Inductance Free, 1.5A Flash LED Driver

Features

- Programmable 1.5A LED Current Source
  - Flash: 2.94mA~1.5A, 256 levels 5.87mA/level
  - Torch: 0.73mA~375mA, 256 levels 1.47mA/level
  - Flash Timeout: 40ms~1.6s, 16 levels
  - Flash/Torch/IR Mode
- Optimized Flash LED Current During Low Battery Conditions (IVFM)
- Hardware Flash/Torch Enable (STROBE/TORCH)
- 400kHz I²C: AW36411 (I²C Address=0x63)
- 0.35mm Pitch, WLCSP 1.39mm×0.91mm×0.463mm -8B Package

Application

Smartphone Camera Flash

General Description

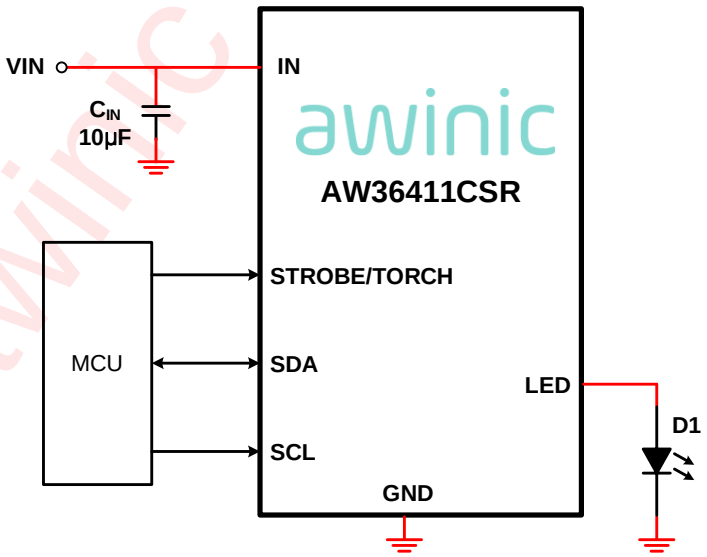
The AW36411 is a single channel LED flash driver that provides a high level of adjustability within a small solution size. The AW36411 can provide up to 1.5A flash current and up to 375mA torch current. There are 256 levels current sources provide the flexibility to adjust the current of LED in Flash/Torch/IR modes.

The AW36411 are controlled via an I²C - compatible interface. The main features of the AW36411 include: programmable flash/torch current, flash timeout duration, UVLO and IVFM. The AW36411 also provides hardware flash/torch pin (STROBE/TORCH) to control Flash/Torch events.

The device operates over a –40°C to +85°C ambient temperature range.

The AW36411 is available in small 0.35mm pitch WLCSP 1.39mm×0.91mm×0.463mm-8B package.

Typical Application Circuit



Typical Application Circuit of AW36411

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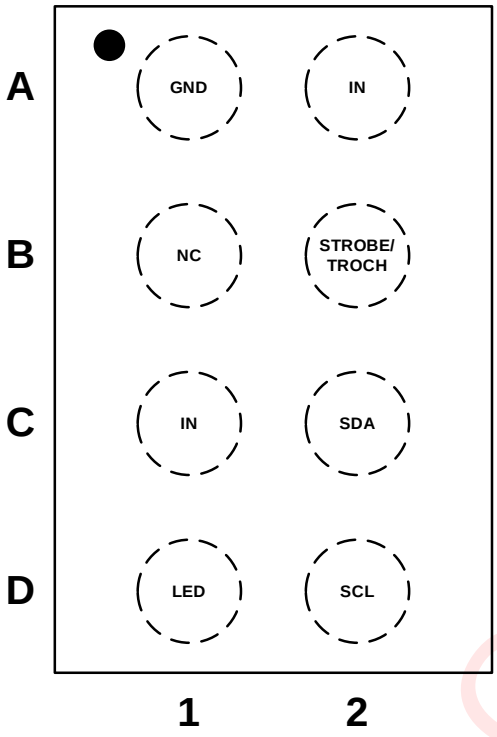
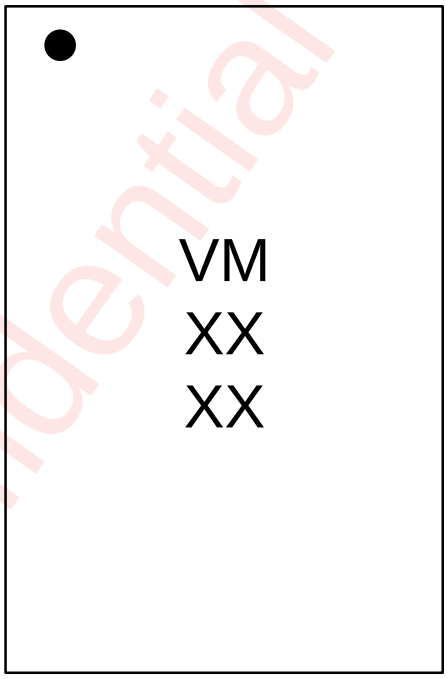
Pin Configuration And Top Mark

