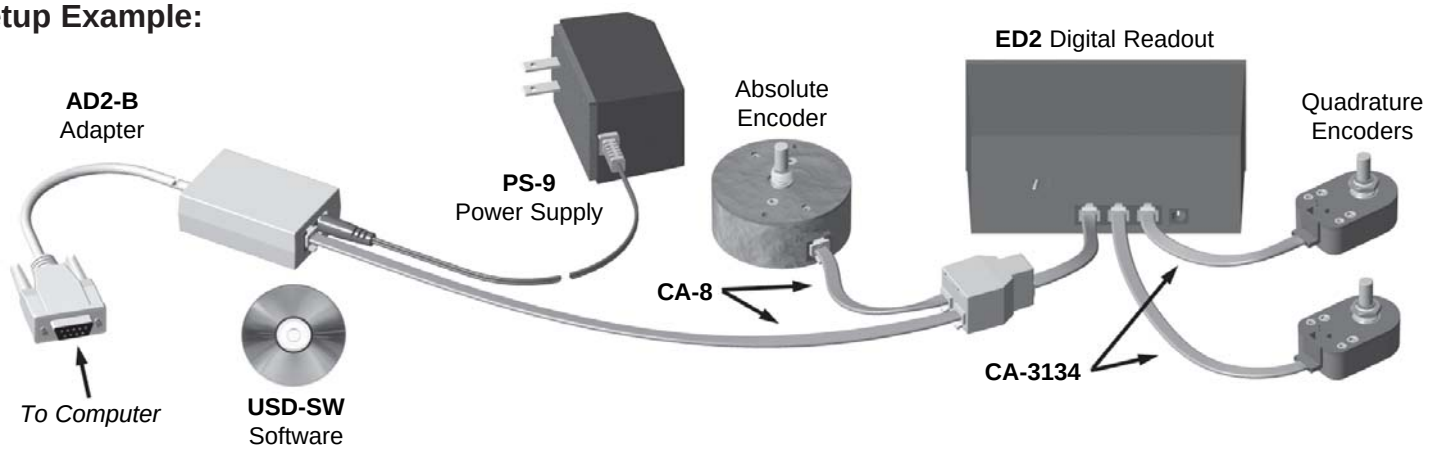
Technical Information:

In advanced mode, each display register may be programmed for one of six different display modes. These modes include scaled count, scaled sum of counts, scaled difference of counts, rate of count, scaled rate of sum of counts, and scaled rate of difference of counts.

Input into the **ED2** is generally in the form of quadrature signals into Ports A and B, or serial signals into Port S. The **ED2** can be used to display values from any incremental encoder that has quadrature output, as well as any of US Digital's line of absolute encoders which communicate serially. The **ED2** can be used for non-quadrature signals as well, and can even be used as a frequency counter up to 2MHz. The **ED2** can also be used as a remote display, displaying values sent from a PC via a serial link.

Port A accepts a quadrature signal or a pulsed TTL signal. Port B can be configured either as a quadrature input, pulsed TTL input, or as a set of TTL I/O. When Port B is configured for TTL I/O, the **ED2** can be used to control external equipment such as alarm horns, auto-pagers, indicator lights, etc. The **ED2** can be powered from a 9-16VDC, >150mA power supply, or can draw its power from the US Digital **SEI** bus.

Setup Example:



DC Electrical Characteristics:

Parameter	Min.	Typ.	Max.	Units	Notes
Supply Voltage (PWR)	9	12	16	Volts	
Supply Current (backlight off)	-	40	80	mA	No encoders
Supply Current (backlight on)	-	100	150	mA	No encoders
Voltage to Incremental Encoder	4.75	-	5.25	Volts	Ports A & B
Total Current to Incremental Encoders	-	-	160	mA	Ports A & B
TTL Input Voltage Low	-	-	0.8	Volts	Ports A & B
TTL Input Voltage High	2.0	-	-	Volts	Ports A & B
TTL Output Source Current	-	-	0.3	mA	Port B
TTL Output Sink Current	-	-	64	mA	Port B
Non-quadrature Count Frequency	0	-	2	mHz	Ports A & B
Quadrature Count Frequency	0	-	300	kHz	Ports A & B

➢ Specifications apply over entire operating temperature range.
➢ Typical values are specified at Vcc=12V and 25°C.

