Model JI-820
Incremental Encoder Emulator

User Manual

Version 1.1

Jupiter Instruments

5/20/2018 Edition

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1. INTRODUCTION

The JI-820 is a flexible, easy-to-use, PC controlled instrument designed to precisely emulate the function of a wide variety of incremental encoders. It provides the design, system, or test engineer with a tool to accurately emulate encoder signals generated by motion control and industrial monitoring systems. Variable encoder parameter available to the user include cycles per revolution, cycle frequency, A/B signal phase, Z signal position and polarity, signal amplitude, and selectable signal interface. An intuitive Windows application manages instrument setup and control. Communications and unit power is all provided via a USB 2.0 connection.

Features

- Emulates/Simulates Rotary, Linear, and Quadrature Encoders
- Programmable Pulse-Per-Rev: 4 to 4,000,000
- Adjustable Cycle Frequency: 0.1 Hz to 5.0 MHz (50 nS steps)
- Variable A/B Phase: 10° to 170° in 1° steps (90° nominal)
- Index (Z) Signal: Selectable Polarity (+/- pulse) and Position (+/- 1 cycle)
- Variable Signal (A, B, Z) Amplitude: Internal - 5.0 to 18.0 Volts (100 mV steps)
  External - 5.0 to 30.0 Volts
- Output Interface: RS-422, Open-Drain, Push-Pull, or Push-Pull Complementary
- Instrument Setup and Control via an intuitive Windows Application GUI
- Unit power and communications via USB 2.0. No external power-supply required.

2. BLOCK DIAGRAM

2.0 JI-820 Block Diagram

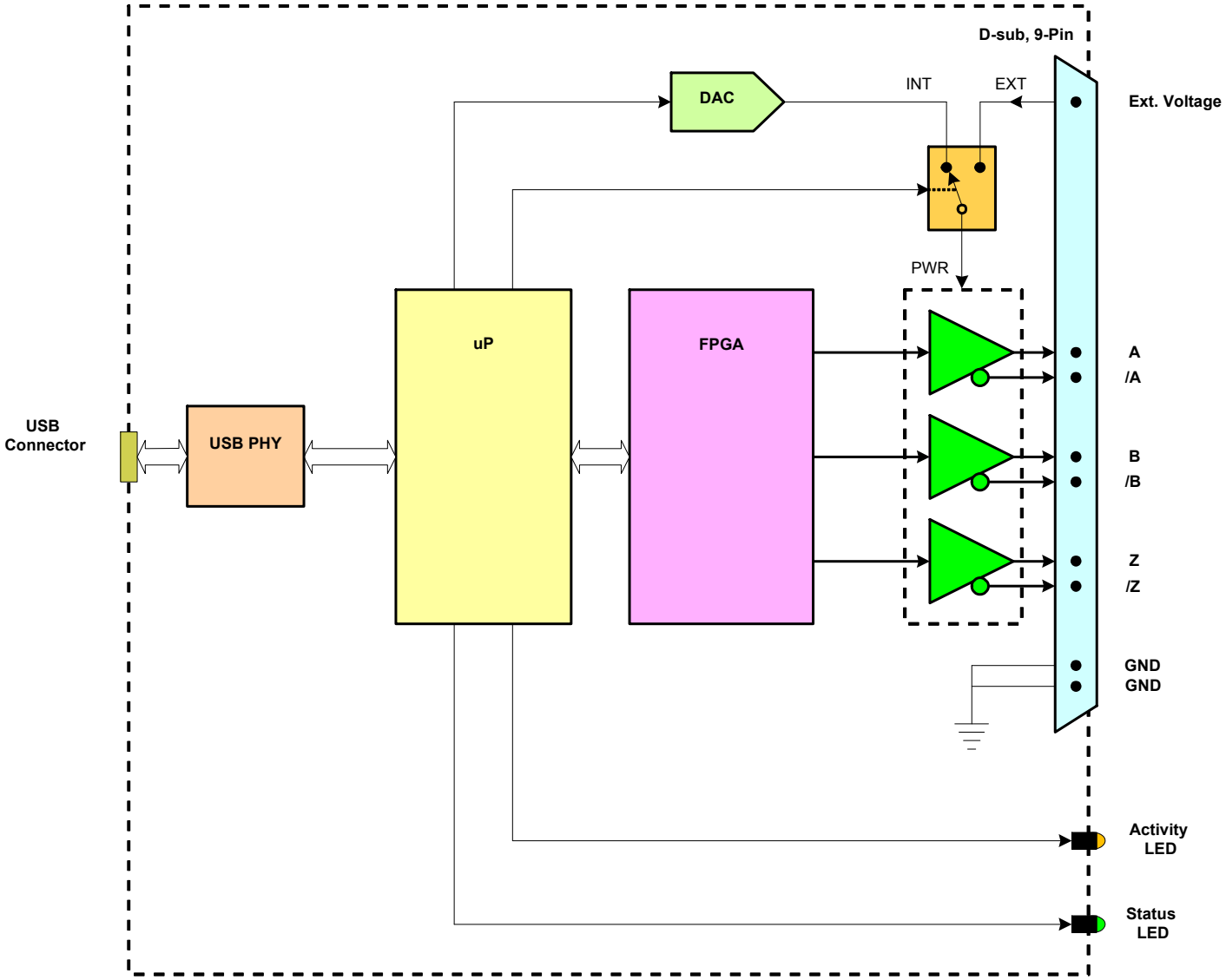


Figure 2.1 JI-820 Block Diagram

3. FRONT AND REAR PANELS

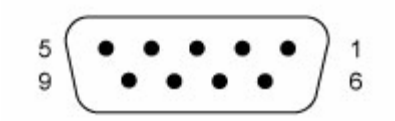
3.0 Front Panel

Description and location of Front Panel Connector and LEDs is shown below.

