

# Honeywell

Functional specification

**OpenTherm TestTool**

V2.4

**Attention:**

Current software is not shipped with this box. It is available for download via our website:

<http://www.hccp.nl/downloads>

## 1. History

Version	Date	Author	Description of the changes
1.0	20-04-2000	BK	<ul style="list-style-type: none"> <li>Action can changed in read, write, data_invalid and (unknown_id)</li> <li>New options in slave tester: minimal request time, repeat when incorrect.</li> <li>Filter on active messages in test slave</li> <li>Current data can saved in otm file</li> <li>New option in master tester: Response time (replaces auto response)</li> <li>Auto response mode is removed</li> <li>All timings are implemented in ottestool</li> </ul>
2.2	26-03-2004	SAL	<ul style="list-style-type: none"> <li>Negative S16 were incorrectly read from OTM files</li> <li>Default response time slave changed from 20ms to 100ms</li> <li>R/W functionality didn't work, function changed to AUTO</li> <li>"Access denied" error message when in monitor and no communication resolved</li> <li>Slave interface and Master interface functionality and layout are similar</li> <li>Slave will respond as is set in slave interface</li> <li>Slave interface displays received request from Master</li> <li>Log files are stored according to regional settings of computer</li> <li>Log files made compatible with excel</li> <li>Reading and Writing of OTM files made regional settings independent</li> <li>Req column removed from Master interface and integrated in Action column</li> <li>Option added to slave interface to give no response to a request</li> <li>Absolute timing in log file improved</li> <li>Firmware hardware interface is detected</li> <li>Auto response is added as an error in log file</li> </ul>
2.4	03-03-2009	SAL	<ul style="list-style-type: none"> <li>New processor for firmware OTT</li> <li>Smart power support for master, slave and monitor</li> <li>Popup menu added to change message action(s), more then 1 row can be selected to be changed.</li> <li>AUTO action wasn't used when another action was defined on the same OpenTherm ID.</li> <li>Idle status of Master and Slave indicated.</li> </ul>

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### 3. **Introduction**

#### 3.1. **Product description**

The OpenTherm testTool consists of a program for Windows'9x, ME, 2000, XP, Vista or Windows NT and a special OpenTherm interface control (OIC). With this system, the communication between an OpenTherm master and an OpenTherm slave can be monitored. Also this system can act as an OpenTherm master or an OpenTherm slave control. For presentation, and program flow in case master mode, an ASCII file with OpenTherm ID definitions is used. The PC has to be connected via a RS232 communication port to the special interface control (OIC)

### 4. **Software and hardware requirements**

For the OpenTherm test is needed:

- A PC with windows and the OpenTherm Monitor 2.4 software
- An OpenTherm Interface Control with firmware V3.0, older firmware versions can be controlled by OpenTherm monitor 2.2 software.

### 5. **OpenTherm interface connections**

L	Power supply 230VAC
N	Power supply 230VAC
1,2	OpenTherm slave tester
V,gnd,I	Connections for oscilloscope probes
3,4	OpenTherm master tester
V,gnd,I	Connections for oscilloscope probes
5,6	OpenTherm bus monitor, master connection
7,8	OpenTherm bus monitor, slave connection
V,gnd,I	Connections for oscilloscope probes

Connections for oscilloscope probes:

- V Voltage on the OT bus
- GND Ground
- I Current in OT bus (10mV/mA)

## 6. Communication interface

The PC application communicates with the OpenTherm interface control via RS232 communication, the properties are:

- Baud rate: 57K600
- Data bits: 8
- Parity: None
- Stop bits: 1

### 6.1. Monitor, Master, Slave mode

Start- and stop characters will be used to determine begin and end of the message. The message is build in such a manner that it is readable with a terminal program. This is realised by sending all bytes, except the start and stop byte, in readable ASCII format. The maximum message length is 22 bytes. The frame structure is as follows:

Byte 1: Start character (0x02)  
 Byte 2: Mode  
 Byte 3: Port / Status code (optional)  
 Byte 4..7: Time stamp (optional)  
 Byte 8..15: OpenTherm message (optional)  
 Byte 16..17: Midbit info (optional)  
 Byte 18..21: Response time (optional)  
 Byte 22: Stop character (0x03)

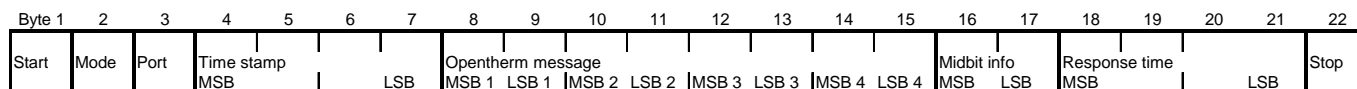


Figure 1 Standard RS232 message frame

Elements of the frame structure are described below.

#### 6.1.1. Mode

This byte indicates in which mode the OpenTherm control is or should be. The OpenTherm testTool program sends the requested mode to the control. The control will answer with an acknowledge to the message. When there is no communication for 5 seconds the PC checks if the control is still on line. When the control receives an OpenTherm message from the master or slave interface a message (as defined) will be send.

Defined values for PC => OIC:

- '0' = OpenTherm Monitor mode
- '1' = OpenTherm Master mode
- '2' = OpenTherm Slave mode
- '3' = Used for transfer of smart power settings, for message frame see 6.3
- '4' = OpenTherm Lite Master mode
- '5' = OpenTherm Lite Slave mode
- '6' = Testing 'control is still live' and firmware version check
- '7' = Stop, the testtool stops receiving or sending message on the OT-bus

Defined Values for OIC => PC:

- '0' = OpenTherm Monitor received message
- '1' = OpenTherm Master received message
- '2' = OpenTherm Slave received message
- '8' = Acknowledge OpenTherm Monitor mode

- '9' = Acknowledge OpenTherm Master mode
- 'A' = Acknowledge OpenTherm Slave mode
- 'B' = Acknowledge OpenTherm Smart Power settings, see 6.3
- 'C' = Acknowledge OpenTherm Lite Master mode
- 'D' = Acknowledge OpenTherm Lite Slave mode
- 'E' = Acknowledge 'control is still live', also returns extra status information
- 'F' = Acknowledge stopping

## 6.1.2. Port

### 6.1.2.1. PC => OIC

Port indication is only used in combination with mode '2'; when the port is set to '8' the slave will not respond to the request of the master, when another value is set the slave will respond to the request of the master.

### 6.1.2.2. OIC => PC

#### 6.1.2.2.1. Master, Slave and Monitor received messages

These values can be expected to be received from the control with mode '0', '1' or '2'.

The port byte indicates which port received the message frame and also indicates the idle level of DUT.

- '0' From the Master port, DUT idle level is low (Slave and monitor mode).
- '1' From the Slave port, DUT idle level is low. (Master and monitor mode).
- '8' From the Master port, DUT idle level is high (Slave and monitor mode).
- '9' From the Slave port, DUT idle level is high (Master and monitor mode).

#### 6.1.2.2.2. Acknowledge Slave Mode

These values can be expected to be received from the control with mode 'A'.

The port byte indicates if the PC is in time with the reply message and the idle level of the control

- '0' Reply message received in time, interface idle level is low.
- '2' Reply message received in time, interface idle level is high.
- 'D' Reply message received too late, interface idle level is low.
- 'F' Reply message received too late, interface idle level is high.

