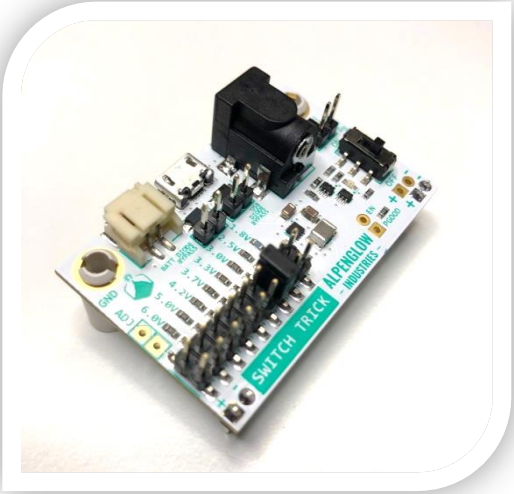
ALPENGLOW INDUSTRIES

SWT-0001

The SwitchTrick
Breadboard-Compatible Voltage-Selectable Power Supply

FEATURES

- 1A buck (step-down) converter
- Output voltage selectable by jumper between: 1.8V, 2.5V, 3.0V, 3.3V, 3.7V, 4.2V, 5.0V, 6.0V, and a resistor-adjustable voltage
- Input voltage from 3-17V
- Diode-protected inputs include barrel jack, JST PH-2 battery header, USB, or alligator clips into plated holes
- Diodes can be bypassed with jumpers if the diode Vf drop is undesirable
- Plugs into breadboard power rails with included headers, board can be supported off breadboard with included standoffs
- EN and PGOOD broken out to breadboard-compatible holes
- ON/OFF switch enables/disables with LED for visual feedback of output presence
- Based off the Texas Instruments TPS62106 chip



APPLICATIONS

- Breadboarding
- Low voltage processors (1.8V, 2.5V)
- 3.0 and 3.3V processors
- Simulating Li-Ion battery voltages at full, nominal, and low charge states (4.2V, 3.7V, 3.0V), from a 5V USB supply
- Servo driving (6.0V, 1A) from a 12V input

DESCRIPTION

Meet breadboard's hottest new power supply, the SwitchTrick! It's got EVERYTHING: a barrel jack, USB, 8 selectable output voltages, one adjustable voltage, and even an ON/OFF switch. It finally answers the question: whiiiiiiiich?

ELECTRICAL CHARACTERISTICS

Symbol	Parameter	Typical Value	Units
Vin	Input Voltage	3 – 17	V
Vout (+)	Output Voltage *(Note 1)*	1.0 – 6.0	V
Iout	Output Current	1.0	A
EN	Enable *(Note 2)* (input)	0 = Disabled 0.6V – Vin = Enabled	V
PGOOD	Power Good (output)	0 = Bad Vout = Good	V
Fsw	Switching Frequency	2.25	MHz

Note 1: The SwitchTrick may be adjusted down to 0.9V if an on-board resistor is replaced, see "Output Voltage" below.
Note 2: This pin has internal connections and must not exceed Vin, for proper use see "Enable" below

For more detailed characteristics, please refer to the TPS62160 datasheet.

