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Mega_Link 2

APPLICATION NOTE AN046
Power Supply Operation

Summary

Mega_Link 2 can be specified with three types of power supply;

External 12V power.

External 24V power.

110/240 VAC Mains power supply with internal battery back-up.

This document describes how to monitor status of the power supply e.g. voltage, mains charging status etc. using the following:

LCD display menu.
DCD2 diagnostics commands.
Modbus RTU digital and register addresses.

1. Introduction

Mega_Link 2 can be specified with three power options as follows.

Part Number	Type	Unit Fitted Internally With
7800-1xxD	12V	7581-4 12V jumper
7800-2xxD	24V	7682-1 24V REGULATOR
7800-AxxD	Mains with internal battery back-up	7680-1 MAINS POWER SUPPLY

2. 12V Operation

2.1 General

The 12v power operating range is 8 – 16V. 16V is absolute maximum, higher than this will cause damage!

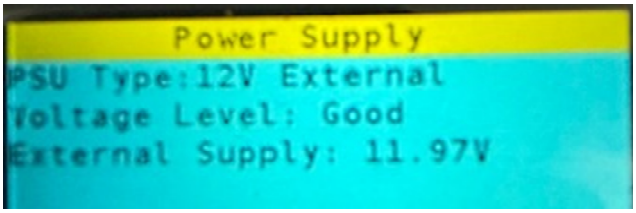
Minimum operating voltage is 4.0V below which the unit will power down.

The 12V power supply option can be used for powering from following examples; 12V system power supply derived from mains, 12V battery with solar panels and/or wind generator or 4x 'D' cells alkaline battery pack.

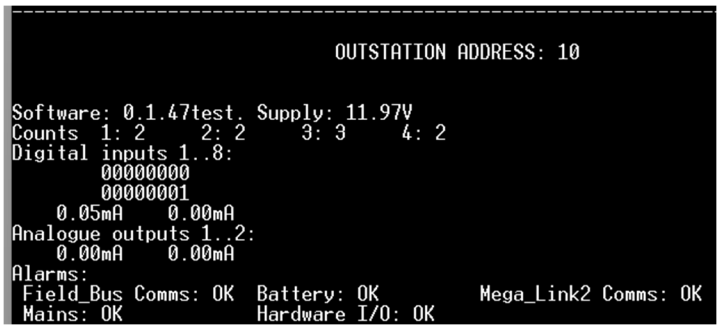
2.2 Nominal Voltage Reading

In this example outstation #10 is powered by 12.00V.

Looking on the display at System Configuration→Power Supply, this shows the PSU Type to be "12V External" and a reading of 11.97V. Voltage level is "Good".



Using DCD2 Diagnostics "S" command at the Outstation will show supply value and "Battery OK".



In a running system using DCD2 Diagnostics "IR" command at the Basestation will show the value at register address 84 to be 11.97V.

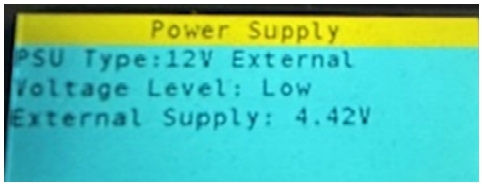
Note, the value of 12.06V at address 4 is the Basestation power supply voltage level.

```
                                INPUT REGISTERS

If analogues not 0..20mA, scale as necessary

 Reg  Block
 No.   No.       0       1       2       3       4       5       6       7
   0:    0:     10      10      10      10  12.06V   -76dBm  0.37mA  0.35mA
   8:    1:      0       0       0       0       0       0       0     0 B
  16:    2:      -       -       -       -       -       -       -       -
  24:    3:      -       -       -       -       -       -       -       -
  32:    4:      -       -       -       -       -       -       -       -
  40:    5:      -       -       -       -       -       -       -       -
  48:    6:      -       -       -       -       -       -       -       -
  56:    7:      -       -       -       -       -       -       -       -
  64:    8:      -       -       -       -       -       -       -       -
  72:    9:      -       -       -       -       -       -       -       -
  80:   10:      2       2       3       2  11.97V   -80dBm  0.05mA  0.00mA
  88:   11:      -       -       -       -       -       -       -       -
  96:   12:      -       -       -       -       -       -       -       -
 104:   13:      -       -       -       -       -       -       -       -
```

2.3 Low Voltage Threshold

In this example outstation #10, when the power supply drops to around 4.40V.

The display at System Configuration→Power Supply, will change to warning that Voltage Level is “Low”.



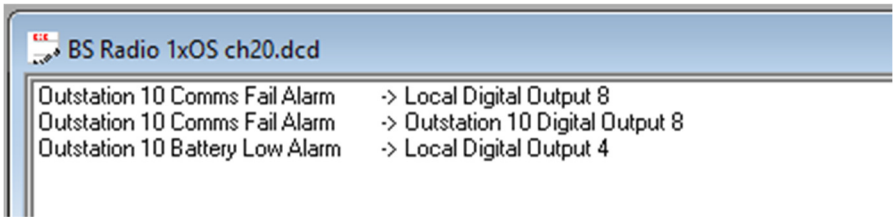
In a running system using DCD2 Diagnostics “IR” command at the Basestation will show the value at register address 84 to be 4.38V.

```
                                INPUT REGISTERS

If analogues not 0..20mA, scale as necessary

 Reg  Block
 No.   No.       0       1       2       3       4       5       6       7
   0:    0:     10      10      10      10  12.05V   -79dBm  0.37mA  0.35mA
   8:    1:      0       0       0       0       0       0       0     0 B
  16:    2:      -       -       -       -       -       -       -       -
  24:    3:      -       -       -       -       -       -       -       -
  32:    4:      -       -       -       -       -       -       -       -
  40:    5:      -       -       -       -       -       -       -       -
  48:    6:      -       -       -       -       -       -       -       -
  56:    7:      -       -       -       -       -       -       -       -
  64:    8:      -       -       -       -       -       -       -       -
  72:    9:      -       -       -       -       -       -       -       -
  80:   10:      2       2       3       2   4.38V   -78dBm  0.05mA  0.00mA
  88:   11:      -       -       -       -       -       -       -       -
  96:   12:      -       -       -       -       -       -       -       -
 104:   13:      -       -       -       -       -       -       -       -
```

2.4 Battery Low Alarm

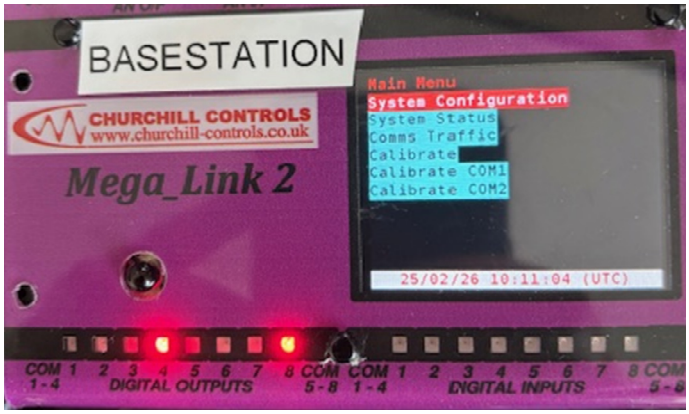
In a system, an output at the Basestation is often used as a battery low alarm for an outstation.

The following example line 3 shows this being sent to output 4.



