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A Multiple "Wall-Wart" Power Supply

By Ron Tipton

Get organized with this handy device that can reduce the rat's nest of plugs and wires.

A power supply is perhaps not a very glamorous or exciting project, but this one is very useful. It replaces ten DC wall-wart supplies, thereby freeing up nine AC outlets. And this, in itself, is a worthwhile accomplishment.

Each output voltage is isolated from the others so there is no common return or ground. I have operated the prototype unit continuously for over three years with no problems. I chose to make nine of the outputs 24V DC, with the tenth one at 14V. The output voltage is easily settable with two 1% resistors, so you can choose whatever voltages you need (up to about 30V) with the transformers in the parts list. If you set all the outputs to a lower voltage, using a transformer with a lower secondary voltage would minimize power dissipation in the regulators.

The circuit diagram is shown in **Fig. 1**. All ten circuits are identical, with the exception of the voltage set resistor val-

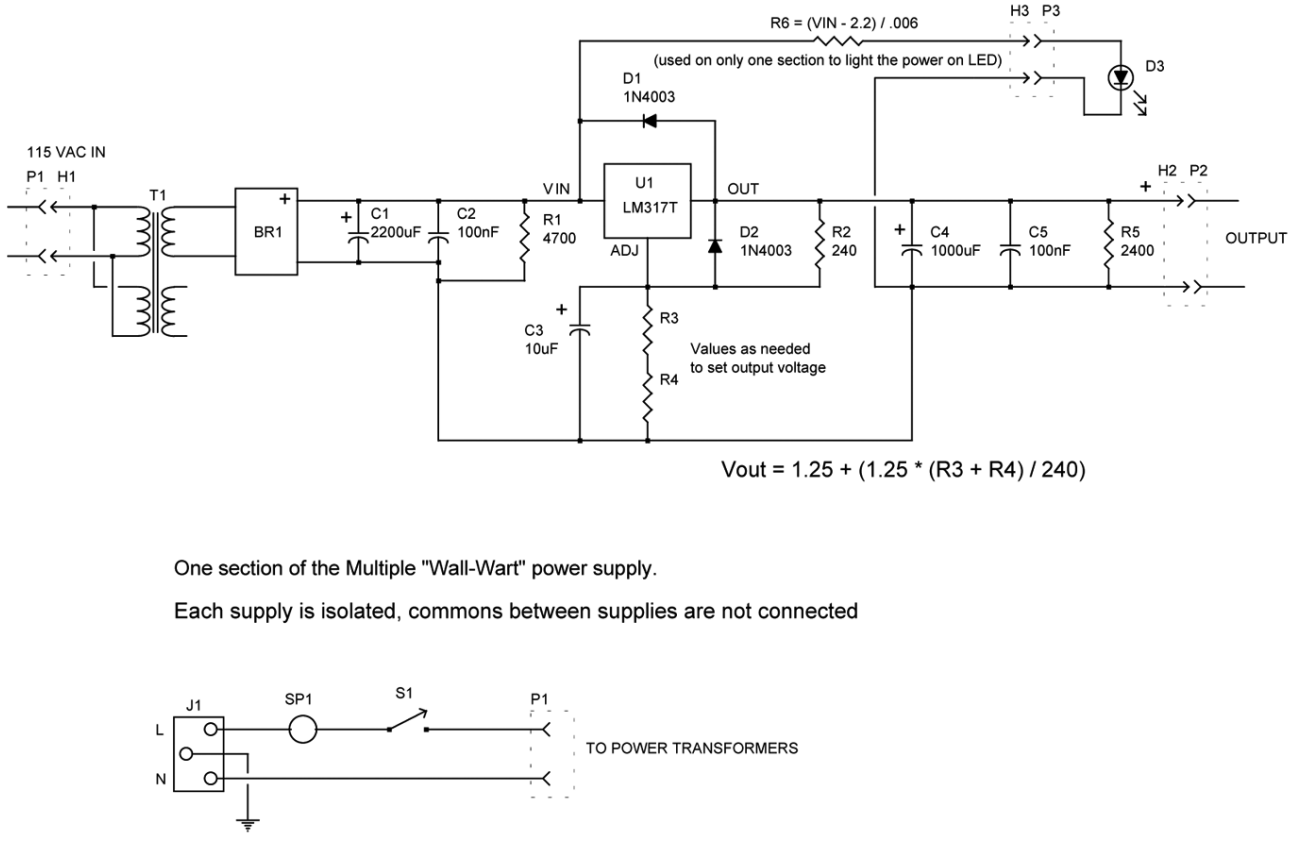

FIGURE 1: Multiple "wall-wart" power supply circuit diagram.

ues R3 and R4. The needed values are calculated from:

Vout = 1.25 + (1.25 * (R3 + R4)/240)

For example, for 24V (R3 + R4) = 4368Ω. This is closely approximated by choosing standard 1% resistors of 4120 and 249Ω.

