Canon Digital SLR 8V Power Supply

Introduction

One of the concerns regarding the Canon line of digital SLR's and their use in astronomy is their battery life. This is especially true considering that unlike a manual camera, the Canon digital SLR consumes the same amount of current while holding the shutter open as having the LCD operating. Coupled with cold temperatures, battery runtimes are severely limited.

Currently, there are only two off-the-shelf options available to run the camera using an external power supply. One requires the use of the OEM battery charger and power cord which needs to be operated from 120VAC (from either a home outlet or inverter output), and the other is through the use of expensive professional portable battery systems.

To solve this problem, I wanted to design a very simple power supply that would operate from the same +12 VDC battery that most astronomers run most of their telescope equipment with. A switching regulator topology would have been the most efficient choice for a power supply, but I ended up choosing a linear design to purposely keep it simple for others to follow and one that would allow almost anyone to build their own. Plus, even though this linear design is about 60% efficient, with the size batteries most astronomers use and the relatively low current draw of the Canon digital SLR, any losses due to inefficiencies are negligible.

Power Supply Requirements

Using a bench power supply and current measuring device, I tabulated a list of conditions my Canon D60 operates at and what the power requirements were. The Canon D60 is the only digital SLR I have currently, so my measurements were limited to this camera. However, I will assume that the load characteristics are very similar from camera to camera.

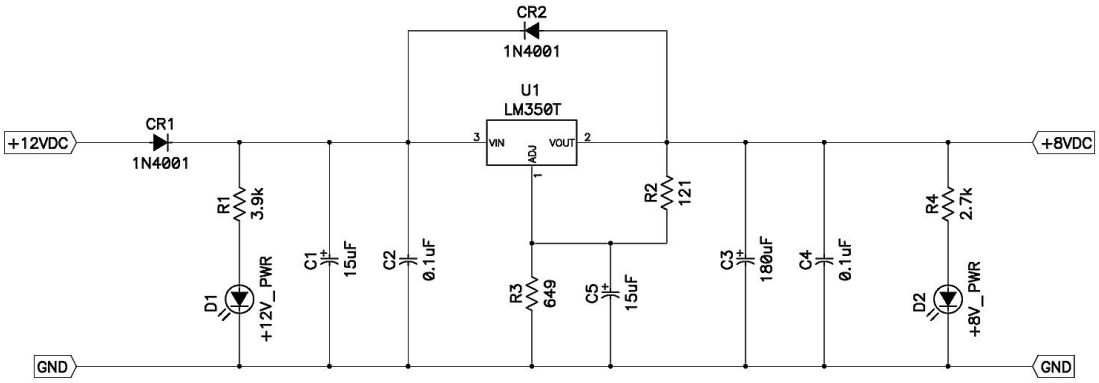
Operating Mode	Power Drain (@ 8.0 v)
Capture Mode, w/LCD	403 mA
Capture Mode, no LCD	103 mA
Half-pressed w/o LCD	370 mA
Shutter Open (Long Exposures)	400 mA
Memory Write (transient)	480 mA
Flash Recharge (transient)	1050 mA
Image Playback	403 mA

Canon D60 Load Measurements

Supported Cameras

This power supply design should support the following cameras. However, it is important to check the power requirements of your specific camera before attempting to use this power supply with it.

- Canon D30, D60
- Canon 10D, 20D, 30D
- Canon 300D Rebel, 350XT, 400D



Schematic – Canon Digital SLR 8V Power Supply

Linear Power Supply

This power supply uses a simple and almost foolproof linear design. There is a wide variety of linear regulator chips on the market which simply take some DC input voltage and regulate it to some lower DC output voltage. In my particular case, I used an LT1083 adjustable regulator since that is what I had at the time of the build. But any simple adjustable linear regulator will work fine (i.e. LM317T, LM350T, etc…) and they are available almost anywhere including Radio Shack.

Operation

The design is fairly simple. U1 is the adjustable linear regulator chip and its output voltage is set through the resistive divider comprised of R2 and R3.

Output voltage of the linear regulator can be determined by the following equation:

$V_{OUT} = 1.25 * (1 + R3/R2)$

And it is important to know that the input voltage must be at least 2.0V higher than the output voltage for the linear regulator to work properly.

C1, C2, C3, and C4 are simply filter capacitors used for both filtering and stability of the linear regulator. CR1 is used to provide reverse voltage protection for the power supply. If the input polarity is accidentally reversed, damage won't occur to the supply. CR2 provides a similar reverse voltage protection across the linear regulator.

Two indicator LEDs were also added, D1 and D2, which light when the +12V input power is applied and when +8V output power is enabled.

