DREAM 2
2 Wired RTU System
USER GUIDE

GOLDTEC
CONTROL SYSTEMS

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CONTENTS

THE TWO WIRED SINGLE CABLE SYSTEM OF THE DREAM 2

1. SYSTEM OVERVIEW

The DREAM 2, TWO WIRED SINGLE CABLE SYSTEM utilizes **R**emote **T**erminal **U**nits for connecting remote valves and distant meters to the control system covering territories of up to 10 Km radius by use of 2 wired cables.

The Remote Terminal Units (RTU) have the ability to communicate with the DREAM, to carry out the received commands and to report back the status of the meters connected to them.

The 2 wired line may handle as many as 60 RTUs. There are three types of RTUs: the MODULAR RTUs the ECONOMICAL RTU and the MOULDED RTU.
Each MODULAR RTU can handle up to 8 outputs (in steps of 2,4,6,8),and up to 8 digital inputs (in steps of 4,8) . Each ECONOMICAL RTU may have 0, 1 or 2 outputs and 0, 1 or 2 inputs.
Each MOULDED RTU may have 0, 1 or 2 outputs and 0 or 1 input.
The outputs activate 2 wired 12v DC pulse latching solenoids. The inputs are dry contacts. The system is a DC system designed for low power consumption and may be powered by solar energy.

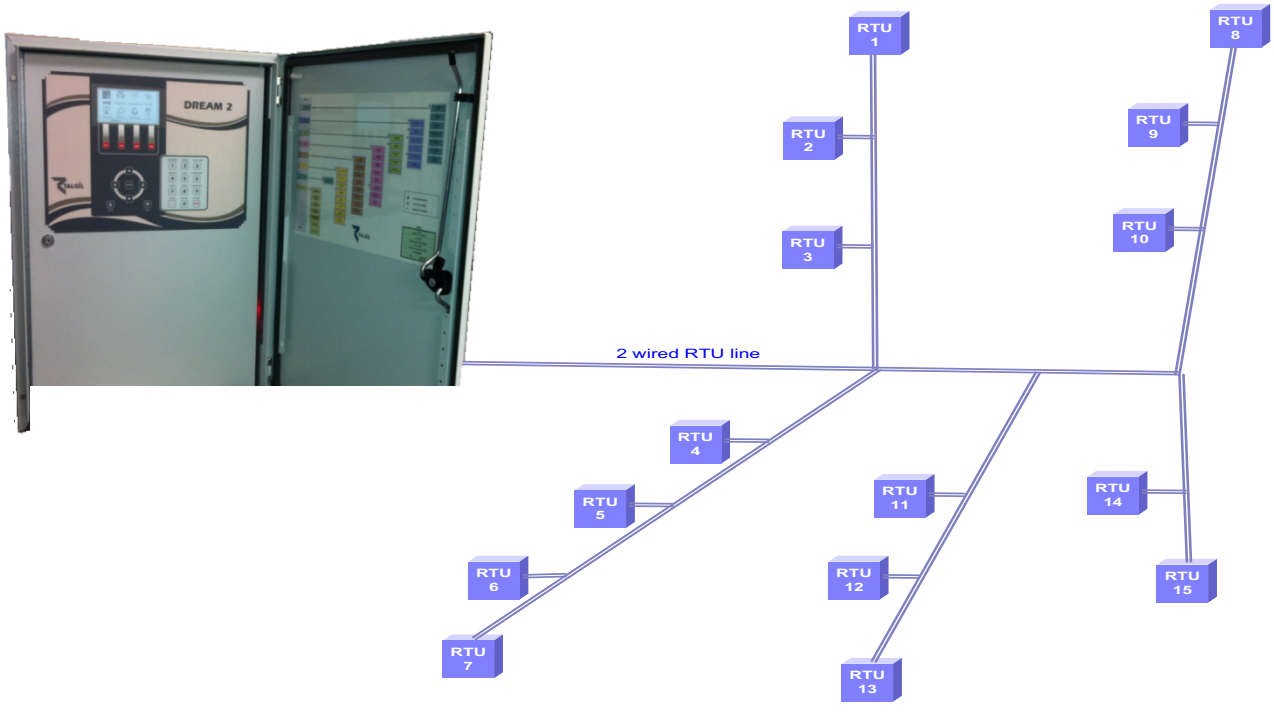
One DREAM may handle several single cable channels, each channel may contain up to 60 RTUs all of them will be scanned second by second.

1.1 THE PARTS OF THE SYSTEM AND THEIR FUNCTION

The heart of the system is the DREAM 2 control unit that controls the whole system. The two-wired RTU system is connected to the DREAM 2 by a special interface called 2W RTU INTERFACE which will be connected through the REMOTE I/O serial communication line (RS485). The 2W RTU INTERFACE handles both the communication and the energy supply to all the RTU units. The 2 wired line between the interface and the RTU units goes like branches of a tree whose root is at the interface and the leaves are the RTUs.

The whole system can be powered either from the mains or by a 20 Watt solar panel using a rechargeable car battery of 40 Ah or more, for backup. However when the DREAM 2 contains more than one 2W RTU channel (more than one 2W interface), the additional 2W channels will have their own separate power supply/charger and another car battery of 40 Ah or more.

The system will usually have a lightning protection unit installed close to the 2W interface. When the area is known to be lightning prone, more protection units may be installed in the field.



