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REPORT

on

PROGRAMMABLE CONTROLLERS
FOR USE IN HAZARDOUS LOCATIONS

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Watertown, CT

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DESCRIPTION

PRODUCT COVERED:

USL, CNL Programmable Controller, Control Wave Series and Control Wave I/O Expansion Rack for use in Class I, Division 2, Groups A, B, C, D Hazardous Locations. Consists of the following modules:

Chassis:

396356-03-6, 396356-02-8, 396356-01-0

Power Supply Module:

396351-02-6, 396351-01-8

CPU Module (Control Wave):

396359-12-4, 396359-11-6, 396359-10-8, 396359-09-4,
396359-08-6, 396359-07-8, 396359-06-0, 396359-05-1,
396359-04-3, 396359-03-5, 396359-02-7, 396359-01-9

CPU Module (Control Wave I/O Expansion Rack):

396359-13-2, 396359-14-0, 396458-01-7, 396458-02-5

I/O Module:

396352-14-6, 396352-13-8, 396352-12-0, 396352-11-1,
396352-04-9, 396352-03-0, 396352-02-2, 396352-01-4,
396353-14-2, 396353-13-4, 396353-12-6, 396353-11-8,
396353-04-5, 396353-03-7, 396353-02-9, 396353-01-0,
396357-14-8, 396357-13-0, 396357-12-1, 396357-11-3,
396357-04-0, 396357-03-2, 396357-02-4, 396357-01-6,
396358-12-8, 396358-11-0, 396358-02-0, 396358-01-2,
396362-14-1, 396362-13-3, 396362-12-5, 396362-11-7,
396362-04-4, 396362-03-6, 396362-02-8, 396362-01-0

Thermocouple Input Module:

396877-01-0, 396877-02-8,

RTD Input Module

396878-01-6, 396878-02-4

ENGINEERING CONSIDERATIONS (NOT FOR FIELD REPRESENTATIVE'S USE):

UNL indicates investigation to United States UL Standard 508 and 1604.

CNL indicates investigation to Canadian Standards C22.2 No. 142-M1987 and C22.2 No. 213-M1987.

GENERAL:

Open Type devices that employ a scalable, modular hardware design. Units contain a Backplane that supports up to 2, 4 or 8 I/O modules. Each *Control Wave Process Automation Controller or Control Wave I/O Expansion Rack is comprised of a Backplane Board (mounted in the Chassis), a Power Supply Module, a CPU Module and from 0 to 8 I/O Modules. All system modules plug into the Backplane Board (2, 4, or 8 I/O versions). Each I/O Module provides the circuitry and field interface hardware necessary to interconnect the assigned field I/O circuits. Additionally the CPU Board implements a Port-80 Display consisting of two TI TIL311 Displays. Isolated power is generated and regulated by the Power Supply/Sequencer Module that provides +3.3 V dc, +5 V dc, +12 V dc (optional) and -12 V dc (optional) from a bulk *10.6 to 20 V dc or 20.7 to 30 V dc source. The I/O Expansion Rack adds *four new lower power CPU boards.

RATINGS:

Electrical -

| <u>Module P/N</u> | <u>Description</u> | <u>Rating</u> |
|-------------------|---------------------------------------|--|
| 396356-03-6 | 2 Slot I/O | 75 mA at 5 Vdc |
| 396356-02-8 | 4 Slot I/O | 100 mA at 5 Vdc |
| 396356-01-0 | 8 Slot I/O | 350 mA at 5 Vdc |
| 396351-02-6 | +12 Vdc | 1650 mA at 12 Vdc 6800 mA at 12/24 Vdc (field) |
| 396351-01-8 | +24 Vdc | 850 mA at 24 Vdc 3600 mA at 12/24 Vdc (field) |
| 396359-12-4 | (2) RS232, (2) RS485, (3) Ethernet | 600 mA at 3.3 Vdc 850 mA at 5 Vdc |
| 396359-11-6 | (2) RS232, (3) Ethernet | 450 mA at 3.3 Vdc 850 mA at 5 Vdc |
| 396359-10-8 | (2) RS232, (2) RS485 | 600 mA at 3.3 Vdc 250 mA at 5 Vdc |
| 396359-09-4 | (3) RS232, (1) RS485 | 600 mA at 3.3 Vdc 250 mA at 5 Vdc |
| 396359-08-6 | (4) RS232 | 650 mA at 3.3 Vdc 250 mA at 5 Vdc |
| 396359-07-8 | (2) RS232, (2) RS485, (1) Ethernet | 600 mA at 3.3 Vdc 450 mA at 5 Vdc |
| 396359-06-0 | (3) RS232, (1) RS485, (1) Ethernet | 600 mA at 3.3 Vdc 450 mA at 5 Vdc |
| 396359-05-1 | (3) RS232, (1) RS485, (2) Ethernet | 600 mA at 3.3 Vdc 650 mA at 5 Vdc |
| 396359-04-3 | (4) RS232, (1) Ethernet | 650 mA at 3.3 Vdc 450 mA at 5 Vdc |
| 396359-03-5 | (2) RS232, (2) Ethernet | 650 mA at 3.3 Vdc 650 mA at 5 Vdc |
| 396359-02-7 | (2) RS232 | 450 mA at 3.3 Vdc 250 mA at 5 Vdc |

