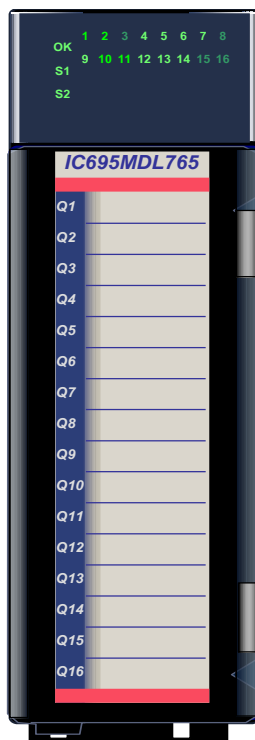# PACSystems™ RX3i

16-CHANNEL DIGITAL OUTPUT MODULE WITH DIAGNOSTICS (IC695MDL765)

Warnings and Caution Notes as Used in this Publication

⚠ WARNING

Warning notices are used in this publication to emphasize that hazardous voltages, currents, temperatures, or other conditions that could cause personal injury exist in this equipment or may be associated with its use.

In situations where inattention could cause either personal injury or damage to equipment, a Warning notice is used.

⚠ CAUTION

Caution notices are used where equipment might be damaged if care is not taken.

> **Note:** Notes merely call attention to information that is especially significant to understanding and operating the equipment.

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Introduction

The 24/48/125 Vdc 2A Smart Digital Output module, IC695MDL765, provides sixteen discrete outputs in two isolated groups of eight outputs. Each group of eight outputs is referenced to an isolated common, providing group-to-group isolation. The module accepts 24 Vdc, 48 Vdc, or 125 Vdc.

The outputs are positive logic or sourcing-type outputs; they switch the loads on the positive side of the power supply and supply current to the load. The outputs can switch user loads over the ranges of +18 Vdc to +60 Vdc or 105 Vdc to 132 Vdc and can source a maximum current of 2 Amps per point. Power for the loads must be provided by the user.

The field status LEDs (S1 and S2) indicate whether the external +24 Vdc, 48 Vdc, or +125 Vdc power supply is present and above the minimum level, whether faults are present, and whether the terminal block is locked into place. The module also logs an Addition of Terminal Block or Loss of Terminal Block message to the I/O fault table to report the terminal block status.

Each point has electronic short circuit protection (ESCP) that shuts down an output and generates an individual fault if capacitive or incandescent surge current exceeds 10 amps, or if it exceeds 2 amps for more than 10ms. In addition to output driver faults being sent back to the RX3i controller, the module provides a loss of field side power fault, ESCP point failure within a group and field terminal block ON/OFF status.

The red bands on the label indicate that the MDL765 is a high-voltage module.

Features of the Smart Digital Output module include:

- Output pulse test capability
- Output hold last state or default

Additional diagnostics include:

- Over temperature
- Failed Switch detection
- Overload detection and shutdown
- No-load detection

This module can be installed in any I/O slot in an RX3i system. The module supports insertion into and removal from an RX3i universal backplane that is under power. Refer to the PACSystems RX3i System Manual (GFK-2314), Chapter 2 Installation.

This module can be used with a Box-style (IC694TBB032), Extended Box-style (IC694TBB132), Spring-style (IC694TBS032), or Extended Spring-style (IC694TBS132) terminal block. Extended terminal blocks provide the extra shroud depth typically needed for field wiring to AC devices. For more information, refer to the PACSystems RX3i System Manual (GFK-2314) Chapter 17 Terminal Blocks and Interconnect Cables . The terminal block is ordered separately.

Electronic Short-Circuit Protection (ESCP)

Each output point provides protection against overcurrent, short circuit and overtemperature. The fault is present until the condition that caused the fault is removed and the faulted point is turned off.

Each output point provides transient voltage protection to clamp high voltages at or below 136Vdc.

