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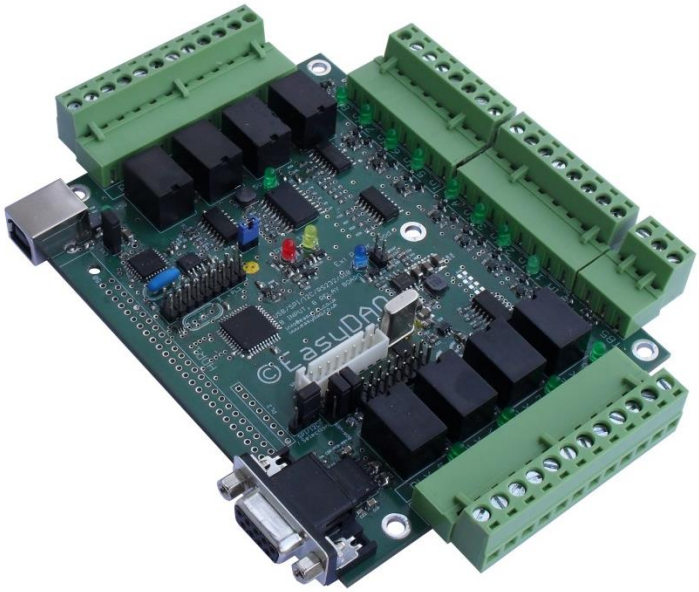
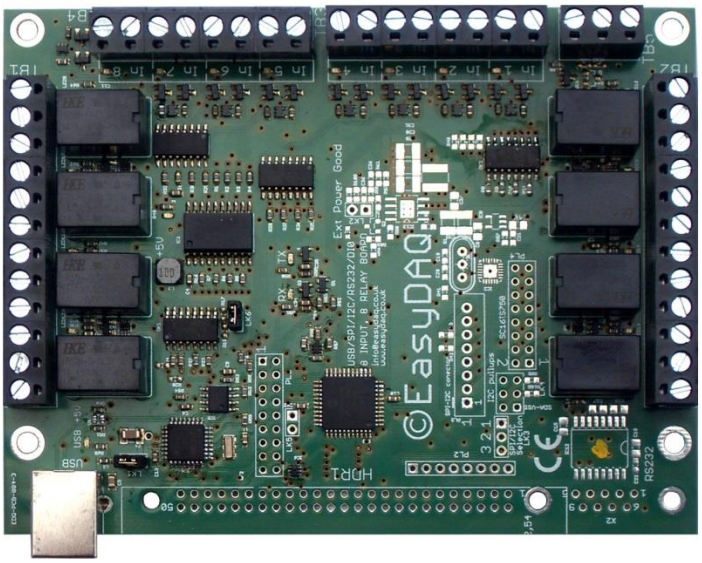
Features

- USB, I2C/SPI communications and RS232 communications
- Communications data activity LEDs
- 3 communications inputs can exist at the same time.
- 8 3A, 120V Opto-isolated signal replays + individual LEDs
- 8 Opto-isolated, wide input voltage sensors + individual LEDs. Max input 60V AC or DC.
- On board regulator with 7V to 24V input.
- Same board outline as USB8PR
- 2-part horizontal connectors
- 8-bit 5V logic DIO
- 8-bit 3V3 logic DIO on the I2C interface
- Optional bespoke software





Description

General purpose relay card with 8 opto-isolated, 120V, 3A signal relays and 8, 3V to 60V, AC/DC, opto-isolated voltage sensing inputs.

This card has 4 communication options:

- USB
- RS232
- I2C
- SPI

This card also has 3 powering options:

- USB power
- External 5V DC with reverse polarity protection.
- External 7 to 24V DC with reverse polarity protection and regulated 5V output on the external 5V terminal for powering your own hardware. See detailed Power Supply description below.

Two LEDs indicate data transfers between your control hardware and the relay card for help with debugging and testing.

Each relay channel or voltage sensing input has its own LED to indicate status.