1. **Power** – Power-on LED (Green). Also indicates JI-820 device has been enumerated.
2. **D-Sub Connector:** 9-Pin, Female Socket, (AMP L77SDE09SA4CH4R)
   Suggested Mating Connector (AMP DE09P065H TXLF)
3. **Output** – Output signals (A, B, Z) are enabled (Amber)

3.0.1 D-Sub Connector Signals

9-Pin, Female, D-Sub Connector



DE-09S (Female Socket Front View)

Pin #	Direction	Signal Name	Description
1	Input	Ext. Voltage	External Encoder Voltage (Optional) Voltage Range: 5.0 to 30.0V
2	Output	Z	Z (Index) Encoder Signal
3	Output	A	A Encoder Signal
4	Output	B	B Encoder Signal
5	-	GND	GND – signal return
6	-	GND	GND – signal return
7	Output	/Z	Inverted Z (Index) Encoder Signal
8	Output	/A	Inverted A Encoder Signal
9	Output	/B	Inverted B Encoder Signal

3.1 Rear Panel

Rear Panel shown below.

1. **USB Connector:** Type ‘B’, (Molex 67068-0000)
   Suggested USB Cable (Molex 88732-9200)

4. SOFTWARE INSTALATION

4.1 Software Installation

A USB driver as well as JI-820 Control software will be installed on the host PC. Step-by-step installation instructions are as follows:

4.1.1 USB Driver Installation

a. Host PC *with* an Internet Connection

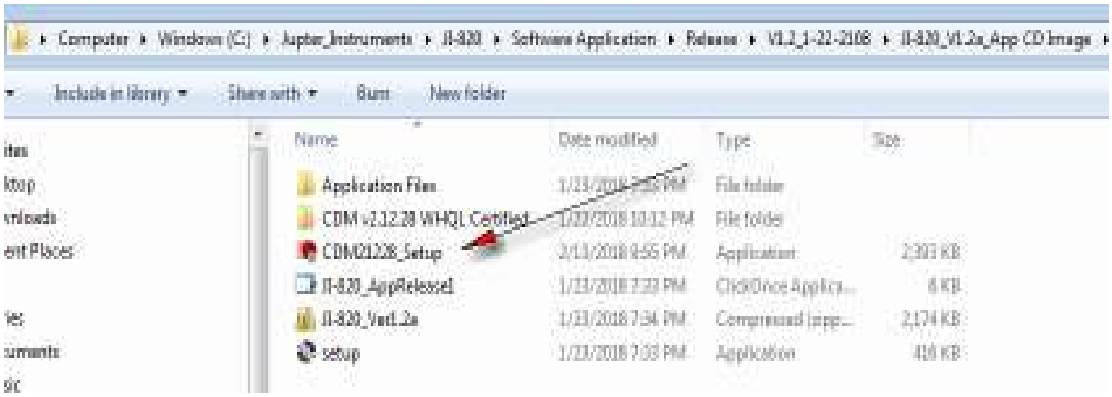
1. Ensure the host PC is connected to the internet.
2. Connect the JI-820 to a spare USB port on the PC.
3. Windows will silently connect to the Windows Update website and install the required driver(s). *In some cases, this could take several minutes to complete.*
4. At installation conclusion, verify that the front panel Power LED is on.

   Note: If the drivers were not automatically found or the JI-820 device has not been added, continue to the "Host PC *without* internet Connection" step below.

5. Driver installation is now complete.

b. Host PC *without* Internet Connection

1. Insert the JI-820 USB Flash Drive (included with your JI-820 purchase) into a spare USB port on the host PC.
2. Using Windows Explorer, find the FTDI CDN driver installation program (CDM21228_Setup.exe) on the flash drive. Double click on the file to begin installation.



3. Follow the on screen instructions until the installation is complete.
4. Driver installation is now complete.

4.1.2 Control Software Installation

1. Insert the JI-820 USB Flash Drive (included with your JI-820 purchase) into a spare USB port on the host PC (or download the latest **JI-820 Control Application** from http://www.jupiteri.com/JI-820/JI-820_Ver1.2a.zip to a temporary location on your PC.)

