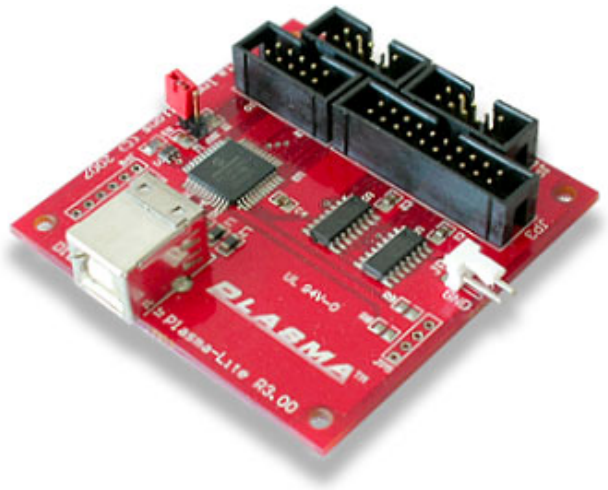
Plasma-Lite V2 USB Module



Product ID. : 910
Board Rev. : 3.00
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Firmware Rev. : 2.82

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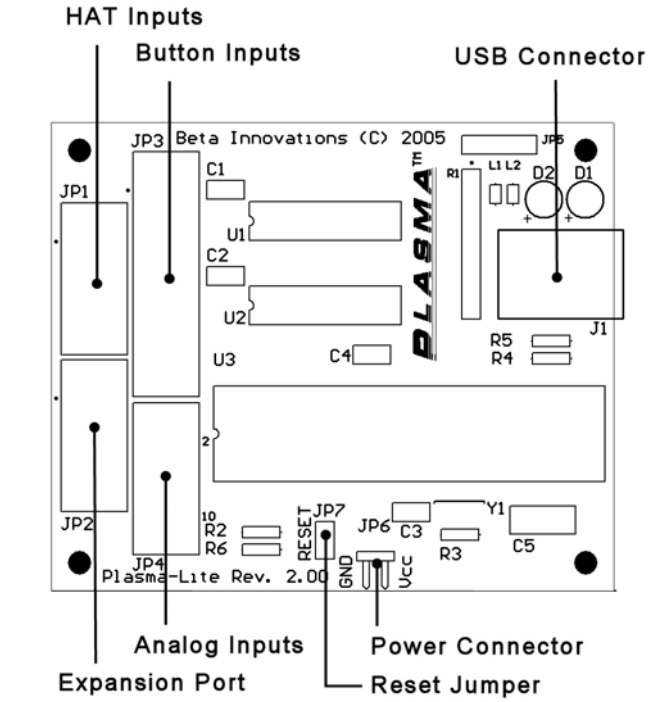
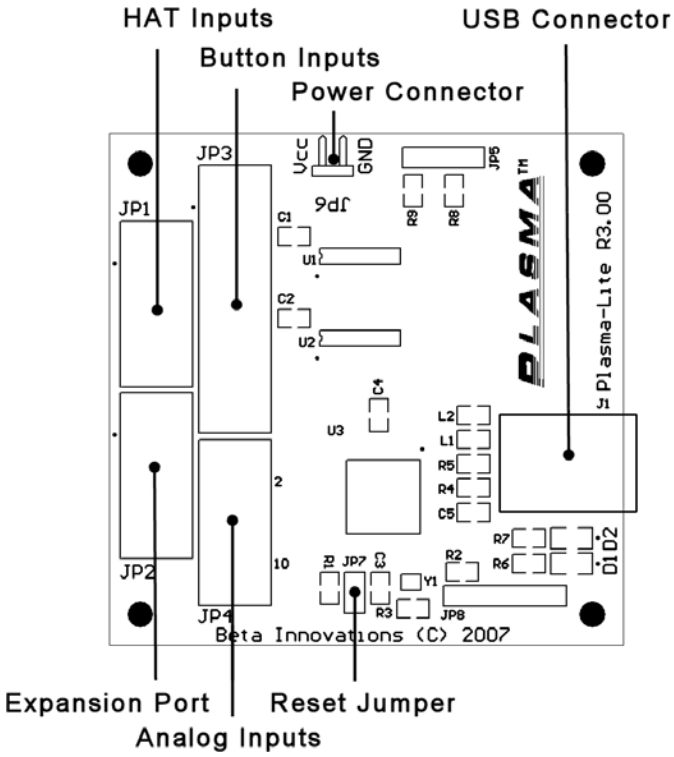




Main Features

- **Easy installation**
  The Plasma-Lite V2 device is a Full Speed USB HID compliant device, which employs default drivers supplied by most OS and powered by the USB Bus.

- **Analog Axis Input**
  Supports a variety of input devices including, Potentiometers, Hall-Effect sensors, and pressure transducers or force sensors for precise control.

- **Expansion Port**
  Supports multiple expansion modules such as the ACE-4X 32 button input module, 13-Bit Absolute Encoders or Character LCDs.

- **Filtering Algorithm**
  Features a proprietary user adjustable 2 level *Recursive Moving Delta Sigma* filtering algorithm virtually eliminating noise, spike and jitter for stable output.

- **Hardware Calibration**
  All axis channel calibration data is stored onboard eliminating the need for calibration in Windows. Additionally, axis channels can be tweaked for optimal performance as needed by setting trim zones.

- **Axis Resolutions**
  Up to 12-bits (4095 steps) axis resolution on analog channels and up to 16-bits (65535 steps) on digital channels.

- **POV HAT Support**
  2 Digital 8-way POV HAT inputs.

- **Button Inputs**
  Up to 24 button inputs (Active Low) compatible with any kind of switch: toggle, push button, etc. Each input individually configurable for various modes of operation.

- **Rotary Encoders**
  Up to 8 rotary encoders supported. Decoding options include Gray Code 1X, 2X, 4X.

- **Incremental Encoder**
  Supports a single high-resolution incremental encoder for up to 4000 PPR (1000 CPR) and 16-bit range (0 to 65535).

- **Absolute Encoders**
  Up to 6 absolute encoders (13-bits) supported.

- **Software Configurable Operation**
  Device features can be customized through a simple to use configuration utility.

- **Flash Loader Mode**
  Incorporates a Flash Loader for easy firmware update via USB.

Introduction

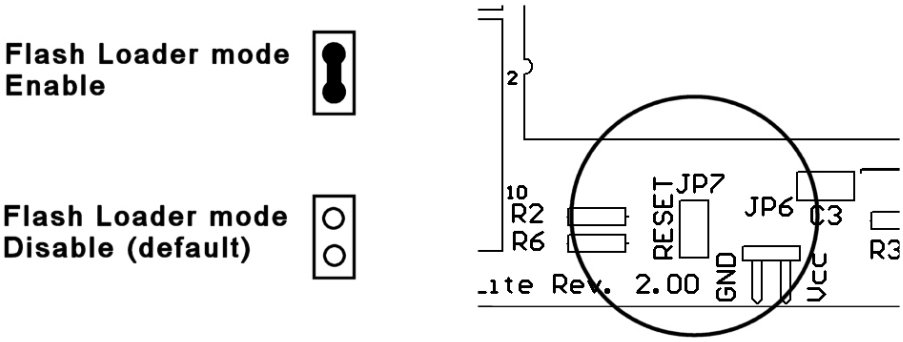
The Plasma-Lite V2 USB adapter is the next generation input device now featuring 12-bit resolution on analog channels, 16-bit resolution on digital channels and software configurable. Through various parameters, many aspects of the device can be controlled, adjusted, activated or deactivated to meet individual needs. In each case the Plasma unit will reconfigure itself without the need to re-enumerate. As such, the configuration settings can be altered at any time during normal operation without the need to disconnect the device from the USB bus.

Driver installation is automatic and most OS will install the required drivers without any user intervention. Note: Reset jumper JP7 should be removed prior to plugging the device into a USB port.

Flash Loader Mode : JP7

The Plasma-Lite V2 USB adapter consists of 2 devices in 1. In Flash Loader mode, the module enumerates as a non-joystick device used solely for updating the core firmware via USB. In Device mode the Plasma unit operates as a standard DirectX compatible joystick device.