AW36411CSR (Top View)



AW36411CSR Marking (Top View)



VM – AW36411CSR
XX/XX – Production Tracing Code

Pin Configuration and Top Mark

Pin Definition

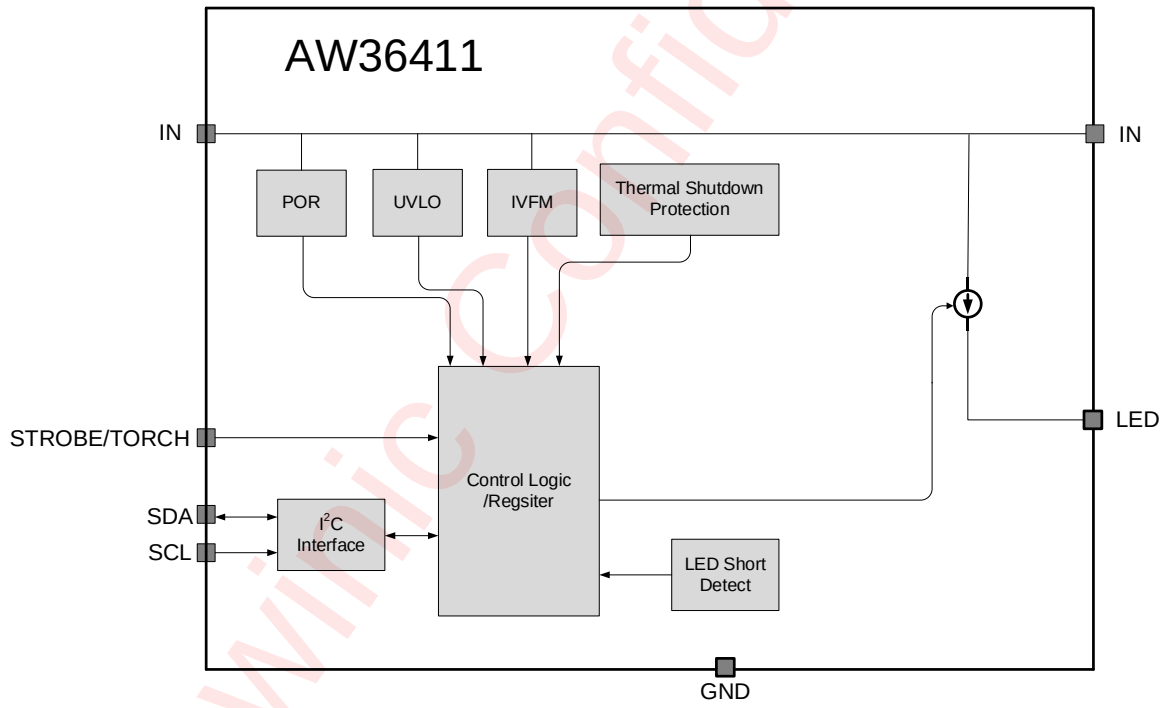
No.	NAME	TYPE	DESCRIPTION
A1	GND	Ground	Ground
A2, C1	IN	Power	Input voltage connection. Connect IN to GND with a 10μF or larger ceramic capacitor.
B1	NC	-	No connect
B2	STROBE/TORCH	I/O	Active high hardware flash/torch/IR enable. Drive STROBE/TORCH high to turn on Flash/Torch/IR pulse. Internal pull down resistor of 300kΩ between STROBE/TORCH and GND.
C2	SDA	I/O	Serial data input/output of the I^2C interface.
D1	LED	Power	High-side current source output for flash LED.
D2	SCL	I/O	Serial clock input of the I^2C interface.

