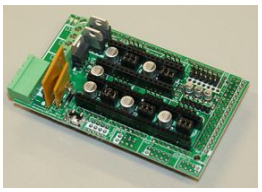
RAMPS 1.4

From RepRapWiki

RAMPS
Version specific info **RAMPS 1.4** | RAMPS 1.3 | RAMPS 1.2 (RAMPS 1.2 old) and older

RAMPS 1.4

Release status: Working



Description	RepRap Arduino Mega Pololu Shield Arduino MEGA based modular RepRap electronics.
License	GPL
Author	johnnyr
Contributors	
Based-on	Pololu Electronics
Categories	RAMPS
CAD Models	none
External Link	none

Contents

Summary

In RAMPS 1.4, the resistors and capacitors are now surface mount to fit more passive components. This does add another set of steps to assembly, but we stuck with larger sizes to make it fairly painless.

Reference board orientation is component side up, power inputs to the left.

Safety Tip

> Once you start putting electricity into your RepRap - even at just 12 volts - you have to take basic, common sense precautions to avoid fires. Just in case these fail, test your workshop smoke detector (http://en.wikipedia.org/wiki/Smoke_detector) . Got no smoke detector? Get one!

Assembly

Component Soldering

Required Tools

You must have: Solder iron, solder wire, good tweezers You really need: Solder wick, solder sucker, flux pen Optional methods use: Solder paste, hot plate or oven

Shield Assembly

Soldering RAMPS 1.4 includes both surface mount and through hole soldering.

The surface mount can be done a few ways. Since all the SMT components on this board are large 2 pad parts you can do pin by pin soldering pretty easy with normal soldering equipment. Start by putting a small amount of solder on one pad. If you have flux, coat the soldered pad. Use the tweezers to hold the component down in position and heat the solder to tack the component into place (make sure the entire solder blob flows so you don't get a cold solder). Then solder the other pad. Also popular is using solder paste for pad by pad soldering, Oven Reflow (need link), and HotplateReflowTechnique

Solder the SMT components first. Then the PTH on top of the board. Finally solder the pin headers on the bottom.

C2 - 100nF capacitor

This can be placed in any orientation.

LED1 - Green LED

Place these with the end having green dots away from the + mark on the PCB.

LED2, LED3, LED4 - Red LED

Place these with the end having green dots away from the + mark on the PCB.

R13, R14, R15 - 10 Ohm resistor

These can be placed in any orientation.

R12 - 1K resistor

These can be placed in any orientation.

R23, R24, R25 - 1.8K resistor

These are marked 1K on the PCB, but we are using larger ones to accommodate higher voltages.
These can be placed in any orientation.

R1, R7, R11, R21, R22 - 4.7K resistor

These can be placed in any orientation.

R16, R17, R18, R19, R20 - 10K resistor

These can be placed in any orientation.

R2, R3, R4, R5, R6, R8, R9, R10 - 100K resistor

These can be placed in any orientation.

C1, C5, C8 - 10uF capacitor

These must be placed in the proper orientation. The board has the foot print of the components printed on it. The rounded corners on the base of the capacitor must line up with the white print on the PCB.

C3, C4, C6, C7, C9, C10 - 100uF capacitor

These must be placed in the proper orientation. The board has the foot print of the components printed on it. The rounded corners on the base of the capacitor must line up with the white print on the PCB.

Reflow SMT soldering

If you are doing oven or hot plate method, now is the time apply heat (add links here). If you used a solder iron, you have probably already soldered all these components.

Make sure to inspect the SMT soldering at this point since it will be harder to rework after the headers are on top.

Top pins

Solder 1 1x6, 6 1x4, and 7 2x3 pin headers on top of the board. The long post should be standing up to take a connector. Solder one leg on each one to tack them into place. Then re-heat the joint and push on the component until it is perfectly situated. Then you'll want to solder the rest of the leads. You will get burnt if you touch the other side of the pin you are soldering.

If you want to use the extra pin outputs, now is the time to solder on the rest of the headers.

