EMX-75XX SERIES

64-CHANNEL
DIGITAL INPUT / OUTPUT

USER'S MANUAL

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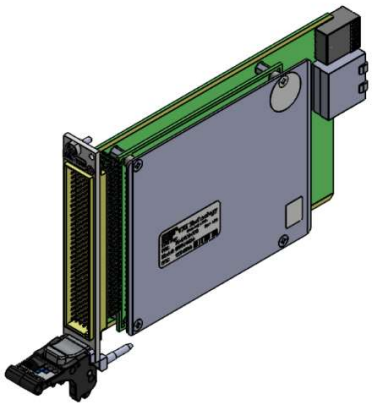

AMETEK Programmable Power
9250 Brown Deer Road
San Diego, CA 92121, (858) 450-0085

TABLE OF CONTENTS

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CONTACT INFORMATION

Telephone: +1 800 733 5427 (toll free in North America)
+1 858 450 0085 (direct)
Fax: +1 858 458 0267
Email: sales.ppd@ametek.com
service.ppd@ametek.com
Web: http://www.vtiinstruments.com/

CERTIFICATION

VTI Instruments (VTI) certifies that this product met its published specifications at the time of shipment from the factory. VTI further certifies that its calibration measurements are traceable to the United States National Institute of Standards and Technology (formerly National Bureau of Standards), to the extent allowed by that organization's calibration facility, and to the calibration facilities of other International Standards Organization members.

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AMETEK Programmable Power, Inc. ("AMETEK"), provides this written warranty covering the Product stated above, and if the Buyer discovers and notifies AMETEK in writing of any defect in material or workmanship within the applicable warranty period stated above, then AMETEK may, at its option: repair or replace the Product; or issue a credit note for the defective Product; or provide the Buyer with replacement parts for the Product.
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- damaged by modifications, alterations or attachments thereto which are not authorized by AMETEK;
- installed or operated contrary to the instructions of AMETEK;
- opened, modified, or disassembled in any way without AMETEK's consent;
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Request a Return Material Authorization (RMA) number from the repair facility (**must be done in the country in which it was purchased**):

- **In the USA**, contact the AMETEK Customer Service Department prior to the return of the product to AMETEK for repair:

  Telephone: 800-733-5427, ext. 2295 or ext. 2463 (toll free North America)
  858-450-0085, ext. 2295 or ext. 2463 (direct)
- https://www.vtiinstruments.com/service-and-support/rma-request

When requesting an RMA, have the following information ready:

- Model number
- Serial number
- Description of the problem

NOTE: Unauthorized returns will not be accepted and will be returned at the shipper's expense.
NOTE: A returned product found upon inspection by AMETEK to be in specification is subject to an evaluation fee and applicable freight charges.

GENERAL SAFETY INSTRUCTIONS

Review the following safety precautions to avoid bodily injury and/or damage to the product. These precautions must be observed during all phases of operation or service of this product. Failure to comply with these precautions, or with specific warnings elsewhere in this manual, violates safety standards of design, manufacture, and intended use of the product.

Service should only be performed by qualified personnel.

TERMS AND SYMBOLS

These terms may appear in this manual:

WARNING Indicates that a procedure or condition may cause bodily injury or death.

CAUTION Indicates that a procedure or condition could possibly cause damage to equipment or loss of data.

These symbols may appear on the product:

ATTENTION - Important safety instructions

Frame or chassis ground

Indicates that the product was manufactured after August 13, 2005. This mark is placed in accordance with *EN 50419, Marking of electrical and electronic equipment in accordance with Article 11(2) of Directive 2002/96/EC (WEEE)*. End-of-life product can be returned to VTI by obtaining an RMA number. Fees for takeback and recycling will apply if not prohibited by national law.

WARNINGS

Follow these precautions to avoid injury or damage to the product:

Use Proper Power Cord To avoid hazard, only use the power cord specified for this product.

Use Proper Power Source To avoid electrical overload, electric shock, or fire hazard, do not use a power source that applies other than the specified voltage.

Power Consumption Prior to using these cards, it is imperative that the power consumption of all cards that will be installed in the mainframe be calculated on all power supply rails. ***Failure to do so may result in damaging the switch card and the mainframe***.

WARNINGS (CONT.)

Avoid Electric Shock

To avoid electric shock or fire hazard, do not operate this product with the covers removed. Do not connect or disconnect any cable, probes, test leads, etc. while they are connected to a voltage source. Remove all power and unplug unit before performing any service. ***Service should only be performed by qualified personnel.***

Ground the Product

This product is grounded through the grounding conductor of the power cord. To avoid electric shock, the grounding conductor must be connected to earth ground.

Operating Conditions

To avoid injury, electric shock or fire hazard:

- Do not operate in wet or damp conditions.
- Do not operate in an explosive atmosphere.
- Operate or store only in specified temperature range.
- Provide proper clearance for product ventilation to prevent overheating.
- DO NOT operate if any damage to this product is suspected. ***Product should be inspected or serviced only by qualified personnel.***

Improper Use

The operator of this instrument is advised that if the equipment is used in a manner not specified in this manual, the protection provided by the equipment may be impaired.
Conformity is checked by inspection.

SECTION 1

INTRODUCTION

OVERVIEW

The EMX-75XX Series is a family of high-performance PXIe modules consisting of multiple I/O configurations and logic levels. Dedicated input or output cards are available for high channel count applications while other cards provide ultimate flexibility with eight, 8-bit ports (64 channels) that can be configured as an input or output under programmatic control.

FEATURES

Models capable of sinking 300 mA include built-in clamping diodes, making these modules ideal for driving and sensing external devices such as relays, while all clamping diodes and open collector channels can be pulled up internally, rather than on a per channel basis, simplifying overall system cabling. Isolated models are also available for more demanding applications.

PREPARATION FOR USE

UNPACKING

When an EMX-75XX Series module is unpacked from its shipping carton, the contents should include the following items:

- An EMX-7510/EMX-7511/EMX-7512/EMX-7513/EMX-7514/EMX-7515/EMX-7519

All components should be immediately inspected for damage upon receipt of the unit. ESD precautions should be observed while unpacking and installing the instrument into a PXI Express chassis. The part number, model number, and serial number can be found on the side cover of the card as shown below.

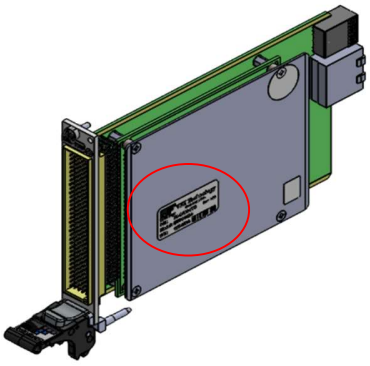

Figure 1-1: Serial Number Location

INSPECTING THE EMX-75XX SERIES

The EMX-7510/EMX-7511/EMX-7512/EMX-7513/EMX-7514/EMX-7515/ EMX-7519 modules were carefully inspected both mechanically and electrically before shipment. They should be free of marks or scratches and they should meet their published specifications upon receipt. If the module was damaged in transit, do the following:

- Save all packing materials
- File a claim with the carrier
- Call a Programmable Power sales and service office

INSTALLATION

INSTALL EMX-75XX

1. Set up the PXI Express chassis. See the *Chassis' Installation Guide* for assistance.
2. Make sure the PXI Express chassis is powered off.
3. Select a PXIe slot or a hybrid slot in the PXI Express chassis for the EMX-75XX and insert it carefully.
4. After the EMX-75XX is inserted all the way, secure it with the screws at the top and bottom of the EMX-75XX front panel.

STORAGE AND SHIPMENT

STORING INSTRUMENTS

Store the module in a clean, dry, and static-free environment. For other requirements, see storage and transport restrictions in *Specification*.

TRANSPORTING INSTRUMENTS

Package the module using the original factory packaging or packaging identical to the factory packaging. Containers and materials identical to those used in factory packaging are available through AMETEK Programmable Power. If returning the module to AMETEK Programmable Power for service, refer the previous section for RMA process. The following information will be required:

- Serial number
- Model number
- Type of service required
- Return address
- If applicable, a description of the problem that is being encountered which provides specific detail relating the instrument being returned.

In any correspondence, refer to the serial number and RMA number. Mark the container "FRAGILE" to ensure careful handling. If it is necessary to package the module in a container other than the original packaging, observe the following (although use of other packaging material is not recommended):

1. Wrap the module in heavy paper or anti-static plastic
2. Protect the front panel with cardboard
3. Use a double-wall carton made of at least 350 lbs test material
4. Cushion the module to prevent damage

ORDERING INFORMATION

Sl.no.	Model	Part no.	Configuration
1	EMX-7510	70-0409-190R	64-CH DIO, Source/Sink, 60 V max Static I/O
2	EMX-7511	70-0409-401R	64-CH, DIO TTL, Static I/O
3	EMX-7512	70-0409-402R	64-CH, DIO LV TTL, Static I/O
4	EMX-7513	70-0674-000R	32DI/32DO, Source/Sink, 60 V max, Isolated Static I/O
5	EMX-7514	70-0672-000R	64 DO, Source/Sink, 60 V max, Isolated Static
6	EMX-7515	70-0673-000R	64 DI, 60 V max, Isolated Static
7	EMX-7519	70-0409-400R	64-CH DO, Source/Sink, 60 V max Static

TABLE 1-1: EMX-75XX CARDS

SPECIFICATIONS

TECHNICAL SPECIFICATIONS

Data Card Specifications			
EMX-7510	Digital Input	Channels	64 (Eight 8-Bit Ports)
		V_{IN} (high)	>40% of VCLAMP
		V_{IN} (low)	<14% of V_{CLAMP}
		V_{IN} (max)	60 V
	Data Output Characteristics	V_{OUT} (high)	>2 V to 60 V
		V_{OUT} (low)	<1.5 V @ 300mA max. (sink)
		Connector Type	ERNI 160-Pin
	Voltage Range	Internal Voltage (V_{CLAMP})	3.3 V, 5.0 V, 12.0 V, and 24.0 V
		User Voltage (V_{CLAMP})	>2 V up to 60 V
EMX-7511	Digital Input/Output	Channels	64 (Eight 8-Bit Ports)
		Logic Levels	Standard TTL @ 24mA sink/source
		Connector Type	ERNI 160-Pin
EMX-7512	Digital Input/Output	Channels	64 (Eight 8-Bit Ports)
		Logic Levels	Standard LV TTL @ 24mA sink/source
		Connector Type	ERNI 160-Pin
EMX-7513	Digital Input	Channels	32
		Logical High	2.8 V to 60 V
		Logical Low	< 2 V
		Isolation to Computer GND	1000 V
	Digital Output	Channels	32
		Maximum switching voltage	60 V (AC/DC)
		Maximum switching current	100 mA
		Potential Free	Yes
		Isolation to Computer GND	1000 V
		Connector Type	ERNI 160-Pin
EMX-7514	Digital Output	Channels	64
		Maximum switching voltage	60 V (AC/DC)
		Maximum switching current	100 mA
		Potential Free	Yes
		Isolation to Computer GND	1000 V
		Connector Type	ERNI 160-Pin
EMX-7515	Digital Input	Channels	64
		Logical High	2.8 V to 60 V
		Logical Low	< 2 V
		Isolation to Computer GND	1000 V
		Connector Type	ERNI 160-Pin
EMX-7519	Data Output Characteristics	Channels	64 (Eight 8-Bit Ports)
		V_{OUT} (high)	>2 V to 60 V
		V_{OUT} (low)	<1.5 V @ 300mA max. (sink)
		Connector Type	ERNI 160-Pin
	Voltage Range	Internal Voltage (V_{CLAMP})	3.3 V, 5.0 V, 12.0, V, and 24.0 V
		User Voltage (V_{CLAMP})	>2 V up to 60 V

TABLE 1-2: TECHNICAL SPECIFICATIONS

ENVIRONMENTAL SPECIFICATIONS

Data Card Specifications	
Operating Environment	
Operating Temperature	0°C to +50 °C
Storage Environment	
Storage Temperature	-40°C to +71°C
Relative Humidity, Non Condensing	5% to 95 %
Altitude	4600 m

TABLE 1-3: ENVIRONMENTAL SPECIFICATIONS

SECTION 2

EMX-7510, 64-CHANNEL, DIGITAL I/O CARD

The EMX-7510 is a high-performance, Multipurpose Digital I/O module with eight ports of 8 bits (64 channels) each. Each 8-bit port may be configured as an Input or Output under program control. Each channel can sink 300 mA, and includes built-in clamping diodes, making this module ideal for driving and sensing external devices such as relays.

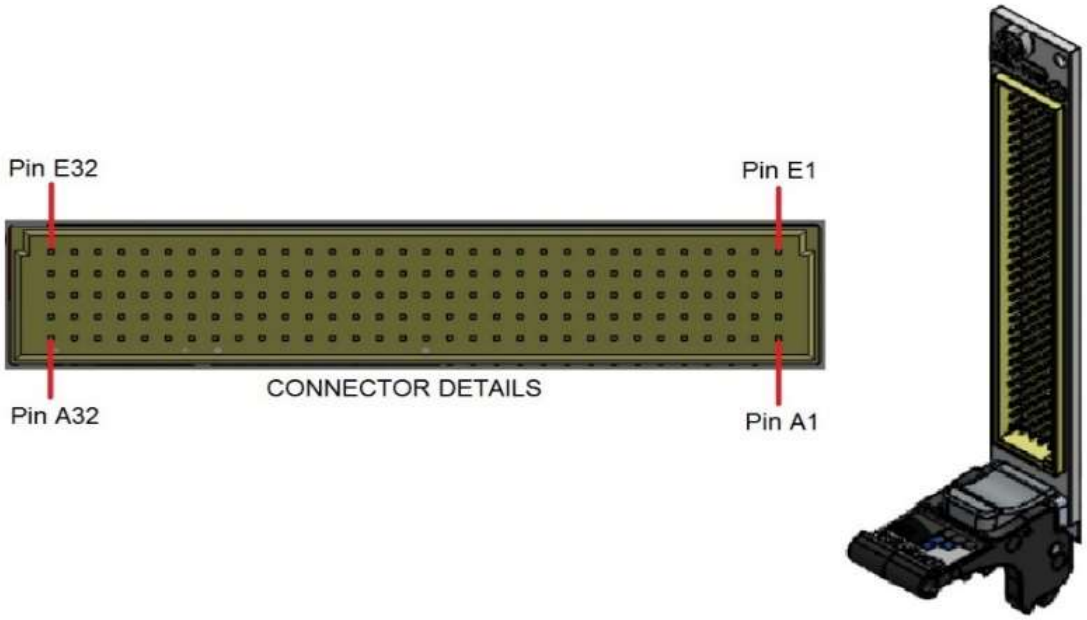

Figure 2-1: EMX-7510 Front Panel Connector Details

Measurement Performance

This section discusses tips and procedures that can help maximize the actual performance realized with the EMX-7510 and aid the user in avoiding some common pitfalls associated with making measurements.

Voltage Outputs

A channel output is pulled to the configured voltage through a pull-up resistor. The actual output that will be seen by the unit under test is defined by the standard voltage divider equation:

$$V_0 = V_{CLAMP} \left(\frac{R_{USER} \parallel R_{INPUT}}{R_1 + (R_{USER} \parallel R_{INPUT})} \right)$$

Where,

V_0 is the output voltage
V_{CLAMP} is the User configured voltage
R_1 is the internal pull-up resistor
R_{USER} is the external load presented by the unit under test

In normal mode, R_1 is 100 kΩ. In TTL emulation mode, R_1 is 499 Ω and in LV emulation mode, R1 is 330 Ω. So the pull-up to V_{CLAMP} is much stronger. TTL emulation mode is available for the 3.3 V and 5 V voltage levels.

If voltages higher than those provided by the equation above are desired, the User can supply a voltage with an external power supply in conjunction with a low-value pull-up resistor to get closer to the user's V_{CLAMP} voltage. The 300 mA sink capability of the channel still must be observed.

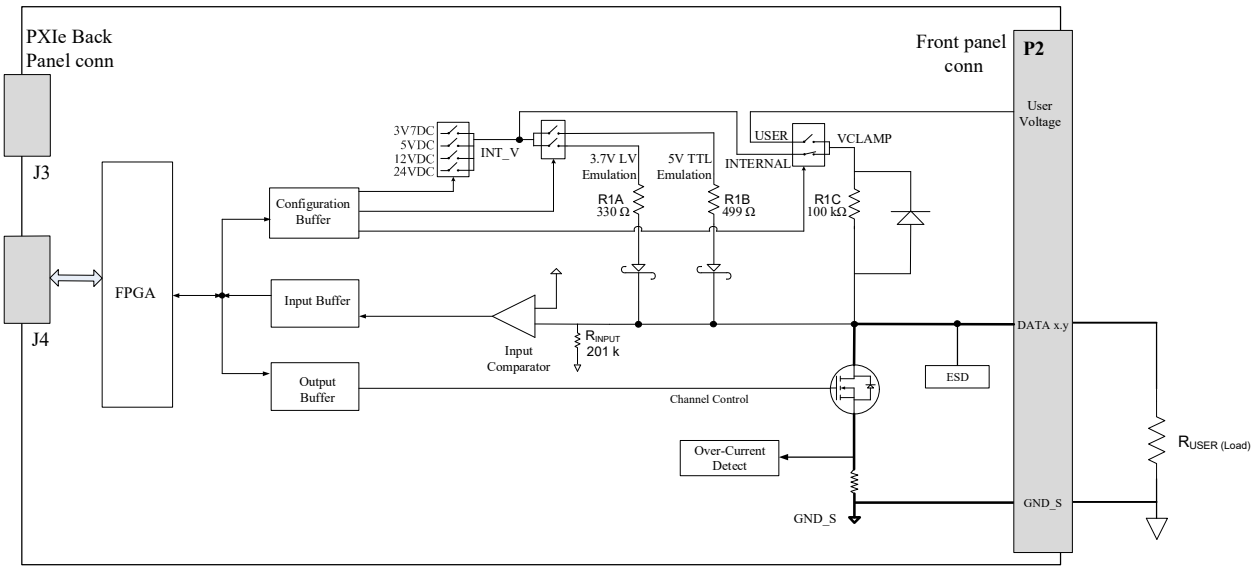

Figure 2-2: Voltage Output _ EMX-7510

Voltage Output

Mode	Internal Supply	Pull-Up (R_1)	*Open Circuit V_0*
Normal	24 V	100 kΩ (R_{1C})	~15.84 V
Normal	12 V	100 kΩ (R_{1C})	~7.92 V
Normal	5 V	100 kΩ (R_{1C})	~3.3 V
Normal	3.3 V	100 kΩ (R_{1C})	~2.47 V
TTL Emulation	5 V	499 Ω (R_{1B})	~4.6 V*
LV Emulation	3.3 V	330 Ω (R_{1A})	~3.3 V*
**For TTL and LV modes, there is approximately a 0.35 V drop due to the Schottky diode, resulting in an actual internal supply voltage of 4.6 V and 3.3V, respectively.*			
Mode	**External Supply**	**Load**	***$V_{O\text{-}USER}$***
Normal	V_{CLAMP}	R_{USER}	$V_{CLAMP}\left[\frac{R_{USER} \parallel R_{INPUT}}{100\,k\Omega + (R_{USER} \parallel R_{INPUT})}\right]$

TABLE 2-1: EMX-7510 OUTPUT VOLTAGES

Connector Pin/Signal Assignment

The connector pins and their signal assignments are shown below . For mating connector and accessory information, please see Appendix C.

Pin	Signal	Pin	Signal	Pin	Signal	Pin	Signal	Pin	Signal
A1	GND_S	**B1**	GND_C	**C1**	GND_S	**D1**		**E1**	
A2	GND_S	**B2**	GND_S	**C2**	GND_S	**D2**		**E2**	GND_S
A3	DATA1.4	**B3**	GND_S	**C3**	DATA1.8	**D3**	GND_S	**E3**	DATA1.5
A4	DATA1.1	**B4**	GND_S	**C4**	DATA1.2	**D4**	GND_S	**E4**	DATA1.6
A5	DATA1.3	**B5**	GND_S	**C5**	DATA1.7	**D5**	GND_S	**E5**	DATA2.5
A6	DATA2.4	**B6**	DATA2.1	**C6**	DATA2.8	**D6**	GND_S	**E6**	DATA2.2
A7	GND_S	**B7**	GND_S	**C7**	GND_S	**D7**	DATA2.3	**E7**	GND_S
A8	GND_S	**B8**	GND_S	**C8**	GND_S	**D8**	GND_S	**E8**	DATA2.6
A9	DATA2.7	**B9**	USER_V2	**C9**	DATA3.8	**D9**	GND_S	**E9**	DATA3.5
A10	DATA3.4	**B10**	GND_S	**C10**	DATA3.1	**D10**	USER_V1	**E10**	GND_S
A11	DATA3.2	**B11**	GND_S	**C11**	DATA3.7	**D11**	GND_S	**E11**	DATA3.6
A12	DATA3.3	**B12**	GND_S	**C12**	DATA4.2	**D12**	GND_S	**E12**	DATA4.4
A13	GND_S	**B13**	USER_V4	**C13**	GND_S	**D13**	GND_S	**E13**	DATA4.5
A14	GND_S	**B14**	GND_S	**C14**	GND_S	**D14**	GND_S	**E14**	DATA4.8
A15	DATA4.1	**B15**	GND_S	**C15**	DATA4.7	**D15**	GND_S	**E15**	GND_S
A16	DATA4.3	**B16**	USER_V3	**C16**	DATA5.1	**D16**	GND_S	**E16**	GND_S
A17	DATA5.3	**B17**	GND_S	**C17**	DATA5.2	**D17**	USER_V6	**E17**	DATA4.6
A18	DATA5.8	**B18**	GND_S	**C18**	DATA5.4	**D18**	GND_S	**E18**	DATA5.5
A19	GND_S	**B19**	GND_S	**C19**	GND_S	**D19**	GND_S	**E19**	DATA5.7
A20	GND_S	**B20**	USER_V5	**C20**	GND_S	**D20**	GND_S	**E20**	DATA5.6

A21	DATA6.4	**B21**	GND_S	**C21**	DATA6.5	**D21**	GND_S	**E21**	GND_S
A22	DATA6.1	**B22**	GND_S	**C22**	DATA6.8	**D22**	GND_S	**E22**	GND_S
A23	DATA6.3	**B23**	GND_S	**C23**	DATA6.2	**D23**	GND_S	**E23**	DATA6.6
A24	DATA7.4	**B24**	USER_V7	**C24**	DATA7.1	**D24**	USER_V8	**E24**	DATA6.7
A25	GND_S	**B25**	GND_S	**C25**	GND_S	**D25**	GND_S	**E25**	DATA7.8
A26	GND_S	**B26**	GND_S	**C26**	GND_S	**D26**	GND_S	**E26**	DATA7.5
A27	DATA7.3	**B27**	GND_S	**C27**	DATA7.6	**D27**	GND_S	**E27**	GND_S
A28	DATA7.2	**B28**	GND_S	**C28**	DATA7.7	**D28**	GND_S	**E28**	GND_S
A29	DATA8.4	**B29**	GND_S	**C29**	DATA8.1	**D29**	GND_S	**E29**	DATA8.5
A30	DATA8.2	**B30**	GND_S	**C30**	DATA8.6	**D30**	GND_S	**E30**	DATA8.8
A31	GND_S	**B31**	GND_C	**C31**	GND_S	**D31**	GND_S	**E31**	GND_S
A32	DATA8.3	**B32**	GND_S	**C32**	DATA8.7	**D32**	GND_S	**E32**	GND_S

TABLE 2-2: EMX-7510 CONNECTOR PIN SIGNAL ASSIGNMENT

EMX-7510 SPECIFICATIONS

GENERAL SPECIFICATIONS	
CHANNEL COUNT	
	64 Digital Input / Output channels (Eight 8-Bit Ports)
DATA INPUT CHARACTERISTICS	
V_{IN} (high)	> 40% of Vclamp (Typical)
V_{IN} (low)	< 14% of Vclamp (Typical)
V_{IN} (max)	60 V
DATA OUTPUT CHARACTERISTICS	
V_{OUT} (high)	> 2 V to 60 V
V_{OUT} (low)	< 1.5 V @ 300 mA (Sink)
VOLTAGE RANGE	
Internal voltage	3.3 V, 5.0 V, 12.0 V, and 24.0 V
User	> 2 V up to 60 V

THEORY OF OPERATION

This section provides an overview of how the EMX-7510 works.

The EMX-7510 supports a static mode where user-driven software commands execute reading/writing data channels on a per port basis. Each port can be programmed for direction and polarity. The default direction is input and default polarity is normal. Ports also need a voltage reference before data can be read or written; this voltage is used for pulling up open drain data lines and setting reference voltage for threshold detection in input path. No voltage should be applied on data lines before voltage selection and during voltage configuration process. User can select a voltage from 3.3 V, 5 V, 12 V or 24 V provided on the module or supply a voltage through front panel connector (User Voltage), to be used as V_{CLAMP}. By default, no voltage is selected and data lines are floating. There is also an option of configuring a port's voltage setting as either TTL or Low Voltage emulation. In TTL emulation setting, open drain lines are pulled up to 5 V and have a sourcing capability of 4 mA, whereas in Low Voltage (LV) option the pull-up voltage is 3.3 V with 4 mA drive strength.

When doing read and writes, data written to a port set for output, updates data on that port, data written to a port set for input does not have any effect. Data read from a port always reads current status of data pins (whether driven by card or by user).

When a port's direction is output, data is driven by the DIO on the corresponding channels and no user voltage should be applied on those channels. When direction is input, data lines are pulled up to V_{CLAMP} using 100 kΩ resistor and user can drive their data on the channels with a V_{IN} range of zero to V_{CLAMP}.

TTL and LV emulation voltage selection is only applicable when port's direction is output. Input mode will not be allowed for emulation voltage.

Power on Reset

Power on Reset / Soft Reset of EMX-7510 brings the ports to a default state as in Table 2-3.

Model	Direction	Polarity	Data	Voltage
EMX-7510	Input	Normal	(Invalid Data as no V_{CLAMP} voltage selected)	No voltage selected

TABLE 2-3: RESET CONDITION

Voltage Configuration

- When the card is reset, no Voltage will be selected at the ports and data in output registers are set to FF.
- A ports output register data is set to FF for any voltage configuration when polarity is Normal. Only concerned port is affected.
- A ports output register data is set to 0 for any voltage configuration except 0.0V when polarity is Inverse. Only concerned port is affected.
- A port's direction is changed to output, when its voltage is set for TTL/LV emulation. Only concerned port is affected.

Data in output registers is retained if direction is changed. So for example, when an output port that is driving AA on data lines is made input, all its channels are pulled up so that user data can be driven but when the direction is changed back to output, AA gets driven, given that polarity and voltage setting didn't change.

Polarity settings are applicable irrespective of direction. On output channels, changing the polarity flips the state of data lines and further writes are done according to polarity selection (for example, if polarity is configured as reversed then writing 1 to a channel writes a 0 to it and vice versa). Read back of data, whether driven by card when direction is output or driven by user when direction is input, also checks for polarity and if polarity is reversed, 1 is read as 0, otherwise as 1 and 0 is read as 1, otherwise as 0.

Configuration Section

This section of circuit is used to select reference voltage (V_{CLAMP}) for ports. Each port has a set of programmatically controlled switches that let the user select a voltage from 3.3 V, 5 V, 12 V, 24 V and User supplied voltage, which can be anywhere from > 2 V up to 60 V. In addition, LV and TTL emulation modes can be selected which use 3.3 V and 5 V as V_{CLAMP} respectively, and insert a low impedance pull-up resistor in the path to source 4 mA.

