Model JI-4040
USB Multifunction Digital I/O Module - Isolated

User Manual

Version 1.2

Jupiter Instruments

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1. INTRODUCTION

The JI-4040 module is a versatile, easy-to-use device for adding universal digital I/O capability to a computer system via a USB connection. The module is comprised of 36 bidirectional I/O channels and 2 Special Function Ports (SFP). The SFP can be software programmed as a variable duty-cycle clock/pulse generator, event counter, or interval/pulse timer. The I/O is selectable to interface 5.0 V, 3.3 V, 2.5 V, or 1.8 V systems. Host to module isolation eliminates ground-loops and provides protection from noise and switching transients on external signals. The JI-4040 is available as either a desktop unit or low-cost OEM board.

The JI-4040 includes a Windows 2000/XP/7 compatible software package. This contains sample programs and source code written in Visual C#, and an application program that provides access to all I/O ports and control of the SFPs.

Features

- 36 bidirectional I/O channels – Four 8-bit and two 2-bit ports
- 2 Special Function Ports (SFP). Programmable functions include:
    - Event Counter
    - Pulse/Period Timer
    - Clock/Pulse Generator
- Selectable I/O voltage: 5.0V, 3.3V, 2.5V, 1.8V, and Adj.
- High-current I/O drive: +/-32 mA @ 5.0 V, +/-24 mA @ 3.3 V
- Selectable I/O pull-up/pull-down resistors
- 500Vrms Isolation rating
- USB 2.0 compatible
- Available as either a desktop unit or low-cost OEM board.
- Power provided via USB bus*

    * Optional power supply required if combined I/O source current exceeds 300 mA

2. CONNECTORS AND JUMPERS

2.1 Connectors

Onboard connectors link the JI-4040 to external devices such as host computer (USB), optional I/O power supply, and user specified I/O.

2.1.1 Connector Locations

Figure 1. Connector Locations

1. **I/O Connector**: 50-pin IDC, keyed (3M D2550-5002-AR)
2. **USB Connector**: Type 'B', (Molex 67068-0000)
3. **External I/O Power Connector (Optional)**: Circular, 2.1MM (CUI PJ-102A)

2.1.2 I/O Connector 50-pin

Figure 2 shows the pin-outs of the 50-pin connector.

50-Pin Connector Pin Outs

Connector type	50-pin, IDC, 0.10" x 0.10" with polairization. PN: 3M D2550-5002-AR

Connector Pin-Outs

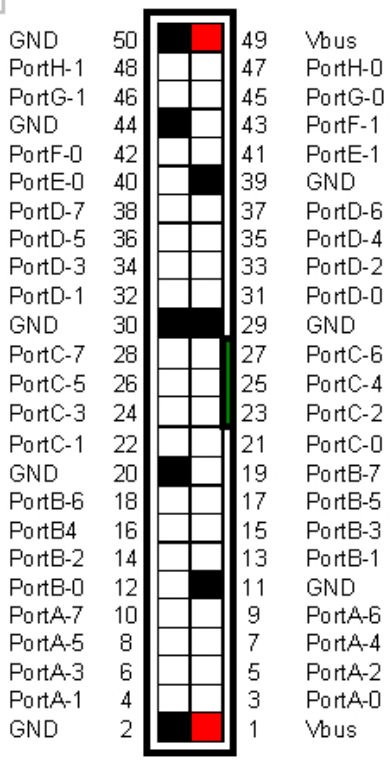

Figure 2. 50-pin I/O Connector

The following table contains a brief description of the connector signals.

Signal Name	Direction	Description
Port A <7..0> Port B <7..0> Port C <7..0> Port D <7..0>	Input/Output	8-bit General Purpose I/O port. Software direction configurable.
Port E <1..0> Port F <1..0>	Input/Output	2-bit General Purpose I/O port. Software direction configurable.
Port G <1..0> Port H <1..0>	Input/Output	2-bit Special Function Port (SFP). Software configurable for the following functions: 1. Clock/Pulse Generator – Output 2. Pulse/Period Timer – Input 3. Event Counter – Input
Vbus	Output	Voltage source (I/O Voltage Level)
GND	-	Ground – Reference for the port signals and the Vbus supply.

Table 1. Connector Signals

2.2 Jumper Settings

Figure 3 below shows the location of the four jumpers (J2, J3, J5, and J6) used to select the I/O voltage and I/O pull-up polarity.

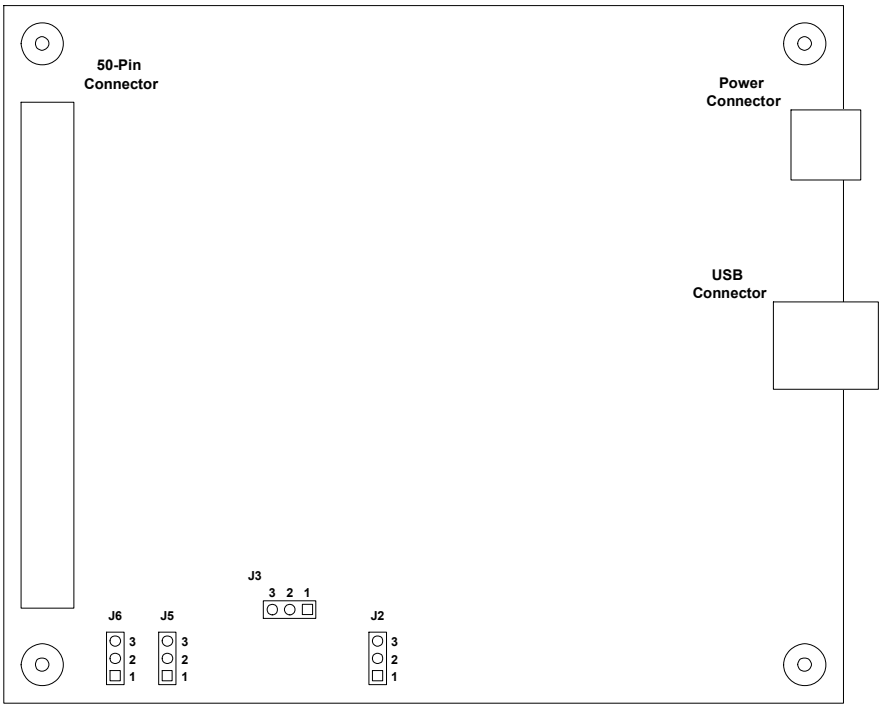

Figure 3. Jumper Locations (PCB Top Side)

2.2.1 I/O Voltage

The I/O voltage is configured via jumpers J2, J3, and J5 located on the lower left hand side of the circuit board towards the 50-pin connector (see Figure 3). If the JI-4040 enclosure is used, see appendix F for instructions on removing the back panel to access these jumpers. Use the following table to set the desired I/O voltage.

J2	J3	J5	Power Source	I/O Voltage
1 to 2	1 to 2	X	Internal (Standard)	5.0V
1 to 2	2 to 3	Open	Internal (Standard)	3.3V
1 to 2	2 to 3	2 to 3	Internal (Standard)	2.5V
1 to 2	2 to 3	1 to 2	Internal (Standard)	1.8V
2 to 3	1 to 2	X	External (Optional)	5.0V
2 to 3	2 to 3	Open	External (Optional)	3.3V
2 to 3	2 to 3	2 to 3	External (Optional)	2.5V
2 to 3	2 to 3	1 to 2	External (Optional)	1.8V

Table 2. I/O Voltage Configuration Table

2.2.2 I/O Pull-up

The I/O pull-up/pull-down selection is configured via jumper J6 located on the lower left hand side of the circuit board towards the 50-pin connector (see Figure 3). If the JI-4040 enclosure is used, see appendix E for instructions on removing the back panel to access these jumpers. Use the table below to set the desired pull-up polarity.

J6	Configuration
1 to 2	Pull-up to Vbus
2 to 3	Pull-down to GND
Open	Float

Table 3. I/O Pull-up/Pull-down Configuration Table

3. GETTING STARTED

3.1 Set I/O Voltage and Pull-ups

If you have not already done so, set the JI-4040 I/O voltage to 5.00 volts and configure the I/O pull-up for pull-up. See section 2.2 and 2.3 for details.

3.2 Software Installation

A USB driver as well as test software will be installed. Refer to appendix C and D for step-by-step installation instructions.

3.3 USB Driver Check

1. Connect the JI-4040 to the host PC using the 6' USB cable.
2. After a few seconds, confirm that the JI-4040 is powered by verifying that the green PWR LED on the rear panel is on.

   If the PWR LED does not illuminate or if the LED goes out after 10 – 20 seconds, an error has occurred. Begin troubleshooting by verifying that USB driver is installed. See appendix C for details.
3. The USB Drive/HW Check has passed.

3.4 Software Check

1. Ensure that the JI-4040 unit is connected to the host PC and power is on.
2. Go to the folder where the test application software is installed (ex. C:/JI-4040/)
3. Launch the test application by clicking JI-4040_Test_App_VerXX.exe.
4. Verify that the test application main window is displayed as shown in figure 4.