RESET Jumper JP7



RESET jumper JP7 can be used to restart the device in Flash Loader mode. It should remain open (disable) for normal device operation. The device can be set in Flash Loader mode when needed in order to update the core Plasma-Lite firmware. The jumper must be removed after successful firmware update prior to rebooting the device. See the Device Manager utility user manual for details on firmware update procedures.

Plasma-Lite V2 Button Structure

Buttons Structure

Digital Channel Buttons	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**
	9	**10**	**11**	**12**	**13**	**14**	**15**	**16**
HAT Digital Mode	**17**	**18**	**19**	**20**	**21**	**22**	**23**	**24**
ACE-4X	**25**	**26**	**27**	**28**	**29**	**30**	**31**	**32**
	33	**34**	**35**	**36**	**37**	**38**	**39**	**40**
	41	**42**	**43**	**44**	**45**	**46**	**47**	**48**
	49	**50**	**51**	**52**	**53**	**54**	**55**	**56**

GT-X64	**25**	**26**	**27**	**28**	**29**	**30**	**31**	**32**
	33	**34**	**35**	**36**	**37**	**38**	**39**	**40**
	41	**42**	**43**	**44**	**45**	**46**	**47**	**48**
	49	**50**	**51**	**52**	**53**	**54**	**55**	**56**
	57	**58**	**59**	**60**	**61**	**62**	**63**	**64**
	65	**66**	**67**	**68**	**69**	**70**	**71**	**72**
	73	**74**	**75**	**76**	**77**	**78**	**79**	**88**

The structure above lists the button order as seen by applications running on systems supporting USB HID compliant devices. Note that not all OS drivers are capable of reading all inputs. Legacy Windows drivers will only support the first 32 buttons including the Game Controllers applet found in the Control Panel. However, DirectX drivers and any software that uses DirectX Direct Input can support up to 128 buttons per device. There are no limits for Beta Innovations custom drivers, which as of this writing support up to 256 inputs per device.

When digital inputs are configured as rotary encoders, decoded outputs will be in pairs as illustrated below.

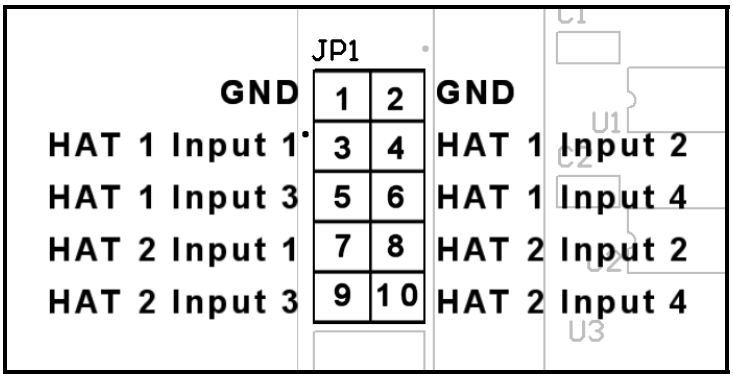
	Rotary 1		**Rotary 2**		**Rotary 3**		**Rotary 4**	
Digital Channel Rotary Mode	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**
	9	**10**	**11**	**12**	**13**	**14**	**15**	**16**
	Rotary 5		**Rotary 6**		**Rotary 7**		**Rotary 8**	

The current firmware revision only supports rotary encoders on digital channels. Support for rotary encoders on other channels may be added in a future firmware update.

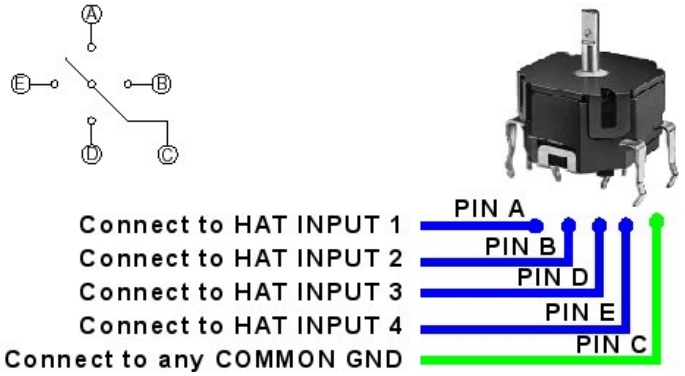
Plasma-Lite V2 Pin-Out

JP1: HAT Port

POV Mode

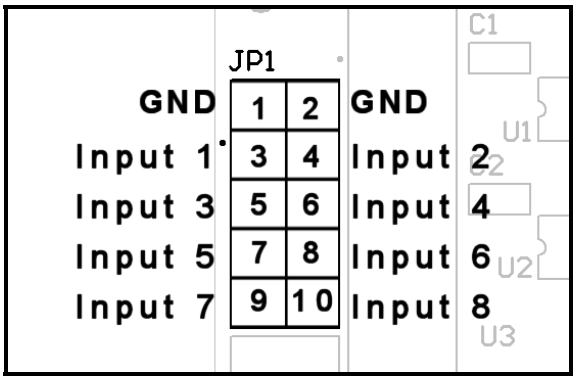


HAT input 1: POV SWITCH UP
HAT input 2: POV SWITCH RIGHT
HAT input 3: POV SWITCH DOWN
HAT input 4: POV SWITCH LEFT



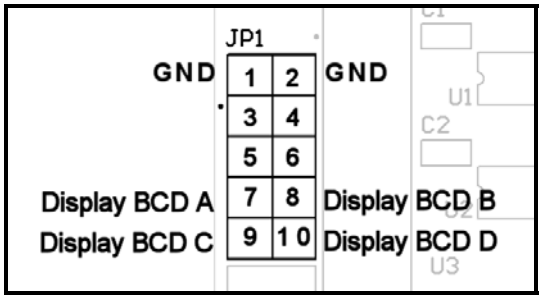
The POV HAT switch common pin must be connected to one of the ground pins. All other HAT switch pins must be connected to the appropriate input pins as describe above.

Digital Mode

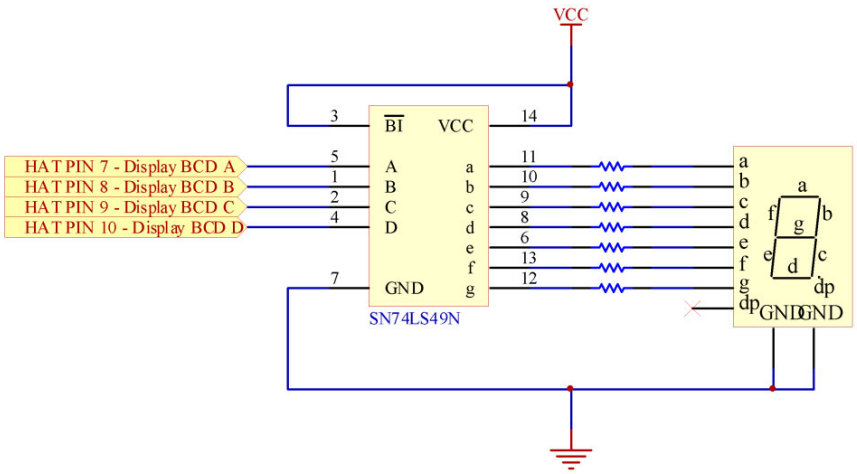


When the POV HAT port is configured in Digital Mode, standard switches can be connected for 8 additional button inputs to the standard compliment of 16 for a total of 24 button inputs. Refer to the **Button Inputs** section for details on connecting switches to POV HAT port inputs.