2. Using Windows Explorer, find the file “setup.exe” on the CD drive. Double click on the file to begin installation.

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

4. Control installation is now complete.

4.2 Software Check

1. Using the USB cable that was included with your purchase, connect the JI-820 unit to a USB port on the host PC.

2. Verify that the front panel Power LED (green) is on.

3. Launch the JI-820 application by clicking the JI-820 icon.

4. Verify that the application main window is displayed as shown in figure 4.3-1

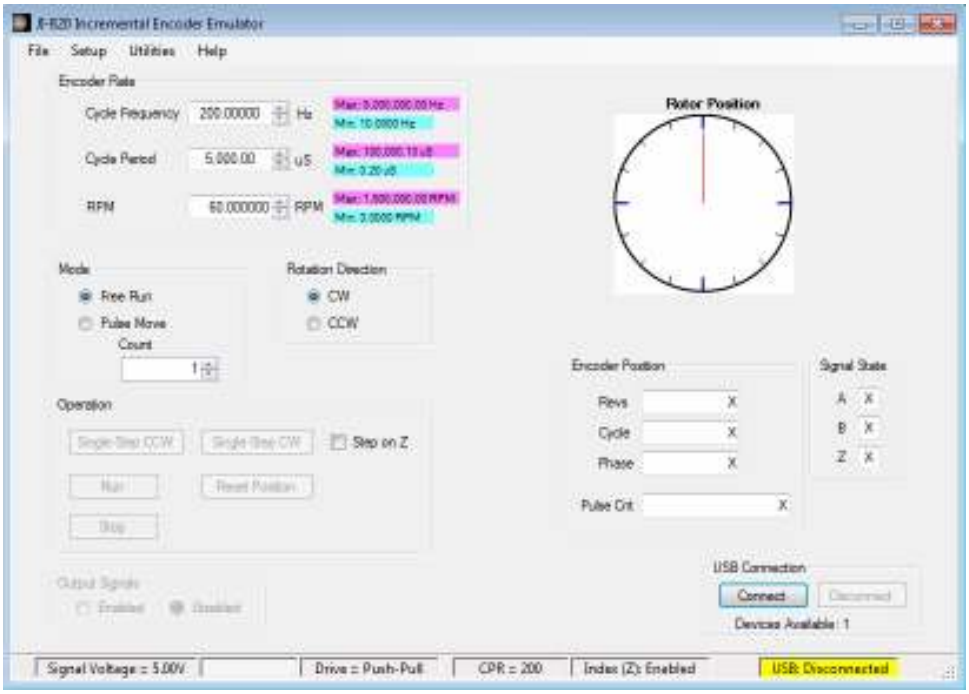
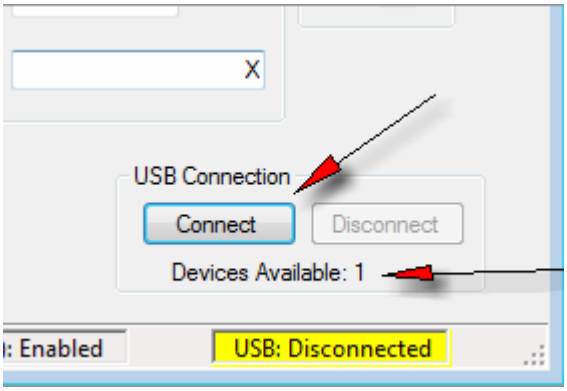
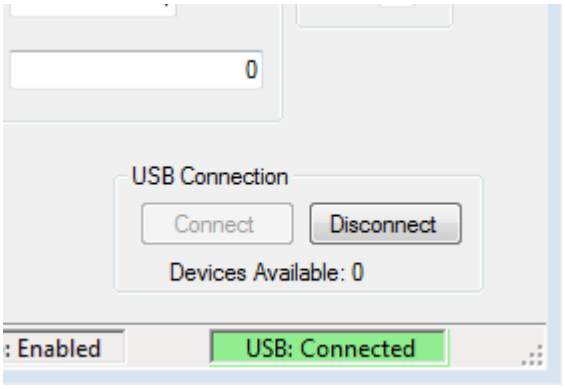


Figure 4.3-1 JI-820 Control Application Main Window

5. At the main window, verify that a JI-820 device is available then open the USB port by clicking the **Connect** button at the bottom right corner of pane.



6. Verify a USB connection by confirming a **USB: Connected** port status.



7. At the menu bar, open the **About** message box by clicking **Help** then **About**.

8. Verify that the version numbers for the **HW Version** and **FW Version** are valid (i.e. HW Version: A, VHDL Version: 3, etc.) If a question mark (HW Version: ?, or VHDL Version: ?) or some other character appears, an error has occurred.

Figure 4.3-2 JI-820 About Window

9. If no errors have occurred (or if errors have been resolved) the Software Check is complete.

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5. JI-820 CONTROL APPLICATION

5.0 Main Window

The JI-820 Control Application *Main Window* is shown in figure *5.0-1*.

