MOTOROLA

MOSCAD-M™

Remote Terminal Unit

Owner's Manual

68P02961C50-O

CONTENTS

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INTRODUCTION

Scope of this Manual

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

This manual covers the basic RTU and most communications and I/O options. The online help of the MOSCAD-M RTU Configurator contains additional information on the RTU.

General Description

The RTU is a remotely located unit used for monitoring and control of local equipment. The unit can operate in stand-alone mode, or as an intelligent RTU or node on a distributed control system.

The RTU consists of the following components installed in a plastic case: printed circuit board, internal/external radio, and battery housing. This manual describes both basic and expanded I/O models.

The MOSCAD-M is a low-power unit that incorporates a variety of power save modes which enable the unit to operate with minimal power consumption.

The RTU case is suitable for either wall or DIN rail mounting.

Figure 1 provides a general view of the MOSCAD-M RTU.

The MOSCAD-M RTU is enclosed in an indoor plastic case and is intended for outdoor base station use. The installer must make sure that the installation meets the requirements of the standard and protects the unit from weather hazards.

The antenna must be physically secured at a permanent outdoor location.

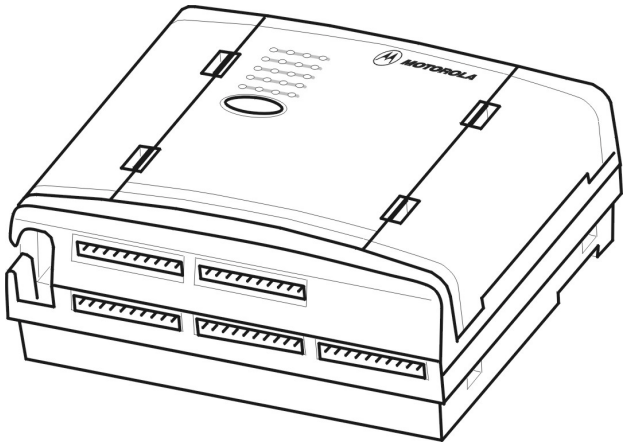


Figure 1
MOSCAD-M RTU –General View with Case

Hardware Options

Line, RS232 and RS485 Communication Interfaces

A variety of Line, RS232, and RS485 communication interfaces are available:

- RS485 adapter
- RS232 multiplexer
- Ethernet Interface Unit

Radio Communication Interfaces

A variety of radios can be attached using internal DPSK or duo-binary modem:

- Internal radio UHF High Band
- Internal radio UHF Low Band
- Variety of external radios (GP140/328, HT750, PRO5150)

For details on the available external radio models, and their connection to the RTU, see Appendix B.

I/O Configurations

Different models of the MOSCAD-M RTU have slightly different I/O configurations.

Models with basic I/O configuration:

- 12 Digital Input
- 8 Digital Output (4 Magnetically Latched, 4 Open Collector)
- 2 Digital Output (Solid State)

Models with expanded I/O configuration:

- 15 Digital Input
- 8 Digital Output (4 Magnetically Latched, 4 Open Collector)
- 4 Analog Input (4-20 mA)
- 1 Analog Output (0-5V or 4-20mA)
- 2 Digital Output (Solid State)

Power Supply and Battery

The power supply and backup battery options are:

- 9-30V DC power input (compatible with 12V DC Solar Panel)
- 3 x “C” backup battery (for Real Time Clock and RAM retention)

INSTALLATION

General

MOSCAD-M SAFETY SUMMARY

The MOSCAD-M should be installed by qualified and authorized technicians. If the installation involves high-voltage connections, technicians must be specifically qualified to handle high voltage.

This equipment was tested with cables 3 meters in length. If longer cables and/or cabinets are used, the installer is responsible for making sure that the installation complies with the requirements of the relevant standard.

The product is a radio accessory. The installer must make sure that the radio connected to the system has all required approvals and that the installation meets the requirements of the standard. This equipment is a base station unit and complies with the FCC base station requirements. The antenna must be installed outdoors.

Power Connections:

This device accepts 9-30V DC input, maximum 2.5A @15V DC.

This chapter covers the following installation procedures:

- Wall mounting
- Connections
- Backup Batteries
- Miscellaneous

Wall Mounting

The dimensions of the unit are: width – 21.5 cm (8.46"), height – 18.5 cm (7.28"), depth – .85 cm (.33"), weight – 1.5kg maximum (see Figure 2).

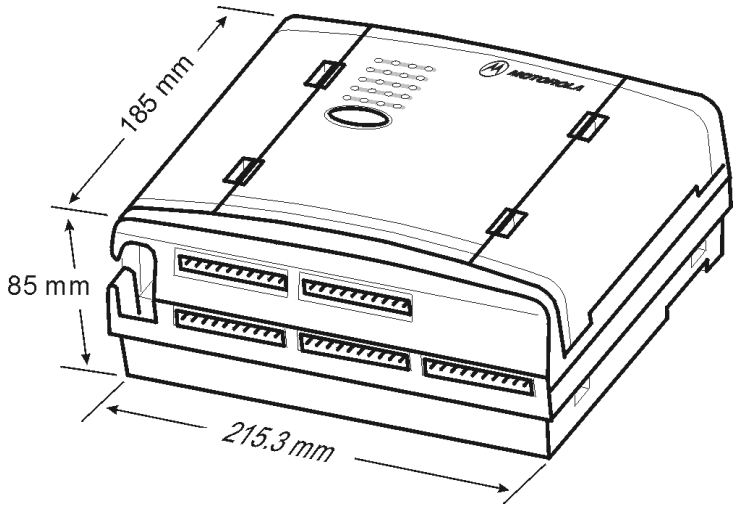


Figure 2
Dimensions of MOSCAD-M RTU Plastic Case

The unit can be installed on screws or on DIN rail mounting. Before installing the MOSCAD-M RTU, verify that there is sufficient space around the unit. Allow 20 cm (7.87") from the bottom of the box for the TB connectors. When an RF connector is attached (internal radio models), allow for an extra 10 cm (4"): 2.02 cm (.8") from the top of the box for the RF connector and 8 cm (3.15") for the wires. For models with external radios, allow 8 cm (3.15").

Wall Mounting with Screws

The MOSCAD-M can be mounted on the wall using screws, as shown in Figure 3.

1. Secure two screws (maximum head size 0.9 mm) on the wall, 105 mm apart.
2. Hang the unit on the screws, fitting the two cavities on the back cover of the unit over the screws (see Figure 3).

The screws used should not protrude from the wall surface by more than 6 mm or by less than 4 mm.

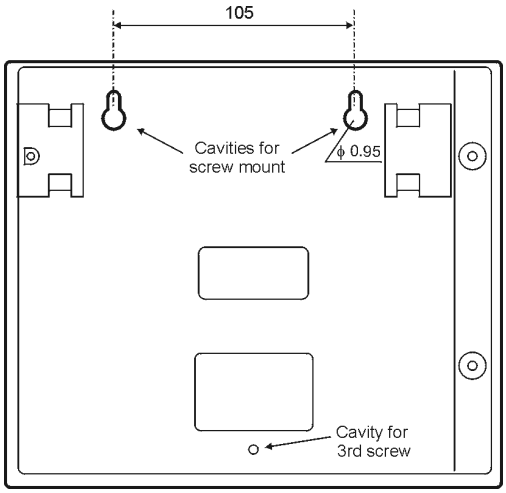


Figure 3
Installation of MOSCAD-M – Screw Mount

It is also possible to attach the MOSCAD-M to the wall using the small screw hole at the bottom of case, though this requires dismantling the RTU, which is generally discouraged. Consult Motorola service personnel before opening the MOSCAD-M casing. To mount the RTU:

1. Open the case and dismantle the parts of the MOSCAD-M.
2. Secure the back of the case against the wall using a screw whose diameter is less than 3.5 mm and head size is at least 5.5 mm.
3. Reassemble the parts of the MOSCAD.

Warning

Before beginning any disassembly or reassembly procedures, you should be adequately grounded to prevent damage to static sensitive devices in the unit.

Wall Mounting on DIN Rail

For mounting the RTU on a DIN rail, two universal foot elements (Phoenix Connectors MFC PIN UMK-FE) are required. To mount the unit, proceed as follows:

1. Slide the two foot elements into the recesses on the back cover of the unit as shown in Figure 4. Press until they click behind the snaps that secure their placement. (See zoomed image in Figure 5.)

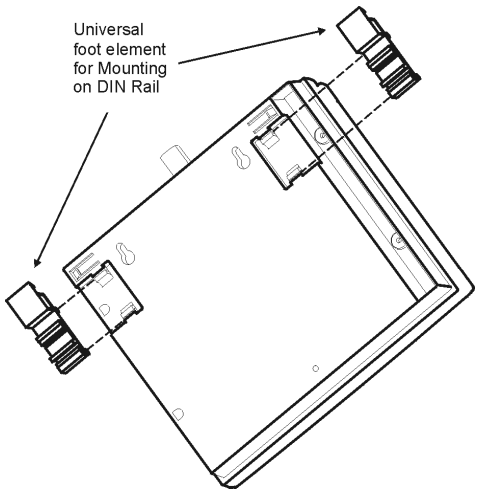


Figure 4
DIN Rail Attachment

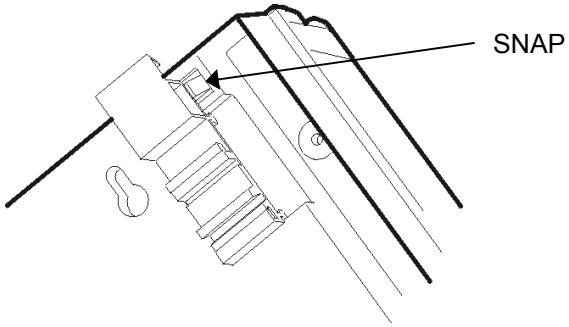


Figure 5
DIN Rail Attachment-Foot Element Snap-in (Enlarged)

2. Press the unit onto the DIN rail, using both universal foot elements. The elements can be used on DIN rail 35 mm and G rails. (See Figure 6).

