

# ControlWave® Micro

Emerson's ControlWave® Micro is a highly programmable controller that combines the unique capabilities of a programmable logic controller (PLC) and a remote terminal unit (RTU) into a single hybrid controller. The ControlWave Micro maximizes the performance of a wide range of control systems with a design emphasis on low power consumption, scalability, and modularity.

The ControlWave Micro meets the requirements of the most demanding process plant and remote SCADA system environments due to its small form factor and rugged industrial design. The ControlWave Micro can be seamlessly combined with other members in the ControlWave family of products for optimum system architecture.

## Features

- ARM processor provides exceptional performance and low power consumption
- Up to two 10/100 Mbps Ethernet ports
- Up to 11 serial communication ports with built-in modem option
- Three, four, and eight slot base unit with two, four, and eight slot I/O expansion base
- Mixed I/O cards for cost effective small RTU applications
- Optional isolated I/O modules
- IEC 61131-3 programming with ACCOL III process control function block library
- Open standards for programming, network configuration, and communication
- Security key-lock to prevent unauthorized access
- Wide temperature range (-40 to 70°C)
- Class I, Div. 2 hazardous location approval

## Base and Expansion Units

The ControlWave Micro base unit is constructed of aluminum and consists of a power module; a CPU module; and a three, four, or eight-slot housing. The CPU and power modules are installed into the first two slots of the housing, and the remaining slots are used to add optional input/output (I/O) modules or communications modules.

Expansion units are constructed of aluminum and add an additional two, four, or eight-slot housing that attaches to the base unit. These additional slots may be used for I/O modules.



*ControlWave Micro (4-slot)*

## CPU Options

The ControlWave Micro is available with either a 33 MHz CPU module for low-power applications or a 150 MHz CPU module for greater processing power.

The 33 MHz CPU module contains 2 MB of battery-backed SRAM, 64 MB SDRAM and 16 MB of flash memory. The 33 MHz CPU module also contains two on-board RS-232 communication ports and one on-board RS-485 communication port.

The 150 MHz CPU module contains 2 MB of SRAM, 64 MB SDRAM and 16 MB of flash memory. The 150 MHz CPU module is available with the following on-board communication port configurations:

- Two RS-232 ports and one RS-485 port
- One Ethernet port, two RS-232 ports, and one RS-485 port
- Two Ethernet ports, one RS-232 port, and one RS-485 port

## Power Modules

The power module is installed in the first slot of the ControlWave Micro base unit and provides power to the rest of the device. Three power modules are available including:

- 6 to 18 V power supply sequencer module (PSSM)
- 12 to 24 V power supply sequencer module (PSSM)
- 12 to 24 V power supply sequencer module (PSSM) with keylock and watchdog alarm output

## Communications

The ControlWave Micro base unit is available with up to two on-board RS-232 ports, one RS-485 port, and up to two on-board Ethernet ports, dependent upon your CPU selection. Additional communications modules may be installed into slots three and four of the ControlWave Micro base unit. Available communication modules include:

- Communication module with one RS-232 port and one RS-485 port
- Communication module with one RS-232 port, one RS-485 port, and integral 56 kb dial-line modem
- Communication module with two RS-232 ports and two RS-485 ports

## Communication Protocols

The ControlWave Micro supports BSAP (Bristol Standard Asynchronous Protocol), Modbus, FOUNDATION fieldbus, HART, DFI, CIP, DNP3, and serial ASCII as standard features.

The DNP3 protocol lends itself to an added layer of security through Secure Authentication (SA). SA version 5 is available in the ControlWave product when executed in the application. SAv5 authenticates the devices which significantly improve resistance to outside influence.

ControlWave Micro supports the following Modbus protocols:

- Modbus serial and TCP/IP Open Modbus (Ethernet) Gould and ENRON modes
- Master and Slave
- Modbus RTU and ASCII
- Command code 1 through 8, 15, and 16
- Integer and IEEE 4-byte floating point
- User-defined commands at master

## Inputs and Outputs

ControlWave Micro I/O modules are designed to maximize usability while minimizing installation and maintenance costs. The base chassis accommodates up to six I/O modules. An I/O expansion base extends the base chassis to support up to a total of fourteen I/O modules. Even further I/O expansion is available with the Distributed I/O System (DIOS) that provides Ethernet connectivity to multiple remote I/O chassis.