#### 6.1.2.2.3. Acknowledge status

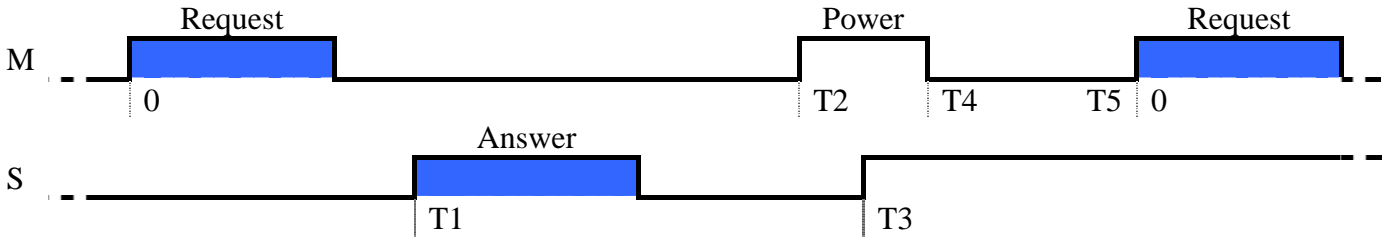
These values can be expected to be received from the control with mode 'E'.

- '8' Slave idle level switches from high to low, time stamp also returned
- '9' Slave idle level switches from low to high, time stamp also returned
- 'A' Live check, time stamp is used to return firmware version control
- 'B' Master idle level switches from high to low, time stamp is also returned
- 'C' Master idle level switches from low to high, time stamp is also returned
- 'E' Slave / Master message is send by control, time stamp of sending is also returned
- 'F' Serial message is incorrect or not properly received.

## 6.1.3. Time stamp

The time stamps are the relative times to the start of last Master request, see next figure:

**Table 1 Time stamps**



Time stamps:

- T1: slave answer
- T2: idle level switch Master
- T3: idle level switch Slave
- T4: idle level switch Master
- T5: Request Master

The time stamp is measured in 500 microsecond units. The time stamp indicates the start of a message frame that is send or received or an idle level change of more than 2 milliseconds. After each request from the master the time stamp is cleared. The time is presented as a 4-byte ASCII string. When the PC sends a message to the control the time stamp is used to indicate the bit time in microseconds divided by 6,5.

**6.1.4. OpenTherm message**

This field contains an OpenTherm message. The 4-byte hex code of the message is presented as an 8 byte ASCII string (message 0x90 0x01 0x4B 0x60 is written as '90014B60').

**6.1.5. Midbit info**

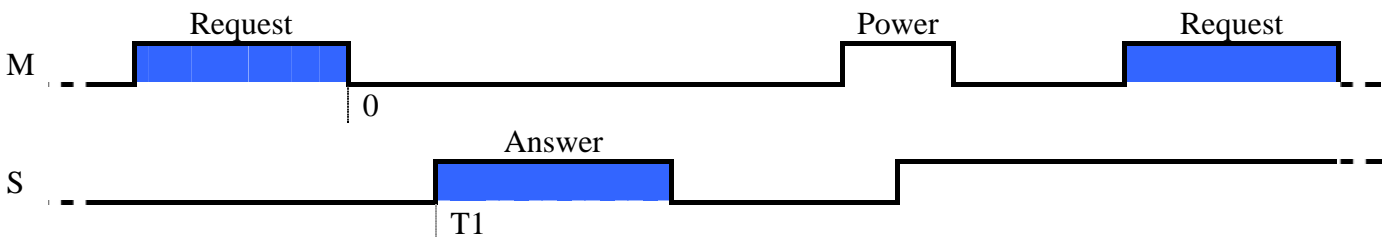
When the control is in Master or Slave mode and the PC sends a message to the control, this data field contains the value of the bit where a midbit fault must occur. No midbit fault occurs when the value is equal to zero.

When the control is in Monitor, Master or Slave mode and it sends a received OpenTherm message to the PC, the data field holds the number of correctly received bits. A value of 35 is returned by the control when the message is received without midbit errors.

**6.1.6. Response time**

The response time is calculated from the end of the last received master message to the start of the slave response.

**Table 2 Response time**



When the control is in Monitor or Master mode, and the control sends a received OpenTherm slave message to the PC, this 4 byte data field holds the response time in 500 microseconds steps, between the end of the master request frame and the start of the slave answer frame.

When the control is in slave mode and the PC sends a message to the control this data field contains the response time, in 500 microseconds steps, in which the control must automatically answer the OpenTherm message received from the Master when no answer is received from the PC. The time is presented as a 4-byte ASCII string.



## 6.2. OpenTherm Lite Master and Slave mode

Byte 1: Start character (0x02)  
 Byte 2: Mode  
 Byte 3: Port  
 Byte 4: Status  
 Byte 5..8: Time High  
 Byte 9..12: Time Low  
 Byte 13: Stop character (0x03)

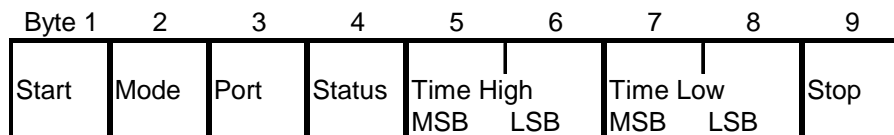


Figure 2 RS232 message frame Lite modes

These modes are no longer supported by the OpenTherm association; functionality is maintained in the OpenTherm testTool.

Elements of the format structure are described below.

### 6.2.1. Mode and Port

The formats of these two bytes are the same as discussed in paragraphs 6.1.1 and 6.1.2.

### 6.2.2. Status

This byte indicates the status of the slave. When in OpenTherm master Lite the control sends a message to the PC containing the status of the slave, i.e. normal operation or boiler lockout fault.

When in OpenTherm Lite slave mode, the PC sends the selected slave status to the control.

### 6.2.3. Time High

These bytes contain de time in 50 microseconds steps in which the output is/ must be high. It is a byte value, presented as a 2 byte ASCII string.

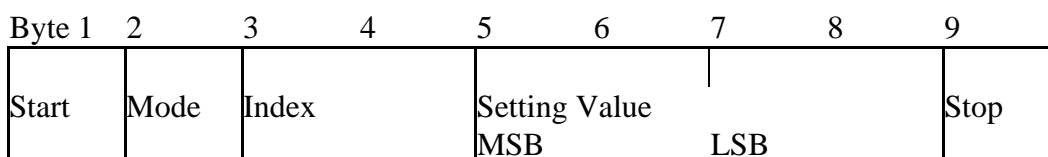
### 6.2.4. Time low

These bytes contain de time in 50 microseconds steps in which the output is/ must be Low. It is a byte value, presented as a 2 byte ASCII string.

## 6.3. Smart Power Settings

Byte 1: Start character (0x02)  
 Byte 2: Mode  
 Byte 3..4: Index  
 Byte 5..8: Status  
 Byte 9: Stop character (0x03)

Table 3 RS232 Frame smart power settings



### 6.3.1. Mode

Defined values for PC => OIC:

‘3’= Smart power settings

Defined Values for OIC => PC:

‘B’= Acknowledge Smart Power settings.

Other values are not allowed.

### 6.3.2. Index

These bytes contain the setting index to be transferred.

The following indices are defined:

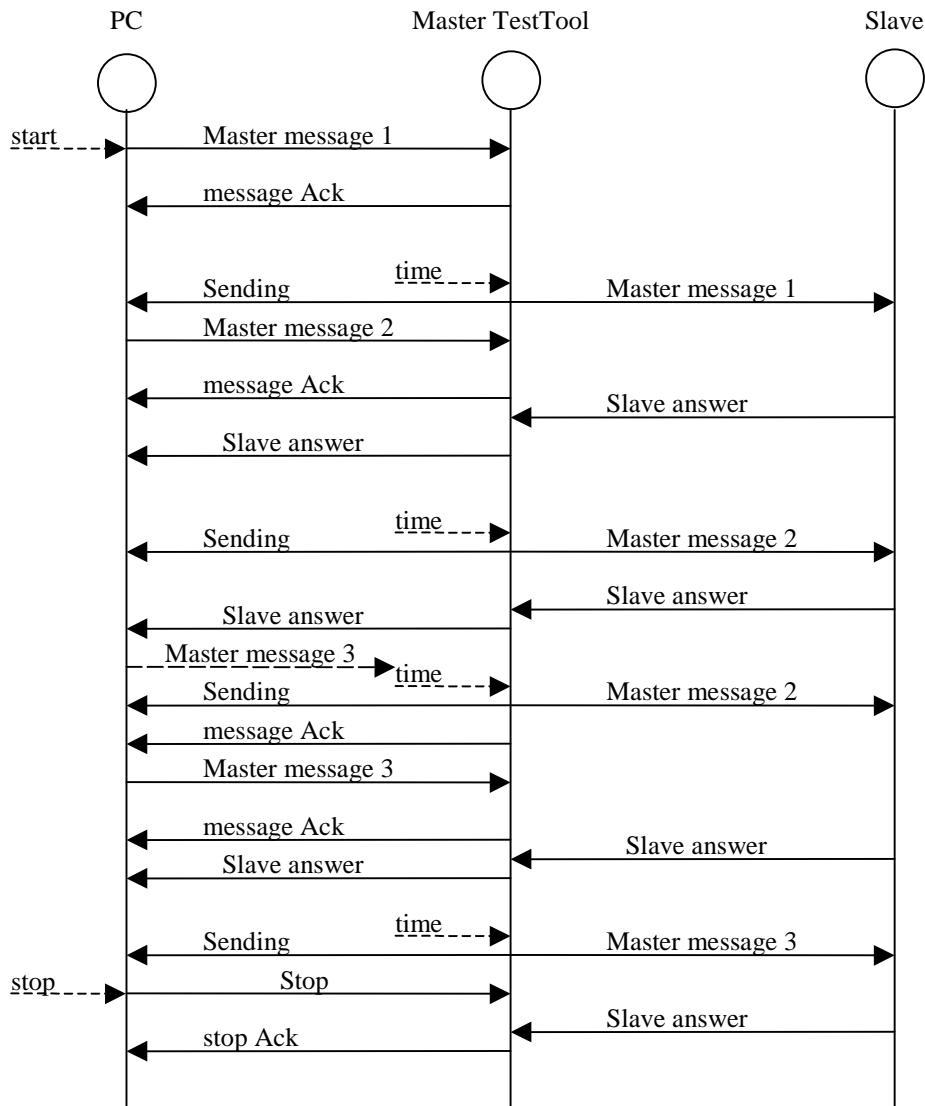
**Table 4 Smart power settings list**

#	Description	Default	Min	Max	Unit	Remark
‘0’	Power mode	0	0	2		Master mode 0 Low power 1 Medium power 2 High power  Slave mode 0 Automatic switching 1 Low idle current 2 High idle current
‘1’	Pulse length medium => low power	15	1	50	Milli-seconds	
‘2’	Pulse length low power => medium power	10	1	50	Milli-seconds	
‘3’	Idle time before switching	20	1	1000	Milli-seconds	
‘4’	Idle time after switching	20	1	1000	Milli-seconds	
‘5’	Switch type	0	0	2		0 Immediate 1 Timed after answer 2 Timed after request
‘6’	Answer delay to high current	5	2	50	Milli-seconds	
‘7’	Answer delay to low current	5	2	50	Milli-seconds	
‘8’	Auto switch time to idle	0	0	10000	Milli-seconds	

### 6.3.3. Setting value

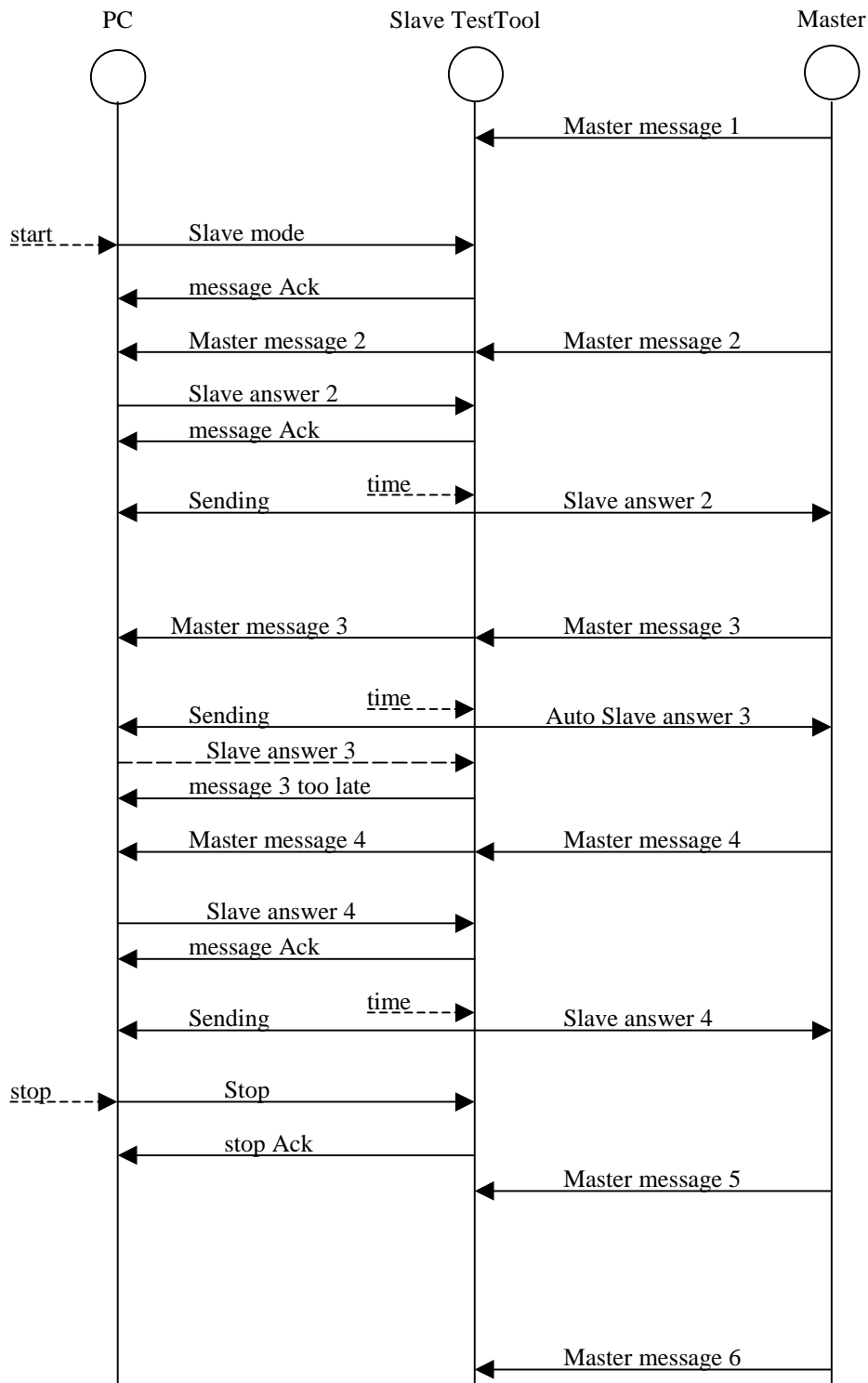
These bytes contain the value of the setting transferred.

### 6.4. Communication in master mode



After pressing the start button a message is send to the control so it will enter master mode and sending the first message to the slave in 10 milliseconds. When the message is send to the slave the PC will be informed about this with a message in the form: ‘●EExxx♥’. See paragraph 6.1.2.2.3 for explanation. When the computer is too late with a message the TestTool re-send the same message (message 2). The computer knows it because the sending status message comes before the acknowledge message of the control.

### 6.5. Communication in slave mode



After pressing on the start button the control enters the slave mode, before it will not react on any message from the master. After it's in slave mode it will send the message from the master through to the pc. The pc will respond as quickly as it can. After the response time the slave answer is send to the master. When the pc didn't send a reply message in time, the control sends an acknowledgement to the master and tells the pc that the message was too late. The sending message looks the same as in master mode.

The too late message has the form: '●AX♥', see paragraph 6.1.2.2.2 for explanation.