Specifications: MDL765

| Specification	Description
Power Requirement	
Field Power Voltage (24V† nominal I/O), VIn	18 Vdc to 60Vdc
Field Power Voltage (125V nominal I/O), VIn	105 Vdc to 132Vdc
Ripple Voltage, Field Power	10%Vpp
Outputs per Module	16 (two isolated groups of 8 outputs each)
Isolation	
Field to Backplane 　　　　　Continuous 　　　　　For 1 minute	250Vac 1500Vac
Group to Group 　　　　　Continuous 　　　　　For 1 minute	250Vac 1500Vac
Backplane Power Consumption 　　　　+3.3Vdc 　　　　+5.1Vdc	152mA 540mA
Thermal Derating	None required with output currents of 1 amp per channel. For 2 amps per channel, see thermal derating below.
Continuous Output Current per Point	Refer to Output Load Ratings below.
Output Characteristics	
Peak Inrush Current	10A supplied for 10ms without ESCP trip
Output Leakage Current	1mA maximum
Group Output Current at 35ºC ambient	8A maximum
Module Output Current at 35ºC ambient	16A maximum
Sourcing Circuit Output ON Voltage (IOUT = 2A)	(VIn-2) to VIn
Minimum Load Current with no-load detection enabled	50 mA
On Response Time	1ms maximum
Off Response Time	1ms maximum
Maximum Switching Frequency	Refer to Output Load Ratings below.
Protection	Short-circuit protection, overcurrent protection, and overtemperature protection. Recovery from overtemperature, short-circuit, and overcurrent faults is accomplished by turning the point off and back on.
† For use with 48V nominal loads, configure the channel to 24VDC operation.	

Note: *Refer to the PACSystems RX3i System Manual (GFK-2314) for product standards, general operating specifications, and installation   requirements. Manuals can be downloaded from https://www.emerson.com/Industrial-Automation-Controls/support.*

Output Load Ratings: MDL765

| Type of Load	Specification
Resistive	2A at 132Vdc
	2A at 60Vdc
	No external suppression components required.
Inductive (Pilot Duty)	0.6A at 132Vdc
	For inductive loads greater than 2.2H, maximum switching frequency is 0.125Hz.
	Overall maximum switching frequency: 1 Hz
	No external suppression components required.
	1.2A at 60Vdc
	For inductive loads greater than 0.8H, maximum switching frequency is 0.5Hz.
	Overall maximum switching frequency: 1 Hz
	No external suppression components required.
Incandescent (Lamp)	0.75A at 132Vdc
	0.75A at 60Vdc
	No external suppression components required.

Thermal Derating: MDL765

With output currents of 1 Amp per channel, no temperature derating is required, and all channels can operate within the entire Surrounding Air temperature range. With output currents of 2 Amps per channel, the number of active channels must be reduced as temperature increases, according to the following derating curve.

Figure 1: Thermal Derating
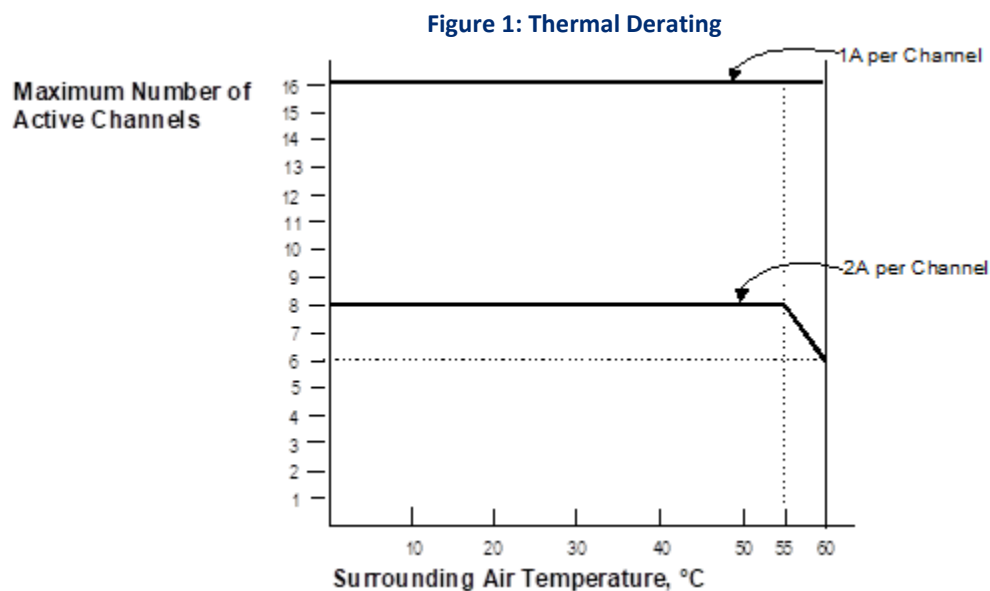
Field Wiring: MDL765

