BERMAD Irrigation

BIC 2500 2-Wire RTU

SYSTEM GUIDE

VERSIONS : 2007

CONTENTS

I. System Overview

The BIC 2500 TWO WIRE SINGLE CABLE SYSTEM use Remote Terminal Units (RTU) for connecting remote valves and water meters to the control system within a radius of 10 KM / 6 miles by a 2-wire jacketed cable.

The RTU communicate with the BIC 2500, receiving commands, and transmitting the status of sensors connected to the RTU.

A single 2 wire line can manage up-to 60 RTUs via one 2-wire interface. One BIC 2500 can manage multiple single cable channels, each channel may contain up-to 60 RTUs scanned every second.

MODULAR RTU can control 2,4,6 or 8 outputs and 4 or 8 digital inputs or 2 analog inputs. The outputs activate 2 wire 12v DC latching solenoids. The inputs are dry contacts or analog.

COMPACT RTU can control 1 or 2 outputs and 1 or 2 digital inputs

The system is a DC system designed for low power consumption and may be powered by solar energy.

BIC 2500 configuration can be done from the controller panel as described in this manual and also via the Cloud using the Console administrative tools. Configuring a BIC 2500 remotely requires cellular or LAN internet connection set up in the controller

I.I. Technical Specifications

Modular Remote Terminal Unit (RTU):

Power supply: 36V DC
Minimum Power Supply: 20V DC
Outputs: Up-to 8 12-17V DC Pulse (Latch)
Inputs: 4 Dry contact or analog.
Enclosure: IP 67 / NEMA 4 Non-Metal.

Compact Remote Terminal Unit (RTU):

Power supply: 36V DC
Minimum Power Supply: 20V DC
Outputs: 1 or 2 12-17V DC Pulse (Latch)
Inputs: 1 or 2 Dry contact
Enclosure: IP 68 / NEMA 6P Molded Epoxy
Dimension: 120 x 87 x 30 mm
Weight: 0.47 kg

2-Wire Interface:

Power supply: 12 VDC 2.5 A
Minimum Power Supply: 10.5 VDC
No Load Current: 115-120 mA
RTU Load: 1.5-2.2 mA
Output Voltage: 36 VDC *.
Main Fuse: 8A.
Line Fuse: 2x1A.
Enclosure: IP 67 / NEMA 4 Non-Metal.

* The output voltage of the 2W interface is varying in a high frequency and can not be measured by regular volt meters. The output voltage of 36v DC can only measured under test mode. To put the 2W interface in special test mode, set the address switch to 000000 and press the RESET button.

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I.I. SYSTEM COMPONENTS

The BIC 2500 Two Wire System includes:

