AC-DC LM317 DIY Voltage Reg Top Adjust-Narrow-Notes R2.2a 01-27-20

This board provides a compact, easy to assemble, inexpensive, versatile, adjustable DC voltage regulator. It is capable of up to a 500 ma load, can be powered by AC or DC, and won't interfere with DCS. It is suitable for use in any railcar or engine, or for any trackside lighting or accessory use, using an **isolated** ground. (ie, The output ground must be isolated from the input ground.)

This board is narrow in order to fit into slim spots. Dimensions are 12.7mm wide x 45mm long.
There are only six components, easy thru-hole assembly.
Board material is 1.6 or 0.8 mm thick with 2 oz copper. You can use either AC or DC supply.
Load carrying traces are a full 0.5mm width. 2-pin headers accommodate input & output connections.

L1 is a 22 uH 600 ma 0410 choke to mitigate DCS interference, bulk from offshore.
It is rated at 600 ma so this limits the practical AC input current to 500 ma or so.
If dcs interference is not an issue (ie trackside or building), you can simply jumper the L1 pads with wire and remove this limitation. Then the 1 amp max current of D1 bridge diode becomes the circuit limit.
But for O gauge train use, eliminating possible DCS interference with L1 is prudent.

R2 is a 5K 3362P Bourns style trim pot. This gives a range of 1.5 to 35 volts output, depending on the AC supply. Resolution down to 1/10 of a volt. CW rotation increases output. Digikey 3362P-502LF-ND.
You can sub a fixed resistor in place of pot R2 (pads 1-2) to set a fixed voltage output from the board.
The output voltage is found by: $V_{out}=1.25V(1+R2/R1)+I_{adj}(R2)$; where I_{adj} is 100 uA.
In my testing 18 vac track power produces up to 23 vdc output from the board.
D1 is a standard 1 amp DB107G bridge DIP package diode. Digikey 641-1685-ND
C1 can be up to 1000 uF 35 vdc electrolytic. But you can use a 470 or 680 uF cap to reduce size. Higher values give smoother output; less ripple.
If the input is DC (trackside application), you don't need D1 or C1 at all, though a 10 to 22 uF electrolytic will help stabilize U1 input. Just jumper straight across the D1 pads.
For an application where supply and output grounds must be common, use a 1N4002 diode from AC2 to pad1(+), and jumper AC1 to – out. This gives you common-ground half wave rectification.
U1 is the good old LM317T reg package, rated at 1.5 amp output. A heat sink will be needed for load losses through U1 exceeding about 2 watts.
The board should not be mounted with the LM317 near anything plastic; it does get hot.

The board accepts 0.1" (2.54 mm) 2 pin input and output headers (eg. Dupont) if you want to use them.
It can also be hard-wired directly using up to 22 AWG solid or stranded wire.
It can also be used with pre-wired Mini JST 1.25 male/female 2-pin (limit 600 ma) or other connector.
For high transient loads a 1 uF 35 V tantalum cap across the DC outputs will smooth the response.

Where height is an issue, you can bend U1 over at 90 degrees, away from C1 cap; and mount C1 remotely off-board, or with it's leads bent over at 90 degrees.
You can also mount U1 underneath the board if that is more convenient.
The top adjust trim pot makes adjustment easy in most mounting locations.
The LM317T data sheet indicates that it can dissipate 30 watts plus TDH with suitable heat sinking.
The tab of the 317 can be heatsinked to an engine or railcar frame or any other metal surface, since it is flush with the end of the board. However if the sink is grounded, the LM317 must be electrically isolated from it using a silicon pad insulating kit, since the tab is common to pin 2, which is Vout. An option for this is to use the insulated LM317P version, then you can fasten the reg directly to the heatsink.

Using all domestic components and OSH Park boards, the total cost is about $5 each.
Using all offshore components and boards, the total cost is under $1 each.