WIRELESS RECEIVER WRM-TS

U S E R M A N U A L

Rev. 1.2a

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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, S or C mode, 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 480 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 M-bus Primary addressing of attached devices from 1 to 252 (defined by user), and AES-128 decryption addresses with separate key for each meter.

Normally three scenarios can occur:

- Connect WRM-TS to master m-bus converter/display, like MBM-TFT 64/128/250 – 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 C.

All settings are made through serial PC port. Because 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:

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– 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 or software.

This is second 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, C, T1+C
M-bus slave interface	- 1.5 mA
M-bus interface parameters	- 300/1200/2400/4800, default 2400/even
Maximum devices allowed	- up to 480
AES-128 encryption/decryption	- AES-128 Mode 5
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	– < 2W
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 15 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

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

Normally device is 'listening' the air for incoming transmissions. If it is time to save a telegram - then current message is saved in non-volatile memory.

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 252 for m-bus reading 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. The 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 send blank m-bus telegram (only header) and manufacturer code will be "GIN".

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 01.01.2020, 00:00:00.

Devices above primary address of 252 (253, 254 and 255 are reserved!) are read either through serial port with command "set read=xxx", or by the means of Secondary addressing through m-bus slave interface.

WRM-TS also can be set to return RSSI of each telegram. All m-bus wireless telegrams are kept untouched, except adding own timestamp in the telegram and RSSI byte as manufacturer specific sub-telegram at the end of wired m-bus answer.

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.

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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 FW Version, type, working mode and Device ID

4.1.2. Reading communication parameters

Command: get serv

Returns:
- Number of activated devices
- Serial PC com port parameters
- M-bus connection parameters
- 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:
- RSSI in telegram mode ON/OFF
- AES-128 decryption ON/Off
- Timestamp in m-bus telegram ON/OFF
- using Master AES key for activated meters On/Off
- number of saved telegrams in EEPROM memory
- number of total processed telegrams from power ON
- transparent mode ON/OFF
- which additional non-OMS devices are decoded automatically

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Transparent mode, if ON, means that device will return to PC full radio telegram read, not an m-bus telegram. This is used when programming device with some meters and user wants to catch meters from the air and not to import directly. 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). Timestamp is always the first sub-telegram in data payload. RSSI is always the last sub-telegram in the payload, coded as manufacturer specific value (DIF 0x0F).

4.1.4. Reading active primary addresses in memory

Command: get addr

Returns:
- Activated devices from MAX possible number (xxx/480)
- returning ADDRESS MASK for up to 480 devices. Address mask is in HEX-ASCII type. Each bit represents Primary address being activated for regular readout. Values are packed to 16 ASCII-HEX bytes, ending with CR LF on each 16-byte sequence.

Example answer:

Activated devices: 12/480<CR>
00000000000000000000000000000000<CR>
00000000000000000000000000000000<CR>
00000000000000000000000000000000<CR>
00000000000000000000000000000000<CR>
00000000000000000000000000000000<CR>
00000000000000000000000000000000<CR>
00000000000000000000000000000000<CR>
00000000000000000000000000000000<CR>
00000000000000000000000000000000<CR>
00000000000000000000000000000000<CR>
00000000000000000000000000000000<CR>
00000000000000000000000000000000<CR>
00000000000000000000000000000000<CR>
00000000000000000000000000000000<CR>
00000000000000000000111111111111<CR>

4.1.5. 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 data is in format XXX,YYYYYYYY<LF>
XXX = Primary address

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YYYYYYYY = Secondary address (ID)

4.1.6. 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!!!

4.1.7. Read encryption key (AES-128) for a particular meter ID

Command: get akey=xxxxxxxx

Limits:
xxxxxxxx = 00000000-99999999

Read encryption key for particular meter ID. XXXXXXXX is meter's Secondary address in WRM-TS memory.
If ID is '00000000' - then MASTER KEY is returned.
Answer is in ASCII bytes, see example:
12 34 56 78 9A BC DE FF FF FF FF FF FF FF FF FF<CR>

4.1.8. Read encryption key (AES-128) for a particular address

Command: get encr=xxx

Limits:
xxx = <1-250> or 0
yyyyyyyyyyyyyyyy = 16-byte HEX code

Read encryption key for particular meter. Xxx is meter's Primary address in WRM-TS memory, while yyyyyyyyyyyyyyyy is 16-byte AES-128 encryption key, returned in HEX value on serial port. Work only for addresses from 1 to 250. Above that address command 'get akey' should be used.

