XL Series Built-in I/O – Model 5 I/O
12 DC Inputs, 12 DC Outputs, 2 Universal Analog In & 2 Analog Out
for XLe, XLt, XL6 (all models) and XL10e
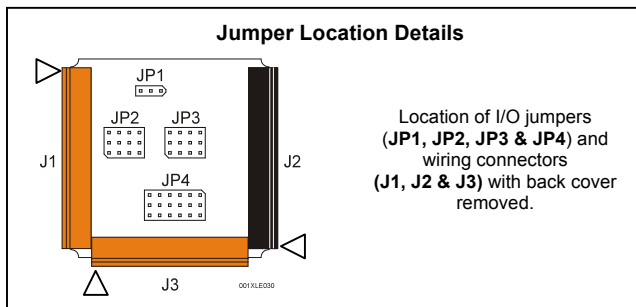
1   Specifications

Specifications			
Digital DC Inputs		**Digital DC Outputs**	
Inputs per Module	12 including 4 configurable HSC inputs	Outputs per Module	12 including 2 configurable PWM outputs
Commons per Module	1	Commons per Module	1
Input Voltage Range	12 VDC / 24 VDC	Output Type	Sourcing / 10 K Pull-Down
Absolute Max. Voltage	35 VDC Max.	Absolute Max. Voltage	28 VDC Max.
Input Impedance	10 kΩ	Output Protection	Short Circuit
Input Current	Positive Logic	Negative Logic	Max. Output Current per point	0.5 A
Upper Threshold	0.8 mA	-1.6 mA	Max. Total Current	4 A Continuous
Lower Threshold	0.3 mA	-2.1 mA	Max. Output Supply Voltage	30 VDC
Max Upper Threshold	8 VDC	Minimum Output Supply Voltage	10 VDC
Min Lower Threshold	3 VDC	Max. Voltage Drop at Rated Current	0.25 VDC
OFF to ON Response	1 ms	Max. Inrush Current	650 mA per channel
ON to OFF Response	1 ms	Min. Load	None
HSC Max. Switching Rate	10 kHz Totalizer/Pulse, Edges 5 kHz Frequency/Pulse, Width 2.5 kHz Quadrature	OFF to ON Response	1 ms
		ON to OFF Response	1 ms
		Output Characteristics	Current Sourcing (Positive Logic)

Analog Inputs, High Resolution			
Number of Channels	2	Thermocouple	Temperature Range
Input Ranges (Selectable)	0 - 10 VDC 0 – 20 mA 4 – 20 mA 100mV PT100 RTD, and J, K, N, T, E, R, S, B Thermocouples	B / R / S	2912°F to 32.0°F (1600°C to 0°C)
		E	1652°F to -328°F (900°C to -200°C)
		T	752.0°F to -400.0°F (400°C to -240°C)
Safe input voltage range	10 VDC: -0.5 V to +15 V 20 mA: -0.5 V to +6 V RTD / T/C: ±24 VDC	J	1382.0°F to -346.0°F (750°C to -210°C)
		K / N	2498.0°F to -400°F (1370°C to -240°C)
		Thermocouple Common Mode Range	±10V
Nominal Resolution	10V, 20mA, 100mV: 14 Bits RTD, Thermocouple: 16 Bits	Converter Type	Delta Sigma
Input Impedance (Clamped @ -0.5 VDC to 12 VDC)	Current Mode: 100 Ω, 35mA Max. Continuous Voltage Mode: 500 kΩ, 35mA Max. Continuous	Max. Error at 25°C (*excluding zero)	*4-20 mA ±0.10%* *0-20 mA ±0.10%* *0-10 VDC ±0.10%* RTD (PT100) ±1.0 °C 0-100 mV ±0.05%
		Max Thermocouple Error (After Warm Up Time of One Hour)	±0.2% (±0.3% below -100°C)
%AI full scale	10 V, 20 mA, 100 mV: 32,000 counts full scale. RTD / T/C: 20 counts / °C	Conversion Speed, Both Channels Converted	10V, 20mA, 100mV: 30 Times/Second RTD, Thermocouple: 7.5 Times/Second
Max. Over-Current	35 mA	Conversion Time per Channel	10V, 20mA, 100mV: 16.7mS RTD, Thermocouple: 66.7mS
Open Thermocouple Detect Current	50 nA	RTD Excitation Current	250 μA