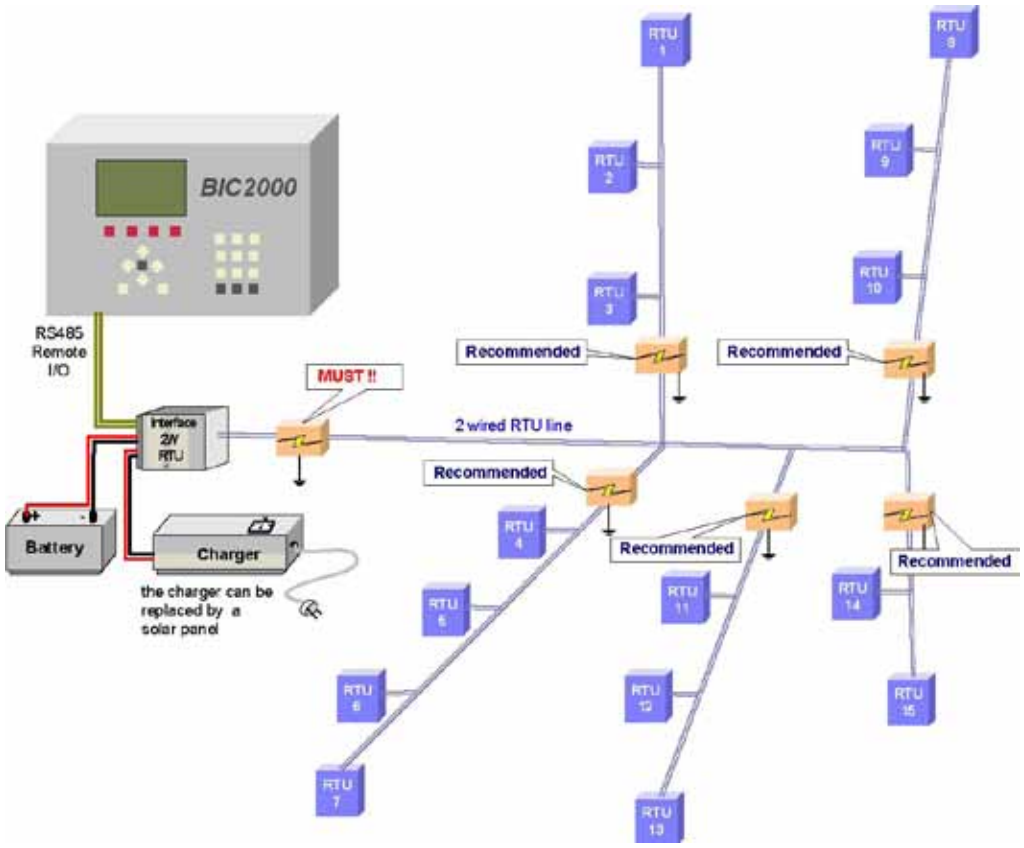
BIC 2500 2-Wire Controller

Interface 2-Wire:

The Interface manage the communication with the RTU and power supply through a remote I/O communication line (RS485).

Power Supply: The system can be powrd by a 20 Watt solar panel, recharging a 40Ah battery or by 120V AC and a backup 7Ah battery.

BIC 2500 2-Wire System Illustration:



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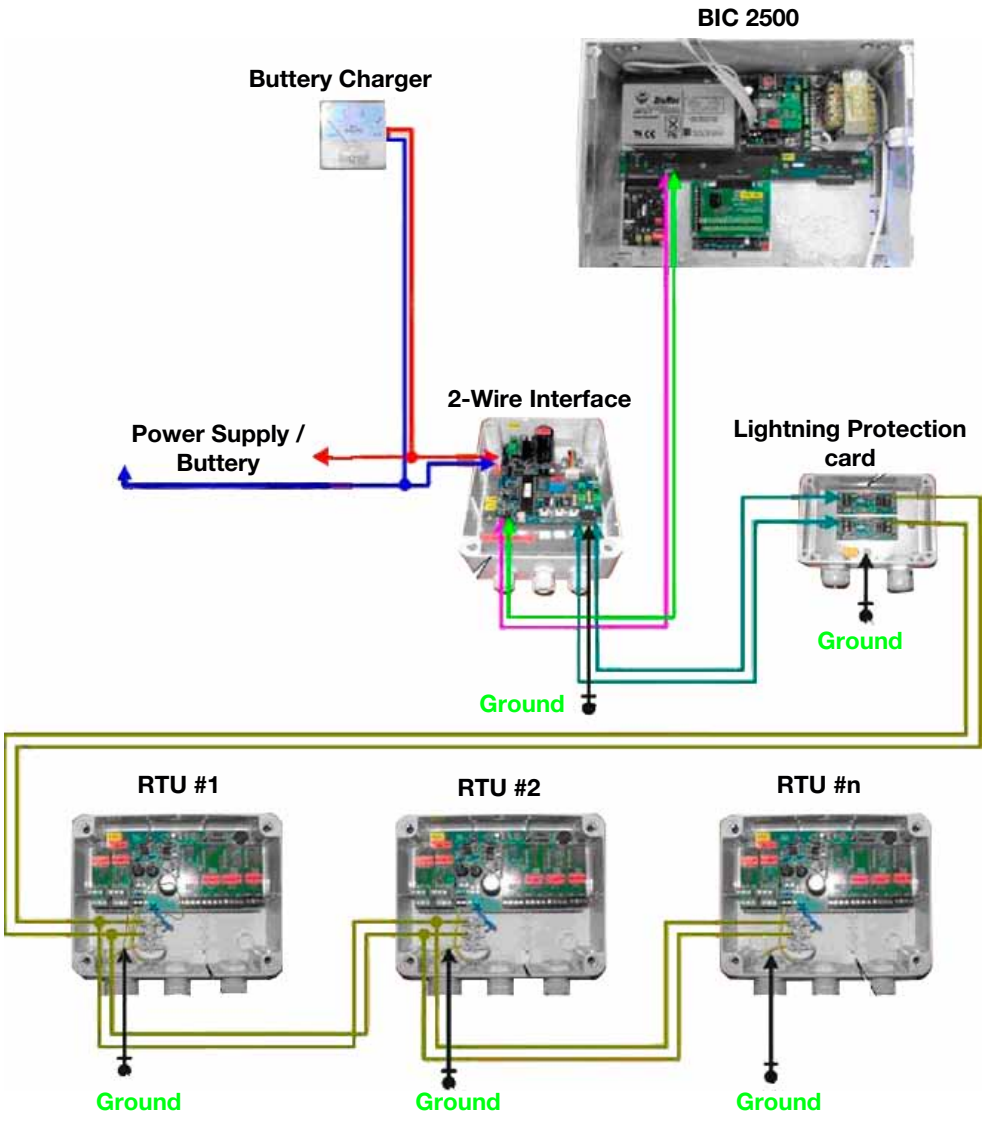
2. Installation

