AAT1282

2A Driver for High Intensity LED Camera Flash

General Description

The AAT1282 is a high-efficiency, high-current step-up converter capable of 2A maximum output current. It is an ideal power solution for LED photo flash applications in all single cell Li-ion powered products.

The AAT1282 maintains output current regulation by switching the internal high-side and low-side switch transistors. The transistor switches are pulse-width modulated at a fixed frequency of 2MHz. The high switching frequency allows the use of a small inductor and output capacitor, making the AAT1282 ideally suited for small battery-powered applications. A high-capacity Super Capacitor on the secondary side of the step-up converter provides the high-peak flash LED current, thereby reducing the peak current demand from the Li-ion battery. To achieve this, the step-up converter features a fixed, input current limiter.

An industry-standard I^2C serial digital input is used to enable, disable and set the movie-mode current for each flash LED with up to 16 movie-mode settings. The AAT1282 also includes a separate Flash Enable input to initiate both the flash operation and the default timer which can be used either to terminate a flash event at the end of a user-programmed delay or as a safety feature.

The maximum flash and movie-mode current is set by one external resistor where the ratio between Flash to Movie-mode current is set at approximately 7.3:1. One or two LEDs can be connected to the AAT1282, where in the case of two LEDs the output current is matched between each diode. The ratio of maximum flash current to movie-mode current can also be adjusted via the I^2C control.

The AAT1282 contains a thermal management system to protect the device in the event of an output short-circuit condition. Built-in circuitry prevents excessive inrush current during start-up. The shutdown feature reduces quiescent current to less than 1.0µA.

The AAT1282 is available in a Pb-free, thermally-enhanced 14-pin 3 x 3mm TDFN package.

Features

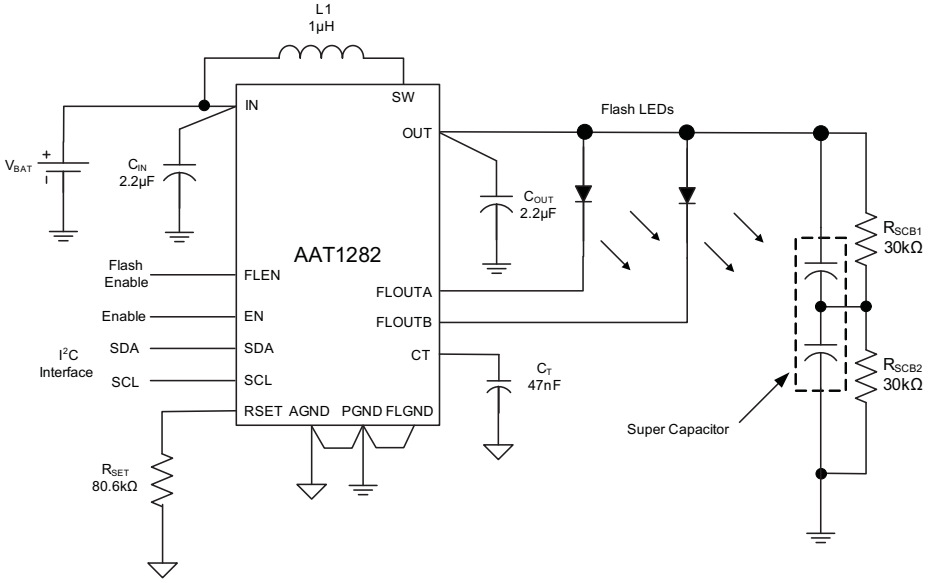
- V_{IN} Range: 2.7V to 5.5V
- Dual Channel Output
  - Up to 2A Regulated Output Current
    - 1A per channel
- Integrated Fixed Input Current Limit
  - 800mA*
  - Suited for Super Capacitor Applications
- Up to 80% Efficiency with Small Magnetics
- 2MHz Switching Frequency
- Independent Flash Enable
- User-programmable Safety Timer
- Single Resistor Sets Flash and Movie-mode Current
- Two Wire, I^2C Compliant Serial Interface:
  - Fast, 400kHz Serial Transfer Rate
    - 16 level Movie-mode Current
    - Flash/Movie-mode
    - Current Output Channel Control
    - Safety Timer
- True Load Disconnect
- Supply Current in Shutdown: <1.0µA
- TDFN33-14 Package

Applications

- Camcorder Video Light (Torch Light)
- Camera Phones/Smartphones
- Digital Still Cameras (DSC)
- LED Photo Flash Light (Strobe Light)
- Mobile Handsets

* Contact Sales for alternative current limits.

Typical Application Circuit

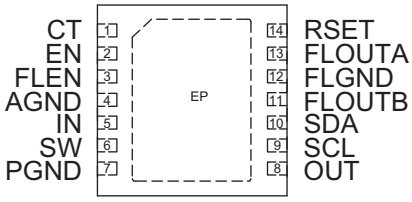


Pin Descriptions

Pin #	Symbol	Function	Description
1	CT	I	Flash timer control input. Connect a capacitor between CT and AGND to set default ON time for the flash output. A 47nF ceramic capacitor defaults the flash timer to 600ms. Alternative timeout periods can be programmed via I²C. To disable the flash timer, connect CT to AGND.
2	EN	I	Enable control input, an active HIGH asserted input. EN must be strobed low-to-high to enable the AAT1282 to accept I²C programming instructions.
3	FLEN	I	Flash enable pin. A low-to-high transition on the FLEN pin initiates a flash pulse and starts the flash timer.
4	AGND	P	Analog ground pin. Connect AGND to PGND and FLGND at a single point as close to the AAT1282 as possible.
5	IN	PI	Power input. Connect IN to the input power supply voltage. Connect a 2.2µF or larger ceramic capacitor from IN to PGND as close as possible to the AAT1282.
6	SW	O	Step-up converter switching node. Connect a 1µH inductor between SW and IN.
7	PGND	P	Power ground pin. Connect PGND to AGND and FLGND at a single point as close to the AAT1282 as possible.
8	OUT	O	Power output of the step-up converter. Connect a 2.2µF or larger ceramic capacitor from OUT to PGND as close as possible to the AAT1282. Connect OUT to the super capacitor and the anode(s) of the Flash LED(s).
9	SCL	I	I²C Interface: Serial Control Line.
10	SDA	I	I²C Interface: Serial Data/Address.
11	FLOUTB	O	Flash Output B. Connect cathode of Flash LEDB to FLOUTB. For a single flash LED, connect FLOUTB and FLOUTA together. For two flash LEDs, each output will conduct 50% of the total flash output current. Can be turned off or on via I²C.
12	FLGND	P	Flash ground pin. Connect FLGND to PGND and AGND at a single point as close to the AAT1282 as possible.
13	FLOUTA	O	Flash Output A. Connect cathode of Flash LED A to FLOUTA. For a single flash LED, connect FLOUTA and FLOUTB together. For two flash LEDs, each output will conduct 50% of the total flash output current. Can be turned off or on via I²C.
14	RSET	I	Flash current setting input. A 80.6kΩ resistor from RSET to AGND sets the maximum flash current available at FLOUTA and FLOUTB to 2000mA. Each FLOUTA and FLOUTB channel will conduct 50% of the maximum programmed current (1000mA). The AAT1282's flash-to-movie-mode default ratio is a fixed at 7.3 but can be adjusted via I²C.
	EP		Exposed paddle (bottom); Connect EP to PGND as close as possible to the AAT1282.

Pin Configurations

TDFN33-14
(Top View)



Absolute Maximum Ratings[1]

T_A = 25°C unless otherwise noted.

Symbol	Description	Value	Units
V_{IN}, V_{SW}, V_{OUT}	IN, SW, OUT to GND or PGND	-0.3 to 6.0	V
V_{RSET}, V_{EN}, V_{FLEN}, V_{SCL}, V_{SDA}, V_{CT}, V_{FLOUTA}, V_{FLOUTB}	RSET, EN, FLEN, SCL, SDA, CT, FLOUTA, FLOUTB to GND, PGND, or FLGND	V_{IN} + 0.3	
I_{OUT}	FLOUT1 and FLOUT2[2]	2200	mA

Thermal Information[3]

Symbol	Description	Value	Units
Θ_{JA}	Thermal Resistance	50	°C/W
P_D	Maximum Power Dissipation	2	W
T_J	Maximum Junction Operating Temperature	-40 to +150	°C
T_{LEAD}	Maximum Soldering Temperature (at leads, 10 sec)	300	

1. Stresses above those listed in Absolute Maximum Ratings may cause permanent damage to the device. Functional operation at conditions other than the operating conditions specified is not implied. Only one Absolute Maximum Rating should be applied at any one time.
2. Based on long-term current density limitation.
3. Mounted on an FR4 circuit board.

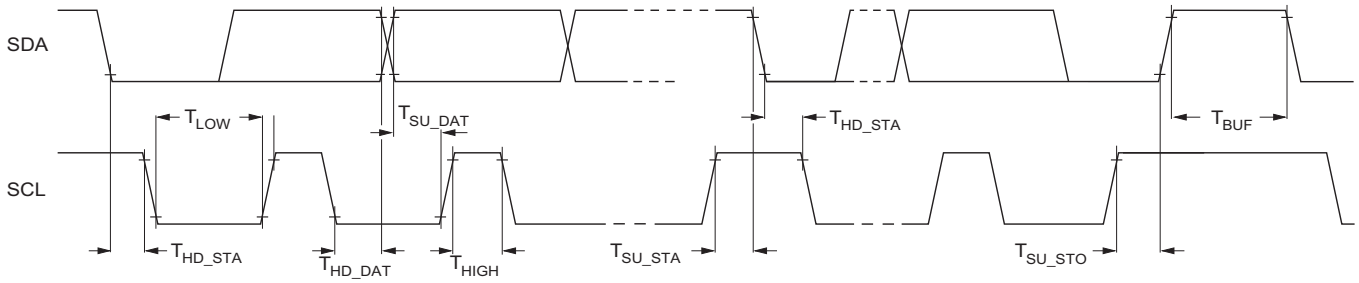
Electrical Characteristics[1]

V_{IN} = 3.6V; C_{IN} = 2.2µF; C_{OUT} = 2.2µF; L = 1µH; R_{SET} = 80.6kΩ; T_A = -40°C to +85, unless otherwise noted. Typical values are T_A = 25°C.

