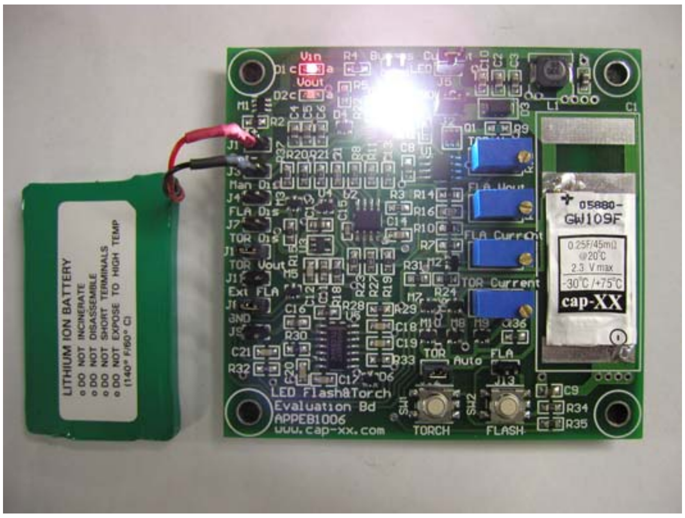
User's Manual

Camera Phone Flash Evaluation Board

APPEB1006



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Board Features
FLASH mode with adjustable voltage and current
TORCH/MOVIE mode with adjustable voltage and current
Vin and Vout indicating LED's
On-board or External triggering
On-board or External white LED
LED and inductor current measurement ability
Undervoltage lockout (UVLO)
Boost enable/disable during flash and torch for different power architectures
Auto run for flash or torch

Quick Setup
The following jumpers should be in place J2, J5, J7, J8 and J10. Connect the positive terminal of a single cell Lithium Ion rechargeable battery (3.3V-4.2V) to any pin on J1 and connect the negative terminal to any pin of J3. The red LED (D1) should come on immediately and the yellow LED (D2) should increase in brightness over a few seconds whilst the supercapacitor charges up.

When the TORCH push button (SW1) is pressed 100mA will flow through the white LED (D5). At 100mA the button can be held down continuously.

When the FLASH push button (SW2) is pressed 1A will flow through the white LED (D5) for approximately 80ms. If the button is held down continuously the flash will retrigger approximately every 2.5s. This duty cycle is imposed due to the thermal constraints of the white LED.

Circuit Description (refer to schematics at the end of this manual)
Input Voltage
The circuit is designed to operate from an external Li ion battery (4.2V-3.3V).
Vbat is the node connected to the battery via J1.

J1 is to be connected to battery positive terminal. Pins 1 and 2 of J1 are joined.
J3 is to be connected to battery negative terminal. Pins 1 and 2 of J3 are joined.

An undervoltage lockout (UVLO) has been included (U2B) such that when the battery voltage drops below 3.1V the main switch (MOSFET M1) opens. It will reclose with 350mV of hysteresis (3.45V). The 3V regulator remains operational during a UVLO.

The main reason for the UVLO is that the boost controls Vout which is the sum of the input voltage (battery or perhaps bench top supply) plus the supercap (C1) voltage. The voltage across the supercap is not measured. Therefore, if the input voltage was say 3V and Vout was controlled to be 5.7V then the supercap would be at 2.7V which reduces its life. For maximum life the supercap should be kept below 2.3V. However, the supercapacitor voltage can be increased to 2.5V for short periods, such as while taking flash photos, without affecting life.

Indicating LED's
D1 is a red LED that indicates a source voltage is present and that a UVLO has not occurred.
D2 is a yellow LED and indicates that Vout is present and above approximately 5V.

Boost Converter

J2 needs to be jumpered for normal operation. This jumper has been included so a wire loop can easily be inserted to measure the inductor current. By measuring the inductor current and monitoring the base drive voltage of Q1 the current through Q1, D3 and supercap can also be determined.