The card has been designed with future expansion in mind including access to 8, 5V DIO channels connected to the main controller and a further 8, 3V3 DIO channels connected to the I2C/SPI port if this option is fitted. The programming pins for the control processor are also available to enable re-purposing of the card by loading application specific software.

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The card is also available with reduced options fitted. See the order codes table.

The card is RoHS compliant and CE marked.

Specification

Power supply

- USB or external 5V powered (up to 8 relays @ 40mA per relay).
- External 7V – 24V switch-mode 6W maximum input power. Up to 500mA at 5V DC available to the user's hardware from the 5V terminal.

Control Interfaces

- USB 1, 2 or 3, Type B connector, hot pluggable.
- RS232 9 way D female.
- I2C or SPI on a JST XH 8pin header.

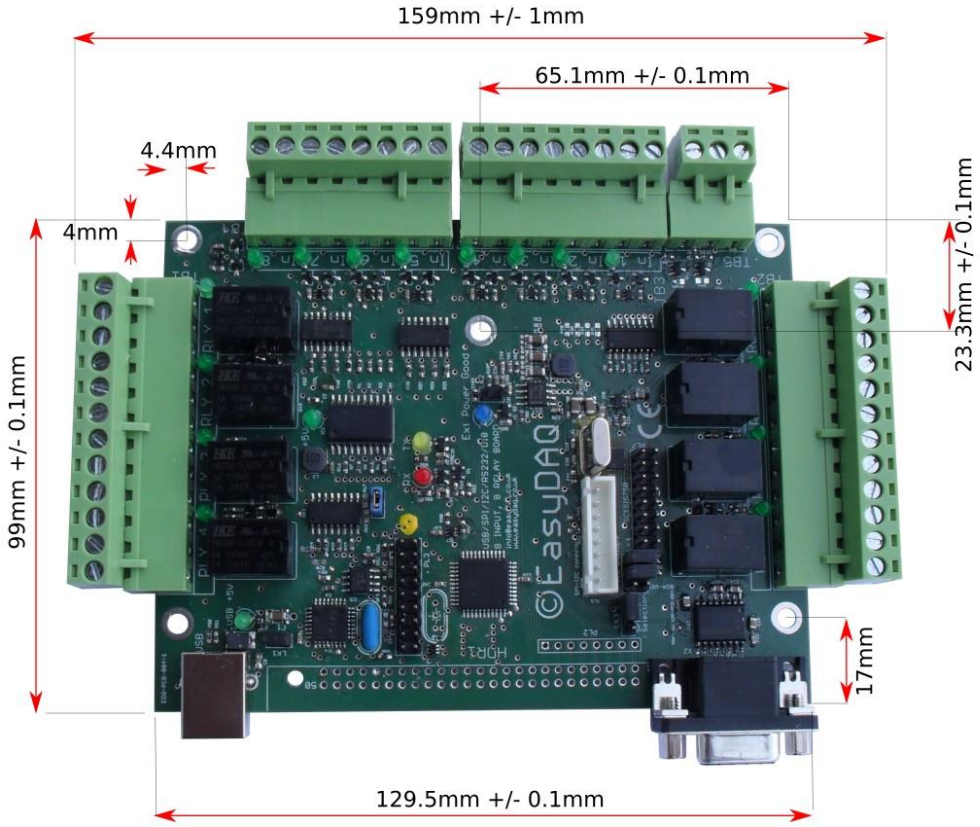
Operating temp range

-20 to +80^{0}C

Relays

Rated voltage/current	5VDC/42mA each
Must operate/release voltage	75%/10% of rated voltage
Maximum contact ratings	1A/120VAC or 1A 30VDC
Minimum recommended contact rating	5V @ 20mA
Contact resistance	100mΩ max
Operate/release time	5mS/5mS
Contact bounce period	0.6mS operate/ 7.2mS release
Contact material	AgAu
Operational life (min)	Mechanical 10^7 / Electrical 10^5
Contact arrangement	SPDT, Form C

Dimensions



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Detailed description and control