Output Section

The output section of each channel consists of an N-channel MOSFET, pull-up resistors and over current sense circuitry. When a 1 is driven on channel, the MOSFET is turned off and data line is pulled-up to V_{CLAMP} using appropriate pull-up resistor (330 Ω for LV emulation, 500 Ω for TTL emulation and 100 kΩ otherwise). The rising voltage level at data channel exhibits RC charging with a rise time of approximately 70 µs with 100 kΩ pull-up resistor and about 600 ns with low impedance pull-up in TTL and LV voltage configurations. When a 0 is driven on channel, the MOSFET is turned on and data line is connected to ground via a current sense resistor of 0.3 Ω. The falling edge is much sharper with a maximum fall time of 300 ns approximately.

The load resistor and pull-up resistor form a voltage divider of V_{CLAMP} and determine output voltage, thus output voltage decreases with decreasing load resistance. The minimum load resistance that can be connected on channels is 500 Ω for LV emulation, 750 Ω for TTL emulation and 150 kΩ otherwise.

The data lines have a current sinking capacity of 300 mA. If the current through MOSFET increases above limited value, the over current protection circuit turns off all FETs in the concerned port. The over current condition must last for greater than 12.8 µs before over current protection circuit is activated. This is done to prevent false over current events due to transients. It takes approximately 20 µs from first occurrence of the over current event before the FETs are turned off. The over current circuit will activate with 340 mA hold current and 475 mA trip current, where hold current is the maximum current circuit will allow without tripping and trip current is the minimum current required to trip the circuit. The absolute maximum limit on sinking current is 500 mA. Staying within these limits is user's responsibility. Over current readings from ports will be latched and can be read by user. When they reset over current condition, then port will be enabled and data last written to port will be applied on channels.

Input Section

The input section converts the high or low voltage on the data channels to 1 or 0 that can be read by the user. The port's V_{CLAMP} voltage is used as a reference for threshold detection. When the port is set as input, the data lines are pulled up using 100 kΩ resistor. If voltage on data line is greater than 40% of port's V_{CLAMP} voltage, 1 is read and if voltage on data line is less than 14% of port's V_{CLAMP} voltage, 0 is read. Hysteresis loop is implemented on input comparison meaning that on rising voltage, level has to cross higher threshold (VIH) to record a 1 and on falling voltage, level has to cross lower threshold (VIL) to record a 0. In between VIH and VIL the digital state of data channel reading stays the same. Please refer to the recommended operating conditions for input threshold values.

The input section also has a fly-back protection diode. The port's reference voltage VCLAMP is routed to the cathode of a fly-back protection diode, whose anode is then connected to the associated port's data line. Every data line has a diode installed to suppress transients in case of

voltage overshooting. The current through diode must be limited as indicated in absolute maximum ratings.

TYPICAL APPLICATIONS

Driving and sensing external devices such as relays with Flyback Diode

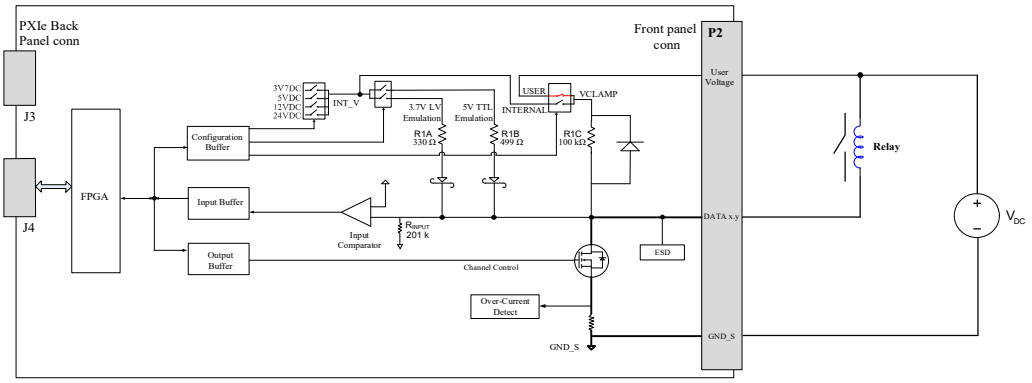

FIGURE 2-3: Driving and sensing Relay

Driving LED

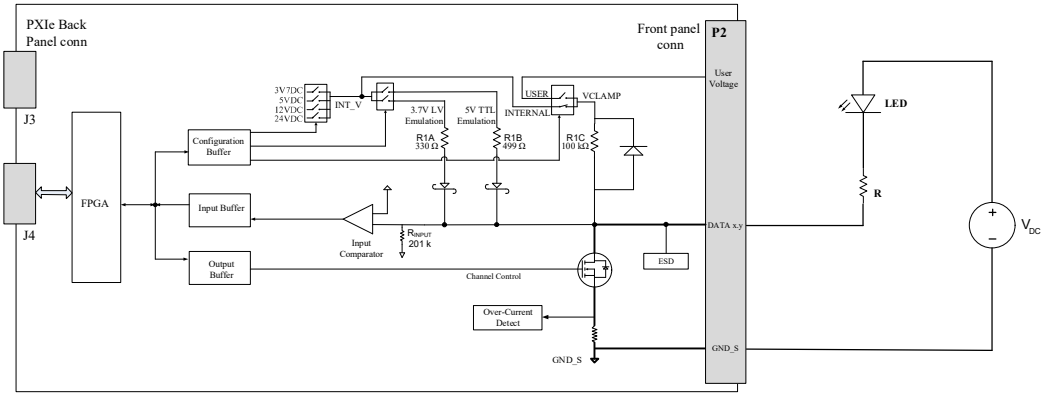

Figure 2-4: Driving LED with external supply

TTL Emulation

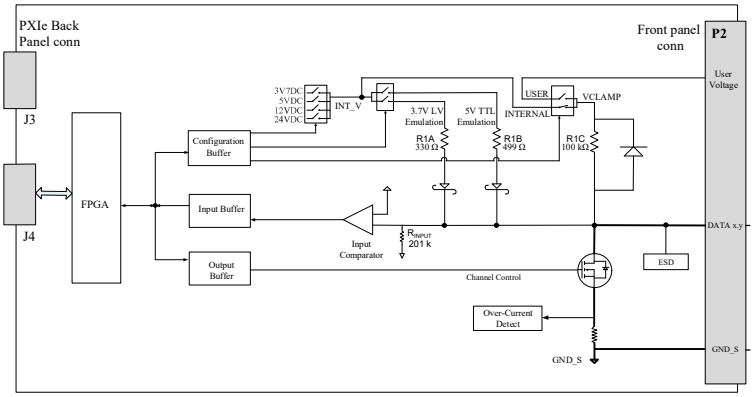

Figure 2-5: TTL Emulation

LVTTL Emulation

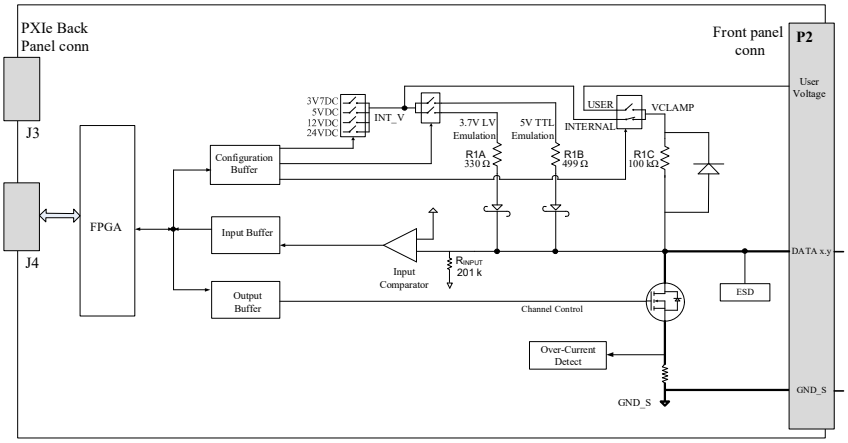

Figure 2-6: LVTTL Emulation

TTL/LVTTL Driving LED

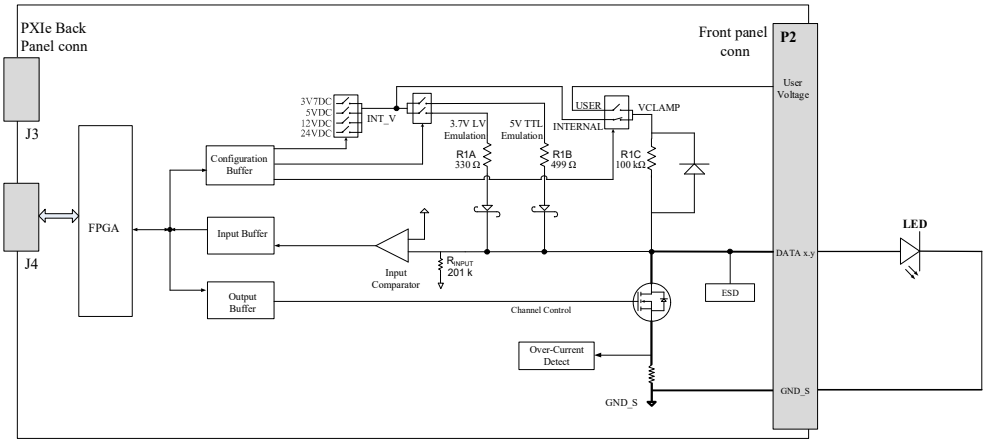

Figure 2-7: Driving LED in TTL/LVTTL mode

Switch state reading

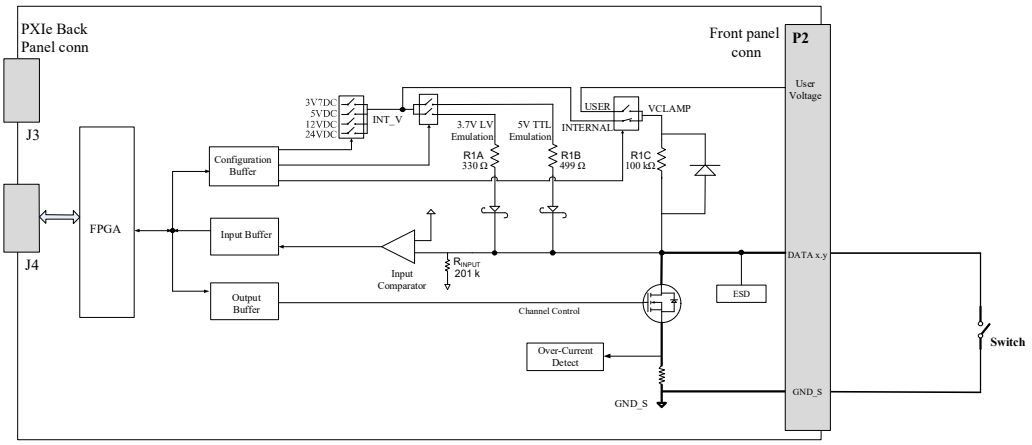

Figure 2-8: Switch state reading

DIO with Multiple Voltage Pullup selection

Internal Pullup Voltages (V_{CLAMP}) : 3.3 V, 5.0 V, 12.0, V, and 24.0 V

User Voltage (V_{CLAMP}) : 2 V to 60 V

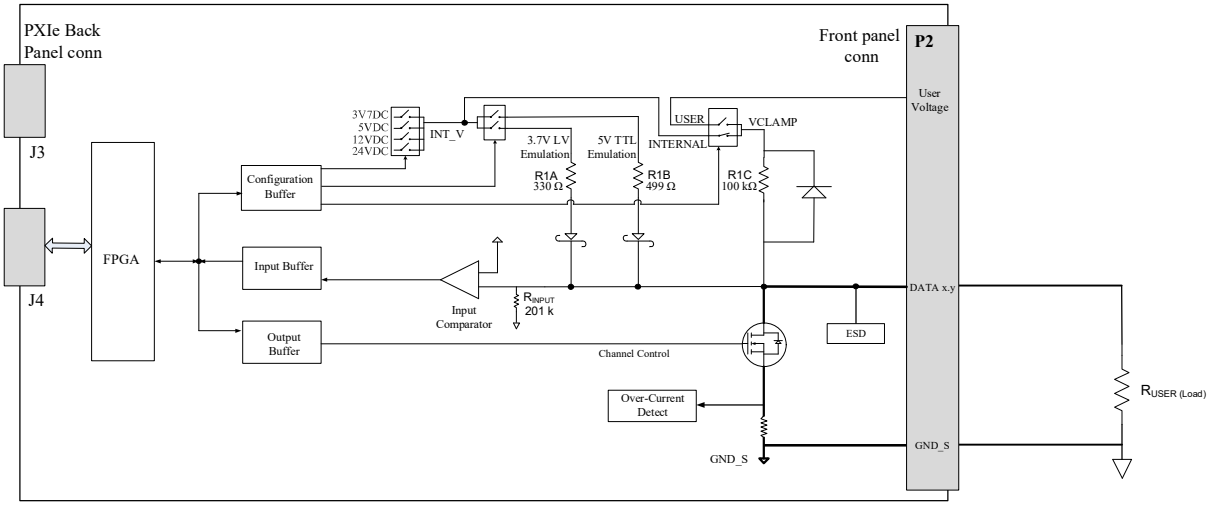

Figure 2-9: DIO with Multiple Voltage Pullup selection

Voltage Output			
Mode	**Internal Supply**	**Pull-Up (R_1)**	***Open Circuit V_0***
Normal	24 V	100 kΩ (R_{1C})	~15.84 V
Normal	12 V	100 kΩ (R_{1C})	~7.92 V
Normal	5 V	100 kΩ (R_{1C})	~3.3 V
Normal	3.3 V	100 kΩ (R_{1C})	~2.47 V
TTL Emulation	5 V	499 Ω (R_{1B})	~4.6 V*
LV Emulation	3.3 V	330 Ω (R_{1A})	~3.3 V*
**For TTL and LV modes, there is approximately a 0.35 V drop due to the Schottky diode, resulting in an actual internal supply voltage of 4.6 V and 3.3V, respectively.*			
Mode	**External Supply**	**Load**	***$V_{O\text{-}USER}$***
Normal	V_{CLAMP}	R_{USER}	$V_{CLAMP}\left[\frac{R_{USER} \parallel R_{INPUT}}{100\,k\Omega + (R_{USER} \parallel R_{INPUT})}\right]$

TABLE 2-4: OUTPUT VOLTAGES

V_{IN} (high)	> 40% of Vclamp (Typical)
V_{IN} (low)	< 14% of Vclamp (Typical)
V_{IN} (max)	60 V

EMX-7511, 64-CHANNEL, DIGITAL I/O TTL CARD

The EMX-7511 is a high-performance I/O module with eight ports of 8 bits (64 channels) each with standard TTL voltage levels. Each 8-bit port may be configured as an Input or Output under program control.

BLOCK DIAGRAM

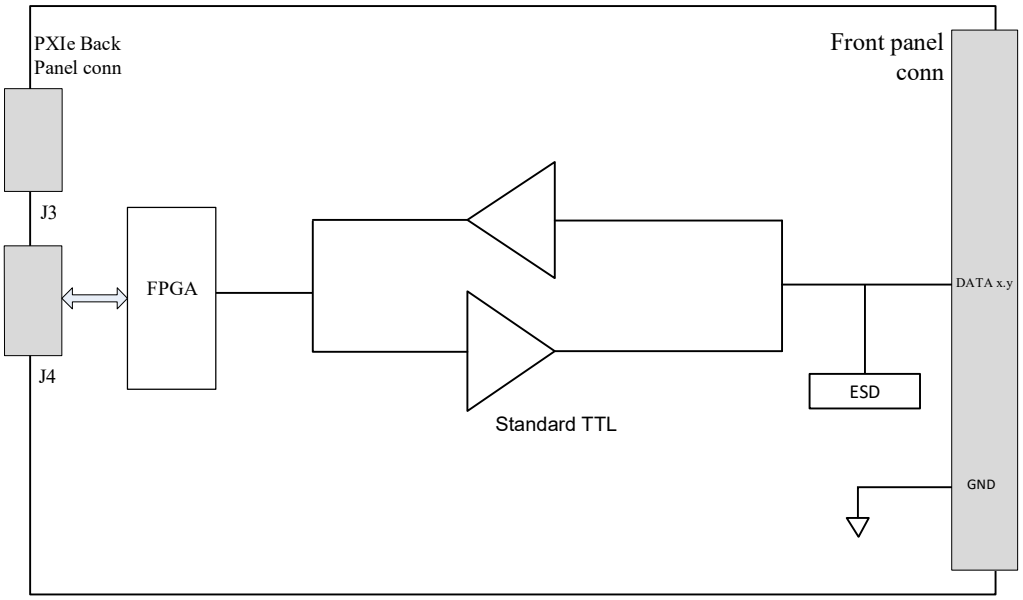

Figure 2-10: EMX-7511 Block Diagram

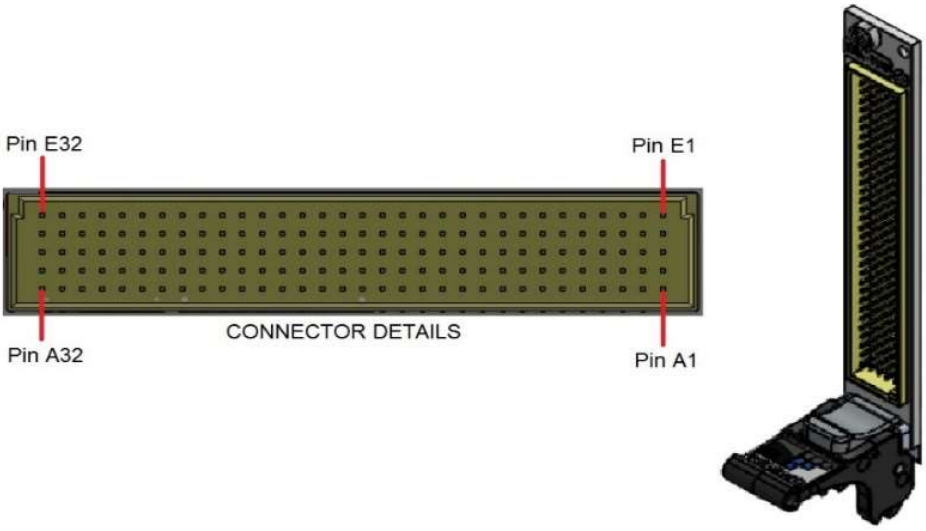

Figure 2-11: EMX-7511 Front Panel Connector Details

Connector Pin/Signal Assignment

The connector pins and their signal assignments are shown below 3.. For mating connector and accessory information, please see Appendix C.

Pin	Signal	Pin	Signal	Pin	Signal	Pin	Signal	Pin	Signal
A1	GND	**B1**	GND_C	**C1**	GND	**D1**		**E1**	
A2	GND	**B2**	GND	**C2**	GND	**D2**		**E2**	GND
A3	DATA1.4	**B3**	GND	**C3**	DATA1.8	**D3**	GND	**E3**	DATA1.5
A4	DATA1.1	**B4**	GND	**C4**	DATA1.2	**D4**	GND	**E4**	DATA1.6
A5	DATA1.3	**B5**	GND	**C5**	DATA1.7	**D5**	GND	**E5**	DATA2.5
A6	DATA2.4	**B6**	DATA2.1	**C6**	DATA2.8	**D6**	GND	**E6**	DATA2.2
A7	GND	**B7**	GND	**C7**	GND	**D7**	DATA2.3	**E7**	GND
A8	GND	**B8**	GND	**C8**	GND	**D8**	GND	**E8**	DATA2.6
A9	DATA2.7	**B9**		**C9**	DATA3.8	**D9**	GND	**E9**	DATA3.5
A10	DATA3.4	**B10**	GND	**C10**	DATA3.1	**D10**		**E10**	GND
A11	DATA3.2	**B11**	GND	**C11**	DATA3.7	**D11**	GND	**E11**	DATA3.6
A12	DATA3.3	**B12**	GND	**C12**	DATA4.2	**D12**	GND	**E12**	DATA4.4
A13	GND	**B13**		**C13**	GND	**D13**	GND	**E13**	DATA4.5
A14	GND	**B14**	GND	**C14**	GND	**D14**	GND	**E14**	DATA4.8
A15	DATA4.1	**B15**	GND	**C15**	DATA4.7	**D15**	GND	**E15**	GND
A16	DATA4.3	**B16**		**C16**	DATA5.1	**D16**	GND	**E16**	GND
A17	DATA5.3	**B17**	GND	**C17**	DATA5.2	**D17**		**E17**	DATA4.6
A18	DATA5.8	**B18**	GND	**C18**	DATA5.4	**D18**	GND	**E18**	DATA5.5
A19	GND	**B19**	GND	**C19**	GND	**D19**	GND	**E19**	DATA5.7
A20	GND	**B20**		**C20**	GND	**D20**	GND	**E20**	DATA5.6
A21	DATA6.4	**B21**	GND	**C21**	DATA6.5	**D21**	GND	**E21**	GND
A22	DATA6.1	**B22**	GND	**C22**	DATA6.8	**D22**	GND	**E22**	GND
A23	DATA6.3	**B23**	GND	**C23**	DATA6.2	**D23**	GND	**E23**	DATA6.6
A24	DATA7.4	**B24**		**C24**	DATA7.1	**D24**		**E24**	DATA6.7
A25	GND	**B25**	GND	**C25**	GND	**D25**	GND	**E25**	DATA7.8
A26	GND	**B26**	GND	**C26**	GND	**D26**	GND	**E26**	DATA7.5
A27	DATA7.3	**B27**	GND	**C27**	DATA7.6	**D27**	GND	**E27**	GND
A28	DATA7.2	**B28**	GND	**C28**	DATA7.7	**D28**	GND	**E28**	GND
A29	DATA8.4	**B29**	GND	**C29**	DATA8.1	**D29**	GND	**E29**	DATA8.5
A30	DATA8.2	**B30**	GND	**C30**	DATA8.6	**D30**	GND	**E30**	DATA8.8
A31	GND	**B31**	GND_C	**C31**	GND	**D31**	GND	**E31**	GND
A32	DATA8.3	**B32**	GND	**C32**	DATA8.7	**D32**	GND	**E32**	GND

TABLE 2-5: EMX-7511 CONNECTOR PIN SIGNAL ASSIGNMENT

EMX-7511 SPECIFICATIONS

GENERAL SPECIFICATIONS	
CHANNEL COUNT	
	64 Digital Input / Output channels (Eight 8-Bit Ports)
DATA INPUT / OUTPUT CHARACTERISTICS	
Logical Level	Standard TTL
Sink / Source current	24mA

TYPICAL APPLICATIONS

Driving LED (Sink)

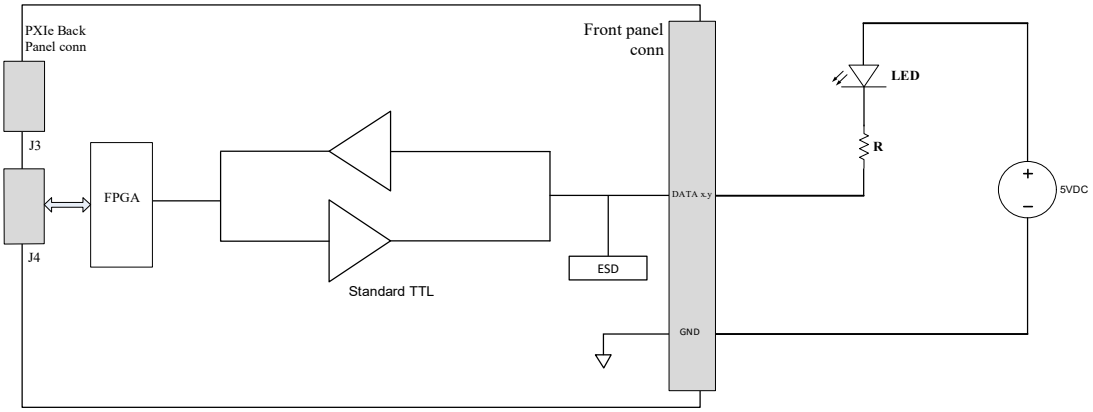

Figure 2-12: Driving LED with external supply

TTL DIO

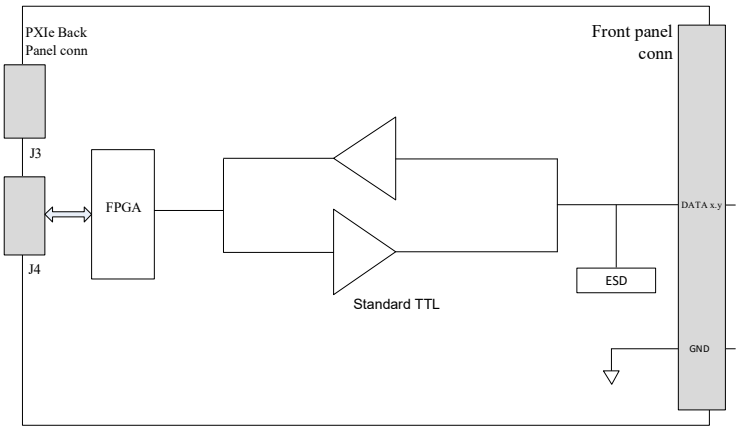

Figure 2-13: TTL DIO

Driving LED (Source)

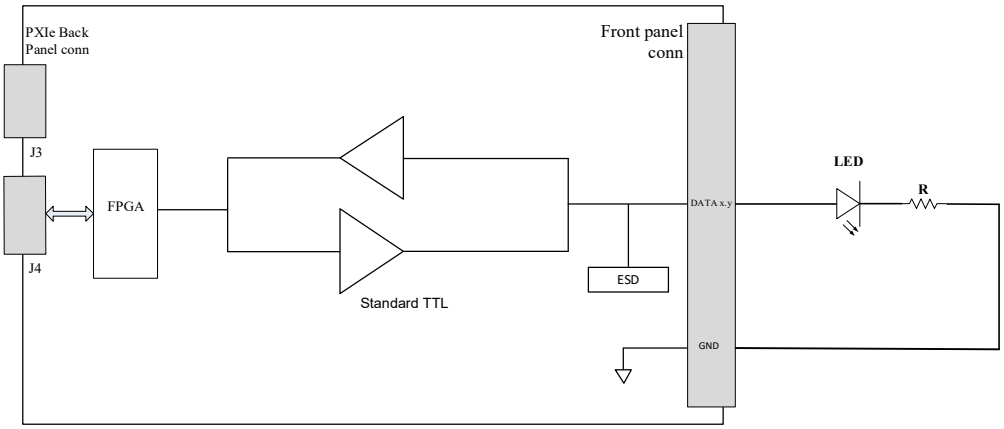

Figure 2-14: Driving LED

Switch state reading

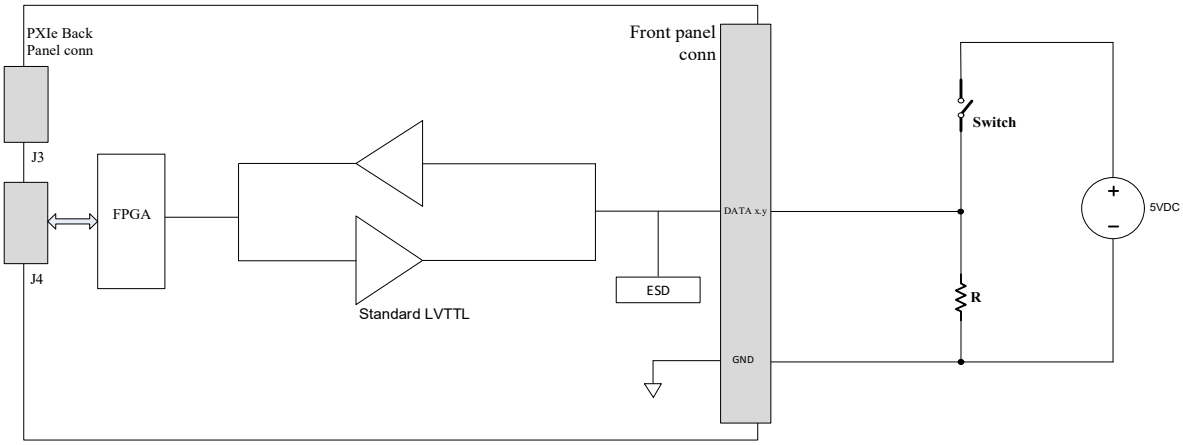

Figure 2-15: Switch state reading

EMX-7512, 64-CHANNEL, DIGITAL I/O LV TTL CARD

The EMX-7512 is a high-performance I/O module with eight ports of 8 bits (64 channels) each with standard LV TTL voltage levels. Each 8-bit port may be configured as an Input or Output under program control.

