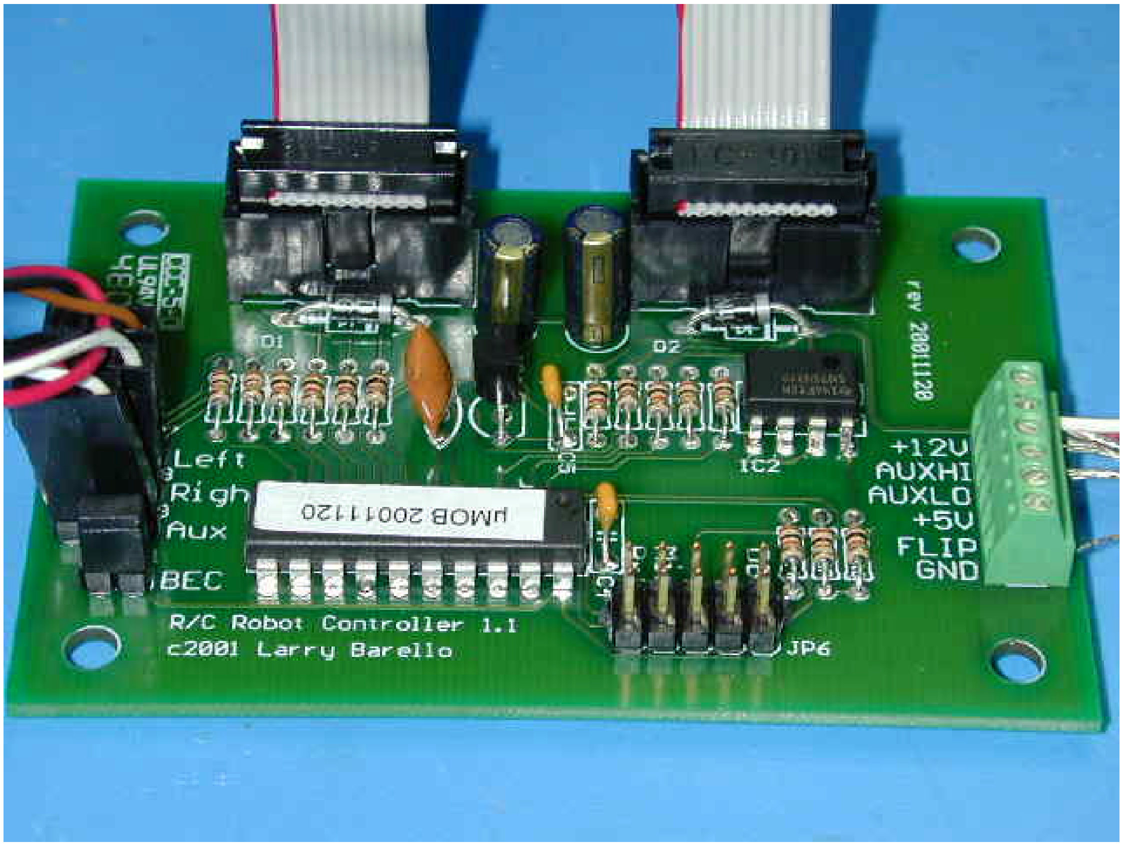
µRRC – µR/C Robot Controller – v1.1



OVERVIEW

The µRRC is a simple, easy to use interface between a 3-channel R/C receiver and the OSMC H-Bridge controller for battle style robots. In principle, the µRRC can be used to drive any motor controller that accepts PWM, Direction and Enable signals. Learn more about the OSMC project at:

http://groups.yahoo.com/group/osmc

TECHNICAL SPECIFICATIONS

- R/C input range: 200 5uS steps between 1.0 and 2.0ms
- PWM output: +/- 64 steps @ 5uS per step (~3 kHz)
- Dead-Band: Selectable 20 or 60uS.
- Input mixing: Selectable mixed (single stick) or normal (tank style)
- Brake Mode: Selectable Brake/Coast
- Outputs: 10 pin headers compatible with the OSMC H-Bridge board.
- Auxiliary outputs: two open collector terminals suitable for driving relays.
- Supply voltage range: 6.5 to 15v (LM2940)
- BEC output: 5.0v .7A max (limited by the 12v supply)

