SGM3771A
28V, 2A, Synchronous Buck LED Driver with PWM Input Analog Dimming Mode

GENERAL DESCRIPTION

The SGM3771A is a 2A, synchronous Buck LED driver with 28V maximum input voltage. The integrated power MOSFETs and fixed 1MHz (TYP) switching frequency provide high efficiency and extremely small solution size.

The SGM3771A supports analog dimming with digital input. It accepts an external PWM dimming signal, and the internal reference voltage changes proportionally to the duty cycle of the PWM signal in 1% to 100% range. The reference voltage is 100mV (TYP) when a 100% duty cycle PWM signal (DC voltage) is applied. And the recommended PWM signal frequency is from 20kHz to 200kHz.

The SGM3771A implements full protections, including over-current protection with hiccup mode, LED+ short to GND, LED short and open, FB sense resistor short and open, and thermal shutdown.

The SGM3771A is available in a Green TSOT-23-6 package. It operates over a wide junction temperature range of -40℃ to +125℃.

FEATURES

- **4V to 28V Wide Input Range**
- **Maximum 2A LED Driving Capability**
- **Fixed 1MHz (TYP) Switching Frequency**
- **Low R_{DSON} for Internal MOSFETs**
  High-side/Low-side: 100mΩ/65mΩ (TYP)
- **Low Shutdown Current: 2μA (TYP)**
- **Peak-Current Mode Control**
- **Output Discharge in Turn-Off**
- **Over-Current Protection with Hiccup Mode**
- **Output Short-Circuit Protection**
- **LED Short and Open Protection**
- **FB Sense Resistor Short and Open Protection**
- **+160℃ (TYP) Die Temperature Thermal Shutdown**
- **Available in a Green TSOT-23-6 Package**

APPLICATIONS

General IR/White LED Driver
IP Camera System
Indicator Driving
Industrial and Commercial Lighting

SIMPLIFIED SCHEMATIC

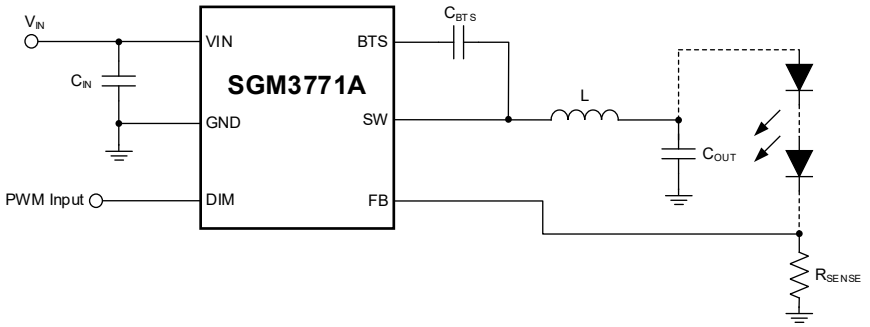


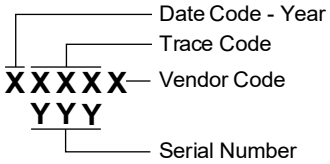
Figure 1. Simplified Schematic

PACKAGE/ORDERING INFORMATION

MODEL	PACKAGE DESCRIPTION	SPECIFIED TEMPERATURE RANGE	ORDERING NUMBER	PACKAGE MARKING	PACKING OPTION
SGM3771A	TSOT-23-6	-40℃ to +125℃	SGM3771AXTN6G/TR	XXXXX 1WV	Tape and Reel, 3000

MARKING INFORMATION

NOTE: XXXXX = Date Code, Trace Code and Vendor Code.



Green (RoHS & HSF): SG Micro Corp defines "Green" to mean Pb-Free (RoHS compatible) and free of halogen substances. If you have additional comments or questions, please contact your SGMICRO representative directly.

ABSOLUTE MAXIMUM RATINGS

VIN, SW ..... -0.3V to 30V
SW to GND (10ns Transient) ..... -5V
BTS to SW Voltage ..... -0.3V to 6V
FB, DIM ..... -0.3V to 6V
Package Thermal Resistance
TSOT-23-6, θ_{JA} ..... 105.2℃/W
TSOT-23-6, θ_{JB} ..... 24.9℃/W
TSOT-23-6, θ_{JC} ..... 68.2℃/W
Junction Temperature ..... +150℃
Storage Temperature Range ..... -65℃ to +150℃
Lead Temperature (Soldering, 10s) ..... +260℃
ESD Susceptibility (1) (2)
HBM ..... ±4000V
CDM ..... ±2000V

NOTES:

1. For human body model (HBM), all pins comply with ANSI/ESDA/JEDEC JS-001 specifications.

2. For charged device model (CDM), all pins comply with ANSI/ESDA/JEDEC JS-002 specifications

RECOMMENDED OPERATING CONDITIONS

Input Voltage, V_{IN} ..... 4V to 28V
Maximum LED Current 2A
Operating Junction Temperature Range ..... -40℃ to +125℃

OVERSTRESS CAUTION

Stresses beyond those listed in Absolute Maximum Ratings may cause permanent damage to the device. Exposure to absolute maximum rating conditions for extended periods may affect reliability. Functional operation of the device at any conditions beyond those indicated in the Recommended Operating Conditions section is not implied.

ESD SENSITIVITY CAUTION

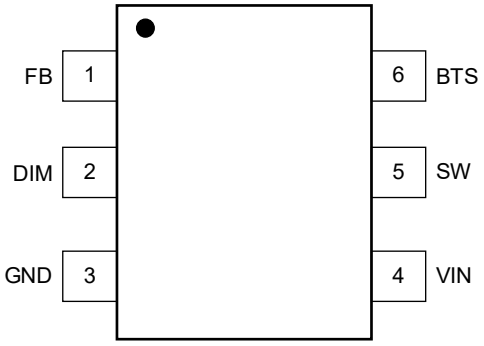
This integrated circuit can be damaged if ESD protections are not considered carefully. SGMICRO recommends that all integrated circuits be handled with appropriate precautions. Failure to observe proper handling and installation procedures can cause damage. ESD damage can range from subtle performance degradation to complete device failure. Precision integrated circuits may be more susceptible to damage because even small parametric changes could cause the device not to meet the published specifications.

DISCLAIMER

SG Micro Corp reserves the right to make any change in circuit design, or specifications without prior notice.

PIN CONFIGURATION

(TOP VIEW)



TSOT-23-6

PIN DESCRIPTION

PIN	NAME	TYPE	FUNCTION
1	FB	AI	Current Sensing Input. Kelvin connects it to the sense resistor sample terminal.
2	DIM	AI	Dimming and Enable Control Input. Default low (internally pulled low). Feed continuous PWM train into this pin to keep this chip operation and control the LED current in proportional to the duty cycle of the PWM input signal.
3	GND	P	Power Ground and Current Sensing Zero Reference Point. Placing the sense resistor close to this pin is recommended for less ground difference interference induction.
4	VIN	P	Power Input.
5	SW	P	Switching Node. Connect this pin to the external Inductor.
6	BTS	AI	Bootstrap Input. Connect it to the SW pin through a capacitor.

NOTE: P = Power Supply, AI = Analog Input.

ELECTRICAL CHARACTERISTICS

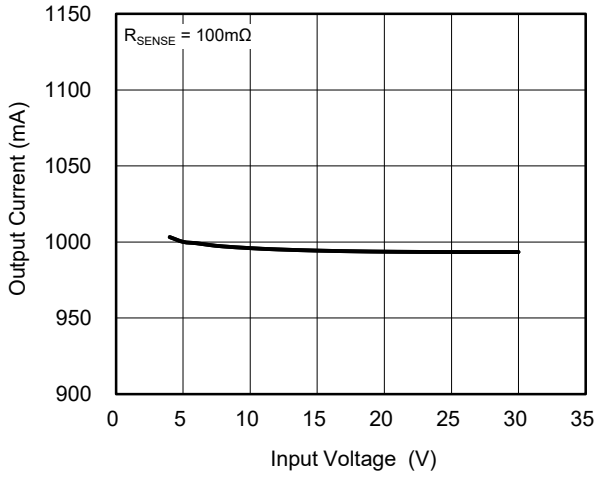
(V_{IN} = 4V to 28V, T_J = -40℃ to +125℃, all typical values are measured at T_J = +25℃, unless otherwise noted.)

