Rambo development

RAMBo Pages: **RAMBo .:. RAMBo v1.0-1.1 .:. RAMBo v1.2 .:. RAMBo v1.3 .:. RAMBo v1.4 .:. RAMBo Firmware .:. RAMBo Development .:. MiniRambo .:. MiniRambo Development .:. EinsyRambo .:. EinsyRambo Development**

This page contains information relevant to the development of the RAMBo PCB. You can find general info at Rambo.

Contents

Pins

The extension headers are in the format "Extension Name" "Pin Number" "Function". Example: MX1-5 Direction = "Motor Extension 1" "Pin 5".

Pin Number	Pin Name	Arduino Pin Name	RAMBO Function
1	PG5 (OC0B)	Digital pin 4 (PWM)	PWM-Ext 6
2	PE0 (RXD0/PCINT8)	Digital pin 0 (PWM) (RX0)	USB – serial comms, SER0 3
3	PE1 (TXD0)	Digital pin 1 (PWM) (TX0)	USB – serial comms, SER0 4
4	PE2 (XCK0/AIN0)	RamboDigital pin 78	Ext2 20
5	PE3 (OC3A/AIN1)	Digital pin 5 (PWM)	PWM-Ext 5
6	PE4 (OC3B/INT4)	Digital pin 2 (PWM)	Fan 2, PWM-Ext 4
7	PE5 (OC3C/INT5)	Digital pin 3 (PWM)	Bed Heater
8	PE6 (T3/INT6)	RamboDigital pin 79	Ext2 18
9	PE7 (CLKO/ICP3/INT7)	RamboDigital pin 80	Ext2 16
10	VCC	VCC	VCC
11	GND	GND	GND
12	PH0 (RXD2)	Digital pin 17 (PWM) (RX2)	Serial 7
13	PH1 (TXD2)	Digital pin 16 (PWM) (TX2)	Serial 8
14	PH2 (XCK2)	RamboDigital pin 84	Ext2 8
15	PH3 (OC4A)	Digital pin 6 (PWM)	Fan 1
16	PH4 (OC4B)	Digital pin 7 (PWM)	Heat 1
17	PH5 (OC4C)	Digital pin 8 (PWM)	Fan 0
18	PH6 (OC2B)	Digital pin 9 (PWM)	Heat 0

19	PB0 (SS/PCINT0)	Digital pin 53 (PWM)(SPI-SS)	SPI-Ext SS 6
20	PB1 (SCK/PCINT1)	Digital pin 52 (PWM)(SCK)	SPI-Ext SCK 5
21	PB2 (MOSI/PCINT2)	Digital pin 51 (PWM)(MOSI)	SPI-Ext MOSI 4
22	PB3 (MISO/PCINT3)	Digital pin 50(MISO)	SPI-Ext MISO 3
23	PB4 (OC2A/PCINT4)	Digital pin 10 (PWM)	Z Min Endstop
24	PB5 (OC1A/PCINT5)	Digital pin 11 (PWM)	Y Min Endstop
25	PB6 (OC1B/PCINT6)	Digital pin 12 (PWM)	X Min Endstop
26	PB7 (OC0A/OC1C/PCINT7)	Digital pin 13 (PWM)	LED, PWM-Ext 3
27	PH7 (T4)	RamboDigital pin 85	Ext2 6
28	PG3 (TOSC2)	RamboDigital pin 71	Ext3 7
29	PG4 (TOSC1)	RamboDigital pin 70	Ext3 5
30	RESET	RESET	Reset
31	VCC	VCC	VCC
32	GND	GND	GND
33	XTAL2	XTAL2	XTAL2
34	XTAL1	XTAL1	XTAL1
35	PL0 (ICP4)	Digital pin 49	Y Direction
36	PL1 (ICP5)	Digital pin 48	X Direction
37	PL2 (T5)	Digital pin 47	Z Direction
38	PL3 (OC5A)	Digital pin 46 (PWM)	MX3-5 Direction
39	PL4 (OC5B)	Digital pin 45 (PWM)	MX2-5 Direction
40	PL5 (OC5C)	Digital pin 44 (PWM)	MX1-5 Direction
41	PL6	Digital pin 43	E0 Direction
42	PL7	Digital pin 42	E1 Direction
43	PD0 (SCL/INT0)	Digital pin 21 (SCL)	I2C SCL
44	PD1 (SDA/INT1)	Digital pin 20 (SDA)	I2C SDA
45	PD2 (RXDI/INT2)	Digital pin 19 (RX1)	Serial 5
46	PD3 (TXD1/INT3)	Digital pin 18 (TX1)	Serial 6
47	PD4 (ICP1)	RamboDigital pin 81	Ext2 14
48	PD5 (XCK1)	RamboDigital pin 82	Ext2 12
49	PD6 (T1)	RamboDigital pin 83	Ext2 10
50	PD7 (T0)	Digital pin 38	Digipot SS
51	PG0 (WR)	Digital pin 41	X Microstep2
52	PG1 (RD)	Digital pin 40	X Microstep1
53	PC0 (A8)	Digital pin 37	X Step
54	PC1 (A9)	Digital pin 36	Y Step
55	PC2 (A10)	Digital pin 35	Z Step
56	PC3 (A11)	Digital pin 34	E0 Step
57	PC4 (A12)	Digital pin 33	E1 Step
58	PC5 (A13)	Digital pin 32	MX1-4 Step
59	PC6 (A14)	Digital pin 31	MX2-4 Step
60	PC7 (A15)	Digital pin 30	Z Max, MX3-4 Step
61	VCC	VCC	VCC
62	GND	GND	GND
63	PJ0 (RXD3/PCINT9)	Digital pin 15 (RX3)	Serial 9