J4 is not jumpered during normal operation. This jumper has been included to manually disable the boost if required. If jumpered it forces the feedback voltage at pin 6 of the boost to be 3V which is >> than the 730mV of the internal reference thereby instructing the boost to cease switching.

The boost can also be disabled by pulling the gate of M3 low. This can be done automatically during a FLASH pulse by jumpering J7 or while in TORCH mode by jumpering J10.

The advantage of disabling the boost during a FLASH pulse is that the maximum battery current is equal to the load (flash LED) current, however, the disadvantage is that the supercap discharge current is also equal to the load current and it will discharge at a faster rate than if the boost was enabled. The disadvantage of enabling the boost during a Flash pulse is that the maximum battery current is greater or much greater then the load current depending on the current limit set on the boost.

FLASH MODE

The boost generates an output voltage (Vout) that is > the battery voltage. For FLASH mode, Vout is factory set to 5.7V. This voltage can be increased by turning R17 (a 2k pot) anticlockwise. Care must be taken if this voltage is increased not to overvoltage the supercap, ie the supercap voltage will be Vout minus the voltage of the battery. For maximum supercapacitor life the voltage should be kept below 2.3V however short term overvoltages (seconds) may go up to 2.7V.

TORCH MODE

The continuous current required for TORCH is << FLASH current (typically 100mA Vs 1A). Therefore the voltage dropped across the LED will be less. To increase efficiency (and to reduce thermal stress on the current limiting MOSFET (M4)) Vout should also be reduced.

There are two options for the TORCH Vout, if constant high output light is more important than efficiency then option a) should be chosen.

a) In this option the Boost is enabled with J10 removed and J11 is jumpered. Vout can be adjusted using R12 (a 500k pot). Vout is factory set to 4.2V. This means that Vout will always be > Vin irrespective of the battery voltage. In this mode the forward voltage to drive the LED at 200mA, for example, will always be available even when the battery nears its end voltage (3.3V).

b) In this option the Boost is disabled with J10 jumpered and J11 is don't care. This means Vout will always be equal to Vin minus the drops incurred by the inductor's (L1) DC resistance and D3. This is the most efficient mode because the current limiting MOSFET (M4) does not have to drop as many volts and the Boost is not operating. However, depending on the LED current required, there may not be enough voltage headroom in Vout when the battery nears its end voltage (3.3V). For example, if the LED current was chosen to be 200mA and the voltage across a typical LED at this current was also 3.3V then there would be no volts available across the current sense resistor (R22) and M4 and then only say 150mA would be available. Option b) is factory chosen and the TORCH current is set to 100mA.

The user must decide on what is the end voltage of the Li ion battery and what current gives acceptable light for the Torch. Of course the user may also decide that it is acceptable to have slightly less light output as the battery nears its end voltage (after all, most users are familiar with this behavior in an incandescent torch).

Current Control
The FLASH current is factory set to 1.0 Amp. It can be reduced by turning R25 (10k pot) anti-clockwise. The maximum LED current rating is 2 Amps. The FLASH current needs to be adjusted prior to the TORCH current because the FLASH setting affects the TORCH setting but not vice versa.

The TORCH current is factory set at 100mA. It can be reduced by turning R26 (2k pot) anti-clockwise.

External Flash LED
An External white LED (or other load) can be connected to the board via J5. This also requires that the on-board LED (D5) be bypassed with J6. Alternatively, a second flash LED (LXCL-PWF1) can be connected in parallel to D5 across J6 (pin 2 is +ve).