PARAMETER	SYMBOL	CONDITIONS	MIN	TYP	MAX	UNITS
Input Supply						
Input Voltage Range	V_{IN}		4		28	V
Input Under-Voltage Lockout Threshold	V_{UVLO}	V_{IN} rising	3.47	3.67	3.87	V
Input Under-Voltage Lockout Hysteresis	V_{UVLO_HYS}	V_{IN} falling		220		mV
Shutdown Current	I_{SD}	V_{IN} = 12V, V_{DIM} = 0V		2	4	μA
Quiescent Current	I_Q	V_{DIM} = 5V		0.8	1.3	mA
Feedback						
FB Pin Internal Reference Voltage	V_{REF}	DIM signal duty cycle = 100%, V_{IN} = 12V, output is 3 IRLEDs in series	96	100	103	mV
		DIM signal duty cycle = 1%		1		mV
Dimming Input						
DIM Low-Level Input Voltage	V_{DIM_L}				0.3	V
DIM High-Level Input Voltage	V_{DIM_H}		1.3			V
DIM Minimum On-Time for Dimming	$t_{DIM_ON_MIN}$				50	ns
Delay Time from DIM High-Level to Enable Device	$t_{DIM_EN_DLY}$			117		μs
Deglitch Time for DIM Low-Level to Disable Device	$t_{DIM_DIS_DGL}$			1.12		ms
Switching						
Switching Frequency	f_{SW}		0.8	1	1.2	MHz
Maximum Duty Cycle	D_{MAX}			96		%
Minimum On-Time	t_{ON_MIN}			74		ns
Minimum Off-Time	t_{OFF_MIN}			72		ns
BTS Voltage						
Bias Voltage for High-side FET Driver	V_{BTS_SW}			4.5		V
Integrated Power Switches						
High-side FET On-Resistance	R_{DSON_HS}	V_{IN} ≥ 5V		100		mΩ
Low-side FET On-Resistance	R_{DSON_LS}	V_{IN} ≥ 5V		65		mΩ
High-side FET Peak Current Limit	I_{LIM_HS}		2.9	3.6	4.3	A
Low-side FET Valley Current Limit	I_{LIM_LS}		2	3.0	3.9	A
Low-side FET Negative Current Limit	$I_{LIM_LS_N}$	T_J = +25℃	0.65	1.2	1.8	A
		T_J = -40℃ to +125℃	0.5	1.2	2	
Hiccup Mode						
Hiccup Auto-Retry On-Time	t_{RETRY_ON}			512		Cycles
Hiccup Auto-Retry Off-Time	t_{RETRY_OFF}			66		ms
Soft-Start						
Internal Soft-Start Time	t_{SS}	DIM signal duty cycle = 100%		0.4		ms
Thermal Shutdown						
Thermal Shutdown Threshold	T_{SD}			160		℃
Thermal Shutdown Hysteresis	T_{SD_HYS}			15		℃

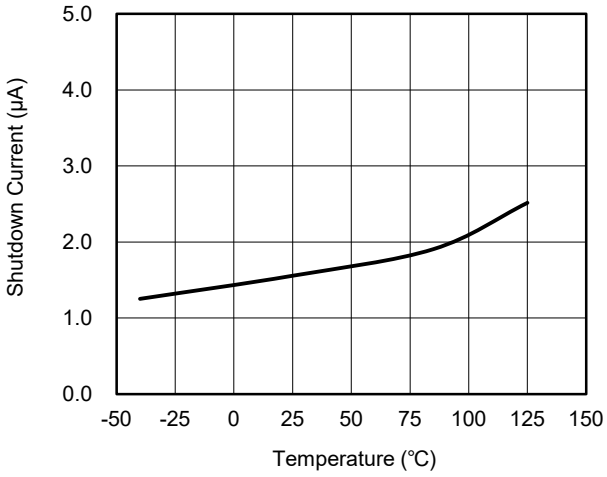
TYPICAL PERFORMANCE CHARACTERISTICS

V_{IN} = 12V, unless otherwise noted.

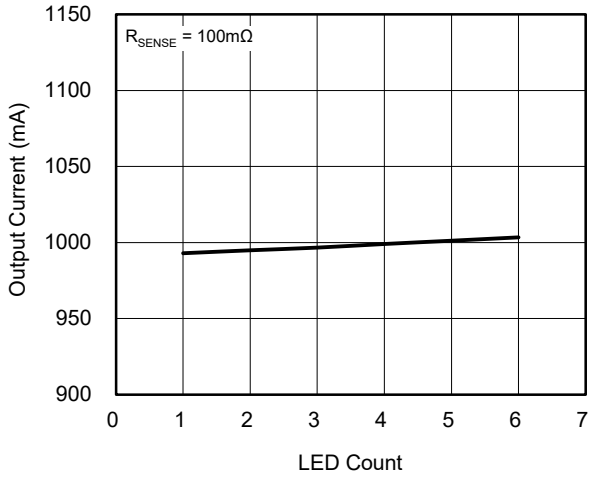
Output Current vs. Input Voltage



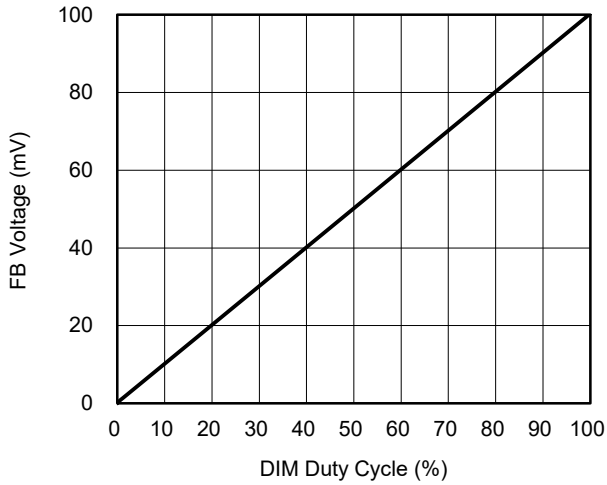
Shutdown Current vs. Temperature



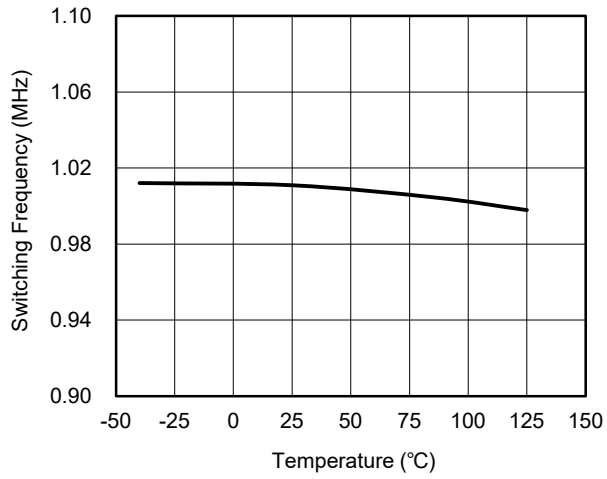
Output Current vs. LED Count



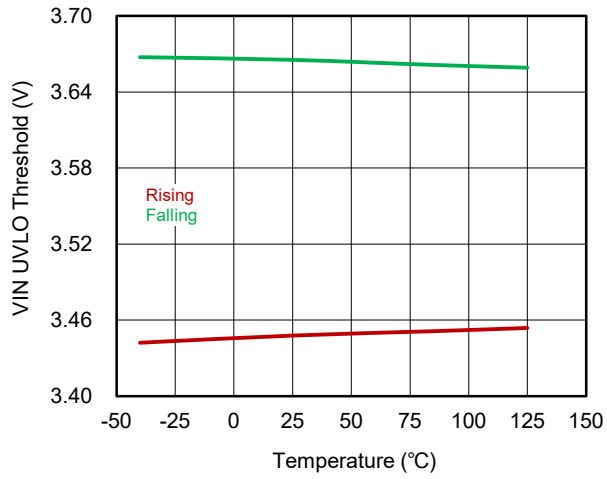
DIM Duty Cycle vs. FB Voltage in Analog Dimming



Switching Frequency vs. Temperature



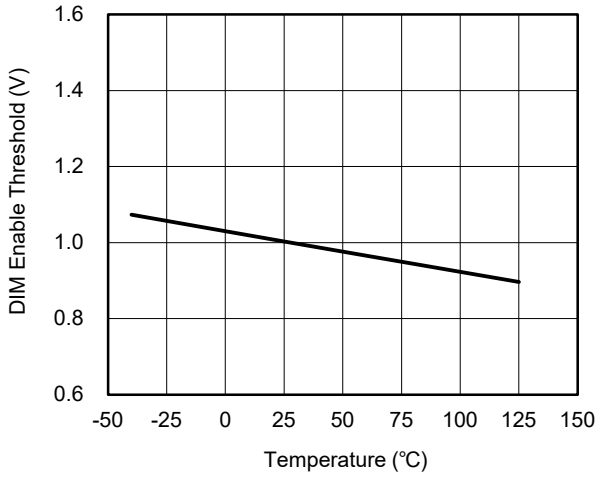
VIN UVLO Threshold vs. Temperature



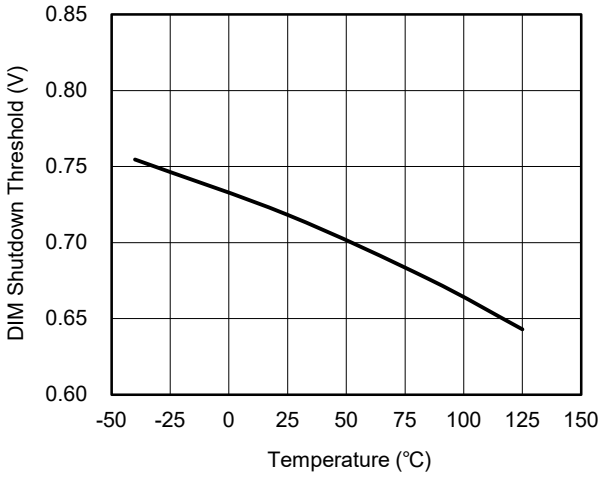
TYPICAL PERFORMANCE CHARACTERISTICS (continued)

V_{IN} = 12V, unless otherwise noted.

