Cyclotron Rotary Decoder Module

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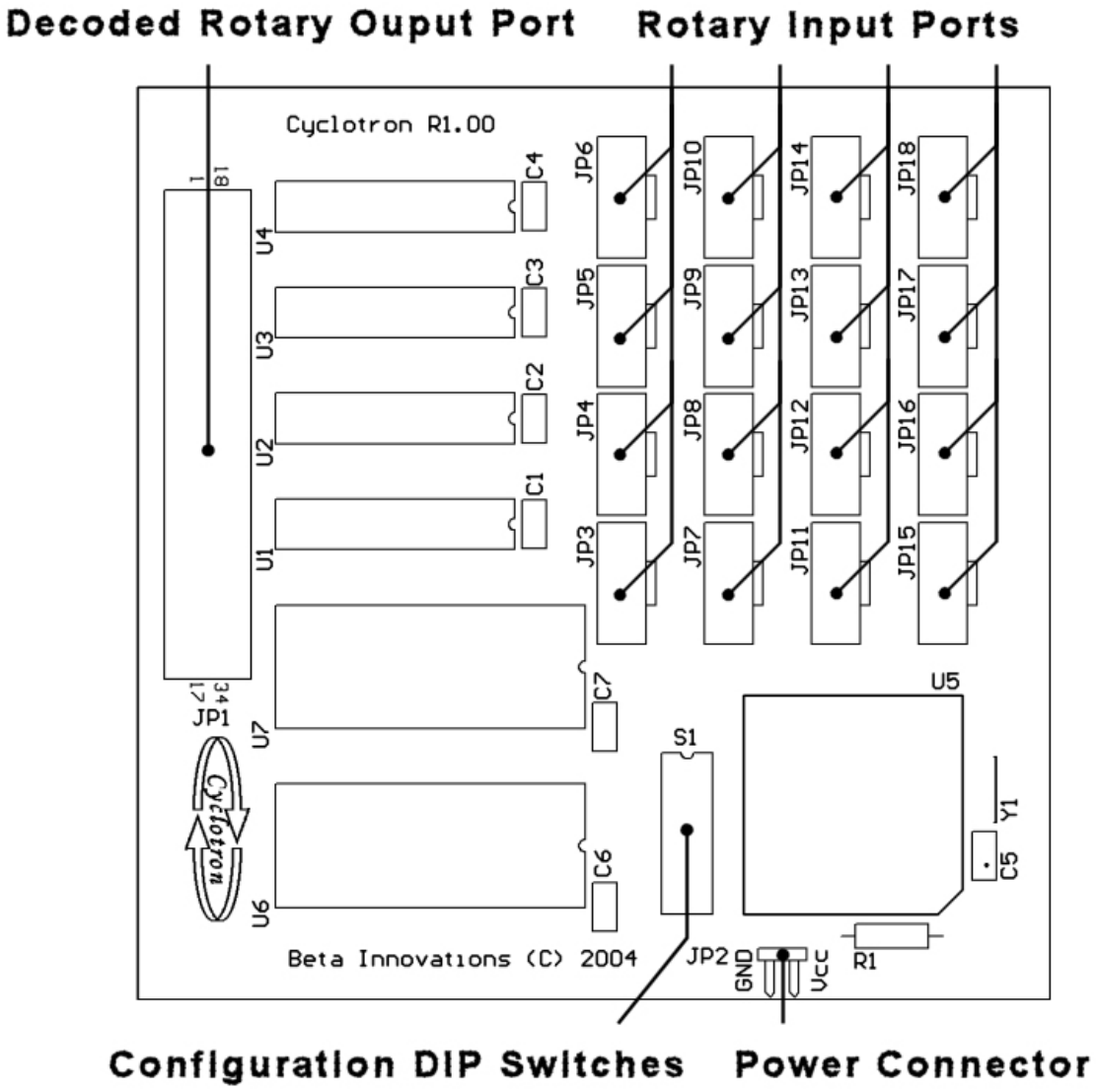


Main Features

- **Easy installation**
  The Cyclotron connects directly to any GammaRay series of input devices through a single 34 PIN IDC ribbon cable. All power supplied through the GammaRay's power connector. No additional software/drivers required.

- **Gray Code Rotary Support**
  Support for up to 16 gray code rotaries or up to 8 with integrated push button switch.

- **Standard Quadrature 2-Bit Code Rotary Support**
  Support for up to 16 standard quadrature 2-bit code rotaries or up to 8 with integrated push button switch.

- **Optical & Mechanical Rotary Encoder Support**
  Optical rotaries are supported when power is supplied by an external source. Mechanical rotaries can be connected directly into input ports.

- **Push Button Switch Support**
  Push button switch support selectable for up to 8 rotary encoders.

- **Output FIFO Buffer**
  Input signals from all encoders are stored in a FIFO buffer preventing any lost inputs no matter how fast the encoder is turned (within RPM limits or encoder). Output pulse rate to the interface module remains constant ensuring that all input signals are processed.

- **Output Pulse Width Resolution**
  User selectable output pulse width from 6 ms (83 PPS) to 60 ms (8.3 PPS) suitable for various input interface module polling rates.

- **Configurable Input Ports**
  Input port banks can be configured for 2-bit binary or gray code encoders, with or without push button support. As a result of this flexibility, different types of incompatible encoders can be simultaneously connected to a single module.

Introduction

The Cyclotron Rotary Decoder Module is an add-on device used to decode various rotary encoders. Decoded output signals are fed to a suitable input interface module such as the GammaRay series of USB device.

