XL15 Datasheet - Model 6

12 DC In, 12 DC Out, 6 –14-bit Analog In (mA/V/Tc/mV/RTD), 4 – 12-bit Analog Out

MAN1129 Revision 20
25 MAY 2023

HG-003

Part Numbers

Global Part Number	HE-XP7E6
European Part Number	HEXT751C116

User Manual and Add-Ons

Find the documents via the Documentation Search.

Part #	Description
MAN1106	XL15+ User Manual
MAN1142	Rechargeable Battery Manual
HE-BAT013	Rechargeable 3.6V Lithium Battery
HE-XCK	Programming Cables
HE-XDAC007	2 channel Analog Output I/O option kit, selectable 0-10V, +/-10V, 4-20mA.
HE-XDAC107	4 channel Analog Output I/O option kit, selectable 0-10V, +/-10V, 4-20mA.
HE-XKIT	Blank I/O Board
HE200MJ2TRM	Adapter, RJ45 (8P8C) male to 8-position terminal strip.
HE-FBD001	Ferrite core for filtering out electrical noise.

Battery Maintenance

The XL15+ uses a replaceable non-rechargeable 3V Lithium coin-cell battery to run the Real-Time Clock and to keep the retained register values. This battery is designed to maintain the clock and memory for 7-10 years. Please reference **MAN1106** providing instructions on how to replace the battery.

Table of Contents

TECHNICAL SPECIFICATIONS

General Specifications

Required Power (Steady State)	2137mA @ 10V (21.37W)
	886mA @ 24V (8.86W)
Heater Option	800mA @ 24VDC
Power Backlight 50%	385mA (9.6W)
Power Backlight Off	290mA (7W)
Inrush Current	25A for < 1ms @ 24VDC DC
Primary Pwr. Range	18–30VDC
Clock Accuracy	+/ - 20 ppm maximum at 25°C (+/- 1 min/month)
Real Time Clock	With Battery (5-10 Yrs life, Replaceable)
Relative Humidity	5 to 95% non-condensing
Operating Air Temp	-10°C to +60°C
Storage Temp	-30°C to +70°C
Weight	7.63 lbs/3.46 kg (without I/O)
Certifications (UL/CE)	North America or Europe

Display

Display Type	15" XGA TFT (500 cd/m^2 typical)
Resolution	1024 x 768
Color	24-bit (16,777,216)
Built-In Storage	4 GB
User-Program Screens	1023 max pages; 1023 objects per page
Backlight	LED - 50,000 hour life
Brightness Control	0-100% via System Register
Touchscreen	Resistive w/laminated cover, 1,000,000+ touch life

Connectivity

3x Serial Ports	RS-232 full handshaking or RS-485 half duplex on first Modular Jack (MJ1) RS-232 or RS-485 on second Modular Jack (MJ2) RS-232 or RS-485 on third Modular Jack (MJ3)(Software Controlled RS-485 Termination/Biasing)
USB mini-B	USB 2.0 (480 Mbps) Programming & Data Access
3x USB A (500mA max)	USB 2.0 (480 Mbps) for USB flash drives (2TB)
2x CAN	125 kbps – 1 Mbps, Remote I/O, Peer-to- Peer Comms, Cscape (Isolated Ports)
2 x Ethernet	1 Gb (Auto-MDX), Modbus TCP C/S, HTTP, FTP, SMTP, Cscape, Ethernet IP
Remote I/O	SmartRail, SmartStix, SmartBlock, SmartMod
Removable Memory	microSD, SDHC, SDXC IN FAT32 format, support for 128 GB max. Application Updates, Datalogging, more
Audio	Beeper, Mic In, Line Out

Control and Logic

Control Lang. Support	Advanced Ladder Logic Full IEC 1131-3 Languages
Logic Program Size & Scan Rate	2MB
Online Programming Changes	Supported in Advanced Ladder
Logic Scan Rate	.006ms/kB
Digital Inputs	2048
Digital Outputs	2048
Analog Inputs	512
Analog Outputs	512
Gen. Purpose Registers	49,999 (words) Retentive 16,384 (bits) Retentive 16,384 (bits) Non-retentive

High Speed Inputs

Number of Counters	4
Maximum Frequency	1MHz Max
Accumulator Size	32-bits each
Modes Supported	Totalizer, quadrature, pulse measurement, frequency measurement, set-point controlled outputs

High Speed Ouputs

Number of Counters	Stepper, PWM
Output Frequency	500kHz

USB Webcams

USB Webcams supported should support the UVC (USB Video class) protocol for the OCS to be able to display video. Most USB based video devices support this today. Special feature such as zoom and high definition are not supported by the OCS.