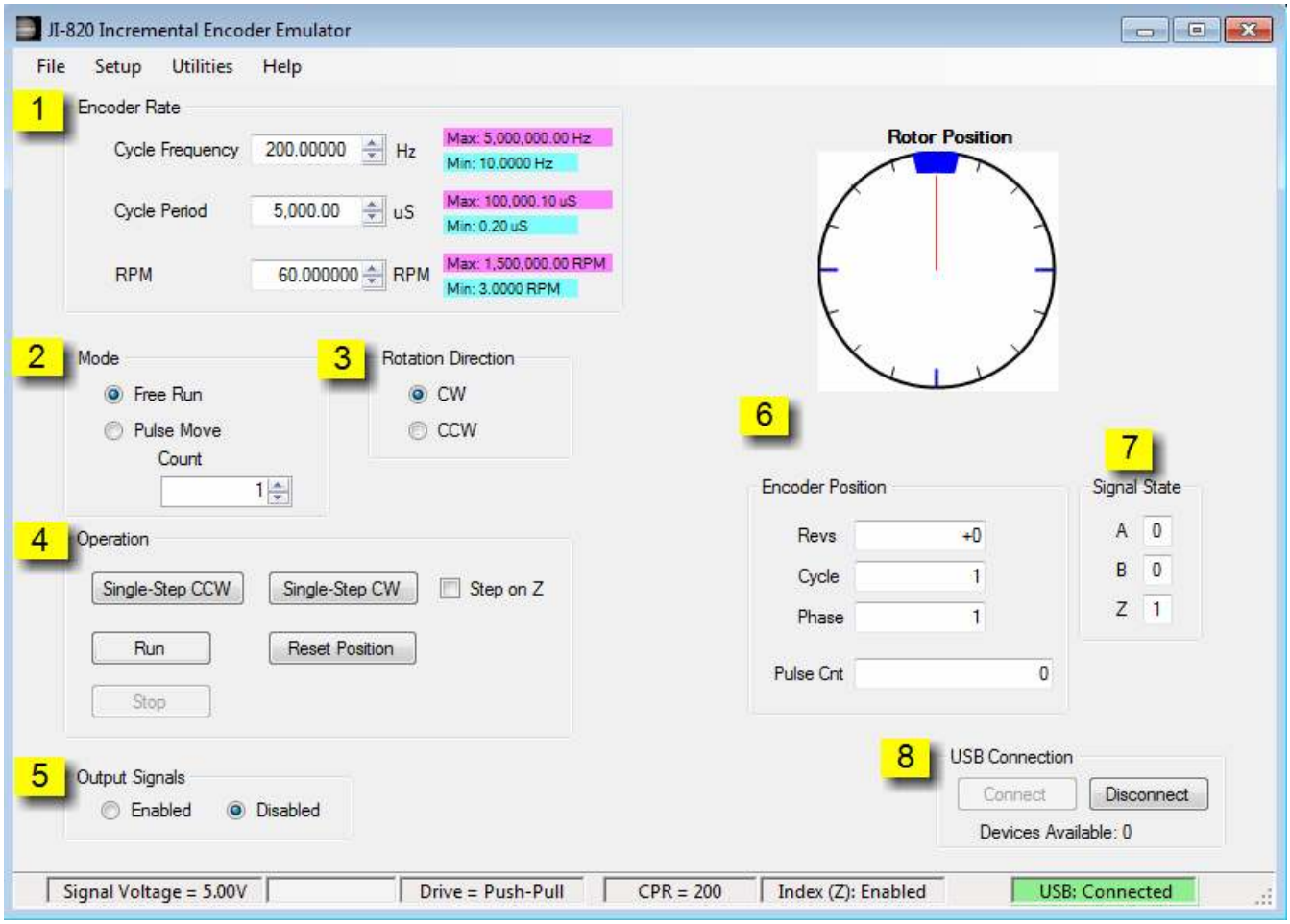

Figure 5.0-1. JI-820 Control Application Main Window

1. **Encoder Rate** – Quadrature encoder rate is entered as a **Cycle Frequency**, **Cycle Period**, or **RPM**. Maximum and minimum limits are listed for each parameter. Note that the signal phase resolution setting will affect maximum and minimum limits as well as the parameter resolution.
2. **Mode** – The behavior of the encoder is selected as either **Free Run** or **Pulse Move**. The Free Run mode provides continuous, endless operation of the encoder. The **Run** button starts operation and the **Stop** button halts operation. The Pulse Move mode control the transmission of I2C messages. The **Run** button initiates a session where by I2C messages stored in the message list are squelchy executed. The session starts at the cursor position and ends either by the execution of the lasted message in the list or by clicking the **Stop** button.
3. **Rotation Direction** – The encoder can operate in either the clock-wise (**CW**) or counter-clock-wise (**CCW**) direction.
4. **Operation** – This group of controls provides:

a. Signal Single-Stepping in either the clock-wise (**Single-Step CW**) or counter-clock-wise (**Single-Step CCW**) direction. If the **Step on Z** check box is selected and the Z signal (index) is enabled, Single-Step will also step on each Z signal transition.

b. **Reset Position** – Clicking this button resets the encoder position:

1. Revolutions = 0
2. Cycle = 1
3. Phase = 1 (A = 0, B = 0)
4. Pulse Count = 0

c. **Run** – Clicking this button starts either a **Free Run** or **Pulse Move** operation.

d. **Stop** – Clicking this button halts either a **Free Run** or **Pulse Move** operation.

5. **Output Signal** – Output signal (A, B, Z) control (On/Off).
6. **Encoder Position** – The current position of the encoder is displayed both numerically and visually (**Rotary Position**)
7. **Signal State** – The current state of the output signals (A, B, Z) is displayed here.
8. **USB Connection** – Connected/Disconnected a JI-820 device to the application.

5.1 Setup Menu

Encoder parameters such as Cycles-Per-Revolution (or Pulses-Per-Revolution), Index Signal, and encoder voltage are entered at the Setup Menu. The *Setup Menu* is shown below in figure *5.1-1*. To access the Setup menu, click **Setup** followed by **Setup Menu** at the Main Window menu bar.