BLOCK DIAGRAM

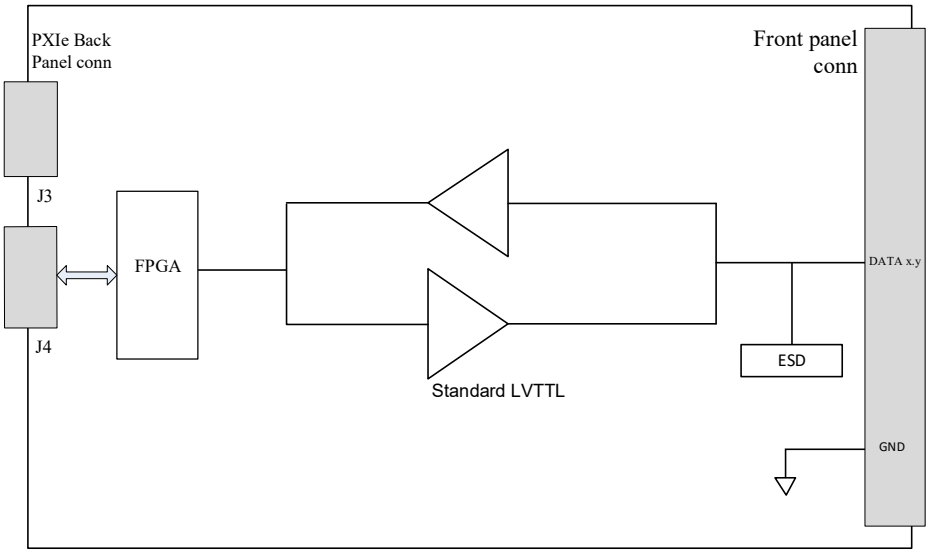

Figure 2-16: EMX-7512 Block Diagram

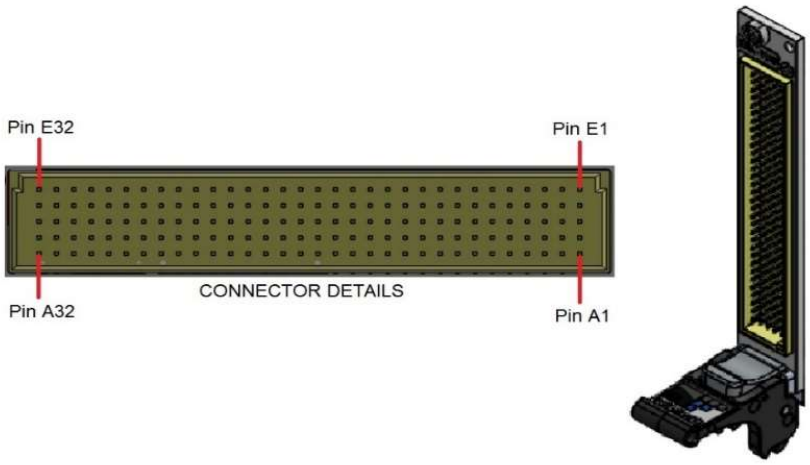

Figure 2-17: EMX-7512 Front Panel Connector Details

Connector Pin/Signal Assignment

The connector pins and their signal assignments are shown below Table 2-6. For mating connector and accessory information, please see Appendix C.

Pin	Signal	Pin	Signal	Pin	Signal	Pin	Signal	Pin	Signal
A1	GND	**B1**	GND_C	**C1**	GND	**D1**		**E1**	
A2	GND	**B2**	GND	**C2**	GND	**D2**		**E2**	GND
A3	DATA1.4	**B3**	GND	**C3**	DATA1.8	**D3**	GND	**E3**	DATA1.5
A4	DATA1.1	**B4**	GND	**C4**	DATA1.2	**D4**	GND	**E4**	DATA1.6
A5	DATA1.3	**B5**	GND	**C5**	DATA1.7	**D5**	GND	**E5**	DATA2.5
A6	DATA2.4	**B6**	DATA2.1	**C6**	DATA2.8	**D6**	GND	**E6**	DATA2.2
A7	GND	**B7**	GND	**C7**	GND	**D7**	DATA2.3	**E7**	GND
A8	GND	**B8**	GND	**C8**	GND	**D8**	GND	**E8**	DATA2.6
A9	DATA2.7	**B9**		**C9**	DATA3.8	**D9**	GND	**E9**	DATA3.5
A10	DATA3.4	**B10**	GND	**C10**	DATA3.1	**D10**		**E10**	GND
A11	DATA3.2	**B11**	GND	**C11**	DATA3.7	**D11**	GND	**E11**	DATA3.6
A12	DATA3.3	**B12**	GND	**C12**	DATA4.2	**D12**	GND	**E12**	DATA4.4
A13	GND	**B13**		**C13**	GND	**D13**	GND	**E13**	DATA4.5
A14	GND	**B14**	GND	**C14**	GND	**D14**	GND	**E14**	DATA4.8
A15	DATA4.1	**B15**	GND	**C15**	DATA4.7	**D15**	GND	**E15**	GND
A16	DATA4.3	**B16**		**C16**	DATA5.1	**D16**	GND	**E16**	GND
A17	DATA5.3	**B17**	GND	**C17**	DATA5.2	**D17**		**E17**	DATA4.6
A18	DATA5.8	**B18**	GND	**C18**	DATA5.4	**D18**	GND	**E18**	DATA5.5
A19	GND	**B19**	GND	**C19**	GND	**D19**	GND	**E19**	DATA5.7
A20	GND	**B20**		**C20**	GND	**D20**	GND	**E20**	DATA5.6
A21	DATA6.4	**B21**	GND	**C21**	DATA6.5	**D21**	GND	**E21**	GND
A22	DATA6.1	**B22**	GND	**C22**	DATA6.8	**D22**	GND	**E22**	GND
A23	DATA6.3	**B23**	GND	**C23**	DATA6.2	**D23**	GND	**E23**	DATA6.6
A24	DATA7.4	**B24**		**C24**	DATA7.1	**D24**		**E24**	DATA6.7
A25	GND	**B25**	GND	**C25**	GND	**D25**	GND	**E25**	DATA7.8
A26	GND	**B26**	GND	**C26**	GND	**D26**	GND	**E26**	DATA7.5
A27	DATA7.3	**B27**	GND	**C27**	DATA7.6	**D27**	GND	**E27**	GND
A28	DATA7.2	**B28**	GND	**C28**	DATA7.7	**D28**	GND	**E28**	GND
A29	DATA8.4	**B29**	GND	**C29**	DATA8.1	**D29**	GND	**E29**	DATA8.5
A30	DATA8.2	**B30**	GND	**C30**	DATA8.6	**D30**	GND	**E30**	DATA8.8
A31	GND	**B31**	GND_C	**C31**	GND	**D31**	GND	**E31**	GND
A32	DATA8.3	**B32**	GND	**C32**	DATA8.7	**D32**	GND	**E32**	GND

TABLE 2-6: EMX-7512 CONNECTOR PIN SIGNAL ASSIGNMENT

EMX-7512 SPECIFICATIONS

GENERAL SPECIFICATIONS	
CHANNEL COUNT	
	64 Digital Input / Output channels (Eight 8-Bit Ports)
DATA INPUT / OUTPUT CHARACTERISTICS	
Logical Level	Standard LV TTL
Sink / Source current	24mA

TYPICAL APPLICATIONS

Driving LED (Sink)

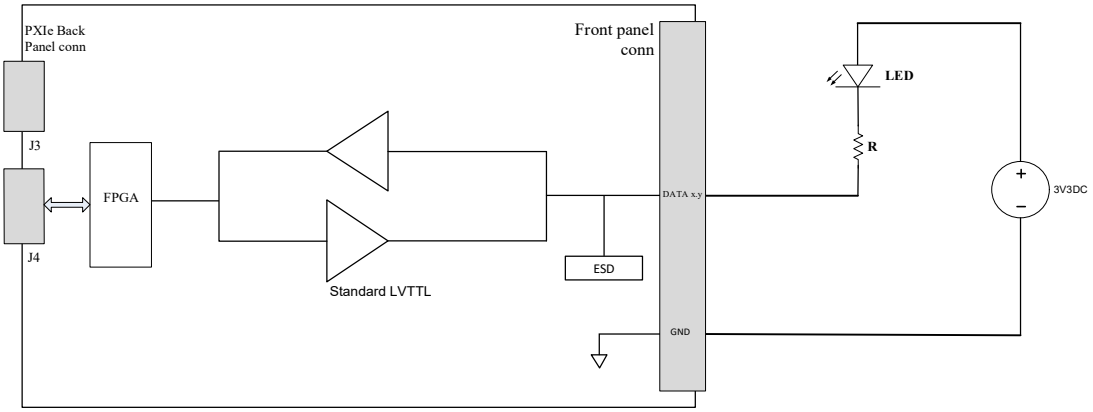

FIGURE 2-18: Driving LED with external supply

LVTTL DIO

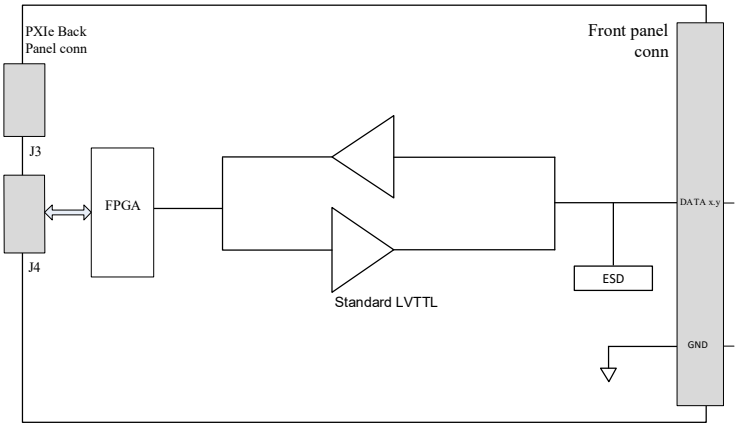

Figure 2-19: LVTTL DIO

Driving LED (Source)

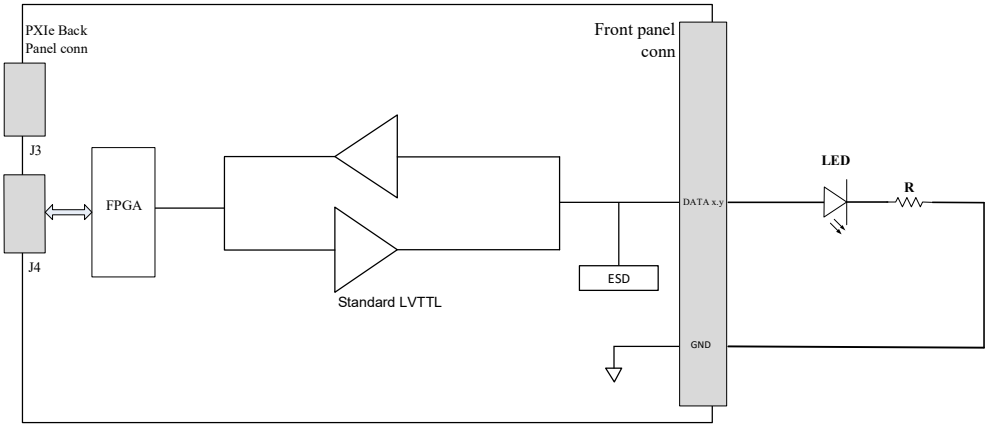

Figure 2-20: Driving LED

Switch state reading

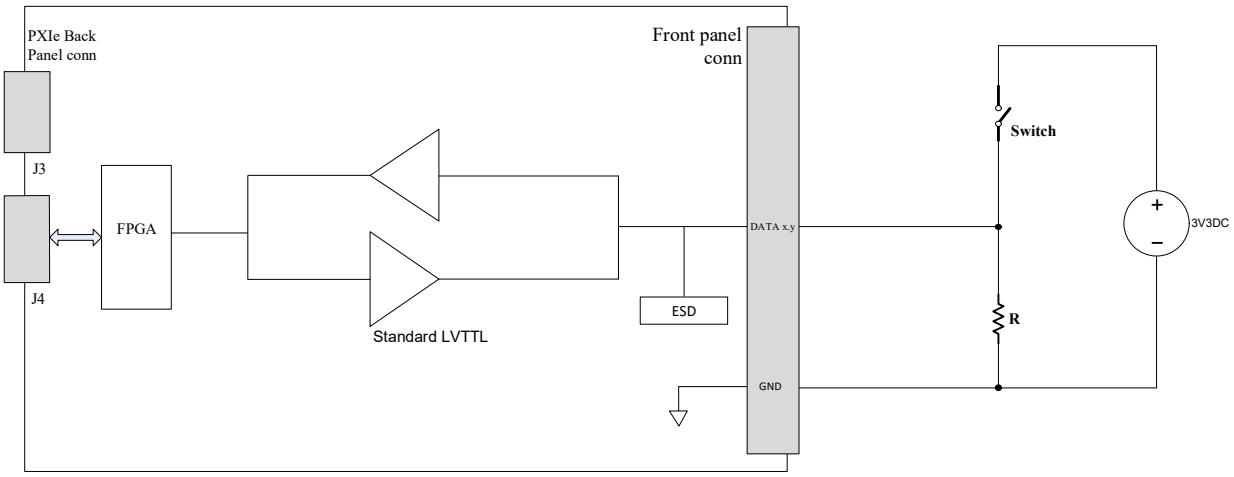

Figure 2-21: Switch state reading

EMX-7513, 32DI AND 32DO ISOLATED CHANNELS CARD

The EMX-7513 is a high-performance module with 32 Isolated Digital Input channels and 32 Isolated Digital Output channels.

BLOCK DIAGRAM

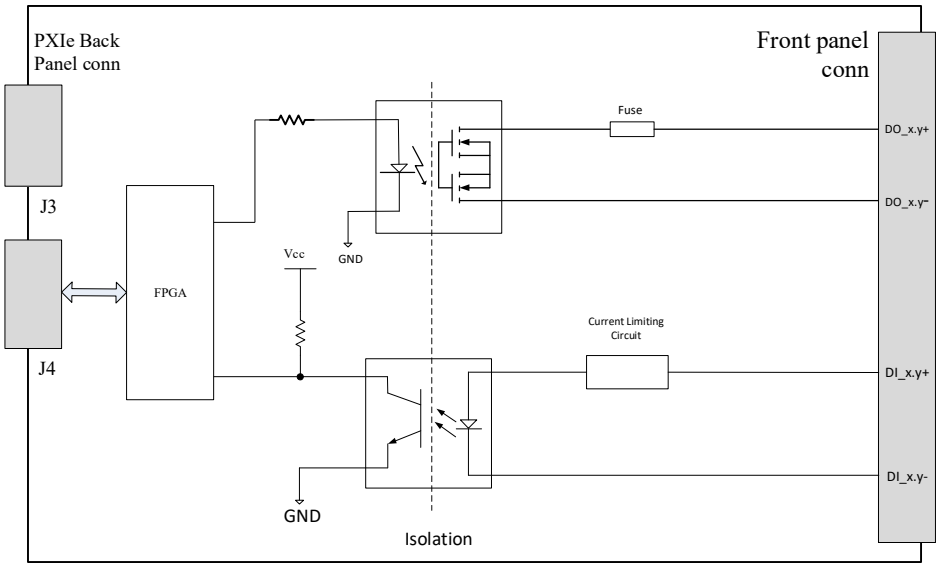

Figure 2-12: EMX-7513 Block Diagram

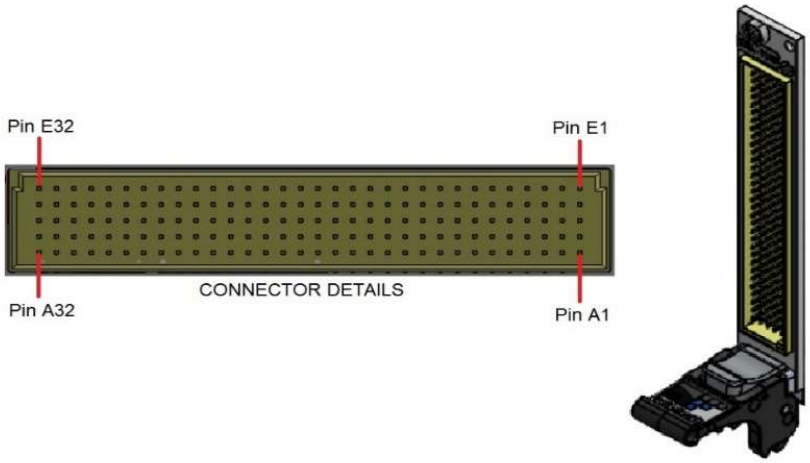

Figure 2-23: EMX-7513 Front Panel Connector Details

Connector Pin/Signal Assignment

The connector pins and their signal assignments are shown below Table 2-7. For mating connector and accessory information, please see Appendix C.

Pin	Signal	Pin	Signal	Pin	Signal	Pin	Signal	Pin	Signal
A1		B1		C1		D1		E1	
A2		B2		C2		D2		E2	
A3		B3		C3	DI_1.5-	D3		E3	DI_2.1-
A4		B4		C4	DI_1.5+	D4		E4	DI_2.1+
A5	DI_1.1-	B5	DI_1.2-	C5	DI_1.6-	D5	DI_1.7-	E5	DI_2.2-
A6	DI_1.1+	B6	DI_1.2+	C6	DI_1.6+	D6	DI_1.7+	E6	DI_2.2+
A7	DI_2.3-	B7	DI_1.3-	C7	DI_2.7-	D7	DI_1.8-	E7	DI_3.3-
A8	DI_2.3+	B8	DI_1.3+	C8	DI_2.7+	D8	DI_1.8+	E8	DI_3.3+
A9	DI_2.4-	B9	DI_1.4-	C9	DI_2.8-	D9	DI_3.1-	E9	DI_3.4-
A10	DI_2.4+	B10	DI_1.4+	C10	DI_2.8+	D10	DI_3.1+	E10	DI_3.4+
A11	DI_3.5-	B11	DI_2.5-	C11	DI_4.1-	D11	DI_3.2-	E11	DI_4.5-
A12	DI_3.5+	B12	DI_2.5+	C12	DI_4.1+	D12	DI_3.2+	E12	DI_4.5+
A13	DI_3.6-	B13	DI_2.6-	C13	DI_4.2-	D13	DI_4.3-	E13	DI_4.6-
A14	DI_3.6+	B14	DI_2.6+	C14	DI_4.2+	D14	DI_4.3+	E14	DI_4.6+
A15	DI_4.7-	B15	DI_3.7-	C15	DO_5.3-	D15	DI_4.4-	E15	DO_5.7-
A16	DI_4.7+	B16	DI_3.7+	C16	DO_5.3+	D16	DI_4.4+	E16	DO_5.7+
A17	DI_4.8-	B17	DI_3.8-	C17	DO_5.4-	D17	DO_5.5-	E17	DO_5.8-
A18	DI_4.8+	B18	DI_3.8+	C18	DO_5.4+	D18	DO_5.5+	E18	DO_5.8+
A19	DO_6.1-	B19	DO_5.1-	C19	DO_6.5-	D19	DO_5.6-	E19	DO_7.1-
A20	DO_6.1+	B20	DO_5.1+	C20	DO_6.5+	D20	DO_5.6+	E20	DO_7.1+
A21	DO_6.2-	B21	DO_5.2-	C21	DO_6.6-	D21	DO_6.7-	E21	DO_7.2-
A22	DO_6.2+	B22	DO_5.2+	C22	DO_6.6+	D22	DO_6.7+	E22	DO_7.2+
A23	DO_7.3-	B23	DO_6.3-	C23	DO_7.7-	D23	DO_6.8-	E23	
A24	DO_7.3+	B24	DO_6.3+	C24	DO_7.7+	D24	DO_6.8+	E24	
A25	DO_7.4-	B25	DO_6.4-	C25	DO_7.8-	D25	DO_8.1-	E25	
A26	DO_7.4+	B26	DO_6.4+	C26	DO_7.8+	D26	DO_8.1+	E26	
A27	DO_7.6-	B27	DO_7.5-	C27	DO_8.3-	D27		E27	
A28	DO_7.6+	B28	DO_7.5+	C28	DO_8.3+	D28		E28	
A29	DO_8.4-	B29	DO_8.2-	C29	DO_8.5-	D29		E29	DO_8.6-
A30	DO_8.4+	B30	DO_8.2+	C30	DO_8.5+	D30		E30	DO_8.6+
A31	DO_8.7-	B31		C31	DO_8.8-	D31		E31	
A32	DO_8.7+	B32		C32	DO_8.8+	D32		E32	

TABLE 2-7: EMX-7513 CONNECTOR PIN SIGNAL ASSIGNMENT

EMX-7513 SPECIFICATIONS

GENERAL SPECIFICATIONS	
CHANNEL COUNT	
	32 Isolated Digital Input and 32 Isolated Digital Output channels
DATA INPUT CHARACTERISTICS	
Logical High	2.8 V to 60 V
Logical Low	< 2 V
	(Note: DC voltages between 2V and 2.8V may not register a consistent or usable value)
Isolation	1000 V
DATA OUTPUT CHARACTERISTICS	
Sink/Source	60 V @ 100 mA (AC/DC)
Potential free	Yes
Isolation to computer GND	1000 V

TYPICAL APPLICATIONS

Driving LED

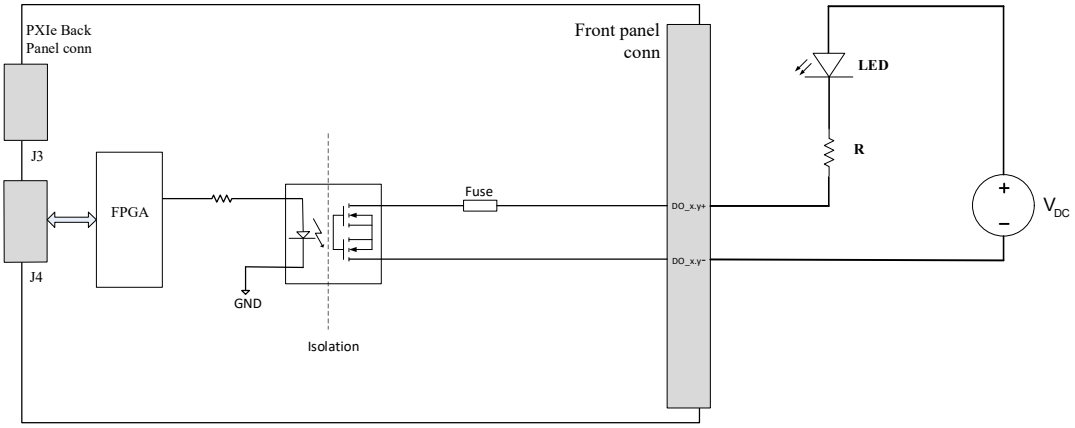

Figure 2-24: Driving LED with external supply

Driving external devices such as relays with external Flyback Diode

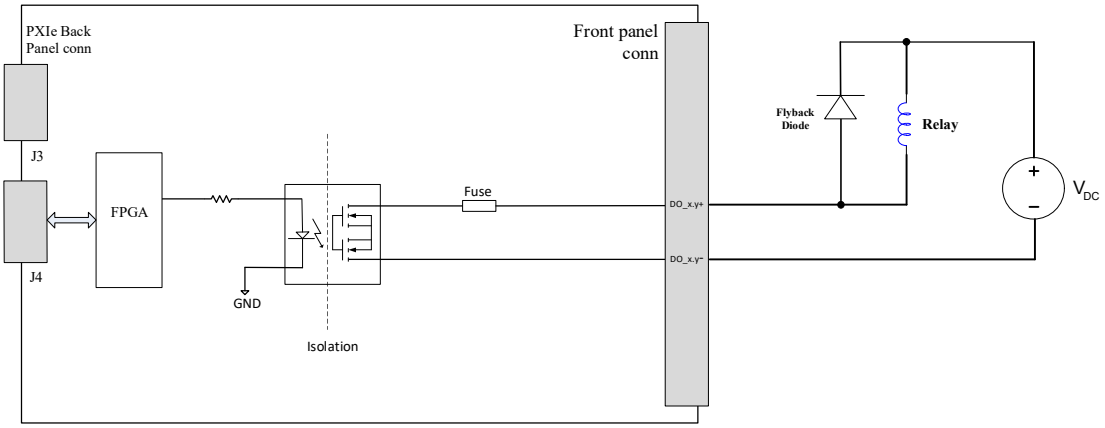

Figure 2-35: Driving Relay with external Flyback diode

TTL Output

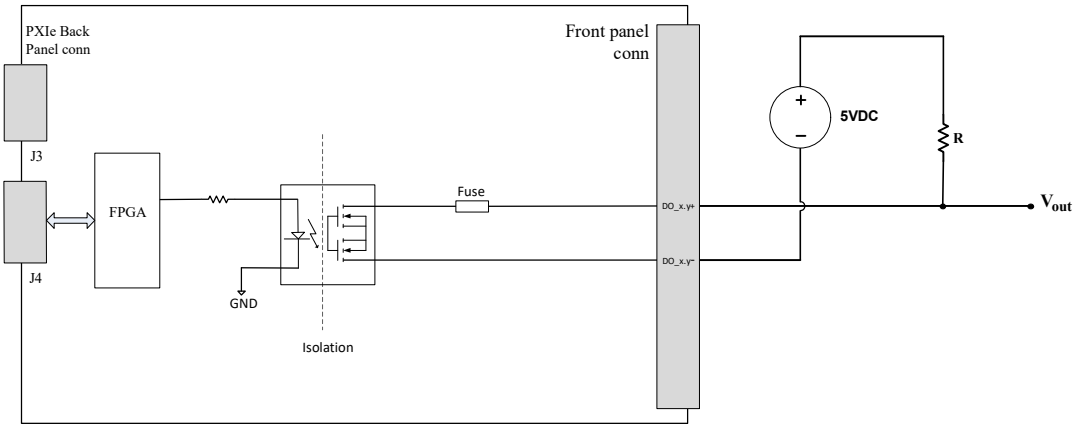

Figure 2-46: TTL DO

Switch state reading

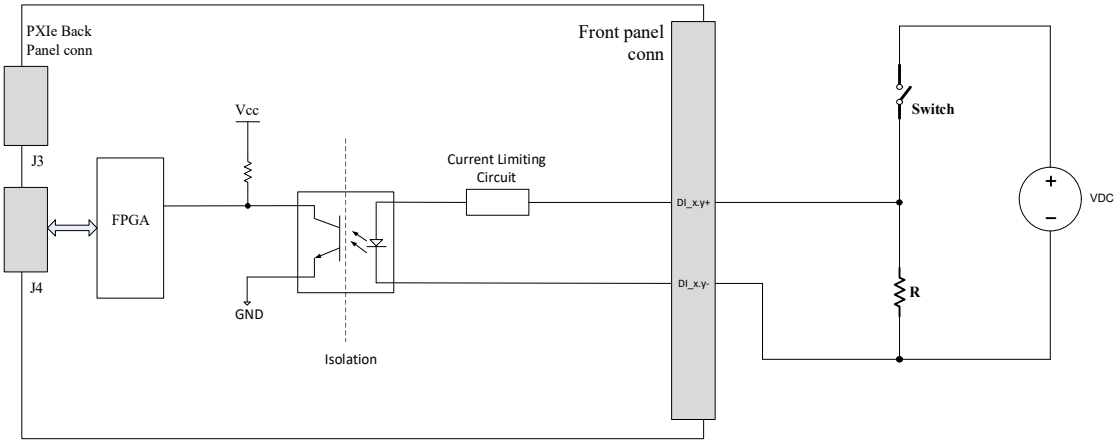

Figure 2-57: Switch state Reading

EMX-7514, 64 DO ISOLATED CHANNELS CARD

The EMX-7514 is a high-performance module with 64 Isolated Digital Output channels.