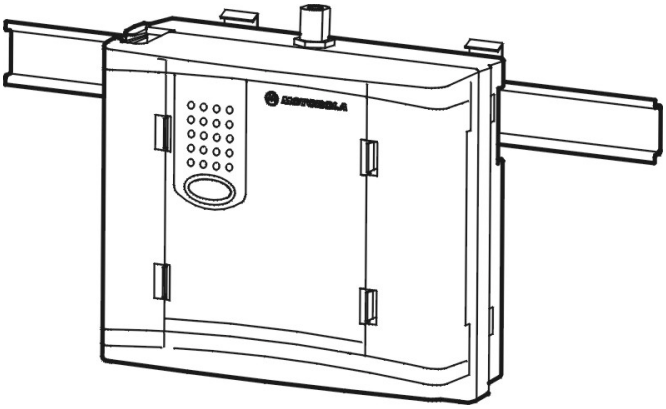


Figure 6
MOSCAD-M Mounted on DIN Rail

Connections


Note

Verify that all power and ground connections are made in accordance with local standards.

Ground Connection


Warning

Connect the grounding cable directly to the protective grounding pins 9 and 10 (PGND) in the main power-in connector (see TB1 in Figure 9).

Power Connections

The unit can be connected directly to a 9-30V DC source through the main Power-In connector (see Figure 9) where Pin #1 is + (positive) and Pin #2 is – (negative).


Warning

It is recommended to connect the main power supply to the unit with a 3.5 amp fuse on the cable.

Backup Battery Connection

The RTU has a special chamber for 3 "C" alkaline backup batteries (not supplied) that are used to retain the unit's RAM and Real Time Clock in power fail situations.

Internal Radio Connection - antenna

The internal radio is connected through the 14-pin connector on the Main board inside the plastic housing. Its power is driven from that connector. When an internal radio is installed, Port 3 of the radio cannot be used.

External Radio Connection

Connect the external radio to Port 3 (see Figure 9). Verify that the radio button is set to ON.

The radio signals are driven from the AUX connector in Figure 9.


Warning

It is recommended to replace the external radio only when the unit is powered off.

If the external radio is connected to an outside power supply, first power on the unit, and then power on the radio.

The auxiliary power supply (maximum 2A) can be changed to 6V, 6.5V, 7.5V, 8V, 9V or 9.6V DC by changing the setting of the P11 jumper located on the Main board. (See markings on the board.) To set the power to 8V, remove the jumper and save for future use.

This is usually set in the factory according to the external power supply of the radio. The default setting is 9V DC. To change the voltage, follow the disassembly instructions in Appendix C, place the jumper and reassemble.

Line Communication Connection

Line Communications are connected through Ports 1 or 2 (see Figure 9.) Port 1 can be programmed as RS485 (1A) or RS232 (1B). Port 2 can be programmed as RS232.

Installation of Backup Batteries

Warning

The backup battery should not be installed before the unit is connected to the main power supply. This may cause the battery to drain.

1. Place 3 “C” size alkaline batteries into the carton cylinder, each in the same direction, as shown in Figure 7 below.

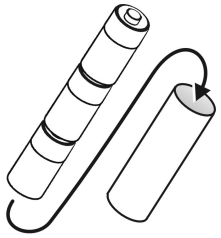


Figure 7
Backup Battery Cylinder and 3 Backup C Batteries

2. Place the cylinder with the batteries into the battery case in the direction indicated on the unit (see Figure 8 below).

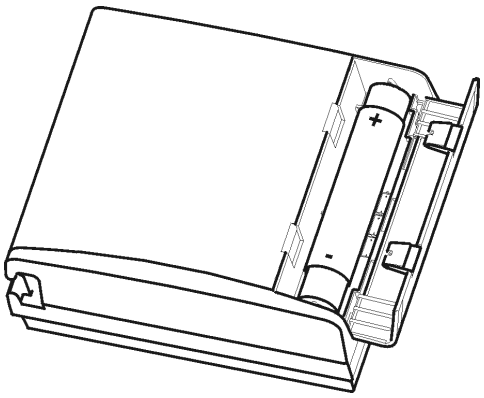


Figure 8
Installation of Backup Batteries

Miscellaneous

Open the Case Door

To open the case door properly, press the two clips (latches) and pull the wing to an open position. The cable cover is opened counter-clockwise to expose the cable connections and the backup battery cover is opened clockwise to expose the battery housing.

Close the Case Door

To close the case door properly, press until the latch clicks. Note that if the batteries in the housing are not inserted properly, the backup battery cover door may not close. If the cable connections are not threaded properly through the cable holes, the cable cover may not close.

Antenna Placement

The antenna is connected to the internal radio through the snap hole on top of the plastic housing (see Figure 9). For models with external radios, screw the antenna onto the radio antenna connector.

An antenna placed on top of the plastic housing produces strong electromagnetic fields that could be harmful to the electronics of the MOSCAD-M RTU and to people in the vicinity.

Fixed Site Antennas

The antenna installation must comply with the following requirements in order to assure optimal performance and make sure human exposure to radio frequency electromagnetic energy is within the guidelines set forth by the local regulations.

- The antenna must be mounted outside the building.
- Mount the antenna on a tower if at all possible.
- If the antenna is to be mounted on a building, then it must be mounted on the roof.
- As with all fixed site antenna installations, it is the responsibility of the licensee to manage the site in accordance with applicable regulatory requirements. This may require additional compliance actions such as site survey measurements, signage, and site access restrictions in order to ensure that exposure limits are not exceeded.

THE MOSCAD-M UNIT

Overview

The MOSCAD-M RTU (shown below) contains power connections, line communication ports, internal/external radio interfaces, radio modems and I/Os.

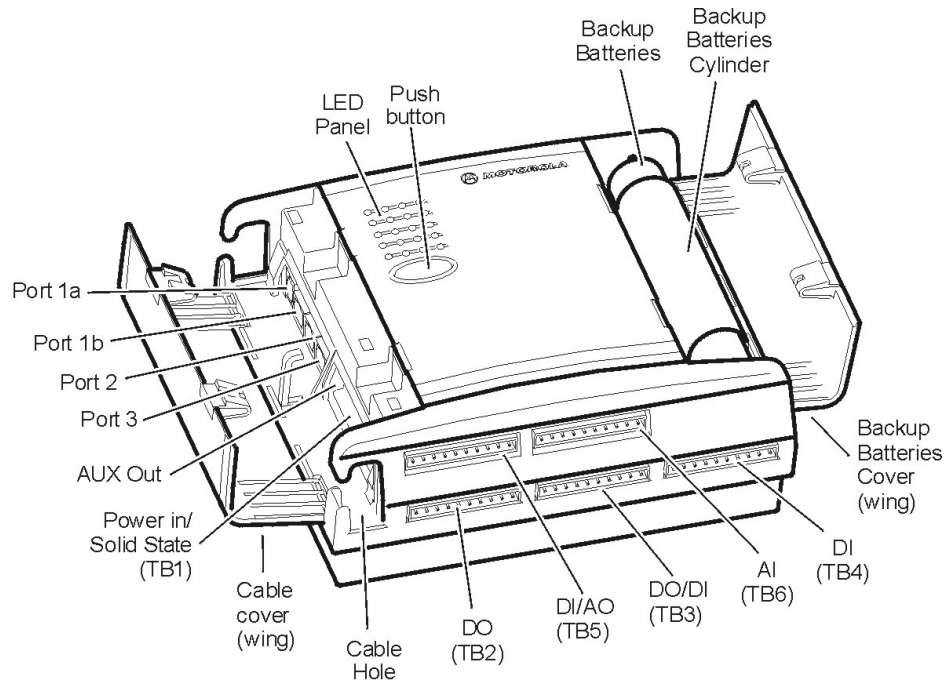


Figure 9
MOSCAD-M Unit

Communication Ports

The MOSCAD-M RTU has 3 ports available:

PORT 1 - RS232 Configurator Port (for programming and monitoring the unit), RS232 External Dialup Modem, or RS485 Communication, User protocol
(1A is used for RS485)
(1B is used for RS232)

PORT 2 – Secondary Port RS232 (User protocol)

PORT 3 – External Radio interface

Ports 2 and 3 can work simultaneously with each other and with either Port 1A or Port 1B. Ports 1A and 1B cannot work simultaneously. Port 3 cannot be used when an internal radio is installed.

Connectors

The MOSCAD-M RTU has the following connectors available (see Figure 9):

RS485 Port 1A (RJ45, 4 pin)

RS232 Port 1B (RJ45, 8 pin)

RS232 Port 2 (RJ45, 8 pin)

External Radio Port 3 (RJ45, 8 pin)

AUX out for external radio power supply (2 pin)

Power In/Solid State DO (10 pin) - TB1

DO (10 pin) – TB2

DO/DI (10 pin) – TB3

DI (10 pin) – TB4

DI/AO (10 pin) – TB5

AI (10 pin) - TB6

The MOSCAD-M RTU has the following internal connectors.

Internal radio connector (14 pin)

Backup Battery connector (2 pin)

I/O Expansion connector (26 pin)

Controls and Indicators

The push-button is used to activate the LED panel, to toggle the LED panel so that it displays the status of the CPU or of the I/Os, to initiate software downloading to the CPU, and to erase User Flash memory and RAM.

LED Control

Display On/Advance

When the display is off, pressing the push-button once, momentarily, activates the display. Every consecutive momentary depression of the push-button advances the display to the next page, in the following order: CPU > IO1 (I/O Page 1-DI) > IO2 (I/O Page 2-DO) > IO3 (I/O Page 3-AI) > Page 4 (AO) > Page 5 (User Application Controlled) > Page 6 (Hardware Test Controlled). The next depression of the push-button returns the display to the CPU.

Display Off

The display can be programmed using the Configurator Site Configuration tool to turn off automatically after a predefined period of time if the push-button has not been pressed.

LED Test

When the push-button is pressed continuously for a few seconds, all LEDs light up simultaneously. When the push-button is released, the LEDs turn off.

