

Commissioning

Contents [[hide](#)]

- [1 IMPORTANT: note about USB 5V power](#)
- [2 Establishing communication with the Duet](#)
 - [2.1 First connection](#)
 - [2.1.1 What to do if it isn't working?](#)
 - [2.2 Check SD card Settings](#)
 - [2.2.1 Is the SD card being read?](#)
 - [2.2.2 Is the SD card being read AT STARTUP?](#)
 - [2.2.3 What to do if it isn't working?](#)
- [3 Update your firmware!](#)
- [4 No, really, update your firmware!](#)
- [5 Connect via Pronterface](#)
- [6 Now connect the ATX power supply unit](#)
- [7 Testing machine control](#)
 - [7.1 Checking the heaters](#)
 - [7.1.1 Hot end](#)
 - [7.1.2 Heated bed](#)
 - [7.2 Test axis movement](#)
 - [7.3 Homing](#)
 - [7.4 Pronterface – RepRapPro Duet features](#)
- [8 Connect via web interface](#)
- [9 Problems?](#)

There are six pieces of software required to use the RepRapPro Ormerod:

1. [Arduino IDE](#) (Integrated Development Environment) – used for device drivers, basic communication, problem solving
2. The [RepRap firmware](#) – this controls the hardware functions of the Duet board
3. [Pronterface](#) – used for communication and control over the USB connection
4. [Google Chrome](#) – used for controlling the Duet via the web interface
5. [Slic3r](#) – used for translating 3D files into the g-code, which controls the movements of the printer
6. The [Ormerod](#) files – profiles for Slic3r, and all the files you need to print another Ormerod

IMPORTANT: note about USB 5V power

When using the Duet with 5V power supplied by the USB cable only (ie not ATX PSU power), you may find that the board doesn't respond correctly. The web interface, SD card reading, IR sensor may all be unreliable. Three different voltages are used on the Duet: 12V for motors, fans and heaters, 5V is used to drive the MOSFETs, and is converted to 3.3V for most other parts of the board (ARM chip, thermistors, stepper drivers, proximity sensor, SD card, USB, Ethernet).

It's possible that your 5V USB power source doesn't supply enough voltage, or current, to power the Duet, particularly if you're working through a low quality USB power supply, an unpowered USB hub, or laptop with low power USB ports. The Raspberry Pi, which uses a similar ARM chip, also has this problem. Plugging all the other connections in may also drain enough power to cause problems. A way to test this would be to check the actual voltage of the 5V and 3.3V power lines. You can measure the 5V on pin 1 of the expansion header, 3.3V on pin 3 – these are the pins closest to the heated bed connection, just under the 'SION' of 'EXPANSION'. Anything below 4.5V on the 5V line will make for a marginal 3.3V supply, and could cause a multitude of strange effects on the board.

The Duet should work correctly when 5V is supplied by the ATX PSU, but don't plug this in yet!

Establishing communication with the Duet

This first section should be done with the ATX PSU disconnected.

The Duet electronics board is based on the Open Source [Arduino Due](#) board, with the addition of ethernet, stepper drivers (to control the stepper motors), SD Card slot, temperature sensing and other inputs and outputs needed by a 3D printer.

First connection

Download Arduino IDE v1.5.5 BETA (with Arduino Due support) for your operating system from: <http://arduino.cc/>.

Install Arduino IDE

Connect USB cable to Duet, making sure it is pushed all the way in. An LED should light up, near the USB connector. See the important note above about 5V USB power if it does not. If your Y-axis endstop is fitted, a second LED will light up near this connection on the board. It will be lit if the Y carriage is away from the endstop, and will go out if you move the Y carriage until it touches the microswitch.

The device drivers should be found and installed automatically.

WINDOWS 7 AND 8 USERS - a note about device drivers. (click to expand)

Open the Arduino IDE and go to Tools->Board menu and select 'Arduino Due (Native USB)'. If this is greyed out, check the device drivers have been installed.

Then go to Tools->Port menu and select the USB port for your Ormerod.

Then go to Tools->Serial Monitor. Make sure the speed is set to 115200 (bottom right) and that Newline is selected (next to the speed).

Wait for 1 minute (this is normal when no ethernet is connected and the firmware is searching for the network), and following should show:

```
RepRapFirmware is up and running.
```

If no message is received, send the following command:

```
M105
```

Note: All codes sent to the printer MUST be **UPPER CASE**. Don't use lower case, and don't mix them, or you will get no response.

