Part No.
CPU-to-radio communication cable	FKN5953A
Modem connection TB (6 contacts)	2808508G10
Plastic housing	1502804E01

AC ANALYZER

1. OVERVIEW

1.1 GENERAL

The MOSCAD AC Analyzer (ACA) system enables the MOSCAD RTU to analyze a three-phase electrical network. It performs various calculations such as power and harmonics, which are transferred to the CPU module for local processing or for reporting to a central facility.

The MOSCAD ACA system is a key component in Electrical Distribution Automation systems. It is typically used for Monitoring and Control of Feeder Switches, Capacitor switches and Sub-stations, as well as in End-of-Interval Demand applications.

The ACA system includes two major units: ACA Module and ACA Termination Panel. A cable that connects the two units is also supplied. Figure 1 shows a general view of the ACA system.

The ACA system is available in the following configurations:

- FRN1988A ACA Module
- FRN2031A ACA Termination Panel, 115 V ac operation

1.2 MOSCAD RTU AND TOOL BOX SOFTWARE VERSION COMPATIBILITY

Programming Tool Box

The ACA System is supported by Programming Tool Box versions 2.10 or higher.

MOSCAD RTU System Software

The ACA System is supported by MOSCAD RTU system software versions 2.00 or higher.

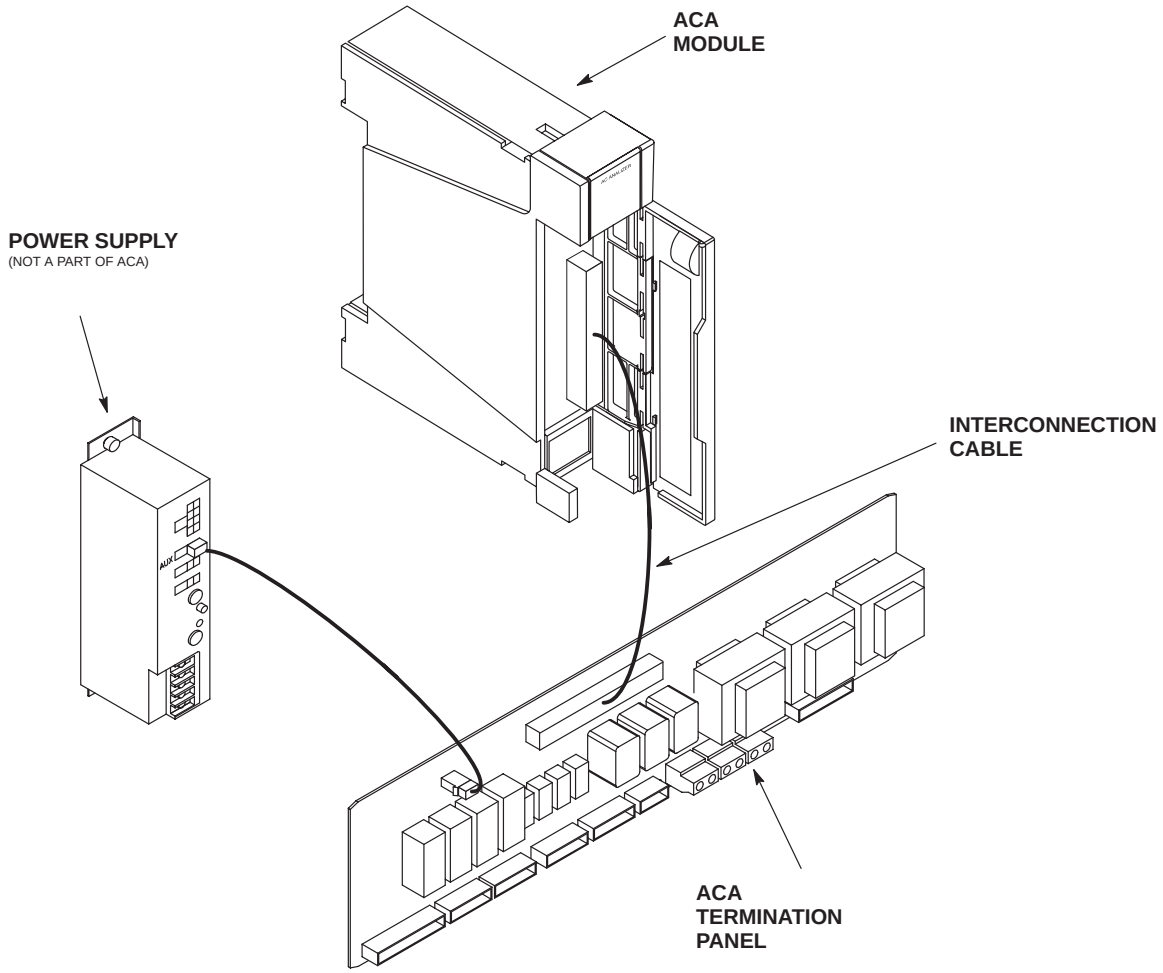


Figure 1. ACA System - General View

1.3 DESCRIPTION

The ACA system is used to analyze the voltage, current and other parameters of an ac electrical network. The system has three pairs of voltage-current analog inputs and a pair of auxiliary analog inputs for monitoring an ac network. In addition, it has eight digital wet inputs and eight relay outputs.

All the analog inputs are independent. The only limitation is that one of the voltage inputs (V1, V2 or V3) must be connected to synchronize the wave cycle time.

User connections are made to the Termination Panel, which is connected to the ACA module via a 64-pin cable. The Termination Panel adjusts the ac network voltage and current input levels to the ACA module levels by transformers and resistor networks. The auxiliary analog inputs are adjusted by resistor networks only. In addition, the Termination Panel houses the user control relays and the digital wet inputs. Figure 2 shows the ACA Termination Panel layout.

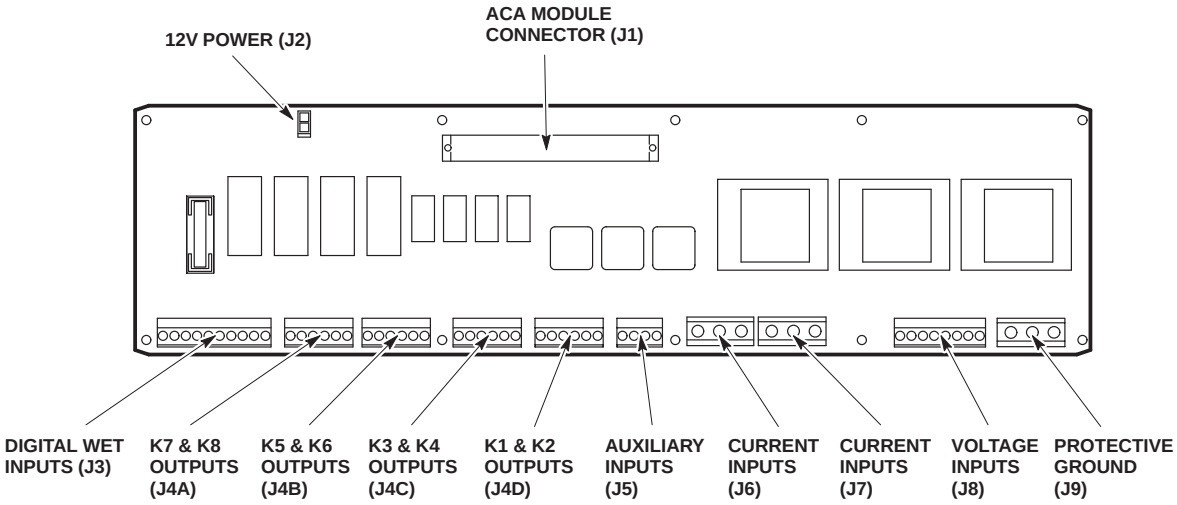


Figure 2. ACA Termination Panel

1.4 MODULE I/O CONNECTOR

The ACA module and the Termination Panel are interconnected by a 64-pin cable. Table 1 details the module I/O connector pin definitions, which also applies to the Termination Panel J1 connector.

Table 2. Module I/O Connector - Pin Definitions

Pin No.	Signal Name		Pin No.	Signal Name
1A	–		1C	–
2A	V1		2C	V1RET
3A	GND		3C	I1
4A	I1RET		4C	V2
5A	GND		5C	V2RET
6A	GND		6C	I2
7A	I2RET		7C	GND
8A	V3		8C	V3RET
9A	GND		9C	I3
10A	I3RET		10C	GND
11A	AUX1		11C	AUX1RET
12A	GND		12C	AUX2
13A	AUX2RET		13C	GND
14A	RELAYRET1		14C	K1 ON
15A	K2 ON		15C	K3 ON
16A	K4 ON		16C	K5 ON
17A	K6 ON		17C	RELAYRET2
18A	K7 ON		18C	K8 ON
19A	K9 ON		19C	K10 ON
20A	RELAYRET3		20C	K11 ON
21A	K12 ON		21C	K13 ON
22A	K14 ON		22C	K15 ON
23A	K16 ON		23C	RELAYRET4
24A	–		24C	DI1
25A	DI1RET		25C	DI2
26A	DI2RET		26C	DI3
27A	DI3RET		27C	DI4
28A	DI4RET		28C	DI5
29A	DI5RET		29C	DI6
30A	DI6RET		30C	DI7
31A	DI7RET		31C	DI8
32A	DI8RET		32C	–

1.5 AC ANALYZER SYSTEM SPECIFICATIONS

AC ANALYZER MODULE (FRN1988A)

INPUTS

8 Analog Inputs	10 V ptp maximum, 50/60 Hz
8 Digital Wet Inputs	ON: 7 to 28 V OFF: 0 to 3.5 V

OUTPUTS

Type	16 Open Drain
Maximum Voltage	50 Vdc
Maximum Current	0.5 A
ON Resistance	0.1 Ω maximum
Maximum Power	1.7 W

INDICATIONS

20 LEDs

USER CONNECTION

64–pin DIN connector	For connection to termination panel

AC ANALYZER 115V TERMINATION PANEL (FLN2031A)

VOLTAGE INPUTS

Number of Transformers	3
Input Voltage	FLN2031A: 115 Vac
Maximum Input Voltage	300 Vac
Dielectric Strength	2500 V between primary and secondary
Full Scale Adjustment	FLN2031A: V_{in} = 115 Vac provides V_{out} = 2.5 to 3 Vac
TB Type	8 positions header with plug
TB Pin Assignment	6 voltage inputs 1 protective ground 1 spare
TB Rating	12 A, 250 V
Number of TBs	1
TB Wire	12 AWG

CURRENT INPUTS

Number of Transformers	3
Current Sense Range	0 to 5 A ac/dc typical, 20 A ac peak
Dielectric Strength	2500 V between primary and secondary
Full Scale Adjustment	I_{in} = 10 Aac provides 3 to 3.3 Vac
TB Type	3 connectors, two positions each
TB Rating	34 A, 750 V
Number of TBs	3

AUXILIARY ANALOG INPUTS

Number of Inputs	2
Current Sense Range	0 to 9 Vac
Full Scale Adjustment	V_{in} = 5 Vac provides 2.4 to 2.9 Vac
TB Type	4 positions header with plug
TB Pin Assignment	4 positions for voltage inputs
TB Rating	12 A, 250 V
Number of TBs	1
TB Wire	12 AWG

DIGITAL WET INPUTS

Number of Inputs	8
Input Range	
• ON	8 to 28 V
• OFF	0 to 3.5 V
TB Type	10 positions header with plug
TB Pin Assignment	Common return for every 4 inputs
TB Rating	12 A, 250 V
Number of TBs	1
TB Wire	12 AWG

2A ELECTRICALLY ENERGIZED RELAYS

Number of Relays	2
Form	C
Contact Rating	2 A, 250 Vac, 220 Vdc, 60 W, 125 VA

2A MAGNETICALLY LATCHED RELAYS

Number of Relays	2
Form	C
Contact Rating	2 A, 250 Vac, 220 Vdc, 60 W, 125 VA

8A ELECTRICALLY ENERGIZED RELAYS

Number of Relays	2
Form	C
Contact Rating	8 A, 250 Vac/dc, 150 W, 2000 VA

8A MAGNETICALLY LATCHED RELAYS

Number of Relays	2
Form	C
Contact Rating	8 A, 250 Vac/dc, 150 W, 2000 VA

Relays' TB

• TB Type	6 positions header with plug
• TB Rating	12 A, 250 V
• Number of TBs	4
• TB Wire	12 AWG

POWER FOR RELAYS

Voltage	10.4 Vdc minimum 16 Vdc maximum
Current	253 mA maximum
Surge Withstand all I/Os	ANSI/IEEE C.37.90.1

2. INSTALLATION

2.1 AC ANALYZER MODULE LOCATION

The AC Analyzer module should be installed in a MOSCAD RTU slot designated by the Programming Tool Box site configuration program.