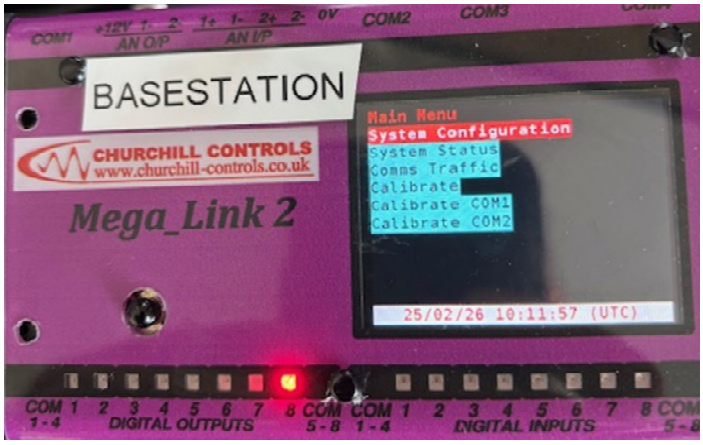
During normal operation with the outstation #10 power supply voltage >6.8V the output 4 will be **ON.**

Outstation #10 battery voltage = **ON** = **No Alarm**.



When the outstation power supply drops to <6.7V the output 4 will be **OFF**.

Outstation #10 battery voltage = **OFF** = **Battery Low Alarm**.



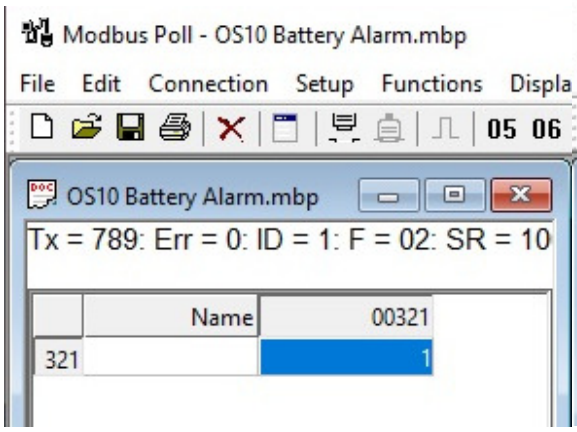
In a running system using DCD2 Diagnostics “ID” command at the Basestation will show a “B” at Digital Input address 321. B: Battery Low Alarm Flag.

```
                                INPUT DIGITALS

Alarm Flags:
 C: Mega_Link2 Comms Fail
 B: Battery Low
 H: Hardware Fail
 M: Field_Bus Fail
 F: Complete Comms Fail
 A: Batt not charging
 P: Primary Comms Fail
 S: Secondary Comms Fail

  Reg  Block
  No.   No. 0            15 16           31 0            15 16           31
    0:    0: _______Soooooooo oooooooooooooooo ---------------- ----------------
   64:    2: ---------------- ---------------- ---------------- ----------------
  128:    4: ---------------- ---------------- ---------------- ----------------
  192:    6: ---------------- ---------------- ---------------- ----------------
  256:    8: ---------------- ---------------- ---------------- ----------------
  320:   10: _B_____Soooooooo oooooooooooooooo ---------------- ----------------
  384:   12: ---------------- ---------------- ---------------- ----------------
  448:   14: ---------------- ---------------- ---------------- ----------------
  512:   16: ---------------- ---------------- ---------------- ----------------
  576:   18: ---------------- ---------------- ---------------- ----------------
  640:   20: ---------------- ---------------- ---------------- ----------------
  704:   22: ---------------- ---------------- ---------------- ----------------
  768:   24: ---------------- ---------------- ---------------- ----------------
```

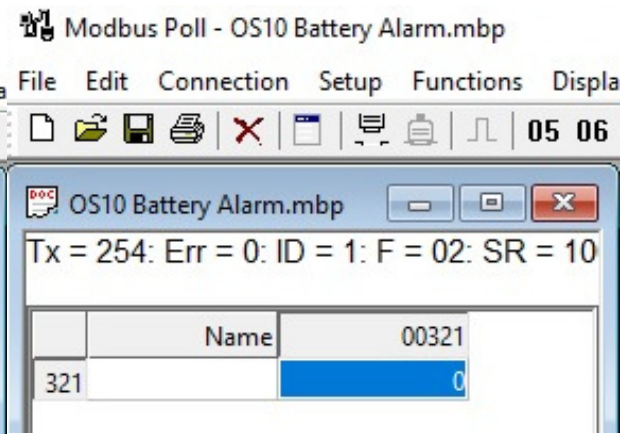
2.5 Modbus RTU

Looking at Digital Input address 321, using “02 Read Discrete Inputs (1x)” with a Modbus RTU Master shows:

>6.8V = 1

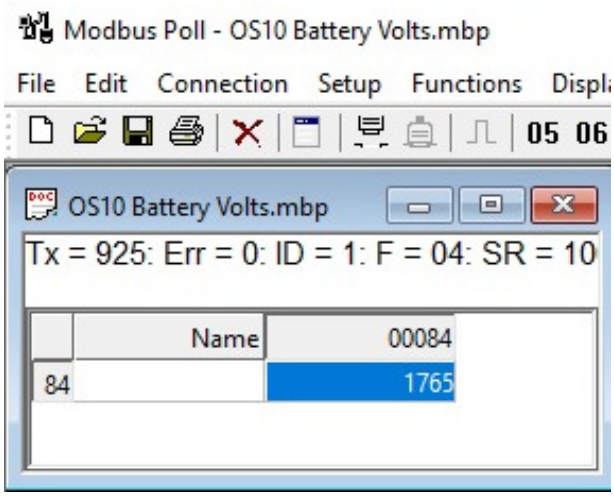


<6.7V = 0

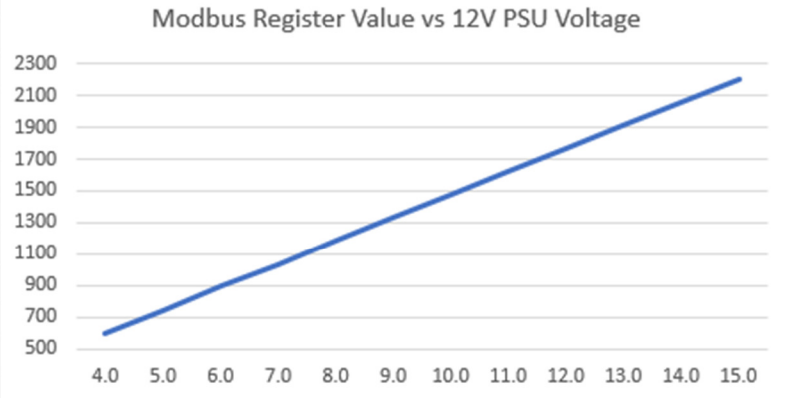


Looking at Analogue Register address 84, using “04 Read Input Registers (3x).

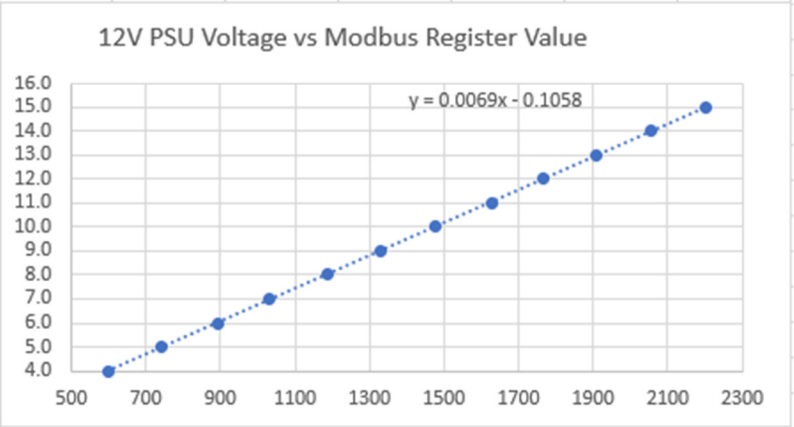
At 12V nominal this shows a value of 1765 on screen below.



