

Distributed Power System Universal Drive Controller Module

B/M O-57552

Universal Drive Controller Module EM

B/M O-57652

Instruction Manual S-3007-3

 **Rockwell** Automation

Throughout this manual, the following notes are used to alert you to safety considerations:



ATTENTION: Identifies information about practices or circumstances that can lead to personal injury or death, property damage, or economic loss.

Important: Identifies information that is critical for successful application and understanding of the product.

The thick black bar shown at the margin of this paragraph will be used throughout this manual to indicate new or revised text or figures.



ATTENTION: Only qualified personnel familiar with the construction and operation of this equipment and the hazards involved should install, adjust, operate, or service this equipment. Read and understand this manual and other applicable manuals in their entirety before proceeding. Failure to observe this precaution could result in severe bodily injury or loss of life.

ATTENTION: The user is responsible for conforming with all applicable local, national, and international codes. Failure to observe this precaution could result in damage to, or destruction of, the equipment.

ATTENTION: The user must provide an external, hardwired stop circuit outside of the drive circuitry. This circuit must disable the system in case of improper operation. Uncontrolled machine operation may result if this procedure is not followed. Failure to observe this precaution could result in bodily injury.

ATTENTION: Only qualified Rockwell personnel or other trained personnel who understand the potential hazards involved may make modifications to the rack configuration and application tasks. Any modifications may result in uncontrolled machine operation. Failure to observe this precaution could result in damage to equipment and bodily injury.

ATTENTION: Registers and bits in the UDC module that are described as "read only" or for "system use only" must not be written to by the user. Writing to these registers and bits may result in improper system operation. Failure to observe this precaution could result in bodily injury.

The information in this users manual is subject to change without notice.

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CHAPTER 1

Introduction

The AutoMax™ Universal Drive Controller (UDC) module is used for Distributed Power drive control applications. The Distributed Power System (DPS) is a programmable microprocessor-based control system that is capable of real-time control of AC and DC drives. The JDC module plugs into the backplane of an AutoMax rack and is used to control one or two drives. Both AC and DC drives can be controlled from one JDC module. Up to 10 UDC modules can be mounted in an AutoMax rack permitting control of up to 20 drives from a single rack.

The UDC module communicates with the AutoMax Processor module(s) in the rack via the Multibus™ backplane and with up to two Power Module Interfaces (PMIs) via separate fiber-optic communication links. Refer to figure 1.1. The PMI, located at the Power Module, executes the control algorithm and transmits diagnostic and I/O data to the UDC module over the fiber-optic link. The control type (current, vector, brushless, etc.) is determined by the operating system contained in the PMI.

The UDC module contains non-volatile flash memory to store the operating systems for the UDC module and the PMIs, the drive configuration information, and the UDC tasks (one for each drive). The UDC module runs the outer control loop task and sends real time control information to the PMI over the fiber-optic link. The UDC module also contains dual port memory which is used as a storage buffer for exchanging data with the AutoMax Processor module(s) in the AutoMax rack.

This manual describes the functions and specifications of the UDC module as well as installation procedures. Unless specifically noted otherwise, the information in this manual applies to both B/M O-57552 and B/M O-57652. For information about DPS application programming and a description of the registers in the UDC module's dual port memory, see the appropriate Configuration and Programming instruction manual.

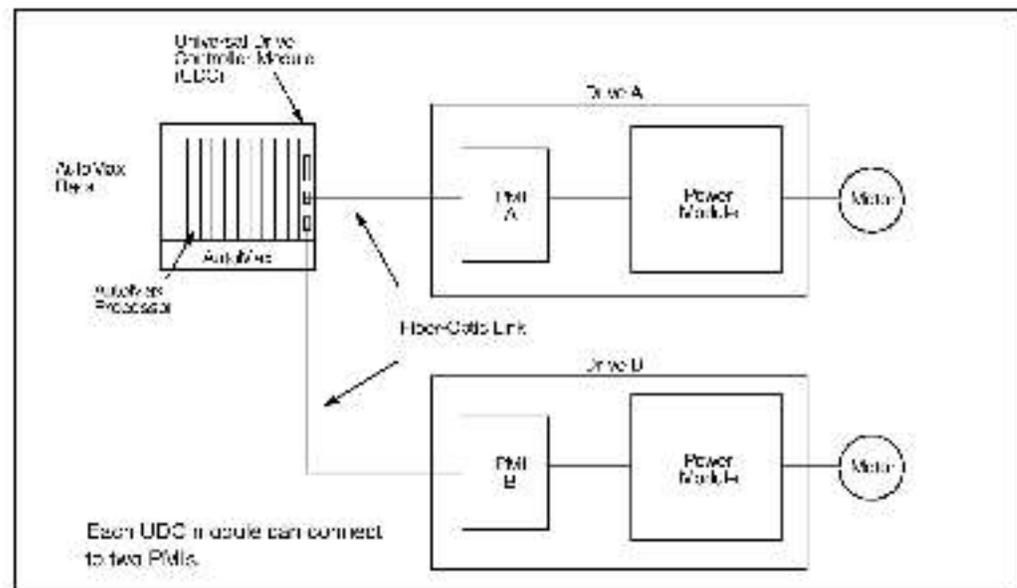


Figure 1.1 - Typical Hardware Configuration

1.1 Related Publications

The documentation that describes the SD3000/SF3000, SA500, SA3000, and SA3100 DPS drives is contained in separate binders. Most of the manuals are tailored to describe the hardware and/or software features in detail for each drive type. Table 1.1 shows the associated document part number for each drive type.

