Applied Kilovolts Digital Control System

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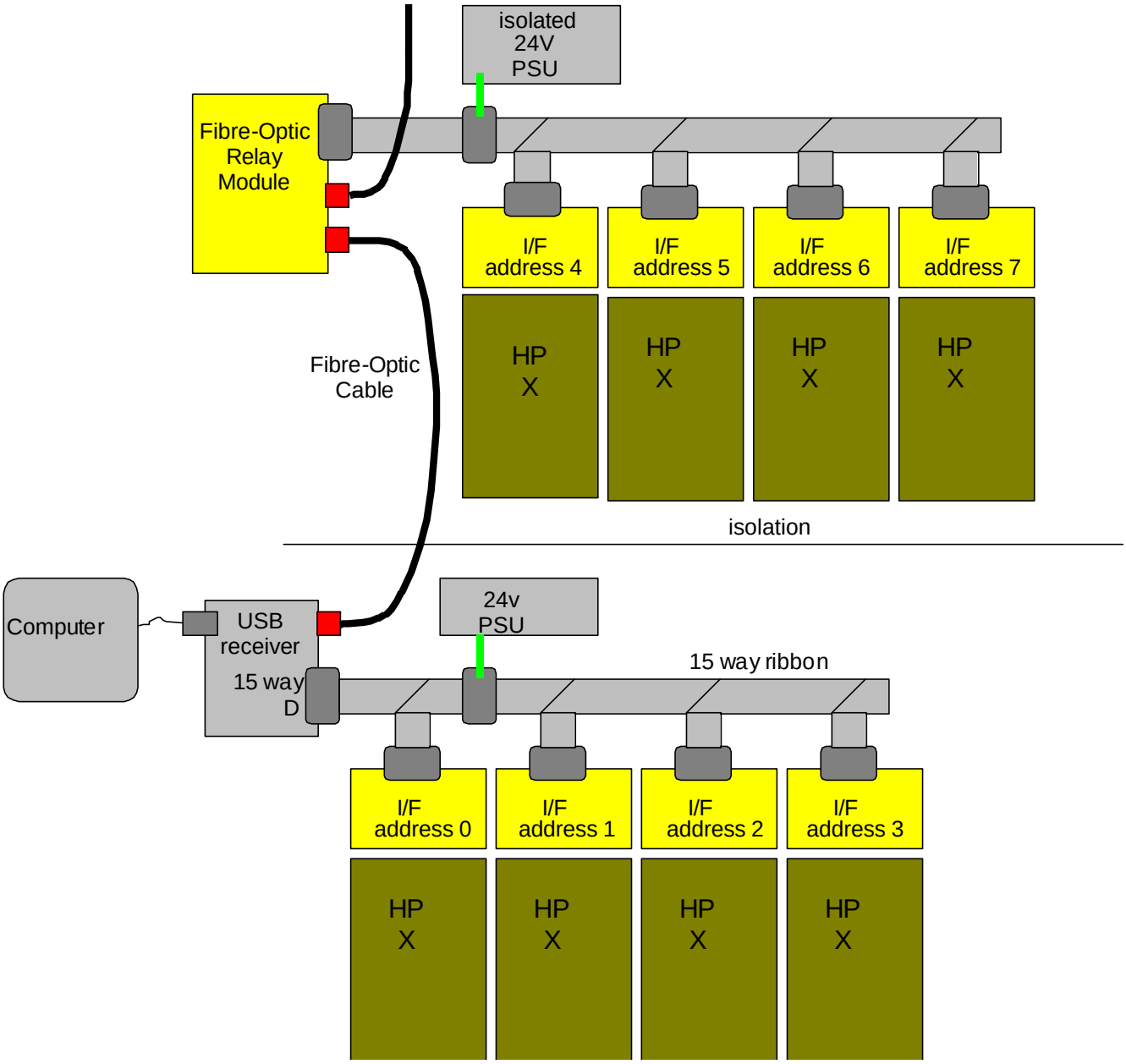

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Design Concept

The digital control system is a set of small circuit boards that plug onto Applied Kilovolts power supplies that allow then to be networked and controlled digitally.

Power supplies can be connected together on a common ribbon cable simplifying wiring.

Each board has galvanic isolation which reduces common mode voltage shifts from switched mode power supply noise, and pick-up from the communication logic transitions.

Power supplies can be driven with a fibre optic cable allowing supplies, or groups of supplies to be floated with respect to each other.