If address is 0 - then MASTER KEY is returned.

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

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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

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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. Activate/attach meter in WRM-TS memory

Command: set entr=xxx,yyyyyyyy

where:
xxx = Primary address we want device to respond for this device;
yyyyyyyy = ID of the meter user wants to read

Limits:
x = <1-480>
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.

4.2.6. Define type of readout interval

Command: set minc=x

Values: 0 or 1
Defines automatic readout/saving time should be in minutes (1) or hours (0).
Default value: **1** (minutes)

4.2.7. Set readout interval (in minutes or hours)

Command: set pito=xxx

Limits:

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xxx = <1-240>

Set readout period (in minutes or hours). If readout interval is in minutes then lower value that can be set is 15 minutes.
Default value: **15 minutes**

4.2.8. 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**

4.2.9. 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**

4.2.10. Define position of timestamp in telegrams

Command: set tmsb=0/1

Values: 0 (end of telegram) or 1 (start of data payload)

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: Start of data payload in m-bus telegram readout

4.2.11. Define telegram mode

Command: set trns=0/1

Set transparent mode ON/OFF.
Values: 0 (OFF) or 1 (ON)

In transparent mode WRM-TS sends everything received in the air to its serial RS-232 port. This is used usually in programming mode. Telegram send is wireless m-bus radio telegram, according to EN13757-4

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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.

Default value: **OFF**

4.2.12. Set wireless m-bus mode of operation

Command: set wmod=xxx

Sets Wireless m-bus mode.
Limits:
x= <0-3>

Values: **0** = T1+C, 1 = T1, 3 = S1, 5 = C mode
2 and 4 set automatically mode to T1, because are not implemented.

Default value: **0**

4.2.13. 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**
Note: version 1.2x and above can not work as a repeater. This is valid only for older versions of WRM-TS!

4.2.14. Read particular meter on RS-232C port

Command: set read=xxx

Limits:
x= <1-480>

Return m-bus EN13757-3 telegram on UART. Device must be activated in memory in order WRM-TS to respond.

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4.2.15. Define encryption key (AES-128) for particular address

Command: set encr=xxx,yyyyyyyyyyyyyyyy

Limits:
xxx = <1-250> or 0
yyyyyyyyyyyyyyyy = 16-byte HEX code

Set encryption key for particular meter. Xxx is meter's Primary address in WRM-TS memory, while yyyyyyyyyyyyyyyy is 16-byte AES-128 encryption key. Work only for addresses from 1 to 250. For above address user should use command 'set akey', which sets decryption key by device ID.

If address is 0 - then MASTER KEY is saved, in other words - one AES-128 key for all meters.

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

Command: set akey=xxxxxxxx,yyyyyyyyyyyyyyyy

Limits:
xxxxxxxx = 00000000 - 99999999
yyyyyyyyyyyyyyyy = 16-byte HEX code

Set encryption key for particular meter. XXXXXXXXX is meter's Secondary Address in WRM-TS memory, while yyyyyyyyyyyyyyyy is 16-byte AES-128 encryption key.

If ID is '00000000' - then MASTER KEY is saved, in other words - one AES-128 key for all meters.

4.2.17. 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 from WRM-TS.

Note: This also is automatically enabled, if the user saves any AES-128 key to a meter.

4.2.18. Turn MASTER KEY On/Off

Command: set mast=0/1

Values: 0 (OFF) or 1 (ON)

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This enables decryption of AES-128 encrypted messages with one key for all meters - **MASTER key**

Note: This also is automatically enabled, if the user saves MASTER key to a 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

4.2.24. Reset command
version 1.26BTF and above only command
Command: set rset=1

Resets the device. Useful in some cases when device is in unknown state due to power supply strikes or something like that.

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 = <1-483>

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. Delete all devices in memory

Command: del full

Clears all memory data, including AES-128 encryption keys.