AWINIC Flash LED Driver Series

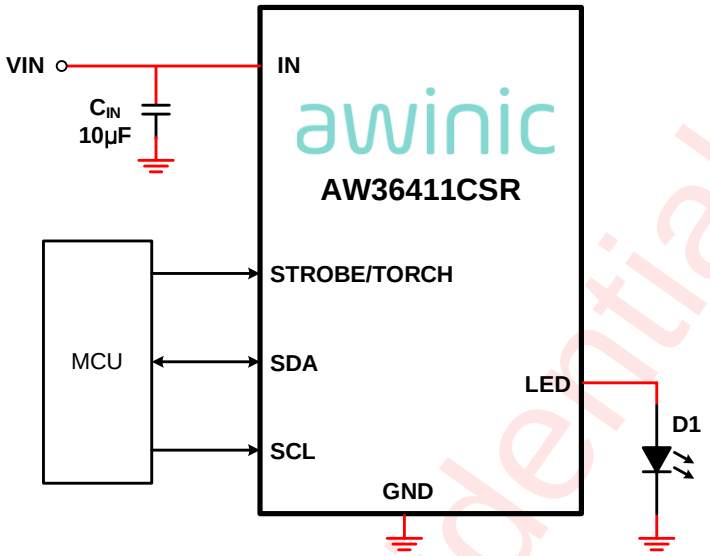
Product	Channels	Type	Description	Package
AW36411	1	Inductorless	Inductance Free, 1.5A Flash LED Driver	WLCSP-8B
AW36410	1	Boost	High Efficiency, 1.5A Flash LED Driver	WLCSP-8B
AW36515E	2	Boost	High Efficiency, Dual Independent 2A Flash LED Driver	FCQFN-10L
AW36514E	2	Boost	High Efficiency, Dual Independent 1.5A Flash LED Driver	FCQFN-10L
AW36518E	1	Boost	High Efficiency, 1.5A Flash LED Driver	FCQFN-10L
AW36515A	2	Boost	High Efficiency, Dual Independent 2A Flash LED Driver	FCQFN-10L
AW36514A	2	Boost	High Efficiency, Dual Independent 1.5A Flash LED Driver	FCQFN-10L
AW36518A	1	Boost	High Efficiency, 1.5A Flash LED Driver	FCQFN-10L
AW36515	2	Boost	High Efficiency, Dual Independent 2A Flash LED Driver	FCQFN-10L
AW36514	2	Boost	High Efficiency, Dual Independent 1.5A Flash LED Driver	FCQFN-10L
AW36518	1	Boost	High Efficiency, 1.5A Flash LED Driver	FCQFN-10L
AW3644	2	Boost	High Efficiency, Dual Independent 1.5A Flash LED Driver	CSP-12B
AW3643	2	Boost	High Efficiency, Dual 1.5A Flash LED Driver	CSP-12B
AW36413	2	Boost	High Efficiency, Dual 1.5A Flash LED Driver	CSP-12B
AW3648	1	Boost	High Efficiency, 1.5A Flash LED Driver	CSP-12B
AW3642	1	Boost	High Efficiency, 1.5A Flash LED Driver	CSP-9B
AW3641E	1	Charge Pump	Flash Current & Flash Timer Programmable 1A Flash LED Driver	DFN-10L
AW36402	1	Current Sink	200mA 1-wire Configurable Front Flash LED Driver with Ultra Small Package	DFN-6L
AW36404	1	Current Sink	400mA 1-wire Configurable Front Flash LED Driver with Ultra Small Package	DFN-8L
AW36406	1	Current Sink	600mA PWM Configurable Front Flash LED Driver with Ultra Small Package	DFN-8L
AW36428	1	Inductorless	Inductorless Single Channel 1.5A Flash LED Driver	FCQFN-10L
AW36528	1	Inductorless	Inductorless Single Channel Flash & Indicator 2in1 LED Driver	FCQFN-10L

AW36423	2	Inductorless	Inductorless Dual Channel 1.0A Flash LED Driver	FCQFN-10L
AW36523	2	Inductorless	Inductorless Dual Channel Flash & Indicator 2in1 LED Driver	FCQFN-10L
AW36426	3	Inductorless	Inductorless Triple Channel 1.0A Flash LED Driver	FCQFN-10L
AW36526	3	Inductorless	Inductorless Triple Channel Flash & Indicator 2in1 LED Driver	FCQFN-10L
AW36429	4	Inductorless	Inductorless Four Channel 1.0A Flash LED Driver	FCQFN-10L
AW36529	4	Inductorless	Inductorless Four Channel Flash & Indicator 2in1 LED Driver	FCQFN-10L

Functional Block Diagram



Typical Application Circuits



AW36411 Application Circuit

Notice for Typical Application Circuits:

1: Please place C_{IN} as close to the chip as possible.

2: For the sake of driving capability, the power lines and the connection lines of LED should be short and wide as possible.

3: Traces carry high current are marked in red in the above figure.

Ordering Information

Part Number	Temperature	Package	Marking	Moisture Sensitivity Level	Environmental Information	Delivery Form
AW36411CSR	-40°C~85°C	WLCSP 1.39mm×0.91 mm×0.463mm -8B	VM	MSL1	ROHS+HF	4500 units/ Tape and Reel

Absolute Maximum Ratings(NOTE1)

PARAMETERS		Range	Unit
IN, LED		-0.3 to 6	V
SCL, SDA, STROBE/TORCH		−0.3 to (VIN+0.3)	V
Continuous power dissipation(NOTE2)		Internally limited	
Max Junction Temperature T_{JMAX}		155	°C
Storage Temperature T_{STG}		-65 to 150	°C
Maximum lead temperature (soldering)		260	°C
Junction to Ambient Thermal Resistance θ_{JA}		101	°C /W
ESD, All Pins(NOTE3)	HBM	±2000	V
	CDM	±1500	V
Latch-Up (Test method: JEDEC JESD78F-2022)		+IT: +200 -IT: -200	mA

Recommended Operating Conditions

PARAMETERS	Range	Unit
V_{IN}	2.7 to 5.5	V
Junction temperature (T_J)	-40 to 125	°C
Ambient temperature (T_A)	-40 to 85	°C

