

WIRELESS RECEIVER WRM-TS

USER MANUAL

Rev. 1.0c

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1. General information

WRM-TS is a wireless m-bus receiver, intended to collect data from various devices, working in modes T or S according to wireless m-bus standard (EN13757-4). WRM-TS have the following main features and characteristics:

- serial RS-232C interface for communicating with external device (computer, communication device/controller, etc.)
- wired m-bus interface, slave device in a m-bus network
- memory for saving data for up to 250 devices
- real time clock
- several LEDs for work state information
- external power supply (adapter [12V@0.5A](#)), included

This device has simple function – collect data from every wireless meter which is told to, and convert this data to normal m-bus telegram. This telegram can be read both through PC interface and/or m-bus interface by external controller. It is ideal for mixed type networks (wire and wireless m-bus) because it can read wireless devices and send needed data through standard m-bus interface. Supports Primary addressing of attached devices from 1 to 250 (defined by user), but can decrypt (if AES-128 data encryption) addresses from 1 to 64.

Normally three scenarios can occur:

- Connect WRM-TS to master m-bus converter/display, like MBM-64/250 – then data will be visualized on display or read through wired m-bus interface
- Connect WRM-TS to communication device like Ethernet/GPRS/phone modem – then data can be read from remote location
- Connect portable computer to RS-232 port and read information manually.

In next version USB-interface will be provided in order to have ability for quick data download without need of a computer.

WRM-TS works in 868MHz range and can recognize wireless m-bus modes T, S and R.

All settings are made through serial PC port. Since all commands are ASCII based this can be done with simple terminal program, although easy setup software is provided for setting and reading.

Since most of wireless meters (water-meters and heat-meters mainly) work in T1 mode, this means that they transmit data in short packages (2-5ms) every few seconds (normally something between 30 and 120 seconds). WRM-TS can be set to memorize this data on particular interval – from 15 minutes to 240 hours. Device can be set to send data in two modes then:

– via m-bus interface with m-bus telegram, according to EN13757-3 (SND_UD2). Timestamps can be turned ON or OFF;

- via RS-232C interface either with m-bus telegram or with full radio-telegram received.

If full radio-telegram is chosen further processing shall be made by external controller/software. In this scenario encryption can be made also by the external device, if primary addresses exceed 64.

This is first version of this device, so further upgrades shall be made in the future or by user requests.

2. Technical parameters

- RF band – 868Mhz, 12 channels
- Wireless m-bus modes - T1, T2, S1, S2
- M-bus slave interface - 1.5 mA
- M-bus interface parameters - 300/1200/2400/4800, default 2400/even
- Maximum devices allowed - up to 250
- AES-128 encryption/decryption - for addresses 1-64
- serial port baud rate – 0.3/1.2/2.4/4.8/9.6/19.2/38.4 kbps
- power supply – 6-12 Vdc/0.5 A, adapter 2 mm
- max. power consumption @ 12Vdc – < 5W
- ambient temperature, operating – -20÷+50 °C
- ambient temperature, storage – -50÷+85 °C
- air humidity, operating & storage – 40÷90 %
- dimensions (L/W/H) – 125/70/30 mm (without antenna)
- protection class - IP30
- display - 3 leds (on/RF, RS-232 comm, m-bus)
- weight – 170 g

3. Normal mode of operation

WRM-TS are set only through serial interface commands. Full list of commands and explanation is given in next chapter. Serial interface can be set to different speeds to match external reading device. For wireless device data to become available particular device must be *ACTIVATED* in WRM-TS memory. Once activated it is regularly read and updated. WRM-TS itself keeps track of time and saves timestamp with each record. There are no historical values. Read period can be set in minutes or hours, with maximum value of 240 hours and minimum value of 5 minutes.

To start reading particular device there are two main steps that must be done:

- set WRM-TS in desired wireless m-bus mode
- activate a device in memory
- *set desired interval for memorizing

*by default this value is on every 6 hours

And that's all, you are ready to go.

Normally device is 'listening' the air for incoming transmissions. It can be set in two modes:

- work with filtering – "*Normal mode*", which means that all transmissions that do not have proper headers, are rejected
- work in "*Accept all*" mode, which means that every message in the air is processed

If one is not sure in which mode should work – we recommend using "*Accept all*" mode (which is default by the way). There is only one scenario in which filtering must be used – if wireless data is AES-128 encrypted.