## 6.6. OpenTherm ID file (\*.otm)

In each mode an OpenTherm ID file is used. This file is an ASCII file. Each line consists of either 7 or 11 fields:

- ID, number from 0 to 255
- ID description, can be any text up to 28 capital letters or 40 small letters
- Message type, valid values are READ, WRITE, AUTO, NONE. READWRITE is supported to be compatible with old OTM files, in this version it is translated to AUTO.
- Data format1, valid formats are F8.8, U16, S16, flag8, U8 or S8.
- Minimum value data1
- Maximum value data1
- Default value data1
- Data format2, valid formats are FLAG8, U8 or S8. These values are only entered when the first data byte is FLAG8, U8 or S8, otherwise this and following values should not be entered.
- Minimum value data2
- Maximum value data2
- Default value data2

Empty lines and comment lines starting with a semicolon are allowed in the OpenTherm ID file.

Example:

```

"0","STATUS","READ","FLAG","00000000","FLAG","00000000"
"1","CONTROL SETPOINT","WRITE","F8.8","0","100","50"
"2","MASTER","WRITE","FLAG","00000000","U8","0","255","50"
"3","SLAVE","READ","FLAG","00000000","U8","0","255","50"
; Comment
"4","COMMAND","READWRITE","U8","0","255","50","U8","0","255","50"

```

OTM-files of previous versions of the OpenTherm windows GUI can be used for this version. When these files are saved, they are converted to the new format.

## 6.7. OpenTherm log file (\*.log)

All listed/read messages can be saved as OpenTherm log files to disk. Also the stream function writes the messages to disc as OpenTherm log files. The OpenTherm log file is an ASCII file.

Each line starts with 5 fixed data fields (sender, time stamp, message type, id and description), followed by the data in the defined format and the data in hex value. In case of a message with two 1-byte formats (flag8, u8 or s8) the line consists of two formatted data values and the data in hex value.

Example:

```

"M ->","00:00:00,997","READ_DATA","0","STATUS","00000000-00000000","0x00","0x00","-5986"
"M ->","00:00:01,996","READ_DATA","0","STATUS","00000000-00000000","0x00","0x00","999"

```

## 7. Functions

### 7.1. Monitor mode

- An OpenTherm Master and OpenTherm Slave device are connected to the OpenTherm bus monitor. The master is connected to terminals 5 and 6; the slave is connected to terminals 7 and 8. When the slave polarity does not match the internal circuitry, this will be indicated by the red LED just right of the terminals
- All messages between master and slave are read and listed in a window with time stamps. The reading of the messages can be started and stopped. Only OpenTherm/plus communication can be monitored.
- The messages are translated/decoded using an OpenTherm ID file (\*.otm). See section 6.6.
- The parity of each message is checked and displayed on screen.
- Master and slave messages can be viewed separated (split mode) or combined (mixed mode).
- Statistics are held of the minimum and maximum communication time of the master (the inter-message conversation time) and the response time of the slave.
- Idle level switches of both master and slave are listed.
- The listed messages can be saved as an OpenTherm log file (\*.log).
- Standard functions for the log files (new, open, save, save as, print)
- With the stream function all sent and received messages, when running, are written as OpenTherm log files directly to disk.
- The messages in the list are removed after 15 min, if you want to keep the messages use the stream function.

### 7.2. Master mode

- An OpenTherm slave device is connected to the OpenTherm slave tester, terminals 1 and 2. When the slave polarity does not match the internal circuitry, this will be indicated by the red LED just right of the terminals
- The OpenTherm ID file defined in settings is listed in a window.
- Each message can be set to send (Action column sets sending of message or not).
- The messages with Action set to another value than NONE are sequential sent by the master. Sending can be started and stopped.
- The parity of each message from the slave is checked and displayed. It is possible to generate a parity fault in a selected message from the master
- Idle levels are indicated
- Switching idle levels are indicated
- In a separate column the number of correctly received bits of an OpenTherm message is listed. If a midbit fault was detected, the number displayed is the bit where the error occurred.
- While running, data can be changed.
- The time between requests can be adjusted.
- The transmission bit time can be adjusted.
- A midbit fault can be generated, the bit where the fault should occur can be adjusted
- With the stream function all sent and received messages, when running, are written as OpenTherm log files directly to disk.
- The message action can be changed from Read, Write, Data Invalid to None.
- Action can be set for multiple rows by selection tool and pop-up.

### 7.3. Slave mode

- An OpenTherm master device is connected to the OpenTherm master tester, terminals 3 and 4.
- The OpenTherm ID file defined in settings is listed in a window.
- Answering can be started and stopped.
- The parity of each message from the Master is checked and displayed. It is possible to generate a parity fault in the message from the slave.
- In a separate column the number of correctly received bits of an OpenTherm message is listed. If a midbit fault was detected, the number displayed is the bit where the error occurred.
- Idle levels are indicated
- Switching idle levels are indicated
- While running data can be changed.
- The transmission bit time can be adjusted.
- A midbit fault can be generated, the bit where the fault should occur can be adjusted
- With the stream function all sent and received messages, when running, are written as OpenTherm log files directly to disk.
- The message action can be changed from Read, Write, Data Invalid, Unknown ID, Auto reply to None.

### 7.4. OpenTherm Lite Master mode

- An OpenTherm slave device is connected to the OpenTherm slave tester, terminals 1 and 2. When the slave polarity does not match the internal circuitry, indicated by the red LED just right of the terminals, the terminals need to be switched.
- The status of the slave is displayed, i.e. normal operation or boiler lockout fault. The status is updated every second.
- The control set point can be adjusted. The control converts the set point to a PWM signal
- The period of the PWM signal can be adjusted

### 7.5. OpenTherm Lite Slave mode

- An OpenTherm master device is connected to the OpenTherm master tester, terminals 3 and 4.
- The control set point is shown on the PC. The value is updated every second.
- The status of the slave can be adjusted, i.e. normal operation or boiler lockout fault.

## 8. User interface

### 8.1. Windows OpenTherm Monitor

#### 8.1.1. Menu

After starting the program a menu will appear. There are several possibilities:

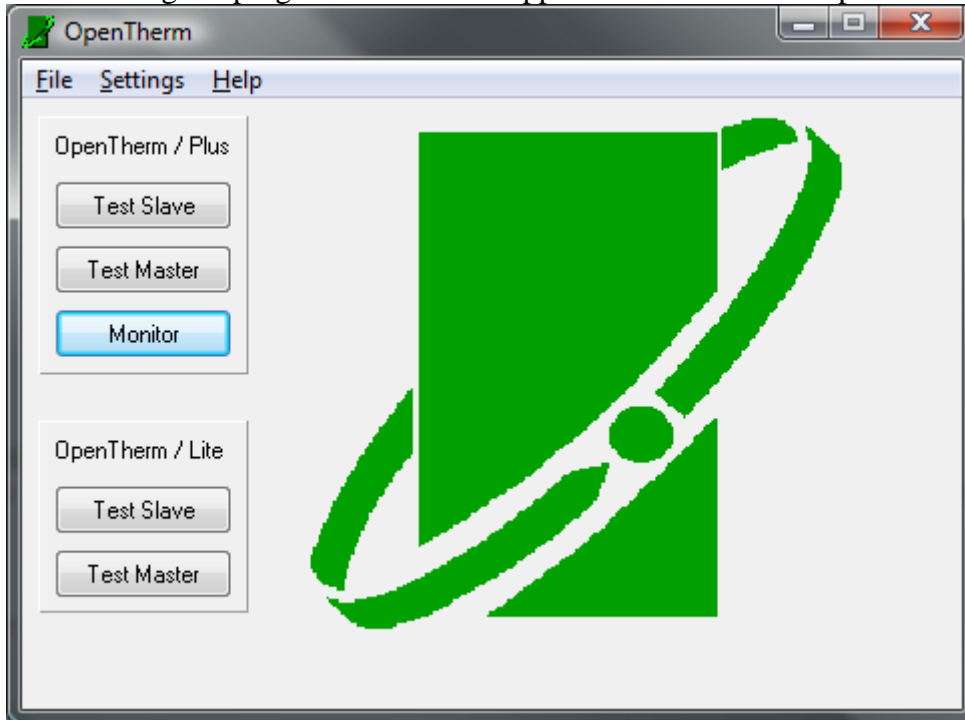


Figure 3 Selection menu

- Test Master
- Test Slave
- Monitor
- Test Master Lite
- Test Slave Lite
- Settings (menu)

#### 8.1.2. Settings

On the first tab-page is the possibility to select an OpenTherm ID file for every mode. When there isn't a file selected the mode will be disabled in the menu. The layout for these files is discussed in section 6.6.