⚠ Disconnect all power sources including charger/solar panel and battery.

2.1 Cable Test

Wires must be tested as explained in appendix “B” prior to connecting the 2 wire line to the RTUs and to the BIC 2500.

One Channel System wiring diagram:



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2.2. Ground Rods

The 2W RTU interface, Lightning protection card and each RTU must be well grounded for the lightning protection to function properly. The resistance to the ground should not exceed 4 ohms.

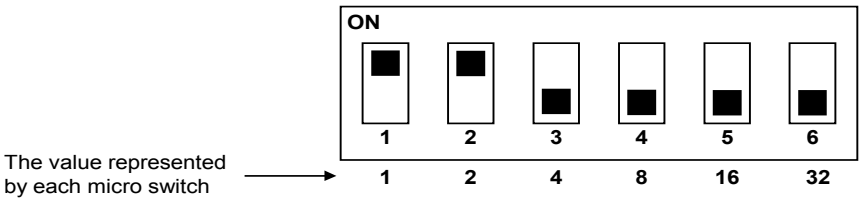
2.3 Addressing the Interface and RTU

Address the 2-Wire Interface to "1" unless other interfaces are installed in the system. If more than one interface is installed address the 2-Wire interface to the next available address.
RTU installed in the system should have a unique address.
The location of each output in the system is define by 3 numbers:

II - Interface address
RR - RTU Address
L - Location of each output in the RTU

Interface and RTU addresses are done by using a set of DIP Switches located on the board of each Interface and RTU. The RTU addresses range between "1" and "60"

RTU DIP Switch Block:



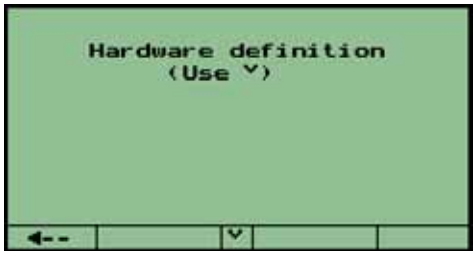
The micro switches are numbered 1 to 6. Each micro switch according to it's ordinal number represents a value between 1 and 32 as shown above.
The values are set in a binary code. See Appendix "A" for conversion from binary to decimal and switch settings.

