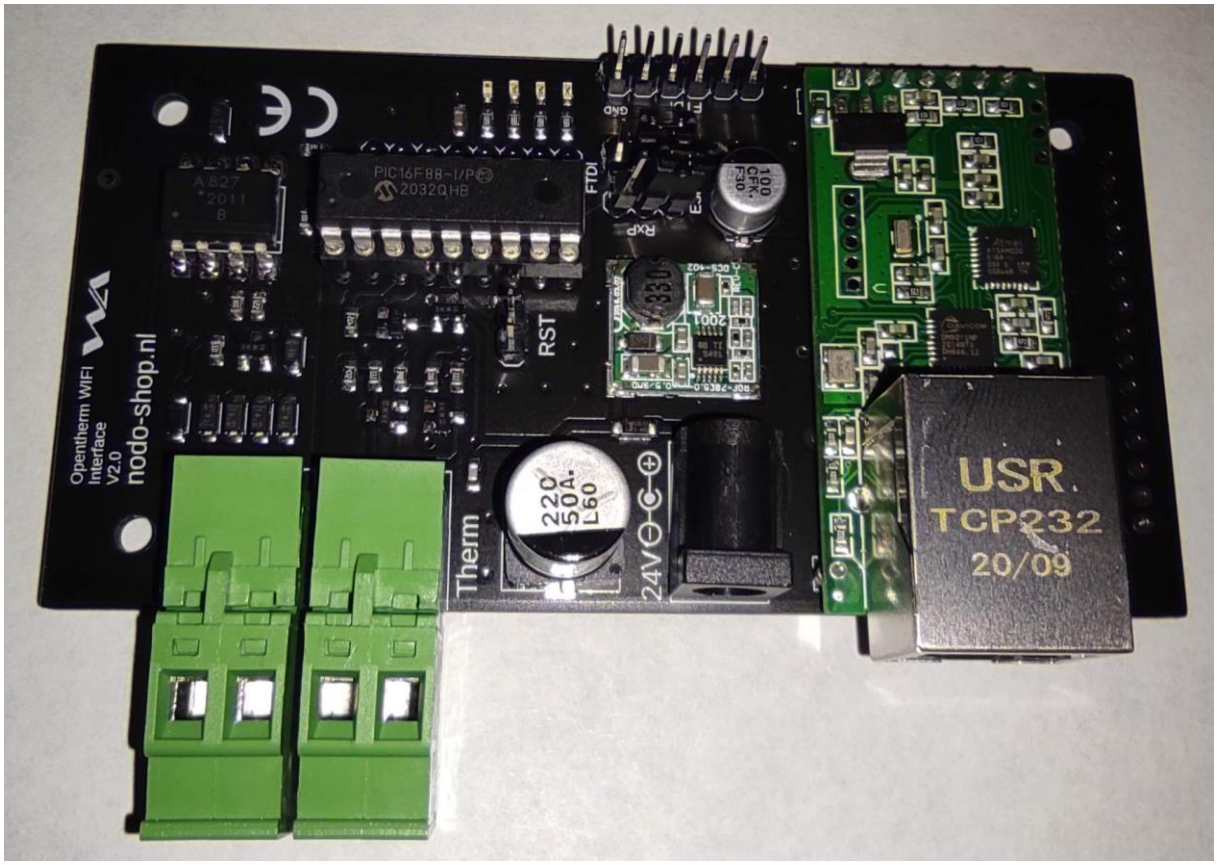
Assembly and Operation
Nodo OpenTherm Gateway



More information about the OpenTherm Gateway can be found on the website of the designer: http://otgw.tclcode.com/

This product is based on the design that can be found on that website.

You will also find a good explanation of the principles of the OpenTherm Gateway.

The site also contains a table with information about supported systems and thermostats.

Contents

Assembly

The board can be assembled even by those not very experienced in soldering.