NOTE1: *Conditions out of those ranges listed in "absolute maximum ratings" may cause permanent damages to the device. In spite of the limits above, functional operation conditions of the device should within the ranges listed in "recommended operating conditions". Exposure to absolute-maximum-rated conditions for prolonged periods may affect device reliability.*

NOTE2: *Internal thermal shutdown function to avoid the device damage. Thermal shutdown is triggered at Tj=155°C； Released at Tj=135°C. Thermal shutdown is guaranteed by design.*

NOTE3: *The human body model is a 100pF capacitor discharged through a 1.5kΩ resistor into each pin. Test method: ANSI/ESDA/JEDEC JS-001-2017. CDM test method: ANSI/ESDA/JEDEC JS-002-2020.*

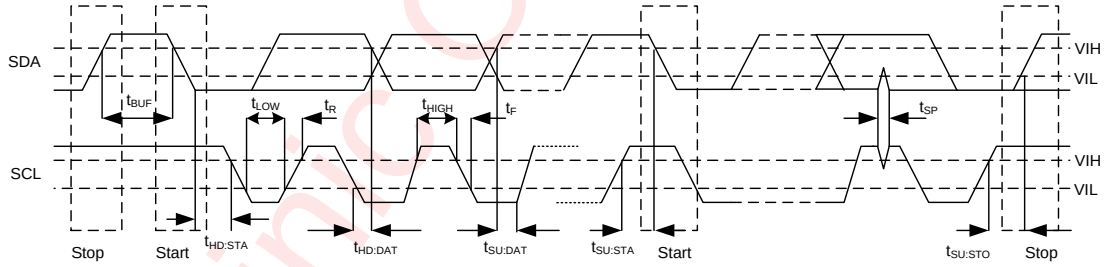
Electrical Characteristics

Ambient temperature is 25°C, input voltage is 3.6 V, C_{IN}=10 µF and L=1 µH, unless otherwise noted.

Symbol	Description	Test Condition	Min	Typ	Max	Unit
Vin Supply						
V_{IN}	Input operating range		2.7		5.5	V
I_Q	Quiescent supply current	Device not switching, pass mode		0.4	0.8	mA
I_{SB}	Standby supply current	Device disabled, 2.7V≤VIN≤5.5V,SCL=SDA=0V		3	10	µA
UVLO	Under voltage lockout threshold	Falling V_{IN}		2.5		V
		Rising V_{IN}		2.6		V
Current Source Specifications						
I_{LED}	Current source accuracy	V_{IN}=4V, flash code=0xFF ILED=1.5A	1.4	1.5	1.6	A
		V_{IN}=4V, torch code=0x7F ILED=187.4mA	168.7	187.4	206.2	mA
V_{HR_LED}	Headroom voltage of LED	flash code=0xFF, ILED=1.5A		400		mV
		torch code=0xFF, ILED=375mA		260		mV
V_{IVFM}	Input voltage flash monitor trip threshold	Reg 0x02, bits[5:3]="000"	2.81	2.9	2.99	V
T_{SD}	Thermal shutdown threshold			155		°C
	Thermal shutdown hysteresis			20		
I²C-Compatible Interface Specifications(SCL,SDA)						
V_{IL}	Input logic low		0		0.36	V
V_{IH}	Input logic high		0.84		V_{IN}	V
V_{OL}	Output logic low	I_{LOAD}=3mA			0.4	V
STROBE/TORCH Voltage Specifications						
V_{IL}	Input logic low		0		0.36	V
V_{IH}	Input logic high		0.84		V_{IN}	V
R_{PD}	Internal pull down resistors			300		kΩ

I²C Interface Timing

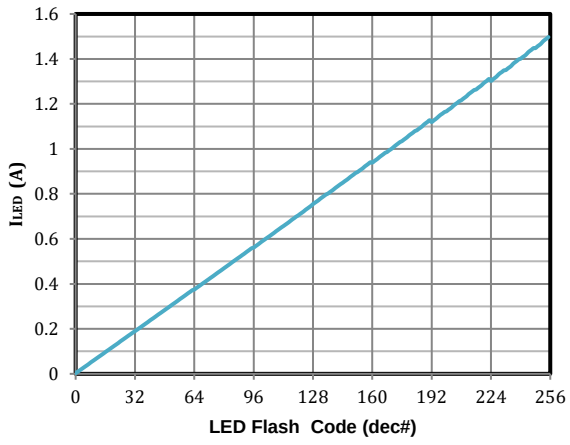
Symbol	Description		Min	Typ	Max	Units
F_{SCL}	Interface Clock frequency				400	kHz
$T_{DEGLITCH}$	Deglitch time	SCL		200		ns
		SDA		250		ns
$T_{HD:STA}$	(Repeat-start) Start condition hold time		0.6			μs
T_{LOW}	Low level width of SCL		1.3			μs
T_{HIGH}	High level width of SCL		0.6			μs
$T_{SU:STA}$	(Repeat-start) Start condition setup time		0.6			μs
$T_{HD:DAT}$	Data hold time		0			μs
$T_{SU:DAT}$	Data setup time		0.1			μs
T_R	Rising time of SDA and SCL				0.3	μs
T_F	Falling time of SDA and SCL				0.3	μs
$T_{SU:STO}$	Stop condition setup time		0.6			μs
T_{BUF}	Time between start and stop condition		1.3			μs