All I/O modules include 8-bit wide bus access and surge protection that meets C37.90-1978 and IEC 801-5.

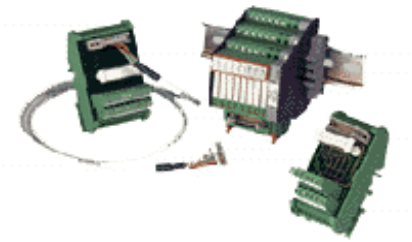
Local Terminations – All I/O modules are available with local terminations. Local terminations allow field wiring to be connected directly to the I/O module terminal blocks.

Optional I/O modules with local terminations include:

- 6 DI/DO, 4 AI, 2 HSC, and 1 AO
- 12 DI and 4 DO
- Isolated 12 DI and four DO
- 16 DI (24 Vdc input).
- 16 DI (12 Vdc input)
- 8 DI (120-240 Vac output)
- 16 DO
- 8 DO (120-240 Vac output)
- 6 AI and 2 AO
- 6 AI
- Isolated 8 AI
- Isolated 4 AO
- 6 TC
- 4 RTD
- 4 HSC (High Speed/Low Speed Counter)
- 8 HART/BTI Interface (2 channels may be AO)

Remote Terminations – Most I/O modules are available with remote terminations. Remote terminations consist of remotely mounted terminal blocks that provide a convenient alternative to the standard direct connect termination. Remote terminal blocks allow a concentration of electrical connections from one or more controllers to be located in one area, such as the rear of a cabinet.

Remote terminal blocks are often used for enclosure installations because they eliminate the need for point-to-point wiring from the RTU I/O to the field terminal strips. Each remote I/O module has connections to two remote terminal blocks. Remote terminal blocks are DIN-rail mountable and connect to the I/O module with two pre-wired connector cables. To simplify installation, all I/O modules use the same cable.



*Remote Terminal Blocks*

Optional I/O modules with connections for remote terminations include:

- 6 DI/DO, 4 AI, and 2 HSC (with fuses)
- 6 DI/DO, 4 AI, 2 HSC, and 1 AO (with fuses)
- 12 DI and 4 DO (with or without fuses)
- 16 DI (with or without fuses)
- 16 DI (120-240 Vac output)
- 16 DO, 24 Vdc (with or without fuses)
- 16 DO Relay (6 A, without fuses)
- 6 AI and 2 AO (with or without fuses)
- 6 AI (with or without fuses)
- Isolated 8 AI (with or without fuses)
- Isolated 4 AO (with or without fuses)
- 6 TC
- 4 RTD
- 4 HSC (High Speed/Low Speed Counter)
- 8 HART/BTI Interface (2 channels may be AO)

## Distributed I/O System

The ControlWave Micro Distributed I/O System (DIOS) is a remotely mounted housing for the installation of additional ControlWave Micro I/O modules. The DIOS supports up to fourteen slots of I/O using the same form factor as the ControlWave Micro. The DIOS supports installation of most ControlWave Micro I/O modules. The remotely mounted DIOS communicates with the ControlWave Micro base unit through a standard Ethernet connection.

The DIOS contains a CPU module used as an Ethernet communication engine that is dedicated to communications between the main processor located in the ControlWave Micro base unit and the DIOS unit. The CPU module in the DIOS unit also includes power fail/recovery control and battery backed RAM to retain I/O data during short power outages.

## Display/Keypad

An optional 4-line by 20-character LCD display with adjustable contrast is available with either a 2-button keypad or a 25-button keypad. Both options are connected to the ControlWave Micro base unit via a standard CAT5 cable.

The 2-button keypad display allows you to view site configuration and process data on the display. Screens are organized in a series of lists. You can select a list and then manually scroll through the data. Additionally, an automatically scrolling user-defined list of data can be set.

The 25-button keypad display performs the same functions as the 2-button display and allows you to view and modify the ControlWave Micro inputs, process variables, calculated variables, setpoints, tuning parameters, and outputs. Status controls include the alarm state, alarm acknowledge, control, and manual (Auto/Man).

## Software

The ControlWave Micro is supported by multiple software packages for programming, system configuration, and diagnostics.

ControlWave Designer – ControlWave Designer is a fully IEC 61131-3-compliant programming environment for the ControlWave Micro. ControlWave Designer includes all five IEC 61131-3 process languages for batch, continuous, and discrete control: Function Block Diagram, Structured Text, Sequential Function Chart, Ladder Logic Diagram, and Instruction List.