Symbol	Description	Conditions	Min	Typ	Max	Units
Power Supply						
V_{IN}	Input Voltage Range		2.7		5.5	V
$I_{IN(Q)}$	Supply Current	EN = IN; FLEN = AGND; Set load = 2A; R_{SET} = 80.6kΩ		0.57	1	mA
$I_{SHDN(MAX)}$	Shutdown Current	EN = FLEN = AGND			1.0	µA
$I_{FL(TOTAL)}$	Total Output Current, Flash Mode	R_{SET} = 80.6kΩ; FLOUTA + FLOUTB	1800	2000	2200	mA
$I_{FL(MATCH)}$	FLOUTA and FLOUTB Current Matching			10		%
$I_{MM(TOTAL)}$	Total Output Current, Movie-mode	R_{SET} = 80.6kΩ; Movie-mode Current Set = 100%; FLOUTA + FLOUTB		274		mA
f_{OSC}	Switching Frequency	T_A = 25°C	1.5	2.0	2.5	MHz
$t_{DEFAULT}$	Default ON time	C_T = 47nF		600		ms
T_{SD}	Thermal Shutdown Threshold			140		°C
$T_{SD(HYS)}$	Thermal Shutdown Hysteresis			15		°C
I²C Control – SDA, SCL						
V_{IL}	Input Threshold Low				0.4	V
V_{IH}	Input Threshold High		1.4			V
I_I	Input Current		-1.0		1.0	µA
V_{OL}	Output Logic Low (SDA)	I_{PULLUP} = 3mA			0.4	V
f_{SCL}	SCL Clock Frequency		0		400	kHz
t_{LOW}	SCL Clock Low Period		1.3			µs
t_{HIGH}	SCL Clock High Period		0.6			µs
t_{HD_STA}	Hold Time START Condition		0.6			µs
t_{SU_STA}	Setup Time for Repeat START		0.6			µs
t_{SU_DAT}	SDA Data Setup Time		100			ns
t_{HD_DAT}	SDA Data Hold Time				0.9	µs
t_{SU_STO}	Setup time for STOP Condition		0.6			µs
t_{BUF}	Bus Free Time between STOP and START Condition		1.3			µs
EN, FLEN Logic Control						
$V_{EN(L)}$, $V_{FLEN(L)}$	EN, FLEN Input Low Threshold				0.4	V
$V_{EN(H)}$, $V_{FLEN(H)}$	EN, FLEN Input High Threshold		1.4			V
t_{FLEN_OND}	FLEN ON Delay Time	EN = AGND		40		µs
t_{FLEN_OFFD}	FLEN OFF Delay Time	EN = AGND		10		µs

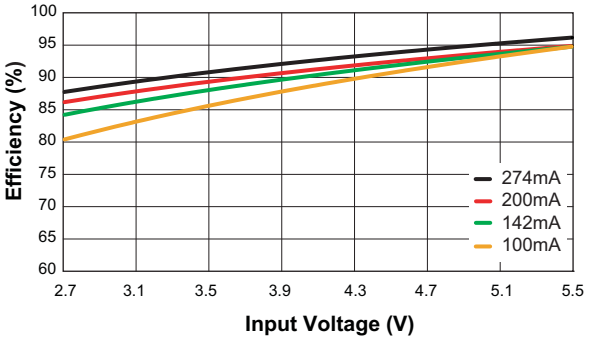
1. The AAT1282 is guaranteed to meet performance specifications over the -40°C to +85°C operating temperature range and is assured by design, characterization, and correlation with statistical process controls.

I²C Interface Timing Details

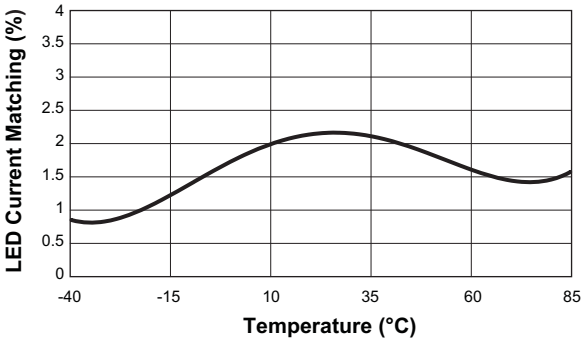


Typical Characteristics

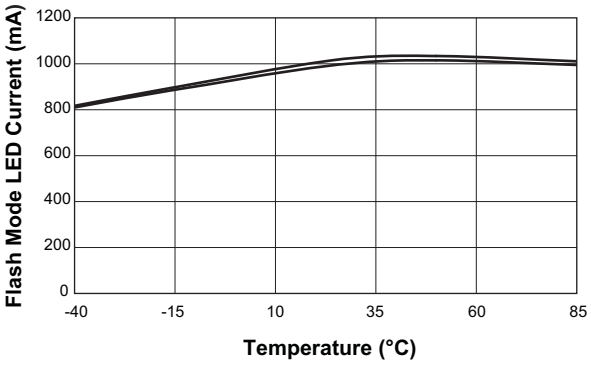
Boost Converter Efficiency (P_{OUT}/P_{IN}) without SuperCap
(L = 1µH)



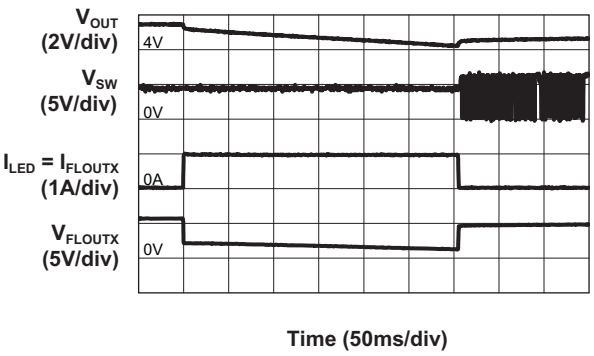
Flash Mode LED Current Matching vs. Temperature
(I_{FLOUTX} = 1A/Channel; V_{IN} = 3.6V; SuperCap [5.5V, 0.55F])



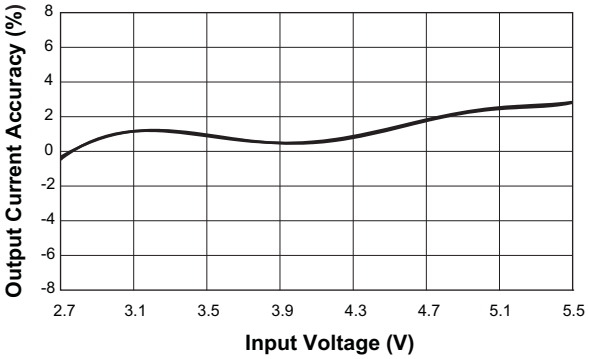
Flash Mode LED Current vs. Temperature
(I_{FLOUTX} = 1A/Channel; V_{IN} = 3.6V; SuperCap [5.5V, 0.55F])



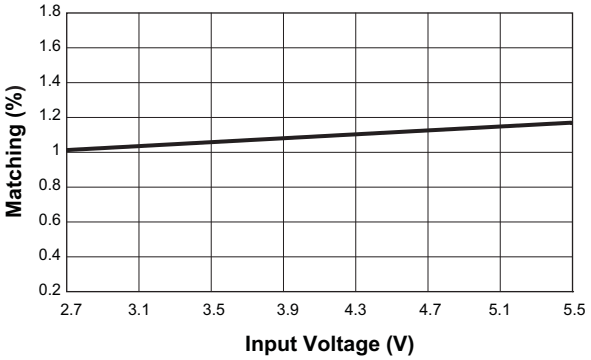
Flash Turn On Characteristic
(I_{FLOUTX} = 1A/Ch; V_{IN} = 3.6V; SuperCap [5.5V, 0.55F])



Movie Mode LED Current Accuracy
(I_{FLOUTX} = 100mA/Channel; L = 1µH)

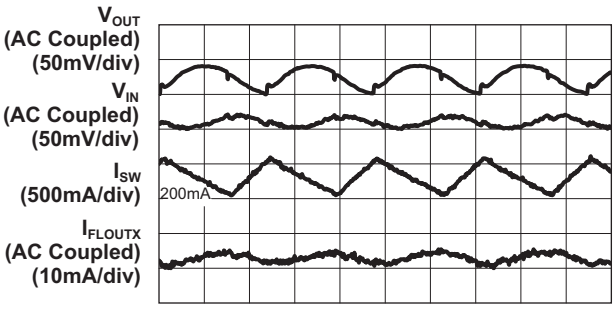


Movie Mode LED Current Matching
(I_{FLOUTX} = 100mA/Channel; L = 1µH)



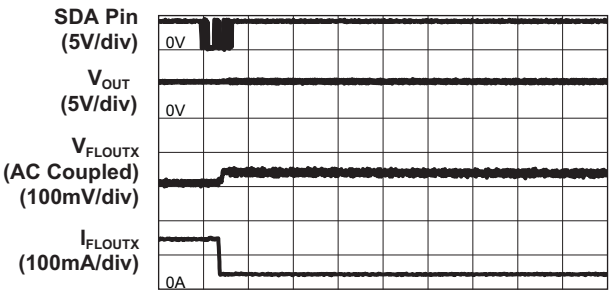
Typical Characteristics

Movie Mode Ripple
(V_{OUT} = 5.5V; V_{IN} = 3.6V; I_{FLOUTX} = 137mA/Ch; L = 1µH)



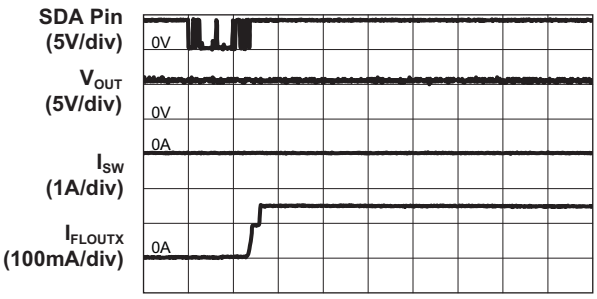
Time (200ns/div)

Movie Mode Transition Characteristic
(I_{FLOUTX} = 137mA/Ch to 50mA/Ch; SuperCap [5.5V, 0.55F])