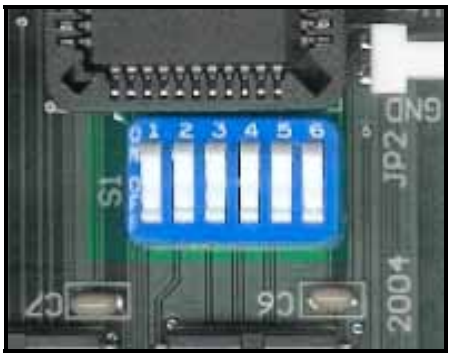


Figure 1 – DIP Configuration Switches

The Cyclotron can be operated in various user configurable modes through 6 onboard DIP switches (Figure 1) for optimal performance and flexibility. The various operational modes can be selected without having to disconnect the device from the interface device or power it down. The microcontroller will automatically detect the new configuration settings and update the operational features in real-time.

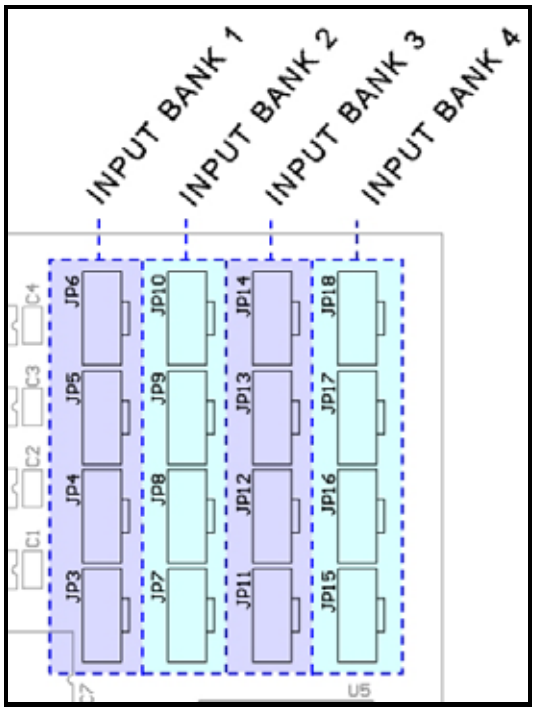


Figure 2 – Input Bank pairs

Rotary Encoder input ports are grouped into two input BANK pairs as shown in Figure 2. Setting the appropriate DIP configuration switches can individually control the features of the Bank pairs.

Cyclotron Configuration

The Cyclotron module has several user selectable DIP switches that allow the configuration of various onboard features and device modes.

Mode Selection DIP Switches

The Mode DIP switches (Figure 3: S1 – switch 1 & switch 2) are used to activate the integrated push button switches on rotaries in BANK 3 & 4 only. BANK 1 & 2 do not support pushbutton switches. Activation of these switches affect whether input BANKs 1 or 2 are active resulting in 4 possible modes of operation.

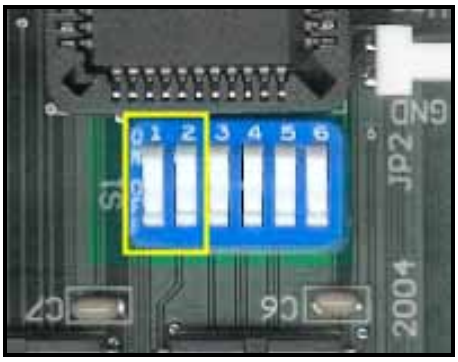


Figure 3 – Mode Selection DIP switches

DIP Switch S1:

Switch 1 – Mode Switches LSB
Switch 2 – Mode Switches MSB

Input Banks Mode of Operation:

Mode	S1 DIP	Bank 1	Bank 2	Bank 3	Bank 4
A	Switch 1: **OFF** Switch 2: **OFF**	√	√	√	√
B	Switch 1: **ON** Switch 2: **OFF**	√	X	⊥	√
C	Switch 1: **OFF** Switch 2: **ON**	√	X	√	⊥
D	Switch 1: **ON** Switch 2: **ON**	X	X	⊥	⊥

Legend: √ - Active, X – Inactive, ⊥ - Active with Pushbutton Switch

Mode Selection Options:

Mode A: All input Banks are active and functional without push button switch support. When operated in this mode, it is imperative that no rotaries with integrated switches are plugged into Banks 3 or 4. Pressing on the pushbutton switch may trigger false signals in Banks 1 & 2.

Mode B: Input Bank 3 supports integrated pushbutton switches. As such, input Bank 2 is inactive due to the limited number of output pins and should remain empty to avoid triggering false signals on input Bank 3. Banks 1 & 4 operate normally without pushbutton switch support.

Mode C: This mode operates like Mode B except that Bank 4 supports integrated pushbutton switches. Input Bank 2 remains inactive due to the limited number of output pins and should remain empty to avoid triggering false signals on input Bank 4. Banks 1 & 3 operate normally without pushbutton switch support.

Mode D: Both input Banks 3 & 4 are active with support for integrated pushbutton switches. Input Banks 1 & 2 remain inactive due to the limited number of output pins and should remain unconnected to avoid triggering false signals on input Banks 3 & 4.

Decoding Selection DIP Switches

Decoding selection DIP switches (Figure 4) set the decoding algorithm for input bank pairs. Each Input Bank is comprised of 4 rotary encoder ports as shown in Figure 2 and must use the same type of encoding either 2-bit binary or gray code.