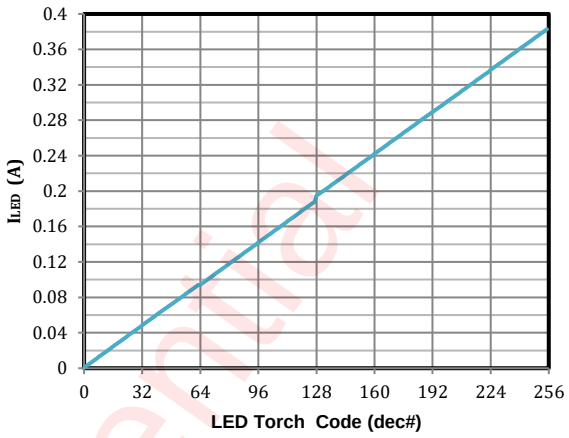
I²C INTERFACE TIMING

Typical Characteristics

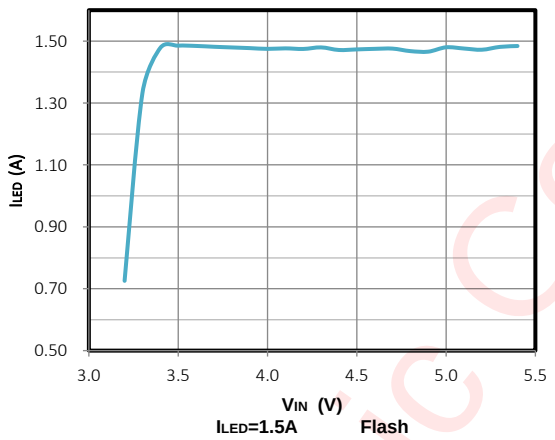
Ambient temperature is 25°C, input voltage is 3.6 V, C_{IN}=10 µF and L=1 µH, unless otherwise noted.