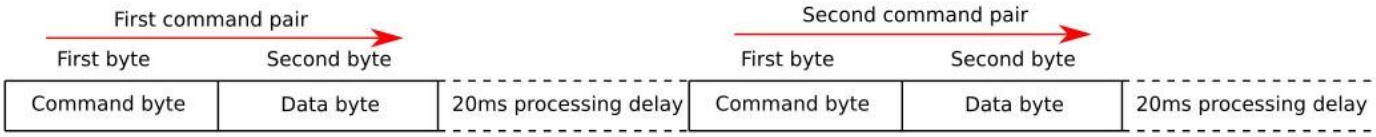
The USB-RS232-I2C-SPI-8VI8SRMx-2 is unusual in that it may be controlled through up to 4 different signal ports. However, the signals coming into the board are logically OR wired and all the output signals are transmitted at the same time. The processor only has 1 data-stream and that is shared with all the communication paths.

Also, the I2C/SPI system provided by the onboard NXP SC16IS750 I2C/SPI to serial converter can only be in one communication mode at a time.

Command format

The card is commanded via simple single ASCII characters (+ status byte). I.e. a 2-byte pair. These are commands that address each port of the PIC processor device (Hex equivalent shown in brackets). The card can be controlled using a Terminal emulator if connected via USB or RS232– see below.

It is important to include a 20ms processing delay between command pairs.

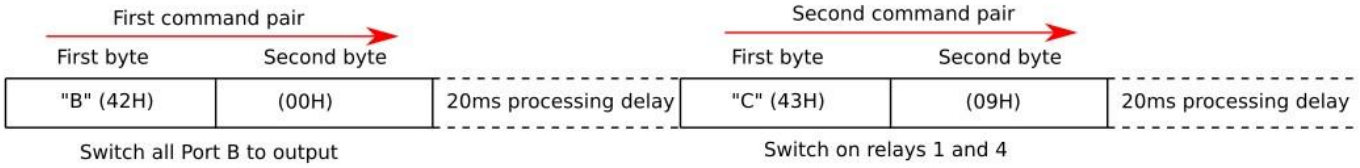


Port B (Channels 1-8) Relay commands:

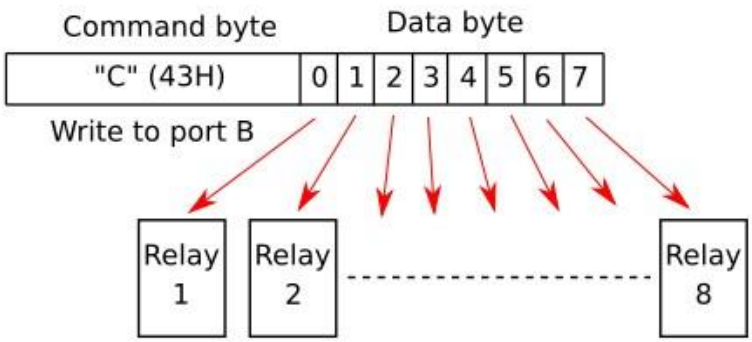
ASCII 'B' (42H), X Initialises the card (sets the port & channel I/O directions). Set direction of Port B, 1=Input, 0= output. (i.e. where X=10111111 (AFH) = sets bit 7 as an output, the rest as inputs).

ASCII 'C' (43H), X Write data X to Port B (i.e. X=00000001 (01H), sets channel 1 to active). Valid data bytes are latched by the card until a further valid data byte is written to it.

Example: To set all Port B to output for controlling the relays and switch on relays 1 and 4:



The first byte pair initialises the port to all output and the second and subsequent byte pairs are then used to control the relays. The 8 bits of the data byte represent the relays to be controlled. Relay 1 is controlled by Bit 0, relay 2 is controlled by Bit 1 and so on to relay 8 being controlled by Bit 7.