2.2 TERMINATION PANEL MOUNTING

The Termination Panel location should be selected so that the cables connecting it to the RTU will not interfere with the wires connected to the user connectors. The distance between the Termination Panel and MOSCAD RTU should fit the length of the control and power cables interconnecting the units (the maximum recommended cable length is one meter).

The Termination Panel is supplied installed in a plastic rail housing. Side brackets mounted on both of its sides secure the Termination panel to the plastic housing and, in addition, allow for wall mounting of the panel (by means of four screws). The Termination panel kit also includes a 19" DIN rail for installing the Termination Panel in 19" racks and the adaptors for mounting the plastic rail housing on the DIN rail.

Figure 3 shows the Termination Panel installation dimensions.

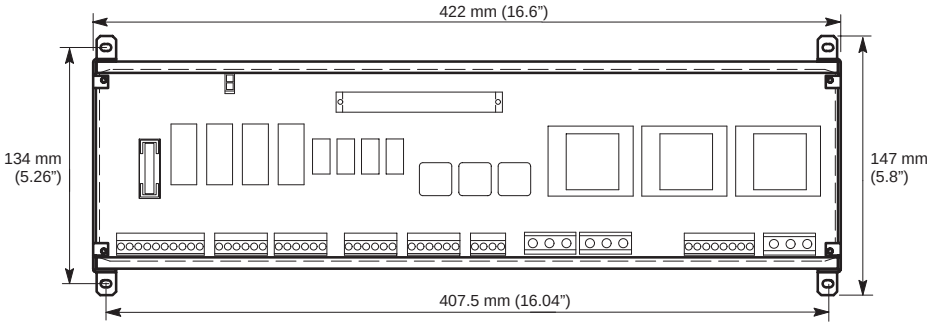


Figure 3. Termination Panel Installation Dimensions

2.3 ELECTRICAL CONNECTIONS

(1) Connect good earth ground directly to the protective ground strip of the MOSCAD RTU.

(2) Connect the earth ground to one of the pins of the protective ground TB (J9) on the Termination Panel (see Figure 4).

(3) Connect power cable FKN4090A between the MOSCAD power supply AUX connector and the Termination Panel 12 V IN connector (J2) (see Figures 1 and 4).

(4) Connect the Interconnection cable between the ACA module user connector and the Terminal Panel's J1 connector (see Figure 1).

NOTE

For best performance, the interconnection cable length should be limited to 1 m (40").

(5) Connect the user devices to the user connection TBs. Refer to Figures 4 and 5.

IMPORTANT

The wires connected to analog inputs should be isolated from the other wires, in order to avoid wire crosstalk.

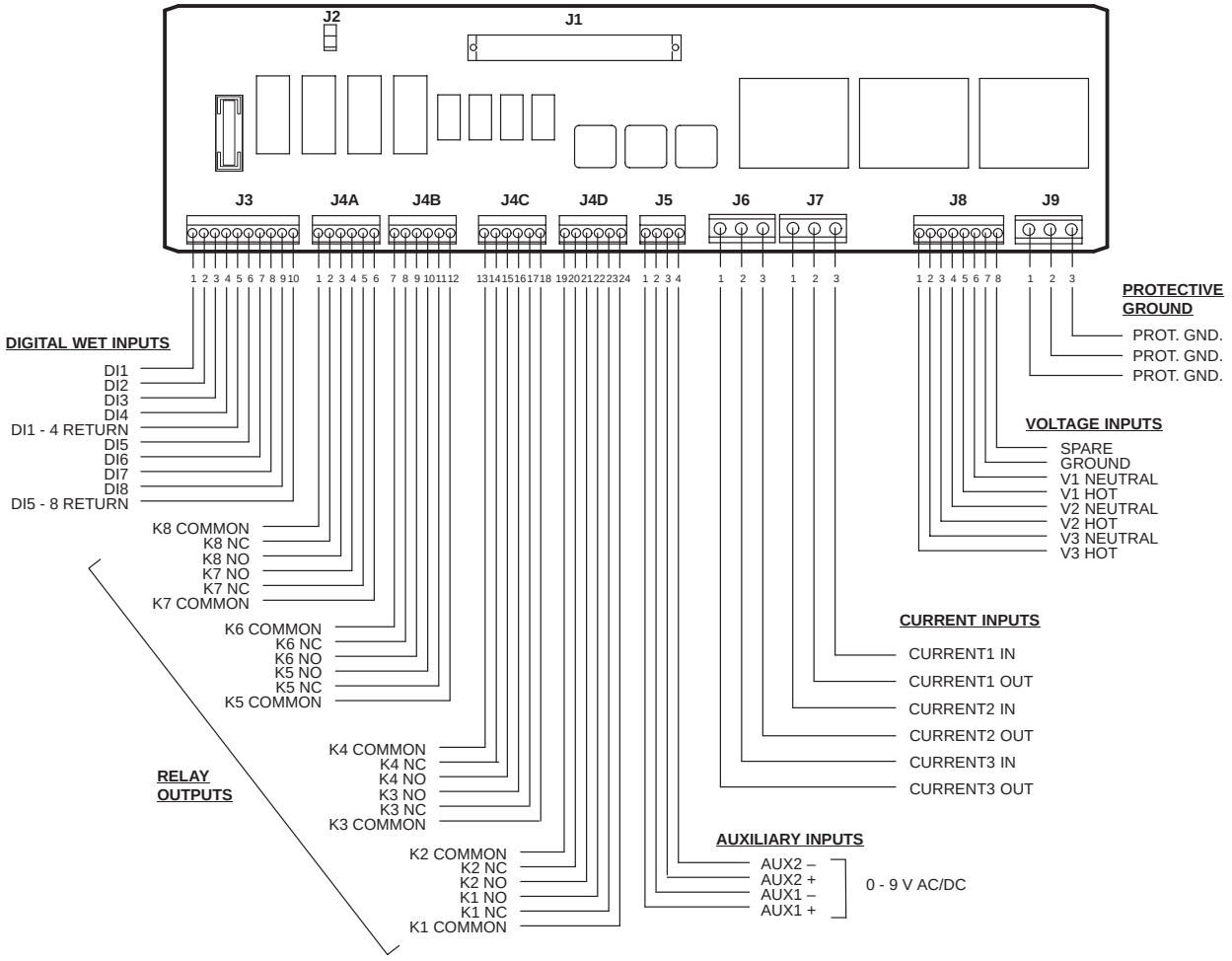


Figure 4. User Connectors - Pin Definition

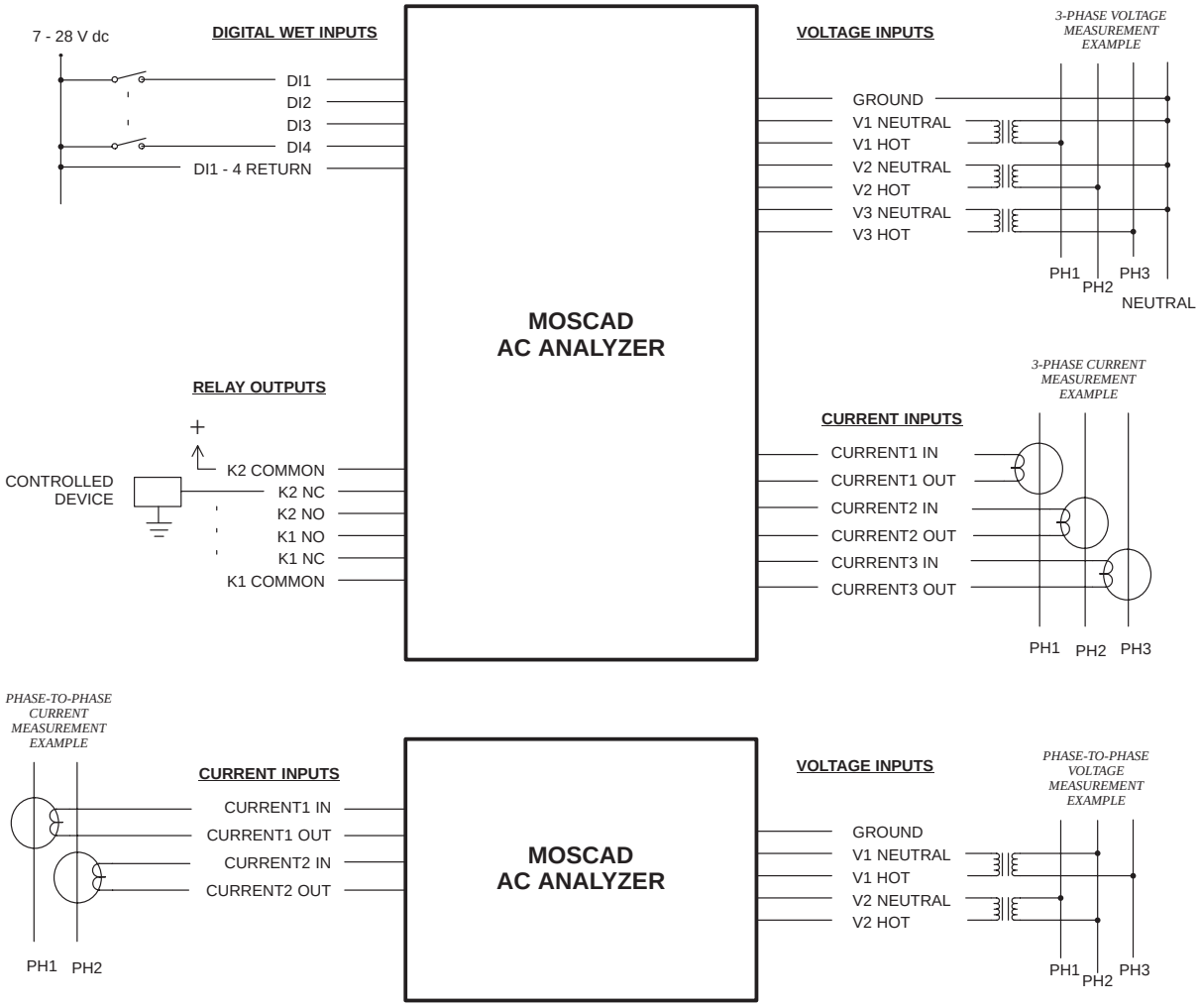


Figure 5. Typical User Connections

2.4 AC ANALYZER MODULE REPLACEMENT

Refer to the RTU INSTALLATION chapter in this manual.

3. SCALING THE ANALOG INPUTS

3.1 GENERAL

By default, the ACA module reports the results in units as a proportion of the full scale measurements as opposed to physical units. The MOSCAD Programming Tool Box can be used for scaling the analog input measurements into physical units, e.g. volts and ampers.