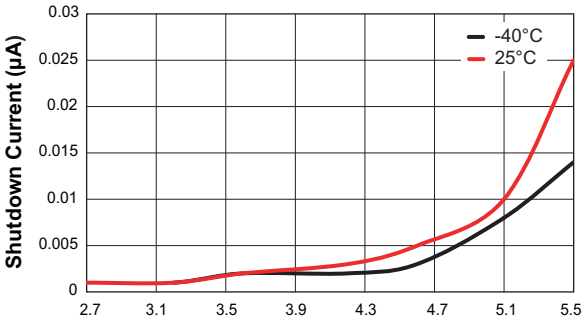
Time (200µs/div)

Movie Mode Turn On Characteristic
(I_{FLOUTX} = 137mA/Ch; V_{IN} = 3.6V; SuperCap [5.5V, 0.55F])

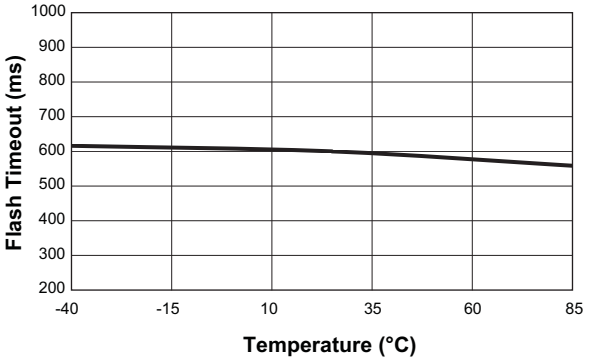


Time (100µs/div)

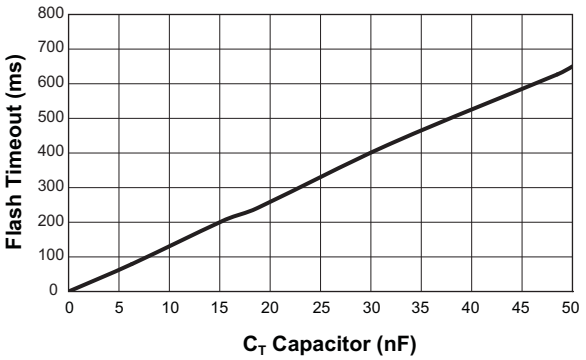
Shutdown Current vs. Input Voltage
(V_{EN} = V_{FLEN} = GND = AGND = FLGND)



Flash Timeout vs. Temperature
(V_{IN} = 3.6V; C_T = 47nF; I_{FLOUTX} = 1A/Ch)

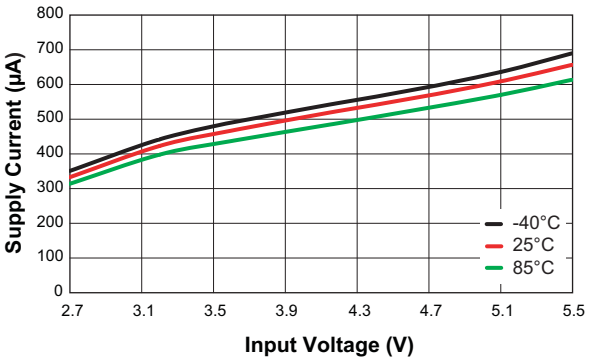


Flash Timeout vs. C_T Capacitor
(I_{FLOUTX} = 1A/Ch; SuperCap [5.5V, 0.55F])

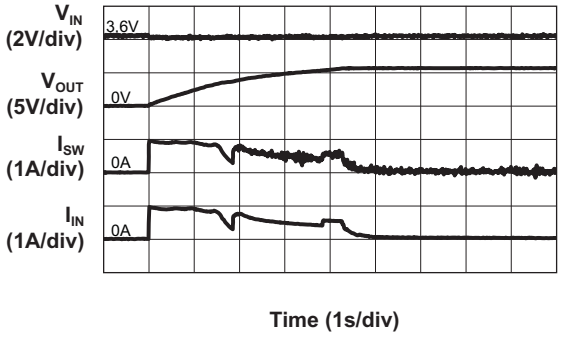


Typical Characteristics

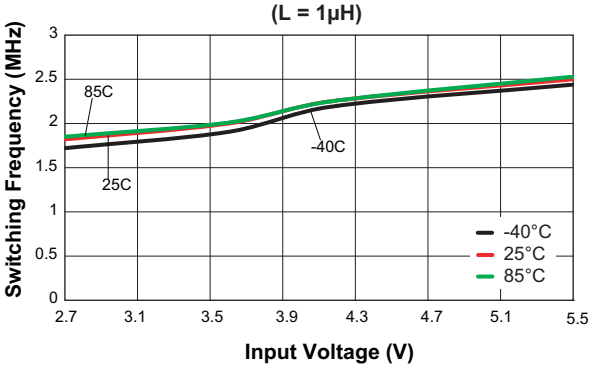
Supply Current vs. Input Voltage
(V_{EN} = 3.6V; V_{FLEN} = FLGND)



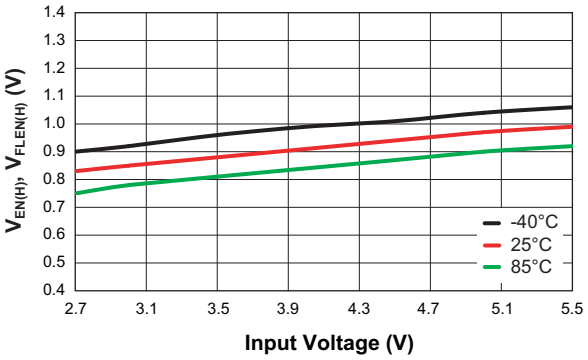
Enabling and SuperCap Charging Characteristic
(V_{IN} = 3.6V; SuperCap [5.5V, 0.55F])



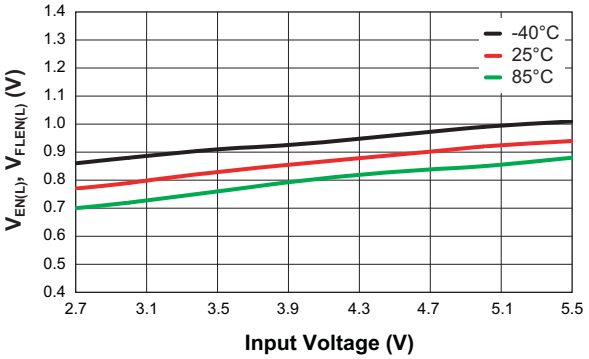
Movie Mode Switching Frequency vs. Input Voltage
(L = 1µH)



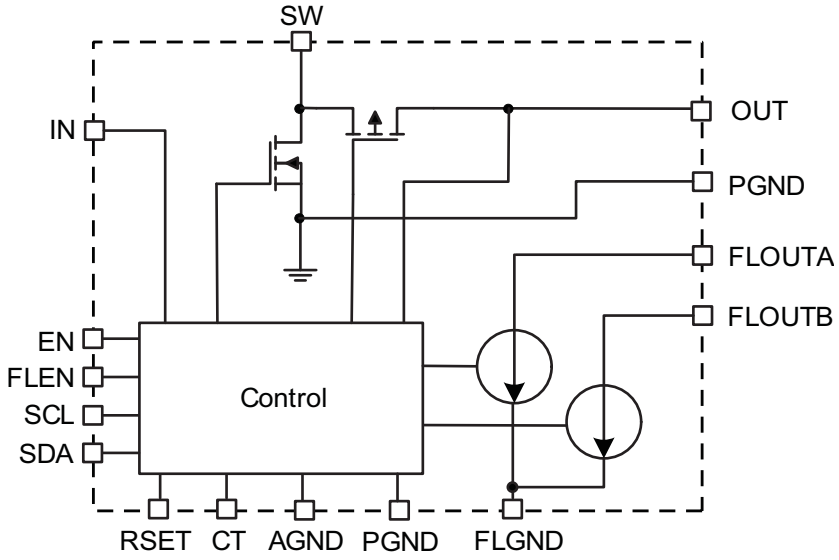
EN, FLEN High Threshold Voltage vs. Input Voltage



EN, FLEN Low Threshold Voltage vs. Input Voltage



Functional Block Diagram



Functional Description

The AAT1282 is a high power, 2A Flash LED driver. This device utilizes a highly efficient inductive step-up converter to achieve to desired output voltage (Super Capacitor voltage, 5.5V). The current of two output channels are regulated evenly which is discharged from the output Super Capacitor, mainly for camera flash applications.

The maximum flash current is set by an external resistor, R_{SET}, which also sets the maximum movie-mode current. The maximum movie-mode current is equal to the maximum programmed flash current reduced by the flash-to-movie-mode ratio with the default value set to 1:7.3. A flash pulse is initiated by strobing the FLEN input pin low-to-high, which initiates a flash pulse and also starts the internal safety timer. The maximum flash time is determined by an external timing capacitor connected to the CT pin. The flash duration can be set from 50ms up to a maximum of 1s. The flash timer will terminate the flash current regardless of the status of the FLEN pin. This can be either used as a simple flash timing pulse or can be used as a safety timer in the event of a control logic malfunction to prevent the LEDs from over-heating.

If the safety timer is not needed in the application, it can be disabled by connecting the CT pin directly to AGND. Further adjustments to the timeout period can be obtained by programming through the I^2C interface.

When the AAT1282 is enabled, the step-up convertor operates at 2MHz switching and charged up the Super Capacitor to 5.5V in seconds. As soon as the Super Capacitor reaches 5.5V, the AAT1282 automatically changes to light load mode operation to maintain output regulation at light load or no load condition. This is discontinuous mode operation, and is normal behavior for a switching regulator. At this point, the LEDs are ready to be flashed.

During the flash, the boost engine is shut down, and the two LEDs connected to its corresponding current channel (FLOUTA or FLOUTB) share the output current supplied by the Super Capacitor equally. (The duration of the flash will be further discussed in the Applications Information section of this datasheet.) In applications where only one LED is connected to either FLOUTA or FLOUTB, the unused current channel must be directly connected to OUT, thereby disabling that channel. For the single ultra bright LED application which requires doubling the flash current, the two current channels can be connected together which allow this ultra bright single LED getting the full output current (please check with the LED specification from LED suppliers).