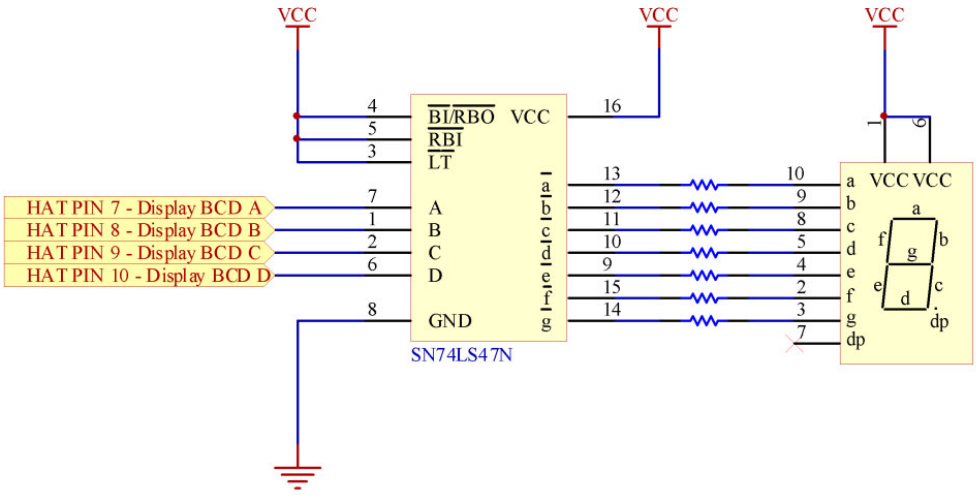
RXC: Shifter Display Mode



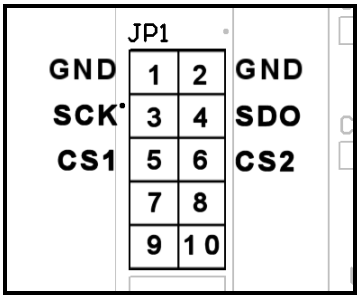
When HAT channel 2 is set to RXC : Shifter Display mode, pins 7 through 10 will be configured as BCD (Binary Coded Decimal) output pins. Shifter positions supported are from 1 to 9 with Neutral being displayed as 0 and Reverse as blank output. These outputs can be used to drive a 7-segment display through any standard BCD-TO-SEVEN SEGMENT decoder driver chip as illustrated bellow.



The schematic above uses a Common Cathode display with a 7449 decoder IC. Alternately, a 7447 IC can be used with Common Anode displays.



RXC: 12-Bit DACs Mode

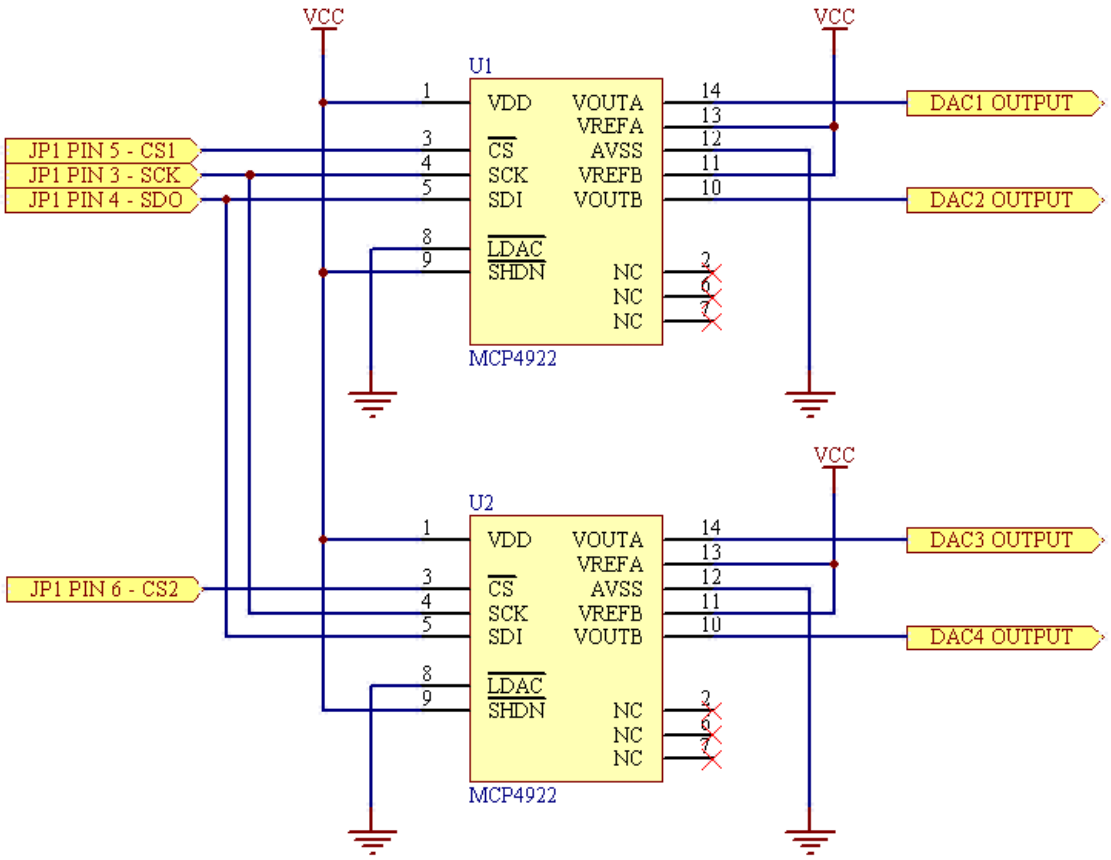


When HAT channel 1 is set to RXC: 12-Bit DACs mode, pins 3 through 6 will be configured as SPI output pins to control up to 4 12-Bit DACs such as the MCP4922. The MCP4922 is a dual DAC on a single IC package capable of Rail-to-Rail output and employs an SPI interface.

SPI Interface:

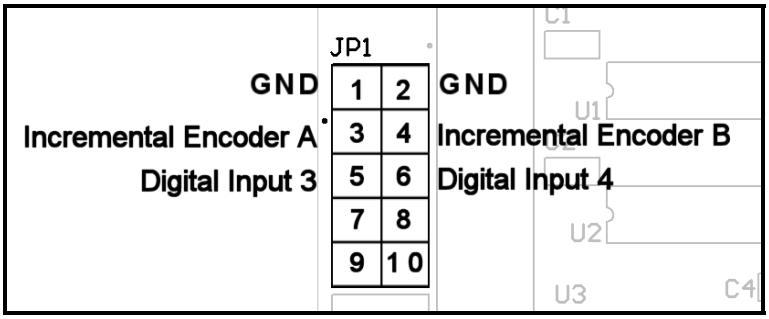
SCK – Clock
SDO – Data
CS1 – Chip Select 1
CS2 – Chip Select 2

DAC outputs can be connected to standard Air-Core driver circuit such as the AC305A/B and AC360A/B/C circuits.



Decoupling capacitors (0.1µF Ceramic) should be placed as close to the VCC pins of the DAC ICs.

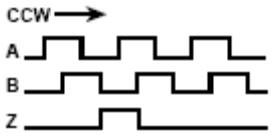
Incremental Encoder Mode



When the HAT channel 1 is set for Incremental Rotary Encoder mode, pins 3 through 6 will be reconfigured as show above. Inputs on pins 5 and 6 are defaulted to digital inputs mode. Incremental inputs will decode any standard quadrature encoded rotary for up to 4000 PPR (Pulses Per Revolution) or 4000 discrete steps per revolution up to a maximum range from 0 to 65535 (16-bits).

Note: Manufacturer's encoder documentation may specify output as PPR or CPR (Cycle Per Revolution). To determine PPR, multiply CPRs by 4.

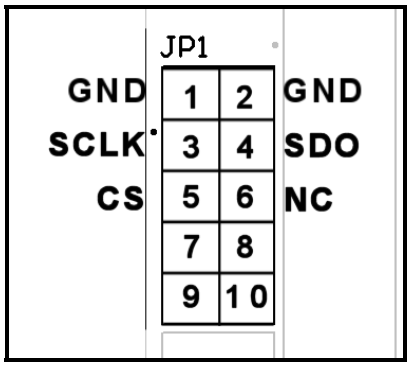
Typical incremental output pulses are illustrated below.



Pulse output A leads B by 90 deg. Index Z pulse occurs once per revolution. Current firmware does not support index pulses.

IMPORTANT: Only TTL output drivers (4.5V – 5.5V) can be directly connected to the Plasma-Lite pins. Rotary encoder current consumption must not exceed 100mA. Rotary encoders with current consumption exceeding 100mA will require their own power supply. Refer to manufacturer's specification sheets for details.

LBG10-DG Mode



When HAT channel 1 is set to LBG10-DG mode, pins 3 through 5 will be configured as SPI output pins to control a single LED bar graph display.

SPI Interface:

SCLK – Serial Clock
SDO – Serial Data Out
CS – Chip Select
NC – No Contact

In addition to the above pins, the LBG10-DG must be connected to any one of the 5V pins not shown. Refer to LBG10 user manual for details.

