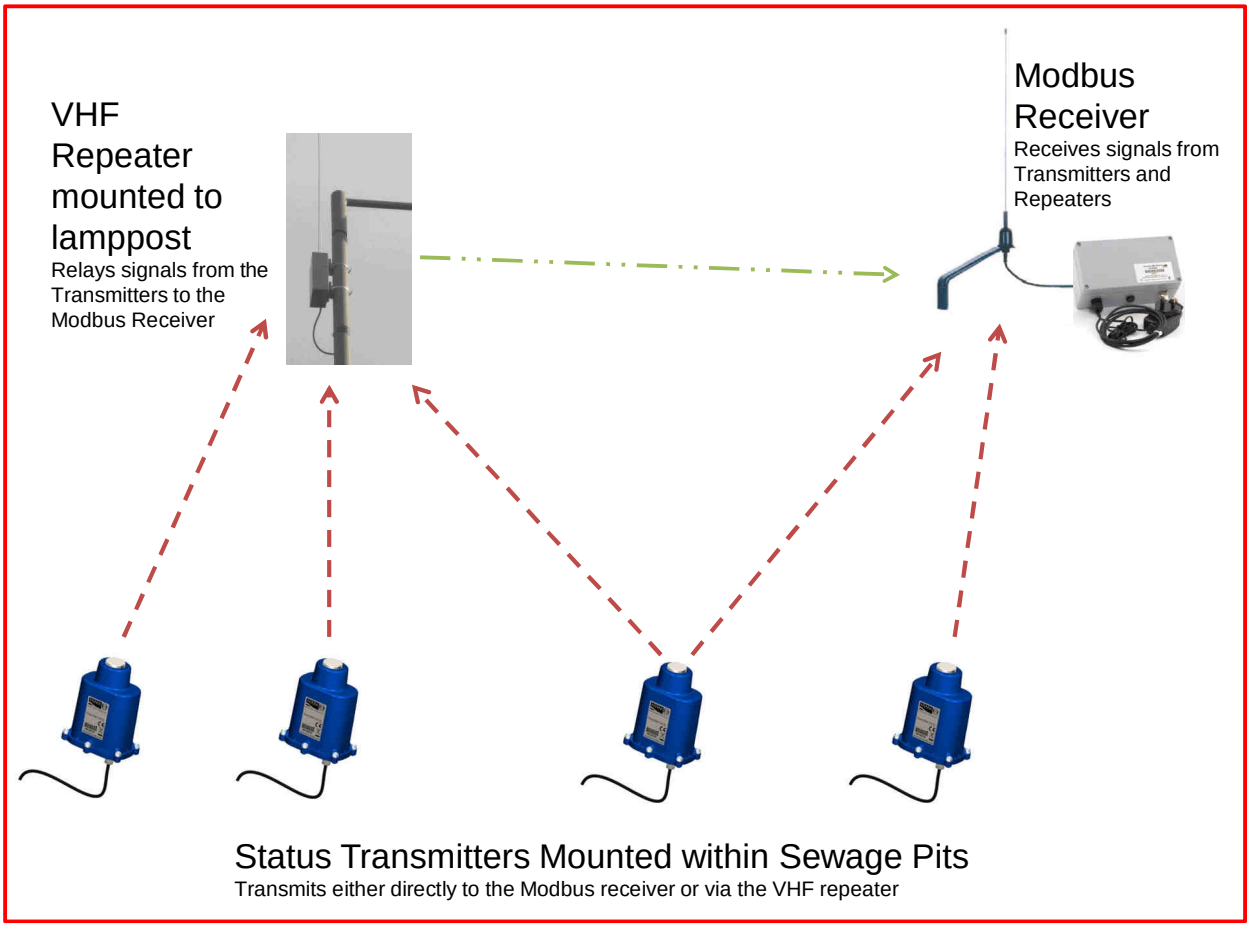
Installation Manual for Fixed Monitoring Network

Contents

System Components

There are 3 parts to the complete system installation, the Transmitter, Repeater and Modbus Receiver. A portion of the overall system structure looks as below:-



Transmitter units have a range of 2.5km line of sight. Obstructions such as buildings can reduce this range so site the repeater units carefully such that all the transmitters are within range of a repeater or Modbus receiver.

Installing the Status Transmitter

The Transmitter has 2 inputs for monitoring status switches.
Connect the appropriate switches to the transmitter following the colour code below:-

CHANNEL 1	CHANNEL 2
Red +Ve	Yellow +Ve
Black -Ve	Blue -Ve

Connections to the wires need to be made using a waterproof connector housing, such as the “Tuff-Splice” enclosure.

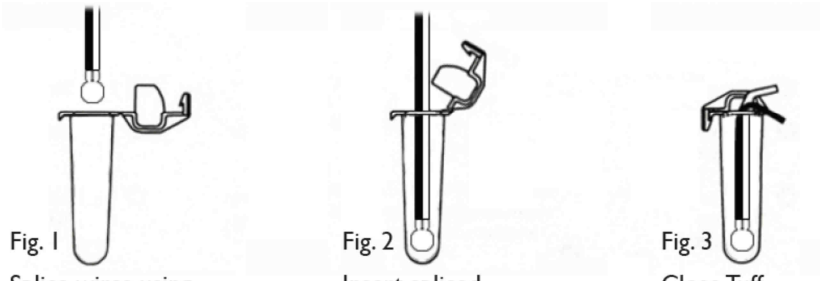


Fig. 1
Splice wires using supplied crimp connectors.
(DO NOT STRIP WIRES BACK).

Fig. 2
Insert spliced wires into the gel filled tube.

Fig. 3
Close Tuff-Splice lid for secure seal.

Final connection

Note that Long data connections should always be made using screened cable. The use of screened cable will ensure maximum rejection of interference from outside sources. Always use a common ground point without creating ground loops.

Once the connections are complete, the transmitter needs to be activated. To do this, place and hold a magnet over the label on the front of the unit.

To check if the unit is transmitting, tune an RF scanner to your frequency (printed on the transmitter label) and listen for frequent clicking sound.

To time the regular transmission, release the magnet at the precise time that you wish the transmitter to send its regular status message.