HANDLING CONSIDERATIONS

The µRRC and similar boards have proved rugged in casual use. However, µRRC is a CMOS device and normal electrostatic discharge precautions apply. Always keep the board in an anti-static environment until installed. Always discharge your self by touching the ground terminal of the robot before touching the board.

CABLING

The cabling from µRRC and the OSMC motor controllers are standard straight 10 pin IDC connectors. These are easily made from sockets and flat cable and a vice or channel lock pliers.

Custom female-to-female R/C cables are required between the receiver and µRRC. The R/C cables are held in place with three pin headers. In a high vibration environment they may come loose. To insure the cables don't come loose, a hole is provided near the headers for tying them down with a nylon cable tie. If building a kit, you may consider soldering the R/C radio cables directly to the board, instead of making female-to-female cables. In this case, discard the three pin headers supplied in the kit.

POWER

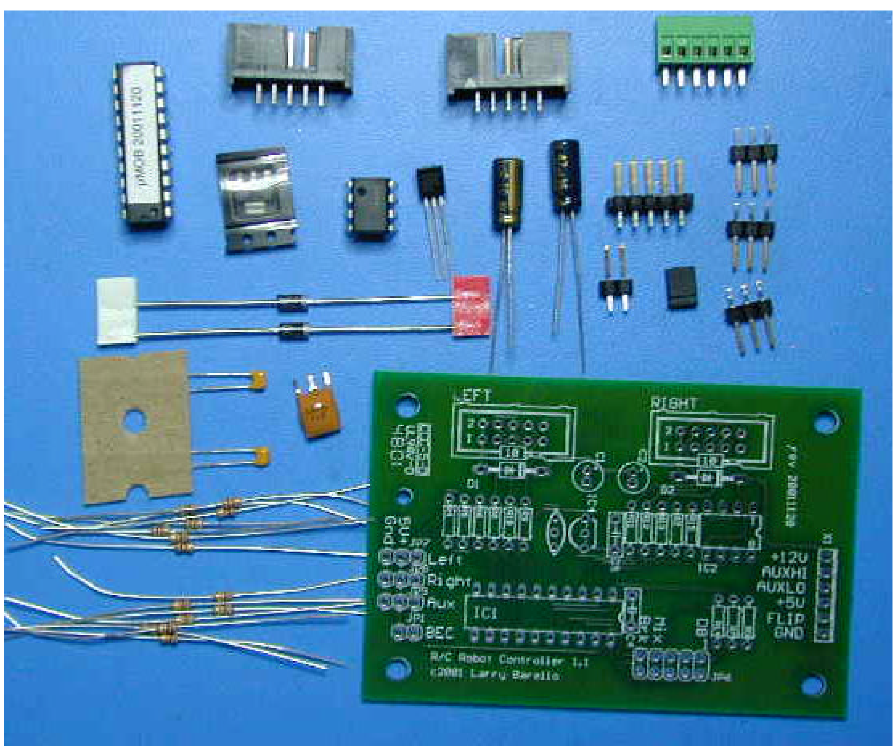
The µRRC is powered from the +12v supply of the OSMC 3.2 boards. Each OSMC can supply approximately 400ma and that needs to be considered when connecting relays or R/C receivers to the µRRC. Because the µRRC is isolated from the OSMC via diodes, one could supply +12-15 volts via the terminal strip to power the R/C receiver and µRRC. If using external power, the total current draw is limited by the power dissipation ratings of the LM2940 voltage regulator, which is about 2 watts. Please refer to regulator data sheets for more information.