2.1mm Male Power Jack

Pin Description for Port S, SEI:

Pin	Name	Description
1	GND	Ground, common for Power, Data and Busy pairs
2	Busy+	Differential input line, active high, has 10k pull up
3	Busy-	Differential input line, active low, has 10K pull up
4	PWR	Power input / output to encoder, 9 to 16 volts
5	DataL	Bidirectional differential data line, has 10K pull up
6	DataH	Bidirectional differential data line, has 10K pull down

*See the **SEI** data sheet.*

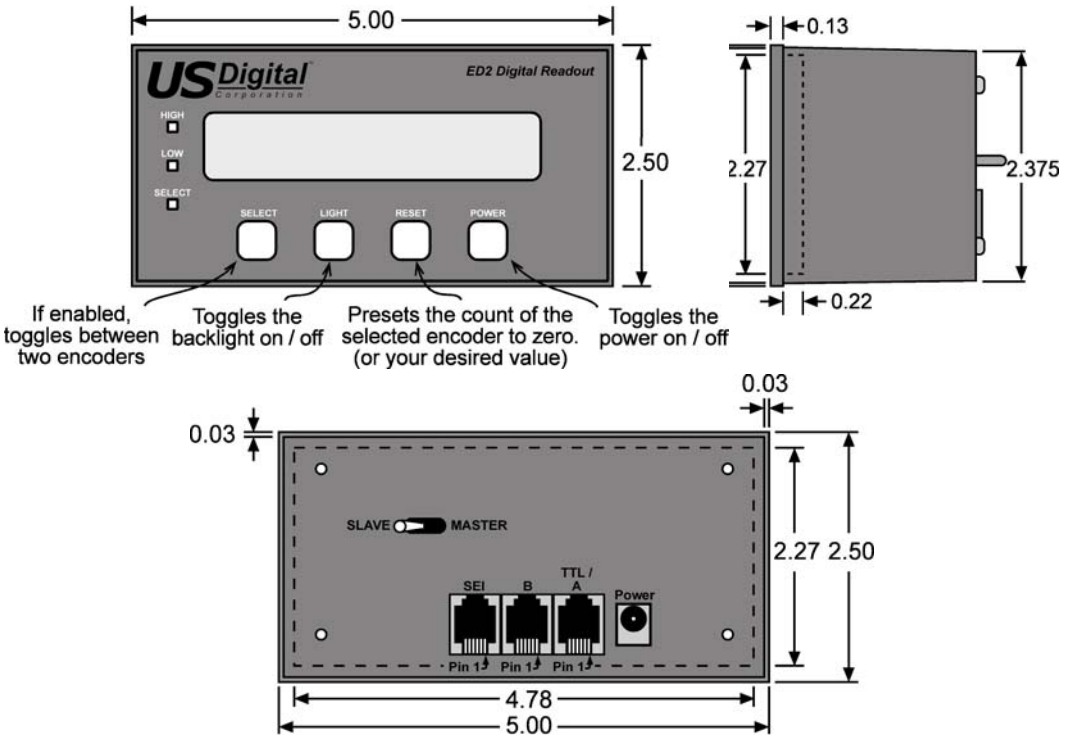
Absolute Maximum Rating:

Parameter	Min.	Max.	Units
Storage Temperature	0	100	°C
Operating Temperature	0	60	°C
Humidity Temperature	0	95	%
Supply Voltage (PWR)	0	16	Volts

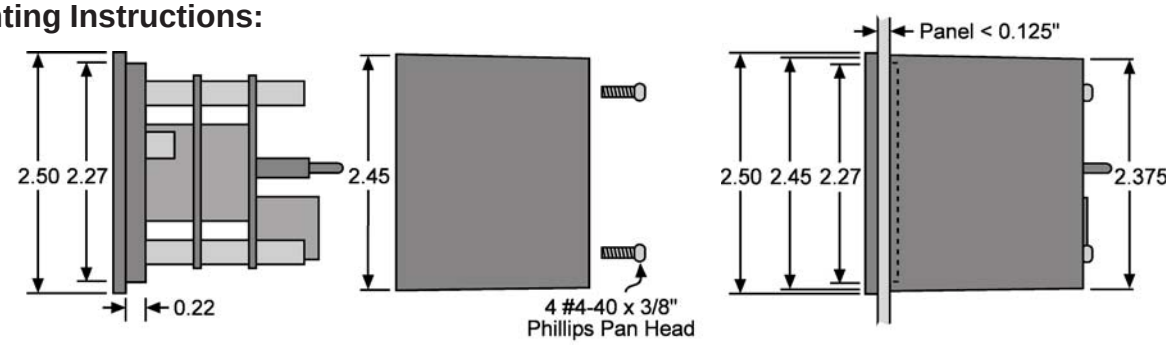
ESD Warning: Normal handling precautions should be taken to avoid static discharge.