And you should get a response from the machine, similar to this:

```
T:5.3 B:18.4
```

or this:

```
serial: M105  
ok T:5.3 B:18.4
```

If you get no response, close the Serial Monitor window, unplug the USB, check the Arduino settings and try connecting again. Wait for 1 minute after plugging in the USB.

If you get temperatures of -273.1 on either the hot end or heated bed thermistor, it usually means the thermistor is disconnected, or shorting out. Check your thermistor wiring.

Note: It's not uncommon to have different temperatures for the hot end and heated bed at room temperature. Thermistors tend to be inaccurate at the very bottom and the very top of their range. We make sure they are at their peak accuracy where we need it; for the hot end between 150 and 250C. Below about 10C ambient, the hot end reading will drop below -30C, and the Duet assumes this is a fault, so reports -273. So long as the temperature reported is above -30, you won't have any problem turning on the heater. By the time it hits 25C, it's accurate. On cold mornings a mild warming with a hair dryer on the hot end soon sorts it out! A future firmware update will improve low temperature accuracy.

What to do if it isn't working?

See the note at the top of the page 'IMPORTANT: note about USB 5V power'. If the power is low, it can cause strange problems, such as odd temperature readings, failure of SD card, and failure of Ethernet. If you don't have any other USB power source available, turn off the Duet, remove the motor and heater wires from the board, put a jumper on JP9 and connect the ATX power supply. See the later section 'Now connect the ATX power supply unit' for full details, but return to this point, and try connecting again.

It's also possible that the USB socket on the Duet is loose, and the USB lines have broken. Check the USB socket; it has 4 legs that go through the board. All four of these should be soldered, to hold the socket firmly on the board. If they are not, you can solder them yourself; this is easier from the back of the board. If you still get no response, contact support.

Check SD card Settings

Your Ormerod was supplied with an SD card, and a USB adapter. Put the SD card in the USB adapter, and into your computer – it should appear on your desktop. The SD Card is used for storing settings, serving the web pages of the web interface, and has some test gcode files for printing.

Download the RepRap firmware from our [Github repository](#). Do this by going to the page, and clicking the 'Download ZIP' button on the right hand side. Extract the ZIP file once downloaded.

In the extracted directory is a directory called 'SD-Image'. Open this, and copy the contents (three directories – gcodes, sys and www) to the root of the SD card, so that they are the first thing you see when you open the SD card.

Eject the SD card, remove it from the adapter, and put it into the SD card holder on the Duet. It should click in.

Is the SD card being read?

Connect the USB cable to the Duet, and connect to it using the Arduino Serial Monitor, as above. Wait for 1 minute, and you should then see (again):

```
RepRapFirmware is up and running.
```

In the top part of the Serial Monitor window, type, without quotes 'M503' and press 'Send'.

Note: All codes sent to the printer MUST be **UPPER CASE**. Don't use lower case, and don't mix them, or you will get no response.

The response should be similar to:

```
; RepRapPro Ormerod
; Standard configuration G Codes
M111 S1; Debug on
M550 POrmerod; Set the machine's name
M551 Preprap; Set the password
M552 P192.168.1.14; Set the IP address
M553 P255.255.255.0; Set netmask
M554 P192.168.1.1; Set the gateway
```

```
M555 P2; Emulate Marlin USB output
M92 E420; Set extruder steps/mm
G21 ; Work in mm
G90 ; Absolute positioning
M83 ; Extrusions relative
M558 P1 ; Turn Z Probe on
G31 Z0.5 P500 ; Set Z probe height and threshold
M906 X800 Y800 Z800 E800 ; Motor currents (mA)
T0 ; Select extruder 0
```

If the SD card is not inserted, or not being correctly read (the error code may be different), you get:

```
Can't open 0:/sys/config.g to read from. Error code: 12
Configuration file not found
```

Check that you have inserted the SD card properly. Some customers have reported problems with the supplied SD cards and/or the USB adapter. If you can, try a different SD card, and writing files to it with a different adapter. SD cards come in a variety of sizes; we have tested cards up to 8GB. They should be a FAT32 formatted disk.

Is the SD card being read AT STARTUP?

The most important thing to check is that the SD Card is read WHEN THE PRINTER IS POWERED ON. The list of commands above are the config.g file, in the sys folder on the SD card. This is the settings file for the printer, and should be read when the printer starts up. It does important things like set the network settings, put the printer into a mode that lets Pronterface talk to the Duet (M555 P2; Emulate Marlin USB output), and turn on the proximity sensor (M558 P1 ; Turn Z Probe on – otherwise the printer won't home the X and Z axis properly).