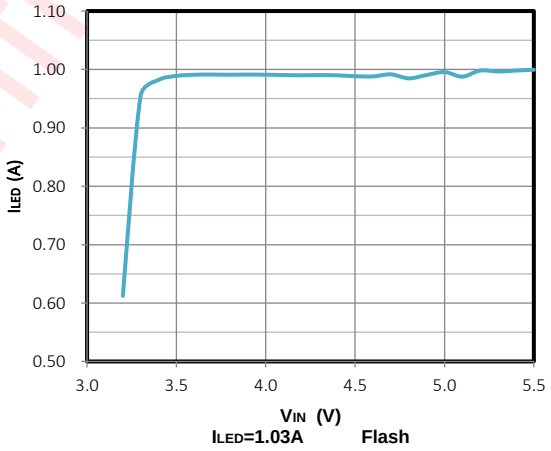
LED Flash Current vs Brightness Code



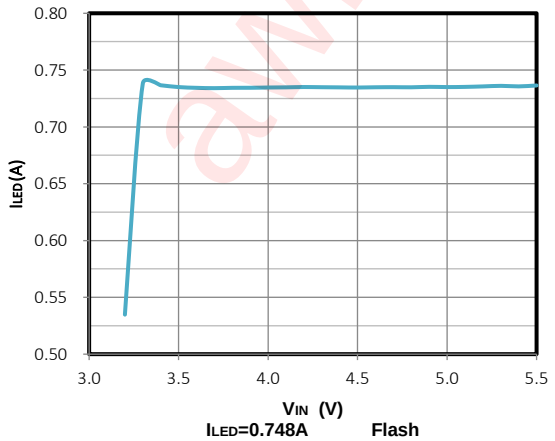
LED Torch Current vs Brightness Code



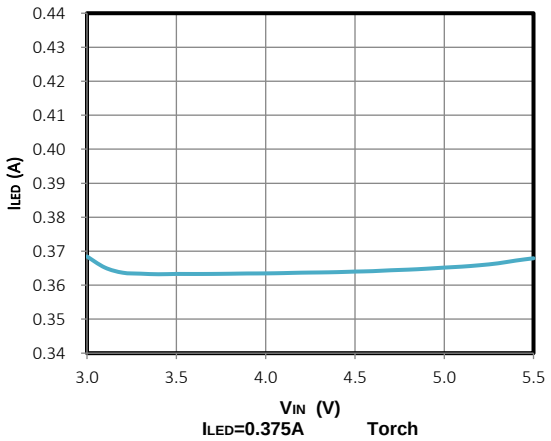
LED Flash Current vs Input Voltage



LED Flash Current vs Input Voltage

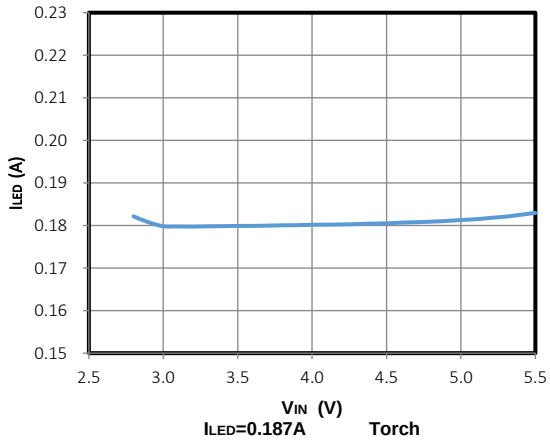


LED Flash Current vs Input Voltage

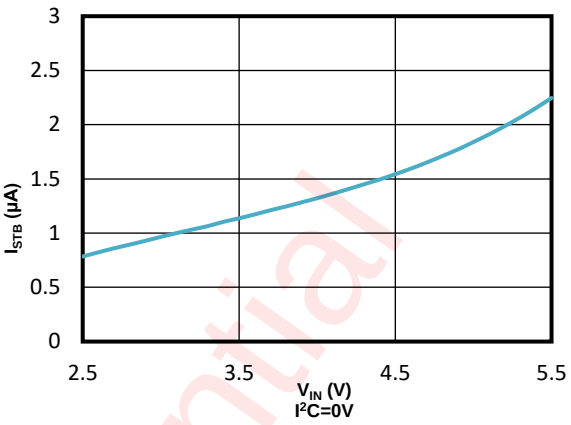


LED Torch Current vs Input Voltage

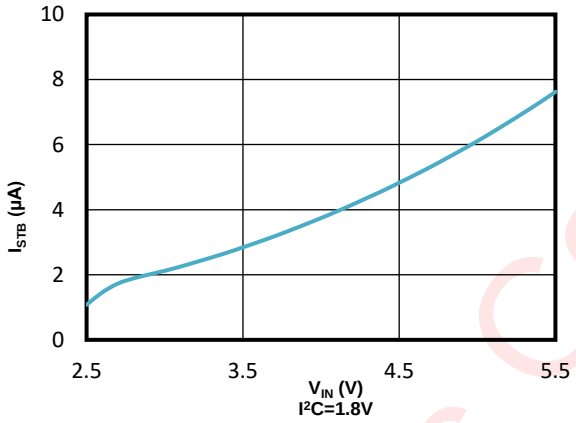
Ambient temperature is 25°C, input voltage is 3.6 V, C_{IN}=10 μF and L=1 μH, unless otherwise noted .