Table 1.1 – DPS Documentation

Document	Document Part Number			
	SD/SF3000 Binder S-3000	SA500 Binder S-3002	SA3000 Binder S-3001	SA3100 Binder S-3053
DPS Overview	S-3005	S-3005	S-3005	S-3005
UDC Module	S-3007	S-3007	S-3007	S-3007
Fiber-Optic Cabling	S-3009	S-3009	S-3009	S-3009
Configuration & Programming	S-3006 ¹ S-3036 ²	S-3044	S-3042	S-3056
Power Module Interface	S-3008	S-3018	S-3019	S-3057
Power Module	S-3037	S-3018	S-3020 ³ S-3029 ⁴	S-3058
Diagnostics, Troubleshooting & Start-Up Guidelines	S-3011	S-3022	S-3021	S-3059
DC Bus Supply	N/A	S-3017	N/A	N/A
Information Guide	S-3012	S-3024	S-3023	S-3054

1. SD3000 2. SF3000 3. Medium Power 4. High Power

1.1.1 1567 Power Max™ Documentation

1567 Power Max medium voltage AC drives also operate under the control of the AutoMax DPS system. The 1567 Power Max binder (S-3040) contains the following manuals:

Table 1.2 – Power Max™ Documentation (Binder S-3040)

Document	Document Part Number
DPS Overview	S-3005
UDC Module	S-3007
Fiber-Optic Cabling	S-3009
Medium Voltage Inverter	S-3041
12-Pulse Diode Rectifier	S-3048
PMI Subsystem	S-3049
Drive Configuration & Programming	S-3050
Liquid Cooling System	S-3051
Installation Guidelines	S-3052
Drive Information Guidelines	S-3046

Mechanical/Electrical Description

The following is a description of the faceplate LEDs, connectors, switches, and the electrical characteristics of the module.

2.1 Mechanical Description

The UDC module is a printed circuit board assembly that plugs into the backplane of an AutoMax rack. It consists of a printed circuit board, a faceplate, and a protective enclosure. The faceplate contains tabs at the top and bottom to simplify removing the module from the rack. The back of the module contains two edge connectors that attach to the rack backplane. Module dimensions are listed in Appendix A. See figure 2.1 for the module faceplate. (Note that, except for the B/M number designation, the UDC module faceplates are identical.)

The faceplate contains six status and fault LEDs for diagnostic purposes. These are described in detail in section 2.2.1. Ports are provided for two sets of fiber-optic cables which provide the connections between the UDC module and the PMI(s). The UDC module is shipped with dust caps covering the fiber-optic connectors. To prevent damage to the connectors, the dust caps should not be removed until you are ready to connect the fiber-optic cables (see section 3.2), and should be replaced whenever the cables are disconnected from the UDC module. The UDC module has four analog output ports which can be connected to meters or chart recorders (see section 2.2.4). Any register in the UDC dual-port memory can be mapped to these ports for output to a meter or data-logging device. A switch and push-button located on the faceplate can be used for test purposes (see section 2.2.5).

2.2 Electrical Description

The UDC module is designed to work in an AutoMax rack as a Multibus slave only. It is not capable of acquiring the bus to read or write data to an I/O module.

The UDC module uses a 32-bit RISC (Reduced Instruction Set Computer) microprocessor running at 20 MHz. (The UDC EM also contains cache memory on the microprocessor, allowing UDC tasks to execute faster.) The module also contains a local watchdog timer which must be written to by internal software every 9 milliseconds. If a watchdog time-out occurs, the Card OK LED on the module faceplate will turn off. The module can generate interrupts to an AutoMax application task based on a user-defined time period for the purpose of synchronizing multiple drives.

Two separate fiber-optic links are used to provide high-speed serial communication between the UDC module and the PMIs. The fiber-optic links transmit Manchester-encoded data at a rate of 10 Mbit/sec, using cyclical redundancy (CRC) error checking. The links are used to load the PMI operating system to the PMI and to transmit/receive reference and feedback data. See section 2.2.3 for a description of the communication cycle between the UDC module and the PMI.

The UDC module contains three types of memory, as shown below.

UDC Memory Type	UDC Memory Size ¹	
	UDC Module B/M O-57552	UDC EM Module B/M O-57652
Non-volatile read/write flash	256 Kbytes	384 Kbytes
Volatile SRAM (local memory)	512 Kbytes	512 Kbytes
Dual-port SRAM	4 Kbytes	4 Kbytes

¹ Both modules contain the same amount of memory for application tasks.

The non-volatile flash memory contains the operating systems for the UDC module and the PMI, the drive configuration information, the UDC application tasks (one for each drive), and the tunable variable data. After the initial power up of the AutoMax rack, all of this data must be loaded to the UDC module using the AutoMax Programming Executive software. Note that the UDC EM module (B/M O-57652) provides more non-volatile read/write flash memory for storing operating systems.

After power up, the UDC operating system and the UDC tasks (if they exist) are read into SRAM from flash memory. The SRAM is also used to store all the local variables. Note that local variables are not retained through a power cycle, but tunable variables are retained.

The dual-port memory is used as a storage buffer for exchanging data with other modules in the AutoMax rack. The dual-port memory on a UDC module can be accessed by the AutoMax Processor and the UDC microprocessor.