(Table Cont'd.)

| <u>Module P/N</u> | <u>Description</u> | <u>Rating</u> |
|-------------------------------|---------------------------------------|--|
| 396359-01-9 | (2) RS232, (1) Ethernet | 450 mA at 3.3 V dc 450 mA at 5 V dc |
| *396359-13-2, *396458-01-7 | (2) RS232, (1) Ethernet | 280 mA at 3.3 V dc 280 mA at 5 V dc |
| *396359-14-0, *396458-02-5 | (1) RS232, (1) RS485, (1) Ethernet | 290 mA at 3.3 V dc 220 mA at 5 V dc |
| 396352-14-6 | 8 point remote (1-5 V dc) | 120 mA at 5 V dc |
| 396352-13-8 | 8 point remote (4-20 mA) | 120 mA at 5 V dc 425 mA at 12 V dc (field) 230 mA at 24 Vdc (field) |
| 396352-12-0 | 16 point remote (1-5 V dc) | 130 mA at 5 V dc |
| 396352-11-1 | 16 point remote (4-20 mA) | 140 mA at 5 V dc 850 mA at 12 V dc (field) 450 mA at 24 V dc (field) |
| 396352-04-9 | 8 point local (1-5 V dc) | 120 mA at 5 V dc |
| 396352-03-0 | 8 point local (4-20 mA) | 120 mA at 5 V dc 425 mA at 12 V dc (field) 230 mA at 24 V dc (field) |
| 396352-02-2 | 16 point local (1-5 V dc) | 130 mA at 5 V dc |
| 396352-01-4 | 16 point local (4-20 mA) | 140 mA at 5 V dc 850 mA at 12 V dc (field) 450 mA at 24 V dc (field) |
| 396353-14-2 | 4 point remote (1-5 V dc) | 70 mA at 5 V dc 260 mA at 12 V dc (field) 150 mA at 24 V dc (field) |
| 396353-13-4 | 4 point remote (4-20 mA) | 70 mA at 5 V dc 210 mA at 12 V dc (field) 120 mA at 24 V dc (field) |
| 396353-12-6 | 8 point remote (1-5 V dc) | 70 mA at 5 V dc 500 mA at 12 V dc (field) 270 mA at 24 V dc (field) |
| 396353-11-8 | 8 point remote (4-20 mA) | 70 mA at 5 V dc 400 mA at 12 V dc (field) 220 mA at 24 V dc (field) |
| 396353-04-5 | 4 point local (1-5 V dc) | 70 mA at 5 V dc 260 mA at 12 V dc (field) 150 mA at 24 V dc (field) |

(Table Cont'd.)