AUXILIARY OUTPUTS

The auxiliary outputs are intended to drive relays connected to the +12v supply or a digital input. E.g. flip input. The SN75477 dual peripheral driver has a 300ma limit per channel. The total current draw may be less to stay within the limits of the +12v supply.

KIT CONTENTS

The kit of parts is shipped in a static barrier bag. The parts are loose. First open the bag of parts and verify that all components are included. Since some components are static sensitive, open the bag in a static safe environment. The voltage regulator is a surface mount part and quite small. Make sure you don't lose it!



Item	#	Digikey Part Number	Description
1	1	LM2940IMP-5.0CT-ND	LM2940-IMP 5.0 voltage regulator, Surface Mount SOT-223
2	2	P5164-ND	47 uF low ESR 15v radial 5mm capacitor.
3	2	BC1127CT-ND	.1uF monolithic ceramic cap .1" lead spacing.
4	1	S2011-05-ND	2x5 bare pin header.
5	2	A26267-ND	2x5 shrouded header.
6	2	1n4001GCT-ND	1N4001 1A 50piv diode.
7	1	AT90S1200-12PC-ND	AT90S1200-12PC CPU 20 Pin DIP.
8	1	X907-ND	12mhz ceramic resonator.
9	3	S1011-03-ND	1x3 bare pin header.
10	1	S1011-02-ND	1x2 bare pin header.
11	1	277-1277-ND	Phoenix 2.54mm 6 position terminal block.
12	7	1.0KEBK-ND	1k 1/8wt resistor 5% (brown, black and red stripe)
13	7	10KEBK-ND	10k 1/8wt resistor 5%. (Brown, black and orange stripe)
14	1	MCP130-475DI/TO-ND	MCP130-475DI CPU Reset Chip TO-92.
15	1		R/C Robot Controller PCB Board.
16	1	296-9920-5-ND	TI SN75477 Dual Peripheral Driver 8 Pin DIP.
17	1	S9002-ND	.1” Gold Plated Shunt (Jumper block)

ASSEMBLING THE KIT

The kit construction is straightforward. All parts, with the exception of the voltage regulator, are mounted on the top of the board. The voltage regulator is mounted on the bottom of the board. The topside has printed legends showing where each part is inserted and their orientation.

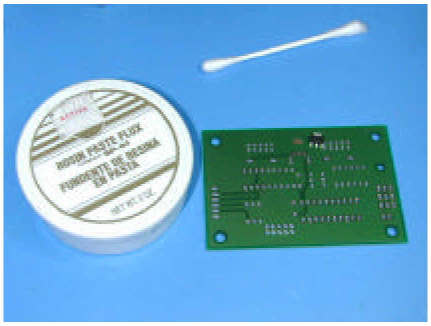
When soldering components, use a fine tip 40wt soldering iron and thin 60:40 rosin-core solder. When soldering parts like headers (things with multiple pins) solder one corner pin, double check alignment and adjust if needed by holding with fingers, melting the solder and adjusting the part. Once you are satisfied, then solder the remaining pins in place.

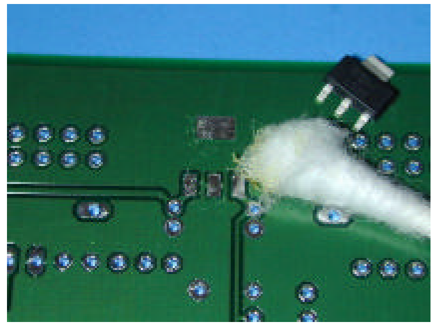
Soldering the IC’s in place is recommended. However, if you prefer sockets, gold plated machine screw sockets are preferred. In the harsh environment of a battle-bot cheap sockets will eventually fail through vibration and corrosion.