PSU Volts	Register Value
4.0	598
5.0	741
6.0	892
7.0	1033
8.0	1188
9.0	1331
10.0	1476
11.0	1626
12.0	1765
13.0	1909
14.0	2057
15.0	2202



Register Value	PSU Volts
598	4.0
741	5.0
892	6.0
1033	7.0
1188	8.0
1331	9.0
1476	10.0
1626	11.0
1765	12.0
1909	13.0
2057	14.0
2202	15.0



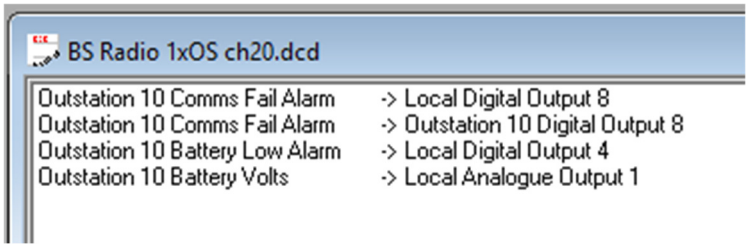
From this graph for 12V.

Scale factor = 0.0069 Volts per register bit and **Offset = -0.1058**.

E.g. a register value of 1765 equates to: 0.0069*1765 – 0.1058 = 12.07V

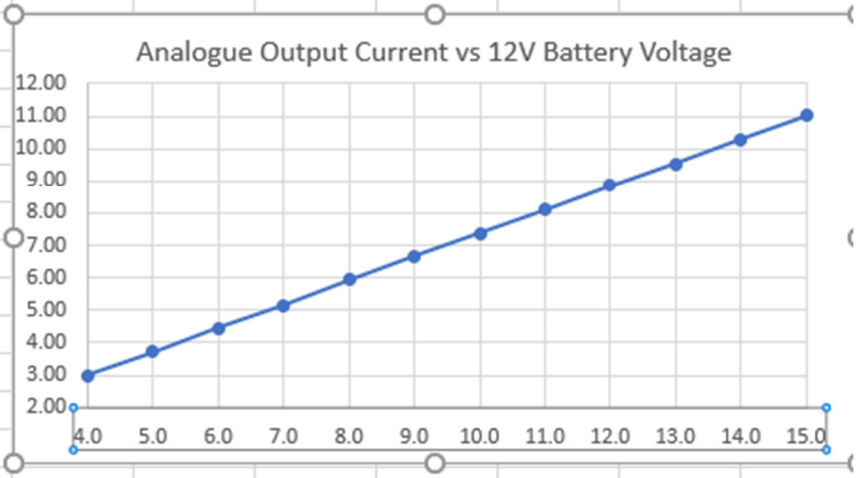
2.6 Converting Outstation Battery Voltage to an Analogue Output Current

The following example line 4 shows how Outstation #10 battery volts can be presented as a local Analogue Output current at the Basestation.

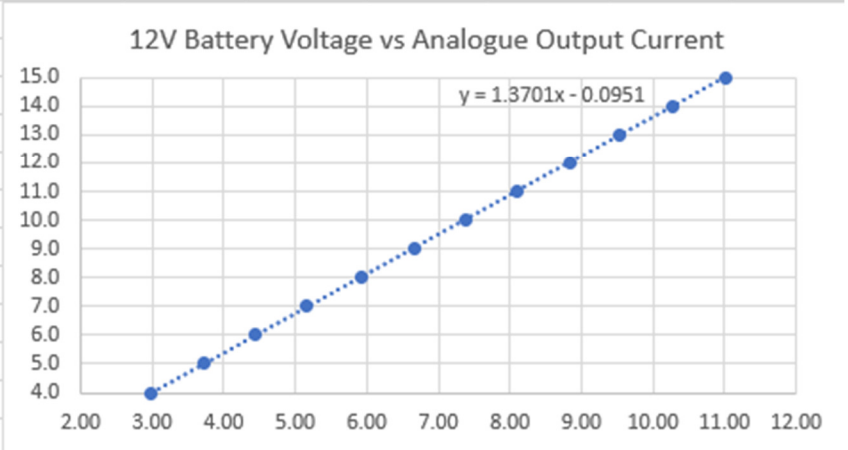


The transfer function is as follows.

PSU Volts	Current Output (mA)
4.0	2.98
5.0	3.72
6.0	4.44
7.0	5.16
8.0	5.93
9.0	6.66
10.0	7.37
11.0	8.10
12.0	8.85
13.0	9.54
14.0	10.28
15.0	11.01



Current Output (mA)	PSU Volts
2.98	4.0
3.72	5.0
4.44	6.0
5.16	7.0
5.93	8.0
6.66	9.0
7.37	10.0
8.10	11.0
8.85	12.0
9.54	13.0
10.28	14.0
11.01	15.0



From this graph for 12V.

Scale factor = 1.3701 Volts per mA and **Offset = -0.0951**.

E.g. a current output of 8.85 mA equates to: 1.3701*8.85 – 0.0951 = 12.03 V

3. 24V Operation

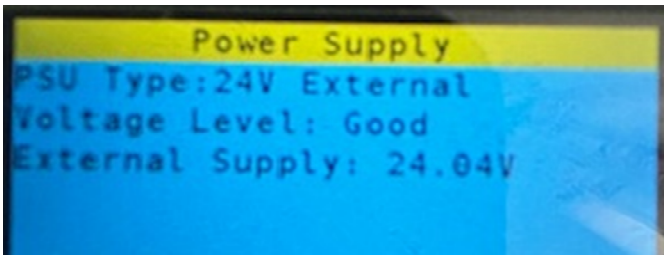
3.1 General

The 24V power supply operating range is 16 – 32V. 32V is absolute maximum, higher than this will cause damage!

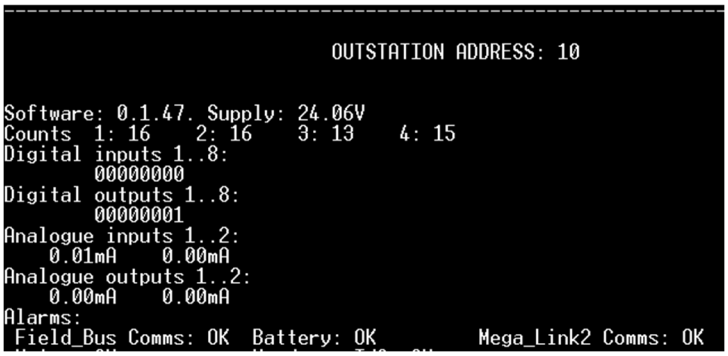
3.2 Nominal Voltage Reading

In this example outstation #10 is powered by 24.00V.

Looking on the display at System Configuration→Power Supply, this shows the PSU Type to be "24V External" and a reading of 24.04V. Voltage level is "Good".



Using DCD2 Diagnostics "S" command at the Outstation 10 will show supply value, in this example 24.06V, and "Battery OK".