US DIGITAL
info@usdigital.com ▪ www.usdigital.com
Local: 360.260.2468 ▪ Sales: 800.736.0194
Support: 360.397.9999 ▪ Fax: 360.260.2469
1400 NE 136th Ave. ▪ Vancouver, Washington ▪ 98684 ▪ USA

Mechanical Drawing:



Mounting Instructions:



Install in a panel with a thickness up to 0.125 Inches.
Cut a rectangle in the panel: Width = 4.78" (+0.04, -0) Height = 2.27" (+0.04, -0).
Remove the four screws in the back of the **ED2** and pull apart the case.
Slide the front part of the display into the panel.
Slide the back cover over the circuitry from the other side of the panel and install the screws.

Pin Description for Port A, ENC1:

Pin	Name	Description
1	I	Index
2	GND	Ground
3	A	A channel
4	PWR	+5VDC power
5	B	B channel
6	GND	Ground

Pin Description for Port B, ENC2:

Pin	Name	Description
1	I	Index
2	GND	Ground
3	TTL1 / A	TTL I/O or A channel
4	PWR	+5VDC power
5	TTL2 / B	TTL I/O or B channel
6	GND	Ground

Communications Protocol:

The **SEI** bus can support 1 to 15 **SEI** Devices. The simplest configuration is a single **ED2** connected to an RS-232 port via US Digital's **AD2-A** interface. If multiple **SEI** Devices are installed, they are each assigned a unique address between 0 and E. Address F is used to communicate to all devices on the bus at the same time. A device responds by activating the busy line if a valid request byte is received with the correct address. The busy line is activated after a delay of 0 to 100 microseconds after receiving the request byte. The device processes the command and then releases the busy line. If the address is incorrect or the command is invalid (including framing errors), the device ignores the command. If the address is F, all devices activate the busy line until the command is processed by every one (wired-OR). If a device has the busy line active while processing a command, other devices ignore all data.

In the case of a single-byte command, the host only sends one byte which contains the address and the command. The selected device activates the busy line, sends a response, and then releases the busy line.

In the case of a multiple-byte command, the host sends the first byte which contains the address. The selected device activates the busy line to acknowledge the selection. The host sends the rest of the command and the busy line remains active until the particular command in completed.
Large numbers are transmitted with the most significant byte first.

Single Byte User Commands:

Request Command:

7	6	5	4	3	2	1	0
cmd3	cmd2	cmd1	cmd0	addr3	addr2	addr1	addr0

Addr3-0: Address of device to be selected (0 to E). Address F selects any and all devices on the bus. If there is only one device on the bus, address F can be used for all operations. If there are multiple devices on the bus, address F is only useful for a few commands.

cmd3-cmd0	request type
0000	(reserved for control codes)
0001	**position 1**
0010	**position 2**
0011	reserved
0100	reserved
0101	reserved
0110	reserved
0111	**inputs**
1000	reserved
1001	reserved
1010	reserved
1011	reserved
1100	reserved
1101	reserved
1110	reserved
1111	**(multiple byte command)**

Position1: The **ED2** sends position of Display Register 1. The format is four bytes, IEEE float. Contact US Digital for more information on IEEE format.

Position2: The **ED2** sends position of Display Register 2. The format is four bytes, IEEE float.

Inputs: The **ED2** sends a byte back, telling the state of it's digital inputs:

Bit#	Description
bit0	Push Button #1 State
bit1	Push Button #2 State
bit2	Push Button #3 State
bit3	TTL Input #1 State
bit4	TTL Input #2 State
bit5	undefined
bit6	undefined
bit7	Black Switch State (1 = Slave mode, 0 = Master mode)

Multiple Byte Commands:

All multiple byte commands start with the request byte F0+addr; after receiving this byte, the addressed **ED2** will acknowledge by activating the busy line within 100 microseconds. After the acknowledgment, the **ED2** is ready to receive the rest of the command. If the address is F and multiple **SEI** Devices are on the bus, wait 10 microseconds before sending the other bytes of the command to make sure they are all ready. When the command is successfully completed, the **ED2** sends a checksum byte, and then releases the busy line; if the command is invalid or failed the **ED2** releases the busy line without sending a checksum.

A Checksum Byte allows verification of the serial data that was sent. The checksum byte is the exclusive OR of all bytes sent by the computer and all of the bytes returned by the **ED2**. The checksum is reset before each command. This is a good check of data integrity, especially in the case of a bus with multiple **SEI** Devices.

Reset Position:
2 bytes: request byte, 01.
Returns checksum if command successful.
Sets the absolute 0 at the current position.