XL15+ User Manual [MAN1106]

The User Manual includes extensive information on:

- Built-in I/O
- I/O Status and Calibration
- Common %S & %SR Registers
- HSC/PWM/Totalizer/Quadrature & Accumulator Registers
- Resource Limits

Digital DC Input

Inputs per Module	12	
Commons per Module	1	
Input Voltage Range	12- 24VDC	
Absolute Max. Voltage	30VDC Max.	
Input Impedance	10kΩ	
Input Current	Positive Logic	Negative Logic
Upper Threshold	0.8mA	-1.6mA
Lower Threshold	0.3mA	-2.1mA
Max. Upper Threshold	8VDC	
Min. Lower Threshold	3VDC	
OFF to ON Response	1ms	
ON to OFF Response	1ms	
Galvanic Isolation	None	
Logic Polarity	Selectable in Cscape	
I/O Indication	9 (IN 9-12)	
High Speed Counter Max Freq	1MHz	
Connector Type	3.5mm Pluggable Cage Clamp Connector	

*See I/O info below for detail regarding HSC and PWM

Digital DC Outputs

Outputs per Module	12
Commons per Module	1
Output Type	Half-Bridge
Absolute Max. Voltage	28VDC Max.
Output Protection	Short Circuit & Overvotlage
Max. Output Currentper Point	0.5A
Max. Total Current per Driver (Q1-4, Q5-8, Q9-12)	2A Total Current (All Drivers) UL-Rated, 6A UL Pending
Max. Output Supply Voltage	30VDC
Min. Output Supply Voltage	10VDC
Max. Voltage Drop at Rated Current	0.25VDC
Min. Load	None
I/O Indication	None
Galvanic Isolation	None
OFF to ON Response	150ns
ON to OFF Response	150ns
Output Characteristics	Current Sourcing (Pos. Logic)
PWM Out*	500kHz Max
Rise Time	150ns Max
Fall Time	150ns Max
Modes Supported	Stepper, PWM

Analog Inputs

Number of Channels	6
Input Ranges (Selectable)	0-20mA; 4-20mA DC; 0-60mV; 0-10VDC; **T/C (Ungrounded)**: J, K, N, T, E, R, S, B **RTD**: PT100, PT1000
Nominal Resolution	17 Bits
%AI Full Scale	**10V, 20MA, 60mV**: 32,000 counts full scale **RTD/TC**: 10 counts/ °C
Absolute Max. Input Voltage	-0.5 to -12VDC (+/- 30VDC)
Input Impedance (Clamped @ -0.5 to 10.23VDC)	T/C / RTD / mV > 2MΩ mA: 15Ω + 1.5V V: 1.1MΩ
Galvanic Isolation	None
Conversion Speed	Min. All Channels Converted in app. < 250ms or 41ms per channel enable

	Input Type:	Range:	Accuracy:
Sensor Range and Accuracy	TC J (Ungrounded)	-120 to 1000°C / -184 to 1832°F	+/- 0.2% of full scale +/- 1°C
	TC K (Ungrounded)	-130 to 1372°C / -202 to 2501.6°F	+/- 0.2% of full scale +/- 1°C
	TC T (Ungrounded)	-130 to 400°C / -202 to 752°F	+/- 0.2% of full scale +/- 1°C
	TC E (Ungrounded)	-130 to 780°C / -202 to 1436°F	+/- 0.2% of full scale +/- 1°C
	TC N (Ungrounded)	-130 to 1300°C / -202 to 2372°F	+/- 0.2% of full scale +/- 1°C
	TC R, S (Ungrounded)	20 to 1768°C / 68 to 3214.4°F	+/- 0.2% of full scale +/- 3°C
	TC B (Ungrounded)	500 to 1820°C / 212 to 3308°F *Functions below 500°C with reduced accuracy.	+/- 0.2% of full scale +/- 3°C
	PT100/1000	-200 to 850°C / -328 to 1562°F	+/- 0.15% of full scale
	0-20mA	0-20mA	+/- 0.15% of full scale
	0-60mV	0-60mV	+/- 0.15% of full scale
	0-10V	0-10V	+/- 0.15% of full scale

Analog Outputs

| Number of Channels	4
Output Ranges	0-10VDC, 0-20mA, 4-20mA
Nominal Resolution	12 Bits
Max. Error at 25°C (Excluding Zero)	0-20mA 0.1% of full scale 0-10V 0.1 % of full scale
Maximum Loop Voltage	27V
Response Time	One Update per program logic scan
Minimum Resistance Load	400Ω
Conversion Speed	Min. All Channels Once per Scan
Galvanic Isolation	None
Temperature Drift Error	20mA.......0.000143%/°C 0 - 10V.....0.000151%/°C

CONTROLLER OVERVIEW

Port Controllers

HG-004

1. Virtual Function Keys Slide in from the Right Upon Touching Top Right Corner of Screen
2. Optional Built-In I/O
3. High Capacity microSD Slot
4. USB Mini-B Port
5. Dual CAN Port
6. USB A Ports (3)
7. Mic Input / Audio Output
8. Dual Ethernet LAN Port
9. Mini Display Port Video Output
10. Wide-Range DC Power
11. Dual CAN Port
12. RS232/RS485 Serial Ports (3)

NOTE: See Precaution #12 on page 4 about USB and grounding.