In a running system using DCD2 Diagnostics "IR" command at the Basestation will show the value at register address 84 to be 24.06V.

Note, the value of 12.08V at address 4 is the Basestation power supply voltage level.

INPUT REGISTERS

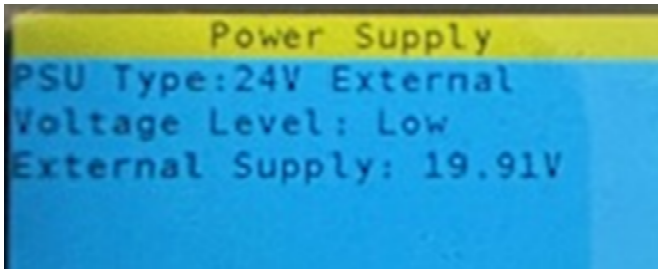
If analogues not 0..20mA, scale as necessary

Reg No.	Block No.	0	1	2	3	4	5	6	7
0:	0:	10	10	10	10	12.08V	-65dBm	0.37mA	0.36mA
8:	1:	-	-	-	-	-	-	-	-
16:	2:	-	-	-	-	-	-	-	-
24:	3:	-	-	-	-	-	-	-	-
32:	4:	-	-	-	-	-	-	-	-
40:	5:	-	-	-	-	-	-	-	-
48:	6:	-	-	-	-	-	-	-	-
56:	7:	-	-	-	-	-	-	-	-
64:	8:	-	-	-	-	-	-	-	-
72:	9:	-	-	-	-	-	-	-	-
80:	10:	16	16	13	15	24.06V	-63dBm	0.00mA	0.00mA
88:	11:	-	-	-	-	-	-	-	-
96:	12:	-	-	-	-	-	-	-	-
104:	13:	-	-	-	-	-	-	-	-

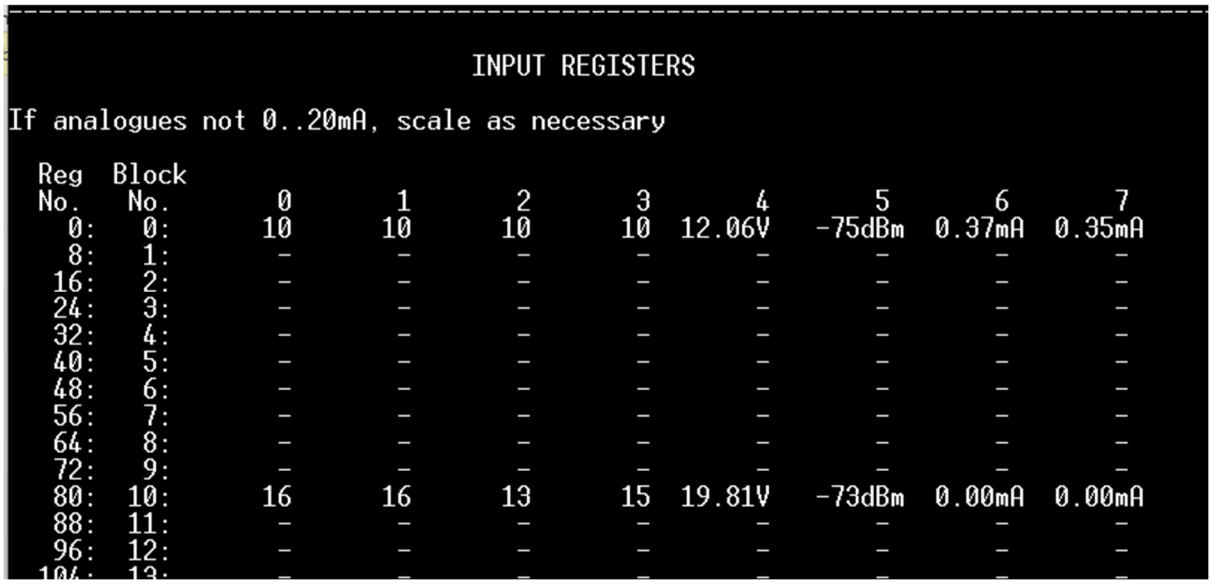
3.3 Low Voltage Threshold

In this example outstation #10, when the power supply drops to below 20V.

The display at System Configuration→Power Supply, will change to warning that Voltage Level is “Low”.



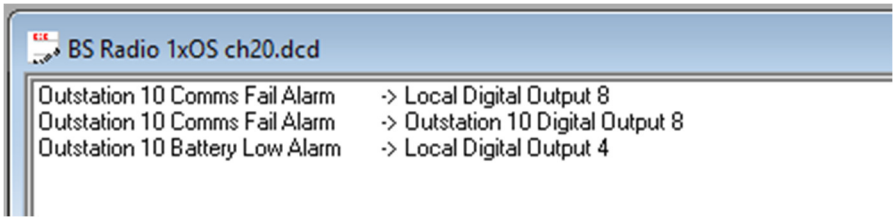
In a running system using DCD2 Diagnostics “IR” command at the Basestation will show the value at register address 84 to be 19.81V.



3.4 Battery Low Alarm

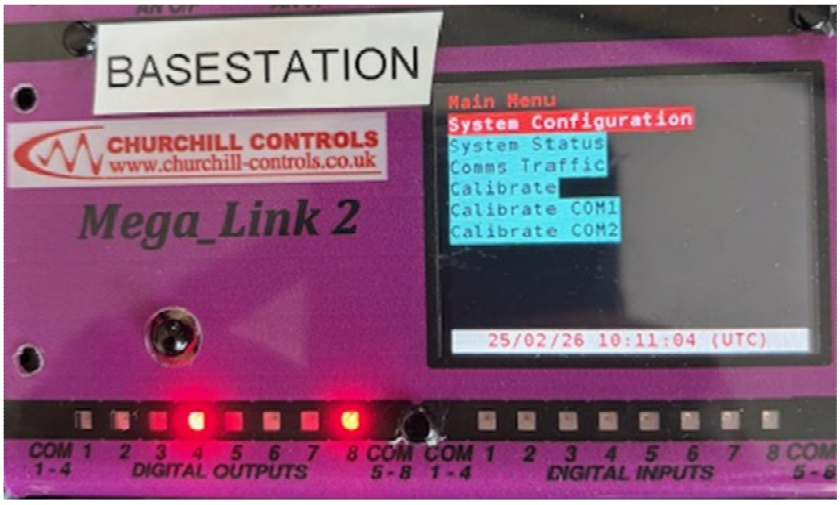
In a system, an output at the Basestation is often used as a battery low alarm for an outstation.

The following example line 3 shows this being sent to output 4.