Driver sockets

Place the female headers for the stepper drivers on top of the board. You can use the 1x8 and 1x6 pin headers to jig them straight. Turn the board over and solder these pins.

D1, D2 - Diodes

These must be placed in the proper orientation. The band on the diode must be turned the same way as the mark on the board.

Definitely solder D2 in. D2, F1, and F2 are shown installed here.

D1 should only be installed if the 5A rail is powered by 12V. It can be omitted and the Arduino will be powered from USB. You will want D1 installed if you add components to print without a PC. To reiterate, D1 MUST be omitted if you are powering the 5A rail by more than 12V, or the power is not absolutely clean, otherwise you may damage your ramps.

Where to find the D1 and D2 diodes

F1 - MFR500 Fuse

This is the smaller yellow fuse. This can be placed in any orientation. When soldering the fuses it is best to use a piece of 3mm filament or something similar to keep the ceramic coating on the pins from blocking proper solder along the through hole.

Since the fuses are the tallest parts, it is simpler and more convenient to solder them last. From this point on, solder the rest of the RAMPS in order of bottom pins, reset switch, terminals, mosfets and then fuses.

Bottom pins

Place these on the bottom of the board with the long post out to plug into the Arduino MEGA. You can plug them into the MEGA to hold them in place while you solder. Do not overheat the pins while in Arduino or you may damage its connectors.

Reset switch

This can only be oriented in one direction.

Mosfet Terminal

This must be oriented where the wire holes are turned towards the edge of the board. Solder a pin on each end and make sure the component is flat on the board and solder the middle pins.

Standard RAMPS 1.4 D8-10 Terminal Block

Alternative Plug/Jack Connectors

Power Terminal

This can only be oriented in one direction.

Q1, Q2, Q3 - Mosfets

These must be orientated as in the picture. The tall heat sink part of the mosfet needs to be turned the same as the mark on the board.

F2 - MFR1100 Fuse

This is the larger yellow fuse. This can be placed in any orientation.

Inspection

Inspect your work. Clean any solder bridges and suspect solders.

Stepper Driver Boards

1. ▪ Jumpers need to be installed under each stepper driver:

```
jumper   Yes/No  step size
1     2    3
no    no    no    full step
yes   no    no    half step
no    yes   no    1/4 step
yes   yes   no    1/8 step
no    no    yes   1/16 step
yes   no    yes   1/32 step
no    yes   yes   1/64 step
yes   yes   yes   1/128 step
```

If the jumpers set it to a higher number of micro steps than supported by the driver it will operate at the maximum number of micro steps for that driver. For now the default is maximum micro stepping (all jumpers installed under drivers), which results in 1/16 micro stepping for A4988 drivers and 1/32 for DRV8825

Note: This can vary for different drivers.

1. Cut the pin headers to 8 pins long so that they fit each side of the stepper driver.
2. Insert the pin headers into the sockets on RAMPS
3. Fit the stepper drivers onto the pin headers and solder. Only heat each pin for a few seconds at time to avoid damage to the socket.
   - Glue the heatsink (if used) to the top of the A4988/A4983 chip using the provided pad of double-sided adhesive.

Opto Endstops

Opto endstop build instructions can be found at Gen7_Endstop_1.3.1, and also here (http://reprapsource.com/oe-r1) for reprapsource.com's instructions.

1. ▪ Cut the 26awg 3 conductor cable into 3 length.
   - Note: you may want to wait until you've built your machine to cut the cables to the perfect length.
   1. ▪ crimp and solder a female connector to the ends of each wire. (solder not necessary with proper crimp tools)
   - use the 2.54mm 1x3 housing.
   - Connect at least the minimum endstops.

RAMPS End		
SIG (S)	White	Top pin
GND (-)	Black	Center pin
VCC (+)	Red	Lower pin

Endstop End	
VCC (+)	Red
SIG (S)	White
GND (-)	Black

Mechanical Endstops

The recommended firmware will provide a configuration to use mechanical endstops with just two wires.