Power Wiring

HG-007
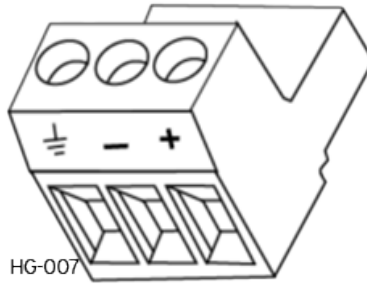
Primary Power Port Pins		
PIN	**Signal**	**Description**
1	Ground	Frame Ground
2	DC-	Input Power Supply Ground
3	DC+	Input Power Supply Voltage

DC Input/Frame

- Solid/Stranded Wire: 12-24 awg (2.5-0.2mm)
- Strip length: 0.28" (7mm)
- Torque Rating: 4.5 – 7 in-lbs (0.50 – 0.78 N-m)

DC- is internally connected to I/O V-, but is isolated from CAN V-. A Class 2 power supply must be used.
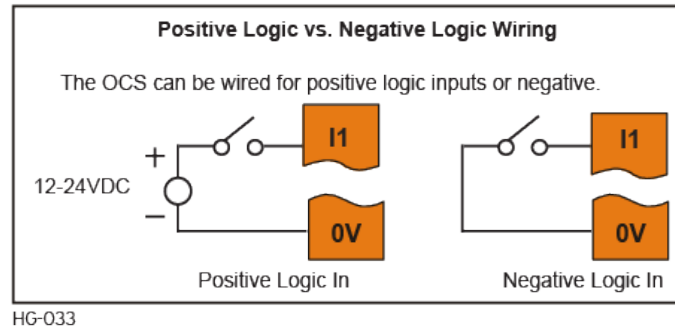
Power Up

1. Attach ferrite core with a minimum of two turns of the DC+ and DC- signals from the DC supply that is powering the controller.

HG-006

2. Connect to earth ground.
3. Apply recommended power.

WIRING: INPUTS AND OUTPUTS

Digital Inputs

Positive Logic vs. Negative Logic Wiring

The OCS can be wired for positive logic inputs or negative.

HG-033

Digital inputs may be wired in either a Positive Logic or Negative Logic fashion as shown. The setting in the Cscape Hardware Configuration for the Digital Inputs must match the wiring used in order for the correct input states to be registered. No jumper settings are required for XL+. When used as a normal input and not for high speed functions, the state of the input is reflected in registers %I1 – %I12.

Digital inputs may alternately be specified for use with High Speed Counter functions, also found in the Hardware Configuration for Digital Inputs. Refer to the User Manual via the Documentation Search for more details.
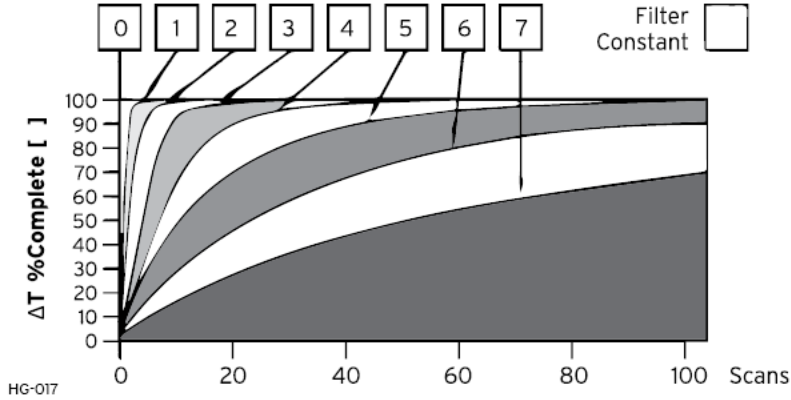
Digital Outputs

Digital outputs are Positive Logic. If an output is turned on, the voltage supplied at the Vext terminal is applied to that output. When used as normal outputs, the state of the output may be controlled using the registers %Q1 - %Q12.

The first two digital outputs may alternately be specified for use as Pulse Width Modulation (PWM) or Stepper outputs. The configuration for these functions is found in the Cscape Hardware Configuration for Digital Outputs. Refer to the XL+ User Manual (MAN1106) for full details.

Analog Inputs Information

Raw input values for channels 1-4 are found in the registers as Integer- type data with a range from 0 – 32000.

Analog inputs may be filtered digitally with the Filter Constant found in the Cscape Hardware Configuration for Analog Inputs. Valid filter values are 0-7 and act according to the following chart:

HG-017

Data Values	
Input Mode:	**Data Format, 12-bit INT:**
0-20mA, 4-20mA	0-32000
0-41V	0-32000
T/C & RTD	°C or °F may be selected in the Hardware Configuration section in Cscape. The raw value is an integer, so the user should divide by 10.

Connector Overview

HG-080

HG-081
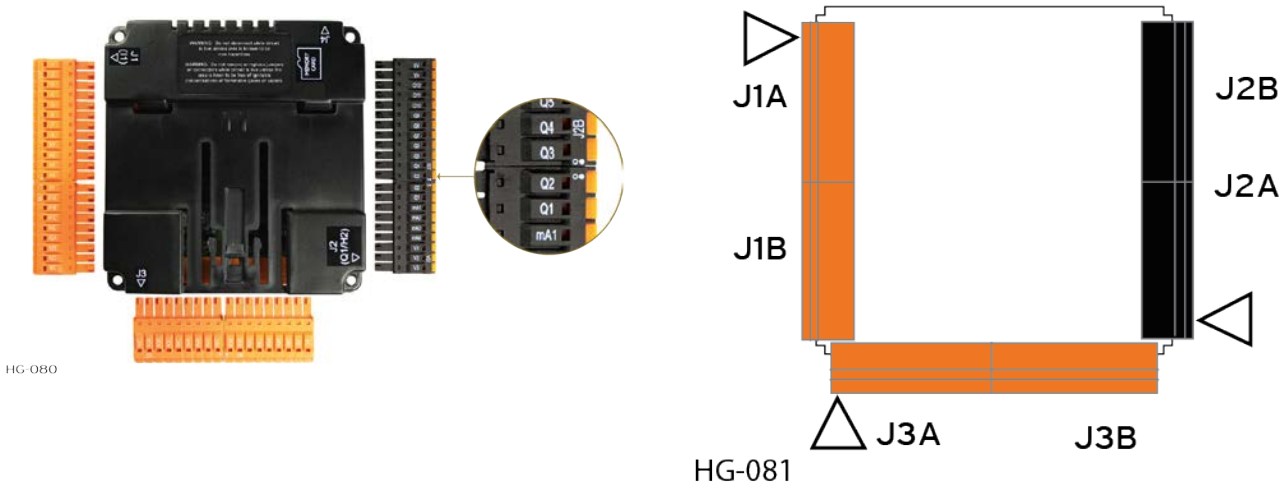
For ease of operability, the high density terminals are divided into more manageable pairs of connectors (J1A + J1B, J2A + J2B, J3A + J3B). To ensure proper installation, connector symbols must match.