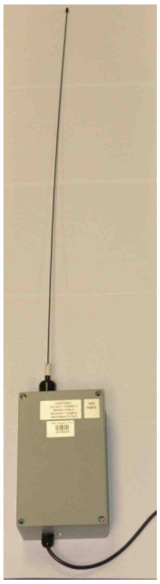
Once the transmitter has been activated, attach it to the underside of the chamber lid using the magnet integrated into the top of the unit.

For maximum transmission range, always ensure that the transmitter is vertical once the chamber lid is closed.

Remember to record the serial number, connection details and location of the unit as you will need this when programming the Modbus receiver later on.

Carefully close the lid so that the transmitter remains attached to the lid of the chamber as shown in the picture above.

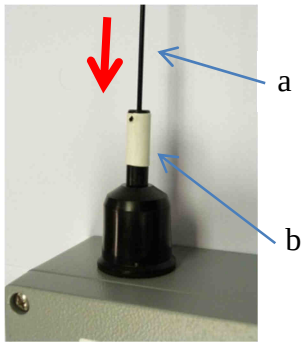
Installing the VHF repeater

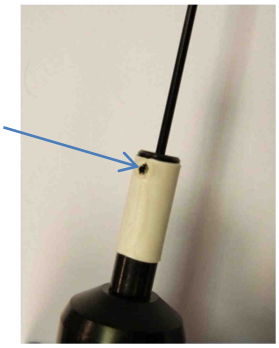


1) Determine the best locations for the repeaters. They need to have a clear line of sight to the locations of the transmitters and a good path to the receiver location.

2) Insert the rod antenna (a) into the top of the aerial base (b), pushing it all the way in, you may need to release the grub screw (c) in order to insert the antenna rod.

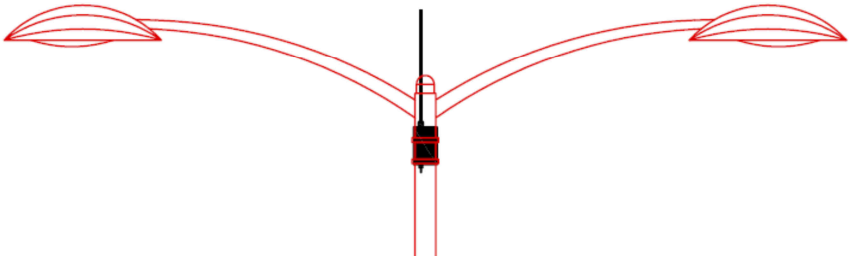
IMPORTANT: Insert Antenna BEFORE powering on unit, otherwise damage to the unit may occur





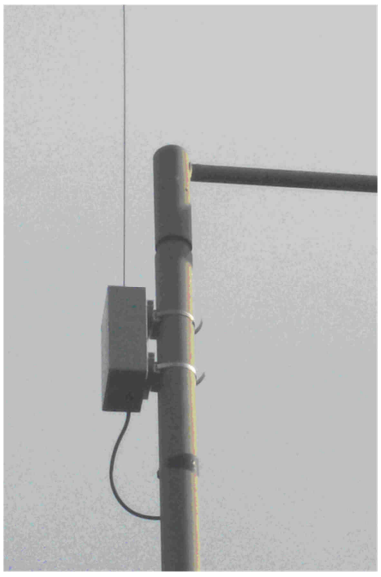
3) Hand tighten the grub screw (c) and ensure the rod is held firmly in place.

4) Next, using the mounting bracket supplied, attach the unit to the lamppost as in the diagram below. Where possible try to keep the antenna higher than the metal of the lamppost this will provide the best signal path.



5) Connect the power supply to the unit taking appropriate steps to ensure no water ingress to the unit and that wiring meets the appropriate local standards for lamppost connection.

No configuration of the unit is required.



Installing the RTcom™ Modbus Receiver

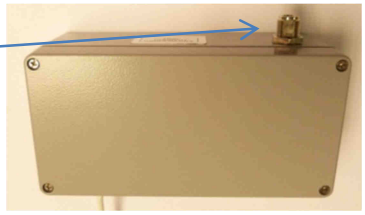
To ensure optimum performance it is advised that all receiver antennas are located externally above ground. If coaxial cable is to be used to extend the distance between the antenna and the receiver, this length should be no longer than 10m.

1) When choosing the location of the antenna, ensure a minimum spacing of 0.5m between antennas on a multiple receiver site.

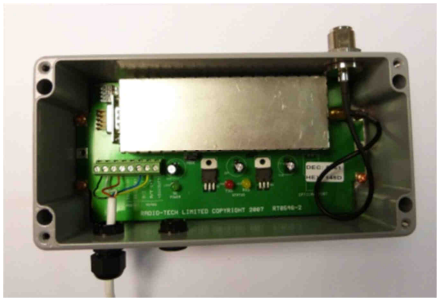
2) Choose the location of the receiver. We recommend that the receiver is located away from sources of heat and electrical apparatus such as Inverters. Care should be taken to minimise cable lengths both with respect to the antenna location and to the attached terminal equipment.

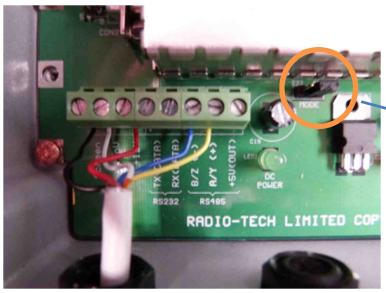
3) Connect the antenna (using an extension cable if required) to the RF input on the receiver.

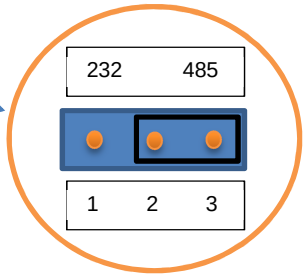
IMPORTANT: Insert Antenna BEFORE powering on unit, otherwise damage to the unit may occur.



4) Next unscrew the 4 screws and remove the top cover to allow access to the connections







5) Select the communications MODE by adjusting the jumper to the Left position (1&2) for RS323 or to the Right position (2&3) for RS485.