If you need a bit of practice, check this site:
https://www.makerspaces.com/how-to-solder/

Tools required for assembly:

- Soldering iron (with thin tip) for electronics, preferably temperature controlled
- Solder for electronics, preferably 60/40 leaded solder with rosin flux core

Components:

The kit contains the following components:

- OpenTherm gateway board, fitted with SMD components
- 1 PIC 16F88 (already programmed)
- 1 IC socket 18 pins
- 1 14 x 1 pin male header
- 2 15 x 1 female header
- 2 male connectors
- 2 female connectors (screw terminal connection)
- 1 jack socket 5.5mm x 2.1mm
- 2 jumper caps

Connections:

The board supports the following connections

- Boiler
- Thermostat
- Power supply (19-24V DC, centre +ve)
- FTDI connection (for programming the PIC)
- NodeMCU *or* USR-TCP232-T2 (must be ordered separately)
- I2C bus (SCL, SDA)
- GPIO (for DS18S20 temperature sensor)

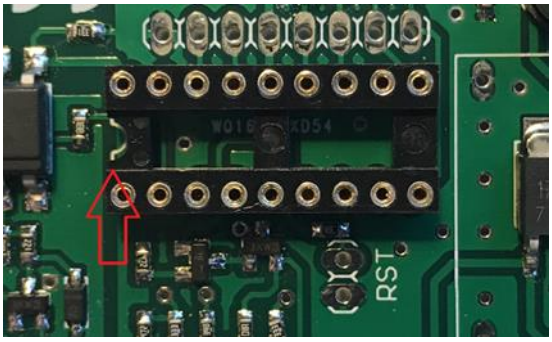
Assembly:

Read carefully before taking each step.

IC socket for PIC:

- **Take care to position the socket in the right direction!** On one of the short sides you will find a small cutout. This needs to be aligned with the marking on the board.

- Position the socket
- Hold the socket down with one finger and turn the board over. Now solder two of the corners to hold the socket.
- Now solder all pins carefully



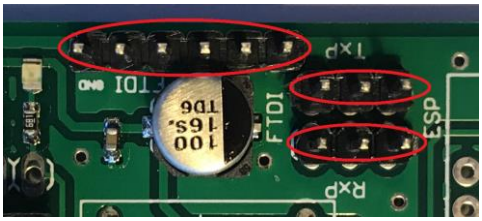
14 x 1 pin male header:

Cut the 14 (18 minus 4) x 1 pin male header into the following lengths:

- 1 x 6 pin
- 2 x 3 pin
- 1 x 2 pin

Position the 6 x 1 pin header on the board where you see “FTDI”. Hold it with one finger, turn the board over and solder the six pins.

Repeat this with the 2 x 3 male headers, at “RxP” and “TxP”, and the 1 x 2 pin header at “RST”.



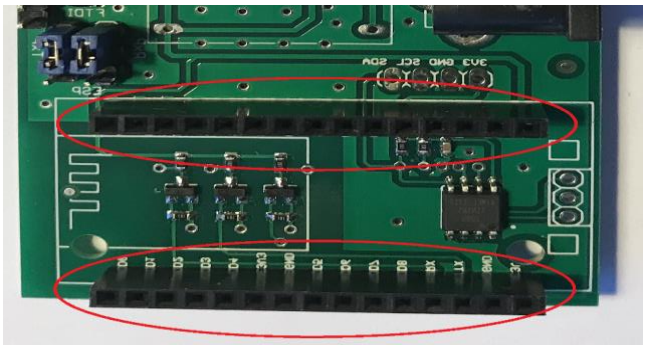
2 x 15 pin female header:

These only need to be fitted if you intend to use NodeMCU (WiFi) or USR-TCP232-T2 (Ethernet) with your gateway. The installation position of the headers depends on the board chosen.

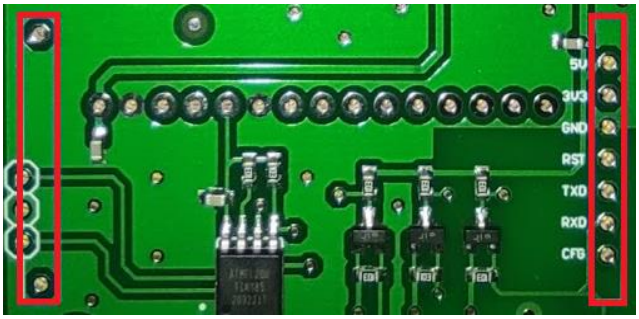
NodeMCU or USR-TCP232-T2 are not included in this kit and must be purchased separately.

Note that different types of NodeMCU are available. If you order from the Nodo shop, you will be sure to receive the correct type of NodeMCU for your OpenTherm Gateway.

For NodeMCU: Position one 1 x 15 pin female header on the top side of the board. Hold with one finger, turn, and solder 2 of the pins. Check if the header is vertical on the board, adjust if needed, and solder all pins. Repeat with the other 1 x 15 female header.