| <u>Module P/N</u> | <u>Description</u> | <u>Rating</u> |
|-------------------|--------------------------------|---|
| 396353-03-7 | 4 point local (4-20 mA) | 70 mA at 5 Vdc 210 mA at 12 Vdc (field) 120 mA at 24 Vdc (field) |
| 396353-02-9 | 8 point local (1-5 Vdc) | 70 mA at 5 Vdc 500 mA at 12 Vdc (field) 270 mA at 24 Vdc (field) |
| 396353-01-0 | 8 point local (4-20 mA) | 70 mA at 5 Vdc 400 mA at 12 Vdc (field) 220 mA at 24 Vdc (field) |
| 396357-14-8 | 16 point remote (ext. powered) | 60 mA at 5 Vdc 30 mA at 12 Vdc (field) 30 mA at 24 Vdc (field) |
| 396357-13-0 | 32 point remote (ext. powered) | 100 mA at 5 Vdc 30 mA at 12 Vdc (field) 30 mA at 24 Vdc (field) |
| 396357-12-1 | 16 point remote (int. powered) | 60 mA at 5 Vdc 180 mA at 12 Vdc (field) 110 mA at 24 Vdc (field) |
| 396357-11-3 | 32 point remote (int. powered) | 100 mA at 5 Vdc 330 mA at 12 Vdc (field) 200 mA at 24 Vdc (field) |
| 396357-04-0 | 16 point local (ext. powered) | 60 mA at 5 Vdc 30 mA at 12 Vdc (field) 30 mA at 24 Vdc (field) |
| 396357-03-2 | 32 point local (ext. powered) | 100 mA at 5 Vdc 30 mA at 12 Vdc (field) 30 mA at 24 Vdc (field) |
| 396357-02-4 | 16 point local (int. powered) | 60 mA at 5 Vdc 180 mA at 12 Vdc (field) 110 mA at 24 Vdc (field) |
| 396357-01-6 | 32 point local (int. powered) | 100 mA at 5 Vdc 330 mA at 12 Vdc (field) 200 mA at 24 Vdc (field) |
| 396358-12-8 | 16 point remote | 80 mA at 5 Vdc |
| 396358-11-0 | 32 point remote | 150 mA at 5 Vdc |

(Table Cont'd.)

| <u>Module P/N</u> | <u>Description</u> | <u>Rating</u> |
|--------------------|--|------------------------|
| 396358-02-0 | 16 point local | 80 mA at 5 Vdc |
| 396358-01-2 | 32 point local | 150 mA at 5 Vdc |
| 396362-14-1 | 6 point remote (w/o debounce) | 60 mA at 5 Vdc |
| 396362-13-3 | 12 point remote (w/o debounce) | 100 mA at 5 Vdc |
| 396362-12-5 | 6 point remote (with debounce) | 60 mA at 5 Vdc |
| 396362-11-7 | 12 point remote (with debounce) | 100 mA at 5 Vdc |
| 396362-04-4 | 6 point local (w/o debounce) | 60 mA at 5 Vdc |
| 396362-03-6 | 12 point local (w/o debounce) | 100 mA at 5 Vdc |
| 396362-02-8 | 6 point local (with debounce) | 60 mA at 5 Vdc |
| 396362-01-0 | 12 point local (with debounce) | 100 mA at 5 Vdc |
| 396877-01-0 | 6 point local Thermocouple Input | 191 mA at 5 Vdc |
| 396877-02-8 | 6 point remote Thermocouple Input | 191 mA at 5 Vdc |
| 396878-01-6 | 4 point local RTD Input | 118 mA at 5 Vdc |
| 396878-02-4 | 4 point remote RTD Input | 118 mA at 5 Vdc |

Ambient - 70° maximum

MARKINGS:

The following markings are provided:

1. **Listee's name, part number, electrical ratings, "Class I, Div. 2, Groups A, B, C, D" and "Maximum Ambient 70°C".**
2. Located near supply terminals, "Warning - Explosion Hazard - Do Not Disconnect While Circuit Is Alive Unless Area Is Known To Be Non-Hazardous".
3. Date Code of Manufacturer - Provided by Serial Number.
4. Temperature Code: T4A

INSTALLATION MANUAL:

Installation and operating instructions are provided with each device. Installation instructions should contain statement that input and output (I/O) wiring must be in accordance with Class I, Div. 2 wiring methods and in accordance with the authority having jurisdiction.

The following shall be provided:

- 1) "This Equipment 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".
- 3) "Warning - Explosion Hazard - Do Not Disconnect Equipment Unless Power Has Been Switched Off Or The Area is Known To Be Non-Hazardous".

SPACINGS:

Spacing - Spacing of non-Class 2 circuits are not less than 1.6 mm through air and 3.2 mm over surface, maintained between an uninsulated live part and uninsulated live part of opposite polarity, uninsulated grounded part, or exposed metal part

Spacings are not specified in the secondary circuits of the power supplies and modules.

CONSTRUCTION DETAILS:

General - The construction details are shown in the following drawings and associated descriptive pages. The general design, shape and arrangement shall be as shown unless variations are specifically indicated. All dimensions are approximate unless otherwise indicated.

Corrosion Protection - All metal parts are corrosion resistant material or plated or painted as corrosion protection.