Field wiring connections to the module are made to the removable terminal assembly, as described in the RX3i System Manual (GFK-2314).

Figure 2: Field Wiring
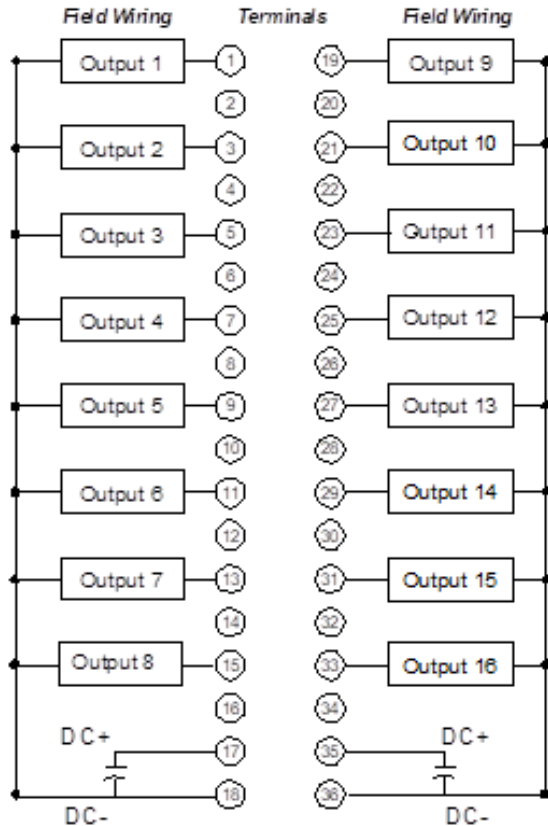
Connections	Terminals	Terminals	Connections
Output 1	1	19	Output 9
NC	2	20	NC
Output 2	3	21	Output 10
NC	4	22	NC
Output 3	5	23	Output 11
NC	6	24	NC
Output 4	7	25	Output 12
NC	8	26	NC
Output 5	9	27	Output 13
NC	10	28	NC
Output 6	11	29	Output 14
NC	12	30	NC
Output 7	13	31	Output 15
NC	14	32	NC
Output 8	15	33	Output 16
NC	16	34	NC
DC+	17	35	DC+
DC-	18	36	DC-

Installation Location

This product is intended for use with the RX3i system. Its components are considered open equipment (having live electrical parts that may be accessible to users) and must be installed in an ultimate enclosure that is manufactured to provide safety. At a minimum, the enclosure shall provide a degree of protection against solid objects as small as 12mm (fingers, for example). This equates to a NEMA/UL Type 1 enclosure or an IEC60529 IP20 rating providing at least a pollution degree 2 environment. For details about installing RX3i rack systems, refer to the PACSystems RX3i System Manual (GFK-2314).

For complete installation information, please refer to RX3i Installation and Maintenance Requirements document, GFK-2975.

Circuit Operation: MDL765

Two Eight-Circuit DC Sourcing Groups

The DC sourcing circuit groups have all output devices connected to the negative side of the power supply (DC-). The sourcing circuit outputs provide power to the output devices. For sourcing circuit outputs, an ON condition is logic 1 and an OFF condition is logic 0.