For USR-TCP232-T2: Cut down the 2x15 female header strips and solder to the positions shown.



DC jack socket:

Position the connector on the board (can only fit in one way) and solder this carefully to the board (make sure to fill the holes with solder). You may need to use a larger soldering iron.

2 pin male connectors:

Position the two 2-pin green connectors on the place where you see the labels THERM and BOILER, with the opening for the wires on the outside of the board. Solder them to the board.

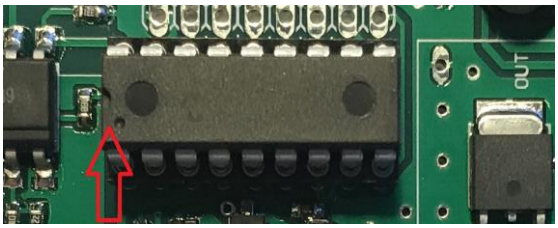
Cleaning

Clean your solder joints with PCB cleaner or isopropyl alcohol to remove flux.

Install PIC:

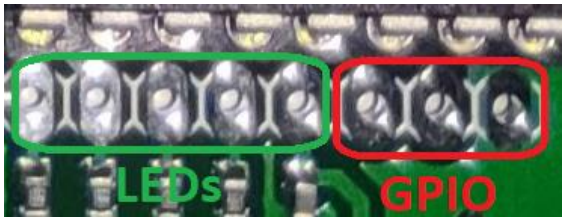
If you are able to, first connect the DC power supply to the board and use a meter to check that +5V is present between GND and 5V on the row of pads near the NodeMCU connector.

Make sure the board is not connected to power then carefully insert the pre-programmed PIC into the IC socket, aligning the small semicircular mark on the chip with the semicircular cutout in the socket.



Connections

- Boiler: connector for the boiler
- Therm: connector for the thermostat
- Jack socket: connector for the power supply (19-24V DC, centre +ve)
- 2 x 3 pin:
    - RxP from PIC to FTDI or network
    - TxP from PIC to FTDI or network
- 1 x 6 pin: FTDI serial port
- 1 x 2 pin: RST short together to reset PIC
- 2 x 15 pin for NodeMCU **or** USR-TCP232-T2
- 1 x 3 pin for I2C (SCL, SDA, GND)
- 1 x 5 pin for offboard LEDs
- 1 x 3 pin for GPIO (see http://otgw.tclcode.com/peripherals.html for more information)



LEDs

- Yellow: Boiler flame on
- Green: Transmit data active
- Green: Temperature set point override active
- Red: System error

Operation

The board is based on the reference design with a few alterations:

- SMD components where appropriate
- Offboard power supply for improved safety
- ATTiny85 watchdog for automatic reset of NodeMCU and PIC if software fails
- FTDI serial connection instead of RS232
- *Optional* NodeMCU (WIFI) *or* USR-TCP232-T2 (Ethernet) for network connection

Tools required:

- Small screwdriver
- Cutting pliers
- 19 – 24 V DC power supply (an old laptop supply could be used, but check voltage/polarity!)
- PC / laptop

Optional items not included with OpenTherm Gateway:

- FTDI cable or breakout board (Serial/USB)
- NodeMCU (WiFi)
- USR-TCP232-T2 (Ethernet)

The board has the following connections:

- Boiler & Thermostat OpenTherm connections
- Power supply (19-24V DC, centre +ve)
- FTDI connection (for control or reprogramming the PIC)
- I2C (NodeMCU)
- GPIO (e.g. for DS18S20 temperature sensor)
- LEDs (for optional external LEDs, onboard LEDs are provided)
- NodeMCU *or* USR-TCP232-T2 (available separately)

Connecting between boiler and thermostat

- Verify the existing thermostat connection is OpenTherm **not mains voltage!**
- Decide where to install the gateway between boiler and thermostat
- Disconnect the boiler from the mains supply
- Cut the wire that connects the thermostat to the boiler
- Strip the insulation from the cut wires (4 ends)
- Insert the wires into the green connectors and screw them down
  (THERM to the thermostat, BOILER to the boiler)
- Reconnect the boiler to the mains
- Connect the power supply to the gateway
- If all is well, you will see the green LED blink (above the yellow one)

Connecting a PC

The gateway does not require a PC to operate, however it would be usual to connect a PC via FTDI (serial/USB) cable, USR-TCP232-T2 or NodeMCU (WiFi) so the gateway can be configured.