Edge Connectors and Wire Connectors - All edge connectors and wire connectors are provided with means for mechanically latching all mating plugs and receptacles unless otherwise indicated.

Make/Break Components - All such components, such as dip switches and non-latching connectors are not accessible without removing power and disassembling the unit.

Printed Wiring Board - All printed wiring boards are Recognized Component (ZPMV2), rated minimum 105°C, 94V-0. Printed wiring boards for power supply and AC rated modules are also suitable for direct support of live parts.

Class 2 Circuitry - Except for make/break components, modules listed as "Logic Level" or rated less than 30 V rms under electrical ratings require no evaluation of circuit components, spacing, or assembly.

PROGRAMMABLE CONTROLLERS, CONTROL WAVE SERIES - BACKPLANE

General - Provides for interconnection of the Power Supply/Sequencer Module (PSSM), CPU Module and I/O Modules. Available in three versions supporting 2, 4 or 8 I/O modules. All module slot connections are implemented with Compact PCI (CPCI) type connectors. See ILLS. 1 through 3 for details.

PROGRAMMABLE CONTROLLERS, CONTROL WAVE SERIES -
POWER SUPPLY/SEQUENCER MODULE

General - Represents the +12 and +24 V dc versions. The Power Supply/Sequencer Module (PSSM) plugs into the system's backplane board (connector P1) via connector J1. Also provided with the PSSM is a piggyback converter board to provide a 3.3 V dc logic circuit. The assembly, parts list and component layout shall be as shown in ILLS. 4 through 8. The following are user accessible make/break components.

1. Power Switch (SW1) - Provided on the secondary side of the power supply and within a nonincendive circuit. Powered via the VI input of the terminal block and its switched output is connected to the VO/NO output of the terminal block.
2. Fuse (XF1) - Any R/C (JDYX2), rated 3 A, slow blow. Used to protect the entire system. Latching.
3. Fuse (XF2) - Any R/C (JDYX2), rated 10 A, slow blow. Used to protect the I/O Module field supplies. Latching.
4. Terminal Block (TB1, TB2) - Any R/C (XCFR2), suitable for field wiring.
5. Connector (J1) - Compact PCI (CPCI) type keyed 110-pin connector secured to backplane.

PROGRAMMABLE CONTROLLERS, CONTROL WAVE SERIES -
CPU MODULE

General - Represents all versions covered in this report, both single and dual card. The CPU Module houses the CPU Board and, if present, an optional PC/104-Plus communications board referred to as the Secondary Communications Board (SCB). The base version of the CPU Board includes two RS-232 communication ports and an Ethernet RJ-45 communication port. The assembly and component layout shall be as shown in ILLS. 9 and 12. The following are user accessible make/break components.

1. Connector - All are latching.

J1 - 132 pin, I/OB connector
J2 - 9 pin, COM 1 male D-sub
J2 (SCB) - 8 pin, COM 3 RJ-45
J3 - 9 pin, COM 2 male D-sub
J3 (SCB) - 9 pin, COM 4 male D-sub
J4 - 8 pin Ethernet 10/100Base-T RJ-45 #1
J5 (SCB) - 8 pin Ethernet 10/100Base-T RJ-45 #2
J7 (SCB) - 8 pin Ethernet 10/100Base-T RJ-45 #3
J10 - 3 pin, battery connector

2. Switches - All are located within a nonincendive circuit.

SW1 - eight bit, user configuration settings
SW3 - four bit, provides battery back-up and forced recovery functions.
SW1 (SCB) - eight position, provides loopback control
SW4 (SCB) - eight position, provides loopback control
Run/Remote/Local - allows user to set unit
Reset - allows stop and restart during maintenance

PROGRAMMABLE CONTROLLERS, CONTROL WAVE I/O EXPANSION RACK -
CPU MODULE

General - Represents all versions covered in this Report. The CPU Module houses the CPU Board. There are two basic versions of the CPU Module; with Ethernet and two RS232 ports, or with Ethernet and one RS232 port and one RS485 port. The assembly and component layout shall be as shown in ILLS. 24 and 25. The following are user accessible make/break components.