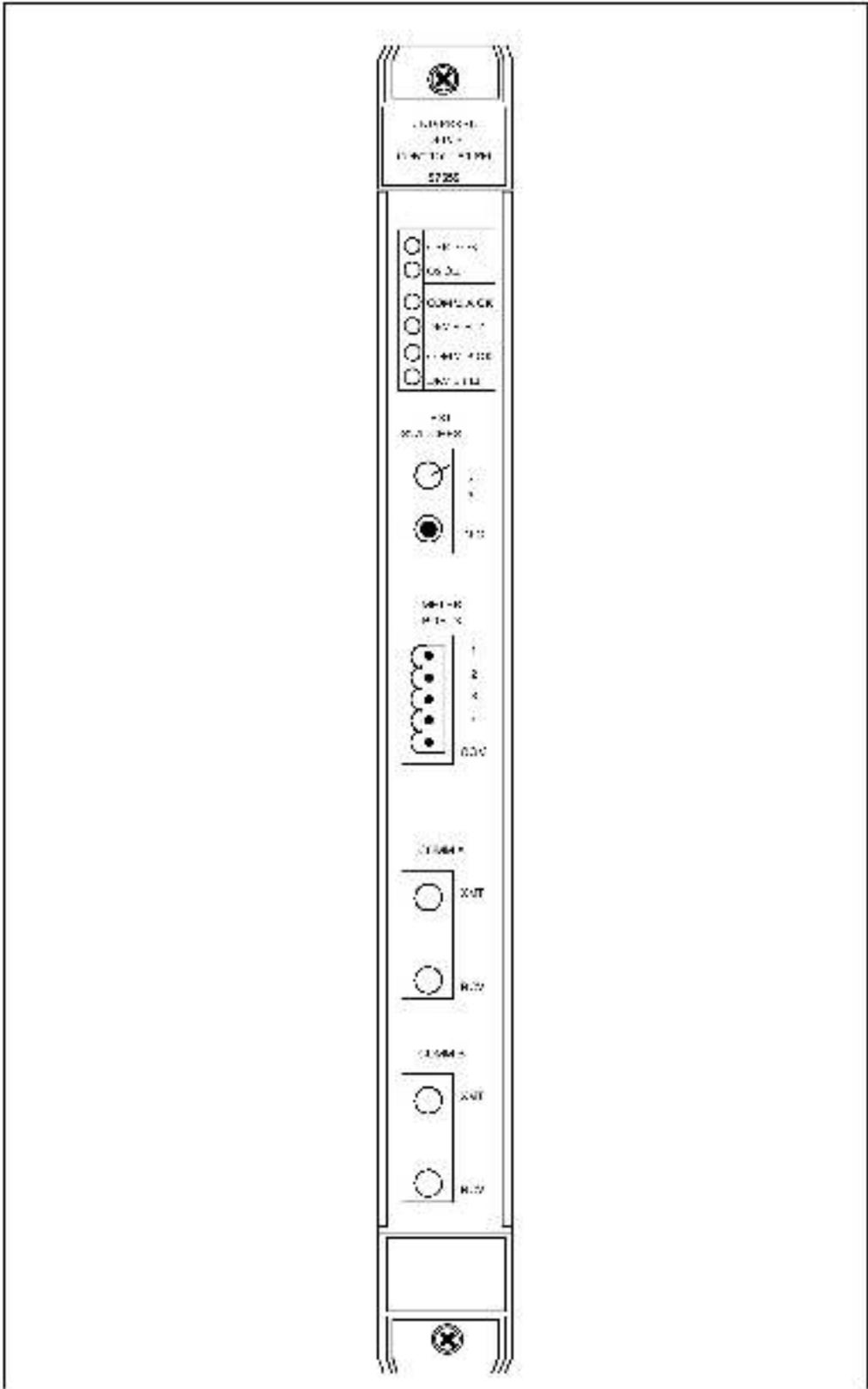


Figure P-1 – Module Faceplate (RM Q-5-65P)

2.2.1 Status and Fault LEDs

The module faceplate contains six status and fault LEDs for diagnostic purposes. A description of each of the LEDs follows.

CARD OK (green) - The CARD OK LED will turn on after the module's power-up self tests have been completed successfully. It will remain on unless there is a local watchdog timeout or until power is cycled.

OS OK (green) - The OS (Operating System) OK LED will turn on after the UDC operating system is loaded onto the module. It will remain on until power is cycled. On subsequent power-ups, this LED will turn on to indicate that the OS is still resident on the module. Note that this LED is also used to indicate any failure that may occur during power-up diagnostics (see section 2.2.3). If the UDC module fails any of its power-up diagnostics, it must be replaced.

COMM A OK and COMM B OK (green) - The Communication Status LEDs will turn on after the UDC module has established communication with the PMI rack(s) over the fiber-optic link(s). COMM A indicates the status of communication link A. COMM B indicates the status of communication link B. When the LED is lit, it indicates that messages are being received over that channel. Each channel operates independently. If a channel is not being used, its LED will remain off.

DRV FLT A and DRV FLT B (red) - The Drive Fault LEDs are normally off. If a Drive Fault LED is lit, it indicates that a Drive Shutdown fault has been detected for the drive using that channel. When a drive fault is detected, a bit is set in register 202 for drive A or register 1202 for drive B in the UDC module's dual port memory. Bit 8 of the Drive Status Register (200/1200) is also set. Refer to the appropriate Configuration and Programming instruction manual for more information.

2.2.2 UDC Error Codes

The UDC module can generate three error codes which will be displayed on the leftmost AutoMax Processor.

Error "38" indicates that the UDC module has generated a STOP ALL. If this error occurs, refer to the UDC task error log for additional information regarding the error.

Error "39" indicates a UDC module interrupt allocation failed. In this case, try to cycle power to the rack and re-load the rack configuration and application tasks.