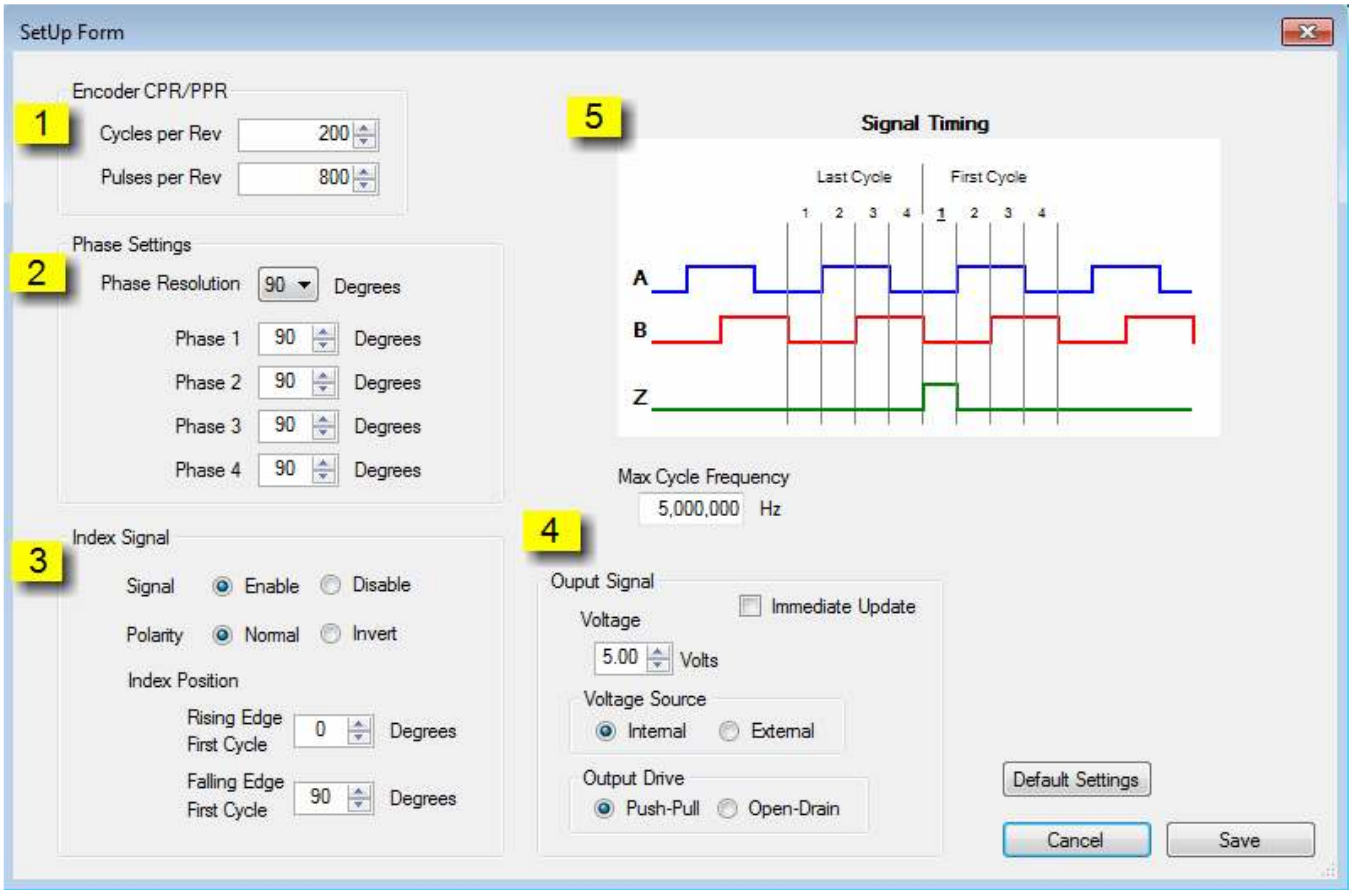

Figure 5.1-1 JI-820 Control Application Setup Menu

1. **Encoder CPR/PPR** – The encoder **Cycles-Per-Revolution** (CPR) or **Pulses-Per-Revolution** (PPR) parameter is entered here.
2. **Phase Setting** – The 4 phases that comprise a single cycle of an ideal encoder are equally spaced at exactly 90 degrees. Settings or adjustments other than 90 degrees can be applied to all 4 phases via the **Phase Setting** control. The coarseness of the setting (90, 45, 10, 5, 1 degrees) is selected using the **Phase Resolution** control. Note that Phase Resolution settings will affect maximum and minimum limits of Cycle Frequency, Cycle Period, and RPM.
3. **Index Signal** – This group of controls provides:
    a. **Index Signal Enable/Disable**
    b. **Index Single Polarity** – Normal or Inverted.
    c. **Index Single Position –** Position is adjusted relative to Phase 1 of the first cycle and is displayed in the signal timing diagram. Note that Phase Resolution settings will affect the coarseness of the setting.

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4. **Output Signal** – This group of controls provides:
    a. **Voltage Source –** The voltage source to drive the encoder signals is selected as either **Internal** or **External**. The Internal voltage range is from 5.0V to 18.0V, adjustable in 100 mV increments. The External voltage is applied to pin-1 of the 9-pin D-Sub connector and has a voltage range from 5.0V to 30.0V.
    b. **Output Drive** – The encoder signal drive type is selected as either **Push-Pull** or **Open-Drain**.
    c. Changes to parameters in this group can be updated immediately if the **Immediate Update** check box is checked. For example, changes in A, B, and Z signal amplitude can be observed in real-time using **Immediate Update.**
5. **Signal Timing** – This is a visual representation in time of all 3 encoder signals (A,B,Z)

6. SYSTEM EXERCISE

6.0 Encoder Emulation

This exercise will demonstrate how to configure and emulate the behavior of an incremental encoder. As an example, we will emulate a Dynapar Series 60 Incremental Encoder (PN: 63AAEF1000AB, Appendix B). Electrical specifications:

- Voltage: 5V to 15V
- Output: Single-Ended, Push-Pull
- Pulses/Rev: 1000
- Option: Marker (Z Index)
- Maximum Frequency: 50 KHz
- Minimum Free Path: 12.5% (jitter, phase, and symmetry shifts)

Equipment needed for this exercise:

1. JI-820 unit
2. 4-channel oscilloscope
3. Break-out connector for 9-pin D-sub.
4. PC/Laptop loaded with JI-820 Control Application software

A. Equipment Setup

Connect the equipment as follows:

1. Connect 9-pin D-sub break-out connector to 9-pin D-sub on JI-820.
2. Connect oscilloscope channel 1 to D-sub break-out connector pin-3 (signal A).
3. Connect oscilloscope channel 2 to D-sub break-out connector pin-4 (signal B).
4. Connect oscilloscope channel 3 to D-sub break-out connector pin-2 (signal Z).
5. Connect oscilloscope channel RTNs to D-sub break-out connector pins- 5 & 6 (GND).
6. Set amplitude for all three oscilloscope channels to 10V/div.
7. Set sweep speed to 50us/div.
8. Set trigger to Normal, Rising-Edge, Channel 3.
9. Finally, using the supplied USB cable, connect the JI-820 to a spare USB port on the PC.

TBD

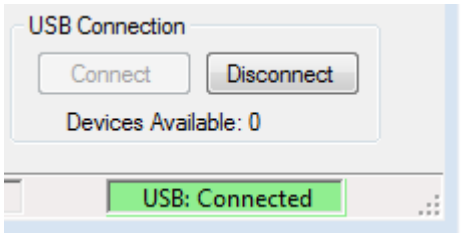
Figure 6.0-1 Test Setup

B. Encoder Configuration

At the PC:

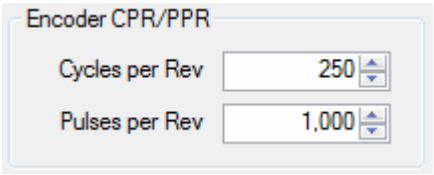
1. Launch the application by double clicking on the JI-820 icon.

2. At the main window, verify that a JI-820 device is available then open the USB port by clicking the **Connect** button at the bottom right corner of pane.

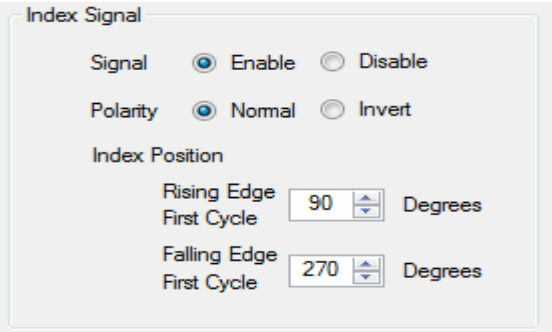


3. Next, open the Setup menu by click **Setup** followed by **Setup Menu** at the Main Window menu bar. The Setup Menu opens (see *Figure 5.1-1*)

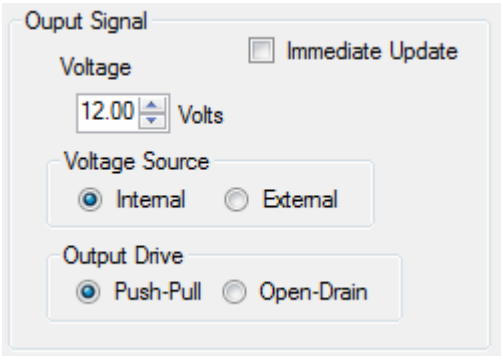
4. At the Encoder CPR/PPR group box, set the Pulses per Rev to 1000.



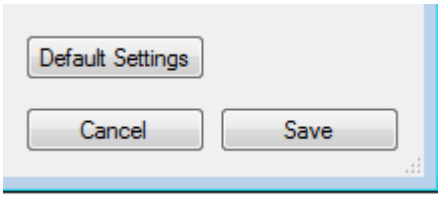
5. At the Index Signal group box, set
   - Signal: Enable
   - Polarity: Normal
   - Index position:
     - Rising Edge, First Cycle: 90 degrees
     - Rising Edge, First Cycle: 270 degrees



6. At the Output Signal group box, set
   - Voltage: 12.0V
   - Voltage Source: Internal
   - Output Drive: Push-Pull



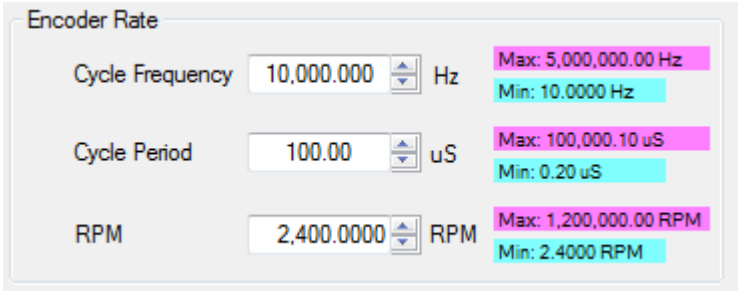
7. Save the encoder configuration by clicking the Save button at the bottom right corner of the pane.



