SCADA*Link* DC100 Data Concentrator

User Manual

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TABLE OF CONTENTS

1 Overview

This document summarizes the installation, operation and configuration of the SCADALink DC100 Data Concentrator.

The DC100 is a powerful and easy-to-configure multiport controller used for concentrating and redistributing I/O data in SCADA & Telemetry systems. Data concentration provides the following useful functions:

- Provide polling capabilities to PLC/DCS systems that have no polling capabilities
- Reduce communication load to a central site by polling one large packet instead of many small ones
- Improving polling frequency
- Reduce communication costs
- Interface systems/equipment with incompatible protocols
- Generate and provide physical I/O to/from intelligent remote devices
- Enable I/O communication between remote sites in a point-multipoint system without the need for a SCADA Host

The DC100:

- Stores concentrated I/O data that can be polled by a host computer or PLC
- Stores concentrated I/O data that it can write it to a host PLC/RTU/DCS
- Replicates remote I/O data as physical I/O connected to the data concentrator

The DC100 Data Concentrator can be used for SCADA Applications for sites where there are multiple devices such as:

- VFD
- Flow Computers
- RTU
- EFM
- PLC
- Pump Controllers

It comes with RS-232, RS-485 and one 100Base-T Ethernet port. User configuration via a simple menu driven GUI interface allows users to easily configure Master ports, Slave ports and up to 96 separate I/O polls. The combination of ease of configuration and multiple ports makes the DC100 a powerful solution for point-to-multipoint SCADA and I/O concentration applications.

The DC100 is part of the SCADALink family of rugged, compact, SCADA and telemetry products. It can be easily integrated with other SCADALink family devices as well as legacy hard wired I/O systems or SCADA/PLC systems.

It offers flexible features such as:

- Easy snap-on connection to SCADA*Link* SMX-900 I/O modules

- Interface to third party Modbus devices
- Functionality over wired or wireless
- Interface to serial or Ethernet networks
- Easy configuration and setup via a simple-to-use Windows Graphical User Interface (GUI)

This manual is divided into the following sections:

1. Overview
2. Hardware description
3. Installation instructions
4. Setting up a configuration session
5. Data architecture
6. GUI layout, navigation and configuration parameters
7. Operation
8. Configuration examples
9. Appendix with cables, diagnostics, firmware upgrade

2 Hardware Overview

2.1. Hardware Features

Major features of the DC100 are shown in Figure 1 below:

POWER   DI, DO

COM 1 RS-232   RELAY

HARDWARE RESET BUTTON

ETHERNET PORT   LED's

COM 2 RS-232   COM 0 FIRMWARE LOADING PORT

COM 3 RS-232

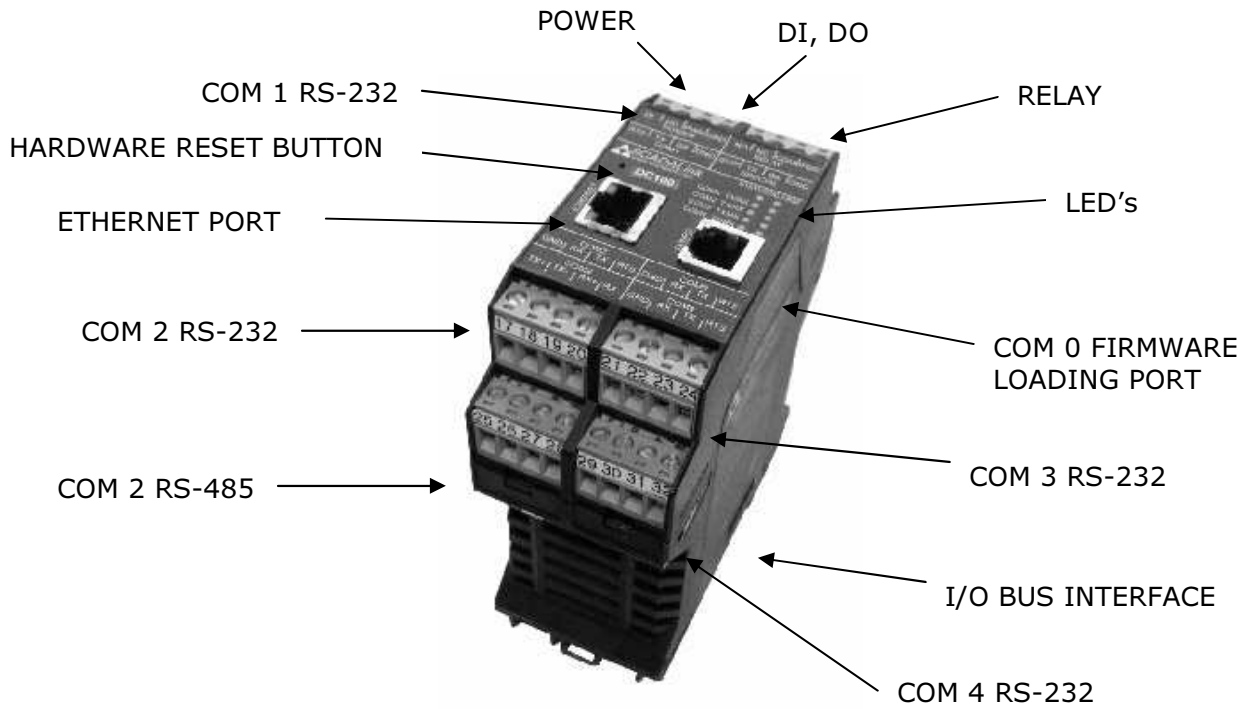COM 2 RS-485

I/O BUS INTERFACE

COM 4 RS-232

Figure 1: DC100 Hardware Major Features
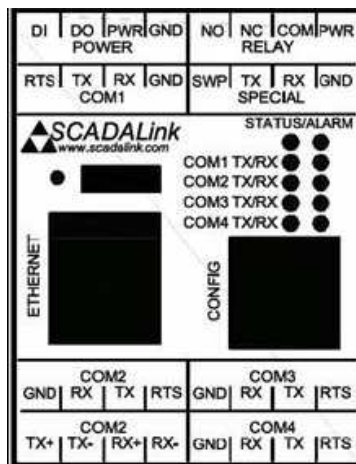
Figure 2: Top View Terminal Blocks