Figure 3: DC Sourcing Group
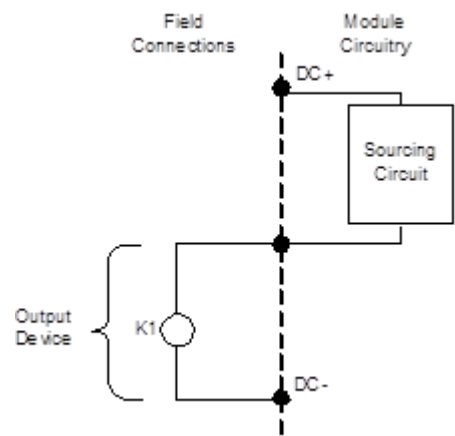
LED Operation: MDL765

Figure 4: LEDs

The 16 green/amber channel status LEDs on the module indicate the ON/OFF/Fault status of points 1 through 16.

The Module OK LED indicates module status.

The field status LEDs (S1 and S2) indicate whether the external +24 Vdc, 48 Vdc, or +125 Vdc power supply is present and is above the minimum level, whether faults are present, and whether the terminal block is locked into place. The module also logs an Addition of Terminal Block or Loss of Terminal Block message to the I/O fault table to report the Terminal Block connection status.

LED	Function	LED Indications
OK	Module status	Off: Module is not receiving power from the RX3i backplane or the module has failed self-test.
		Solid green: Module OK and configured.
		Blinking green: The module has not received configuration from the CPU. If configuration is not successful, the module will continue to blink in this mode.
		Amber: Module hardware watchdog timeout.
		Blinking amber: Module internal error. Record the blink pattern and contact technical support.
1–16	Channel status	Off: Output is off
		Green: Output is on
		Amber: Output fault
S1, S2	Terminal block and field power status	Off: Terminal block present and field power not present
		Green: Terminal block and field power present
		Red: Terminal block not present or field power error. Field power errors include detecting 125Vdc when configured for 24Vdc or detecting only 24Vdc when configured for 125Vdc.

Input and Output Data Formats: MDL765

Output Value Data

The application uses these bits (one bit per output), beginning at the configured Outputs Reference Address to write the commanded output values to the module.

Output Command Value Feedback Data

The module uses these bits (one bit per output), beginning at the configured Output Command Reference Address to report the output feedback data values.

Channel Diagnostic and Status Data

The module can be configured to report channel diagnostic and status data to the CPU. The CPU stores this data at the module's configured Diagnostic Reference Address. Use of this feature is optional.

The data for each channel occupies two words whether the channel is used or not.

Note: At least two sweeps must occur to clear the diagnostic bits: one scan to send the %Q data to the module and one scan to return the %I data to the CPU. Because module processing is asynchronous to the controller sweep, more than two sweeps may be needed to clear the bits, depending on the sweep rate and the point at which the data is made available to the module.

Bit Offset	Description
0–3	Reserved
4	Set on when open load is detected.

Bit Offset	Description
5	Set on when short to power is detected.
6	Set on when over load detected.
7	Set on when over temperature detected.
8	Set on when failed switch detected.
9	Set on when pulse test has failed.
10–14	Reserved
15	Set on when channel communication error is detected.
16	Set on when pulse test is complete. Note: This bit remains set until the corresponding pulse test command bit is cleared.
17–30	Reserved
31	Set on when any channel fault is detected.

Module Status Data

The module can be configured to return two words of module status data to the CPU. The CPU stores this data in the module's 32-bit configured Module Status reference area.

Bit Offset	Description
0	When on, indicates module I/O data is ready.
1	Set on when terminal block is present.
2	Set on when loss of field power for one or more groups is detected.
3	Set on when module over temperature is detected.
4	Set on when pulse test has failed on any channel.
5	Reserved
6	Set on when loss of group 1 field power is detected.
7	Set on when loss of group 2 field power is detected.
8	Set on when channel fault is reported on any channel.
9–31	Reserved

Pulse Test Command Output Data

The module uses these bits (one bit per output), beginning at the configured Pulse Command Output Reference Address to command an on-demand pulse test. To command an on-demand pulse test, the Pulse Test Enable parameter for the channel must be set to Enabled – Manual.

