Assembly and Operation
Nodo OpenTherm Gateway
V2.3
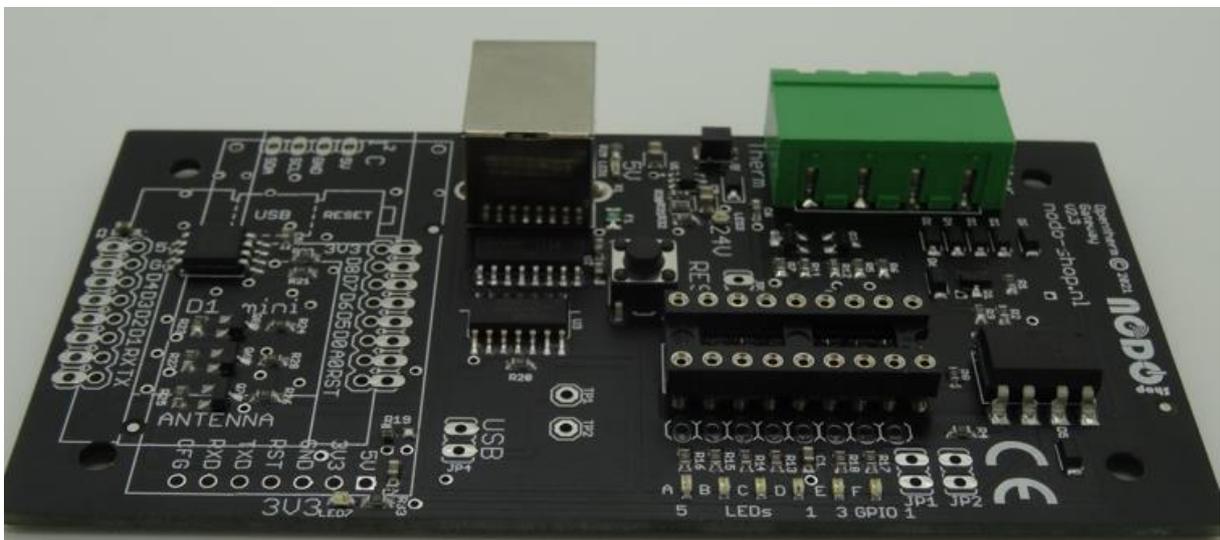
This product is based on http://otgw.tclcode.com/ with improved features.

There is comprehensive information on the design and a table of boilers and thermostats.

Requires a boiler and thermostat that use the OpenTherm protocol.

We would appreciate your feedback on this product: https://tinyurl.com/otgwfb

Contents

Assembly

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

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

Tools required for assembly:

- Soldering iron (with narrow 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:
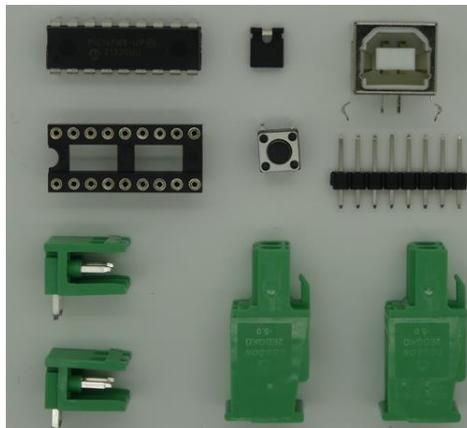
- 1 x OpenTherm gateway board (already fitted with SMD components)
- 1 x PIC (already programmed, taped to board for shipping)
- 1 x IC socket for PIC
- 1 x 8 pin headers (optional)
- 2 x 2 pin PCB connectors (for Boiler/Therm)
- 1 x USB B socket
- 1 x jumper cap (for reprogramming PIC if Ethernet module fitted)
- 1 x push button switch (for resetting the PIC)

Connections:

The board supports the following connections

- Boiler
- Thermostat
- USB (power & data)
- WeMos D1 Mini *or* USR-TCP232-T2 (must be ordered separately)
- I^{2}C bus for use by optional items e.g. OLED display
- PIC GPIO (for use by e.g. DS18S20 temperature sensor)

Most of the components are already fitted to the board.
Only three components need to be fitted for a fully functional gateway.
Read the instructions carefully before attempting each step of the assembly process.

IC socket for PIC

- Remove the PIC and sticky tape from the board before fitting the socket.
- **Take care to position the socket in the proper direction!** On one end you will see a semicircular notch. This needs to be aligned with the marking on the board.
- Hold the socket down with one finger and turn the board over. Now solder two of the corner pins to hold the socket.
- Check position then solder remaining pins.

USB connector

Position the connector on the board (can only fit one way) and solder 4 pins to the board. Fill the mounting holes with solder so the socket is firmly attached.

2 x 2 pin connector

Position the 2 pin connectors on the place where you see the labels **Therm** and **Boiler**, with the opening for the wires on the edge of the board. Solder in place.

4 x 2 Pin headers (optional)

You need to cut the 8 pin header strip into four 2 pin sections. Position one of the 2 pin headers on the board where you see "RST". Hold it vertical, turn the board over and solder the pins. Repeat with the remaining 2 pin headers at JP1, JP2 and USB.