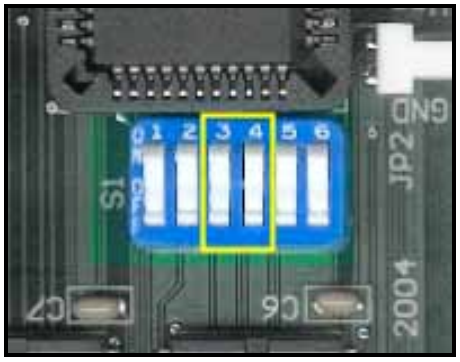


Figure 4

DIP Switch S1:

Switch 3 – **2-Bit Binary / Gray Code**, Input Banks 1 & 3
Switch 4 – **2-Bit Binary / Gray Code**, Input Banks 2 & 4

Decoding Selection Modes:

S1 DIP - Switch 3	Bank 1	Bank 3
ON	GRAY	GRAY
OFF	BINARY	BINARY

S1 DIP – Switch 4	Bank 2	Bank 4
ON	GRAY	GRAY
OFF	BINARY	BINARY

Decoding Selection Options

2-Bit Binary / Gray Code: When using Gray Code type encoders, it is imperative that rotaries are selected having the same number of detents and output pulses (i.e. 20 pulses / 20 detents). Using rotaries with unmatched pulses / detents will result in what will appear to the users as skipped pulses due to the extra detents.

This is not an issue with 2-Bit Binary type encoders and encoders with any number of detents can be safely employed.

Output Pulse Width Selection DIP Switches

The Output Pulse Width can be selected and controlled. This function works independently of input pulse width on the rotary encoder inputs. Rotaries can thus be turned as fast as slowly or as the user desires without affecting data transfer from the Cyclotron module to the input interface device.

Through the use of double buffering all input signals are stored in a circular FIFO buffer eventually being fed to the output port at a specified pulse width and output rate. This feature is necessary in order to prevent lost inputs due to slow interface modules and quickly rotated encoders.

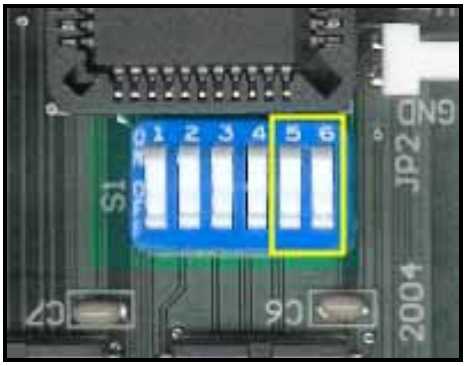


Figure 5 – Output Pulse Width Selection DIP switches

DIP Switch S1:

Switch 5 – **Pulse Width LSB**
Switch 6 – **Pulse Width MSB**

Output Pulse Width Selection Chart:

S1 DIP	Pulse Width	GammaRay-64	GammaRay-256	Plasma
Switch 5: ON Switch 6: ON	**6.5 ms**	**X**	**X**	**X**
Switch 5: OFF Switch 6: ON	**16 ms**	√	**X**	√ **Single Mode (V1 Only)**
Switch 5: ON Switch 6: OFF	**40 ms**	√	√	√ **Single / Dual Mode**
Switch 5: OFF Switch 6: OFF	**60 ms**	√	√	√ **Single / Dual Mode**

Output Pulse Width Options

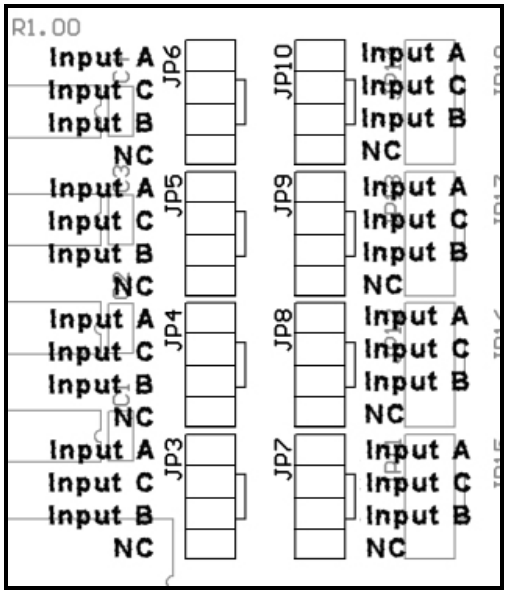
Output Pulse Width: is critical for the proper operation of the Cyclotron decoder in conjunction with input interface devices such as GammaRay. Without a proper pulse width, rotary inputs will invariably be lost due to the fact that the input interface device cannot keep up with the output data stream from the Cyclotron module. Increasing the

pulse width will insure that pulses will not be missed, however please note that a delay will become increasingly noticeable between the time a rotary is turned and the last pulses is read by the input interface device when using longer pulse widths. It is therefore advisable to use the minimum possible pulse width for optimal real-time updates of rotary encoder inputs.

IMPORTANT: Cyclotron employs a 40 MHz Microcontroller scanning the rotary inputs incredibly fast assuring that absolutely no inputs are missed. Variations in rotary encoder manufacturing quality limits how fast a rotary can be turned without signal degradation. As such rotating an encoder beyond the manufacturer's specifications can result in erroneous inputs despite Cyclotron's best efforts to debounce and decode inputs.