ControlWave Designer includes an extensive library of more than 200 basic IEC 61131-3 functions and function blocks common to many IEC 61131-3 based products. These include:

- Flip-flops, Counters, and Timers
- Ladder diagram functions (coils and contacts, etc.)
- Numerical, Arithmetic, and Boolean functions (Sine, Cosine, Add, Sub, Square Root, And, Or, etc.)

- Selection and Comparison (Min, Max, Greater Than, Equal, Less Than, etc.)
- Type conversions (integer to real, Boolean to Word, etc.)

ACCOL III – In addition to the basic functions and function blocks, ControlWave Designer brings the benefit of over 20 years of SCADA and plant control experience in Emerson’s ACCOL III function block library. ACCOL III includes over 60 function blocks valuable for use in oil and gas, water and wastewater, and process measurement and control applications. The ACCOL III library includes function blocks for:

- Average, Compare, Totalize
- Scheduling and Sequencing
- PID and Lead/Lag
- AGA gas flow and liquids calculations
- File handling

OpenBSI – Emerson’s OpenBSI (Open Bristol System Interface) is a set of network setup, communication diagnostic, and data viewing utilities that provide access to both ControlWave and Network 3000 controllers and RTUs. At the core of OpenBSI is a communication interface through which other applications communicate. OpenBSI supports both serial BSAP protocol and Ethernet Internet Protocol communication to ControlWave RTUs and controllers.

ObjectServer – ObjectServer is an OPC-compliant server that provides direct communication to the ControlWave family of controllers, RTUs, PLCs, and flow computers through the OpenBSI communications interface. It supports serial multi-drop, remote telemetry, and Ethernet communication networks. Unlike traditional OPC servers, ObjectServer is designed to provide reliable access to RTUs that are connected via low-bandwidth, high-latency, and poor-quality networks common with radio, satellite, and cellular connections.

## Historical Data Collection

The ControlWave Historical Data Collection system is a time-stamped historical database stored in ControlWave flash memory. OpenBSI collects the historical data either on a scheduled or on-demand basis. The collected data is converted to .CSV and ODBC-compliant file formats for use in spreadsheets and reports. If data is missing due to a communication failure, the data is collected when the communication is re-established, and the PC historical database is backfilled with the missing data.

This distributed historical database architecture provides data reliability and integrity during communication or PC failure.

Another important historical feature is the audit system. The audit system is made up of files stored in ControlWave flash memory that contain significant events, and both real-time and historical time-stamped alarms.

The audit system files are collected through OpenBSI and saved as a text file in the PC. This functionality is extremely useful in providing an event trail during communication disruption, PC downtime, or other system problem.

## Open Network Connectivity

By embracing the open system network technologies available through TCP/IP, Ethernet, OPC, and Microsoft DNA, as well as pseudo-standards such as Modbus and Open Modbus, the ControlWave Micro provides a total process automation management solution for in-plant LAN-based networks and wide-area network SCADA systems. Access to real-time data and operating conditions, historical data, maintenance, and performance data are available to the global network.

## Data Reliability

The ControlWave Micro is designed to provide the optimum level of data reliability by using distributed database architecture. All data, including time stamped alarms, alarm limits, and historical data, is stored locally in non-volatile flash memory in each ControlWave Micro.

The historical data is collected as un-edited binary data from the ControlWave Micro. The collected data is converted and appended to a .CSV and/or ODBC-compliant database. The original binary historical data is not changed, in compliance with API 21 requirements.

## Key Switch

The ControlWave Micro is available with a three-position front-panel key switch. The front-panel key switch provides a high level of manual security by controlling three modes of operation.

In Run Mode, the ControlWave Micro rejects any attempt to download or modify the running program, either locally or over the network.

In Remote Mode, the ControlWave Micro allows downloading and on-line program modification through the network connection after the security access requirements have been met. Local download and on-line modification of the running program is prohibited.

In Local Mode, the ControlWave Micro allows downloading and on-line modification through either the network connection or through a local serial communication port after the security access requirements have been met.

## Multi-User Security Access

The ControlWave Micro employs a username/password access system protected by a 56-bit encryption technique. You can configure usernames and passwords for up to 240 users. Both the username and the password can be up to 16 characters in length.