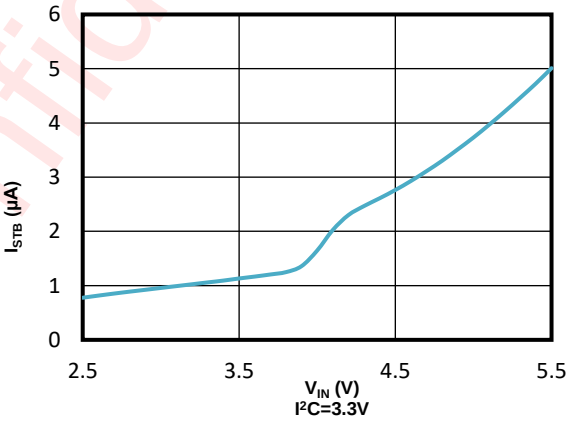
LED Torch Current vs Input Voltage



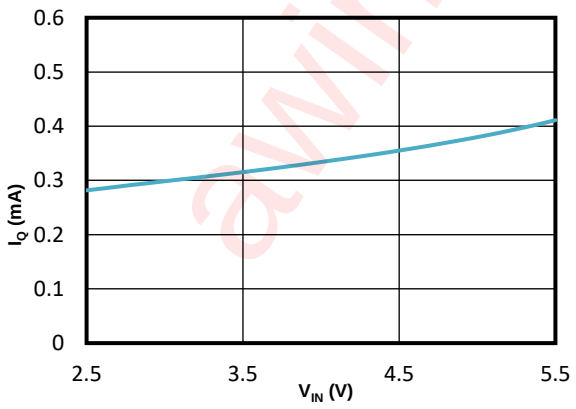
Standby Current vs Input Voltage



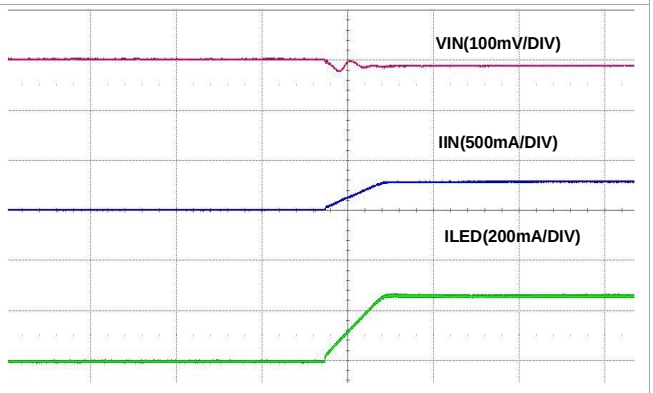
Standby Current vs Input Voltage



Standby Current vs Input Voltage

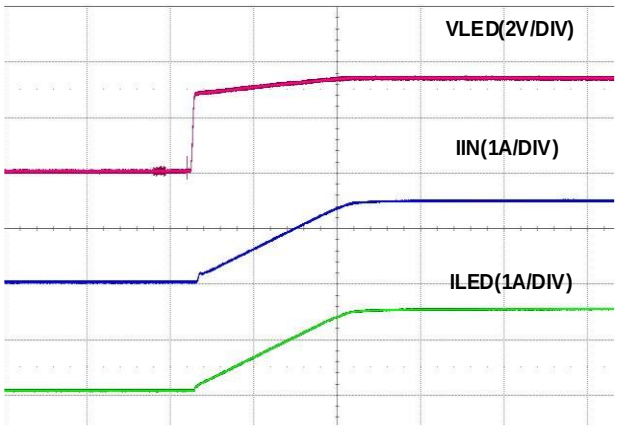


Quiescent Supply Current vs Input Voltage

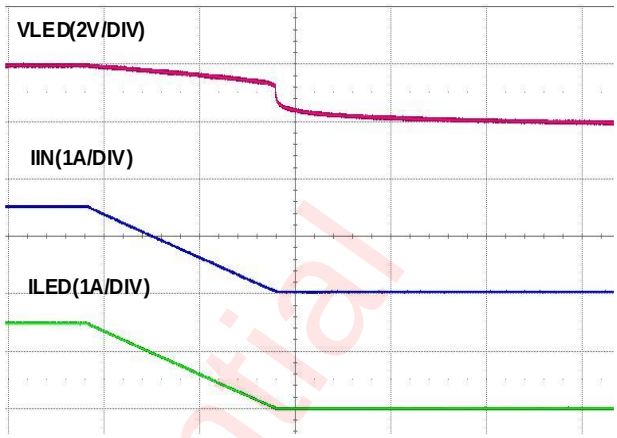


IVFM-Stop and Hold

Ambient temperature is 25°C, input voltage is 3.6 V, C_{IN}=10 μF and L=1 μH, unless otherwise noted .



Ramp Up



Ramp Down

Detailed Functional Description

The AW36411 is a high-power LED flash driver capable of delivering up to 1.5A to the LED over the 2.7V to 5.5V input voltage range.

The AW36411 has a reusable hardware Flash/Torch Enable (STROBE/TORCH). The logic input has internal 300kΩ (typical) pull-down resistors to GND.

Control is done via an I²C-compatible interface. This includes adjustment of the Flash and Torch current levels, changing the Flash Timeout Duration, and changing the switch current limit. Additionally, there are flag and status bits that indicate flash current timeout, LED over-temperature condition, LED failure (open/short), device thermal shutdown, and VIN under-voltage conditions.

Features Description

Power On Reset

When the supply voltage VIN drops below a predefined voltage VPOR (2.0V typical), the device generates a reset signal to perform a power-on reset operation, which will reset all control circuits and configuration registers.

Once VIN goes above around VPOR (2.0V typical), it should stay high for at least 2ms time before any I²C command can be accepted.

Software Reset

By setting bit[7](Software Reset Bit) to a '1' in the Reset Configuration Register(0x07) via I²C interface will reset the AW36411 internal circuit and all configuration registers, after the soft reset command is input through I²C, it needs to wait at least 2ms before any other I²C command can be accepted.

Flash Mode

In Flash Mode, the LED current source provides 256 target current levels from 2.94mA to 1.5A. The Flash currents are adjusted via the LED Flash Brightness Registers. Flash mode is activated by the Enable Register(setting M1, M0 to '11'), or by pulling the STROBE/TORCH pin HIGH when bit[5] (Strobe Enable Bit) is '1' in the Enable Register(0x01). Once the Flash sequence is activated the current source ramps up to the programmed Flash current by stepping through all current steps until the programmed current is reached.

When the device is enabled in Flash Mode through the Enable Register, all mode bits in the Enable Register are cleared after a flash timeout event.

Torch Mode

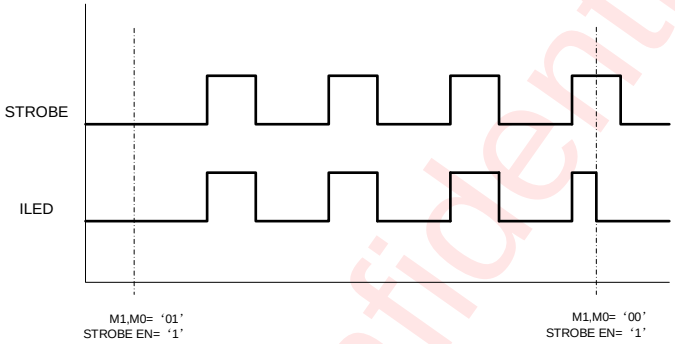
In Torch mode, the LED current source provides 256 target current levels from 0.73mA to 375mA . The Torch currents are adjusted via the LED Torch Brightness Register. Torch mode is activated by the Enable Register (setting M1, M0 to '10'), or by pulling the STROBE/TORCH pin HIGH when bit[4] (Torch Enable Bit) is '1' in the Enable Register(0x01). Once the TORCH sequence is activated the active current source ramps up to the programmed Torch current by stepping through all current steps until the programmed current is reached. The rate at which the current ramps is determined by the value chosen in the Timing Register.