Activating a device means that certain device is written in WRM-TS memory with Primary and Secondary address. Secondary address is device ID, which is usually written on the device (8-digit code). Primary address can be a number from 1 to 250 and is up to user to select it. It is not mandatory to use sequential Primary addresses. In other words, if we want to read 10 devices – not necessary to set Primary addresses from 1 to 10. They can be random.

Then, when external m-bus converter or device asks these Primary addresses – WRM-TS will answer with m-bus style telegram, including timestamp (if activated).

If a device is activated, but not yet transmitted information – it will not be available for reading.

If timestamps will be used – it is good to set time and date. WRM-TS has internal Real Time Clock, which has a backup battery in case main power supply fails. Normally it will keep clock up and running around 1 month. Then date and time will be lost and clock will start from 01.01.2016, 00:00:00.

4. Command reference

All commands and parameters are ASCII based with one exception – encryption key command (look paragraph 4.2.21 for further info). Each command consists of three* basic parts:

- command type
- command description
- parameters*

*parameters are optional for some of the commands.

Command types are consisted of 3-letter ASCII and are three main types – '*get*', '*set*' and '*del*'.

Command description is a 4-letter command code.

Command parameters are one or two ASCII sequences, separated with a ',' symbol. When parameters have to be set in WRM-TS memory, after command description is always present symbol '='.

WRM-TS respond with ASCII-based messages after processing each command. New command should be send after previous command has been processed and WRM-TS have responded to the user.

So, there are 3 types of command that the user can send to WRM-TS:

<command type> <command description>
<command type> <command description>=parameter 1
<command type> <command description>=parameter 1, parameter 2

Examples:

- 1) get main - returns type and serial number of device
- 2) set time=18:46:32 - sets time to 18:46:32
- 3) set com1=6,2 - sets RS-232 port to 19200, Even

4.1. Command 'get'

Command '*get*' is used to obtain information from WRM-TS. This information is current status, information about main parameters, active addresses, etc.

4.1.1. Reading identification of device

Command: get main

Returns Version, type and Device ID

4.1.2. Reading communication parameters

Command: get serv

Returns:

- Working time without power interrupt
- Serial PC com port parameters
- M-bus connection parameters
- Timeout for reading command from PC and m-bus
- Readout period – in minutes or hours
- Current time and date of internal real-time clock

4.1.3. Reading working status information

Command: get stat

Returns:

- DEBUG mode ON/OFF
- Transparent mode ON/Off
- Timestamp in m-bus telegram ON/OFF

Debug mode is only for service maintenance, so user should not be concern about it. Transparent mode, if ON, means that device will return to PC full radio telegram read, not an m-bus telegram. Timestamp in m-bus telegram, if ON, means that in m-bus telegram will be present date and time of reading (according to WRM-TS clock, of course).

4.1.4. Reading active primary addresses in memory

Command: get addr

Returns:

- MAX devices number (0-250)
- returning ADDRESS MASK for up to 250 devices. Address mask is in HEX-ASCII type. Each bit represents Primary address being activated for regular readout.

4.1.5. Reading time of device

Command: get time

Returns time of device in format "hh:mm:ss"

4.1.6. Reading date of device

Command: get date

Returns date of device in format "dd/mm/yy"

4.1.7. Reading full meter address information

Command: get full

Returns ALL Primary addresses and Secondary addresses activated. To each Primary address there is corresponding ID of a wireless m-bus device in the network.

Return is in format XXX,YYYYYYYYY<LF>

XXX = Primary address

YYYYYYYYY = Secondary address (ID)

4.1.8. Read information about particular primary address

Command: get entr=xxx

xxx = Primary address we need information for.

Return ID of device with primary address xxx. This is read from EEPROM memory.

Responds only if this device is Active!!!

4.1.9. Reading bind list of meters

Command: get bind

Binding is a special option in WRM-TS. It is different from activating a device for reading. WRM-TS can be set to work in filtering mode. This means that incoming messages will be filtered according to a *bind list*. If a device is binded – then this telegram is passed through, otherwise is rejected. Also, AES-128 encryption can be done only for *binded* devices. Normally WRM-TS work in mode "Accept All", so in this case binding will not be necessary thing to do. The only valid reason to use it should be if meters are encrypted and AES-128 decryption should be made on received data.

Up to 64 meters can be bind. It is mandatory also to use primary addresses form 1 to 64.