Figure 4. JI-4040 Test Application Main window

If an error occurs and the window does not appear, begin by verifying that the .NET Framework is installed on the host PC. To do this, click **Start** on your windows desktop, select **Control Panel**, and then double-click the **Add or Remove Programs** icon. When the window appears, scroll through the list of installed programs. Verify that the .NET Framework 3.0 (or higher) is listed. If not, go to http://msdn2.microsoft.com/en-us/netframework/aa569263.aspx for instructions on downloading and installing the latest .NET Framework version.

5. At the main window, open a USB port by clicking the **Open** button in the USB Connection group.

6. At the menu bar, open the **About** message box.

7. Verify that the version numbers for the **HW Version** and **VHDL Version** are valid (i.e. HW Version: 1.0, VHDL Version: 2.1, etc.) If a question mark (HW Version: ?, or VHDL Version: ?) or some other character appears, an error has occurred.

8. If no errors have occurred (or if errors have been resolved) the Software Check has passed.

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3.5 GPIO Test

This exercise verifies GPIO operation and familiarizes the user with the four 8-bit, and two 2-bit GPIO ports. Required equipment to complete this exercise is listed below:

1. Output Test Fixture (see appendix F) or an oscilloscope or DVM.
2. Input Test Fixture (see appendix G) or a set of 8 jumper wires.
3. JI-4040 test application software (JI-4040_Test_App_VerXX.exe)

3.5.1 Output Test

Complete the following steps:

A. Setup

1. Remove JI-4040 power by disconnecting the USB cable.

2. Ensure that the JI-4040 I/O voltage is set to 5.00 volts and the I/O pull-up is configured for pull-up. (See section 2.2 for details)

3. Connect the Output Test Fixture to Port A.

    1. Connect the test fixture GND lead a convenient ground pin on the 50-pin connector (See figure 2).
    2. Connect the 8 LED leads to corresponding port pins (i.e. LED-0 connects to port A-0)

4. Connect the JI-4040 to the host PC.

5. Launch the JI-4040 test application and open the USB-port.

B. Run Test

1. At the main window, set ports A –F to output by clicking the **Output** button in the Data Direction grouping for each port.

2. Set port A to 55h by writing 55h to the port A write text box in the Red/Write grouping, followed by clicking the **Write** button.

3. Verify that every other LED is illuminated beginning at LED-1. Specifically, LEDs 0, 2, 4, and 6 are on, and LEDs 1, 3, 5 and 7 are off.

4. Now, change port A data to AAh (i.e. repeat step B-2).

5. Verify that every other LED is illuminated beginning at LED-2. Specifically, LEDs 1, 3, 5 and 7 are on and LEDs 0, 2, 4 and 6 are off.

6. Port A Output Test is complete.

C. Test remaining ports B – F

1. Next, repeat step A and B for the remaining 5 ports (B – F), moving the test fixture to each port. For ports E and F, only connect LEDs 0 and 1.

2. If no errors were encountered in the above steps, the Output Test has passed

3.5.2 Input Test

Complete the following steps:

A. Setup

1. Remove JI-4040 power by disconnecting the USB cable.

2. Ensure that the JI-4040 I/O voltage is set to 5.00 volts and the I/O pull-up is configured for pull-up. (See section 2.2 for details)

3. Connect the Output Input Test Fixture to Port A.

    1. Connect the test fixture GND lead a convenient ground pin on the 50-pin connector (See figure 2).
    2. Connect the 8 DIP switch leads to corresponding port pins (i.e. SW-0 connects to portA-0)

4. Connect the JI-4040 to the host PC.

5. Launch the JI-4040 test application and open the USB-port.

B. Run Test

1. At the main window, set ports A –F to input by clicking the **Input** button in the Data Direction grouping for each port.

2. At the Input Test fixture, alternately switch every other switch on beginning at SW-0. Specifically, SW-0, 2, 4, and 6 are on, and SW-1, 3, 5, 7 are off.

3. Read port A by clicking the **Read** button for port A in the Red/Write grouping.

4. Verify that port A reads 55h.

5. Now, change test fixture settings such that every other switch is on beginning at SW-1. Specifically, SW-1, 3, 5, 7 are on, and SW-2, 4, 6, and 8 are off.

6. Verify that port A reads AAh.

7. Port A Input Test is complete.

C. Test remaining ports B – F

1. Next, repeat step A and B for the remaining 5 ports, moving the test fixture to each port. For ports E and F, only connect switches SW-0 and SW-1. Substitute the value 1 for 55h in step B-2 and 2 for AAh in step B-6.

2. If no errors were encountered in the above steps, the Input Test has passed

3.6 SFP Test

This exercise verifies SFP operation and familiarizes the user with the four operational modes:

1. Clock Generator
2. Pulse Generator
3. Pulse/Period Timer
4. Event Counter

Required equipment to complete this exercise is listed below:

1. Output Test Fixture (see appendix F) or an oscilloscope or DVM.
2. 1 jumper wire.
3. JI-4040 test application software (JI-4040_Test_AppXX.exe)

3.6.1 Clock and Pulse Generator

Complete the following steps:

A. Setup

1. Remove JI-4040 power by disconnecting the USB cable.
2. Ensure that the JI-4040 I/O voltage is set to 5.00 volts and the I/O pull-up is configured for pull-up. (See section 2.2 for details)
3. Connect the Output Test Fixture to Port E.
    1. Connect the test fixture GND lead a convenient ground pin on the 50-pin connector (See figure 2).
    2. Connect the 2 LED leads to corresponding port pins (i.e. LED-0 connects to port G-0)
4. Connect the JI-4040 to the host PC.
5. Launch the JI-4040 test application and open the USB-port.

B. Set Clock Generator to 1Hz and run test

1. At the Port G Configuration, select **10uS** in the CLK Prescalar group box.
2. Begin by testing the CLK Generator. Select the CLK mode by clicking the **CLK** button in the Generator group box.
3. Next, enter 500ms in both the tHIGH and tLOW text boxes.
4. Now, start the CLK by clicking the green **Start** button at the bottom.
5. Verify two, alternate blinking LEDs. The frequency should be 1 Hz.
6. Next, stop the CLK by clicking the red **Stop** button.
7. Verify that the blinking has stopped and that LED-0 is off and LED-1 is on.
8. The Clock Generator test is complete.

C. Set Pulse Generator for 500ms and run test

1. Select the Pulse Generator by clicking the **Pulse** button in the Generator group box.
2. Now, generate a 500mS pulse by clicking the **Start** button at the bottom.
3. Verify that the LED-0 is on and LED-1 is off for 500mS each time the start button is clicked.
4. The Pulse Generator test is complete.

D. Run Port H Pulse/Period Test

1. Next, repeat step A – C for port H.
2. If no errors were encountered, the port H Clock and Pulse Generator test is complete.

3.6.2 Pulse/Period Timer

Complete the following steps:

A. Setup

1. Remove JI-4040 power by disconnecting the USB cable.
2. Ensure that the JI-4040 I/O voltage is set to 5.00 volts and the I/O pull-up is configured for pull-up. (See section 2.2 for details)
3. Connect a jumper wire from port G pin-1 to port H pin-1.
4. Connect the JI-4040 to the host PC.
5. Launch the JI-4040 test application and open the USB-port.

B. Configure Port H as a 1KHz clock source

1. At the Port H Configuration, ensure that the **1uS** is selected in the CLK Prescalar group box
2. Select the CLK mode by clicking the **CLK** button in the Generator group box.
3. Next, enter 500us in both the tHIGH and tLOW text boxes.
4. Now, start the CLK by clicking the **Start** button at the bottom.
5. Port H 1KHz clock source is now running.

C. Configure Port G as a Period Timer and run test

1. At the Port G Configuration, ensure that **1uS** is selected in the CLK Prescalar group box
2. Next, select period timer by clicking the **Period** button in the Timer group box.
3. Now, start the timer by clicking the green **Start** button at the bottom of the group box.
4. After a few seconds, verify that the Status reads “Done” and the Time reading is 1000uS.
5. The port G Period Timer test is complete.

D. Configure Port G as a Pulse Timer and run test

1. At the Port G Configuration, ensure that **1uS** is selected in the CLK Prescalar group box
2. Next, select period timer by clicking the **Pulse** button in the Timer group box.
3. Now, start the timer by clicking the **Start** button at the bottom of the group box.
4. After a few seconds, verify that the Status reads “Done” and the Time reading is 500uS.
5. The port G Pulse Timer test is complete.

E. Run Port H Pulse/Period Test

1. Repeat steps A – D by substituting the text Port G for Port H in step B, and Port H for Port G in steps C and D.
2. If no errors were encountered, the port H Pulse/Period Timer test is complete.

3.6.3 Event Counter

Complete the following steps:

A. Setup

1. Remove JI-4040 power by disconnecting the USB cable.
2. Ensure that the JI-4040 I/O voltage is set to 5.00 volts and the I/O pull-up is configured for pull-up. (See section 2.2 for details)
3. Connect a jumper wire from port G pin 1 to port H pin 1.
4. Connect the JI-4040 to the host PC.
5. Launch the JI-4040 test application and open the USB-port.

B. Configure Port H as a 1000uS One-shot

1. At the Port H Configuration, ensure **1uS** is selected in the CLK Prescalar group box
2. Select the CLK mode by clicking the **Pulse** button in the Generator group box.
3. Next, enter 1000us in the tHIGH text box.