During the movie-mode operation, the safety timer is disabled. Enabling each output channel (FLOUTA and FLOUTB can be enabled or disabled individually or together) and programming the flash-to-movie-mode

current ratio can be set using the AAT1282's I²C-compliant interface. The movie-mode current level can be adjusted in 16 steps using a logarithmic scale. The maximum flash safety timer can be externally set by CT, and the timer can be programmed from the maximum value in 16 linear steps through I²C-compliant interface. The FLEN signal takes priority over movie-mode operation. Lastly, the EN pin must be toggled low-to-high to enable the AAT1282 to accept any I²C programming instructions.

Over-Temperature Protection

Thermal protection disables the AAT1282 when internal power dissipation becomes excessive, as it disables both MOSFETs. The junction over-temperature threshold is 140°C with 15°C of temperature hysteresis. The output voltage automatically recovers when the over-temperature fault condition is removed.

Over-Voltage Protection (Open LED, Open Super Capacitor)

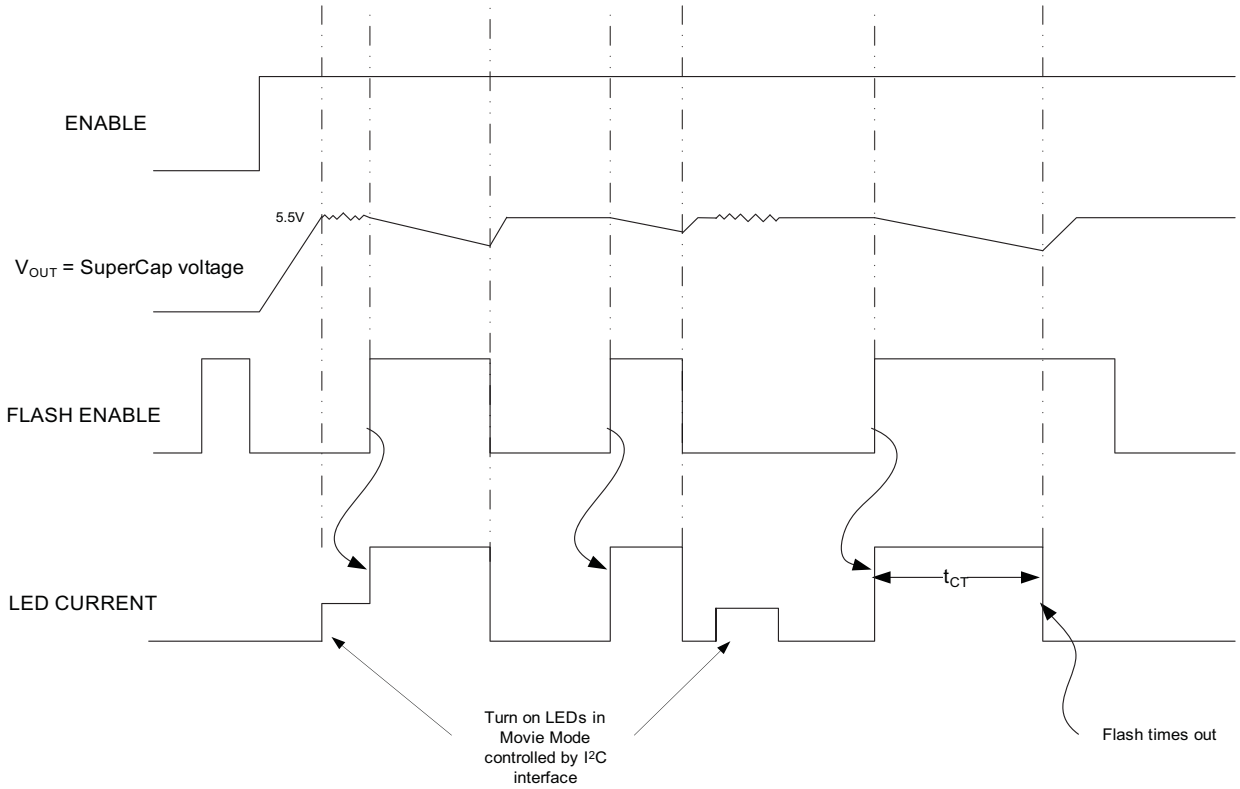
The AAT1282's output voltage is limited by internal over-voltage protection circuitry, which prevents damage to the AAT1282 from an open super capacitor condition. During this condition, the output voltage rises and reaches 5.5V (typical), preventing the output voltage from rising higher. Once the open super capacitor condition is removed, charging of the super capacitor will resume. The controller will return to normal operation and maintain an average output voltage.

If one LED channel accidently becomes open, the remaining LED channel of AAT1282 will still work, but may not be regulated to the desired current.

Device Start up and Shutdown

The AAT1282 is put into operation when EN is set high. It is put into a shutdown mode when EN is set to GND. In the shutdown mode, AAT1282 draws less than 1µA from the battery. All data and register contents are cleared (reset to the default value) during shutdown. During start up of this LED driver, the peak current is limited in order to avoid high peak current drawn from the battery.

Operating Diagram



Applications Information

LED Selection

The AAT1282 is specifically designed to drive ultra bright flash LEDs with typical forward voltage of 2.5V to 4.0V within 1A forward current. Since the FLOUTA and FLOUTB pins have internal current-mirror circuitry which matches both channels with tight accuracy up to 1A per channel; the LED-to-LED brightness will be matched regardless of the individual LED forward voltage (V_F). Circuit designers should consult the LED supplier for LED specifications.

Flash Mode LED Current

The LED current is controlled by the R_{SET} resistor. For maximum accuracy, a 1% tolerance resistor is recommended. FLOUTA and FLOUTB can be programmed up to a maximum total flash current of 2000mA or up to 1000mA per channel. FLOUTA and FLOUTB output current is matched across the programming range. A flash event is initiated by asserting the FLEN pin. A flash event is automatically terminated when FLEN is disabled or if the safety timer terminates before the FLEN pin is disabled.

The maximum flash current in each FLOUTA and FLOUTB is set by the R_{SET} resistor and can be calculated using the following equation:

$$I_{FLOUTA} = I_{FLOUTB} = \frac{81k\Omega \cdot A}{R_{SET}} = \frac{81k\Omega \cdot A}{80.6k\Omega} = \sim 1000mA \text{ per channel}$$

To prevent excessive power dissipation during higher flash current operation, R_{SET} values smaller than 80.6kΩ are not recommended.

Since the super capacitor is the only source for the LED flash current, the duration of the flash is determined by the energy stored in the super capacitor. During flash, the energy of the super capacitor is discharged; at the same time, the voltage of the super capacitor is decreased. Once the super capacitor voltage is lowered to a level (the minimum sink pin voltage + the LED forward voltage), the flash is ended. With a fully charged super capacitor in place, the flash for two 1A LEDs can last for more than 500ms.

Movie Mode LED Current

The maximum movie-mode current level is set by the maximum, programmed flash current reduced by the programmed flash-to-movie-mode ratio in which the default value is 7.3:

$$I_{MOVIE\text{-}MODE[A/B]} = \frac{I_{FLOUT[A/B](MAX)}}{7.3} = \frac{1000mA}{7.3} = 137mA$$

To change the configuration or the settings, the AAT1282 can be programmed via the I²C interface. Triggering the FLEN low to high will enable a flash event with the maximum flash current set by the R_{SET} resistor or with programmed flash current set via the I²C interface. Concurrently, the flash timer is also initiated. All data and register contents are cleared (reset to the default value) after each flash event.

Flash Safety Timeout

The AAT1282 includes a timer circuit that enables the flash current for a programmed period of time. This feature eliminates the need for an external, housekeeping baseband controller to contain a safety delay routine. It also serves as a protection feature to minimize thermal issues with the flash LEDs in the event an external controller's flash software routine experiences hang-up or freeze. The flash safety timeout, T can be calculated by the following equation:

$$T = 13.5s/\mu F \cdot C_T$$

Where T is in seconds and C_T is the capacitance of the timer capacitor in µF.

For example, using a 74nF capacitor for C_T sets the flash timeout to:

$$\text{Flash Safety Timeout} = 13.5s/\mu F \cdot 0.074\mu F = 1s$$

The relationship between the flash safety timeout and the capacitance of the timer capacitor is illustrated in Figure 1.

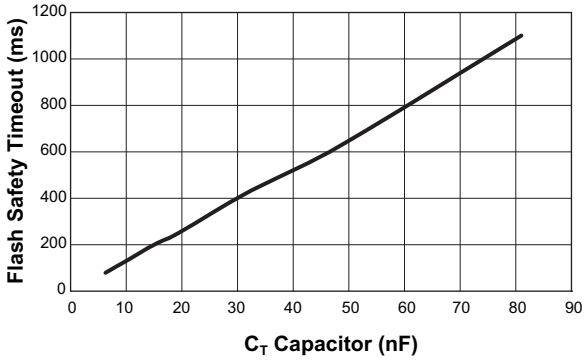


Figure 1: Flash Safety Timeout vs. Timer Capacitor.

I²C Serial Interface

The AAT1282 is fully compliant with the industry-standard I²C interface. The I²C two-wire communications bus consists of SDA and SCL lines. SDA provides data, while SCL provides clock synchronization with speed up to 400kHz. SDA data transfers device address followed by a register address and data bits sequence. When using the I²C interface, EN is pulled high to enable the device or low to disable the device. The I²C serial interface requires a master to initiate all the communications with target devices. The AAT1282 is a target device and only supports the write protocol. The AAT1282 is manufactured with a target device address of 0x37 (Hex). See Figure 2 for the I²C interface diagram.

I²C START and STOP Conditions

START and STOP conditions are always generated by the master. Prior to initiating a START, both the SDA and SCL pins are in idle mode (idle mode is when there is no activity on the bus and SDA and SCL are pulled high by the external pull-up resistors). A START condition occurs when the master strobes the SDA line low and after a short period strobes the SCL line low. A START condition acts as a signal to all ICs that transmission activity is about to occur on the I²C bus. A STOP condition, as shown in Figure 2, is when master releases the bus and SCL changes from low to high followed by SDA low-to-high transition. The master does not issue an ACKNOWLEDGE and releases the SCL and SDA pins.