Find the area labelled "endstops" in the upper right corner of the board and for each of the X, Y, and Z pairs of pins (label should be below each set) do the following:

1. Connect S (top row, labelled to the left) on RAMPS to NC on the switch.
2. Connect GND on RAMPS to C on the switch.

Note: The latest firmware such as Marlin seems to use NO as the default pin on the switch. Otherwise you may need to invert the endstops in the firmware. You can use M119 to check your endstops status.

Put the connectors on the motor wires

1.
   - solder a female connector to the ends of each wire.
   - use the 2.54mm 1x3 housing.
   - Shown is the type used for servos in RC projects. See Stepper Motors for info on motors.

Thermistor Wires

Use a 2 pin 0.1" connector to terminate the thermistor wires.

1.
   - Connect the cable so the 2 wires go to T0
2. Connect the 2 heater wires to D10 (E0H on older boards) and the + connection above it.
   - If changing to an unverified firmware it is best to verify heater circuit function with a meter before connecting heater to prevent damage to the extruder.

Pololu carriage

This section assumes you are using Pololu, but there are other options. Insert two 1x8 pin headers into the board. If you bought a kit with one 16 pin header, simply cut it so that you have two 1x8. Make sure that the side with the labels has the long ends of the posts, and the side you want to solder is the side with the heat sink. Doing this backwards will cause you not to see the labels and will most likely not fit. Remember to apply a heat-sink to the largest chip on the back.

Insert the motor boards with the potentiometer to the right side (furthest from the power connectors).

Final Setup

Pre-Flight Check

If you think you may have mistakes you can install only one stepper driver during initial testing and risk only one stepper driver.

The trimpot on the stepper drivers controls the current limit. Turn it all the way down (counter clock wise) and back up 25%. Be careful to not force the trimpot, it is delicate. You will need to fine tune the current limit later. Note that it is allways giving the motors that much power, even when not moving, so if your stepper motor drivers are getting hot, you may want to turn it down slightly.

Connect the minimum endstops (http://reprap.org/mediawiki/index.php?title=Arduino_Mega_Pololu_Shield#Make_the_cables_up_for_the_opto_endstops) for X,Y, and Z

Connect Motors (Do not disconnect or connect motors while powered; if the connection is loose, this will cause the motors to spazz and possibly kill your stepper driver.)

You may want to use this code (http://reprap.org/wiki/File:RAMPSTestCode.pde) to test all the electronics before installing any of the suggested firmwares.

Install firmware (More info below). Firmware flashing can be done without 12V power supply connected.

Wiring

It is relatively simple to wire up the RAMPS. Just add the extruder heating coil wire to D10, the thermistor to the two T0 pins on middle right right, and wire up the steppers and endstops. From left to right, wire all of the stepper motor's wires as red, blue, green, and black or red, green, yellow, blue into the pins next to the Pololus. When you connect the wires to the endstops (if you are using 3 endstops, plug them into the MIN (-) slots), make sure you match the labels.

Note that Tesla & Tonok firmware use D9 and Sprinter, Marlin, and Johnny/Tonok use D10 for the extruder hot end.

Warnings

Reversing +/- or otherwise incorrectly connecting power can destroy your electronics and cause fire hazard.

Incorrectly inserting stepper drivers will destroy your electronics and cause a fire risk. Always make sure power and USB is disconnected when removing or adjusting stepper drivers. Always make sure to insert drivers in correct orientation and in the socket correctly.

The endstop pins are Signal - GND - VCC, instead of the VCC - Sig - GND like the rest of RepRaps boards. Make sure to wire them correctly. This is done to allow squeezing fatter traces on the printable board.

DON'T secure Arduino/RAMPS with conductive screws through both mounting holes. The screw may cut into the positive trace creating a HIGH current short.

Connecting Power

Connect your 12V power supply to the RAMPS shield. Reversing +/- or otherwise incorrectly connecting power can destroy your electronics and cause fire hazard.

The bottom pair of connectors marked 5A power the stepper drivers and Extruder heater/fan (D9, D10). The source should be rated a minimum of 5A.