BLOCK DIAGRAM

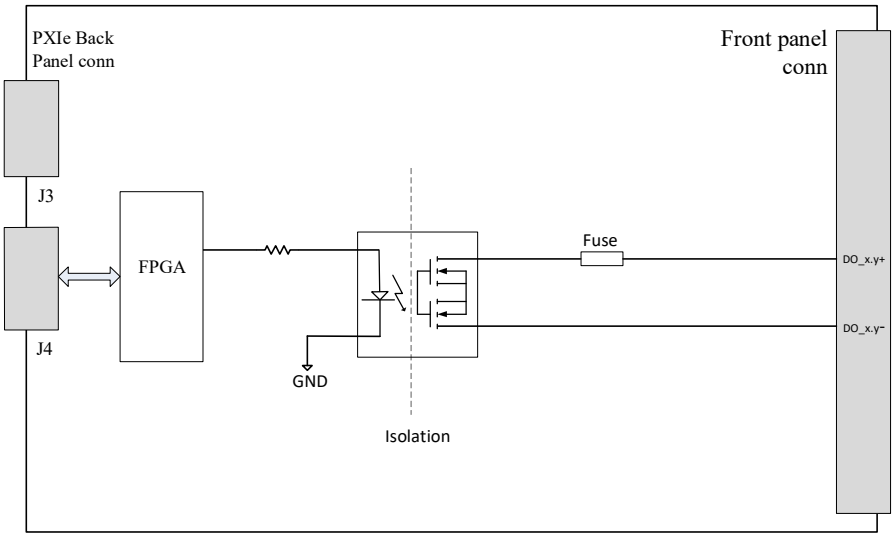

Figure 2-28: EMX-7514 Block Diagram

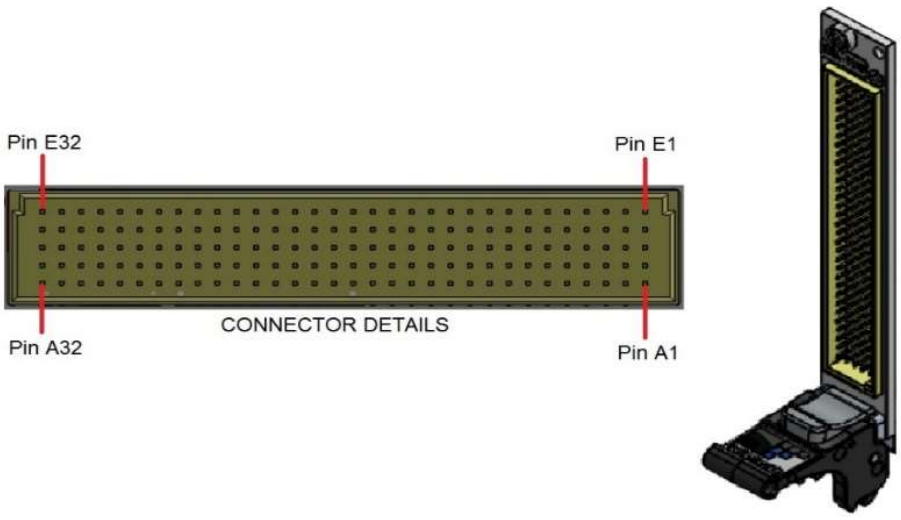

Figure 2-29: EMX-7514 Front Panel Connector Details

Connector Pin/Signal Assignment

The connector pins and their signal assignments are shown below Table 2-8. For mating connector and accessory information, please see Appendix C.

Pin	Signal	Pin	Signal	Pin	Signal	Pin	Signal	Pin	Signal
A1		**B1**		**C1**		**D1**		**E1**	
A2		**B2**		**C2**		**D2**		**E2**	
A3		**B3**		**C3**	DO_1.5-	**D3**		**E3**	DO_2.1-
A4		**B4**		**C4**	DO_1.5+	**D4**		**E4**	DO_2.1+
A5	DO_1.1-	**B5**	DO_1.2-	**C5**	DO_1.6-	**D5**	DO_1.7-	**E5**	DO_2.2-
A6	DO_1.1+	**B6**	DO_1.2+	**C6**	DO_1.6+	**D6**	DO_1.7+	**E6**	DO_2.2+
A7	DO_2.3-	**B7**	DO_1.3-	**C7**	DO_2.7-	**D7**	DO_1.8-	**E7**	DO_3.3-
A8	DO_2.3+	**B8**	DO_1.3+	**C8**	DO_2.7+	**D8**	DO_1.8+	**E8**	DO_3.3+
A9	DO_2.4-	**B9**	DO_1.4-	**C9**	DO_2.8-	**D9**	DO_3.1-	**E9**	DO_3.4-
A10	DO_2.4+	**B10**	DO_1.4+	**C10**	DO_2.8+	**D10**	DO_3.1+	**E10**	DO_3.4+
A11	DO_3.5-	**B11**	DO_2.5-	**C11**	DO_4.1-	**D11**	DO_3.2-	**E11**	DO_4.5-
A12	DO_3.5+	**B12**	DO_2.5+	**C12**	DO_4.1+	**D12**	DO_3.2+	**E12**	DO_4.5+
A13	DO_3.6-	**B13**	DO_2.6-	**C13**	DO_4.2-	**D13**	DO_4.3-	**E13**	DO_4.6-
A14	DO_3.6+	**B14**	DO_2.6+	**C14**	DO_4.2+	**D14**	DO_4.3+	**E14**	DO_4.6+
A15	DO_4.7-	**B15**	DO_3.7-	**C15**	DO_5.3-	**D15**	DO_4.4-	**E15**	DO_5.7-
A16	DO_4.7+	**B16**	DO_3.7+	**C16**	DO_5.3+	**D16**	DO_4.4+	**E16**	DO_5.7+
A17	DO_4.8-	**B17**	DO_3.8-	**C17**	DO_5.4-	**D17**	DO_5.5-	**E17**	DO_5.8-
A18	DO_4.8+	**B18**	DO_3.8+	**C18**	DO_5.4+	**D18**	DO_5.5+	**E18**	DO_5.8+
A19	DO_6.1-	**B19**	DO_5.1-	**C19**	DO_6.5-	**D19**	DO_5.6-	**E19**	DO_7.1-
A20	DO_6.1+	**B20**	DO_5.1+	**C20**	DO_6.5+	**D20**	DO_5.6+	**E20**	DO_7.1+
A21	DO_6.2-	**B21**	DO_5.2-	**C21**	DO_6.6-	**D21**	DO_6.7-	**E21**	DO_7.2-
A22	DO_6.2+	**B22**	DO_5.2+	**C22**	DO_6.6+	**D22**	DO_6.7+	**E22**	DO_7.2+
A23	DO_7.3-	**B23**	DO_6.3-	**C23**	DO_7.7-	**D23**	DO_6.8-	**E23**	
A24	DO_7.3+	**B24**	DO_6.3+	**C24**	DO_7.7+	**D24**	DO_6.8+	**E24**	
A25	DO_7.4-	**B25**	DO_6.4-	**C25**	DO_7.8-	**D25**	DO_8.1-	**E25**	
A26	DO_7.4+	**B26**	DO_6.4+	**C26**	DO_7.8+	**D26**	DO_8.1+	**E26**	
A27	DO_7.6-	**B27**	DO_7.5-	**C27**	DO_8.3-	**D27**		**E27**	
A28	DO_7.6+	**B28**	DO_7.5+	**C28**	DO_8.3+	**D28**		**E28**	
A29	DO_8.4-	**B29**	DO_8.2-	**C29**	DO_8.5-	**D29**		**E29**	DO_8.6-
A30	DO_8.4+	**B30**	DO_8.2+	**C30**	DO_8.5+	**D30**		**E30**	DO_8.6+
A31	DO_8.7-	**B31**		**C31**	DO_8.8-	**D31**		**E31**	
A32	DO_8.7+	**B32**		**C32**	DO_8.8+	**D32**		**E32**	

TABLE 2-8: EMX-7514 CONNECTOR PIN SIGNAL ASSIGNMENT

EMX-7514 SPECIFICATIONS

GENERAL SPECIFICATIONS	
CHANNEL COUNT	
	64 Isolated Digital Output channels
DATA OUTPUT CHARACTERISTICS	
Sink/Source	60 V @ 100 mA (AC/DC)
Potential free	Yes
Isolation to computer GND	1000 V

TYPICAL APPLICATIONS

Driving LED

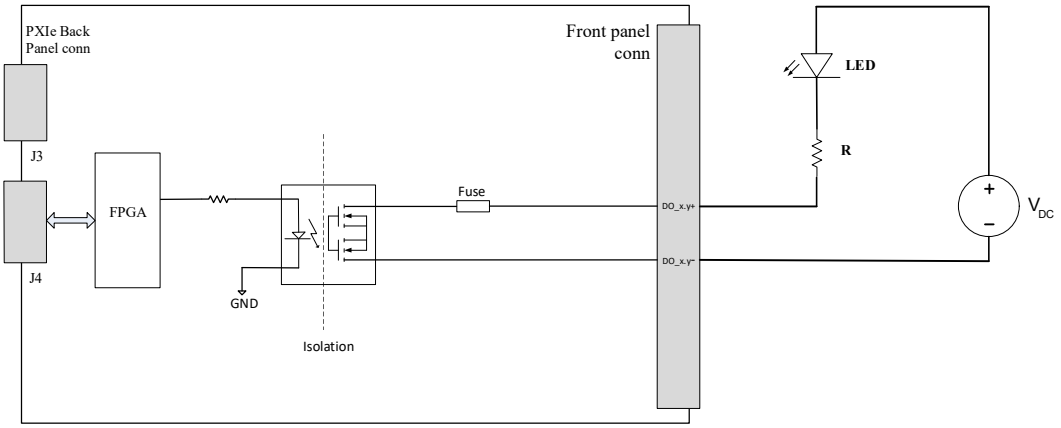

Figure 2-30: Driving LED with external supply

Driving external devices such as relays with external Flyback Diode

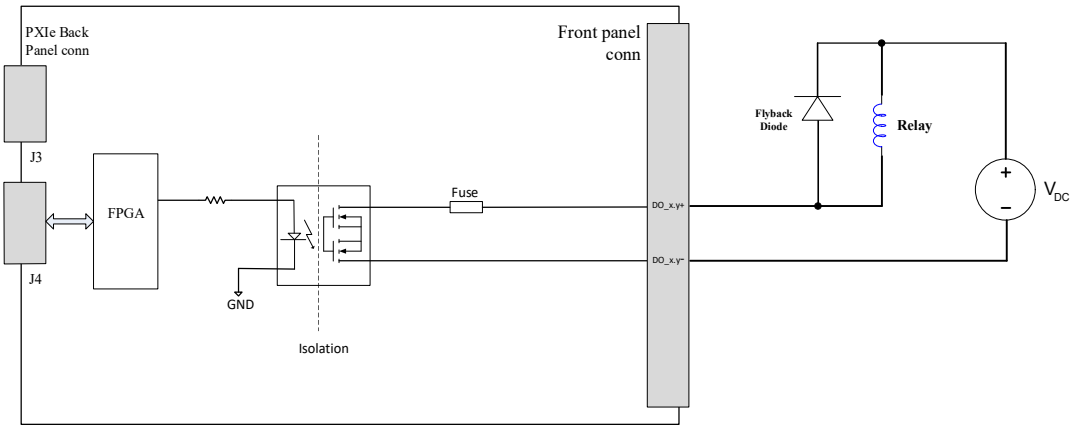

Figure 2-31: Driving Relay with external Flyback diode

TTL Output

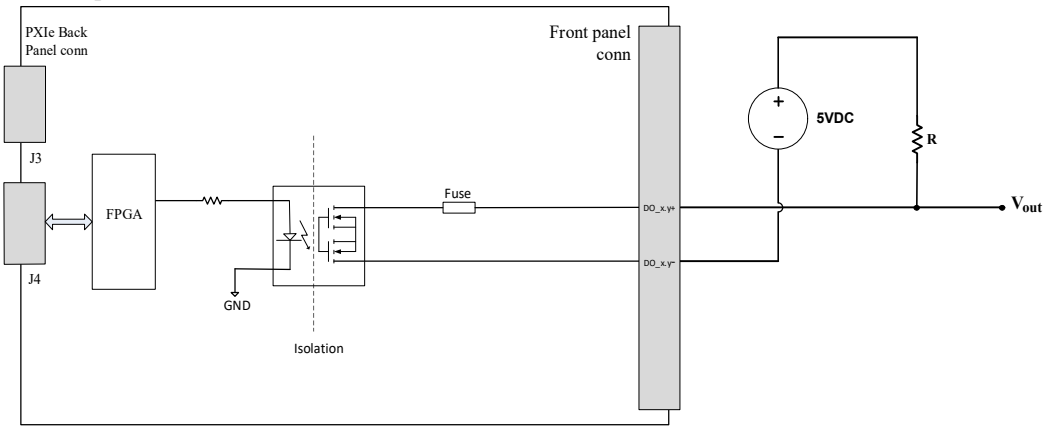

Figure 2-32: TTL DO

EMX-7515, 64 DI ISOLATED CHANNELS CARD

The EMX-7515 is a high-performance module with 64 Isolated Digital Input channels.

BLOCK DIAGRAM

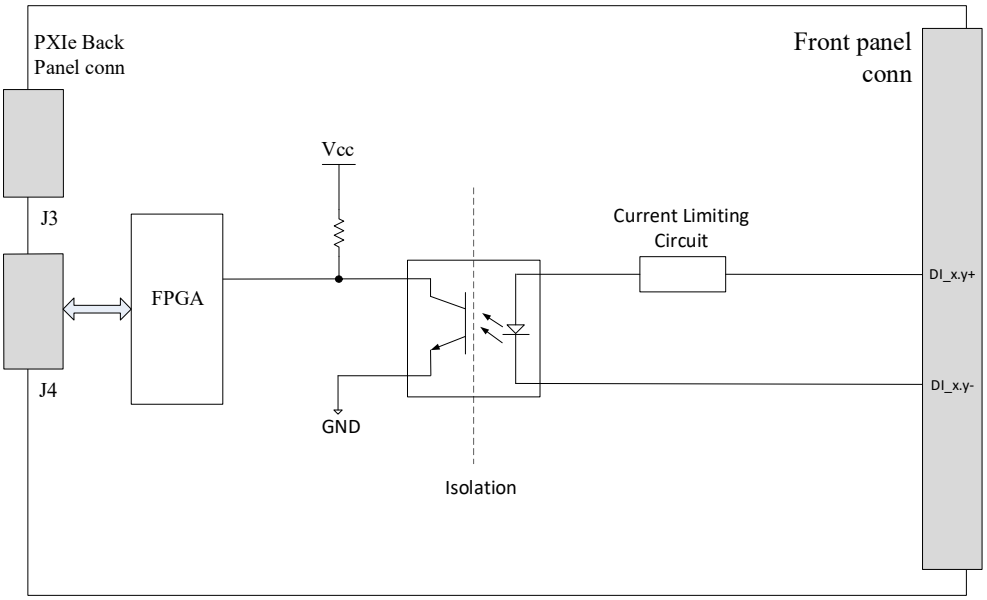

Figure 2-33: EMX-7515 Block Diagram

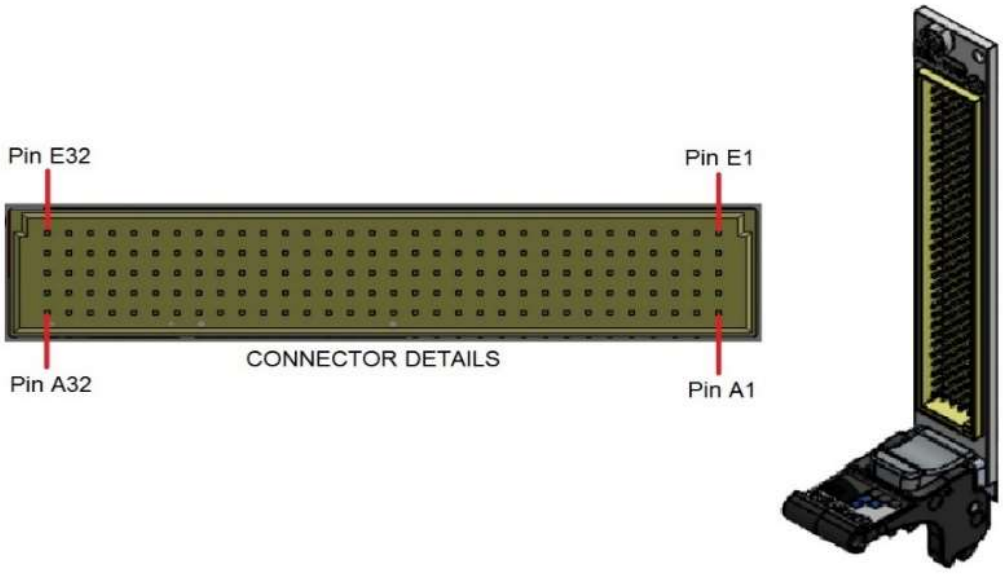

Figure 2-34: EMX-7515 Front Panel Connector Details

Connector Pin/Signal Assignment

The connector pins and their signal assignments are shown below Table 2-9. For mating connector and accessory information, please see Appendix C.

Pin	Signal	Pin	Signal	Pin	Signal	Pin	Signal	Pin	Signal
A1		**B1**		**C1**		**D1**		**E1**	
A2		**B2**		**C2**		**D2**		**E2**	
A3		**B3**		**C3**	DI_1.5-	**D3**		**E3**	DI_2.1-
A4		**B4**		**C4**	DI_1.5+	**D4**		**E4**	DI_2.1+
A5	DI_1.1-	**B5**	DI_1.2-	**C5**	DI_1.6-	**D5**	DI_1.7-	**E5**	DI_2.2-
A6	DI_1.1+	**B6**	DI_1.2+	**C6**	DI_1.6+	**D6**	DI_1.7+	**E6**	DI_2.2+
A7	DI_2.3-	**B7**	DI_1.3-	**C7**	DI_2.7-	**D7**	DI_1.8-	**E7**	DI_3.3-
A8	DI_2.3+	**B8**	DI_1.3+	**C8**	DI_2.7+	**D8**	DI_1.8+	**E8**	DI_3.3+
A9	DI_2.4-	**B9**	DI_1.4-	**C9**	DI_2.8-	**D9**	DI_3.1-	**E9**	DI_3.4-
A10	DI_2.4+	**B10**	DI_1.4+	**C10**	DI_2.8+	**D10**	DI_3.1+	**E10**	DI_3.4+
A11	DI_3.5-	**B11**	DI_2.5-	**C11**	DI_4.1-	**D11**	DI_3.2-	**E11**	DI_4.5-
A12	DI_3.5+	**B12**	DI_2.5+	**C12**	DI_4.1+	**D12**	DI_3.2+	**E12**	DI_4.5+
A13	DI_3.6-	**B13**	DI_2.6-	**C13**	DI_4.2-	**D13**	DI_4.3-	**E13**	DI_4.6-
A14	DI_3.6+	**B14**	DI_2.6+	**C14**	DI_4.2+	**D14**	DI_4.3+	**E14**	DI_4.6+
A15	DI_4.7-	**B15**	DI_3.7-	**C15**	DI_5.3-	**D15**	DI_4.4-	**E15**	DI_5.7-
A16	DI_4.7+	**B16**	DI_3.7+	**C16**	DI_5.3+	**D16**	DI_4.4+	**E16**	DI_5.7+
A17	DI_4.8-	**B17**	DI_3.8-	**C17**	DI_5.4-	**D17**	DI_5.5-	**E17**	DI_5.8-
A18	DI_4.8+	**B18**	DI_3.8+	**C18**	DI_5.4+	**D18**	DI_5.5+	**E18**	DI_5.8+
A19	DI_6.1-	**B19**	DI_5.1-	**C19**	DI_6.5-	**D19**	DI_5.6-	**E19**	DI_7.1-
A20	DI_6.1+	**B20**	DI_5.1+	**C20**	DI_6.5+	**D20**	DI_5.6+	**E20**	DI_7.1+
A21	DI_6.2-	**B21**	DI_5.2-	**C21**	DI_6.6-	**D21**	DI_6.7-	**E21**	DI_7.2-
A22	DI_6.2+	**B22**	DI_5.2+	**C22**	DI_6.6+	**D22**	DI_6.7+	**E22**	DI_7.2+
A23	DI_7.3-	**B23**	DI_6.3-	**C23**	DI_7.7-	**D23**	DI_6.8-	**E23**	
A24	DI_7.3+	**B24**	DI_6.3+	**C24**	DI_7.7+	**D24**	DI_6.8+	**E24**	
A25	DI_7.4-	**B25**	DI_6.4-	**C25**	DI_7.8-	**D25**	DI_8.1-	**E25**	
A26	DI_7.4+	**B26**	DI_6.4+	**C26**	DI_7.8+	**D26**	DI_8.1+	**E26**	
A27	DI_7.6-	**B27**	DI_7.5-	**C27**	DI_8.3-	**D27**		**E27**	
A28	DI_7.6+	**B28**	DI_7.5+	**C28**	DI_8.3+	**D28**		**E28**	
A29	DI_8.4-	**B29**	DI_8.2-	**C29**	DI_8.5-	**D29**		**E29**	DI_8.6-
A30	DI_8.4+	**B30**	DI_8.2+	**C30**	DI_8.5+	**D30**		**E30**	DI_8.6+
A31	DI_8.7-	**B31**		**C31**	DI_8.8-	**D31**		**E31**	
A32	DI_8.7+	**B32**		**C32**	DI_8.8+	**D32**		**E32**	

TABLE 2-9: EMX-7515 CONNECTOR PIN SIGNAL ASSIGNMENT

EMX-7515 SPECIFICATIONS

GENERAL SPECIFICATIONS	
CHANNEL COUNT	
	64 Isolated Digital Input channels
DATA INPUT CHARACTERISTICS	
Logical High	2.8 V to 60 V
Logical Low	< 2 V (Note: DC voltages between 2V and 2.8V may not register a consistent or usable value)
Isolation to computer GND	1000 V

TYPICAL APPLICATIONS

Switch state reading

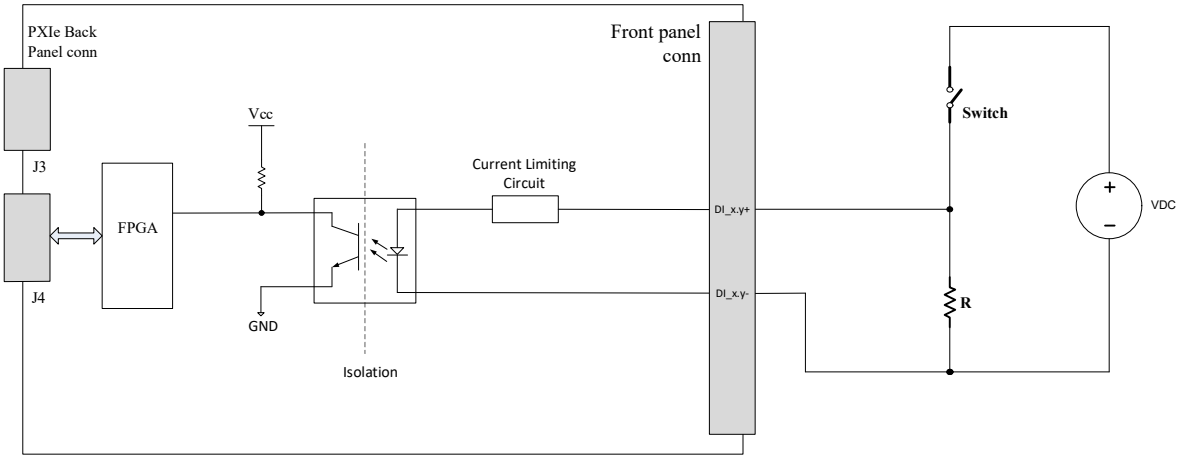

Figure 2-35: Switch state Reading

EMX-7519, 64-CHANNEL, DIGITAL OUTPUT CARD

The EMX-7519 is a high-performance Digital output module with eight ports of 8 bits (64 channels) each. In order to ease overall system cabling, all clamping diodes and open collector channels are pulled up internally, rather than on a per-channel basis.

Each channel can sink 300 mA, and includes built-in clamping diodes, making this module ideal for driving external devices such as relays.