The easiest way to test if the card is being read at startup is to open the Arduino Serial Monitor, connect, and then send a command, like M105. The correct response should be:

```
serial: M105
ok T:-273.1 B:-273.1
```

The important thing is the 'ok', which means the M555 P2 (Emulate Marlin USB output) command has run. If you send M105 and get:

```
T:-273.1 B:-273.1
```

(without the command echoed, and no 'ok') the config.g has NOT been read at start up.

What to do if it isn't working?

Update your firmware (see next section); there are some fixes in it to improve the chances of the SD card being read.

Replace the SD Card with a better or known-working card.

For some people, it helps to apply power to the board, then after a couple of seconds press the reset button on the Duet, then the SD card gets read.

The SD card needs to be working correctly to be able to communicate and print, so it's worth checking if you are having problems.

Update your firmware!

Your Ormerod will have been supplied with firmware flashed in its microcontroller. Now you have established communication with the Duet, it's a good idea check you have the latest version, and update the firmware on the Duet if not. [See here for how to do that](#). We will be adding features and squashing bugs regularly, to improve the usability of your printer, so check often.

No, really, update your firmware!

Recent updates have improved network connectivity, improved USB communication, improved accuracy of thermistors, improved the SD card reading, fixed homing problems, fixed printer stopping problems, and many others. So please, to save yourself potential frustration, update your firmware.

To check your firmware version, connect to your Duet board via the Arduino IDE Serial Monitor and send the 'M115' gcode. The response should be something like:

```
FIRMWARE_NAME:RepRapFirmware FIRMWARE_VERSION:0.57a ELECTRONICS:Duet
DATE:2014-01-16
```

If the response is:

```
Error: invalid M Code: M115
```

You have an very old version of the firmware, and should definitely update!

Compare the firmware version information from your response to M115, with the file name of the file in [this link](#), which is on our github page. But DO NOT DOWNLOAD THIS FILE DIRECTLY! [See here for the full firmware update instructions](#).

Following updating the firmware, don't forget to update the SD Card with the latest files from the 'SD-Image' folder.

Connect via Pronterface

Pronterface is used to control the printer's basic functions, via USB. Any version of Pronterface should work with the Duet, though we supply a customised version for our customers.

Two installation methods are available:

- **Easy** – download the pre-compiled version here, [Windows](#) or [Mac](#), and extract the zip file.
- **Advanced** – For Windows/Mac/Linux – download the zip file from our [Github repository here](#), installation instructions [HERE](#). This is slightly modified version of Pronterface, enhanced for the Duet.

Once installed, close the Arduino Serial Monitor if it is still open, connect the USB cable to the Duet, then run Pronterface.

Select the USB port that your computer has allocated the Duet in Pronterface's 'Port' box, select a communication speed of 115200, and click the **Connect** button.

As before, wait for about a minute, and the software will confirm when the printer is online.

Press the GET POS button, and if the machine returns a position of X0.00 Y0.00 Z0.00 your serial communication is functioning correctly.

IMPORTANT. Next press "Check Temp" and check that both the hot end and the heated bed are reporting a temperature that is around room temperature (it may be a couple of degrees out – the thermistors are designed for accuracy at their operating temperature). Pronterface reports the temperatures in the bottom left of the window; you can also turn on the graph. If you get a stream of temperatures in the 'log' window (on the right), the SD card hasn't been read at start up (see 'Is the SD card being read AT STARTUP' above), and the Duet has not started in 'Marlin emulation' mode, which Pronterface needs. Reset the printer, check the SD card is working (try another if it is not), and reconnect Pronterface to the Duet board.

If a temperature is too high then there is probably a short circuit in the corresponding thermistor circuit. If it is too low, then there may be an open circuit. In either case, find the fault and fix it before you go on.

NOTE: If your pronterface window does not display the custom buttons (GET POS, BL, BR, CENTRE, etc...), you most likely have installed a version of Pronterface previously, and the settings file .pronsolerc already exists in your main User folder (the one with the main 'Documents', 'Downloads' and 'Pictures' folders in it – usually C:\Users\{username} on Windows). This file is an invisible/system file, though; make them visible, delete the file and reload the software. You should now see the extra buttons.

Check the settings by sending 'M503' by typing it into the command line in the bottom right hand side of the Pronterface window. The settings will scroll above the command line, in what we call the log window. This establishes that Pronterface is talking correctly to the Duet, and it is responding correctly.

Now close Pronterface, and disconnect the USB lead, to turn off the Duet.