The RTcom™ Modbus Receiver supports RS232 and RS485 (2 wire) communications. The RS232 port should be used for short cable runs of up to 10m and the RS485 can be used for extended distances up to 300m. The receiver communicates at 4800 baud, no parity, 8 data bits and 1 stop bit.

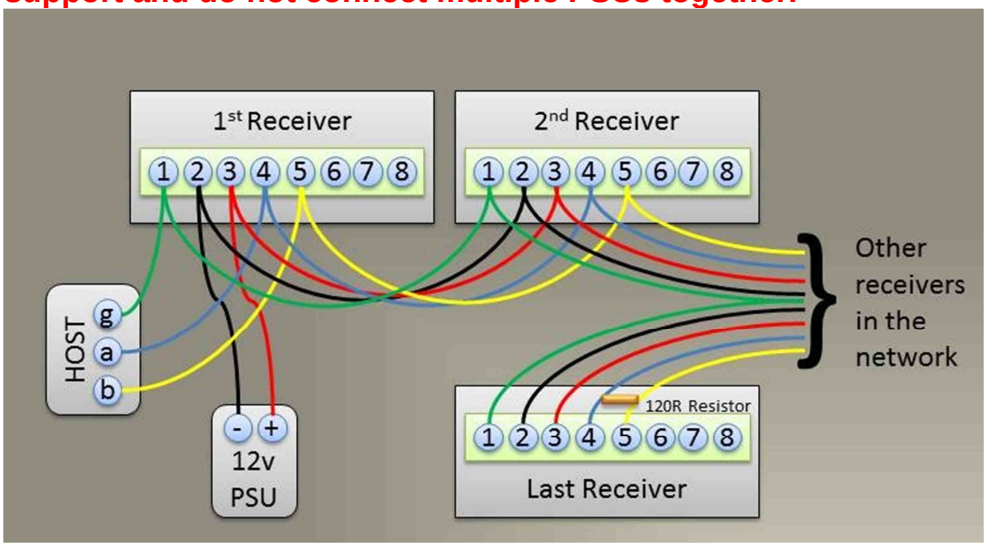
6) Make connections to the receiver. Data and power connections should always be made using screened cables to ensure best performance. Always use a common ground point and avoid the formation of earth loops. Connections are as follows:-

Terminal	No	Description
Screen	1	Cable Screen
0V	2	DC Ground
+12V	3	DC Positive
TX (DATA)	4	RS232 Tx Input (DTE-DCE)
RX (DATA)	5	RS232 RX Output (DCE-DTE)
B/Z (-)	6	RS485 –ve
A/Y (-)	7	RS485 +ve
+5V (OUT)	8	5V logic output

IMPORTANT: When making connections to the unit or changing the jumper positions, ESD precautions must be observed.

7) If making RS232 connections for a single receiver installation skip to step 9.

8) If making RS485 connections for a multiple receiver installation, repeat steps 1) to 6) for each receiver in the group following the diagram below. **IMPORTANT: Do not connect more receivers to the PSU than it can support and do not connect multiple PSUs together.**



NOTE: The last receiver in the chain needs to have a 120ohm resistor connected between AY (4) and BZ (5) terminals to terminate the cable correctly. Also confirm that the host device is correctly terminated, this may be internal to the device.

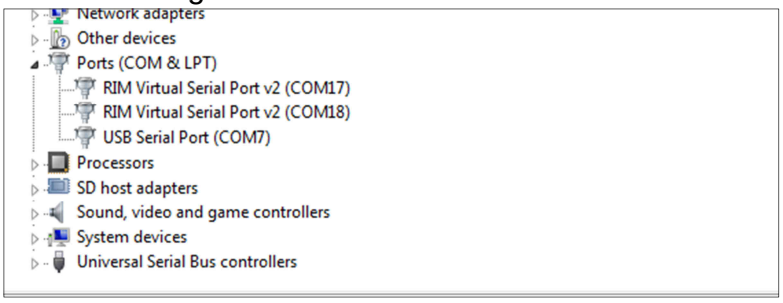
9) Once all the connections have been made, the lid can be replaced. Alternatively, for diagnostic purposes the lid can be replaced later so that the 3 status LEDs can be viewed.
GREEN=Power, RED=Transmit RF data and YELLOW=Receive RF data.

Configuration and Operation

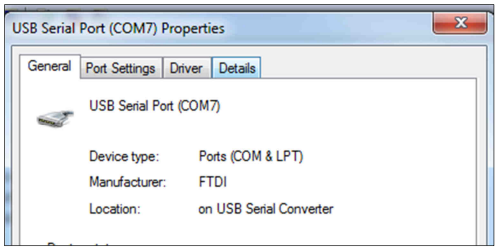
If you are configuring the receivers from your host system (recommended) please use the information and tables in the Technical Information section. Otherwise, please use the Configuration tool as described as follows.

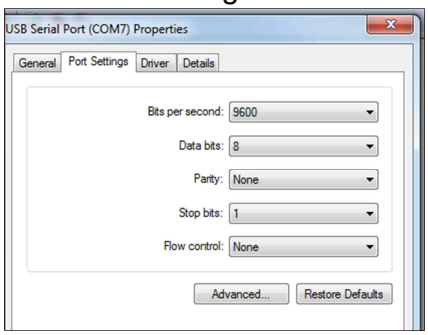
For the purposes of these instructions, it is assumed that a temporary connection is made to the receiver to allow for configuration before being connected to the host system.

1) Connect your computer to the receiver to be connected. Either
    a. Use an existing COM port or
    b. Insert a USB adaptor cable
2) Navigate to your Windows Device Manager via the control panel. (A useful shortcut is to press the Windows key and the Pause key at the same time)
3) Expand the Ports item and confirm that the desired COM port is listed and that it is configured for COM8 or lower.