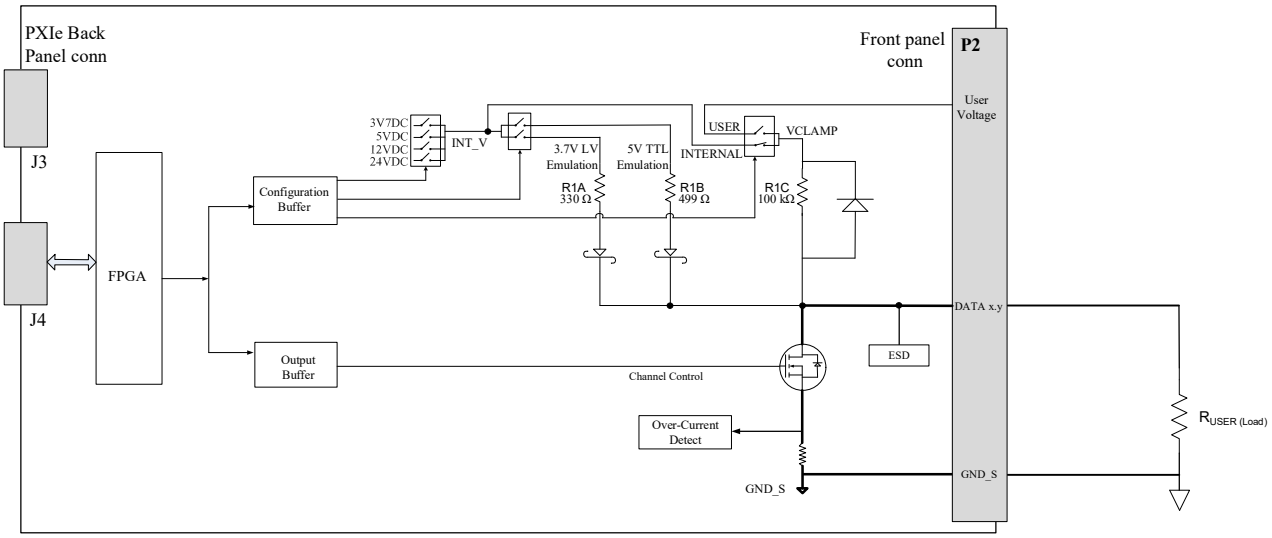

Figure 2-36: EMX-7519 Block Diagram

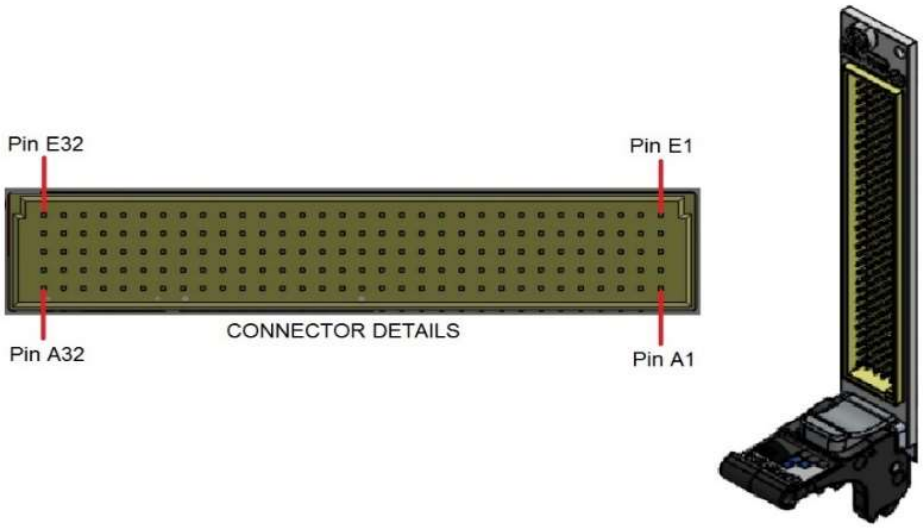

Figure 2-37: EMX-7519 Front Panel Connector Details

USING THE INSTRUMENT

Measurement Performance

This section discusses tips and procedures that can help maximize the actual performance realized with the EMX-7519 and aid the user in avoiding some common pitfalls associated with making measurements.

Voltage Outputs

A channel output is pulled to the configured voltage through a pull-up resistor. The actual output that will be seen by the unit under test is defined by the standard voltage divider equation:

$$V_0 = V_{CLAMP}\left(\frac{R_{USER}}{R_1+R_{USER}}\right)$$

Where,

V_0 is the output voltage
V_{CLAMP} is the User configured voltage
R_1 is the internal pull-up resistor
R_{USER} is the external load presented by the unit under test

In normal mode, R_1 is 100 kΩ. In TTL emulation mode, R_1 is 499 Ω and in LV emulation mode, R1 is 330 Ω. So the pull-up to V_{CLAMP} is much stronger. TTL emulation mode is available for the 3.3 V and 5 V voltage levels.

If voltages higher than those provided by the equation above are desired, the User can supply a voltage with an external power supply in conjunction with a low-value pull-up resistor to get closer to the user's V_{CLAMP} voltage. The 300 mA sink capability of the channel still must be observed.

Voltage Output			
Mode	**Internal Supply**	**Pull-Up (*Rx*)**	***Open Circuit V0***
Normal	24 V	100 kΩ (R_{1C})	~24 V
Normal	12 V	100 kΩ (R_{1C})	~12 V
Normal	5 V	100 kΩ (R_{1C})	~5 V
Normal	3.3 V	100 kΩ (R_{1C})	~3.3 V
TTL Emulation	5 V	499 Ω (R_{1B})	~4.6 V*
LV Emulation	3.3 V	330 Ω (R_{1A})	~3.3 V*
**For TTL and LV modes, there is approximately a 0.35 V drop due to the Schottky diode, resulting in an actual internal supply voltage of 4.6 V and 3.3V, respectively.*			
Mode	**External Supply**	**Load**	***VO-USER***
Normal	V_{CLAMP}	R_{USER}	$V_{CLAMP}\left[\frac{R_{USER}}{100\ k\Omega + (R_{USER})}\right]$

TABLE 2-10: OUTPUT VOLTAGES

Connector Pin/Signal Assignment

The connector pins and their signal assignments are shown below Table 2-11. For mating connector and accessory information, please see Appendix C.

Pin	Signal	Pin	Signal	Pin	Signal	Pin	Signal	Pin	Signal
A1	GND_S	**B1**	GND_C	**C1**	GND_S	**D1**		**E1**	
A2	GND_S	**B2**	GND_S	**C2**	GND_S	**D2**		**E2**	GND_S
A3	DATA1.4	**B3**	GND_S	**C3**	DATA1.8	**D3**	GND_S	**E3**	DATA1.5
A4	DATA1.1	**B4**	GND_S	**C4**	DATA1.2	**D4**	GND_S	**E4**	DATA1.6
A5	DATA1.3	**B5**	GND_S	**C5**	DATA1.7	**D5**	GND_S	**E5**	DATA2.5
A6	DATA2.4	**B6**	DATA2.1	**C6**	DATA2.8	**D6**	GND_S	**E6**	DATA2.2
A7	GND_S	**B7**	GND_S	**C7**	GND_S	**D7**	DATA2.3	**E7**	GND_S
A8	GND_S	**B8**	GND_S	**C8**	GND_S	**D8**	GND_S	**E8**	DATA2.6
A9	DATA2.7	**B9**	USER_V2	**C9**	DATA3.8	**D9**	GND_S	**E9**	DATA3.5
A10	DATA3.4	**B10**	GND_S	**C10**	DATA3.1	**D10**	USER_V1	**E10**	GND_S
A11	DATA3.2	**B11**	GND_S	**C11**	DATA3.7	**D11**	GND_S	**E11**	DATA3.6
A12	DATA3.3	**B12**	GND_S	**C12**	DATA4.2	**D12**	GND_S	**E12**	DATA4.4
A13	GND_S	**B13**	USER_V4	**C13**	GND_S	**D13**	GND_S	**E13**	DATA4.5
A14	GND_S	**B14**	GND_S	**C14**	GND_S	**D14**	GND_S	**E14**	DATA4.8
A15	DATA4.1	**B15**	GND_S	**C15**	DATA4.7	**D15**	GND_S	**E15**	GND_S
A16	DATA4.3	**B16**	USER_V3	**C16**	DATA5.1	**D16**	GND_S	**E16**	GND_S
A17	DATA5.3	**B17**	GND_S	**C17**	DATA5.2	**D17**	USER_V6	**E17**	DATA4.6
A18	DATA5.8	**B18**	GND_S	**C18**	DATA5.4	**D18**	GND_S	**E18**	DATA5.5
A19	GND_S	**B19**	GND_S	**C19**	GND_S	**D19**	GND_S	**E19**	DATA5.7
A20	GND_S	**B20**	USER_V5	**C20**	GND_S	**D20**	GND_S	**E20**	DATA5.6
A21	DATA6.4	**B21**	GND_S	**C21**	DATA6.5	**D21**	GND_S	**E21**	GND_S
A22	DATA6.1	**B22**	GND_S	**C22**	DATA6.8	**D22**	GND_S	**E22**	GND_S
A23	DATA6.3	**B23**	GND_S	**C23**	DATA6.2	**D23**	GND_S	**E23**	DATA6.6
A24	DATA7.4	**B24**	USER_V7	**C24**	DATA7.1	**D24**	USER_V8	**E24**	DATA6.7
A25	GND_S	**B25**	GND_S	**C25**	GND_S	**D25**	GND_S	**E25**	DATA7.8
A26	GND_S	**B26**	GND_S	**C26**	GND_S	**D26**	GND_S	**E26**	DATA7.5
A27	DATA7.3	**B27**	GND_S	**C27**	DATA7.6	**D27**	GND_S	**E27**	GND_S
A28	DATA7.2	**B28**	GND_S	**C28**	DATA7.7	**D28**	GND_S	**E28**	GND_S
A29	DATA8.4	**B29**	GND_S	**C29**	DATA8.1	**D29**	GND_S	**E29**	DATA8.5
A30	DATA8.2	**B30**	GND_S	**C30**	DATA8.6	**D30**	GND_S	**E30**	DATA8.8
A31	GND_S	**B31**	GND_C	**C31**	GND_S	**D31**	GND_S	**E31**	GND_S
A32	DATA8.3	**B32**	GND_S	**C32**	DATA8.7	**D32**	GND_S	**E32**	GND_S

TABLE 2-11: EMX-7519 CONNECTOR PIN SIGNAL ASSIGNMENT

EMX-7519 SPECIFICATIONS

GENERAL SPECIFICATIONS	
CHANNEL COUNT	
	64 Output channels (Eight 8-Bit Ports)
DATA OUTPUT CHARACTERISTICS	
VOUT (high)	> 2 V to 60 V
VOUT (low)	< 1.5 V @ 300 mA (Sink)
VOLTAGE RANGE	
Internal voltage	3.3 V, 5.0 V, 12.0 V, and 24.0 V
User	> 2 V up to 60 V

THEORY OF OPERATION

This section provides an overview of how the EMX-7519 works.

The EMX-7519 supports a static mode where user-driven software commands execute writing data channels on a per port basis. Each port can be programmed for polarity. The default polarity is normal. Ports also need a voltage reference before data can be written; this voltage is used for pulling up open drain data lines. No voltage should be applied on data lines before voltage selection and during voltage configuration process. User can select a voltage from 3.3 V, 5 V, 12 V or 24 V provided on the module or supply a voltage through front panel connector, to be used as V_{CLAMP}. By default, no voltage is selected and data lines are floating. There is also an option of configuring a port's voltage setting as either TTL or Low Voltage emulation. In TTL emulation setting, open drain lines are pulled up to 5 V and have a sourcing capability of 4 mA, whereas in Low Voltage (LV) option the pull-up voltage is 3.3 V with 4 mA drive strength.

When doing a write, data written to a port set for output updates data on that port.

TTL and LV emulation voltage selection is only applicable when port's direction is output.

Power on Reset

Power on Reset/Soft Reset of EMX-7519 brings the ports to a default state as in Table 2-12.

Model	Direction	Polarity	Data	Voltage
EMX-7519	Output	Normal	0xFF (Invalid Data as no voltage selected)	0V

TABLE 2-12: RESET CONDITION

Voltage Configuration

- When the card is reset, no Voltage will be selected at the ports and data in output registers are set to FF.
- A ports output register data is set to FF for any voltage configuration. Only concerned port is affected.

Polarity settings are applicable in EMX-7519. On output channels, changing the polarity flips the state of data lines and further writes are done according to polarity selection (for example, if polarity is configured as reversed then writing 1 to a channel writes a 0 to it and vice versa).

Configuration Section

This section of circuit is used to select reference voltage (V_{CLAMP}) for ports. Each port has a set of programmatically controlled switches that let the user select a voltage from 3.3 V, 5 V, 12 V, 24 V and User supplied voltage, which can be anywhere from > 2 V up to 60 V. In addition, LV and TTL emulation modes can be selected which use 3.3 V and 5 V as V_{CLAMP} respectively, and insert a low impedance pull-up resistor in the path to source 4 mA.

Output Section

The output section of each channel consists of an N-channel MOSFET, pull-up resistors and over current sense circuitry. When a 1 is driven on channel, the MOSFET is turned off and data line is pulled-up to V_{CLAMP} using appropriate pull-up resistor (330 Ω for LV emulation, 500 Ω for TTL

emulation and 100 kΩ otherwise). The rising voltage level at data channel exhibits RC charging with a rise time of approximately 70 µs with 100 kΩ pull-up resistor and about 600 ns with low impedance pull-up in TTL and LV voltage configurations. When a 0 is driven on channel, the MOSFET is turned on and data line is connected to ground via a current sense resistor of 0.3 Ω. The falling edge is much sharper with a maximum fall time of 300 ns approximately.

The load resistor and pull-up resistor form a voltage divider of V_{CLAMP} and determine output voltage, thus output voltage decreases with decreasing load resistance. The minimum load resistance that can be connected on channels is 500 Ω for LV emulation, 750 Ω for TTL emulation and 150 kΩ otherwise.

The data lines have a current sinking capacity of 300 mA. If the current through MOSFET increases above limited value, the over current protection circuit turns off all FETs in the concerned port. The over current condition must last for greater than 12.8 µs before over current protection circuit is activated. This is done to prevent false over current events due to transients. It takes approximately 20 µs from first occurrence of the over current event before the FETs are turned off. The over current circuit will activate with 340 mA hold current and 475 mA trip current, where hold current is the maximum current circuit will allow without tripping and trip current is the minimum current required to trip the circuit. The absolute maximum limit on sinking current is 500 mA. Staying within these limits is user's responsibility. Over current readings from ports will be latched and can be read by user. When they reset over current condition then port will be enabled and data last written to port will be applied on channels.

TYPICAL APPLICATIONS

Driving external devices such as relays with Flyback Diode
Sink _ 300mA max

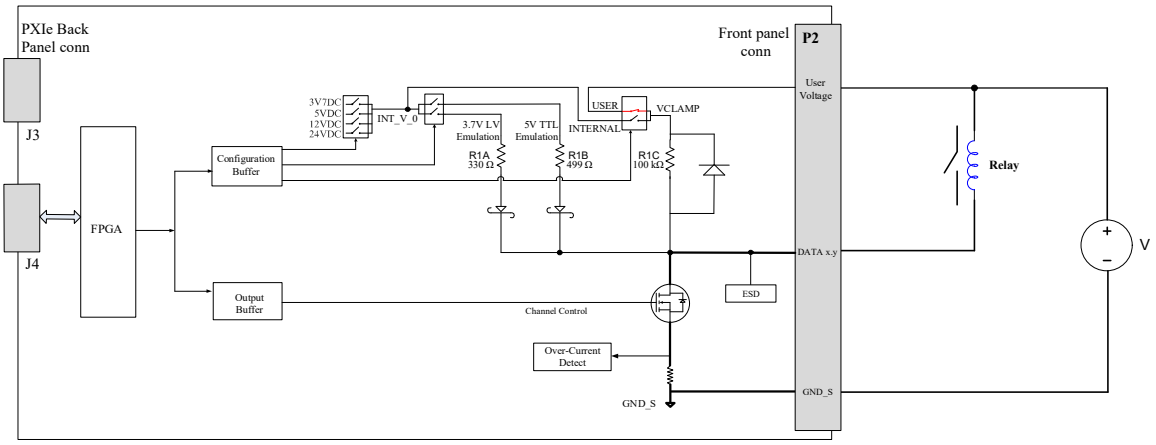

Figure 2-38: Relay Driving

LED Driving

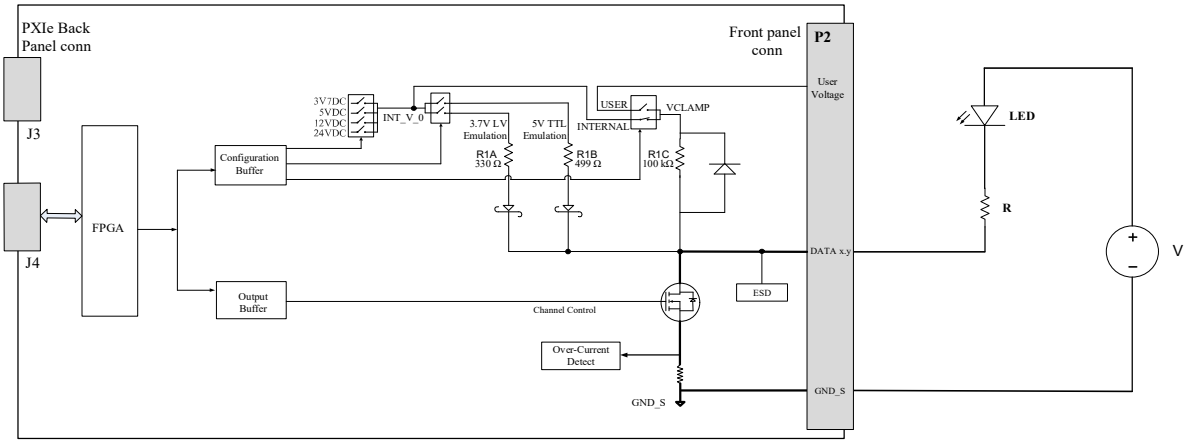

Figure 2-39: Driving LED with external supply

TTL output

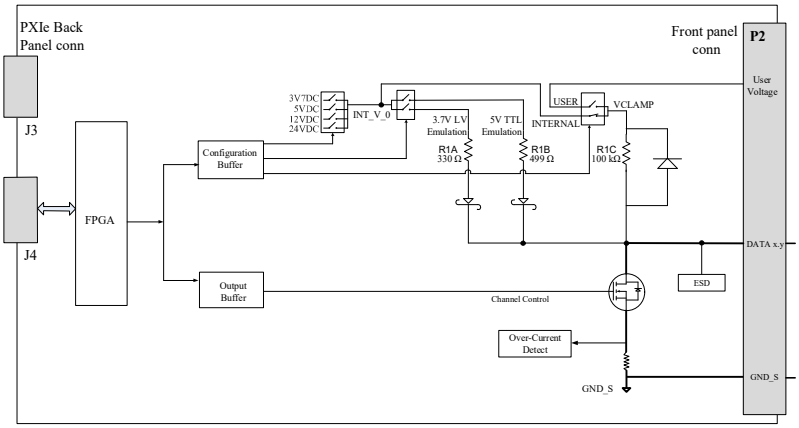

Figure 2-40: TTL output

LVTTL output

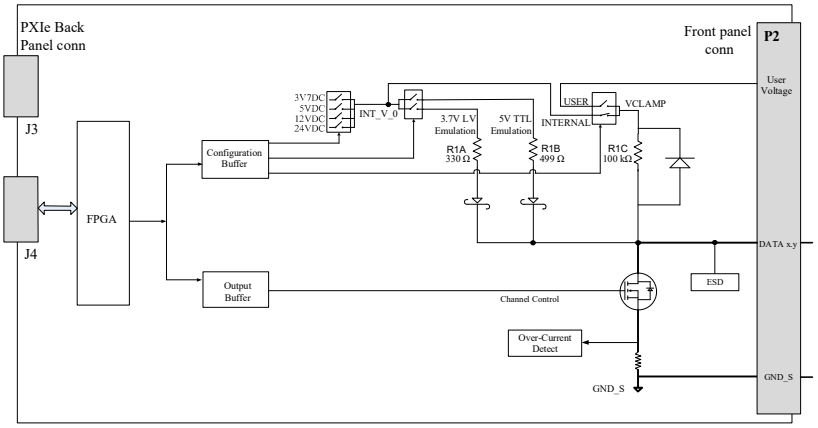

Figure 2-41: LVTTL output

TTL/LVTTL Driving LED

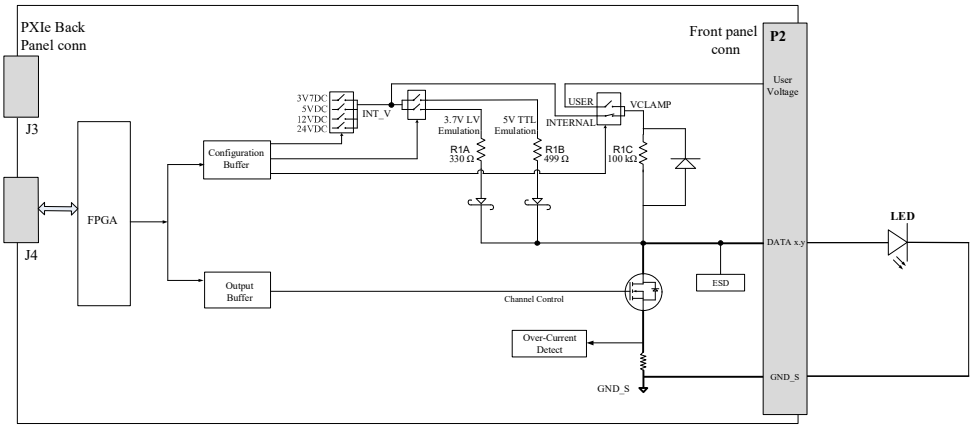

Figure 2-42: LED Driving

Digital Output with Multiple Voltage Pullup selection

Internal Pullup Voltages ($V_{CLAMP)}$: 3.3 V, 5.0 V, 12.0, V, and 24.0 V

User Voltage (V_{CLAMP}) : 2 V to 60 V

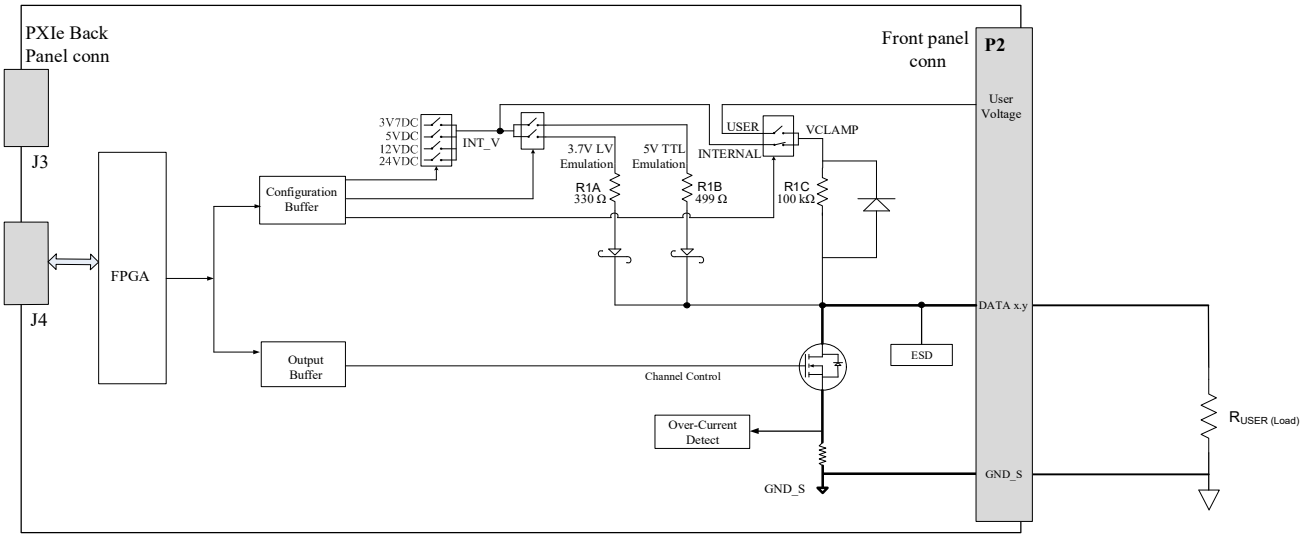

Figure 2-43: DO with Multiple Voltage Pullup selection

Voltage Output			
Mode	**Internal Supply**	**Pull-Up (R_X)**	***Open Circuit V_0***
Normal	24 V	100 kΩ (R_3)	~24 V
Normal	12 V	100 kΩ (R_3)	~12 V
Normal	5 V	100 kΩ (R_3)	~5 V
Normal	3.3 V	100 kΩ (R_3)	~3.3 V
TTL Emulation	5 V	499 Ω (R_2)	~4.6 V*
LV Emulation	3.3 V	330 Ω (R_1)	~3.3 V*
**For TTL and LV modes, there is approximately a 0.35 V drop due to the Schottky diode, resulting in an actual internal supply voltage of 4.6 V and 3.3V, respectively.*			
Mode	**External Supply**	**Load**	***$V_{O\text{-}USER}$***
Normal	V_{CLAMP}	R_{USER}	$V_{CLAMP}\left[\frac{R_{USER}}{100\ k\Omega + (R_{USER})}\right]$

TABLE 2-13: OUTPUT VOLTAGES

SECTION 3

SOFTWARE INSTALLATION

The fastest way to begin controlling an EMX-75XX card is to discover the EMX-2500 chassis in which the card can be plugged. This can be found using the LXI Discovery Tool utility (a free tool available from LXI Consortium). For more information, refer to: http://lxistandard.org/Resources/LXIDiscoveryTool.aspx

The **LXI Discovery Tool** searches for all LXI Devices on the LAN Subnet. It uses mDNS and VXI-11 protocols to detect the LXI Instruments. The mDNS service additionally has some dependency on "Apple Bonjour Print Services" and hence the user has to install this service in the system to perform discovery mechanism. However, it is not mandatory to install this service, since LXI devices use various other protocols and services for discovery.

DRIVER INSTALLATION

VTI Instruments provides two types of drivers for this instrument. For Windows there is an IVI driver, based on the industry standard IVI driver architecture specifications. The IVI driver exposes both IVI-COM and IVI-C interface APIs. The IVI-COM interface can be used from any programming language that supports Microsoft COM (Component Object Model). For Linux, there is a driver that provides a C++ API. Both Windows and Linux drivers have a consistent API design so that the application software developed for one can be easily migrated to the other. The drivers are compatible with both 32-bit and 64-bit operating systems. In general, the API descriptions in this document apply to both the Windows and Linux drivers unless otherwise specified.

To control the EMX-75XX series card programmatically (via a user generated program or through tools such as Agilent VEE®, NI LabVIEW®, Mathworks Matlab®, etc.), two additional components must be installed: the IVI Shared Components library (for Windows OS only) or the VTI Common Library (for Linux OS only) and the provided VTI Instruments driver. For 32-bit Windows OS, install the 32-bit driver. For Windows 7 (64-bit), Windows 8 (64-bit), and Windows 10 (64-bit), the 64-bit driver installer includes both 64-bit and 32-bit compatible drivers. These drivers are available for free download on the VTI Instruments web portal (www.vtiinstruments.com), in the respective product page, under download tab. The following sections describe installing the required software.

IVI Shared Components Installation (Windows Only)

If this component was installed during a previous LXI instrument installation, please proceed to Instrument Driver Installation. First, close all other open programs, leaving only Windows Explorer open. Navigate to the `<CD-ROM Drive>:\EMX Platform Requisites` directory on the CD and run the `IVISharedComponentsX.X.X.exe` program. Next, follow the on-screen instructions. Do not proceed to the next step until this installation completes successfully. If instructed to reboot the PC, it will be necessary to do so at that time. Alternatively, the latest IVI shared components can be downloaded and installed from IVI Foundation Web page, www.ivifoundation.org.