Table 1: Port Pinouts

PIN No.	NAME	FUNCTION	DESCRIPTION
1	DI	Power	Discrete Input, Active Low, (switched to GND), 30VDC, 125mA resettable fuse
2	DO		Discrete Output, Open Drain, 30VDC/50mA max, Sinking, 125mA resettable fuse, ESD protect.
3	PWR		10-30VDC, 50mA@12Vdc Reverse Polarity Protection
4	GND		Power Negative
5	NO	Relay	NO Contact, 30Vdc@50mA max. (not used in this firmware)
6	NC		NC Contact, 30Vdc@50mA max. (not used in this firmware)
7	COM		Common Relay Pole
8	PWR O/P		Sourced Vin-0.5V@250mA max.
9	RTS	COM1	RS-232. Connect to a PLC/RTU, DCS or SCADA Host. Can be a Modbus Master or Slave. Or Configuration Parameter Port to GUI.
10	TX		
11	RX		
12	GND		
13	SWP	Special	Switched Power = Vin-0.5V
14	TX		Reserved for future use
15	RX		
16	GND		
17	GND	COM2	RS-232. Connect to a PLC/RTU, DCS or SCADA Host. Can be a Modbus Master or Slave. Runs simultaneous to COM2 RS-485 port, same data, data rates and port settings.
18	RX		
19	TX		
20	RTS		
25	TX+	COM2	RS-485. Connect to a PLC/RTU, DCS or SCADA Host. Can be a Modbus Master or Slave. Runs simultaneous to COM2 RS-232 port, same data, data rates and port settings.
26	TX -		
27	RX+		
28	RX -		
21	GND	COM3	RS-232. Connect to a PLC/RTU, DCS or SCADA Host. Can be a Modbus Master or Slave.
22	RX		
23	TX		
24	RTS		
29	GND	COM4	RS-232. Connect to a PLC/RTU, DCS or SCADA Host. Can be a Modbus Master or Slave.
30	RX		
31	TX		
32	RTS		
-	-	ETH0 Ethernet	10/100 Base-T, 8 pin RJ45
-	-	COM0	RJ11 Firmware Loading Port. Or Connect to a PLC/RTU, DCS or SCADA Host. Can be a Modbus Master or Slave. Or Configuration Parameter Port to GUI.

2.2 Specifications

Table 2: Hardware Specifications

Parameter	Description	Min	Typ	Max	Units
POWER					
Vin	Input voltage (reverse polarity protected)	10		30	V
Iin (note 1)	Input current @12V			50	mA
	Input current @24V			25	mA
RELAY PWR pin					
Vout	Secondary power voltage			Vin-0.5	V
Iout	Secondary power current			250	mA
SERIAL COMMUNICATIONS					
(Async, 7/8 data bits, parity: o/e/none, stop: 1/2, speed: up to 115 Kbps, flow control: rts/rts & cts/none)					
COM0	RS-232, , RJ-11				
COM1	RS-232, 4 pin terminal block				
COM2	RS-232 or RS-485, 4 pin terminal block				
COM3	RS-232, 4pin terminal block				
COM4	RS-232,4 pin terminal block				
ETHERNET COMMUNICATIONS					
ETH0	10/100 Base-T, status LEDs, RJ-45				
INPUTS & OUTPUTS					
DI pin	Active low input, switched to GND				
Vin	ESD protected, clamped			30	V
Iin	Clamped by resettable fuse				mA
	Resetable fuse			125	mA
DO pin	Open drain output, sinking				
Vout				30	V
Iout				50	mA
	Resettable fuse			125	mA
SWP pin	Switched power (reverse polarity protected)				
Vout				Vin-0.5	V
Iout				2	A
RELAY NO pin	Isolated relay output, Normally Open				
Vout				30	V
Iout	AC or DC			50	mA
RELAY NC pin	Isolated relay output, Normally Closed				
Vout				30	V
Iout	AC or DC			50	mA
PHYSICAL					
Dimensions					
	4.5 x 1.8 x 3.9				Inches
	114 x 45 x 99				mm
Mounting	35 mm DIN rail				
ENVIRONMENTAL					
Operating Temp		-45		70	Celcius
Relative Humidity	Non condensing			90	%
MISC. ELECTRICAL					
Connection	4 pin terminal block, flathead screw terminals	12		24	AWG
Battery	Battery backup for RAM and realtime clock				
LED	10 LEDs - Status, Alarm, COM port Tx, COM port Rx				
Reset	Recessed h ardware reset button located above Ethernet port				
AGENCY APPROVALS					
Hazardous Location					
CSA	Class I Div 2, Group C,D T3C, Ta temperature	-40		70	Celcius

Notes: 1 Current is measured for no load condition.