I²C Address Bit Map

Figure 4 illustrates the address bit transfer. The 7-bit address is transferred with the Most Significant Bit (MSB) first and is valid when SCL is high. This is followed by the R/W bit in the Least Significant Bit (LSB) location. The R/W bit on the eighth bit determines the direction of the transfer (a '1' for read or a '0' for write). The AAT1282 is a write-only device and the R/W bit must be set low. The Acknowledge bit (ACK) is set to low by the AAT1282 to acknowledge receipt of the address.

I²C Register Address/Data Bit Map

Figure 5 illustrates the Register Address or the serial data bit transfer. The 8-bit data is always transferred most significant bit first and is valid when SCL is high. The Acknowledge bit (ACK) is set low by the AAT1282 to acknowledge receipt of the register address or the data.

I²C Acknowledge Bit (ACK)

The Acknowledge bit is the ninth bit of each transfer on the SDA line. It is used to send back a confirmation to the master that the data has been received properly by the target device. For each ACK to take place, the master must first release the SDA line, and then the target device will pull the SDA line low, as shown in Figures 1, 4, and 5.

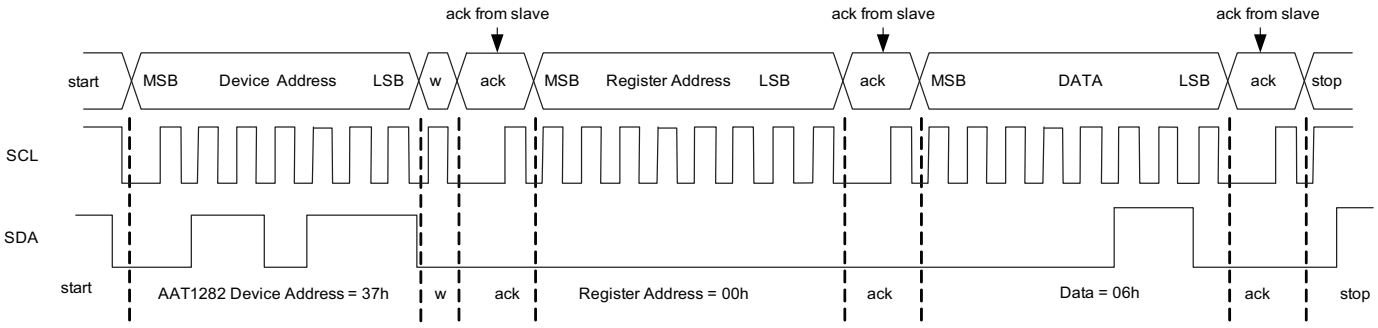


Figure 2: I²C Interface Diagram.

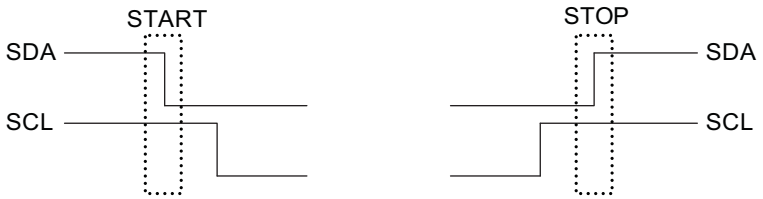


Figure 3: I²C STOP and START Conditions.
START: A High "1" to Low "0" Transition on the SDA Line While SCL is High "1"
STOP: A Low "0" to High "1" Transition on the SDA Line While SCL is High "1"

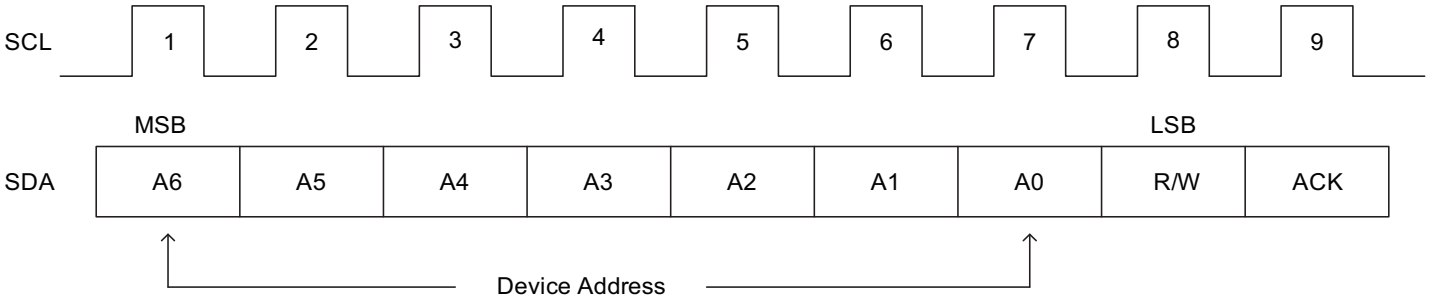


Figure 4: I²C Address Bit Map;
7-bit Slave Address (A6-A0), 1-bit Read/Write (R/$\overline{W}$), 1-bit Acknowledge (ACK).



Figure 5: I²C Register Address and Data Bit Map;
8-bit Data (D7-D0), 1-bit Acknowledge (ACK).

Device Register Information

To program the register through the I²C interface, the master needs to send the AAT1282's device address, 0x37 (Hex), first, and then sends an 8-bit register address and 8-bit data. The AAT1282 has two registers, Register 0 and Register 1. If no instruction is written to the register, the default value is applied.

Register 0 (REG0), Register Address: 00h

Bits [7:4] Program the movie-mode current with 16 different percentage levels.

Bits [3:0] Program the flash safety timeout with 16 different fractions from the hardware configuration, CT.

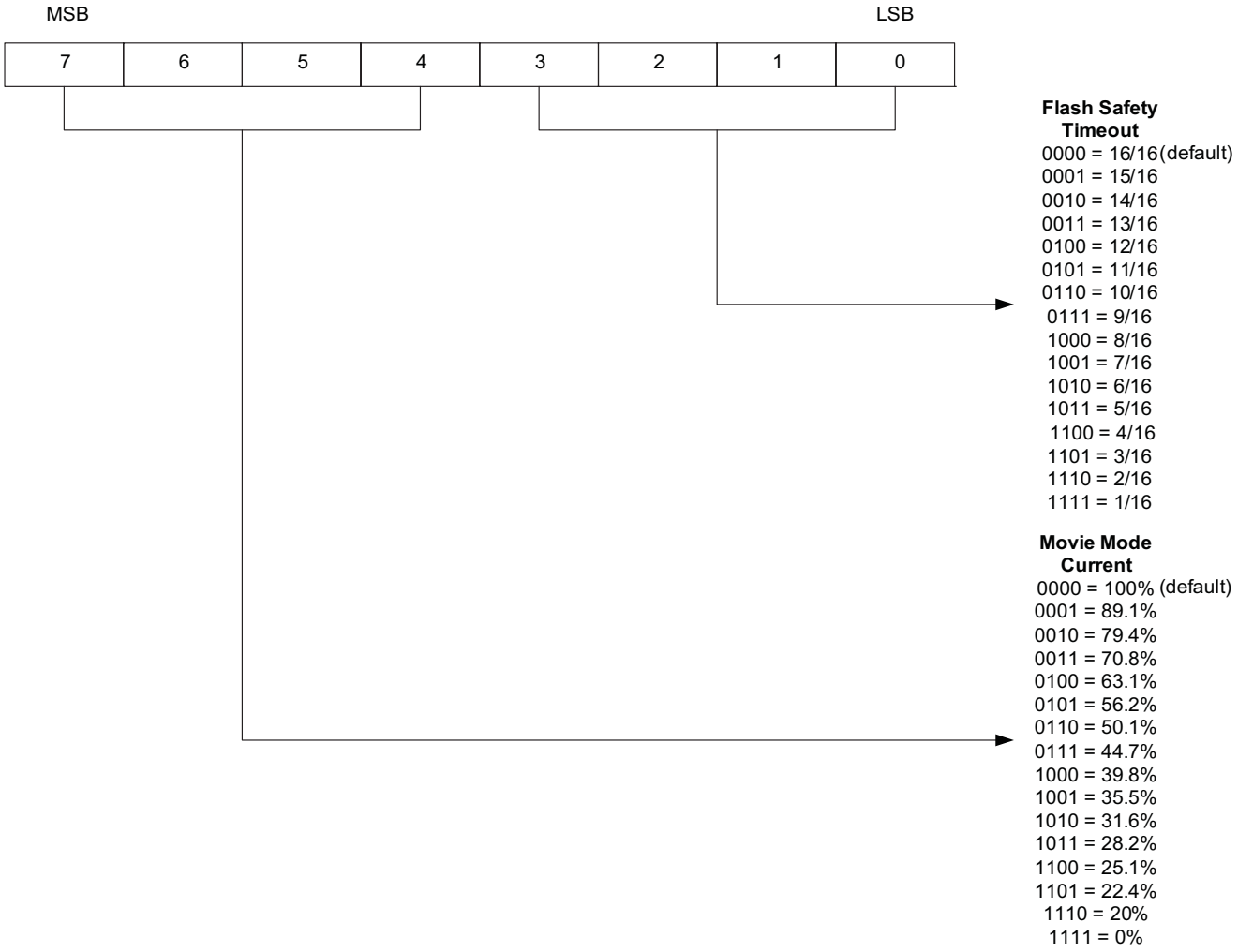


Figure 6: AAT1282 Register 0 Programming.

Register 1 (REG1); Register Address: 01h

Bits [5:4] Program the FLOUTA and FLOUTB with four ON/OFF configurations.

Bits [3:0] Program the flash-to-movie mode ratio with 16 different fractions from the hardware configuration, RSET.