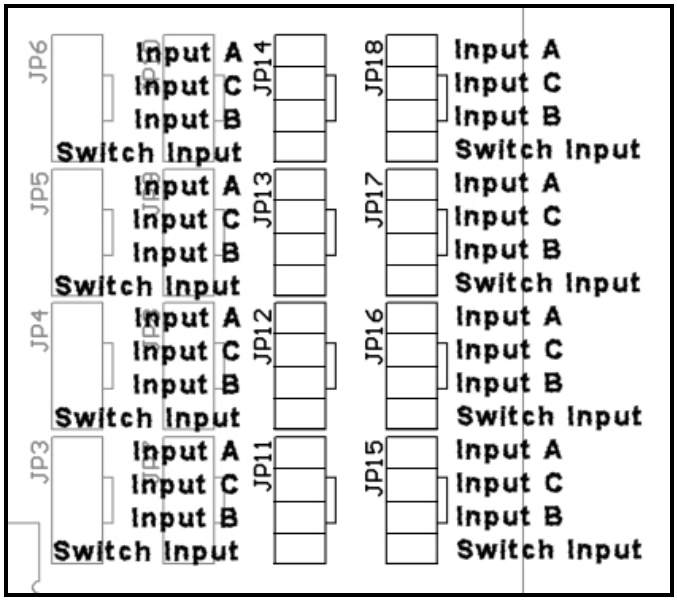
Cyclotron Pin-Out

Input Banks 1 & 2



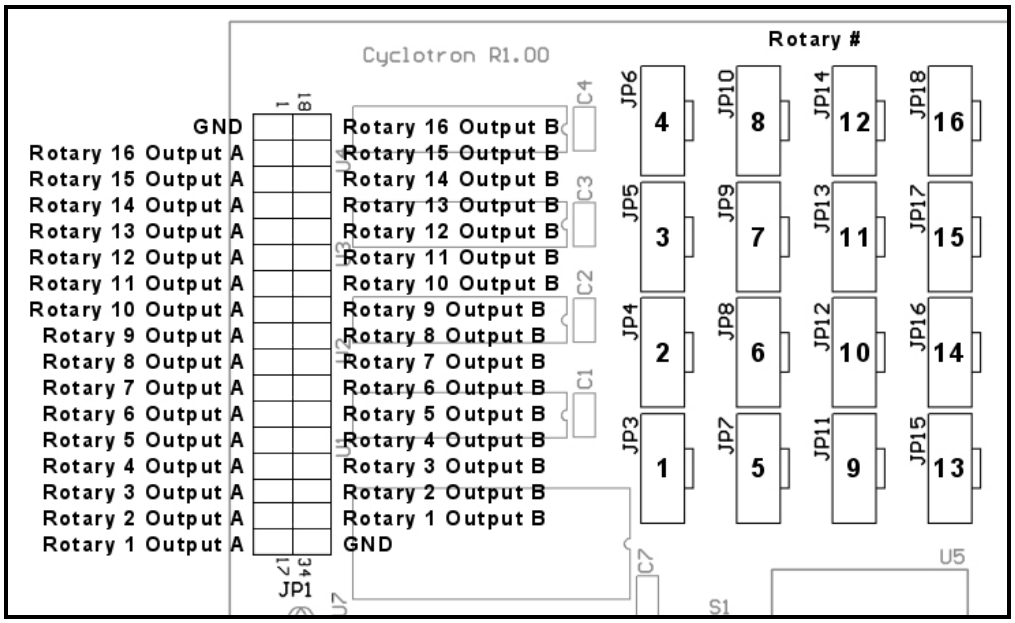
The rotary encoder input pin-out apply to both quadrature 2-bit and gray code type encoders.

Input Banks 3 & 4

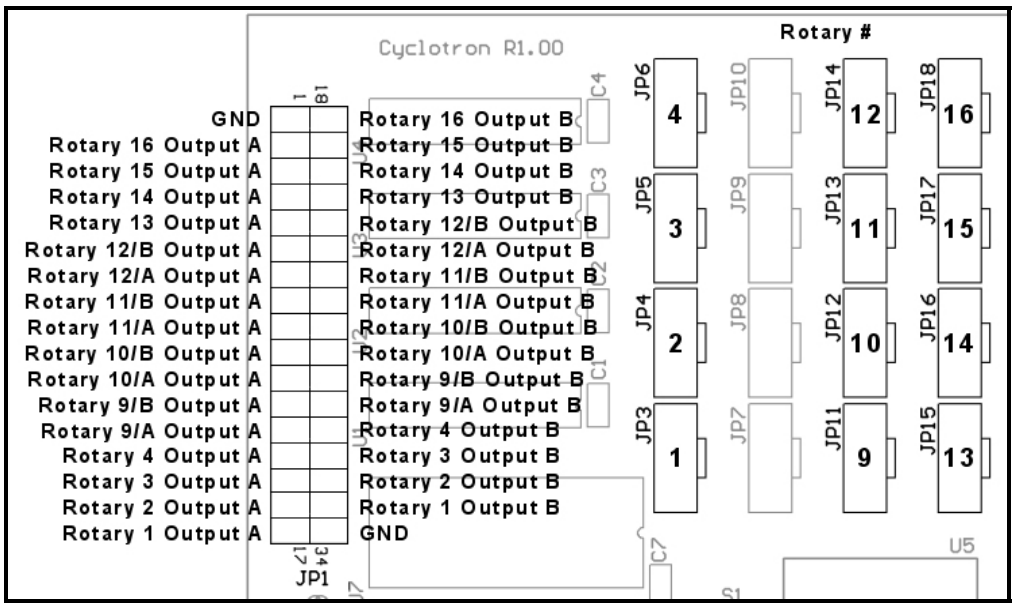


The rotary encoder input pin-out apply to both 2-bit binary and gray code type encoders with integrated pushbutton switch.