Error "3A" indicates that the UDC module's operating system and the AutoMax operating system are not compatible. If this error occurs, re-load the most current operating systems.

2.2.3 Power-Up Routine

When power is applied to the AutoMax rack, the UDC module performs the following series of self tests: SRAM Write/Read test, Boot Checksum, Watchdog test, Dual Port RAM Write/Read test, Timer/Counter test, and Serial Controller test. When all of the tests are completed, the CARD OK LED will turn on. If a failure occurs, the OS OK LED will flash rapidly to indicate that a self test failed.

The first time the rack is powered up, the UDC module will not contain its operating system (OS). After the UDC OS is loaded to the UDC module using the AutoMax Programming Executive software, it will be stored in non-volatile flash memory for subsequent power-ups.

After passing their own power-up diagnostics, the PMIs will request their operating systems from the UDC module. The UDC module will download an operating system to each PMI connector. Each PMI will send a feedback message to the UDC module. The UDC module will respond with a command message, configuration data, and the UDC task time base. Subsequent command messages from the UDC module will contain clock (CCLK) synchronization data so that the PMI can calculate when to send feedback data to the UDC.

2.2.4 Meter Ports

The module faceplate contains four analog output ports on a single connector labeled METER PORTS. A 5-point removable plug connector with screw-type terminal points is used to connect meters or data-logging devices to the UDC module. All connections are made using 14-22 AWG wire. Terminals 1-4 can each be connected to a separate analog device. All devices share a single COMMON connector terminal, labeled COM. The outputs are not isolated from each other. Note that these terminals (1-4 and COM) must not be connected to earth ground.

Any register in the UDC dual port memory (common) or any local variable can be mapped to these ports for output to a meter or chart recorder. These devices can be located up to 4 m (13 ft.) from the UDC module. Each port provides 8-bit resolution of internal data over a -10 VDC to +10 VDC range (78.125 mV/bit). The maximum output current is 20 mA at -10 VDC. The registers to be output and their minimum and maximum values are user-configurable. Values are updated each scan of the UDC if CCLK is on and a UDC task is running. If CCLK is not on, values are updated every 0.20 ms. The analog output ports default to outputting 0 VDC until they are configured otherwise in an application task or online. See the AutoMax Programming Executive instruction manual for instructions on how to configure the meter ports. Refer to the appropriate Configuration and Programming instruction manual for the UDC register assignments.

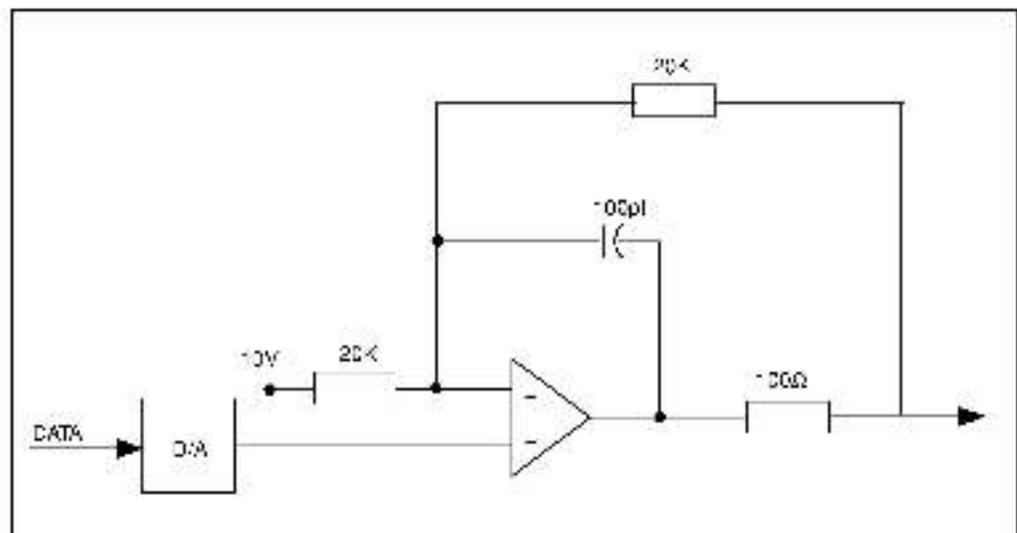


Figure 2.2 Analog Output Circuit (Meter Ports)

2.2.5 UDC Test Switches

The module faceplate contains a 3-position spring return-to-center switch and a push-button that can be used for test purposes. Pressing the push-button sets register 1000, bit 0. When the switch is held in the up position, register 1000, bit 1 is set; when held in the down position, register 1000, bit 2 is set. These bits can be tested for in an application task, and any resulting action is determined by the application task.

This chapter describes how to install and replace the UDC module. Refer to the appropriate Distributed Power System Diagnostics, Troubleshooting, and Start-Up Guidelines instruction manual for system connection instructions.



ATTENTION: Only qualified electrical personnel familiar with the construction and operation of this equipment and the hazards involved should install, adjust, operate, and/or service this equipment. Read and understand this manual and other applicable manuals in their entirety before proceeding. Failure to observe this precaution could result in severe bodily injury or loss of life.

ATTENTION: The user is responsible for conforming with all applicable local, national, and international codes. Failure to observe this precaution could result in damage to, or destruction of, the equipment.

ATTENTION: Inserting or removing a module may result in unexpected machine motion. Power to the machine should be turned off before inserting or removing a module. Failure to observe these precautions could result in bodily injury.

3.1 Wiring

The installation of wiring should conform to all applicable codes. To reduce the possibility of noise interfering with the control system, exercise care when installing wiring from the system to external devices. For detailed recommendations, refer to IEEE Standard 518.