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Port C (Channels 9-16) Input commands:

The 8, 3V to 60V, AC/DC, opto-isolated voltage sensing inputs need to be enabled before use. This requires bit 2 of port "E" to be set to an output and pulled low. To do this use the following commands:

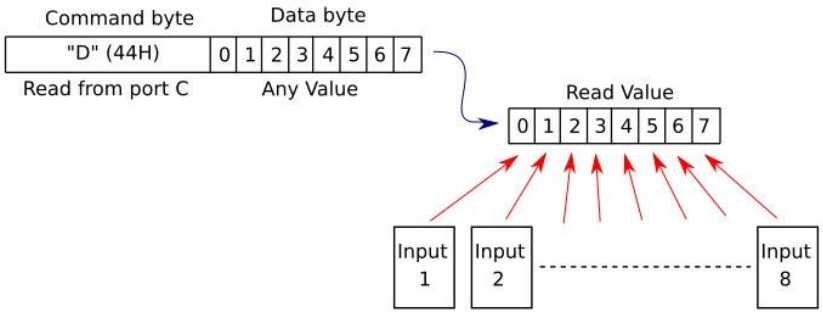
ASCII 'L' (4CH), 0x0B Initialises the port (sets the port & channel I/O directions) so that E2 is an output.

ASCII 'M' (4DH), 0x00 Ensures that the pin E2 is low which will enable the input buffer.

ASCII 'E' (45H), 0xFF Initialises port C as input.

ASCII 'D' (44H), X Read Port C data.

This is a two-byte command with the second byte being any value and is ignored. The data byte will be transmitted after the dummy byte has been received.



Port D (Channels 17-24) DIO commands:

ASCII 'H' (48H), X Initialises the card (sets the port & channel I/O directions). Set directions of individual bits of Port D

ASCII 'J' (4AH), X Write data X to Port D (i.e. X=00000001 (01H), sets channel 17 to input and the rest to output).

ASCII 'G' (47H), X Read Port D. X is a dummy value. The data byte is returned after the dummy byte has been received.

Port E commands:

3 bits of Port E are controllable.

Bit 0 is free for user applications.
Bit 1 is connected to "Power Good" via a 100K resistor.
Bit 2 is used to enable the wide input buffer on port C

ASCII 'L' (4CH), X Initialises the port as inputs and outputs. Usually this is set to 0BH, Bits 0 and 1 inputs and bit 2 output to control the Port C buffer.

ASCII 'M' (4DH), X Write data X to Port E. Usually X = 0H to enable the Port C buffer.

ASCII 'K' (4BH), X Read Port E. X is a dummy value. The data byte is returned after the dummy byte has been received.

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Summary of EasyDAQ relay card commands.

Letter	HEX	Function
A	41	Read Port B
B	42	Set direction of Port B
C	43	Write data to Port B
D	44	Read Port C
E	45	Set direction of Port C
F	46	Write data to Port C
G	47	Read Port D
H	48	Set direction of Port D
I	49	NOT USED
J	4A	Write data to Port D
K	4B	Read Port E
L	4C	Set direction of Port E
M	4D	Write data to Port E

Serial Port settings

For the RS232 and the USB CDC interfaces the controlling system must be set to:

Baud rate: 9600
Parity: 0
Data: 8 bits
Stop bits: 1
Handshaking: None

Auto detection & com port assignment

When you connect this card to a USB port of your computer for the first time, it will be auto-detected and ask you to install drivers (downloadable from the 'downloads' section of our website). After installation, the card will appear as a 'virtual' COM port and be automatically assigned a COM port number by your OS. Following installation, the COM port number can be manually re-assigned via the control panel if required. Following reboots or disconnects of the USB card, the same COM port number will be assigned.

Using a Terminal Emulator

In order to test operation, the card can be connected to a serial port and controlled from a terminal emulator program such as "PuTTY" or "Realterm". See our "Data Sheet 50 (Using Terminal Emulators to control and test EasyDAQ cards)". Ensure port configuration is set as shown above, type (ASCII) characters shown above to achieve port direction and read or write command/data.

RS232 control

The optional RS232 port runs in parallel with the USB port with the incoming signals to be board OR wired together and the output from the processor being transmitted off the board through all the ports simultaneously. The Serial port utilises a 9 pin "D" socket with the following pin connections:

Pin	Name	Function
2	TxD	Data being transmitted from the board.
3	RxD	Data being transmitted to the board.
5	GND	0V reference signal.
7	CTS	Connected to port D2 on the processor but not used for flow control.
8	RTS	Connected to port D3 on the processor but not used for flow control.
1, 4, 6 and 9	NC	Not Connected

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I2C/SPI control

If the I2C/SPI option is fitted then the card can be controlled directly from another processor such as an Arduino, Raspberry Pi, BeagleBone etc.