C. Configure Port G as a Counter and run test

1. At the Port G Configuration, click the **Rising Edge** button in the Counter group box.
2. Next, click the enabled **Always** radio button.
3. Now, start the counter by clicking the **Start** button at the bottom of the group box.
4. Next, send 10 pulses to port H by clicking the **Start** button at the Port H Configuration.
5. Now, stop the counter by clicking the **Stop** button at the Port G Configuration.
6. Verify that the port G count reading is 10.
7. The port G Event Counter test is complete.

D. Run Port H Event Counter Test

1. Substitute the text “Port G” for “Port H” and “Port H” for “Port G” in steps A – C. Then repeat steps A – C.
2. If no errors were encountered, the Port H Event Counter test is complete.

4. FUNCTIONAL DESCRIPTION

4.0 Block Diagram

Figure 5 shows the key functional components of the JI-4040.

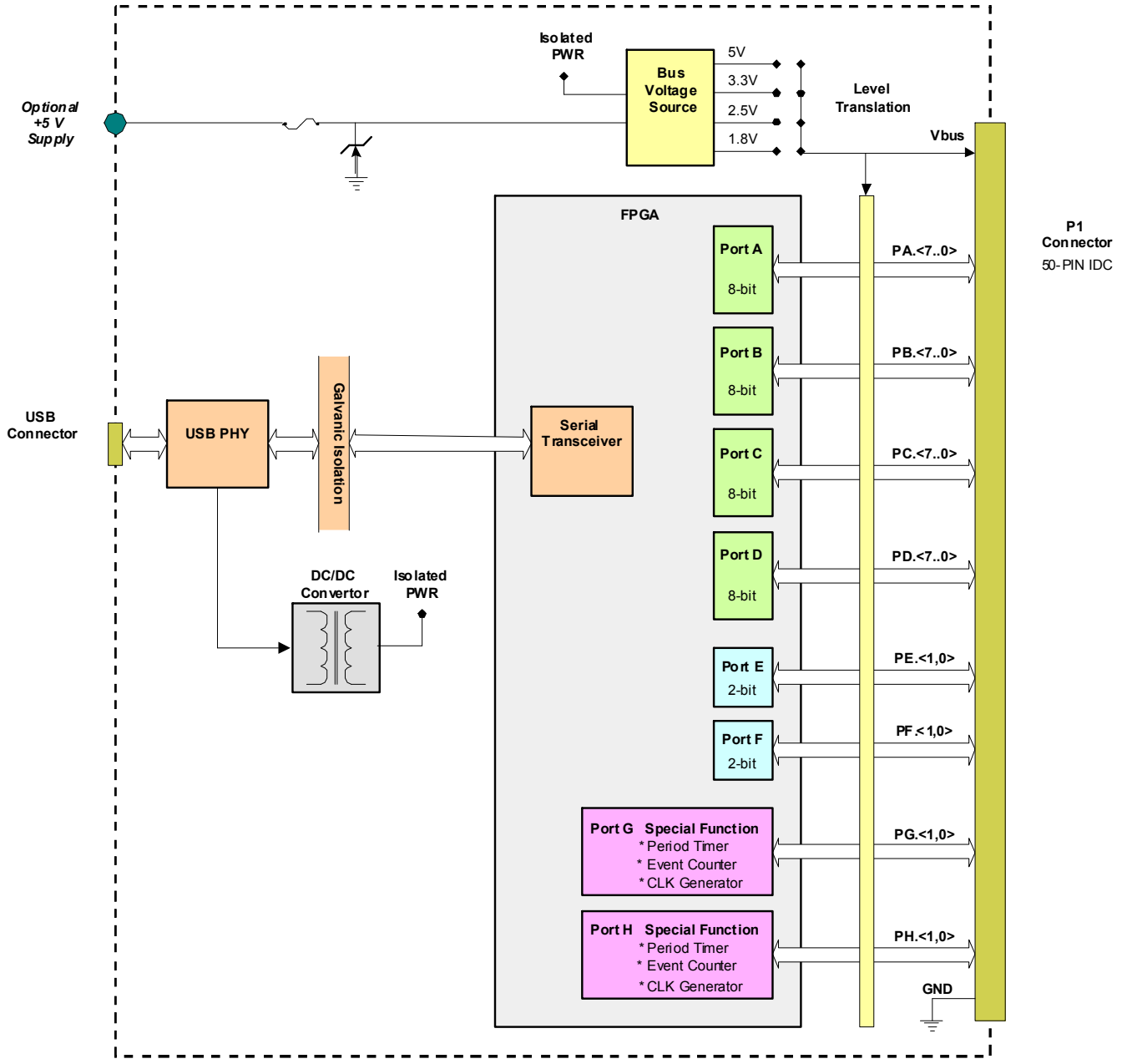


Figure 5. JI-4040 Block Diagram

4.1 I/O Ports

The JI-4040 is comprised of 2 port types:

1. General Purpose I/O (GPIO) 8-bit and 2-bit
2. Special Function Port

There are four, 8-bit GPIO, two, 2-bit GPIO ports and two, 2-bit Special Function Ports (SFP) for a total of 40 I/O pins. All I/Os include a 100K resistor that is jumper configurable as either a pull-up or pull-down (see Table 3). The I/O voltage is jumper selectable for either 5.0V, 3.3V, 2.5V, or 1.8V operation (see Table 2). Custom voltages can be selected with a single resistor change (See Appendix TBD) or ordered custom from the factory.

4.1.1 General Purpose I/O

The JI-4040 includes 36 general purpose I/Os organized as four, 8-bit ports (A, B, C, D) and two, 2-bit ports (E, F). Each port is assigned as either an input or output via a Data Direction command. Upon power-up, all ports are reset to input. Commands are available to read/write each port either individually (8-bit, byte mode) or concurrently (32-bit, long word mode) for ports A – D. 8-bit and 2-bit GPIO block diagrams are shown in figures 6 and 7, respectively.

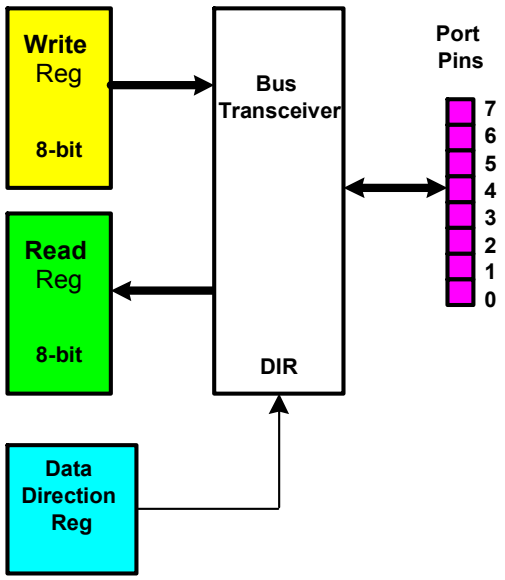


Figure 6. 8-Bit Port Block Diagram

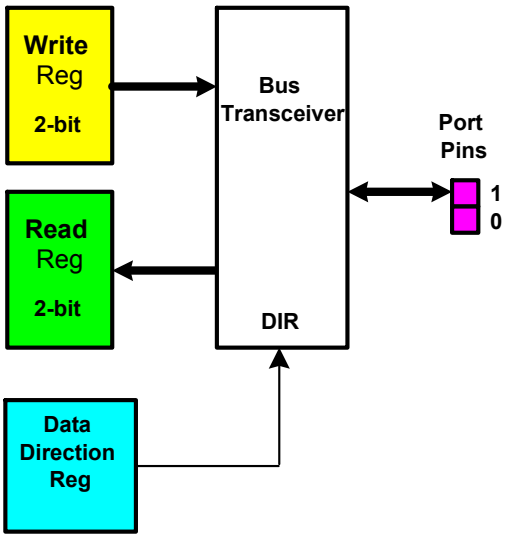


Figure 7. 2-Bit Port Block Diagram

Registers

Each GPIO is individually controlled by way of three registers:

1. Data Direction Register (DDR)
2. Read Register
3. Write Register

The DDR selects the direction of data flow for the selected port. The direction is typically set once at the beginning of a session. However, bi-directional data flow is possible by setting the DDR for each change in direction.

As the names suggest, the Read register reads data from the port pins and the Write register latches data to the port pins. A read or write can be performed irrespective of the DDR setting.

4.1.2 Special Function Port (SFP)

The JI-4040 includes 2 special function ports (G, H). Each port is configured in one of four modes:

1. Clock Generator
2. Pulse Generator
3. Pulse/Period Timer
4. Event Counter

The Mode is selected via the Port Configuration Register.

Data (HEX)	Function	Operation Details
20	CLK Gen	Continuous Wave (CW)
21	Pulse Gen	One-Shot Pulse
30	Period Timer	Positive, rising-edge to rising-edge
31	Period Timer	Period, falling-edge to falling-edge
32	Pulse Timer	Pulse, rising-edge to falling-edge
33	Pulse Timer	Pulse, falling-edge to rising-edge
40	Event Counter	Rising-edge, D0 = X
41	Event Counter	Falling-edge, D0 = X
44	Event Counter	Rising-edge, Enable when D0 = 0
45	Event Counter	Falling-edge, Enable when D0 = 0
46	Event Counter	Rising-edge, Enable when D0 = 1
47	Event Counter	Falling-edge, Enable when D0 = 1

Figure 3. Port Configuration Register

4.1.2.1 Clock Generator

A block diagram of the Clock Generator is shown in figure 8 below.