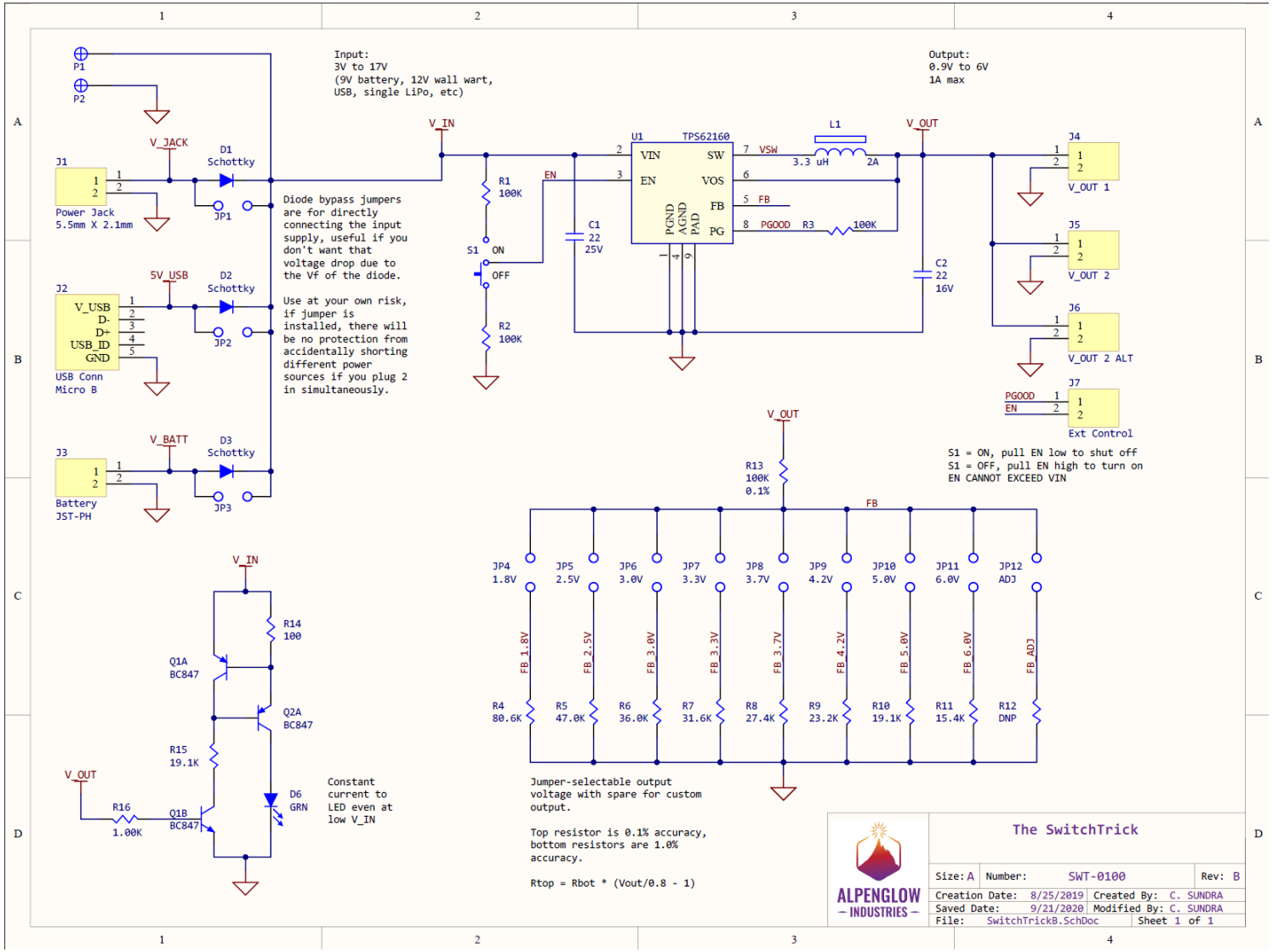
PROTECTIONS

- Undervoltage lockout
- Over current
- Short circuit
- Over temperature

WHAT'S WITH THE NAME?

It's a tricked-out switching power supply. And I like snowboarding.

SCHEMATIC


Input:
3V to 17V
(9V battery, 12V wall wart,
USB, single LiPo, etc)
Output:
0.9V to 6V
1A max
P1
P2
V_JACK
J1
Power Jack
5.5mm X 2.1mm
D1
Schottky
JP1
5V_USB
J2
V_USB
D-
D+
USB_ID
GND
USB Conn
Micro B
D2
Schottky
JP2
V_BATT
J3
Battery
JST-PH
D3
Schottky
JP3
Diode bypass jumpers
are for directly
connecting the input
supply, useful if you
don't want that
voltage drop due to
the Vf of the diode.
Use at your own risk,
if jumper is
installed, there will
be no protection from
accidentally shorting
different power
sources if you plug 2
in simultaneously.
V_IN
R1
100K
S1
ON
OFF
R2
100K
EN
C1
22
25V
U1
TPS62160
VIN
EN
SW
VOS
FB
PG
PGND
AGND
PAD
VSW
FB
PGOOD
R3
100K
L1
3.3 uH
2A
V_OUT
C2
22
16V
J4
V_OUT 1
J5
V_OUT 2
J6
V_OUT 2 ALT
J7
PGOOD
EN
Ext Control
S1 = ON, pull EN low to shut off
S1 = OFF, pull EN high to turn on
EN CANNOT EXCEED VIN
R13
100K
0.1%
FB
JP4
1.8V
JP5
2.5V
JP6
3.0V
JP7
3.3V
JP8
3.7V
JP9
4.2V
JP10
5.0V
JP11
6.0V
JP12
ADJ
R4
80.6K
R5
47.0K
R6
36.0K
R7
31.6K
R8
27.4K
R9
23.2K
R10
19.1K
R11
15.4K
R12
DNP
Jumper-selectable output
voltage with spare for custom
output.
Top resistor is 0.1% accuracy,
bottom resistors are 1.0%
accuracy.
Rtop = Rbot * (Vout/0.8 - 1)
R14
100
Q1A
BC847
Q2A
BC847
R15
19.1K
R16
1.00K
Q1B
BC847
D6
GRN
Constant
current to
LED even at
low V_IN
The SwitchTrick
Size: A
Number: SWT-0100
Rev: B
Creation Date: 8/25/2019
Created By: C. SUNDRA
Saved Date: 9/21/2020
Modified By: C. SUNDRA
File: SwitchTrickB.SchDoc
Sheet 1 of 1