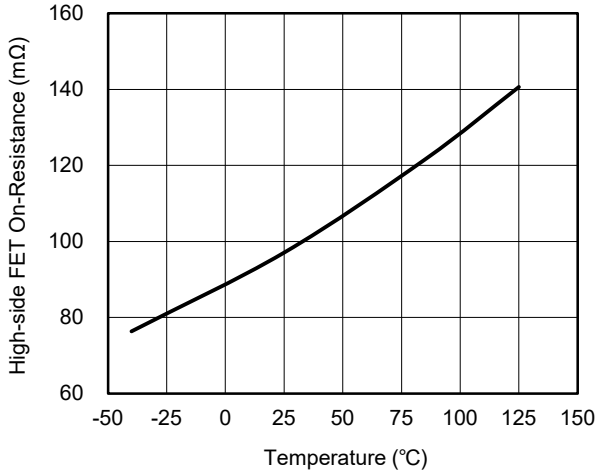
DIM Enable Threshold vs. Temperature



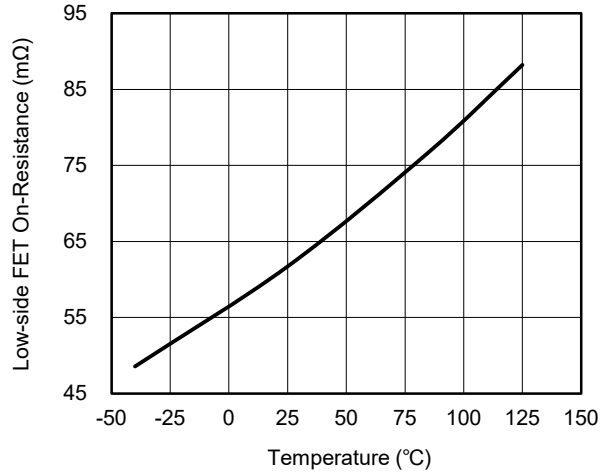
DIM Shutdown Threshold vs. Temperature



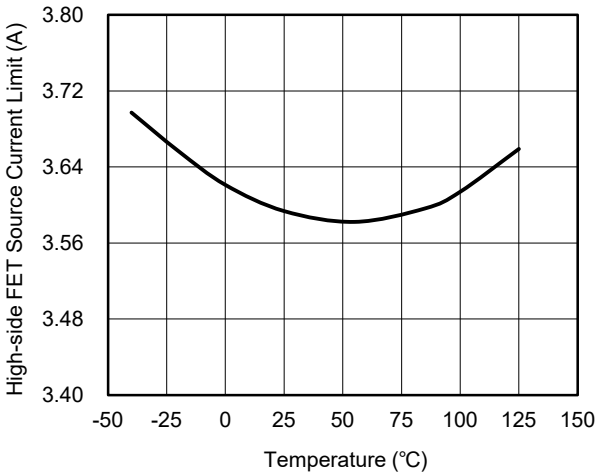
High-side FET On-Resistance vs. Temperature



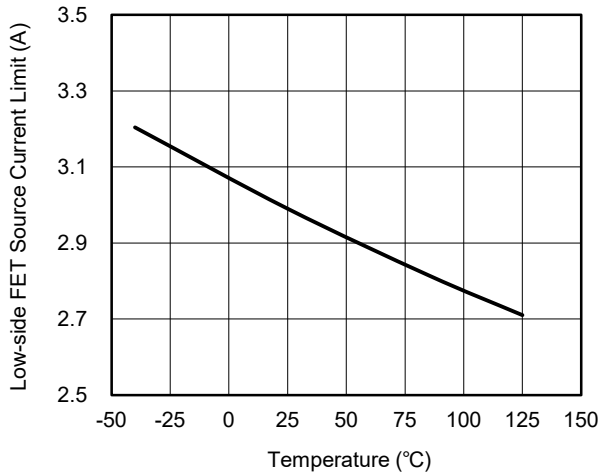
Low-side FET On-Resistance vs. Temperature



High-side FET Source Current Limit vs. Temperature



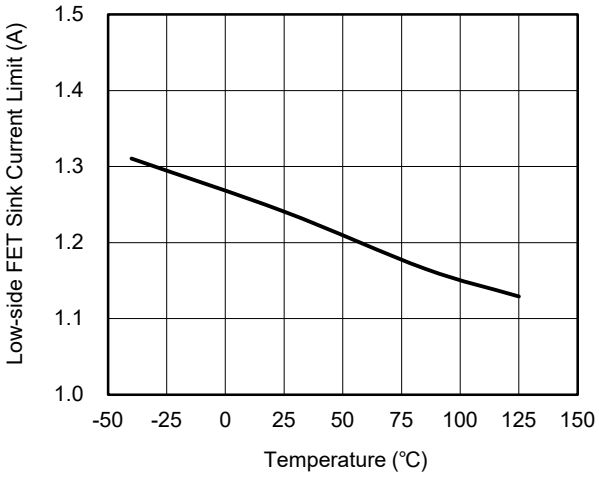
Low-side FET Source Current Limit vs. Temperature



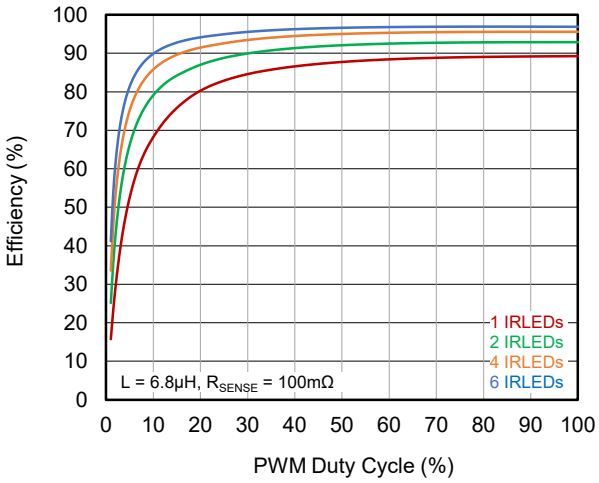
TYPICAL PERFORMANCE CHARACTERISTICS (continued)

V_{IN} = 12V, unless otherwise noted.

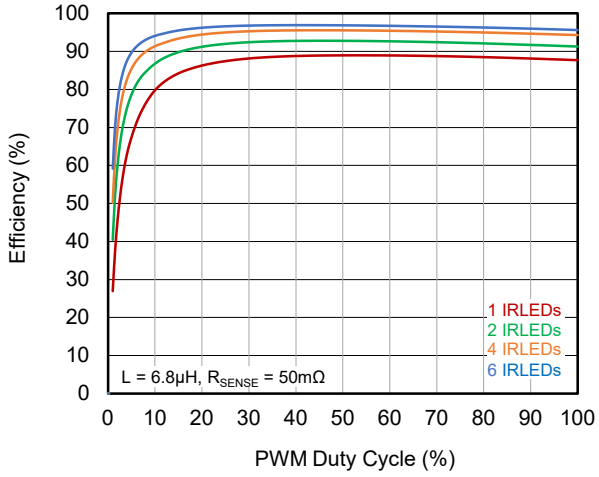
Low-side FET Sink Current Limit vs. Temperature



Efficiency at Maximum 1A Output Current

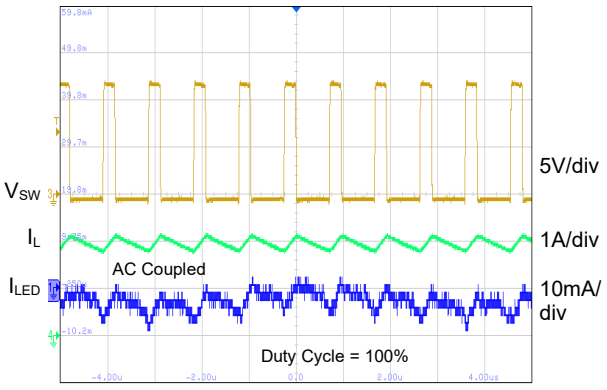


Efficiency at Maximum 2A Output Current

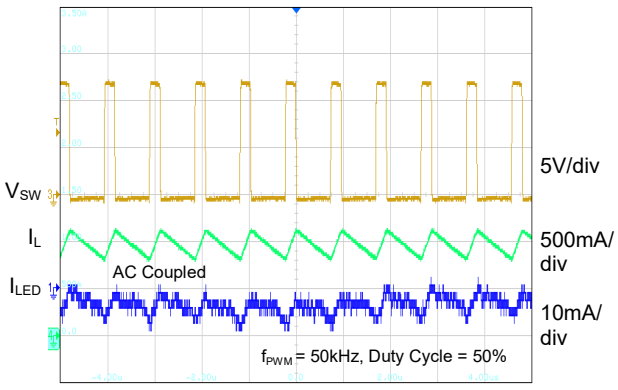


T_A = +25℃, V_{IN} = 12V, unless otherwise noted.