2. INSTALLATION DIRECTIONS

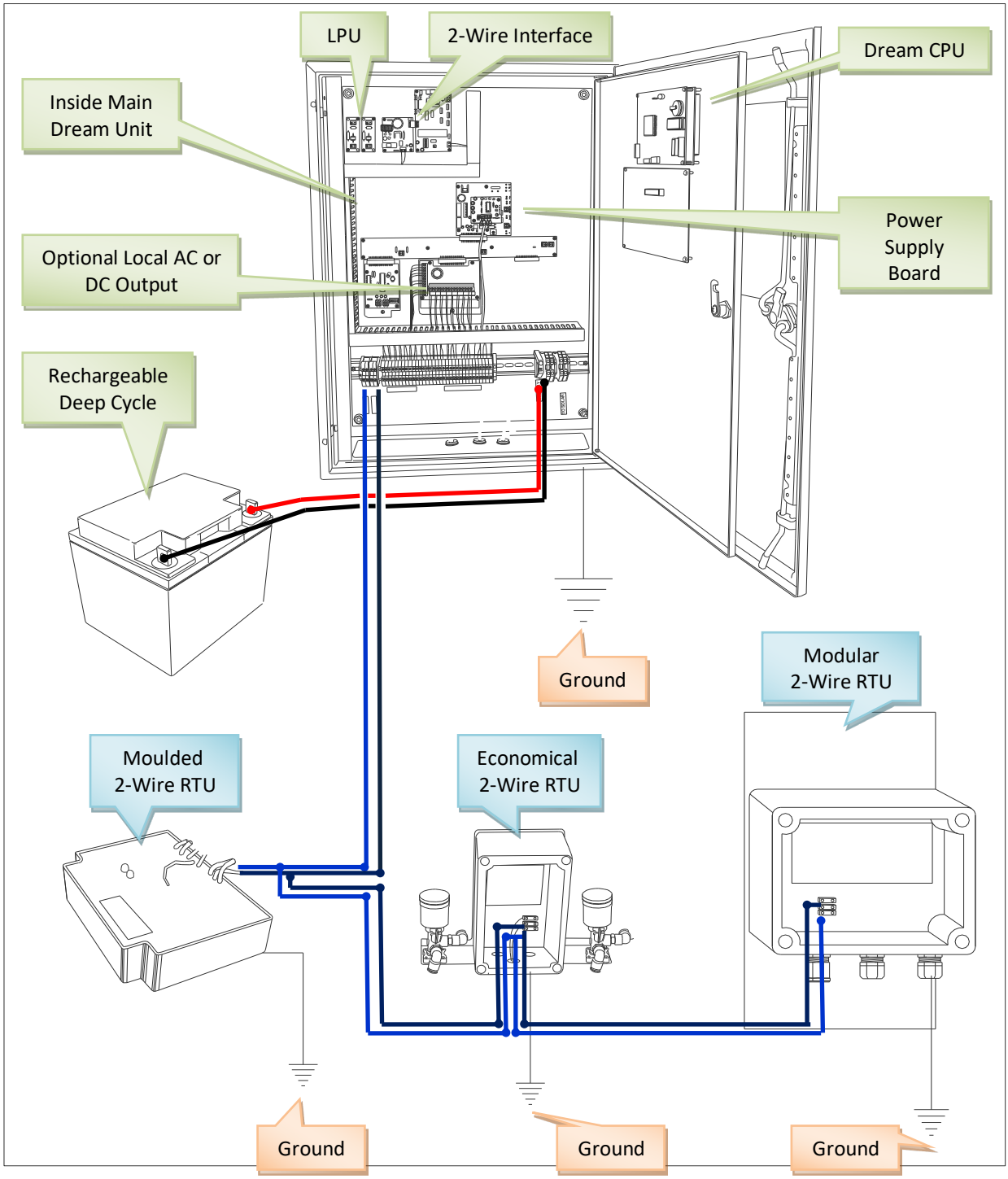
Wiring must be done while the system is not energized. Remember to disconnect both the charger/solar-panel and the rechargeable battery.

2.1 CABLE TESTING

Prior to connecting the 2 wired line to the RTUs and to the DREAM 2 they must be checked as explained in appendix "B".

The following picture shows in details the wiring between the various parts of the system.

In case of multiple 2 wired channels connected to the same Dream 2, special wiring is required see appendix "D"

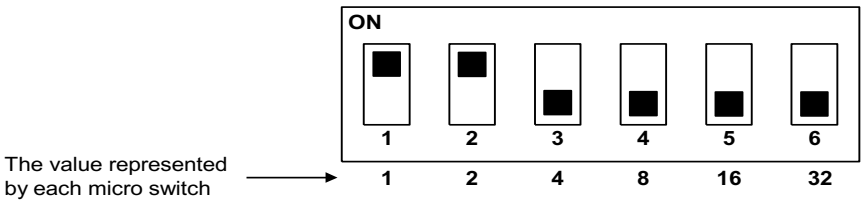


2.2 GROUND CONNECTIONS

Inside the "2W RTU interface", inside the "lightning protection" and in each "RTU" there are grounding points which have to be well "grounded" otherwise the lightning protection will not function properly. The resistance to the ground should not exceed 4 ohms.

2.3 SETTING THE ADDRESSES

In order for the DREAM 2 to be able to differentiate between the "2W RTU interface" and the other I/O interfaces that may exist in the system, each interface must be given a unique address and in order for the "2W RTU interface" to be able to differentiate between the various RTUs, each RTU must have its own address. So each output and input in the 2 wired system will have its location defined by 3 numbers: II;RR;L – "II" is the address of the interface, "RR" is the address of the RTU and "L" is the location of the specific output or input in the terminal block of the actual RTU. The addressing is done by dipswitches onboard the interface and onboard each RTU. The range of the RTU addresses is 1-60. The following drawing demonstrates the dipswitches block used for addressing the RTUs:

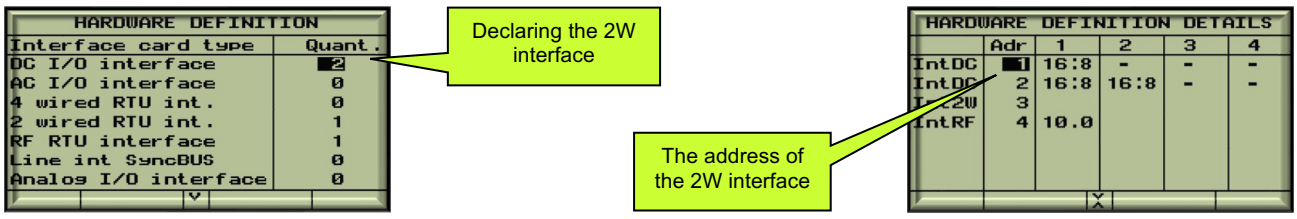


The micro switches are numbered 1 to 6. Each micro switch according to its ordinal number represents a value between 1 and 32 as shown above. The values are used in the binary coding system. The address is calculated by summing up the values of the micro switches that are in the ON position. Appendix "A" supplies a conversion table from binary to decimal and shows the setting of the switches required for each address.

2.4 DEFINITIONS TO BE MADE INSIDE THE DREAM

2.4.1 DECLARING THE 2W RTU INTERFACE

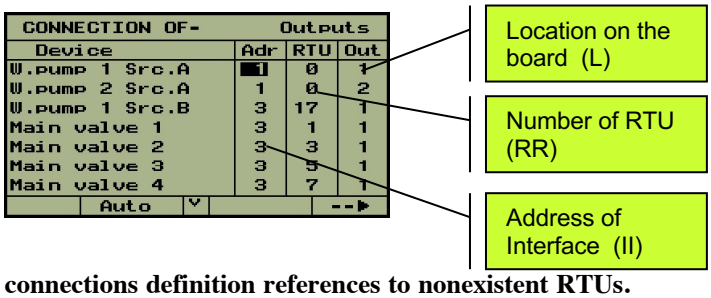
During system configuration the DREAM 2 has to be told about the 2W RTU interface that is connected to its "Remote I/O" line. This is done during the HARDWARE DEFINITION as shown below:



2.4.2 DEFINING THE CONNECTIONS

During the definition of the physical connection point of each output and each input device, the DREAM is told which of them reside on the 2W RTUs and where exactly each of them is connected. An example can be seen below:

All outputs that have the interface address "3" reside on the 2W RTUs. Taking for example the Main valve No. 4, it has to be connected to RTU 7 position 1. A more detailed explanation of this step can be found in the "INSTALLATION MANUAL" of the DREAM 2.

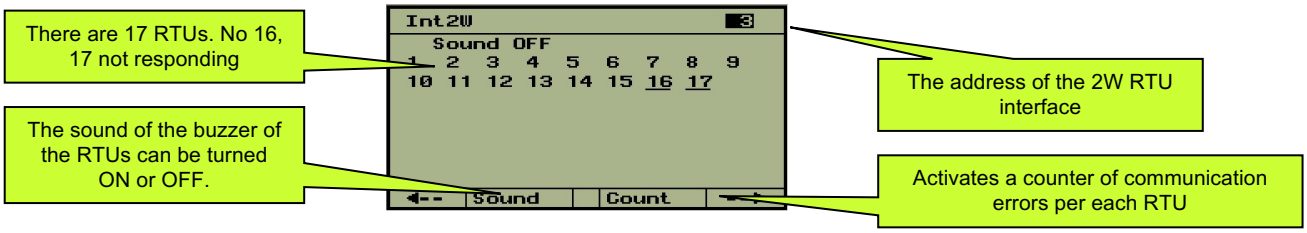


It is strongly recommended not to include in the connections definition references to nonexistent RTUs. Otherwise each second the DREAM 2 will try to communicate the nonexistent units and when not receiving answer, it will try again, causing all other units to wake up unnecessarily, this is a significant

waste of energy.

2.4.3 CHECKING COMMUNICATION WITH THE RTUs

The fifth screen to the right in the subject of "CURRENT STATUS" shows the quality of communication with each of the 2W RTUs. An RTU with communication problem will be underlined.