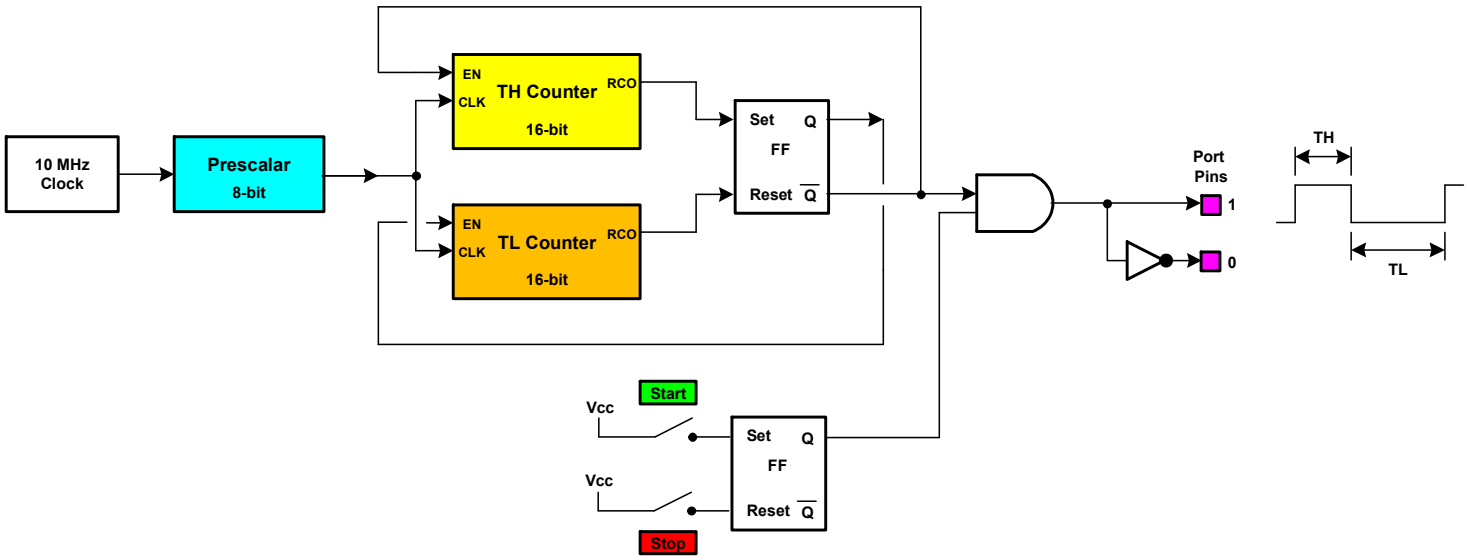


Figure 8. Clock Generator Diagram

The Clock Generator produces a variable duty-cycle, variable frequency signal with stop/start control. The signal is output on pin 1 and the complement is available on pin 0. The Clock Generator mode is selected by writing 20h to the configuration register of the selected port.

The frequency and duty-cycle of the clock signal is controlled by the setting of the Prescalar, TH Counter, and TL Counter registers. Register definitions are as follows,

N_{TH} = TH Register, valid range 0000h to ffffh
N_{TL} = TL Register, valid range 0000h to ffffh
N_{PRE} = Prescalar Register, valid range 00h to ffh

$$t_H = (N_{TH} + 1) * (N_{PRE} + 1) * (0.1)uS$$
$$t_L = (N_{TL} + 1) * (N_{PRE} + 1) * (0.1)uS$$

Using the following equations to set the CLK frequency and duty cycle

Duty Cycle

$$D = t_H / (t_H + t_L)$$
$$= (N_{TH} + 1) / ((N_{TH} + 1) + (N_{TL} + 1))$$

Frequency

$$f = 1/ (t_H + t_L)$$
$$= 10^7 / ((N_{TH} + N_{TL} + 2)(N_{PRE} + 1)) \quad Hz$$

Below are calculated register values for selected CLK frequencies and duty cycles.

Frequency	Duty Cycle %	Configuration Register	Prescalar Register (N_{PRE})	TH Register (N_{TH})	TL Register (N_{TL})
5MHz	50	20h	00h	0000h	0000h
1MHz	50	20h	00h	0004h	0004h
100KHz	50	20h	09h	0004h	0004h
10KHz	50	20h	09h	0031h	0031h
10KHz	25	20h	09h	0018h	004ah
1KHz	50	20h	09h	01f3h	01f3h
100Hz	50	20h	09h	1387h	1387h
1Hz	50	20h	F9h	4e1fh	4e1fh

Table 6. Register values for selected CLK frequencies and duty cycles

4.1.2.2 **Pulse Generator**

A block diagram of the Pulse Generator is shown in figure 9 below.

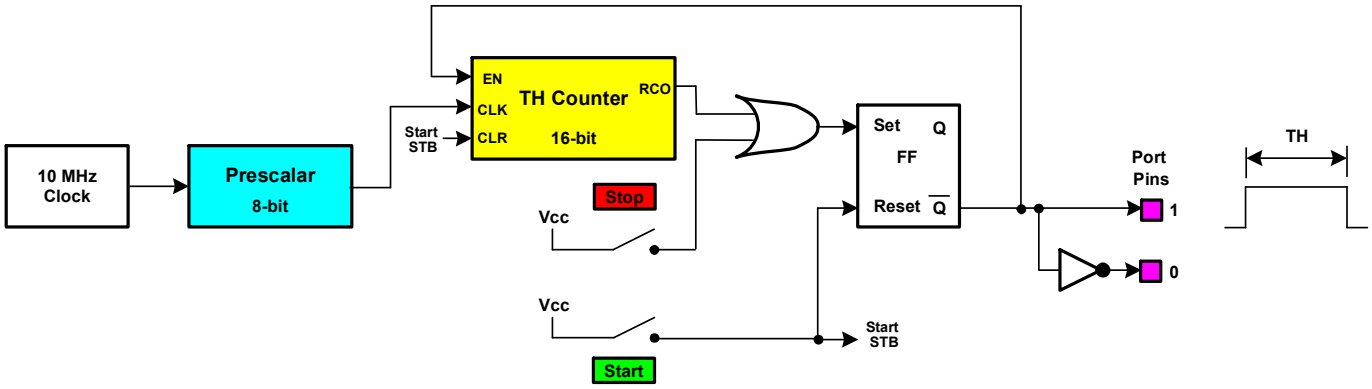


Figure 9. Pulse Generator Diagram

The Pulse Generator produces a single pulse with each write to the start control. The width of the pulse is set by the Prescalar and TH Counter registers. The pulse signal can be prematurely terminated by issuing a stop command. The signal is output on pin 1 and the complement is available on pin 0. The Pulse Generator mode is selected by writing 21h to the Configuration register of the selected port.

Using the following equation to set the period of the signal

N_{TH} = TH Register, valid range 0000h to ffffh
N_{PRE} = Prescalar Register, valid range 00h to ffh

$$t_H = (N_{TH} + 1) * (N_{PRE} + 1) * (0.1)uS$$

Below are calculated register values for selected pulse widths.

Pulse Width	Configuration Register	Prescalar Register (N_{PRE})	TH Register (N_{TH})
100nS	21h	00h	0000h
1.00uS	21h	00h	0009h
10.0uS	21h	09h	0009h
50uS	21h	09h	0031h
100uS	21h	09h	0063h
1mS	21h	09h	03e7h
100mS	21h	31h	4e1fh
0.5S	21h	F9h	4e1fh

Table 5. Register values for selected pulse widths

A “Done” bit in the Port Status register indicates pulse completion. The bit location is shown below

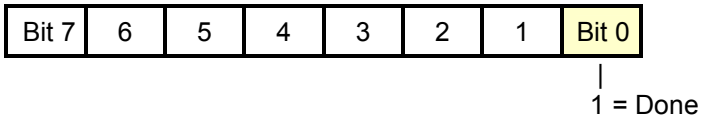


Figure 10. Port Status Register

4.1.2.3 **Pulse/Period Timer**

A block diagram of the Pulse/Period Timer is shown in figure 11 below.