There are two ways to use the command:

- if without parameter returns ID's of all registers for bind devices
- if with parameter '=xxx' - returns ID for particular register. XXX must be <

65

4.1.10. Reading wireless m-bus status

Command: get wsta

Obtain wireless status. Returns Wireless m-bus mode, M-bus wireless frame format (Start/Stop, CRC, RSSI, etc.), Network type of WRM-TS, Work mode ("Normal" or "Accept All"), Presence of RSSI byte in the telegrams.

Command returns two sets of parameters:

- EEPROM settings, made by user
- Actual condition of the wireless part of the device

Two sets should be equal, other wise this means problems in device or settings should be done again.

4.1.11. Reading measured temperature on board

Command: get temp

Returns measured temperature from board sensor in degrees Celsius.

4.1.12. Reading measured microcontroller voltage

Command: get volt

Returns measured supply voltage from board sensors, in mV. Normally it should be between 3.200 Volts and 3.800 Volts.

4.1.13. Reading current signal strength

Command: get rssi

Return last received packet RSSI (signal strength).

If good wireless connection this parameter should be between 80 and 120dBm.

4.1.14. Reading readout information

Command: get flag

Return status of all write flags. When readout interval is set (in minutes or hours) each activated devices is associated with *write flag*. When readout interval comes all flags are cleared. On successful readout for a particular device its flag is SET. This means that no further processing will be done for this device until new readout interval occurs, because data is already memorized.

Normally used for diagnosing problems in WRM-TS work.

4.2. Command 'set'

Command '*set*' is used to set values to different parameters of WRM-TS. It is always used with one or two parameters.

4.2.1. Set time of device

Command: set time=hh:mm:ss

Set current time of WRM-TS.

Limits:

hh = <0-23>

mm = <0-59>

ss = <00-59>

4.2.2. Set date of device

Command: set date=dd/mm/yy

Set date of WRM-TS. User can not set date before 01/01/16.

Default value: 01/01/16

Limits:

dd = <1-31>
mm = <1-12>
yy = <16-99>

4.2.3. Set communication parameters for serial port

Command: set com1=x,y

Limits:
X = <0-7>
Y = <0-2>

Set serial port parameters for communication.

x = speed (0 = 300bps, 1 = 600bps, 2 = 1200, 3 = 2400bps, 4 = 4800, 5 = 9600, 6 = 19200 bps, 7 = 38400bps)

y = parity (0 = Even, 1 = Odd, 2 = None)

Default value: 2400, Even

Example:
set com1=3,0

This will set serial port to 2400, Even.

4.2.4. Set m-bus communication parameters

Command: set com3=x,y

Limits:
X = <0-4>
Y = <0-2>

Set m-bus port parameters for communication.

x = speed (0 = 300bps, 1 = 600bps, 2 = 1200, 3 = 2400bps, 4 = 4800)
y = parity (0 = Even, 1 = Odd, 2 = None)

Default value: 2400, Even

Example:
set com3=3,0

This will set m-bus port to 2400, Even.

4.2.5. Set respond timeouts for serial interface

Command: set neto=xxx

Limits:

xxx = <1-240>

Set timeout in xxx*32ms for reacting on received command through serial or m-bus port. This means that when last byte is received command will be processed after this amount of time.

Default value: 2

4.2.6. Activate/attach meter in WRM-TS memory**Command: set entr=x,yyyyyyyy**

where:

x = Primary address we want device to respond for this device;

yyyyyyyy = ID of the meter user wants to read

Limits:

x = <1-240>

y = 8-digit (each digit is between 0-9)

This command ACTIVATES particular meter in WRM-TS memory. Once activated, read data will be stored on every readout interval. Here 'x' represents primary address, which is chosen by the user. This is the address that WRM-TS will use when sending m-bus or radio telegram to external device on read. There are two objective reasons when selecting Primary address:

- there must be no two identical Primary address in same network, otherwise there will be collision on reading;
- if filtering mode will be used and/or AES-128 encryption/decryption – then address should be only between 1-64.

4.2.7. Set measure unit for data of particular meter**Command: set unit=xxx,yy**

Limits:

x = <1-250>

y = <0-31>

Sets medium for this meter in WRM-TS memory. xxx is Primary address, yy is coded medium, like it is in m-bus. Unit must be a number below 32, since 32-255 are RESERVED (m-bus standard). Others must be coded like m-bus table for variable data structure.