The pair of connectors above marked 11A power a Heated Bed, or other output (D8). The source should be rated a minimum 11A (if both power rails are connected to the same supply it should have a minimum rating of 16A).

The barrel connector, on the Arduino MEGA, will NOT power RAMPS and will not provide power to the stepper motors, heated bed, etc.

The power connector plug may not be obviously labeled, looking at the power connection the positive is on the left and the negative is on the right of the plug.

Power Supply

RAMPS is quite happy with the 12 V line from PCPowerSupply. Or you can hack up a 12V laptop power supply, or other 12 V "wall wart" power supply. Make sure that the power supply can output 5A or greater. Additional 11A may be needed for heated bed support.

See Connecting power above.

The 3 pins next to the reset switch are meant to optionally connect to your PSU.

The PS_ON pin is intended to switch your power supply on and off. Many firmwares support pulling this pin low with M80 command to turn the power supply on, and M81 to turn it off. This behavior is desired for ATX power supplies and can be modified in firmware to support 5V high power supplies like those borrowed from an Xbox.

Without D1 installed, or when the 12VIN is not connected, the Arduino gets its power from USB. If you want your kit powered without USB connected you need to solder in D1 OR connect VCC to your PSU.

The VCC pin can be connected to your ATX's 5Vsb to continuously power the Arduino from your ATX power supply. You will want to make sure that D1 is not installed or cut out. The Arduino is not designed to be powered directly on the VCC rail and the VIN pin at the same time.

Where to find the D1 diode (note that D2 is shown at the left, not D1)

If you want to use PS_ON to turn on your power supply then don't use diode D1, you need your Arduino to be powered from 5Vsb otherwise when no USB is connected the PS_ON pin floats (and your power supply pulses on and off).

The 5V pin in that connector on RAMPS only supplies the 5V to the auxiliary servo connectors. It is designed so that you can jumper it to the VCC pin and use the Arduino's power supply to supply 5V for extra servos if you are only powered from USB or 5V. Since there is not a lot of extra power from the Arduino's power supply you can connect it directly to your 5V power supply if you have one. You can also leave this pin not connected if you have no plan to add extra servos.

Maximum Input Voltage

Power Supply without diode

There are three limiting factors to the maximum voltage that you can put into the RAMPS:

1. The Arduino Mega maximum input voltage
2. Filtering capacitor maximum voltages
3. PTC fuse maximum voltages

First, the 1N4004 diode connects the RAMPS input voltage to the Arduino Mega which has a recommended maximum input voltage of 12 volts. If your board does not have this diode soldered in (or if you cut it), you will need to power the Mega through the USB connector or through a separate 5v line, but this allows a higher RAMPS voltage.

Second, most boards use 25v or 35v aluminum electrolytic capactors (C2, C3, C4, C6, C7, C9, and C10). To be safe, you should only go to half of your rated maximum voltage -- thus if your board has 35v capacitors (code VZA) then you should use a maximum input of 17.5v. The absolute maximum voltage is determined by the pololu servo drivers, which themselves are limited to 35V.

Third, the MF-R500 (5A) PTC fuse is rated to 30V and the MF-R1100 (11A) PTC fuse is rated to 16V. They will need to be replaced with real fuses.

Power Supply with diode

If your board has a 1N4004 diode soldered in, do not apply more than 12 V to it. Original flavor Arduino Mega are rated to 12 V input. While Arduino Mega 2560 can take 20 V, it is not recommended.

Firmware and Pin Assignments

RAMPS 1.4 uses the same pin definitions as 1.3.

You will need the Arduino software at http://www.arduino.cc/en/Main/Software to upload the firmware to Arduino Mega. The version of Arduino you need may be determined by the firmware you want to use. The current (as of 2014-01-22) Marlin firmware is compatible with Arduino version 1.0.5. Some other firmwares may require Arduino software version 0023, NOT the most recent version. Please see your firmware documentations if you need assistance.