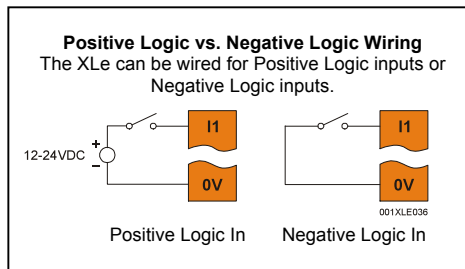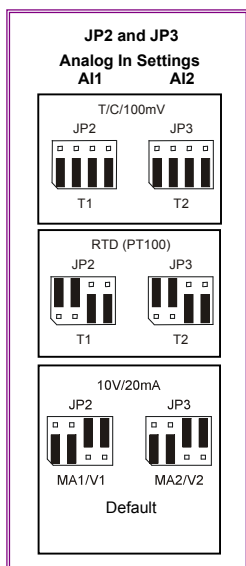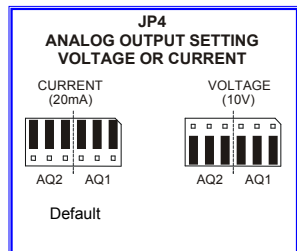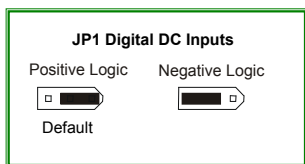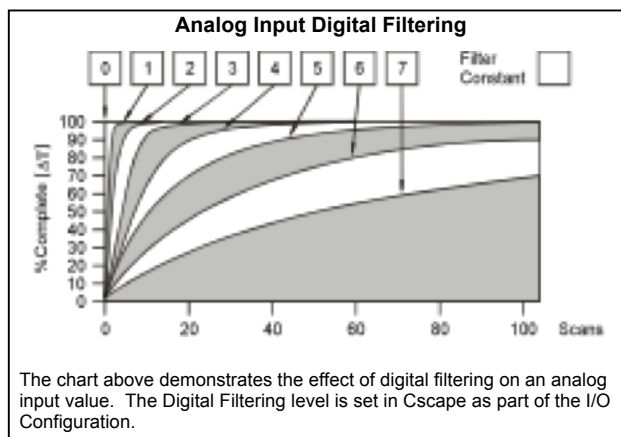| Analog Outputs			
Number of Channels	2	Minimum 10 V load	1 kΩ
Output Ranges	0-10 VDC, 0-20 mA	Maximum 20 mA load	500 Ω
Nominal Resolution	12 Bits	Analog Outputs; Output Points Required	2
Update rate	Once per PLC scan	Maximum Error at 25°C (excluding zero)	0.1%
		Additional error for temperatures other than 25°C	0.01% / °C

2   Wiring and Jumpers

Wiring Specifications

♦ For I/O wiring (discrete), use the following wire type or equivalent: Belden 9918, 18 AWG (0.8 mm²) or larger.

♦ For shielded Analog I/O wiring, use the following wire type or equivalent: Belden 8441, 18 AWG (0.8 mm²) or larger.

♦ For CAN wiring, use the following wire type or equivalent: Belden 3084, 24 AWG (0.2 mm²) or larger. Use copper conductors in field wiring only, 60/75° C

Jumper Location Details

Location of I/O jumpers (**JP1, JP2, JP3 & JP4**) and wiring connectors (**J1, J2 & J3**) with back cover removed.