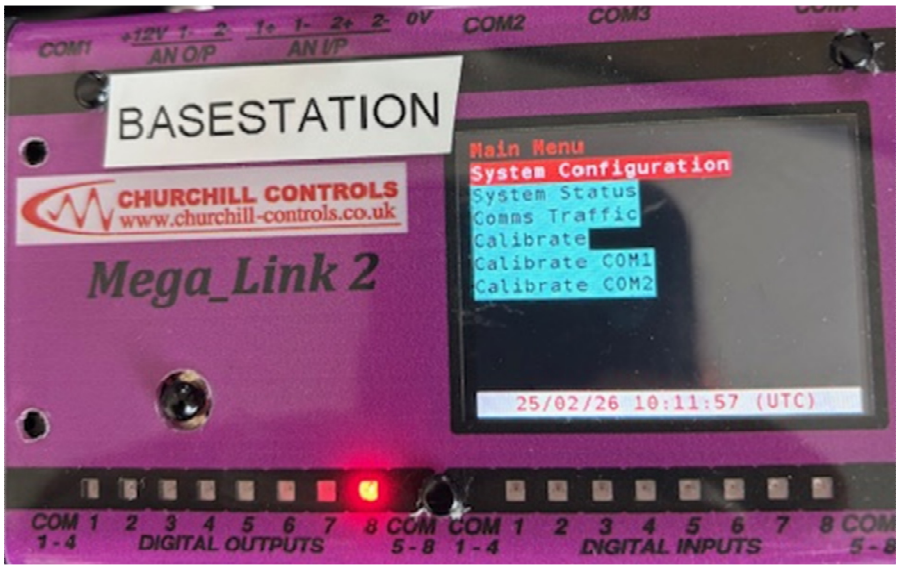
During normal operation with the outstation #10 power supply voltage >20.0V the output 4 will be **ON.**

Outstation #10 battery voltage = **ON** = **No Alarm**.



When the outstation power supply drops to <20.0V the output 4 will be **OFF**.

Outstation #10 battery voltage = **OFF** = **Battery Low Alarm**.



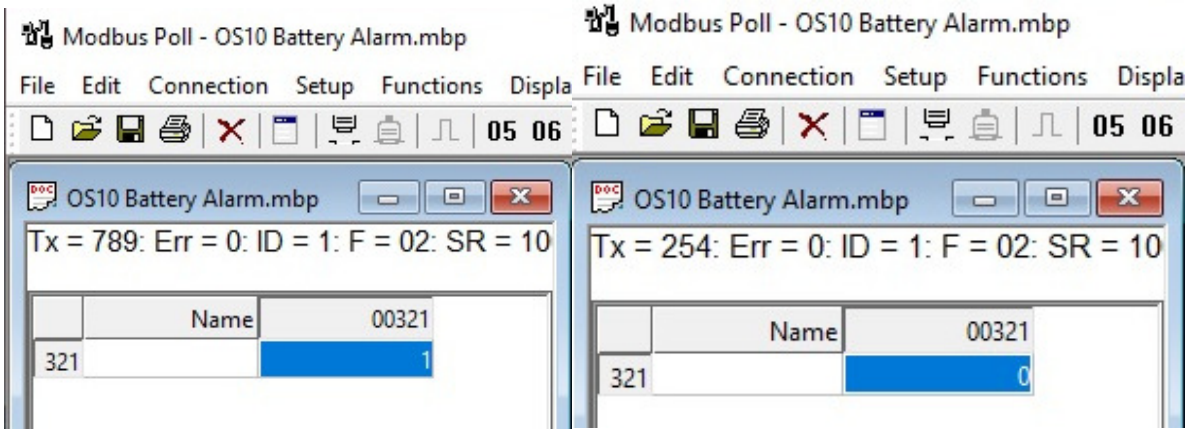
In a running system using DCD2 Diagnostics “ID” command at the Basestation will show a “B” at Digital Input address 321. B: Battery Low Alarm Flag.

```
                                INPUT DIGITALS

Alarm Flags:
 C: Mega_Link2 Comms Fail
 B: Battery Low
 H: Hardware Fail
 M: Field_Bus Fail
 F: Complete Comms Fail
 A: Batt not charging
 P: Primary Comms Fail
 S: Secondary Comms Fail

  Reg  Block
  No.   No. 0            15 16           31 0            15 16           31
    0:    0: _______$ooooooooo ooooooooooooooo ---------------- ----------------
   64:    2: ---------------- ---------------- ---------------- ----------------
  128:    4: ---------------- ---------------- ---------------- ----------------
  192:    6: ---------------- ---------------- ---------------- ----------------
  256:    8: ---------------- ---------------- ---------------- ----------------
  320:   10: _B_____$ooooooooo ooooooooooooooo ---------------- ----------------
  384:   12: ---------------- ---------------- ---------------- ----------------
  448:   14: ---------------- ---------------- ---------------- ----------------
  512:   16: ---------------- ---------------- ---------------- ----------------
  576:   18: ---------------- ---------------- ---------------- ----------------
  640:   20: ---------------- ---------------- ---------------- ----------------
  704:   22: ---------------- ---------------- ---------------- ----------------
```

3.5 Modbus RTU

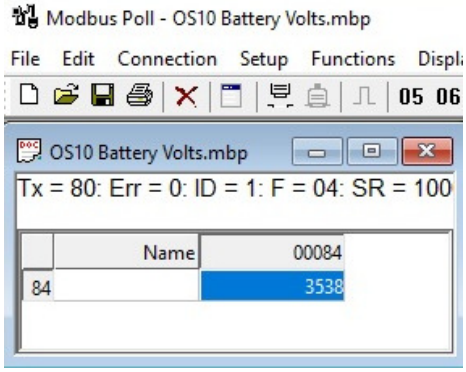
Looking at Digital Input address 321, using “02 Read Discrete Inputs (1x)” with a Modbus RTU Master shows:

>20.0V = 1 **<20.0V = 0**

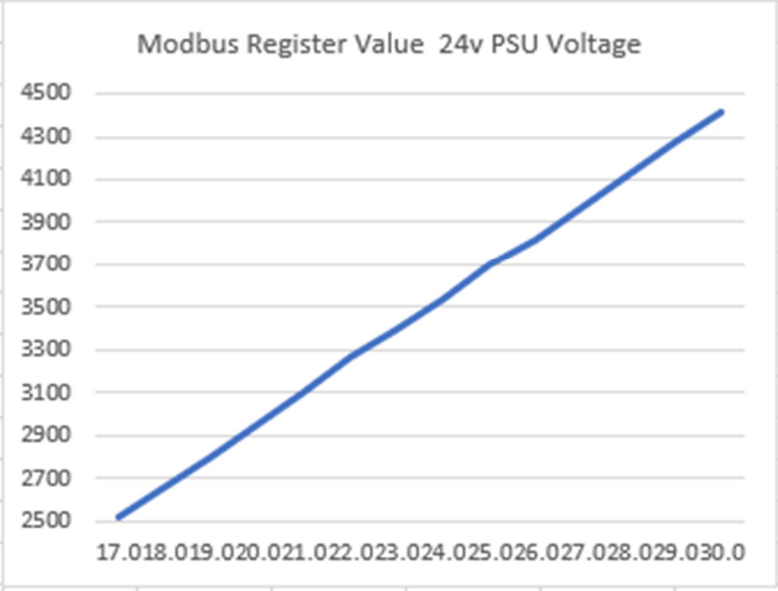


Looking at Analogue Register address 84, using “04 Read Input Registers (3x).