Diagnostics: MDL765

The module always performs its standard diagnostic checks, plus one optional output diagnostic. The module returns current circuit diagnostics to %I bits for all circuits.

For Overtemperature, Short Circuit, Failed Switch and Overload, the user must de-assert the output %Q bit to clear the error. The corresponding %I bit will be turned off within at least two CPU sweeps.

Over Temperature Diagnostics

Each circuit has a built-in thermal sensor. If the internal temperature exceeds the allowable limit the module logs an OVERTEMPERATURE fault in the I/O fault table and turns off the circuit to protect its internal electronics. The temperature must decrease below the allowable limit before the output can turn on again. This diagnostic is always performed for all the outputs.

Short circuit Diagnostics

Output circuits are protected by a short circuit threshold sensor at the switching device. If the instantaneous current on an output exceeds 10 amps, the module turns the output off within microseconds. The module will try to restart the load; if two additional attempts are unsuccessful, the output circuit is forced off, and the module logs a SHORT CIRCUIT fault in the I/O fault table. To restore normal operation to output the cause of the current surge must be removed, then the diagnostic must be cleared from the CPU.

This diagnostic detects shorts across the load only. Also, systems with floating power supplies do not detect shorts of I/O points to ground because there is no return current path. Systems with power supplies grounded on the negative side detect grounded output points as Short Circuit.

Partial (high resistance) shorts may not draw enough current to be detected by the Pulse Test.

Failed Switch Diagnostics

The module automatically monitors all circuits for several types of faults, which may be reported as Failed Switch diagnostics.

Failed Switch is reported if the circuit's switch state is not the same as its commanded state. The module logs a FAILED SWITCH fault in the I/O fault table identifying the failed circuit. The logic state of the circuit is set to OFF.

When an output fault occurs, the actual condition of the output switch is not known. If the output switch has failed shorted (or closed), current flow is not interrupted when the module forces the output state OFF. Action external to the module must be taken to remedy the problem. The FAILED SWITCH fault can alert personnel or cause program logic to be activated, possibly shutting off power to the module, I/O section, or process.

No load Diagnostics

Reporting for this diagnostic can be enabled or disabled for individual outputs.

By default, outputs are configured to report No-Load conditions. In this configuration, energizing the output activates a no-load current level. If the load does not continuously draw 50mA from the output circuit, the module logs a NO LOAD fault in the I/O fault table. This diagnostic should be not be used for circuits on which very small loads (small relays or indicating lamps) will draw less than 50 mA. To clear the No-Load error, a load of at least 85mA must be applied to the output.

Overload Diagnostic

In addition to the protection provided by the module's built-in Short Circuit detection, Overload Shutdown provides further protection for output loads, field wiring, and switching devices. If a load exceeds 2 amps DC continuously for 10ms, the module turns the output off and logs an OVERLOAD fault in the I/O fault table.

Under-Voltage Detection

The field power supply on each group includes support for detecting supply voltages below the minimum voltage for the selected voltage standard. The fault can be disabled by group. Detecting the fault has no impact on the state of the output control.

Output Pulse Test

The Output Pulse Test is an optional diagnostic feature that exercises the output points to confirm they can be switched to a known state.

The pulse test attempts to switch the output from its Normal State to its Default State. For a load with a Normal State of ON, the source output is pulsed OFF. For a load with a Normal State of OFF, the source output is pulsed on. A fault is logged in the I/O fault table if a failure is detected in the output point.

Pulse Testing should remain enabled if the module has loads that hold one state for long periods of time, unless any load(s) are sensitive to pulses or interruptions of up to 16ms. It should be disabled if the module's loads will normally change state as the program executes. These will report faults during normal operation, and do not need to be pulsed.

Pulse Test Selections: Pulse test frequency
Output Default State / Output Normal State

On Demand Pulse Test

To use this feature, the channel's Pulse Test Enable parameter must be set to Enabled-Manual. To command a pulse test, set the Pulse Test Command bit for the channel(s) to be pulse tested.

