Application Note

DATRAN Q03 RTU – AB DF1 Interface

Background

The DATRAN Allen Bradley DF1 PLC driver is designed to provide a communication interface between an RTU and an Allen Bradley SLC-500 Family PLC, particularly the SLC-5/03 processor. Where used with a lower specified processor a Comms module is required in the PLC. The driver is an optional extra in the Q03 that can be unlocked at the time of purchase, or an unlock code can be purchased for an existing RTU by contacting QTech Data Systems. The purchase of the DF1 interface option includes a 500mm interface cable with a D9 connector on the PLC end.

The communications between the AB PLC and the RTU is based on the Allen-Bradley DF1 communications protocol. The physical link between the AB PLC and the QComms module is via the RS-232 serial port by using an interface module. The RTU then maps the I/O data from the AB PLC to the QTech DATRAN SCADA system. To the DATRAN VI Base Station the PLC I/O appears as if it were RTU expansion I/O.

Communication Protocol

The communication protocol between the RTU and AB PLC communication interface module is the Allen Bradley full-duplex point-to-point protocol (DF1 full-duplex), which allows two-way simultaneous transmission. The reason for using full-duplex protocol is that it gives faster data throughput than half-duplex.

The default communication parameters for the DF1 port are; 9600 baud, 8 data bits, 1 stop bit with no parity. 19k2 can also be used.

The RTU interface “talks” to the N9 common interface file in the AB PLC. The I/O may be placed anywhere in this file but the following rules must be followed;

Digital I/O

The start address must be at the start of the word. i.e. If we configure inputs to read from N9:0 the first input will be N9:0/0 the 16th input is N9:0/15.

Analog I/O

Each word is read or written as a full 16-bit *unsigned* integer. The RTU does not deal with negative numbers.

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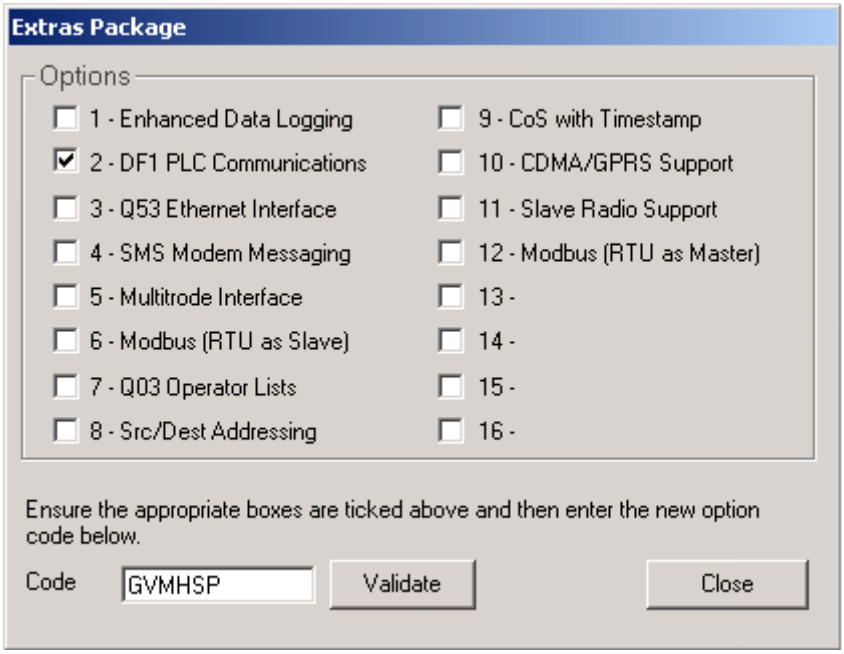
Unlocking the RTU Functionality

Once an unlock code has been purchased from QTech, it needs to be entered into the RTU to activate it. This is done using the Q90 Diagnostics and Configuration tool. Once Q90 is connected to the RTU use the Configuration drop-down menu and choose “Extras Package”.



Once the “Extras Package” window opens, tick the boxes for the extras you have purchased, enter the code and click “Validate”. If the code is correct, the functionality will be unlocked.

Prerequisites

While the DF1 interface has been available for a long time, we recommend the following as a minimum starting point to take advantage of all of the improvements:

- RTU to have a 25MHz Q03 processor and a spare RS232 Port
- RTU to have v5.22 firmware or later

Configuration

Configuration for the DF1 Interface is achieved via the Q90 configuration software. Once the interface is unlocked, the option for DF1 will be available in either of the RS-232 port drop down boxes. Extended configuration can then be accessed via the “Configure” button.

The I/O being passed between the RTU and the PLC is divided into four categories:

1) Digital Inputs
2) Digital Outputs
3) Analog Inputs
4) Analog Outputs

Inputs and Outputs are named from the RTU’s perspective. In other words, Inputs come from the PLC and go into the RTU; outputs are driven by the RTU and are written to the PLC. There are no read/write registers.

The RTU is configured by specifying the N9 starting addresses of each of the four I/O blocks, and then specifying the total number of elements to read or write in each case. Digitals must be specified in multiples of 16 as there are 16 digital values stored in each N9 word.

Each block should be arranged so that I/O points are ordered sequentially. "White Space" or unused spare registers are allowed, but if they exist within a block they should be kept to a minimum as they will contribute to the RTU's total I/O count as detailed below. White space *between* blocks is allowed and as it is not addressed by the RTU there is no limitation on how big it can be.
Before embarking on the integration project, the I/O mapping definition must be completed, below is a short extract of the typical documentation required:

PLC I/O Count	N9 Interface	Description	Type	I/O Number
	N9 File Inputs PLC to Datran			
1	N9:0/0	Plant Reset Checkback	RDI	25
2	N9:0/1	Mains Fail	RDI	26
3	N9:0/2	Pump 1 Auto Selected	RDI	27
4	N9:0/3	Pump 1 Off Selected	RDI	28
5	N9:0/4	Pump 1 Manual Selected	RDI	29
6	N9:0/5		RDI	30
7	N9:0/6	Pump 1 Running	RDI	31
8	N9:0/7	Pump 1 Drive Fault	RDI	32

I/O Limitations
There are two limitations to consider when allocating I/O in an N9 table to be passed to the RTU.