On the second tab-page the communication port can be selected for the OpenTherm testTool. Connect the OpenTherm testTool to the selected com-port.



### 8.1.3. Test Master

An OpenTherm Slave window will appear:

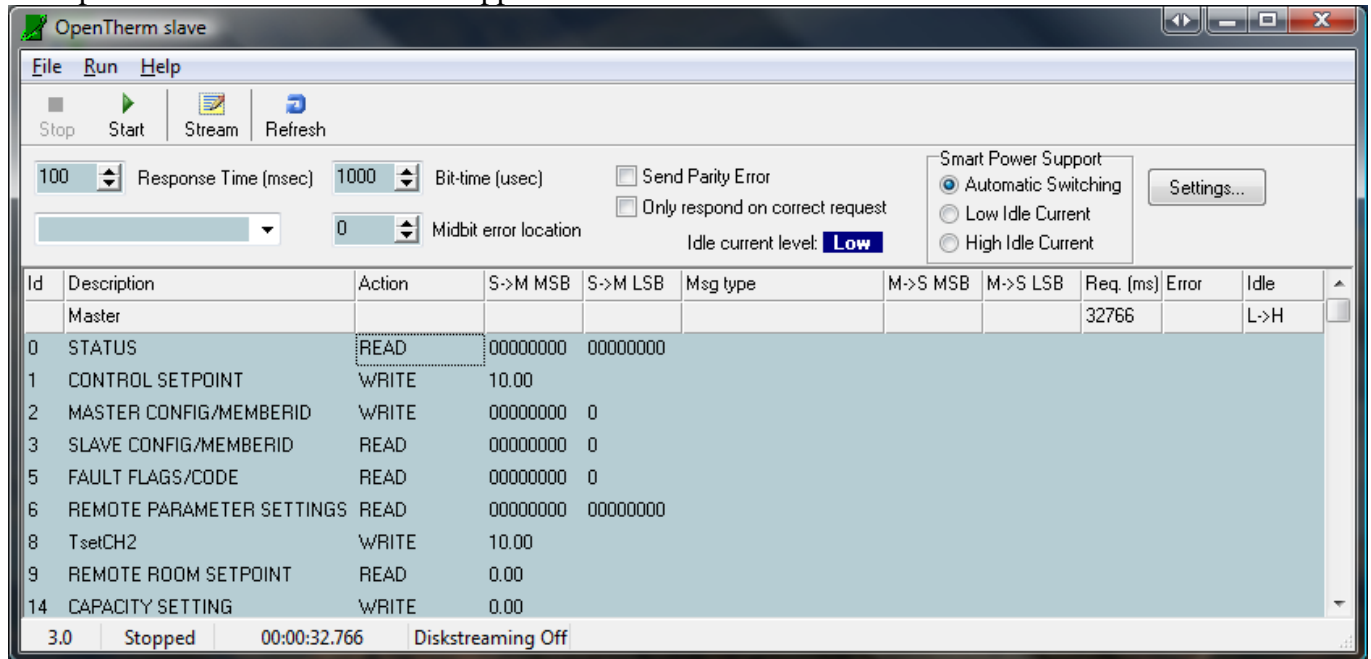


Figure 4 OpenTherm slave control window

A short explanation will follow for each part of the window in the next paragraphs.

#### 8.1.3.1. Tool buttons

- Stop  
This button stops the communication of the testtool, can also be selected from the “Run” menu
- Start  
This button starts the communication of the testtool, can also be selected from the “Run” menu
- Stream  
This button toggles the logging of the communication to a log-file, can also be selected from the “File” menu
- Refresh  
This button clears the past communication information from the screen.

#### 8.1.3.2. Response time

This item will change the wait time between the end of the master request and begin of the slave response. When the window is first opened the value is set to 100 milliseconds. The OpenTherm specification allows a response time ranging from 20 milliseconds to 800 milliseconds, for testing purposes the response time can be adjusted between 5 and 1500 milliseconds. When a response time shorter than 20 milliseconds is chosen and the computer can't answer the message quick enough then the OpenTherm testTool will generate an auto-response at the selected time. This response is only an acknowledgement of the request; the data send by the master is returned in the response. When an auto-response is sent instead of the intended response the error column will indicate this with an 'auto-ack'. This is also indicated when streaming to a file.

#### 8.1.3.3. Not listed requests

This item will list the received master request ID's that are not found in the selected OTM-file. The last received message that cannot be listed in the normal view is also listed in the second row of the list.

#### 8.1.3.4. Bit time

This item will change the length of a bit. When the window is first opened the value is set to 1000 microseconds, this is the OpenTherm standard bit time. The OpenTherm specification allows an error of – 10%/+15% on the bit time, for testing purposes the value can be adjusted between 700 and 1300 microseconds.

#### 8.1.3.5. Midbit error location

This item will generate a midbit transition error in the slave response at the selected value. When the window is first opened the value is set to 0, indicating that no midbit transition error will be generated. The value can be adjusted between 0 and 34.

#### 8.1.3.6. Send Parity Error

This item will generate a parity error in the slave response when selected.

#### 8.1.3.7. Only respond when correct request

This item will force the testTool only to respond to correct request from the master when selected. If selected the testTool will not respond when the master request has a midbit transition error or a parity error. This action is specified by the OpenTherm specification.

#### 8.1.3.8. Idle level

This item indicates the idle current level of the control itself.

#### 8.1.3.9. Smart Power Support

This item allows the user to select different smart power options.

1. Automatic Switching: The control will react automatically when the master requests a power mode switch. The control will only react when ID 2 is received with the High bit 0 set. Detection of the bit is reset when the communication is stopped.
2. Low Idle Current: The control will switch to/ remain in low idle current regardless of the actions of the Master
3. High Idle Current: The control will switch to/ remain in high idle current regardless of the actions of the Master

The control will switch the idle level immediately after the selection is changed, not in case automatic mode is selected.

#### 8.1.3.10. Settings

When this button is pressed a settings menu is shown, which allows adjustment of the Smart Power settings. The settings are sent to the control when the communication is started or the settings menu is closed.

The following menu is shown:

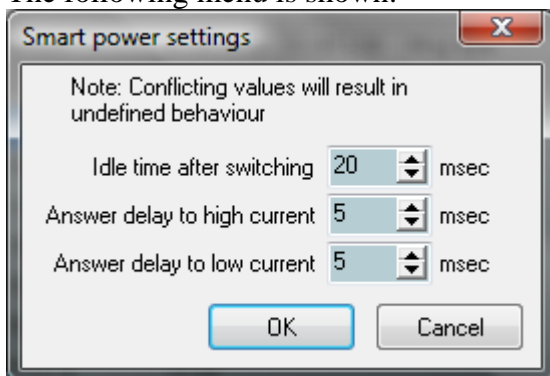


Figure 5 Smart power settings slave

### 8.1.3.10.1. Idle time after switch

This item sets the time the slave control will wait after an idle level switch of the master, before it may send its response. If a switch of the master occurs just before the set response time, the response will be delayed according to this setting.

The OpenTherm interface control uses a 2 millisecond wait time after an idle level switch of itself (this is not explicitly defined by the OpenTherm specification).

### 8.1.3.10.2. Answer delay high current

This item sets the time the slave control will wait before acknowledging a smart power switch to medium or high power.

### 8.1.3.10.3. Answer delay low current

This item sets the time the slave control will wait before acknowledging a smart power switch to low power.