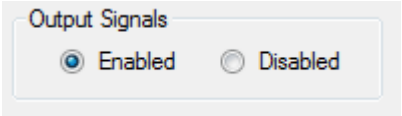
C. Encoder Operation

At the PC:

1. At the main window, set the Cycle Frequency to 10K Hz. Cycle Frequency is found in the Encoder Rate group box.

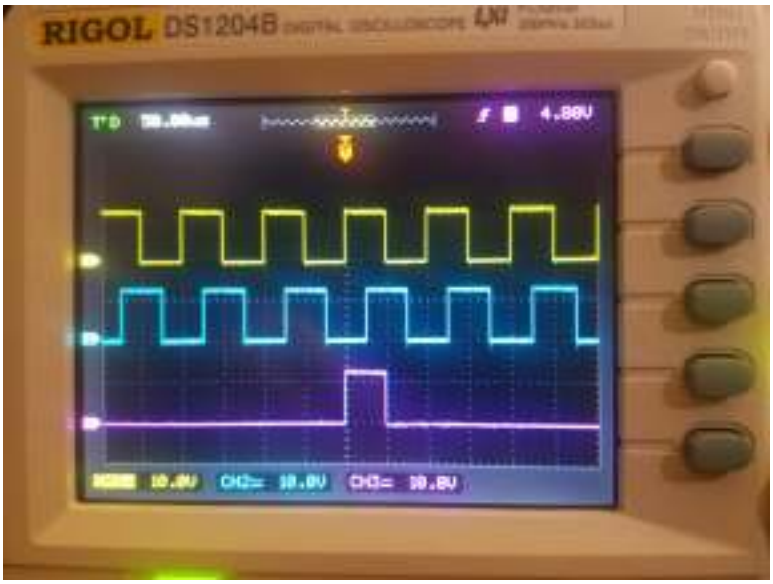


2. At the Output Signals group box, enable the output signals A, B, and Z.

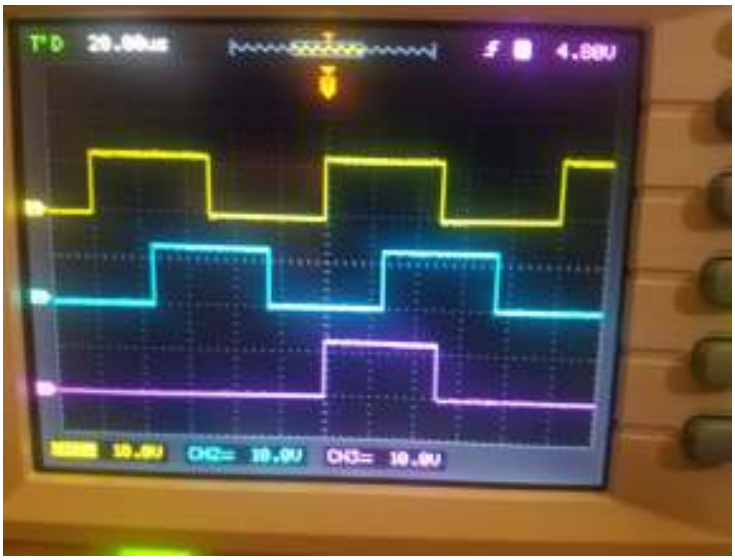


3. Finally, start encoder operation by clicking run in the Operations group box.

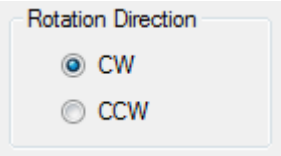
4. Verify the following waveform on the oscilloscope.



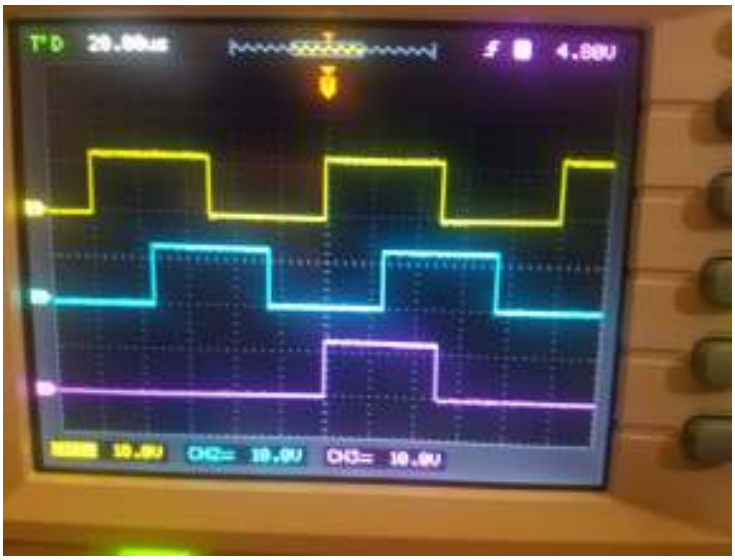
5. At the oscilloscope, increase the sweep speed to 20uS/div. Verify the following waveform on the oscilloscope.



6. At the main window, change encoder rotation direction from CW to CCW by selecting CCW in the Rotation Direction group box.



7. At the oscilloscope, verify the following waveform. Note that the phase sequence has changed from 1,2,3,4 to 4,3,2,1.



8. While running, experiment with the encoder behavior and configuration by making changes to:
    - Cycle Frequency
    - Z Signal
        - Polarity
        - Rising/Fall Edge positions
    - Signal Amplitude

