GE Fanuc IC695MDL765

Rx3i PacSystem

Smart Digital Output Module

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Digital Output Module with Diagnostics – 16-Channel

The 24/125 volt DC 2A **Smart Digital Output module,** IC695MDL765, provides 16 discrete outputs in two isolated groups of 8 outputs. Each group of 8 outputs is referenced to an isolated common, providing group-to-group isolation. The module uses 24 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 V to +30 VDC or 105 V 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 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 10 ms. 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.

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 used with either a Box-style (IC694TBB032) or Spring-style (IC694TBS032) front Terminal Block. The Terminal Block is ordered separately.
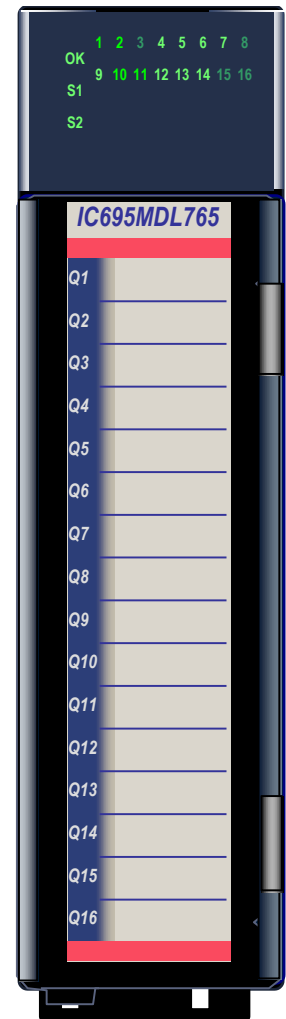
The red bands on the label show that the MDL765 is a high-voltage module.

This module can be installed in any I/O slot in an RX3i system.

Electronic Short-circuit Protection

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.

MDL765 Specifications

|	
Field Power Voltage (24V nominal I/O), V_{In}	18 to 30VDC
Field Power Voltage (125V nominal I/O), V_{In}	105 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 "MDL765 Thermal Derating Curve."
Continuous Output Current per Point	Refer to "Output Load Ratings."
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 (I_{OUT} = 2A)	(V_{In}-2) to V_{In}
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" on page 3.
Protection	Short-circuit protection, overcurrent protection, and overtemperature protection. Overtemperature, short-circuit, and overcurrent faults must be recovered by turning the point off and back on.

Refer to the PACSystems RX3i System Manual, GFK-2314, for product standards, and general operating specifications, and installation requirements. Manuals can be downloaded from www.ge-ip.com/support.

Output Load Ratings

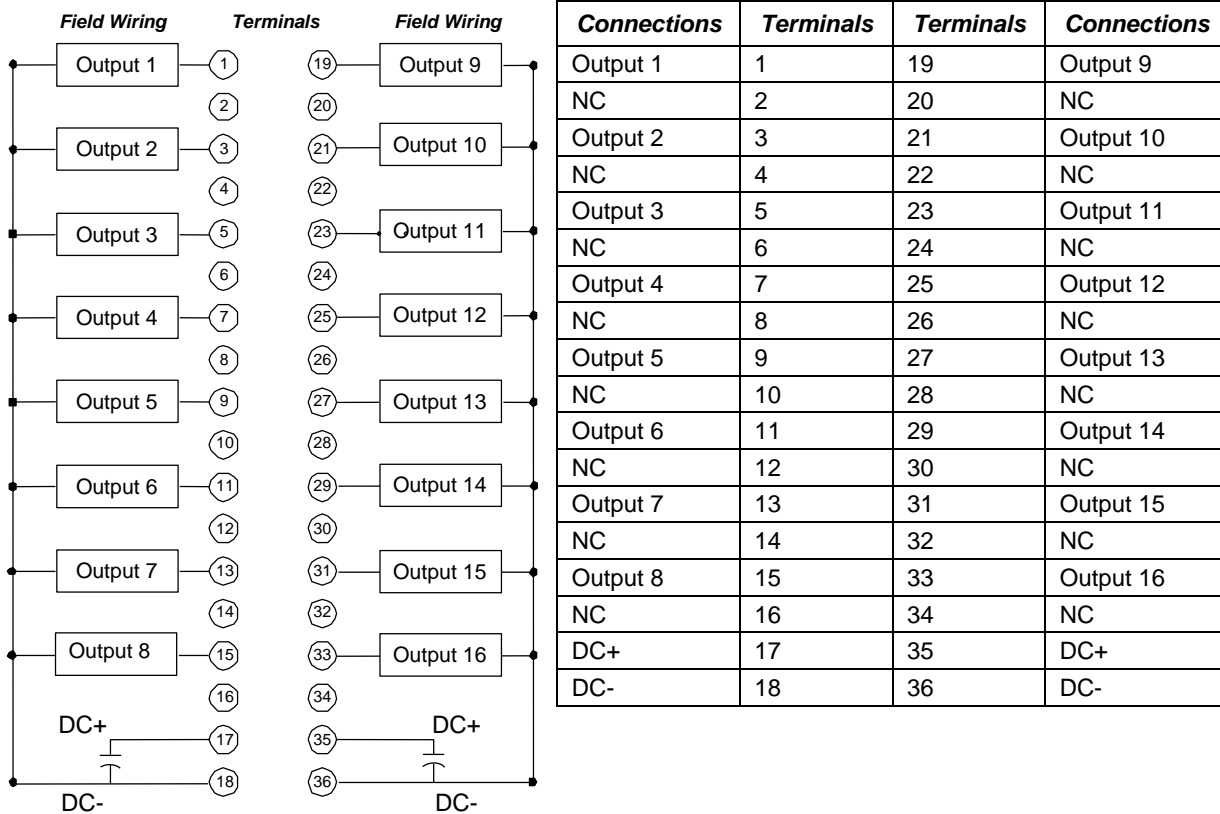| Resistive	2A at 132VDC
	2A at 30VDC
	No external suppression components required.
Inductive (Pilot Duty)	0.6A at 132VDC
	For inductive loads greater than 2.2H, maximum switching frequency is 0.125Hz.
	Overall maximum switching frequency: 1 Hz
	No external suppression components required.
	1.2A at 30VDC
	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 30VDC
	No external suppression components required.