1. Connector -

All are latching

J1 - 9 pin, COM 1 male D-sub
J2 - 9 pin, COM 1 male D-sub
J3 - 8 pin, Ethernet 10/100 Base-T RJ-45
J4 - 132 pin, I/O Bus Connector
J5 - 24 pin, Port 80 Diagnostics

Not User Accessible

J6 - 3 pin, Battery Connector
J7 - 10 pin, 3128 PLD JTAG Header
P1 - 64 pin, PC-104
P2 - 40 pin, PC-104

2. Switches - All are located within a nonincendive circuit.

SW3 - 8 bit, user configuration settings
SW5 - 4 bit, provides battery back-up and forced recovery functions.
Reset - Allows stop and restart during maintenance

PROGRAMMABLE CONTROLLERS, CONTROL WAVE SERIES -
I/O MODULE

General - There are no user accessible make/break components.

Analog Output Modules are factory configured to support either 4-20 mA or 1-5 V dc analog outputs. Each module contains field interface circuitry for up to 8 or 4 analog outputs. Each module consists of a Terminal Board Assembly, an Analog Output PCB (with a daughter board when configured for 1-5 V dc operation), an LED Housing Assembly, a Terminal Housing Assembly as well as I/O assembly and mounting hardware. The assembly and component layout shall be as shown in ILLS. 13 through 16.

Two types of Analog Input Modules are available, 4-20 mA or 1-5 V dc input versions. Each module contains field interface circuitry for up to 16 or 8 analog inputs. Each module consists of a Terminal Board Assembly, an Analog Input PCB, an LED PCB, an LED Housing Assembly, a Terminal Housing Assembly as well as I/O assembly and mounting hardware. The assembly is as shown in ILL. 17, the LED PCB is as shown in ILLS. 18 and 19, and the component layout shall be as shown in ILLS. 20 and 21.

Digital Input Modules are factory configured to support either externally powered source or dry contact applications. Each module contains field interface circuitry for up to 32 or 16 discrete inputs with an input range of 24 V dc and 5 mA. Each module consists of a Terminal Board Assembly, a Discrete Input PCB, an LED PCB, an LED Housing Assembly, a Terminal Housing Assembly as well as I/O assembly and mounting hardware. The assembly is as shown in ILL. 17, the LED PCB is as shown in ILLS. 18 and 19, and the component layout shall be as shown in ILL. 22.

Digital Output Modules contain an optically isolated open source MOSFET and surge suppressor that are capable of handling 500 mA at 31 V dc. Each module consists of a Terminal Board Assembly, a Discrete Output PCB, an LED PCB, an LED Housing Assembly, a Terminal Housing Assembly as well as I/O assembly and mounting hardware. The assembly is as shown in ILL. 17, the LED PCB is as shown in ILLS. 18 and 19, and the component layout shall be as shown in ILL. 23.

Universal Digital Input Module provide a total of 12 or 6 inputs. Each input is optically isolated from the field device. Factory configured with all inputs set with debounce enabled or with all inputs set with debounce disabled. Each module consists of a Terminal Board Assembly, a Universal Digital Input PCB, an LED PCB, an LED Housing Assembly, a Terminal Housing Assembly as well as I/O assembly and mounting hardware. The assembly is as shown in ILL. 17, the LED PCB is as shown in ILLS. 18 and 19, and the component layout shall be as shown in ILLS. 24.

The Low Level Analog Thermocouple Input Module, Models 396877-01-0 (for local terminations) and 396877-02-8 (for remote terminations), Fig. 1, supports six individually isolated differential inputs for thermocouples and mV inputs. The board contains 6 LLAI channels and a CJC channel. Each channel contains signal conditioning circuitry, surge suppression and a 24 bit A to D converter. Each module consists of a Terminal Board Assembly (Local or Remote), a Low Level Analog Input PCB, an LED PCB, an LED Housing Assembly, a Terminal Housing Assembly as well as I/O assembly and mounting hardware. The schematic, assembly, component layout drawings, and parts lists shall be as shown in ILLS. 26 through 33.

The CWM Isolated RTD Input Module, Models 396878-01-6 (for local terminations) and 396878-02-4 (for remote terminations), Fig. 2, supports four individually isolated RTD inputs for 2, 3, or 4 wire inputs. Each channel contains signal conditioning circuitry, surge suppression and a 24 bit A to D converter. Each module consists of a Terminal Board Assembly, a Low Level Analog Input PCB, an LED PCB, an LED Housing Assembly, a Terminal Housing Assembly as well as I/O assembly and mounting hardware. The schematic, assembly, component layout drawings, and parts lists shall be as shown in ILLS. 34 through 38.