The system provides a simple and flexible way of communicating with a number of high precision low noise power supplies, whether at Ground potential, or groups at different High Voltage levels, requiring significant isolation between them.

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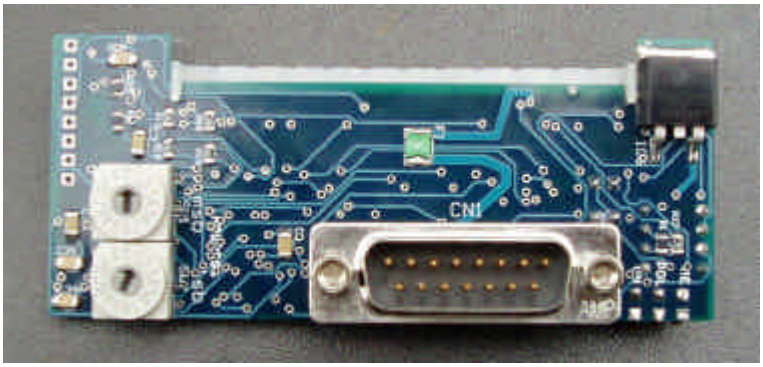
Basic interface module

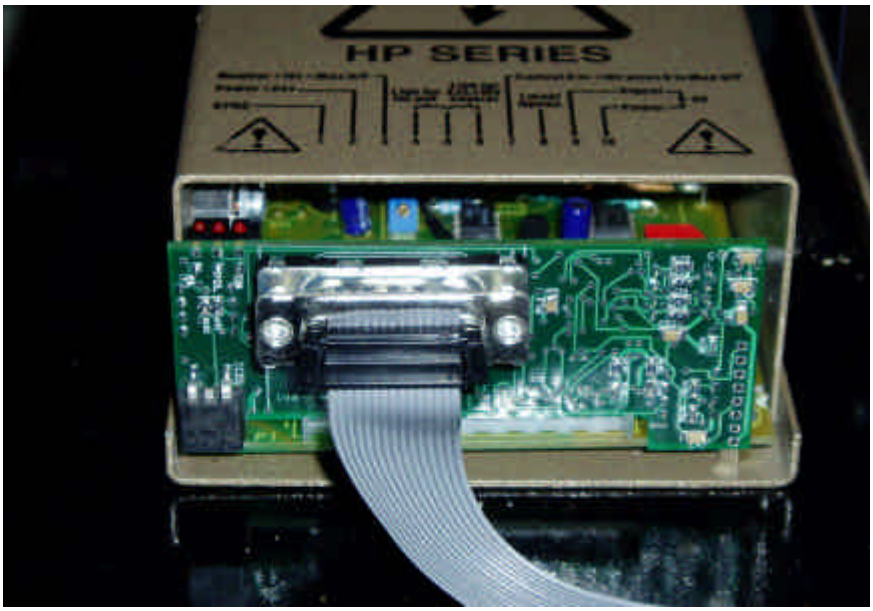
Features

15 way D connector input.
10 or 12 way molex connector output.
Plugs onto power supply.
Addressable device.
High precision reference voltage 3ppm deg C.
Local switching on and off of the power supply.
Low voltage optically isolated.
Digital voltage readback.
Digital current readback.
Switching relay readback.
Size 85x30mm.



The card is mounted on a panel with a lip to engage into a slot in the top of the HP module. This provides support, for when plugging and unplugging the ribbon connector. The panel also provides heatsinking for components on the PCB. Because of the different heights of the different HP Modules, different panels are required. We do apologise for the lack of backwards compatibility with earlier HP modules that do not have the slot. Removing the lip is a simple operation, and the unit will then work as intended, if care is taken not to stress the Molex connector on mating and unplugging the Ribbon cable connection.

It fits onto an Applied Kilovolts HP Series power supply like this.



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Fibre-optic Relay Module

This module relays information from one fibre-optic connection to another and also to a group of supplies at its isolation voltage via the standard 15W D-type and ribbon cable .
So where a group of supplies share a common isolation voltage away from ground, then a pair of fibre-optic cables connect this to the Ground referenced USB Receiver, and a 15W D-Type connector connects this Relay Module, to its local PSUs.

The Fibre-optic Relay Module also has another pair of fibre-optic connections, so another group of isolated supplies at a different isolation voltage can be daisy-chained by another fibre-optic connection to a second Relay Module. See diagram on page 8

Control Signals

The fifteen way ribbon cable contains 4 data signals that go out to the power supply and 1 data line back and it contains the power to drive the HP series power supply.
The power and control signals are isolated from each other.