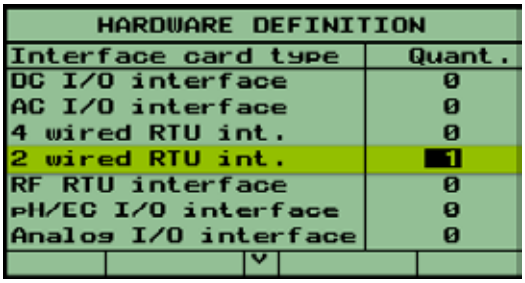
2.4. BIC 2500 Setup

definitions of the 2-Wire interface, RTU and outputs/inputs are done in the Setup menu of the BIC 2500

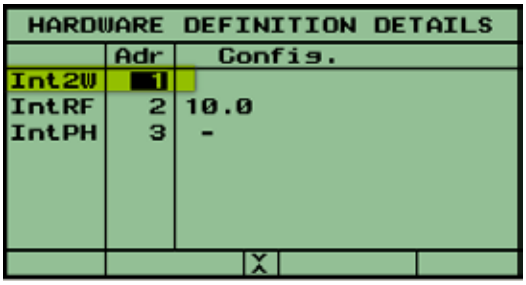
2.4.I. Hardware Definitions - Interface

The 2-Wire Interface definitions are done in the Hardware definition screen.





Define The number of 2-Wire Interface installed



Define The address of the 2-wire Interface

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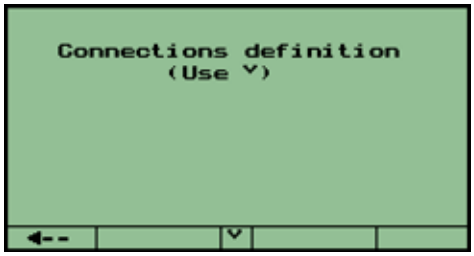
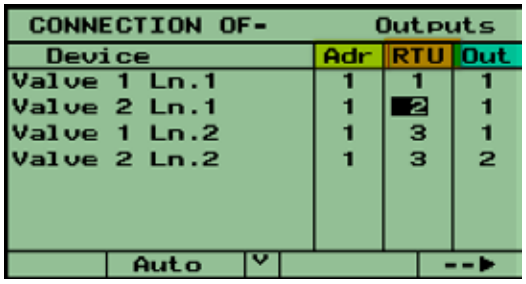
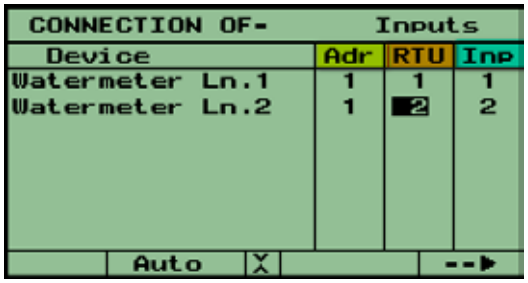
2.4.2. Connection Definitions - RTU and I/O

The RTU and I/O unique address define in the Connections Menu





Set the physical address of each output: Interface address, RTU Address & Output address within the RTU

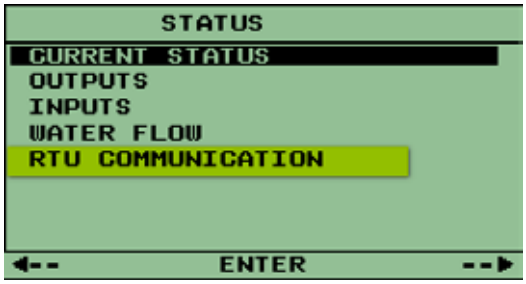


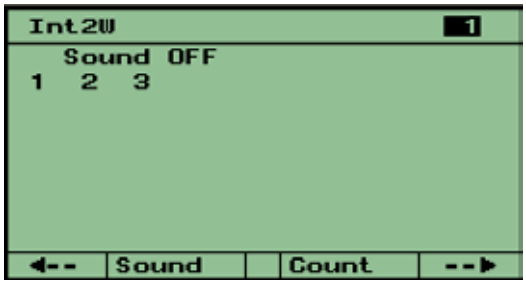
Set the physical address of each Input: Interface address, RTU Address & Input address within the RTU