3 Installation & Wiring

3.1 Mounting and Power Connection

NOTE: All terminal block plugs are keyed to headers to prevent accidental insertion

1. Mount the DC100 onto a 35mm DIN rail. Use a flathead screwdriver to pry open the spring-loaded plastic clip on the bottom of the DC100 package, position and release the clip so that the DC100 snaps tightly and securely onto the DIN rail

2. Connect a regulated 10-30VDC power supply to the (+) and (-) power supply screw terminals of the power supply terminal block plug via 12-24 AWG multistrand wire. Observe proper polarity.

3. Insert the plug into the DC100 power supply header.

3.2 Data Connection

- The DC100 has 5 serial ports (COM0 to COM4) and a 100Base-T Ethernet port with auto-detection, ETH0.
- COM1 to COM4 are connected via 4 pin screw terminal plugs using a small flathead screwdriver and 12-24 AWG multi-strand wire. (See DC100 side label)
- COM1 to COM4 are DTE RS-232 ports with TX, RX, RTS & GND
- COM0 can be used as a Firmware Loading Port in this software version. See Appendix A for cable.   COM0 can also be used for data and has a cable for that purpose.
- Ethernet port can auto-detect straight thru or crossover cable

.

4 Setting Up a Configuration Session

The DC100 Data Concentrator's behavior is set by configuration parameters found in the Data Concentrator GUI application running on a PC with a serial programming cable connected to either of COM0, COM1, or an Ethernet cable connected to the Ethernet Port ETH0.

> **NOTE:** If you are configuring a **new** factory DC100, you **must** use a COM port and configure the IP / network settings and password for future Telnet configuration

Cable Requirements:

Serial: DB9M (DTE) to 4-pole Terminal Block cable, Bentek Systems Part No. *CBL-100-USER* (See Appendix A)

Ethernet: Normal Ethernet Cable

Software Requirements:

Installer for the SCADALInk DC100 GUI Application. Download this from the Bentek website or copy from the provided CD to your hard drive.

Steps:

1. Plug in the serial or Ethernet cable.
2. Insert DB9M side of cable into your programming PC.
3. Apply power to the DC100. The status LED should light red to indicate status. If it does not, check your power connections and power supply.
4. Click on the DC100 GUI installer. The DC100 main menu will appear.
5. If you are configuring a new DC100, go to the Comm / Network menu and configure all network settings if you wish to configure by Ethernet in the future.
6. Configure parameters for your application (See section: *Configuration Parameters* and *Configuration Examples* for explanations and examples for setting parameters).
7. When configuration is done, remove programming cable and turn power off.
8. Connect cables and equipment as per your application.
9. Restart the power. The DC100 should enter RUN mode after about 5 seconds. The Status LED should be on.

5 Data Architecture

The DC100s basic function is to transfer data from the Source port to the Destination port.

NOTE: Any port that has been selected to be a Source or Destination is automatically a Master port, not a Slave. If the Host port is selected as a Source or Destination, ensure that the Modbus Setting is also a Master.

5.1 The Internal Registers

There are two types of internal registers:

1. I/O Internal registers (synchronized to I/O modules)
2. General purpose registers

There are 3 blocks of internal registers each having 500 memory locations:

1. Coils
2. Discretes
3. Inputs
4. Holdings

Holdings and inputs are grouped together in one block.

A detailed register map is in the DC100 GUI help at Help > Registers.

The internal registers play a critical role for data concentration. When the DC100 polls data from a number of remote sites, the collected data can be written into a contiguous block in the general registers. These can then be read or written out all at once by an external device connected to the DC100.

5.2 Modbus Request / Response

When entering Polls, the DC100 GUI provides 2 methods for entering internal register numbers:

1. Register number convention: enter a number from 1 to 500
2. I/O Bus numbering convention: use I/O Bus position (1 to 8) and signal numbers

To calculate the register number when using the I/O Bus convention,use Appendix B to translate I/O Bus module position and signal number to a register number between 1 to 162.

Data addresses are used in Modbus Request / Response messages. Register numbers start at 1 wheras Modbus data addresses start at 0. A register number is therefore converted into Modbus data address by subtracting one.

5.3 DC100 Data Transfer

The power and flexibility of the DC100 lay in its ability to connect a DC100 user port with another DC100 user port. This configuration is done in the GUI *Data Transfer* menu. Through the GUI *Data Transfers* menu, the user can define data transfers (polls).

In particular, users can define the same port as both source and destination. This is useful if the user needs to transfer data from one remote site to another. For example, If the polling port is both a source and destination and if it is connected to a Point-Multipoint radio system, it could read data from one remote location and write it to another remote location.

6 Configuration

The DC100 GUI application is used to configure the DC100's ports and to define the data transfers between them.

The GUI can be downloaded from the Bentek website or copied to your hard drive from a CD provided for that purpose. Always install the GUI from your hard drive and not directly from an external device.

Figure 3: DC100 GUI

A detailed description of the application is provided in the GUI Help.

7 Operation

Once configuration is complete, recycle power and allow DC100 to reset.

In-service operation of the DC100 is completely automatic. Once the unit is properly installed and configured, operator actions are limited to observing the front panel LED status indicators for proper operation.