2.1   I/O Jumper Settings

JP1 Digital DC Inputs

Positive Logic   Negative Logic

Default

JP4
ANALOG OUTPUT SETTING
VOLTAGE OR CURRENT

CURRENT   VOLTAGE
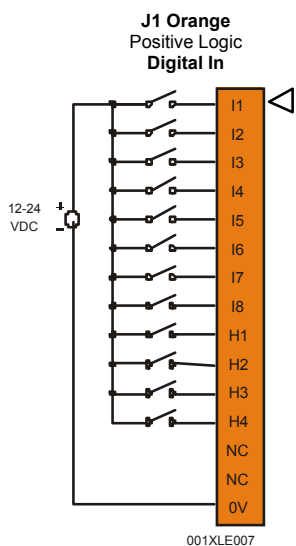(20mA)   (10V)

AQ2   AQ1   AQ2   AQ1

Default

Note: When using **JP4** (output) *or* **JP2 / JP3** (inputs), each channel can be independently configured. For example, JP2 can be configured for 10 V and JP3 can be configured as an RTD.
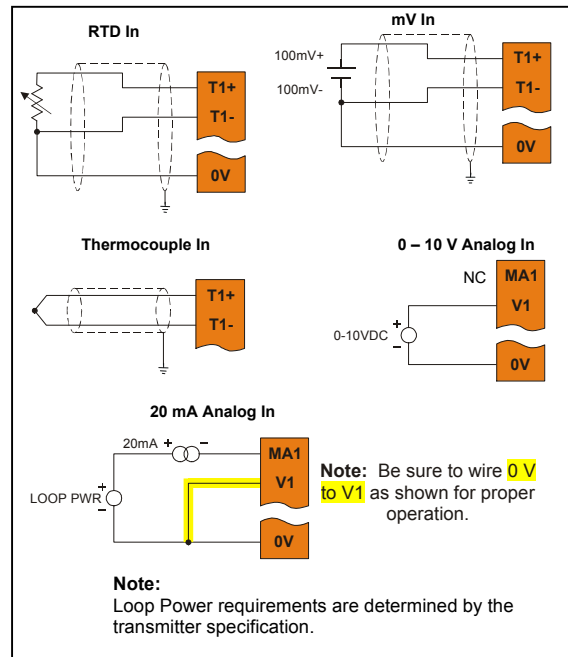
JP2 and JP3
Analog In Settings
AI1   AI2

T/C/100mV
JP2   JP3

T1   T2

RTD (PT100)
JP2   JP3

T1   T2

10V/20mA
JP2   JP3

MA1/V1   MA2/V2

Default

Positive Logic vs. Negative Logic Wiring
The XLe can be wired for Positive Logic inputs or Negative Logic inputs.

12-24VDC   I1   I1

0V   0V

001XLE036

Positive Logic In   Negative Logic In

Analog Input Digital Filtering

Filter Constant

The chart above demonstrates the effect of digital filtering on an analog input value. The Digital Filtering level is set in Cscape as part of the I/O Configuration.

3   Digital Input Wiring Details

J1 Orange	Name
I1	IN1
I2	IN2
I3	IN3
I4	IN4
I5	IN5
I6	IN6
I7	IN7
I8	IN8
H1	HSC1 / IN9
H2	HSC2 / IN10
H3	HSC3 / IN11
H4	HSC4 / IN12
NC	No Connect
NC	No Connect
0V	Ground

J1 Orange
Positive Logic
Digital In

I1
I2
I3
I4
12-24   I5
VDC   I6
I7
I8
H1
H2
H3
H4
NC
NC
0V

001XLE007

4   Digital Output Wiring Details

J2 Black	Name
	Ground
	V+*
	No Connect
	OUT12
	OUT11
	OUT10
	OUT9
	OUT8
	OUT7
	OUT6
	OUT5
	OUT4
	OUT3
	OUT2 / PWM2
	OUT1 / PWM1