Now connect the ATX power supply unit

The PSU will supply the motors and heaters with 12V, while the logic is supplied with 5V. Make sure that there is a jumper on the JP9 (5V_EN) pins (see picture below for location of jumper). With no USB lead connected, a light should turn on on the board, near the reset button.



IMPORTANT: The first thing that should happen is the hot end fan should start turning. If not, **TURN OFF the ATX PSU**, and check your wiring of the hot end connector. The thick red hot end heater wires should go to the doubled-up yellow and brown wires in the other connector (polarity not important). The thermistor wires should go to the middle pins, the blue and green wires on the other connector (polarity not important). The red and black fan wires should go to the red and black wires on the other connector, and match them – polarity IS important. Then check the fan power is connected to the Duet correctly.

Watch for smoke in case something has gone horribly wrong! If there is a problem, turn off the power by **SWITCHING OFF THE ATX PSU**. Some customers have reported the hot end turning on straight away, full power, so check the hot end isn't heating up – it will do this quickly, so check first! Also, make sure that the heated bed, motors and the four motor driver chips aren't getting hot. Take care with the chips – they have internal temperature shutdowns that kick in around 80°C, a temperature that will burn your finger unless you just touch lightly and briefly.

NOTE: The first 220 Ormerod (red plastics) printers supplied by RS Components need the USB lead to be connected **at all times**, to supply the logic side of the board with 5V. If they wish, buyers of the initial 220 machines with this restriction can return their Duet electronics to RepRapPro Ltd for an updated Duet without this restriction. Email support to arrange this.

Testing machine control

Checking the heaters

Plug in the USB and run the Pronterface program. Click “Connect” and wait for your RepRap to appear online.

The heated bed and the hot end are the two parts of the printer that may cause damage as they are high-current devices; we check them first, in case there are any problems that have caused a fault.

Tick the ‘Watch’ check box (or ‘monitor’, depending on Pronterface version) to report the temperatures of your heatbed and nozzle. Ensure that the readings are similar to the ambient temperature of the room. If they are not, check connections. Usually, if they are very low (-273), this indicates the thermistors are not connected.

Hot end

IMPORTANT: Check that the hot end fan is running. This needs to be on ALL THE TIME there is power to the printer – it should be connected directly to 12V power. It is part of the design of the hot end that the top part of it is continuously cooled, and the extruder will work extremely poorly, or not at all, if it is not cooled. If it is not running, check the connections, power, and the fan polarity. Check that you can feel air coming OUT of the nozzle around the hot end.

Command the nozzle to 100C, by typing ‘100’ in the box next to ‘Heater’, and watch the temperature rise, overshoot and eventually settle around 100C. Keep an eye on the nozzle during this test. If you see lots of smoke come out of the hot end, turn off the heater and check your wiring. You may have a short on the heater wires, or to the heater block, or there may be some contamination around the heater block.

Repeat the test with a target temperature of 200C. The nozzle should reach the target temperature in about 1 minute or less and settle within a couple of degrees of 200C. Some smell of oil burning off is not unusual – it’s the oil from machining the parts – but should dissipate after a minute.

Press ‘Off’ next to ‘Heater’ to turn off the hot end.

Heated bed

Command the heatbed to 45C (warm), by typing ‘45’ in the box next to ‘Bed’, and click ‘Set’. Verify that the heatbed temperature reading rises and stabilises around 45C, and that the heatbed is actually warm.

The heated bed will heat up more slowly than the hot end.

Press ‘Off’ next to ‘Bed’ to turn off the heated bed.

Test axis movement

Now type in the following command in the command line:

```
G1 X5 F500
```

in the field below the log window and click Send. The X-carriage should move to 5mm in the positive direction (X5) at 500mm/min (F500).

Now type:

```
G1 X0 F500
```

and send. The X-motor should move back to its starting location (X0).

Repeat the above test for the Y axis, replacing the 'X' in the above command with 'Y'.

For Z, make the feedrate 200 mm/minute:

```
G1 Z5 F200
```

You can use the 'jog dial' on the left hand side of the Pronterface window.

NOTE: When you turn on the printer, where each axis is, is where the printer thinks X=0, Y=0 and Z=0 are.

Homing

'Homing' sends an axis to the end of its travel, and hits an endstop, which gives the printer a reference point. Then it will know where the bed is.

Send a homing command for the Y axis first. Either press 'Y' homing button in Pronterface (above the 'dial' on the left of the Pronterface window), or use the homing command: for example

```
G28 Y0
```

The Y carriage should move towards the Y motor, hit the microswitch, then reverse to the other end of the Y axis. The Y endstop is a 'MAX' endstop; it records the point where the Y axis is at its maximum point, ie 200mm, then moves to 0, at the other end of the axis.