3.2 Initial Installation

Use the following procedure to install the module:

Step 1. Stop any application tasks that may be running.



ATTENTION: This equipment is at line voltage when AC power is connected. Disconnect and lock out all ungrounded conductors of the AC power line. Failure to observe these precautions could result in severe bodily injury or loss of life.

Step 2. Turn off power to the system. All power to the rack, as well as all power to the wiring leading to the rack, should be off.

Step 3. Take the module out of its shipping container. Take it out of its anti-static bag, being careful not to touch the connector on the back of the module. Save the anti-static bag in a safe place. The module must be stored in an anti-static bag whenever it is not installed in the rack.

Step 4. Insert the module into the desired slot in the rack (refer to section 4.1 for module restrictions). Use a screwdriver to secure the module in to the rack.



ATTENTION: Turn off, lockout, and tag the power to both the rack containing the UDC module and to its corresponding PMI hardware before viewing the fiber-optic cable or transmitter under magnification. Viewing a powered fiber-optic transmitter or connected cable under magnification may result in damage to the eye. For additional information refer to ANSI publication z136.1-1981. Failure to observe this precaution could result in bodily injury.

ATTENTION: Do not damage the ends of the fiber-optic cable connectors by touching or dropping them. Do not use factory-compressed air to clean the fiber-optic ports or connectors because the air may contain impurities that could scratch them. Failure to observe this precaution could result in damage to, or destruction of, the equipment.

Step 5. Use the following procedure to connect a fiber-optic cable (P/N 613613-xxR) between the UDC module and the PMI:

- a. Remove the dust cover caps from the fiber-optic ports on the UDC module and the PMI.
- b. Remove the dust cover caps from the fiber-optic cable's connectors.
- c. Store the dust cover caps in a safe place. The dust cover caps must be re-installed on the fiber-optic ports and connectors whenever they are disconnected.



ATTENTION: Do not bend or kink the cable when you attach it to the port. Bending the cable sharply could break the fiber inside. Failure to observe this precaution could result in damage to, or destruction of, the equipment.

- d. Attach the cable's connectors to the following ports as shown in figure 3.1.
 - UDC module XMI port: blue fiber optic cable
 - UDC module RCV port: orange fiber optic cable
 - PMI XMI port: orange fiber optic cable
 - PMI RCV port: blue fiber optic cable

Note that the fiber optic cables are color coded. Typically, the cables are orange and blue. The cables used in your installation may be of a different color but they should be installed in the same manner as described here.

Align the connector's pin with the slot in the module's port. See figure 3.2. Push the connector onto the port. Turn the connector clockwise until it locks onto the port's two pins. Refer to the Fiber Optic Cabling Instruction manual (S 3009) for additional information.

- Step 6. Disconnect the METER PORTS plug connector from the module faceplate. Use 14-22 AWG wire to connect the analog devices to terminals 1-4 of the plug connector. Connect all of the COMMON leads from the analog devices and run a single lead to terminal 5 (COM) on the plug connector. Re-connect the plug connector to the module faceplate. Figure 3.3 illustrates the terminal connections.