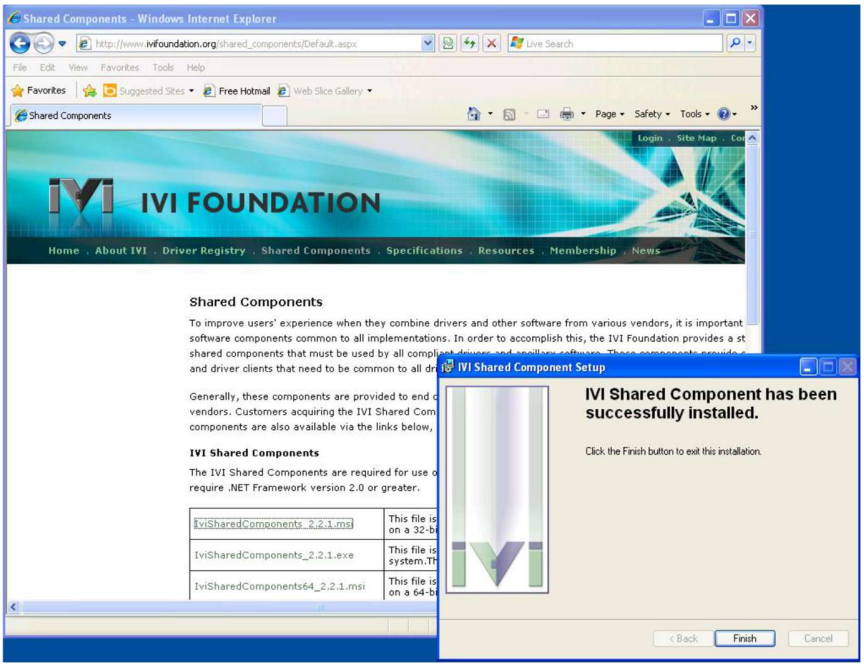

Figure 3-1: IVI Shared Component Installation

Instrument Driver Installation

IF THE VTEXDIO INSTRUMENT DRIVER WAS INSTALLED PREVIOUSLY ON THE HOST PC, YOU MAY SKIP THIS STEP OF THE INSTALLATION PROCESS, AND PROCEED TO PLATFORM/LXISYNC INSTRUMENT DRIVER INSTALLATION. THE PREVIOUSLY INSTALLED DRIVER MAY NEED TO BE UPDATED TO THE MOST RECENTLY RELEASED VERSION TO SUPPORT THE EMX-75XX. TO INSTALL THE VTEXDIO INSTRUMENT DRIVER, NAVIGATE *TO* `<CD-ROM DRIVE>:\DRIVERS\LXI DRIVERS\EMX SERIES`, ON THE CD, OPEN THE APPROPRIATE ZIP FILE IN THIS DIRECTORY, AND THEN RUN THE `.MSI` INSTALLER. ALTERNATELY THE DRIVERS ARE AVAILABLE FOR FREE DOWNLOAD FROM VTI INSTRUMENTS ONLINE PORTAL (WWW.VTIINSTRUMENTS.COM) UNDER THE SPECIFIC PRODUCT'S DOWNLOAD PAGE.

Figure 3-2: Instrument Driver Installation

The Linux driver (32-bit and 64-bit) is located under `<CD-ROM Drive>:\Drivers\Linux Drivers\Linux EMX Series`. Open the appropriate zip file in this directory and then run the RPM Installer. Alternately the instrument drivers for Linux OS are also available for free download from VTI Instrument website, www.vtiinstruments.com

DIRECT PCIE REGISTER CONTROL INTERFACE FOR EMX 75XX CARDS

All EMX-75xx DIO Plug-In cards use PCIe Base Address Registers 0 and 2, in 64-bit mode for message-based communication with the SentinelEX web server. Alternatively, Base Address Register 4 can be used to control the card via direct register access over PCIe. Please refer "82-0127-100_ EMX-75XX Direct PCIe ICD" from "DOCUMENTS AND DOWNLOAD" section of respective EMX-75xx DIO Model from https://www.vtiinstruments.com/ products/platforms/pxie-series for more information.

PROGRAMMING THE INSTRUMENT

This section provides programming examples for the EMX-75XX series. Additional information can be found in the driver help file. If the instrument will be used on a Linux system, a .chm viewer must be installed on the host PC (examples of these programs can be found at the following URL: http://www.linux.com/news/software/applications/8209-chm-viewers-for-linux.)

NOTE	Programming examples are installed with the IVI Driver – DIO, typically located in the "<HDD Designation>\Program Files\IVI Foundation\IVI\Drivers\VTEXDIO\Examples" folder.

RELATED SOFTWARE COMPONENTS

IVI-COM Driver
IVI-C Driver
LabView Driver (Currently this is not available)
Linux C++ Driver (Currently this is not available)

USING THE DRIVER

The EMX-75XX series may be used in a variety of environments including: Visual Basic, C#, C++, LabView. VTI instruments provides a IVI-C and IVI-COM compliant driver as well as a shared object that can be used on Linux systems that comply with the Linux Standard Base (Version 3.1).

Here is how to use the driver in each environment:

1) **Visual Studio C++**
```
#import "IviDriverTypeLib.dll" no_namespace
#import "VTEXDIO.dll" no_namespace
```

2) **C#**
Add a reference to VTEXDIO.dll in the project. Include the following at the top of any code file that will access the driver:
```
using VTI.VTEXDIO.Interop;
```

3) **C/C++ on Windows**
Link against VTEXDIO.lib and include VTEXDIO.h in the file.

4) **C++ on Linux**
Link against /opt/vti/lib/libdio.so and include all the headers in /opt/vti/include in the source file.

5) **LabView**
Copy the driver package to the <Labview>/instr.lib directory and access all relevant Vis

USING THE EMX-75XX SERIES

INITIALIZING\CLOSING THE INSTRUMENT

The base interface of the EMX-75XX IVI driver, VTEXDIO (LibDIO on Linux), is used to open and close connections to the instrument as well as containing pointers to all other interfaces to access the functionality of the instrument.

Initialization

Prior to using the EMX-75XX, an instrument driver connection must be made to the EMX-75XX. Once a connection is made using the Initialize call, the user can execute their test code. Before the program exits, the user should release the resources using the Close call. Users familiar with other VTI Instrument Drivers for the EMX series should find this driver is very similar to ones they have used before.

C++

```
#import "IviDriverTypeLib.dll" no_namespace
#import "VTEXDio.dll" no_namespace

int main()
{
	//Windows driver creation
	::CoInitialize(NULL); // start COM layer
	try
	{
		IVTEXDIOPtr Dio (__uuidof(VTEXDIO));
		/*We chose to give this driver an empty options string. If you have more
		than one DIO card in your chassis, you will have to give it options such
		as a slot number. This is because the DIO driver does not support more
		than one card per driver instance. Note also that we set the reset flag
		so that we can get a clean start witht he unit */

		Dio->Initialize("TCPIP::10.20.1.5::INSTR", VARIANT_TRUE, VARIANT_TRUE,
		"");
		dio->Close();
		::CoUninitialize();
	}
	catch (_com_error &e)
	{
			::MessageBox(NULL, e.Description(), e.ErrorMessage(),
			MB_ICONERROR);
	}
	catch (...)
	{
	// handle errors here, depending on needs
	}
	Return 0;
}
```

Option Strings

The VTEX drivers provide option strings that can be used when Initializing an instrument. The option string values exist to change the behavior of the driver. The following options strings are available on VTI IVI drivers:

- **Simulate**: Allows the user to run a program without commanding switch card or instruments. This option is useful as a debugging tool.

- **Cache**: Per the IVI specification, this option "specifies whether or not to cache the value of attributes." Caching allows IVI drivers to maintain certain instrument settings to avoid sending redundant commands. The standard allows for certain values to be cached always or never. In VTI IVI-drivers, all values used are of one of these types. As such, any values entered have no effect.
- **QueryInstrumentStatus**: Queries the instrument for errors after each call is made. As implemented in the VTI IVI drivers, instruments status is always queried regardless of the value of this property.
- **DriverSetup**: Must be last, and contains the following properties:
  - **Logfile**: Allows the user to specify a file to which the driver can log calls and other data.
  - **Logmode**: Specifies the mode in which the log file is opened. The allowed modes are:
    - **w**: truncate s the file to zero length or creates a text file for writing.
    - **a**: opens the file for adding information to the end of the file. The file is created if it does not exist. The stream is positioned at the end of the file.
  - **LogLevel**: Allows the user to determine the severity of a log message by providing a level-indicator to the log entry.
  - **Slots**: This is the most commonly used option and it allows for a slot number or a slot number and a card model to be specified.
    "Slots=(2)" - Just slot 2.
    "Slots=(2=EMX_75XX)" - slot and card model
    "Slots=(2,3)" - Multiple slots
- **InterchangeCheck**: Boolean option that enables/disables IVI Interchangeability checking. As implemented in the VTI IVI drivers, values entered for this property have no effect.
- **RangeCheck**: Boolean option that enables or disables driver validation of user-submitted values. As implemented in the VTI IVI drivers, validation of user inputs is always performed at the firmware level regardless of this property's value.
- **RecordCoercions**: Boolean option that enables driver recording of coercions. As implemented in the VTI IVI drivers, coercions are handled in the firmware and cannot be recorded.

BASIC OPERATION

The EMX-75XX Series is a family of high-performance PXIe modules consisting of multiple I/O configurations and logic levels. Dedicated input or output cards are available for high channel count applications while other cards provide ultimate flexibility with eight, 8-bit ports (64 channels) that can be configured as an input or output under programmatic control

Voltage

This example covers the main functionality of the device: setting a voltage as an output in a port. Note that the voltage should be set first, then enabled. This prevents enabling the port with the default value enabled, which is the maximum value.

C++

```
//For Microsoft products
#import "IviDriverTypeLib.dll" no_namespace
#import "VTEXDio.dll" no_namespace

int main()
{
  //Windows driver creation
  ::CoInitialize(NULL); //Start the COM layer
  try
  {
    IVTEXDioPtr Dio(__uuidof(VTEXDio));
```

```
    /*We chose to give this driver an empty options string. If you have more than one
DIO card in your chassis, you will have to give it options such as a slot number. This
is because the DIO driver does not support more than one card per driver instance.
Note also that we set the reset flag so that we can get a clean start with the unit */

    Dio->Initialize("TCPIP::10.20.1.5::INSTR", VARIANT_TRUE, VARIANT_TRUE, "");

    /* Now we get to the meat of the example code. First, we want to drill down into
the ports interface. The first thing we always want to do is set a voltage. Many other
operations in the ports interface depend on having a voltage set. */

    Dio->Normal->Ports->Item["PORT1"]->VoltageRange = 5.0;

    /* By default, ports are set to input direction and normal polarity. This means we
should be able to read the current state of the pins on the 5V range, as long as we
don't have an OverCurrent condition. Let's check for OverCurrent before we read the
data back. */

    if(Dio->Normal->Ports->Item["PORT1"]->LatchedOverCurrent == 1)
    {
    //The port is in an OverCurrent state, so we would want to take some action here.
    }

    /* We want to check the Latched OverCurrent because while the OverCurrent tells us
if we are in an OverCurrent state now, the LatchedOverCurrent bit will tell us if we
have ever had one. If we have ever had an OverCurrent condition, the port will be
stuck in the reset state until we fix the inputs and call ResetOverCurrent. Now that
we've verified there's no OverCurrent condition, Let's read some data. */

       int data = Dio->Normal->Ports->Item["PORT1"]->Data;

       /* We can also change our Polarity if we want to read the data inverted. */

       Dio->Normal->Ports->Item["PORT1"]->Polarity = VTEXDioPolarityInverse;
       data = Dio->Normal->Ports->Item["PORT1"]->Data;

       /*Now let's pick another port and set it to an output, and output some data on
it. Changing the direction to Output allows us to write data as well as read it back.
Note that we also have to set a voltage on the port before we can write data.*/

       Dio->Normal->Ports->Item["PORT2"]->Direction = VTEXDioDirectionOutput;
       Dio->Normal->Ports->Item["PORT2"]->VoltageRange = 3.3;
       Dio->Normal->Ports->Item["PORT2"]->Data = 128;

       /* Changing the Polarity of an output changes both the output and readback
polarity. This means the user will always read back what they wrote, but the opposite
signal will be placed on the line. */

       Dio->Normal->Ports->Item["PORT2"]->Polarity = VTEXDioPolarityInverse;
       Dio->Normal->Ports->Item["PORT2"]->Data = 128; //Looks the same as above,
really outputting 127
       data = Dio->Normal->Ports->Item["PORT2"]->Data; //Will return 128.

       /* The Configure call lets us set all the values for a particular port quickly.
Here we will configure the port with a direction of Output, a Polarity of Normal, a
VoltageSource of User, and a voltage of 5V TTL Emulation (which has no effect, since
the voltage source is set to User. */
       Dio->Normal->Ports->Item["PORT3"]->Configure(VTEXDioDirectionOutput,
VTEXDioPolarityNormal, VTEXDioVoltageSourceUser, -1.0);

       /* We can also work with multiple ports at once. The ReadPorts and WritePorts
functions allow us to set or get data from several ports at a time. Setting data on
ports with an Input direction is ignored. */
```

```
      Dio->Normal->WritePorts(VTEXDioDataWidth16, 2, 255); //Writes a data of 255 on
port 2, and 0 on port 3.

      Dio->Close();

      ::CoUninitialize(); //Turn off the COM layer.
  }
  catch(...)
  {
       //Exception handling here
  }
  return 0;
}
```

C#

```
using System;
using System.Runtime.InteropServices;
using VTI.VTEXDio.Interop;

namespace PortConfiguration
{
    class PortConfiguration
    {
        static void Main(string[] args)
        {
            try
            {
                VTEXDio Dio = new VTEXDio();

                try
                {
                    Dio.Initialize("TCPIP::10.20.1.6::INSTR", true, true, "");
                    Dio.Normal.Ports.get_Item("PORT1").VoltageRange = 5.0;

                    /* By default, ports are set to input direction and normal
polarity. This means we should be able to read the current state of the pins on the 5V
range, as long as we don't have an OverCurrent condition. Let's check for OverCurrent
before we read the data back. */

                    if (Dio.Normal.Ports.get_Item("PORT1").LatchedOverCurrent == true)
                    {
                        //The port is in an OverCurrent state, so we would want to
take some action here.
                    }

                    /* We want to check the Latched OverCurrent because while the
OverCurrent tells us if we are in an OverCurrent state now, the LatchedOverCurrent bit
will tell us if we have ever had one. If we have ever had an OverCurrent condition,
the port will be stuck in the reset state until we fix the inputs and call
ResetOverCurrent. Now that we've verified there's no OverCurrent condition,
                       Let's read some data. */

               int data = Dio.Normal.Ports.get_Item("PORT1").Data;

           /* We can also change our Polarity if we want to read the data inverted. */

                    Dio.Normal.Ports.get_Item("PORT1").Polarity =
VTEXDioPolarityEnum.VTEXDioPolarityInverse;
                    data = Dio.Normal.Ports.get_Item("PORT1").Data;

                    /*Now let's pick another port and set it to an output, and output
some data on it. Changing the direction to Output allows us to write data as well as
```

```
read it back. Note that we also have to set a voltage on the port before we can write
data.*/
                    Dio.Normal.Ports.get_Item("PORT2").Direction =
VTEXDioDirectionEnum.VTEXDioDirectionOutput;
                    Dio.Normal.Ports.get_Item("PORT2").VoltageRange = 3.3;
                    Dio.Normal.Ports.get_Item("PORT2").Data = 128;

                    /* Changing the Polarity of an output changes both the output and
readback polarity. This means the user will always read back what they wrote, but the
opposite signal will be placed on the line. */
                    Dio.Normal.Ports.get_Item("PORT2").Polarity =
VTEXDioPolarityEnum.VTEXDioPolarityInverse;
                    Dio.Normal.Ports.get_Item("PORT2").Data = 128; //Looks the same as
above, really outputting 127
                    data = Dio.Normal.Ports.get_Item("PORT2").Data; //Will return 128.

                    /* The Configure call lets us set all the values for a particular
port quickly. Here we will configure the port with a direction of Output, a Polarity
of Normal, a VoltageSource of User, and a voltage of 5V TTL Emulation (which has no
effect, since the voltage source is set to User. */

Dio.Normal.Ports.get_Item("PORT3").Configure(VTEXDioDirectionEnum.VTEXDioDirectionOutp
ut, VTEXDioPolarityEnum.VTEXDioPolarityNormal,
VTEXDioVoltageSourceEnum.VTEXDioVoltageSourceUser, -1.0);

                    /* We can also work with multiple ports at once. The ReadPorts and
WritePorts functions allow us to set or get data from several ports at a time. Setting
data on ports with an Input direction is ignored. */

                    Dio.Normal.WritePorts(VTEXDioDataWidthEnum.VTEXDioDataWidth16, 2,
255); //Writes a data of 255 on port 2, and 0 on port 3.

                    Dio.Close();
                }
                catch (COMException e)
                {
                    //Error handling for driver-related errors goes here
                }
            }
            catch (Exception e)
            {
                //Error handling for instantiation errors goes here
            }
        }
    }
}
```

SECTION 4

SFP OPERATION

INTRODUCTION

The EMX-2500 chassis accommodates the EMX-75XX card and provides an internal web page, which allows easy configuration, management and troubleshooting of the device. This internal Soft Front Panel (SFP) is a JavaScript based application which is designed to work, within web browser environment. If you know the IP address of the instrument, you can type it in the address bar of any modern web browsers, such as Microsoft Internet Explorer, Mozilla Firefox etc.

To open the embedded web page, simply type the IP address of the instrument into browsers address bar, and navigate accordingly. In order for your browser to communicate with the instrument, the instrument and your computer should be within the same network, and may require permissions from your network/computer administrator.

There are various ways to search the IP address, and other network configuration parameters of the instrument. The easiest method is to refer to the embedded display on the instrument, and use the menu key to navigate to necessary details. However, if the device display is not physically accessible, you can use LXI Discovery tool, or any standard IO Libraries tool, such as National Instruments (c) Measurement and Automation Explorer (MAX) and the Keysight (formerly Agilent) (c) Connection Expert (ACE) to discover the instrument. The instrument also supports mDNS protocols, so that any tools meant for Zero Configuration Networking, such as Apple ® Bonjour ® or Avahi, can also be used to discover the instrument. For more information on installation of these software utilities, please refer to their respective vendors.

The LXI Discovery tool is a free utility, available for download from LXI Consortium itself. It uses both VXI-11, as well as mDNS protocols to detect the LXI instruments present in your network. Once installed, this software will discover EMX-2500 instruments, if available, as shown below.

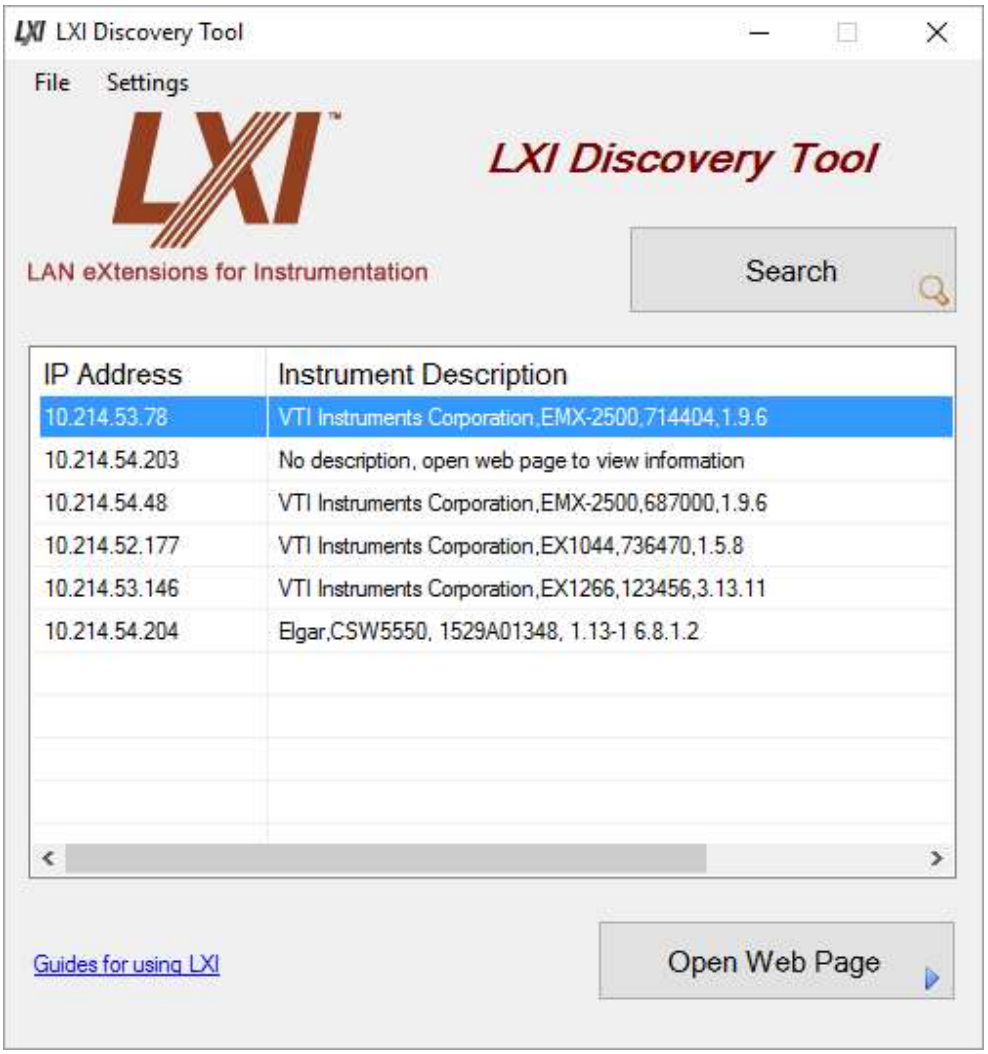

Figure 4-1: LXI Discovery Tool with EMX-2500 Selected

Alternatively, the EMX-2500 may also be discovered using Internet Explorer's Bonjour for Windows plug-in. The IP address of the EMX-2500 can also be entered into the address bar of any web browser to view the embedded web page. By default, the EMX-2500 will first attempt to use DHCP to set its IP Address. If DHCP is not available on the network it is connected to, it will instead use Auto IP. Determining the Auto IP address has been provided in the *EMX-75XX Series User's Manual*. Other discovery methods, such as VXI-11, can be used as well.

COMMON ISSUES

Although Ethernet is an easy connectivity option, some users may experience difficulty discovering LXI devices. Most often, these issues have been caused by networking issues, such as the instrument and host computer being connected to different sub-nets of the network. The user can either search internet or contact their system/network administrator for assistance on these issues. Here are few other causes that may be present in the user system which may obstruct instrument discovery:

Multiple Network Ports

It is possible that the user computer, can have multiple network adaptors (physical/virtual). Common example of this case, is use of Wireless Internet/Wi-Fi in Laptop computers, whose Wired Ethernet connections are connected to LXI device connected network. In some cases, virtual network adaptors could have been created for use by some of the installed applications on user system. The easy solution to these problems is to disable all other Ethernet connections and so force the computer to select the network port which is used by LXI Instrument.

Firewall

It is possible that the firewall of the computer may be stopping the data traffic to the connected LXI device. It may not be always feasible to stop the Firewall completely, and hence the user may contact their computer administrator for making exceptions in Firewall configuration to allow LXI data traffic. Here are the list of ports and protocols, typically used by LXI devices.

Protocol / Service	Port	Base Protocol	Remarks
mDNS	5353	UDP/TCP	Zero-config protocol for <hostname>.local address resolution; service discovery; Multicast 224.0.0251, FF02::FB
HTTP	80	TCP	Instrument web pages (SFP) and driver communication
ICMPv4		ICMP	Typically enables echo request/respond for ping
ICMPv6		ICMP	Optional - Typically enables echo request/respond for ping, also SLAAC for IPv6 addresses, RDDNS
Arp		Arp	Used to confirm address assignments
DHCPv4	67/68	UDP/TCP	IPv4 address assignment, DNS Server, Dynamic DNS, Gateway
DNS	53	UDP	Naming service
SSH	22	TCP	Bidirectional interactive text oriented communication
RPC port-mapper	111	UDP/TCP	Builds upon Sun-RPC and port-mapper
VXI-11	Varies	TCP	VXI-11 instrument discovery The exact port number varies; query the RPC port-mapper to determine which port is current in use
LXI-eventsvc	5044	UDP/TCP	LXI Event support for instrument triggering; multicast 224.0.23.159, FF02::138. LXI Events can use other ports also, but default port number is 5044
Ptp-event	319	UDP/TCP	LXI Profile IEEE 1588 Precision Time Protocol (PTP); multicast 224.0.1.129, FF02::181
Ptp-general	320	UDP/TCP	LXI Profile IEEE 1588 Precision Time Protocol (PTP); multicast 224.0.1.129, FF02::181
Data stream	9900	TCP	Driver data stream

TABLE 4-1: STANDARD PORTS, PROTOCOLS, AND SERVICES

GENERAL WEB PAGE OPERATION

When initial connection is made to the EMX-2500, the instrument home page, or **Index**, appears. This page displays instrument-specific information. This page is accessible from any other instrument page by clicking on the EMX-2500 web page header. The EMX-2500 Navigation Menu is displayed on the left hand side of every internal web page. The entries on the Navigation Menu represent two types of pages:

Status: These pages perform no actions and accept no entries. It provides operational status and information only. The Index page is an example of a status page.

Entry: These pages display and accept changes to the configuration of the instrument. The **Network Configuration** page is an example of an entry page. Use of the entry-type web pages in the EMX-2500 are governed by a common set of operational characteristics:

- Pages initially load with the currently-entered selections displayed.
- Each page contains a Submit button to accept newly entered changes. Leaving a page before submitting any changes has the effect of canceling the changes, leaving the instrument in its original state.
- Navigation through a parameter screen is done with the Tab key. The Enter key has the same function as clicking the Submit button and cannot be used for navigation.

LOGIN

When accessing a page that allows changing configuration parameters of the EMX-2500, a password may be required. If so, the Login page will appear.

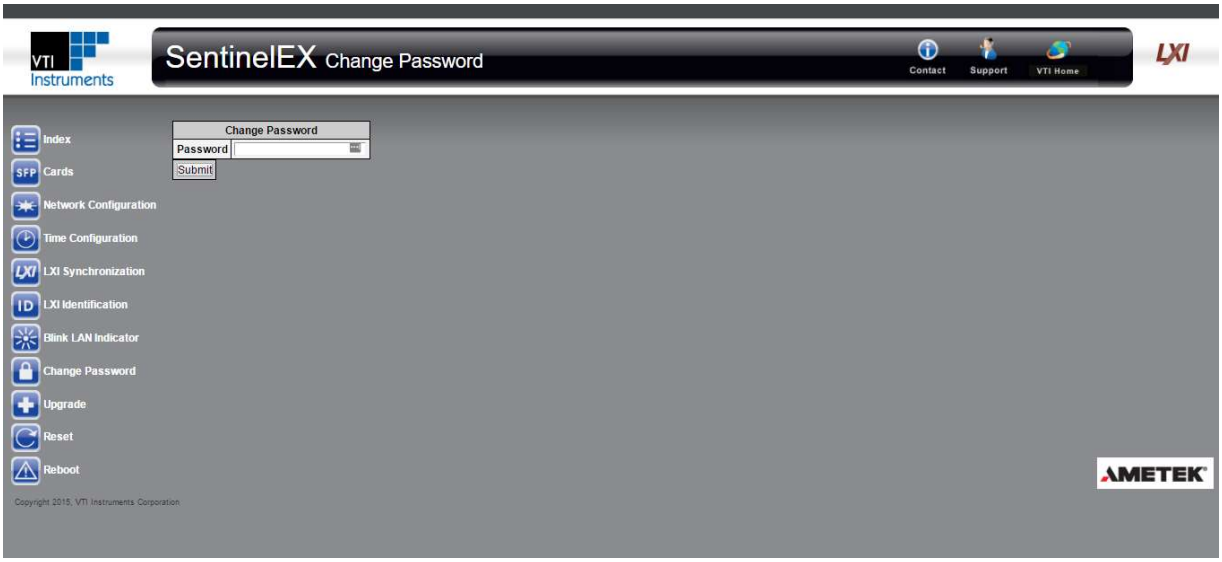

Figure 4-2: Login Page

To log in, simply enter the password in the given text field, and press the Submit button. By default, the EMX-2500 has no password. To change the password, visit the Change Password page. If the password is unknown, performing a network reset operation will reset the EMX-2500 to no password.

INDEX

The Index page provides the general information about the EMX-2500.