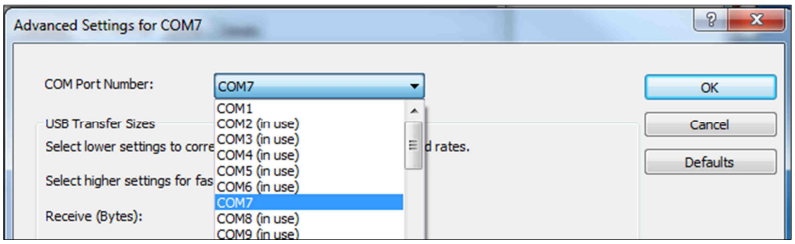


4) If the port number is greater than COM8, double click the line containing the port you wish to change and click the Port Setting Tab





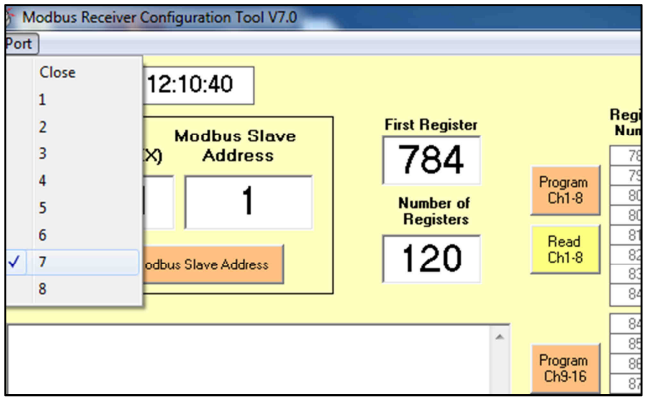
Click the Advanced Button
Under COM Port number



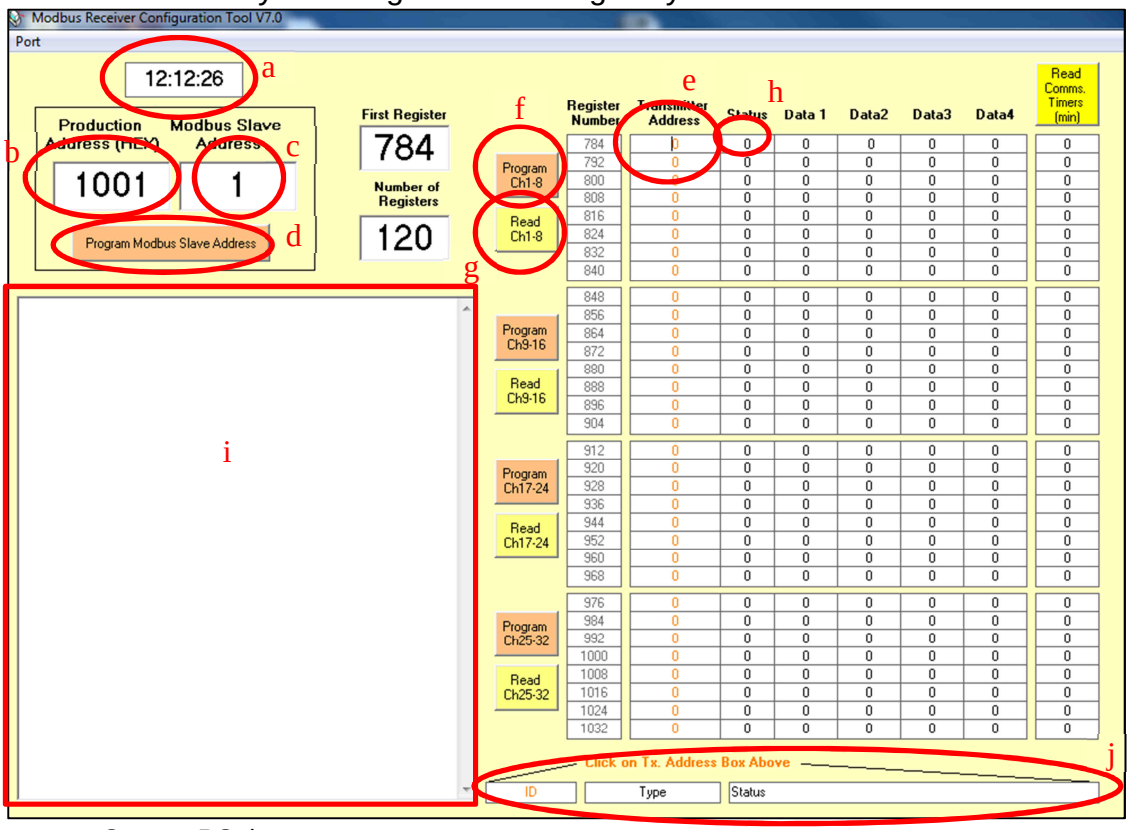
Choose COM8 or lower. Windows sometimes reserves (“in use”) ports if other devices have been used before. If you are sure that an “in use” port is available, then select it from the list, otherwise choose an unused port.

5) Click OK to confirm your choice, if you have chosen an “in use” port, you may be prompted to confirm this choice, just click Yes
6) Close the device manager and continue installing the software.

7) Install the Modbus Configuration Tool on your computer.
    a. Install and run the “RTL Modbus Receiver setup utility” (available from the HWM-Water.com website)
8) Once the main window opens, click on Port and select the COM port that you configured in steps 3) to 4) above, COM7 in is set in the example below.



9) You are now ready to configure the settings in your Modbus Receiver



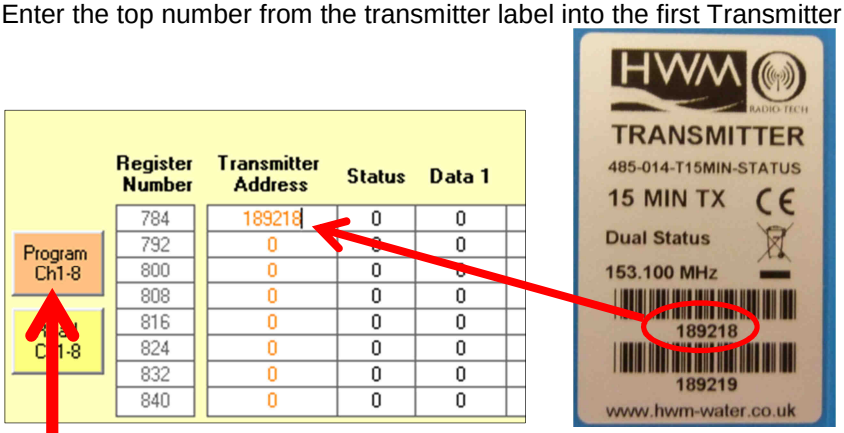
a. Current PC time
b. Modbus address in Hexadecimal, printed on the receiver label
c. Slave address of receiver to be programmed
d. Programming button for receiver address
e. Entry cell for transmitter ID (printed on transmitter unit)
f. Programming button for Transmitter addresses
g. Read back button for transmitter status
h. Transmitter input status value
i. Communications window
j. Data Decoding information