3.2 SCALING PROCEDURE

The scaling procedure is provided by the Programming Tool Box.

4. DIAGNOSTIC LEDS

The ACA module includes a LED panel composed of 20 LEDs (see Figure 4). All the LEDs (except for the CLK LED) light in the corresponding conditions only if they are enabled by the CPU module.

The LEDs in the IN/OUT area of the panel are dual-function. The upper (white) labels indicate the status of the module inputs, while the lower (green) labels indicate the status of the module outputs. The OUT LED indicates the currently active function. The LED functions are as follows:

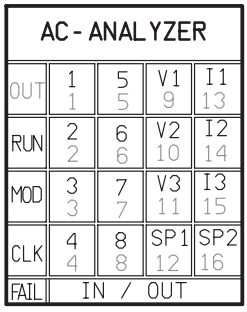


Figure 6. ACA Module LED Panel

OUT - Indicates LED display mode. When off, the upper labels of the IN/OUT LEDs indicate the current LED function. When lit, the lower labels of the IN/OUT LEDs indicate the current LED function.

RUN - When lit, indicates that the downloading has been performed and the module software is running. When off, it indicates that either download has not yet been performed, or there is a hardware malfunction.

MOD - When lit, indicates that the CPU cannot access the module. This happens when either the module has failed or is installed in a slot assigned for another module.

CLK - When lit, indicates absence of system clock.

1-8 LEDs - *If the OUT LED is off:*
Display status of the corresponding digital input:
LED lit = input is closed (voltage is present); LED off = input is open (no voltage is present).

If the OUT LED is lit:
Displays status of the corresponding digital output:
LED lit = output is ON, LED off = output is OFF.

V1-V3 LEDs - *Applicable only when the OUT LED is off.* When lit, indicates that the corresponding input voltage is above the predefined value set via the Tool Box.

I1-I3 LEDs - *Applicable only when the OUT LED is off.* When lit, indicates that the corresponding input current is above a predefined value set via the Tool Box.

SP1, SP2 LEDs - *Applicable only when the OUT LED is off.* Represents the AUX1 and AUX2 inputs. When lit, indicates that the corresponding input is above a predefined value set via the Tool Box.

9-16 LEDs - *Applicable only when the OUT LED is lit:*
Displays status of the corresponding digital output:
LED lit = output is ON, LED off = output is OFF.

5. FIELD REPLACEABLE SPARE PARTS

Description	Part No.
19” DIN Rail	0704858K01
Side Bracket for Plastic Rail Housing	0704851K01
Plastic Rail Housing	1504436E01
ACA Module-to-Termination Panel Interconnection Cable (flat)	3002233C07
ACA Module-to-Termination Panel Interconnection Cable (round)	3002132C16
User’s Connection Plug, 4-contacts	3108509G20
User’s Connection Plug, 6-contacts	3108509G21
User’s Connection Plug, 8-contacts	3108509G19
User’s Connection Plug, 10-contacts	3108509G18
Adaptor for DIN Rail	4202922S02
Door label	5402853D14
Protective plastic strip for door label	6108874S01
Power Supply-to-Termination Panel DC Cable	FKN4090A

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8A POWER SUPPLY/CHARGER
MODELS FPN5522A, FPN5544A

1. OVERVIEW

The power supply provides DC power for the RTU operation and charges the RTU battery. Figure 1 provides a general view of the power supply.

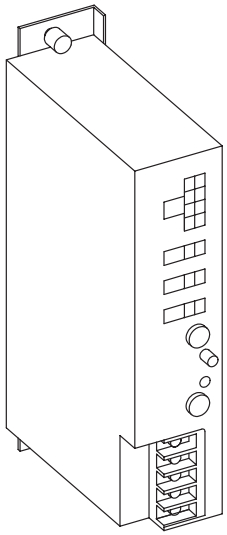


Figure 1. RTU Power Supply - General View

The following power supply models are covered by this chapter:

FPN5522A - Charging power supply 8 A, 120 VAC.

FPN5544A - Charging power supply 8 A, 220 VAC.

2. ELECTRICAL CONNECTION

WARNING

Make sure that line power is off before connecting it to the RTU.

(1) The RTU power supply operating voltage is printed on the power supply front panel above the TB. Make sure that this voltage matches your line voltage.

(2) Remove plastic cover from the power supply TB. Connect the power wiring according to Figure 2.

NOTES

1. Use the RTU dedicated ground strip as the source for the line ground input.

2. It is recommended that a 10 A fuse dedicated to the MOSCAD RTU be installed in the site's power distribution panel.

3. The DC ON/OFF switch on the power supply front panel controls the 12 VDC voltage only.

(3) Mount the plastic cover back on the power supply TB.

(4) Make sure the radio DC cable is connected to the power supply connector RADIO (J2).

(5) Connect the cable from the battery to the power supply connector BATT (J1). (This cable is deliberately disconnected at factory to remove power from the unit during shipment.)

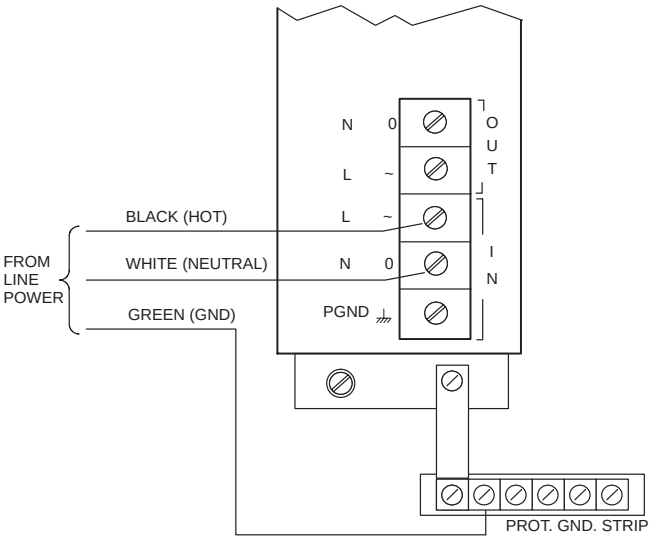


Figure 2. Power Supply TB Layout

3. OPERATION

3.1 CONTROLS, INDICATORS AND CONNECTORS

The power supply controls, indicators and connectors are described in Table 1 and illustrated in Figure 3.

Table 1. Power Supply - Controls, Indicators and Connectors

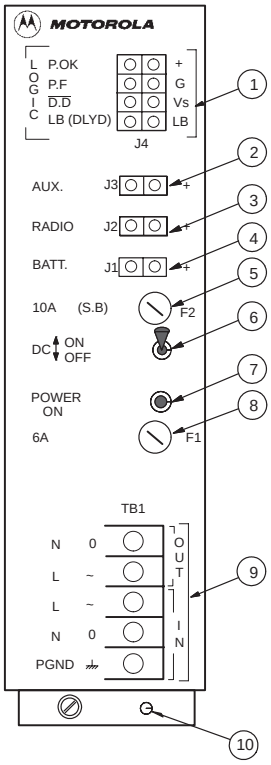


Figure 3. Power Supply Front Panel

Item in Figure 3	Name	Function
1	LOGIC (J4)	Connector. Connects power and logic signals to the motherboard.
2	AUX (J3)	DC output connector. Supplies 12 VDC power to auxiliary circuits.
3	RADIO (J2)	DC output connector. Supplies 12 VDC power to the radio.
4	BATT (J1)	Connector. Used for interconnecting 12 VDC power between the power supply and the battery.
5	F2	10 A fuse (6508448S06). Protects against DC power overload to battery.
6	DC ON/OFF	Switch. Controls power supply DC output.
7	DS1	Lamp. Lit when the power supply is on.
8	F1	6 A fuse (6508448S10). Protects against AC power overload.
9	TB1	Terminal block (TB). Provides line power input and output connections.
10		Screw. Protective ground connection.

3.2 OPERATING INSTRUCTIONS

To turn on the RTU, set the DC switch on the power supply front panel to ON.

NOTE

If the lithium battery insulating strip is removed and the power supply is off, lithium battery power is used for maintaining data stored in the CPU RAM. If this data is not required (i.e. the RTU is currently not operational) insert the insulating strip back into the lithium battery housing.

4. REMOVAL AND INSTALLATION

The power supply is attached to the RTU by two captive screws.

5. FIELD REPLACEABLE SPARE PARTS

Description	Part No.
Fuse F1, 6.3 A	6508448S10
Fuse F2, 10 A, slow blow	6508448S06
TB plastic cover	3808448S02

MAXTRAC® VHF RADIO
MAXTRAC® UHF RADIO
MAXTRAC® 800 AND 900 TRUNKED RADIO
MAXTRAC® 800 CONVENTIONAL RADIO

1. ELECTRICAL CONNECTIONS

NOTES

Make sure the radio DC cable is connected to the appropriate connector of the internal power supply (refer to the specific power supply chapter).

Make sure the radio communication cable (the cable with a telephone plug at both ends) is connected between PORT 3 connector in the CPU module and the connector on the rear panel of the radio.

2. OPERATION

Set that the radio ON/OFF knob to the ON position.

NOTE

The volume level does not affect the quality of the RTU operation. It is, therefore, recommended to set the volume to the minimal level, so as to minimize power consumption from the battery in case of power failure.

3. REMOVAL AND INSTALLATION

3.1 REMOVAL

(1) Disconnect the DC power and antenna cables connected to the radio.

(2) Disconnect the data cable connected to the 16-pin connector adapter on the radio rear panel.

(3) Press the snap fastening the adaptor to the radio (see Figure 1) and remove the adaptor.

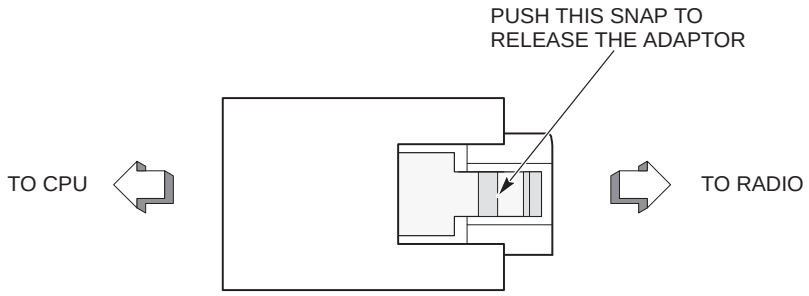


Figure 1. Radio Communications Cable Adaptor

(4) Remove the screw securing the radio to the radio mounting bracket.

(5) Partially release (but don't remove!) the screw securing the radio mounting bracket to the RTU chassis, to allow convenient radio removal from the bracket.

3.2 INSTALLATION

Perform the removal instructions in reverse order.

4. FIELD REPLACEABLE SPARE PARTS

Description	Part No.
MaxTrac radio mounting bracket	FHN5600B
MaxTrac data cable adaptor	FLN6433B

DARCOM 9000®-2 RADIO

1. ELECTRICAL CONNECTIONS

NOTES

Make sure the radio DC cable is connected to the appropriate connector of the internal power supply (refer to the chapter in this manual pertaining to the power supply installed).

Make sure the radio communication cable (the cable with a telephone plug at both ends) connects CPU PORT 3 and the connector on the rear panel of the radio.

2. REMOVAL AND INSTALLATION

The following procedure applies to a MOSCAD RTU with a basic Darcom 9000-2 radio unit.

NOTE

MOSCAD system that uses Darcom radios includes a Repeater. Make sure to adjust the repeater according to the tables provided in its manual. Refer to the chapter Using Darcom in MOSCAD Systems (68P02933C30) in the MOSCAD RTU Service manual (68P02991G90).

Removal:

(1) Disconnect the radio DC power cable from the power supply and the antenna cable from the radio.

(2) Disconnect the data cable connected to the 8-pin phone connector.