The module performs one or more pulse tests for each channel selected. Since this will take many sweeps, you should keep the Pulse Test Command bit set until the Pulse Test Complete bit is set for that channel in the Channel Diagnostic and Status Data.

The module keeps the Pulse Test Complete bit set as long as the Pulse Test Command bit is set. If the pulse test fails, the Pulse Test Failed bit is set at the same time as the Pulse Test Complete bit. One output scan with the Pulse Test Command bit cleared clears the Pulse Test Complete status bit and Pulse Test Failure diagnostic bit.

Automatic Pulse Test

To use this feature, set the channel's Pulse Test Enable parameter to Enabled-Auto. The Output Pulse Test occurs at a frequency selected in the Hardware Configuration, with no intervention from the CPU. The pulse test execution is based on the Time of Day clock set in the CPU, and the frequency is relative to 12:00am. For example, a frequency of 12 hours will result in a pulse test run at 12:00am and 12:00pm.

If the pulse test fails, the Pulse Test Failed bit is set.

Configuration: MDL765

Module Settings Ordered lists

Parameter	Function
Outputs Reference Address Outputs Value Reference Length	Specifies the memory location used by the module for 16 bits of output data.
Output Command Feedback Reference Address	Specifies the starting address where the module returns 16 bits of feedback output data.
Output Command Feedback Reference Length	Provides 1 bit per channel of feedback output data. Setting this value to 0 disables feedback data reporting.
Diagnostic Reference Address	Specifies the starting address for reporting channel diagnostics data.
Diagnostic Reference Length	Provides 32 bits of diagnostic data per channel. Setting this value to 0 disables channel diagnostics reporting.
Module Status Reference Address	Specifies the starting address for reporting module status data.
Module Status Reference Length	Provides 32 bits of module status data. Setting this value to 0 disables channel diagnostics reporting.
Pulse Test Command Output Reference Address/ Pulse Test Command Output Reference Length	Specifies the memory location for 16 bits of manual pulse test command data.
Channel Faults w/o Terminal Block	Enables or disables generation of channel faults and alarms after a Terminal Block has been removed.
Loss of Terminal Block Detection	Enables or disables logging of a fault to indicate a Terminal Block has been removed.
Loss of Field Power Group 1 Detection/ Loss of Field Power Group 2 Detection	Enables or disables loss of field power detection for the specified group.
Voltage Selection	Specifies field power voltage level for under-voltage detection. Can be enabled or disabled by the Loss of Field Power Group 1/Group 2 Detection parameter.

Parameter	Function
Inputs Default	Specifies whether inputs will go to Force Off or Hold Last State if the module loses communication with the CPU. An output goes to its power up default state when the module is first powered up.
I/O Scan Set	Assigns the module I/O status data to a scan set defined in the CPU configuration. Determines how often the RX3i polls the data.

Channel Settings

Parameter	Function
Outputs Default Mode	Force Off, Force On, or Hold Last State Outputs are forced into this state when the CPU is placed into Outputs Disabled. This includes immediately after download of Hardware Configuration. Outputs remain in the Outputs Default state indefinitely or until one of the following occurs: CPU is placed into Outputs Enabled. Communications with the CPU are restored. Power is removed from the module.
Pulse Test Enable	Enables or disables pulse testing of the output. Allows you to select Manual or Automatic pulse testing. For details about this feature, refer to Output Pulse Test above.
Pulse Test Frequency	If Pulse Test Enable is set to Auto, allows you to select the frequency of pulse testing.
Pulse Test Normal State	Available when Pulse Test is enabled. Specifies the state in which this output point will spend the majority of its time. The module performs a pulse test only from the normal state to the default state.
Pulse Test Default State	Available when Pulse Test Enable is enabled. Specifies the state the point will go to if a channel failure occurs. When the output is placed into the default state the module will not perform a pulse test into the normal state.
Diagnostic Reporting Enable	Enables or disables channel diagnostics. If enabled, channel diagnostic data is written to the Channel Diagnostic and Status Data.
Open Load Reporting Enable	If enabled, an open load (no-load) condition is reported in the Channel Diagnostic and Status Data.
Pulse Test Failed Enable	If enabled, the results of manual or automatic pulse testing are reported in the Channel Diagnostic and Status Data.
Over Load Reporting Enable	Always enabled: An output over load condition is reported in the Channel Diagnostic and Status Data.
Fault Reporting Enable	If enabled, channel faults are reported to the I/O fault table.