If unit >= 31, this means for the program to use DEV byte from wireless m-bus telegram as a valid MEDIUM byte in EN13757-3 wire m-bus telegram.

Default value: 0 (Other).

4.2.8. Define type of readout interval

Command: set minc=x

Values: 0 or 1

Defines automatic readout time should be in minutes (0) or hours (1).

Default value: 1 (hours)

4.2.9. Set readout interval (in minutes or hours)

Command: set pito=xxx

Limits:

xxx = <1-240>

Set readout period (in minutes or hours). If readout interval is in minutes then lower value that can be set is 5 minutes.

Default value: 6 hours

4.2.10. Set due date for reading attached meters

Command: set dued=dd/mm/yy

Sets DUE DATE for readout. When this date occurs, all devices are read, no matter readout interval. Then, due date is increased with one month. Limits are the same as setting WRM-TS date (section 4.2.2)

4.2.11. Put particular meter in the *bind list*

Command: set bind=xxx,yyyyyyyy

Limits:

xxx = <1-64>

yyyyyyyy = 8-byte HEX code

Bind an address for filtering and/or AES-128 encryption. Here 'yyyyyyyy' is not meter ID, but a concatenation between ID, Manufacturer code, version and device bytes in wireless m-bus frame header.

Normally this command is issued by Gineers software, but can be used manually by experienced users, which knows well m-bus frame formats.

4.2.12. Set encryption flags

Command: set amsg=xxx,yy

Limits:

xxx = <1-64>

yy = two bytes, hex, flags

4.2.13. Define signal strength information

Command: set rssi=0/1

Values: 0 (OFF) or 1 (ON)

Enables attaching RSSI byte to each wireless frame received. This byte is also re-translated to wire m-bus telegram in manufacturer specific part.

Default value: ON

4.2.14. Define presence of timestamp in telegrams

Command: set tmst=0/1

Values: 0 (OFF) or 1 (ON)

Enable WRM-TS Timestamp On/Off in m-bus telegram. If enabled - timestamp with internal RTC values is added in wire m-bus telegram readout.

Default value: ON

4.2.15. Define telegram mode

Command: set trns=0/1

Set transparent mode ON/OFF.

Values: 0 (OFF) or 1 (ON)

WRM-TS can send to external device two types of telegrams:

- m-bus type telegram, according to EN13757-3
- wireless m-bus radio telegram, according to EN13757-4

If transparent mode is ON -> wireless telegram is transmitted, with START (0x68) and STOP (0x16) byte. If RSSI byte is set for transmission – it will be the last byte before STOP byte.

If transparent mode is OFF then m-bus telegram according to EN13757-3 will be sent on request.

Default value: OFF

4.2.16. Set wireless m-bus mode of operation

Command: set wmod=xxx

Sets Wireless m-bus mode.

Limits:

x= <0-3>

Values: 0 = S2, 1 = T1, 2 = T2, 3 = S1, 4 = R

Default value: 1

4.2.17. Set work mode

Command: set wwrk=xxx

Set work mode. Three modes possible:

0 = Normal mode

1 = Install mode

2 = Accept all messages

For now install mode is reserved for future use, so user must work in either "*Normal mode*" (this mean filtering all devices outside *bind list*) or "*Accept All*".

Default value: **Accept All**

4.2.18. Set WRM-TS role in wireless network

Command: set nrol=xxx

Set WRM-TS Network Role - Master/Concentrator, Slave or Repeater.

Limits:

x= <0-2>

Possibilities:

0 = Slave/Meter

1 = Master/Concentrator

2 = Repeater

Default value: 1

4.2.19. Set Primary m-bus address to WRM-TS

Command: set mbsa=xxx

Limits:

xxx = <1-250>

Sets wired m-bus primary address of WRM-TS itself. On this address device responds only to initialization command (SND_NKE) and responds with 0xE5 (ACK).

4.2.20. Read particular meter on RS-232C port

Command: set read=xxx

Limits:

x= <1-240>

Return wireless EN13757-4 or m-bus EN13757-3 telegram (depending to transparent mode) on UART. Device must be activated in memory in order WRM-TS to respond.