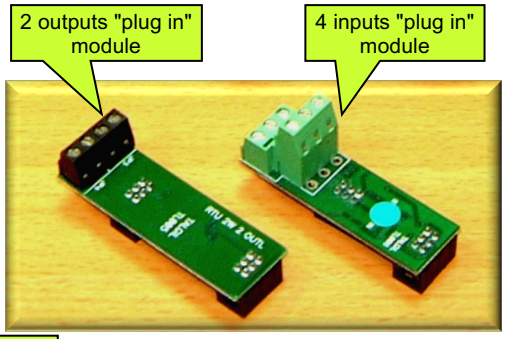
3. THE VARIOUS TYPES OF RTU UNITS

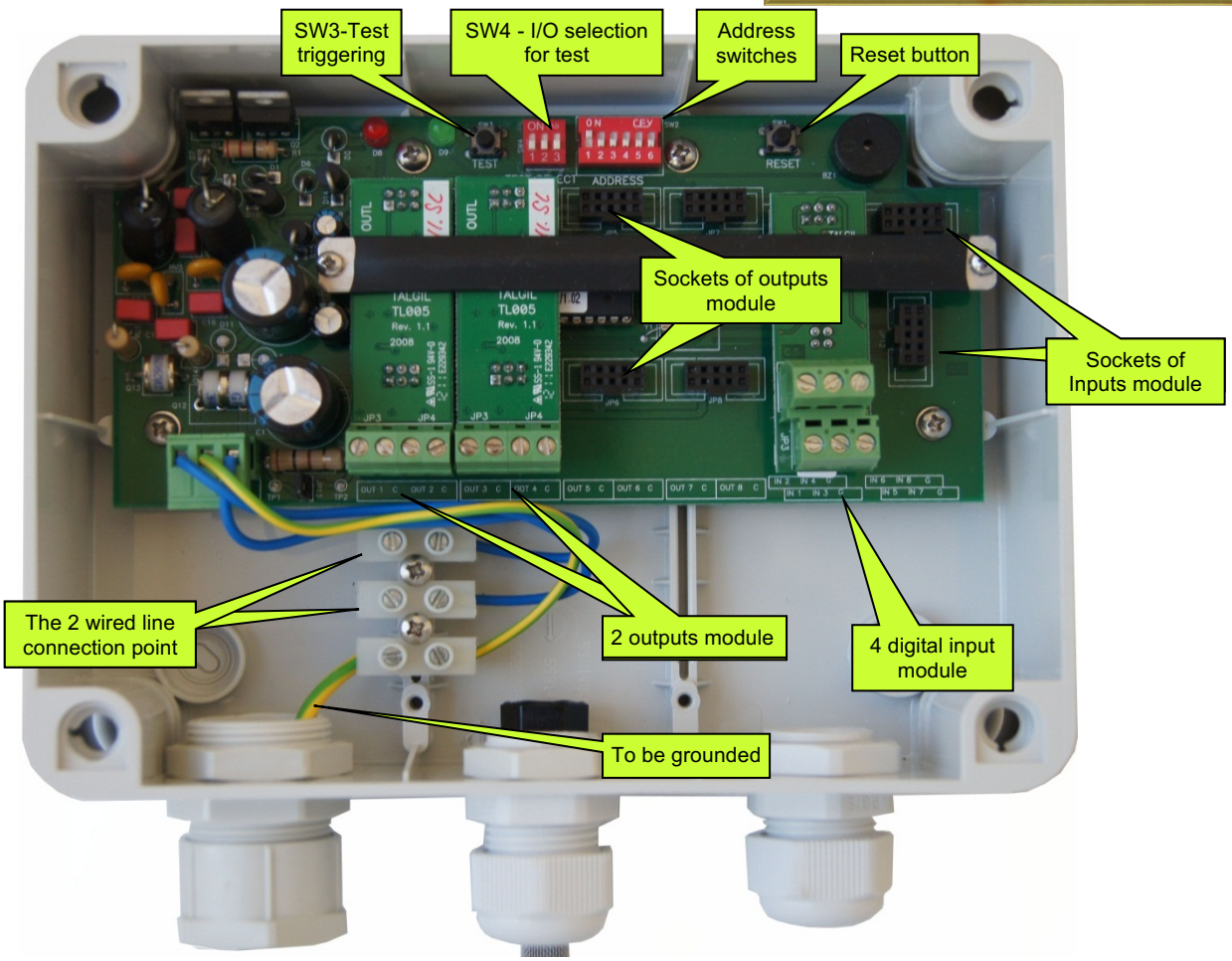
There are two kinds of RTU units for the 2 wired single cable systems; there are modular RTUs and compact RTUs. The following paragraphs describe both types.

3.1 MODULAR RTUS

The modular RTUs can handle up to 8 outputs and 8 digital inputs. The outputs are built of "plug in" modules with 2 outputs each, there can be up to 4 modules per RTU, therefore the units may come with 0, 2, 4 6 or 8 outputs.

The digital inputs are built of "plug in" modules of 4 inputs. There can be up to 2 modules per RTU, and therefore we may have RTUs with 0, 4 or 8 digital inputs.





The system can handle analog inputs as well. There are "plug in" modules of 2 analog inputs that can be used in place of each module of 4 digital inputs, using the same sockets. Therefore, each analog inputs module reduces the number of left digital inputs of that RTU by 4.

Analog inputs	Possible digital inputs
0	Up to 8
1 or 2	Up to 4
3 or 4	0

3.1.1 SETTING THE ADDRESSES OF THE DIGITAL AND ANALOG INPUTS

We shall now explain how to decide about the addresses of the digital and analog inputs. Let us assume a modular RTU whose address is "N".

- When there are only digital inputs they will be numbered as follows:

Input No.	of RTU No.
1	N
2	N
3	N
4	N
5	N
6	N
7	N
8	N

- When there are both 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	Will be known as input No.	of RTU No.
1	1	N+1
2	1	N+2

- When there are only analog inputs

Analog input	Will be known as input No.	of RTU No.
1	1	N
2	1	N+1
3	1	N+2
4	1	N+3

Notice that the addresses N+1, N+2, N+3 which became occupied by the analog inputs <u>cannot</u> be used for addressing other RTUs, they must be skipped.

3.1.2 SETTING THE JUMPERS OF THE ANALOG “PLUG-IN” BOARD

On the analog "plug in" board there are 3 jumpers which are used for deciding the followings:

Jumper No.	When removed indicates	When inserted
1	1 analog input in use	2 analog inputs in use
2	First input uses 4-20 mA	First input uses 0-2.5 v
3	Second input uses 4-20 mA	Second input uses 0-2.5 v

3.1.3 THE LEDS AND THE 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 its 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.

3.1.4 TESTING INPUTS AND OUTPUTS OF THE MODULAR RTU

The inputs and outputs are tested one by one. The number of the input and output to be tested is selected by dipswitch block SW4 as follows:

SW4	Input/Output under test
000	1
100	2
010	3
110	4
001	5
101	6
011	7
111	8

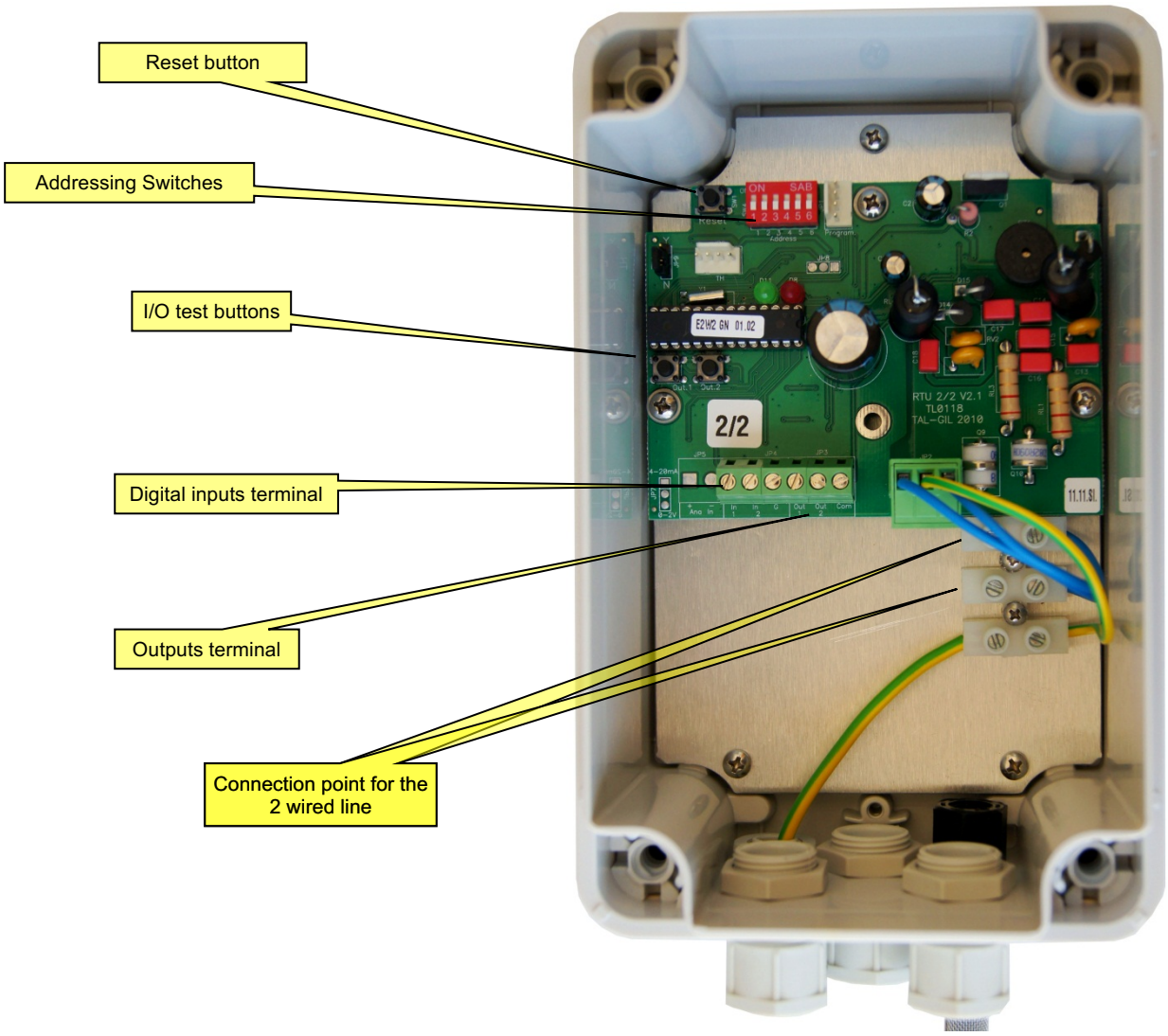
INPUT TEST – The test begins by pushing the button SW3. Each change in the status of the selected input will be indicated by a short beep of the buzzer.

OUTPUT TEST – While being in INPUT 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 . Another push of SW3 generates a "close" command followed by a double beep .
Each push of SW3 will switch 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.

3.2 ECONOMICAL RTU'S

The economical RTUs can handle up to 2 outputs and 2 digital inputs.



The new generation Economical RTU has simple Addressing via dip switches. Oder generation Economical RTU required software and communication interface to change the RTU address. Please contact your Goldtec representative for more information.

3.2.1 THE LEDS AND THE BUZZER INDICATIONS

The LEDs and the buzzer indications of the economical RTU are similar to the modular RTU. However there is a special ticking sound that can only be heard in the compact RTU which has digital inputs defined.

3.2.2 TESTING INPUTS AND OUTPUTS OF THE COMPACT RTU

The unit is equipped with tools for testing the inputs and outputs under field conditions. There are 2 I/O test buttons, when number 1 is pushed the first input and output are tested, when number 2 is pushed the second input and output are tested.

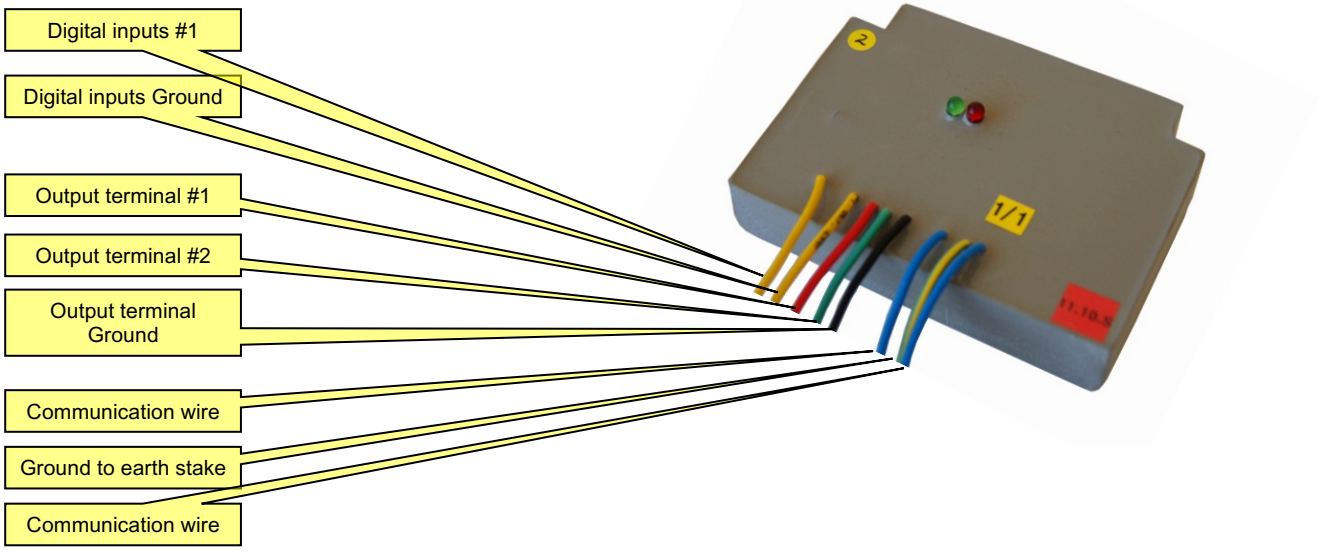
INPUT TEST – The test begins by pushing the appropriate test button and it is indicated by a long beep . Each change in the status of the selected input will generate a short beep of the buzzer .