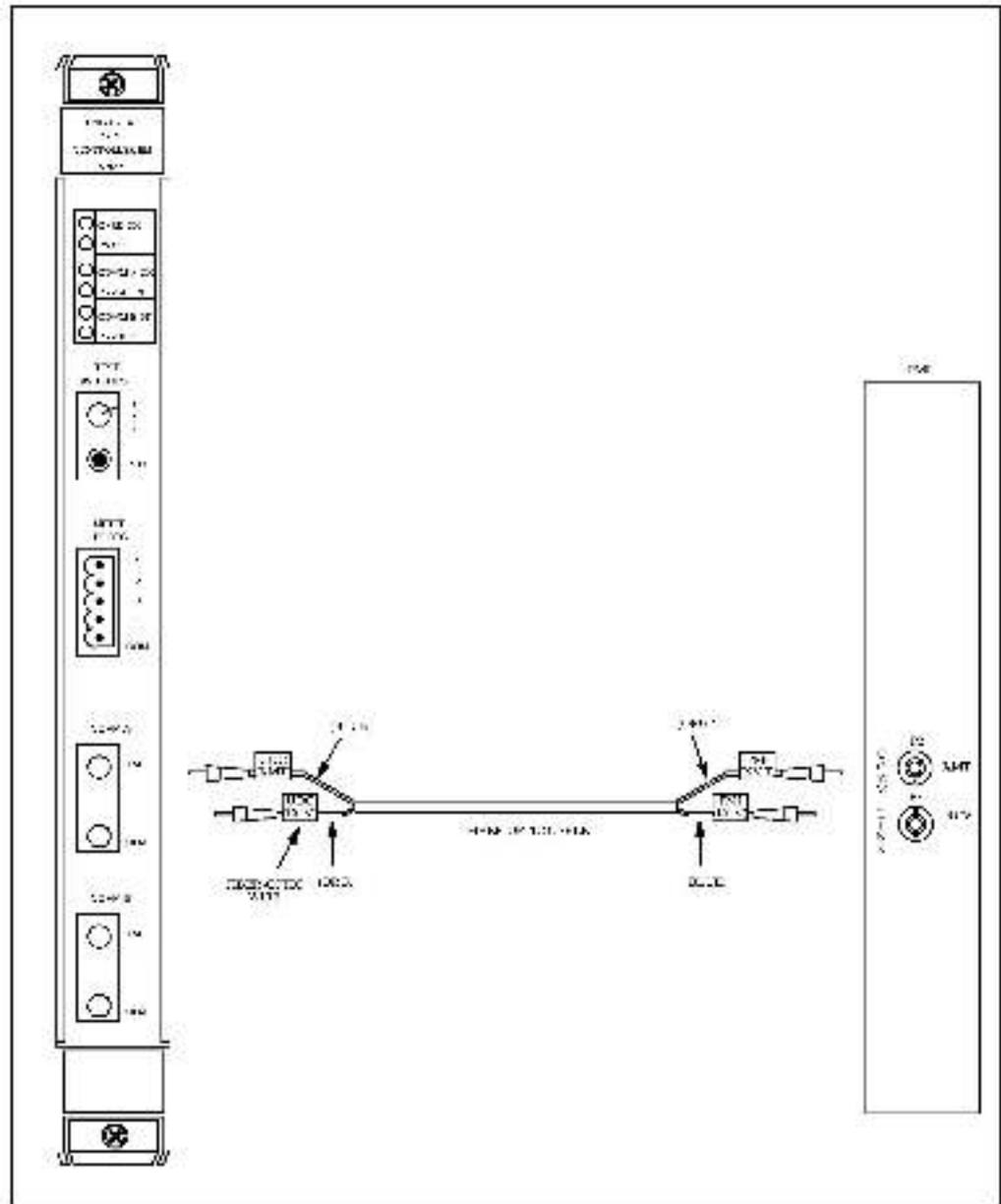


Figure 3.1 – Fiber-Optic Gsbe Connections

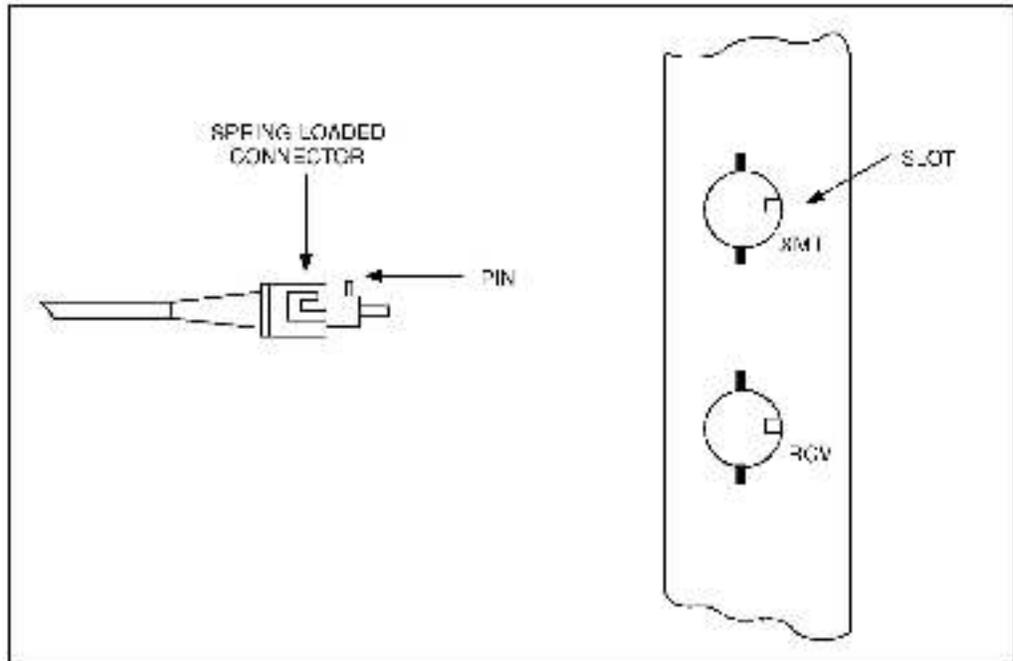


Figure 3.2 – Fiber-Optic Ports and Connectors

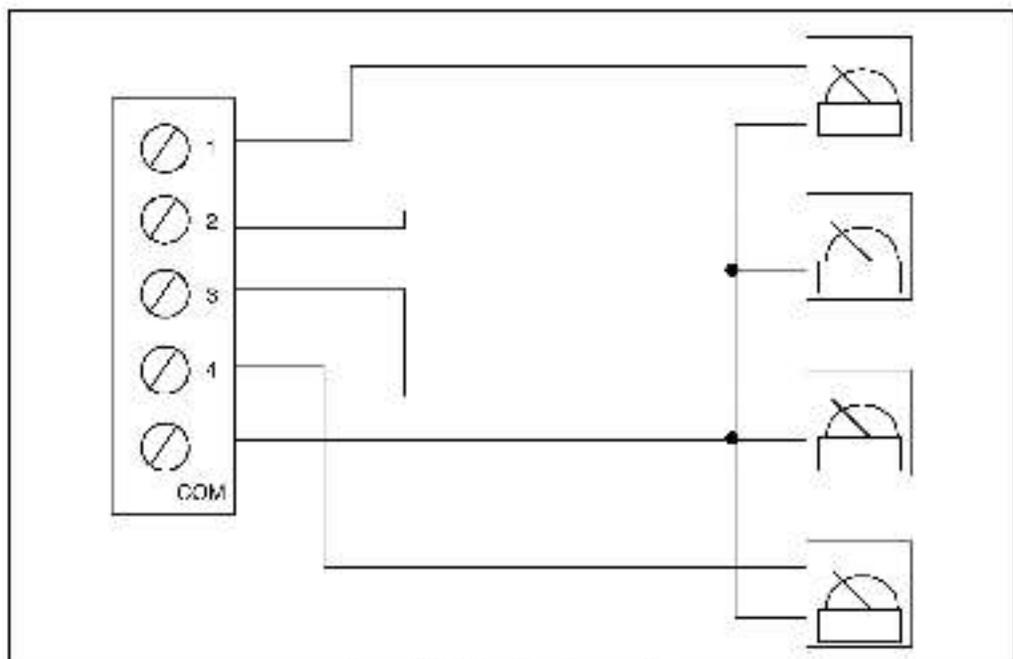


Figure 3.3 – Motor Port Connections

3.3 Module Replacement

Use the following procedure to replace the JDC module.