Troubleshooting: You may need to make sure that the driver is installed for the Arduino MEGA by going to Control Panel -> Hardware and Sound -> Device Manager. If the device that appears/disappears when you plug in and unplug the board USB is "Unknown Device" under "Other devices", then you need to right click on the device and click the update driver button. Find where on your computer you saved/installed the Arduino software, and tell the wizard to search in the driver folder there. Windows 8 will give this error: "The third party INF does not contain digital signature". If so, save the zip for the latest version of Arduino on your PC, and repeat the steps above with the driver folder in there. It should contain the digital signature Windows needs.

Sprinter and Marlin are popular and stable firmwares for RAMPS as of 3/28/2012. Pronterface is a cross platform printer control program that can be used for testing/printing.

Working preconfigured **Sprinter** firmware can be downloaded at http://ultimachine.com/sites/default/files/UltiMachineRAMPS1-4Sprinter.zip . Mechanical is in the folder ending with ME, optical endstop firmware is in the folder ending in OE.

Working preconfigured **Marlin** firmware can be downloaded at http://adf.ly/1RKUfV . is for mechanical endstops. For optical, you will need to reverse the endstop logic in configuration.h. The language of display is in italian, but can easy be changed in language.h. It is preconfigured for the RepRap Discount Smart Controller and similar LCD module. You will need to disable LCD in configuration.h if not using it.

Others (Need pins set in Firmware as below):

- mechanical endstops (now the default ultimachine.com option) require **#define OPTO_PULLUPS_INTERNAL 1** to be added to configuration.h if not there by default.

Here are the pin definitions for this board.

```
// For RAMPS 1.4
#define X_STEP_PIN         54
#define X_DIR_PIN          55
```

```
#define X_ENABLE_PIN       38
#define X_MIN_PIN           3
#define X_MAX_PIN           2

#define Y_STEP_PIN         60
#define Y_DIR_PIN          61
#define Y_ENABLE_PIN       56
#define Y_MIN_PIN          14
#define Y_MAX_PIN          15

#define Z_STEP_PIN         46
#define Z_DIR_PIN          48
#define Z_ENABLE_PIN       62
#define Z_MIN_PIN          18
#define Z_MAX_PIN          19

#define E_STEP_PIN         26
#define E_DIR_PIN          28
#define E_ENABLE_PIN       24

#define SDPOWER            -1
#define SDSS               53
#define LED_PIN            13

#define FAN_PIN            9

#define PS_ON_PIN          12
#define KILL_PIN           -1

#define HEATER_0_PIN       10
#define HEATER_1_PIN       8
#define TEMP_0_PIN          13   // ANALOG NUMBERING
#define TEMP_1_PIN          14   // ANALOG NUMBERING
```

Source

FILE ID#	TYPE	DESCRIPTION	DOWNLOAD
File:ArduinoMegaPololuShield.zip	Eagle Files	These are the files you need to make the board.(Use the File: link to the left to access older versions of the file.)	media:ArduinoMegaPololuShield.zip
File:RepRapjr.lbr	Eagle Libraries	The components used in this board are here. see Eagle_Library	media:RepRapjr.lbr

Bill of Materials

ID	Description	Quantity	Part Number	Reichelt Order Number	
U1	Arduino Mega	1	2560 or 1280		1 N
U2,U3,U4,U5	Pololu stepper driver boards	4	A fifth one can be used for a 2nd extruder or extra axis		N
C2	100nF capacitor (0805)(> highest planned voltage)	1			3 1
C1,C5,C8	10uF capacitor (153CLV-0405)(>5V)	3			3 6
C3,C4,C6,C7,C9,C10	100uF capacitor (153CLV-0605)(> highest planned voltage)	6			3 6
R1,R7,R11,R21,R22	4.7K resistor (0805)(1%)	5			R v
R2,R3,R4,R5,R6,R8,R9,R10	100K resistor (0805)	8			R d
R12	1K resistor (0805)	1			R d 0
R23,R24,R25	1.8K resistor (0805)	3			3 1.
R16,R17,R18,R19,R20	10K resistor (0805)	5			P N
R13,R14,R15	10 ohm resistor (0805)	3			5 d 0