OUTPUT TEST – While being in INPUT TEST, push the appropriate test button 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 . Another push of the test button generates a "close" command followed by a double beep .
Each push of the appropriate test button will switch the solenoid between "open" and "close" positions.

The system will exit test mode and return to normal activity after 60 seconds without touching the buttons.

3.3 MOLDED ECONOMICAL RTU'S

The molded economical RTUs can handle up to 2 outputs and 1 digital input. This RTU has been sealed in a resin to allow installation in moist environments such as installed in a valve box or buried in the ground.



3.3.1 THE LEDS INDICATIONS

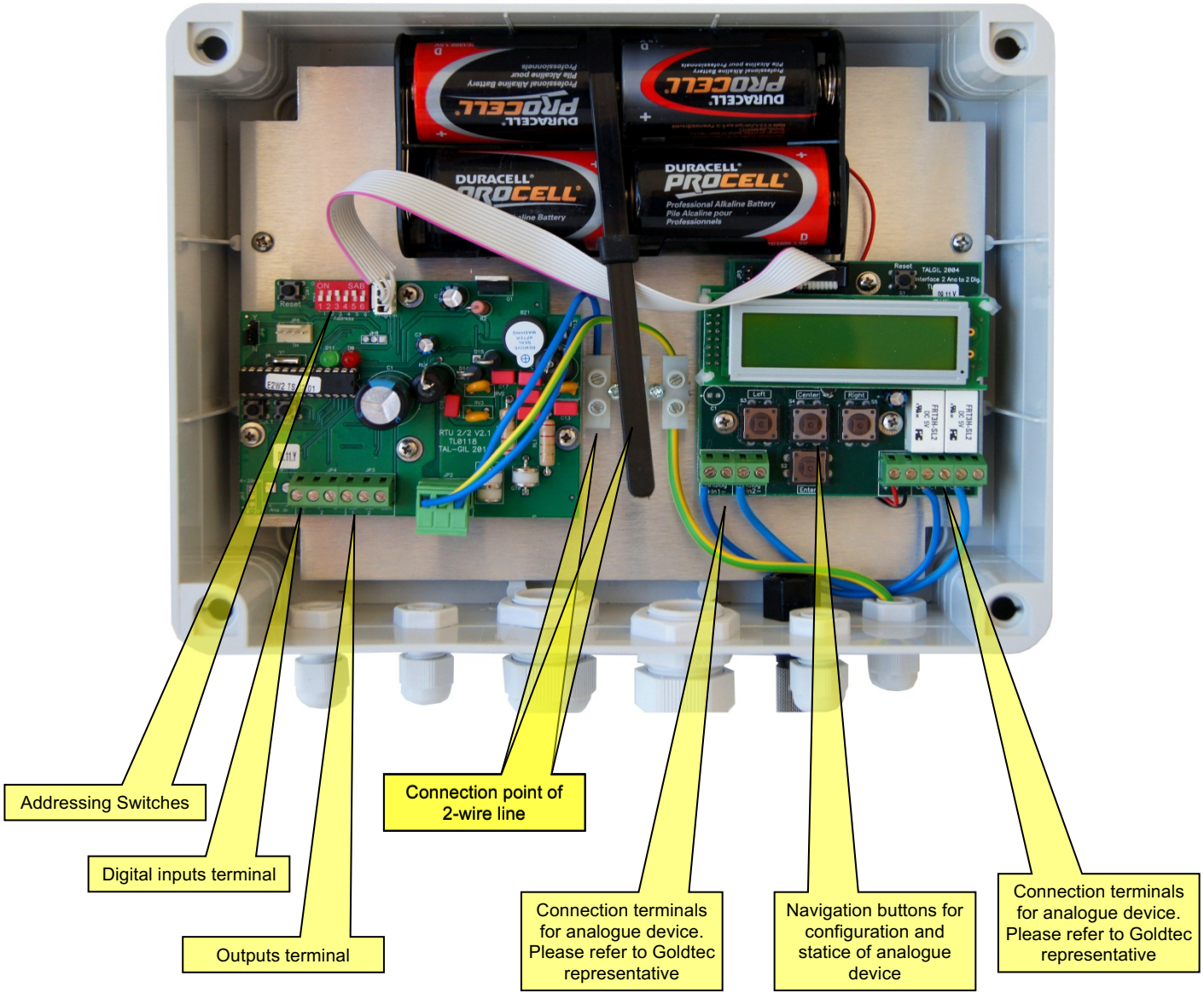
The LEDs and the buzzer indications of the molded economical RTU are similar to the economical RTU.

- The GREEN LED indicates communication in progress
- The RED LED indicates RTU is powered and flashes every second.

The molded economical RTU does not have an address switch; the address is set by communication using special utility software and a special communication interface. Please contact your Goldtec representative for more information.