A push button switch may be soldered at the position marked RESET.

Optional interfaces

WeMos D1 Mini *or* USR-TCP232-T2 may be fitted to the board for WiFi or 10baseT Ethernet. These optional interfaces are not included with the kit and must be purchased separately.

Note that different WeMos D1 Mini boards are available, some have small 3V3 regulators.

If you order from the Nodo shop, you will be sure to receive the correct WeMos D1 Mini for your OpenTherm Gateway.

WeMos D1 Mini (red): Position one 8 socket header on the top side of the board. Hold it vertical, turn the board over, 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 socket header to make a place for the WeMos D1 Mini to plug in.
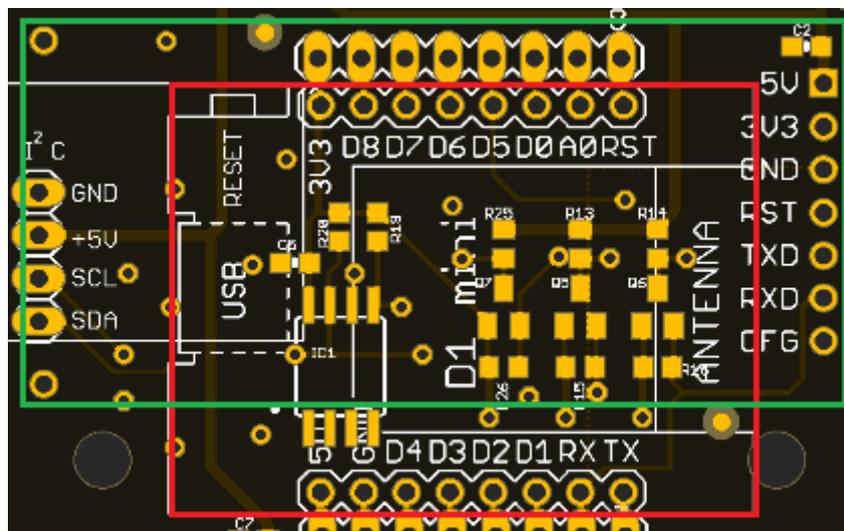
USR-TCP232-T2 (green): Solder directly to the board in the position shown.

Cleaning

Clean joints with isopropyl alcohol and a small brush to remove flux.

Install PIC

Make sure the board is not connected 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.
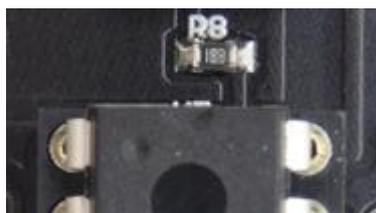
Board connections

- Boiler/Therm: connector for the boiler and thermostat
- USB socket: for USB power and data
- USB jumper: for selecting USB serial input if ESP/USR present on board.
- RESET (short together to reset PIC)
- WeMos D1 Mini (optional)
- I²C (3V3, SCL, SDA, GND)
- PIC connections: LEDs and GPIO pins.
- JP1 and JP2 jumpers: for use of DS18x20, omit jumpers and fit 4k7 resistor like this:
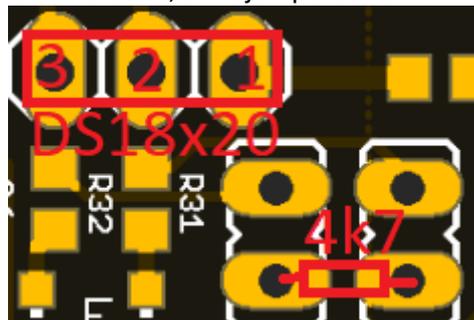
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- See http://otgw.tclcode.com/peripherals.html for more information

On board LEDs

- A Yellow: Boiler flame on
- B Green: Transmit data active
- C Green: Temperature set point override active
- D Red: System error
- E Green: Thermostat in High power mode
- F Green: Domestic Hot Water Enabled

LEDs can be reconfigured in software. Jumpers JP1 and JP2 must be installed to enable LEDs E & F.

There are also LEDs to show 5V, 24V and 3V3 (if used) power rails are active.

Operation

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

- SMD components
- USB powered with 500mA resettable fuse
- ATTiny85 watchdog for automatic reset of WeMos D1 Mini and PIC if software fails.
- Built in USB serial converter for easy operation with a PC. Automatically disabled if USR/ESP.
- *Optional* WeMos D1 Mini (WIFI) *or* USR-TCP232-T2 (Ethernet) for network connection

Items required:

- Cutting pliers
- USB A-B cable and a source of USB power at 5V 500mA (charger, hub, PC etc.)