INPUT VOLTAGE

The SwitchTrick utilizes a buck or step-down topology, meaning the input voltage must always be higher than the output voltage. The equation for this relationship is:

$$V_{in(min)} = V_{out(min)} + I_{out}(R_{DS(on)} + R_L)$$

where
RDS(on) = 0.430 ohms (rough estimate over input voltage range)
RL = 0.065 ohms

The minimum input voltages for each jumper-selectable output voltage are:

Jumper-Selectable Vout	Minimum Vin @ 250mA	Minimum Vin @ 500mA	Minimum Vin @ 1A
1.8V	1.93V	2.05V	2.3V
2.5V	2.63V	2.75V	3.0V
3.0V	3.13V	3.25V	3.5V
3.3V	3.43V	3.55V	3.8V
3.7V	3.83V	3.95V	4.2V
4.2V	4.33V	4.45V	4.7V
5.0V	5.13V	5.25V	5.5V
6.0V	6.13V	6.25V	6.5V

OUTPUT VOLTAGE

The ADJ holes are for you to create your own custom voltage by soldering in a resistor. Find the value of Rbottom to insert for your desired output voltage using:

$$R_{bottom} = \frac{R_{top}}{\frac{V_{out}}{0.8} - 1}$$

where Rtop = 100k.

Note that Rbottom should not exceed 400k, which gives a minimum output voltage of 1.0V with Rtop at the default 100k. If you would like to adjust the SwitchTrick to the minimum 0.9V output that the TPS62160 is capable of, you'll need to also replace Rtop (resistor on the right side of the header, and I hope your SMT skills are good).

ENABLE

Note in the schematic that the EN pin is either pulled high or low, depending on where the ON/OFF switch is set. If you'd like to use a processor to control this pin, first determine which your default state is (ON or OFF), and set the switch accordingly. Note that voltage on this pin cannot exceed Vin! For more info, see the TPS62160 datasheet.

POWER GOOD

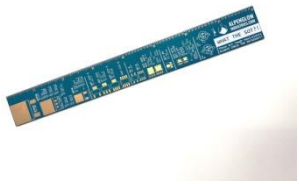
This is an open-drain output of the TPS62160, meaning it's either disconnected inside the chip, or pulled to GND inside the chip. When the output voltage has not settled to the setpoint (power is not good), PGOOD is pulled to GND. When the output voltage is 90-95% of the set voltage, it's "open-drain" (essentially disconnected inside the TPS62160) and R3 on the SwitchTrick schematic pulls it up to the output voltage. You can daisy-chain supplies and do power-up sequencing by connecting the PGOOD output of the first supply to the EN of the second. But be sure the keep in the mind the EN voltage limit.

THE SHENANIGANS BY THE LED

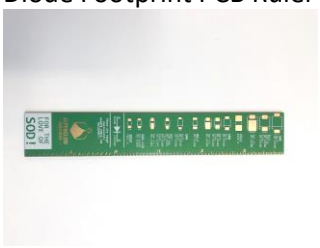
Turns out it's not a trivial task to turn on a 2V Vf LED with a 1.8V output. It took 4 electrical engineers a chain of 57 emails to figure out which circuit to use, and of course it was the old analog-genius guy that came up with it. Thanks, Tom! So yes, all that business is just to have a nice green LED light up with almost constant brightness no matter what your input or output voltage is.

YOU MAY ALSO LIKE

RUL-0001
What the SOT?!
Transistor Footprint PCB Ruler



RUL-0002
For the Love of SOD
Diode Footprint PCB Ruler



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