User Flash Erase

After power-up, all LEDs light up. To erase the User Flash, press the push-button while the LEDs are lit. All the LEDs flash three times. Now, release the push-button.

Alternatively, press the push-button continuously for at least 40 seconds at any time to erase the User Flash.

User RAM Erase (Cold Restart)

Turn off the power supply, while the push-button is depressed. The next time the unit is powered up, it will perform "cold restart", which means all data stored in the RAM is erased.

Note: The data that is stored in the Flash (i.e. applications, site configuration, and network configuration) will not be erased.

System Software Downloading

During power up, press the push-button continuously. This will cause the unit to enter bootstrap downloading mode, in which the FLASH is programmed from a PC connected to Port 1 of the MOSCAD-M. The CPU LED will begin to blink at 1 Hz, indicating that the CPU has entered bootstrap downloading mode. If after 120 seconds no bootstrap software is loaded and executed, the normal power-up procedure is performed.

CPU Reset

To reset the CPU when a backup battery is not installed, turn the power supply to the unit off and on again. When a backup battery is installed, follow the Cold Restart method described above.

LED Display Indications

A 5 × 4 matrix of LEDs is used for diagnostics and testing of the unit (see Figure 10). The top row indicates to which page or toggle (CPU, IO1, IO2, IO3, Page 4, Page 5, Page 6) the LED panel is set. To advance from one page to another, press the push-button once quickly. The first depression of the push-button activates the display. Subsequent short depressions of the push-button advance the display to the next page: CPU > IO1 (I/O Page 1-DI) > IO2 (I/O Page 2-DO) > IO3 (I/O Page 3-AI) > Page 4 (AO) > Page 5 (User Application Controlled) > Page 6 (Hardware Test Controlled). In each page, the LEDs have different functions, as described in the charts below.

CPU	IO1	IO2	IO3
1	5	9	13
2	6	10	14
3	7	11	15
4	8	12	16

Figure 10
LED Panel

CPU Page LED Functions

The following table describes the functions of the diagnostic LEDs when set to the initial CPU (Page 0) toggle or display (CPU LED on).

Name	On/Off	Function/Indication
CPU	On:	Display is in CPU mode.
	Flashing:	CPU is in bootstrap mode OR FPGA is not loaded correctly.
IO1	Off	
IO2	Off	
IO3	Off	
LED 1 LOAD	On	A file (e.g. configuration, application program) is being downloaded to FLASH memory.
LED 5 CONF	On	A Site configuration definition has been loaded into FLASH memory.
LED 9 APPL	On	An application program has been loaded into FLASH memory.

Name	On/Off	Function/Indication
LED 13 MON	On	Controlled by application for user use.
LED 2 RST	On	The CPU is in Reset mode.
LED 3 ERR	On	An error has occurred.
LED 4 BATT	On	The backup battery does not exist or has reached a critical level of 3.5V.
LED 6 TX1	On	The RTU is transmitting data via Port 1.
LED 7 RX1	On	The RTU is receiving data via Port 1.
LED 8 CM1	On	The communication channel used by Port 1 is busy.
LED 10 TX2	On	The RTU is transmitting data via Port 2.
LED 11 RX2	On	The RTU is receiving data via Port 2.
LED 12 CM2	On	The communication channel used by Port 2 is busy.
LED 14 TX3	On	The RTU is transmitting data via Port 3.
LED 15 RX3	On	The RTU is receiving data via Port 3.
LED 16 CM3	On	The communication channel used by Port 3 is busy.

IO1 Page LED Functions

The following table describes the functions of the diagnostic LEDs when set to the IO1 (Page 1) toggle or display (IO1 LED on).

Name	On/Off	Function/Indication
CPU	Off	
	Flashing:	FPGA is not loaded correctly.
IO1	On	Display is in IO1 page.
IO2	Off	
IO3	Off	
LED 1	On	DI1 is on.
LED 2	On	DI2 is on.
LED 3	On	DI3 is on.
LED 4	On	DI4 is on.
LED 5	On	DI5 is on.
LED 6	On	DI6 is on.
LED 7	On	DI7 is on.
LED 8	On	DI8 is on.
LED 9	On	DI9 is on.
LED 10	On	DI10 is on.
LED 11	On	DI11 is on. (Can be fast counter)
LED 12	On	DI12 is on. (Can be fast counter)
LED 13	On	DI13 is on. (Models with expansion board only)
LED 14	On	DI14 is on. (Models with expansion board only)
LED 15	On	DI15 is on. (Models with expansion board only)


Note

The LED is not updated after each change in DI status, but rather after the user performs a scan. Thus, the status of the DI reflects the status as of the last software scan.

IO2 Page LED Functions

The following table describes the functions of the diagnostic LEDs when set to the IO2 (Page 2) toggle or display (IO2 LED on).

Name	On/Off	Function/Indication
CPU	Off	
	Flashing:	FPGA is not loaded correctly.
IO1	Off	
IO2	On	Display is in IO2 page.
IO3	Off	
LED 1	On	DO1 is set.
LED 2	On	DO2 is set.
LED 3	On	DO3 is set.
LED 4	On	DO4 is set.
LED 5	On	DO5 is set.
LED 6	On	DO6 is set.
LED 7	On	DO7 is set.
LED 8	On	DO8 is set.
LED 9	On	Solid State 1 (AI wetting) is set.
LED 10	On	Solid State 2 (DI wetting) is set.

IO3 Page LED Functions

The following table describes the functions of the diagnostic LEDs when set to the IO3 (Page 3) toggle or display (IO3 LED on). Each AI has two LEDS which represent its status (underflow or overflow). When both LEDS are lit, that means that this specific AI is not calibrated.

Name	On/Off	Function/Indication
CPU	Off	
	Flashing:	FPGA is not loaded correctly.
IO1	Off	
IO2	Off	
IO3	On	Display is in IO3 page.
LED 1	On	AI1 Overflow.
LED 2	On	AI1 Underflow.
LED 3	On	AI1 is uncalibrated.
LED 4	Off	AI1 measures Current. (If AI1 is On, it measures Voltage.)
LED 5	On	AI2 Overflow.
LED 6	On	AI2 Underflow.
LED 7	On	AI2 is uncalibrated.
LED 8	Off	AI2 measures Current. (If AI2 is On, it measures Voltage.)
LED 9	On	AI3 Overflow.
LED 10	On	AI3 Underflow.
LED 11	On	AI3 is uncalibrated.
LED 12	Off	AI3 measures Current. (If AI3 is On, it measures Voltage.)
LED 13	On	AI4 Overflow.
LED 14	On	AI4 Underflow.
LED 15	On	AI4 is uncalibrated.
LED 16	Off	AI4 measures Current. (If AI4 is On, it measures Voltage.)

AO Page LED Functions

The following table describes the functions of the diagnostic LEDs when set to the AO (Page 4) toggle or display (CPU and IO1 LEDs on).

Name	On/Off	Function/Indication
CPU	On	
IO1	On	
IO2	Off	
IO3	Off	Display is in AO page.
LED 1	On	AO1 Voltage.
LED 2	On	AO1 Current.
LED 3	On	AO1 is uncalibrated.
LED 4	Off	
LED 5	Off	
LED 6	Off	
LED 7	Off	
LED 8	Off	
LED 9	Off	
LED 10	Off	
LED 11	Off	
LED 12	Off	
LED 13	Off	
LED 14	Off	
LED 15	Off	
LED 16	Off	

User Page LED Functions

The following table describes the functions of the diagnostic LEDs when set to the User (Page 5) toggle or display (CPU and IO2 LEDs on). The LEDs are controlled by the user 'C' Application.

Name	On/Off	Function/Indication
CPU	On	
IO1	Off	
IO2	On	
IO3	Off	
LED 1	On	User Controlled
LED 2	On	User Controlled
LED 3	On	User Controlled
LED 5	On	User Controlled
LED 6	On	User Controlled
LED 7	On	User Controlled
LED 9	On	User Controlled
LED 10	On	User Controlled
LED 11	On	User Controlled
LED 13	On	User Controlled
LED 14	On	User Controlled
LED 15	On	User Controlled
LED 16	On	User Controlled

The user may choose to define the functions of the diagnostic LEDs in an application program. The display returns from a user-defined toggle to the CPU toggle when the push-button is pressed or as a result of a 'C' command. (See 'C' Toolkit for MOSCAD Family RTUs manual.)

Hardware Test Page LED Functions

The following table describes the functions of the diagnostic LEDs when set to the Hardware Test (Page 6) toggle or display (CPU and IO3 LEDs on). The LEDs are controlled by the Hardware Test utility of the MOSCAD-M Configurator.

Name	On/Off	Function/Indication
CPU	On	
IO1	Off	
IO2	Off	
IO3	On	
LED 1	On	Hardware Test Controlled
LED 2	On	Hardware Test Controlled
LED 3	On	Hardware Test Controlled
LED 5	On	Hardware Test Controlled
LED 6	On	Hardware Test Controlled
LED 7	On	Hardware Test Controlled
LED 9	On	Hardware Test Controlled
LED 10	On	Hardware Test Controlled
LED 11	On	Hardware Test Controlled
LED 13	On	Hardware Test Controlled
LED 14	On	Hardware Test Controlled
LED 15	On	Hardware Test Controlled

I/Os (All Models)

Wetting switch connection (x2)

Two solid state (SS1, SS2) Digital Outputs are provided for wetting/supply voltage control of the DI, AI, or external devices. They are connected to the Power In TB1 (pins 3-8) and can drive up to 400mA each. The switches are equipped with over-current protection, limiting the current driven through each of them to 400 mA maximum. Figure 11 shows how the solid state DOs are to be connected.

It is recommended that the wetting power be connected to the solid state output with a fuse of 1 amp.