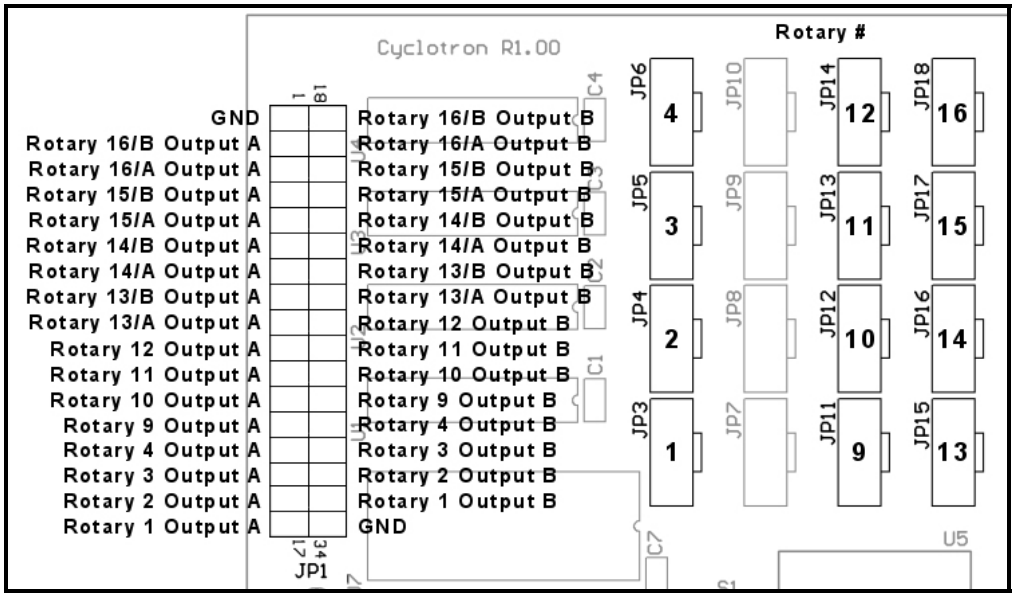
Mode A Output Pin-out



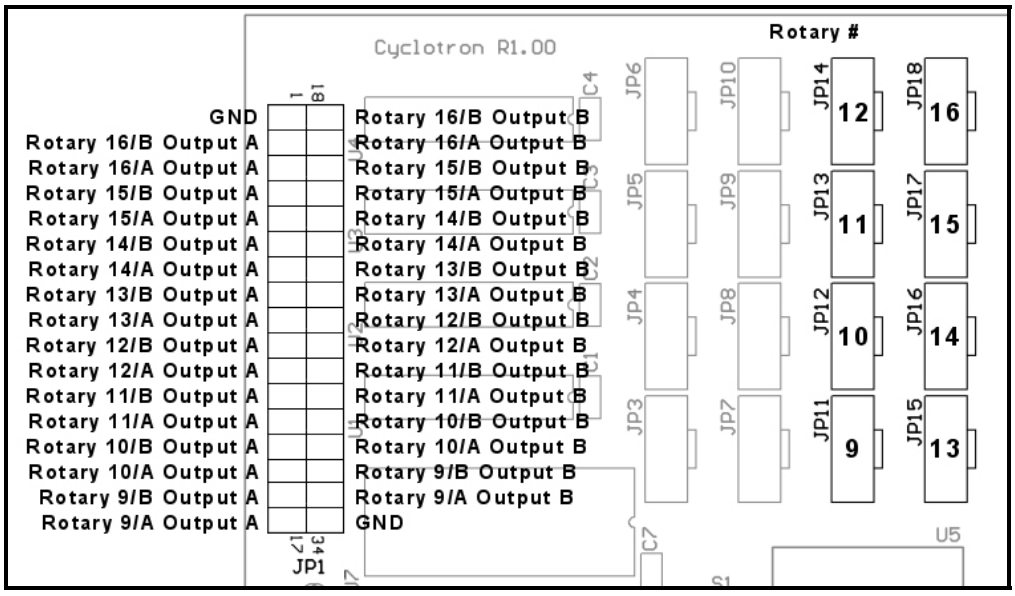
Mode B Output Pin-out



Mode C Output Pin-out



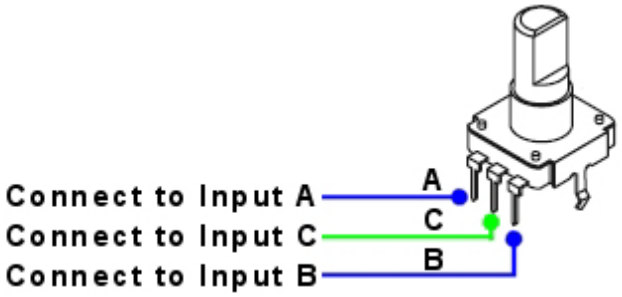
Mode D Output Pin-out



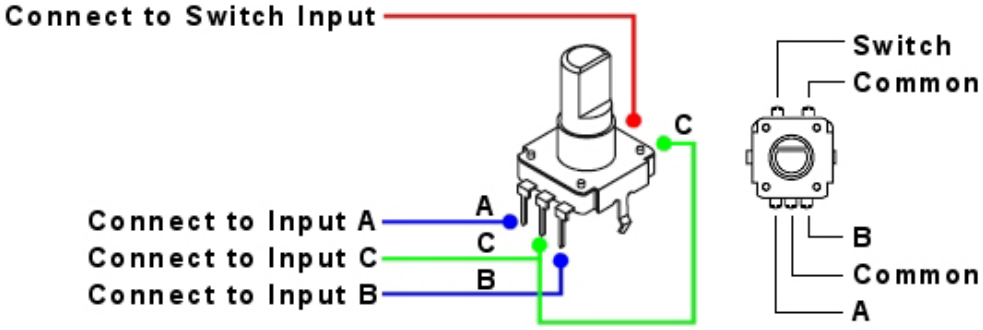
Connecting Various Rotaries – All Modes

The Cyclotron module can accept a large variety of rotary encoders with or without integrated pushbutton switch. Optical Encoders can also be used if powered by an external power source. Push/Pull rotary functionality is not supported by the current version of Cyclotron but will function properly when used as a standard pushbutton switch.