3.4 ECONOMICAL RTU'S with ANALOGUE INPUT in conjunction with AQUAFLEX SOIL MOISTURE/TEMPARATURE SENSORS

The economical RTU with analogue input can handle up to 2 outputs and up to 2 digital inputs as well as the inclusion of an analogue input card that allows the connection of Aquaflex soil Moisture sensors. Each RTU can handle one Aquaflex sensor with 1 moisture and 1 temperature input or 2 aquaflex sensors with 1 input each. As the Aquaflex sensors require energy for reading, 4 x “d” alkaline batteries need to be installed in the holder located in the RTU enclosure.



3.5 TECHNICAL INFORMATION

The 2W interface	
Power supply	12v DC 2.5 A
Minimal supply voltage	10.5v DC
Load free consumption	115-120 mA

Consumption contributed by each RTU	1.5 - 2.2 mA
Output voltage***	36v DC***
Main fuse	8A
Line fuses	2 x 1A

The 2W RTU			
Typical supply voltage***		36v DC***	
Minimal supply voltage***		20v DC***	
Consumption measured by 2W tester		Compact RTU	Economical RTU
	Test voltage 8v DC	0 mA	0 mA
	14v DC	-	0.75 mA
	36v DC	0.5 mA	0.75 mA
Output voltage		12-17v DC latch – pulse width 70 ms	
Digital inputs		Dry contact	
Analog inputs		4-20 mA or 0-2.5v externally energized	

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

Appendix "A" – DECIMAL TO BINARY CONVERTION

In the following table a switch ON is marked by 1 and a switch OFF by 0.

Decimal address	Binary value set by the Dip Switch Positions: 1 2 3 4 5 6		
1	1 0 0 0 0 0	31	1 1 1 1 1 0
2	0 1 0 0 0 0	32	0 0 0 0 0 1
3	1 1 0 0 0 0	33	1 0 0 0 0 1
4	0 0 1 0 0 0	34	0 1 0 0 0 1
5	1 0 1 0 0 0	35	1 1 0 0 0 1
6	0 1 1 0 0 0	36	0 0 1 0 0 1
7	1 1 1 0 0 0	37	1 0 1 0 0 1
8	0 0 0 1 0 0	38	0 1 1 0 0 1
9	1 0 0 1 0 0	39	1 1 1 0 0 1
10	0 1 0 1 0 0	40	0 0 0 1 0 1
11	1 1 0 1 0 0	41	1 0 0 1 0 1
12	0 0 1 1 0 0	42	0 1 0 1 0 1
13	1 0 1 1 0 0	43	1 1 0 1 0 1
14	0 1 1 1 0 0	44	0 0 1 1 0 1
15	1 1 1 1 0 0	45	1 0 1 1 0 1
16	0 0 0 0 1 0	46	0 1 1 1 0 1
17	1 0 0 0 1 0	47	1 1 1 1 0 1
18	0 1 0 0 1 0	48	0 0 0 0 1 1
19	1 1 0 0 1 0	49	1 0 0 0 1 1
20	0 0 1 0 1 0	50	0 1 0 0 1 1
21	1 0 1 0 1 0	51	1 1 0 0 1 1
22	0 1 1 0 1 0	52	0 0 1 0 1 1
23	1 1 1 0 1 0	53	1 0 1 0 1 1
24	0 0 0 1 1 0	54	0 1 1 0 1 1
25	1 0 0 1 1 0	55	1 1 1 0 1 1
26	0 1 0 1 1 0	56	0 0 0 1 1 1
27	1 1 0 1 1 0	57	1 0 0 1 1 1
28	0 0 1 1 1 0	58	0 1 0 1 1 1
29	1 0 1 1 1 0	59	1 1 0 1 1 1
30	0 1 1 1 1 0	60	0 0 1 1 1 1

Appendix "B" – ABOUT THE CABLE

ABOUT THE CABLE TO BE USED

Recommendations for the cable to be used with the 2 wired systems:

- Never mix in one cable two lines of separate 2w channels.
- Never mix in the same cable a 2 wired channel and an RS485 communication line.
- Always maintain a distance of at least 20 cm between the cables of different 2W channels and RS485 when laid in the ground.
- The cable should be type NYY, which is double, coated and is suitable for being laid underground.
- Thickness 1.5 mm2
- The cable capacity is of great importance, the lower the better. A capacity of 0.1 μF per km is OK. 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).
- The cable used for the "2 wired" system should not be used for other purposes such as communication between the DREAM and other interfaces or between the DREAM and the PC.

CABLE RESISTANCE TESTING

1. The cable must be tested for continuity of its wires, and for having good isolation between the wires and between each wire and the ground.
2. 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.
3. 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 at least not lower than 1 MΩ.
4. 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 at least not lower than 1 MΩ.
5. Make a short circuit between the wires at one end of the cable and test the resistance between the wires at the other end. This time 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 1 Km distance and with a pair of wires with 1.5 mm^2 cross section the resistance should be about 22Ω. The formula for calculating the expected resistance of a pair of copper wires is the following:

$$\text{Resistance (in } \Omega) = \frac{0.017 \times \text{Length (in meters)}}{\text{Cross section (in } mm^2)}$$

Appendix "C" – TESTING PROCEDURE

TESTING PROCEDURE OF THE 2W SYSTEM

The 2W interface has three main functions:

1. Supplying energy to all the RTUs in the system.
2. Scanning all the RTUs second by second.
3. Exchanging information with the DREAM second by second.

The 2 wired cable originating from the 2W interface and arriving to all the RTUs carries both the energy and the communication to the RTUs. Due to the variable nature of the signal carried by the 2W line, it cannot be measured by a voltmeter, not as a DC voltage and not as an AC voltage. The testing procedure described herewith helps us to overcome this obstacle and enables us to differentiate between a normal system and a system with problems.