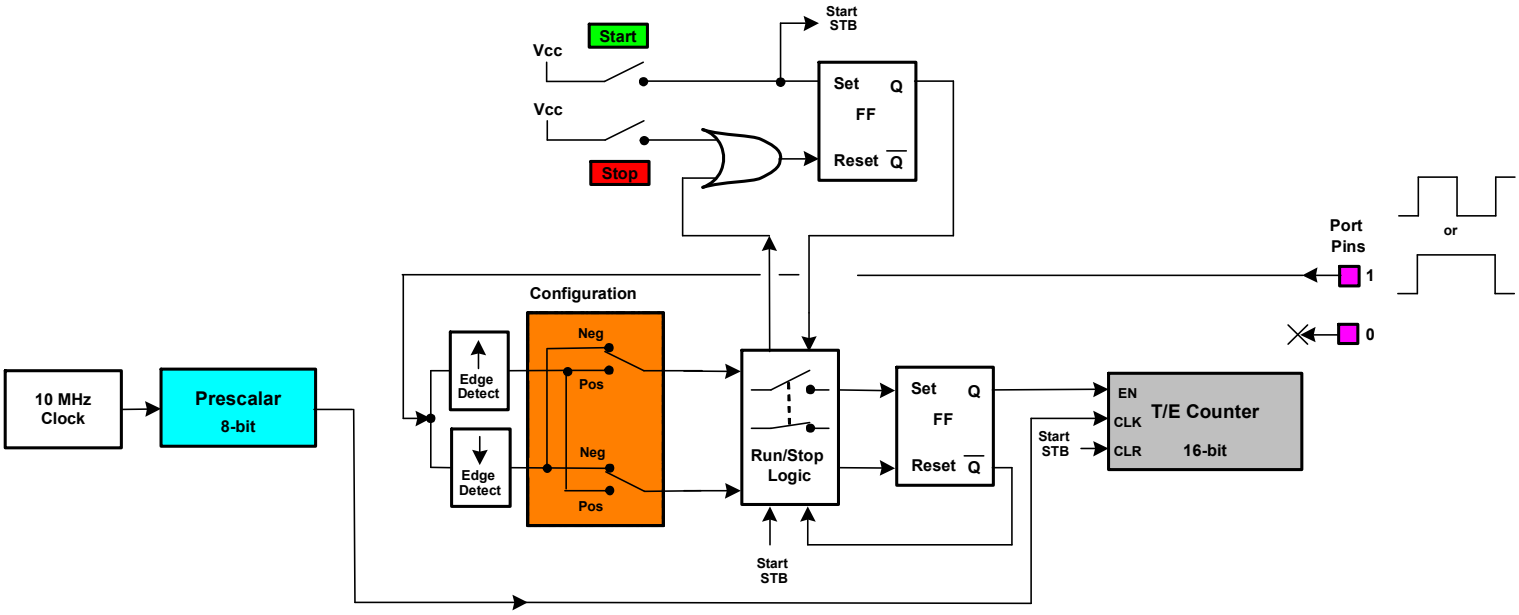
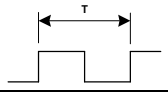
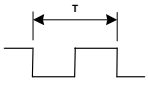
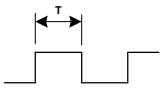


Figure 11. Pulse/Period Timer Diagram

The Pulse/Period Timer measures the period or pulse width of a signal. The measurement resolution/maximum period is set by the Prescalar register. Measurement options include rising or falling edge period measurements, and positive or negative pulse width measurements. A Start command initiates a measurement, and a “Data RDY” bit in the Port Status register indicates measurement completion. An “Overflow” bit signals a measurement error. A Stop command aborts any measurement in process. The signal input is on pin 1. Pin 0 is not used.

Use the table below to select the Pulse/Period Timer mode and measurement options.

Configuration Register	Function
30h	Period – Positive 
31h	Period – Negative 
32h	Pulse – Positive 

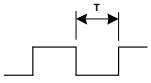
33h	Pulse – Negative 

Table 6. Pulse/Period Timer Configuration

Use the following equations to set the resolution/maximum period of the measurement.

N_{PRE} = Prescalar Register, valid range 00h to ffh
$N_{T/E}$ = T/E Register, valid range 00h to ffffh

Resolution (minimum period)

$$T_{min} = (N_{PRE} + 1)*0.100uS$$

Maximum period

$$T_{max} = (N_{PRE} + 1)*6.5536mS$$

Use the following equation to calculate the period of the signal.

$$T = (N_{PRE} + 1)(N_{T/E})*0.100uS$$

Below are register values for selected configurations.

Function	Configuration Register	Prescaler Register	Resolution	Maximum Period
Period-positive	30h	00h	100nS	65.536mS
Period-negative	31h	09h	1uS	65.536mS
Pulse-positive	32h	63h	10uS	655.36mS
Pulse-negative	33h	67h	20uS	1.3107S

Table 7. Register values for selected configurations

Status bits for the Pulse/Period Timer are located in the Port Status Register

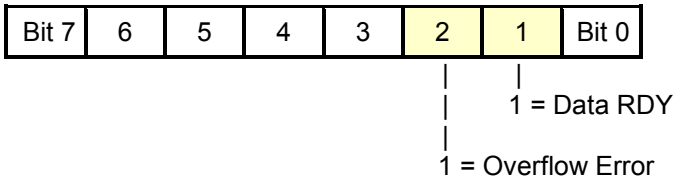


Figure 12. Port Status Register

4.1.2.4 Event Counter

A block diagram of the Event Counter is shown in figure 13 below.

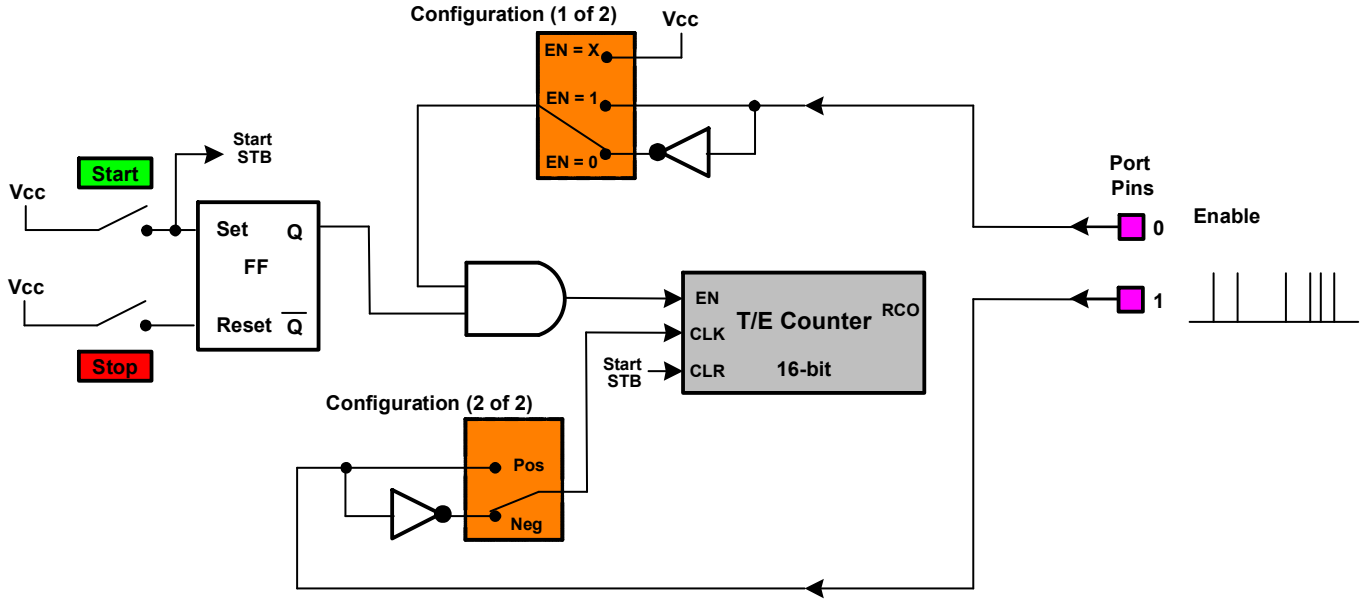


Figure 13. Event Counter Block Diagram

The Event Counter, counts the occurrence of a signal transition. Measurement options include selection of a rising or falling edge transition and a qualification signal that enables counting when pulled to a 1 or 0 state. A Start command initiates a measurement, and a Stop command halts a measurement. A "Done" bit in the Port Status register indicates measurement completion and that valid data is available at the T/E Register. An "Overflow" bit signals a measurement error. The signal input is on pin 1. Pin 0 is the optional input enable signal.

Use the table below to select the Event Counter mode and measurement options.

Configuration Register	Counter Enabled	Count Transition
40h	Always	Rising-Edge
41h	Always	Falling-Edge
42h	Bit 0 = 1	Rising-Edge
43h	Bit 0 = 1	Falling-Edge
43h	Bit 0 = 0	Rising-Edge
40h	Bit 0 = 0	Falling-Edge

Table 8. Event Counter Configuration

Status bits for the Event Counter are located in the Port Status Register

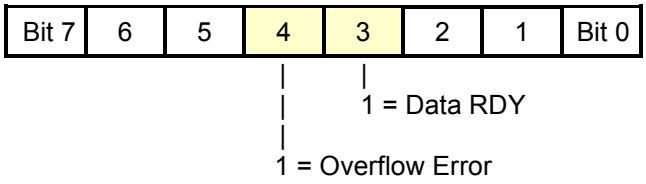


Figure 14. Port Status Register

APPENDIX A

1.0 Specifications

USB Multifunction Digital I/O Module - Isolated
Model JI-4040 *Jupiter Instruments*
Ver 1.4