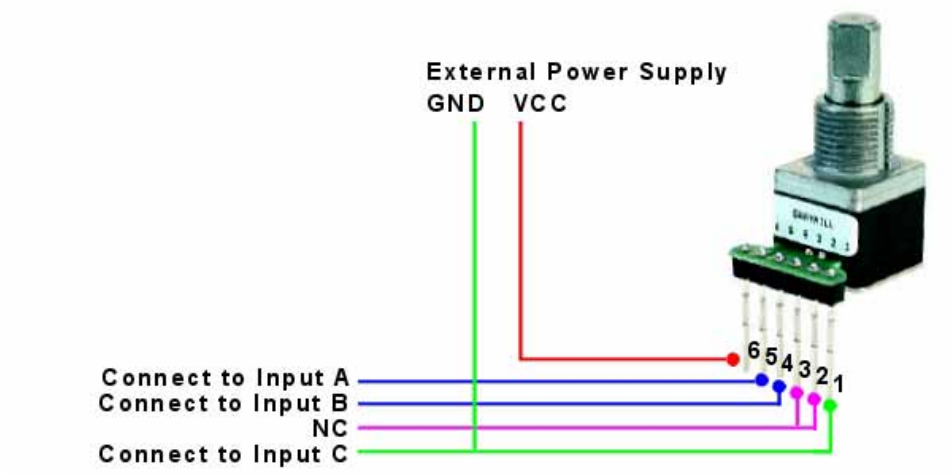
Connecting Mechanical Rotary Encoders

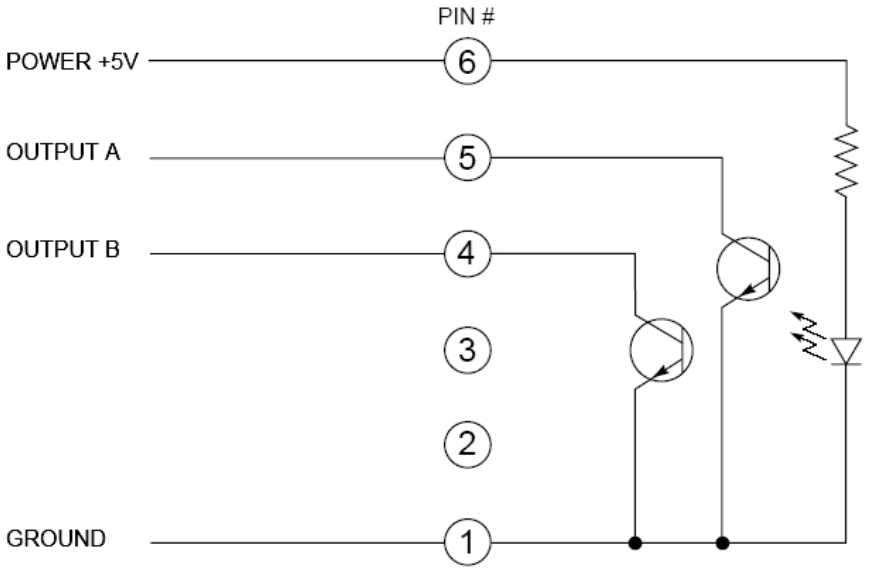


Connecting Mechanical Rotary Encoders with Pushbutton Switch

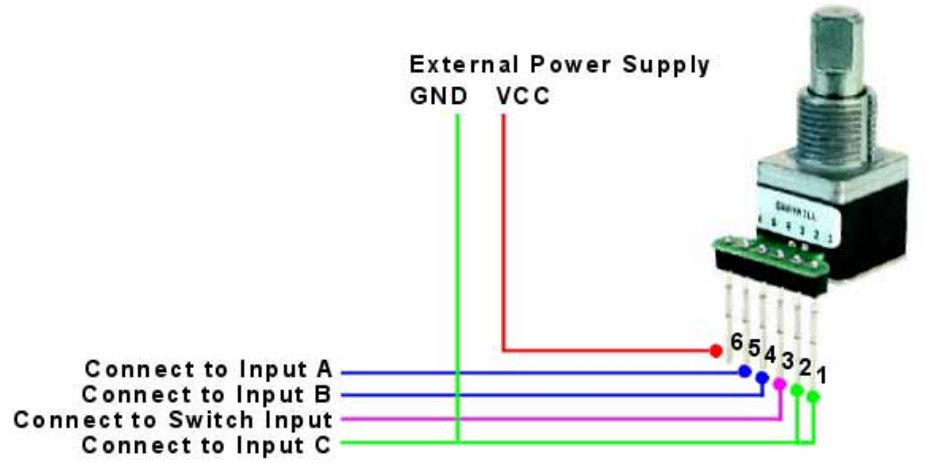


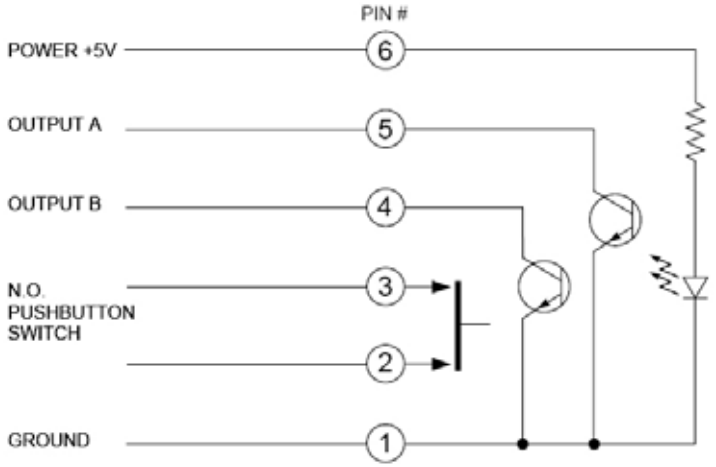
Connecting Optical Rotary Encoders



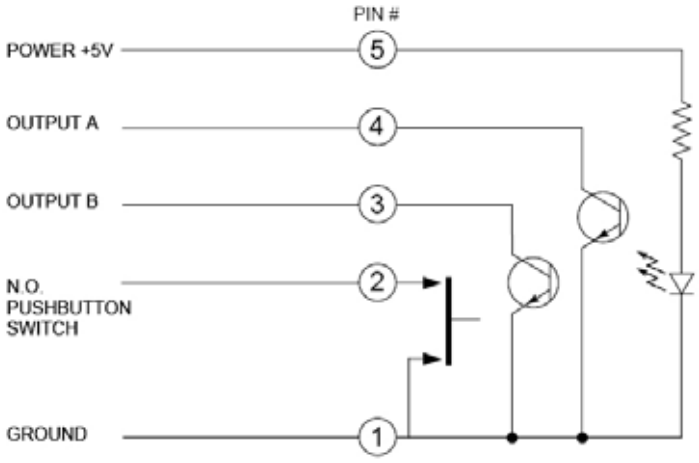


Connecting Optical Rotary Encoders with Pushbutton Switch





Alternate schematic for 5-pin variety of optical encoders.



