Tracking Bipolar ± 1.25V to 15V Power Supply

This simple little project provides provides a positive and negative bench-top power supply for testing electronic projects. It's both easy to build and very reliable.

Specification

The basic specification is ±15V output, the maximum current available will depend on the output voltage. The reasoning for this is explained below.

1.25V to 15V 500mA.
5V to 12.5V 1.5A.

When the voltage is set very low (below about 5V) the LM317 will need to dissipate a lot of power and the safe area protection will kick-in limiting the current.

With the voltage set to the high end (above about 12.5V) and 1.5A drawn the ripple might become unacceptable, especially if the mains is a bit low and the capacitor is on its lower tolerance limit. Using an 18V transformer would help to resolve this but would make the low current at low voltage problem worse. Larger filter capacitors would also help but wouldn't completely eliminate this and would make it more expensive.

Circuit Operation

U3 is configured as an inverting buffer with a gain of 1 which inverts the output voltage from U1. U2 isn't used as a voltage regulator and just buffers the output from U3. D3 reduces the positive supply voltage to U3 to 9V which has a maximum supply voltage rating of ±22V and would otherwise be damaged if connected directly across the voltage on C1 + C2. R1 is a current limiting resistor for both D2 and D3.

C3 helps to increase the ripple rejection by keeping the voltage at the ADJ pin at a steady DC voltage, i.e. bypassing the variable resistor to 0V at higher frequencies. Stabilising the voltage on the ADJ has a greater affect than increasing the output capacitance because any ripple on the ADJ pin is amplified and transferred to V_{OUT}

F1 is a slow blow fuse, 500mA for a 200V to 240V transformer, 1A for a 100V to 130V transformer.

Notes:

All capacitors 20%, <1µF ceramic, >1µF aluminium electrolytic.
D2 general purpose LED indicator, colour of your choice.
D3 general purpose zener >125mW, not critical 8.2V to 12V.
D4 & D5 general purpose diode, e.g.1N4001.
R1, R2 & R4 general purpose carbon film 5%.
R3, R5 & R6 metal film 1%
R5 & R6 can be any value between 1k and 100k providing they are equal.
R2 equal to half of R5 or R6 ±20% i.e. with 10k used for R5 and R6, R2 can range from 4k3 to 5k6.

Heat-sinking

U1 and U2 need to be mounted on a good heat-sink, preferably one with a thermal resistance to ambient of less than 1ºC/W. The better the heat-sink, the more current it will be able to supply at the lower voltage settings. Ensure the heat-sink is adequately ventilated, consider adding a fan.

Also note that if a non-electrically isolated package is used for U1 and U2 thermally conductive electrically insulating pads will be required.