Optional items not included:

- WeMos D1 Mini (ESP) for WiFi
- USR-TCP232-T2 (USR) for Ethernet

The board has the following connections:

- Boiler & Thermostat OpenTherm connections
- USB (for power, control, or reprogramming the PIC)
- I^{2}C (from WeMos D1 Mini if fitted)
- GPIO (for DS18S20 temperature sensor – omit jumpers JP1 and JP2, fit 4K7 resistor)
- LEDs (for optional external LEDs, onboard LEDs are provided)
- WeMos D1 Mini *or* USR-TCP232-T2 (available separately)

Connecting between boiler and thermostat

- **Verify the 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 2 core wire that connects the thermostat to the boiler
- Strip the insulation from the cut wires (4 ends)
- Insert the wires into the connector (**Therm** to the thermostat, **Boiler** to the boiler)
- Reconnect the boiler to the mains
- Connect USB power to the gateway using a standard USB A-B cable
- If all is well, you will see a green LED blinking.

It is very important not to accidentally swap over the Boiler and Therm connections.

Configuring WeMos D1 Mini

This must be done before the WeMos D1 Mini is plugged in to the board.

Requirements:
> - WeMos D1 Mini
> - Micro USB cable
> - PC

STEP 1: Connect WeMos D1 Mini to PC

⚠ **Do not connect a Micro USB cable to the WeMos D1 Mini while it is connected to the gateway!**

Connect the WeMos D1 Mini to your PC using a Micro USB cable.
If the WeMos D1 Mini is not recognized by your PC, download and install the USB driver:
> https://github.com/wemos/ch340_driver/raw/master/CH341SER_WIN_3.5.ZIP

Linux users will need the usbserial and ch341 modules.

STEP 2: Download and install firmware

Firmware is available for the WeMos D1 Mini which enables use of OpenTherm Monitor, allows reprogramming of the PIC, and supports MQTT and REST API.
> https://github.com/rvdbreemen/OTGW-firmware/wiki

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

Connection methods

USB

Use a standard USB A-B cable to connect the OpenTherm Gateway to your PC.

If the OpenTherm Gateway is not recognized by your PC, download and install the USB driver:
        https://github.com/wemos/ch340_driver/raw/master/CH341SER_WIN_3.5.ZIP

Network

WeMos D1 Mini (ESP):

- Disconnect USB cable from the gateway
- Ensure that the WeMos D1 Mini has appropriate firmware installed (see above)
- Insert WeMos D1 Mini into the board as shown by the diagram on the board.
- Reconnect USB cable

⚠ **Do not connect a Micro USB cable to the WeMos D1 Mini while it is connected to the gateway!**

USR-TCP232-T2 (USR)

The module is set for the 192.168.0/24 subnet and has an IP address of 192.168.0.7. Set your PC to 192.168.0.201 then use a Web browser to connect to 192.168.0.7. The baud rate will need to be altered to 9600. You should now be able to connect OpenTherm Monitor to 192.168.0.7 port 20108.

Refer to the instruction sheet provided with the module for more information on configuration.

Note The built in USB/serial chip is connected to the PIC unless ESP or USR modules are fitted, in which case the PIC serial interface is connected to the ESP/USR instead. To enable the USB/serial if ESP or USR modules are fitted, for example to reprogram the PIC, install a jumper on the USB pins.

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 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 Network (ESP/USR):

- 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

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 USB requires the most recent version of OpenTherm Monitor and a PC.
If you have a WeMos D1 Mini, use the WeMos 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 RESET pins.

- Check the LOG tab to see if the gateway is running the new software
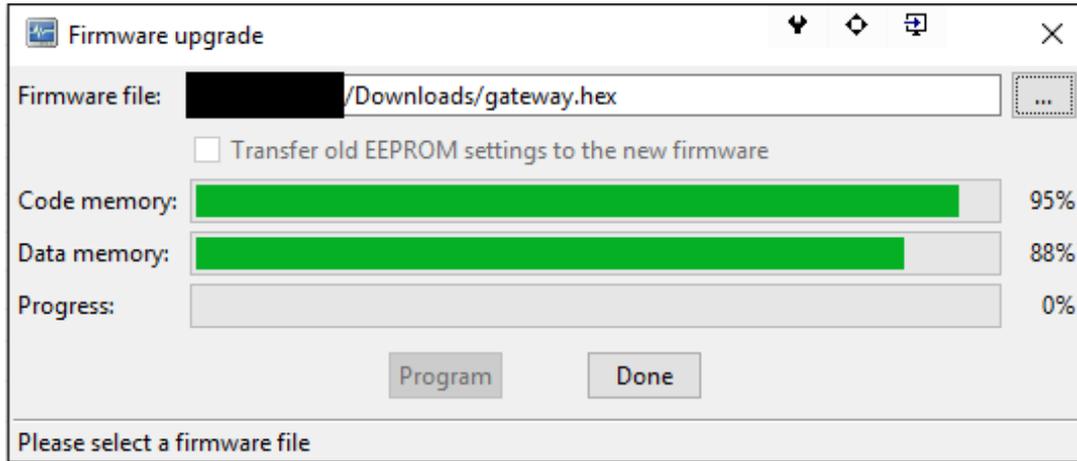
Domoticz

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 network (ESP/USR):

- 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 WeMos D1 Mini connected to the gateway
- Port: the port number set in Device Serial server in the WeMos D1 Mini
- Add

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

- o 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!)
- o 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.