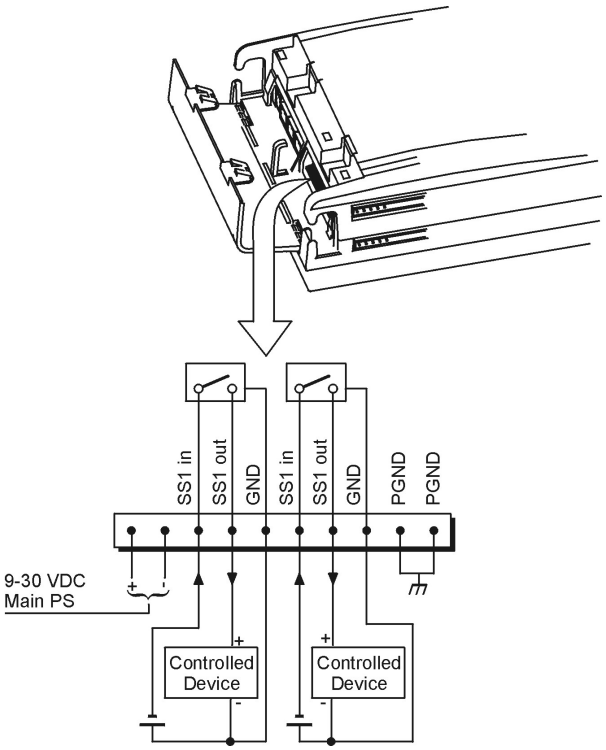


Figure 11
Main Board Solid State Digital Output I/O Connection

DO Magnetic Relay connection (x4)

Four magnetically latched Digital Outputs are connected to TB2. They can drive up to 2A. Figure 12 shows how the DOs are to be connected.

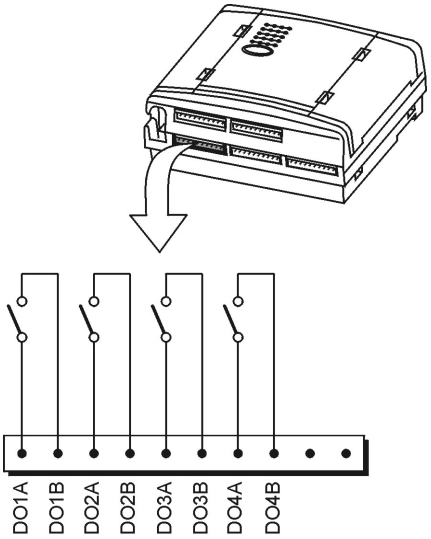


Figure 12
Main Board Magnetically Latched Digital Output I/O Connection

DO Open Collector (x4)

Four open collector Digital Outputs are connected to TB2/TB3. The DOs can sink a current of up to 500mA. They are divided into two groups of two, each with a common ground. Figure 13 shows how the DOs are to be connected

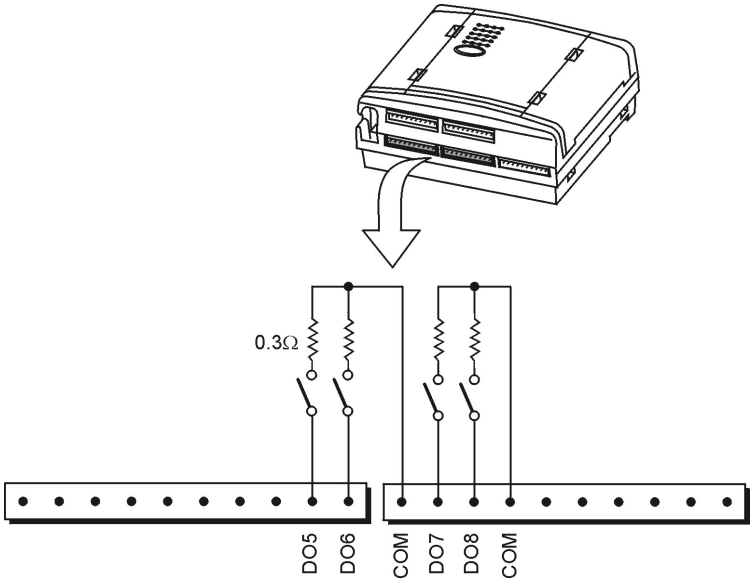


Figure 13
Main Board Open Collector Digital Output I/O Connection

DI (x12)

Twelve wet Digital Inputs are connected to TB3-TB5. Three of these (DI1-DI3) may be used as Wakeup events for the RTU. DI11-DI12 can be used to count pulses of up to 10KHz. They count the rising edge of the pulse. They can also show the actual state of the DI (On/Off). Figure 14 shows how the DIs are to be connected.

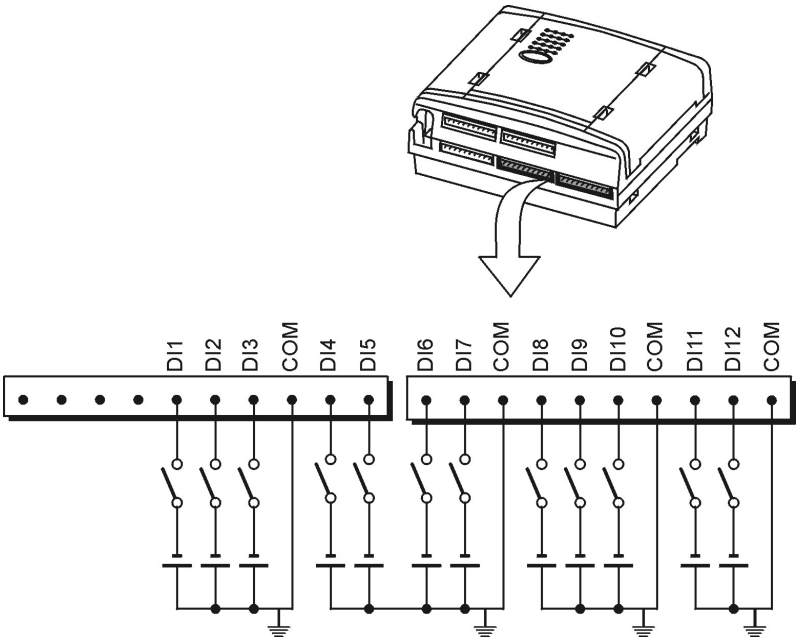


Figure 14
Main Board Digital Inputs I/O Connection

Additional I/Os (Expanded I/O Models only)

AI (x4)

Four Analog Inputs are connected via TB6. (See Figure 9.) The AIs are 4-20mA or 0-5V. Each AI has a jumper which determines the measurement. If the jumper is placed (closed), the AI is set up to measure current (4-20mA). If it is not placed (removed), it measures voltage (0-5V). The jumpers are placed in the factory based on customer order.

If the status of the jumpers is changed, the AI Type must be changed accordingly in the Hardware Test tool of the MOSCAD-M Configurator. See Configurator help.

Four options are available for the AI expansion configuration. The default AI setup of all MOSCAD-M PLUS radios will be 4-20mA (no option is required.)

Options	AI1	AI2	AI3	AI4
Default	4-20mA	4-20mA	4-20mA	4-20mA
V741	4-20mA	4-20mA	4-20mA	0-5V
V742	4-20mA	4-20mA	0-5V	0-5V
V743	4-20mA	0-5V	0-5V	0-5V
V744	0-5V	0-5V	0-5V	0-5V

A label on the plastic housing will specify the AI setup. If, for some reason, the jumpers need to be changed, the RTU must be disassembled. For instructions, see Appendix C. Figure 15 shows how the AIs are to be connected.

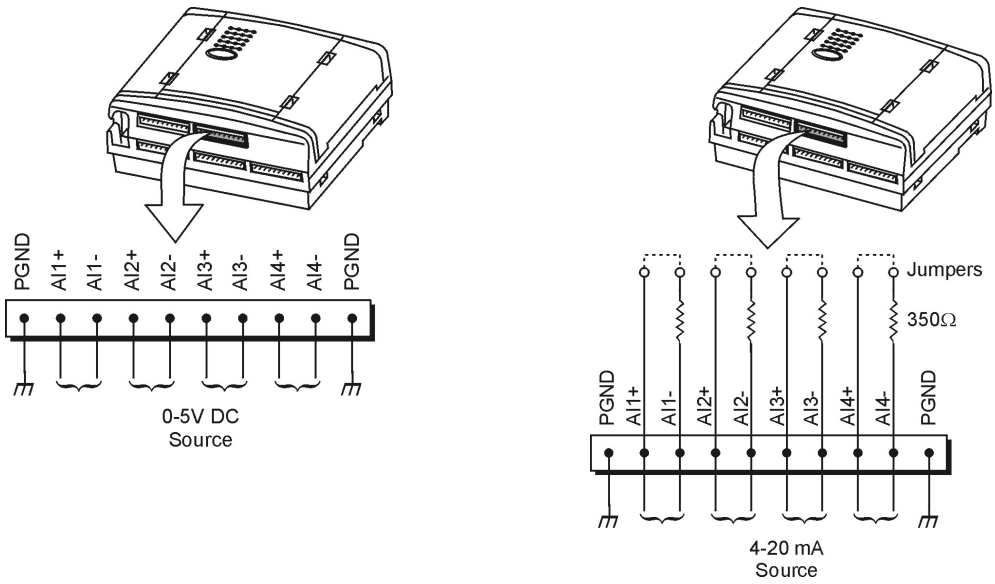


Figure 15
Expansion Board Analog Input (Voltage/Current) I/O Connection

AO (x1)

One Analog Output is connected to TB5. The AO is 0-20mA or 0-5V. The AO type (current or voltage) is determined by connecting to the proper pin on the TB and by selecting the proper AO type in the software (either via the Configurator Hardware Test utility or the user software application.)

The AO can be driven from an internal or external power supply. The minimum output resistance for voltage is 5KΩ. The maximum output resistance for current is as shown below:

Power Supply	Current Output	Maximum Output Resistance
Internal	8VDC	120 Ω
Internal	6VDC	100 Ω
Internal	9VDC	250 Ω
External (24VDC)	23-30VDC	750 Ω
External (24VDC)	22VDC	700 Ω
External (24VDC)	20VDC	Max 600 Ω

The figure below shows how the AO is to be connected.