Minimum Component Ratings

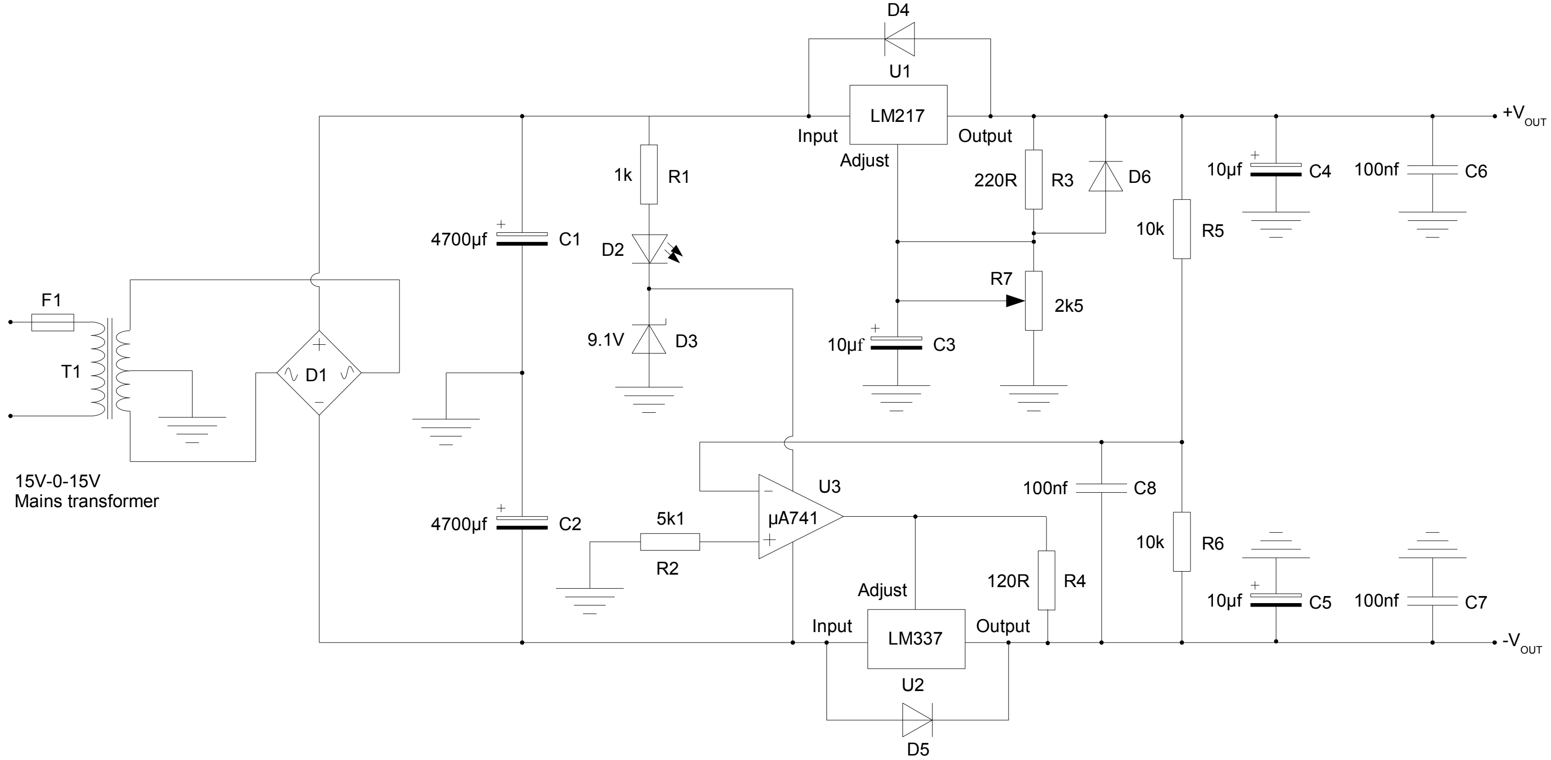
D1	2.5A
D3	125mW
C1 & C2	30V
C3 to C8	20V
R1	250mW
R2 to R6	50mW
R7	125mW
U3	Most op-amps will do, providing it's unity gain stable can sink 10mA and are rated for 36V from positive to negative rail.
T1	2.2A

Beware that changing any component values my affect the component ratings. For example if the value of R5 and R6 is reduced to 1k, their power rating will need to be increased to from 50mW to 250mW to account for the increased current and therefore power dissipation.

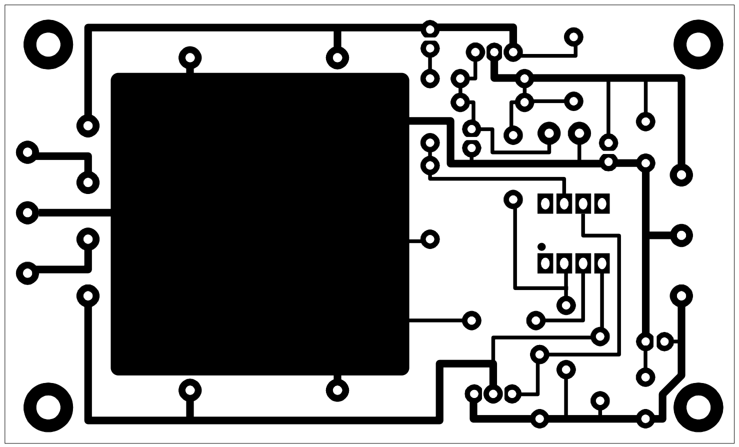
Possible substitutions

Ref.	Substitute	You'll also need to change:
U1	LM317	R3 to 82R and R7 to 1k
U2	LM137	No further changes required
U3	MC34071	
R7	2k2	R3 to 200R