NITRO Mode

Refer NITRO user manual for details.

JP2: ACE Port

The ACE Port on the Plasma-Lite module provides the means to expand current options and features not supported by the standard ports. The expansion port was designed to provide interconnectivity with external hardware using minimal support circuitry.

Note that as new firmware features are added, it may become necessary to make changes to the layout of any support circuitry in order to maximize functionality and efficiency. Before updating the device firmware, verify that the addition of new features do not conflict with previous ACE port add-ons in use.

ACE-4X expansion card

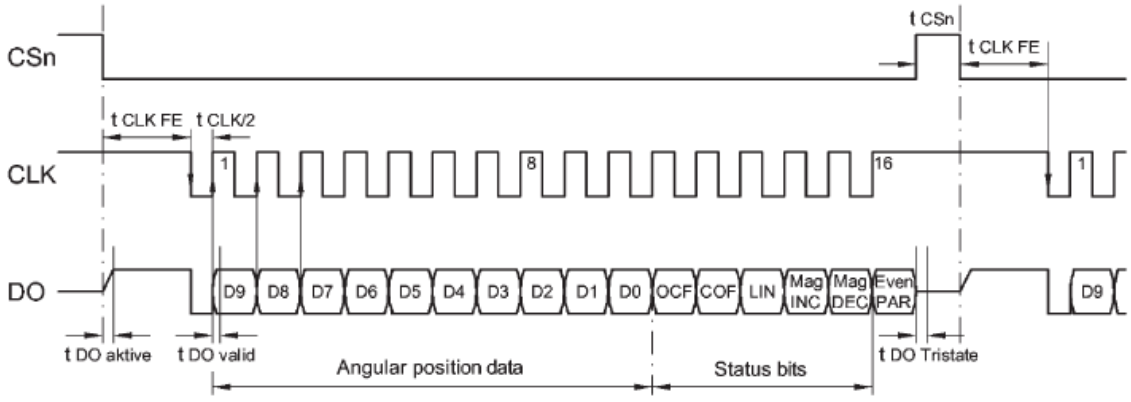
Refer to ACE-4X user manual.

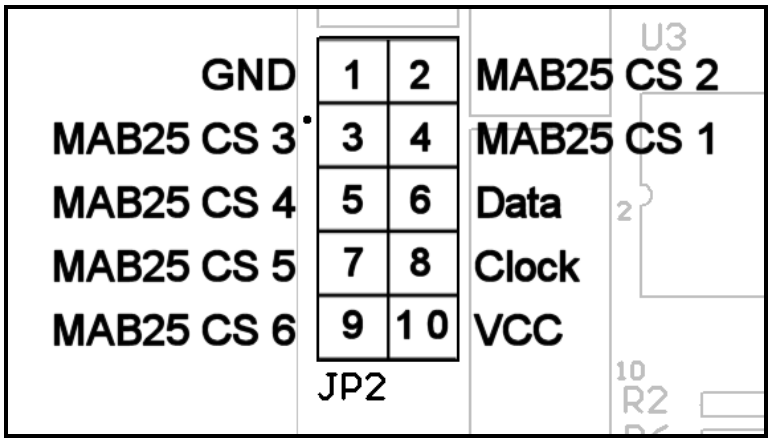
GT-X64 expansion card

Refer to GT-X64 user manual.

Absolute MAB25 Encoders

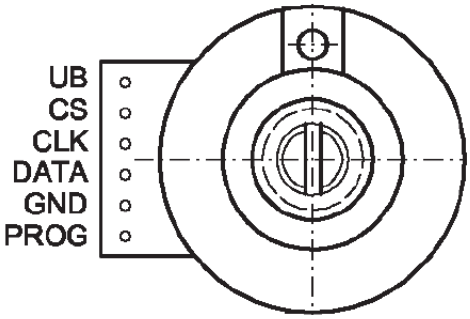
Current firmware supports up to 6 MAB25 series Absolute Encoders connected to the ACE expansion port using Synchronous Serial Interface 16-bit data words as illustrated in the timing diagram bellow.





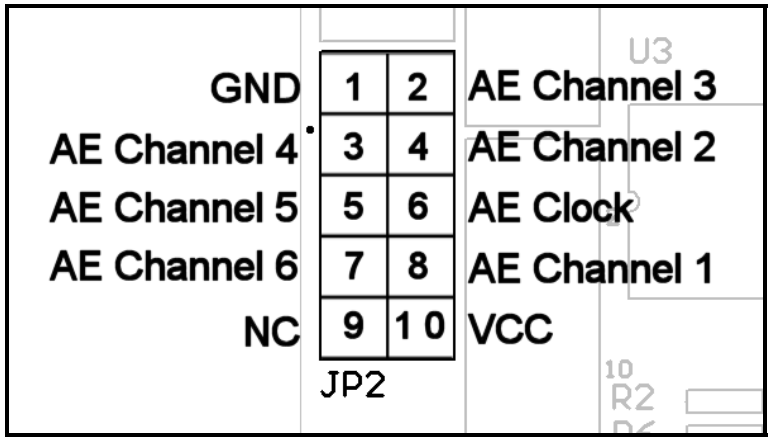
MAB25 Pin out

UB – JP2 Pin 10, VCC
CS – JP2 CS 1 - 6 pins
CLK – JP2 Pin 8
DATA – JP2 Pin 6
GND – JP2 Pin 1, GND
PROG – NC



The maximum supported resolution is 12-bits per channel. Contact us for custom solutions requiring higher resolutions. MAB25 absolute encoders employ non-contacting hall-sensor technology. No additional support circuitry or power supply is required when connecting these encoders to the ACE port.

Absolute SSI Encoders



Current firmware supports up to 6 Absolute Encoders such as the Heidenhain ROC-41X connected to the ACE expansion port using 13-bit data words SSI (Serial Standard Interface) as illustrated in the timing diagram bellow.

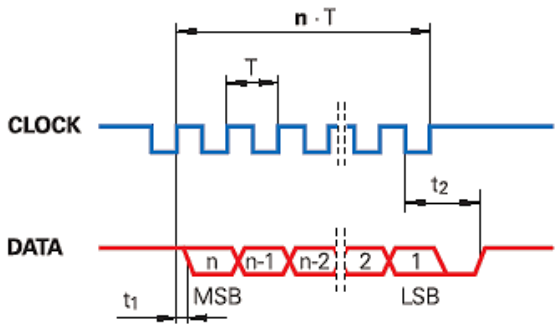
Data transfer

T = 1 to 10 µs

$t_1 \leq 0.4$ µs

t_2 = 14 to 17 µs

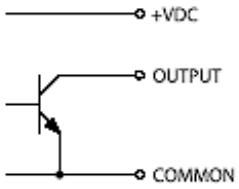
n = Data word length
13 bits



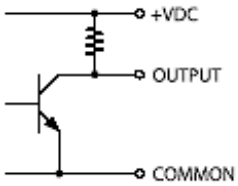
The maximum supported resolution is 13-bits per channel. Contact us for custom solutions requiring higher resolutions.

Serially interfaced absolute encoders employ either standard or proprietary communication protocols. The current firmware supports standard serial interfaces, some of which require minimal support circuitry ranging from a simple pull-up resistor to RS-485 transceivers for clock and data lines on differential interfaces.

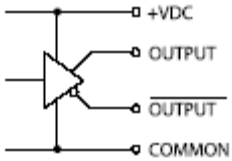
- Open Collector: requires a pull-up resistor between the OUTPUT pin and Plasma-Lite Vcc. Can be connected directly to Plasma's inputs provided the outputs are TTL (4.5V-5.5V). Refer to manufacturer's specifications for value of pull-up resistor.



- Pull-Up Resistor: can be connected directly to Plasma's inputs provided the outputs are TTL (4.5V-5.5V).