64	PJ1 (TXD3/PCINT10)	Digital pin 14 (TX3)	Serial 10
65	PJ2 (XCK3/PCINT11)	RamboDigital pin 72	Ext2 9
66	PJ3 (PCINT12)	RamboDigital pin 73	Ext2 11
67	PJ4 (PCINT13)	RamboDigital pin 75	Ext2 15
68	PJ5 (PCINT14)	RamboDigital pin 76	Ext2 17
69	PJ6 (PCINT 15)	RamboDigital pin 77	Ext2 19
70	PG2 (ALE)	Digital pin 39	Y Microstep2
71	PA7 (AD7)	Digital pin 29	X Enable
72	PA6 (AD6)	Digital pin 28	Y Enable
73	PA5 (AD5)	Digital pin 27	Z Enable
74	PA4 (AD4)	Digital pin 26	E0 Enable
75	PA3 (AD3)	Digital pin 25	E1 Enable
76	PA2 (AD2)	Digital pin 24	X Max, MX3-3 Enable
77	PA1 (AD1)	Digital pin 23	Y Max, MX2-3 Enable
78	PA0 (AD0)	Digital pin 22	MX1-3 Enable
79	PJ7	RamboDigital pin 74	Ext2 13
80	VCC	VCC	VCC
81	GND	GND	GND
82	PK7 (ADC15/PCINT23)	Analog pin 15	Y Microstep1
83	PK6 (ADC14/PCINT22)	Analog pin 14	Z Microstep1
84	PK5 (ADC13/PCINT21)	Analog pin 13	Z Microstep2
85	PK4 (ADC12/PCINT20)	Analog pin 12	E0 Microstep2
86	PK3 (ADC11/PCINT19)	Analog pin 11	E0 Microstep1
87	PK2 (ADC10/PCINT18)	Analog pin 10	E1 Microstep2
88	PK1 (ADC9/PCINT17)	Analog pin 9	E1 Microstep1
89	PK0 (ADC8/PCINT16)	Analog pin 8	Analog-Ext 1
90	PF7 (ADC7/PCINT15)	Analog pin 7	Thermistor 3, Analog-Ext 5
91	PF6 (ADC6/PCINT14)	Analog pin 6	Analog-Ext 3
92	PF5 (ADC5/TMS)	Analog pin 5	Analog-Ext 8
93	PF4 (ADC4/TMK)	Analog pin 4	Analog-Ext 6
94	PF3 (ADC3)	Analog pin 3	Analog-Ext 4
95	PF2 (ADC2)	Analog pin 2	Thermistor 2
96	PF1 (ADC1)	Analog pin 1	Thermistor 1
97	PF0 (ADC0)	Analog pin 0	Thermistor 0
98	AREF	Analog Reference	
99	GND	GND	GND
100	AVCC	VCC	VCC

Thermocouple and additional thermistors

You can use the Analog Extension header to connect thermistors and analog thermocouple amplifiers (example:AD595) to the RAMBo board. You can also connect thermocouple amplifiers that communicate via SPI or other bus.

You will need to configure your firmware for the pin change and new sensor type.

Analog Extension

Arduino Analog Pin **Analog-Ext location**			
GND Analog-Ext 2	3 Analog-Ext 4	4 Analog-Ext 6	5 Analog-Ext 8
5V Analog-Ext 1	6 Analog-Ext 3	7 Analog-Ext 5	9 Analog-Ext 7

Note that Analog-Ext 5 is shared with thermistor 3. That circuit may need modified if depending on Analog-Ext 5's use.