You can customize each user's security level based on 64 access rights, including the ability to read and write data values and files via FTP, access and configure historical and audit data information, edit configuration, run internal diagnostics, and read and reset system status.

## ControlWave Micro

### CPU Module

ControlWave Micro 33	Type	32-bit ARM 9 processor, 33 MHz Sleep mode for low power applications	
	Memory	Boot	512 KB
		Flash	16 MB on-board flash
		SRAM	2 MB, battery backed
		SDRAM	64 MB
ControlWave Micro 150	Type	32-bit ARM 9 processor, 150 MHz	
	Security	Key-lock security switch (optional)	
	Memory	Boot	512 KB
		Flash	16 MB
		SRAM	2 MB, battery backed
SDRAM		64 MB	

Clock	Real-time clock provides a full BCD clock calendar with programmable periodic/wakeup interrupt and a programmable clock generator with adjustable spectrum spreading		
	Accuracy	1 second/day at 25 °C	

### Communications

On-Board Ports	RS-232 (1 included and 1 optional)	Quantity	2
		Type	9-pin male D-sub connectors on CPU module
		Baud Rate	Up to 115.2 KB
	RS-485	Quantity	1
		Type	9-pin male D-sub connectors on CPU module
		Baud Rate	Up to 115.2 KB
	Ethernet (optional)	Quantity	Up to 2
		Type	10/100 Base-T Ethernet port with RJ45 connector (two serial ports with dual Ethernet CPU)
	Communication Modules (optional)	1 Port RS-232 / 1 Port RS-485	Quantity
Type			9-pin male D-sub connectors on CPU module
Baud Rate			Up to 115.2 KB
Isolation			RS-485 port isolated to 500 Vdc

2 Port RS-232 / 2 Port RS-485	Quantity	2 RS-232 ports 2 RS-485 ports
	Type	9-pin male D-sub connectors on CPU module
	Baud Rate	Up to 115.2 KB
	Isolation	RS-485 port isolated to 500 Vdc
Dial-up Modem	Type	Dial-up modem add-on

### Inputs/Outputs

I/O Modules (optional)	Mixed I/O	6 DIO, 4 AI, 2 HSC with local terminations or remote terminations with fuses. For more information, refer to <i>Product Data Sheet CWMICRO:MIX</i> .
	Mixed I/O with AO	6 DIO, 4 AI, 2 HSC, 1 AO with local terminations or remote terminations with fuses. For more information, refer to <i>Product Data Sheet CWMICRO:MIX</i> .
	Mixed DI/DO	12 DI, 4 DO with local terminations or remote terminations without fuses. For more information, refer to <i>Product Data Sheet CWMICRO:DIO</i> .
	Isolated Mixed DI/DO	12 DI, 4 DO with local terminations. For more information, refer to <i>Product Data Sheet CWMICRO:DIO</i> .
	Isolated DI	16 DI with local terminations or remote terminations without fuses. For more information, refer to <i>Product Data Sheet CWMICRO:DIO</i> .
	Isolated DI (24 Vdc)	16 DI with local terminations. For more information, refer to <i>Product Data Sheet CWMICRO:DIO</i> .
	Isolated DI (12 Vdc)	16 DI with local terminations. For more information, refer to <i>Product Data Sheet CWMICRO:DIO</i> .
	Isolated DO	16 DO local terminations, remote terminations with fuses, or remote terminations without fuses. For more information, refer to <i>Product Data Sheet CWMICRO:DIO</i> .
	Isolated Vac DI	8 DI with local terminations. For more information, refer to <i>Product Data Sheet CWMICRO:DIO</i> .
	Relay Isolated Vac/Vdc DO	8 normally open relays with local terminations. For more information, refer <i>Product Data Sheet CWMICRO:DIO</i> .
	Mixed AI/AO	6 AI, 2 AO with local terminations, remote terminations with fuses, or remote terminations without fuses. For more information, refer to <i>Product Data Sheet CWMICRO:AIO</i> .
	AI	6 AI with local terminations, remote terminations with fuses, or remote terminations without fuses. For more information, refer to <i>Product Data Sheet CWMICRO:AIO</i> .
	Isolated AI	8 AI with local terminations, remote terminations with fuses, or remote terminations without fuses. For more information, refer to <i>Product Data Sheet CWMICRO:AIO</i> .