⚠ Do not setup Virtual RTU in the system to prevent unnecessary communication cycles and to reduce energy consumption

2.4.3. RTU Communication test

The RTU Communication Is located in the Status Menu
The display shows the quality of communication with each of the 2-Wire RTU.





RTU with communication problem will be underlined.

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3. Modular 2-Wire RTU

The modular RTUs can handle up to 8 outputs and 8 digital inputs.

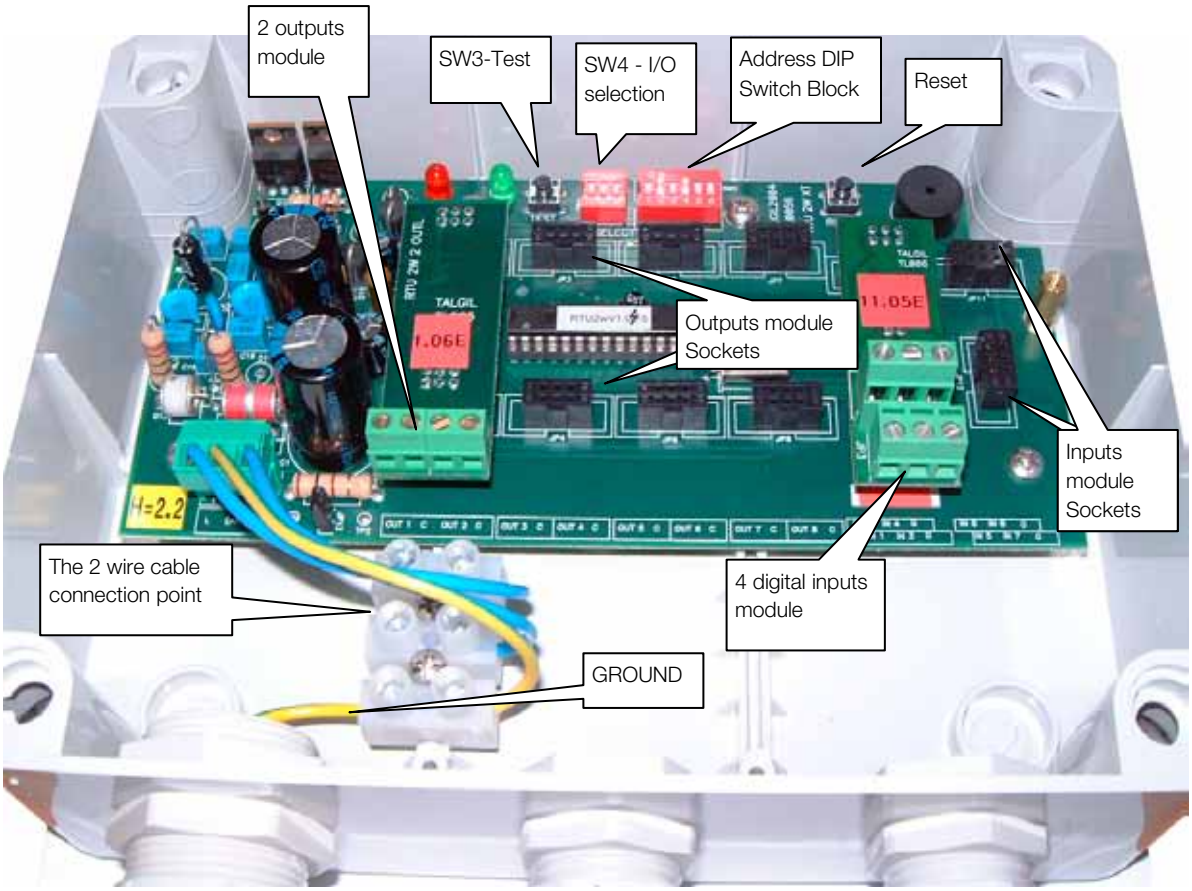
The outputs are built of “plug in” modules with 2 outputs; 2, 4, 6, or 8 outputs per RTU.