10) Find the HEX address of the Modbus receiver you wish to program and enter it into box (b)

11) Next choose the Modbus slave address for the receiver that you wish to program – refer to your system design to select an appropriate value – and enter it into the box (c)
12) Next press button (d) to "Program Modbus Slave Address" into the receiver with the address chosen in step 10) above.
You should see the Yellow LED flash to indicate the receipt of a data message from the host. If not, please check your wiring and port settings and try again.

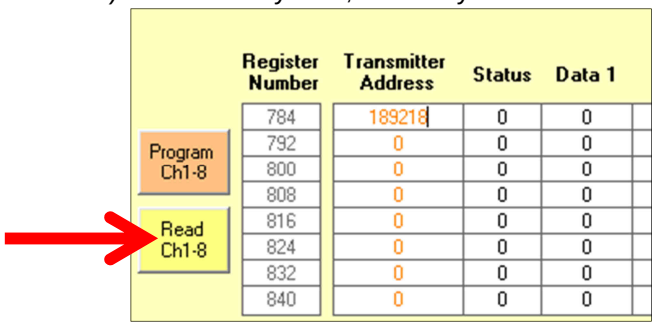
You are now ready to pair your transmitters into the receiver

13) Enter the top number from the transmitter label into the first Transmitter Address box (e)



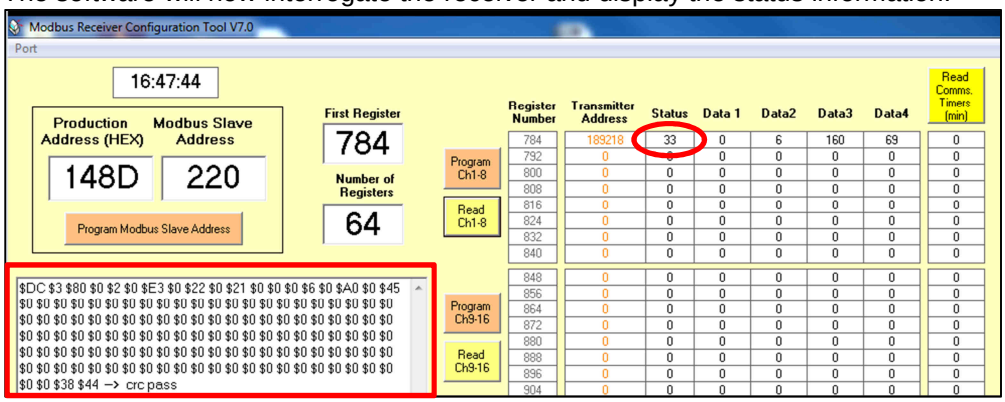
Repeat for each transmitter in the first group of 8 receiver channels or until all required transmitters added.

14) Press the "Program Ch1-8" button (f) to program the first batch of transmitters into the receiver.
15) Repeat step 13) and 14) for the other 3 groups of channels in the receiver.
16) To test the system, artificially close a contact on a transmitter and wait a few seconds.



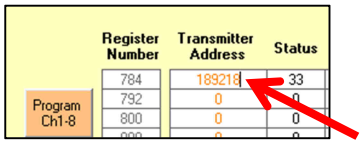
Next press the appropriate "Read Chxx-yy" button alongside the transmitter being tested.

17) The software will now interrogate the receiver and display the status information.

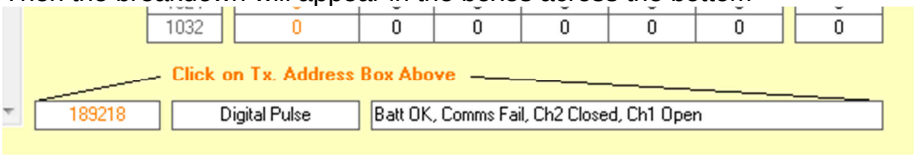


Note that the raw communication data is displayed in the window (i) and the status data is displayed in the column (h)

18) For a breakdown of the status information, click in the transmitter address box you are interested in



Then the breakdown will appear in the boxes across the bottom



Alternatively the status byte is decoded below as:

Status	Transmitter Channel 1	Transmitter Channel 2
1	Open	Open
17	Closed	Open
33	Open	Closed
49	Closed	Closed

19) The Modbus receiver is now commissioned and can be connected to the host system.
20) Finally repeat steps 10) to 19) for the remainder of the receivers that are to be part of the network.

The following sections contain detailed information for engineers who will not be using the set up tool.

Detailed Technical Information

The Modbus Receiver supports the Modbus RTU Slave Mode. Only two standard function codes are supported (3 & 16) with an additional custom code (66) to program unit ID.

For the receiver to operate, it needs to be programmed with the addresses of the transmitters it is expected to receive. A memory map is defined (see Appendix 1) that holds the transmitter IDs' and the information received. This can be read by a Modbus Master device.

The addresses of the transmitters need to be programmed into the memory map and read back with the data as verification. For example, consider transmitter 2:

No.	Reg(Dec)	Reg(Hex)	Description
2	792	0318	Transmitter Address HHO
2	793	0319	Transmitter Address HO
2	794	031A	Transmitter Address LO
2	795	031B	Transmitter Status
2	796	031C	Data 1
2	797	031D	Data 2
2	798	031E	Data 3
2	799	031F	Data 4

Registers 792-794 hold the 24 bit transmitter address, so if data needs to be received from transmitter number 54322, the registers will need to be programmed with the value 00D432, 00 into register 0318, D4 into register 0319 and 32 into register 031A.

When data is received from the transmitter, the rest of the register will be filled with the data received. The transmitter status and data values vary in their content types depending on the transmitter type being received.