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4.3.4. Delete encryption key (AES-128) for particular meter ID

Command: del akey=xxxxxxxx

Limits:
xxxxxxxx = 00000000-99999999

Delete encryption key for particular meter ID. XXXXXXXX is meter's Secondary address in WRM-TS memory. Deletion means that all bytes of a key will become 0xFF. Still a key can be read by command 'get encr=xxx' or 'get akey=xxxxxxxx', but will not be used for decryption of a message.

If ID is '00000000' - then MASTER KEY is deleted.

4.3.5. Delete encryption key (AES-128) for particular address

Command: del encr=xxx

Limits:
xxx = <1-250> or 0
yyyyyyyyyyyyyyyy = 16-byte HEX code

Delete encryption key for particular meter. Xxx is meter's Primary address in WRM-TS memory, while yyyyyyyyyyyyyyyy is 16-byte AES-128 encryption key. Work only for addresses from 1 to 252. Deletion means that al bytes of a key will become 0xFF. Still a key can be read by command 'get encr=xxx', but will not be used for decryption of a message.
If address is 0 - then MASTER KEY is deleted.

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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;
- set encryption keys for AES-128 decryption;
- 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:

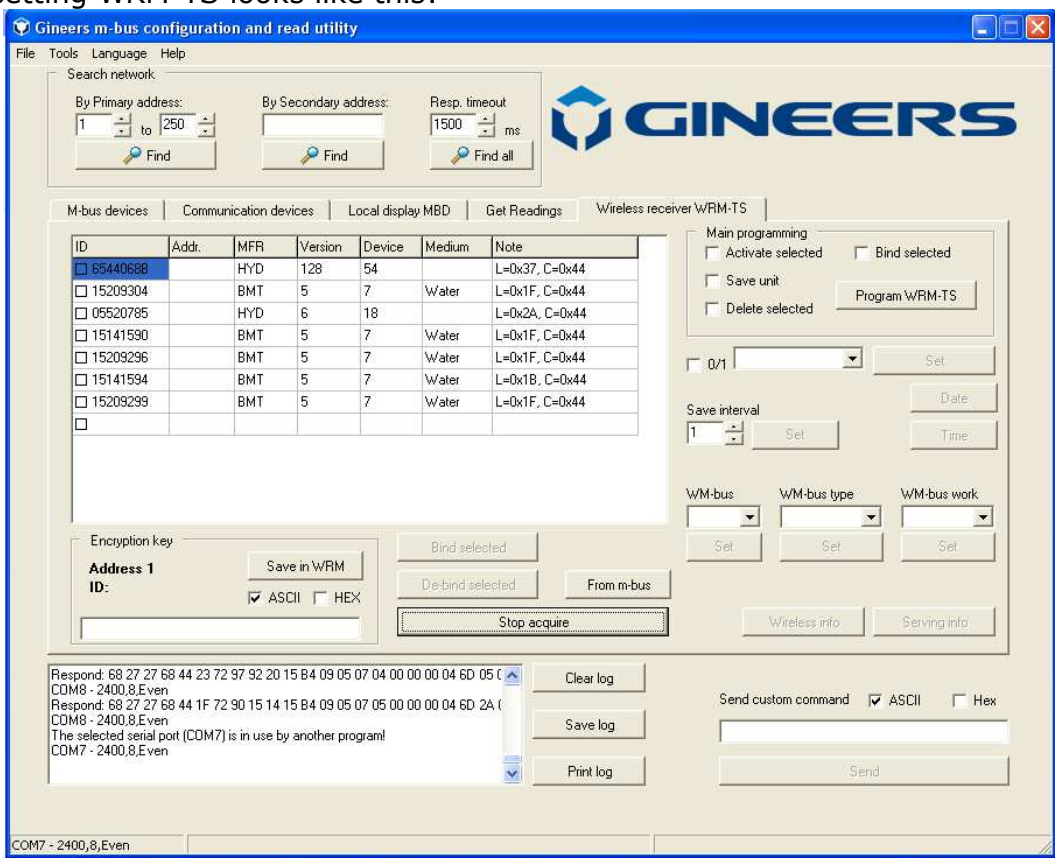

Fig. 1. Main view of WRM-TS setting software

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

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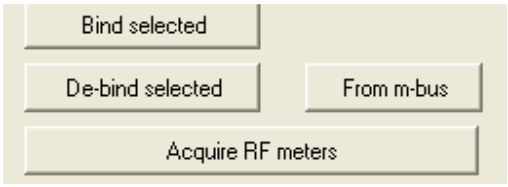

Automatic means that button ***"Acquire meters"*** must be pressed. Then user just has to wait all meters he wants to be found and filled in the table. All valid messages will be presented in the table. User must have in mind also, that one meter will be present only once in the table. If button ***"Acquire 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 250
- 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.