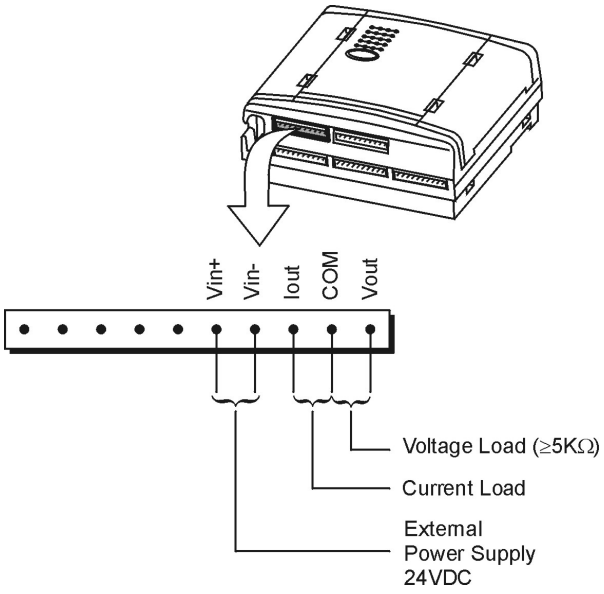


Figure 16
Expansion Board Analog Output I/O Connection

DI (x3)

An additional 3 wet Digital Inputs are connected via TB5. Figure 17 shows how the DIs are to be connected.

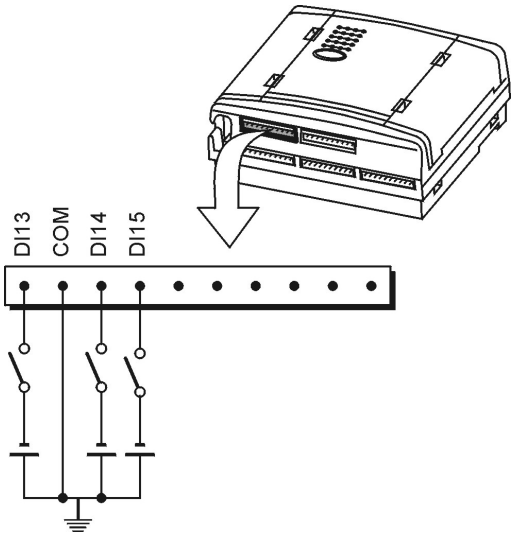


Figure 17
Expansion Board Wet Digital Input I/O Connection

Pin Assignment - Main Board TBs

The following charts indicate the function of each pin in the various terminal blocks (TBs) on the Main board as shown in Figure 9.

TB1 (Power) Pin #	Function
1	Vin +
2	Vin -
3	SS1in
4	SS1out
5	SS1gnd
6	SS2in
7	SS2out
8	SS2gnd
9	PGND
10	PGND

TB2 (DO) Pin #	Function
1	DO1A in
2	DO1B out
3	DO2A in
4	DO2B out
5	DO3A in
6	DO3B out
7	DO4A in
8	DO4B out
9	DO5 (OC)
10	DO6 (OC)

TB3 (DO/DI) Pin #	Function
1	COM DO5, DO6
2	DO7
3	DO8
4	COM DO7, DO8
5	DI1
6	DI2
7	DI3
8	COM DI1-DI3
9	DI4
10	DI5

TB4 (DI) Pin #	Function
1	DI6
2	DI7
3	COM DI4-DI7
4	DI8
5	DI9
6	DI10
7	COM DI8-DI10
8	DI11
9	DI12
10	COM DI11-DI12

Pin Assignment - Expansion Board TBs

The following charts indicate the function of each pin in the various terminal blocks (TBs) on the Expansion board as shown in Figure 9.

TB5 (DI/AO) Pin #	Function
1	DI13
2	COM DI13-DI14
3	DI14
4	DI15
5	PGND
6	Vin +
7	Vin -
8	Iout
9	COM AO
10	Vout

TB6 (AI) Pin #	Function
1	PGND
2	AI1 +
3	AI1 -
4	AI2 +
5	AI2 -
6	AI3 +
7	AI3 -
8	AI4 +
9	AI4 -
10	PGND

Backup Battery

Below 8.9V DC, the unit enters Low Power Sleep mode. As long as the input power is above 6V DC, the unit is still powered from the main power supply input. If the input power drops below 6V DC, the unit will use the backup battery to preserve the contents of the RAM and Real Time Clock (RTC) data. In this case, the unit is in Low Power Sleep mode and not in Reset mode. This means that the status of outputs 1 to 8 is preserved.

The battery will retain the data for at least 70 days (cumulative). Power consumption from the backup battery will be <5mA @ 4.5V DC.

If no backup battery is detected, or if the backup battery falls below 3.1V DC (power fail), the unit will shut down until power is restored. In this case, the RAM and Real Time Clock (RTC) data will not be retained. LED 4 (BATT) will indicate when the backup battery voltage drops below 3.5V. This indication is also available for the user application. Under these circumstances, the SS1 and SS2 Solid State switches are turned off even if they were set to independent operation mode.

Power Supply

The MOSCAD-M can be operated from an input of 9-30V DC. The minimum input level is determined by the output voltage level required for the AUX/Internal radio.

The table below describes the minimum input levels for the different settings:

Output Power	Minimum Input Power
6	9
6.5	9
7.5	9
8	10
9	10.5
9.6	11.5

The AUX/Internal radio power is set by a jumper on the Main board. The table below describes the different models with their default settings from the factory:

Model	Output Power	Minimum Input Power
F4570A	9.6	11.5
F4571A	9	10.5
F4572A	9	10.5
F4573A	7.5	9
F4574A	7.5	9
F4575A	7.5	9
F4580A	9.6	11.5
F4581A	9	10.5
F4582A	9	10.5
F4583A	7.5	9
F4584A	7.5	9
F4585A	7.5	9

POWER MANAGEMENT

Overview

The MOSCAD-M includes a Power Management feature which is controlled by the user application. The unit can operate in four power save modes:

- Power Management Disabled (in which the entire system is operational and no power saving technique is used)
- Run mode (in which the entire system is operational and power is provided only to active ports of the unit)
- Idle Sleep mode (in which the unit uses low power)
- Low Power Sleep mode (in which the unit is basically off)

When the MOSCAD-M is powered up, it operates in Run mode. If **all** application and system tasks are idle, and the Power Management Feature is enabled, the RTU will enter Idle Sleep mode in order to conserve power. The unit will return to Run mode if one of several Wakeup events occurs.

If the input power falls below 8.9V, the unit automatically enters Low Power Sleep mode. The unit will return to its previous mode (Run or Idle Sleep) when the input power returns to at least 9.3V.


Note

The Power Management Feature, which is disabled by default, can be enabled by the user application.

Run Mode

In Run mode, tasks will execute, suspend and exit, as necessary. In order to execute, each application and system task will request a 'visa' from the 'visa manager'. When the task suspends or exits, its visa is returned. If all visas in the system have been returned, the unit can enter Idle Sleep mode. A task can choose to operate without a visa; however, it may be forced into Idle Sleep mode by the system when all other tasks have returned their visas.

Before a task suspends itself, it will define those Wakeup events which will cause it to wake up. When the requested Wakeup event occurs, the task will receive a signal and awaken (even if the Power Management feature is disabled.) If one of these events occurs while the system is in Run mode, it will prevent the system from entering Idle Sleep mode.

Total power consumption from the main power supply in Run mode is at most 150mA @ 14V DC. Typically, power consumption will be 50mA. The additional power consumed by the radio in Run mode depends on the radio type and will be at least 40mA.

Sleep Mode

The MOSCAD-M will enter Sleep mode in the following situations:

- Idle Sleep - All system and application tasks are idle.
- Low Power Sleep - The main power supply falls below 8.9V.

Power consumption is minimized by switching off the power of all non-active circuits and devices (communications inputs and outputs, etc). In Sleep mode, the unit's power consumption will be <5mA @ 14V DC.


Note

In Sleep mode, the current consumption is <5mA. However, the power consumption will be significantly higher if the AO is enabled or the radio port is defined as a Wakeup event. If Port 3 is enabled in Sleep mode, the power consumption will be 30mA and the radio power consumption will be at least 40mA, for a total of at least 70mA.

When entering Idle Sleep mode, the following power supplies are disabled:

- Radio/auxiliary power supply
- AI power supply
- AO power supply
- SS1 and SS2 switches power supply
- 3.3V Peripheral power supply
- Port 1 UART, Port 2 UART power supply

One or more of these power supplies might be left active, depending on the type of Wakeup events that are selected. (See Wakeup events below.)


Note

The AO power supply will not be disabled in Idle Sleep mode if a value is set in the AO.


Note

By default, The solid state SS1 and SS2 switches are controlled by the Power Management feature. However, it is possible to configure them to an independent operation mode where they are controlled (enabled/disabled) by the user application only. If the unit enters Low Power Sleep mode, SS1 and SS2 will be turned off even if set to independent operation mode.

If one of several preprogrammed Wakeup events occurs, the unit will return from Idle Sleep mode to Run mode. Those tasks which requested the Wakeup event will wake up and any other tasks will remain suspended.

If, however, the unit is in Low Power Sleep mode, it will not respond to Wakeup events. When a power level of 9.3V is restored at the power input, the unit will revert to its previous mode.

Wakeup Events

When enabling the Power Management feature, the MOSCAD-M user should configure those Wakeup events that will wake up the unit from Idle Sleep mode.

The possible Wakeup events are:

- DI Wakeup

  When a Change of State occurs in DI1 and/or DI2 and/or DI3, a Wakeup event is generated.

- Push-Button Wakeup

  Pressing the push-button when the unit is in Idle Sleep Mode will cause a Wakeup event. (The push-button is enabled at all times.) The unit will enter Run mode for at least 30 seconds.

- Communication Port Wakeup

  A signal received at one of the unit's three ports, if designated by the user as a Wakeup event, will cause the unit to wake up.

  Port 1 Wakeup: when data stream is received.

  Port 2 Wakeup: when data stream is received.

  Port 3 Wakeup: when an indication for an active channel (channel monitor) is received.

- Periodic (Internal) Wakeup

  The Real Time Clock (RTC) will cause the unit to wake up every 5 minutes to reset the watchdog timer.

The user application can request a wakeup after a certain period of time or upon receipt of a specific Wakeup event. This will then cause the system tasks (and the unit) to wake up and the unit to return to Run mode.

See the 'C' Toolkit for MOSCAD Family RTUs manual (68P02956C75) for details on the system functions which provide these services to the application.

For more information on the Power Management Feature, see the MOSCAD-M RTU Configurator User's Guide (68P02961C55).

ETHERNET INTERFACE OPTION

Overview

The Ethernet interface option is used as a communication link for the MOSCAD-M units with Local Area Networks (LAN). The Ethernet interface option supports TCP/IP protocol on a Twisted Pair (TP) connector, with automatic polarity correction.

External Ethernet Interface Unit

Enclosed in a plastic box, the external Ethernet Interface unit provides an RS232 port for connection of MOSCAD units to LAN. The external Ethernet unit is powered by 9-15V DC and has indication LEDs on its front panel. The system software of the external Ethernet unit can be upgraded using the Ethernet Interface Downloader program.

The following figure depicts the front panel of the Ethernet unit.

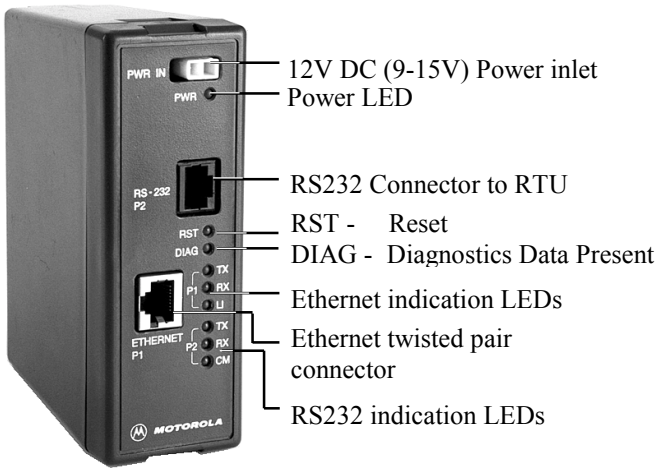


Figure 18
External Ethernet Unit – Front Panel

The Ethernet indication LEDs are:

- TX - Ethernet Transmit
- RX - Ethernet Receive
- LI - Ethernet Link Integrity

The RS232 indication LEDs are:

- TX - RS232 Transmit
- RX - RS232 Receive
- CM - RS232 Channel Monitor

Installation

The unit can be connected to Port 1 or Port 2 of the MOSCAD-M RTU. (See Figure 9.)

Connections

To connect the external Ethernet Interface unit, proceed as follows:

1. Connect the communication cable (FKN5953A) between the external Ethernet Interface unit RS232 Port (P2) and the MOSCAD-M RS232 port (Port 1B or Port 2). If the communication cable is not long enough (80 cm) for external connections, use a longer cable.
2. If no radio is attached to the MOSCAD-M, connect the power cable (FKN4465A) between the Ethernet unit power inlet and the AUX DC connector on the MOSCAD-M. Make sure that the AUX DC is configured to 9V DC and above, as described in the External Radio Connection section of the Installation chapter.

   If a radio (internal or external) is attached to the MOSCAD-M, connect the Ethernet unit power inlet to an external 9-15V DC power supply using the external power cable FKN4090A (not supplied).
3. Connect the Ethernet Interface unit Ethernet Port (P1) to the LAN, using an Ethernet twisted pair shielded cable. Install a Suppression Core (Fair-Rite) P.N. 0443164151 on the cable as shown below.

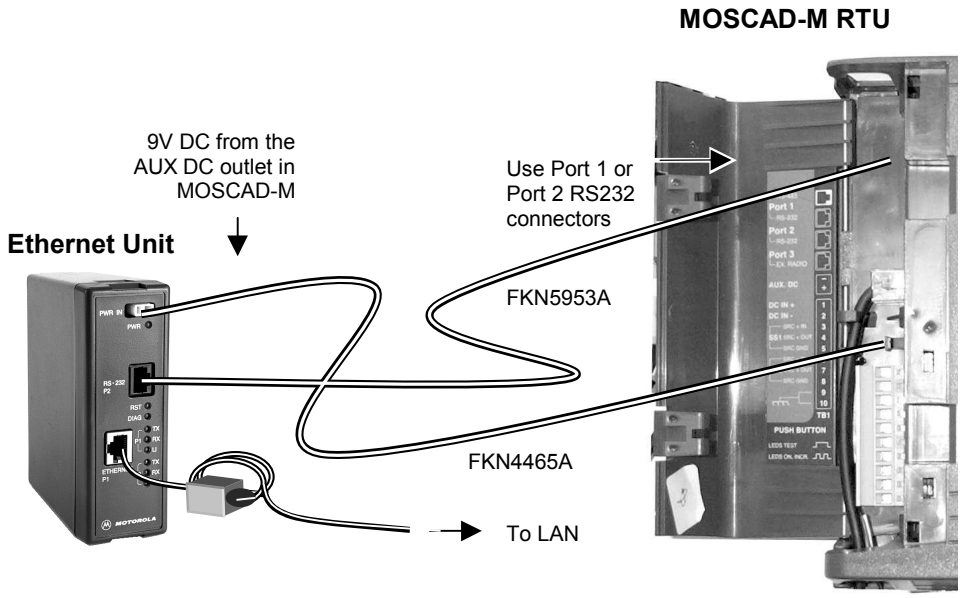


Figure 19
Connection of External Ethernet Unit to MOSCAD-M RTU (without radio)

APPENDIX A: CABLES AND ADAPTERS

General

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

- RTU-to-Computer/Terminal Connections
- RTU-to-Modem Connections
- RTU-to-RTU Connections

RTU-to-Computer/Terminal Connections

For a 25-pin or 9-pin D-type connector, use the FLN6457 cable kit, in order to connect one of the RTU RS232 ports to a computer or terminal. The kit includes a cable with RJ45 modular jacks on both ends, an RJ45 to 25-pin female D-Type adapter, and an RJ45 to 9-pin D-Type adapter.

Note

When the connector is facing upwards, the left-hand pin is Pin No. 1, and the right-hand pin is Pin No. 8.

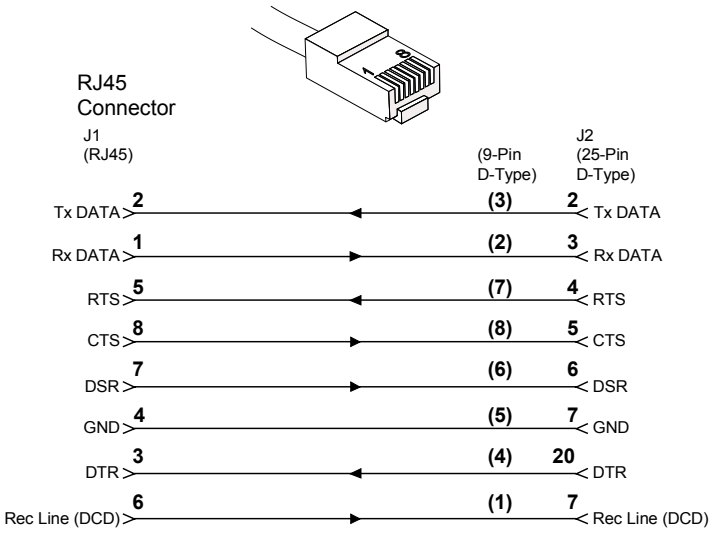


Figure 22
RJ45-to-D-Type Female Connector Adapter

RTU-to-Modem Connections

Note

Only R&TTE approved modems should be used to connect the RTU to the PSTN.

RTU-to-Modem Asynchronous Connection

For a 9-pin or 25-pin connection, use the FLN6458 cable kit to connect one of the MOSCAD-M 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 an RJ45 to 9-pin and 25-pin male D-Type adapter (see Figure 21). The possible RTU configurations are detailed below:

Port No.	Configurator Definition
1	RS-232 UART External Dialup Modem (MDLC)

Note

1. Before transmitting, the RTU sends an RTS=on signal to the modem, and will not transmit unless it receives a feedback CTS=on signal from the modem.
2. The RTU will not receive unless it receives a DCD=on signal from the modem.
3. When using a modem in auto-answer mode (connected to a computer port) for remote service, the RTU does not support the RTS/CTS protocol, as the port is designed to operate with a local computer as well as with a modem.

Note

When the connector is facing upwards, the left-hand pin is Pin No. 1, and the right-hand pin is Pin No. 8.

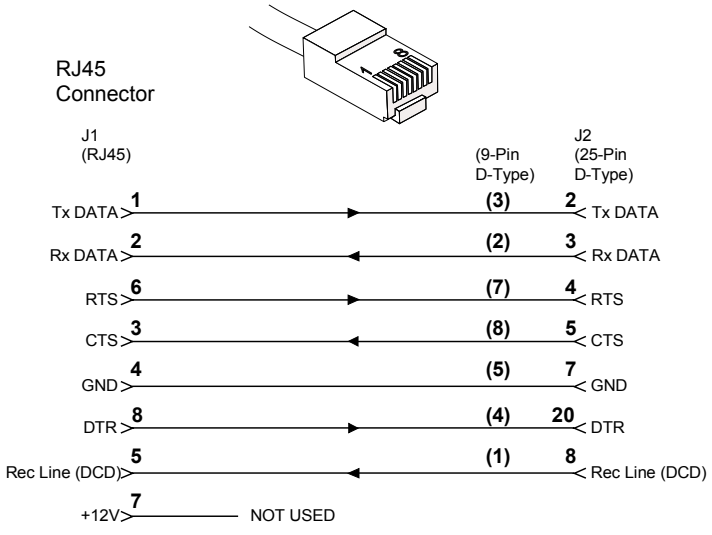


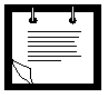
Figure 21
RJ45-to-D-Type Male Connector Adapter

RTU-to-RTU Connection

RTU-to-RTU Asynchronous Communications Connection

This section provides data on the cable (not supplied) recommended for the RTU-to-RTU RS232 asynchronous interconnection (refer to Figure 22). The following table defines the RTU port for this connection type.

Port No.	Configurator Definition
1B	RS-232 UART RTU-to-RTU (MDLC)
2	RS-232 UART RTU-to-RTU (MDLC)



Note

When the connector is facing upwards, the left-hand pin is Pin No. 1, and the right-hand pin is Pin No. 8.

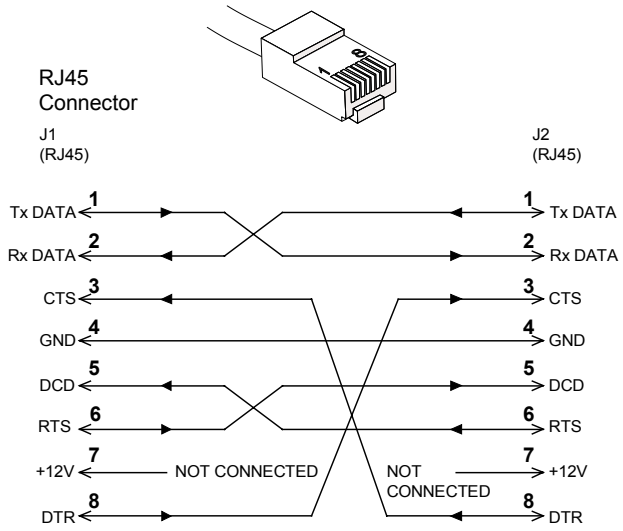


Figure 22
RTU-to-RTU RS232 Asynchronous Communications Cable

APPENDIX B: MODELS AND ACCESSORIES

General

The chart below describes the models, options and accessories available.

MOSCAD-M RTU Models	Model
MOSCAD-M with Interface to External Radio	F4570
MOSCAD-M with 4W 403-433 MHz Internal Radio	F4571
MOSCAD-M with 4W 438-470 MHz Internal Radio	F4572
MOSCAD-M with 5W 136-174 MHz External Radio	F4573
MOSCAD-M with 4W 403-470 MHz External Radio	F4574
MOSCAD-M with 4W 470-512 MHz External Radio	F4575
MOSCAD-M Plus with Interface to External Radio	F4580
MOSCAD-M Plus with 4W 403-433 MHz Internal Radio	F4581
MOSCAD-M Plus with 4W 438-470 MHz Internal Radio	F4582
MOSCAD-M Plus with 5W 136-174 MHz External Radio	F4583
MOSCAD-M Plus with 4W 403-470 MHz External Radio	F4584
MOSCAD-M Plus with 4W 470-512 MHz External Radio	F4585

MOSCAD-M Options	Option
ENH: Set radio to: HT750	V951
ENH: Set radio to: GP140	V952
ENH: Set radio to: GP328	V953
ENH: Set radio to: PRO5150	V954
ALT: Set 4AI to: 3 x 4-20mA & 1 x 0-5V	V741
ALT: Set 4AI to: 2 x 4-20mA & 2 x 0-5V	V742
ALT: Set 4AI to: 1 x 4-20mA & 3 x 0-5V	V743
ALT: Set 4AI to: 4 x 0-5V	V744

Miscellaneous	**Accessory**
ADD: MOSCAD-M Installation Kit for GP/HT/PRO Radios	V154 FLN3010
ADD: MOSCAD-M Installation Kit for HT1000 Radio	V153
ADD: DIN Rail	V020
ADD: Bracket for Ethernet Unit	V056

Programming Tools	**Model**
MOSCAD-M Configurator	F4560
MOSCAD Family ‘C’ Toolkit Software	F4561
MOSCAD-M Debug Kit (C Toolkit)	FLN3012

Installation of MOSCAD-M with GP140/328/HT750/PRO5150 Radio

MOSCAD-M models which are equipped with GP140, GP328, HT750 or PRO5150 radios should be connected as shown below.

If your MOSCAD-M model does not include one of these radios, the MOSCAD-M Installation Kit for GP140/GP328/HT750/PRO5150 Radios can be purchased. The radio is then connected as shown below.

GP140/GP328/HT750/PRO5150 Radio

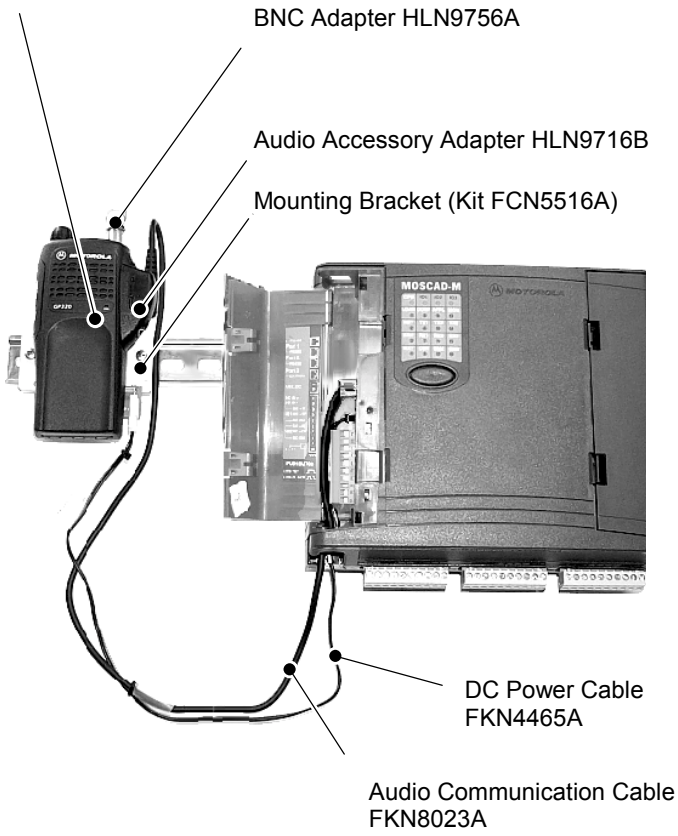


Figure 23
Connection of MOSCAD-M to GP140/328/HT750/PRO5150 Radio

- Secure the Mounting Bracket to the DIN Rail.
- Attach the radio to the Mounting Bracket using snaps.
- Route the Audio Communication Cable from the "PORT 3" connector of the MOSCAD-M to the Audio Accessory Adapter. Plug in and tighten the connector.
- Route the DC Power Cable from the "AUX. DC" connector of MOSCAD-M to the Mounting Bracket and plug in the connector. Make sure the AUX power is set to 7.5V DC. Set the middle knob (channel select knob) to Channel 1.
- Use the BNC Adapter to connect an external antenna to the radio.

MOSCAD-M Installation Kit for GP140/GP328/HT750/PRO5150 Radios

The MOSCAD-M Installation Kit for GP140/GP328/HT750/PRO5150 Radios enables users to install a GP140, GP328, HT750 or PRO5150 radio (externally) to the MOSCAD-M. The Installation Kit includes:

- Mounting Bracket (FCN5516A)
- Audio Communication Cable (FKN5953A)
- Audio Accessory Adapter (HLN9716B)
- DC Power Cable (FKN4465A)
- BNC Adapter (HLN9756A)
- DIN Rail Radio Connectors (Part #0786144U05)

See Figure 23 for connection details.

MOSCAD-M Debug Kit

The MOSCAD-M Debug kit enables the user to debug a 'C' application using the XRAY debugger. Set up the MOSCAD-M Configurator PC as described below, then follow the debugging instructions in the 'C' Toolkit for MOSCAD Family RTUs manual.

MOSCAD-M Board

The kit consists of a special MOSCAD-M board, specifically built for debugging. The system software (system.krl) is burned into the flash memory at the factory. Another system file (MmxyyD2.krl) is available with the Debug System Installation (FVN9779) MOSCAD-M Configurator and must be downloaded before using the Microtec XRAY debugger.

The debug board has no plastic housing and all components are visible. Next to the push-button there are two additional buttons which do not exist in the standard MOSCAD-M. The leftmost button is Reset. The rightmost button is NMI (Non Masked Interrupt). The NMI (or CTRL+C from the PC keyboard) will stop the program.

Two megabytes of RAM are installed in the debug board to enable downloading the system software from the PC to the unit.

Debug Setup

By default, downloading from the PC to the unit is done via Port 2. When the unit is first powered up, LED 12 (CM2) should be lit, indicating that the debugger should be downloaded via Port 2.

In order to connect to Port 1, a modified system file must be downloaded to the flash. This file is available from the factory.

To set up the system for debugging, do as follows:

a) Compile and link your application using Microtec tools.

b) Connect the MOSCAD-M Configurator to the debug board as you would the standard MOSCAD-M board.

c) In the Site Configuration utility, set Port 2 to Not Used.

d) Download the site configuration.

e) Connect Port 1 of the RTU to the COM port of the PC.

f) Switch off the RTU, then switch it on again, while the push-button is pressed. The system will then be in bootstrap mode where a new system can be downloaded.

g) If a communication session is open with the RTU, make sure to use the Stop Communication utility in the Configurator.

h) In the Downloader utility, make sure the proper PC COM port is specified in the download session and download the system file using the MMxyyD2.KRL file. The .krl file, which is found in the C:\MConf150\system directory when the debug system is installed, downloads the corresponding system and kernel files to the RTU.

i) Make sure that the CM2 LED is lit, indicating that the port is ready to communicate with the Microtec debugger.

j) Connect Port 2 of the RTU to the PC COM port on which the XRAY debugger runs.

k) Copy the include file (e.g. MM_V100.inc) which suits your MOSCAD-M version into the directory. Compile and link your source files.

l) Use the MCDEBUG.BAT file to load the 'C' application into the RAM.

m) Follow the debug instructions in the 'C' Toolkit for MOSCAD Family RTUs manual.

Note

If the unit is powered off or if the main power input falls below 3.1V DC, the RAM data will not be retained and the debugger will have to be downloaded again.

Logic Analyzer

The MOSCAD-M debug board can be connected to a Logic Analyzer in order to perform sophisticated debugging. The Logic Analyzer is used when it is necessary to see what is running on the data and address bus. This is generally in extreme cases where the memory is corrupted and the problem cannot be found using the debugger capabilities.

The Logic Analyzer is connected to the board through connectors P12, P13, and P14 on the upper right-hand side of the board. These connectors (Motorola part # 2808044H09) are not provided with the MOSCAD-M board and must be ordered separately and assembled.

The pins of the connection cable should be configured according to the Pin Assignment below. Once the pins are configured, the cables should be connected from the Logic Analyzer to the connectors on the board.

Pin Assignment – Logic Analyzer TBs

The following charts indicate the function of each pin in the various connectors.

P12 Pin #	Function
1	NC
2	NC
3	PG0_DTACK
4	Address bus Add bit 15
5	Address bus Add bit 14
6	Address bus Add bit 13
7	Address bus Add bit 12
8	Address bus Add bit 11
9	Address bus Add bit 10
10	Address bus Add bit 9

P12 Pin #	Function
11	Address bus Add bit 8
12	Address bus Add bit 7
13	Address bus Add bit 6
14	Address bus Add bit 5
15	Address bus Add bit 4
16	Address bus Add bit 3
17	Address bus Add bit 2
18	Address bus Add bit 1
19	PG1_A0
20	GND

P13 Pin #	Function
1	EMUCS
2	EMUIRQ
3	HIZ
4	Data bit 21
5	Flash chip select (CSA0)
6	UDS signal
7	LDS signal
8	LWE_LB signal
9	UWE_UB signal
10	RW signal

P13 Pin #	Function
11	EN_OF signal
12	RESET signal
13	CSB1 - upper RAM chip select
14	CSB0 - lower RAM chip select
15	Data bus D20
16	Data bus D19
17	Data bus D18
18	Data bus D17
19	Data bus D16
20	GND

P14 Pin #	Function
1	NC
2	NC
3	CLK0 (clock out signal)
4	Data bus D15
5	Data bus D14
6	Data bus D13
7	Data bus D12
8	Data bus D11
9	Data bus D10
10	Data bus D9

P14 Pin #	Function
11	Data bus D8
12	Data bus D7
13	Data bus D6
14	Data bus D5
15	Data bus D4
16	Data bus D3
17	Data bus D2
18	Data bus D1
19	Data bus D0
20	GND

APPENDIX C: CHANGING THE ANALOG INPUT MEASUREMENT TYPE

General

This chapter describes changing the units of measurements of the AIs, from current to voltage and vice versa. To do so, the RTU is disassembled, jumpers are placed on the Expansion board, and the unit is reassembled, as described below. The AI setup of the MOSCAD-M PLUS radios is described under *AI (x4)* in the Installation chapter.


Note

If the status of the jumpers is changed, the AI Type must be changed accordingly in the Hardware Test tool of the MOSCAD-M Configurator. See Configurator help.


Warning

Before beginning any disassembly or reassembly procedures, you should be adequately grounded to prevent damage to static sensitive devices in the unit.

Disassembling the RTU

Remove Connectors

Before opening the RTU, the five 10-pin connectors on the bottom of the RTU must be disconnected. Note the configuration of the connections so that they can be easily reconnected after placing the jumpers and reassembling the RTU.

Open RTU

Turn the unit upside down, so that the rightmost wing is closer to you. Using both thumbs, press the two tabs (A) at the bottom of the unit, as shown in Figure 24, to release the back of the case. Lift the cover (B) and push forward slightly (C), to release the cover from the top tabs.

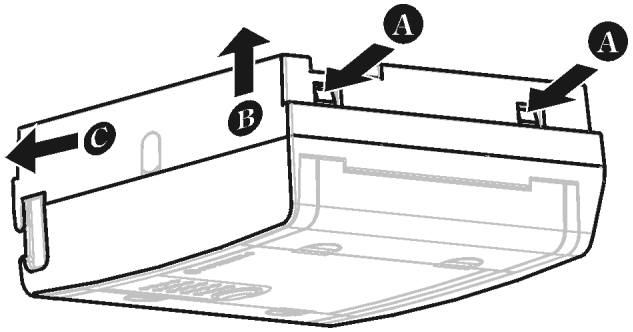


Figure 24
Opening MOSCAD-M RTU Plastic Case

Remove Main Board

Press the two small tabs (A) at the top of the Main board (shown in Figure 25) to release the top of the Main board. Then press the two small tabs at the bottom of the Main board (B) to release the bottom of the Main board. Lift the Main board out of the housing.

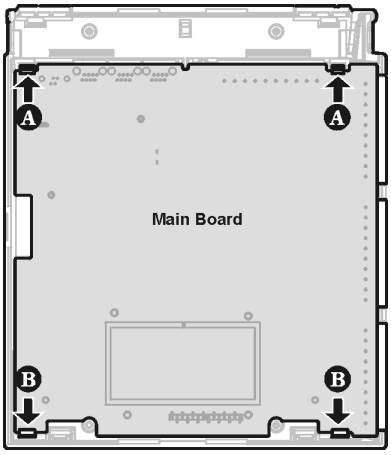


Figure 25
Removing Main Board from MOSCAD-M RTU

Remove Expansion Board

Press the two small tabs at the top of the Expansion board (A) to release the top of the Expansion board. (See Figure 26.) Then press the two small tabs at the bottom of the Expansion board (B) to release the bottom of the Expansion board. Lift the Expansion board out of the housing.

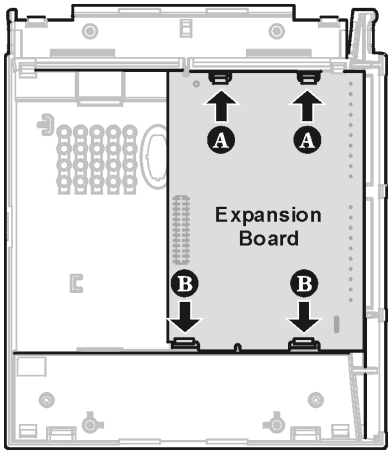


Figure 26
Removing Expansion Board from MOSCAD-M RTU

Place Jumpers

Flip over the Expansion board. Locate the four jumpers marked P7, P8, P9, and P10, near the center of the board, as shown in Figure 27. All jumpers which are placed measure 4-20mA.

To change an AI to 0-5V, remove the jumpers. Make sure to save the cap. To change an AI to 4-20mA, place the jumpers. Press the cap down until you hear it click.

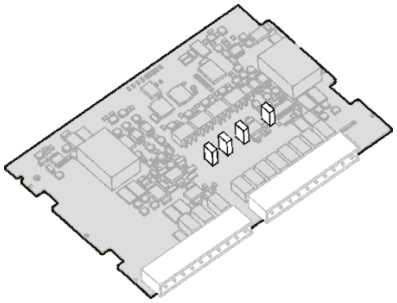


Figure 27
Expansion Board with Jumpers

The chart below shows the correlation of jumpers to AIs.

AI1	AI2	AI3	AI4
P7	P8	P9	P10

Reassembling the RTU

Install Expansion Board

With the jumpers facing down and the 10-pin connectors on your right, lower the bottom of the Expansion board into the case. Align the peg on the upper left-hand side of the board (A) and the two tongues toward the bottom of the board (A) with the matching grooves (A) (see Figure 28). Press the Expansion board under the two large snaps at the bottom of the board until you hear them click (B). Press the top of the Expansion board under the two small snaps until you hear them click (C).

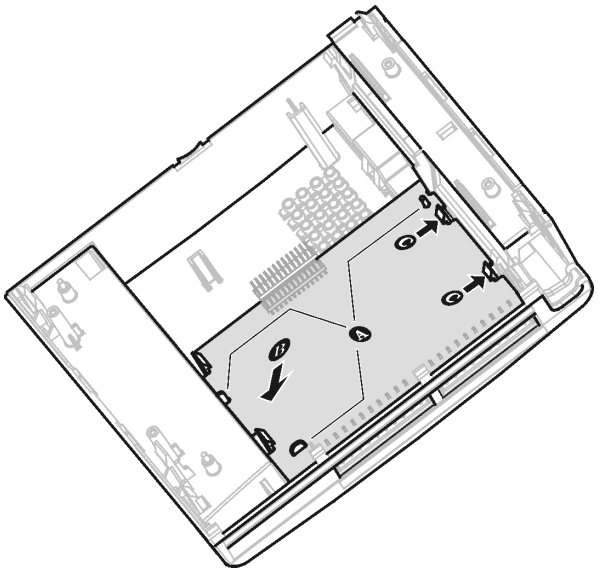


Figure 28
Installing Expansion Board

Install Main Board

Hold the Main board with the push-button facing down and the 10-pin connectors on the right. Lower the board, aligning the two small gray round pegs (A) (see Figure 29) on the bottom of board and the small oblong peg on the upper left-hand side of the board with the matching grooves. Using both thumbs, press the bottom of the Main board under the two bottom snaps (B). Use both thumbs to press the top of the board under the two top snaps (C).

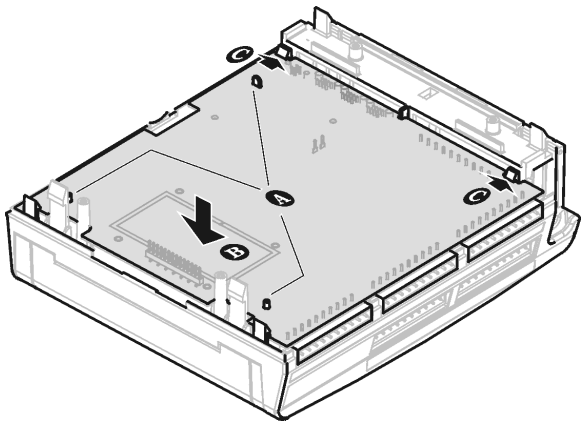


Figure 29
Installing Main Board

Close Case

Hold the back of the case face down, with the holes for screw mount to your left. Align the two top snaps with the two grooves on the top of the case back. Press with both thumbs until you hear it click. Use both thumbs to press the bottom of case back under the snaps until you hear it click.

Turn the unit right side up.

Reconnect the 10-pin connectors in their original configuration.