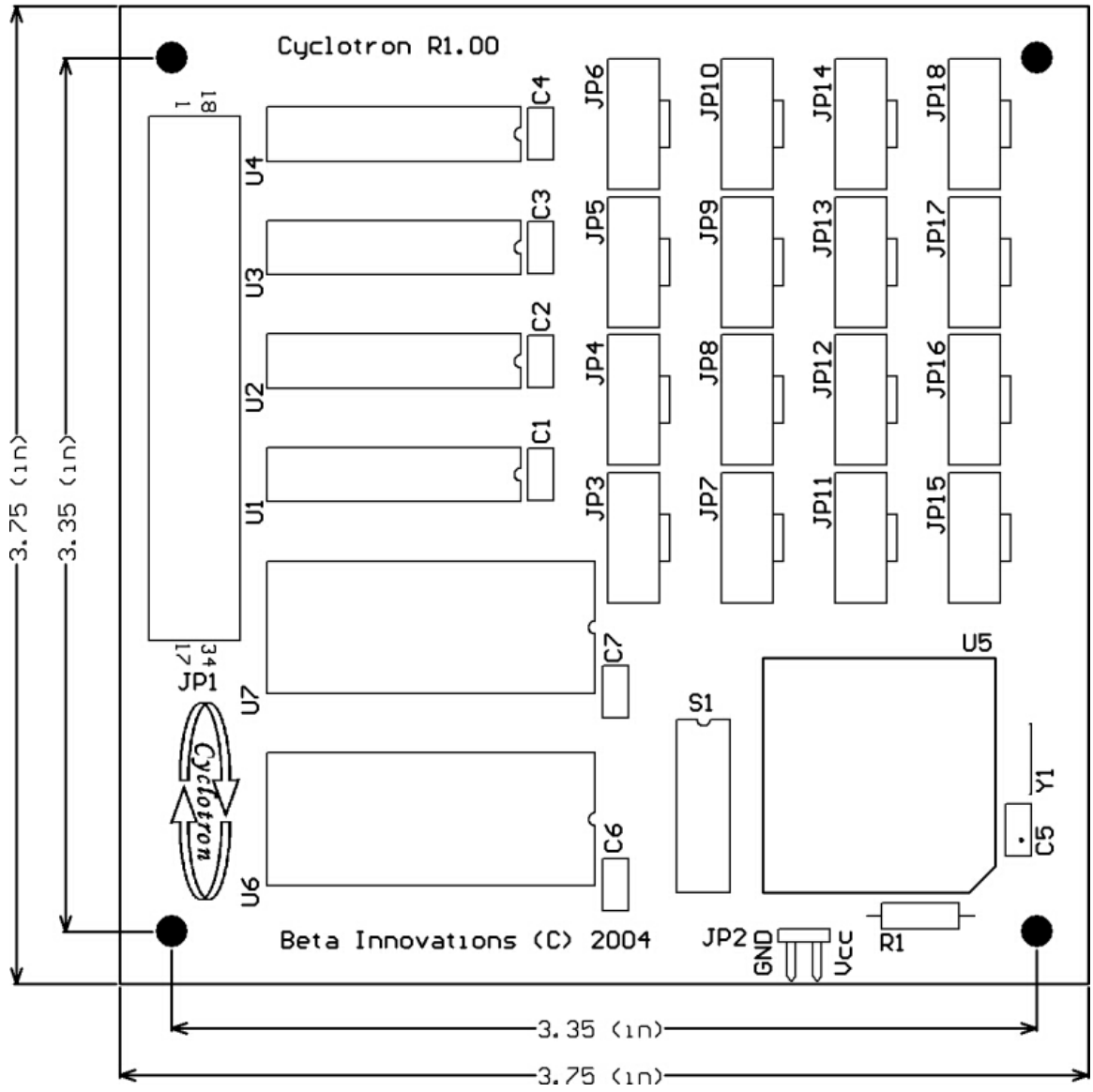
Hardware Specifications

The firmware runs at 40 MHz in all Modes of operation and is independent of the interface module's polling rate or speed. All inputs are debounced prior to decoding and processing insuring that no false signals get through. Note that all inputs and outputs are active low making this device suitable to function only with Beta Innovations products and modules. Connecting this device to other hardware can result in damage to both devices and should only be attempted by an experienced user.

Maximum power consumption is 125mW (25mA) and is powered by the USB bus of the GammaRay module. You do not need to use an external power supply for this device unless connecting optical encoders rated at 5V.

NOTE: **DO NOT CONNECT any of the Cyclotron Vcc pins to external power supplies or voltage sources and to the GammaRay module.** Although common grounds can be safely connected to external grounds, it is not recommended and should be avoid whenever possible. Doing so may adversely affect performance, possibly causing strange or erratic behavior under certain conditions.

Mechanical Specifications



Bill Of Materials

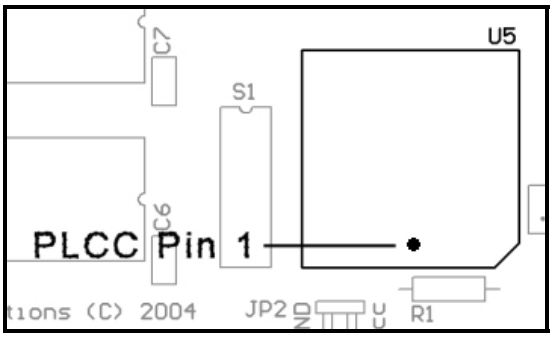
C1	0.1µF, 20%, 50VDC Ceramic
C2	0.1µF, 20%, 50VDC Ceramic
C3	0.1µF, 20%, 50VDC Ceramic
C4	0.1µF, 20%, 50VDC Ceramic
C5	0.1µF, 20%, 50VDC Ceramic
C6	0.1µF, 20%, 50VDC Ceramic
C7	0.1µF, 20%, 50VDC Ceramic
JP1	Header, 34-Pin .100, Dual row
JP2	Header, 2-Pin .100, Right Angle
JP3	Header, 4-Pin AMP - 103735-3
JP4	Header, 4-Pin AMP - 103735-3
JP5	Header, 4-Pin AMP - 103735-3
JP6	Header, 4-Pin AMP - 103735-3
JP7	Header, 4-Pin AMP - 103735-3
JP8	Header, 4-Pin AMP - 103735-3