Steady State



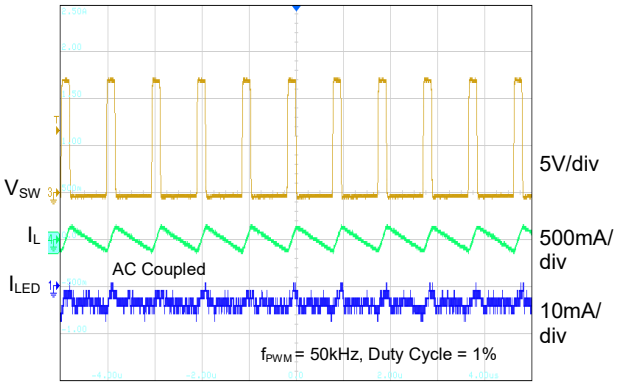
Steady State



TYPICAL PERFORMANCE CHARACTERISTICS (continued)

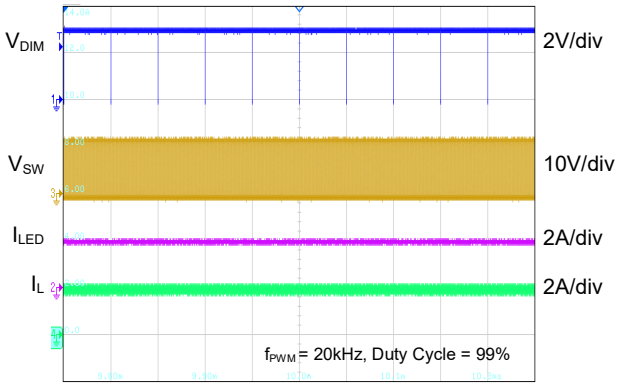
T_A = +25℃, V_{IN} = 12V, unless otherwise noted.

Steady State



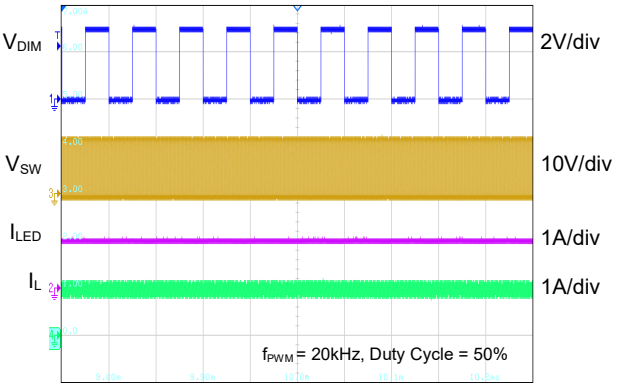
Time (1μs/div)

LED Current



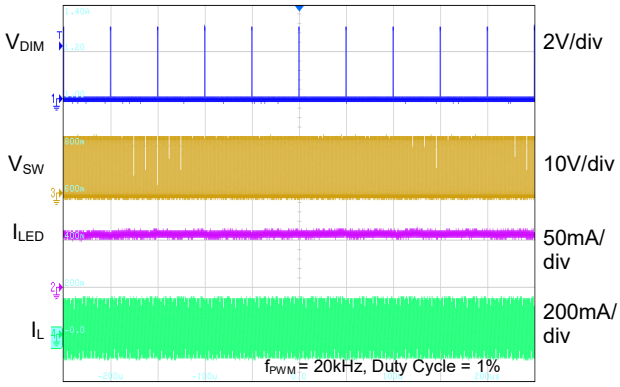
Time (50μs/div)

LED Current



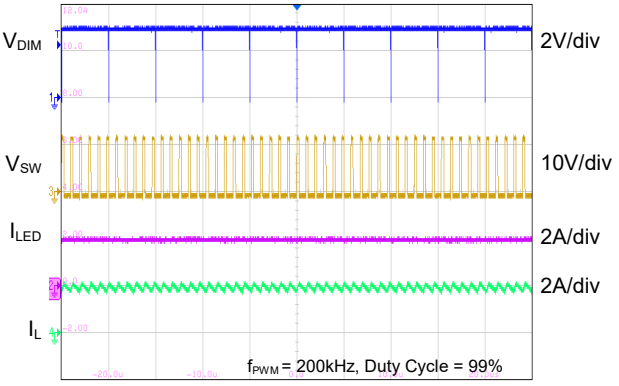
Time (50μs/div)

LED Current



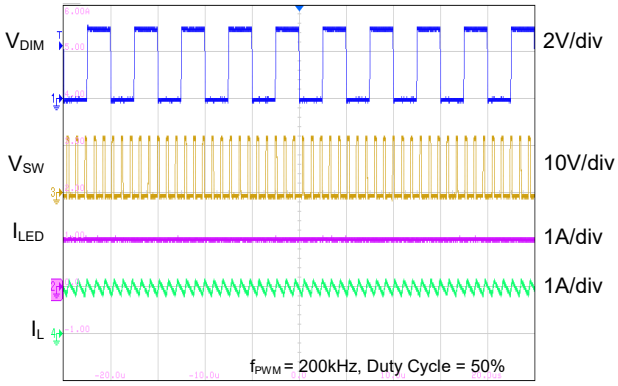
Time (50μs/div)

LED Current



Time (5μs/div)

LED Current

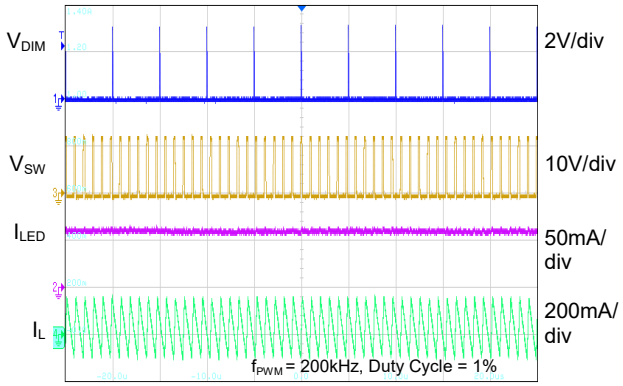


Time (5μs/div)

TYPICAL PERFORMANCE CHARACTERISTICS (continued)

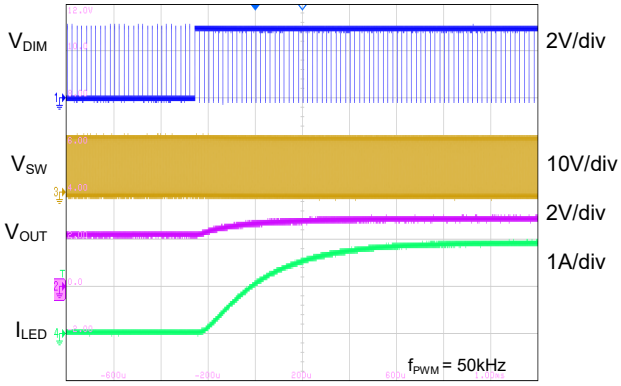
T_A = +25℃, V_{IN} = 12V, unless otherwise noted.