Electrical Specifications 4/21/2011 Edition

Digital I/O	
Channel Count	36 Input/output (Four 8-bit and two 2-bit ports)
Power-on State	Default to inputs, pull-up/pull-down (100 K ohms)
Data Transfers	Programmed I/O
Special Function Port (SFP)	
Number of SFPs	Two independent ports (2-bit)
Function Modes:	
Event Counter	
Count	16-bits with overflow flag
Trigger	Configurable: Rising/falling edge and 1-bit input qualifier
Pulse width	>100 ns minimum
Pulse/Period Timer	
Timer	16-bits with a programmable 8-bit prescalar
Base Clock	10 MHz
Configuration	Rising/falling edge combinations
Pulse Width	>100 ns minimum
Measurement Range	100 ns to 1.677 s with overflow flag
CLK Generator	
Configuration	t_{HIGH} & t_{LOW} 16-bit timers with an 8-bit prescalar
Base Clock	10 MHz
Frequency Range	0.298 Hz to 5.00 MHz
Duty cycle	Programmable: (2^16 - 1) steps from 0.0015% to 99.84%
Pulse Generator	
Configuration	t_{HIGH} 16-bit timer with an 8-bit prescalar
Base Clock	10 MHz
Pulse Width Range	100 nS to 1.67 S
I/O Charactersicts	
I/O Voltage	Selectable: 5.0V, 3.3V, 2.5V, 1.8V, and Adj.
V_{IH} High-level input voltage	2.0 V min @ Vbus = 3.3 V
	1.7 V min @ Vbus = 2.5 V
	1.2 V min @ Vbus = 1.8 V
V_{IL} Low-level input voltage	1.5 V max @ Vbus = 5.0 V
	0.8 V max @ Vbus = 3.3 V
	0.7 V max @ Vbus = 2.5 V
	0.6 V max @ Vbus = 1.8 V
I_I Input current	+/- 2 uA max @ Vbus = 1.8 V to 5.0 V
I_O Output current	+/- 32 mA max @ Vbus = 5.0 V
	+/- 24 mA max @ Vbus = 3.3 V
	+/- 8 mA max @ Vbus = 2.5 V
	+/- 4 mA max @ Vbus = 1.8 V
V_{IMAX} Max. input voltage range	-0.5 V to 6.5 V
ESD protection	4000V Human-Body Model (A114-A)

Electrical Specifications (continued)

Power	
Power source	USB supplied (std.) or external 5.0 V supply* (high current)
Current consumption	Idle: 40 mA max.
	USB supplied: 400 mA max.
	External 5.0 V supplied: 1.4 A max.
Power connector (external)	2.1mm ID, 5.5mm OD (CUI PJ-102A)
PC Interface	
Communication	USB 2.0 Full Speed
Connector	Standard type B socket

* Optional power supply required if combined I/O source and Vbus current exceeds 400 mA

Mechanical and Environmental Specifications

Mechanical		
Dimensions	Board only:	3.9" x 0.5" x 4.7" (WxHxL)
	Enclosure:	4.1" x 1.1" x 5.5" (WxHxL)
Weight	Board only:	0.1 lbs
	Enclosure:	0.9 lbs
Environmental		
Operating Temperature	Board only:	0C to 70C
	Enclosure:	0C to 60C
Storage Temperature	-40C to 70C	

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APPENDIX B

1.1 PC System Requirements

- Microsoft Windows 2000/XP/Vista or Windows 7
- Pentium 4 or equivalent processor (600 MHz minimum)
- USB 2.0 port
- CD-ROM drive
- 25 MB Free hard disk space
- 256 MB Memory

APPENDIX C

1. Installing USB Device Driver

Two types of drivers will be installed: Virtual COM Port (VCP) and Direct Drive (D2XX). The VCP driver allows control of the JI-4040 adapter via ASCII serial commands sent using a terminal emulation program such as Windows Hyper Terminal. The D2XX driver allows direct access to a USB device via a DLL interface. Both drivers are supplied by the manufacture of the USB interface IC designed into the JI-4040. Complete USB driver information can be found at the FTDI website: (http://www.ftdichip.com/FTDrivers.htm)

Instructions below assist with the installation of JI-4040 drivers for the following Windows Operating systems: Windows 2000/XP/Vista or Windows 7

1.1 Windows 7

To install drivers for the JI-4040 under Windows 7, follow the instructions below:

Internet Connection

1. Ensure the host PC is connected to the internet.
2. Connect the JI-4040 to a spare USB port on the PC.
3. Windows 7 will silently connect to Windows Update website and install the required driver(s).
4. At the conclusion of the installation, verify that the green PWR LED on the rear panel of the JI-4040 is on. Installation is now complete.
5. If the drivers were not automatically found or the PWR LED did not illuminate, continue to the “No Internet Connection” steps below.

No Internet Connection

1. Please refer to the FTDI Drivers Installation Guide for Windows 7 for detailed instructions. (http://www.ftdichip.com/Documents/AppNotes/AN_119_FTDI_Drivers_Installation_Guide_for_Windows7.pdf)

1.2 Windows Vista

To install drivers for the JI-216 under Windows Vista, follow the instructions below:

Internet Connection

1. Ensure the host PC is connected to the internet.
1. Connect the JI-4040 to a spare USB port on the PC.
2. Vista will silently connect to Windows Update website and install the required driver(s).

3. At the conclusion of the installation, verify that the green PWR LED on the rear panel of the JI-4040 is on. Installation is now complete.

4. If the drivers were not automatically found or the PWR LED did not illuminate, continue to the "No Internet Connection" steps below.

No Internet Connection

1. Please refer to the FTDI Drivers Installation Guide for Windows Vista for detailed instructions. (http://www.ftdichip.com/Documents/AppNotes/AN_103_FTDI_Drivers_Installation_Guide_for_VISTA(FT_000080).pdf)

1.3 Windows XP

To install drivers for the JI-4040 under Windows XP, follow the instructions below. For additional installation information, please refer to the FTDI Drivers Installation Guide for Windows XP (http://www.ftdichip.com/Documents/AppNotes/AN_104_FTDI_Driver_Installation_Guide_for_WindowsXP(FT_000093).pdf)

1. Temporarily disconnect the host PC from the Internet. (Simply remove the network cable from the PC)

2. Insert the JI-4040 CD-ROM into the computer's CD drive (or download the latest drivers from the FTDI_Web_Site and unzip them to a temporary location on your PC.)

3. Connect the JI-4040 unit to a spare USB port.

4. Now, verify that the "Found New Hardware Wizard" window is displayed as shown in Figure 1.

Figure 1. Found New Hardware Wizard Window

5. Select “No, not at this time” from the options, and then click “Next”.

6. At the “Found New Hardware Wizard” window (Figure 2), select “Install from a specific list or location (Advanced)”, and then click “Next”.

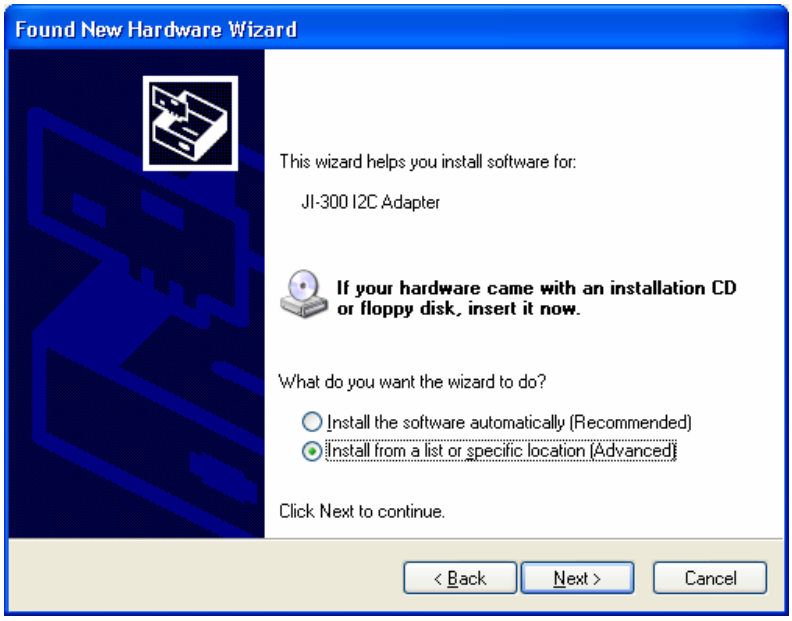


Figure 2. Found New Hardware Wizard Window #2

7. At the “Found New Hardware Wizard” window (Figure 3), select “Search for the best driver in these locations” followed by “Search removable media (floppy, CD-ROM…)”. Click Next.