Schematic Diagram

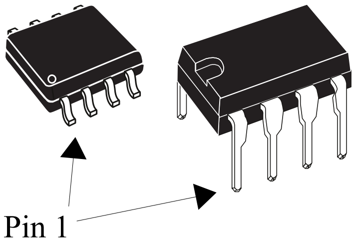


PCB

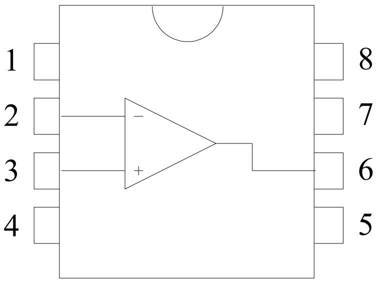


Pinouts and case styles

S08 DIP8

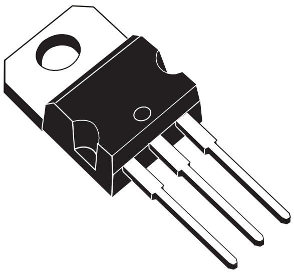


µA741

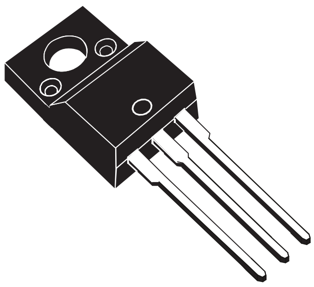


1 - Offset null 1
2 - Inverting input
3 - Non-inverting input
4 - V_{CC}^-
5 - Offset null 2
6 - Output
7 - V_{CC}^+
8 - N.C.

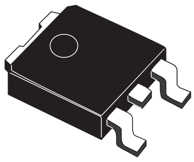
T0-220



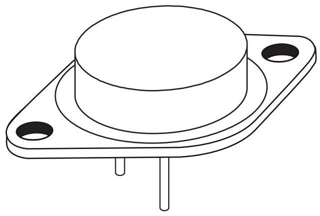
T0-220FP



D^2PAK

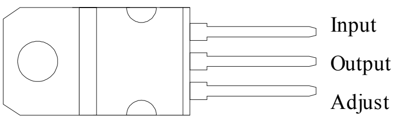


T0-3



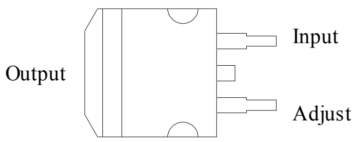
LM217/317

T0-220(FP)

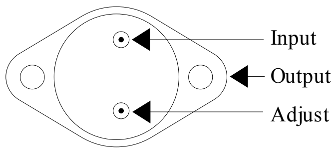


Case connected to output on T0-220 Option

D^2PAK

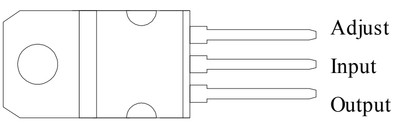


T0-3



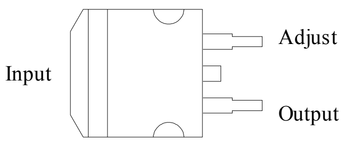
LM337

T0-220(FP)

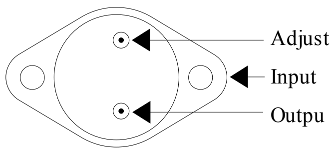


Case connected to output on T0-220 Option

D^2PAK



T0-3



Note the different pin-out for the LM337