(3) Release the screws securing the radio mounting bracket to the RTU chassis.

(4) Remove the 8-pin phone connector adapter as follows:

a. Remove the screws securing the radio mounting bracket to the radio and remove the bracket.

b. Remove the radio bottom cover.

c. Remove the adaptor support bracket.

Installation:

Perform the removal instructions in reverse order.

3. FIELD REPLACEABLE SPARE PARTS

Description	Part No.
Darcom radio mounting bracket	FHN5626A
Adaptor board for Darcom data cable	FLN6594A
Metal support bracket for the radio cable adaptor board	0702831F01

MT 2000™ MODEL A4 RADIO

1. ELECTRICAL CONNECTIONS

NOTES

Make sure the radio DC cable is properly connected to the power supply (refer to the chapter in this manual pertaining to thepower supply installed or to appendix B if an external power supply is used).

Make sure the radio communication cable (the cable with a telephone plug at both ends) connects CPU PORT 3 and the connector on the rear panel of the radio.

2. OPERATION

Set the radio ON/OFF knob to the ON position.

NOTE

The volume level does not affect the quality of the RTU operation. It is, therefore, recommended to set the volume to the minimal level, so as to minimize power consumption from the battery in case of power failure.

3. REMOVAL AND INSTALLATION

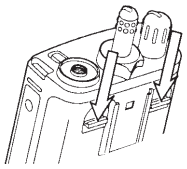
3.1 REMOVAL

(1) Disconnect the radio DC power, antenna and data cables connected to the radio.

(2) Release the two screws securing the radio mounting bracket to the RTU chassis and remove the radio assembly.

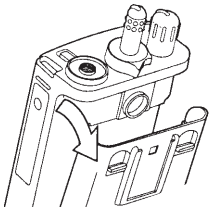
(3) Press inwards the two snaps securing the radio plastic base to the bracket.

(4) Rotate the radio base and remove it from the mounting bracket.



(5) Hold the radio so that its control panel faces upwards.

(6) Press down on the two release levers securing the radio base to the radio.



(7) With the release levers pressed down, rotate the radio base away from the radio and separate them.

3.2 INSTALLATION

Perform the removal instructions in reverse order.

4. FIELD REPLACEABLE SPARE PARTS

Description	Part No.
Interface Board	FLN5751A
Adaptor Board	FLN5753A
Plastic Base	1504336K01
Adaptor Board Cover	1504338K01
SMA to BNC Adaptor	5880348B33
Mounting Bracket	0704816K01

APPENDIX A:
CABLES AND ADAPTERS

1. GENERAL

This appendix provides supplementary data on cables and adaptors used in various MOSCAD systems. The following applications are covered:

- RTU-to-computer/terminal connections
- RTU-to-modem connections
- RTU-to-radio connections
- RTU-to-X.25 connections
- RTU-to-RTU connections
- Connecting a user port to a printer

2. RTU-TO-COMPUTER/TERMINAL CONNECTION

2.1 RTU-TO-COMPUTER/TERMINAL ASYNCHRONOUS COMMUNICATIONS

Use the FLN6457 cable kit to connect one of the MOSCAD RTU RS232 Ports to a computer or a terminal. The kit includes a cable with RJ45 modular jacks on both ends and a RJ45 to 25-pin female D-Type adaptor (part no. 0198213661, see Figure 1). The RTU port configurations are detailed in Table 1.

Table 1. RTU-to-Computer/Terminal Asynchronous Communications - Port Data

CPU Port No.	Used with Piggyback Board	Toolbox Definition
1B	–	RS-232 UART Local Computer (MDLC)
2	–	RS-232 UART Local Computer (MDLC)
3	FRN5655A	RS-232 UART Local Computer (MDLC)
3	FRN5724A	RS-232 UART Local Computer (MDLC)

NOTE

When a User Port is defined as Computer/Terminal with DTR support:

1) The RTU will not transmit unless it receives DTR=on from the computer/terminal.

2) The RTU will not receive unless it receives RTS=on from the computer/terminal. See pin 20 of the 25-pin Female connector.

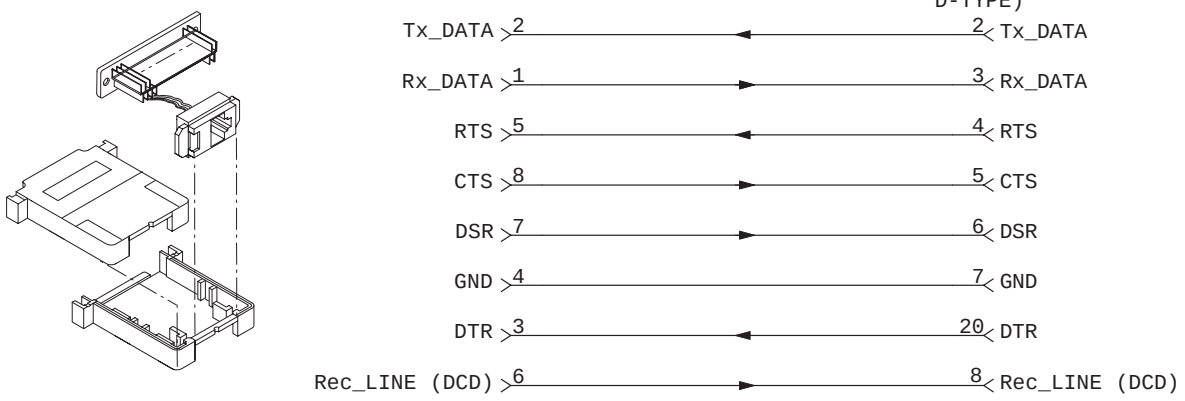


Figure 1. RJ45-to-D-Type Female Connector Adaptor 0198213661

2.2 RTU-TO-COMPUTER/TERMINAL SYNCHRONOUS/ASYNCHRONOUS COMMUNICATIONS ADAPTOR

The RTU can be connected to a computer or a terminal via its serial communications port and serve as a DCE. This section provides data on the FRN5726A adaptor which interfaces between the RJ45 connector on the cable connected to the RTU and the 25-pin D-Type connector on the cable connected to the modem (refer to Figure 2).

The FRN5726A adaptor includes jumpers that allow it to operate in both the synchronous and asynchronous modes (see Table 2). The RTU port configurations are detailed in Tables 3 and 4.

Table 2. FRN5726A Adaptor Configuration

Mode	Jumper Position	
	SYNC/ASYNC	TxCLK
Asynchronous (default)	ASYNC	NORMAL, ASYNC
Synchronous	SYNC	NORMAL / DTE SOURCE *

* According to the ToolBox definition.

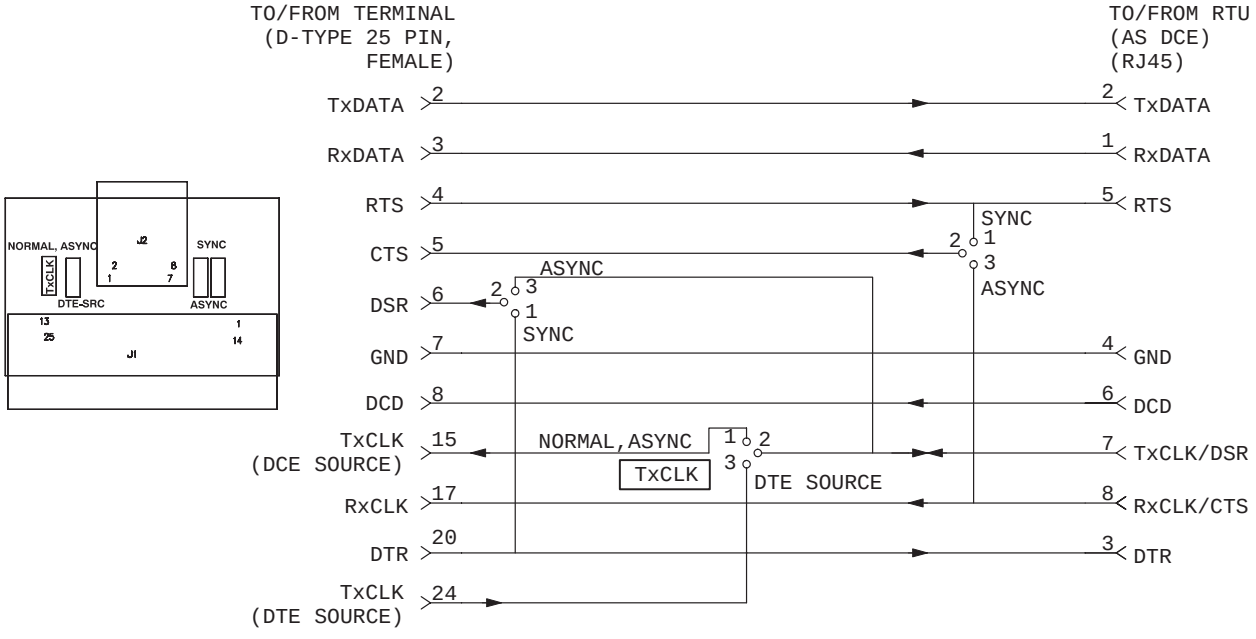


Figure 2. FRN5726A RJ45-to-D-Type Female Connector Adaptor

Table 3. RTU-to-Computer/Terminal Synchronous Communications - Port Data

CPU Port No.	Used with Piggyback Board	Toolbox Definition
1B	–	RS-232 Sync RTU-to-RTU (MDLC)
3	FRN5654A	RS-232 Sync (RTU as DCE)
3	FRN5654A	RS-232 Sync (RTU as DCE with TxCLK input)
3	FRN5724A	RS-232 Sync (RTU as DCE)
3	FRN5724A	RS-232 Sync (RTU as DCE with TxCLK input)

Table 4. RTU-to-Computer/Terminal Asynchronous Communications - Port Data

CPU Port No.	Used with Piggyback Board	Toolbox Definition
1B	–	RS-232 UART Local Computer (MDLC)
2	–	RS-232 UART Local Computer (MDLC)
3	FRN5655A	RS-232 UART Local Computer (MDLC)
3	FRN5724A	RS-232 UART Local Computer (MDLC)

3. RTU-TO-MODEM CONNECTION

3.1 RTU-TO-MODEM ASYNCHRONOUS CONNECTION (DTE-TO-DCE)

Use the FLN6458 cable kit to connect one of the MOSCAD RTU RS232 Ports asynchronously to a Modem (the RTU serves as DTE). The kit includes a cable with RJ45 modular jacks on both ends and a RJ45 to 25-pin female D-Type adaptor (part no. 0198213662, see Figure 3). Table 5 details the possible RTU configurations.

Table 5. RTU-to-Asynchronous Modem Communications - Port Data

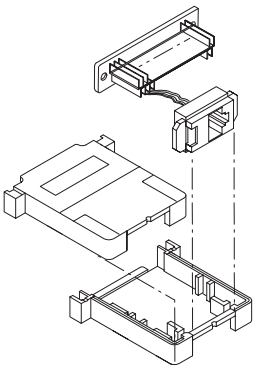
CPU Port No.	Used with Piggyback Board	Toolbox Definition
2	–	RS-232 UART External Modem (MDLC)
3	FRN5655A	RS-232 Async External Modem, Full Duplex or Multi-Drop Half Duplex
3	FRN5724A	RS-232 Async External Modem, Full Duplex or Multi-Drop Half Duplex

NOTES

1. Before transmitting, the RTU sends RTS=on to the modem, and expects CTS=on from the modem as a condition for transmitting.

2. The RTU will receive data from the modem only when DCD=on.

3. When using a modem in auto-answer mode (connected to a Computer port) for remote service, the RTU does not support RTS/CTS protocol, as the port is designated to operate with a local computer as well as with a modem. Refer to the jumpers setting described in the Utilities chapter of the Programming Tool Box Operating Instructions manual.