MDL765 Thermal Derating Curve

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.
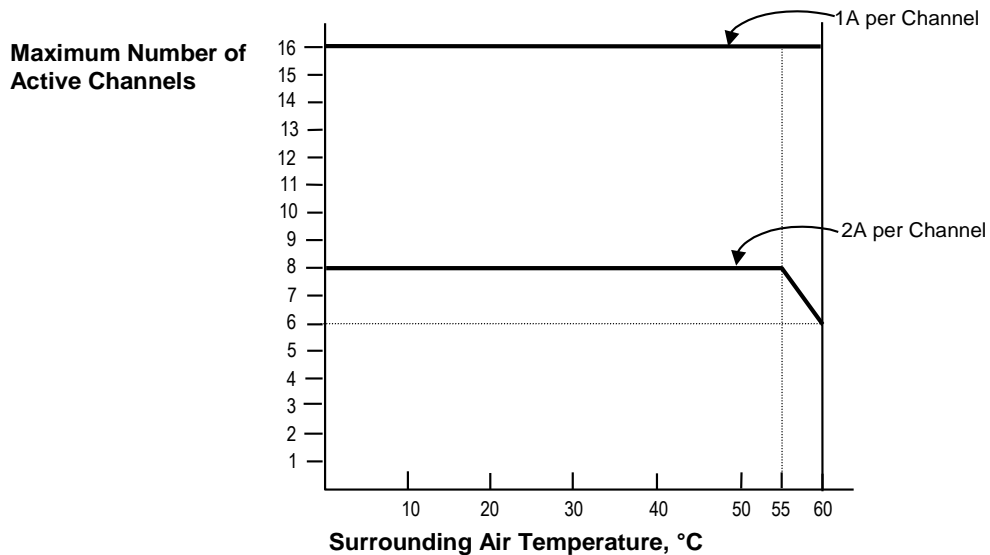
MDL765 Field Wiring

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

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-

Circuit Operation

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.

LED Operation

OK
S1
S2

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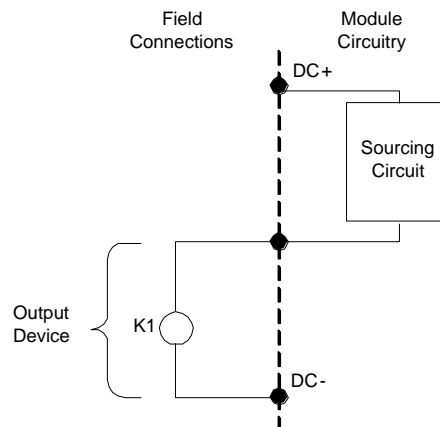
The 16 green/amber channel status LEDs on the module indicate the ON/OFF status of points 1 through 16.

The Module OK LED indicates module status. The field status LEDs (S1 and S2) indicate whether the external +24 VDC 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 status.

LED Name	*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.

Note: The **OK, S1** and **S2** LEDs blink green in unison when the module is in firmware update mode.

Input and Output Data Formats

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.
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

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

Module Settings

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.
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" on page 8.
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.
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.

Release History

Part Number	Firmware Version	Comments
IC695MDL765-AB	Primary: 1.01 Boot: 1.01	Resolves a problem with the module not powering up properly under elevated temperature conditions.
IC695MDL765-AA	Primary: 1.00 Boot: 1.00	Initial release

Important Product Information for this Release

Upgrades

If a module exhibits the symptoms described in "Problems Resolved by Release 1.01" contact GE Intelligent Platforms for corrective actions. The primary firmware upgrade can ***not*** be installed on a module that has boot firmware version 1.00.

Problems Resolved by Release 1.01

Subject	Description
Under some conditions, the module does not power-up properly.	At elevated ambient temperatures, some IC695MDL765 modules do not power up successfully. If this happens, the module has all outputs and LEDs off and a "Loss of Module" fault is logged to the I/O fault table. Additionally, all module point faults are correctly set if point faults are enabled. If this behavior is encountered, contact GE Intelligent Platforms for corrective actions.

Functional Compatibility

Programming Software	Proficy 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.

UL Class 1 Division 2 & ATEX Zone 2 Hazardous Area Warnings

1. EQUIPMENT LABELED WITH REFERENCE TO CLASS I, GROUPS A, B, C, D, DIV. 2 HAZARDOUS AREAS IS SUITABLE FOR USE IN CLASS I, DIVISION 2, GROUPS A, B, C, D OR NON–HAZARDOUS LOCATIONS ONLY.

2. WARNING – EXPLOSION HAZARD – SUBSTITUTION OF COMPONENTS MAY IMPAIR SUITABILITY FOR CLASS I, DIVISION 2 & ATEX ZONE 2.

3. WARNING – EXPLOSION HAZARD – DO NOT DISCONNECT EQUIPMENT UNLESS POWER HAS BEEN SWITCHED OFF OR THE AREA IS KNOWN TO BE NON–HAZARDOUS.

ATEX Zone 2 Hazardous Area Requirements

In order to maintain compliance with the ATEX Directive, an RX3i system located in a Zone 2 area (Category 3) must be installed within a protective enclosure meeting the criteria detailed below:

- IP54 or greater, and

- Mechanical strength to withstand an impact energy of 3.5 Joules