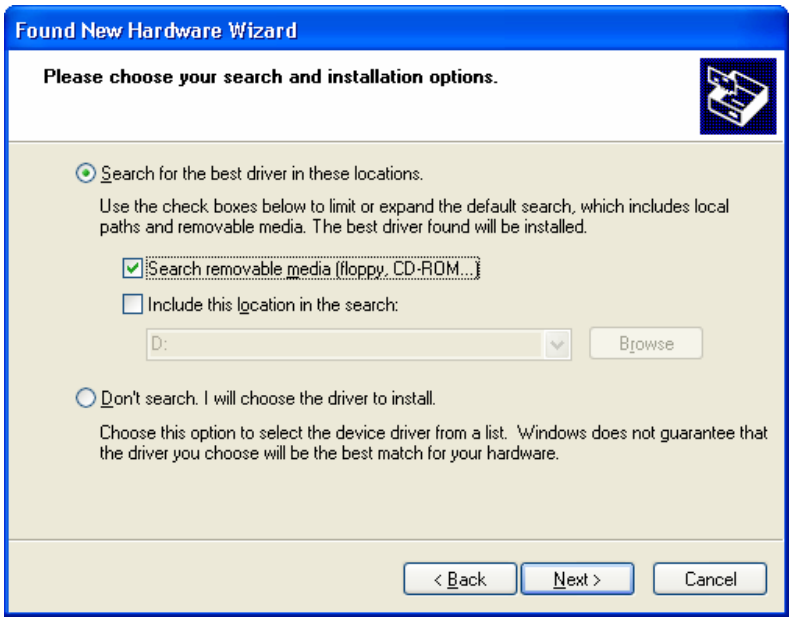


Figure 3. Found New Hardware Wizard Window #3

8. A window is now displayed showing the driver software being located and then copied (Figure 4).

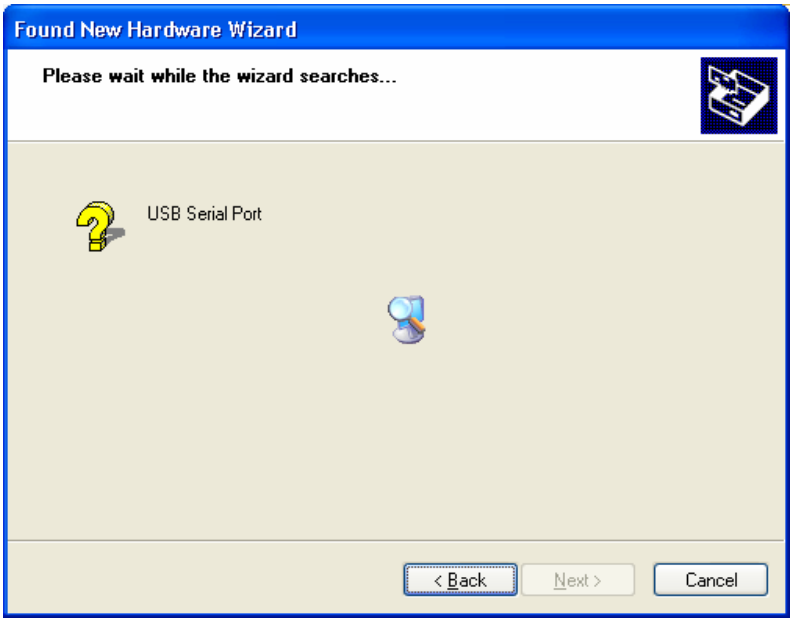


Figure 4. Driver Coping Window

9. A window indicating that the installation was successful should now be displayed (Figure 5).

Figure 5. Installation Success Window

10. The D2XX driver is now installed. Click Finish.

11. Repeat steps 5 through 11 to install the VCP driver.

12. The installation is now complete.

1.4 Windows 2000

To install drivers for the JI-4040 under Windows 2000, follow the instructions below. For additional installation information, please refer to the Windows 2000 Installation Guide (http://www.ftdichip.com/Documents/InstallGuides/Windows_2000_Installation_Guide.pdf)

1. Temporarily disconnect the host PC from the Internet. (Simply remove the network cable from the PC)

2. Insert the JI-4040 CD-ROM into the computer's CD drive (or download the latest drivers from the FTDI Web Site and unzip them to a temporary location on your PC.)

3. Connect the JI-4040 unit to a spare USB port.

4. Now, verify that the "Found New Hardware Wizard" window is displayed as shown in Figure 1.

Figure 1. Found New Hardware Wizard Window

5. Click "Next", to continue.

6. At the next "Found New Hardware Wizard" window (Figure 3), select "Search for a suitable driver for my device (recommended)" as shown below, then click next.

Figure 1. Found New Hardware Wizard Window #2

7. At the next “Found New Hardware Wizard” window (Figure 4), check the box next to "CD-ROM drives" and uncheck all others. Click next.

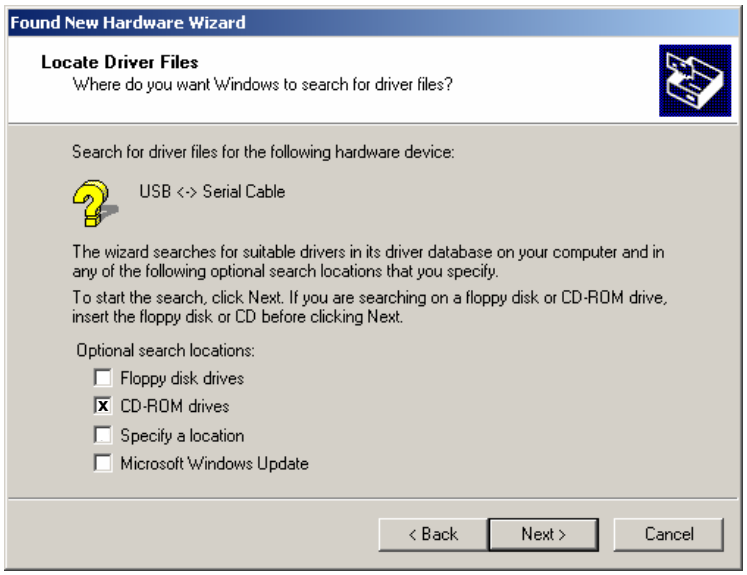


Figure 1. Found New Hardware Wizard Window #3

8. Once Windows has found the required .INF driver file (Figure 4), click next to proceed.

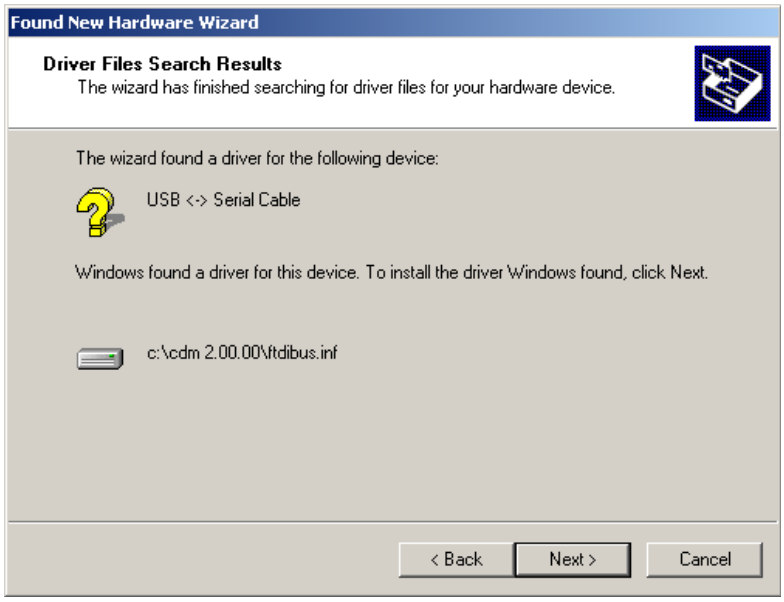


Figure 4. Driver Found Window

9. A window indicating that the installation was successful should now be displayed (Figure 5). Click Next.

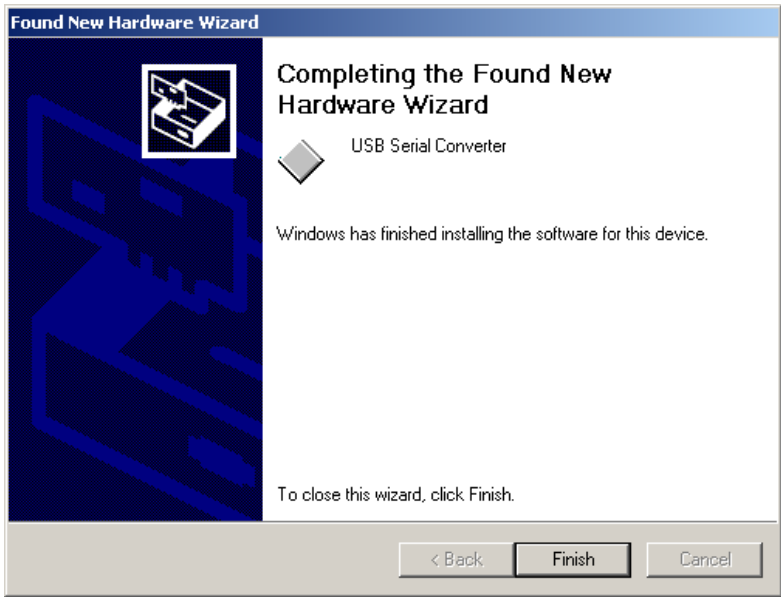


Figure 5. Installation Success Window

10. The installation is now complete.

APPENDIX D

1.0 Installing Application Software

The JI-4040 application software can be installed locally on the host PC's hard drive (C:) or executed directly from CD-ROM. To install:

2. Insert the CD-ROM into the host PC's CD/DVD drive (or download the latest executable from (http://www.jupiteri.com/JI-4040_Files/JI-4040_Top.html) to a temporary location on your PC.)

3. Using Windows Explorer, find the file "setup.exe" on the CD drive. Double click on the file to begin the installation.