Source

Development is taking place on Github (https://github.com/ultimachine/RAMBo) Latest stable release is in tags - Github tags (https://github.com/ultimachine/RAMBo/tree/1.0)

Programming Bootloaders

https://raw.githubusercontent.com/ultimachine/RAMBo/master/bootloaders/RAMBo-usbserial-DFU-combined-32u2.HEX

Example avrdude command with AVRISPmkII connected to the ICSP1 port for programming the 32u2 with replacement firmware.

```
avrdude  -v -v -c avrispmkII -P usb -patmega32u2 -Uefuse:w:0xF4:m -Uhfuse:w:0xD9:m -Ulfuse:w:0xEF:m -Ulock:w:
```

https://raw.githubusercontent.com/ultimachine/Arduino-stk500v2-bootloader/master/goodHexFiles/stk500boot_v2_mega2560.hex

Example avrdude command with AVRISPmkII connected to the ICSP port for programming the 2560 with replacement firmware.

```
avrdude -v -v -c avrispmkII -P usb -pm2560 -Uflash:w:stk500boot_v2_mega2560.hex:i -Uefuse:w:0xFD:m -Uhfuse:w:
```

Fuses and lockbits

32u2 fuses - BODLEVEL = 3V0; HWBE = [X]; DWEN = [ ]; RSTDISBL = [ ]; SPIEN = [X]; WDTON = [ ]; EESAVE = [ ]; BOOTSZ = 2048W_3800; BOOTRST = [ ]; CKDIV8 = [ ]; CKOUT = [ ]; SUT_CKSEL = EXTXOSC_8MHZ_XX_16KCK_4MS1

EXTENDED = 0xF4; HIGH = 0xD9; LOW = 0xEF

2560 Fuses BODLEVEL = 2V7; OCDEN = [ ]; JTAGEN = [ ]; SPIEN = [X]; WDTON = [ ]; EESAVE = [X]; BOOTSZ = 4096W_1F000; BOOTRST = [X]; CKDIV8 = [ ]; CKOUT = [ ]; SUT_CKSEL = EXTXOSC_8MHZ_XX_16KCK_65MS

EXTENDED = 0xFD; HIGH = 0xD0; LOW = 0xFF;

Lock bits for both only set BLB1 = LPM_SMP_DISABLE (0x0F).

Maximum motor current

In version 1.0d R30 (4.99K) limited the current to ~1.65A. this is changed in revision 1.0e (3.33K) to raise the current limit to 2A. Version 1.0d assemblies can be patched to allow setting the increased current by soldering a 10K 0603 resistor in parallel (on top of) R30.

Heated bed maximum voltage

The heated bed circuit's voltage is limited by the RGEF1400 PTC fuse which is rated to 16V. If a higher voltage is required this fuse can be replaced with a jumper wire and off board fuse holder. Make sure that your wire and solder are sufficient to carry the high current of this rail.

Changelog

- 1.3L
  - Add TVS diode to motor outputs (prevents failure due to hot-plugging motor and excessive BEMF)
  - Add filter capacitors to motor outputs
  - Add ferrite bead to motor and logic/extruder power inputs
  - The varistor providing ESD to USB pathway is replaced with a TVS diode
  - Flyback diode on mosfets now 3A to reduce unique part count
  - Icoupler decoupling now 100nF at each power pin
  - Remove solder mask between QFN pins
  - Shrink 12.5mm capacitor drill size
  - New footprints for 0603 components
  - Silk screen fixes
- 1.2g(p)
  - The varistor change from 1.2fp is now in the design and the solder mask is stopped for the component. (electrically the same as 1.2fp)
- 1.2fp
  - Patch to 1.2f. Add varistor between USB GND and GND to shunt ESD to USB shield. Done by manually removing solder mask
- 1.2f
  - Assembly yield improvements:
    - update 0402, 0603, SOT669, SOIC8, and QFN32 footprint
    - shrink motor connector drill size
    - remove stop from thermal vias
    - add overprint to paste layer for fuse holder
  - fix MX2 and MX3 silk screen reversed
  - schematic cleanup (no changes to nets)
- 1.2e
  - shrink vias around motor drivers to improve yield in wave process
- 1.2d
  - remove solder mask between Atmega2560 leads
  - minor rerouts
- 1.2c
  - isolate USB
  - thermistor over voltage protection up to 24V.
  - add LC filter to analog power input
  - board power inputs now support up to 35V
  - VCC now from built in SMPS, pads are provided to disable SMPS for powering from alernate VCC source
  - rotate some auxiliary connectors and improve pad size for wave process
  - change mounting hole type to ease wave process (no more polyimide taping)
  - Seperate decoupling for each VDD pin on motor drivers
  - add freewheeling diodes to mosfets
  - new layer stackup
  - rework pcb edge noise rail

    - numerous routing and silk screen updates
    - through hole capacitors in case they ever need replaced
- 1.1b
    - change stepper driver to A4982 and microstepping options are now 1,1/2,1/4,1/16
    - change Fan1 output mosfet to SOT23 package and add another identical circuit to expand to 6 mosfet outputs
    - change heated bed fuse from PTC to ATO (auto blade) fuse increasing heated bed rail max voltage to match others (24V max recommended PSU)
    - additional decoupling caps
    - change license to match Arduino's published requirements
- 1.0e Rambo_1_0
    - change R30 value
    - remove stop on vias and under drivers
    - clarify PS_ON and other silk screen fixes
- 1.0d Initial release