Because there are two secondary windings on each transformer, two supplies share a transformer. I considered using one large circuit board, but on second thought this didn't seem like a practical idea. I settled for two different boards: one for four supplies (two boards needed), and the other single board for two supplies. The circuit board layouts (single-sided) are shown in **Figs. 2** and **3**. (You can download the layout files from the TDL® website.[1]) I named this supply a Model 701 (just to keep track of circuit boards and parts), but it is not a product, and I have built only the one prototype. Hence, the front panel has no labels.

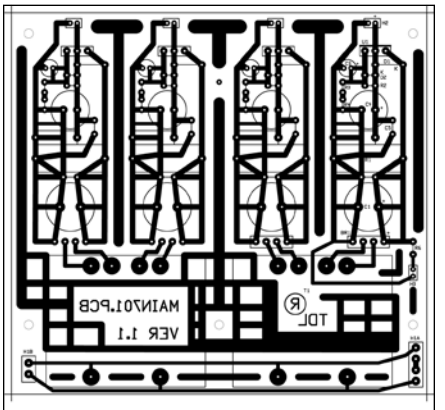

FIGURE 2: Four section supply circuit board. Note that H1B is used to connect AC power from board to board.

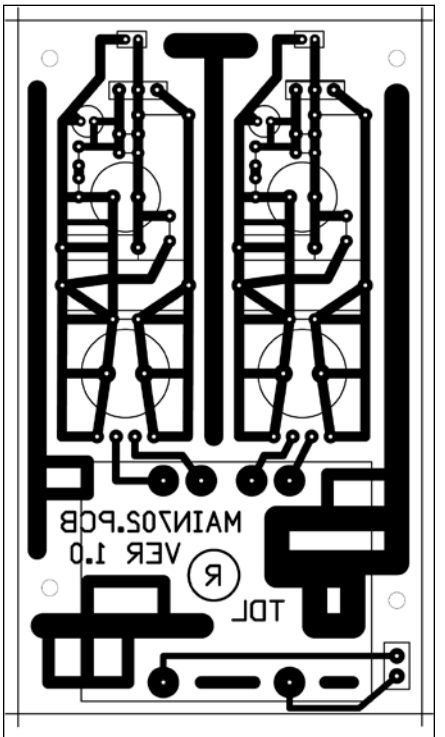

FIGURE 3: Two section supply circuit board.

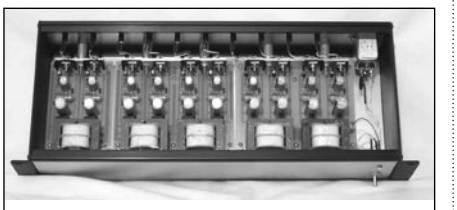

PHOTO 1: Multiple wall-wart power supply inside view. The inrush current limiter, SP1, is directly wired to the fused, IEC AC power input connector.

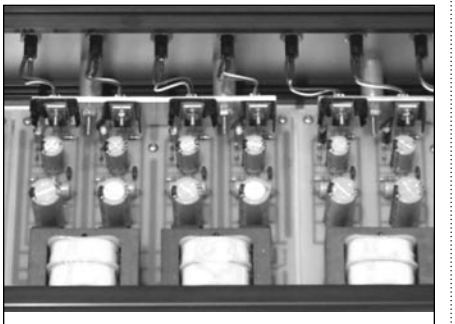

PHOTO 2: Multiple wall-wart power supply inside view. After mounting the circuit boards, measure the distance from the aluminum heatsink bar to the rear panel and cut the ½″ diameter aluminum rod to this length.

CONSTRUCTION

The construction is straightforward and not critical. But because the circuit boards almost fill the enclosure, there isn't much room for variation (**Photos 1** and **2**).

For reliable operation it's important to get the heat out of the regulators and into the air, preferably outside of the enclosure. Each group of regulators (either two or four) share a common 1″ wide × 1/8″ thick aluminum bar, which is thermally connected to the rear panel through a length of ½″ aluminum rod drilled to pass a 6-32 machine screw. As you can see from the photos, each regulator has its own small finned aluminum heat dissipater between the regulator and the aluminum bar. These may not be necessary because the supply operates very cool. However, I prefer to err on the side of "overkill."