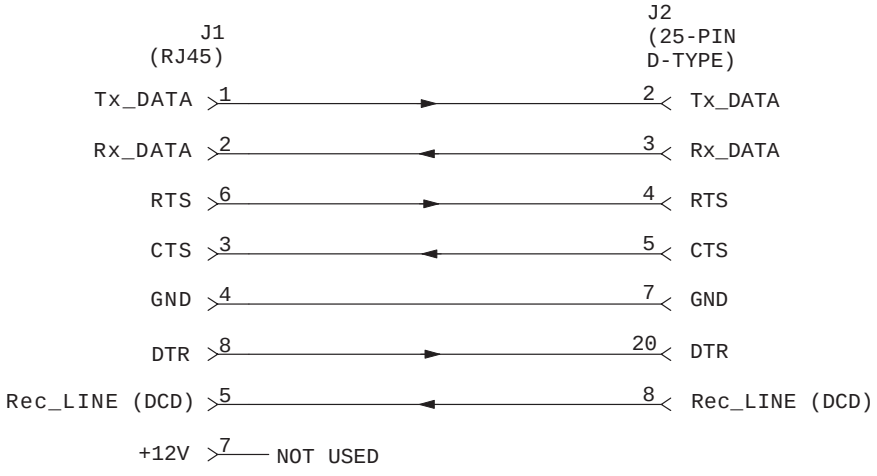


Figure 3. RJ45-to-D-Type Male Connector Adaptor 0198213662

3.2 RTU-TO-MODEM SYNCHRONOUS CONNECTION (DTE-TO-DCE)

Use the FLN6704A cable kit to connect one of the MOSCAD RTU RS232 Ports synchronously to a Modem (the RTU serves as DTE). The kit includes a cable with RJ45 modular jacks on both ends and a RJ45 to 25-pin female D-Type adaptor (part no. 0198213703, see Figure 4). Table 6 details the possible RTU Port configurations.

Table 6. RTU-to-Modem Synchronous Communications -Port Data

CPU Port No.	Used with Piggyback Board	Toolbox Definition
3	FRN5654A	RS-232 Sync External Modem, Full Duplex or Multi-Drop Half Duplex, Darcom Modem, Darcom Master/Repeater
3	FRN5724A	RS-232 Sync External Modem, Full Duplex or Multi-Drop Half Duplex, Darcom Modem, Darcom Master/Repeater

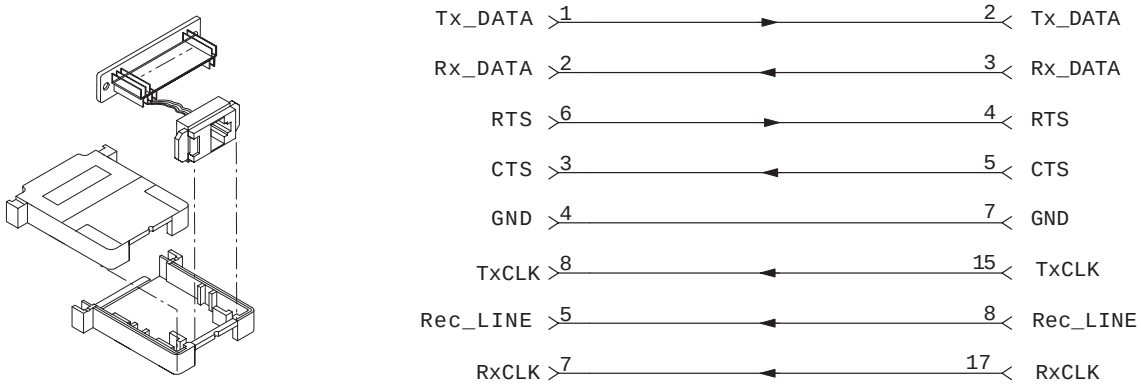


Figure 4. RJ45-to-D-Type Male Connector Adaptor 0198213703

3.3 RTU-TO-MODEM SYNCHRONOUS/ASYNCHRONOUS COMMUNICATIONS ADAPTOR BOARD (DTE-to-DCE)

The FRN6893A adaptor board can be configured by jumpers for both synchronous and asynchronous communications with a modem. The adaptor interfaces between the RJ45 connector on the cable connected to the RTU and the 25-pin D-Type male connector on the cable connected to the modem (refer to Figure 5). Table 7 defines the adaptor configurations. Tables 5 and 8 detail the possible RTU Port configurations.

Table 7. FRN6793A Synchronous/Asynchronous Adaptor Configuration

Mode	Jumper Position	
	MODE	TxCLK
Asynchronous (default)	ASYNC	NORMAL
Synchronous	SYNC	NORMAL / DTE SOURCE *

* According to the ToolBox definition.

Table 8. RTU-to-Modem Synchronous/Asynchronous Communications - Port Data

CPU Port No.	Used with Piggyback Board	Toolbox Definition
3	FRN5654A	RS-232 Sync External Modem
3	FRN5724A	RS-232 External Modem (MDLC)
3	FRN5724A	RS-232 Sync

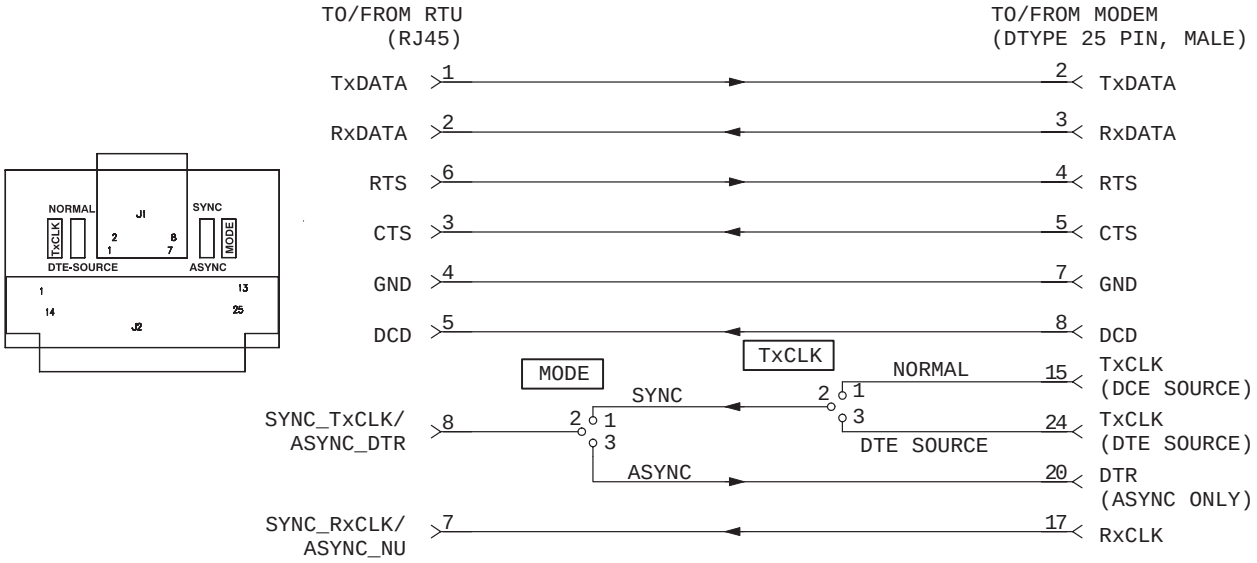


Figure 5. FRN6893A Adaptor Board

4. RTU-TO-RADIO CONNECTION

4.1 RTU-TO-DARCOM 9000-2 RADIO WITH DIAGNOSTICS (via port 3)

Use the FLN6796A cable kit to connect the CPU port 3 to a Darcom 9000-2 radio with diagnostics (option V110AB). The kit includes a cable with RJ45 modular jacks on both ends and a RJ45 to 25-pin D-Type adaptor (part no. 0198213861, see Figure 6). The adaptor interfaces between the RJ45 connector on the cable connected to the RTU and the 25-pin D-Type connector on the cable connected to the VF Interface board FRN5005A. Table 9 details the required RTU configuration.

Table 9. RTU-to-Darcom 9000-2 Radio Communications - Port Data

CPU Port No.	Used with Piggyback Board	Toolbox Definition
3	FRN5614A	Conventional Radio FSK (MDLC)

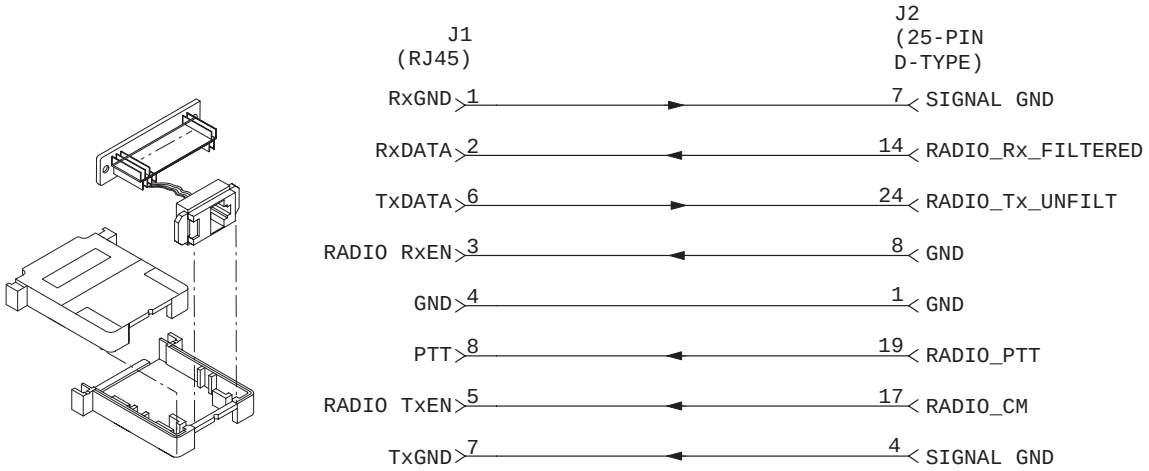


Figure 6. RJ45-to-D-Type Male Connector Adaptor 0198213861

4.2 CONVENTIONAL OR TRUNKED MAXTRAC RADIO ADAPTOR FLN6433B (via port 3)

The RTU can be connected to a MaxTrac radio via CPU port 3. This section provides data on the FLN6433B adaptor which interfaces between the RJ45 connector on the cable connected to the RTU and the 16-pin connector on the radio (refer to Figure 7). The adaptor is connected to the CPU according to Table 10).