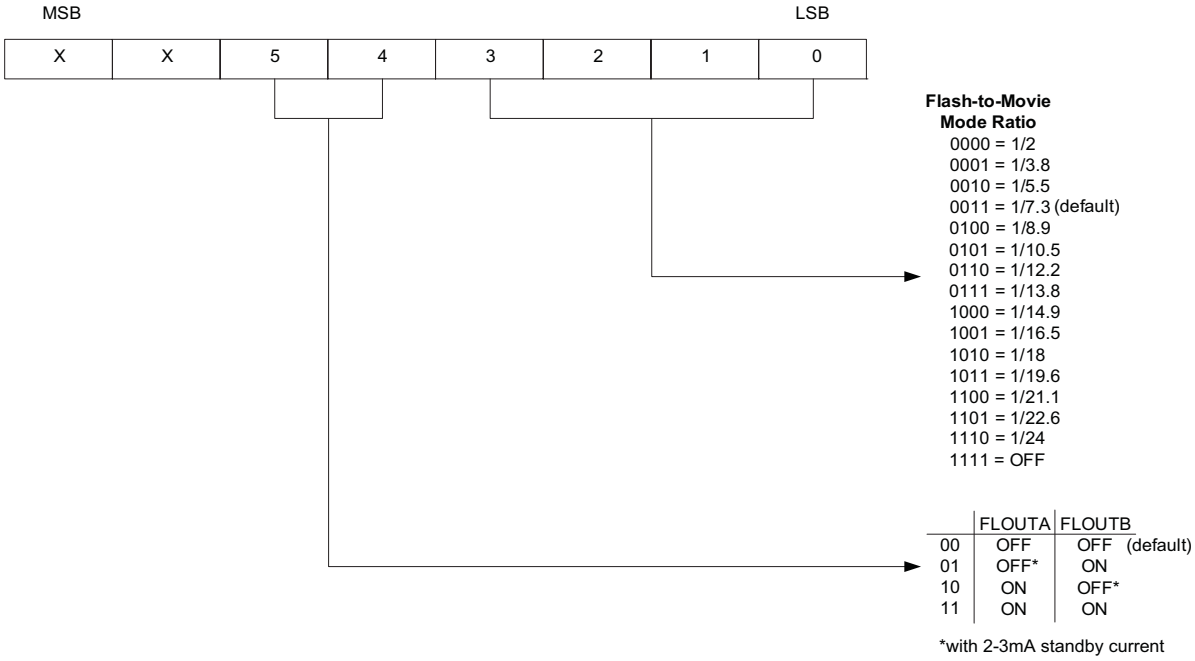


Figure 7: AAT1282 Register 1 Programming.

Selecting the Boost Inductor

The AAT1282 controller utilizes PWM control and the switching frequency is fixed. To maintain 2MHz maximum switching frequency and stable operation, a 1µH inductor is recommended. Manufacturer's specifications list both the inductor DC current rating, which is a thermal limitation, and peak inductor current rating, which is determined by the saturation characteristics. Measurements at full load and high ambient temperature should be performed to ensure that the inductor does not saturate or exhibit excessive temperature rise.

The inductor (L) is selected to avoid saturation at minimum input voltage and maximum output load conditions. Worst-case peak current occurs at minimum input voltage (maximum duty cycle) and maximum load. Bench measurements are recommended to confirm actual I_{PEAK} and to ensure that the inductor does not saturate at maximum LED current and minimum input supply voltage. The RMS current flowing through the boost inductor is equal to the DC plus AC ripple components. Under worst case RMS conditions, the current waveform is critically continuous. The resulting RMS calculation yields worst case inductor loss. The RMS current value should be compared against the inductor manufacturer's temperature rise, or thermal derating guidelines:

$$I_{RMS} = \frac{I_{PEAK}}{\sqrt{3}}$$

For a given inductor type, smaller inductor size leads to an increase in DCR winding resistance and, in most cases, increased thermal impedance. Winding resistance degrades boost converter efficiency and increases the inductor's operating temperature:

$$P_{LOSS(INDUCTOR)} = I^2_{RMS} \cdot DCR$$

Selecting the Boost Capacitors

In general, it is good design practice to place a decoupling capacitor (input capacitor) between the IN and GND pins. An input capacitor in the range of 2.2µF to 10µF is

recommended. A larger input capacitor in this application may be required for stability, transient response, and/or ripple performance. The high output ripple inherent in the boost converter necessitates the use of low impedance output filtering. Multi-layer ceramic (MLC) capacitors provide small size and adequate capacitance, low parasitic equivalent series resistance (ESR) and equivalent series inductance (ESL), and are well suited for use with the AAT1282 boost regulator. MLC capacitors of type X7R or X5R are recommended to ensure good capacitance stability over the full operating temperature range. The output capacitor is selected to maintain the output load without significant voltage droop (ΔV_{OUT}) during the power switch ON interval. A ceramic output capacitor 2.2µF is recommended (see Table 2). Typically, 6.3V or 10V rated capacitors are required for this flash LED boost output. Ceramic capacitors selected as small as 0603 are available which meet these requirements. MLC capacitors exhibit significant capacitance reduction with applied voltage. Output ripple measurements should confirm that output voltage droop and operating stability are within acceptable limits. Voltage derating can minimize this factor, but results may vary with package size and among specific manufacturers. To maintain stable operation at full load, the output capacitor should be selected to maintain ΔV_{OUT} between 100mV and 200mV. The boost converter input current flows during both ON and OFF switching intervals. The input ripple current is less than the output ripple and, as a result, less input capacitance is required.

Super Capacitor

The AAT1282 requires a super capacitor connected to the output and the LEDs. After the super capacitor is fully charged, sufficient energy is stored and ready to provide large power surges such as flash peak current. When selecting a super capacitor, it is highly recommended to select a capacitor with an operating voltage of 5.5V and 500mF DC capacitance for the best results in AAT1282 camera flash applications. Low profile, low impedance (low ESR below 110mΩ), and a wide environmental operating range (-40°C to +85°C) should also be considered when selecting a capacitor for portable power management systems. Please contact the super capacitor manufacturer(s) (such as TDK, CAP-XX or Murata) for detailed information.

PCB Layout Guidelines

Boost converter performance can be adversely affected by poor layout. Possible impact includes high input and output voltage ripple, poor EMI performance, and reduced operating efficiency. Every attempt should be made to optimize the layout in order to minimize parasitic PCB effects (stray resistance, capacitance, and inductance) and EMI coupling from the high frequency SW node. A suggested PCB layout for the AAT1282 High Power 2A Flash LED driver is shown in Figures 8 through 11. The following PCB layout guidelines should be considered:

1. Minimize the distance from capacitor C_{IN} and C_{OUT}'s negative terminals to the PGND pins. This is especially true with output capacitor C_{OUT}, which conducts high ripple current from the output to the PGND pins.
2. Minimize the distance between IN and switching pin SW; minimize the size of the PCB area connected to the SW pin.
3. Maintain a ground plane and connect to the IC PGND pin(s) as well as the PGND connections of C_{IN} and C_{OUT}.
4. Consider additional PCB exposed area for the flash LEDs to maximize heatsinking capability. This may be necessary when using high current application and long flash duration application.
5. Connect the exposed paddle (bottom of the die) to either PGND or GND. Connect AGND, FLGND to GND as close as possible to the package.

Manufacturer	Part Number	Inductance (µH)	Saturated Rated Current (A)	DCR (mΩ)	Size (mm) LxWxH	Type
Cooper Bussmann	SD3812-1R0-R	1	2.69	48	4.0 x 4.0 x 1.2	Shielded Drum Core
Cooper Bussmann	SDH3812-1R0-R	1	3	45	3.8 x 3.8 x 1.2	Shielded Drum Core
Cooper Bussmann	SD10-1R0-R	1	2.25	44.8	5.2 x 5.2 x 1.0	Shielded Drum Core
Sumida	CDH38D11/S	1	2.69	48	4.0 x 4.0 x 1.2	Shielded Drum Core
Coilcraft	LPS4012-102NLC	1	2.5	60	4.1 x 4.1 x 1.2	Shielded Drum Core
TDK	VLS4012T-1RON1R6	1	2.5	60	4.0 x 4.0 x 1.2	Shielded Drum Core

Table 1: Typical Suggested Surface Mount Inductors.

Manufacturer	Part Number	Capacitance (µF)	Voltage Rating (V)	Temp Co.	Case Size
Murata	GRM185R60J225KE26	2.2	6.3	X5R	0603
Murata	GRM188R71A225KE15	2.2	10	X7R	0603
Murata	GRM21BR70J225KA01	2.2	6.3	X7R	0805
Murata	GRM21BR71A225KA01	2.2	10	X7R	0805
TDK	C1608X5R1A225K	2.2	10	X5R	0603
Murata	GRM219R61A475KE19	0.047	10	X5R	0805
TDK	C1005X7R1C473K	0.047	16	X7R	0402
Murata	GRM21BR71A106KE51	10	10	X7R	0805

Table 2: Typical Suggested Surface Mount Capacitors.

Manufacturer	Part Number	Capacitance (F)	Voltage Rating (V)	ESR (mΩ)	Size (mm) LxWxH
TDK	EDLC262020-501-2F50	0.5	5.6	50	20 x 20 x 2.6
CAP-XX	HA230	0.425	5.5	110	20 x 18 x 3.2
Murata	**	0.425	5.5	110	20 x 18 x 3.2

Table 3: Typical Suggested Super Capacitors.

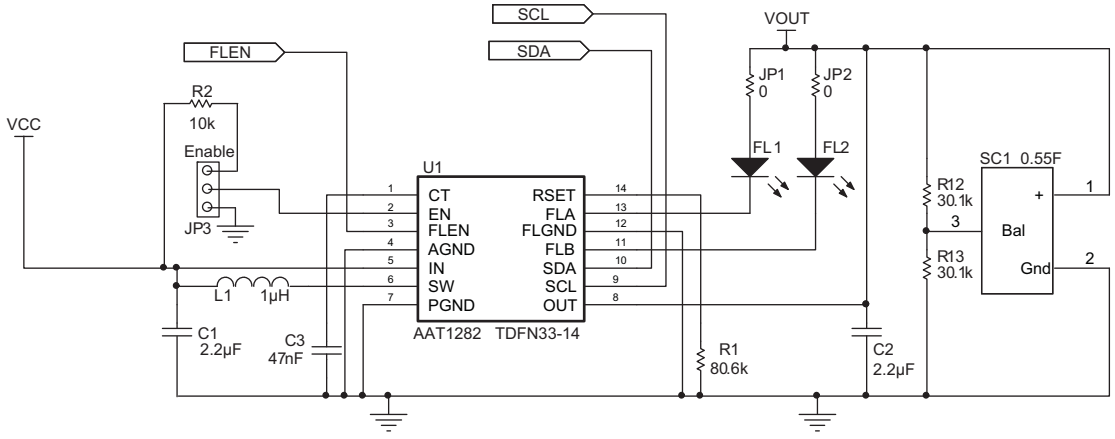


Figure 8: AAT1282 DB1 Microcontroller Evaluation Board Schematic.