Isolated AO	4 AO with local terminations, remote terminations with fuses, or remote terminations without fuses. For more information, refer to <i>Product Data Sheet CWMICRO:AIO</i> .
High Speed / Low Speed Counter	4 HSC with local terminations or remote terminations without fuses. For more information, refer to <i>Product Data Sheet CWMICRO:HSC</i> .
Thermocouple	6 AI with local terminations or remote terminations without fuses. For more information, refer to <i>Product Data Sheet CWMICRO:TEMP</i> .
RTD	4 RTD with local terminations or remote terminations without fuses. For more information, refer to <i>Product Data Sheet CWMICRO:TEMP</i> .
HART / BTI	8 AI and two AO channels with support for HART, BTI, or 4-20 mA signals with local terminations or remote terminations without fuses. For more information, refer to <i>Product Data Sheet CWMICRO:HIM</i> .

Remote Terminal Blocks	AI and AO	Number of Channels	4
		Dimensions	50 mm W by 90 mm H by 67.1 mm D (1.77 in. W by 3.53 in. H by 2.64 in. D)
	DI and DO	Number of Channels	8
		Dimensions	56 mm W by 90 mm H by 66 mm D (2.2 in. W by 3.53 in. H by 2.58 in. D)
DO Relay	Number of Channels	8	
	Dimensions	83 mm W by 99.1 mm H by 94 mm D (3.25 in. W by 3.9 in. H by 3.7 in. D)	
Cable Lengths	46 cm (18 in.) 1 m (39 in.) 2 m (6.5 ft) 4 m (13 ft)		


**Note:** Two remote terminal blocks and two cables are required for each I/O module with remote terminations.

Power		
Input Power	ControlWave Micro Base Unit	6 to 18 Vdc power supply sequencer module (PSSM)
		12 to 24 Vdc power supply sequencer module (PSSM)
		12 to 24 Vdc power supply sequencer module (PSSM) with Keylock and Watchdog Output
	ControlWave Micro Expansion Unit	6 to 18 Vdc power supply sequencer module (PSSM)
		12 to 24 Vdc power supply sequencer module (PSSM)
		12 to 24 Vdc power supply sequencer module (PSSM) with Keylock and Watchdog Output



Operating Range	5.4 V to 18 V (6 to 18 Vdc power supply sequencer module or PSSM)		
	10.79 V to 30.0 V (12 V Input Supply)		
	21.7 V to +30.0 V (24 V Input Supply)		
Output Voltages	3.3 Vdc		
Output Current	10 A max. at 3.3Vdc		
Output Ripple P/P	3.3 V Output: 50 mV, 110 mVpp @ 30 V input		
Fusing	3 A slow blow 5 x 20 mm fuse		
Surge Suppression	500 Vdc MOV, (PSGND) to CHASSIS 32 V Transient Suppressor from +VIN to -VIN (PSGND) Meets ANSI/IEEE C37.90-1978		
Shutdown	+12 V System	Max. ON Voltage	10.79 V
		Min. OFF Voltage	9.87 V
	+24 V System	Max. ON Voltage	22.33 V
		Min. OFF Voltage	20.41 V
Power Supply Sequencer Module (PSSM)	5.4 to 18 Vdc input or 10.79 to 30 Vdc input Power-fail detection and recovery sequencer 2-button or 25-key display interface Six LED status indicators Watchdog and Idle and communication LEDs		
Consumption	Micro 33 CPU without Ethernet	0.1 W	
	Micro 150 CPU without Ethernet	1.0 W	
	Micro 150 CPU with Ethernet	1.2 W	
	Micro 150 CPU with 2 Ethernet	2.0 W	
	Power Supply Sequencer Module (PSSM) 12/24V	0.08 W	
	Power Supply Sequencer Module (PSSM) 6/12V	0.009 W	
	Exp. Comm, Isolated RS485	0.53 W	
	Dial-up Modem	0.8 W	