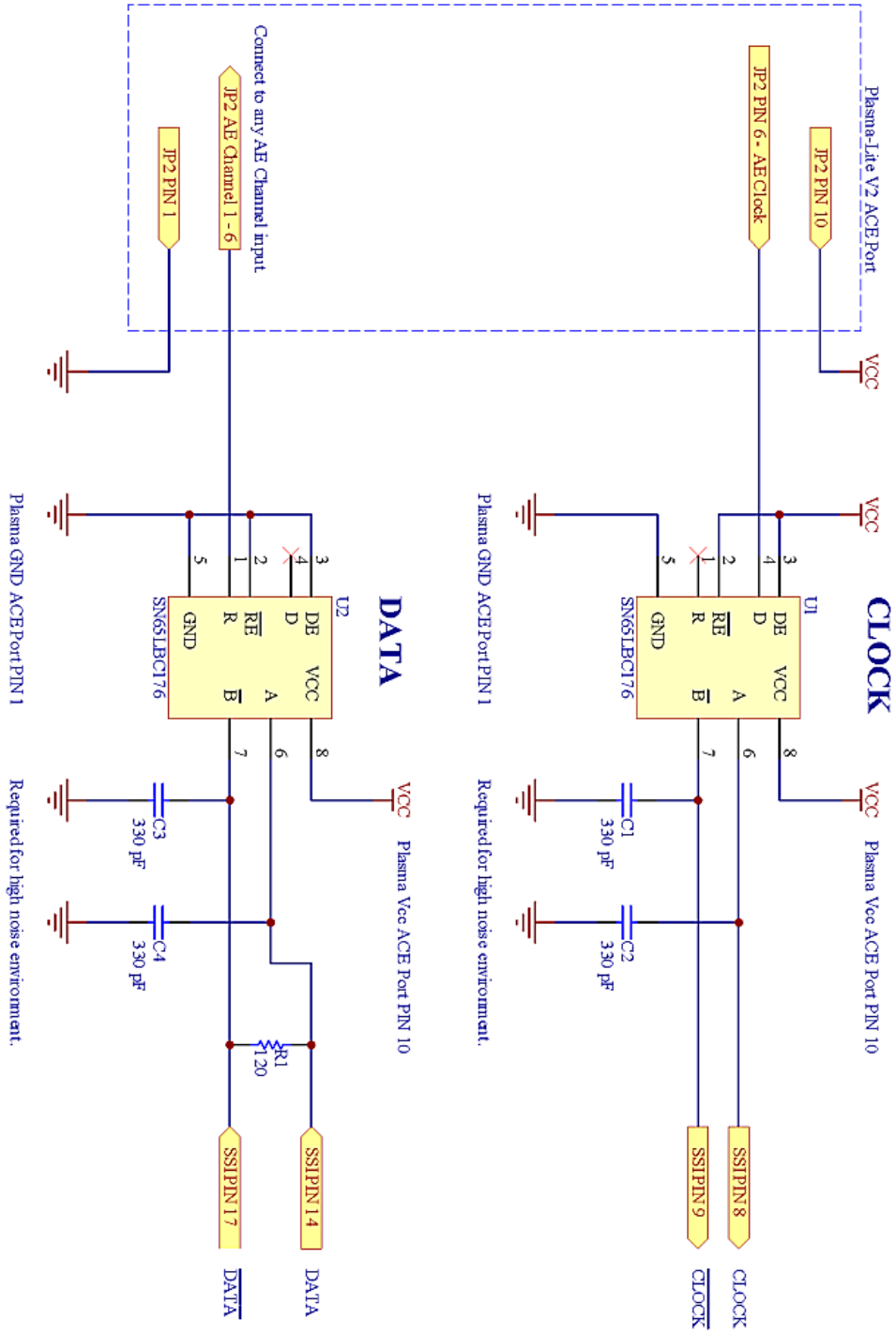


- Line Driver Outputs: requires transceivers to convert differential signals to TTL for compatibility with ACE port inputs pins.

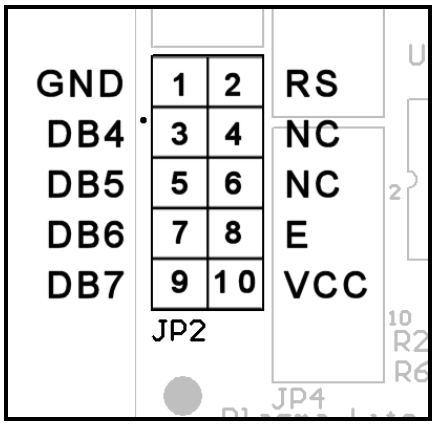


Connecting differential outputs can be a little more complicated due to the vast number of options and differences between various encoder models available on the market. Refer to manufacturer's specifications for differential interface requirements.

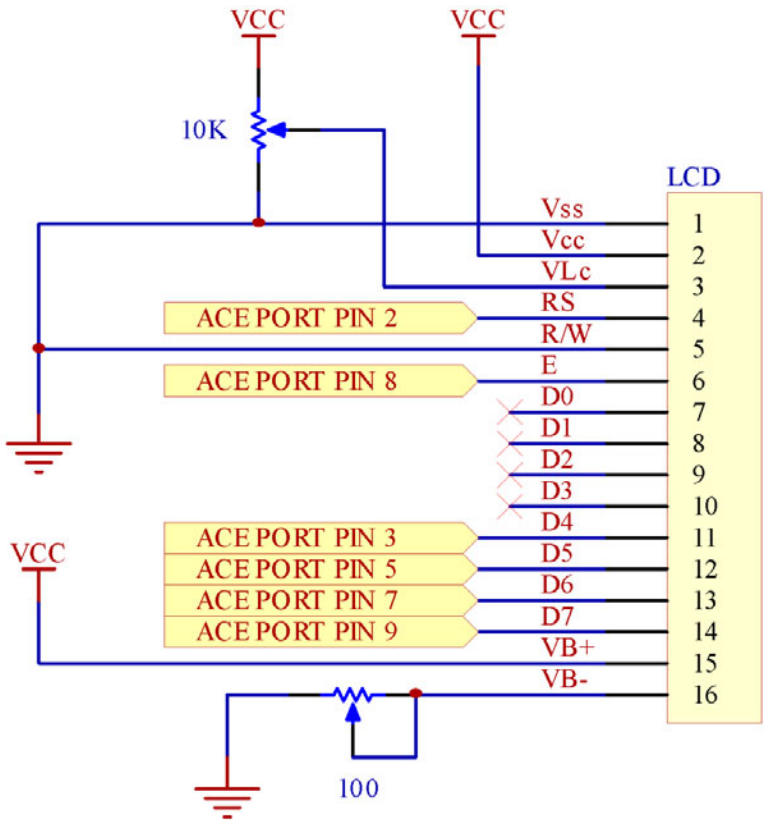
The following diagram illustrates an RS-485 interface for an Absolute Encoder with differential line driver output connected to any one of the 6 ACE port AE channels. All Encoders share a single clock line on pin 6.



Character LCD 20 x 4



When the ACE port is set to "Character LCD 20 x 4" mode, the port pins will be configured as indicated above for controlling any HD44780 compatible character LCD under 4-bit control. Refer to the Device Manager help file for details on configuring the ACE port for LCD support.

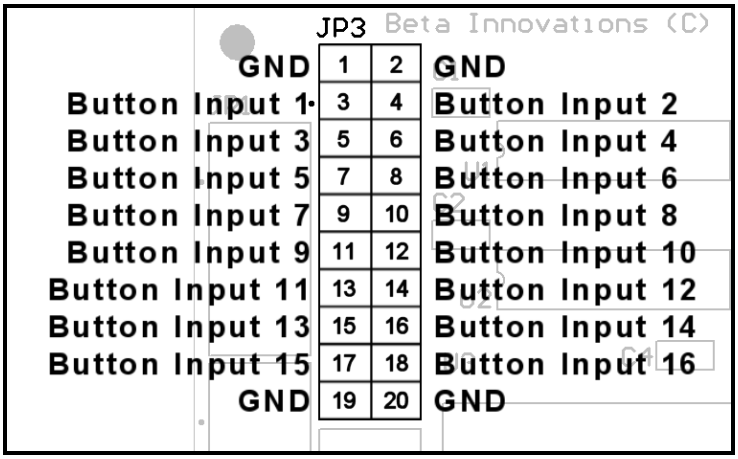


The ACE port can supply all the require current to drive a backlit LCD. The VCC pin 10 on the ACE port supplies power to the LCD.

IMPORTANT: YOU MUST USE a self powered USB HUB or the device will fail enumeration. Standard USB ports can only deliver up to 100mA per port.

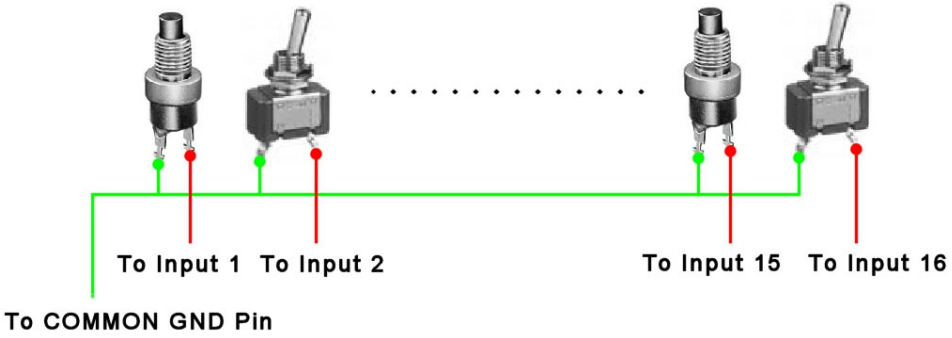
JP3: Button Port

Button Mode Inputs

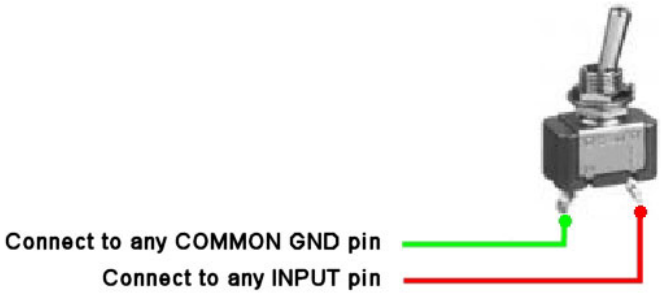


Simplified Wiring

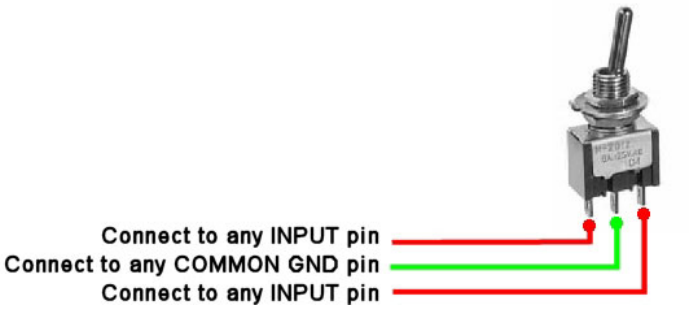
The Plasma module does not use a scan matrix type of input layout. In addition to simplifying wiring considerably, diodes are not required and inputs will not suffer from phantom signals when activating several switches at the same time.



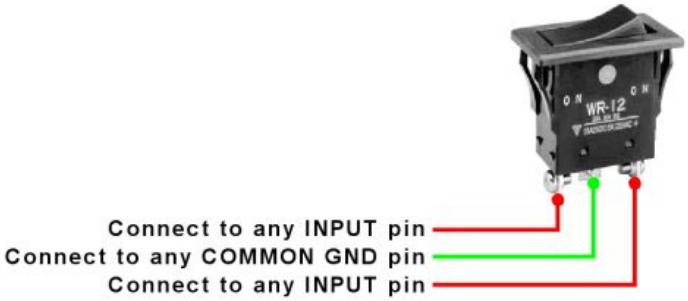
SPST Toggle Switches (On-Off)



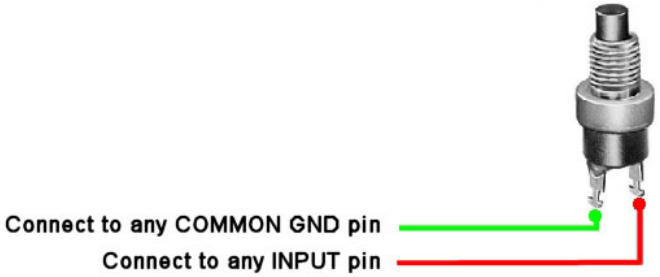
SPDT Switches (On-On)



Rocker Switches (On-Off-On)

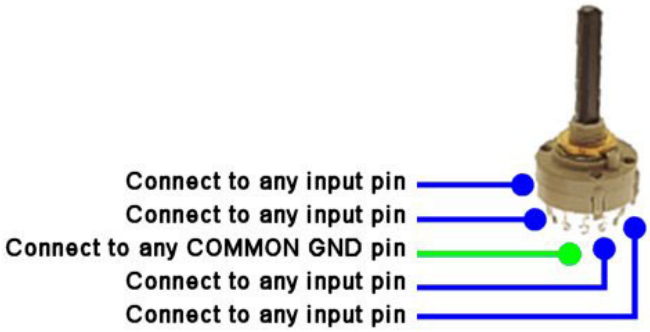


Push Button Switches

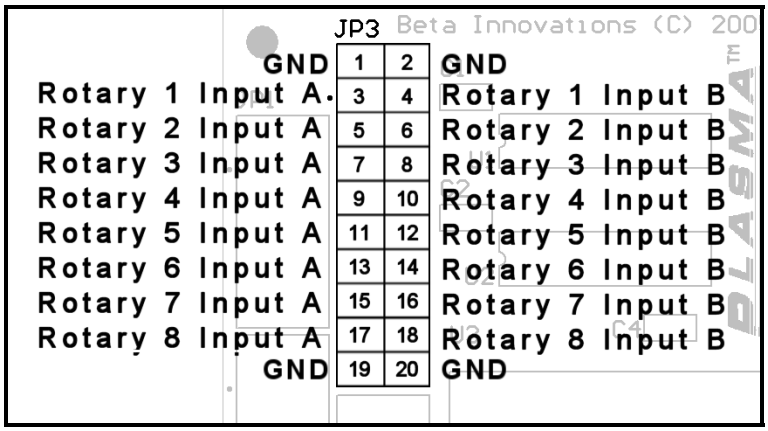


Multi-Position Rotary Switches

Multi-Position Rotary Switches come in many configurations, but the most important thing to note is that they all share one or several common pins. These common pins must to be connected to any one of the common GND pins found on the Plasma unit. All other pins can be connected to any one of the inputs as required.

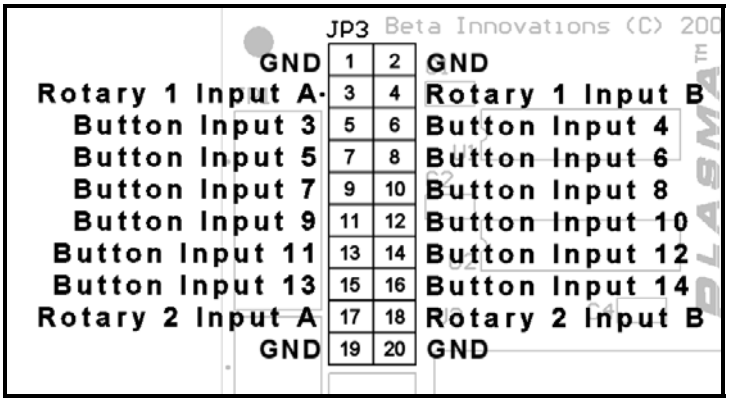


Rotary Mode Inputs

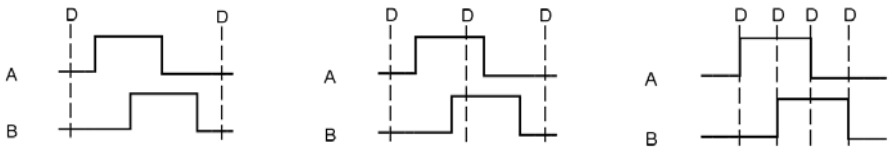


When pairs of digital Inputs are configured in Rotary Mode, standard rotaries can be connected to the inputs for decoding without the need for external decoding circuitry. A maximum of 8 rotaries can be connected to input pairs.

Note that not all inputs need to be configured for rotary support. The example below shows input pairs 1 – 2 & 15 –16 configured for rotary support. All other inputs are in standard digital mode.



Current firmware revision supports 3 types of phase shifted encoding as illustrated below.