LED Current



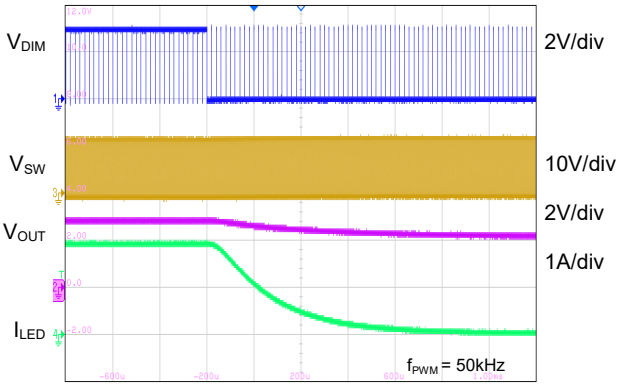
Time (5μs/div)

LED Current Transient from 1% to 99% Duty Cycle



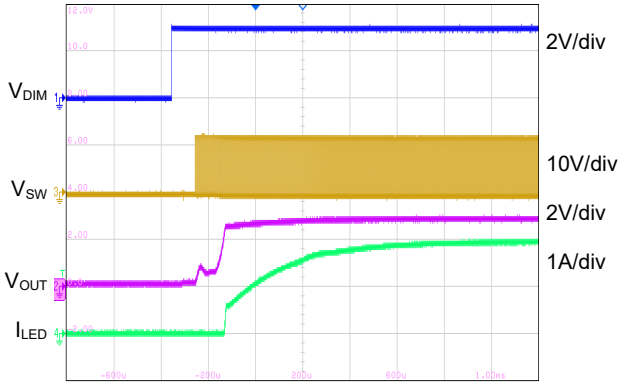
Time (200μs/div)

LED Current Transient from 99% to 1% Duty Cycle



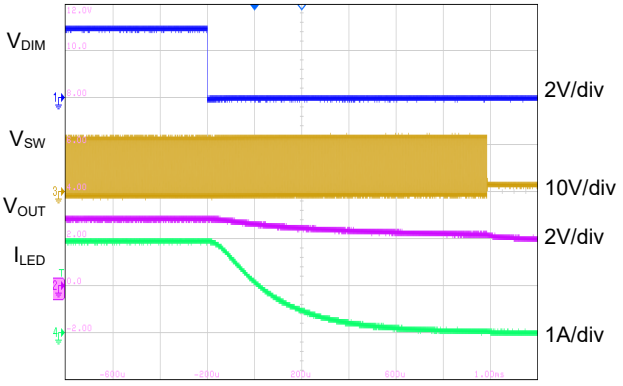
Time (200μs/div)

DIM Start-up



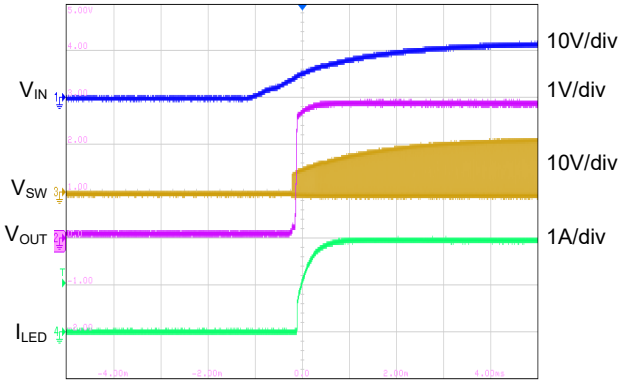
Time (200μs/div)

DIM Shutdown



Time (200μs/div)

VIN Start-up

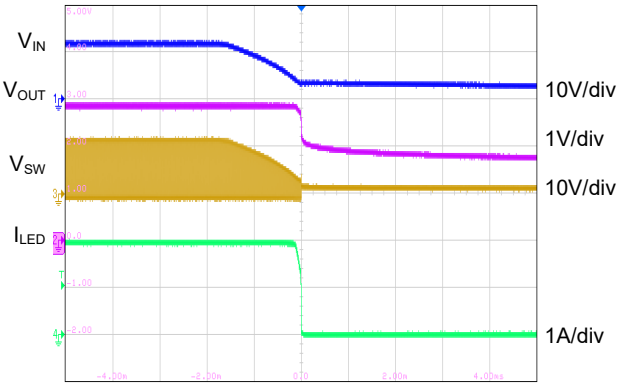


Time (1ms/div)

TYPICAL PERFORMANCE CHARACTERISTICS (continued)

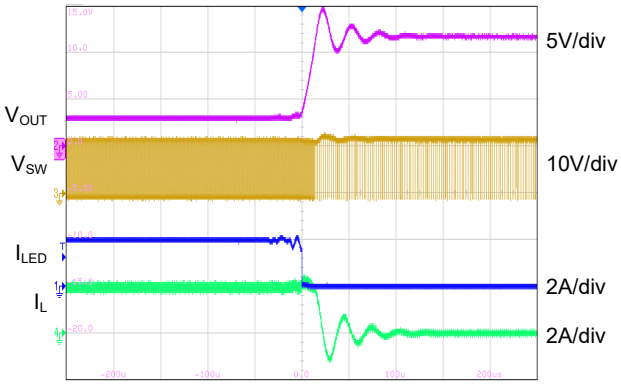
T_A = +25℃, V_{IN} = 12V, unless otherwise noted.

VIN Shutdown



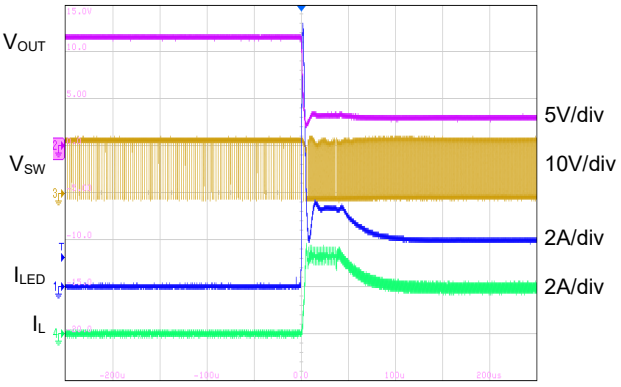
Time (1ms/div)

LED Open Entry



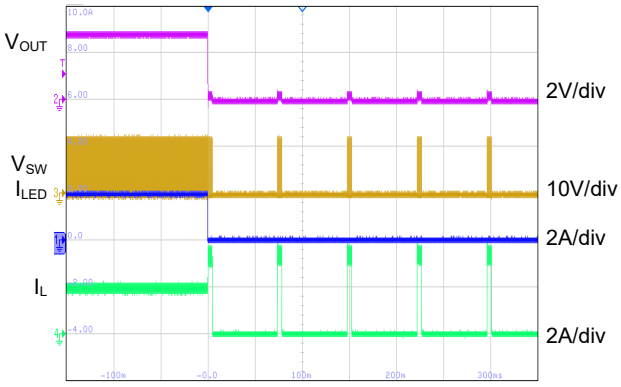
Time (50μs/div)

LED Open Recovery



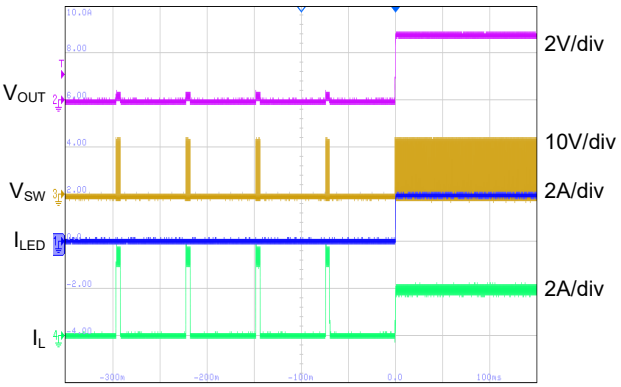
Time (50μs/div)

LED+ Short to GND Entry



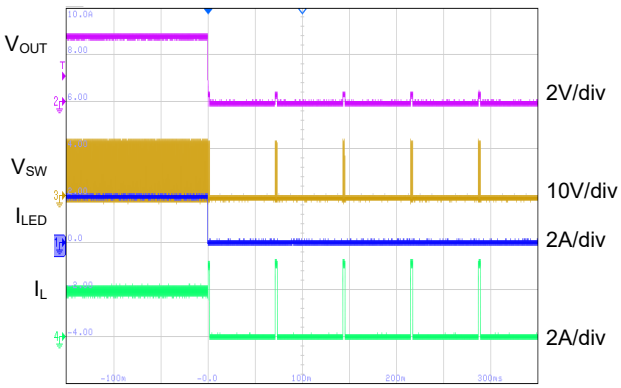
Time (50ms/div)

LED+ Short to GND Recovery



Time (50ms/div)

LED+ Short to LED- Entry

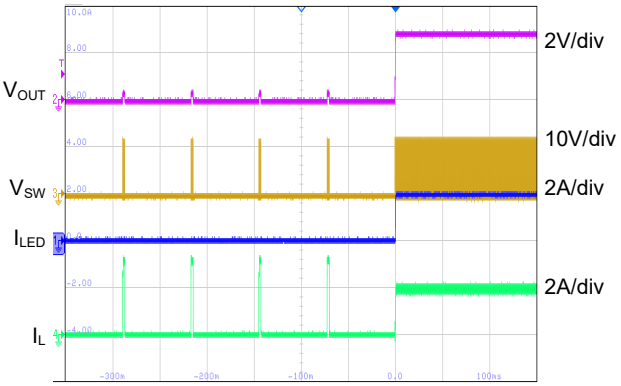


Time (50ms/div)

TYPICAL PERFORMANCE CHARACTERISTICS (continued)

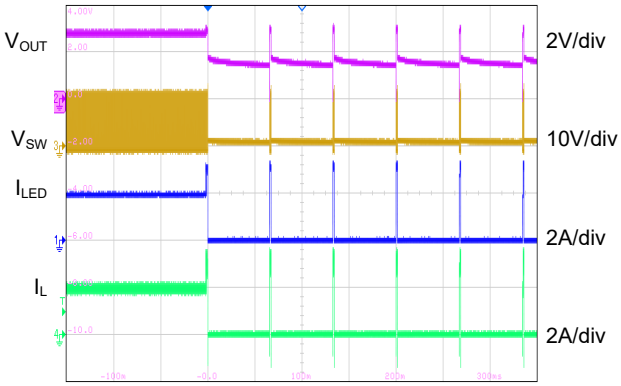
T_A = +25℃, V_{IN} = 12V, unless otherwise noted.