The digital inputs are built of “plug in” modules of 4 inputs; 0, 4 or 8 digital inputsPer RTU.

The 2-Wire system can also manage analog inputs through “plug in” modules of 2 analog inputs that can be used in place of each module of 4 digital inputs, using the same sockets.

Output Card

Input Card



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3.I. Digital and Analog Inputs Addressing.

Input number of RTU “N” - Digital Inputs:

Input Number	Of RTU Number
1	N
2	N
3	N
4	N
5	N
6	N
7	N
8	N

Input number of RTU “N” - Analog Inputs:

Analog Input	Input Number	Of RTU Number
1	1	N
2	1	N+1
3	1	N+2
4	1	N+3

Input number of RTU “N” - Digital and Analog Inputs:
Digital (up to 4) and analog (up to 2) inputs, the digital inputs will be numerated as above but the analog inputs will occupy the addresses following RTU “N” as follows:

Analog Input	Input Number	Of RTU Number
1	1	N+1
2	1	N+2

⚠ Note that the addresses N+1, N+2, N+3 occupied by the analog in-puts cannot be used for addressing other RTUs and must be skipped.

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3.2. LED and Buzzer Indications

Green LED blinking slowly - After resetting the RTU, there is a delay before starting the capacitor charging. The delay depends on the RTUs address, and it is calculated by the RTU's address multiplied by 2. During the delay, there will be slow blinking of the green led.

Green LED blinking fast - The fast blinking exists during the charging of the capacitor.
Usually the charging takes a few seconds, but if it keeps going on for 10 minutes it indicates a problem. The charging stops and the unit disconnects itself from the communication. Both the green and the red LEDs will be switched off. The only way to exit this status is by resetting the RTU.

Red LED blinking each second - Indicates that the RTU recognizes being called by it's address and it is responding.

The buzzer when enabled from the center, sounds a double beep every 5 seconds indicating normal operation. Otherwise, there will be a long beep every 5 seconds. During output test mode, there is a short beep for "open" and 2 short beeps for "close" commands.

3.3. I/O Testing

The inputs and outputs are tested one by one. The number of the input and output tested is selected by DIP Switch SW6.
DIP Switch SW4 Output selection :

Pos 1	Pos 2	Pos 3	Input/Output Tested
0	0	0	1
1	0	0	2
0	1	0	3
1	1	0	4
0	0	1	5
1	0	1	6
0	1	1	7
1	1	1	8

INPUT TEST – Push the TEST button SW3. Each change in the status of the selected input will be indicated by a short beep of the buzzer.

OUTPUT TEST – Push SW3 again, this will terminate the INPUT TEST and will start the OUTPUT TEST. An "open" command will be sent to the selected output followed by a single beep .
Push of SW7 to generate a "close" command followed by a double beep .
Each push of SW7 will toggle the solenoid between "open" and "close" positions.

To exit test mode change the position of SW4 or wait 1 minute and it will exit automatically.

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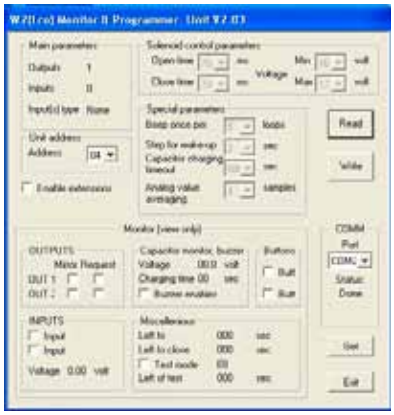
4. Compact Molded 2-Wire RTU

The compact RTUs can handle up to 2 outputs and 2 digital inputs
The compact RTU does not have an address switch; the address is set by communication using a utility software and a communication interface.