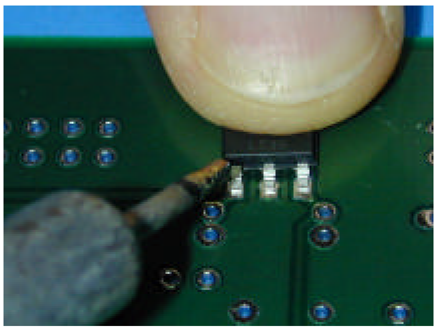
There are two values of resistors in the kit: 1k and 10k. They can be hard to tell apart. Double check with a DVM to insure you correctly identified the resistors. The 1 k resistor is marked with the colors brown, black and red. The 10 k resistor is marked with colors brown, black and orange.

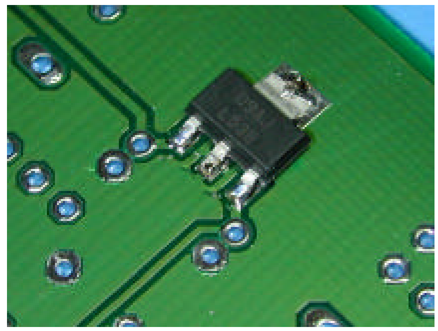
RECOMMENDED ASSEMBLY SEQUENCE

- [ ] Attach the voltage regulator on bottom of board first. First swab a bit of paste solder flux onto the pads. Position the regulator over the pads and hold it in place with your fingers. Then touch the tip of the soldering iron to one of the leads of the regulator. The solder tinning on the PCB should melt and wick under the lead attaching it securely to the board. Once one lead is attached, double check the alignment and then attach the other two leads and then, finally, the heat sink tab, to the PCB. Because the heat sink tab is soldered to the ground plane/heat sink it might be difficult to melt the solder. You might want to put a touch of solder on each of the small leads after the chip is soldered down.









- ❑ 1k resistors: R3, R8, R9, R10, R11, R12 and13. Orientation is not important.
- ❑ 10k resistors: R2, R4, R5, R6, R7, R14 and R15. Orientation is not important.
- ❑ Isolation diodes, D1 and D2. Orient the parts with the band matching the printing on the PCB.
- ❑ .1 uF ceramic bypass capacitors C4 and C5, Orientation is not important.
- ❑ 12 MHz Ceramic resonator (crystal) Orientation is not important
- ❑ CPU reset chip. Align flat side of the unit with the printed legend on the board.
- ❑ Bare pin headers (1x2, 1x3 and 2x5) and the green terminal block. Terminal block openings are toward the edge of the board.
- ❑ Shrouded headers. ***PAY ATTENTION:*** there are two keys on the headers. The side with the key in the center is oriented toward the center of board. These are ***very hard*** to remove without destroying them. Double check orientation before soldering.
- ❑ Power supply capacitors C1 and C2, pay attention to polarity. The band goes towards the center of the board. The longer lead goes towards the edge of the board.
- ❑ IC1 & IC2 (or sockets) Double check you have them installed correctly before soldering in. Each chip has a dot or shiny spot near pin 1 which should be aligned with the notch printed on the board.