LED+ Short to LED- Recovery



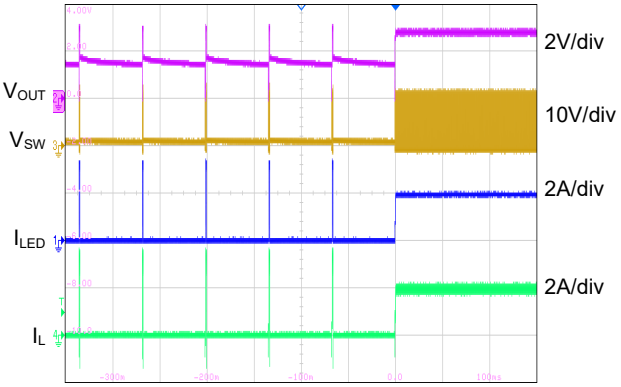
Time (50ms/div)

Sense-Resistor Short to GND Entry



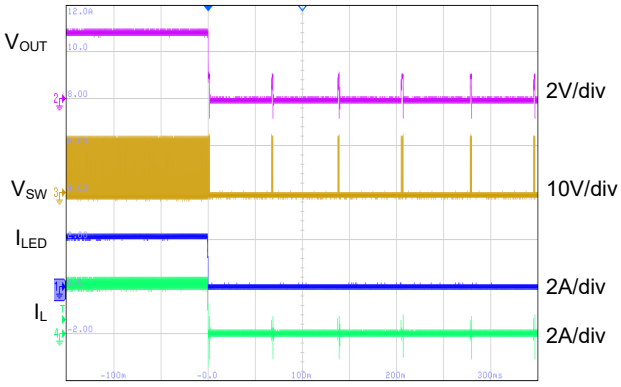
Time (50ms/div)

Sense-Resistor Short to GND Recovery



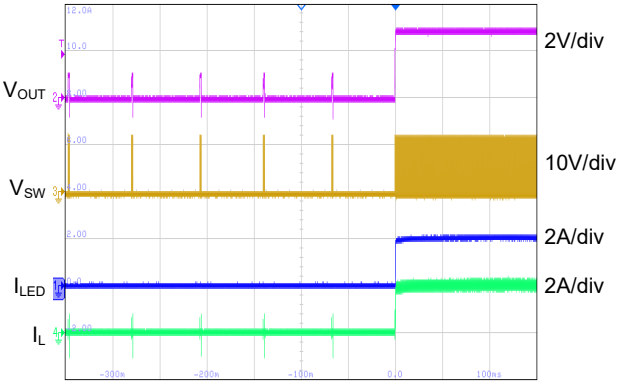
Time (50ms/div)

Sense-Resistor Open Load Entry



Time (50ms/div)

Sense-Resistor Open Load Recovery



Time (50ms/div)

FUNCTIONAL BLOCK DIAGRAM

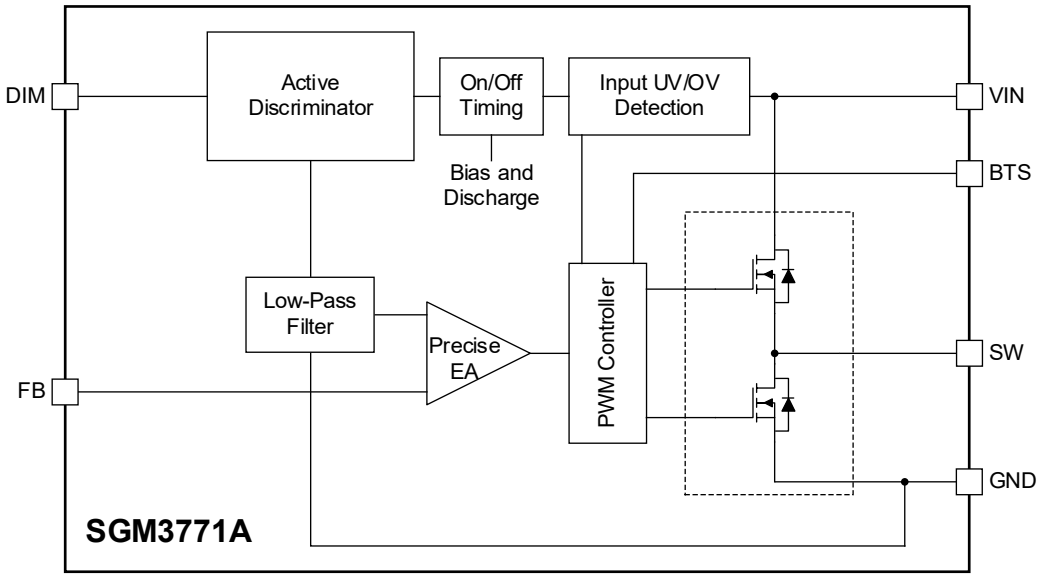


Figure 2. Block Diagram

DETAILED DESCRIPTION

The SGM3771A is a 2A synchronous Buck LED driver with up to 28V input voltage. It implements peak-current-mode control and integrates full compensation to regulate the LED current with high accuracy for LED lighting. The SGM3771A supports analog dimming with digital input, and the LED current is proportional to the duty cycle of the PWM input signal. The SGM3771A provides comprehensive protection features for safety, including the over-current protection with hiccup mode, LED+ short to GND, LED short and open, FB sense resistor short and open, and thermal shutdown.

Peak-Current Mode Control

The SGM3771A uses peak-current mode control to regulate the output current. The output current is sensed by the external sense resistor R_{SENSE}. The sensed voltage on the FB pin (V_{FB}) is compared with the internal reference voltage (V_{REF}) and the error is amplified by the internal error amplifier (EA). During each switching-on cycle, the internal high-side N-MOSFET (HSFET) current measured result (V_{HS_SENSE}) is compared with the EA output voltage (V_{EAO}). When the peak value of V_{HS_SENSE} reaches V_{EAO} (the slope compensation ramp is deducted from the EA output to avoid sub-harmonic oscillations), the HSFET is turned off and the low-side N-MOSFET (LSFET) is turned on after a short dead time. The LSFET remains on until next clock cycle coming or the negative current limit is triggered. The switching frequency is internally set to 1MHz (TYP).

Under-Voltage Lockout

The SGM3771A implements internal under-voltage lockout (UVLO) circuitry to control the device on or off. When the VIN voltage goes above the UVLO threshold (3.67V, TYP), the SGM3771A internal control circuit is enabled. The UVLO threshold has internal 220mV (TYP) hysteresis.

Enable and Dimming

To enable SGM3771A and achieve LED dimming, in addition to V_{IN} above the UVLO threshold, applying an active digital signal on the DIM pin is also needed. The amplitude of the digital signal must be higher than 1.3V for high-level and less than 0.3V for low-level. The PWM signal minimum on-time of high-level must be larger than 50ns. And the device can be disabled if the signal on DIM pin keeps lower than 0.3V for more than 1.12ms (TYP).

The SGM3771A supports the analog dimming mode with digital input signal. In this dimming mode, the internal reference voltage and LED current is changed proportionally to the duty cycle of the digital signal in the range from 1% to 100%. When the DIM pin is pulled constantly high (100% duty cycle), the internal reference voltage is fixed at 100mV (TYP). And the recommended frequency range for the digital signal is from 20kHz to 200kHz. The typical dimming curve is shown in Figure 3.

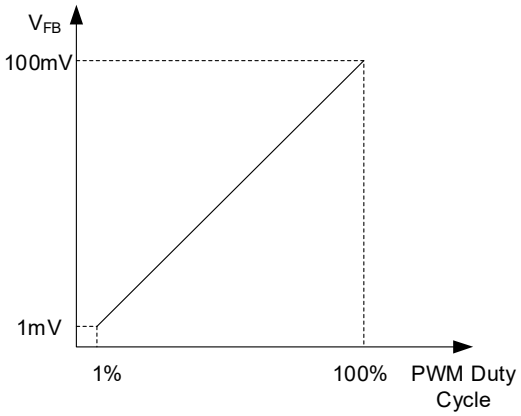


Figure 3. The Analog Dimming Curve with Digital Input

Bootstrap Voltage

The gate driver of the HSFET requires a voltage higher than V_{IN} that is present on its drain. A bootstrap voltage regulator is integrated to provide this voltage which is powered by bootstrapping through a small ceramic capacitor C_{BTS} placed between the BTS and SW pins. C_{BTS} is charged in each cycle when the LSFET is turned on (V_{SW} ≈ 0V) and discharges to the boot regulator when the HSFET is turned on (V_{SW} ≈ V_{IN}). A 0.1μF ceramic capacitor with 16V or higher rated voltage is recommended.