J2 Black
Positive Logic
Digital Outputs

0V
V+
10-30VDC   NC
Q12
Q11
Q10
Q9
Q8
Q7
Q6
Q5
Q4
Q3
Q2
Q1

001XLE008

5   Analog I/O Wiring Details

J3 Orange	Name
T1+	T/C / RTD IN1+ / 100 mV+
T1-	T/C / RTD IN1- / 100 mV-
T2+	T/C / RTD IN2+ / 100 mV+
T2-	T/C / RTD IN2- / 100 mV-
AQ1	10 V / 20 mA OUT1 *
AQ2	0 V / 20 mA OUT2 *
0V	Ground
MA1	20 mA IN1
V1	10 V IN1
0V	Ground
MA2	20 mA IN2
V2	10 V IN2
0V	Ground

* IMPORTANT: the two analog outputs are referenced at registers %AQ9 & %AQ10 in the application program
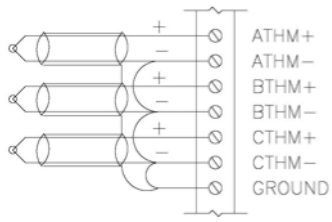
J2 Black
Positive Logic
Digital Outputs

0V
V+
10 - 30VDC   NC
Q12
Q11
Q10
Q9
Q8
Q7
Q6
Q5
Q4
Q3
Q2
Q1

001XLE008

RTD In

T1+
T1-

0V

Thermocouple In

T1+
T1-

20 mA Analog In

20mA

LOOP PWR   MA1
V1

0V

Note: Be sure to wire 0 V to V1 as shown for proper operation.

Note:
Loop Power requirements are determined by the transmitter specification.

mV In

T1+
T1-

Thermocouple

0V +

T1-

0 – 10 V Analog In
RTD In

NC   MA1
V1

0-10VDC   1+

T1-

0V

4 - 20 mA Analog Out   **0 -10 V Analog Out**

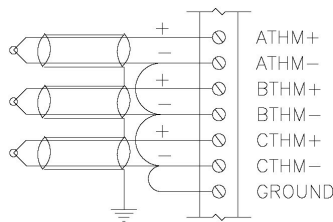20mA   10VDC

AQ1   AQ1

0V   0V

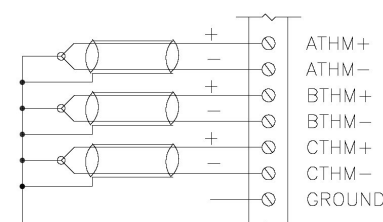## 5.1   Thermocouple Grounding Schemes

Ungrounded Thermocouples

Alternate Shield Connection for Ungrounded Thermocouples.
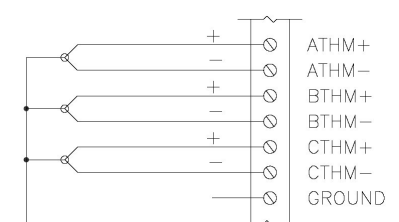
Ungrounded Thermocouples

Preferred Shield Connection for Ungrounded Thermocouples.

Grounded Thermocouples

Field Ground Potential Less Than Seven Volts AC

Typical Shield Connection for Grounded Thermocouples

Grounded Thermocouples

Field Ground Potential Less Than Seven Volts AC

Shields Connected at One End Only May be Used to Reduce Noise

Grounded Thermocouples May Use the Ungrounded Thermocouple Shield Connections if the Shield is not Grounded at the Field End

Note:
These drawings are for illustrative purposes. Up to **two** channels of thermocouple input are supported by the Model 5 I/O.