Q1,Q2,Q3	N-channel Mosfet	3	STP55NF06L ($R_{DS} = 18m\Omega$ On) Upgrade particularly for the bed: IRLB8743PBF ($R_{DS} = 3.2m\Omega$ On) or for even more current IRLB3034PBF ($R_{DS} = 1.5m\Omega$ On)	ZXM 64N035 L3	4 la
D1,D2	Diode	2	1N4004	1N 4004	1 la D
F1	PTC resettable fuse (30V, Hold5A, Trip10A)	1	MF-R500	PFRA 500	M la
F2	PTC resettable fuse (Hold11A)	1	MF-R1100		R la H
J2	D8-D10 Outputs // 6 position screw terminal (min 11A per contact) OR Jack/Plug connector pair	1	282837-6	AKL 101-06	W la 5. A H (I W pi -1
LED1	Green LED (0805)	1			L 2
LED2,LED3,LED4	Red LED (0805)	3			L 2
S1	Push button switch	1	B3F-3100	TASTER 3305B (should fit footprint also, but button will overhang board edge)	4 la
X1	Power jack (Plug and fixed receptacle) (Min 11A per position more is better)	1	MSTBA 2,5 and MSTBT 2,5 (5.04mm spacing 4 connector)		W la & la
	2 x 3 pin header	8	961206-6404-AR		3 la G
	4 pin header	5	961104-6404-AR	SL 1X36G 2,54 (3 of these)	3 la
	6 pin header	2 (? - from http://gala-automation.com/index.php/component/content/article/26-reprap-tutorials/42-ramps-14-bom)	961106-6404-AR		3 la
	2 x 18 Pin Stackable Female Header (non stackables can be used with plated through holes)	1		MALE: SL 2X25G 2,54 (2 of them, shortened with a saw or pliers)	S la N
	8 Pin Stackable Female				

	Header (non stackables can be used with plated through holes)	5			S la N
	6 Pin Stackable Female Header (non stackables can be used with plated through holes)	1			S la N
	24 Pin Female Header * Note *	2	Required to carry enough current for motors		S la R
	8 Pin Female Header * Note *	4	Required to carry enough current for motors		S la R
	0.1" Jumpers	15			A la
	Circuit Board	1	v1.4		N

Note * You can use Female Headers which are not the exact size, but they are hard to break/cut so in this case buy some extra! (one wasted header per cut)

A BOM for sourcing the RAMPS components from Mouser is also available in this google spreadsheet (https://docs.google.com/spreadsheet/ccc?key=0Auf-66FPv0JidHhtRVB0VVplOURwWklrX0tIeXhsS3c&hl=en_US#gid=0) (This list is incomplete and has missing or incorrect quantities.)

Shopping lists for v1.4 [1] (http://www.mouser.com/ProjectManager/ProjectDetail.aspx?AccessID=d126a71257) .

BT Extension

main article: jy-mcu

In order to get rid of the USB connection between RAMPS and the PC, you may like to use Bluetooth. There is a cheap module available in the market called 'JY-MCU' (vendor Shenzhen Jiayuan Electronic Co.,Ltd.).

Change module setting

Before the module can be used, the default setting has to be changed. You can connect to and modify the BT JY-MCU module settings via the Arduino mega 2560 using the pin 10 and pin 9 as Rx and Tx terminals, respectively. Make sure you connect Rx on the BT module to the Tx on the arduino and vice versa, in other words Rx goes to Tx and vice versa. Upload the simple code to arduino located on an instructable entitled "Success-Using-the-JY-MCU-linvor-Bluetooth-Module". Use the serial monitor within arduino IDE or another terminal program, with baudrate set to 9600 and 'No Line Ending' selected, enter the following commands:

AT - the response should be OK (If you see weird characters, the baudrate is wrong--> try a different one

AT+NAMExxxx - Where xxxx is the friendly name of the module

AT+BAUDx - Where x sets the baud rate (values & baud rates below)

AT+VERSION - Returns the firmware version

AT+PINxxxx - Sets a new pairing code (default: 1234)

1——1200 2——2400 3——4800 4——9600 5——19200 6——38400 7——57600 8——115200

Alternatively, you can connect to the module from PC via USB<->RS232 (RxD/TxD) interface with default settings (9600, N, 8, 1). The module shouldn't be paired at that moment. Use the same AT commands as above.