IMPORTANT: It is recommended to interrogate the receiver periodically (and at the minimum rate required for the application) to allow the receiver to collect the data. Interrogation forces the device to concentrate on the Modbus protocol which could be at a vital time required to receive date from the RF transmitters.

As Modbus is an 8 / 16 bit protocol and many of the values implemented on the RTcom-Transmitters vary between 8 / 16 / 24 and 32 bits, the RTcom receiver has implemented an 8 bit Modbus standard. Therefore every register has the 8 bits set as 00, for example, if the data value is 1122867 (decimal) ⇔112233 (hex), for Modbus communications, they would be broken up into 3 registers and sent as 0011, 0022 and 0033.

Similarly, the host has to configure the addresses in the same way.

Below are some example messages:

Code 66 – Program Unit ID

To configure the unit 1001 with a Modbus address 4

00 42 10 01 04 31 EE - all values are hexadecimal

where 00 - indicates global message
42 - Code 66
10 01 - 16 bit unique address of receiver
04 - Modbus address to be programmed into unit
31 EE - CRC

To configure the unit 1010 with a Modbus address 10 (0A)

00 42 10 10 0A BC 7A - all values are hexadecimal

Code 03 – Read Holding Registers

Read Ch1 – Ch8 from Modbus Slave 10

0A 03 03 10 00 40 44 C0 - all values are hexadecimal

where 0A - Slave address 10

03 - Modbus Function Code
03 10 - First Register to Read
00 40 - 64 Registers to read (see Memory map in Appendix)
44 C0 - CRC

Read Ch9 – Ch16 from Modbus Slave 10

0A 03 03 50 00 40 45 14 - all values are hexadecimal

Read Ch17 – Ch24 from Modbus Slave 10

0A 03 03 90 00 40 45 28 - all values are hexadecimal

Read Ch25 – Ch32 from Modbus Slave 10

0A 03 03 D0 00 40 44 FC - all values are hexadecimal

Code 16 – Write Multiple Registers

Write address 51234 (00C822 hex) into Ch1 location and clear all CH1 other locations- to Slave 4

04 10 03 10 08 10 00 00 00 C8 00 22 00 00 00 00 00 00 00 00 00 00 35 93

where 04 - Slave address 4
10 - Modbus Function Code
03 10 - First Register to Write to
08 - Number of register to write to
10 - Number of bytes following (16)
00 00 00 C8 00 22 - address written into first 3 registers
00 00 - Register 4
00 00 - Register 5
00 00 - Register 6
00 00 - Register 7
00 00 - Register 8
35 93 - CRC

Note: All data is transmitted as an 8 bit value and Modbus reads registers as 16 bit (2 registers).
Therefore the HO register is always set as 00.

Detailed Commissioning information

Depending on the transmitter types, below is a description of all the data registers received for each type of transmitter:

Pulse / Alarm / Transmitter (Type 1,7,8)

Transmitter Status : Battery, contact status and Revision Number
- Bit 7 set for low battery
- Bit 6 set when comms OK, clear for comms fail
- Bit 4 is contact status
- Bits 0-3 is **Transmitter Type**

Data 1 – Data 3 : 24 bit pulse count value
For example, value 234455 (hex) = 2311253 (decimal)

Data 4 : Cumulative Counter that increments for each data transmission

The Pulse, and Alarm transmitters present data in the same way. The main difference between them is the operation:

Pulse Transmitter – Transmitter Type 1:
Transmits data periodically (set on manufacture). Bit 4 used to indicate tamper status.

Alarm Transmitter – Transmitter Type 8:
Transmits data periodically (set on manufacture) as well as immediately on contact closure.
Bit 4 used to indicate contact status, bit 5 sometimes used to provide 2nd channel status

Appendix 1: Memory Map – Transmitter Data

Tx. No.	Register No.	Modbus Register Address		Description
		Dec	Hex	
1	1	784	0310	Transmitter Address HHO
1	2	785	0311	Transmitter Address HO
1	3	786	0312	Transmitter Address LO
1	4	787	0313	Transmitter Status
1	5	788	0314	Data 1
1	6	789	0315	Data 2
1	7	790	0316	Data 3
1	8	791	0317	Data 4
2	9	792	0318	Transmitter Address HHO
2	10	793	0319	Transmitter Address HO
2	11	794	031A	Transmitter Address LO
2	12	795	031B	Transmitter Status
2	13	796	031C	Data 1
2	14	797	031D	Data 2
2	15	798	031E	Data 3
2	16	799	031F	Data 4
3	17	800	0320	Transmitter Address HHO
3	18	801	0321	Transmitter Address HO
3	19	802	0322	Transmitter Address LO
3	20	803	0323	Transmitter Status
3	21	804	0324	Data 1
3	22	805	0325	Data 2
3	23	806	0326	Data 3
3	24	807	0327	Data 4
4	25	808	0328	Transmitter Address HHO
4	26	809	0329	Transmitter Address HO
4	27	810	032A	Transmitter Address LO
4	28	811	032B	Transmitter Status
4	29	812	032C	Data 1
4	30	813	032D	Data 2
4	31	814	032E	Data 3
4	32	815	032F	Data 4
5	33	816	0330	Transmitter Address HHO
5	34	817	0331	Transmitter Address HO
5	35	818	0332	Transmitter Address LO
5	36	819	0333	Transmitter Status
5	37	820	0334	Data 1
5	38	821	0335	Data 2
5	39	822	0336	Data 3
5	40	823	0337	Data 4
6	41	824	0338	Transmitter Address HHO
6	42	825	0339	Transmitter Address HO
6	43	826	033A	Transmitter Address LO
6	44	827	033B	Transmitter Status
6	45	828	033C	Data 1
6	46	829	033D	Data 2
6	47	830	033E	Data 3
6	48	831	033F	Data 4