Like the RS232 described above, the communications are run on parallel. The communications via the I2C or SPI are managed by a NXP SC16IS750 I2C/SPI to serial converter.

The communication mode should be selected before power up of the board. This is generally achieved through setting the appropriate links on LK3 and LK4.

LK3 selects between SPI and I2C modes.

LK4 has 2 links to enable 4K7 pull-ups on SDA and SCL when in I2C mode and for pulling SDA low when in SPI mode.

The SC15IS70 needs to be set up by the controlling system to enable communications with the processor on the relay card.

The following is an excerpt from an Arduino program that uses the "Wire.h" library to set up I2C communications:

```
#include <Wire.h>
byte Address = 0x48;          // Address of the SC16IS750 when A0 and A1 are pulled high.
                              // The value in the datasheet has to be shifter right by 1 bit to allow for
                                  // the R/W bit.
int delaytime = 20;           // 20ms minimum delay between instructions

// Register addresses shifted left 3 bits into bits 3:6. See NXP SC16IS740/750/760 datasheet Rev. 7 — 9 June 2011 section
10.4 "Use of subaddresses"

// SC16IS750 Registers :
#define THR         0x00 << 3      // Transmit Holding Register. Can only be written to.
#define RHR         0x00 << 3      // Receive Holding Register. Can only be read from.
#define IER         0x01 << 3
#define FCR         0x02 << 3
#define IIR         0x02 << 3
#define LCR         0x03 << 3      // Line Control Register
#define MCR         0x04 << 3      // Modem Control Register
#define LSR         0x05 << 3
#define MSR         0x06 << 3
#define SPR         0x07 << 3      // Scratch Pad Register
#define TXLVL       0x08 << 3      // Transmitter FIFO Level register (TXLVL) address (0x08)
#define RXLVL       0x09 << 3
#define DLAB        0x80 << 3
#define IODIR       0x0A << 3
#define IOSTATE     0x0B << 3
#define IOINTMSK    0x0C << 3
#define IOControl   0x0e << 3      // I/O Control register
#define EFCR        0x0f << 3      // Extra Features Control Register
#define DLL         0x00 << 3
#define DLH         0x01 << 3
#define EFR         0x02 << 3      // Enhanced Features Register
#define XON1        0x04 << 3
#define XON2        0x05 << 3
#define XOFF1       0x06 << 3
#define XOFF2       0x07 << 3

void setup() {
  Wire.begin();                    // join i2c bus (address optional for master)
  setupBRG();                      //
                                          // rest of your setup here
}

void setupBRG(){
  putByte(IOControl,B00010000);       // Software reset
  delay(100);
```