Efficiency

Efficiency of this power supply assuming +12V input and +8V output is approximately 66% which isn't too bad. Heat dissipation of the linear pass element, U1, can be determined as follows:

$Heat_{DISS} = (V_{IN} – V_{OUT}) * I_{OUT}$

Where: I_{OUT} = Load Current

So for the Canon D60 camera, maximum output current is approximately 430mA

during image playback and therefore heat dissipation would be:

(12V – 8V) * 0.430A = 1.72W

Considering that U1 is attached to a heatsink (and in particular to the metal chassis of my enclosure in my particular design), a dissipation of 1.72W is not going to be an issue with the linear regulator chip.

Also, the relatively low efficiency of this power supply is also not an issue since it will likely be powered from a very large +12V battery.

Building the Supply

The power supply can be built on simple perfboard which is available at your local electronics dealer or local Radio Shack. The only critical element in building this power supply is that the linear regulator chip, U1, must be attached to a heatsink. Also, its important to realize that the metal tab on U1 is "hot" and needs to be electrically insulated from the heatsink if for example you choose to attach U1 directly to the metal chassis of your enclosure etc…

I've compiled a parts list which is shown in the table on the next page. All of the parts, with the exception of the power cord and Canon DC-400 coupler can be ordered directly from Digikey at www.digikey.com. However, other parts may be substituted as required – for example – if you decided to buy your components from your local Radio Shack. Its important though that R2 and R3 be 1% tolerance resistors as this determines the output voltage regulation setpoint.

The Canon DC-400 coupler should have come with your digital SLR camera. You will be hacking off the end of the connector to attach to the power supply, so you may want to buy a separate one if you still need to use it with the battery charger supply.

DISCLAIMER

The author of this document is an amateur, not a professional. The technical information provided in this document should be interpreted with this distinction clearly in mind. The author hereby disclaims any liability for injury to persons or property that may result due the construction and use of this power supply. This publication is for informational purposes only, and makes no claims to its completeness or accuracy.

The use of this power supply may void the warranty for your specific camera. The use of this power supply may also damage your camera if not used properly. When building such a power supply and using it with your camera, you are doing so at your own risk!

Ref Des	Description	Distributor	Part No.
R1	Resistor, 3.9k, 1/4W, 5%	www.digikey.com	3.9KQBK-ND
R2	Resistor, 121 ohm, 1/4W, 1%	www.digikey.com	121XBK-ND
R3	Resistor, 649 ohm, 1/4W, 1%	www.digikey.com	649XBK-ND
R4	Resistor, 2.7k, 1/4W, 5%	www.digikey.com	2.7KQBK-ND
C1,C5	Capacitor, Tantalum, 15uF, 25V	www.digikey.com	399-1344-ND
C2,C4	Capacitor, Ceramic, 0.1uF, 50V	www.digikey.com	BC1084CT-ND
C3	Capacitor, Electrolytic, 180uF, 16V	www.digikey.com	493-1782-ND
U1	Linear Regulator, Adjustable	www.digikey.com	LM350AT-ND
CR1,CR2	Diode, Rectifier	www.digikey.com	1N4001DICT-ND
D1,D2	LED, Red, Panel Mount w/ leads	www.digikey.com	L10041-ND
	10ft 12VDC Extension Cord w/ Cigarette Lighter Plug	Radio Shack	270-1592
	Canon DR-400 DC Coupler	CANON USA	DR-400
	TO-220 Mounting / Insulator Kit	www.digikey.com	4724K-ND
	Aluminum Enclosure (4.4” x 2” x 1”)	www.digikey.com	HM151-ND

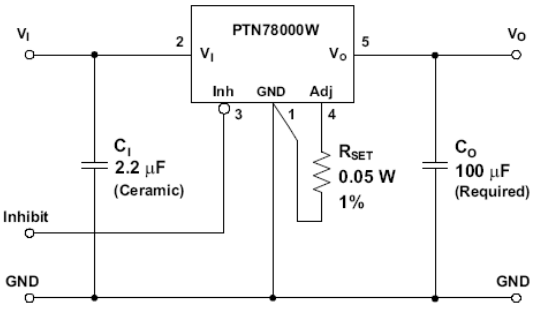
Parts List – Canon Digital SLR 8V Power Supply

Texas Instruments PTN78000W Regulator

Alternate Configuration I

An easier way to build this power supply, and more efficient as well, is to use a switching power regulator. Texas Instruments makes a small integrated switching power supply which can be ordered via a free sample from their website at http://www.ti.com. The power supply, part number PTN78000W, allows an input voltage range of 7V to 36V allowing one to use many different types of input power configurations. Efficiency of the supply is greater than 85%, much more than the linear regulator specified earlier in this document and requires less components as well.