If all parameters are correctly set, start DC100 operation by following these steps:

1. Apply DC power to the DC100
2. Observe the LED status for the proper indications

Table 3 LED Function

LED	Description
STATUS	Solidly lit: Power is good and Firmware running Off: No Power or Firmware not running
ALARM	Flashes Red: Poll Error: Data not received by configured amount of retries
COM1 Tx	Flashes when there is TX on COM1
COM1 Rx	Flashes when there is RX from COM1
COM2 Tx	Flashes when there is TX on COM2
COM2 Rx	Flashes when there is RX from COM2
COM3 Tx	Flashes when there is TX on COM3
COM3 Rx	Flashes when there is RX from COM3
COM4 Tx	Flashes when there is TX on COM4
COM4 Rx	Flashes when there is RX from COM4
Ethernet RJ45 Green LED	Collision Detect
Ethernet RJ45 Yellow LED	Link/Activity

8 Configuration Examples
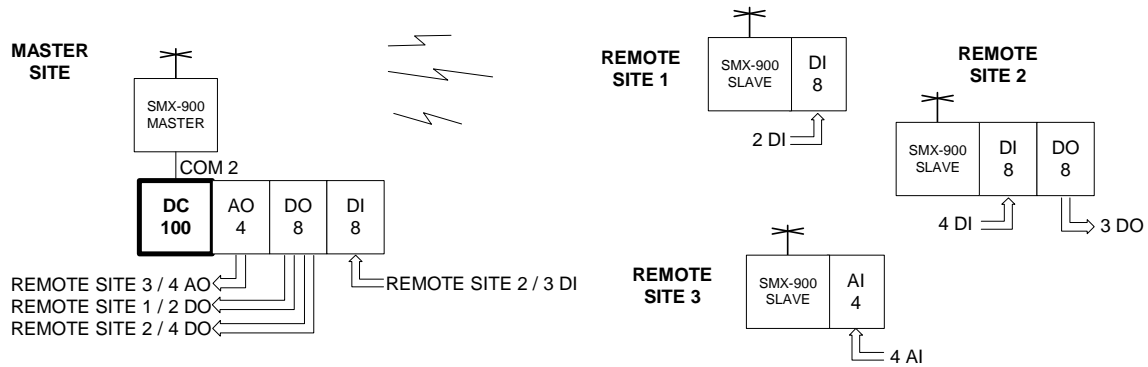
8.1 Point to Multipoint I/O Telemetry

Figure 5: Point to Multipoint I/O Telemetry

Description

This mode enables a DC100 to poll multiple remote sites via a data radio connected to the Polling port and to make the polled data available on terminals of I/O modules physically connected to the DC100's I/O Bus.

Configuration

1. Configure COM2 Serial port parameters
2. Configure COM2 Modbus parameters
3. Configure *I/O to Register* poll to read Modbus address 1 DI to DC100 I/O Bus position 3:
    b. Source: Device port: Polling, RTU Address: 1
    c. Destination: Device port: Internal
    d. Data Settings:
        i. Read from I/O module: DI8
        ii. Module Address: 1
        iii. Signal No.: 1, 2
        iv. Write to register: 00033, 00034 (See Appendix B)
        v. Write command: single coil
4. Repeat step 3 for Modbus address 2 and 3

8.2 Point to Multipoint I/O Telemetry with SCADA
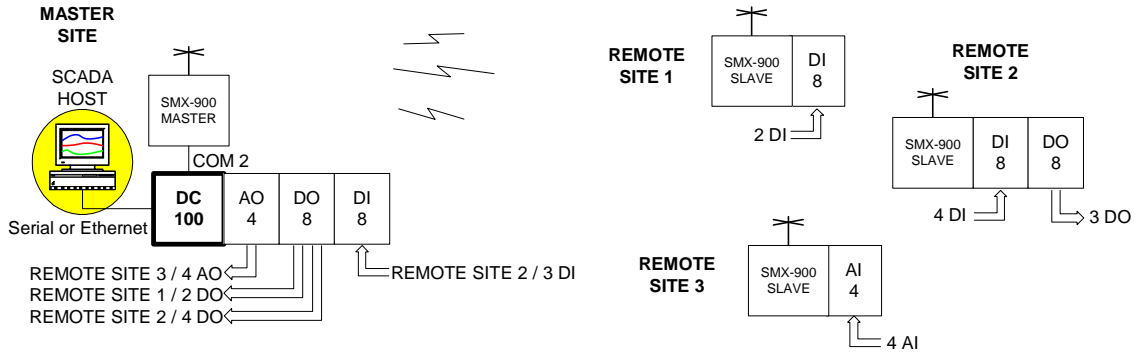
Figure 6: Point to Multipoint I/O Telemetry with SCADA

Description

This mode is exactly the same as the first example however, a SCADA Host is now added to poll the remote I/O data concentrated in the DC100. For this example, we will assume the SCADA Host is connected to the Ethernet port, ETH0.

Configuration

1. Configure exactly as in the first example but in addition, also configure:

2. Configure ETH0 *Comm Settings* network parameters to match SCADA Host settings
3. Configure ETH0 Modbus Slave Settings RTU Address
4. SCADA Host now polls the Internal port using the memory map in Appendix B to read values out of the DC100.

8.3 Data Concentration with PLC/DCS/RTU
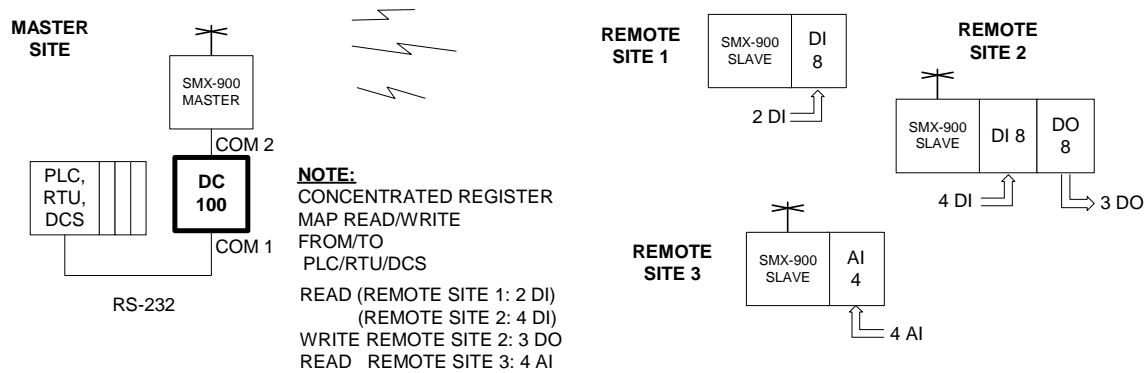
Figure 7: Data Concentration with PLC/RTU/DCS

