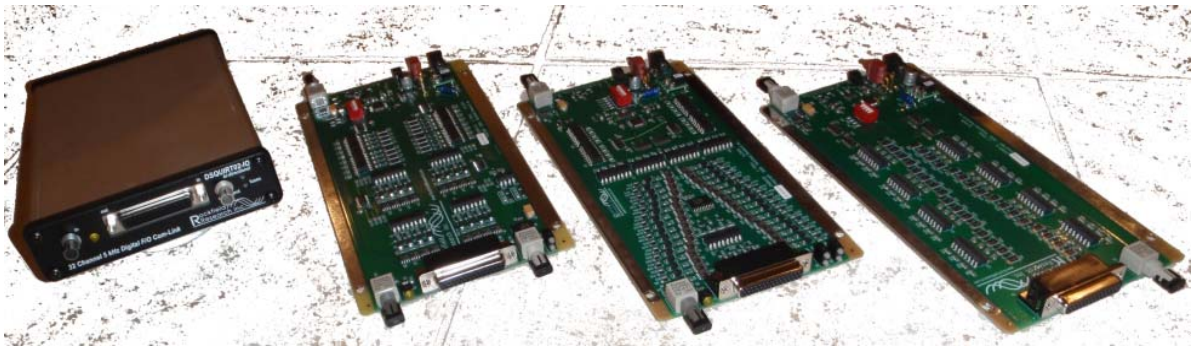
DSQUIRT02

32 channel, 5 kHz, uni- or bi-directional Digital F/O Communications Link

User Manual

December 2010



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IMPORTANT NOTICES:

WARRANTY AND DISCLAIMER

The "DSQUIRT02" is scientific instrumentation. The success or failure of its use depends as much on the integration by the user as on the design and fabrication by the manufacturer. Improper installation or operation can result in equipment failure and/or personal injury. The user accepts responsibility to read and understand this manual, and to ensure safe operation of the installation where it is used. This manual was written to aid the skilled system integrator through the setup and installation of this instrumentation.

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OVERVIEW

The DSQUIRT02 is a high precision isolated link for reproducing digital signals at a remote location in noisy or high-voltage environments. Each unit has 32 channels of digital / fiber interface. Three different options provide for 32 channel copper to fiber, 32 channel fiber to copper, or 16/16 channel bidirectional.

SPECIFICATIONS

Digital Input: Input channels are configured to mimic the Allen Bradley #1771-IBN PLC input module (10-30VDC high true, current sinking input). In keeping with this, the input channels are grouped in blocks of eight, with two common pins per block, thus matching the blockwise pinouts of the AB1771. By design, each channel will interface directly with an Allen Bradley #1771-OBN output module, or another DSQUIRT02 output channel.

Input 10-30V, active = hi, (optimized for 15V operation)

(opto-isolator with series diode and series 1.5kΩ resistor)

Each block of eight inputs shares an isolated common return.

Digital Output: Output channels are configured to mimic the Allen Bradley #1771-OBN PLC output module (10-30 VDC high true, current sources output). In keeping with this, the output channels are grouped in blocks of eight, with one common pin and one power pin per block, thus matching the blockwise pinouts of the AB1771. By design, each channel will interface directly with an Allen Bradley #1771-IBN input module, or another DSQUIRT02 input channel.

Output 10-30V, active=hi, (optimized for 15V operation)

(opto-isolated output driving IRF7473 FET)

Each block of eight outputs shares an isolated power and common.

Each output block (of eight channels) requires an external power supply be provided, of 10-30V (optimized for 15V). This supply feed is fused internally. The fuse status is monitored and shown on the front panel LED. The fuse status is also available as a transmitted signal if desired.

NOTE: each input channel has a 150µs filter on the input, and the response time of the opto-isolators is on the same order. Although the opto-isolated inputs are scanned and transmitted at 5 kHz, the filtered response time will be somewhat slower.

Communications: Serial communications over Avago Series HFBR-0400Z F/O link. Unidirectional or Bi-directional operation.

Input Power: +6VDC to +18VDC (< 2.5 W)

A commercial, UL/CE approved 100-240V 50/60 Hz power unit is included with this product. If desired, any power source in the 6VDC-18VDC range may be used instead. Power should be supplied with a standard 2.1mm connector, center conductor positive.

NOTE: It is quite permissible to use the same +15V supply for both control power and for powering the interface blocks.