Set Absolute Position Command #1:
6 bytes: request byte, 02, position as a four byte IEEE float.
Returns checksum if command successful.
Sets the given absolute position of Display Register #1(at the current resolution) at the current position. Contact US Digital for more information on IEEE format.

Set Absolute Position Command #2:
6 bytes: request byte, 0x12, position as a four byte IEEE float.
Returns checksum if command successful.
Sets the given absolute position of Display Register #2 (at the current resolution) at the current position.

Read Serial Number:
2 bytes: request byte, 03.
Returns 5 bytes: 4 bytes serial number and checksum if command is successful.

Check Serial Number:
10 bytes: request byte, 04, 4 bytes serial number, 4 bytes mask.
Returns nothing.
The SEI device does a logical AND of the devices serial number with the mask supplied; the result is compared to the serial number supplied. If they match, the busy line is held active until another byte is received, otherwise the busy line is released.

Fail Serial Number:
10 bytes: request byte, 04, 4 bytes serial number, 4 bytes mask.
Returns nothing.
The SEI device does a logical AND of the devices serial number with the mask supplied; the result is compared to the serial number supplied. If they don't match, the busy line is held active until another byte is received. If they match, the busy line is released. This is useful in determining if an SEI device, whose serial number is known, is the only one on the bus.

Get Address:
6 bytes: request byte, 06, 4 bytes serial number.
Returns 2 bytes: 1 byte address and checksum if command successful, only if serial number matches.
The SEI device compares its serial number with the one supplied; if they match, it returns its bus address, 0 to F. Otherwise, it returns nothing.

Assign Address:
7 bytes: request byte, 07, 4 bytes serial number, 1 byte address.
Returns checksum if command successful.
The SEI device compares its serial number with the one supplied; if they match, it uses the address supplied as its own, recording it in EEPROM. The address must be between 0 and F.

Read Factory Info:
2 bytes: request byte, 08.
Returns 15 bytes: 2 bytes model number, 2 bytes version, 2 bytes configuration, 4 bytes serial number, month, day, 2 bytes year and checksum if command successful.

Read Resolution Command:
2 bytes: request byte, 09.
Returns 3 bytes: resolution MS byte, resolution LS byte and checksum if command successful.
The resolution is stored in the EEPROM of the ED2. It does not affect the display output or count values. It is only used for storing the resolution of the current encoders. This is useful when using software which requires the resolution of the connected encoders. To change the roll over value or scale factor, use the ED2 configuration software.
A zero value means 16 bit resolution.

Change Resolution Command:
4 bytes: request byte, 0A, resolution MS byte, resolution LS byte.
Returns checksum if command successful.
The Change Resolution command stores a 16 bit integer in the ED2's nonvolatile EEPROM. This can be a handy place to store the resolution of a connected encoder. The interpretation of the number stored in this location is entirely up to the user, as the internal ED2 firmware makes no use of this number, other than to report it back to the user via the Read Resolution command described above.

Reset Command:
2 bytes: request byte, 0E.
Returns checksum if command successful.
After releasing the busy line, the SEI device does a software reset (the baud rate returns to the default after the checksum byte is sent). The SEI device requires 35msec after reset to receive new commands. Other ways to reset: Turn the power off and on or send a break condition (dataL low, dataH high) for at least 0.6 second. Note that the reset threshold of the power input is between 4.5 and 5.5 volts. The EEPROM parameters are not affected, but the temporary mode changes and baud rate change are lost.

Set Outputs Command:
3 bytes: request byte, 19, output.
Returns checksum if command successful.

Bit#	Description
bit0	Push Button #1 State
bit1	Push Button #2 State
bit2	Push Button #3 State
bit3	TTL Output #1 State
bit4	TTL Output #2 State
bit5	not used
bit6	not used
bit7	Or this value with the back switch state* (1 = Slave mode, 0 = Master mode)

* Collector output: 1 = High (10KOhm Pull-up), 0 = Low (Gnd)

Change Baud Rate (Temporary):
3 bytes: request byte, 0F, baud rate code.
Returns checksum if command successful.
The rate will be changed as follows and will be effective after checksum is sent until the SEI device is reset or another baud rate change command is received. At reset the baud rate always defaults to 9600.

7	6	5	4	3	2	1	0
cmd3	cmd2	cmd1	cmd0	addr3	addr2	addr1	addr0

Note: If multiple SEI devices are on the same bus, they need to all be set to the same baud rate.

Technical Data, Rev. 09.29.06, September 2006
All information subject to change without notice.