More details about the configuration you will find here [[2] (http://reprap.org/wiki/Melzi#Connect_via_Bluetooth)]

Troubleshooting: If you see weird characters, the baudrate is wrong--> try a different one Make sure your Tx and Rx are not mixed up Make sure you have the proper resistors installed

Wiring

On RAMPS/Arduino Mega the UART level are 5V but the BT module supports only 3.3V input. Therefore the TxD level has to be divided by resistor. This passive solution is fast enough for 115kBaud. Overall only 4 wires have to be soldered.

Connect via Bluetooth

Once you have setup your BT devices you can select from drop down list and control your RepRap as usual.

RAMPS 1.4 test code

```
#define X_STEP_PIN         54
#define X_DIR_PIN          55
#define X_ENABLE_PIN       38
#define X_MIN_PIN           3
#define X_MAX_PIN           2

#define Y_STEP_PIN         60
#define Y_DIR_PIN          61
#define Y_ENABLE_PIN       56
#define Y_MIN_PIN          14
#define Y_MAX_PIN          15

#define Z_STEP_PIN         46
#define Z_DIR_PIN          48
#define Z_ENABLE_PIN       62
#define Z_MIN_PIN          18
#define Z_MAX_PIN          19

#define E_STEP_PIN         26
#define E_DIR_PIN          28
#define E_ENABLE_PIN       24

#define Q_STEP_PIN         36
#define Q_DIR_PIN          34
#define Q_ENABLE_PIN       30

#define SDPOWER            -1
#define SDSS               53
#define LED_PIN            13

#define FAN_PIN            9

#define PS_ON_PIN          12
#define KILL_PIN           -1

#define HEATER_0_PIN       10
#define HEATER_1_PIN       8
#define TEMP_0_PIN          13   // ANALOG NUMBERING
#define TEMP_1_PIN          14   // ANALOG NUMBERING

void setup() {
  pinMode(FAN_PIN , OUTPUT);
  pinMode(HEATER_0_PIN , OUTPUT);
  pinMode(HEATER_1_PIN , OUTPUT);
  pinMode(LED_PIN  , OUTPUT);

  pinMode(X_STEP_PIN  , OUTPUT);
  pinMode(X_DIR_PIN    , OUTPUT);
  pinMode(X_ENABLE_PIN    , OUTPUT);

  pinMode(Y_STEP_PIN  , OUTPUT);
  pinMode(Y_DIR_PIN    , OUTPUT);
  pinMode(Y_ENABLE_PIN    , OUTPUT);

  pinMode(Z_STEP_PIN  , OUTPUT);
  pinMode(Z_DIR_PIN    , OUTPUT);
  pinMode(Z_ENABLE_PIN    , OUTPUT);

  pinMode(E_STEP_PIN  , OUTPUT);
  pinMode(E_DIR_PIN    , OUTPUT);
  pinMode(E_ENABLE_PIN    , OUTPUT);

  pinMode(Q_STEP_PIN  , OUTPUT);
  pinMode(Q_DIR_PIN    , OUTPUT);
  pinMode(Q_ENABLE_PIN    , OUTPUT);

   digitalWrite(X_ENABLE_PIN    , LOW);
   digitalWrite(Y_ENABLE_PIN    , LOW);
   digitalWrite(Z_ENABLE_PIN    , LOW);
   digitalWrite(E_ENABLE_PIN    , LOW);
   digitalWrite(Q_ENABLE_PIN    , LOW);
}
```

```
void loop () {

  if (millis() %1000 <500)
    digitalWrite(LED_PIN, HIGH);
  else
    digitalWrite(LED_PIN, LOW);

  if (millis() %1000 <300) {
    digitalWrite(HEATER_0_PIN, HIGH);
    digitalWrite(HEATER_1_PIN, LOW);
    digitalWrite(FAN_PIN, LOW);
  } else if (millis() %1000 <600) {
    digitalWrite(HEATER_0_PIN, LOW);
    digitalWrite(HEATER_1_PIN, HIGH);
    digitalWrite(FAN_PIN, LOW);
  } else  {
    digitalWrite(HEATER_0_PIN, LOW);
    digitalWrite(HEATER_1_PIN, LOW);
    digitalWrite(FAN_PIN, HIGH);
  }

  if (millis() %10000 <5000) {
    digitalWrite(X_DIR_PIN    , HIGH);
    digitalWrite(Y_DIR_PIN    , HIGH);
    digitalWrite(Z_DIR_PIN    , HIGH);
    digitalWrite(E_DIR_PIN    , HIGH);
    digitalWrite(Q_DIR_PIN    , HIGH);
  }
  else {
    digitalWrite(X_DIR_PIN    , LOW);
    digitalWrite(Y_DIR_PIN    , LOW);
    digitalWrite(Z_DIR_PIN    , LOW);
    digitalWrite(E_DIR_PIN    , LOW);
    digitalWrite(Q_DIR_PIN    , LOW);
  }

  digitalWrite(X_STEP_PIN    , HIGH);
  digitalWrite(Y_STEP_PIN    , HIGH);
  digitalWrite(Z_STEP_PIN    , HIGH);
  digitalWrite(E_STEP_PIN    , HIGH);
  digitalWrite(Q_STEP_PIN    , HIGH);
  delay(1);

  digitalWrite(X_STEP_PIN    , LOW);
  digitalWrite(Y_STEP_PIN    , LOW);
  digitalWrite(Z_STEP_PIN    , LOW);
  digitalWrite(E_STEP_PIN    , LOW);
  digitalWrite(Q_STEP_PIN    , LOW);
}
```