### 8.1.3.11. Messages list box

This is the main part of the window. It lists the selected OTM-file, and enables the user to change the response to selected ID's. When the windows opens for the first time the default values are read from the selected OTM-file and the information is displayed by the messages list box.

The first line of the list shows the description of each column.

The second line lists the last unknown message or idle level switch of the master or slave.

Table 5 Message list box

Column	Description
ID	The supported ID numbers read from the OTM-file. This field can't be directly edited; this can be only done by changing the OTM file.
Description	Gives a short description of the ID numbers. This field can't be directly edited, this can be only done by changing the OTM file
Action	<p>The following actions are supported:</p> <ul style="list-style-type: none"> <li>• READ Read acknowledgement response is send</li> <li>• WRITE Write acknowledgement response is send</li> <li>• INVALID Data invalid response is send</li> <li>• UNKNOWN Unknown data id response is send</li> <li>• AUTO Response depends on the request from the master, the request is acknowledged with the entered data</li> <li>• NONE No response is send to the request, when selecting this option the response time should not be set below 20 milliseconds, otherwise it is possible that the communication fails.</li> </ul> <p>The action can be changed by editing the OTM file or by double clicking the value to be changed, the action will change from NONE⇒READ⇒WRITE⇒INVALID⇒UNKNOWN⇒AUTO⇒NONE It is also possible to select a cell or multiple cells and right click them, a pop-up menu will be shown to change the action of the selection, see 8.1.3.13</p>
S->M MSB	Data value that will be send to the master in the slave response. The value can be changed by editing OTM file or clicking the value and typing the new value.
S->M LSB	Data value that will be send to the master in the slave response. The value can be changed by editing OTM file or clicking the value and typing the new value.
Msg type	Lists the request message type from the master. This field can't be edited.
M->S MSB	Lists the data value sent by the master. This field can't be edited

Column	Description
M->S LSB	Lists the data value sent by the master. This field can't be edited
Req (ms)	Lists the request time between the current and last master requests
Error	The following errors can be listed: <ul style="list-style-type: none"> <li>• 'P' Parity error</li> <li>• '1'..'34' Midbit error location</li> <li>• 'auto-ack' TestTool generated auto acknowledgement to master request</li> </ul>
Idle	List the idle levels and switches of idle levels: <ul style="list-style-type: none"> <li>• No value Idle level is low</li> <li>• 'High' Idle level is high</li> <li>• 'L =&gt; H' Idle level is switched from low to high</li> <li>• 'H =&gt; L' Idle level is switched from high to low</li> </ul>

When the response data values are changed, it is possible to save these values to the same OTM file or to a different OTM file. To do this select either the "Save OTM" or "Save as OTM..." items from the "File" menu. When the action is changed the changed value will not be stored in the OTM file when it is saved.

### 8.1.3.12. Status bar

The status bar has five panels; these panels give the following information (from left to right):

1. Detected firmware version testTool, firmware versions 2.1 and 2.2 are listed as version 2.1; older versions are listed as '?'.
2. Slave and communication status
3. Running time
4. Stream status
5. Stream file

### 8.1.3.13. Action column pop-up

When one or more cells are selected in the action column and the right button is clicked, a pop-up menu will be shown. With this pop-up menu it is possible to set the action of the selection to the selected option. Options are:

- Default : reset action to default of OTM file
- Read
- Write
- Invalid
- Unknown
- Auto : response depends on request
- None : no response is generated
- Cancel : no change is performed to action

### 8.1.4. Test Slave

An OpenTherm Master window will appear:

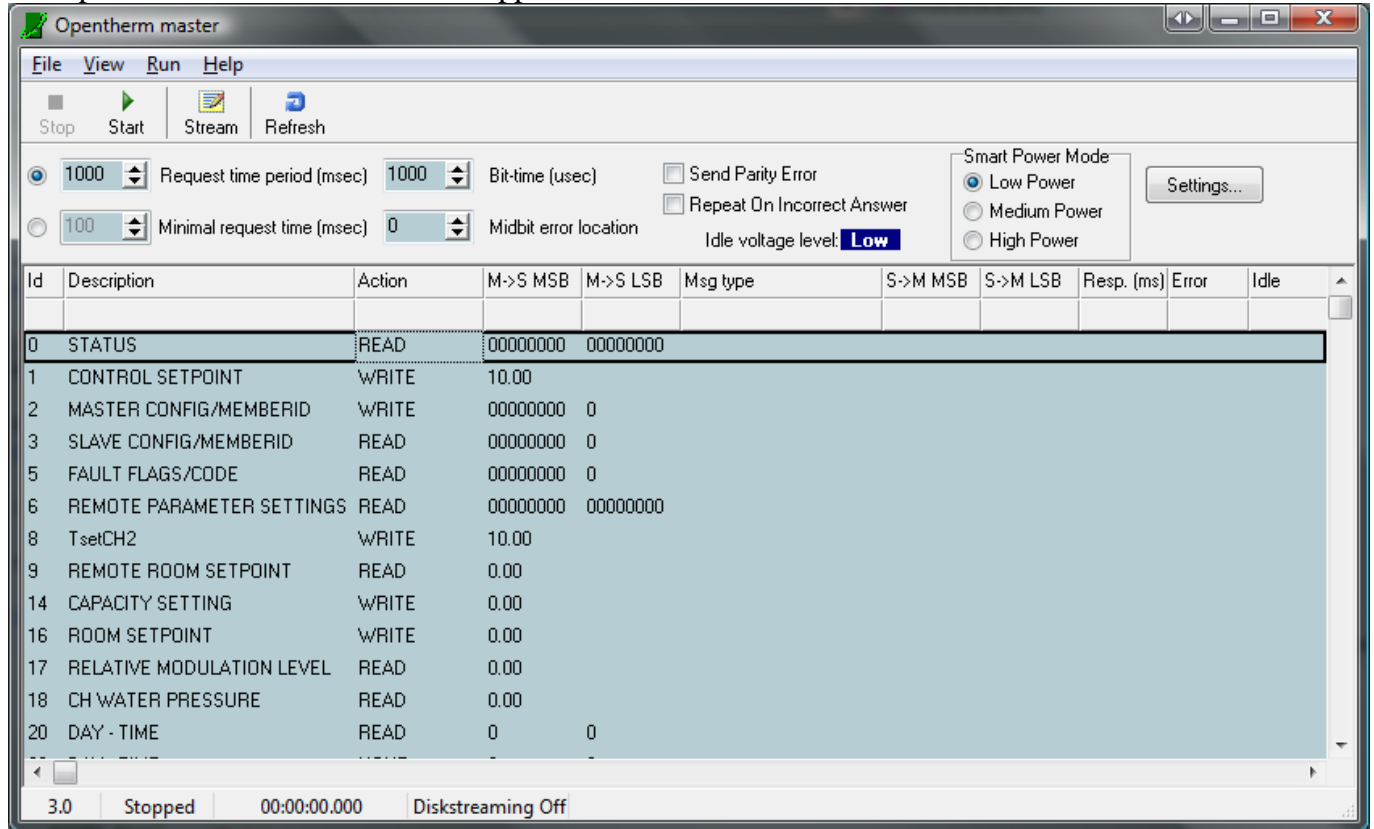


Figure 6 OpenTherm master control window

This interface window is more or less the same as the OpenTherm Slave window. A short explanation will follow for each part of the window in the next paragraphs.

#### 8.1.4.1. Tool buttons

- Stop  
This button stops the communication of the testTool, can also be selected from the “Run” menu
- Start  
This button starts the communication of the testTool, can also be selected from the “Run” menu
- Stream  
This button toggles the logging of the communication to a log-file, can also be selected from the “File” menu
- Refresh  
This button clears the past communication information from the screen.

#### 8.1.4.2. Request time period

This item will change the period between requests of the master, when it is selected. When the window is first opened the value is set to 1000 milliseconds, this is the typical value set by the OpenTherm standard. The OpenTherm specification allows for a request period of approximately 1 second, for testing purposes the value can be adjusted between 5 and 5000 milliseconds. The message will be send regardless if the slave has answered or not, unpredictable behaviour may occur when a very low setting is used.