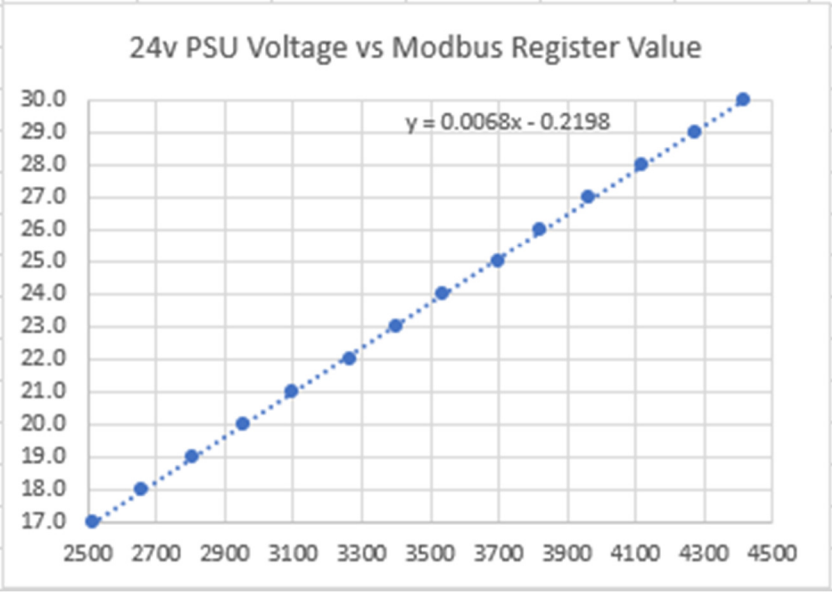
At 24V nominal shows a value of 3538 on screen below.



24v PSU Volts	Register Value
17.0	2513
18.0	2660
19.0	2804
20.0	2953
21.0	3100
22.0	3268
23.0	3400
24.0	3538
25.0	3699
26.0	3822
27.0	3966
28.0	4119
29.0	4274
30.0	4418



Register Value	24v PSU Volts
2513	17.0
2660	18.0
2804	19.0
2953	20.0
3100	21.0
3268	22.0
3400	23.0
3538	24.0
3699	25.0
3822	26.0
3966	27.0
4119	28.0
4274	29.0
4418	30.0



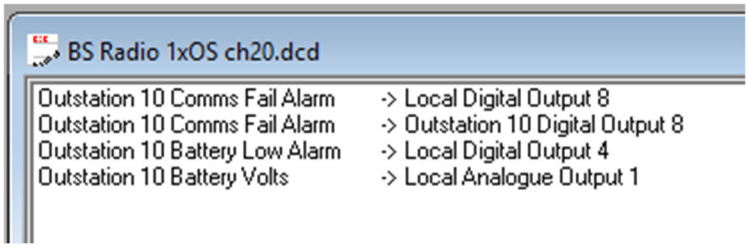
From this graph for 24V.

Scale factor = 0.0068 Volts per register bit and **Offset = -0.2198**.

E.g. a register value of 3538 equates to: 0.0068*3538 – 0.2198 = 23.84V

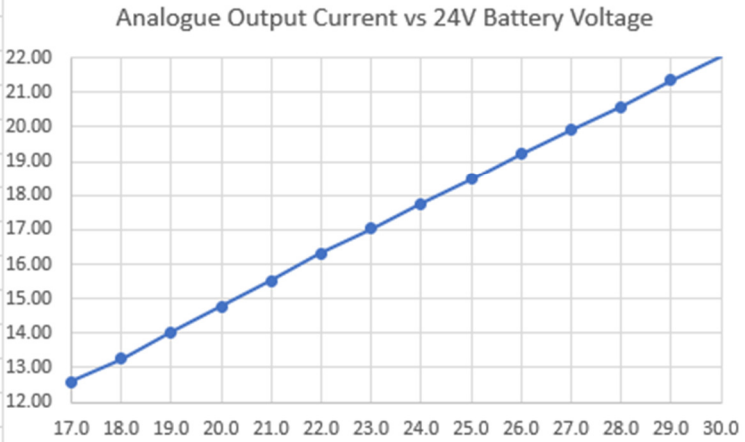
3.6 Converting Outstation Battery Voltage to an Analogue Output Current

The following example line 4 shows how Outstation #10 battery volts can be presented as a local Analogue Output current at the Basestation.

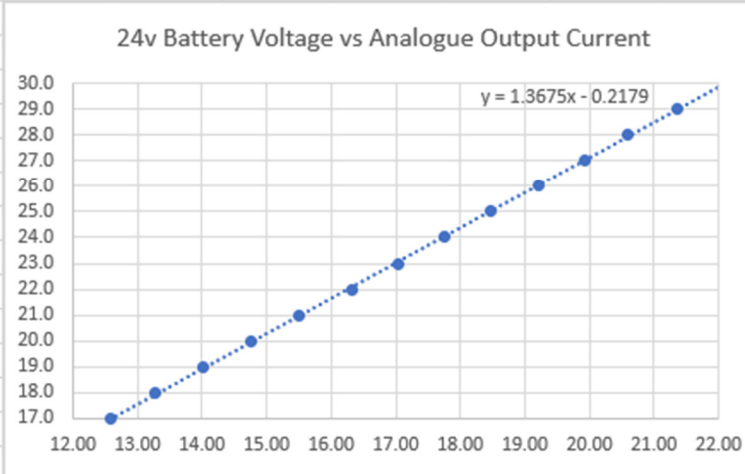


The transfer function is as follows.

PSU Volts	Current Output (mA)
17.0	12.58
18.0	13.27
19.0	14.02
20.0	14.76
21.0	15.51
22.0	16.32
23.0	17.04
24.0	17.75
25.0	18.46
26.0	19.21
27.0	19.92
28.0	20.58
29.0	21.35
30.0	22.04



Current Output (mA)	PSU Volts
12.58	17.0
13.27	18.0
14.02	19.0
14.76	20.0
15.51	21.0
16.32	22.0
17.04	23.0
17.75	24.0
18.46	25.0
19.21	26.0
19.92	27.0
20.58	28.0
21.35	29.0
22.04	30.0



From this graph for 24V.

Scale factor = 1.3675 Volts per mA and **Offset = -0.2179**.

E.g. a current output of 17.75 mA equates to: 1.3675*17.75 – 0.2179 = 24.05 V

4. Mains Operation

4.1 General

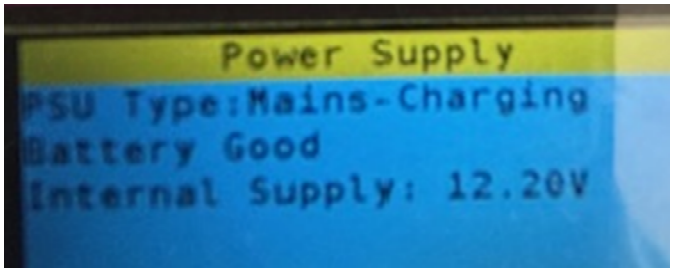
The nominal mains supply voltage is 110 or 240 Vac and this is automatically detected.

The internal mains power supply includes six AA size Nickel-Metal Hydride (NiMH) rechargeable batteries which are automatically trickle-charged when there is a mains connection in order to provide a few hours of battery back-up operation if the mains supply fails during a power cut. The batteries are charging even when the ON/OFF switch is in the OFF position.

4.2 Mains Charging and Nominal Supply/Battery Voltage Reading

In this example outstation #10 is powered by Mains.

Looking on the display at System Configuration→Power Supply, this shows the PSU Type to be “Mains" and that it is “Charging”. “Battery Good” at “12.20V”.



Using DCD2 Diagnostics “S” command at the Outstation will show supply value and “Mains: OK”.

```
Software: 0.1.47. Supply: 12.21V
Counts  1: 16    2: 16    3: 13    4: 15
Digital inputs 1..8:
        00000000
Digital outputs 1..8:
        00000001
Analogue inputs 1..2:
    0.00mA    0.00mA
Analogue outputs 1..2:
    0.00mA    0.00mA
Alarms:
 Field_Bus Comms: OK  Battery: OK          Mega_Link2 Comms: OK
 Mains: OK            Hardware I/O: OK
```

In a running system using DCD2 Diagnostics “IR” command at the Basestation will show the value at register address 84 to be 12.21V.