If the wiring for the microswitch is not connected properly, it will start by moving towards the idler end, eventually clattering off this end! This will stop after a few moments. Don't worry, no damage will be done. Check the wiring for the microswitch, it is possibly disconnected. There is an LED on the Duet above the Y motor connection. It will normally be on, and will go out when the Y endstop switch is hit.

The X axis endstop is not a microswitch; the Ormerod uses the proximity sensor for X homing. This is triggered by the bar that sticks out from the x-motor-bracket. It is important that the X carriage can pass by the electronics housing; this should have been checked earlier in the build. Check that the polarity of the wires connected to the sensor are correct – see the ‘Wiring’ instructions. Also, depending on lighting conditions where the printer is, you may need to add a piece of silver foil (like that used on the bed) to the top of the bar for the sensor to work consistently.

Press ‘X’ homing button in Pronterface, or use the homing command:

G28 X0

The X carriage should move up 5mm, and towards the Z axis. It should stop before it hits the end.

Finally, home the Z axis. Again, this uses the proximity sensor. Press the ‘Z’ homing button in Pronterface, or use the homing command:

G28 Z0

The X carriage should move out, to be over the corner with the aluminium foil underneath, then move down and stop. Initially, the nozzle will be some way from the bed; you will correct this by following the ‘Axis compensation’ instructions.

Pronterface – RepRapPro Duet features

Use of the RepRapPro version of Pronterface, with extended features for the Duet, is [documented here](#).

Connect via web interface

To use the web interface, you need to connect an ethernet cable from the Duet to your ethernet hub, switch or router. The Duet will need to be powered, either by USB or the ATX PSU – it cannot be powered by the Ethernet cable.

It is also possible to connect the Duet directly to your PC via Ethernet, but you will need to set up the ethernet port of your PC to match the Duet (or the Duet to the ethernet port of your PC). Your PC will still need to have access to the internet (via another ethernet port or wifi) for the RepRapPro web interface to work.

You need three pieces of information to set up the Duet for your network; ip address, netmask, and gateway ip address. Often, small networks are setup using DHCP, which assigns ip addresses automatically to the devices that connect to the network. The Duet, at the moment, can’t use this; you need to set the ip address manually.

By default, the settings in sys/config.g on the SD card are:

```
IP address: 192.168.1.14
netmask: 255.255.255.0
gateway: 192.168.1.1
```

If you're on a Windows PC, check that the settings you use on your network by opening a Command Prompt and sending 'ipconfig'. This should respond with something that includes:

```
Wireless LAN adapter Wireless Network Connection:
Connection-specific DNS Suffix . : lan
```

```
Link-local IPv6 Address . . . . . : fe80::45dc:fdd3:67dd:db47%11
IPv4 Address. . . . . : 192.168.1.66
Subnet Mask . . . . . : 255.255.255.0
Default Gateway . . . . . : 192.168.1.254
```

On a Mac OS X, look at the 'Network' preferences panel to get the information. On Linux, look in the Network Manager, or in a terminal window type 'ifconfig'.

This will show the settings you need to put in config.g for these two settings:

```
M553 P255.255.255.0; Set netmask (Subnet Mask)
M554 P192.168.1.254; Set the gateway (Default Gateway)
```

For the last setting, the ip address, choose a number that is 10 higher or lower than the address listed by ipconfig. In the example above, it lists 192.168.1.66, so set:

```
M552 P192.168.1.76; Set the IP address
```

If you need to edit these settings, edit the config.g file in RepRapFirmware/SD-Image/sys/ that you downloaded earlier. Then copy the new config.g onto the SD card.

Connect the ethernet cable to the Duet, and the hub/router/switch at the other end. The GREEN LED on the ethernet connector should light up, and flicker. The Orange LED is a indicator light for 10base-T connections – most ethernet hubs/routers/switches are 100base-T or gigabit, so it will stay switched off.

At the moment, only [Google Chrome](#) is supported. Other browsers will be added with later firmware releases. Download and install [Google Chrome](#).

Run Google Chrome, and enter the ip address you set in config.g into the address bar; for example, 192.168.1.76 (from the example above)

If the web interface is correctly set up, you should be presented with a login screen. The default password is 'reprap'; you can change this in the config.g file, too.

More in-depth use of the web interface is [documented here](#).

Problems?

If you have problems with any of the steps on this page, particularly connecting to the Duet, see the ‘troubleshooting’ section of the instructions.

If you spot any mistakes in these instructions, please email your feedback to the support email address.