4. Follow the instructions on the screen until the installation is complete.

5. Software installation is now complete.

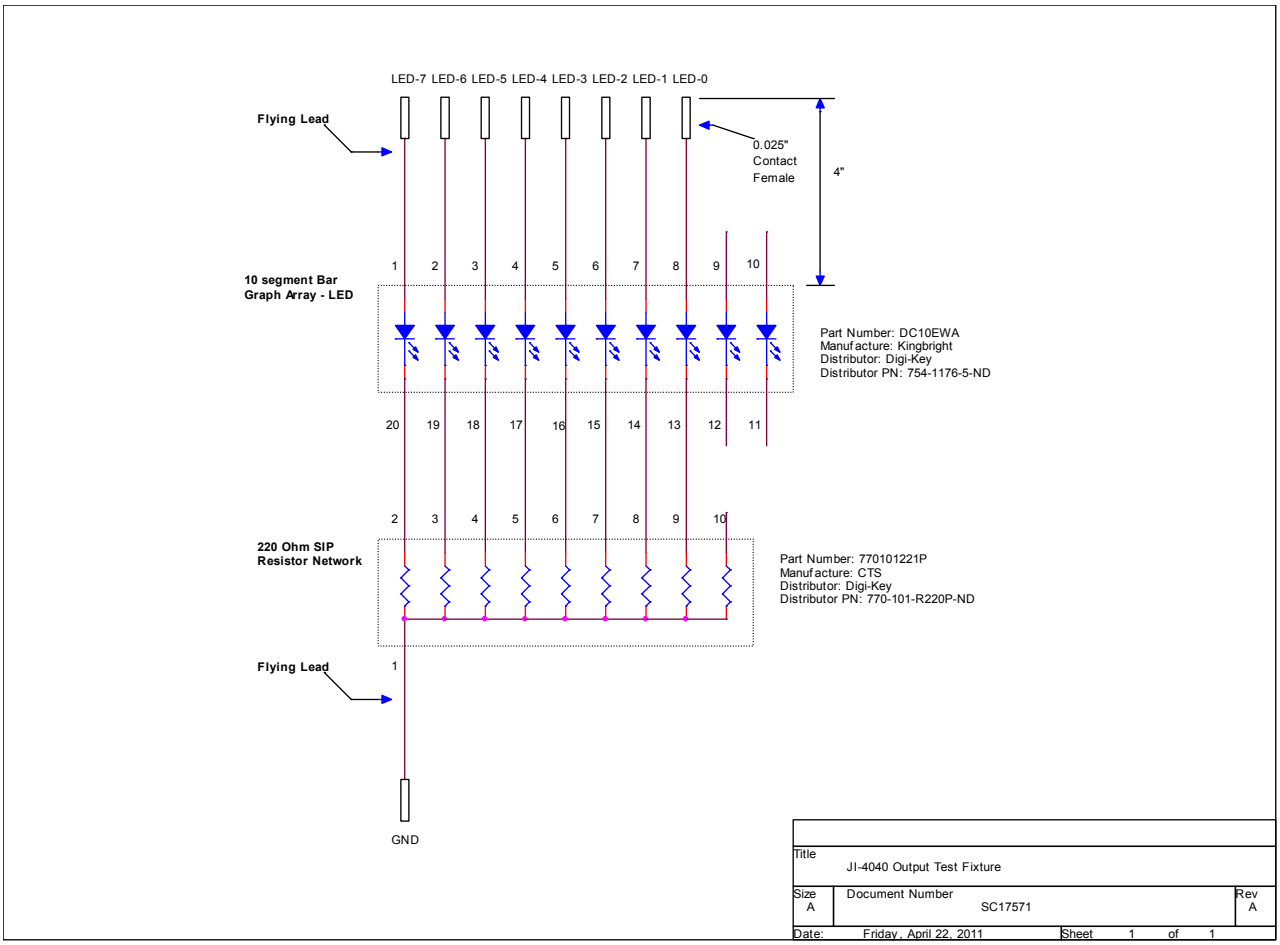
APPENDIX E

1. Top Panel Removal Procedure

TBD

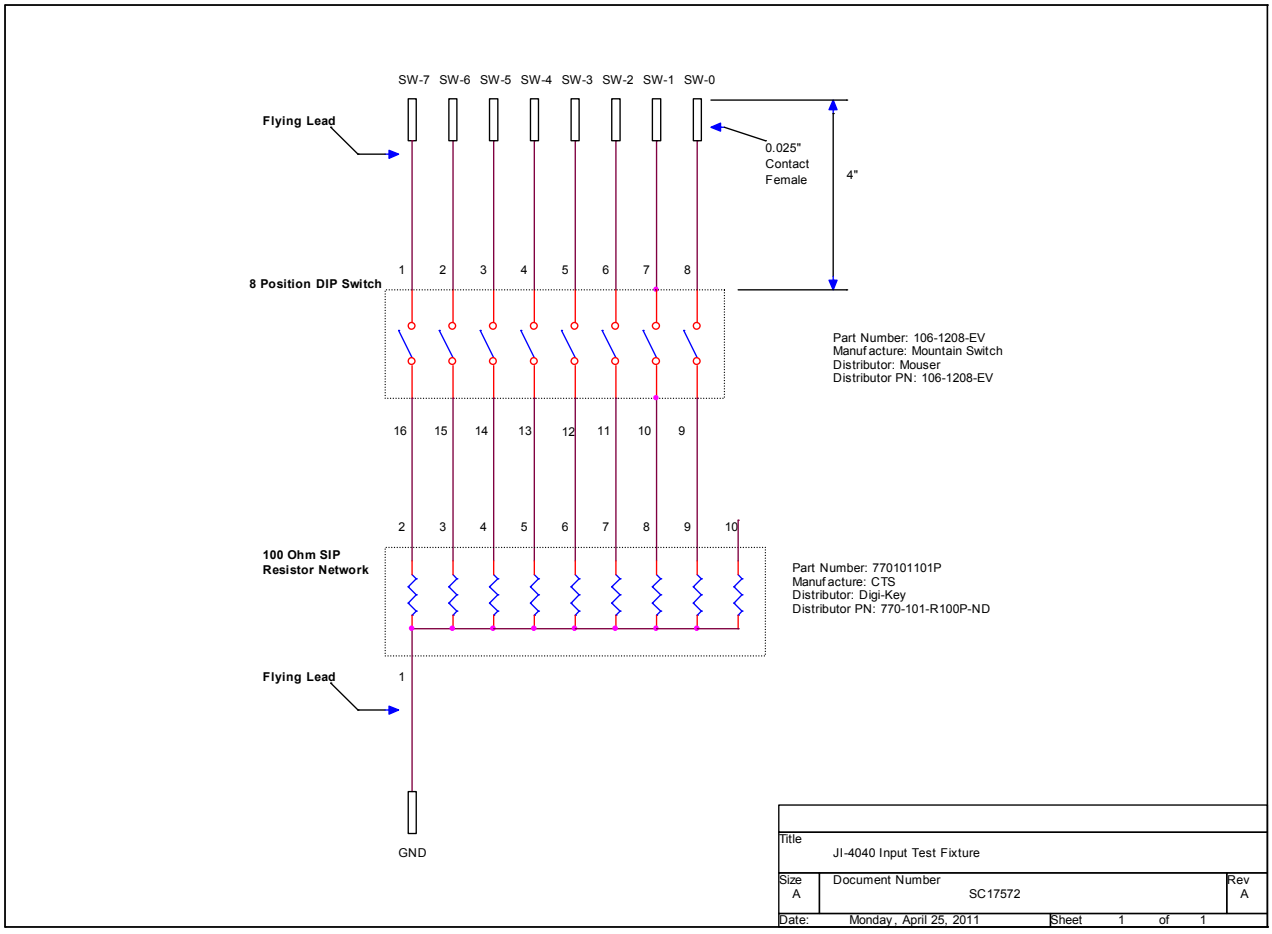
APPENDIX F

1. Output Test Fixture - Schematic



APPENDIX G

1. Input Test Fixture – Schematic



APPENDIX H

1.0 General Information

1.1 Warranty

The equipment is warranted for one year from data of purchase against defects in materials or workmanship. Jupiter Instruments reserves the right to repair or replace products at its own and complete discretion. Customer must obtain from Jupiter Instruments a Return Authorization Number (RMA) prior to returning any products to Jupiter Instruments. Products returned under this Warranty must be unmodified and in original packaging. Jupiter Instruments reserves the right to refuse warranty repairs or replacements for any products that are damaged or not in original form.

The customer is responsible for the shipping and insurance cost arising from the return of products to Jupiter Instruments. Jupiter Instruments will return all in-warranty products with shipping cost prepaid.

1.2 Thirty-Day Return Policy

Customers may return Jupiter Instruments products for a full refund if Jupiter Instruments is contacted within thirty days of the customer's receipt of the product. Customer may return Jupiter Instruments products for credit, exchange, or a refund. Customer must obtain form Jupiter Instruments a Return Authorization Number (RMA) prior to returning any products to Jupiter Instruments. Products must be returned unmodified and in original packaging. Jupiter Instruments reserves the right to refuse return rights for any products that are damaged or not in original form. Volume orders may be subject to a significant restocking fee.

1.3 Limitation of Liability

Jupiter Instruments' liability shall be limited to the repair or replacement of defective products in accordance with the Jupiter Instruments limited warranty.

Jupiter Instruments shall not be liable for any incidental, special or consequential damages for breach of any warranty, expressed or implied, directly or indirectly arising out of Jupiter Instruments' sale of merchandise, including any failure to deliver any merchandise, or arising out of customer's installation or use, whether proper or improper, of the product, separately or in combination with other equipment, or from any other cause. Use all Jupiter Instruments products and accessories at your own risk.

Products sold by Jupiter Instruments are not authorized for use as critical components in life support devices or systems.

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