Description

In this mode, remote I/O data of the same type is concentrated in similar contiguous blocks in the general registers (not the I/O synchronized registers), enabling the PLC to read an entire concentrated block of all the remote DI's, entire block of all DO's and an entire block of all the AI's.

Configuration

1. Configure COM2 Serial port parameters
2. Configure COM2 Modbus parameters
3. Configure COM1 Serial port parameters
4. Configure COM1 Modbus Slave address
5. Configure *I/O to Register* poll to read Modbus address 1, 2 DI's to DC100 general purpose register:
    e. Source: Device port: Polling, RTU Address: 1
    f. Destination: Device port: Internal
    g. Data Settings:
        i.   Read from I/O module: DI8 position 1 and 2
        ii. Module Address: 1
        iii. Signal No.: 1, 2
        iv. Write to register: 00163, 00164 (general purpose register)
        v.   Write command: single coil
6. Configure *I/O to Register* poll to read Modbus address 2, 4 DI's to DC100 general purpose register:
    a. Source: Device port: Polling, RTU Address: 2
    b. Destination: Device port: Internal
    c. Data Settings:

     vi. Read from I/O module: DI8
     vii. Module Address: 1
     viii. Signal No.: 1, 2, 3, 4
     ix. Write to register: 00165, 00166, 00167, 00168 (See Appendix B)
     x. Write command: single coil

  7. Configure remaining 3DO and 4AI as in steps 5 or 6 above.

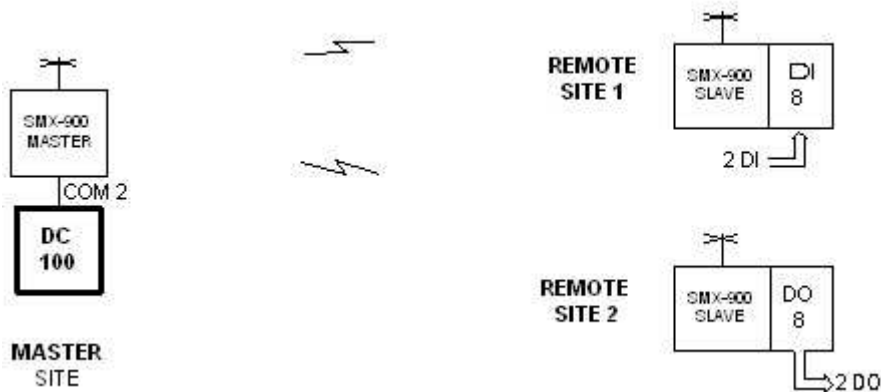## 8.4 Remote I/O to Remote I/O Transfer

Figure 8: Remote I/O to Remote I/O

Description

In this mode, I/O data from one remote site can be replicated at another remote site in a Point-multipoint system without the need of a SCADA Host. The DC100 does the transfer by polling 2 different addresses on the same port.

Configuration

1. Configure COM2 Serial port parameters
2. Configure COM2 Modbus parameters
3. Configure an I/O to I/O poll on COM2:
    a. Source Device Settings: Device port: Polling, RTU address: 1
    b. Destination Device Settings: Device port: Polling, RTU address: 2
    c. Data Settings:
        i. Source I/O module: DI8
        ii. Source module address: 1
        iii. Source signal number: All
        iv. Dest. I/O module: DO8
        v. Dest. module address:2
        vi. Dest. Signal number: All

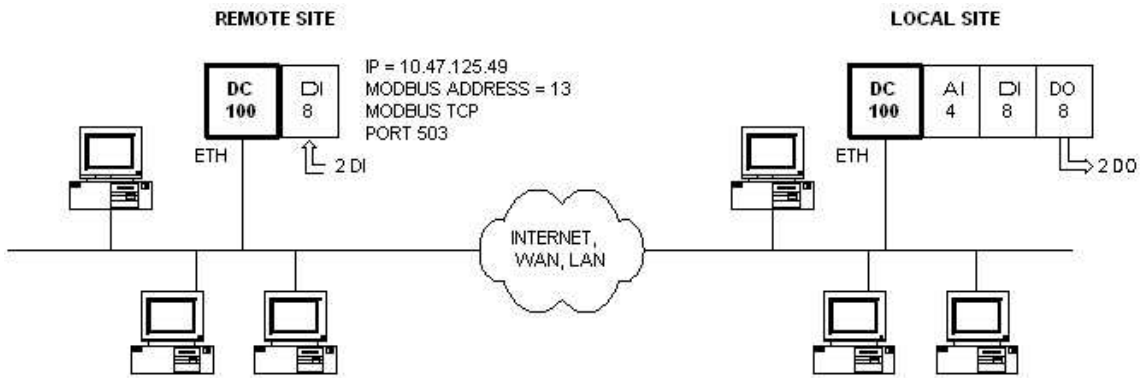**8.5 I/O from remote DC100 on Ethernet bus replicated on local DC100 I/O module**