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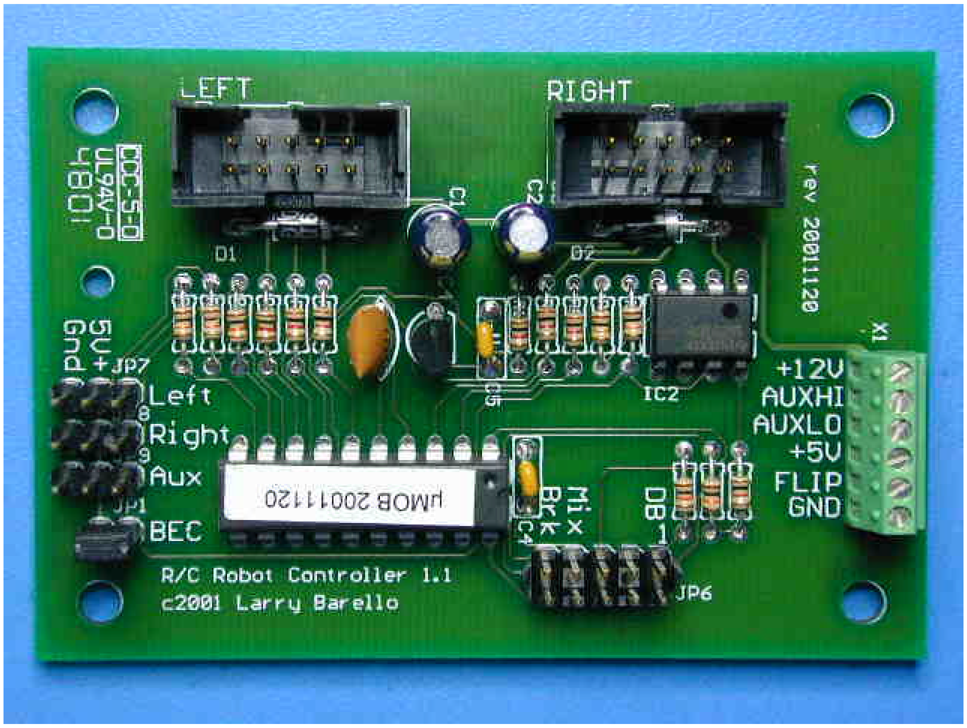


FINAL INSPECTION AND TESTING

After assembly, hold the board up to a light and inspect the bottom to insure there are no solder bridges between a pad and the ground plane. The light shining through the gaps will show bridges well.

Use a DVM to verify that +5v is not shorted to ground by measuring the resistance between pin 10 & 20 of IC1, the CPU. A typical reading should be around 5k. Then, make sure +12v is isolated from +5v and ground at the green terminal block. Typical readings should be in the low meg-ohm range.

Power up the board (either connect to an OSMC board or supply your own +7-15v to the +12v and Gnd connection of the terminal block) and measure the voltage at +5v. You can also check the voltage at pin 1 (reset) of IC1 to make sure it is at +5v.

Connect a three-channel R/C receiver to the board. Verify basic functionality by connecting the flip input to AUX-LO. Measure the voltage at AUX-LO while changing the aux channel it should be at +5v until the stick is at roughly ½ reverse and it should go to zero.

PROGRAMMING

Based upon the Atmel AT90S1200 CPU, the µRRC supports In System Programming (ISP) using the standard Kanda STK200 programming cable. The ISP header doubles as the options select jumpers. The orientation of the header is indicated with a "1" on the board. Programming is not needed as the kit and the assembled boards come with a pre-programmed CPU.

INPUTS/OUTPUTS AND OPTIONS

Looking at the photo of the assembled board, above, starting in the lower left corner and working clock-wise:

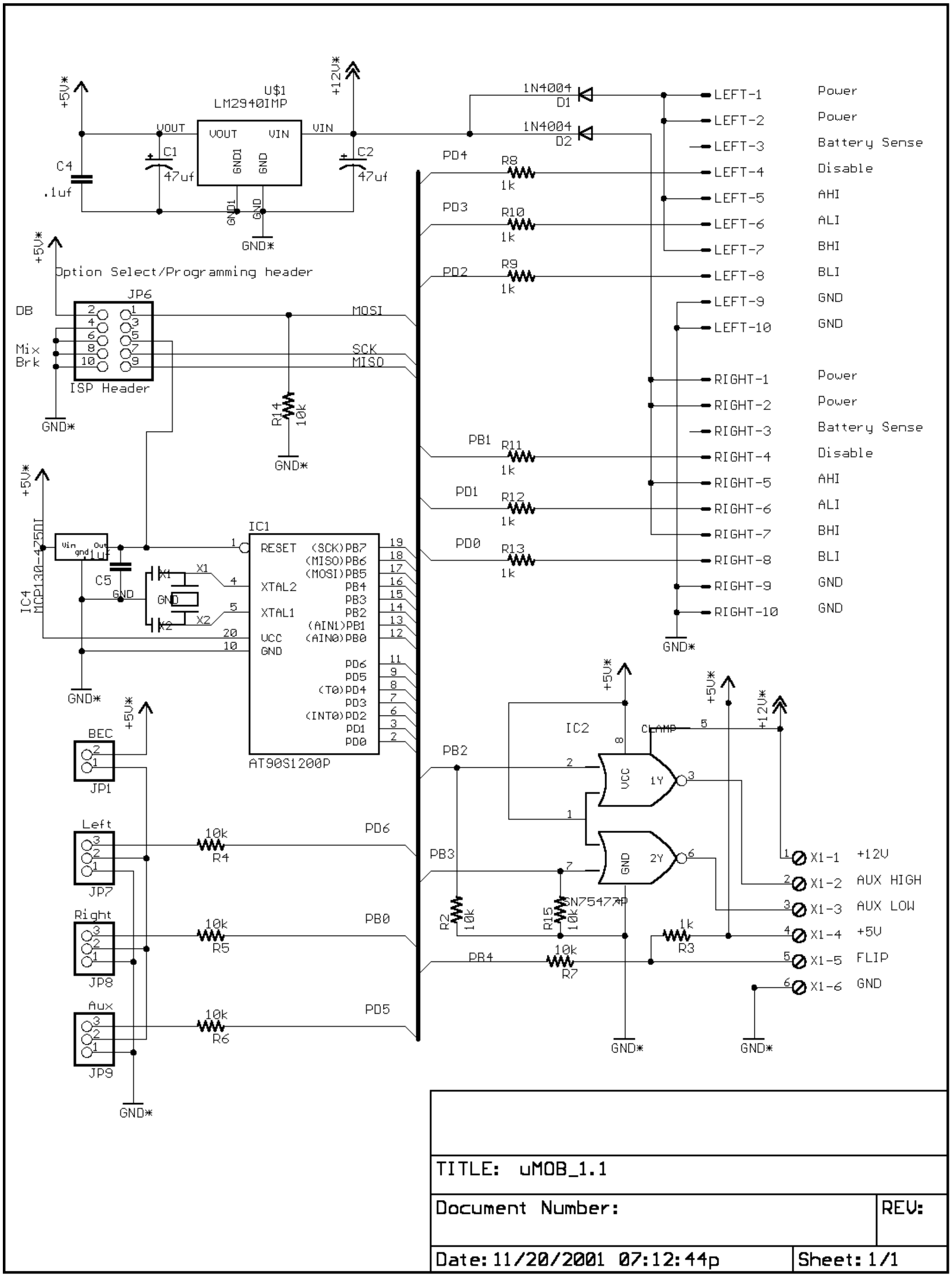
- **BEC**
  Battery Eliminator Circuit. When these pins are connected, the +5v supply of the µRRC powers the R/C receiver. The total current draw from this supply and all other supplies must not exceed the capabilities of the motor controllers supplying the µRRC.