Table 10. RTU-to-Synchronous Modem Communications - Port Data

CPU Port No.	Used with Piggyback Board	Toolbox Definition
3	FRN5546A	Conventional Radio DFM (MDLC, used without the PL, DPL or Repeating mode)
3	FRN5614A	Conventional Radio FSK (MDLC); Trunked FSK (MDLC)
3	FRN5708A	Conventional Radio DPSK (MDLC); Trunked DPSK (MDLC)

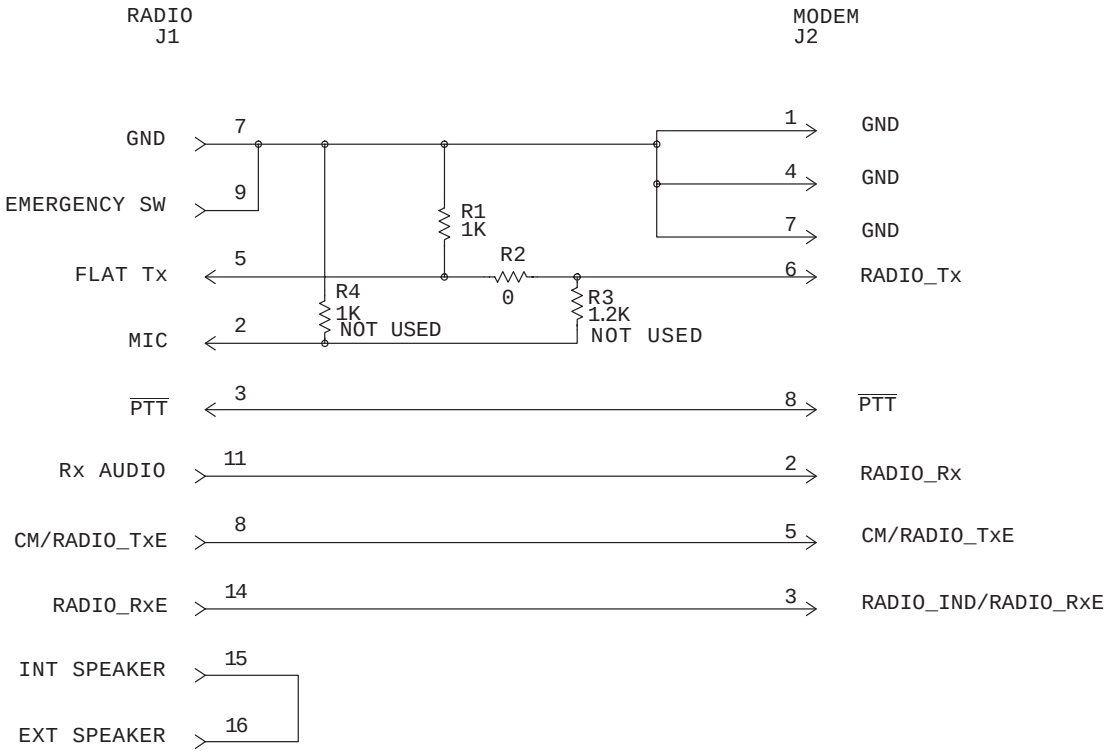


Figure 7. RJ45-to-16-pin Female Connector Adaptor FLN6433B

4.3 MAXTRAC RADIO-TO-TWO CPUs ADAPTOR FLN6423A (via port 3)

NOTE

Adaptor FLN6423A can be ordered only as a special product. Contact your local dealer for details.

This adaptor allows for connecting two CPUs of an RTU to a MaxTrac radio. Adaptor FLN6423A interfaces between the RJ45 connectors on the cables connected to port 3 of the two CPUs and the 16-pin connector on the radio (refer to Figure 8). This adaptor can only be used with conventional VHF/UHF MaxTrac radios, while the appropriate piggyback modem boards should be installed in the RTU CPUs. In addition, *the Brand Rex 851-B adaptor connector should be used for signal splitting.*

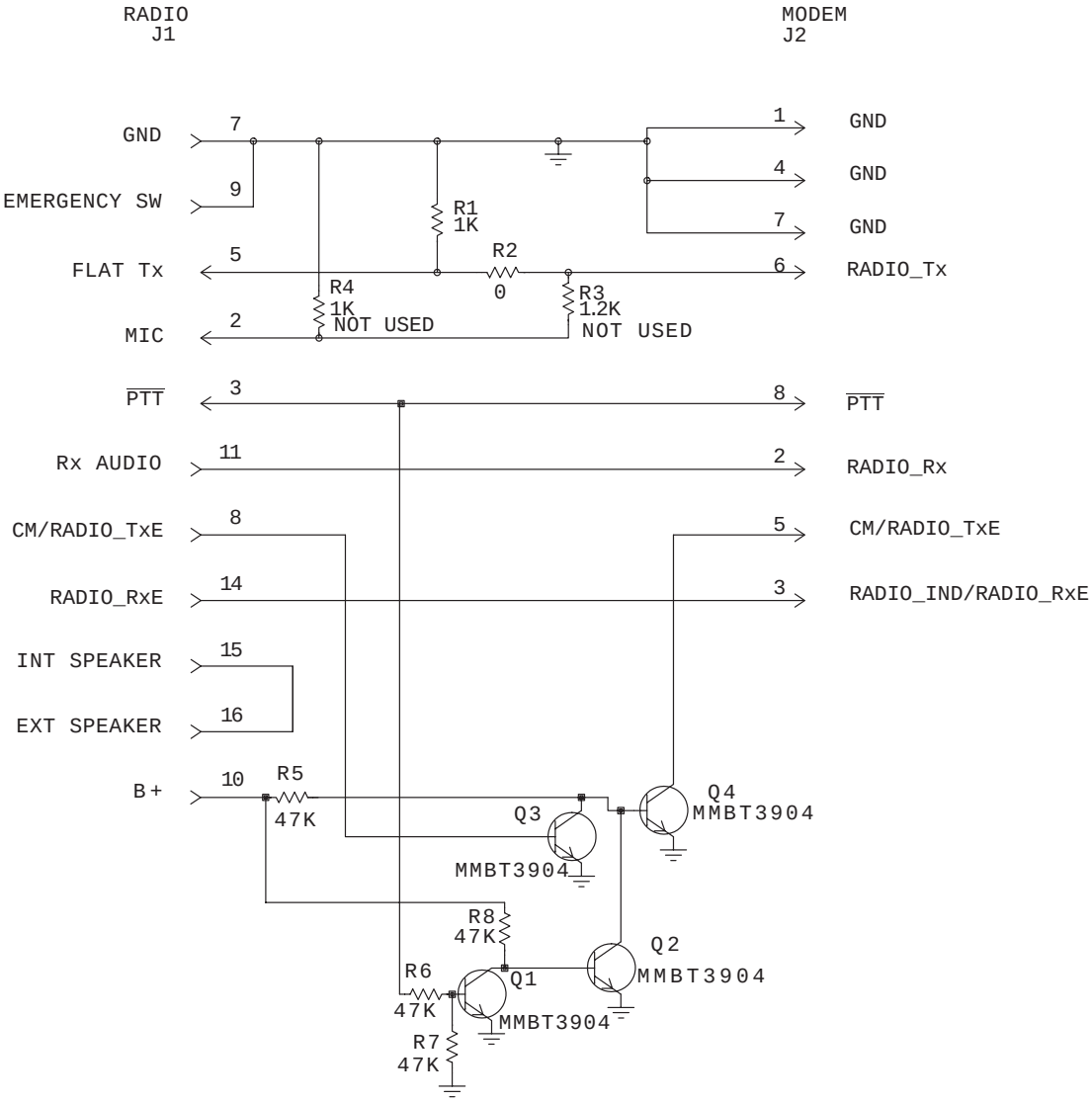
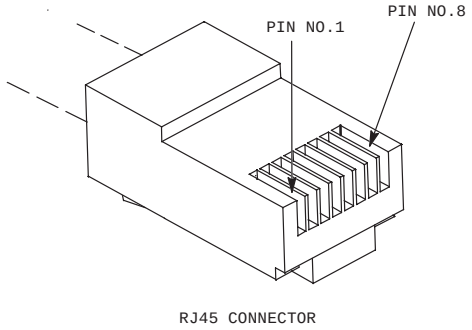


Figure 8. RJ45-to-16 pin Female Connector Adaptor FLN6423A

4.4 RTU-TO-MC MICRO RADIO CABLE FKN4084A

This section provides data on the cable recommended for the RTU-to-MC MICRO radio interconnection (see Figure 9). The cable connects the RTU's CPU port 3 and J5 in the MC MICRO radio. The FSK piggyback board FRN5614A must be installed in the CPU module.



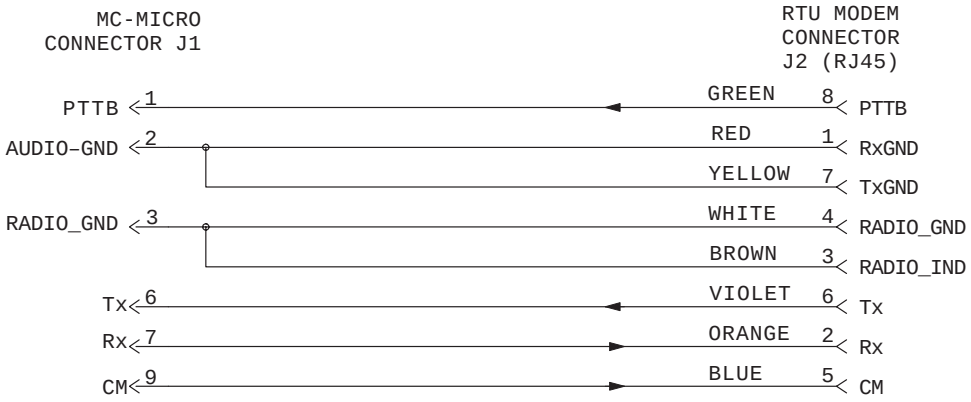


Figure 9. RTU-to-MC Micro Radio Cable

4.5 CONNECTING AN EXTERNAL RADIO

The FKN4091A cable and adaptor kit allows for the connecting of an external radio to the RTU radio port, as shown in Figure 10.

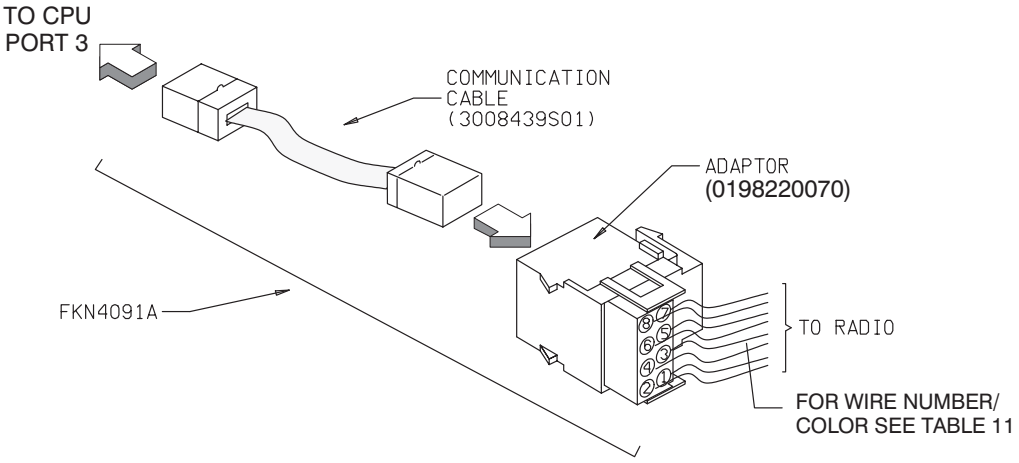


Figure 10. External Radio Connections

The external radio should have a Channel Monitor (CM) and available PTT signal inputs. The MOSCAD external radio adapter includes separate ground signal inputs for Rx and TX. For best performance, the individual ground wires should be connected to a single ground on the *radio* side, and not on the RTU side.

Table 11 details the radio adaptor signal definitions.

Table 11. Adaptor Pin Definition

Wire		Function	Description
No.	Color		
8	Gray	Rx GND	Receive signal ground
7	Violet	RADIO Rx	Receive signal from radio to modem
6	Blue	RADIO RxE	Indicates radio receive status to modem. When radio does not provide this signal, refer to Table 12 for connection instructions.
5	Green	RADIO GND	Ground
4	Yellow	RADIO CM* (RADIO TxE)	Radio Channel Monitor
3	Orange	RADIO Tx	Transmit signal from modem to radio
2	Red	Tx GND	Transmit signal ground
1	Brown	PTT	Push To Talk

* The Radio CM Polarity parameter is set by the ToolBox to BUSY HIGH or BUSY LOW according to radio.