J1 Wiring

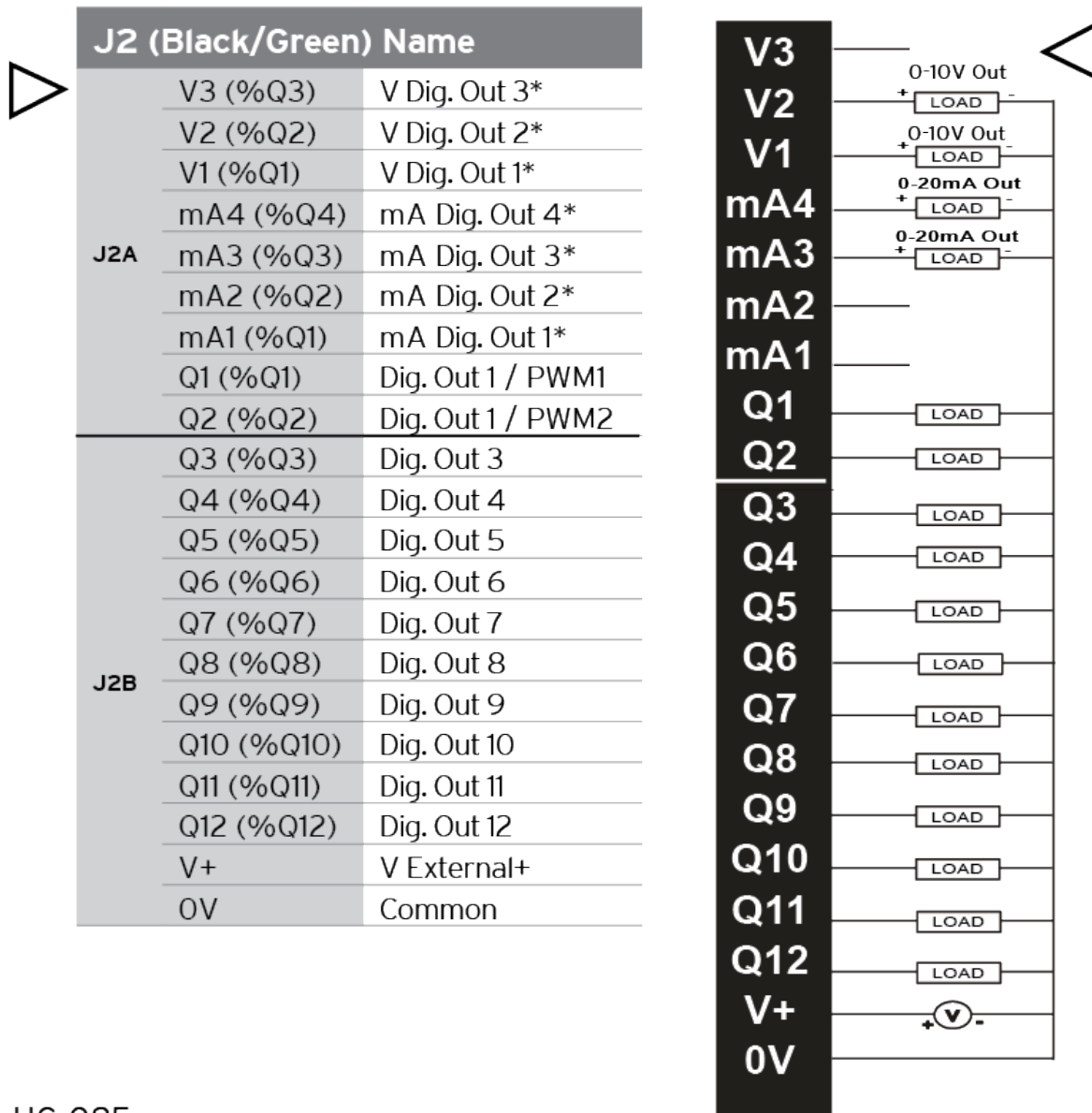| J1 (Orange/Green)		Name
J1A	I1 (%I1)	IN1
	I2 (%I2)	IN2
	I3 (%I3)	IN3
	I4 (%I4)	IN4
	I5 (%I5)	IN5
	I6 (%I6)	IN6
	I7 (%I7)	IN7
	I8 (%I8)	IN8
	H1 (%I9)	HSC1 / V Dig. In 9
	H2 (%I10)	HSC2 / V Dig. In 10
	H3 (%I11)	HSC3 / V Dig. In 11
	H4 (%I12)	HSC4 / V Dig. In 12
J1B	0V	Common
	A1A (%AI33)	Univ. AI 1 Pin 1
	A1B (%AI33)	Univ. AI 1 Pin 2
	A1C (%AI33)	Univ. AI 1 Pin 3
	NC	No Connect
	A2A (%AI34)	Univ. AI 2 Pin 1
	A2B (%AI34)	Univ. AI 2 Pin 2
	A2C (%AI34)	Univ. AI 2 Pin 3
	NC	No Connect