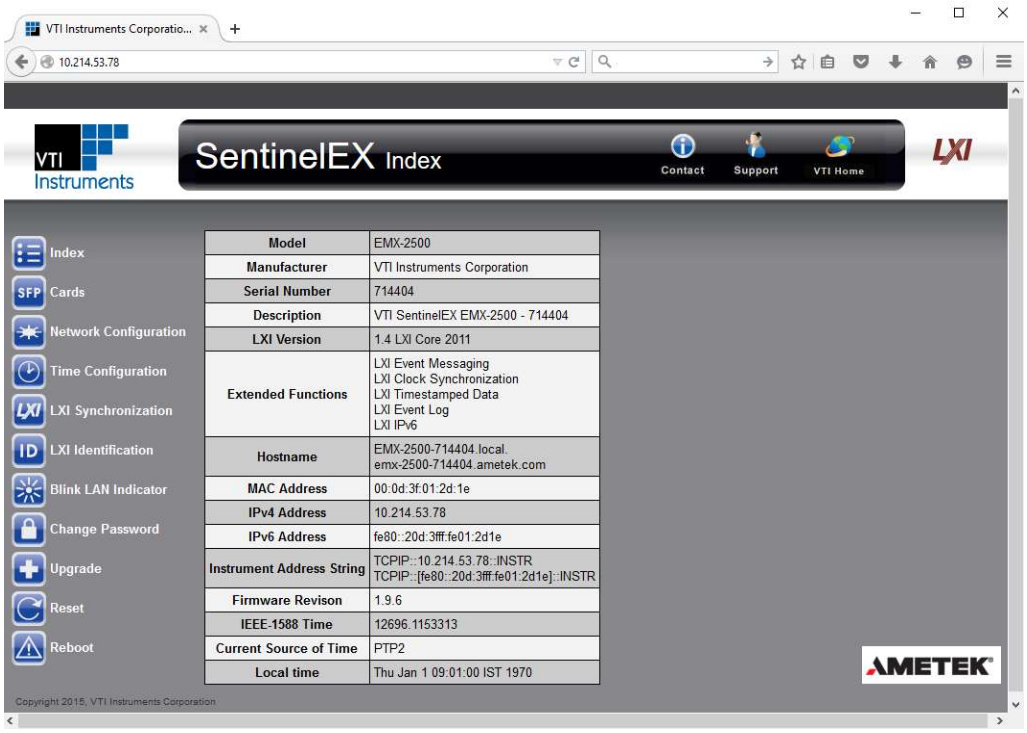

Figure 4-3: EMX-2500 chassis Main Web Page

The **Index** is accessible from any other instrument page by clicking on the EMX-2500 web page header. The EMX-2500 **Command Menu** is displayed on the left-hand side of every internal web page. The entries on the command menu represent three types of pages:

Status This type of page performs no action and accepts no entries. It provides operational status and information only. The **Index** page is an example of a status page.

Action This type of page initiates a command on the instrument, but does not involve parameter entry. The **Reboot** page is an example of an action page.

Entry This type of page displays and accepts changes to the configuration of the instrument. The **Time Configuration** page is an example of an entry page.

Use of the entry-type web pages in the EMX-2500 are governed by a common set of operational characteristics:

- Pages initially load with the currently-entered selections displayed.
- Each page contains a **Submit** button to accept newly entered changes. Leaving a page before submitting any changes has the effect of canceling the changes, leaving the instrument in its original state.
- Navigation through a parameter screen is done with the **Tab** key. The **Enter** key has the same function as clicking the **Submit** button and cannot be used for navigation.

Notes on Web Page Use

If a window needs to be resized, this should be done when the window opens. Resizing requires a refresh which causes the current state to be lost.

VTI Instruments Logo

The VTI Instruments logo that appears on the upper left of all EMX-2500 web pages is a link to the VTI Instruments corporate website: http://www.vtiinstruments.com.

The remainder of this discussion will focus on the EMX-75XX soft front panel. For more information on other EMX-7510 soft front panel elements, please refer to the *EMX-75XX Series User's Manual*.

EMX-75XX Soft Front Panel

To navigate to the EMX-75XX soft front panel, click on **Soft Front Panel** in the **Command Menu** (see Figure **4-4**). Next, select **DIO EMX-75XX** from the list of cards installed in the EMX-75XX.

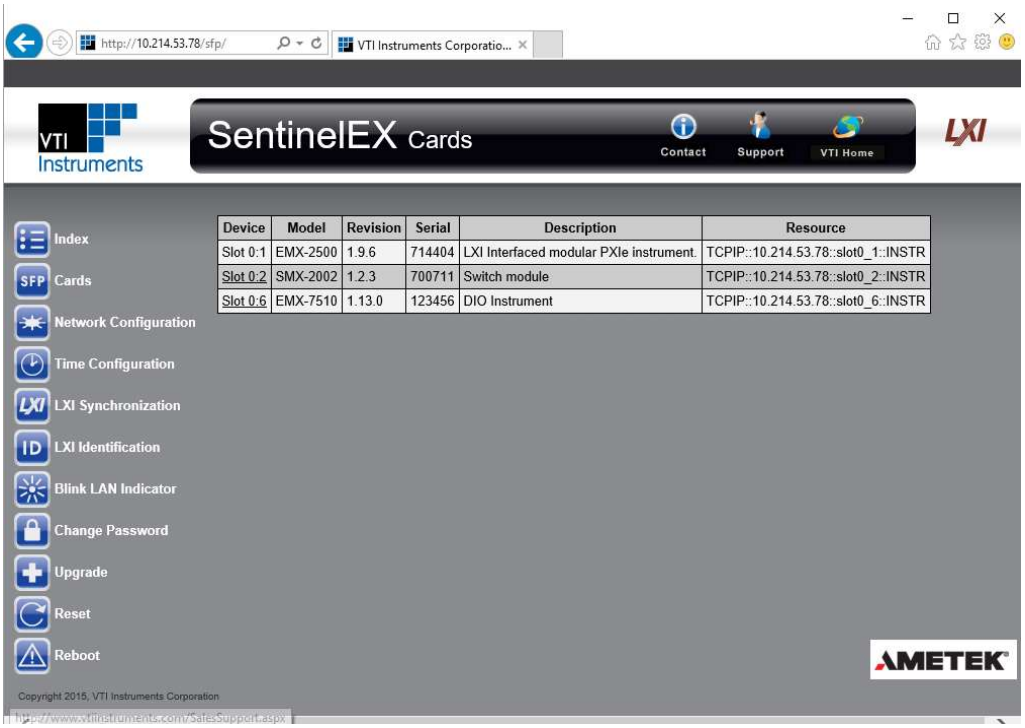

Figure 4-4: EMX-75XX Soft Front Panel Main Page

MONITOR AND CONTROL PAGE

By default, the EMX-75XX SFP opens to the **Monitor and Control** view. From this view, the user can define the DIO's mode, its ports configurations. Although the SFP does not expose the entire functionality of the DIO, the SFP can be used to set up the EMX-75XX in most applications.

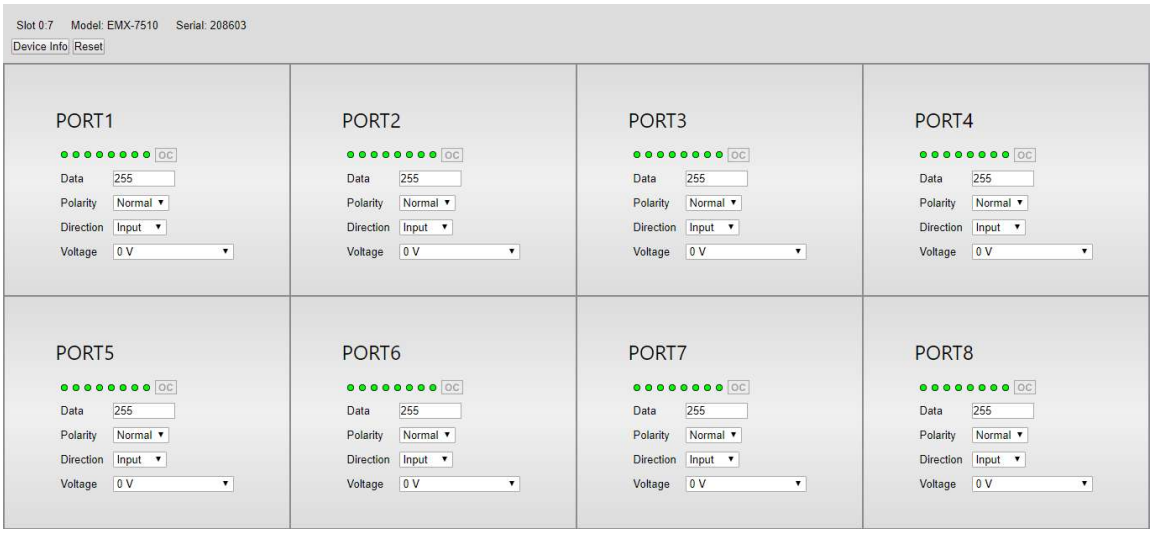

Figure 4-5: EMX-75XX Soft Front Panel (Normal Mode)

Port Configuration Fields

For each Port, the following settings can be configured.

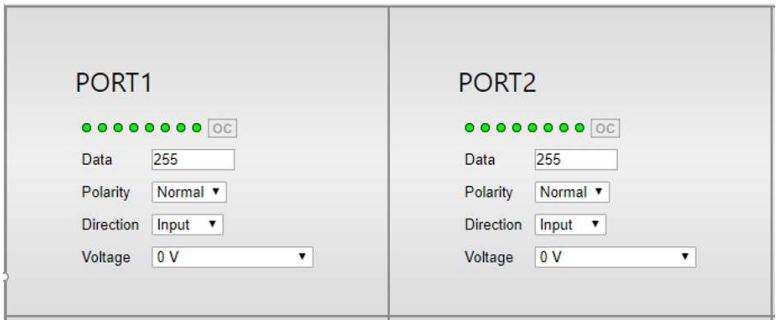

Figure 4-6: Port Configuration Fields

- **Data Indicators**: The LED indicators in each port configuration section indicate the data value this is being sent by or received by the indicated port. The data is an 8-bit integer with the green LEDs indicating an output high (1) and a red LED indicating an output low (0).
- **OC**: If an over-current event occurs, the **OC** indicator will turn **red**, indicating that actions should be taken by the user.
- **Data**: When the direction is set to **Output**, the user can enter the data value that will be sent on the selected port.
- **Voltage**: Select the voltage range for the port. **3**, **5.0**, **12.0**, **24.0**, and **User Voltage Source**. Note that the **-2.0** and **-1.0** are not voltage values, but correlate to LV emulation and TTL emulation, respectively hence if the user sets that value the direction will be changed to Output automatically.
- **Direction**: Sets the port as either an **Input** or an **Output**.
- **Polarity**: Sets the ports polarity as either **Normal** or **Inverse**.

DEVICE INFO DIALOG

If the **Device Info** button is clicked, information regarding the selected instrument will be displayed including the versions of the SFP, firmware, and hardware.

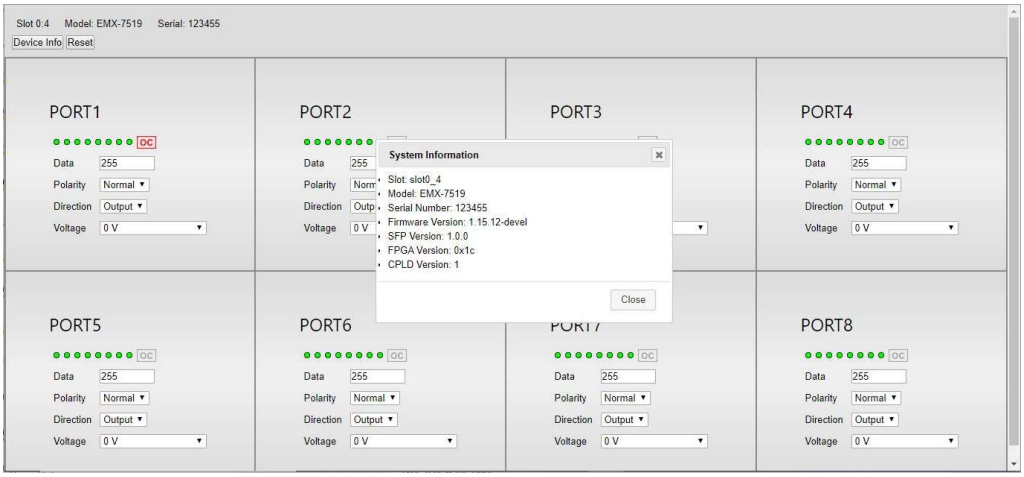

Figure 4-7: Device Information

EMX-75XX HAS 7 VARIANTS AND THEIR SFPS ARE SHOWN BELOW.

- **EMX-7510**

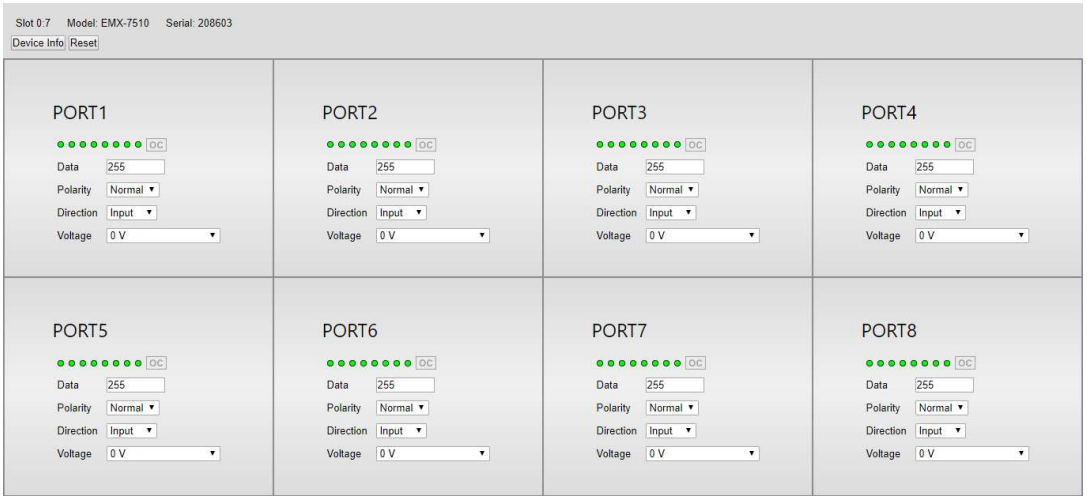

Figure 4-8: EMX-7510 SFP

EMX-7510 is a 64 channel Digital Input / Output, Source/Sink, 60V max static only card. It supports all the features like Direction change, Polarity, Voltage source selection, Port Read / Write, Over Current / Latched Over Current / Reset Latched Over Current registers.

- **EMX-7511**

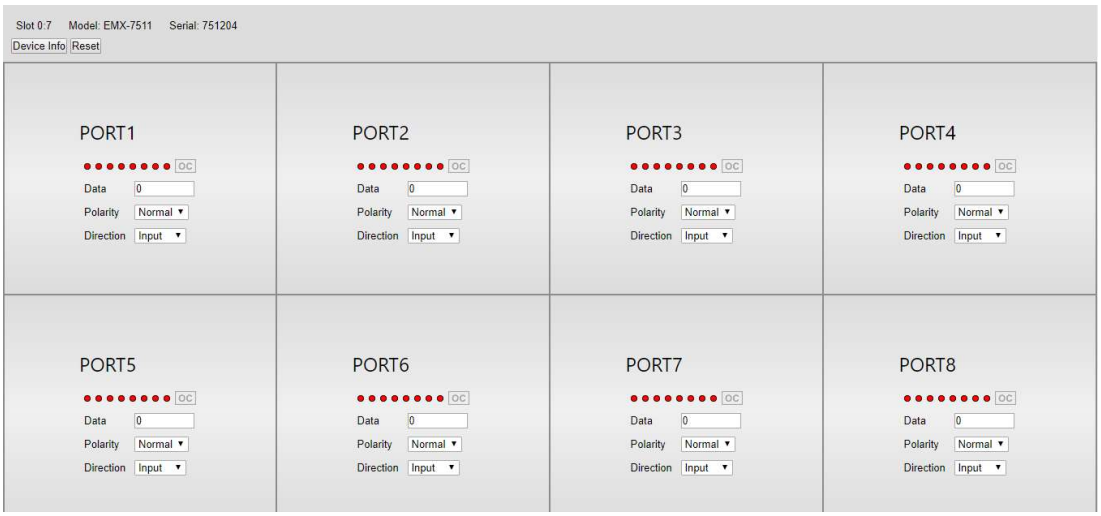

Figure 4-9: EMX-7511 SFP

EMX-7511 is a 64 channel Digital Input / Output 5V TTL static only card. It supports features like Direction, Polarity, Port Read / Write.

- **EMX-7512**

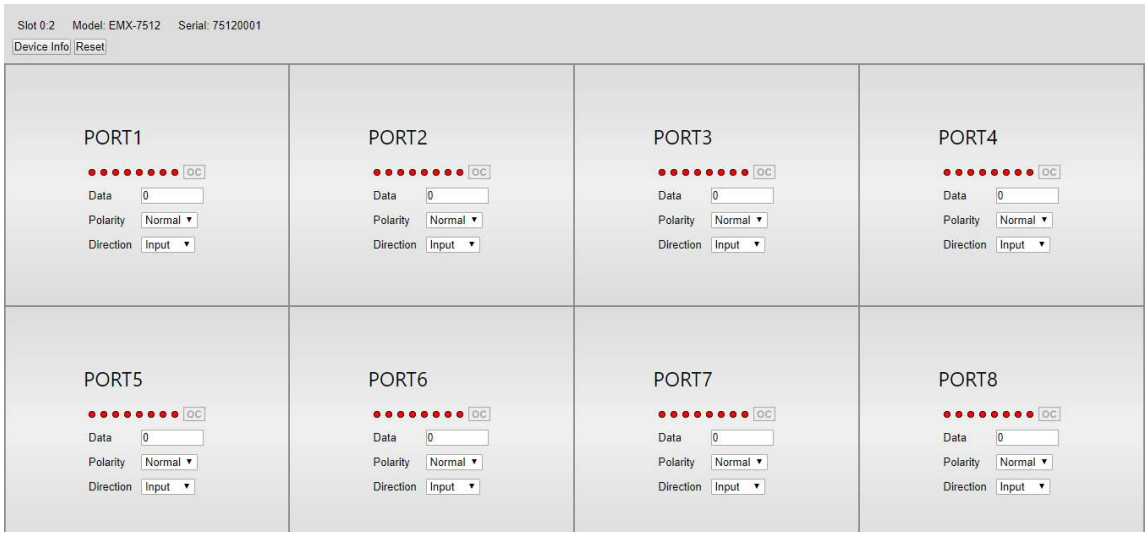

Figure 4-10: EMX-7512 SFP

EMX-7512 is a 64 channel Digital Input / Output 3.3V LV-TTL static only card. It supports features like Direction change, Polarity, Port Read / Write.

- **EMX-7513**

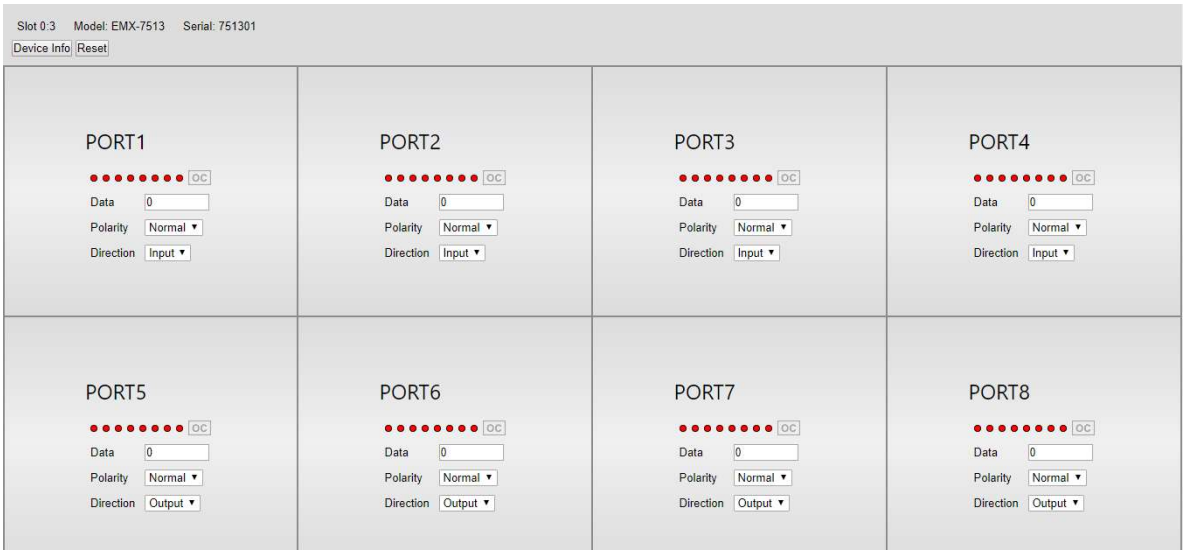

Figure 4-11: EMX-7513 SFP

EMX-7513 is a 32 Digital Input / 32 Digital Output channel, Source/Sink, 60V max, CH-Computer GND isolation, static only card. It only supports features like Polarity change, Port Read / Write.

EMX-7514

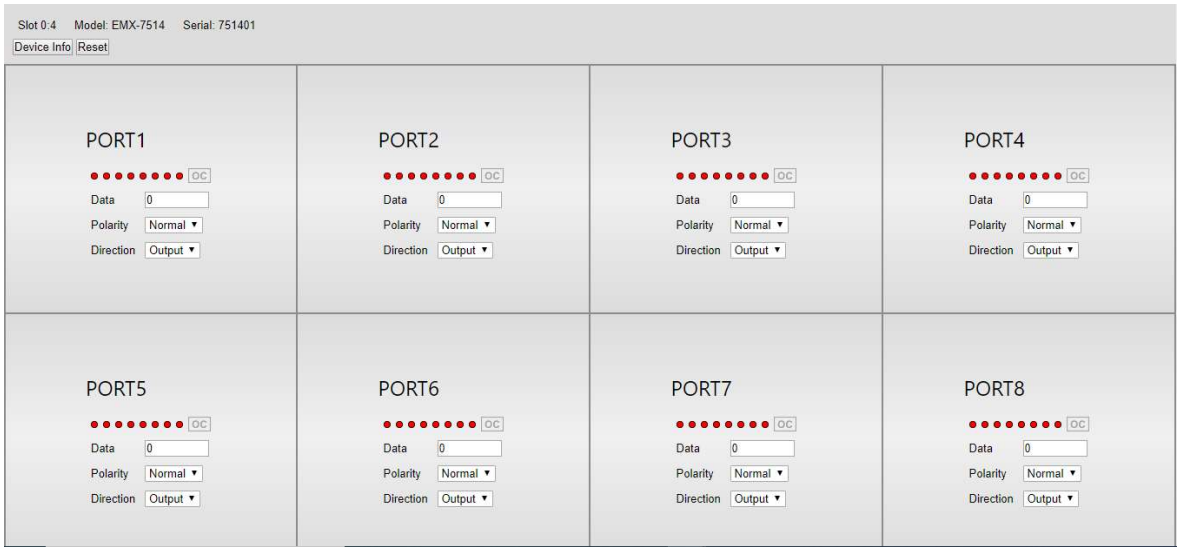

Figure 4-12: EMX-7514 SFP

EMX-7514 is a 64 channel Digital Output, CH-Computer GND isolation, 60V Source/Sink, Static only card. It only supports features like Polarity change, Port Read / Write.

- **EMX-7515**

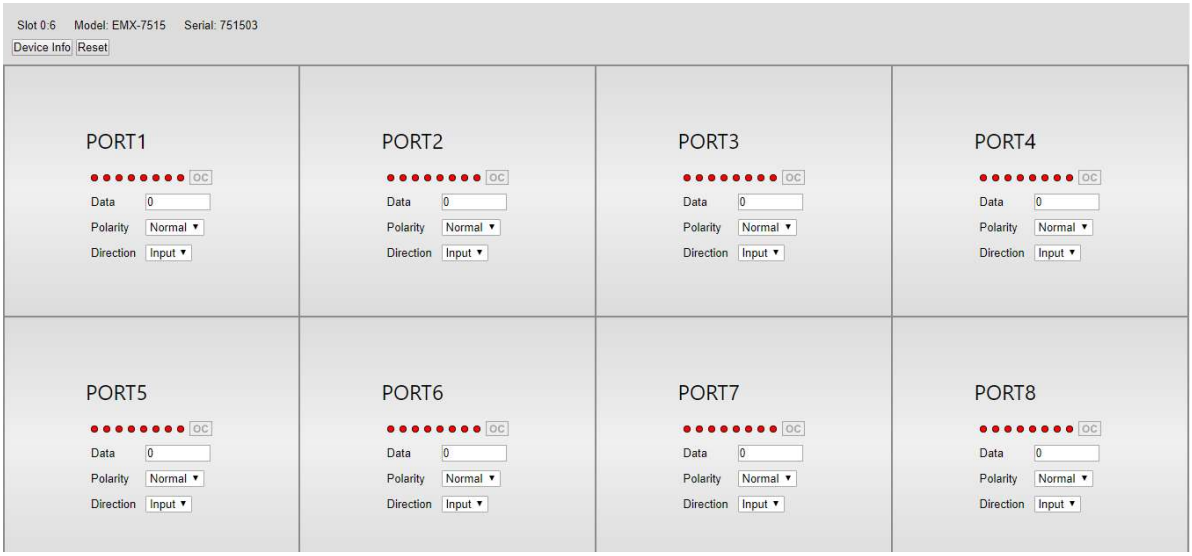

Figure 4-13: EMX-7515 SFP

EMX-7515 is a 64 channel Digital Input, CH-Computer GND isolation, 60V Source/Sink, Static only card. It only supports features like Polarity change & Port Read.

EMX-7519

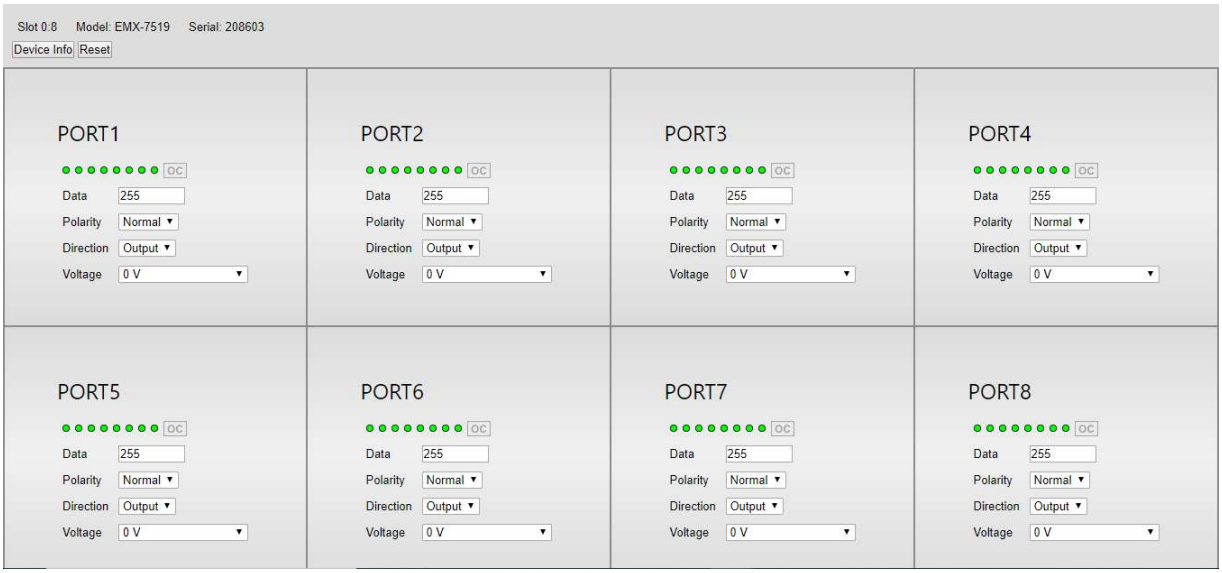

Figure 4-14: EMX-7519 SFP

EMX-7519 is a 64 channel Digital Output, Source/Sink, 60V max, static only card. Except Direction change, it supports all the features like Polarity, Voltage source selection, Port Read / Write, Over Current / Latched Over Current / Reset Latched Over Current registers.