7	49	832	0340	Transmitter Address HHO
7	50	833	0341	Transmitter Address HO
7	51	834	0342	Transmitter Address LO
7	52	835	0343	Transmitter Status
7	53	836	0344	Data 1
7	54	837	0345	Data 2
7	55	838	0346	Data 3
7	56	839	0347	Data 4
8	57	840	0348	Transmitter Address HHO
8	58	841	0349	Transmitter Address HO
8	59	842	034A	Transmitter Address LO
8	60	843	034B	Transmitter Status
8	61	844	034C	Data 1
8	62	845	034D	Data 2
8	63	846	034E	Data 3
8	64	847	034F	Data 4
9	65	848	0350	Transmitter Address HHO
9	66	849	0351	Transmitter Address HO
9	67	850	0352	Transmitter Address LO
9	68	851	0353	Transmitter Status
9	69	852	0354	Data 1
9	70	853	0355	Data 2
9	71	854	0356	Data 3
9	72	855	0357	Data 4
10	73	856	0358	Transmitter Address HHO
10	74	857	0359	Transmitter Address HO
10	75	858	035A	Transmitter Address LO
10	76	859	035B	Transmitter Status
10	77	860	035C	Data 1
10	78	861	035D	Data 2
10	79	862	035E	Data 3
10	80	863	035F	Data 4
11	81	864	0360	Transmitter Address HHO
11	82	865	0361	Transmitter Address HO
11	83	866	0362	Transmitter Address LO
11	84	867	0363	Transmitter Status
11	85	868	0364	Data 1
11	86	869	0365	Data 2
11	87	870	0366	Data 3
11	88	871	0367	Data 4
12	89	872	0368	Transmitter Address HHO
12	90	873	0369	Transmitter Address HO
12	91	874	036A	Transmitter Address LO
12	92	875	036B	Transmitter Status
12	93	876	036C	Data 1
12	94	877	036D	Data 2
12	95	878	036E	Data 3
12	96	879	036F	Data 4
13	97	880	0370	Transmitter Address HHO
13	98	881	0371	Transmitter Address HO
13	99	882	0372	Transmitter Address LO
13	100	883	0373	Transmitter Status
13	101	884	0374	Data 1
13	102	885	0375	Data 2
13	103	886	0376	Data 3
13	104	887	0377	Data 4

14	105	888	0378	Transmitter Address HHO
14	106	889	0379	Transmitter Address HO
14	107	890	037A	Transmitter Address LO
14	108	891	037B	Transmitter Status
14	109	892	037C	Data 1
14	110	893	037D	Data 2
14	111	894	037E	Data 3
14	112	895	037F	Data 4
15	113	896	0380	Transmitter Address HHO
15	114	897	0381	Transmitter Address HO
15	115	898	0382	Transmitter Address LO
15	116	899	0383	Transmitter Status
15	117	900	0384	Data 1
15	118	901	0385	Data 2
15	119	902	0386	Data 3
15	120	903	0387	Data 4
16	121	904	0388	Transmitter Address HHO
16	122	905	0389	Transmitter Address HO
16	123	906	038A	Transmitter Address LO
16	124	907	038B	Transmitter Status
16	125	908	038C	Data 1
16	126	909	038D	Data 2
16	127	910	038E	Data 3
16	128	911	038F	Data 4
17	129	912	0390	Transmitter Address HHO
17	130	913	0391	Transmitter Address HO
17	131	914	0392	Transmitter Address LO
17	132	915	0393	Transmitter Status
17	133	916	0394	Data 1
17	134	917	0395	Data 2
17	135	918	0396	Data 3
17	136	919	0397	Data 4
18	137	920	0398	Transmitter Address HHO
18	138	921	0399	Transmitter Address HO
18	139	922	039A	Transmitter Address LO
18	140	923	039B	Transmitter Status
18	141	924	039C	Data 1
18	142	925	039D	Data 2
18	143	926	039E	Data 3
18	144	927	039F	Data 4
19	145	928	03A0	Transmitter Address HHO
19	146	929	03A1	Transmitter Address HO
19	147	930	03A2	Transmitter Address LO
19	148	931	03A3	Transmitter Status
19	149	932	03A4	Data 1
19	150	933	03A5	Data 2
19	151	934	03A6	Data 3
19	152	935	03A7	Data 4
20	153	936	03A8	Transmitter Address HHO
20	154	937	03A9	Transmitter Address HO
20	155	938	03AA	Transmitter Address LO
20	156	939	03AB	Transmitter Status
20	157	940	03AC	Data 1
20	158	941	03AD	Data 2
20	159	942	03AE	Data 3
20	160	943	03AF	Data 4

21	161	944	03B0	Transmitter Address HHO
21	162	945	03B1	Transmitter Address HO
21	163	946	03B2	Transmitter Address LO
21	164	947	03B3	Transmitter Status
21	165	948	03B4	Data 1
21	166	949	03B5	Data 2
21	167	950	03B6	Data 3
21	168	951	03B7	Data 4
22	169	952	03B8	Transmitter Address HHO
22	170	953	03B9	Transmitter Address HO
22	171	954	03BA	Transmitter Address LO
22	172	955	03BB	Transmitter Status
22	173	956	03BC	Data 1
22	174	957	03BD	Data 2
22	175	958	03BE	Data 3
22	176	959	03BF	Data 4
23	177	960	03C0	Transmitter Address HHO
23	178	961	03C1	Transmitter Address HO
23	179	962	03C2	Transmitter Address LO
23	180	963	03C3	Transmitter Status
23	181	964	03C4	Data 1
23	182	965	03C5	Data 2
23	183	966	03C6	Data 3
23	184	967	03C7	Data 4
24	185	968	03C8	Transmitter Address HHO
24	186	969	03C9	Transmitter Address HO
24	187	970	03CA	Transmitter Address LO
24	188	971	03CB	Transmitter Status
24	189	972	03CC	Data 1
24	190	973	03CD	Data 2
24	191	974	03CE	Data 3
24	192	975	03CF	Data 4
25	193	976	03D0	Transmitter Address HHO
25	194	977	03D1	Transmitter Address HO
25	195	978	03D2	Transmitter Address LO
25	196	979	03D3	Transmitter Status
25	197	980	03D4	Data 1
25	198	981	03D5	Data 2
25	199	982	03D6	Data 3
25	200	983	03D7	Data 4
26	201	984	03D8	Transmitter Address HHO
26	202	985	03D9	Transmitter Address HO
26	203	986	03DA	Transmitter Address LO
26	204	987	03DB	Transmitter Status
26	205	988	03DC	Data 1
26	206	989	03DD	Data 2
26	207	990	03DE	Data 3
26	208	991	03DF	Data 4
27	209	992	03E0	Transmitter Address HHO
27	210	993	03E1	Transmitter Address HO
27	211	994	03E2	Transmitter Address LO
27	212	995	03E3	Transmitter Status
27	213	996	03E4	Data 1
27	214	997	03E5	Data 2
27	215	998	03E6	Data 3
27	216	999	03E7	Data 4