Figure 9: I/O from remote DC100 on Ethernet bus replicated on local DC100 I/O module

Description

In this mode, 8 DI from another remote DC100 in module position 1, with Modbus TCP, IP address 10.47.125.49, Port 502, RTU address 13 on an Ethernet bus is replicated on the local DC100's DO8 module in position 3

Configuration

1. Configure ETH0 Network port parameters
2. Configure ETH0 Modbus Master parameters
3. Determine the remote DC100's Ethernet Modbus Slave address and ports
4. Configure an *I/O to Register* poll:
    a. Source: Device port: Network:
        xi.   IP Address: 10.47.125.49
        xii.   RTU Address
        xiii. Modbus address:13
        xiv.   Port: 502
        xv.   Protocol: Modbus TCP
    b. Destination: Device port: Internal:
    c. Data Settings:
        xvi.   Read from I/O module: DI8
        xvii. Module Address: 3
        xviii. Signal No.: All
        xix.   Write to register: 00033 - 00040 (See Appendix B)
        xx.   Write command: single coil

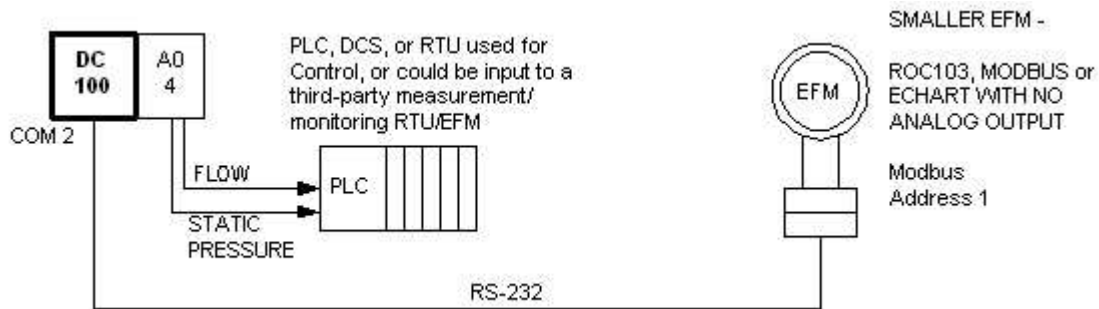### 8.6 Generating Analog Outputs Corresponding to EFM / Flowcomputer Registers Values

Figure 10: Generating Analog Outputs from EFM register values

Description

In this mode, the DC100 can generate analog outputs for devices such as smaller EFM's that have inadequate or no external analog outputs and which only output internal Modbus registers serially.

Configuration

1. Configure COM2 Serial port parameters
2. Confiugre COM2 Modbus port parameters
3. Configure an *Register I/O* poll:
    a. Source: Device port: Polling:
        i. RTU Address 1
    b. Destination: Device port: Internal:
    c. Data Settings:
        i. Read from Register: XXYYY
        ii. Read command: Inputs
        iii. Write to I/O Module: A04
        iv. Module Address: 1
        v. Signal No.: All

9 Troubleshooting

Check obvious things such as cabling, power and physical connections before doing any of the following checks.

No I/O appearing on I/O Module

- Check configuration on both Source and Destination vs real physical system to see if you have configured Module correctly.
- Correct position on I/O bus configured
- Correct type of module configured
- Correct address in internal memory configured
- If you are reading from a register, check to make sure port is configured correctly.
- If there is an external polling device, make sure it is working

SCADA Host getting wrong data

- Check Modbus address of DC100 to make sure SCADA Host is polling the right address.
- Check the port being polled to make sure it's a Slave and configured properly.
- Check the SCADA Host poll's memory location and block size. Make sure it's the same as where the data is being stored and the amount of data being stored there.

Appendix A – Cabling Examples

A1 DB9M (DTE) to COM1 or COM4 Terminal Block
(Bentek Systems Part Number: *CBL-100-USER*)
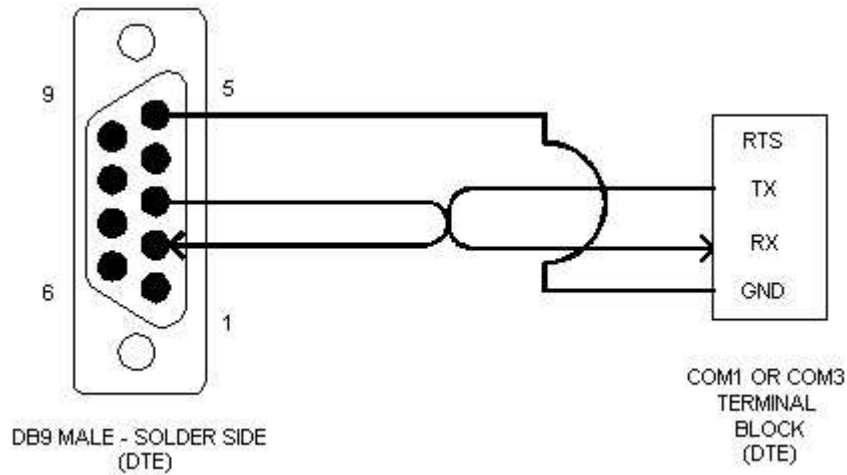
> **NOTE:** Used for COM1 parameter configuration or COM1 or COM4 serial data