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J2 Wiring

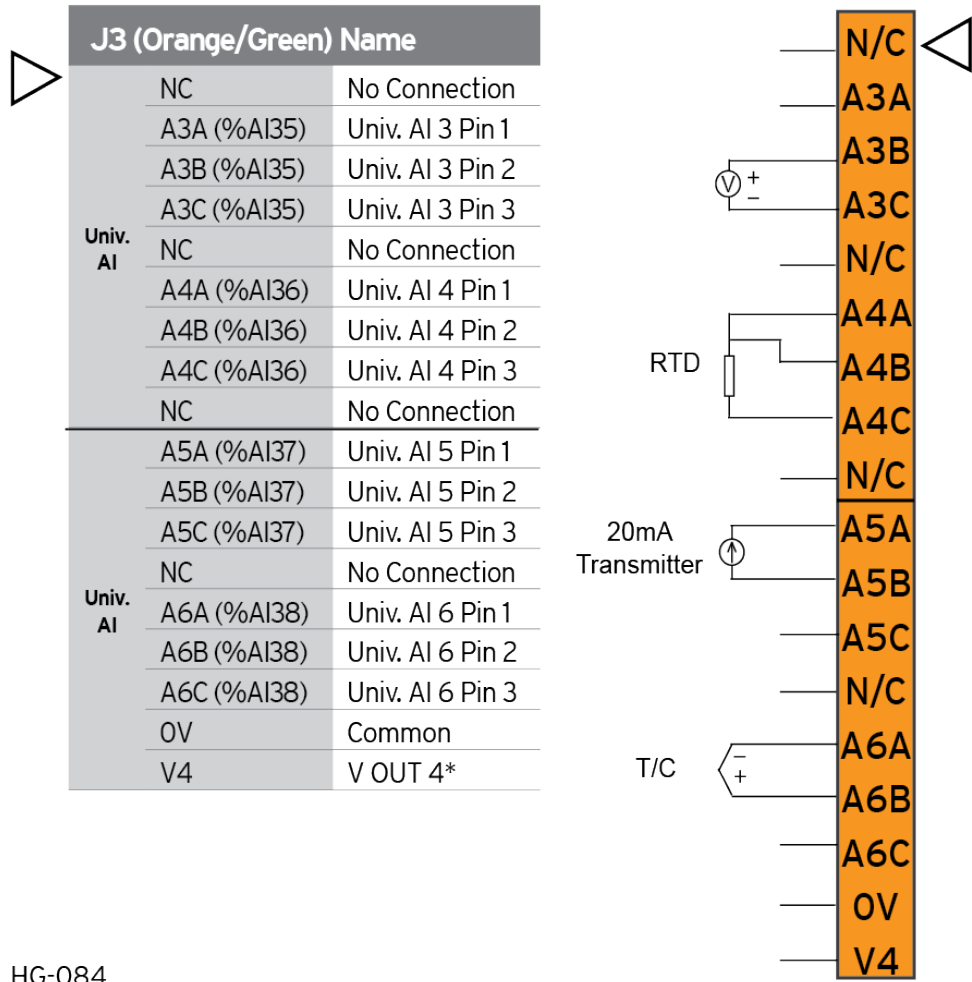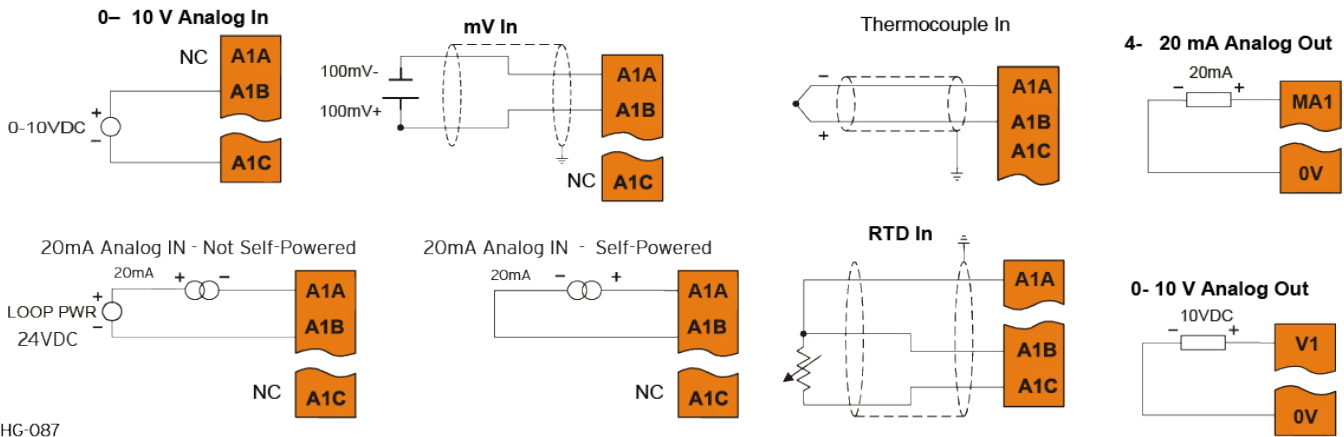| J2 (Black/Green)	Name	
J2A	V3 (%Q3)	V Dig. Out 3*
	V2 (%Q2)	V Dig. Out 2*
	V1 (%Q1)	V Dig. Out 1*
	mA4 (%Q4)	mA Dig. Out 4*
	mA3 (%Q3)	mA Dig. Out 3*
	mA2 (%Q2)	mA Dig. Out 2*
	mA1 (%Q1)	mA Dig. Out 1*
	Q1 (%Q1)	Dig. Out 1 / PWM1
	Q2 (%Q2)	Dig. Out 1 / PWM2
J2B	Q3 (%Q3)	Dig. Out 3
	Q4 (%Q4)	Dig. Out 4
	Q5 (%Q5)	Dig. Out 5
	Q6 (%Q6)	Dig. Out 6
	Q7 (%Q7)	Dig. Out 7
	Q8 (%Q8)	Dig. Out 8
	Q9 (%Q9)	Dig. Out 9
	Q10 (%Q10)	Dig. Out 10
	Q11 (%Q11)	Dig. Out 11
	Q12 (%Q12)	Dig. Out 12
	V+	V External+
	0V	Common

HG-085

NOTE: * Both mA & V outputs are active for each output channel, however, only the configured output type is calibrated (maximum 4 channels simultaneously).

J3 Wiring

J3 (Orange/Green) Name		
Univ. AI	NC	No Connection
	A3A (%AI35)	Univ. AI 3 Pin 1
	A3B (%AI35)	Univ. AI 3 Pin 2
	A3C (%AI35)	Univ. AI 3 Pin 3
	NC	No Connection
	A4A (%AI36)	Univ. AI 4 Pin 1
	A4B (%AI36)	Univ. AI 4 Pin 2
	A4C (%AI36)	Univ. AI 4 Pin 3
	NC	No Connection
Univ. AI	A5A (%AI37)	Univ. AI 5 Pin 1
	A5B (%AI37)	Univ. AI 5 Pin 2
	A5C (%AI37)	Univ. AI 5 Pin 3
	NC	No Connection
	A6A (%AI38)	Univ. AI 6 Pin 1
	A6B (%AI38)	Univ. AI 6 Pin 2
	A6C (%AI38)	Univ. AI 6 Pin 3
	0V	Common
	V4	V OUT 4*

HG-084

Ex: Universal Input Wiring Schematic

HG-087

NOTE: Depending on the transmitter, isolated loop power may be required.

Built-In I/O

The I/O is mapped into OCS Register space, in three separate areas: Digital/Analog I/O, High-Speed Counter I/O, and High-Speed Output I/O. Digital/Analog I/O location is fixed starting at 1, but the high-speed counter and high-speed output references may be mapped to any open register location.

Digital and Analog I/O Functions Registers	
Digital Inputs	%I1-12
Reserved	%I13-31
ESCP Alarm	%I32
Digital Outputs	%Q1-12
Reserved	%Q13-24
Analog Inputs	%AI33-38
Reserved	%AI1-32
Analog Outputs	%AQ9-12
Reserved	%AQ1-8

Status Registers

Selectable Range	Description							
%R1	Bit-wise status register enable: Set %R1.1 - %R1.9 high to enable for registers %R2 to %R9.							
%R2	Firmware version							
%R3	Watchdog count - cleared on power-up.							
%R4	Status Bits:				16...4	3	2	1
					Reserved	Normal	Config	Calibration
%R5	Scan rate of the 106 board (average) in units of 100 µs.							
%R6	Scan rate of the 106 board (max) in units of 100 µs.							
%R7	Channel Status: Channel 2				Channel 1			
	8	7	6	5	4	3	2	1
	Open RTD	Out of Limits	Shorted RTD	Open Sensor	Open RTD	Out of Limits	Shorted RTD	Open Sensor
%R8	Channel Status: Channel 4				Channel 3			
	8	7	6	5	4	3	2	1
	Open RTD	Out of Limits	Shorted RTD	Open Sensor	Open RTD	Out of Limits	Shorted RTD	Open Sensor
%R9	Channel Status: Channel 6				Channel 5			
	8	7	6	5	4	3	2	1
	Open RTD	Out of Limits	Shorted RTD	Open Sensor	Open RTD	Out of Limits	Shorted RTD	Open Sensor
%R10-14	Reserved							

NOTE: For the purposes of the example, the block is shown starting at %R1, but it can be set to anywhere in the %R memory map.
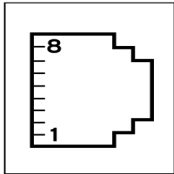
COMMUNICATIONS

Serial Communications

MJ1 Serial Ports
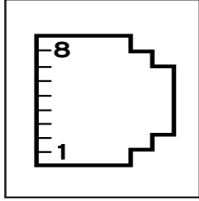
MJ1: RS-232 w/full handshaking or RS-485 half-duplex via software switch
RS-485 termination and biasing via software

HG-008

MJ1 PINS		
PIN	**SIGNAL**	**DIRECTION**
8	TXD	OUT
7	RXD	IN
6	0V	GROUND
5	+5V @ 60mA	OUT
4	RTS	OUT
3	CTS	IN
2	RX-/TX-	IN/OUT
1	RX+/TX+	IN/OUT

MJ2/3 Serial Ports

MJ2/3: RS-232 or RS-485 half or full-duplex, software selectable RS-485 termination and biasing, software selectable

HG-008

MJ2/3 PINS		
PIN	**SIGNAL**	**DIRECTION**
8	TXD RS232	OUT
7	RXD RS232	IN
6	0V	GROUND
5	+5V @ 60mA	OUT
4	TX- RS485	OUT
3	TX+ RS485	OUT
2	RX- RS485	IN
1	RX+ RS485-	IN

NOTE: Attach optional ferrite core with a minimum of two turns of serial cable. See website for more details. [Part #: HE-FBD001]
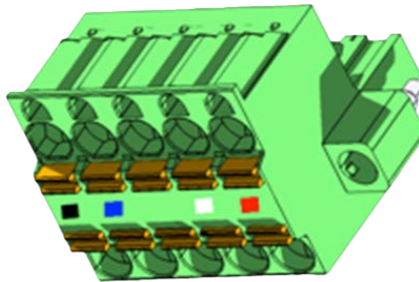
Ethernet
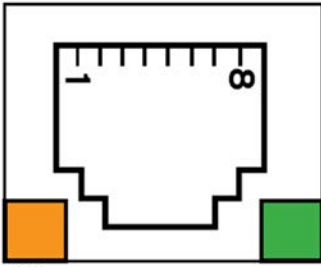
Green LED indicates link - when illuminated, data communication is available.

Orange LED indicates activity - when flashing, data is in transmission.
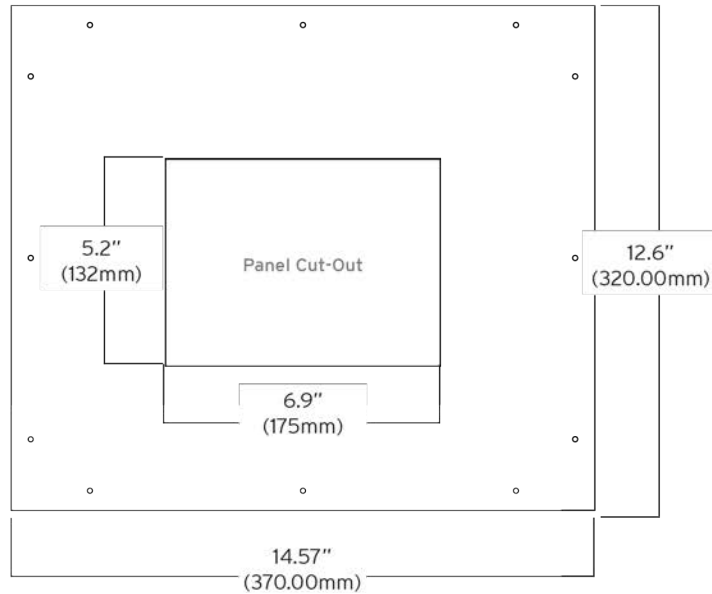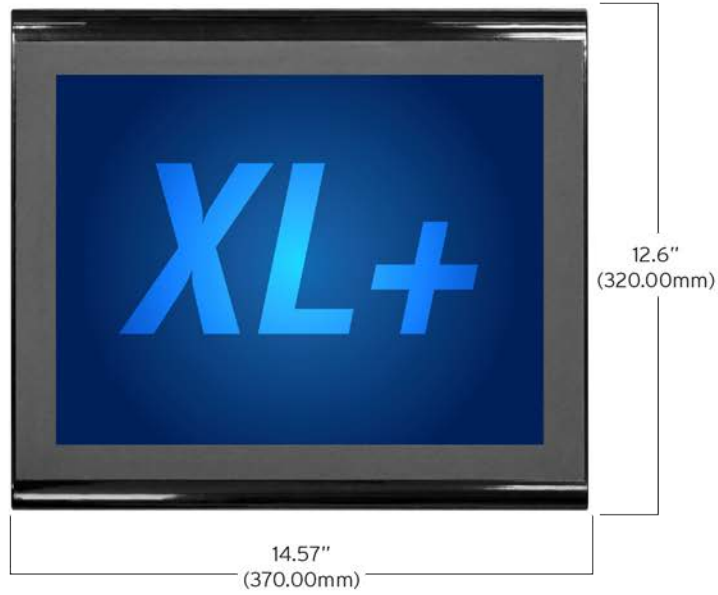
CAN Communications

HG-001

CAN Pin Assignments		
PIN	**SIGNAL**	**DESCRIPTION**
1	V-	CAN Ground – Black
2	CN_L	CAN Data Low – Blue
3	SHLD	Shield Ground – None
4	CN_H	CAN Data High – White
5	V+ (NC)	No Connect – Red

- **Solid/Stranded Wire**: 12-24 awg (2.5-0.2mm).
- **Strip Length**: 0.28" (7mm).
- Locking spring-clamp, two-terminators per conductor.
- **Torque, Terminal Hold-Down Screws**: 4.5 – 7 in-lbs (0.50 – 0.78 N-m).

V+ pin is not internally connected, the SHLD pin is connected to Earth ground via a 1MΩ resistor and 10 nF capacitor.

DIMENSIONS & INSTALLATION

12.6"
(320.00mm)

14.57"
(370.00mm)

4.08"
(103.63mm)

5.2"
(132mm)

Panel Cut-Out

6.9"
(175mm)

12.6"
(320.00mm)

14.57"
(370.00mm)

Panel Tolerance: +/-0.5mm

HG-005

NOTE: For mounting template, please refer to MAN1124.

Installation Procedure

The XL15+ is a panel mounted device and is meant to be an enclosure suitable for the equipment, such that the equipment is only accessible with the use of a tool. The XL15+ is suitable for use in Class I, Division II, Groups F and G, and Class III Hazardous Locations or non-hazardous locations only.

The XL15+ allows unique installation options that simplify installation for systems that may not need robust vibration or water resistance.

If the system does not experience shock or vibration and will not be exposed to weather or wash down conditions the unit can be installed by cutting the rectangular opening and installing the four supplied clips.

For systems that may experience shock or vibration or are installed outdoors or in wash down environments, the rectangular cut and clips are used and perimeter holes must be drilled in the panel. The supplied studs are then inserted into the perimeter of the controller and supplied nuts will secure the perimeter of the unit to the panel.

Please reference the XL15+ Quick Reference Guide (MAN1124) for Mounting Template.

1. Remove all connectors from the XL15+ OCS unit.
2. Carefully locate an appropriate place to mount the XL+. Be sure to leave enough room at the top of the unit for insertion and removal of the microSD card. Also leave enough room at the bottom for the insertion and removal of USB FLASH drives and wiring
3. Carefully cut the host panel per the diagram, with a tolerance of +/- 0.5mm. Remove any burrs/sharp edges and ensure the panel is not warped in the cutting process.
    - If the opening is too large, water may leak into the enclosure, potentially damaging the OCS.
    - If the opening is too small, the OCS may not fit through the hole without damage.
4. Make sure both inner and outer gaskets are installed on the XL15+ OCS and are free from dust and debris. Check that the corners of the gasket are secure. Insert the OCS through the panel cutout (from the front). The gasket needs to be between the host panel and the OCS.
5. The two (2) spring clips will latch the unit in the panel.
6. Insert each of the four (4) mounting clips into the slots in the XL15+ OCS case. One clip should be installed on each corner. Lightly tighten each screw so the clip is held in place.
7. Tighten the screws on the clips such that the gasket is compressed against the panel. Recommended torque is 7-10 in-lbs (0.79-1.13 Nm). If the perimeter studs are needed, it is recommended to use a thread locker (similar to 242 Blue Loctite). Use supplied lock washers and nut.

    NOTE: Recommended torque is 3-4 in-lbs (0.34- 0.45 Nm).

8. Reinstall the I/O Removable Terminal Blocks.
Connect communications cables to the serial port, USB ports, Ethernet port, and CAN port as required.

SAFETY & MAINTENANCE

Warnings

1. To avoid the risk of electric shock or burns, always connect the safety (or earth) ground before making any other connections.
2. To reduce the risk of fire, electrical shock, or physical injury, it is strongly recommended to fuse the voltage measurement inputs. Be sure to locate fuses as close to the source as possible.
3. Replace fuse with the same type and rating to provide protection against risk of fire and shock hazards.
4. In the event of repeated failure, do NOT replace the fuse again as repeated failure indicates a defective condition that will NOT clear by replacing the fuse.
5. Only qualified electrical personnel familiar with the construction and operation of this equipment and the hazards involved should install, adjust, operate, or service this equipment.
6. Read and understand this manual and other applicable manuals in their entirety before proceeding. Failure to observe this precaution could result in severe bodily injury or loss of life.
7. **WARNING** - Battery may explode if mistreated. Do not recharge, disassemble, or dispose of in fire.
8. **WARNING - EXPLOSION HAZARD** - Batteries must only be changed in an area known to be non-hazardous.
9. **WARNING** - Do not disconnect while circuit is live unless are is know to be non-hazardous.

FCC Compliance

This device complies with Part 15 of the FCC Rules. Operation is subject to the following two conditions:

1. This device may not cause harmful interference.
2. This device must accept any interference received, including interference that may cause undesired operation.

Technical Support

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Precautions

All applicable codes and standards need to be followed in the installation of this product. Adhere to the following safety precautions whenever any type of connection is made to the module:

1. Connect the safety (earth) ground on the power connector first before making any other connections.

2. When connecting to the electric circuits or pulse-initiating equipment, open their related breakers.

3. Do NOT make connection to live power lines.

4. Make connections to the module first; then connect to the circuit to be monitored.

5. Route power wires in a safe manner in accordance with good practice and local codes.

6. Wear proper personal protective equipment including safety glasses and insulated gloves when making connections to power circuits.

7. Ensure hands, shoes, and floor are dry before making any connection to a power line.

8. Make sure the unit is turned OFF before making connection to terminals.

9. Make sure all circuits are de-energized before making connections.

10. Before each use, inspect all cables for breaks or cracks in the insulation. Replace immediately if defective.

11. Use copper conductors in Field Wiring only, 60/75°C.

12. Use caution when connecting controllers to PCs via serial or USB. PCs, especially laptops, may use "floating power supplies" that are ungrounded. This could cause a damaging voltage potential between the laptop and controller. Ensure the controller and laptop are grounded for maximum protection. Consider using a USB isolator due to voltage potential differences as a preventative measure.