4.1. Compact RTU Utility Programmer

The molded compact RTU is pre programmed to default factory settings and has a unique address.



A handheld programmer can be purchased for modifying the address, and changing other parameters including:

- Pulse width and amplitude generated for opening and closing solenoids
- Parameters defining the behavior of the unit in various cases and tools for testing outputs, inputs, push buttons, and the buzzer.

4.2. Compact RTU LED Indications

LED indications of the compact RTU are similar to the modular RTU.

Green LED blinking slowly ❋ ❋ ❋ ❋ ❋ - After resetting the RTU, there is a delay before starting the capacitor charging. The delay depends on the RTUs address, and it is calculated by the RTU's address multiplied by 2. During the delay, there will be slow blinking of the green led.

Green LED blinking fast ❋❋❋❋❋❋❋ - The fast blinking exists during the charging of the capacitor.
Usually the charging takes a few seconds, but if it keeps going on for 10 minutes it indicates a problem. The charging stops and the unit disconnects itself from the communication. Both the green and the red LEDs will be switched off. The only way to exit this status is by resetting the RTU.

Red LED blinking each second ❋ ❋ ❋ - Indicates that the RTU recognizes being called by it's address and it is responding.

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Appendix A: Decimal - to - Binary Conversion Table

DECIMAL ADDRESS	BINARY VALUE TO BE SET BY THE DIP SWITCH POSITIONS:					
	Pos 1	Pos 2	Pos 3	Pos 4	Pos 5	Pos 6
1	1	0	0	0	0	0
2	0	1	0	0	0	0
3	1	1	0	0	0	0
4	0	0	1	0	0	0
5	1	0	1	0	0	0
6	0	1	1	0	0	0
7	1	1	1	0	0	0
8	0	0	0	1	0	0
9	1	0	0	1	0	0
10	0	1	0	1	0	0
11	1	1	0	1	0	0
12	0	0	1	1	0	0
13	1	0	1	1	0	0
14	0	1	1	1	0	0
15	1	1	1	1	0	0
16	0	0	0	0	1	0
17	1	0	0	0	1	0
18	0	1	0	0	1	0
19	1	1	0	0	1	0
20	0	0	1	0	1	0
21	1	0	1	0	1	0
22	0	1	1	0	1	0
23	1	1	1	0	1	0
24	0	0	0	1	1	0
25	1	0	0	1	1	0
26	0	1	0	1	1	0
27	1	1	0	1	1	0
28	0	0	1	1	1	0
29	1	0	1	1	1	0
30	0	1	1	1	1	0
31	1	1	1	1	1	0
32	0	0	0	0	0	1
33	1	0	0	0	0	1
34	0	1	0	0	0	1
35	1	1	0	0	0	1
36	0	0	1	0	0	1
37	1	0	1	0	0	1
38	0	1	1	0	0	1
39	1	1	1	0	0	1
40	0	0	0	1	0	1
41	1	0	0	1	0	1
42	0	1	0	1	0	1
43	1	1	0	1	0	1
44	0	0	1	1	0	1
45	1	0	1	1	0	1
46	0	1	1	1	0	1
47	1	1	1	1	0	1
48	0	0	0	0	1	1
49	1	0	0	0	1	1
50	0	1	0	0	1	1
51	1	1	0	0	1	1
52	0	0	1	0	1	1
53	1	0	1	0	1	1
54	0	1	1	0	1	1
55	1	1	1	0	1	1
56	0	0	0	1	1	1
57	1	0	0	1	1	1
58	0	1	0	1	1	1
59	1	1	0	1	1	1
60	0	0	1	1	1	1

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Appendix B: 2-Wire Cable Specifications

Suggested cable:

- Direct Burial, jacketed cable containing two UL listed single coated conductor cable.
- Thickness 16 or 14 AWG.
- Cable capacity: A capacity of 0.1 µF per 3,000' or lower. The total capacity of the cables connected to the "interface 2W" should not exceed 1 µF.
- The resistance of the cable should be reasonably low, with no leakage between the wires and between each wire to the ground. (see testing below).
- Each of the main branches of the cable should have lightning protection.
- The cable used for the "2 wire" system should not be used for other purposes such as communication between the BIC 2500 and other interfaces or between the BIC 2500 and the PC.