JP9	Header, 4-Pin AMP - 103735-3
JP10	Header, 4-Pin AMP - 103735-3
JP11	Header, 4-Pin AMP - 103735-3
JP12	Header, 4-Pin AMP - 103735-3
JP13	Header, 4-Pin AMP - 103735-3
JP14	Header, 4-Pin AMP - 103735-3
JP15	Header, 4-Pin AMP - 103735-3
JP16	Header, 4-Pin AMP - 103735-3
JP17	Header, 4-Pin AMP - 103735-3
JP18	Header, 4-Pin AMP - 103735-3
R1	10K, 10%, 1/4W
S1	AMP 435640-4 DIP Switch, 6 toggle switches
U1	SN74HC373N D-Type Transparent Latch
U2	SN74HC373N D-Type Transparent Latch
U3	SN74HC373N D-Type Transparent Latch
U4	SN74HC373N D-Type Transparent Latch
U5	PIC18F442-I/L FLASH-Based 8-Bit CMOS Microcontroller
	44 pin PLCC socket for U5
U6	HCF4067BEY Analog Multiplexer/Demultiplexer
U7	HCF4067BEY Analog Multiplexer/Demultiplexer
Y1	10MHz Ceramic Resonator with integrated 22 pf capacitors

IMPORTANT: You can substitute both the analog multiplexer IC's (HCF4067BEY) and the D-Type Transparent Latch (SN74HC373N) with practically any other kind without any degradation in performance. Feel free to buy the least expensive types available from your local supplier of electronic components.

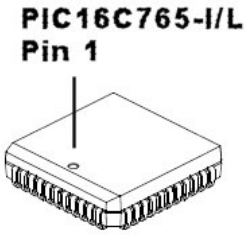
Please verify the specs of the ceramic resonator before substituting with any other kind. If you have a hard time finding these ceramic resonators, you can order them from Digi-Key.

Clearly identify all PIN 1 positions prior to component placement. Particular attention must be paid to the orientation of the following critical components:

PIC16C765-I/L Microcontroller



PLCC Socket Pin 1 Location



PIC16C765-I/L Pin 1 Location

Visit www.betainnovations.com for the availability of kits, fully assembled modules and accessories.