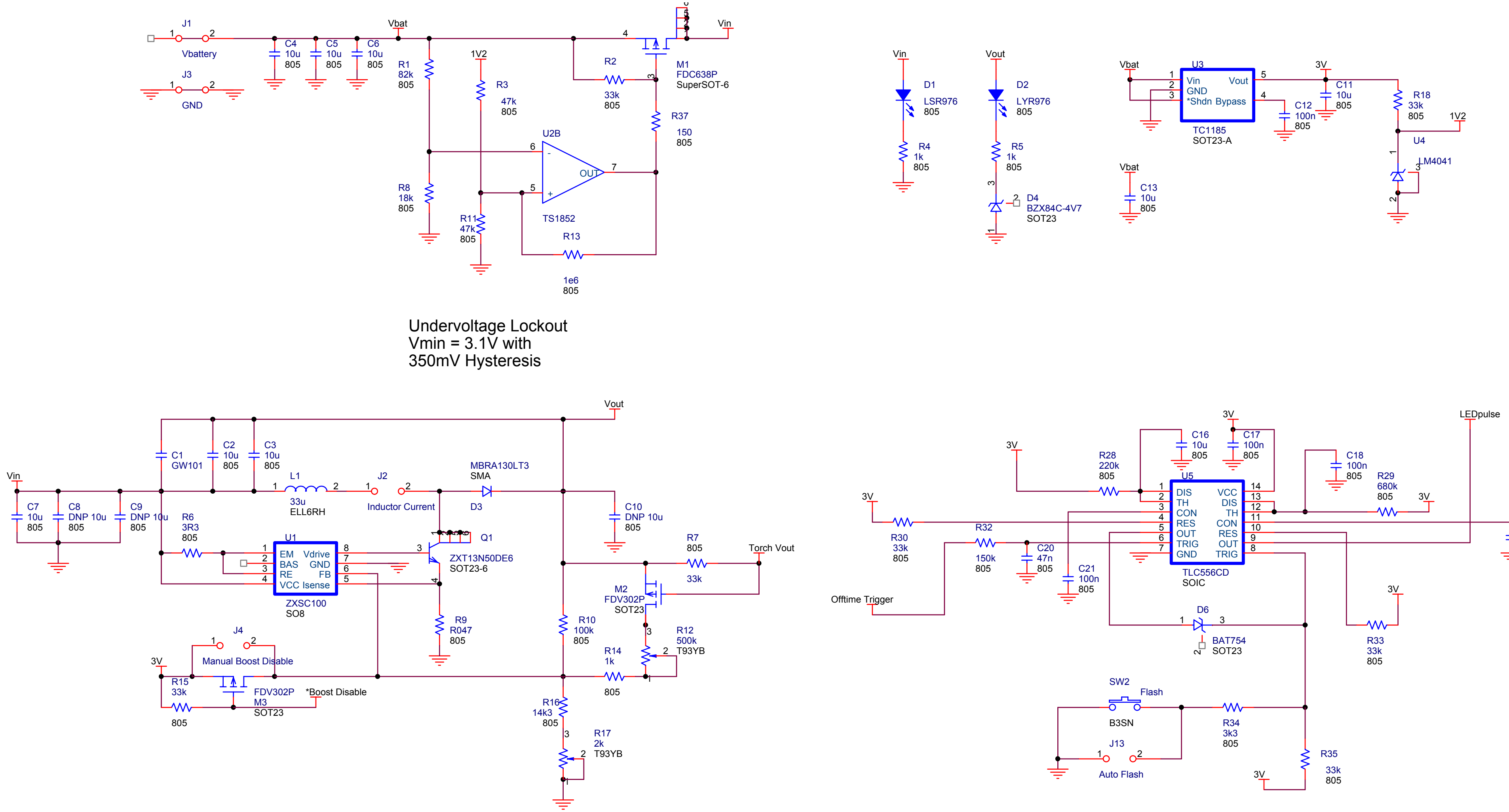
AutoTorch/External Torch Mode Control
If J12 is jumpered, then Torch mode will be permanently on (Auto Torch). Alternatively, an external control signal connected to pin 2 of J12 will select Torch mode when Hi (3V – 5V). This logic signal drives the gates of M8, M9, and M10 and must source 0.1mA to develop 3.3V across R36.

Flash PulseTimers/External Flash Pulse Control
There are two on-board 555 timers. One generates the FLASH on-time and the other generates the off-time. The FLASH trigger from these timers is connected to the Current Control circuitry via J8. J8 is jumpered for normal operation. An external triggering circuit can be connected by removing the jumper from J8 and connecting the external signal to pin 1 of J8. There is a 33k pull down resistor on this pin. A logic high signal on this pin will take a FLASH. Make sure that this signal is < 100ms long and does not occur for at least another 2s otherwise the thermal limits of the white LED (D5) will be violated and it will be destroyed.

Auto Flash
If J13 is jumpered then the two 555 timers will be continuously triggered to generate an 80ms flash pulse every 2.5s.

Further Information
CAP-XX will be pleased to provide further information on the applications described here, and on the use of supercapacitors in any application. Please use the contact details on the header page, or visit the cap-XX web site.

Schematics


J1
Vbattery
J3
GND
C4 10u 805
C5 10u 805
C6 10u 805
Vbat
R1 82k 805
1V2
R3 47k 805
R2 33k 805
M1 FDC638P SuperSOT-6
Vin
R37 150 805
U2B
TS1852
OUT
R8 18k 805
R11 47k 805
R13 1e6 805
Undervoltage Lockout
Vmin = 3.1V with
350mV Hysteresis
D1 LSR976 805
R4 1k 805
Vout
D2 LYR976 805
R5 1k 805
D4 BZX84C-4V7 SOT23
U3
Vin Vout
GND
*Shdn Bypass
TC1185 SOT23-A
3V
C11 10u 805
C12 100n 805
C13 10u 805
R18 33k 805
U4
LM4041
C1 GW101
C2 10u 805
C3 10u 805
C7 10u 805
C8 DNP 10u 805
C9 DNP 10u 805
R6 3R3 805
L1 33u ELL6RH
J2
Inductor Current
MBRA130LT3 SMA
D3
C10 DNP 10u 805
U1
EM Vdrive
BAS GND
RE FB
VCC Isense
ZXSC100 SO8
Q1
ZXT13N50DE6 SOT23-6
R9 R047 805
R7 805 33k
Torch Vout
M2 FDV302P SOT23
R10 100k 805
R12 500k T93YB
R14 1k 805
J4
Manual Boost Disable
R15 33k 805
FDV302P M3 SOT23
*Boost Disable
R16 14k3 805
R17 2k T93YB
LEDpulse
R28 220k 805
C16 10u 805
C17 100n 805
C18 100n 805
R29 680k 805
U5
DIS VCC
TH DIS
CON TH
RES CON
OUT RES
TRIG OUT
GND TRIG
TLC556CD SOIC
R30 33k 805
R32 150k 805
C20 47n 805
C21 100n 805
C19 100n 805
Offtime Trigger
D6 BAT754 SOT23
R33 33k 805
SW2 Flash B3SN
R34 3k3 805
J13
Auto Flash
R35 33k 805

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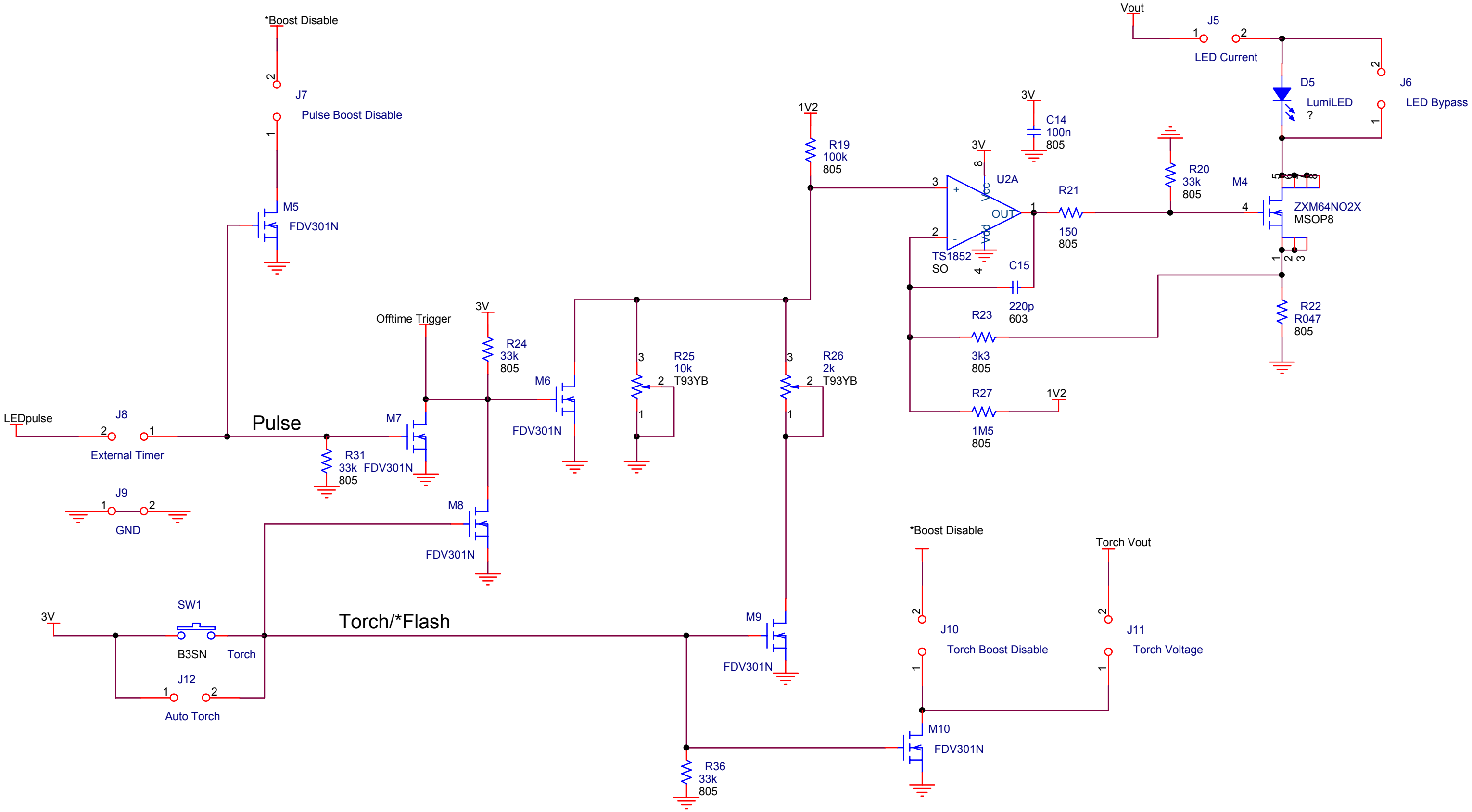

*Boost Disable
J7
Pulse Boost Disable
M5
FDV301N
Vout
J5
LED Current
D5
LumiLED
?
J6
LED Bypass
1V2
R19
100k
805
3V
C14
100n
805
U2A
TS1852
SO
OUT
R21
150
805
R20
33k
805
M4
ZXM64NO2X
MSOP8
C15
220p
603
R23
3k3
805
R22
R047
805
R27
1M5
805
Offtime Trigger
R24
33k
805
M6
FDV301N
R25
10k
T93YB
R26
2k
T93YB
LEDpulse
J8
External Timer
Pulse
M7
R31
33k
805
FDV301N
J9
GND
M8
FDV301N
SW1
B3SN
Torch
J12
Auto Torch
Torch/*Flash
M9
FDV301N
R36
33k
805
*Boost Disable
J10
Torch Boost Disable
Torch Vout
J11
Torch Voltage
M10
FDV301N