- **AUX** R/C input.
  This signal controls the auxiliary high and low outputs.
- **RIGHT** R/C input.
  This signal controls the Right Motor Controller, or the steering in mixed mode.
- **LEFT** R/C input.
  This signal controls the Left Motor Controller, or the forward power in mixed mode.
- **LEFT** Motor Controller Header.
  This 10-pin header is compatible with the OSMC 3.0-2 cable. See the schematic of the OSMC 3.2 for details.
- **RIGHT** Motor Controller Header.
  This 10-pin header is compatible with the OSMC 3.0-2 cable. See the schematic of the OSMC 3.2 for details.
- **+12v** terminal strip output.
  Provides isolated 12v power from the motor controller boards. The total current draw from this supply and all other supplies must not exceed the capabilities of the motor controllers supplying the µRRC.
- **AUX-HI** terminal strip output.
  This open-collector output is driven low (Active) when the Auxiliary signal exceeds approximately 1.7ms (Stick ½ forward). The maximum current draw for this terminal is 300 mA. The clamp diodes (for relay inductive kick) are connected to the +12v supply.
- **AUX-LO** terminal strip output.
  This open collector output is driven low (Active) when the Auxiliary signal is less than approximately 1.3ms (stick ½ reverse). The maximum current draw for this terminal is 300 mA. The clamp diodes (for relay inductive kick) are connected to the +12v supply.
- **+5v** terminal strip output
  Provides regulated +5v from the µRRC to power additional electronics. The total current draw from this supply and all other supplies must not exceed the capabilities of the motor controllers supplying the µRRC.
- **FLIP** terminal strip input
  Flip is an input to the controller that reverses or swaps the left/right PWM outputs, as needed, to correct for an upside down robot. Flip is internally connected to +5v with a 1k resistor. Flip can be wired to either the AUX-HI or LO outputs so the robot controls can be reversed using the AUX channel (landing gear switch works well here). Alternatively, the FLIP input can be connected to electronics or mechanical tilt switches to automate the process
- **GND** terminal strip
  This terminal is connected to the µRRC ground plane which is also connected to the ground pins of the Left and Right motor control headers. One should be aware of the potential of ground loops when deciding what to connect to this terminal. If you are not sure, don't connect anything to the terminal.
- **DB** Option (ISP header)
  Open: gives +/- 30us of dead-band, suitable for cheaper radios
  Closed: gives +/- 10us of dead band around the zero point. This should be adequate for high-end radios or computer control (e.g. Innovation First ISSAC16 or FIRST competition controllers)
- **MIX** Option (ISP header)
  Open: the Left & Right R/C input will drive left & right outputs, respectively.
  Closed: the LEFT and RIGHT are mixed to drive the outputs. The mixing is linear with no variable ratio or exponents.
- **BRK** Option (ISP header)
  Open: the robot will "coast" when zero drive is commanded to the wheels
  Closed: the robot will brake to a stop when zero drive is commanded to the wheels.

DISCLAIMER

Larry Barello (barello.net) provides no warrantee of suitability or performance for any purpose for the µRRC. Use of the µRRC software and or hardware is with the understanding that any outcome whatsoever is at the users own risk. Barello.net sole guarantee is that the software and hardware performs in compliance with this document at the time it was shipped.

SCHEMATIC



U$1
LM2940IMP
VOUT
VIN
GND1
GND
C4
.1uf
C1
47uf
C2
47uf
+5V*
+12V*
GND*
1N4004
D1
D2
LEFT-1
LEFT-2
LEFT-3
LEFT-4
LEFT-5
LEFT-6
LEFT-7
LEFT-8
LEFT-9
LEFT-10
Power
Power
Battery Sense
Disable
AHI
ALI
BHI
BLI
GND
GND
PD4
PD3
PD2
R8
R10
R9
1k
Option Select/Programming header
JP6
DB
Mix
Brk
ISP Header
MOSI
SCK
MISO
R14
10k
RIGHT-1
RIGHT-2
RIGHT-3
RIGHT-4
RIGHT-5
RIGHT-6
RIGHT-7
RIGHT-8
RIGHT-9
RIGHT-10
PB1
PD1
PD0
R11
R12
R13
IC1
RESET
XTAL2
XTAL1
VCC
GND
(SCK)PB7
(MISO)PB6
(MOSI)PB5
PB4
PB3
PB2
(AIN1)PB1
(AIN0)PB0
PD6
PD5
(T0)PD4
PD3
(INT0)PD2
PD1
PD0
AT90S1200P
IC4
MCP130-475DI
C5
X1
X2
BEC
JP1
Left
JP7
Right
JP8
Aux
JP9
R4
R5
R6
PD6
PB0
PD5
IC2
CLAMP
PB2
PB3
PB4
1Y
2Y
R2
R15
SN754770
R3
R7
X1-1
X1-2
X1-3
X1-4
X1-5
X1-6
+12V
AUX HIGH
AUX LOW
+5V
FLIP
GND
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