#### 8.1.4.3. Minimal request time

This item will change the wait time between the end of the slave response and begin of the next master request, when it is selected. When the window is first opened the value is set to 100 milliseconds, this is the OpenTherm standard minimal request time. For testing purposes the value can be changed between 5

and 5000 milliseconds. When a small minimal request time is chosen and the computer can't generate the next message on time, the testTool will resend the previous message at the selected time. When the slave does not respond within 1 second the master will send a new message after 1 second.

#### 8.1.4.4. Bit time

This item will change the length of a bit. When the window is first opened the value is set to 1000 microseconds, this is the OpenTherm standard bit time. The OpenTherm specification allows an error of -10%/+15% on the bit time, for testing purposes the value can be adjusted between 700 and 1300 microseconds.

#### 8.1.4.5. Midbit error location

This item will generate a midbit transition error in the master request at the selected value. When the window is first opened the value is set to 0, indicating that no midbit transition error will be generated. The value can be adjusted between 0 and 34.

#### 8.1.4.6. Send Parity Error

This item will generate a parity error in the slave response when selected.

#### 8.1.4.7. Repeat When Incorrect Answer

This item will force the testTool to resend a request when no or an incorrect answer is returned by the slave. When activated the testTool will resend the same request when the slave response has a midbit transition error or a parity error. This action is specified by the OpenTherm specification.

#### 8.1.4.8. Idle level

This item indicates the idle voltage level of the control itself.

#### 8.1.4.9. Smart Power Mode

This item allows the user to select different smart power modes.

1. Low Power
2. Medium Power
3. High Power

The control will switch the smart power mode according to the smart power settings, see next paragraph.

#### 8.1.4.10. Settings

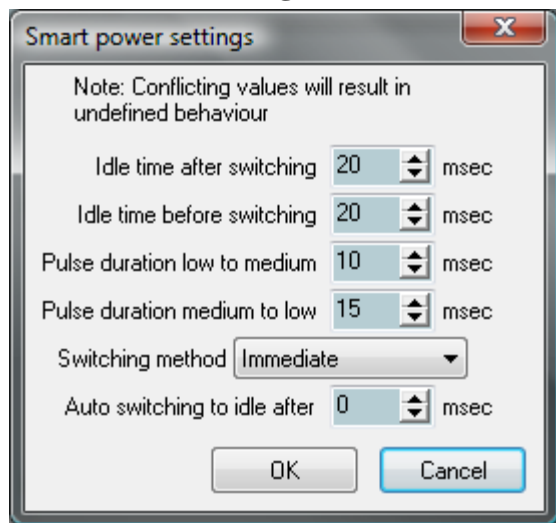


Figure 7 Smart power settings master

#### 8.1.4.10.1. Idle time after power switch

This item sets the time the master control will wait after an idle level switch of itself, before it may send a new request. If a switch of the master occurs just before the set request time, the request will be delayed according to this setting.

The OpenTherm interface control uses a 2 millisecond wait time after an idle level switch of slave (this is not explicitly defined by the OpenTherm specification).

#### 8.1.4.10.2. Idle time before power switch

This item sets the time the master control will wait after a request or response before a switch can be made.

#### 8.1.4.10.3. Pulse duration to switch to medium power

This item sets the pulse length to switch to medium power

#### 8.1.4.10.4. Pulse duration to switch to low power

This item sets the pulse length to switch from medium power to low power

#### 8.1.4.10.5. Switching method

This item sets how the smart power switch should be performed:

1. Immediately:  
The smart power mode is changed immediately after it is changed in the smart power mode control box. When a request is transmitted or a response received, the idle times are taken into consideration before the switch is made.
2. Timed after response:  
When a change in smart power mode is made in the selection box, the smart power switch is made after the set idle time (8.1.4.10.2) after the first received response of the slave. A new request is send immediately after the set idle time (8.1.4.10.1).  
This function can be used to test the slave according to the test specification.
3. Timed after request:  
When a change in smart power mode is made in the selection box, the smart power switch is made after the set idle time (8.1.4.10.2) after the first send request of the master. The switch is send regardless of status of the reception.

#### 8.1.4.10.6. Auto switch to idle

This item selects the time the master control will stay in a smart power mode other than low power. When the time is set to 0 the change is only done manually. Another value will switch the master control automatically back to low power after the set time.

#### 8.1.4.11. Messages list box

This is the main part of the window. It lists the selected OTM-file, and enables the user to change the response to selected ID's. When the windows opens for the first time the default values are read from the selected OTM-file and the information is displayed by the messages list box.

Table 6 Message list box

Column	Description
ID	The supported ID numbers read from the OTM-file. This field can't be directly edited; this can be only done by changing the OTM file.
Description	Gives a short description of the ID numbers. This field can't be directly edited, this can be only done by changing the OTM file

Column	Description
Action	<p>The following actions are supported:</p> <ul style="list-style-type: none"> <li>• NONE The ID is not requested.</li> <li>• READ Read data request is send</li> <li>• WRITE Write data request is send</li> <li>• INVALID Invalid data request is send</li> </ul> <p>The action can be changed by editing the OTM file or by double clicking the value to be changed. The action will change from NONE⇒READ⇒WRITE⇒INVALID⇒NONE. A selection of cells can be changed at once using the pop-up menu, see 8.1.4.14</p>
S->M MSB	Data value that will be send to the slave in the master request. The value can be changed by editing OTM file or clicking the value and typing the new value.
S->M LSB	Data value that will be send to the slave in the master request. The value can be changed by editing OTM file or clicking the value and typing the new value.
Msg type	Lists the response message type from the slave. This field can't be edited.
M->S MSB	Lists the data value sent by the slave. This field can't be edited
M->S LSB	Lists the data value sent by the slave. This field can't be edited
Resp (ms)	Lists the response time of the slave
Error	<p>The following errors can be listed:</p> <ul style="list-style-type: none"> <li>• P Parity error</li> <li>• 1..34 Midbit error location</li> </ul>
Idle	<p>List the idle levels and switches of idle levels:</p> <ul style="list-style-type: none"> <li>• No value Idle level is low</li> <li>• 'High' Idle level is high</li> <li>• 'L =&gt; H' Idle level is switched from low to high</li> <li>• 'H =&gt; L' Idle level is switched from high to low</li> </ul>

When the request data values are changed, it is possible to save these values to the same OTM file or to a different OTM file. To do this select either the "Save OTM" or "Save as OTM..." items from the "File" menu. When the action is changed the change will not be stored in the OTM file when it is saved.

#### 8.1.4.12. Menu "View"

In the view menu there are two options, to show all items or only the available items for sending.