Setting up NodeMCU

Requirements:

- NodeMCU
- Micro USB cable
- PC or Mac

STEP 1: Connect NodeMCU to PC

While the USB cable is connected, the NodeMCU must NOT be attached to the board!

Remove the NodeMCU from the board then connect to your PC using a MicroUSB cable.
If the NodeMCU is not recognized by your PC, download and install the USB drivers:
https://www.silabs.com/developers/usb-to-uart-bridge-vcp-drivers

STEP 2: Download and install firmware

There is firmware available for the NodeMCU from which enables operation with OpenTherm Monitor, provides for local reprogramming of the PIC, and also supports MQTT and REST API.
https://github.com/rvdbreemen/OTGW-firmware/wiki

More basic NodeMCU firmware is available from the designer of the gateway:
http://otgw.tclcode.com/otgwmcu.html

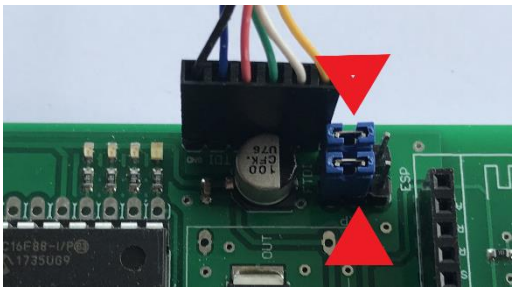
Connection methods

Connecting FTDI (serial/USB)

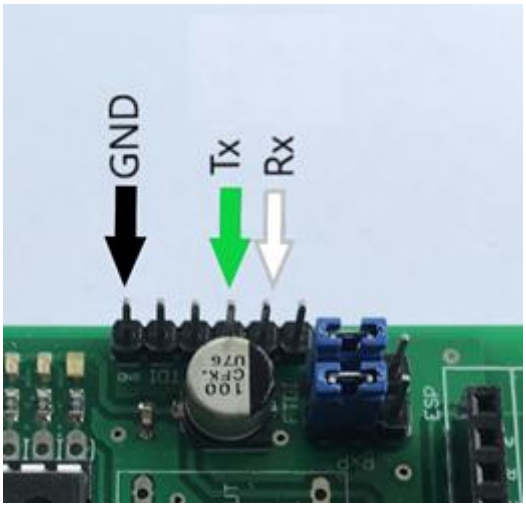
There are various FTDI cables available for communication with the OpenTherm Gateway.

The only connections needed are GND, Rx and Tx.

With a cable with a 6-pin connector, make sure that the black wire of the connector gets connected to GND on the board. Place the two jumpers next to the FTDI connector as shown.



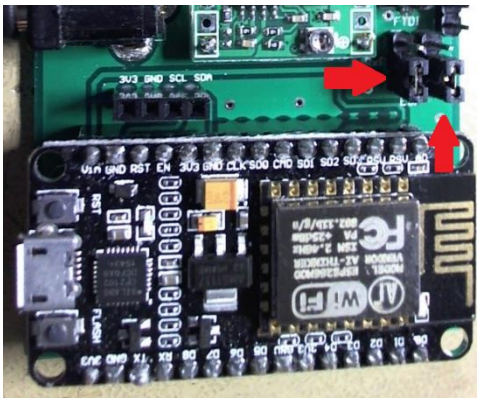
With a cable with 4 separate connectors, only the black, green and white wires must be connected
The connector with the red wire is not necessary.



With an FTDI board, GND on the board connects to GND on the gateway.

Connecting NodeMCU (WIFI):

- Disconnect the power supply from the gateway
- Place the RxP and TxP jumpers (near the FTDI connector) as shown below



- Ensure that the NodeMCU
    - Has appropriate firmware
    - Can connect to your home WiFi network
    - Has been configured for use with OpenTherm Monitor

- Position the NodeMCU into the socket. The USB connector **must** point to the left as shown
- Reconnect the power supply to the gateway

Do not connect a USB cable to the NodeMCU while the NodeMCU is connected to the board.

Connecting USR-TCP232-T2 (Ethernet)

- Position the USR-TCP232-T2 into the socket as shown below.

Refer to the instruction sheet provided with this module for software configuration.

OpenTherm Monitor

Download the latest OpenTherm monitor software for your system from
http://www.otgw.tclcode.com/download.html#utilities.