Figure 11 DB9M (DTE) to COM1..COM4 TERMINAL BLOCK.
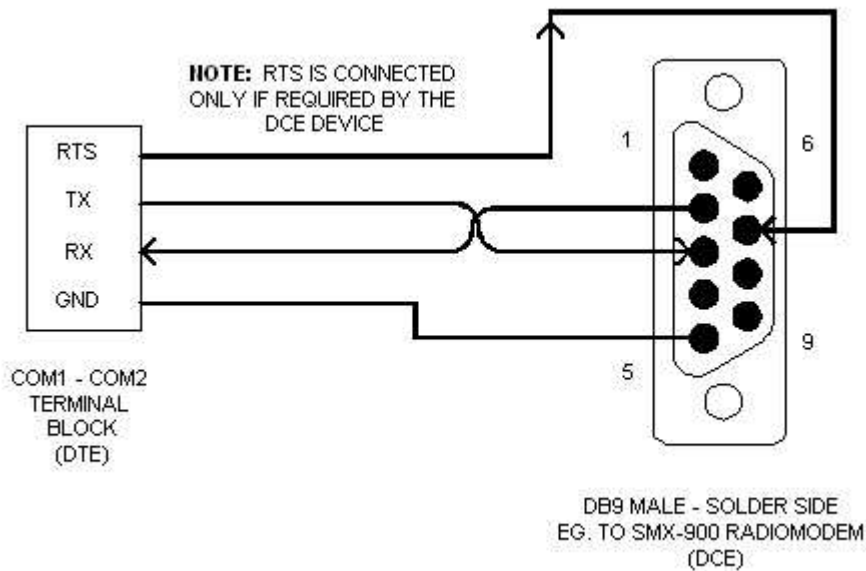
A2 COM1- COM2 Terminal Block to DB9M (DCE)

Figure 12 COM1-COM2 TERMINAL BLOCK to DB9M (DCE)
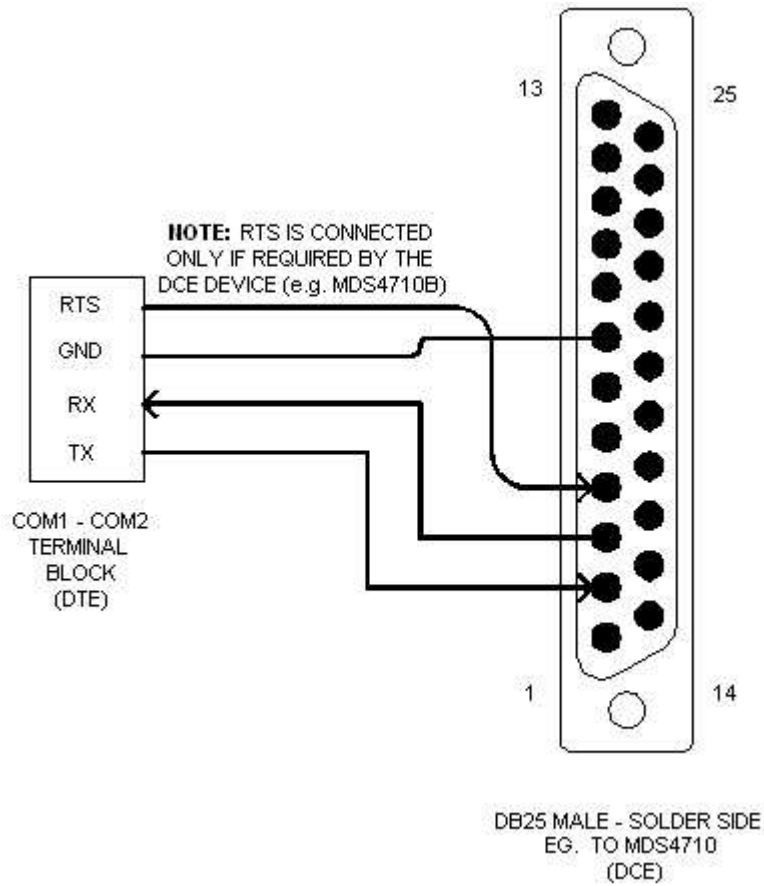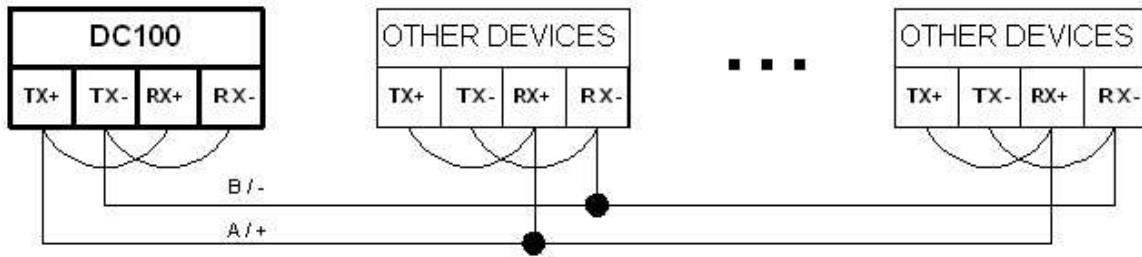
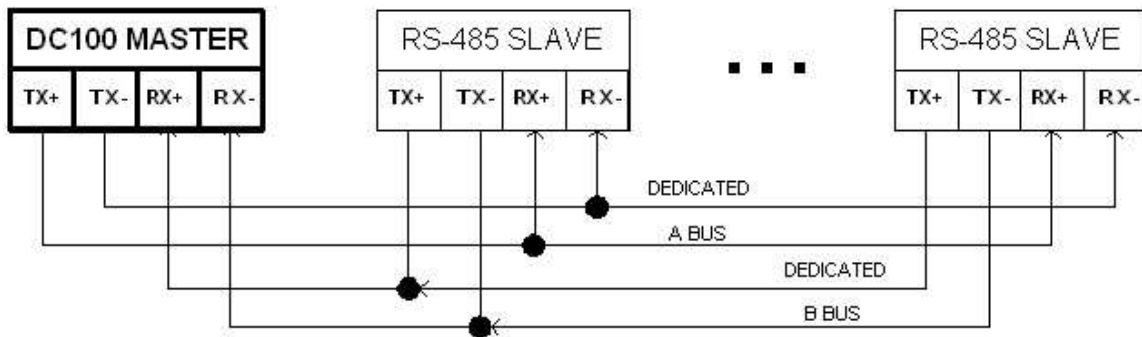## A3 COM1 – COM2 Terminal Block to DB25M (DCE)