The fibre optic cable encodes these 4 signals in an asynchronous serial packet.

The signals are

- Serial data out
- Serial clock 1
- Serial clock 2
- High voltage enable

Returned is

- Serial data in.

For ribbon cable wiring description refer to Page 13

USB Reciever

A USB receiver drives the standard 15 way ribbon cable bus and the fibre optic interface.

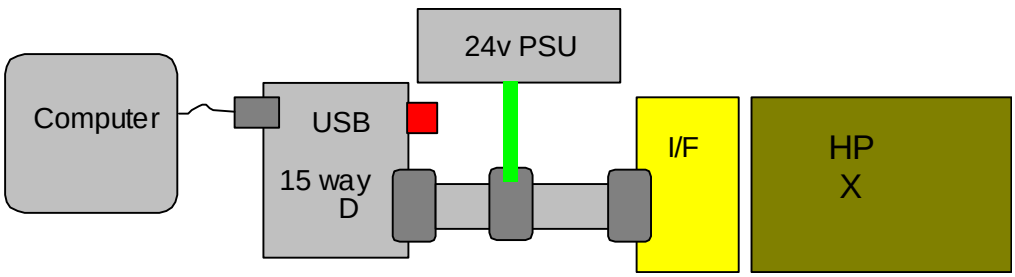
It also comes with its own open source application code.

The receiver can be optionally fitted with a fibre optic port, as shown.

System Topologies

The topologies available with this system using the USB interface are:

Simple point to point



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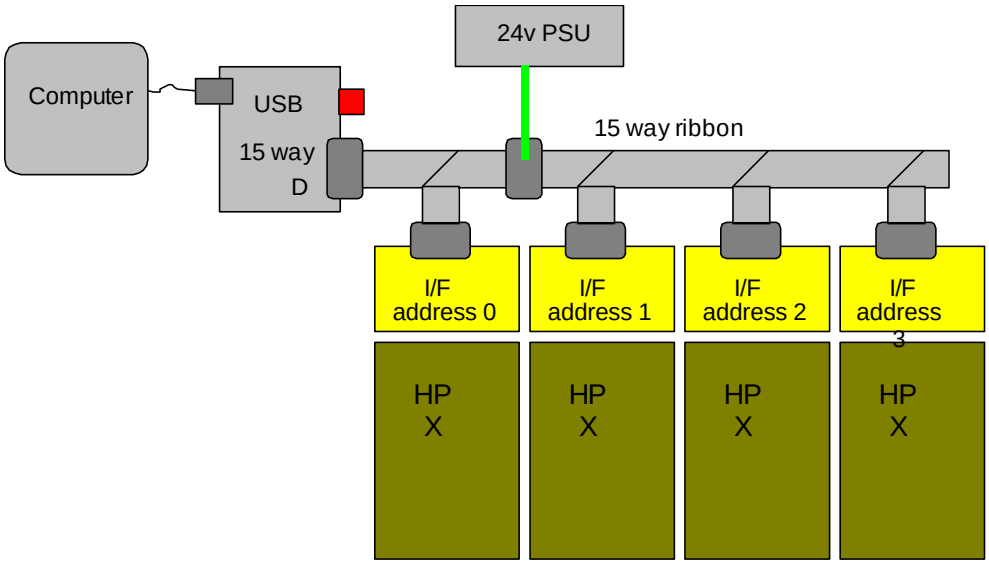
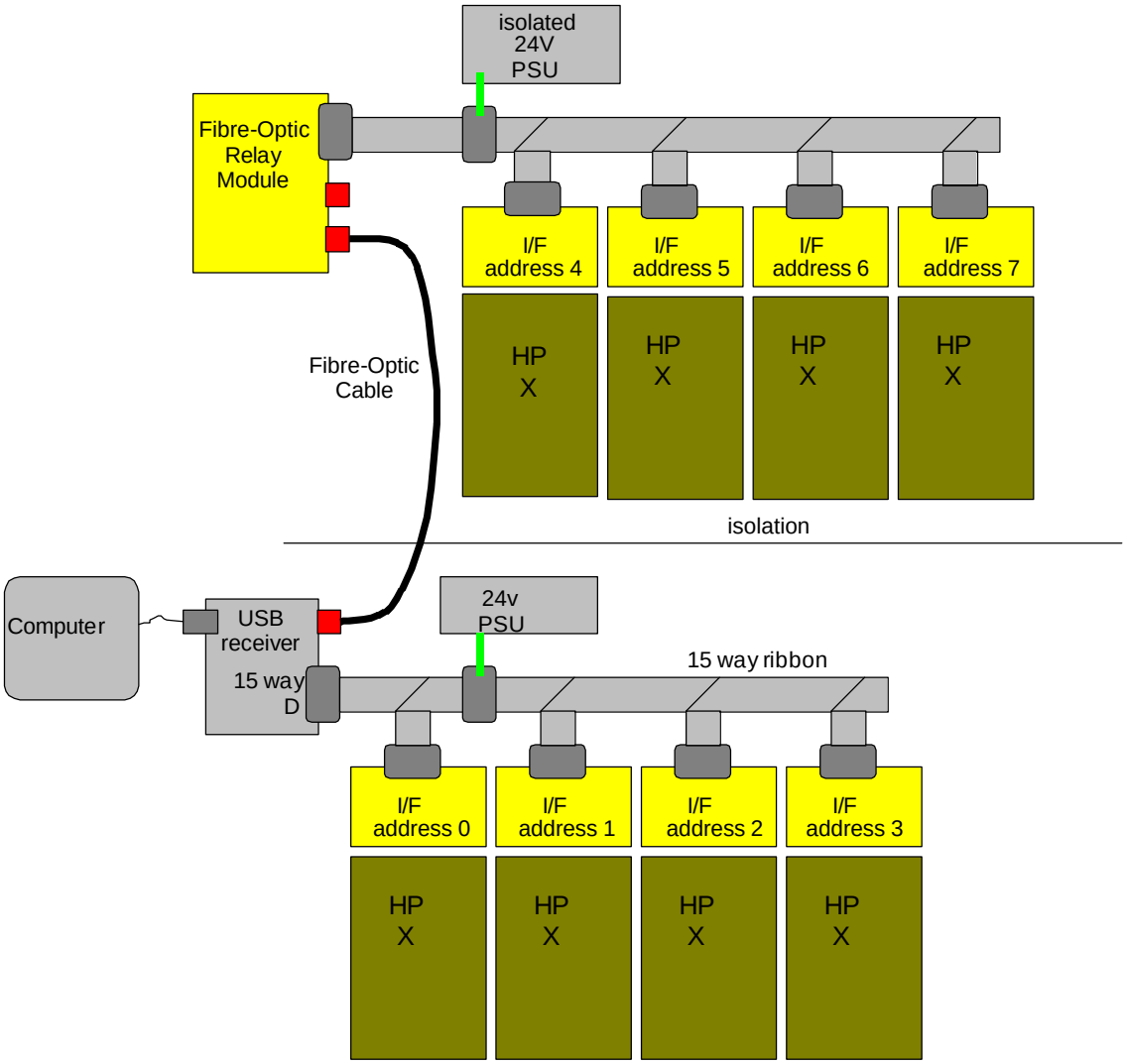
Multi drop connections to modules at Ground potential



Multi drop connections to groups at Ground & Isolated to a High Potential



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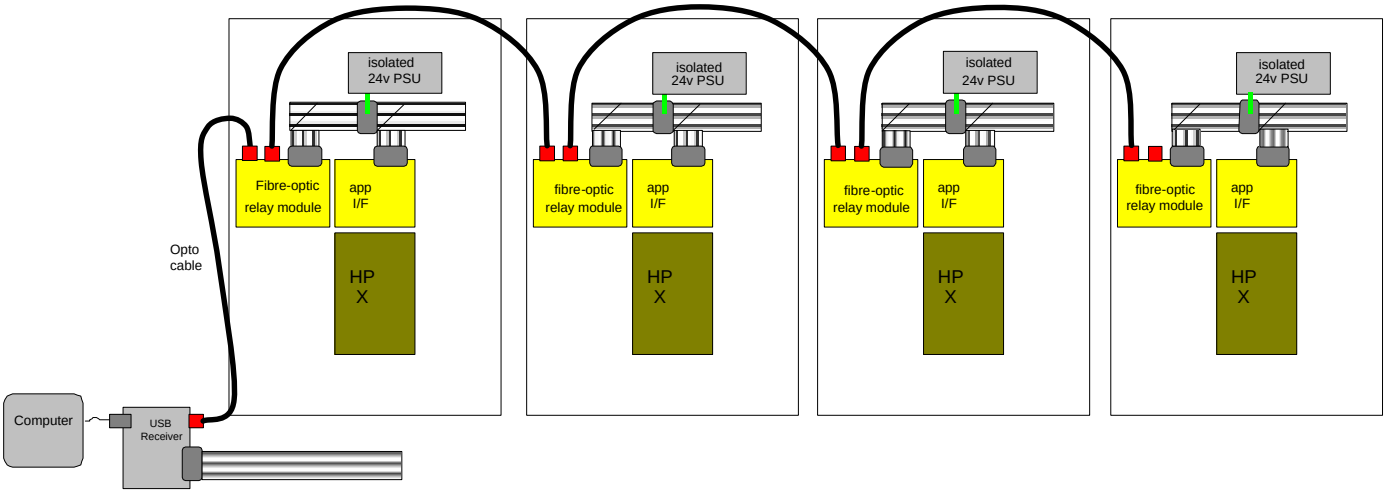
Multi Drop Connections to Groups of Isolated Supplies



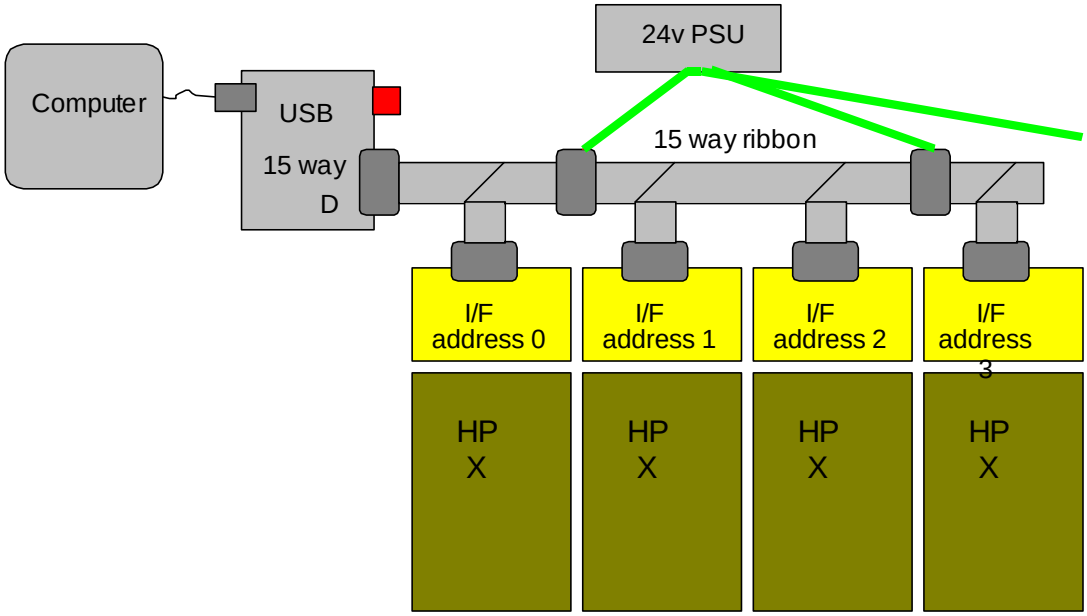
Power Supply On The Ribbon Cable:

HP & LS Modules

The power for the high voltage power supplies comes from 3 pairs of wires on the ribbon cable

Pins 1,2, and 9 carry 24V and
Pins 7,8 and 15 carry 0V power return.

More power can be put into the system ribbon cable by adding more IDC D connectors for power only.



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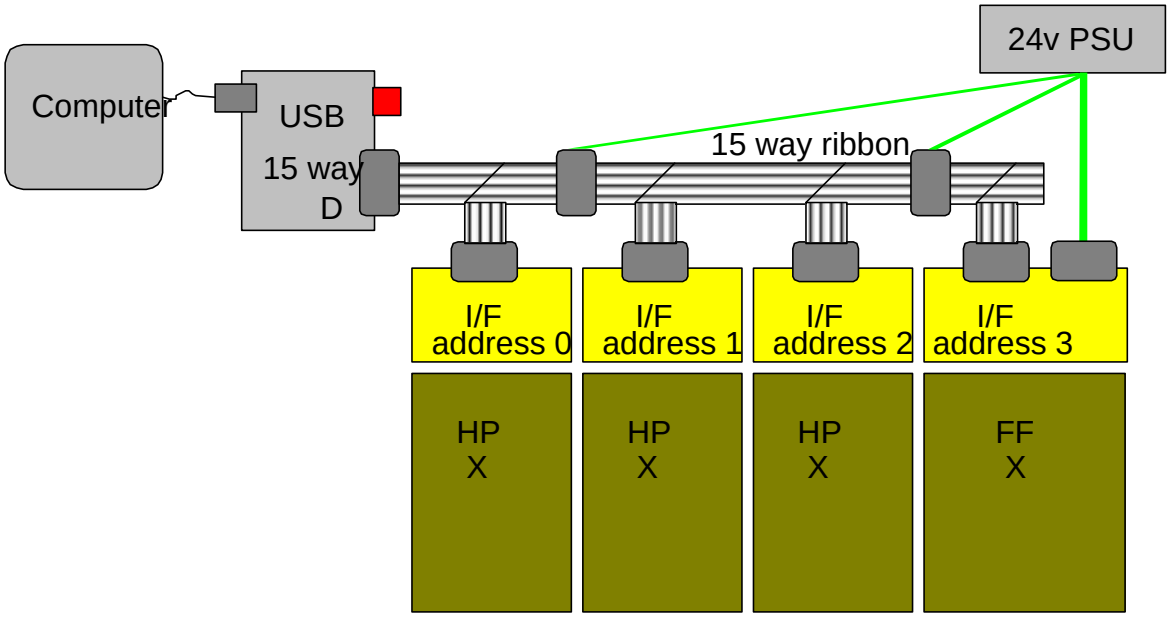
FF & HW Modules

For units that require more than 1amp supply requirement, a separate power connector is provided. This is also coupled through to the Interface, so that a local power connection need not be made to the Ribbon Cable:



Fusing

Each interface board has a 1 amp resettable fuse on it to prevent current overload on the ribbon cable in case of fault.

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Address Settings

Each interface board has its own address which needs to be unique in the system.

There are 2 hexadecimal rotary switches. These allow for 64 addresses on the bus.

Addresses on the isolated fibre optic side of the system work identically to those on the ground referenced side. So these addresses must not overlap. The system finds the device and communicates wherever the interface actually is.

Board jumper for Reversible units

The interface generates the polarity switching signal, but to get this signal to pin 8 on the Molex connector a jumper needs to be fitted to the interface board. This is the jumper marked ‘polarity’ on the board.

Board jumper for Current Monitoring.

Pin 1 is the current monitor o/p for Reversible units.
Pin 8 is the current monitor o/p for Unipolar units.

The current monitor signal connects to pin 1 on the 12 pin units and if the jumper marked ‘opt’ is fitted then the current monitor is also connected to pin 8.

NOTE: The digital interface requires the Precision Imon option to be fitted to the HP units, for it to work correctly.

LS Interface Cards

The LS interface card is closely coupled to the case of both unipolar and reversible LS modules, but for heat and noise reasons is not fitted within the case. The same interface will drive both the Unipolar or the Reversible LS modules, when they are available.

High voltage interlocks

The system has been designed for safety employed on the high voltage.

In the complete system there is a signal on the 15 way ribbon cable called ‘High Voltage Enable’. This signal comes out of the USB demonstration box. If, when the system is enabled the USB powers down, or is unplugged, then the ‘High Voltage Enable’ goes low and the whole system turns the high voltages off.

If this signal is forced externally low with an open collector transistor then the high voltages turn off.

The optical link is designed to always send idle packets so if these packets are not seen for 2 frames then the ‘High Voltage Enable’ is turned off .

The ‘High Voltage ON’ signal on the ribbon cable is diode or’d so that any device connected to the bus can group enable the high voltage.

Any device can disable the high voltages by pulling the signal ‘Not High’ voltage inhibit LOW.

To summarize:

If the USB is off, or unplugged then all high voltages turn off unless another device is diode-oring the ‘High Voltage Enable’ signal ON.

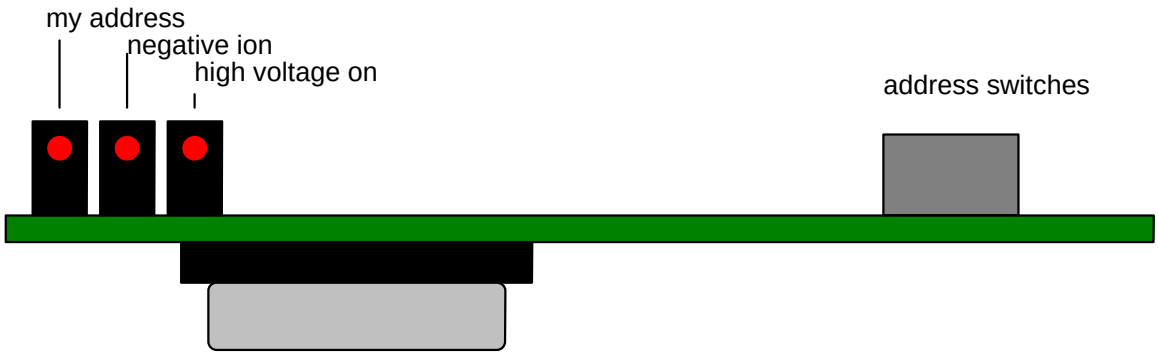
If the opto cable is unplugged then all isolated high voltages turn off.

LED Indicators

The interface boards have 3 leds

These have the meaning:

High voltage on	
Negative Mode	On if negative o/p
My address.	This only pulses ON momentarily



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Interfacing by the End User

The end user can either drive the interfaces with

1) the USB interface
2) the 5 wire ribbon cable interface with TTL
3) the opto cable.

Software drivers are available for the USB
Example code is available for driving the 5 wire interface
HDL code is available for the opto drivers.

Protocols

For full descriptions of the protocol contact the factory.

The ribbon cable protocol is

Out Data

8 address bits (top 4 being 0 for applied KV devices)
1 high voltage enable bit
1 polarity bit
1 spare
16 dac bits

In Data

1 unit present bit
2 relay status bits
8 voltage adc bits
12 current adc bits

The opto link protocol is:

1 start bit
1 high voltage enable bit
1 clock1 bit
1 data bit
1 clock 2 bit
4 stop bits

Ribbon cable pinouts

Pin No	Name	Notes
1	24v power	Isolated from all signals
2	24v power	Isolated from all signals
3	Signal 0v	
4	Signal 5v reserved	Do not use
5	Signal Data In	
6	Signal 0v	
7	0v power	Isolated from all signals
8	0v power	Isolated from all signals
9	24v power	Isolated from all signals
10	Not High voltage inhibit	
11	Signal Clock1	
12	Signal Data Out	
13	Signal Clock2	
14	Signal High Voltage Enable	
15	0v power	Isolated from all signals

Other connectors on the boards

The optical interface board has a 2 pin minifit junior connector on it that has
A 3 amp resetting fuse connecting to the 24v on the ribbon cable.

Pin 1 is 24v
Pin 2 is 0v.

Software driver

The example code to call to one interface card is

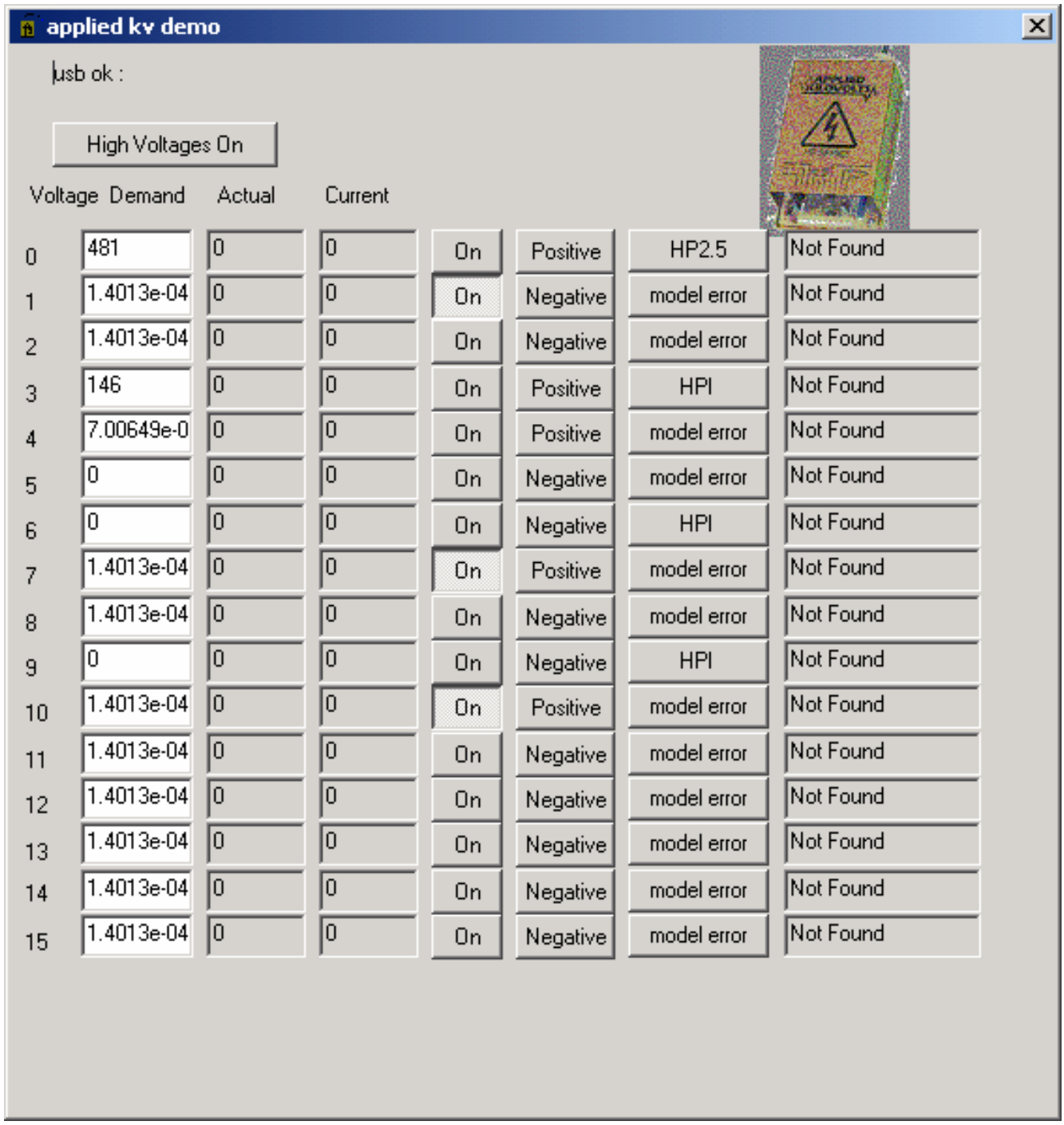
```
process_app_kv_unit(        UINT address,           // interface address
                            float voltage ,         // desired voltage
                            int* actual_voltge,     // actual read back voltage ( in volts )
                            int * actual_current,   // actual read back current % fs
                            int * status_bit_readback,// bits for relay settings+  if unit opto
                            BOOL global_ht_on,      // global high voltage on for system
                            BOOL ht_on,             // high voltage on for this card
                            BOOL negative_ion,      // negative for this card
                            BOOL * present,         // unit found on bus
                            UINT model,             // encoded model number
                            BOOL *fault  )          // set high if fault.
```

Installing the software

The driver software consists of 2 parts

The demonstration software and the USB driver

The demonstration software looks like this:



	Voltage Demand	Actual	Current				
0	481	0	0	On	Positive	HP2.5	Not Found
1	1.4013e-04	0	0	On	Negative	model error	Not Found
2	1.4013e-04	0	0	On	Negative	model error	Not Found
3	146	0	0	On	Positive	HPI	Not Found
4	7.00649e-0	0	0	On	Positive	model error	Not Found
5	0	0	0	On	Negative	model error	Not Found
6	0	0	0	On	Negative	HPI	Not Found
7	1.4013e-04	0	0	On	Positive	model error	Not Found
8	1.4013e-04	0	0	On	Negative	model error	Not Found
9	0	0	0	On	Negative	HPI	Not Found
10	1.4013e-04	0	0	On	Positive	model error	Not Found
11	1.4013e-04	0	0	On	Negative	model error	Not Found
12	1.4013e-04	0	0	On	Negative	model error	Not Found
13	1.4013e-04	0	0	On	Negative	model error	Not Found
14	1.4013e-04	0	0	On	Negative	model error	Not Found
15	1.4013e-04	0	0	On	Negative	model error	Not Found

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Software Installation

To install the software copy all the files in the CD Rom to a directory AppKV.

Set a shortcut to appkvdemo.exe

Then install the driver.

Installing the USB driver

Plug the USB cable into the computer and to the USB demonstration box.
The computer should find the USB device and try to load a driver for it.

Some XP systems recognise the device as a USB –Serial port device. If this is the case then the

My Computer
System Properties
Device Manager
Universal Serial Converter

Should have update driver (right click) set to I will chose driver

And select FTD2xx.inf from the CD Rom

The driver on the device manager should now say FTDI FT8U2XX.

Running the software

Double clicking the appkvdemo.exe shortcut will start the demonstration program.

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