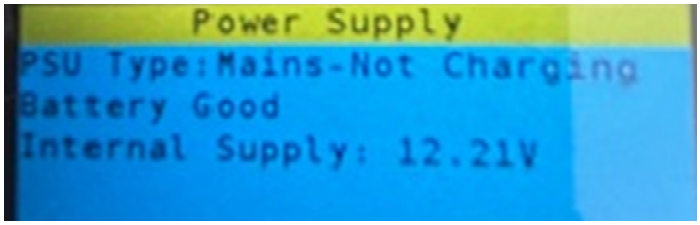
Note, the value of 12.04V at address 4 is the Basestation power supply voltage level.

```
                              INPUT REGISTERS

If analogues not 0..20mA, scale as necessary

 Reg  Block
 No.   No.      0      1      2      3      4      5      6      7
   0:   0:     10     10     10     10 12.04V  -78dBm 0.36mA 0.35mA
   8:   1:      -      -      -      -      -      -      -      -
  16:   2:      -      -      -      -      -      -      -      -
  24:   3:      -      -      -      -      -      -      -      -
  32:   4:      -      -      -      -      -      -      -      -
  40:   5:      -      -      -      -      -      -      -      -
  48:   6:      -      -      -      -      -      -      -      -
  56:   7:      -      -      -      -      -      -      -      -
  64:   8:      -      -      -      -      -      -      -      -
  72:   9:      -      -      -      -      -      -      -      -
  80:  10:     16     16     13     15 12.21V  -75dBm 0.00mA 0.00mA
  88:  11:      -      -      -      -      -      -      -      -
  96:  12:      -      -      -      -      -      -      -      -
```

4.3 Mains Not Charging

In the event of a power-cut or when the mains supply is disconnected then the following is displayed.

In this case the display says “Not Charging”.



In this case the DCD2 Diagnostics “S” command at the Outstation 10 will also show “Mains: Not Charging”.

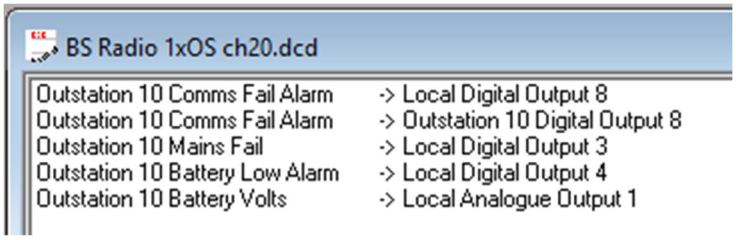
4.4 Mains Fail Alarm

In a system, an output at the Basestation is often used as a Mains Fail alarm for an outstation.

The following example line 3 shows this being sent to output 3.

NB: Obviously, a Mains Fail Alarm is only possible for the duration while its internal battery backup is able to continue to produce sufficient energy for the outstation to operate and to transmit responses.

The Battery Low Alarm form outstation #10 is presented on output 4 as for previous 12V & 24V systems.



During normal operation with the outstation #10 mains power connected the output 3 and 4 will be **ON.**

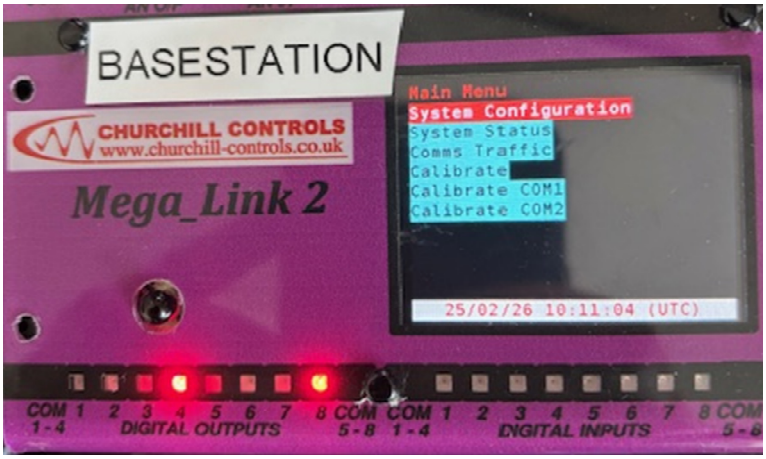
Output 3 = Outstation #10 mains on = **ON = No Alarm.**

Output 4 = Outstation #10 battery voltage = **ON** = **No Alarm**.

In the event of a power-cut or when the mains supply is disconnected:

Output 3 = Outstation #10 mains off = **OFF = Mains Fail Alarm.**

Output 4 = Outstation #10 battery voltage = **ON** = **No Alarm**.



In the event of a power-cut or when the mains supply is disconnected at Outstation #10 on a running system using DCD2 Diagnostics "ID" command at the Basestation will show an "A" at Digital Input address 325.

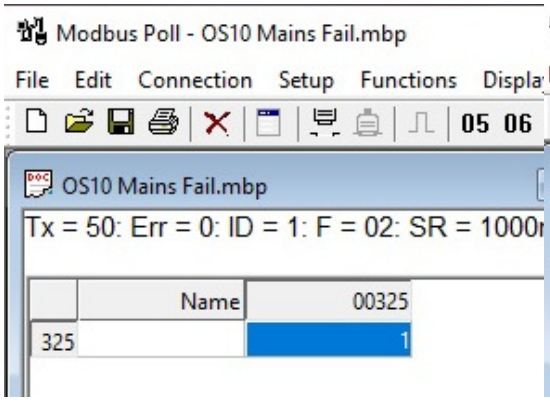
"A: Batt not charging" alarm flag.

```
                                INPUT DIGITALS

Alarm Flags:
 C: Mega_Link2 Comms Fail
 B: Battery Low
 H: Hardware Fail
 M: Field_Bus Fail
 F: Complete Comms Fail
 A: Batt not charging
 P: Primary Comms Fail
 S: Secondary Comms Fail

  Reg  Block
  No.   No. 0            15 16           31 0            15 16           31
    0:    0: _______Soooooooo oooooooooooooooo ---------------- ----------------
   64:    2: ---------------- ---------------- ---------------- ----------------
  128:    4: ---------------- ---------------- ---------------- ----------------
  192:    6: ---------------- ---------------- ---------------- ----------------
  256:    8: ---------------- ---------------- ---------------- ----------------
  320:   10: _____A_Soooooooo oooooooooooooooo ---------------- ----------------
  384:   12: ---------------- ---------------- ---------------- ----------------
  448:   14: ---------------- ---------------- ---------------- ----------------
```

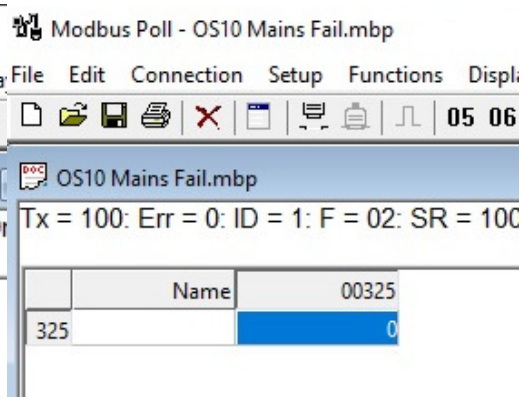
4.5 Mains Fail on Modbus RTU

Looking at Digital Input address 325, using "02 Read Discrete Inputs (1x)" with a Modbus RTU Master shows:

Mains Good = 1



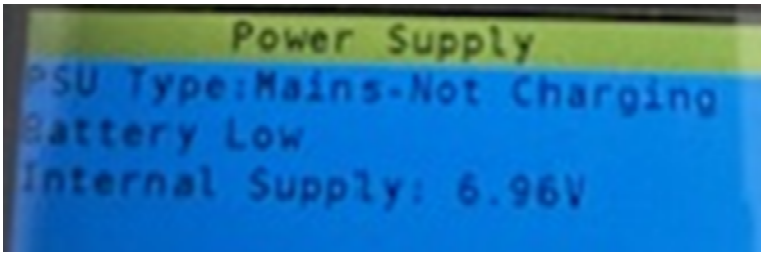
Mains Bad = 0



4.6 Mains-Not Charging Battery Low Voltage Threshold 1

In the situation where the mains supply has failed at Outstation 10, it will continue to operate using internal battery power. After a few hours operation the battery voltage will begin to drop.