6   I/O Register Map

Register Summary		High Speed Counter / PWM-Stepper Register Summary			
Registers	**Description**	**Registers**	**PWM**	**HSC**	**Stepper**
%I1 to %I24	Digital Inputs	%AQ1	PWM1 Duty Cycle (32 bit)	HSC1 Preset Value	Start Frequency
%I32	Output Fault	%AQ2			Run Frequency
%I25 to %I31	Reserved	%AQ3	PWM2 Duty Cycle (32 bit)	HSC2 Preset Value	Accel Count (32 bit)
%Q1 to %Q16	Digital outputs	%AQ4			
%Q17	Clear HSC1 accumulator to 0	%AQ5	PWM Prescale (32 bit)		Run Count (32 bit)
%Q18	Totalizer: Clear HSC2 Quadrature 1-2: Accumulator 1 Reset to max – 1	%AQ6			
%Q19	Clear HSC3 Accumulator to 0	%AQ7	PWM Period (32 bit)		Decel Count (32 bit)
%Q20	Totalizer: Clear HSC4 Quadrature 3-4: Accumulator 3 Reset to max – 1	%AQ8			
%Q21 to %Q32	Reserved				
%AI1 to %AI4	Analog inputs	%Q1			Run
%AI5, %AI6	HSC1 Accumulator	%I30			Ready/Done
%AI7, %AI8	HSC2 Accumulator	%I31			Error
%AI9, %AI10	HSC3 Accumulator				
%AI11, %AI12	HSC4 Accumulator				
%AQ1, %AQ2	PWM1 Duty Cycle				
%AQ3, %AQ4	PWM2 Duty Cycle				
%AQ5, %AQ6	PWM Prescale				
%AQ7, %AQ8	PWM Period				
%AQ9 to %AQ14	Analog outputs				

7   Safety

When found on the product, the following symbols specify:

Warning: Electrical Shock Hazard.		**Warning:** Consult user documentation.
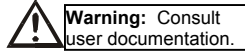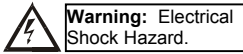
This equipment is suitable for use in Class I, Division 2, Groups A, B, C and D or Non-hazardous locations only

WARNING – EXPLOSION HAZARD – Substitution of components may impair suitability for Class I, Division 2
AVERTISSEMENT - RISQUE D'EXPLOSION - LA SUBSTITUTION DE COMPOSANTS PEUT RENDRE CE MATERIAL INACCEPTABLE POUR LES EMPLACEMENTS DE CLASSE 1, DIVISION 2

WARNING – EXPLOSION HAZARD – Do not disconnect equipment unless power has been switched off or the area is known to be non-hazardous.
AVERTISSEMENT - RISQUE D'EXPLOSION - AVANT DE DECONNECTOR L'EQUIPMENT, COUPER LE COURANT OU S'ASSURER QUE L'EMPLACEMENT EST DESIGNE NON DANGEREUX.

WARNING: To avoid the risk of electric shock or burns, always connect the safety (or earth) ground before making any other connections.

WARNING: 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.

WARNING: Replace fuse with the same type and rating to provide protection against risk of fire and shock hazards.

WARNING: In the event of repeated failure, do <u>not</u> replace the fuse again as a repeated failure indicates a defective condition that will <u>not</u> clear by replacing the fuse.

WARNING: 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. 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.

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.

⬥ 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:

▪ Connect the safety (earth) ground on the power connector first before making any other connections.
▪ When connecting to electric circuits or pulse-initiating equipment, open their related breakers.
▪ Do <u>not</u> make connections to live power lines.
▪ Make connections to the module first; then connect to the circuit to be monitored.
▪ Route power wires in a safe manner in accordance with good practice and local codes.
▪ Wear proper personal protective equipment including safety glasses and insulated gloves when making connections to power circuits.
▪ Ensure hands, shoes, and floors are dry before making any connection to a power line.
▪ Make sure the unit is turned OFF before making connection to terminals.
▪ Make sure all circuits are de-energized before making connections.
▪ Before each use, inspect all cables for breaks or cracks in the insulation. Replace immediately if defective.
• Use Copper Conductors in Field Wiring Only, 60/75° C

8   Technical Support

For assistance and manual updates, contact Technical Support at the following locations:

North America:
(317) 916-4274
www.heapg.com
email: techsppt@heapg.com

Europe:
(+) 353-21-4321-266
www.horner-apg.com
email: techsupport@hornerirl.ie