4.2.21. Define encryption key (AES-128) for particular meter

Command: set encr=xxx,yyyyyyyyyyyyyyyyyy

Limits:

xxx = <1-64>

yyyyyyyyyyyyyyyyyy = 16-byte HEX code

Set encryption key for particular meter. Xxx is meter's Primary address in WRM-TS memory, while yyyyyyyyyyyyyyyyyy is 16-byte AES-128 encryption key. Work only for addresses from 1 to 64.

4.2.22. Turn decryption of received messages On/Off

Command: set decr=0/1

Values: 0 (OFF) or 1 (ON)

This enables decryption of AES-128 encrypted messages. Encryption key must be stored for exact meter in register addresses <1-64>, exact as *bind* register for this meter.

4.2.23. Return all settings to factory default

Command: set fact

Factory default values are loaded and saved. Does not affect:

- ID of WRM-TS
- Activated devices
- readouts

4.3. Command 'del'

This command is used to delete devices from memory and/or memory itself.

4.3.1. Delete/de-attach meter from memory

Command: del entr=xxx

where:

xxx = Primary address we want device to respond for this device;

Limits:

x = <1-240>

Delete particular meter in WRM-TS memory by its Primary address. This de-activated this device for further readouts, both wireless and through serial or m-bus interface.

4.3.2. Deactivate all devices in memory

Command: del addr

Clears ADDRESS MASK only. This means that all meters in memory are de-activated, but previously recorded data for these devices is not cleared!

4.3.3. Remove meter from the *bind list*

Command: del bind=xxx

where:

xxx = Primary address we want to clear from bind list.

Deletes meter 1-64 from bind list.

Limits:

x = <1-64>

5. PC software for setting WRM-TS

Although most of the commands are ASCII-based, there is free and easy to use software for setting up WRM-TS. It has the following functions:

- set wireless mode, network role and behavior of WRM-TS;
- activate/deletes meters for readout in WRM-TS memory;
- searches for meters, transmitting messages in the air;
- binds some meter and sets encryption key for AES-128 encryption;
- gets service information of WRM-TS work.

Software is part of general GMBus application, which means that with it meters can be read through m-bus or some other communication device of Gineers. TAB for setting WRM-TS looks like this:

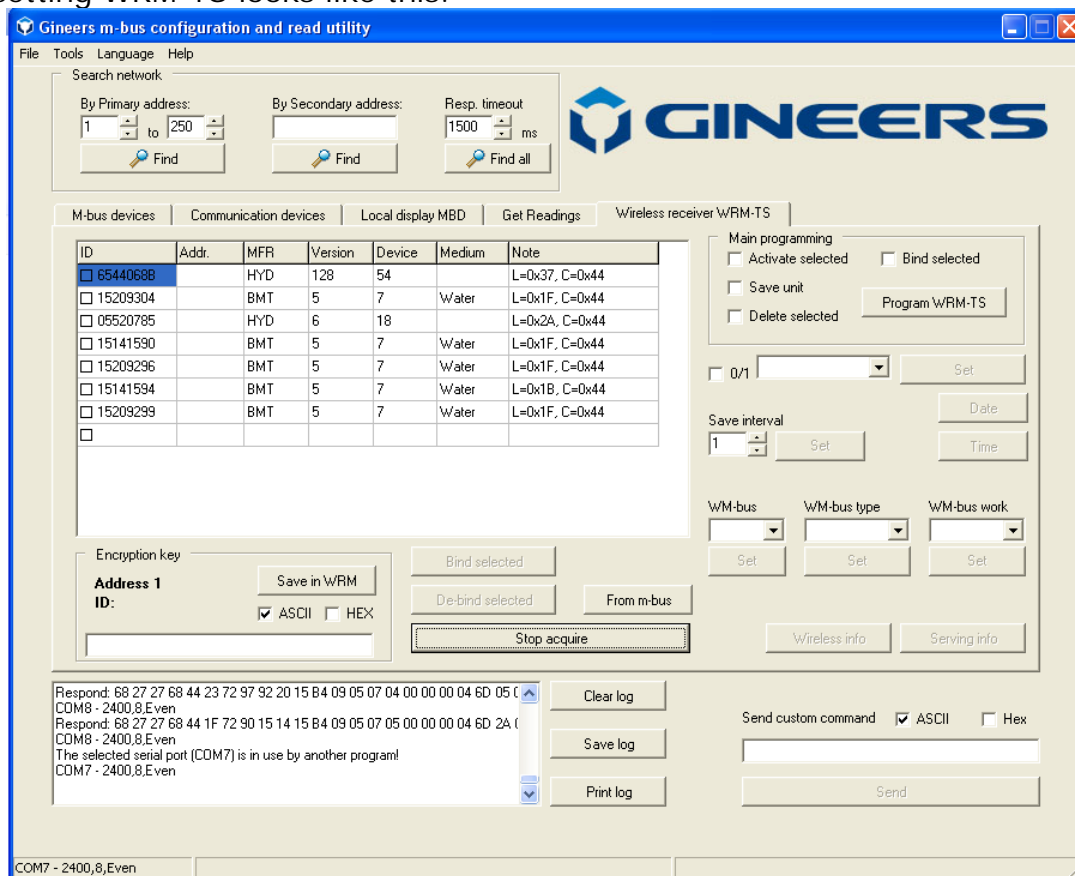
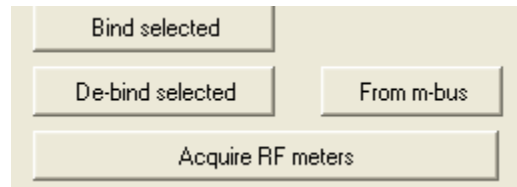