The rear panel (**Photo 3**) also has a finned dissipater held in place by each of the five machine screws passing through the aluminum rods. (The regulator mounting tabs are not isolated, so you also need a silicon rubber insulator between each tab and the aluminum bar as well as insulating washers.)

It is important not to omit the inrush current limiter, SP1, because all five transformers are powered on when S1 is closed and must charge a total of 22,000µF (ten times the value of C1) at turn-on. I used 3.5mm insulated mono phone jacks for output connectors because they provide a positive, locking connection and have sufficient current capacity. You could also use

PHOTO 3: Multiple wall-wart power supply rear panel. During continuous operation, the panel is only slightly warm to the touch.

PHOTO 4: Multiple Wall-Wart power supply front panel.

two-pin DIN or mini-DIN as well as ¼″ insulated mono phone jacks. The circuit boards are attached to the enclosure bottom panel using ½″ long nylon spacers and 4-40 × ¾″ screws and 4-40 nuts.

If all the output voltages are the same, no rear panel labels would necessarily be needed. But I thought it would be useful to keep track of which one was 14V. I used a word processor to print two rows of voltages on an 8½ × 11″ sheet of sticky-back label, cut them into ½″ wide strips, and stuck them to the rear panel over the output connectors. If you are going to build one of these with several different output voltages, it might also be helpful to use a different type output connector for each voltage.

FINAL WORDS

This supply is better than the wall-warts it replaces because all the outputs are regulated and have much less hum and noise. I would build another one if needed, but so far the one prototype has been sufficient, although there are times when all ten outputs are in use.

REFERENCE

1. Download wallwart.zip from the downloads page at www.tdl-tech.com. They are in .pcb format and can be printed with a free version of CIRCAD from www.holophase.com. *aX*

Old Colony Sound Lab often makes available printed circuit boards in support of magazine projects if there is sufficient reader interest. To indicate your interest level in PCBs for this power supply project, contact Old Colony Sound Lab at 603-924-9464, 603-924-9467 (fax), or custserv@audioXpress.com (e-mail). Availability decisions are usually made in about two-three months—watch Old Colony ads for further developments.

PARTS LIST

Reference	value	description	source
R1	470Ω	5%, 3W carbon film	Xicon (Mouser) 283-4.7K-RC
R2	240Ω	1%, ¼W metal film	Xicon (Mouser) 271-value-RC
R3, R4		1%, ¼W metal film	values set output voltage for example: for 24V out R3 = 4120Ω and R4 = 249Ω, for 14V out R3 = 2400Ω and R4 = 47.5Ω
R5	2400Ω	5%, 1W metal oxide	Xicon (Mouser) 286-2.4K-RC
R6		1%, ½W metal film	value depends on input voltage R6 = (Vin – 2.2)/0.006 (medium bright)
C1	2200µF	50V radial electrolytic	Xicon (Mouser) 140-XRL50C2200-RC
C2, C5	100nF	50V polyester film	Panasonic (Digi-Key) P4525
C3	10µF	25V radial electrolytic	Xicon (Mouser) 140-XRL25V10-RC
C4	1000µF	50V radial electrolytic	Xicon (Mouser) 140-XRL50V1000-RC
D1, D2	1N4003	silicon diode	
D3		red LED, panel mount	Lumex (Mouser) SSI-LXR48161D
BR1		bridge rectifier, 2A 100 piv	MCC (Mouser) RS402L-BP
U1	LM317T	adjustable 3-terminal voltage regulator, TO-220	
J1		IEC power connector with built-in line fuse	
H1A		4-pin header, 0.156″	Molex KK-series 26-60-2040
H1B		2-pin header, 0.156″	Molex KK-series 26-60-2020
H2, H3		2-pin header, 0.1″	Molex KK-series 22-03-2021
P1A		(2) 2-pin shell with terminal pins	Molex KK-series 09-50-7021
P2, P3		2-pin shell with terminal pins	Molex KK-series 22-01-2027
SP1	CL40	inrush current limiter (thermistor)	Digi-Key or Mouser
T1		power transformer	depends on output voltage, for example: for 14 and 24V outputs, a good choice is Jameco # 209015 rCR, each secondary is 24V AC at 400mA. If lower output voltages are needed, using a transformer with lower secondary voltages minimizes power dissipation in the regulators.
		inside heatsinks	for example: Avid (Mouser) 530613B00000G
		rear panel heatsinks	for example: Avid (Mouser) 507002B00000G
		enclosure	rack mount 2RU7 (3.5″ high) from Wolgram Engineered Plastics, LLC., 913-491-5414. www.wolgrammfg.com.

The Jameco 209015 is not in their current catalog (#281) but it is on their website, www.jameco.com. The single-quantity price is $2.59