Gray Code 1X

Gray Code 2X

Gray Code 4X

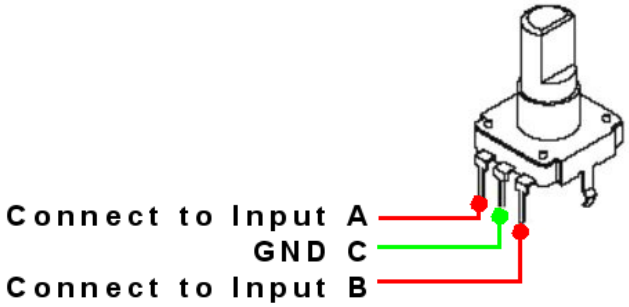
Decoding method depends largely on how the physical detents are implemented on the rotary with respect to output pulses. Rotary encoders that do not have any detents “D” can employ any of the above methods with up to 4X multiplier on output pulses.

Gray code 1X: provides a 1:1 decoding of phased pulses. Each input pulse results in a single output pulse.

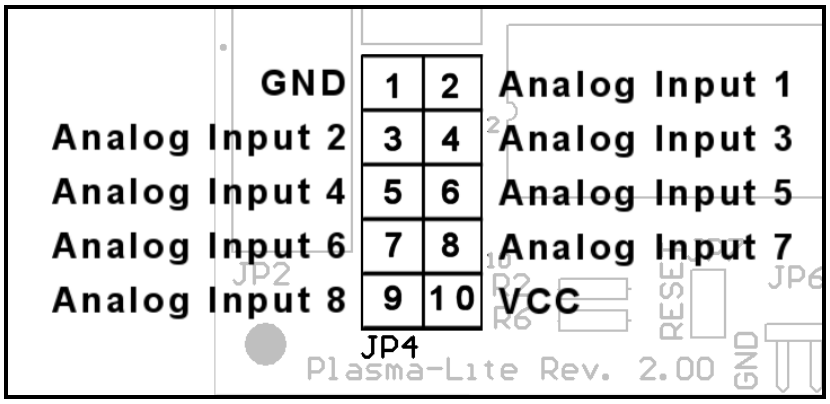
Gray Code 2X: provides a 1:2 decoding of phased pulses. Each input pulse results in 2 output pulses.

Gray Code 4X: provides a 1:4 decoding of phased pulses. Each inputs pulse results in 4 output pulses.

Typical rotaries consist of 3 pins. Pin “A” & “B” are the encoded outputs and one common middle pin “C”. Refer to manufacturer’s specifications for exact pin out.



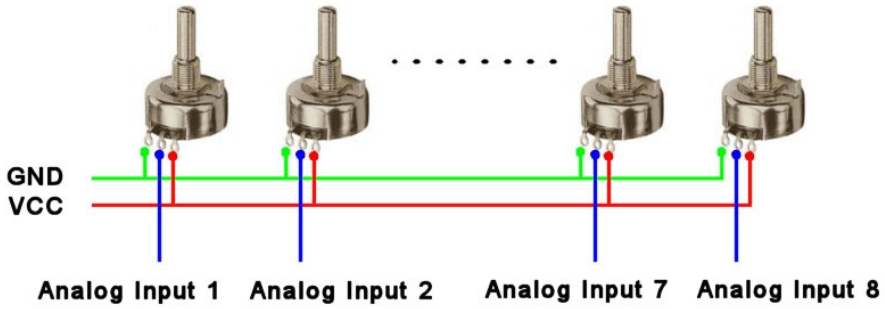
JP4: Analog Port



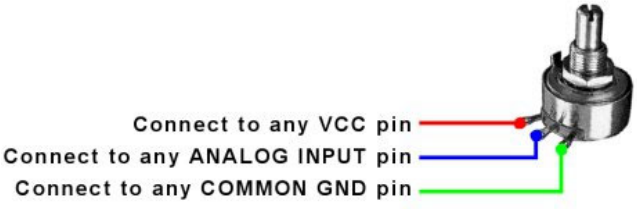
Default Analog Axis Inputs
Analog Input 1: X-Axis
Analog Input 2: Y-Axis
Analog Input 3: Z-Axis
Analog Input 4: X-Rotation
Analog Input 5: Y-Rotation
Analog Input 6: Z-Rotation
Analog Input 7: Slider 1
Analog Input 8: Slider 2

NOTE: Some operating system's default USB drivers may not support 8 axes. MS Windows 98 (USB Upgrade) / ME / 2000 / XP support up to 8 axis per device.

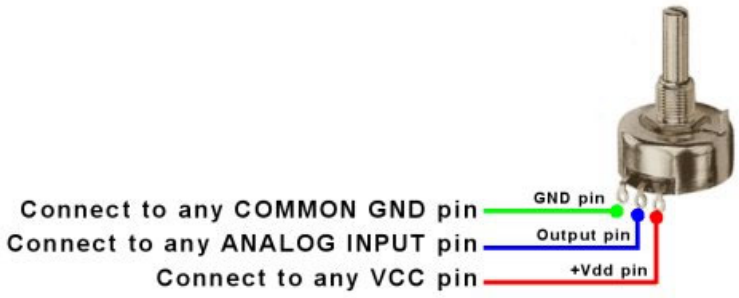
Simplified Wiring



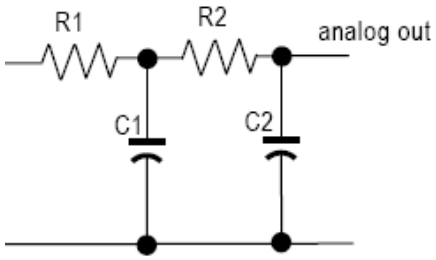
Connecting Potentiometers to Analog Inputs



Connecting Hall-Effect Sensors to Analog Inputs



A low pass filter may be required on the output of some Hall-Effect Sensors due to mismatch conditions with the input impedance of the ADC's sampling circuitry and/or noise from the Hall-Effect Sensor amplifier circuit.

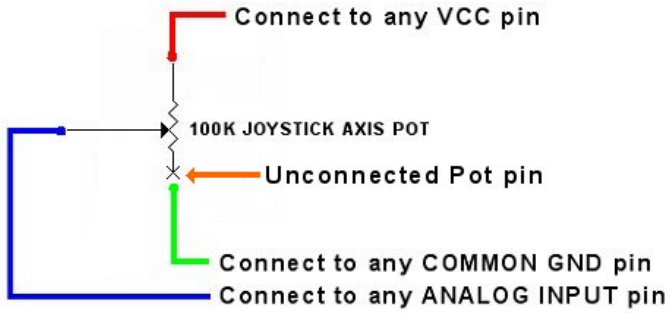


Component values are dependant on the frequency of the output signal noise.

Connecting Linear Transducers to Analog Inputs

Connecting Analog Joystick Pots

NOTE: Conventional analog Joystick potentiometers have one unconnected pin on axis pots. It is imperative that this pin be grounded in order to properly function when connected to the Plasma analog port inputs.



Hardware Specifications

All inputs on the Plasma-Lite V2 are active low, which means you must ground an input in order to register a high “ON” signal at the output.

Most operating systems will detect and load the appropriate HID driver for your device and do not require that a custom device driver be installed. These default drivers may not support all features of the Plasma-Lite V2 module on some operating systems.

Maximum power consumption is 2.5W (500mA) and is powered by the USB bus. You do not need to use an external power supply for this device, even when connecting (and powering) several expansion modules from the onboard power pins specifically added for this purpose.

IMPORTANT: YOU MUST USE a self powered USB HUB or the module will fail enumeration. Standard USB ports can only deliver up to 100mA per port.

Potentiometer values are not critical for the proper operation of analog inputs, but values should not be less than 5K Ohm and not greater than 1Meg Ohm for optimal operation. Keep the wiring tidy and as short as possible. Do not twist pot wires. Use untwisted shielded cabling or a flat ribbon cable.

In order to avoid potential damage to the analog inputs, pots should be connected to the port with the power turned off by disconnecting the unit from the USB bus.