Soft-Start

The SGM3771A employs internal soft-start mechanism to control the LED current ramp slew rate. The internal soft-start time is 0.4ms (TYP) for 100% DIM signal duty cycle.

Output Discharge

The SGM3771A implements internal discharge mechanism to discharge output voltage when one of the following two events happens: VIN_UVLO and thermal shutdown.

DETAILED DESCRIPTION (continued)

Over-Current Protection

Cycle-by-cycle current limits for both peak and valley currents are included in SGM3771A. During each switching-on cycle, the internally measured HSFET current (I_{HS_SENSE}) is compared to the EA output (V_{EAO}). The V_{EAO} is clamped internally to set a fixed HSFET peak current limit (I_{LIM_HS}) to avoid overstress under OCP condition. Once I_{HS_SENSE} reaches I_{LIM_HS}, the HSFET is turned off immediately and the LSFET is turned on. At the end of each clock cycle, if the LSFET measured current (I_{LS_SENSE}) is higher than the valley current limit (I_{LIM_LS}), the LSFET remains on and the HSFET does not turn on. The HSFET turns on again until the I_{LS_SENSE} falls below I_{LIM_LS} and next clock comes.

If the output over-current condition occurs for more than 512 cycles, the device enters into hiccup mode. The device shuts down for 66ms (TYP) and then auto-restarts. If the over-current condition is still detected, a new hiccup cycle is repeated until the over-current condition disappears.

For SGM3771A, the inductor current can go negative at light load or discharge conditions. If the I_{LS_SENSE} exceeds the LSFET negative current limit ($I_{LIM_LS_N}$), the LSFET is turned off immediately to protect the LSFET from large current.

LED+ and GND Short-Circuit Protection

When LED+ is shorted to GND, the V_{FB} is much lower than internal V_{REF}, and internal V_{EAO} is up to its high clamp value. Then the HSFET peak current limit and LSFET valley current limit are triggered. The over-current protection and hiccup mode are active until the short condition is released.

LED+ and LED- Short-Circuit Protection

When LED+ and LED- are shorted, the V_{FB} is higher than internal V_{REF}, and the internal V_{EAO} drops to its low clamp value. In this case, the HSFET turns on for the minimum on-time during each switching-on cycle, and there are two possible cases for the protection behaviors.

Case 1: If the output voltage is too low, the inductor current runs high and is clamped by peak and valley current limit.

Case 2: If the V_{FB} is higher than V_{FB_OVP} rising threshold (140mV, TYP), the device enters into hiccup mode. And upon restart, the switching resumes until the V_{FB} falls below V_{FB_OVP} falling threshold (120mV, TYP). The device repeats these actions until the short condition is removed.

LED Open Load Protection

When LED load is open, the V_{FB} is much lower than internal V_{REF}, and internal V_{EAO} is up to its high clamp value. The output voltage is close to input voltage and the HSFET current slew rate is slow. Due to the slow slew rate and the high clamp V_{EAO}, the device works at the maximum duty cycle under this condition.

Sense Resistor Short-Circuit Protection

When FB pin is shorted to GND, the V_{FB} is lower than internal V_{REF}, and internal V_{EAO} is up to its high clamp value. Then the over-current protection and hiccup mode are triggered until the short condition is released.

Sense Resistor Open Load Protection

When the sense resistor between FB and GND is open, the V_{FB} is higher than internal V_{REF}, and the internal V_{EAO} drops to its low clamp value. In this case, the HSFET turns on for the minimum on-time during each switching-on cycle. If the V_{FB} is higher than V_{FB_OVP} rising threshold (140mV, TYP), the device enters into hiccup mode. And upon restart, the switching resumes until the V_{FB} falls below V_{FB_OVP} falling threshold (120mV, TYP). The device repeats these actions until the open condition is removed.

Thermal Shutdown

When the device junction temperature exceeds +160℃ (TYP), the SGM3771A shuts down to protect device from damaging due to overheating. The device recovers to normal operation when the junction temperature falls below +145℃ (TYP).

APPLICATION INFORMATION

Typical Application

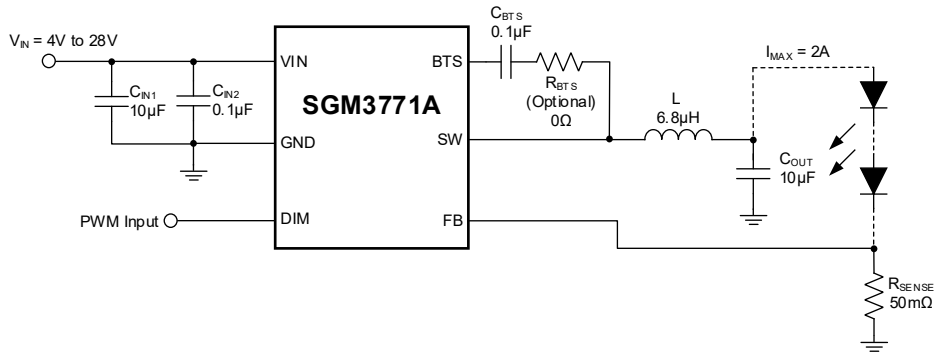


Figure 4. Typical Application Circuit

Input Capacitor Selection

For SGM3771A, a high-quality input capacitor (X5R, X7R or better) is required to reduce the surge current drawn from the input supply and the switching noise from the device. For most applications, it is recommended to use a 10μF input capacitor and an additional 0.1μF capacitor from VIN pin to GND to provide additional high-frequency filtering, and place them as close to the device as possible. The input capacitor voltage rating must be greater than the maximum input voltage.

Inductor Selection

For inductor selection, three main parameters that need to be concerned are inductance, saturation current and rated current. Larger inductance is a good choice for smaller inductor current ripple. However, it leads to higher cost and larger volume. The saturation current rating should exceed the peak current limit of the device, especially for high LED current application. The DCR is also an important factor for efficiency. If high efficiency is a critical requirement, a low DCR inductor should be selected.

To select the inductor, use Equation 1, 2 and 3 to calculate the inductance, inductor current ripple (ΔI_L) and inductor peak current (I_{PEAK}) respectively, where K is the ratio of ΔI_L to the LED current (I_{LED}). The recommended range of K is between 0.2 and 0.4.

$$L = \frac{(V_{IN} - V_{OUT}) \times V_{OUT}}{V_{IN} \times K \times I_{LED} \times f_{SW}} \quad (1)$$

$$\Delta I_L = \frac{(V_{IN} - V_{OUT}) \times V_{OUT}}{V_{IN} \times L \times f_{SW}} \quad (2)$$

$$I_{PEAK} = I_{LED} + \frac{\Delta I_L}{2} \quad (3)$$

For the design with V_{IN} = 12V, V_{OUT} = 6V, I_{LED} = 2A parameters, and by choosing K = 0.2, the calculated inductance will be 7.5μH. A 6.8μH or 8.2μH standard inductor is recommended for this application.

Output Capacitor Selection

The output capacitor is required to reduce the high frequency ripple current through the LED string. Use Equation 4 and 5 to calculate the required minimum effective output capacitance.

$$Z_{COUT} = \frac{(R_{LED} + R_{SENSE}) \times \Delta I_{LED}}{\Delta I_L - \Delta I_{LED}} \quad (4)$$

$$C_{OUT} = \frac{1}{2\pi \times f_{SW} \times Z_{COUT}} \quad (5)$$

where,

R_{LED} = the total dynamic resistance of the LED string, which can be referenced to the LED's datasheet.

ΔI_{LED} = the acceptable LED ripple current.

An output capacitor larger than the calculation result can be chosen due to the derating effect of applied DC voltage. For most applications, a 10μF output capacitor (X5R, X7R or better) with enough voltage rating is recommended.

APPLICATION INFORMATION (continued)

LED Maximum Current Setting

The LED maximum current, I_{MAX}, is determined by the FB sense resistor (R_{SENSE}). The feedback voltage is internally set to 100mV when the PWM duty cycle = 100%. Then the LED maximum current is programmed according to the following equation.

$$I_{MAX} = 100mV/R_{SENSE} \quad (6)$$

For SGM3771A, the LED maximum current is up to 2A, which means the minimum R_{SENSE} is 50mΩ. For accurate LED current settings, the sense resistor with 1% precision is recommended, and the power rating with enough margins should be concerned.