9. Encoder emulation exercise is now complete.

APPENDIX A

1.0 JI-820 Specifications

Incremental Encoder Emulator
Model JI-820

Jupiter Instruments

Ver 1.2

Electrical Specifications

1/21/2018 Edition

General				
Signals	A, /A, B, /B, Z, /Z			
Cycles per Revolution (CPR)	Programmable: 1 to 1,00,000			
Pulses per Revolution (PPR)	Programmable: 4 to 4,00,000			
Signal Phase Resolution	Selectable: 1, 5, 10, 45, or 90 degrees			
Frequency Range, Cycle	Phase Resolution	Freq. Max.	Freq. Min.	Resolution
	90	5.00 MHz	10.0 Hz	50 nS
	45	2.50 MHz	5.00 Hz	100 nS
	10	555 KHz	1.11 Hz	450 nS
	5	277 KHz	0.55 Hz	900 nS
	1	55.5 KHz	0.11 Hz	4500 nS
Position Tracking:				
Revolutions	-2^{31} to 2^{31}			
Cycle	-2^{31} to 2^{31}			
Phase	1 to 4			
Operational Modes	Free Run, Single-Step, Pulse Move			
Index Signal (Z)				
Position	Programmable: +/- 1 cycle span (max)			
Polarity	Selectable: Positive or Negative Pulse			
Output				
Type	Selectable: RS-422			
	Open-Drain			
	Push-Pull			
	Push-Pull Complementary			
	Internal or External			

Voltage Source		
	Internal	
Voltage		Adjustable 5.0V to 18.0V (100mV increments)
Current		Sink: 100 mA (max per signal) Source: 30 mA max per signal (90 mA combined)
	External	
Voltage		5.0V to 30.0V
Current		Sink/Source: 100 mA (max per signal)
	Short-Circuit Protection	Internal and External
	Output Control	Enable/Disable Output

Connector:		
	Type	Standard 9-Pin, D-sub, Female
	Pin-outs	Pin 1 = External Voltage (Input) Pin 2 = Z Pin 3 = A Pin 4 = B Pin 5 = GND Pin 6 = GND Pin 7 = /Z Pin 8 = /A Pin 9 = /B
LEDs		
	Power	Power-On
	Activity	Output Signal Activity
PC Interface		
	Communication	USB 2.0 Full Speed
	Connector	Standard type B socket
	Power	USB supplied
		Current Draw: 270mA (Nominal)
		690mA (Maximum @ max. signal load)

Mechanical and Environmental Specifications

Mechanical	
Dimension	3.3" x 1.1" x 5.0" (WxHxL)
Weight	0.2lbs
Construction	Extruded Aluminum Enclosure
Environmental	
Operating Temp	0C to 45C
Storage Temp	-20C to 70C

APPENDIX B

1.0 Specifications: Incremental Encoder Example

HEAVY DUTY

SERIES 60

Dynapar™ brand

Heavy Duty Rotopulser©

Key Features

- Heavy-duty bearings with 1/2" diameter shaft
- Unbreakable disk
- Wide selection of resolutions available up to 2500 PPR
- Servo ring and face mount options

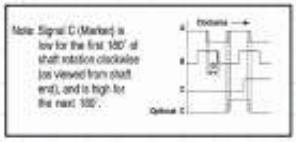
SPECIFICATIONS

STANDARD OPERATING CHARACTERISTICS

Code: Incremental, Optical
Resolution: 1 to 2500 PPR (pulses/revolution) See ordering information
Format: Two channel quadrature (AB) with optional index
Phase Sense: A leads B for CW rotation of the primary shaft
Minimum Free Path: Between any A and B transition (Distance D) will not be less than 12.5% of one full electrical cycle. This includes effects of jitter, phase and symmetry shifts.

ELECTRICAL

Power Requirements: 5 to 15 VDC max. 115 mA max. plus load requirements
Frequency Response: 50 kHz
Output:
7272 Push-Pull: 40mA, sink or source
7272 Differential Line Driver: 40 mA, sink or source
Mating Connector: 10 Pin: Style MS3106A-18-1S, Dynapar Part No. MCN-M6



ELECTRICAL CONNECTIONS

Single-Ended Output (6-pin)		
Function (If Used)	MS Pin No.	#140020900010* Cable Accessory Color Code
Signal A	B	RED
Signal B	D	BLUE
Signal C (Marker)	A	GREEN
+V	E	WHITE
Common	C	BLACK
Shield	F	SHIELD

Differential Line Driver (10-pin)		
Function (If Used)	MS Pin No.	#140041900010* Cable Accessory Color Code
Signal A	B	RED
Signal A	G	BLACK
Signal B	D	BLUE
Signal B	H	BLACK
Signal C (Marker)	A	GREEN
Signal C	I	BLACK
+V	E	WHITE
Common	C	BLACK
Shield	F	SHIELD
Not Used	J	

*This is a mating connector/cable assembly described in the Encoder Accessories section of this catalog. Color-coding information is provided here for reference.

MECHANICAL

Shaft Sizes: 1/4", 1/8"
Speed Range: Up to 3600 RPM
Starting Torque: 0.45 oz-in (0.30 oz-in for 1/4 in. dia. shaft)
Running Torque: 0.35 oz-in (0.15 oz-in for 1/4 in. dia. shaft)
Housing & Cover Material: Aluminum
Shaft Material: Stainless Steel
Disc Material: Mylar
Weight: 26 oz.

ENVIRONMENTAL

Operating Temperature: 0-54°C
Humidity: Up to 98% (non-condensing)
Enclosure Rating: NEMA 12 / IP54;

APPENDIX C

1. Minimum PC System Requirements

- Microsoft Windows 7/8/10
- Pentium 4 or equivalent processor (600 M minimum)
- USB 2.0 port
- 50 MB Free hard disk space
- 256 MB Memory
- (Internet Connection Preferred)

APPENDIX D

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.

1.4 Contact Us

- Address: Jupiter Instruments
  Mission Viejo, CA 92692
- Email: Sales@Jupiteri.com
  Tech@Jupiteri.com
- Phone: Sales and Information: (949)-716-0154
- Website www.Jupiteri.com