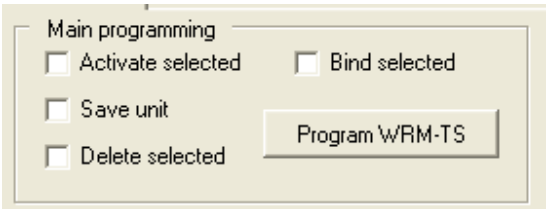

Fig. 3. Main programming options

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:

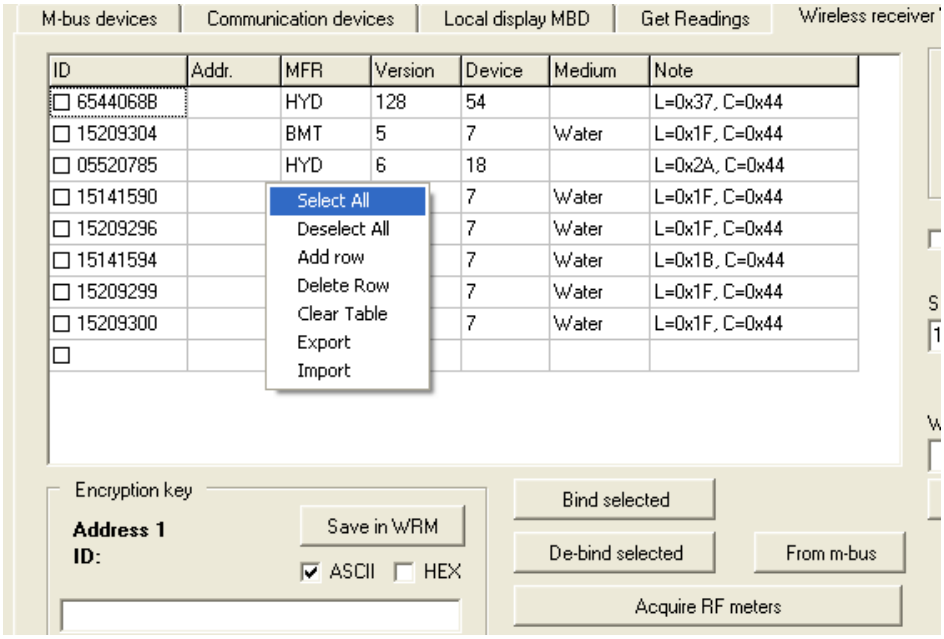

Fig. 4. Manipulating meter list

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.

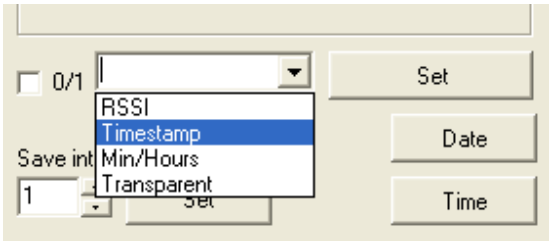

Fig. 5. Auxiliary functions

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.

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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, R (only old versions), T+C
- wireless work mode – Slave, Master, Repeater (for v1.2x only Master)
- way of WRM-TS work – with filtering or Accept All (for v1.2x only 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.

To set AES-128 encryption key user should select a meter from the table, then enter desired code in the field below the table (either in HEX or as a hex-string), then save the key. Or do that through terminal program, issuing direct command to WRM-TS. As described above - key can be linked either to m-bus primary address in WRM-TS memory, or by ID of the meter. In the software user can select either by Prmiary or setting by Secondary address.

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5. Quick start guide

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

- 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,yyyyyyyy', 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.

Note: DO NOT FORGET to exit "Acquire mode" before activating devices in WRM memory!

6. Contacts

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If any questions, suggestions or troubles using this program, please write to support@gineers.com