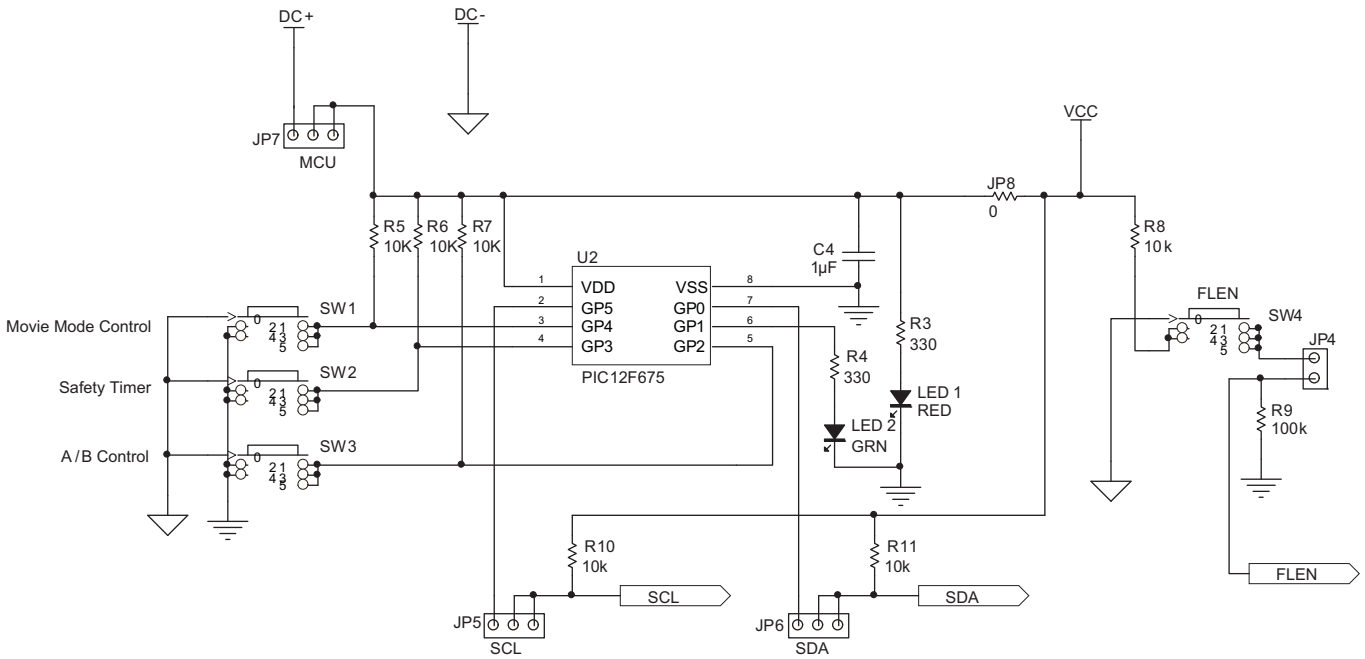


Figure 9: AAT1282 DB1 Microcontroller Evaluation Board MCU Section Schematic.

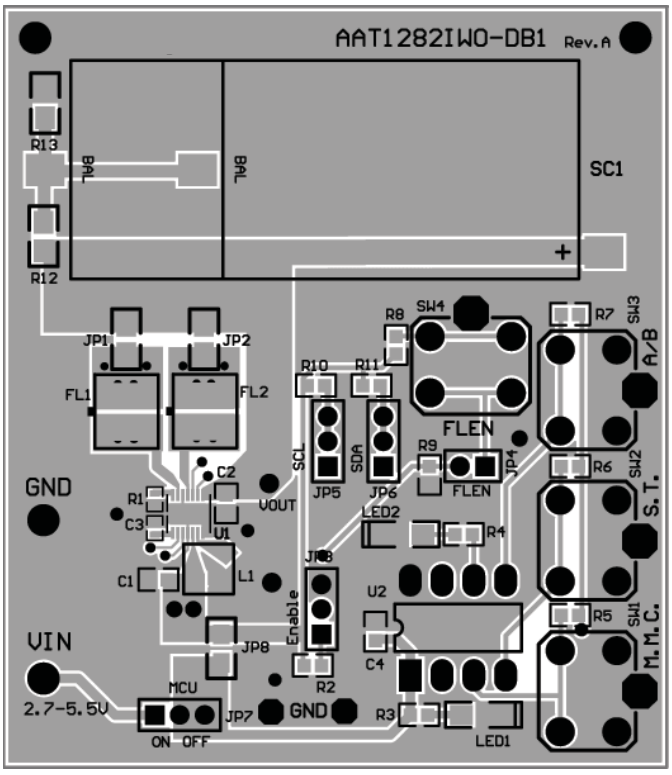


Figure 10: AAT1282 DB1 Microcontroller Evaluation Board Top Side Layout.

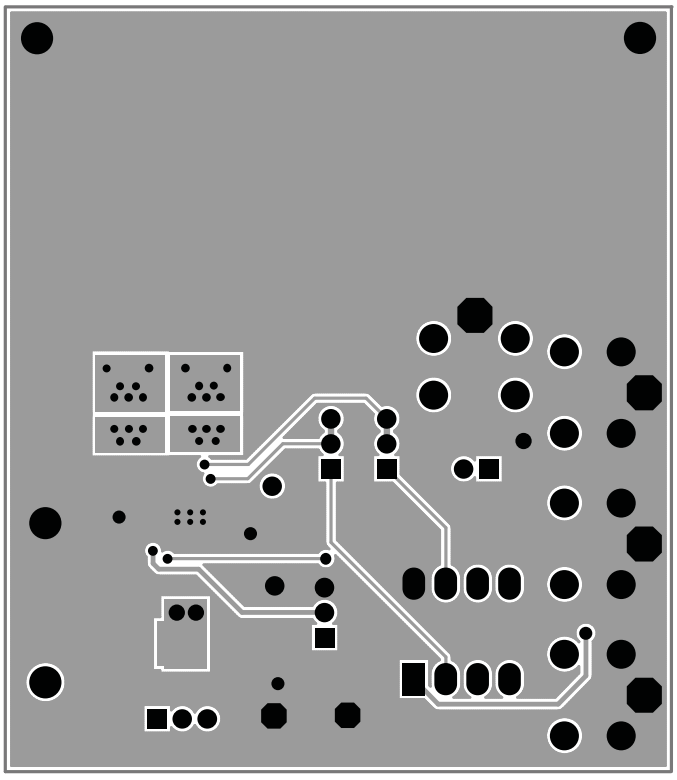


Figure 11: AAT1282 DB1 Microcontroller Evaluation Board Bottom Side Layout.

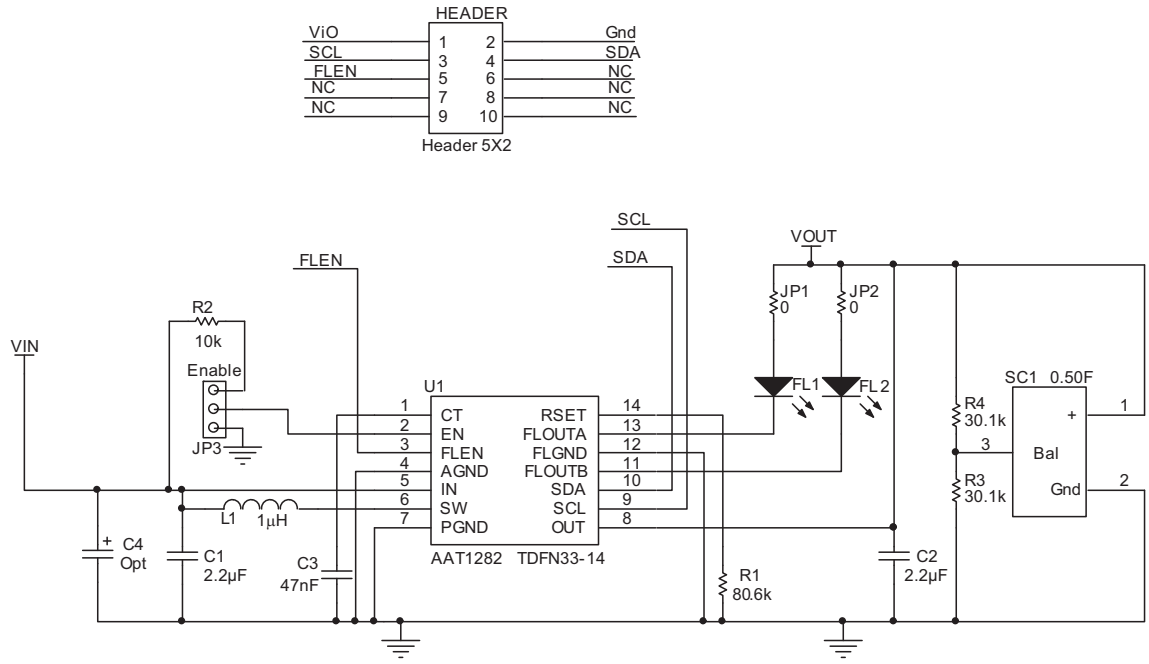


Figure 12: AAT1282 DB2 USB/I²C Evaluation Board Schematic.

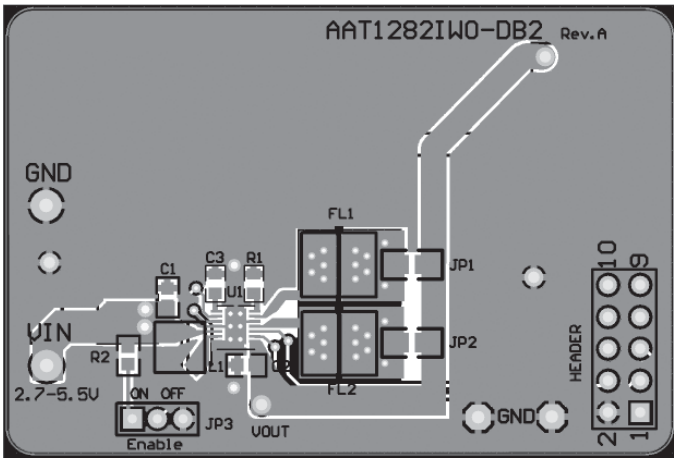


Figure 13: AAT1282 DB2 USB/I²C Evaluation Board Top Side Layout.

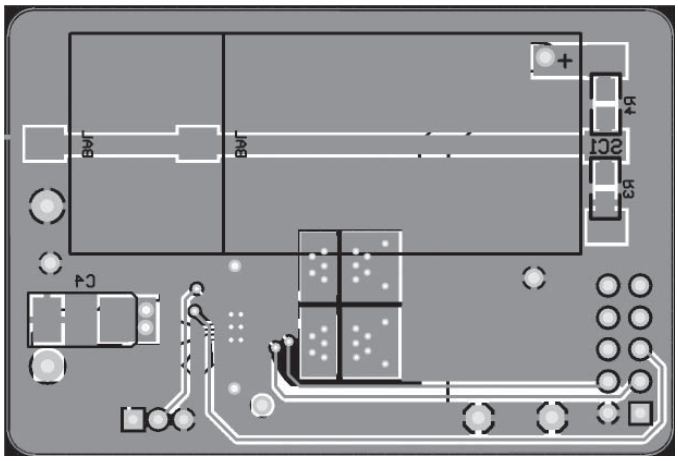


Figure 14: AAT1282 DB2 USB/I²C Evaluation Board Bottom Side Layout.

Component	Part#	Description	Manufacturer
U1	AAT1282IWO	High Power 2A Flash Driver; TDFN33-14 package	Skyworks
U2	PIC12F675	8-bit CMOS, FLASH-based µC; 8-pin PDIP package	Microchip
SW1 – SW4	PTS645TL50	Switch Tact, SPST, 5mm	ITT Industries
R1	Chip Resistor	80.6kΩ, 1%, 1/4W; 0402	Vishay
R9	Chip Resistor	100kΩ, 1%, 1/4W; 0603	Vishay
R2, R5, R6, R7, R8, R10, R11	Chip Resistor	10kΩ, 5%, 1/4W; 0603	Vishay
R3, R4	Chip Resistor	330Ω, 5%, 1/4W; 0603	Vishay
R12, R13	Chip Resistor	30.1kΩ, 1%, 1/4W; 0805	Vishay
JP1, JP2, JP8	Chip Resistor	0Ω, 5%	Vishay
C1, C2	GRM188R71A225KE15	2.2µF, 10V, X7R, 0603	Murata
	C1608X5R1A225K	2.2µF, 10V, X5R, 0603	TDK
C3	GRM155R71A473KA01	47nF, 10V, X7R, 0402	Murata
	C1005X7R1C473K	47nF, 16V, X7R, 0402	TDK
C4	GRM185R61A105KE36	1µF, 10V, X5R, 0603	Murata
L1	SD3812-1R0-R	Drum Core, 1µH, 2.69A, 48mΩ	Cooper Bussmann
	VLS4012T-1RON1R6	Drum Core, 1µH, 2.6A, 60mΩ	TDK
FL1-FL2	*	White Flash LED	*
LED1	CMD15-21SRC/TR8	Red LED; 1206	Chicago Miniature Lamp
LED2	CMD15-21VGC/TR8	Green LED; 1206	Chicago Miniature Lamp
SC1	EDLC262020-501-2F50	5.5V, 0.50F, Low ESR, 30mΩ	TDK
JP3, JP4, JP5, JP6, JP7	PRPN401PAEN	Conn. Header, 2mm zip	Sullins Electronics

Table 4: AAT1282 Evaluation Board Component Listing.

* Lumileds LXCL-PWM1 or LXCL-PWF4, OSRAM LW F65G, Seoul Semiconductor FCW401ZD based on availability from the manufacturer.

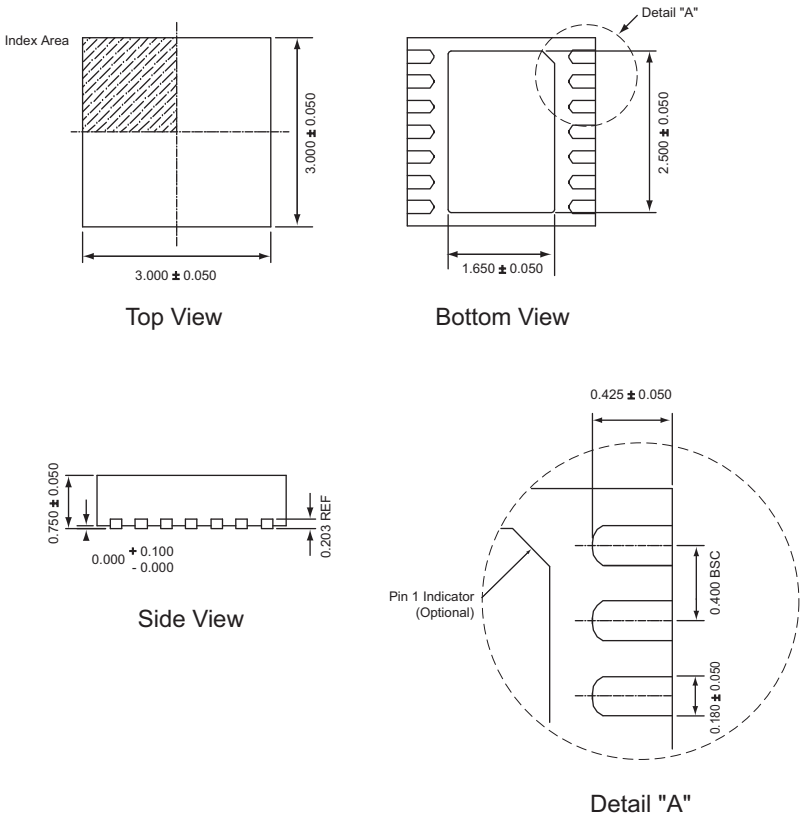
Ordering Information

Package	Marking[1]	Part Number (Tape and Reel)[2]
TDFN33-14	ZGXYY	**AAT1282IWO-T1**

Skyworks Green™ products are compliant with all applicable legislation and are halogen-free. For additional information, refer to *Skyworks Definition of Green™*, document number SQ04-0074.

Package Information

TDFN33-14[3]



All dimensions in millimeters.

1. XYY = assembly and date code.
2. Sample stock is generally held on part numbers listed in **BOLD**.
3. The leadless package family, which includes QFN, TQFN, DFN, TDFN and STDFN, has exposed copper (unplated) at the end of the lead terminals due to the manufacturing process. A solder fillet at the exposed copper edge cannot be guaranteed and is not required to ensure a proper bottom solder connection

Copyright © 2012, 2013 Skyworks Solutions, Inc. All Rights Reserved.

Information in this document is provided in connection with Skyworks Solutions, Inc. ("Skyworks") products or services. These materials, including the information contained herein, are provided by Skyworks as a service to its customers and may be used for informational purposes only by the customer. Skyworks assumes no responsibility for errors or omissions in these materials or the information contained herein. Skyworks may change its documentation, products, services, specifications or product descriptions at any time, without notice. Skyworks makes no commitment to update the materials or information and shall have no responsibility whatsoever for conflicts, incompatibilities, or other difficulties arising from any future changes.

No license, whether express, implied, by estoppel or otherwise, is granted to any intellectual property rights by this document. Skyworks assumes no liability for any materials, products or information provided hereunder, including the sale, distribution, reproduction or use of Skyworks products, information or materials, except as may be provided in Skyworks Terms and Conditions of Sale.

THE MATERIALS, PRODUCTS AND INFORMATION ARE PROVIDED "AS IS" WITHOUT WARRANTY OF ANY KIND, WHETHER EXPRESS, IMPLIED, STATUTORY, OR OTHERWISE, INCLUDING FITNESS FOR A PARTICULAR PURPOSE OR USE, MERCHANTABILITY, PERFORMANCE, QUALITY OR NON-INFRINGEMENT OF ANY INTELLECTUAL PROPERTY RIGHT; ALL SUCH WARRANTIES ARE HEREBY EXPRESSLY DISCLAIMED. SKYWORKS DOES NOT WARRANT THE ACCURACY OR COMPLETENESS OF THE INFORMATION, TEXT, GRAPHICS OR OTHER ITEMS CONTAINED WITHIN THESE MATERIALS. SKYWORKS SHALL NOT BE LIABLE FOR ANY DAMAGES, INCLUDING BUT NOT LIMITED TO ANY SPECIAL, INDIRECT, INCIDENTAL, STATUTORY, OR CONSEQUENTIAL DAMAGES, INCLUDING WITHOUT LIMITATION, LOST REVENUES OR LOST PROFITS THAT MAY RESULT FROM THE USE OF THE MATERIALS OR INFORMATION, WHETHER OR NOT THE RECIPIENT OF MATERIALS HAS BEEN ADVISED OF THE POSSIBILITY OF SUCH DAMAGE.

Skyworks products are not intended for use in medical, lifesaving or life-sustaining applications, or other equipment in which the failure of the Skyworks products could lead to personal injury, death, physical or environmental damage. Skyworks customers using or selling Skyworks products for use in such applications do so at their own risk and agree to fully indemnify Skyworks for any damages resulting from such improper use or sale.

Customers are responsible for their products and applications using Skyworks products, which may deviate from published specifications as a result of design defects, errors, or operation of products outside of published parameters or design specifications. Customers should include design and operating safeguards to minimize these and other risks. Skyworks assumes no liability for applications assistance, customer product design, or damage to any equipment resulting from the use of Skyworks products outside of stated published specifications or parameters.

Skyworks, the Skyworks symbol, and "Breakthrough Simplicity" are trademarks or registered trademarks of Skyworks Solutions, Inc., in the United States and other countries. Third-party brands and names are for identification purposes only, and are the property of their respective owners. Additional information, including relevant terms and conditions, posted at www.skyworksinc.com, are incorporated by reference.