Bootstrap Capacitor Selection

A 0.1μF ceramic capacitor (X5R or X7R) with 16V or higher rated voltage is recommended between BTS and SW pins for supplying the internal HSFET gate drive voltage.

PCB Layout Considerations

Figure 5 shows an example of SGM3771A PCB layout. The following PCB layout design guidelines are recommended:

- The input capacitors must be placed as close as possible to the VIN pin and GND pin of the device.
- Minimize the feedback trace length and keep it away from the noisy nodes (SW).
- The SW trace must be kept as short as possible to reduce radiated noise and EMI.
- Create sufficiently wide VIN and GND plane area to reduce trace impedance. The wide traces have an additional advantage of providing excellent heat dissipation.
- The thermal vias can be used to connect the top layer to the bottom layer for good heat dissipation.

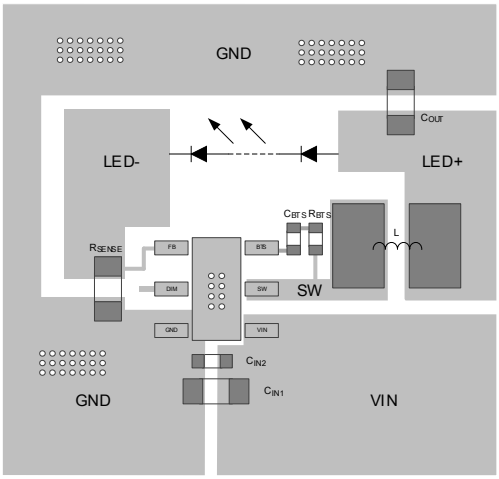


Figure 5. Layout Example

REVISION HISTORY

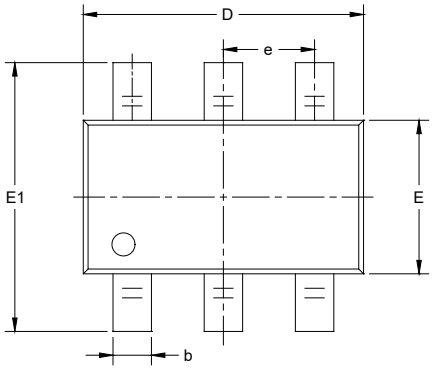
NOTE: Page numbers for previous revisions may differ from page numbers in the current version.

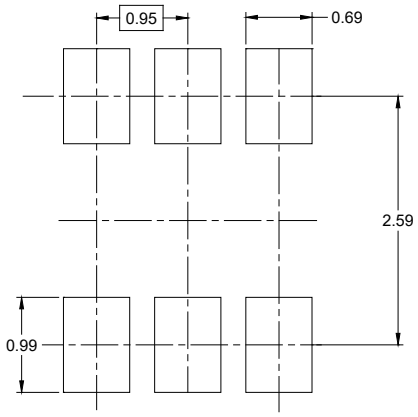
SEPTEMBER 2026 – REV.A to REV.A.1	Page
Updated the test conditions of I_{SD}, I_Q, R_{DSON_HS}, R_{DSON_LS} in ELECTRICAL CHARACTERISTICS section	4

Changes from Original to REV.A (JULY 2026)	Page
Changed from product preview to production data	All

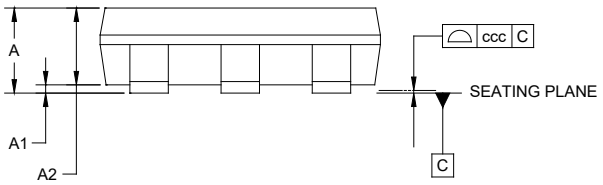
PACKAGE OUTLINE DIMENSIONS

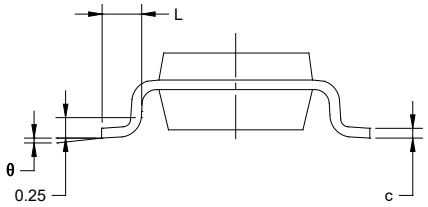
TSOT-23-6





RECOMMENDED LAND PATTERN (Unit: mm)



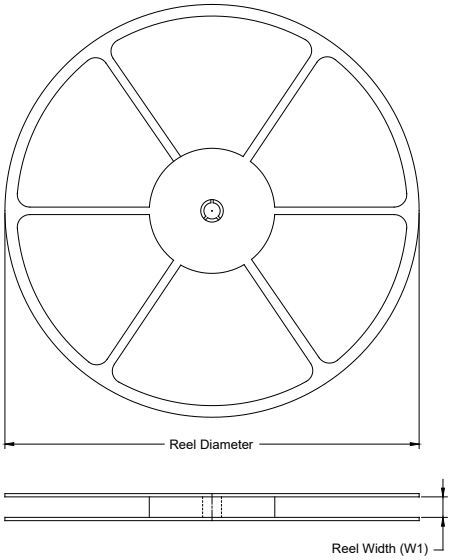


Symbol	Dimensions In Millimeters		
	MIN	NOM	MAX
A	-	-	1.100
A1	0.000	-	0.100
A2	0.700		1.000
b	0.300	-	0.500
c	0.080		0.200
D	2.750	-	3.050
E	1.450	-	1.750
E1	2.600	-	3.000
e	0.950 BSC		
L	0.300	-	0.600
θ	0°	-	8°
ccc	0.100		

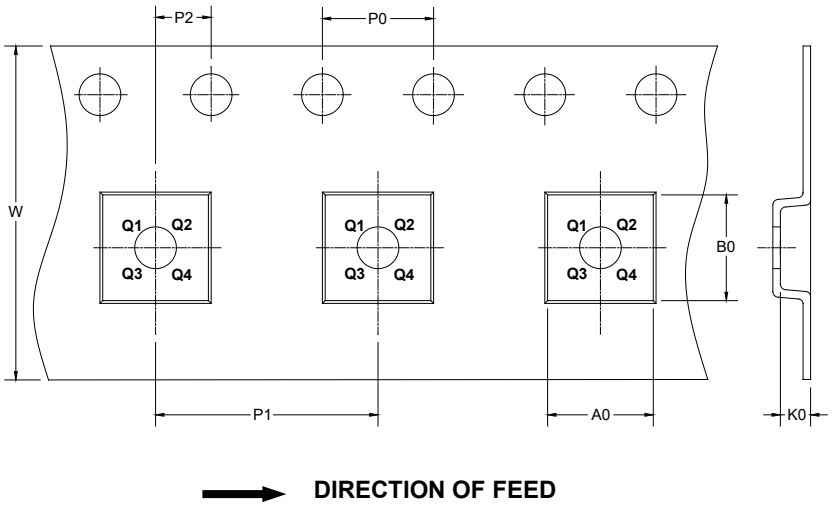
NOTES:
1. This drawing is subject to change without notice.
2. The dimensions do not include mold flashes, protrusions or gate burrs.
3. Reference JEDEC MO-193.

TAPE AND REEL INFORMATION

REEL DIMENSIONS



TAPE DIMENSIONS



DIRECTION OF FEED

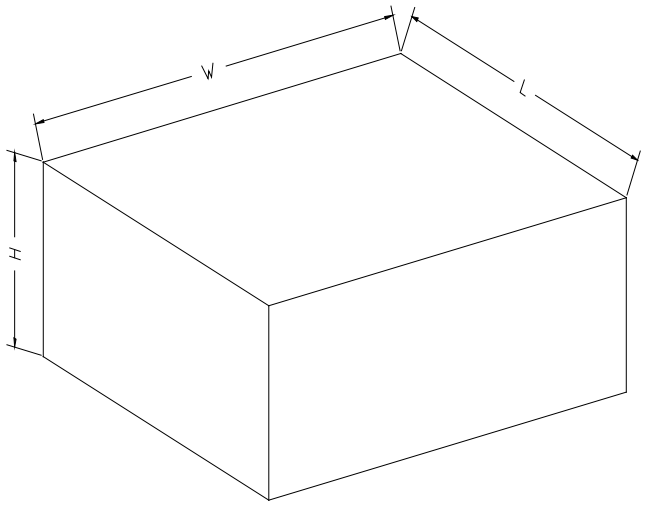
NOTE: The picture is only for reference. Please make the object as the standard.

KEY PARAMETER LIST OF TAPE AND REEL

Package Type	Reel Diameter	Reel Width W1 (mm)	A0 (mm)	B0 (mm)	K0 (mm)	P0 (mm)	P1 (mm)	P2 (mm)	W (mm)	Pin1 Quadrant
TSOT-23-6	7"	9.5	3.20	3.10	1.10	4.0	4.0	2.0	8.0	Q3

DD0001

CARTON BOX DIMENSIONS



NOTE: The picture is only for reference. Please make the object as the standard.

KEY PARAMETER LIST OF CARTON BOX

Reel Type	Length (mm)	Width (mm)	Height (mm)	Pizza/Carton
7″ (Option)	368	227	224	8
7″	442	410	224	18

DD0002