#### 8.1.4.13. Status bar

The status bar has five panels; these panels give the following information (from left to right):

1. Detected firmware version testTool, firmware versions 2.1 and 2.2 are listed as version 2.1, older versions are listed as '?'.
2. Master and communication status
3. Running time
4. Stream status
5. Stream file

#### 8.1.4.14. Action column pop-up

When one or more cells are selected in the action column and the right button is clicked, a pop-up menu will be shown. With this pop-up menu it is possible to set the action of the selection to the selected option  
Options are:

- Default : reset action to default of OTM file
- Read
- Write
- Invalid
- None : the ID is not requested
- Cancel : no change is performed to action



### 8.1.5. Monitor

An OpenTherm monitor window will appear:

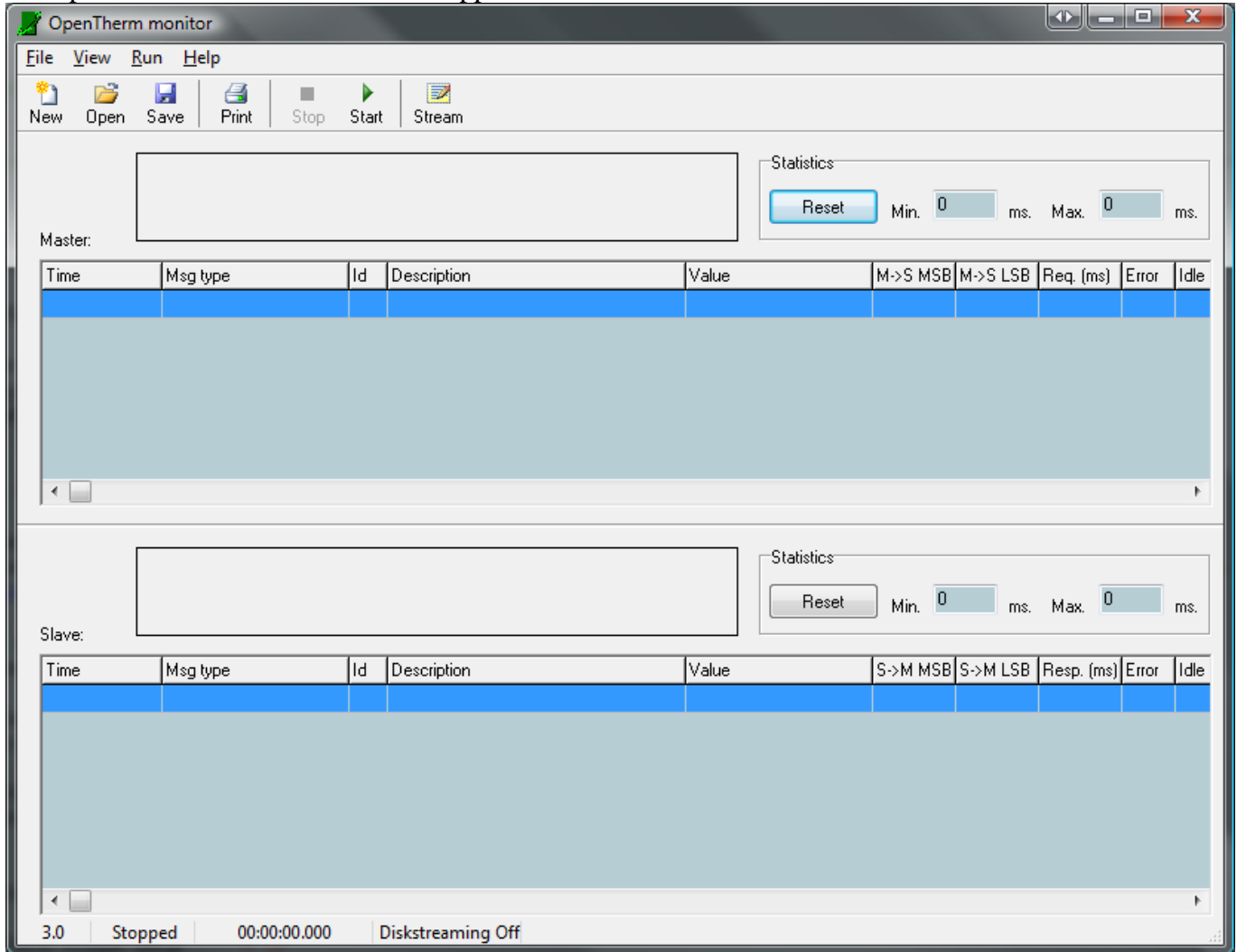


Figure 8 OpenTherm Monitor control window

#### 8.1.5.1. Message list boxes

These are the main parts of the window. The top list box lists the messages from the master; the bottom list box lists the messages from the slave. The information listed in the columns is similar to that of the separate interfaces. The value column contains the translated value of the MSB and LSB columns to the base data value type (e.g. U8,S16,FLAG, etc.).

Atop of each list box is graph that displays the difference in timing over the last 50 messages.

The minimum and maximum values are listed next to the graphs. To reset the values of one of the graphs, the reset button can be pressed. The data listed cannot be edited.

If mixed view is chosen, the messages will be listed in chronological order. The graphs are not available in this view.

Streamed log files can be opened in the monitor mode for further inspection of the data.

#### 8.1.5.2. Tool buttons

- New  
This button clears all previous data and starts a clean monitor window, this can be also selected from the “File” menu

- **Open**  
This button opens and displays a previous saved stream file, this can be also selected from the “File” menu
- **Save**  
This button saves the current data to a stream file, this can be also selected from the “File” menu
- **Print**  
This button prints the current data, this can be also selected from the “File” menu.
- **Stop**  
This button stops the communication of the testTool, can also be selected from the “Run” menu
- **Start**  
This button starts the communication of the testTool, can also be selected from the “Run” menu
- **Stream**  
This button toggles the logging of the communication to a log-file, can also be selected from the “File” menu

#### **8.1.5.3. Menu “View”**

This menu has two options:

- Mixed
- Split

Default split is selected, this view list both master and slave messages in separate list boxes as seen in Figure 8.

When Mixed is selected both master and slave messages are listed in one list box and are listed in chronological order.

#### **8.1.5.4. Status bar**

The status bar has five panels; these panels give the following information (from left to right):

1. Detected firmware version testTool, firmware versions 2.1 and 2.2 are listed as version 2.1, older versions are listed as ‘?’.
2. Monitor and communication status
3. Running time
4. Stream status
5. Stream file

#### **8.1.6. Test slave Lite (No longer supported by OpenTherm)**

The Master Lite will appear on the screen. There are two items time low and time high these controls the set point of the master, displayed in the gauge. ‘Boiler lock-out fault’ displays the current state of the boiler when there is a check in the checkbox the boiler has a ‘Boiler lock-out’.

#### **8.1.7. Test master Lite (No longer supported by OpenTherm)**

The Slave Lite window will appear. Only control is the ‘Boiler lock-out fault’, this simulates a boiler fault. The indicators below give the high and low time of the signal generated by the tested master, the gauge indicates the set point.

## 8.2. OpenTherm Interface Control

### 8.2.1. Power indication

The power LED indicates the correct function of the OpenTherm testTool. When the power supply is switched on the LED is blinking rapidly during initialisation. After 10 seconds the blinking slows down, indicating normal operation.

### 8.2.2. Slave tester

#### 8.2.2.1. Potentiometer, $V_{low}$

With the potentiometer  $V_{low}$  it is possible to adjust the lower bound voltage of the slave tester between 0 and 7 volts. This is according OpenTherm test specification.

#### 8.2.2.2. Potentiometer, $V_{high}$

With the potentiometer  $V_{high}$  it is possible to adjust the upper bound voltage of the slave tester between 15 and 18 volts. This is according OpenTherm test specification.

#### 8.2.2.3. Switch, $1\Omega - 10\Omega$

With this switch it is possible to change the resistor value that is incorporated in the OpenTherm bus. When using the measuring pin provided on the OpenTherm testTool, to measure the current into the bus, put this switch on  $10\Omega$ , otherwise put it on  $1\Omega$ .

#### 8.2.2.4. Polarity indication

This LED indicates when the slave polarity does not match the polarity of the internal circuitry. When it is on the polarities do not match, in this case it is necessary to switch the connections.

### 8.2.3. Master tester

#### 8.2.3.1. Potentiometer, $I_{low}$

With the potentiometer  $I_{low}$  it is possible to adjust the lower bound current of the master tester between 5 and 9 milliamps. This is according OpenTherm test specification.

#### 8.2.3.2. Potentiometer, $I_{high}$

With the potentiometer  $I_{high}$  it is possible to adjust the upper bound current of the master tester between 17 and 23 milliamp. This is according OpenTherm test specification.

### 8.2.4. Bus monitor

#### 8.2.4.1. Switch, $1\Omega - 10\Omega$

With this switch it is possible to change the resistor value that is incorporated in the OpenTherm bus. When using the measuring pin provided on the OpenTherm testTool, to measure the current into the bus, put this switch on  $10\Omega$ , otherwise put it on  $1\Omega$ .