Putting the 2W interface into 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 DREAM and the interface stops blinking and remains constantly ON.

Checking the supply voltage: test the supply of 12v DC to the interface.

Checking the output voltage of the interface: check the existence of 36v DC at the terminals where the 2 wired line is connected to the interface.

Measuring the "load free" consumption of the interface: disconnect the 2 wired line 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. This way we are measuring the consumption of the interface itself. It should be around 115-120 mA.

Measuring the contribution of the cable 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 its length, thickness of the wires and the quality of the coating of the wires. Up to 20-30 mA may be considered reasonable.

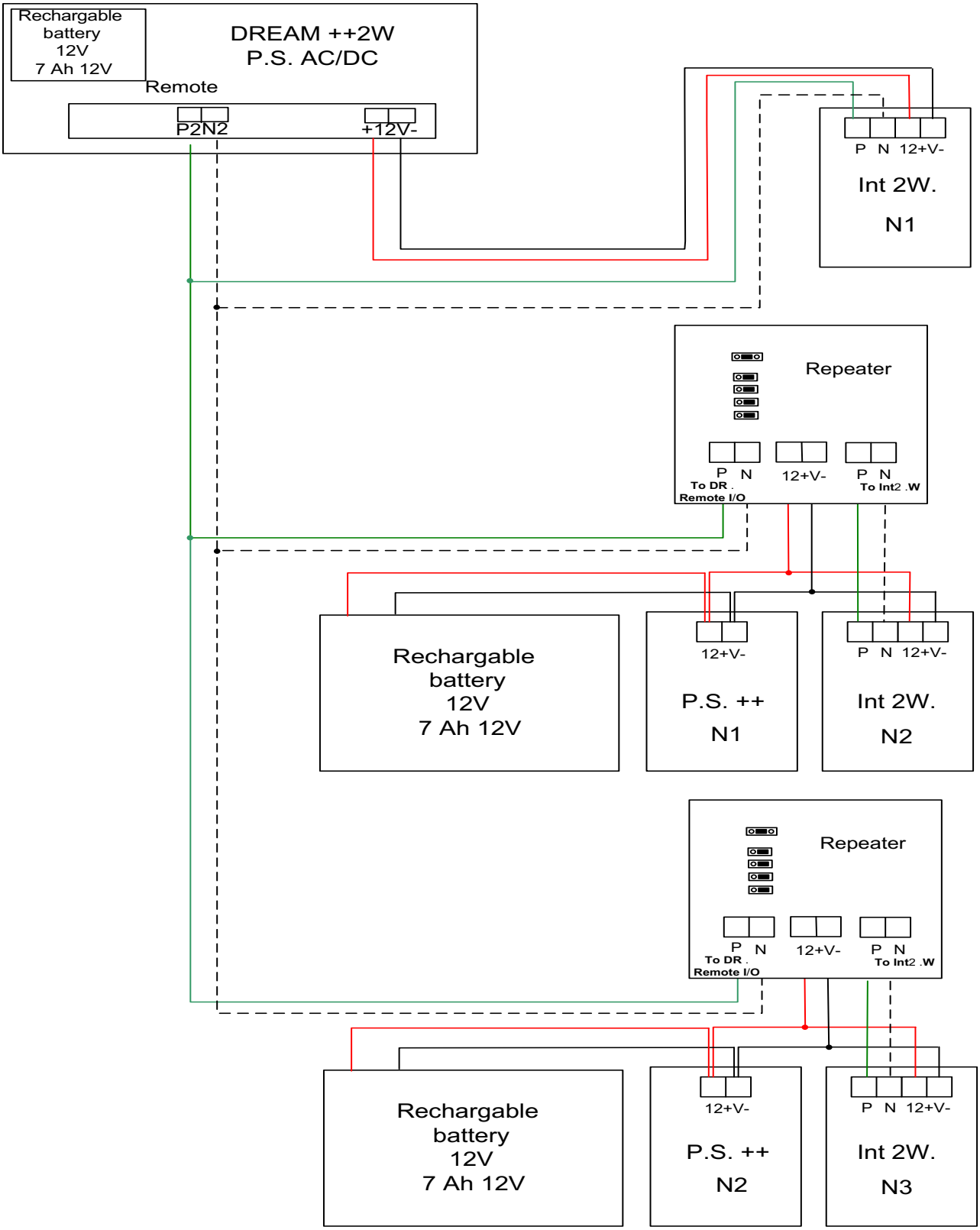
Measuring the contribution of the RTUs to the consumption of the interface: The contribution of each RTU to the consumption of the interface should be about 1.5-2.2 mA. Plug the RTUs back to the 2 wired line one by one and make sure that the consumption grows by 2.2 x N, where N represents the number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

Measuring the consumption of the RTUs in the field: the consumption of each RTU can be measured in the field by the "2W tester" or by a regular Ampere meter. For measuring by the tester, see the instructions of the tester's manual. For measuring by an Ampere meter, the interface 2W must be in "SPECIAL TEST MODE" (see above); in this case the interface is feeding the line with 36v DC. However a voltage drop along the cable down to 20v DC is still acceptable. The individual consumption of the RTU can be measured by inserting the Ampere meter (range of 10-20 mA) in series with one of the 2W wires. A normal result will be 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 its correct address and push its 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.

Appendix "D" – MULTIPLE INTERFACES WIRING

Wiring of a DREAM 2 system which is powered by AC and contains multiple 2-wire interfaces



PLEASE USE THE FOLLOWING SPREAD TO RECORD YOUR RTU # & OUTPUT/INPUT #

IN RELATION TO MASTER VALVE/WATER SOURCE/FIELD VALVE #.

This information is entered into the Dream during commissioning

Valve #	Int ADD	RTU #	Out #	Valve #	Int ADD	RTU #	Out #

Notes: