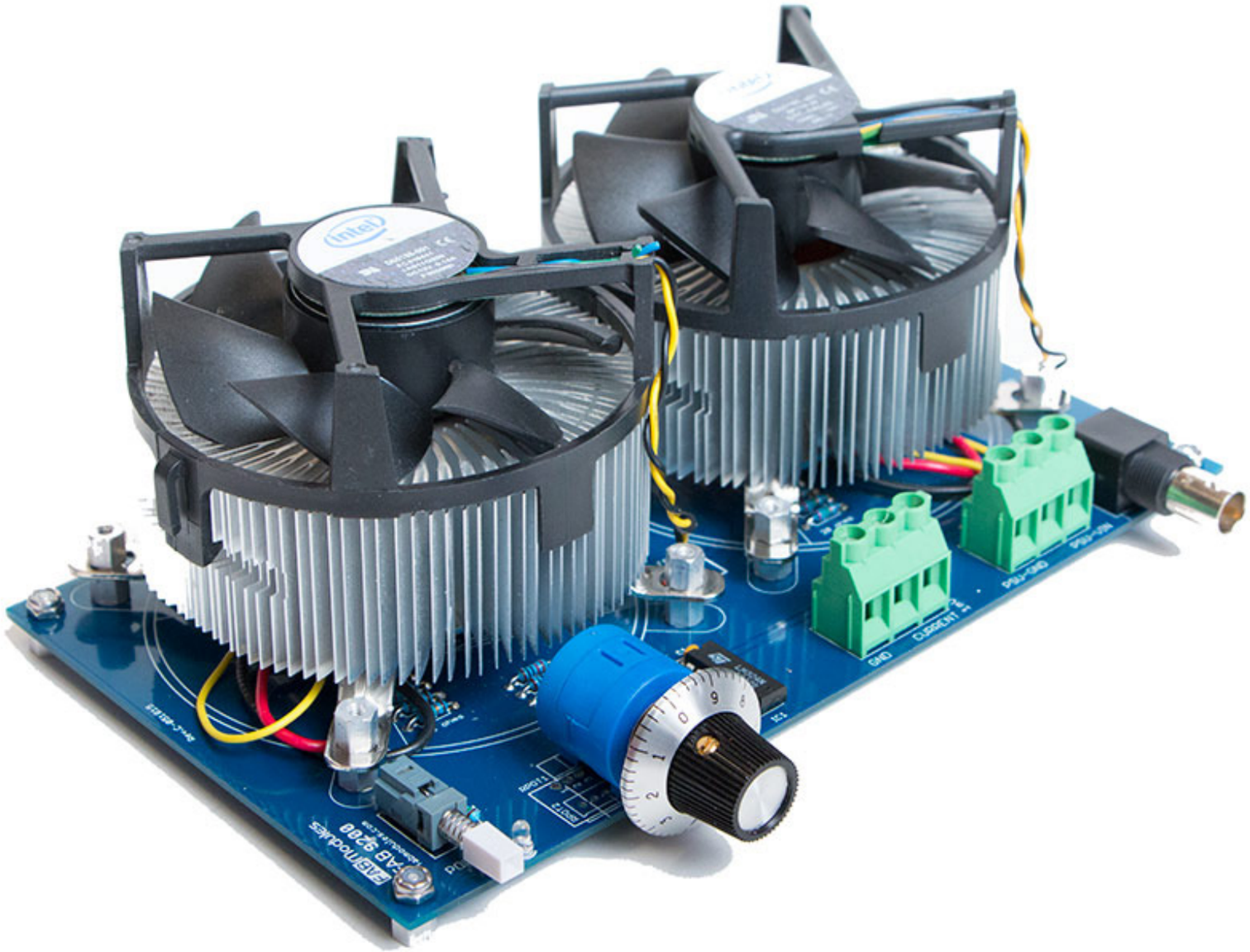
FiveFish

Studios

180-240 Watts Electronic Load Kit Assembly Guide



Revision 1.10 - 20200410

FiveFish Audio

www.fivefishaudio.com

Dear Customer,

Thank you for purchasing our Electronic Load DIY Kit.

Great care has been taken to make this assembly guide complete and as accurate as possible. Our goal is to make your assembly work easy and trouble-free, and deliver to you a working, reliable, and high-performance power supply.

This assembly guide is a work in progress and we're continually working to improve it. As always, we welcome the input of the DIY community if you have any comments, suggestions, or additional information that you think will be helpful for inclusion in this assembly guide.

If you have any questions that are not covered by this assembly guide, please feel free to contact us at www.fivefishaudio.com, or via our facebook page.

Sincerely,

FiveFish Team

SAFETY CONSIDERATIONS

GENERAL

This assembly guide must be reviewed for familiarization with safety markings and instructions before assembly of the Electronic Load kit.

BEFORE APPLYING POWER

Verify that all components and parts are inserted in the right location and correct orientation. Visually inspect that there are no cold solder joints, or short-circuits.

WARNING

The WARNING sign denotes a hazard. Pay attention to the procedure, instructions, or the like, which if not correctly performed could result in damage to your equipment, electronic component or personal injury.

WARNING

Any interruption or disconnection, or lack of connection of the protective earth terminal/safety ground may cause a potential electric shock hazard that could result in personal injury. (Grounding one conductor of a two conductor outlet is not sufficient protection).

If the Power MOSFETs mounted on the CPU heatsink does not have MICA or Sil-Pad insulators, the CPU heatsink body will be at the same potential as the V+ of the power supply under testing.

Additional PCB spacers may be needed to be installed in the middle portion of the board to prevent the PCB from sagging, due to the weight of the CPU heatsinks and fans.

The heatsinks will get HOT (that's why they're called heatsinks!), especially when running the electronic load at high power dissipation.

It goes without saying -- do not stick your finger into the fan blade while the fan is spinning.

For complete protection, it's advisable that you house this electronic load in a suitable metal or aluminum enclosure.

GENERAL INFORMATION

1. DESCRIPTION

This is an Electronic Load useful for testing power supplies, batteries and the like. It works on the principle of a constant current load, using an active device (MOSFET) to vary it's DRAIN-SOURCE resistance being presented to the DUT (Device Under Test), i.e. the power supply.

The Printed Circuit Board is professionally manufactured, with double-sided copper layers, plated-through holes, solder mask, and silkscreen labels.

This Electronic Load needs an external power in the form of 12Volts DC. This can be supplied by either a separate bench power supply, or a DC wall adapter (i.e. wall wart).

An on/off power switch turns the Electronic Load on or off.

You can use a trimmer, linear potentiometer, or a multi-turn potentiometer. I recommend a multi-turn potentiometer to allow fine control of the load current.

There are provisions on the PCB for use of a screw-on terminal. One terminal is dedicated for reading the current draw (in milliVolts, where 1mV = 1mA current draw), and another terminal is dedicated for connecting the DUT to the Electronic Load.

A BNC connector is also provided for hooking up the Electronic Load to your oscilloscope. This is the equivalent of monitoring the DUT output voltage under load.

2. TOOLS & EQUIPMENT REQUIRED

A few basic tools and equipment are required to assemble this kit. These basic tools are not supplied with the kit.

2.1. Soldering Iron and Lead - We recommend a temperature adjustable soldering iron. DO NOT USE A 100 WATT SOLDERING GUN. A small to medium-sized soldering tip is required to solder the small parts. You may use lead-free or 60/40 lead-based solder.

2.2 Cutter - You will need a cutter to cut component leads and wires.

2.3. Solder Sucker Pump - If you need to desolder a component, you'll need one.

2.4. Multitester - Used for measuring resistance, continuity, and voltages.

2.5. Magnifier & Lamp - I recommend a clean and well-lighted space for your assembly area.

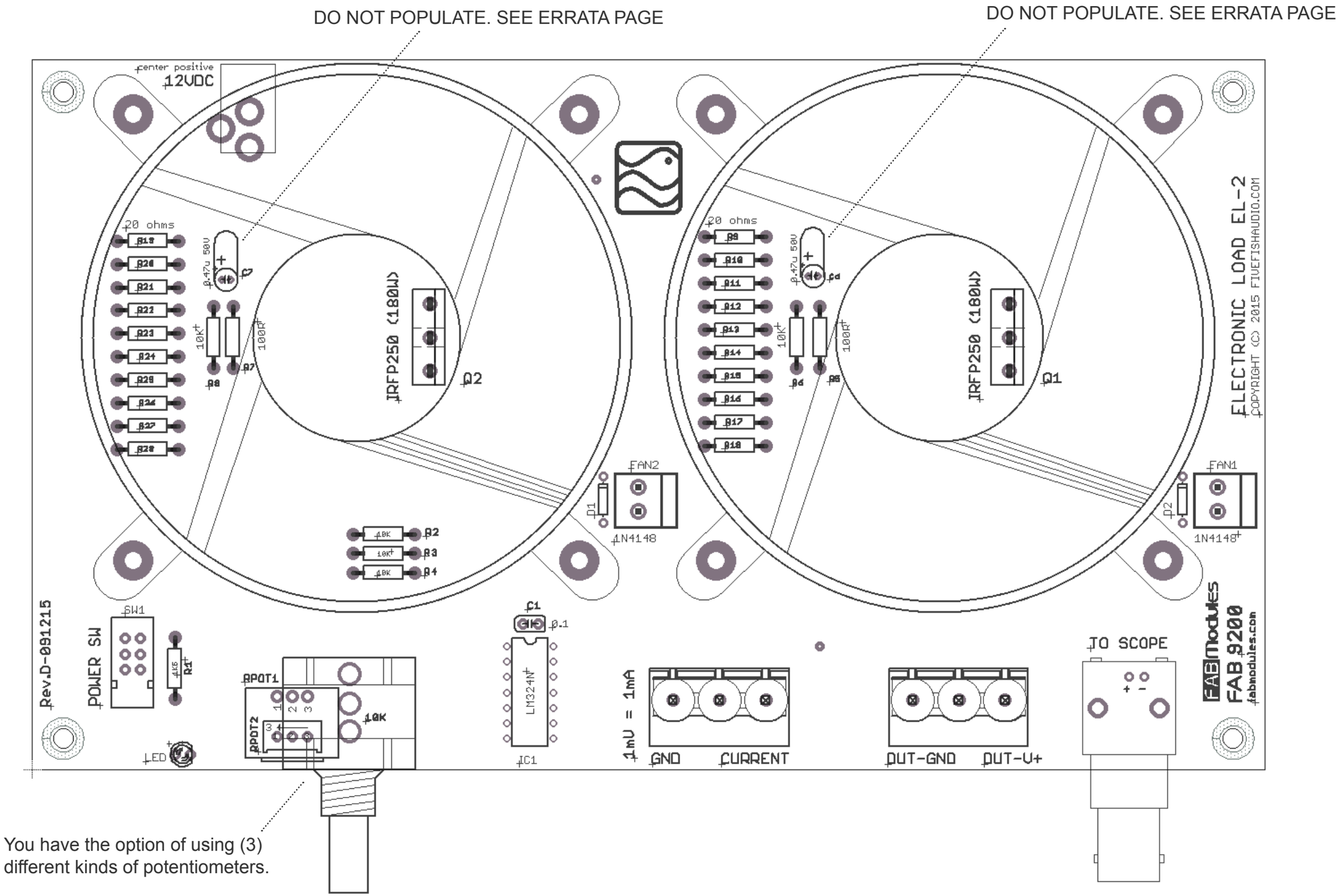
2.6. Other Tools (not required, but nice to have) - Component lead bender, vise, tweezers, wire stripper.

3. PARTS LIST

This Electronic Load uses normal, typical “jelly-bean” parts. Most, if not all parts, can be purchased from eBay, surplus stores, or online retailers like Mouser.com, Digikey.com or Allied, Farnell, etc.

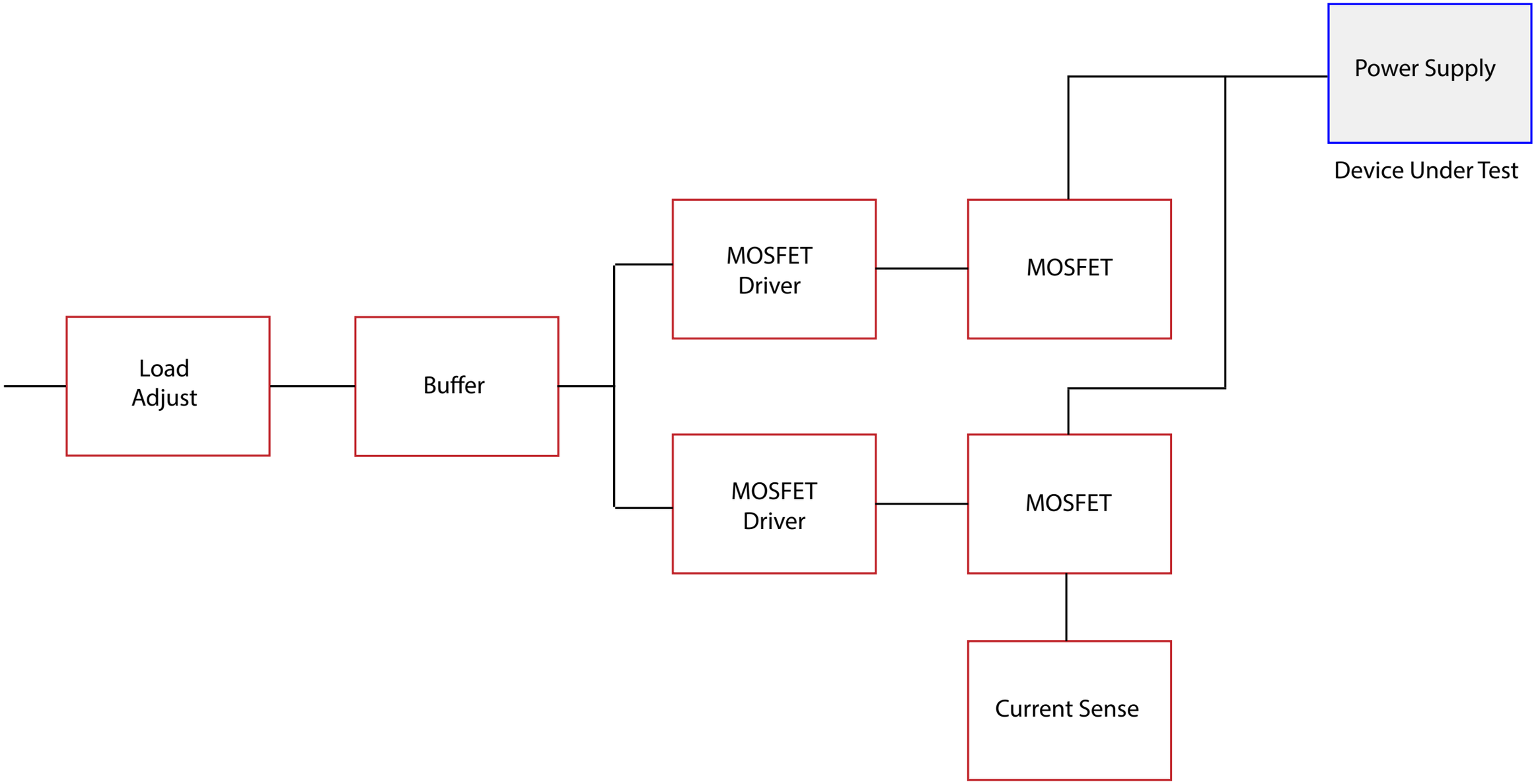
Reference	Value	Notes/Suggested Source
PCB:	Custom PCB	FiveFishAudio.com
R1 :	1K5 1/4 watt	
R2,R3,R4,R6,R8 :	10K 1/4 watt	
R5,R7 :	100R 1/4 watt	
R9-R18 :	20R 1% 1/4 watt (see also alternate method/part*)	
R19-R28 :	20R 1% 1/4 watt (see also alternate method/part*)	
	** use Vishay/Dale 2-ohms, 10Watt 1% resistor (Mouser Part# 71-RW78U2R00F)	
RPOT :	3590S-2 10K	Search eBay for 10K 10-turn multi-turn potentiometer
IC Socket :	14 pin IC Socket	
IC1 :	LM324 Quad OpAmp	
C1 :	0.1uf 100V Ceramic Capacitor	
C2, C3, C4, C5 :	[do not poplate]	
C6, C7 :	0.47uf 50V Electrolytic	Solder capacitors on bottom side of PCB. See ERRATA page for location.
Q1, Q2 :	IRFP250 *	max. tested at 180 watts, 30VDC @ 6Amps, 60VDC @ 3Amps, 100VDC max @ 1.5Amps
Q1, Q2 (upgrade) :	IXFH50N50P3 *	max. tested at 240 watts, same as above + 120VDC max @ 2Amps
D1, D2 :	1N4148 Signal Diode	
LED :	GREEN or RED 3mm LED	
SW1 :	DPDT Push Button, DPDT Switch	
DC JACK :	5.1mm, PCB Mounted	
BNC :	BNC PCB Mounted, optional	
HS1, HS2 :	Intel Core 2 Duo CPU Heatsink with integrated FAN	Search and buy from eBay
		Note: need to tap copper core with 4-40 threaded hole, and remove the plastic legs
Stand-offs/Spacer :	Aluminum 0.25” Standoff + Nuts M-F Standoff	
Stand-offs/Spacer :	Aluminum 0.25” Standoff F-F Standoff	
T1, T2 :	Phoenix Terminal Block	

4. COMPONENT GUIDE

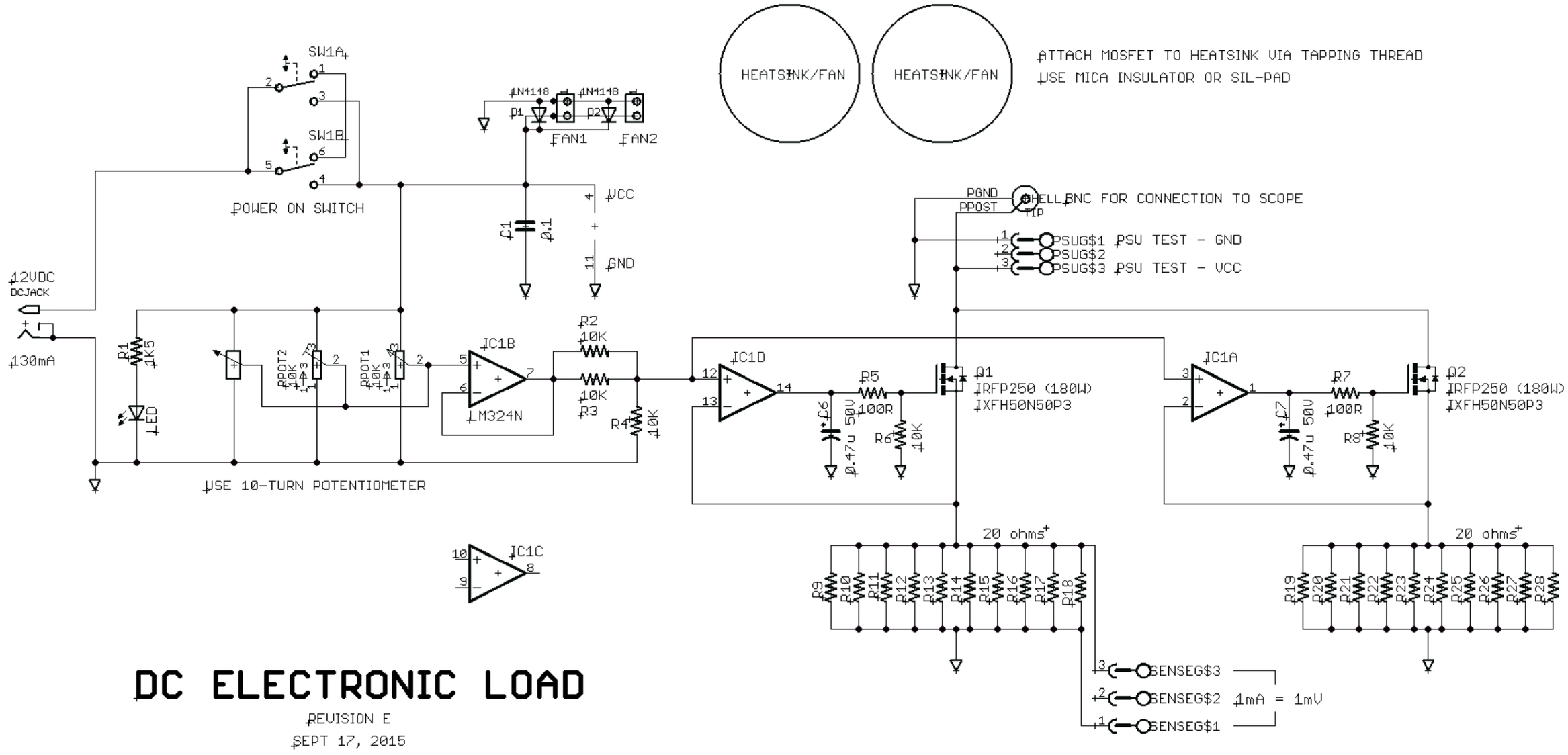


You have the option of using (3) different kinds of potentiometers.

5. BLOCK DIAGRAM



6. SCHEMATIC DIAGRAM



DC ELECTRONIC LOAD

REVISION E

SEPT 17, 2015

7. BUILD GUIDE

1. Each MOSFET section will have (10pcs) 20-ohm resistors in parallel. Use 1% tolerance, or better, resistors for this section. I suggest buying 100pcs of 20-ohm resistors and sort and measure them to find a total of 20pcs of resistors all having a value as close to 20-ohms.

2. I highly recommend the use of a 10-turn potentiometer as shown in the photo. You may also use a 10K single-turn potentiometer, but you won't have fine control of the current load.

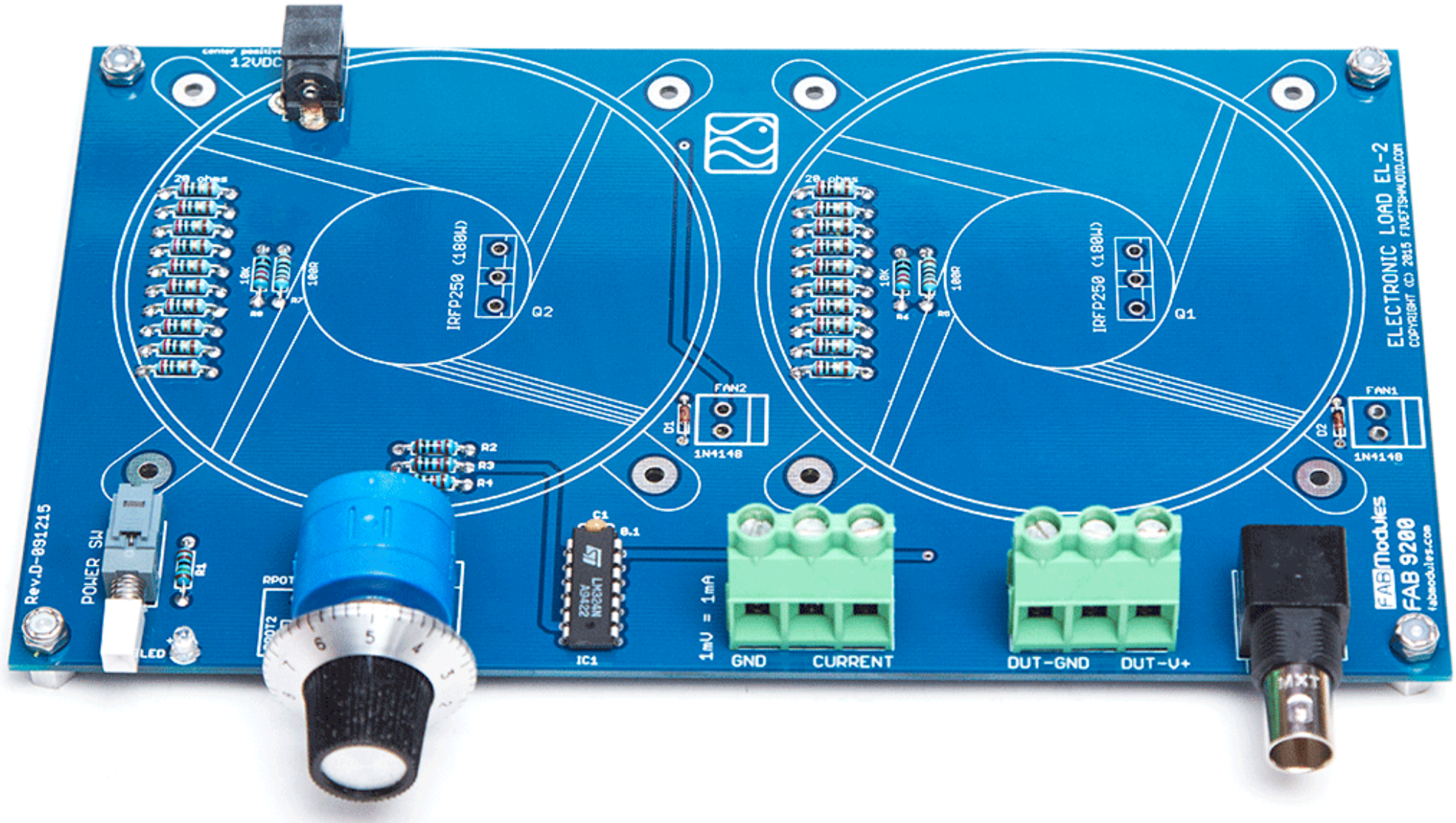
3. At high power dissipation, the PCB may get hot due to the hot air from the heatsinks being blown downwards to the PCB. After using the Electronic Load at high power dissipation, I suggest turning off the Device Under Test (Power Supply being tested) and leave the Electronic Load powered on so the cooling fan can continue operating and lower the MOSFETs temperature to a safe value.

4. BNC connectors are optional, and only required if you want to connect the Electronic Load to an oscilloscope.

5. The hole pads on the Electronic Load PCB (for the DUT and current sense) are for 3-terminal Phoenix connectors. You may instead opt to wire these pads to banana jacks if mounting the PCB inside a metal enclosure.

6. If using a 12VDC wall adapter, make sure DC adapter has enough Amps to drive the (2) cooling fans.

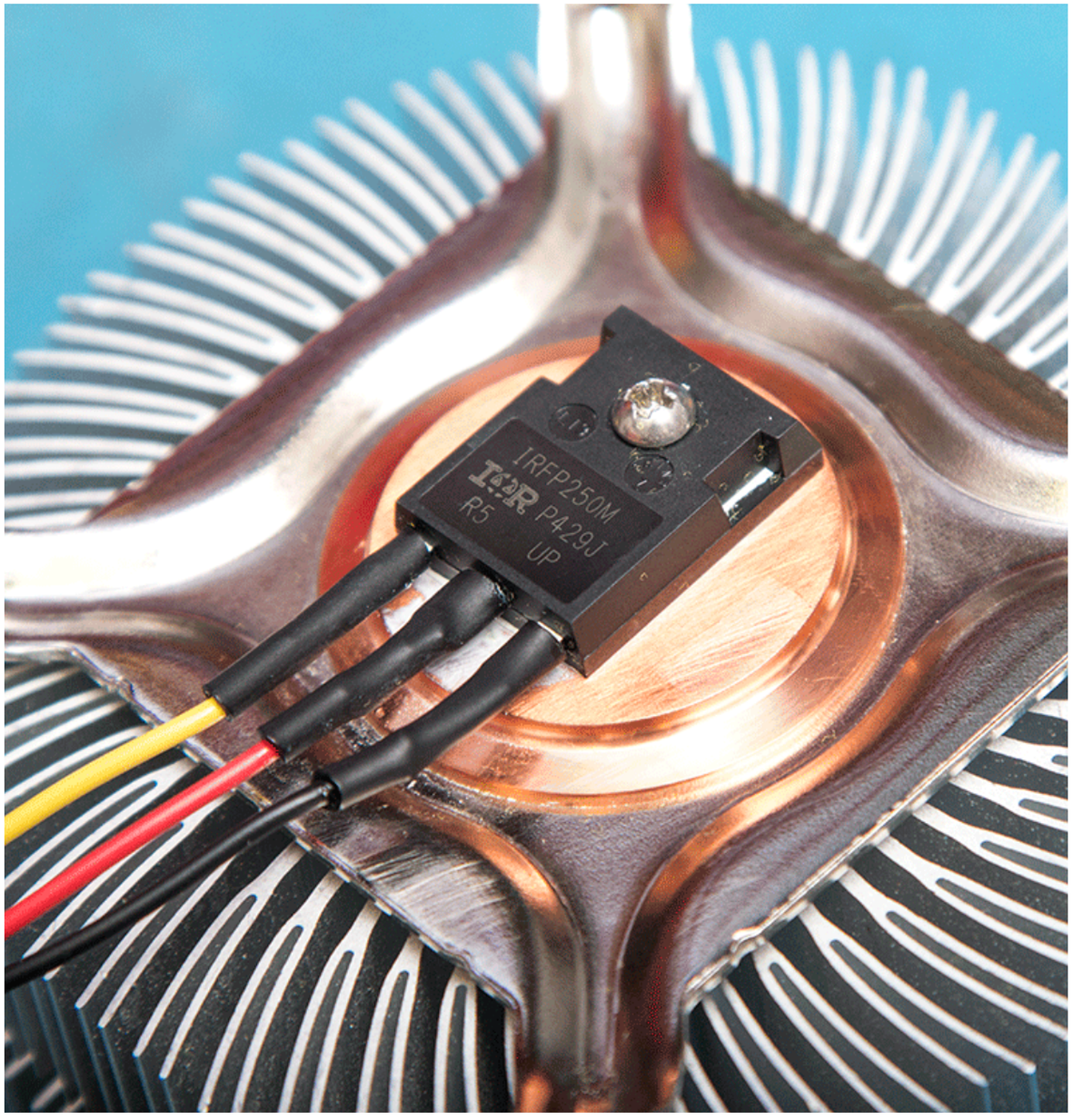
7. Solder the 0.47uf/50V capacitors on the bottom side of the PCB as shown on the ERRATA page, section 8. These capacitors assure the stability of the Electronic Load at various input voltages and current draw combinations.

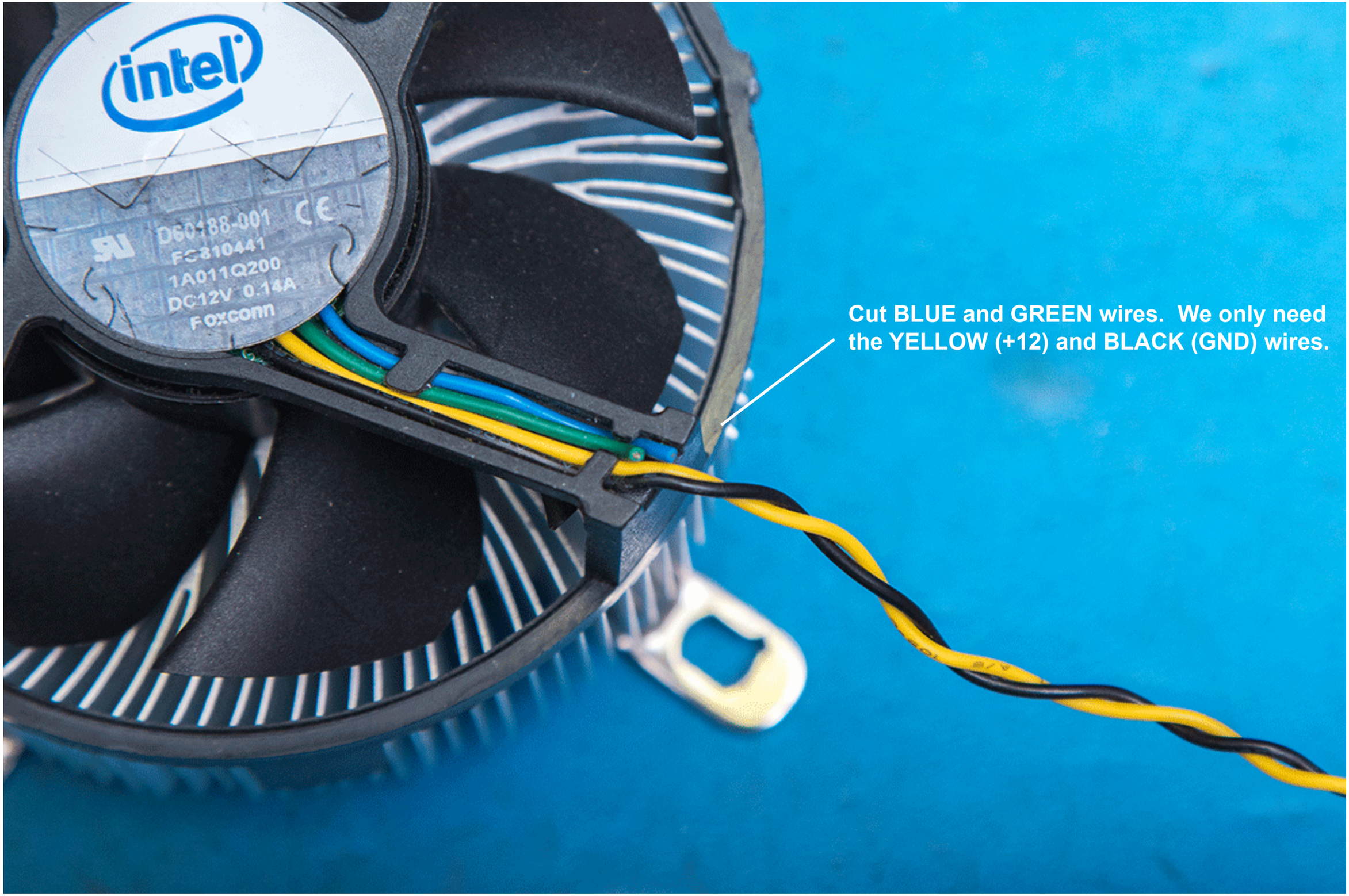


NOTE:
0.47uf / 50V capacitor soldered on bottom side of PCB

8. The CPU heatsink's center copper core needs to be drilled-and-tapped for a 4-40 screw. Screw the MOSFETs directly to the heatsink with a 4-40 machine screw.

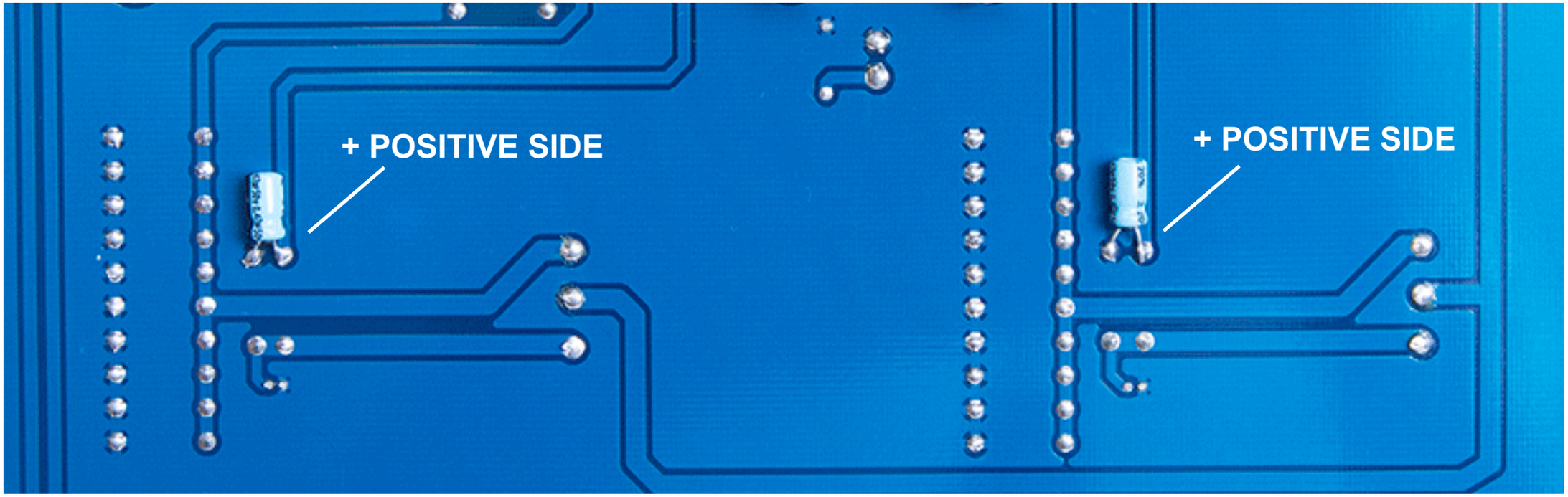
9. You may attach the MOSFETs directly to the heatsink without using any MICA or SilPad insulators for maximum heat transfer to the heatsink. But note that if you do this, the heatsink's body will be at the same V+ voltage as the power supply under test. If you're dealing with low voltages, this may not be an issue. If you'll be dealing with sufficiently high voltages and current, I recommend you insulate the MOSFETs from the heatsink.

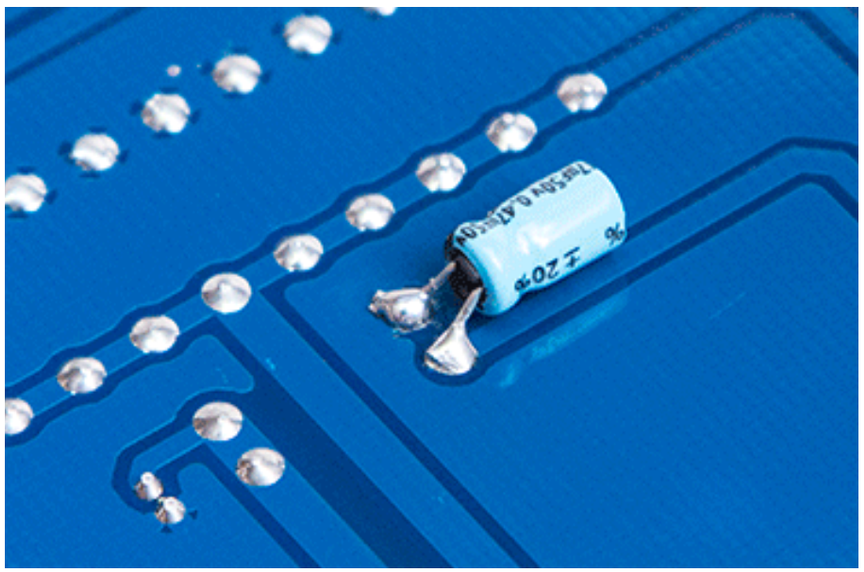


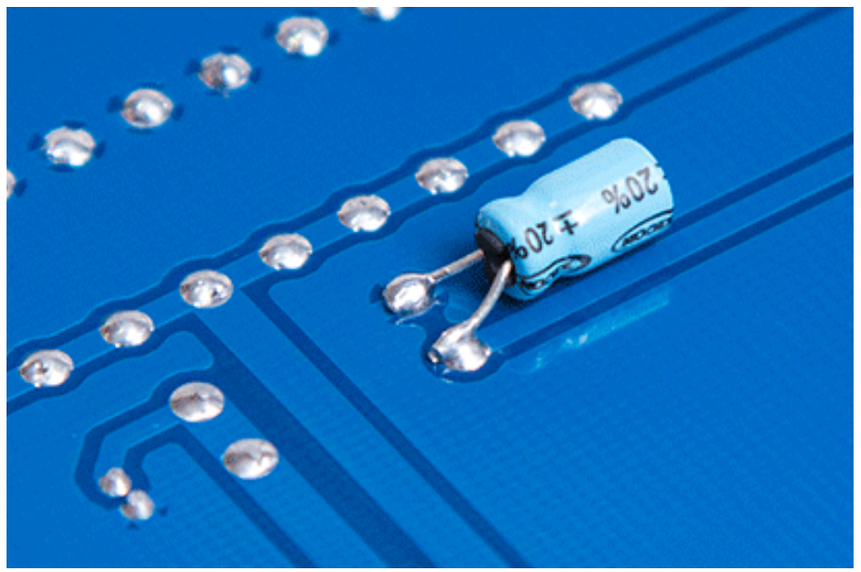


8. ERRATA / MANUAL CHANGE INFORMATION

If you have Revision C or Revision D PCB, solder 0.47uf/50V capacitors on bottom side of PCB as shown on photo below.







CURRENT SENSE RESISTOR UPGRADE

To increase power handling of the Electronic Load, I highly recommend upgrading the 10pcs of 20-ohms 1/4watt resistors to instead use a 2-ohm 10-watt 1% resistor for each section. The bigger size of the 10-watt resistor will need an alternative way of mounting it to the PCB. See photo below. Solder the end of the component leads to one of the round pads. I suggest also filling all the 20 pad holes of the resistor with lead solder on top and bottom.