Parameter	Function
Open Load Reporting Enable	If enabled and the corresponding diagnostic reporting is enabled, an open load (no-load) condition is reported in the I/O fault table.
Pulse Test Failed Enable	If enabled and the corresponding diagnostic reporting is enabled, a failed pulse test is reported in the I/O fault table.
Over Load Reporting Enable	Always enabled: An output over load condition is reported in the I/O fault table.

Important Product Information for this Release

Release History

Part Number	Date	Remarks
IC695MDL765-EB IC695MDL765CA-EB	Nov 2023	Product labels have been updated to show compliance with IECEx and ECAS(UAC) For updated certifications, please refer to https://emerson-mas.force.com/communities/en_US/Article/Certifications-and-Agency-Approvals-Landing-Page
IC695MDL765-CB	Sep 2019	Following Emerson's acquisition of this product, changes have been made to apply appropriate branding and registration of the product with required certification agencies. No changes to material, process, form, fit or functionality.
IC695MDL765-BB	May 2015	Change in packaging. No change in form-fit-functionality.
IC695MDL765-AB	Aug 2011	Resolves a problem with some modules failing to power up properly under elevated temperature conditions.
IC695MDL765-AA		Initial Release

Upgrades

If a module containing firmware version 1.00 exhibits the symptoms described in Restrictions & Open Issues, contact Emerson for corrective actions.

Functional Compatibility

Programming Software	PAC Machine Edition Logic Developer PLC, version 6.00, SIM 21 or later is required to configure the MDL765.
RX3i CPU Firmware	The MDL765 requires CPU firmware version 6.70 or later.

Restrictions and Open Issues

Subject	Description
At elevated ambient temperature conditions, some modules fail to power up properly.	At elevated ambient temperatures, some IC695MDL765 modules containing firmware version 1.00 fail to power up successfully. Whenever this happens, the module has all LEDs off and a Loss of Module fault is logged to the I/O fault table. Additionally, all module point faults are correctly set provided point faults are enabled. If this behavior is encountered, contact Emerson for corrective actions. Firmware version 1.01 or later corrects this problem but cannot be installed with Boot version 1.00.

New Features and Enhancements in this Release

This release adds IECEx and ECAS (UAE) certification to the product.

General Contact Information

Home link: http://www.emerson.com/industrial-automation-controls

Knowledge Base: https://www.emerson.com/industrial-automation-controls/support

Technical Support

Americas
Phone: 1-888-565-4155
                       1-434-214-8532 (If toll-free option is unavailable)

                       Customer Care (Quotes/Orders/Returns): customercare.mas@emerson.com
                       Technical Support: support.mas@emerson.com

Europe
Phone: +800-4444-8001
                       +420-225-379-328 (If toll-free option is unavailable)
                       +39-0362-228-5555 (from Italy - if the toll-free 800 option is unavailable or dialing from a mobile telephone)

                       Customer Care (Quotes/Orders/Returns): customercare.emea.mas@emerson.com
                       Technical Support: support.mas.emea@emerson.com

Asia
Phone: +86-400-842-8599
                       +65-3157-9591 (All other Countries)

                       Customer Care (Quotes/Orders/Returns): customercare.cn.mas@emerson.com
                       Technical Support: support.mas.apac@emerson.com

Any escalation request should be sent to: mas.sfdcescalation@emerson.com

Note: If the product is purchased through an Authorized Channel Partner, please contact the seller directly for any support.

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