Table 12. RADIO RxE Signal Connection

Radio CM Polarity	RADIO RxE
BUSY HIGH	Connect to ground
BUSY LOW	Do not connect (leave open)

If matching of the RADIO Tx output to the radio input is necessary, add an external resistor R_S in parallel to the radio input (see Figure 11). To calculate the resistor use the following formula:

$$R_{tx} = \frac{3}{\frac{4}{V_{o\,pp}} - 4} = \frac{3}{\frac{\sqrt{2}}{V_{o\,rms}} - 4}$$

where: $R_{tx} = R_s \parallel R_{in}$

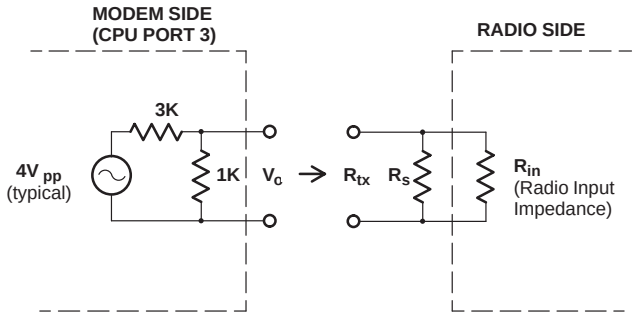


Figure 11. Radio Input Impedance Matching

5. RTU-TO-X.25 CONNECTION

5.1 RTU-TO-X.25 CONNECTION VIA PORT 1B (DTE–TO-DCE)

The RTU can be connected to a X.25 terminal via its serial communications port 1B and serve as a DTE. This section provides data on the adaptor, which interfaces between the RJ45 connector on the cable connected to the RTU and the 25-pin D-Type connector on the cable connected to the terminal (refer to Figure 12). The 1B port should be defined by the Tool Box for an X.25 Protocol.

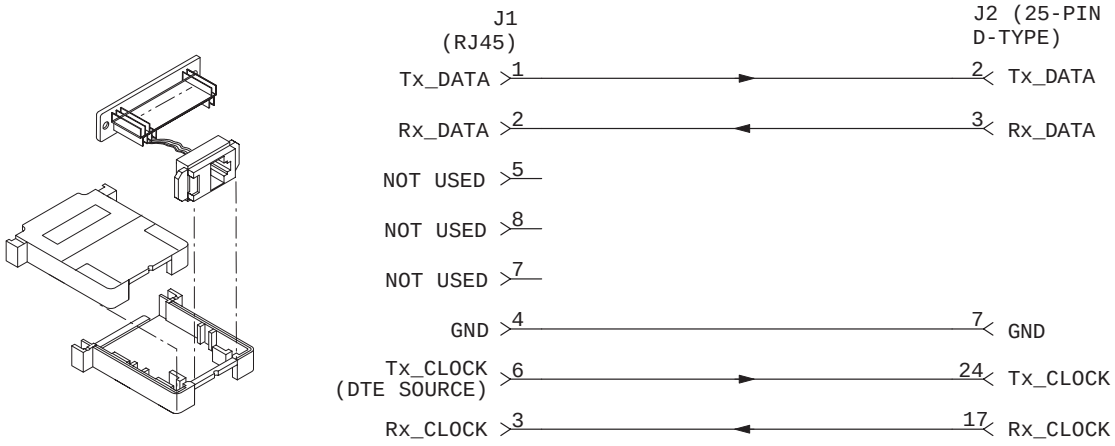


Figure 12. RJ45-to-D-Type Male Connector Adaptor 0198220121

5.2 RTU-TO-X.25 CONNECTION VIA PORT 1B (DCE–TO-DTE)

The RTU can be connected to a X.25 terminal via its serial communications port 1B and serve as a DCE. This section provides data on the adaptor, which interfaces between the RJ45 connector on the cable connected to the RTU and the 25-pin D-Type connector on the cable connected to the terminal (refer to Figure 13). The 1B port should be defined by the Tool Box for an X.25 Protocol.

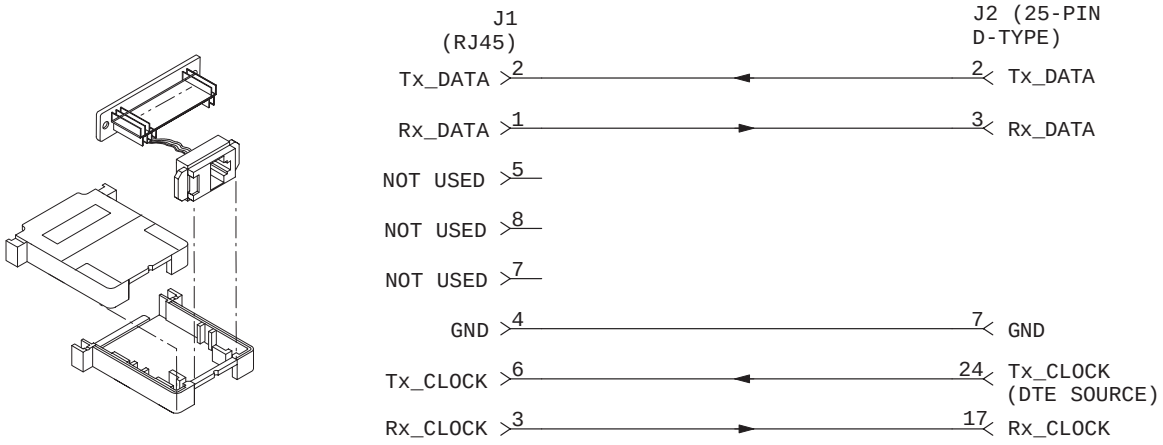


Figure 13. RJ45-to-D-Type Female Connector Adaptor 0198220098

6. RTU-TO-RTU CONNECTION

6.1 RTU-TO-MULTIPLE RTUs TIME SYNCHRONIZATION USING *SYNC* BROADCAST (via port 1B)

The interconnection diagram below describes the Time Synchronization method, which uses a SYNC broadcast via port 1B (refer to Figure 14).

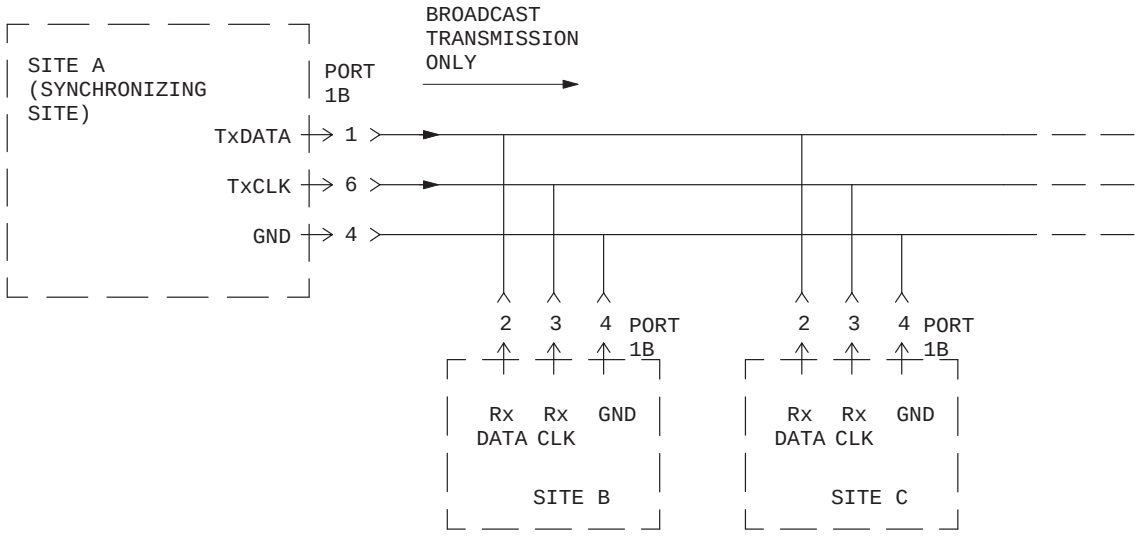


Figure 14. Time Synchronization using SYNC Broadcast –Interconnection Diagram

6.2 RTU-TO-RTU ASYNCHRONOUS COMMUNICATIONS CONNECTION

This section provides data on the cable recommended for the RTU-to-RTU RS-232C asynchronous interconnection (not supplied). Refer to Figure 15. Table 13 defines the RTU port for this connection type.

Use hand-tooling AMP HT-210 with 8-pin connector header for cable preparation. An appropriate 8-pin cable should be used (e.g. Motorola part no. 3008439S01).

Table 13. RTU-to-RTU RS-232 Asynchronous Communications - Port Data

CPU Port No.	Used with Piggyback Board	Toolbox Definition
1B	–	RS-232 UART RTU-to-RTU (MDLC)
2	–	RS-232 UART RTU-to-RTU (MDLC)
3	FRN5655A	RS-232 UART RTU-to-RTU (MDLC)
3	FRN5724A	RS-232 UART RTU-to-RTU (MDLC)

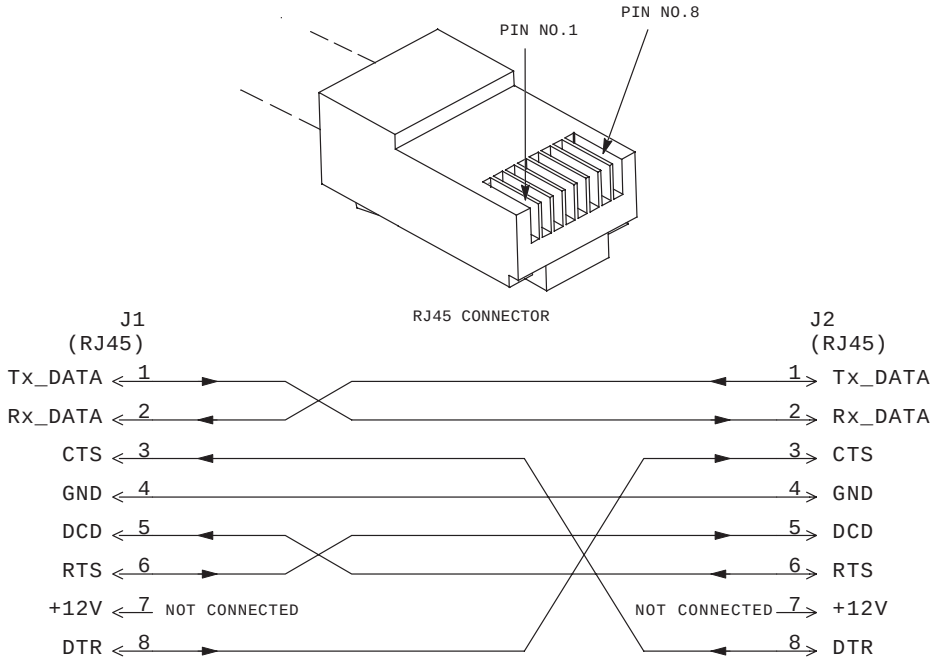


Figure 15. RTU-to-RTU RS-232 Asynchronous Communications Cable

6.3 RTU-TO-RTU SYNCHRONOUS COMMUNICATIONS CONNECTION (via port 1B)

This section provides data on the cable recommended (not supplied) for the RTU-to-RTU synchronous communications via RTU port 1B (see Figure 16). The cable should be connected to the CPU according to Table 14.

Use hand-tooling AMP HT-210 with 8-pin connector header for cable preparation. An appropriate 8-pin cable should be used (e.g. Motorola part no. 3008439S01).