1) The maximum number of digital values an RTU can deal with in terms of either inputs or outputs is 255. This includes any physical I/O on the RTU and any expansion modules, as well as the I/O from the PLC.
2) The maximum number of analog values an RTU can deal with in terms of either inputs or outputs is 120. This includes any physical I/O on the RTU and any expansion modules, as well as the I/O from the PLC.
3) The maximum size of a radio packet is 255 bytes. This includes about 16 bytes for the packet header, 2 bytes for every analog and 1 byte for every 8 digital values (or part thereof).

It is important that item #3 is not overlooked as it is a common cause of problems when commissioning a PLC site. Most radio packets in DATRAN consist of only inputs OR outputs and therefore only inputs OR outputs need to be taken into consideration when calculating the payload size.

There is one packet type, the PUP poll, which includes both inputs and outputs in the same packet. While a PUP poll serves a useful function, it is not mandatory and can be disabled if necessary. However, it is advisable to try and limit the total site I/O count so that PUP polls can still be used.

Example
Consider an eXcel RTU with a DF1 interface to a PLC. The PLC contains most of the control logic for the site, but there are a small handful of functions that are carried out by the RTU also, such as flow pulse counting, a watchdog for the PLC and site security alarm function.

The I/O table for the site is as follows:

I/O Count and Type	Description
RDI 1-8	Native RTU Inputs
RDI 9-40	Two Words of PLC digital inputs
RAI 1-6	Native RTU Inputs
RAI 6-35	PLC Analog inputs
RDO 1-8	Native RTU Inputs
RDO 9-24	One Word of PLC digital outputs
RAO 1-2	Native RTU outputs, whether they are configured or not.
RAO 4-60	PLC Analog Outputs
NDI 1-8	RTU Notional Digital Inputs for derived values from the DLP.
NAI 1-10	RTU Notional Analog Inputs

To calculate the payload size in both the input and output direction simply total up the number of bytes required for each I/O class.

Inputs:

RDIs : Total of 40 with 1 byte required for each 8 = 5 bytes
RAIs : Total of 35 with 2 bytes required for each. = 70 Bytes
NDIs : Total of 8 with 1 byte required for each 8 = 1 byte
NAIs : Total of 10 with 2 bytes required for each = 20 Bytes

Total Inputs = 96 Bytes

Outputs:

RDOs : Total of 24 with 1 byte required for each 8 = 3 bytes
RAOs : Total of 60 with 2 bytes required for each. = 120 Bytes
NDOs : None
NAOs : None

Total Outputs = 123 Bytes

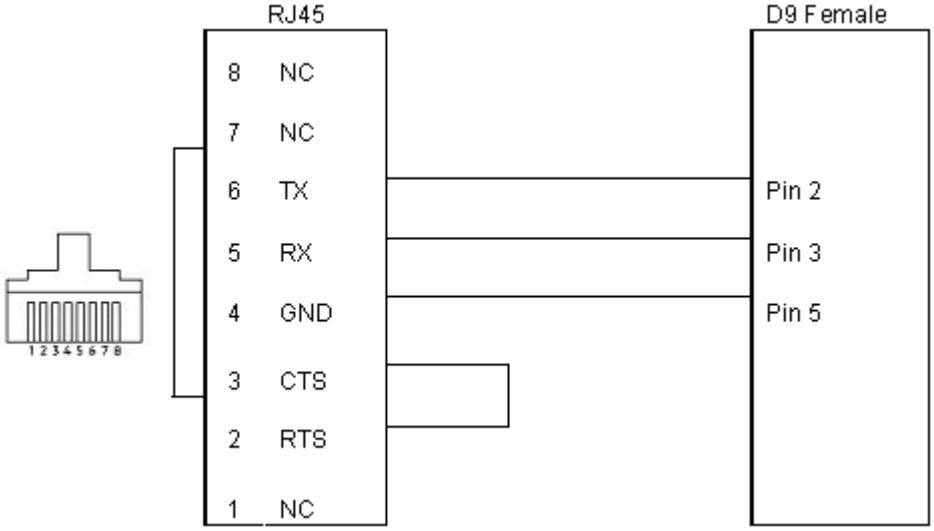
Total I/O = 219 Bytes + 16 bytes of packet header = 235 Bytes total packet.

So, we can see that for the above configuration the payload is less than the maximum limit for both inputs and outputs, which means normal radio comms will work for this site.

We can also see that the total I/O is less than the maximum limit, although we are starting to get quite close. This site will also be able to use PUP polls.

QTech Interface Cable

The following cable is supplied.



Compact Logix PLCs

The QTech DF1 interface was specifically designed for interfacing to SLC series PLCs. Several of our customers have successfully used the DF1 interface to communicate with a Compact Logix PLC, however we are aware that there are several advanced PLC configuration options that are required to get it working correctly. QTech Data Systems cannot fully advocate support for this product as we do not understand the PLC aspects fully. Please contact your PLC vendor.

We understand that these PLCs are becoming more prevalent we will attempt to provide enough information here so that you will be able to 'give it a go' based on feedback from other clients.

Micro Logix Interface Cable

The mini DIN connector required for Micro Logix PLCs is not available from QTech.

We believe the required AB part is P/N 1761-CBL-PM02. Please order this from the PLC vendor and terminate to an RJ45 as shown.