Where to get

- Reprap Austria (http://www.reprap.cc/shop/de/content/ramps-14) (worldwide free shipping)
- Maker Farm Inc (http://www.makerfarm.com/index.php/printer-electronics/ramps.html) USA - (worldwide shipping)
- Thingibox (http://store.thingibox.com/es/electricidad/38-ramps_14.html) Spain - (worldwide shipping)
- RepRap.me Denmark (http://www.reprap.me/electronic/ramps.html) (worldwide shipping)
- RAMPS 1.4 Manufactured in Europe with high quality parts for long printing hours (https://www.tindie.com/products/staticboards/ramps-14-sb-premium/) - (worldwide shipping)
- TaoTac.com (https://taotac.com/sanpham/ramps/)
- HE3D (http://www.reprap.cn/fully-completed-assembly-ramps-14-controller-board-p-52.html)
- Twelvepro (http://twelvepro.com/index.php?route=product/product&path=67&product_id=83)
- Fabberworld (http://www.fabberworld.com/Electronics/RAMPS-1-4-Elektronics-complete::102.html?language=en)
- Aus3D (http://aus3d.com.au/printer-parts/printer-electronics/ramps-14)
- DIY-India.com (https://www.diy-india.com) (India)

RAMPS 1.4.2

RAMPS 1.4.2 has minor changes over RAMPS 1.4. The RAMPS 1.4.2 has below enchantment over 1.4

- Standard blade fuses instead of thermal fuses increasing the heat resilience.
- Current carrying improved by increasing the thickness of the cooper at the PCB from 35 to 70 micro meters.
- Suppression caps added to each end-stop to avoid spurious signals.
- Added an additional connector to XY, E1 and E2 to connect a second stepper motor.
- Connector for external reset added.
- Labeled D8, D9,D10 with Heatbed, Extruder 1 Fan and Extruder 2.

Eagle CAD files: https://github.com/GermanRepRap/Ramps-1.4.2

Where to buy RAMPS 1.4.2

Fully assembled available from German RepRap (http://www.germanreprap.com)