ATTENTION: Inserting or removing a module may result in unexpected machine motion. Power to the machine should be turned off before inserting or removing a module. Failure to observe these precautions could result in bodily injury.

Step 1. Stop any application tasks that may be running.



ATTENTION: This equipment is at line voltage when AC power is connected. Disconnect and lock out all ungrounded conductors of the AC power line. Failure to observe these precautions could result in severe bodily injury or loss of life.

Step 2. Turn off power to the system. All power to the rack, as well as all power to the wiring leading to the rack, should be off.

Step 3. Disconnect the METER PORTS plug connectors.



ATTENTION: Do not look into a fiber-optic transmitter or connected cable with a magnifier. Viewing a fiber-optic transmitter or connected cable under magnification may result in damage to the eye. For additional information, refer to ANSI publication Z136.1 - 1981. Failure to observe this precaution could result in bodily injury.

ATTENTION: Do not damage the ends of the fiber-optic cable connectors by touching or dropping them. Do not use factory-compressed air to clean the fiber-optic ports or connectors because the air may contain impurities that could scratch them. Failure to observe this precaution could result in damage to or destruction of the equipment.

Step 4. Disconnect the fiber-optic cables. Replace the dust cover caps on the module's COMM ports and fiber-optic cable connectors.

Step 5. Use a screwdriver to loosen the screws that hold the module in the rack. Take the module out of the slot in the rack and place it in an anti-static bag.

Step 6. Take the new module out of its shipping container. Take it out of the anti-static bag, being careful not to touch the connectors on the back of the module. Save the anti-static bag in a safe place. The module must be stored in an anti-static bag whenever it is not installed in the rack.

Step 7. Insert the module into the rack, making sure it is well seated in the rack. Tighten the screws that hold the module to the rack.



ATTENTION: Do not bend or kink the cable when you attach it to the port. Bending the cable sharply could break the fiber inside. Failure to observe this precaution could result in damage to or destruction of the equipment.

- Step 8. Remove (and save) the dust cover caps from the fiber-optic cable connectors and the module's COMM ports. Re-connect the fiber-optic cables, making sure the cable for PMI A is connected to the COMM A port.
- Step 9. Re-connect the METER PORTS plug connector.
- Step 10. Turn on power to the rack.

The Configuration and Programming instruction manual describes the register organization in the UDC module, how to configure the module, and how to write a UDC task. See section 1.1 for the appropriate document part number. Refer to the Control Block Language instruction manual (J-3676) and the Enhanced BASIC Language instruction manual (J-3675) for additional programming information. Refer to the AutoMax Programming Executive instruction manual for the procedures used to add the UDC module to the rack, configure variables on the module, and add UDC tasks to the rack.

4.1 Restrictions

The following sections describe limitations and restrictions on the use of the UDC module.

4.1.1 Number of UDC Modules in a Rack

Up to 10 UDC modules may be placed in an AutoMax rack. The rack must also contain at least one AutoMax Processor. If a Common Memory module is in slot 0, or if an Ethernet™ Interface module is being used, UDC modules cannot be placed in the logical slots assigned to these modules. The UDC module cannot be placed in slot 0.

4.1.2 Use with DCS Drive Regulator Set

The UDC module and DCS drive regulator set can be used in the same AutoMax rack.

4.1.3 Use in a Remote Rack

The UDC module cannot be used in a remote rack. It can be used only in a rack containing at least one AutoMax Processor module.

4.1.4 AutoMax Programming Executive Support

The UDC EM module (B/M O-57652) is supported in AutoMax Programming Executive Versions 3.5 and later. See Appendix C.

Technical Specifications

Ambient Conditions

- Storage temperature: -40°C to 85°C
- Operating temperature: 0°C to 60°C
- Humidity: 5% to 95%, non-condensing
- Altitude: 3300 feet (1000 meters) without derating

Dimensions

- Height: 29.8 cm (11.75 inches)
- Width: 9.2 cm (3.62 inches)
- Depth: 18.7 cm (7.37 inches)
- Weight: 0.9 kg (2 pounds)

Maximum Power Dissipation

- 11.1 W

System Power Requirements

- +5 VDC / 1.7 A (8.5 W)
- +1.5 VDC / 100 mA (1.5 W)
- -1.5 VDC / 71 mA (1.1 W)

Analog Output Specifications

- Number of channels: 4
- Number of commons: 1 (shared among all 4 channels)
- Operating range: -10 to +10 VDC
- Maximum output current: 20 mA
- Resolution: 8 bits binary
- Non-Linearity: +1 LSB maximum
- Accuracy: 2.4% of maximum at 25°C
- Thermal Drift: 120 ppm/degree C
- Type of converter: 4 DACs with output buffer amplifiers and interface logic on a monolithic IC