When the internal battery back-up at Outstation 10 drops to below 7.00V then the display at System Configuration→Power Supply, will change to warning "Battery Low".



In a running system using DCD2 Diagnostics "IR" command at the Basestation will show the value at register address 84 to be 6.96V.

```
------------------------------------------------------------------------------

                          INPUT REGISTERS

If analogues not 0..20mA, scale as necessary

  Reg  Block
  No.    No.       0       1       2       3       4       5       6       7
    0:     0:      10      10      10      10  12.05V   -78dBm  0.36mA  0.34mA
    8:     1:       -       -       -       -       -       -       -       -
   16:     2:       -       -       -       -       -       -       -       -
   24:     3:       -       -       -       -       -       -       -       -
   32:     4:       -       -       -       -       -       -       -       -
   40:     5:       -       -       -       -       -       -       -       -
   48:     6:       -       -       -       -       -       -       -       -
   56:     7:       -       -       -       -       -       -       -       -
   64:     8:       -       -       -       -       -       -       -       -
   72:     9:       -       -       -       -       -       -       -       -
   80:    10:      16      16      13      15   6.96V   -76dBm  0.00mA  0.00mA
   88:    11:       -       -       -       -       -       -       -       -
   96:    12:       -       -       -       -       -       -       -       -
  104:    13:       -       -       -       -       -       -       -       -
  112:    14:       -       -       -       -       -       -       -       -
```

4.7 Battery Low Alarm while Mains Not Charging

When the internal battery back-up at Outstation 10 drops to below 6.70V then the battery low alarm will be triggered and in this case the DCD2 Diagnostics “S” command at the Outstation 10 will show “Battery: Low” in addition to the “Mains: Not Charging”.

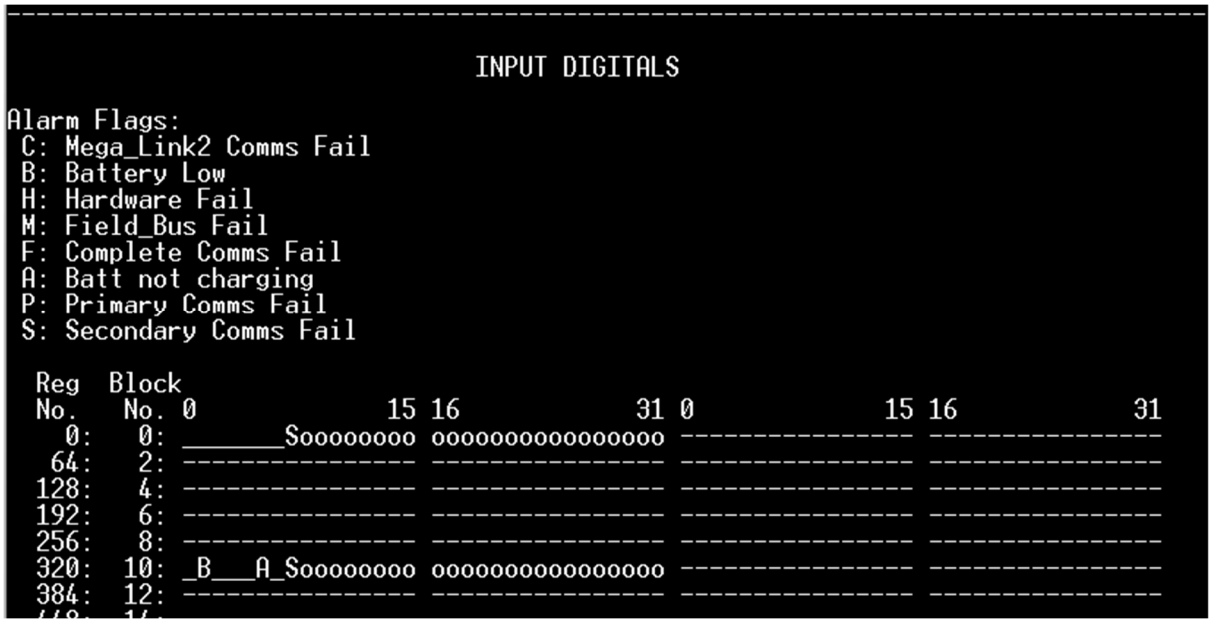
```
------------------------------------------------------------

                          OUTSTATION ADDRESS: 10


Software: 0.1.47. Supply:  6.67V
Counts  1: 16    2: 16    3: 13    4: 15
Digital inputs 1..8:
        00000000
Digital outputs 1..8:
        00000001
Analogue inputs 1..2:
    0.00mA    0.00mA
Analogue outputs 1..2:
    0.00mA    0.00mA
Alarms:
 Field_Bus Comms: OK  Battery: Low        Mega_Link2 Comms: OK
 Mains: Not Charging  Hardware I/O: OK
```

In a running system using DCD2 Diagnostics “IR” command at the Basestation will show the value at register address 84 to be 6.67V.

Note, the value of 12.07V at address 4 is the Basestation power supply voltage level.

```
------------------------------------------------------------------------------

                          INPUT REGISTERS

If analogues not 0..20mA, scale as necessary

  Reg  Block
  No.   No.       0       1       2       3       4       5       6       7
    0:    0:     10      10      10      10  12.07V   -67dBm  0.37mA  0.35mA
    8:    1:      -       -       -       -       -       -       -       -
   16:    2:      -       -       -       -       -       -       -       -
   24:    3:      -       -       -       -       -       -       -       -
   32:    4:      -       -       -       -       -       -       -       -
   40:    5:      -       -       -       -       -       -       -       -
   48:    6:      -       -       -       -       -       -       -       -
   56:    7:      -       -       -       -       -       -       -       -
   64:    8:      -       -       -       -       -       -       -       -
   72:    9:      -       -       -       -       -       -       -       -
   80:   10:     16      16      13      15   6.67V   -65dBm  0.00mA  0.00mA
   88:   11:      -       -       -       -       -       -       -       -
   96:   12:      -       -       -       -       -       -       -       -
```

In a running system using DCD2 Diagnostics “ID” command at the Basestation will show a “B” at Digital Input address 321. B: Battery Low Alarm Flag. In addition to the “A: Batt not charging.



And for the configuration example shown in section 4.4

Output 3 = Outstation #10 mains off = **OFF = Mains Fail Alarm.**

Output 4 = Outstation #10 battery voltage = **OFF** = **Battery Low**.

As further time goes by, the battery will continue to deplete until at about 4.5V the Outstation 10 will power down and no further comms can occur and hence there will be no more updates at the Basestation.

End.