Bitronics

Network Instruments

Application Note

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Network Instruments
AP-7
ONP 3.0 Interface with Harris 020 RTU

NovaTech®
Bitronics ◆ D/3 ◆ Orion

1.0 INTRODUCTION

Bitronics Network Instruments interface with a wide variety of devices including Remote Terminal Units (RTUs), Programmable Controllers, and personal computers. This application note describes the interface to a HARRIS D20 RTU using either RS-232 or RS-485 DNP3Bitronics instruments. These instruments allow the D20 RTU to collect high-accuracy 3-phase electrical quantities.

The Bitronics Network Instrument family consists of a number of product lines. These instruments communicate via a serial interface using a variety of protocols and hardware standards. This application note focuses on the MultiComm™ and PowerPlex™ product lines which contain a DNP serial interface option. The chief difference between these lines is that the MultiComm instrument contains an integral display whereas the PowerPlex is designed for behind-the-panel use. Additional Bitronics interface options include RS-232 MODBUS® 1, RS-485 MODBUS 3.0, and the MODBUS PLUS peer-to-peer network.

2.0 ELECTRICAL INTERFACE

Users can choose between the RS-232 or RS-485 interfaces. The functional difference between these interfaces is that RS-232 allows only a single instrument to be connected with a short cable and RS-485 allows up to 32 devices to share a single connection over distances up to 4000 feet. The D20 RTU has a direct interface for RS-232 connections and can accept an external device which converts the RS-232 to RS-485.

The RS-232 connection is the simplest interface. The 3-wire cable shown in Figure 1 connects the Bitronics instrument to the RTU. The only adjustment for the communication interface on the Bitronics instrument side is the DNP address, which is set via rotary switches. Refer to the DNP3 Interface Option Manual for details. On the D20 side, the interface must be configured for 9600 baud, NO parity, DNP3 mode, and the correct instrument address.

The RS-485 connection is slightly more complex. The shielded 2-wire twisted-pair cable shown in Figure 2, connects the Bitronics instruments to the RS-485 converter. Various converters are available, the B&B Electronics model 485CSP will be used to illustrate the connection. The converter mounts to a standard 9F-25M adapter such as the B&B Electronics Model 232CAMS which in turn mounts to the D20 interface board. The 485CSP converter must be jumpered to enable transmitter control by SD (Send Data) and turn off the echo during transmission. Other converters which support 2-wire RS-485 mode and can use the RS-232 Transmit Data (SD) signal to control the. RS-485 transmitter can also be used.

1 _ MODICON® and MODBUS® are registered trademarks and MODBUS PLUS™ is a trademark of Schweitzer Electric Laboratories.

The RS-485 standard makes specific recommendations for line terminations, biasing, and grounding. Line termination resistors are required at each END of the network to minimize data transmission line reflections. These resistors (typically 120 ohms) are placed across the A and B lines. The RS-485 link is biased (held at the idle state with no transmitter active) by the 1470/1050 and 619 ohm resistors shown in Figure 2. The 1470 and 1050 ohm resistors effectively pull the "B" line to 5.0 volts via a 612 ohm resistor. RS-485 also requires the presence of a signal return path between each node on the link. This is typically accomplished by coupling the cable shield to each transceiver chip power supply common point via a resistor. Bitronics instruments include a 100 ohm resistor from the transceiver common to the terminal block point labeled SHLD for this purpose. Although not strictly required, it is suggested that transceiver common points be kept near earth ground. Bitronics instruments include a resistor limiter from the transceiver common to the terminal block point labeled GND. This point can be connected if all grounds are known to be at the same potential.

3.0 MEASUREMENTS and SCALING

All measurements except for Energy values are communicated as Analog Input Objects (Object 30). Energy values are sent as Static Binary Counter Objects (Object 20) in Primary (scaled) units of KiloWatt/KiloVARs. All four energy counters are zeroed when the instrument receives a Direct Operate command with specific Control Relay Output Block parameters as discussed in the DNP3 Interface Option Manual.

The CT and PT transformer ratios can be set through the DNP interface by writing to Analog Output Objects (Object 40). Note that the point numbers for these Write objects differ from the point numbers for the Read object (DNP3requires that all object point numbers begin with zero). These write points are 0 through 3 and represent the numerator and denominator of the ratio. For example, a PT ratio of 60: 1 would be set by writing the values 6000 and 0100 to Analog Output Object Points 2 and 3 respectively.

Refer to the Bitronics DNP3 Interface Option Manual for the details of measurements and scaling.

4.0 TROUBLESHOOTING

It is not uncommon for complex communication systems to require some initial commissioning work. This section provides some techniques to isolate the more typical problems found during initial system startup when you . suspect either the cabling or the Bitronics Network Instrument. All that is required is a voltmeter.

First, make a visual inspection of the system.

- Verify that all power and data cables are in the correct positions.
- Verify that the Bitronics PowerPlex POWER LED or the MultiComm Digital Displays are illuminated. If not, check for blown fuses or tripped breakers.

- Verify that the instrument address matches the RTU setup (refer to the DNP3 Interface Option Manual).

- Verify that the RTU is configured for use with Bitronics Network Instruments.
- If an RS-485 converter is used, ensure that the fuses and protection devices are intact and that +12v DC is applied to the correct terminals. Also ensure that the jumpers are set for "SD" control and "ECHO OFF".
- Check the Network Instrument diagnostic LED. If it is flashing, this indicates that the instrument is sending a response to the RTU. If flashing, verify that no other instruments have the same DNP address as this instrument.

For RS-232 systems, make the following electrical checks.

- Verify that the voltage at the Network Instrument RxD terminal is more than 3.0 volts negative with respect to the SG terminal when the D20 is not transmitting data. If not, try reversing the TxD and RxD terminals and re-check. Watch this signal to verify that the D20 is occasionally sending messages to the instrument.

- Verify that the Network Instrument is holding the transmit line at the idle state between messages by checking that the TxD terminal is more that 3.0 volts negative with respect to the SG terminal. Watch this signal to check if the Network Instrument is transmitting data.

- If the Network Instrument is transmitting, but the RTU is not receiving, remove the 9-pin connector from the RTU and verify that pin 2 (RxD) is more than 3.0 volts negative with respect to pin 5 (COM). If not, the RxD connection to the RTU is broken.

For RS-485 systems, make the following electrical checks.

- Verify that the voltage at the Network Instrument terminal A is more than 0.2 volts negative with respect to terminal B when the RTU transmit LED is NOT illuminated. If the voltage is more that 0.2 volts positive, it indicates that the A and B wires are reversed.

- If the voltage is within ± 0.2, verify that no more than two line terminators are used on the link. The terminators should only be at each END of the link.

- Monitor the RS-485 converter TX LED to verify that the RTU is transmitting something. If not, the fault is definitely at the RTU end of the RS-485 cable.

- Monitor the RS-485 converter RD LED. If it is flashing, the RTU is being sent a response.

5.0 REFERENCES

The EIA-232 standard defines the electrical specification for single-ended (unbalanced) digital transmissions. This was formerly known as RS-232.

The EIA-485 standard defines the electrical specification for differential (balanced) digital transmissions with multiple transmitters. This was formerly known as RS-485.

The MultiComm and PowerPlex DNP3 Option Manuals describe the internal connections to the various signal and reference points for the serial interface.

B&B Electronics supplies a 22 page application note with their converters which highlights important sections of the EIA standards.

The latest EIA standards may be purchased from Global Engineering Documents. Global may be reached at (202) 429-2860.

The DNP3 protocol is described in "DNP Basic 4 Documentation" set.

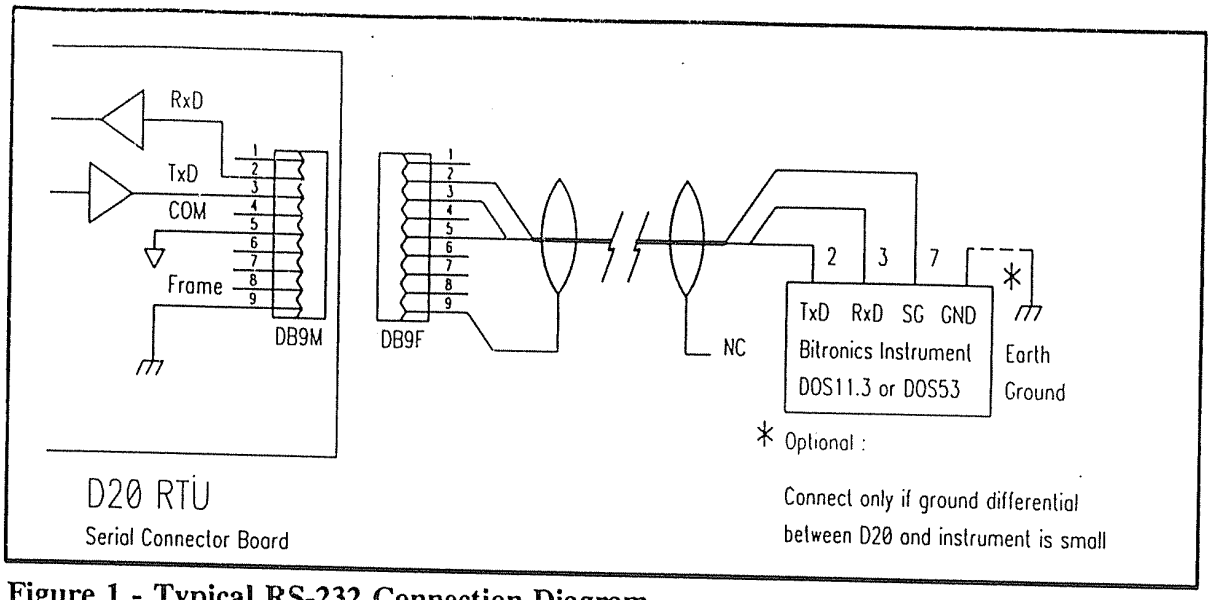

Figure 1 - Typical RS-232 Connection Diagram

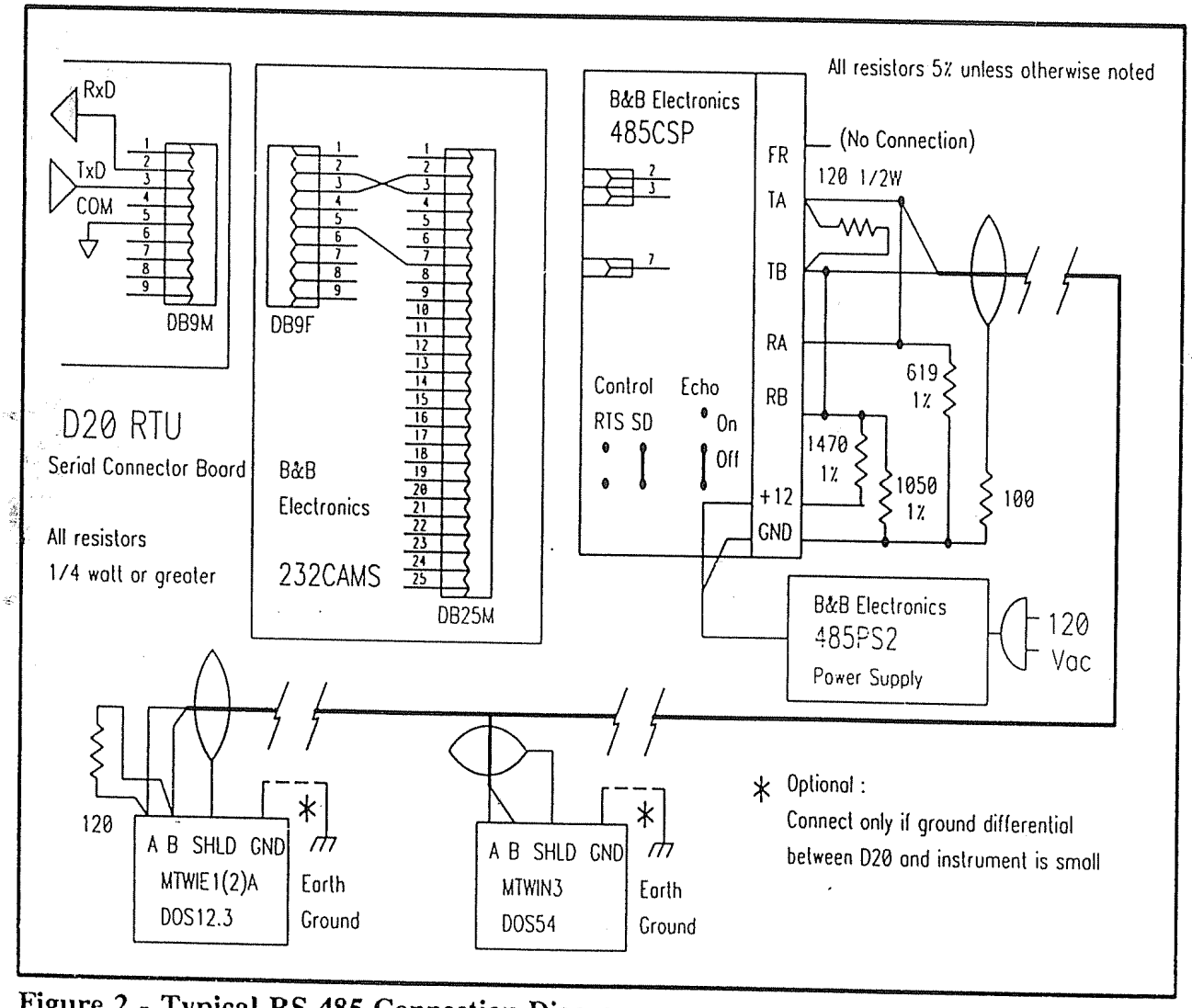

Figure 2 - Typical RS-485 Connection Diagram

Revision	Date	Changes	By
A	01/30/2009	Update Bitronics Name, Logo	E. Demicco
B	08/09/09	Updated logos and cover page	MarCom
C			

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