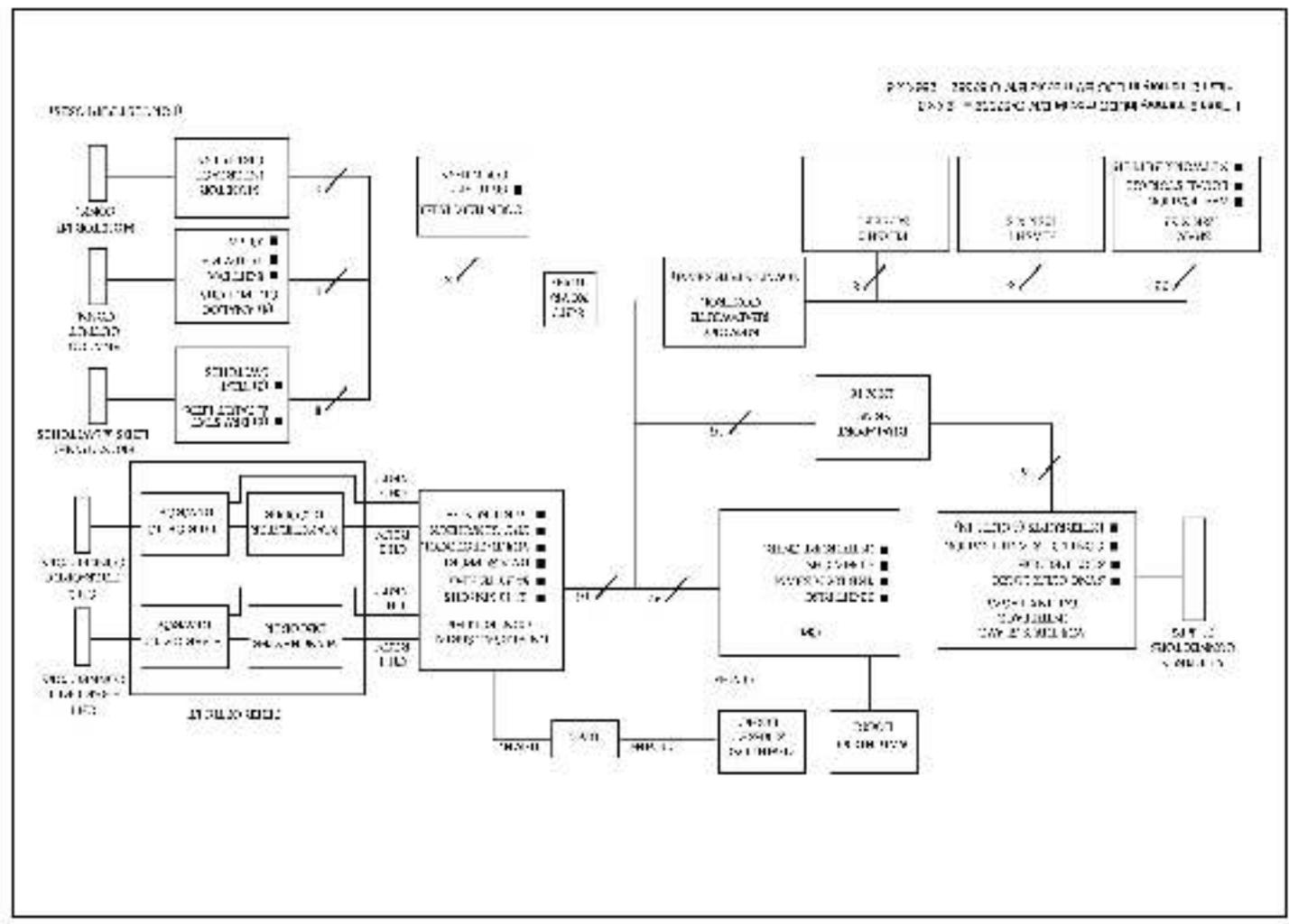
- Speed of conversion: scan dependent
- Output settling time: 20 nsec. maximum
- Minimum load resistance: 100 ohms
- Maximum load capacitance: 10,000 pF

Fiber-Optic Ports

- Transmitters: 2
- Receivers: 2
- Data rate: 10 Mbc
- Coding: Manchester
- Protocol: HDLC (compatible with PMI)

APPENDIX B

Module Block Diagram



DPS Hardware and Software Compatibility by Drive Type

For This Drive Type . . .	The Following Hardware and Software Can Be Used . . .							
	Exec. S/W		Modules					
	V3.4	V3.5 & Later ¹	UDC O-57552 ²	UDC EM O-57652 ³	PMIP O-60000	PMIP O-60021	RDI/O O-60001	RDI/O O-60031
SD3000	•	•	•	•	•	•	•	•
SF3000	•	•	•	•	•	•	•	•
SA500	•	•	•	•	N/A	N/A	N/A	N/A
SA3000	•	•	•	•	•	•		•
SA3000 Constant Power		•	•	•		•		•
SA3100		•	•	•		•		•
SB3000		•	•	•		•		•
1567 Power Max™		Note 1		•		•		•

1. 1567 Power Max™ drives are supported only by V3.8 and later.

2. May not be able to support all combinations of drives supported by AutoMax Programming Executive V3.5 (see below). Contact Heland.

3. UDC EM module is supported by AutoMax Programming Executive V3.5 and later only.

Drive Types Supported By AutoMax Programming Executive Versions 3.4, 3.5, and 3.8 or later

V3.4

SD3000
SF3000
SA500
SA3000

V3.5

SD3000
SF3000
SA500
SA3000
SA3000 Constant Power
SA3100
SB3000

V3.8 or later

1567 Power Max™

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Date:	DIF Number:
Follow-Up Action:	

Rockwell Automation / 24703 Euclid Avenue / Cleveland, Ohio 44117 / (216) 266-7000