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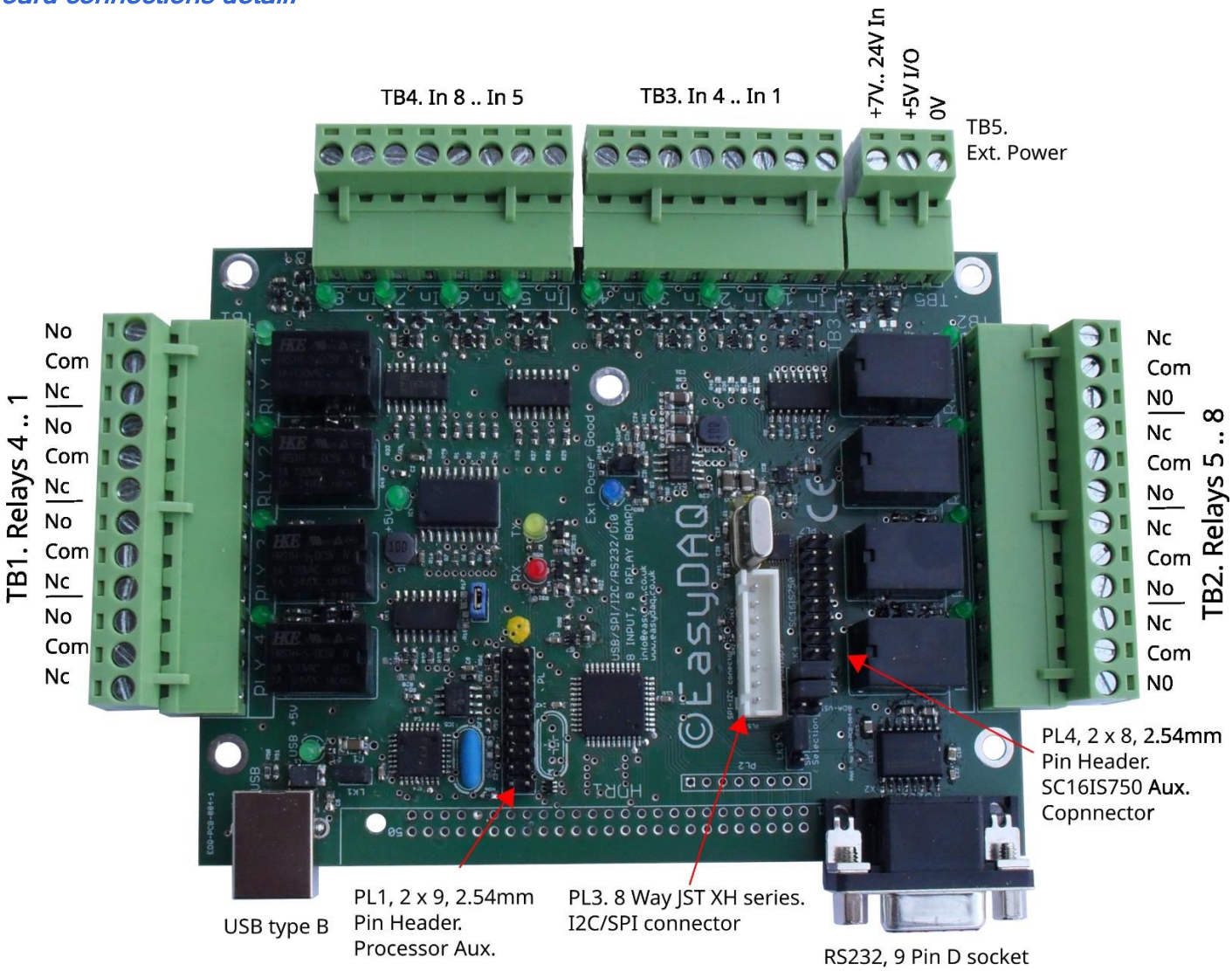
```
  putByte(LCR,0x80);                  // divisor latch enable
  putByte(DLL,12);                    // Lower byte of BRG  ((1.8432MHz/(12x16)). 16 clocks required per bit sent
  putByte(DLH,0x00);                  // Upper byte of BRG  ((1.8432MHz/(12x16)). 16 clocks required per bit sent

  putByte(LCR,0xBF);                  // Access EFR register
  putByte(EFR,0x10);                  // Enable Enhanced functions
  putByte(LCR,0x03);                  // Setup LCR for normal operation: 8 bit data, 1 stop bits, no parity
  putByte(FCR,0x06);                  // Reset FIFOs
  putByte(FCR,0x01);                  // Enable FIFOs
  Serial.println("BRG set up");
  Serial.println("");
}

void putByte(byte reg, byte data){
  Wire.beginTransmission(Address);    // transmit to device
  Wire.write(reg);                    // sends the register address
  Wire.write(data;                    // Setup LCR for normal operation: 8 bit data, 2 stop bits,
                                          // no parity
  Wire.endTransmission();             // stop transmitting
}
```

Complete examples can be found on the download page of our website.

Board connections detail:



USB-RS232-I2C-SPI-8VI8SRMx-2 Main and Auxillary connections.