Fig. 1. Main view of WRM-TS setting software

Main part of the window is a table with meters to be activated/deleted in WRM-TS memory. There are two ways to fill the table:

- automatic
- manual

Automatic search and fill



Automatic means that button **"Acquire meters"** must be pressed. Then user just has to wait all meters he wants to be found and filled in the table. All valid messages will be presented in the table. User must have in mind also, that one meter will be present only once in the table. If button **"Acquire meters"** is pressed then WRM-TS is entered in special state, transmitting radio messages to PC. Button changes its sign to **"Stop acquire"** (like on Fig. 1). To return WRM-TS to normal work mode user must mandatory press button **"Stop acquire"** before any other actions (or to restart WRM-TS). Have in mind that the only field that is not automatically filled, is field "Addr."

Manual fill

User must enter data for each devices, and all fields are mandatory to fill. Also is possible to import from CSV file, but have in mind that CSV separator of import file should be the same as is in GMBus software (Options->Settings). Some fields are only allowed to fill in with digits.

After list of devices is ready, there are three things to be done:

- enter Primary addresses – numbers form 1 to 240
- enter valid medium
- Activate devices in WRM-TS memory and save valid units for each device

Valid mediums are valid mediums according to m-bus standard EN13757-3, in our case are:

Water; Cold water; Hot water; Electricity; Oil; Heat; Gas; Unknown; Other

Activation, medium, binding and deleting a device is made with help of group box in upper right corner.

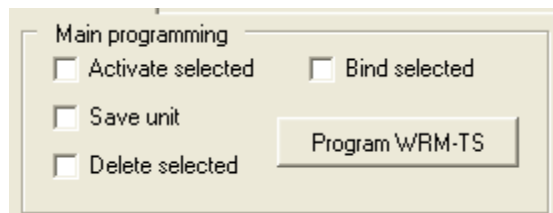


Fig. 3. Main programming options

All devices that we want to activate/delete must be with selected checkboxes. For each device in first column there is a checkbox. This is done either with mouse left-click, or with context menu, which pop-up on right click:

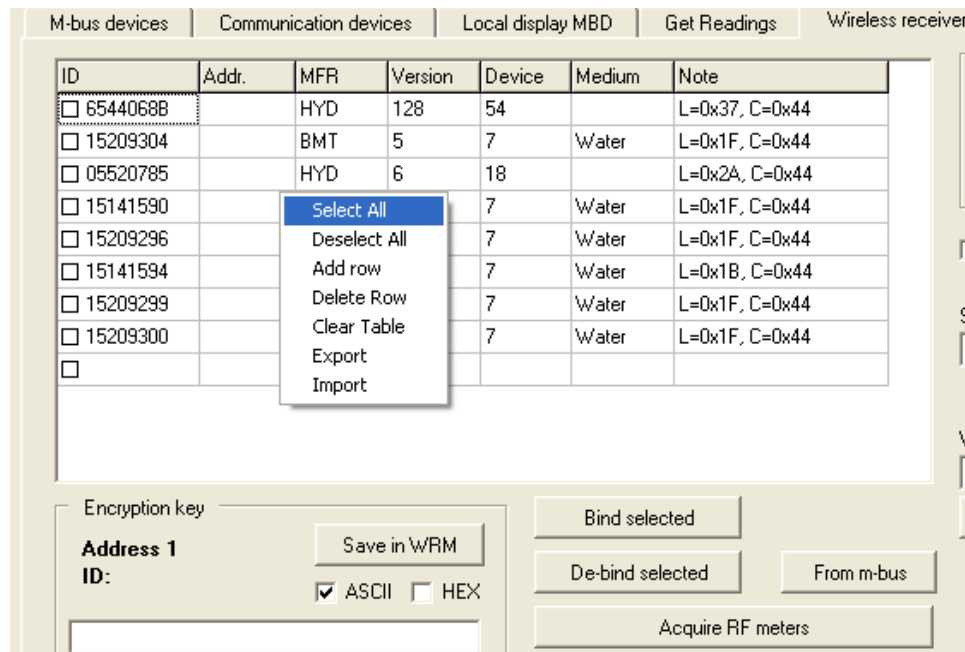


Fig. 4. Manipulating meter list

As can be seen, user can do the following manipulations from that menu:

- select All meters for processing
- deselect All meters
- Add row at the bottom of the table
- Delete CURRENT row
- Clear all table
- Export or import meter list

When desired meters are selected then button "Program WRM-TS" is pressed and user just has to wait process to finish. How is going can be seen from the progress bar and log window, in which every communication between PC and WRM-TS is recorded.

There are some other auxiliary functions that can be set, which are either On or OFF.

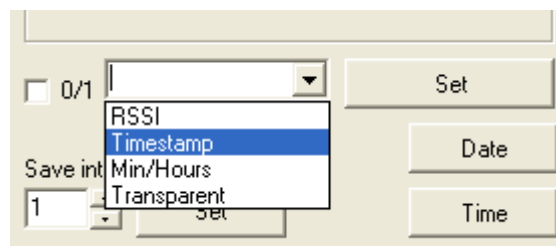


Fig. 5. Auxiliary functions

User must select desired function, then decide ON or OFF (check box "0/1") then press button "Set". Button "Date" sets date of WRM-TS to current PC date, button "Time" sets time of WRM-Ts to current PC time.

Bellow these options are buttons for setting wireless mode of device. Three things can be set here:

- wireless m-bus mode – T1, T2, S1, S2
- wireless work mode – Slave, Master, Repeater
- way of WRM-TS work – with filtering or Accept All

If filtering is used, for sure all meters must be *bind* in WRM-TS memory. Otherwise they will be rejected and not saved with their values. So default mode of work is **Accept all**, but only activated devices are saved in non-volatile memory.

Buttons "*Wireless info*" and "*Serving info*" can ask WRM-TS of important information and return it in log window (look commands *get serv* and *get wsta*).

At bottom right there is a way to send whatever command user wants. This serves as a terminal program. Result of every command will be recorded in log window on the left.

Since AES-128 encryption is not yet fully operating it will not be described here but in later revisions of this document.

5. Quick start guide

In order to put quickly device in operating mode, following steps should be made:

- Turn on the device and connect it to PC or other serial device, through which you can set parameters of WRM-TS
- set PC port to 2400, Even, since this is default speed and parity that WRM-TS works
- write down serial numbers of wireless meters you wish to read and give them Primary addresses. These addresses are from 1 to 250 and the only requirement is that they are unique in the network
- if you are using Gineers software, do the following:
 - enter device ID's and primary addresses in the table (or import them from CSV file)
 - enter measured medium for each device – i.e. Water, Cold water, Hot water
 - select check-boxes "Activate" and "Unit"
 - Right-click on meters table, select "Select All" option
 - press button "Program WRM-TS"
 - wait process to finish
- if you are using terminal program do the following:
 - for each meter issue command 'set entr=xxx,yyyyyyyyy', where xxx is primary address you chose, yyyyyyyy is meter ID
 - for each meter issue command 'set unit-xxx,yy', where xxx is primary address you chose, yy is two-digit code of medium measured due to m-bus standard
 - you are ready

Furthermore, user is good to select readout intervals, should he use timestamping or not and other not too important parameters.

Gineers software have also function automatically to find wireless meter. To do that user must press button "Acquire RF meters" and wait until all meters are found and listed in the table. Then desired meters (all or just the ones we want) just have to be activated in WRM-TS memory.

6. Contacts

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