- **Cable Resistance:**

- Cable should be tested for continuity of the wires, proper isolation between the wires and between each wire and the ground.
- Disconnect both ends of the cable under test (including from any RTU in the middle) and make sure the wires are not touching each other.
- Check the resistance between the wires. Use the highest range available on the ohmmeter (tens or hundreds of KΩ). The resistance should be infinite or not lower than 1 MΩ.
- Check the resistance between each wire to the ground Use the highest range available on the ohmmeter (tens or hundreds of KΩ). The resistance should be infinite or not lower than 1 MΩ.
- Make a short circuit between the wires at one end of the cable and test the resistance between the wires at the other end. Use the lowest range of your ohmmeter (tens or hundreds of Ω). The resistance between a pair of wires increases with the length of the wires and decreases with their thickness. For 3,000' of 14 AWG pair of wires, the resistance should be about 22Ω.

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Appendix C: Testing

The 2W interface has three main functions:

1. Supplying energy to all the RTUs in the system.
2. Scanning all the RTUs every second.
3. Exchanging information with the BIC 2500 every second.

The 2 wire cable connecting between the 2W interface and all the RTUs, carries both the energy and the communication to the RTUs. The two wire path carries variable signal; therefor, cannot be measured by a standard Volt Meter. The testing procedure described below allows troubleshooting a 2W system.

2-Wire interface SPECIAL TEST MODE: set the address switch of the interface to 000000 and press the RESET button of the interface. As a result the red led indicating the communication between the BIC 2500 and the interface stops blinking and remains constantly ON.

Supply voltage: test the supply of 12V DC to the interface.

Output voltage of the interface: check the existence of 36V DC at the terminals where the 2 wired line is connected to the interface.

"Load free" consumption of the interface: To measure the interface current consumption, disconnect the 2 wire path from the interface. Connect an Ampere Meter in the range of 200 or 500 mA between the positive 12V wire feeding the system and the +12V terminal on the interface board where the wire is supposed to be connected. Consumption shall be 115-120 mA.

Cable contribution to the consumption of the interface: unplug all the RTUs from the 2 wired line and reconnect the 2 wired line back to the interface. At this stage the measured consumption of the interface may increase due to possible leakage of the cable. The consumption contributed by the cable depends on it's length, thickness of the wires and the quality of the coating of the wires. Up to 20-30 mA may be considered reasonable.

RTU contribution to the consumption of the interface: The contribution of each RTU to the consumption of the interface should be about 1.5-2.2 mA. Plug the RTUs back to the 2 wired line one by one and make sure that the consumption grows by 2.2 x N, where N represents the number of RTUs in the system. If the consumption is significantly higher it means that some of the RTUs are consuming too much.

RTU consumption: the consumption of each RTU can be measured in the field by standard Ampere meter. Set the 2-wire interface to "SPECIAL TEST MODE" (see above), in this case the interface is feeding the line with 36V DC. A voltage drop along the cable down to 20V DC is acceptable. Measure the RTU current consumption by inserting the Ampere Meter (range of 10-20 mA) in series with one of the 2W wires. The measurement for a good RTU is 0.75 mA for the modular RTU and 0.5 mA for the compact RTU.

Exiting SPECIAL TEST MODE : In order to return to normal operation mode set the address switch of the 2W interface to it's correct address and push it's RESET button. As a result the red led indicating the communication between the DREAM and the interface will start blinking, a short blink each second.

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