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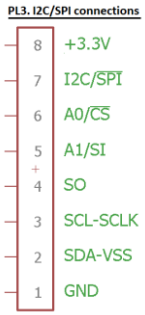
TB1 and TB2 are the relay output connections. Each relay is a single pole change-over type with a group of 3 connections: Normally Open (NO), Common (Com) and Normally Closed (NC). See underside of the board for relay connections.

TB3 and TB4 are the Isolated High Voltage inputs. Each input is independent and requires 2 connections to operate. See "Detailed electrical specification of inputs" below.

PL1 and PL2 Processor Aux1 and Aux2. headers. These headers can be used to extend the functionality of the board and are connected directly to many unused pins on the PIC16F884 processor. Contact EasyDAQ if control of these pins is required.

PL3 is the I2C/SPI connector. It uses an 8-way JST XH series connector with the following connections:



Pin	Name	Function	Notes
1	GND	I2C/SPI Signal 0V	This is the 0V connection to the logic and communication circuits.
2	SDA-Vss	I2C SDA	Data signal for I2C communications. This pin must be connected to 0V (Vss) when the device is in SPI mode.
3	SCL-SCLK	Clock signal for both I2C and SPI modes.	
4	SO	SPI Data output pin	
5	A1/SI	Address A1 in I2C mode and data input pin when the device is in SPI mode.	
6	A0/CS	Address A0 in I2C mode. Active Low Chip Select when in SPI mode.	
7	I2C/SPI	Selection between I2C mode when logic High and SPI when logic Low.	This pin is connected directly to the 3 pin SPI/I2C selection jumper. So, it can be ignored, used to detect which mode is selected or used to control which mode is selected if the jumper is left open.
8	+3V3	3.3V power supply	Can be used to power low power external devices but is mainly used as a reference for the other signals. Maximum output current should be limited to less than 100mA.

PL4 can also be used to extend the functionality of the board through accessing the spare 3V3 compatible GPIO on the NXP SC16IS750 I2C/SPI to serial converter. However, Control of these pins is only available though the I2C or SPI communication paths.

As there is no code in the default software to utilise this port the header is also not generally fitted.

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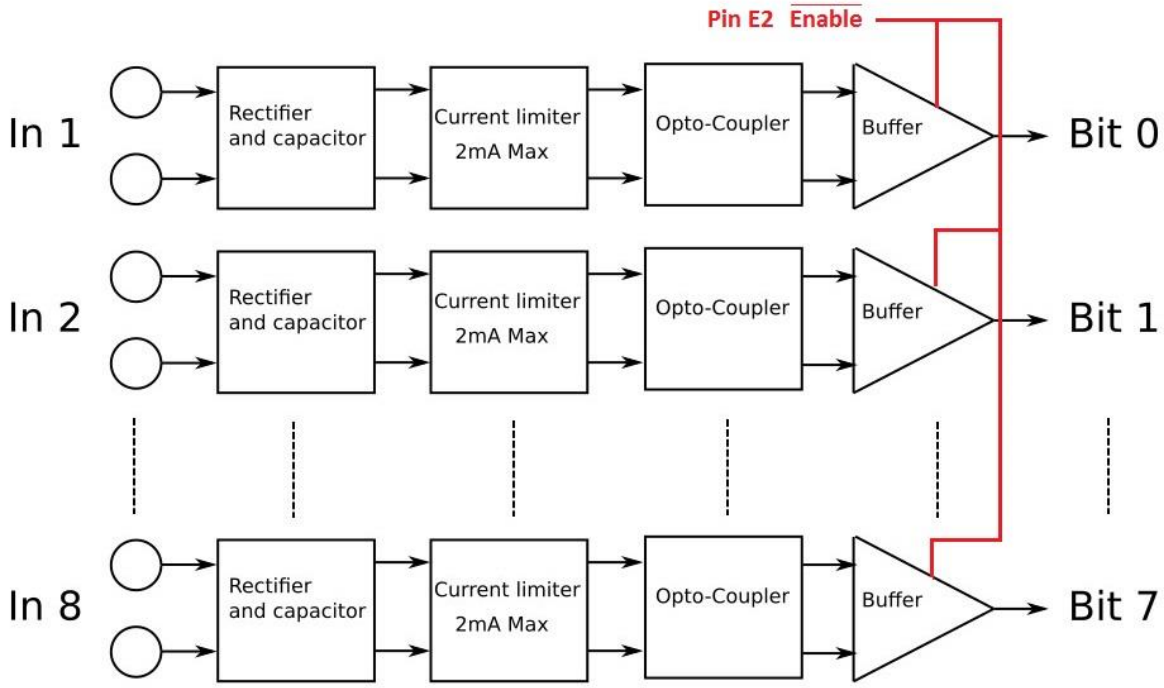
Detailed electrical specification of the High Voltage AC or DC inputs:

This card has opto-coupled, wide voltage range, current limited, AC or DC inputs. To use these inputs the buffer must be enabled by setting Port E, Pin 2 to output and taking this output low.



Each input pair is individually electrically isolated.

Input specification

Parameter	Value	Notes
Max input voltage	60V DC or AC Peak	
Minimum detection voltage	3V DC or AC peak	
Maximum input to card GND voltage	60V DC or AC Peak	
Max input current	+/- 2mA	Current limited input.
Capacitance	100nF	

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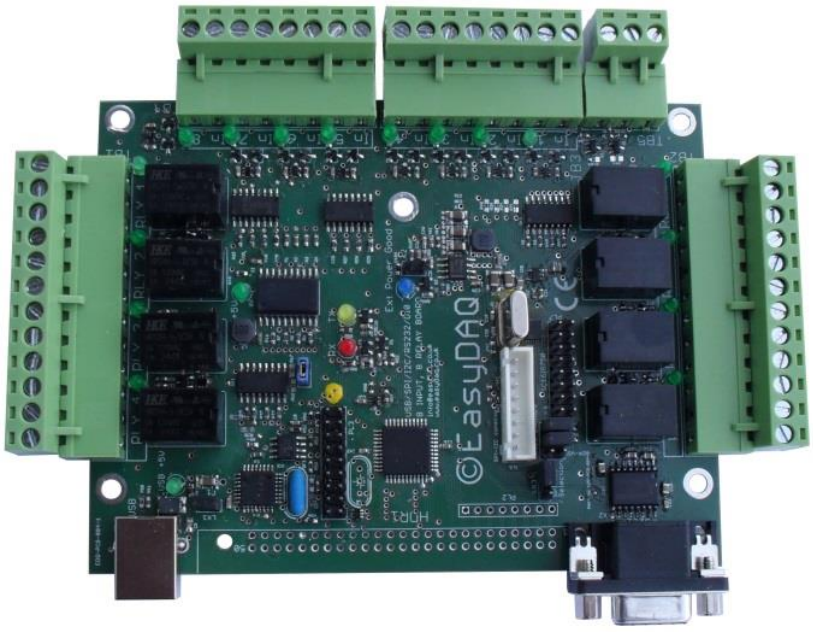
Order codes	
USB-RS232-I2C-SPI-8VI8SRMx-2	The full specification board with all options
USB-RS232-I2C-SPI-8VI8SRMx	As above with single part connectors.
USB-8VI8SRMx-2	As above, but without the RS232, I2C/SPI.
USB-8VI8SRMx	As above with single part connectors.
I2C/SPI-8VI8SRMx-2	As USB-8VI8SRMx-2 above, but fitted with just the I2C and SPI communication circuit. No USB or RS232.
I2C/SPI-8VI8SRMx	As above with single part connectors.
RS232-8VI8SRMx-2	As USB-8VI8SRMx-2 above, but fitted with just the I2C and SPI communication circuit. No USB or RS232.
RS232-8VI8SRMx	As above with single part connectors.
-P	Add –P if no on-board PSU is required. (Note these will be built special to order)
-N	Add –N for No opto-isolation on the relays. (Note these will be built special to order)



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Document versions

Version	Date	Notes
Draft	20th March 2020	Draft document
1.0	27th January 2021	Released
1.1	9th February 2021	Corrections and updates
1.2	16th December 2021	Added more information about port E
1.3	12th May 2025	Added more connection details

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