Table 14. RTU-to-RTU RS-232 Communications - Port Data

CPU Port No.	Used with Piggyback Board	Toolbox Definition
1B	–	RS-232 Sync RTU to RTU (MDLC) Full Duplex or Half Duplex

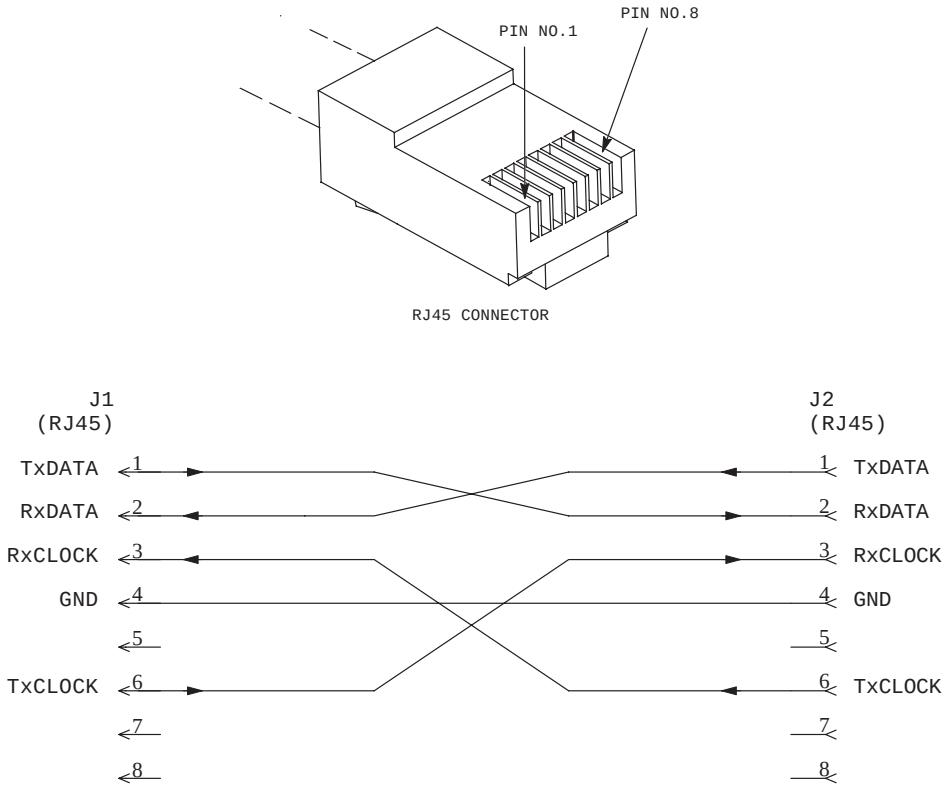


Figure 16. RTU-to-RTU Synchronous Communications Cable

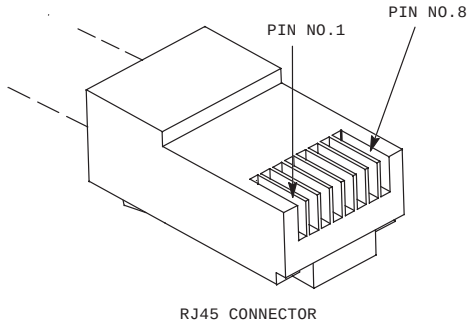
6.4 RTU-TO-RTU RS-232 SYNCHRONOUS COMMUNICATIONS CONNECTION (via port 3)

This section provides data on the cable recommended (not supplied) for the RTU-to-RTU RS-232 synchronous communications via RTU port 3. Refer to Figure 17. The cable should be connected to the CPU according to Table 15.

Use hand-tooling AMP HT-210 with 8-pin connector header for cable preparation. An appropriate 8-pin cable should be used (e.g. Motorola part no. 3008439S01).

Table 15. RTU-to-RTU RS-232 Synchronous Communications - Port Data

CPU Port No.	Used with Piggyback Board	Toolbox Definition
3	FRN5654A	RS-232 Sync External Modem, Full Duplex or Multi-Drop Half Duplex
3	FRN5724A	RS-232 Sync External Modem, Full Duplex or Multi-Drop Half Duplex



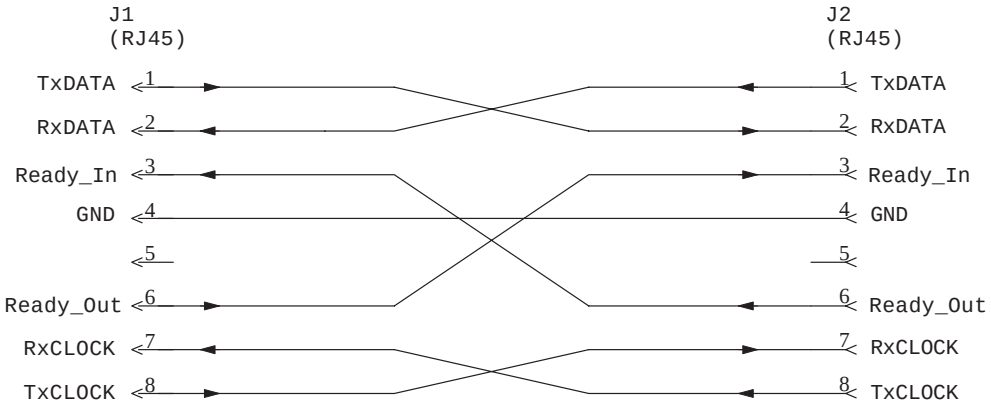


Figure 17. RTU-to-RTU Synchronous Communications Cable

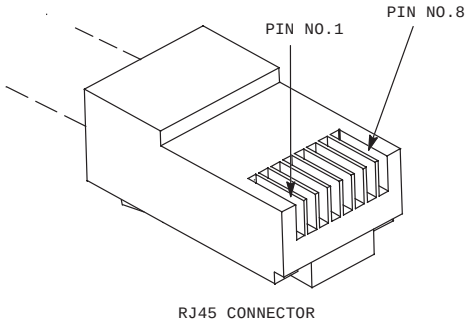
6.5 RTU-TO-RTU COMMUNICATION CONNECTION VIA RADIO PORT

This section provides data on the cable recommended (not supplied) for simulating RTU-to-RTU radio interconnection. Refer to Figure 18. The cable should be connected between the RTUs' Modem connectors (CPU port 3; FSK or DFM Modems are required).

Use hand-tooling AMP HT-210 with 8-pin connector header for cable preparation. An appropriate 8-pin cable should be used (e.g. Motorola part no. 3008439S01).

NOTE

The Channel Monitor polarity parameter should be set to Busy Low by the Tool Box configuration program.



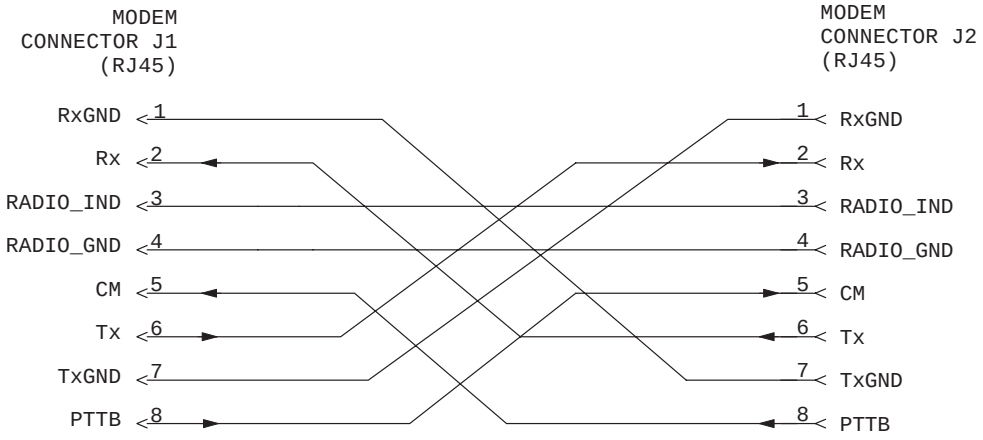


Figure 18. RTU-to-RTU Radio Simulator Cable

7. CONNECTING A USER PORT TO A PRINTER

To connect one of the MOSCAD RTU RS232 Ports defined as User Port to a printer, use either the FLN6457 or the FLN6458 cable. Since the connection to the printer is not defined by the RS232 standard, printer manufacturers define the connectors differently. Therefore, you should select the adapter according to the functions of the various pins.

If the FLN6457 cable (with the *female* 25-pin D-type connector) is used, refer to Table 16.

Table 16. Connection to Printer (with FLN6457 cable)

RS232 Function	25-pin *Female*	Used As	Direction
RX-DATA	3	Printer Rx-Data	to Printer
DTR	20	Printer Ready	from Printer
GND	7	Ground	

If the FLN6458 cable (with the *male* 25-pin D-type connector) is used, refer to Table 17.

Table 17. Connection to Printer (with FLN6458 cable)

RS232 Function	25-pin *Male*	Used As	Direction
TX-DATA	2	Serial Data	to Printer
CTS	5	Printer Ready	from Printer
GND	7	Ground	

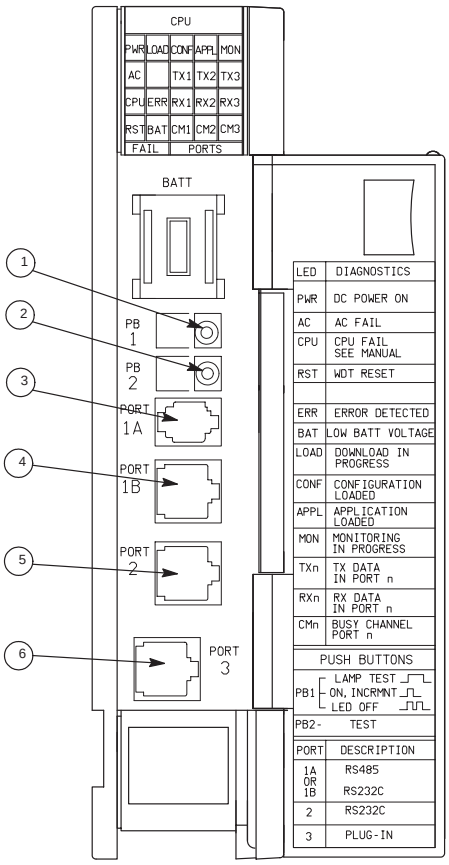
APPENDIX B:
CONNECTING AN EXTERNAL POWER SUPPLY

The RTU option V274 - External Power Supply - includes an additional cable FKN5934A for connecting the RTU to the external power supply.

The FKN5934A external dc power cable is provided with a connector on the RTU's side and open wires at the user side. Connect the FKN5934A cable connector to RTU's motherboard connector J7. Use Table 1 for definitions of the wire functions.

Table 1. FKN5934A External DC Power Cable

Wire Color	Function	Recommended Status/Connection
Red	+ 12 V dc	+ 12 V dc
Brown	Ground	GND/12V-RET
Orange	AC Power Fail	GND/12V-RET
Black	Battery Disconnect Disable	Not connected
Green	DC Loss (Low Battery indication)	GND/12V-RET


CPU
PWR LOAD CONF APPL MON
AC TX1 TX2 TX3
CPU ERR RX1 RX2 RX3
RST BAT CM1 CM2 CM3
FAIL PORTS
BATT
PB 1
PB 2
PORT 1A
PORT 1B
PORT 2
PORT 3
1
2
3
4
5
6
LED DIAGNOSTICS
PWR DC POWER ON
AC AC FAIL
CPU CPU FAIL SEE MANUAL
RST WDT RESET
ERR ERROR DETECTED
BAT LOW BATT VOLTAGE
LOAD DOWNLOAD IN PROGRESS
CONF CONFIGURATION LOADED
APPL APPLICATION LOADED
MON MONITORING IN PROGRESS
TXn TX DATA IN PORT n
RXn RX DATA IN PORT n
CMn BUSY CHANNEL PORT n
PUSH BUTTONS
PB1 LAMP TEST
ON, INCRMNT
LED OFF
PB2- TEST
PORT DESCRIPTION
1A OR 1B RS485 RS232C
2 RS232C
3 PLUG-IN