Schematic



The schematic shown above shows what is required for this 8V power supply. As you can see, it only requires (3) external components making it exceptionally easy to build and the regulator does not require a heatsink.

Programming Resistor, R_{set}

The programming resistor, R_{set}, should be set to 5.99k ohms to set the output voltage to 8V. This should be a 1% resistor, although a potentiometer can be used to allow one to adjust the voltage on the fly. This may be the more viable solution as 1% resistors are not typically available at Radio Shack and must be special ordered through other distributors such as Digikey. Of course, you can use several different resistor values in series to come up with the total resistance of 5.99k ohms as well.

Input Capacitor, C_I

Input capacitor C_I should be a ceramic type. The value isn't critical but should be around 2.0uF. Several 1uF capacitors could be used in parallel as well.

Output Capacitor, C_O

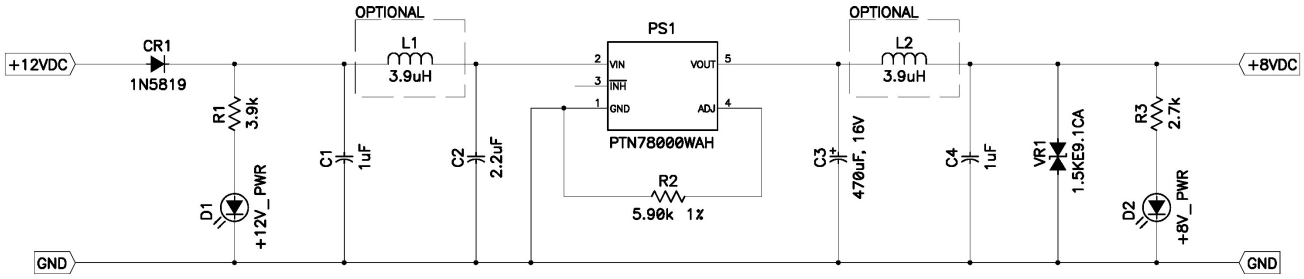
Output capacitor, C_O, should be an electrolytic type with a value of approximately 100uF. The value isn't critical but should be in the range of between 100uF and 1000uF and rated for at least 16V.

Ordering

The PTN78000W can be ordered via a free sample from Texas Instruments at http://www.ti.com. Simply register, and use their automated ordering form to order the component.

Alternate Configuration II

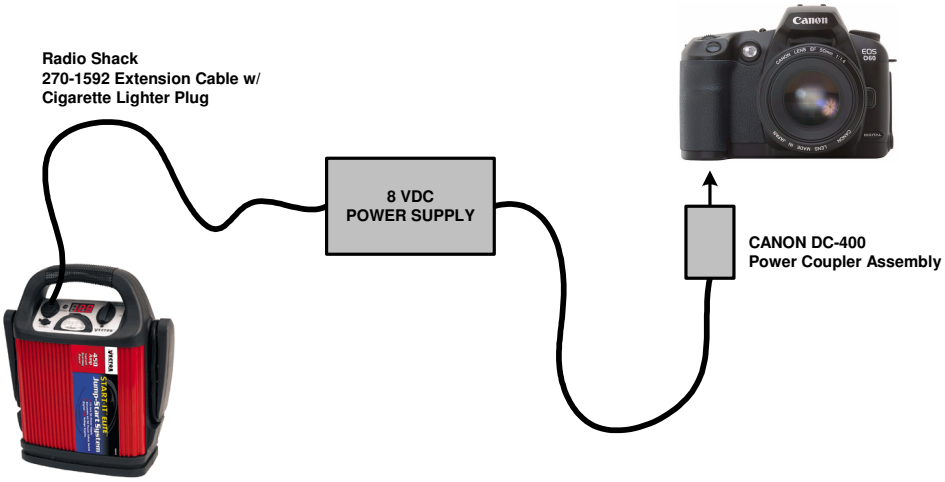
The schematic and parts list shown below show a more advanced version of the previously specified switching regulator using the TI PTN78000W switching regulator. This version includes reverse voltage input protection, input and output indication LEDs, as well as transient voltage protection and input / output filtering. R2 is shown as 5.90k in this schematic, but should be closer to 5.99k to provide 8V output.