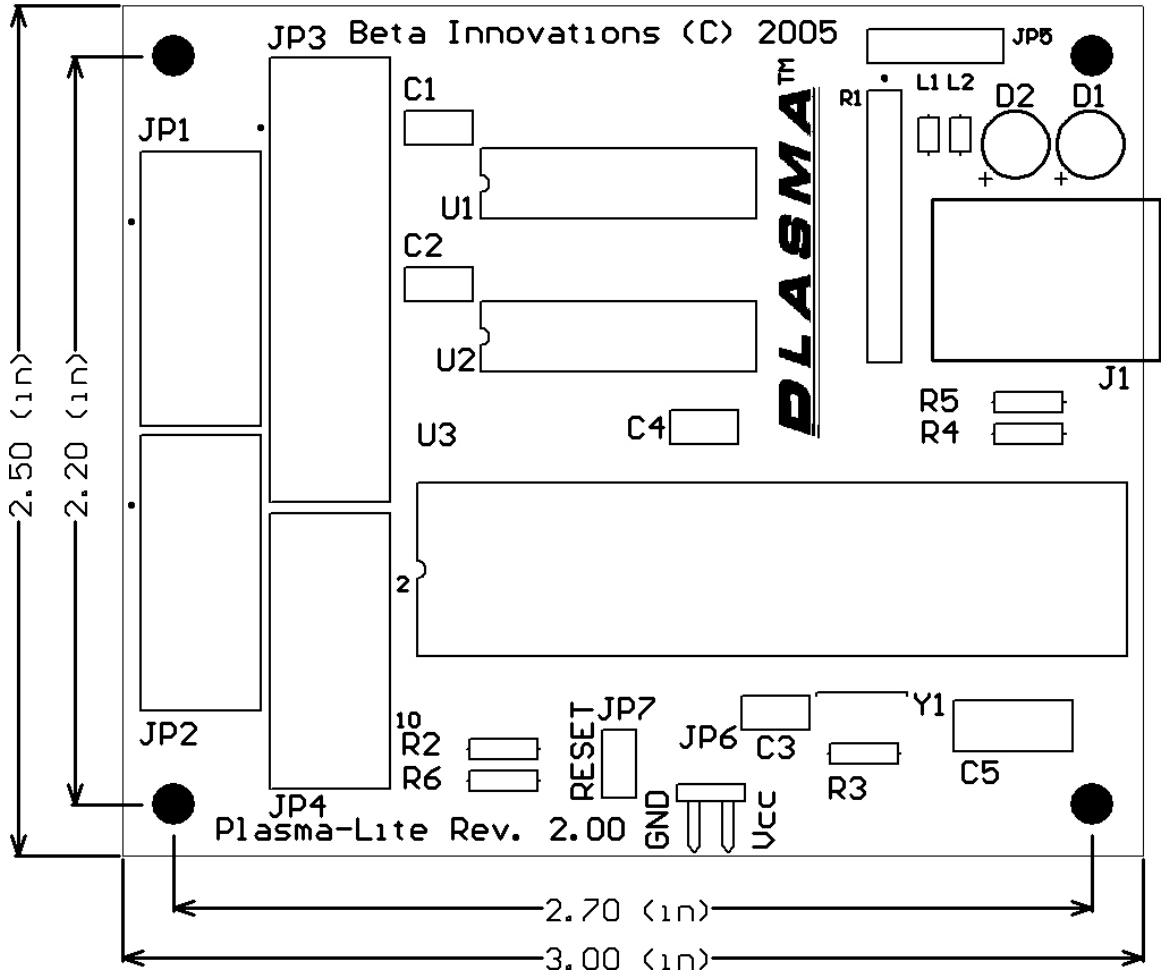
IMPORTANT: DO NOT CONNECT any of the Plasma-Lite V2 Vcc pins to external power supplies or voltage sources. Although common grounds can be safely connected to external grounds, it is not recommended and should be avoided whenever possible. Doing so may adversely affect performance, possibly causing strange or erratic behavior under certain conditions.

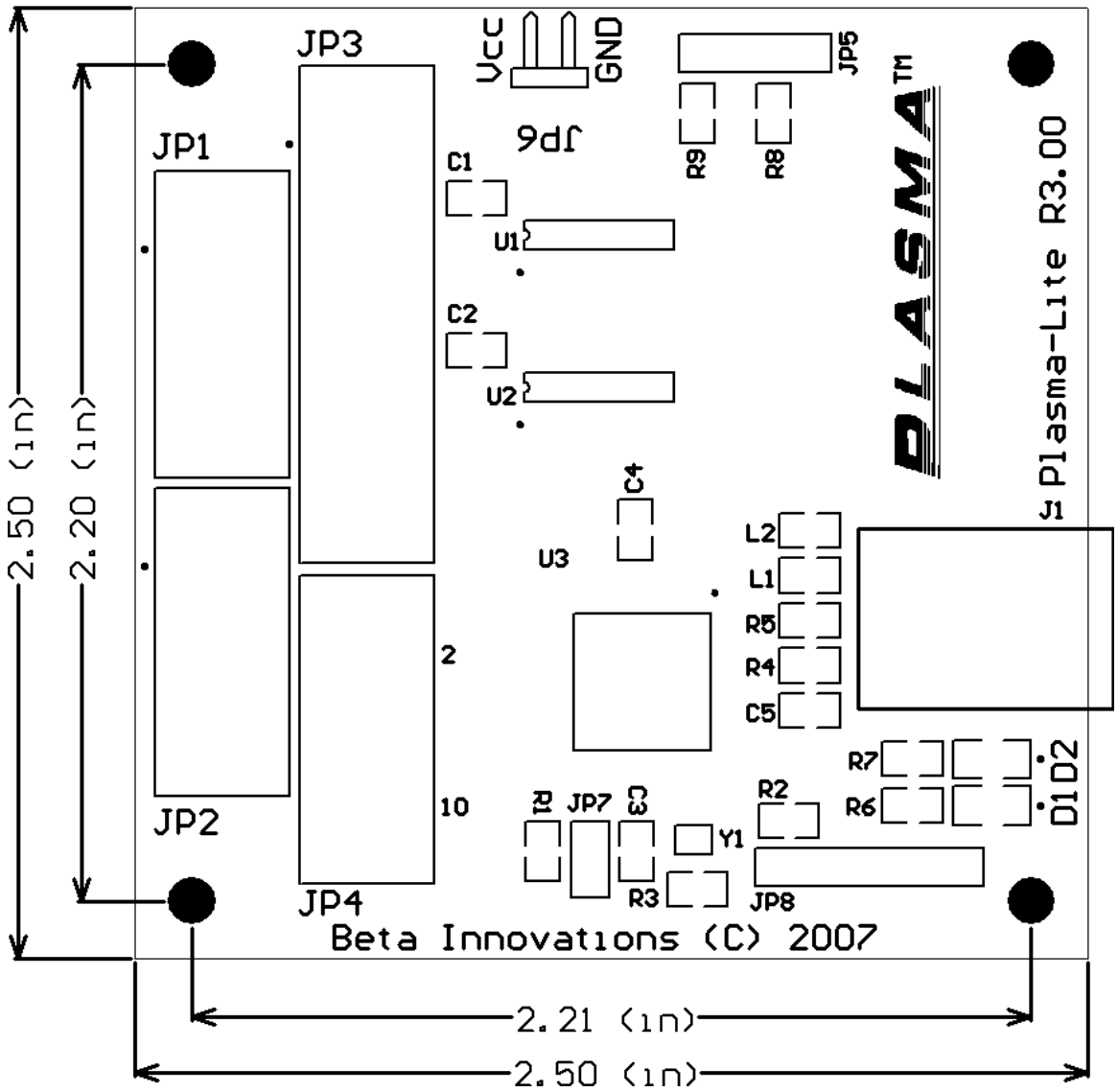
DO NOT PLUG any expansion modules into the expansion port while the unit is plugged into a USB port. Disconnect the device from the USB bus prior to installing an expansion module. See expansion module user manual for details.

Device Status LEDs

D1	D2	Description
● Off	● Off	Device not powered or not enumerated.
● On	● On	Device enumerated in Flash Loader mode.
● On	● Off	Device enumerated in standard Device mode.
● ● Flashing	● ● Flashing	Device in Suspend state.
● On	● ● Flashing	Transmitting data to USB host (Flash Loader Mode).
● ● Flashing	● On	Receiving data from USB host (Flash Loader Mode).
● On	● ● Flashing	Transmitting data to USB host (Device Mode).
● ● Flashing	● ● Flashing	Receiving data from USB host (Device Mode).

Mechanical Specifications





Visit www.betainnovations.com for the availability of expansion modules and accessories.