Response to Link Failure: Any failure of the link results in all output channels reverting to an "OFF" condition, in which it is not pulled high. Failure of the link may include one or more of the following:

- loss of power of either station
- cut or unplugged fiber
- checksum error, firmware version mismatch, or other data message format error
- timeout expiration (~ 20 msec) without valid received data
- mismatch of address between stations (if addressing option is used)

The link will re-synchronize when the communications error is repaired (i.e. fiber is plugged in, etc). Power cycling is not necessary.

Indicators: A **power LED** next to the rear panel power switch indicates that power is on. A **valid-reception LED** next to the front panel input F/O connector indicates that the received information is valid, and that the analog outputs are being updated.

ADDRESSING

Each unit has a 4 (or 5)-position DIP switch, initially set to address 0000. Various information is transmitted along with the data message to ensure fidelity (firmware version number, checksum, etc), and this 4-bit address is included. A receiving unit (OO or IO) must either be set to the default 0000 address, or if different, the address must match that of the transmitter. If the address is non-0000 and does not match the transmitter, the received data is treated as corrupt, and all bits revert to a "safe" off state.

Note that by leaving the address at 0000, the receiver is universal, and will ignore any address information received, accepting data if it otherwise meets correct format for version signature and checksum.

The data transmitted over the rear panel witness F/O transmitters is ALWAYS transmitted with address of 0000, regardless of the switch settings.

It is important to note that the receiving half of each DSQUIRT02 unit acts independently. A mismatched address will not prevent the transmitting half of the unit from continuing to send data – it will only disqualify incoming data from updating the outputs.

To change the address, simply open up the unit by removing the four screws from either end panel, and slide out the circuit board. Set the address, and reassemble the unit.

Note that the DSQUIRT02-II units have 4-position DIP switches which function exactly as specified above, while the DSQUIRT02-OO and DSQUIRT02-IO units have 5-position switches. For the latter, the additional switch changes modes for reporting the output channel fuse state. When on, the highest bit in each output block is sacrificed, and replaced with a status bit showing the state of the output fuse for that block. For these units, note the labeling on the circuit board for proper identification of the switches.

INTERCONNECTIONS

FIBER-OPTIC CONNECTIONS

The F/O interconnections between units should be made with type 62.5/125 fiber with ST-Style (2.5mm Bayonet) connectors. Duplex fiber assemblies meeting this description are available from a number of vendors, such as the 3m long Tyco part number 5503994-5.

The F/O driver is set for 40 mA, which should avoid overdriving for zero length fibers, while providing sufficient signal for over 2km links.

DIGITAL INPUT AND OUTPUT CONNECTIONS

The digital input and output connections use D-Sub 3-row 44-pin high density female connectors. A number of vendors supply these – suitable examples would be:

Norcomp 180-044-103L001 (male connector)

There are three types of DSQUIRT02 boards:

II – 32 channel copper input to fiber output

OO – 32 channel fiber input to copper output

IO – 16/16 channel bidirectional

Although the principal function of the II and OO units are to form a one-way 32 channel link, and a pair of IO units to form a 16 channel bidirectional link, the communications protocol is defined for other combinations – even though this will reduce the useful number of digital channels:

IO to OO will effectively form a one-way 16 channel link, and

II to IO will also effectively form a one-way 16 channel link.

The pinouts follow the same protocol for all units. The 32 channels are arranged in blocks of eight, and mimic the exact pinouts and connections of Allen-Bradley PLC 1771-IBN and 1771-OBM devices. The detailed pinout depends on whether the copper for a particular block of eight channels is input or output. Each block of eight channels is represented on ten pins, thus the first block is on pins 1-10, second on 11-20, third on 21-30, and fourth on 31-40. Exact pinouts are shown in the following table:

Pin	DSQUIRT-II	DSQUIRT-OO	DSQUIRT-IO
	input block A	**output block A**	**input block A**
1	input 00	block A +Vcc	input 00
2	input 01	output 00	input 01
3	input 02	output 01	input 02
4	input 03	output 02	input 03
5	input 04	output 03	input 04
6	input 05	output 04	input 05
7	input 06	output 05	input 06
8	input 07	output 06	input 07
9	block A com	output 07	block A com
10	block A com	block A com	block A com
	input block B	**output block B**	**input block B**
11	input 08	block B +Vcc	input 08
12	input 09	output 08	input 09
13	input 10	output 09	input 10
14	input 11	output 10	input 11
15	input 12	output 11	input 12
16	input 13	output 12	input 13
17	input 14	output 13	input 14
18	input 15	output 14	input 15
19	block B com	output 15	block B com
20	block B com	block B com	block B com
	input block C	**output block C**	**output block C**
21	input 16	block C +Vcc	block C +Vcc
22	input 17	output 16	output 16
23	input 18	output 17	output 17
24	input 19	output 18	output 18
25	input 20	output 19	output 19
26	input 21	output 20	output 20
27	input 22	output 21	output 21
28	input 23	output 22	output 22
29	block C com	output 23	output 23
30	block C com	block C com	block C com
	input block D	**output block D**	**output block D**
31	input 24	block D +Vcc	block D +Vcc
32	input 25	output 24	output 24
33	input 26	output 25	output 25
34	input 27	output 26	output 26
35	input 28	output 27	output 27
36	input 29	output 28	output 28
37	input 30	output 29	output 29
38	input 31	output 30	output 30
39	block D com	output 31	output 31
40	block D com	block D com	block D com

Witness Fiber:

Each unit has a "witness" fiber transmitter on the back panel, useful for redundant data verification or debugging and monitoring without disconnecting existing linkages.

In all cases, the data is transmitted over the witness fiber in II transmission format represents the actual signals on the 32 channel copper interface, regardless of whether said channels are input or output.

In typical use, a single OO unit will be used as a monitor of the witness F/O signal, with the copper output of the OO connected to a suitable interface or LED display.

The data transmitted over the rear panel witness F/O transmitters is ALWAYS transmitted with address of 0000, regardless of the switch settings.

Fuses:

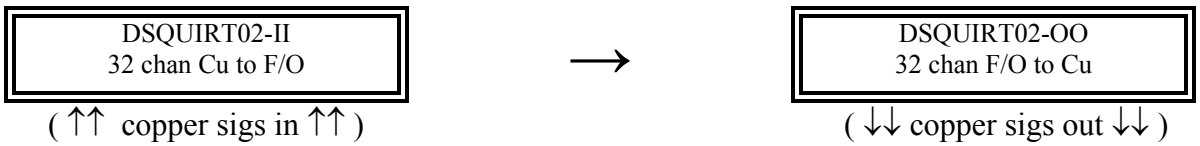
All output blocks are fused with a SMT 4A fuse (thus there are four fuses on a OO unit, two on an IO unit, and none on an II unit). The state of each fuse is detected and displayed on a red/green LED on the front panel – if all LEDs are green, all fuses are ok.

The fuse information is also buried in additional bits transmitted within the F/O message packet. This can be used to diagnose the state of fuses at remote locations, although this function requires the sacrifice of one data bit from each block of eight.

The OO and IO units have a fifth switch on the DIP switch which is used to select the functionality of the fuse diagnostic. By default, this information remains buried, and all data channels remain intact.

If the fuse switch is turned on, then the highest bit in each output block is replaced with the corresponding fuse information from the transmitting unit.

Conventional 32 channel one-way connection of an II and an OO module:



inputs (Cu) channels 0-31

OO fuse sw off: outputs (Cu) ch 0-31 repeat inputs on II

OO fuse sw on: outputs ch 0-6,8-14,16-22,24-30 normal
null (low) channels 7, 15, 23, 31

Since there is no fuse data coming from an II module, there is no purpose to turning on the fuse switch in a normal II to OO connection

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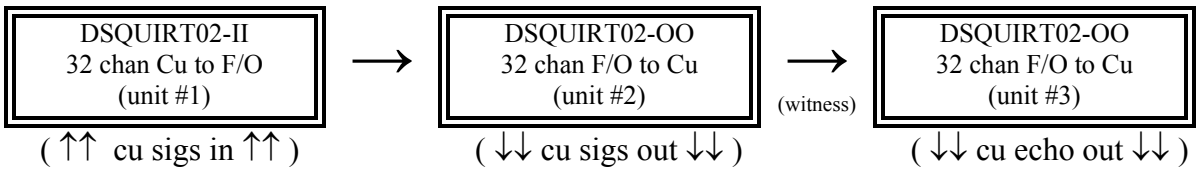
Conventional 32 channel one-way connection of an II and an OO module with debug monitor:



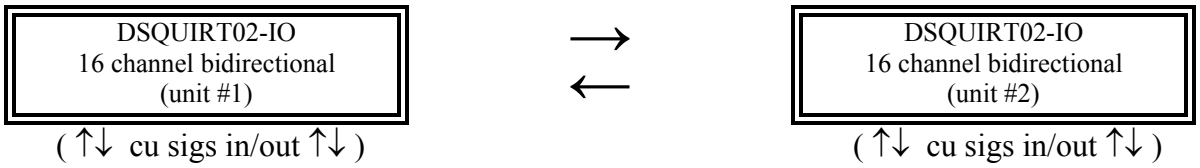
#1 inputs (Cu) channels 0-31

OO #2 fuse sw off: #2 outputs 0-31 repeat #1 inputs 0-31
OO #2 fuse sw on: #2 outputs 7, 15, 23, 31 are null (low)

OO #3 fuse sw off: #3 outputs 0-31 repeat #1 inputs 0-31.
OO #3 fuse sw on: #3 outputs 7, 15, 23, 31 show state of #2 fuses

By using unit #3 as a debugging monitor, we can observe all 32 channels of the communication from #1 to #2, or by flipping the fuse switch in #3, we can (at the sacrifice of 4 data channels) observe the fuse state of the unit #2 fuses.

Conventional 16/16 bidirectional connection of two IO modules:



If all fuse switches are off:

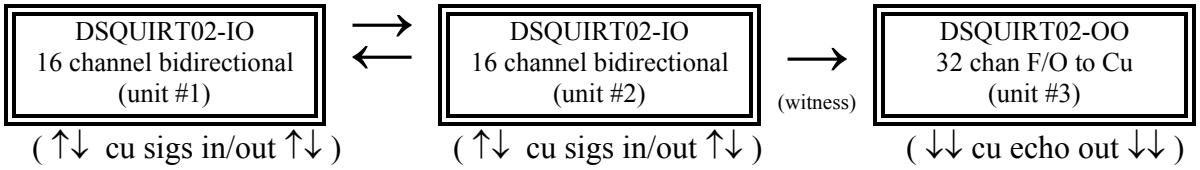
#1 input channels 0-15 *repeat on* #2 output channels 16-31

and

#2 input channels 0-15 *repeat on* #1 output channels 16-31

If fuse switch for unit #2 is set on, then.....#2 output bits 23, 31 show state of #1 fuses.

Conventional 16/16 bidirectional connection of two IO modules with debug monitor:



If all fuse switches are off:

#1 input channels 0-15 repeat on #2 output channels 16-31 ***and*** #3 output channels 16-31;

#2 input channels 0-15 repeat on #1 output channels 16-31 ***and*** #3 output channels 0-15.

To properly use this configuration to diagnose fuse state, set fuse switch off for #1 and #2, and on for #3. The output bits 7 and 15 on unit #3 will then show the state of #2 fuses, and bits 23 and 31 on unit #3 will show the state of #1 fuses.

MISCELLANEA

The DSQUIRT02-IO is really two completely independent systems – a transmitter and a receiver.

The transmitter continually cycles through scanning and transmission of the digital inputs, regardless of the validity of received data. The receiver is not clocked, but rather is driven by the received information from the F/O receiver port. As complete message packets are received, they are validated, and the information is used to update the appropriate output channels. A validation failure will result in all sixteen channels reverting to the "safe" (open) output state.

Note that with this architecture, it is permissible to use a pair of DSQUIRT02-IO units as a one-way analog link, with only one fiber attached. Similarly, a larger number of DSQUIRT02-IO units could be connected in daisy-chain fashion, limited only by imagination.

Use of the DSQUIRT02-II and DSQUIRT02-OO units is similar, with one function disabled in each type, but the number of channels transmitted or received doubled.

A loss of synchronization results in the receiver continuously trying to re-establish communications with the transmitter. This re-synchronization is quite robust, but it will result in slight delays of transmission for a few cycles during an interrupted re-synchronization process. The 5 kHz transmission bandwidth will thus be maintained either with or without a receiver fiber plugged in, but will be interrupted slightly at the time a receive fiber is plugged in. Interruption is also possible if a very long fiber or a dirty fiber connection results in intermittent signal fidelity. If transmission bandwidth is critical, care should be taken to avoid unplugging either fiber in operation, and fiber quality should be attended to.

If chassis grounding is required, a 6-32 threaded aluminum standoff, such as McMaster Carr part number 93505A443, can be substituted for one of the screws which retains the end panels, and used as a grounding lug. Similarly, the negative/ground return leg of the power supply connector, as well as all non-signal pins on input and output connectors, are connected to chassis ground.