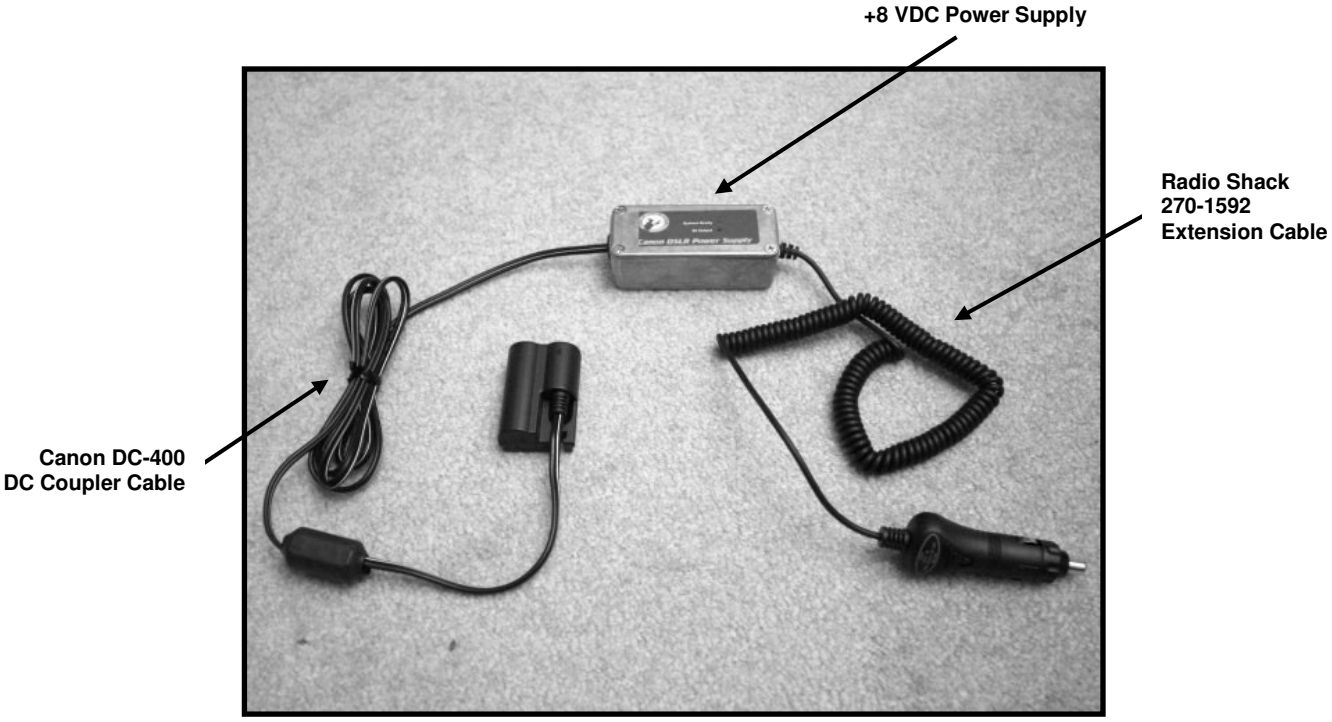
Schematic – 8V Switching Power Supply – Alternate Configuration II

Ref Des	Description	Distributor	Part No.
R1	Resistor, 3.9k, 1/4W, 5%	www.digikey.com	3.9KQBK-ND
R2	Resistor, 5.90k ohm, 1/4W, 1%	www.digikey.com	5.9KXBK-ND
R3	Resistor, 2.7k, 1/4W, 5%	www.digikey.com	2.7KQBK-ND
C1,C4	Capacitor, Ceramic, 1uF, 50V	www.digikey.com	BC1139CT-ND
C2	Capacitor, Ceramic, 2.2uF, 50V	www.digikey.com	P4969-ND
C3	Capacitor, Electrolytic, 470uF, 16V	www.digikey.com	P5532-ND
CR1	Diode, Schottky	www.digikey.com	1N5819DICT-ND
VR1	Transient Voltage Suppressor, 9.1V	www.digikey.com	1.5KE9.1CAGICT-ND
D1, D2	LED, Red, Panel Mount w/ leads	www.digikey.com	L10041-ND
L1,L2	Inductor, 3.9uH	www.digikey.com	M5901-ND
PS1	Adjustable Switching Regulator	www.ti.com	PTN78000WAH-ND
	Aluminum Enclosure (4.4" x 2" x 1")	www.digikey.com	HM151-ND
	10ft 12VDC Extension Cord w/ Cigarette Lighter Plug	Radio Shack	270-1592
	Canon DR-400 DC Coupler	CANON USA	DR-400

Parts List – 8V Switching Power Supply



Canon Digital SLR 8V Power Supply – Typical Application



Canon Digital SLR 8V Power Supply – Completed Assembly