28	217	1000	03E8	Transmitter Address HHO
28	218	1001	03E9	Transmitter Address HO
28	219	1002	03EA	Transmitter Address LO
28	220	1003	03EB	Transmitter Status
28	221	1004	03EC	Data 1
28	222	1005	03ED	Data 2
28	223	1006	03EE	Data 3
28	224	1007	03EF	Data 4
29	225	1008	03F0	Transmitter Address HHO
29	226	1009	03F1	Transmitter Address HO
29	227	1010	03F2	Transmitter Address LO
29	228	1011	03F3	Transmitter Status
29	229	1012	03F4	Data 1
29	230	1013	03F5	Data 2
29	231	1014	03F6	Data 3
29	232	1015	03F7	Data 4
30	233	1016	03F8	Transmitter Address HHO
30	234	1017	03F9	Transmitter Address HO
30	235	1018	03FA	Transmitter Address LO
30	236	1019	03FB	Transmitter Status
30	237	1020	03FC	Data 1
30	238	1021	03FD	Data 2
30	239	1022	03FE	Data 3
30	240	1023	03FF	Data 4
31	241	1024	0400	Transmitter Address HHO
31	242	1025	0401	Transmitter Address HO
31	243	1026	0402	Transmitter Address LO
31	244	1027	0403	Transmitter Status
31	245	1028	0404	Data 1
31	246	1029	0405	Data 2
31	247	1030	0406	Data 3
31	248	1031	0407	Data 4
32	249	1032	0408	Transmitter Address HHO
32	250	1033	0409	Transmitter Address HO
32	251	1034	040A	Transmitter Address LO
32	252	1035	040B	Transmitter Status
32	253	1036	040C	Data 1
32	254	1037	040D	Data 2
32	255	1038	040E	Data 3
32	256	1039	040F	Data 4

As the transmitter address and Data values are 24 bit and modbus works with 16 bit registers, all the above registers are sent as 16 bit addresses and the HO byte will always be 0, for example: for a pulse
count of 34562, the hex is 008702H, will be sent as 0000,0087,0002 for Data 1, Data 2 and Data 3.

Appendix 2: Memory Map – Communications Timers

(Only Valid for Receiver with Firmware later than Rev 5.0)

For each Transmitter, there is a register that counts in minutes, time since it last reported.

This value increments approximately every minute and stops when it reaches 128.

When the value reaches 60 (approx 1 hour), a flag is cleared in the transmitter status register as an indication.

The registers could also be used to determine the reliability of the system during installation.

Tx. No.	Register No.	Modbus Register Address		Description
		Dec	Hex	
1	1	1281	0501	Transmitter 1 Timer
2	2	1282	0502	Transmitter 2 Timer
3	3	1283	0503	Transmitter 3 Timer
4	4	1284	0504	Transmitter 4 Timer
5	5	1285	0505	Transmitter 5 Timer
6	6	1286	0506	Transmitter 6 Timer
7	7	1287	0507	Transmitter 7 Timer
8	8	1288	0508	Transmitter 8 Timer
9	9	1289	0509	Transmitter 9 Timer
10	10	1290	050A	Transmitter 10 Timer
11	11	1291	050B	Transmitter 11 Timer
12	12	1292	050C	Transmitter 12 Timer
13	13	1293	050D	Transmitter 13 Timer
14	14	1294	050E	Transmitter 14 Timer
15	15	1295	050F	Transmitter 15 Timer
16	16	1296	0510	Transmitter 16 Timer
17	17	1297	0511	Transmitter 17 Timer
18	18	1298	0512	Transmitter 18 Timer
19	19	1299	0513	Transmitter 19 Timer
20	20	1300	0514	Transmitter 20 Timer
21	21	1301	0515	Transmitter 21 Timer
22	22	1302	0516	Transmitter 22 Timer
23	23	1303	0517	Transmitter 23 Timer
24	24	1304	0518	Transmitter 24 Timer
25	25	1305	0519	Transmitter 25 Timer
26	26	1306	051A	Transmitter 26 Timer
27	27	1307	051B	Transmitter 27 Timer
28	28	1308	051C	Transmitter 28 Timer
29	29	1309	051D	Transmitter 29 Timer
30	30	1310	051E	Transmitter 30 Timer
31	31	1311	051F	Transmitter 31 Timer
32	32	1312	0520	Transmitter 32 Timer

Appendix 3: Modbus CRC

A CRC-16 checksum is implemented on every message to detect any bit errors in the message. The checksum calculation is only used to detect errors but cannot correct them.

The crc generating polynomial used is: $x^{16} + x^{15} + x^2 + 1$

Visual Basic CRC Routine

```
' CRC Algorithm
Function Tcrcgen()

        Hicrc = &HFF
        Locrc = &HFF

        ' Put data received into array
        For i% = 1 To Len(Outstring)
                Outarray(i%) = Mid$(Outstring, i%, 1)

                Hicrc = Hicrc Xor Asc(Outarray(i%))

                For Q = 1 To 8
                        Carry = Hicrc And &H1

                        ' Below is Hicrc=((Hicrc shr 1)&$7F) OR ((Locrc & $01) shl 7)
                        Hicrc = Hicrc \ 2
                        If (Locrc And &H1) <> 0 Then
                                Hicrc = Hicrc Or &H80
                        End If

                        ' Below is Locrc=(Locrc shr 1) and $7Fh
                        Locrc = Locrc \ 2

                        If Carry <> 0 Then
                                Locrc = Locrc Xor &HA0
                                Hicrc = Hicrc Xor &H1
                        End If

                Next Q%

        Next i%

End Function
```

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