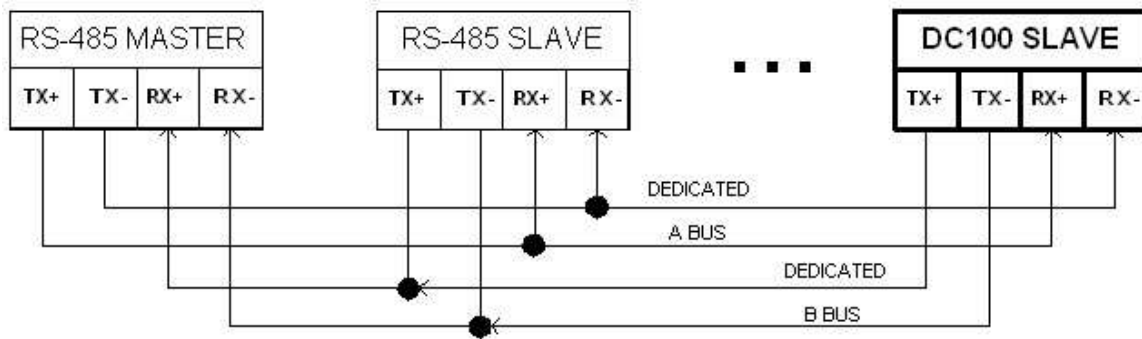**Figure 13: COM1 – COM2 TERMINAL BLOCK to DB25M (DCE)**

A4 COM2 RS-485 Terminal Block Wiring

2 WIRE HALF-DUPLEX RS-485 NETWORK

4 WIRE FULL-DUPLEX RS-485 NETWORK
DC100 IN MASTER MODE

4 WIRE FULL-DUPLEX RS-485 NETWORK
DC100 IN SLAVE MODE

NOTE: Connect all GND terminals together

Figure 14: COM 2 RS-485 Multidrop Wiring

A5 DB9M to COM0 / RJ11 Firmware Loading Cable
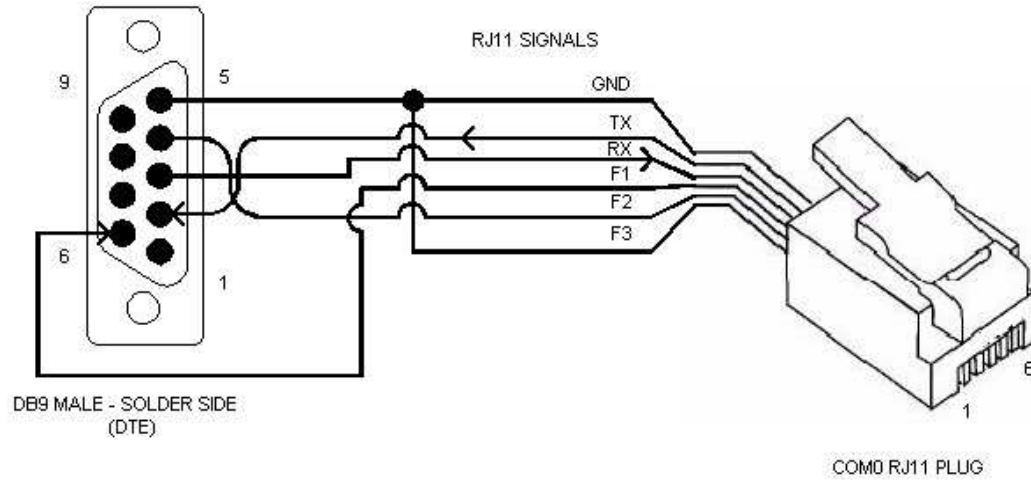 (Bentek Systems Part Number: *CBL-100-FIRMWARE*)

Figure 15: DB9M (DTE) to RJ11 / COM0 plug for firmware loading only

Appendix C – Diagnostics

After startup use the HyperTerminal as a telnet client to connect to port 23 at the DC100 IP address that you have entered.

Whenever entering commands make sure the HyperTerminal has the focus by clicking on it. You may have to do a call to disconnect then connect two times to get a response.

Commands can be entered as either upper or lower case since they are case insensitive. The version command should be the first you try. Then try the time command with no parameter. That will show you what the real-time clock is set to. Then try the time command with a W3C datetime to set the clock to the correct time.

All commands that can be used on the command line are listed in the D100 GUI help.

Appendix D – Firmware Upgrade

Firmware can be field upgraded for feature upgrades or bug fixes. Upgrading new firmware requires:

1. DB9M to RJ-11 firmware loading cable for COM0, Bentek Systems Part No. *CBL-100-FIRMWARE* (See Appendix A)
2. DC100 firmware loading program running on a PC.
3. DC100 firmware file

These files are contained in the DC100 GUI which can be downloaded from the Bentek website. Use the Tools > Load Firmware menu item.