The gateway can be controlled with this software, but also with another program such as Domoticz.

Operation with FTDI cable (USB):

- Open the program OpenTherm monitor
- Options → connection → serial port (enter USB port) → Connect → Done
- Navigate to tab LOG: when communication between gateway and PC is correct, you will see data coming in. The top part of the monitor will show several values, but it may take a little while to come in.

Operation with NodeMCU (WiFi) or USR-TCP232-T2 (Ethernet):

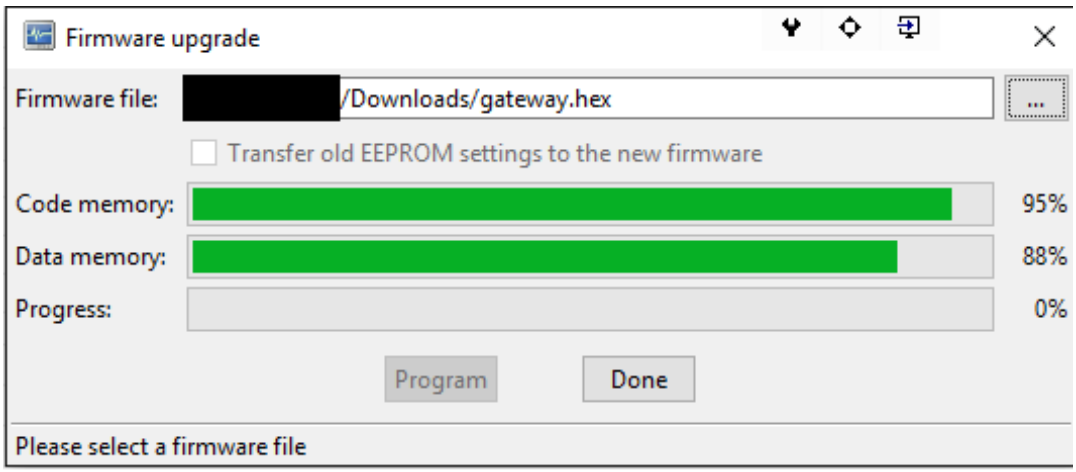
- Open program OpenTherm monitor that was downloaded earlier
- Options → Connection → TCP connection → Remote Host: enter IP address of the gateway (can be a dynamic or static IP)→ Remote port: enter port number (entered earlier when configuring network) → Connect → Done
- Navigate to tab LOG: when communication is OK, you will see data. The top part will (after a little while) show some values

PIC Firmware upgrade using FTDI

When the kit was sent to you, the PIC was pre-programmed with the latest firmware.
Later you may wish to update to a newer release. This can be downloaded from:
http://www.otgw.tclcode.com/download.html#hexfiles

Reprogramming via FTDI requires **latest** OpenTherm Monitor and a PC.
Note: If you have a NodeMCU, use the NodeMCU firmware to reprogram the PIC.

- Open program OpenTherm Monitor
- File → Firmware upgrade → Firmware file: enter the location of the new firmware hex file
- Click Program then when completed click Done. If failed, you may need to short the RST pins.
- Check the LOG tab to see if the gateway is running the new software



Domoticz

Some examples for use of gateway with Domoticz.

Connection via Serial (USB):

- Settings→ Hardware
- Check “active”
- Provide a name, e.g. “OpenTherm”
- Select type: OpenThermGateway USB
- Data timeout: e.g. 5 minutes
- Serial port: USB port to which gateway is connected
- Add

Connection via NodeMCU (WIFI):

- Settings → Hardware
- Select “active”
- Provide a name, e.g. “OpenTherm”
- Select type: OpenThermGateway with LAN interface
- Data timeout: e.g. 5 minutes
- Remote address: the IP address of the NodeMCU connected to the gateway
- Port: the port number set in Device Serial server in the NodeMCU
- Add

After using either of these two methods, Domoticz will now show a button “settings”.

  - Using this button you can add an outside temperature sensor. If your boiler already has one of its own, this is not needed. But if not, you can add one here. The outside temperature can be displayed on the thermostat display (if supported!)
  - In the command field you can enter a command to be executed. Commands are described here: http://otgw.tclcode.com/firmware.html#configuration
    A very important command is “TT=0”, to remove the override temperature and return to the normal thermostat program.

In Domoticz you can check the received data in Settings → Log
Note that initially you may see only numbers and letters, since it will take a little while for the data to be interpreted correctly.