APPENDIX -A

Memory Listing and Clearing Procedure

The below table provides the Flash components information used in the EMX plugin cards. It also contains clearing procedure details for different modules inside the flash components and whether the user can perform writable operation on them or not.

Component	Volatile?	Contains	User Writeable?	Clear Procedure	Models
IC, NOR FLASH, 256Mb, 8P, WSON Part no : 19-0123-000A Man. Part : S25FL256SAGNFV000 / S25FL256SAGNFV001 Manufacturer : SPANSION LLC	No	Firmware	No	None	EMX-7510 EMX-7511 EMX-7512 EMX-7513 EMX-7514 EMX-7515 EMX-7519
		Backup Firmware	No	None	
		Instrument Identity	No	None	

TABLE 1: MEMORY LISTING AND CLEARING PROCEDURE

APPENDIX -B

The following table provide MTBF of EMX-75xx Models,

Sl.no.	Model	MTBF 40°C (Hours)
1	EMX-7510	312,500
2	EMX-7511	312,500
3	EMX-7512	312,500
4	EMX-7513	312,500
5	EMX-7514	312,500
6	EMX-7515	312,500
7	EMX-7519	312,500

TABLE 1: MTBF

APPENDIX -C

LIST OF ACCESSORIES

The following table provides accessories used with the EMX-75XX series DIO cards.

CONNECTOR INFORMATION	
STRAIN RELIEF BRACKET KIT (WITHOUT CONNECTOR)	
VTI Part Number	70-0409-160R
CRIMP PIN	
VTI Part Number	52-0109-000R (includes 100 crimp pins)
Manufacturer/Part Number	ERNI 234064
MATING CONNECTOR	
VTI Part Number	27-0088-160 (one per board)
Manufacturer/Part Number	ERNI 024070
CRIMP PIN	
VTI Part Number	27-0088-000
Manufacturer/Part Number	ERNI 014729
CRIMP TOOL (DIN)	
VTI Part Number	46-0010-000
Manufacturer/Part Number	ERNI 014374
EXTRACTION TOOL (DIN)	
VTI Part Number	46-0011-000
Manufacturer/Part Number	ERNI 471555
TERMINAL BLOCK INFORMATION	
VTI Part Number	70-0367-205R

APPENDIX -D

EMX-75xx-TB160SE Terminal Block

VTI offers a single-ended terminal block for the EMX-75xx cards (P/N: 70-0367-205R). The terminal block simplifies cabling by providing screw-terminal blocks for user wiring. Signal pin mapping of EMX-75xx cards while using TB160SE Terminal Block is available in

TB Ref	Signal	Conn Pin	TB Ref	Signal	Conn Pin	TB Ref	Signal	Conn Pin	TB Ref	Signal	Conn Pin
T1	GND_S	E2	T41	DATA4.1	A15	T81	GND_S	C14	T121	DATA6.1	A22
T2		D2	T42	GND_S	A14	T82	GND_S	B14	T122	DATA6.3	A23
T3	DATA1.5	E3	T43	GND_S	A13	T83	DATA4.7	C15	T123	GND_S	A20
T4	GND_S	D3	T44	DATA3.3	A12	T84	GND_S	B15	T124	DATA5.8	A18
T5	DATA1.6	E4	T45	DATA3.4	A10	T85	DATA5.1	C16	T125	GND_S	A19
T6	GND_S	D4	T46	USER_V1	D10	T86	USER_V3	B16	T126	DATA4.3	A16
T7	DATA2.5	E5	T47	GND_S	E10	T87	DATA5.2	C17	T127	DATA5.3	A17
T8	GND_S	D5	T48	DATA3.7	C11	T88	GND_S	B17	T128	GND_S	D32
T9	DATA2.2	E6	T49	GND_S	B11	T89	DATA5.4	C18	T129	DATA8.8	E30
T10	GND_S	D6	T50	DATA3.2	A11	T90	GND_S	B18	T130	GND_S	D30
T11	GND_S	E7	T51	GND_S	B12	T91	GND_S	C19	T131	DATA8.5	E29
T12	DATA2.3	D7	T52	DATA4.2	C12	T92	GND_S	B19	T132	GND_S	D29
T13	DATA2.6	E8	T53	USER_V4	B13	T93	GND_S	C20	T133	GND_S	E31
T14	GND_S	D8	T54	GND_S	C13	T94	USER_V5	B20	T134	GND_S	D31
T15	DATA3.5	E9	T55	DATA2.7	A9	T95	DATA8.7	C32	T135	DATA8.6	C30
T16	GND_S	D9	T56	GND_S	A8	T96		E1	T136	GND_S	B30
T17	DATA1.8	C3	T57	GND_S	A7	T97	DATA7.5	E26	T137	GND_S	C31
T18	GND_S	B3	T58	DATA2.4	A6	T98	GND_S	D26	T138	GND_C	B31
T19	GND_S	C2	T59	DATA1.3	A5	T99	DATA6.7	E24	T139	GND_S	B29
T20	GND_S	B2	T60	DATA1.1	A4	T100	USER_V8	D24	T140	DATA8.1	C29
T21	DATA1.2	C4	T61	DATA1.4	A3	T101	GND_S	E27	T141	GND_S	B28
T22	GND_S	B4	T62	GND_S	A2	T102	GND_S	D27	T142	DATA7.7	C28
T23	DATA1.7	C5	T63	GND_S	B10	T103	GND_S	E28	T143	GND_S	C25
T24	GND_S	B5	T64	DATA3.1	C10	T104	GND_S	D28	T144	GND_S	B25
T25	DATA2.8	C6	T65	GND_S	E15	T105	DATA6.6	E23	T145	GND_S	B27
T26	DATA2.1	B6	T66	GND_S	D15	T106	GND_S	D23	T146	DATA7.6	C27
T27	GND_S	C7	T67	GND_S	E16	T107	GND_S	E22	T147	GND_S	B26
T28	GND_S	B7	T68	GND_S	D16	T108	GND_S	D22	T148	GND_S	C26
T29	GND_S	C8	T69	DATA4.6	E17	T109	GND_S	D25	T149	GND_S	A26
T30	GND_S	B8	T70	USER_V6	D17	T110	DATA7.8	E25	T150	DATA7.3	A27
T31	DATA3.8	C9	T71	DATA5.5	E18	T111	DATA5.6	E20	T151	DATA7.2	A28
T32	USER_V2	B9	T72	GND_S	D18	T112	GND_S	D20	T152	DATA8.4	A29
T33	DATA3.6	E11	T73	DATA5.7	E19	T113	DATA6.8	C22	T153	DATA8.2	A30
T34	GND_S	D11	T74	GND_S	D19	T114	GND_S	B22	T154	GND_S	A31
T35	GND_S	D12	T75	DATA6.5	C21	T115	DATA6.2	C23	T155	GND_S	E32
T36	DATA4.4	E12	T76	GND_S	B21	T116	GND_S	B23	T156	GND_C	B1
T37	GND_S	D13	T77		D1	T117	DATA7.1	C24	T157	DATA8.3	A32
T38	DATA4.5	E13	T78	DATA6.4	A21	T118	USER_V7	B24	T158	GND_S	A1
T39	GND_S	D14	T79	GND_S	D21	T119	DATA7.4	A24	T159	GND_S	B32
T40	DATA4.8	E14	T80	GND_S	E21	T120	GND_S	A25	T160	GND_S	C1

TABLE 1: EMX-7510 / 7519 TO TB160SE TERMINAL BLOCK PIN AND SIGNAL MAPPING

TB Ref	Signal	Conn Pin	TB Ref	Signal	Conn Pin	TB Ref	Signal	Conn Pin	TB Ref	Signal	Conn Pin
T1	GND	E2	T41	DATA4.1	A15	T81	GND	C14	T121	DATA6.1	A22
T2		D2	T42	GND	A14	T82	GND	B14	T122	DATA6.3	A23
T3	DATA1.5	E3	T43	GND	A13	T83	DATA4.7	C15	T123	GND	A20
T4	GND	D3	T44	DATA3.3	A12	T84	GND	B15	T124	DATA5.8	A18
T5	DATA1.6	E4	T45	DATA3.4	A10	T85	DATA5.1	C16	T125	GND	A19
T6	GND	D4	T46		D10	T86		B16	T126	DATA4.3	A16
T7	DATA2.5	E5	T47	GND	E10	T87	DATA5.2	C17	T127	DATA5.3	A17
T8	GND	D5	T48	DATA3.7	C11	T88	GND	B17	T128	GND	D32
T9	DATA2.2	E6	T49	GND	B11	T89	DATA5.4	C18	T129	DATA8.8	E30
T10	GND	D6	T50	DATA3.2	A11	T90	GND	B18	T130	GND	D30
T11	GND	E7	T51	GND	B12	T91	GND	C19	T131	DATA8.5	E29
T12	DATA2.3	D7	T52	DATA4.2	C12	T92	GND	B19	T132	GND	D29
T13	DATA2.6	E8	T53		B13	T93	GND	C20	T133	GND	E31
T14	GND	D8	T54	GND	C13	T94		B20	T134	GND	D31
T15	DATA3.5	E9	T55	DATA2.7	A9	T95	DATA8.7	C32	T135	DATA8.6	C30
T16	GND	D9	T56	GND	A8	T96		E1	T136	GND	B30
T17	DATA1.8	C3	T57	GND	A7	T97	DATA7.5	E26	T137	GND	C31
T18	GND	B3	T58	DATA2.4	A6	T98	GND	D26	T138	GND_C	B31
T19	GND	C2	T59	DATA1.3	A5	T99	DATA6.7	E24	T139	GND	B29
T20	GND	B2	T60	DATA1.1	A4	T100		D24	T140	DATA8.1	C29
T21	DATA1.2	C4	T61	DATA1.4	A3	T101	GND	E27	T141	G	B28
T22	GND	B4	T62	GND	A2	T102	GND	D27	T142	GND	C28
T23	DATA1.7	C5	T63	GND	B10	T103	GND	E28	T143	GND	C25
T24	GND	B5	T64	DATA3.1	C10	T104	GND	D28	T144	GND	B25
T25	DATA2.8	C6	T65	GND	E15	T105	DATA6.6	E23	T145	GND	B27
T26	DATA2.1	B6	T66	GND	D15	T106	GND	D23	T146	DATA7.6	C27
T27	GND	C7	T67	GND	E16	T107	GND	E22	T147	GND	B26
T28	GND	B7	T68	GND	D16	T108	GND	D22	T148	GND	C26
T29	GND	C8	T69	DATA4.6	E17	T109	GND	D25	T149	GND	A26
T30	GND	B8	T70		D17	T110	DATA7.8	E25	T150	DATA7.3	A27
T31	DATA3.8	C9	T71	DATA5.5	E18	T111	DATA5.6	E20	T151	DATA7.2	A28
T32		B9	T72	GND	D18	T112	GND	D20	T152	DATA8.4	A29
T33	DATA3.6	E11	T73	DATA5.7	E19	T113	DATA6.8	C22	T153	DATA8.2	A30
T34	GND	D11	T74	GND	D19	T114	GND	B22	T154	GND	A31
T35	GND	D12	T75	DATA6.5	C21	T115	DATA6.2	C23	T155	GND	E32
T36	DATA4.4	E12	T76	GND	B21	T116	GND	B23	T156	GND_C	B1
T37	GND	D13	T77		D1	T117	DATA7.1	C24	T157	DATA8.3	A32
T38	DATA4.5	E13	T78	DATA6.4	A21	T118		B24	T158	GND	A1
T39	GND	D14	T79	GND	D21	T119	DATA7.4	A24	T159	GND	B32
T40	DATA4.8	E14	T80	GND	E21	T120	GND	A25	T160	GND	C1

TABLE 2: EMX-7511 / 7512 TO TB160SE TERMINAL BLOCK PIN AND SIGNAL MAPPING

TB Ref	Signal	Conn Pin	TB Ref	Signal	Conn Pin	TB Ref	Signal	Conn Pin	TB Ref	Signal	Conn Pin
T1		E2	T41	DI_4.7-	A15	T81	DI_4.2+	C14	T121	DO_6.2+	A22
T2		D2	T42	DI_3.6+	A14	T82	DI_2.6+	B14	T122	DO_7.3-	A23
T3	DI_2.1-	E3	T43	DI_3.6-	A13	T83	DO_5.3-	C15	T123	DO_6.1+	A20
T4		D3	T44	DI_3.5+	A12	T84	DI_3.7-	B15	T124	DI_4.8+	A18
T5	DI_2.1+	E4	T45	DI_2.4+	A10	T85	DO_5.3+	C16	T125	DO_6.1-	A19
T6		D4	T46	DI_3.1+	D10	T86	DI_3.7+	B16	T126	DI_4.7+	A16
T7	DI_2.2-	E5	T47	DI_3.4+	E10	T87	DO_5.4-	C17	T127	DI_4.8-	A17
T8	DI_1.7-	D5	T48	DI_4.1-	C11	T88	DI_3.8-	B17	T128		D32
T9	DI_2.2+	E6	T49	DI_2.5-	B11	T89	DO_5.4+	C18	T129	DO_8.6+	E30
T10	DI_1.7+	D6	T50	DI_3.5-	A11	T90	DI_3.8+	B18	T130		D30
T11	DI_3.3-	E7	T51	DI_2.5+	B12	T91	DO_6.5-	C19	T131	DO_8.6-	E29
T12	DI_1.8-	D7	T52	DI_4.1+	C12	T92	DO_5.1-	B19	T132		D29
T13	DI_3.3+	E8	T53	DI_2.6-	B13	T93	DO_6.5+	C20	T133		E31
T14	DI_1.8+	D8	T54	DI_4.2-	C13	T94	DO_5.1+	B20	T134		D31
T15	DI_3.4-	E9	T55	DI_2.4-	A9	T95	DO_8.8+	C32	T135	DO_8.5+	C30
T16	DI_3.1-	D9	T56	DI_2.3+	A8	T96		E1	T136	DO_8.2+	B30
T17	DI_1.5-	C3	T57	DI_2.3-	A7	T97		E26	T137	DO_8.8-	C31
T18		B3	T58	DI_1.1+	A6	T98	DO_8.1+	D26	T138		B31
T19		C2	T59	DI_1.1-	A5	T99		E24	T139	DO_8.2-	B29
T20		B2	T60		A4	T100	DO_6.8+	D24	T140	DO_8.5-	C29
T21	DI_1.5+	C4	T61		A3	T101		E27	T141	DO_7.5+	B28
T22		B4	T62		A2	T102		D27	T142	DO_8.3+	C28
T23	DI_1.6-	C5	T63	DI_1.4+	B10	T103		E28	T143	DO_7.8-	C25
T24	DI_1.2-	B5	T64	DI_2.8+	C10	T104		D28	T144	DO_6.4-	B25
T25	DI_1.6+	C6	T65	DO_5.7-	E15	T105		E23	T145	DO_7.5-	B27
T26	DI_1.2+	B6	T66	DI_4.4-	D15	T106	DO_6.8-	D23	T146	DO_8.3-	C27
T27	DI_2.7-	C7	T67	DO_5.7+	E16	T107	DO_7.2+	E22	T147	DO_6.4+	B26
T28	DI_1.3-	B7	T68	DI_4.4+	D16	T108	DO_6.7+	D22	T148	DO_7.8+	C26
T29	DI_2.7+	C8	T69	DO_5.8-	E17	T109	DO_8.1-	D25	T149	DO_7.4+	A26
T30	DI_1.3+	B8	T70	DO_5.5-	D17	T110		E25	T150	DO_7.6-	A27
T31	DI_2.8-	C9	T71	DO_5.8+	E18	T111	DO_7.1+	E20	T151	DO_7.6+	A28
T32	DI_1.4-	B9	T72	DO_5.5+	D18	T112	DO_5.6+	D20	T152	DO_8.4-	A29
T33	DI_4.5-	E11	T73	DO_7.1-	E19	T113	DO_6.6+	C22	T153	DO_8.4+	A30
T34	DI_3.2-	D11	T74	DO_5.6-	D19	T114	DO_5.2+	B22	T154	DO_8.7-	A31
T35	DI_3.2+	D12	T75	DO_6.6-	C21	T115	DO_7.7-	C23	T155		E32
T36	DI_4.5+	E12	T76	DO_5.2-	B21	T116	DO_6.3-	B23	T156		B1
T37	DI_4.3-	D13	T77		D1	T117	DO_7.7+	C24	T157	DO_8.7+	A32
T38	DI_4.6-	E13	T78	DO_6.2-	A21	T118	DO_6.3+	B24	T158		A1
T39	DI_4.3+	D14	T79	DO_6.7-	D21	T119	DO_7.3+	A24	T159		B32
T40	DI_4.6+	E14	T80	DO_7.2-	E21	T120	DO_7.4-	A25	T160		C1

TABLE 3: EMX-7513 TO TB160SE TERMINAL BLOCK PIN AND SIGNAL MAPPING

TB Ref	Signal	Conn Pin	TB Ref	Signal	Conn Pin	TB Ref	Signal	Conn Pin	TB Ref	Signal	Conn Pin
T1		E2	T41	DO_4.7-	A15	T81	DO_4.2+	C14	T121	DO_6.2+	A22
T2		D2	T42	DO_3.6+	A14	T82	DO_2.6+	B14	T122	DO_7.3-	A23
T3	DO_2.1-	E3	T43	DO_3.6-	A13	T83	DO_5.3-	C15	T123	DO_6.1+	A20
T4		D3	T44	DO_3.5+	A12	T84	DO_3.7-	B15	T124	DO_4.8+	A18
T5	DO_2.1+	E4	T45	DO_2.4+	A10	T85	DO_5.3+	C16	T125	DO_6.1-	A19
T6		D4	T46	DO_3.1+	D10	T86	DO_3.7+	B16	T126	DO_4.7+	A16
T7	DO_2.2-	E5	T47	DO_3.4+	E10	T87	DO_5.4-	C17	T127	DO_4.8-	A17
T8	DO_1.7-	D5	T48	DO_4.1-	C11	T88	DO_3.8-	B17	T128		D32
T9	DO_2.2+	E6	T49	DO_2.5-	B11	T89	DO_5.4+	C18	T129	DO_8.6+	E30
T10	DO_1.7+	D6	T50	DO_3.5-	A11	T90	DO_3.8+	B18	T130		D30
T11	DO_3.3-	E7	T51	DO_2.5+	B12	T91	DO_6.5-	C19	T131	DO_8.6-	E29
T12	DO_1.8-	D7	T52	DO_4.1+	C12	T92	DO_5.1-	B19	T132		D29
T13	DO_3.3+	E8	T53	DO_2.6-	B13	T93	DO_6.5+	C20	T133		E31
T14	DO_1.8+	D8	T54	DO_4.2-	C13	T94	DO_5.1+	B20	T134		D31
T15	DO_3.4-	E9	T55	DO_2.4-	A9	T95	DO_8.8+	C32	T135	DO_8.5+	C30
T16	DO_3.1-	D9	T56	DO_2.3+	A8	T96		E1	T136	DO_8.2+	B30
T17	DO_1.5-	C3	T57	DO_2.3-	A7	T97		E26	T137	DO_8.8-	C31
T18		B3	T58	DO_1.1+	A6	T98	DO_8.1+	D26	T138		B31
T19		C2	T59	DO_1.1-	A5	T99		E24	T139	DO_8.2-	B29
T20		B2	T60		A4	T100	DO_6.8+	D24	T140	DO_8.5-	C29
T21	DO_1.5+	C4	T61		A3	T101		E27	T141	DO_7.5+	B28
T22		B4	T62		A2	T102		D27	T142	DO_8.3+	C28
T23	DO_1.6-	C5	T63	DO_1.4+	B10	T103		E28	T143	DO_7.8-	C25
T24	DO_1.2-	B5	T64	DO_2.8+	C10	T104		D28	T144	DO_6.4-	B25
T25	DO_1.6+	C6	T65	DO_5.7-	E15	T105		E23	T145	DO_7.5-	B27
T26	DO_1.2+	B6	T66	DO_4.4-	D15	T106	DO_6.8-	D23	T146	DO_8.3-	C27
T27	DO_2.7-	C7	T67	DO_5.7+	E16	T107	DO_7.2+	E22	T147	DO_6.4+	B26
T28	DO_1.3-	B7	T68	DO_4.4+	D16	T108	DO_6.7+	D22	T148	DO_7.8+	C26
T29	DO_2.7+	C8	T69	DO_5.8-	E17	T109	DO_8.1-	D25	T149	DO_7.4+	A26
T30	DO_1.3+	B8	T70	DO_5.5-	D17	T110		E25	T150	DO_7.6-	A27
T31	DO_2.8-	C9	T71	DO_5.8+	E18	T111	DO_7.1+	E20	T151	DO_7.6+	A28
T32	DO_1.4-	B9	T72	DO_5.5+	D18	T112	DO_5.6+	D20	T152	DO_8.4-	A29
T33	DO_4.5-	E11	T73	DO_7.1-	E19	T113	DO_6.6+	C22	T153	DO_8.4+	A30
T34	DO_3.2-	D11	T74	DO_5.6-	D19	T114	DO_5.2+	B22	T154	DO_8.7-	A31
T35	DO_3.2+	D12	T75	DO_6.6-	C21	T115	DO_7.7-	C23	T155		E32
T36	DO_4.5+	E12	T76	DO_5.2-	B21	T116	DO_6.3-	B23	T156		B1
T37	DO_4.3-	D13	T77		D1	T117	DO_7.7+	C24	T157	DO_8.7+	A32
T38	DO_4.6-	E13	T78	DO_6.2-	A21	T118	DO_6.3+	B24	T158		A1
T39	DO_4.3+	D14	T79	DO_6.7-	D21	T119	DO_7.3+	A24	T159		B32
T40	DO_4.6+	E14	T80	DO_7.2-	E21	T120	DO_7.4-	A25	T160		C1

TABLE 4: EMX-7514 TO TB160SE TERMINAL BLOCK PIN AND SIGNAL MAPPING

TB Ref	Signal	Conn Pin	TB Ref	Signal	Conn Pin	TB Ref	Signal	Conn Pin	TB Ref	Signal	Conn Pin
T1		E2	T41	DI_4.7-	A15	T81	DI_4.2+	C14	T121	DI_6.2+	A22
T2		D2	T42	DI_3.6+	A14	T82	DI_2.6+	B14	T122	DI_7.3-	A23
T3	DI_2.1-	E3	T43	DI_3.6-	A13	T83	DI_5.3-	C15	T123	DI_6.1+	A20
T4		D3	T44	DI_3.5+	A12	T84	DI_3.7-	B15	T124	DI_4.8+	A18
T5	DI_2.1+	E4	T45	DI_2.4+	A10	T85	DI_5.3+	C16	T125	DI_6.1-	A19
T6		D4	T46	DI_3.1+	D10	T86	DI_3.7+	B16	T126	DI_4.7+	A16
T7	DI_2.2-	E5	T47	DI_3.4+	E10	T87	DI_5.4-	C17	T127	DI_4.8-	A17
T8	DI_1.7-	D5	T48	DI_4.1-	C11	T88	DI_3.8-	B17	T128		D32
T9	DI_2.2+	E6	T49	DI_2.5-	B11	T89	DI_5.4+	C18	T129	DI_8.6+	E30
T10	DI_1.7+	D6	T50	DI_3.5-	A11	T90	DI_3.8+	B18	T130		D30
T11	DI_3.3-	E7	T51	DI_2.5+	B12	T91	DI_6.5-	C19	T131	DI_8.6-	E29
T12	DI_1.8-	D7	T52	DI_4.1+	C12	T92	DI_5.1-	B19	T132		D29
T13	DI_3.3+	E8	T53	DI_2.6-	B13	T93	DI_6.5+	C20	T133		E31
T14	DI_1.8+	D8	T54	DI_4.2-	C13	T94	DI_5.1+	B20	T134		D31
T15	DI_3.4-	E9	T55	DI_2.4-	A9	T95	DI_8.8+	C32	T135	DI_8.5+	C30
T16	DI_3.1-	D9	T56	DI_2.3+	A8	T96		E1	T136	DI_8.2+	B30
T17	DI_1.5-	C3	T57	DI_2.3-	A7	T97		E26	T137	DI_8.8-	C31
T18		B3	T58	DI_1.1+	A6	T98	DI_8.1+	D26	T138		B31
T19		C2	T59	DI_1.1-	A5	T99		E24	T139	DI_8.2-	B29
T20		B2	T60		A4	T100	DI_6.8+	D24	T140	DI_8.5-	C29
T21	DI_1.5+	C4	T61		A3	T101		E27	T141	DI_7.5+	B28
T22		B4	T62		A2	T102		D27	T142	DI_8.3+	C28
T23	DI_1.6-	C5	T63	DI_1.4+	B10	T103		E28	T143	DI_7.8-	C25
T24	DI_1.2-	B5	T64	DI_2.8+	C10	T104		D28	T144	DI_6.4-	B25
T25	DI_1.6+	C6	T65	DI_5.7-	E15	T105		E23	T145	DI_7.5-	B27
T26	DI_1.2+	B6	T66	DI_4.4-	D15	T106	DI_6.8-	D23	T146	DI_8.3-	C27
T27	DI_2.7-	C7	T67	DI_5.7+	E16	T107	DI_7.2+	E22	T147	DI_6.4+	B26
T28	DI_1.3-	B7	T68	DI_4.4+	D16	T108	DI_6.7+	D22	T148	DI_7.8+	C26
T29	DI_2.7+	C8	T69	DI_5.8-	E17	T109	DI_8.1-	D25	T149	DI_7.4+	A26
T30	DI_1.3+	B8	T70	DI_5.5-	D17	T110		E25	T150	DI_7.6-	A27
T31	DI_2.8-	C9	T71	DI_5.8+	E18	T111	DI_7.1+	E20	T151	DI_7.6+	A28
T32	DI_1.4-	B9	T72	DI_5.5+	D18	T112	DI_5.6+	D20	T152	DI_8.4-	A29
T33	DI_4.5-	E11	T73	DI_7.1-	E19	T113	DI_6.6+	C22	T153	DI_8.4+	A30
T34	DI_3.2-	D11	T74	DI_5.6-	D19	T114	DI_5.2+	B22	T154	DI_8.7-	A31
T35	DI_3.2+	D12	T75	DI_6.6-	C21	T115	DI_7.7-	C23	T155		E32
T36	DI_4.5+	E12	T76	DI_5.2-	B21	T116	DI_6.3-	B23	T156		B1
T37	DI_4.3-	D13	T77		D1	T117	DI_7.7+	C24	T157	DI_8.7+	A32
T38	DI_4.6-	E13	T78	DI_6.2-	A21	T118	DI_6.3+	B24	T158		A1
T39	DI_4.3+	D14	T79	DI_6.7-	D21	T119	DI_7.3+	A24	T159		B32
T40	DI_4.6+	E14	T80	DI_7.2-	E21	T120	DI_7.4-	A25	T160		C1

TABLE 5: EMX-7515 TO TB160SE TERMINAL BLOCK PIN AND SIGNAL MAPPING