<b>Physical</b>		
Dimensions	3-Slot Base	86.4 mm W by 152.4 mm H by 147 mm D (3.4 in. W by 6.0 in. H by 5.8 in. D)
	4-Slot Base	114.3 mm W by 152.4 mm H by 147 mm D (4.5 in. W by 6.0 in. H by 5.8 in. D)
	8-Slot Base	228.6 mm W by 152.4 mm H by 147 mm D (9.0 in. W by 6.0 in. H by 5.8 in. D)
	2-Slot Expansion Base	57 mm W by 152.4 mm H by 147 mm D (2.25 in. W by 6.0 in. H by 5.8 in. D)
	4-Slot Expansion Base	114.3 mm W by 152.4 mm H by 147 mm D (4.5 in. W by 6.0 in. H by 5.8 in. D)
	8-Slot Expansion Base	228.6 mm W by 152.4 mm H by 147 mm D (9.0 in. W by 6.0 in. H by 5.8 in. D)
	Weight	3-Slot Base
4-Slot Base		0.8 lbs (0.36 kg)
8-Slot Base		1.5 lbs (0.68 kg)
2-Slot Expansion Base		0.6 lbs (0.27 kg)
4-Slot Expansion Base		0.8 lbs (0.36 kg)
8-Slot Expansion Base		1.5 lbs (0.68 kg)
Wiring		Up to size 16 AWG at the removable terminal blocks.
<b>Environmental</b>		
Operating Temp	-40 to 70 °C (-40 to 158 °F) -20 to 70 °C (-4 to 158 °F) (if display/keypad attached)	
Storage Temp	-40 to 85 °C (-40 °F to 185 °F)	
Operating Humidity:	5-95% non-condensing	
Conformal Coating	All boards are conformal coated with a coating that complies with ANSI/ISA 71.04 Class G3 environments.	
Environmental Rating	Product conforms to ANSI/ISA 71.04 Class G3 environmental standards when installed in a minimum NEMA 4x/IP66 rated enclosure intended for outdoor use with all conduit openings sealed.	
Immunity	3 V/m – 80 MHz to 1000 Mhz (IEC 61000-4-3:2002)	
Radiated Emissions	IEC 55022:1998	
Vibration	1.0 g for 10-150 Hz; 0.5 g for 150 Hz to 2000 Hz	

Approvals		
Product Markings for Hazardous Locations	ATEX	<p>Certified by UL International DEMKO A/S                      Models 396560-02-4, 396560-01-6, 396563-16-3, 396581-06-4, 396567-02-8, 396686-01-0, and 396897-02-9                      Cert DEMKO 13 ATEX 1203X                      Ex II 3 G                      Ex nA IIC T4 Gc                      IP54</p> 
		<p>Evaluated per Approval Standards EN 60079-0:2012+A11:2013                      EN 60079-15:2010.                      EN/IEC 60664-1</p>
	UKCA	 <p>UKCA CSAE 22UKEX1142X</p>
	CE	<p>Certified by UL International DEMKO A/S                      Cert DEMKO 06 ATEX 0511610X                      Ex II 3 G                      EEx nC IIC T4                      IP54</p> 
		<p>Evaluated per Approval Standards EN 50021:1999</p>
	UL/CUL	<p>Class I, Division 2, Groups A, B, C, and D T4</p>
		<p>Evaluated per Approval Standards UL 1604 (Electrical Equipment for Use in Class I and II, Division 2 and Class III Hazardous Locations)                      UL 508 (Industrial Control Equipment)                      C22.2 No. 213-M1987 (Non-incendive Electrical Equipment for Use in Class I, Division 2 Hazardous Locations)                      C22.2 No. 142-M1987 (Process Control Equipment)</p>
	TR CU 012/2011	<p>Certified by NANIO "CCVE"                      RU C-US.ГБ05.B.01094 valid from 17.04.2015 to 17.04.2020                      2Ex nA IIC T4 X                      -40C<sup>0</sup> ≤ Ta ≤ +70C<sup>0</sup>                      IP54</p> 
Miscellaneous Approvals	Customs Union	 <p>TR CU 004/2011, TR CU 020/2011                      Certified by "Technoneftegaz"                      TC RU C-US.HO03.B.00302 valid from 30.06.2015 to 29.06.2020</p>

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RoHS2	RoHS (2) EU Directive 2011/65/EU: This product may be considered out-of-scope when used for the intended design purpose in a Large Scale Fixed Installation (LSFI). Consult <a href="https://www.emerson.com/compliance">https://www.emerson.com/compliance</a> for up-to-date product information.
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RoHS (China)
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EMC
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EN 55022:1998 (Emissions) EN 61000-4-3:2002 (Radiated Immunity)
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