AW36411 will execute flash operation when both bit[4] and bit[5] are '1' in the Enable Register with pulling the STROBE/TORCH pin HIGH.

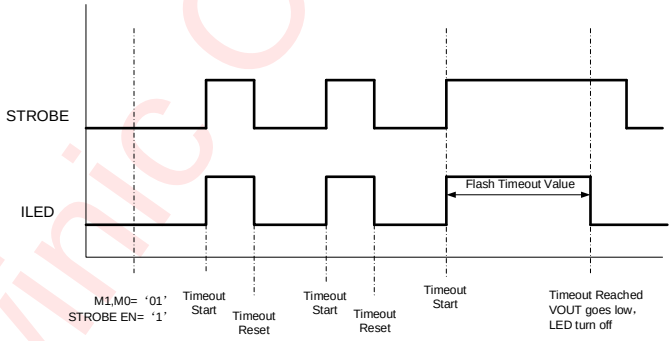
Torch Mode is not affected by Flash Timeout.

IR Mode

In IR Mode, Enable register bit[3:2] should be to ‘01’ (setting M1, M0 to '01') and the STROBE/TORCH pin should be enabled(Strobe Enable Bit). The target LED current is equal to the value stored in the LED Flash Brightness Registers. The STROBE/TORCH pin can only be set to be Level sensitive, meaning all timing of the IR pulse is externally controlled, but it is still protected by flash time-out if STROBE width is too long. In IR Mode, the current sources do not ramp the LED output to the target. LED is enabled to the full current setting without delay or slow ramp during STROBE rising edge, and they are fully turned off immediately without delay or slow ramp during STROBE falling edge.

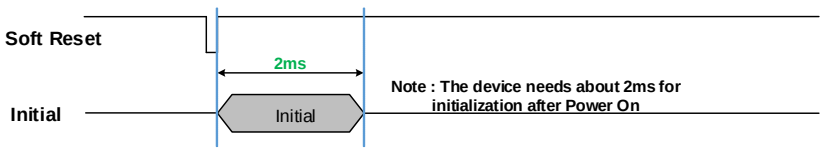


IR Mode

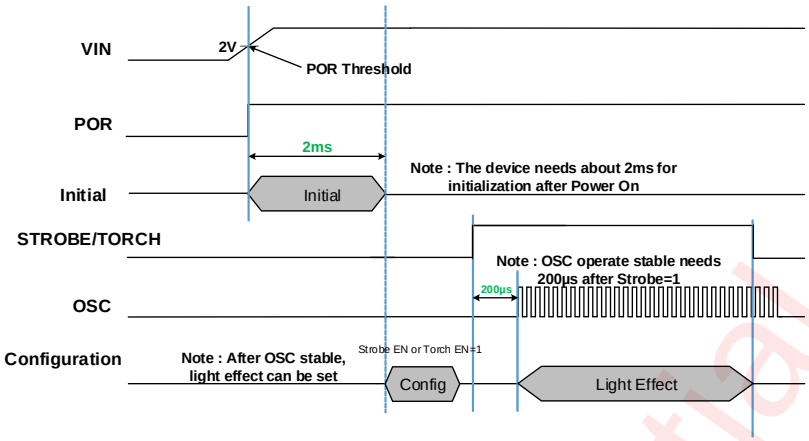


IR Mode Timeout

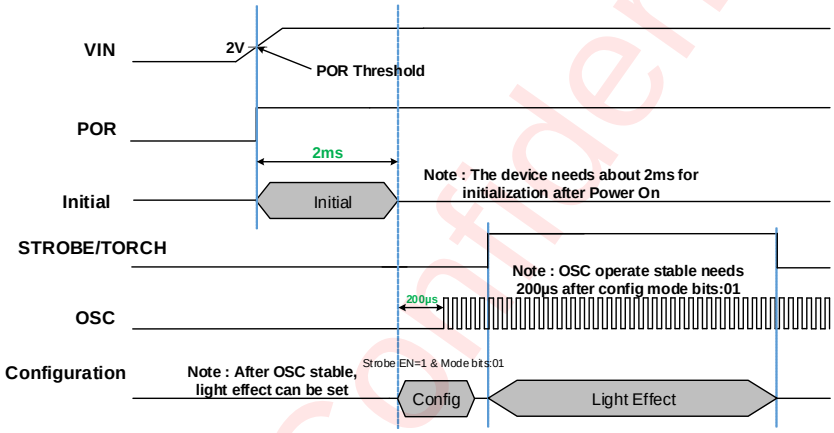
Timing Diagram



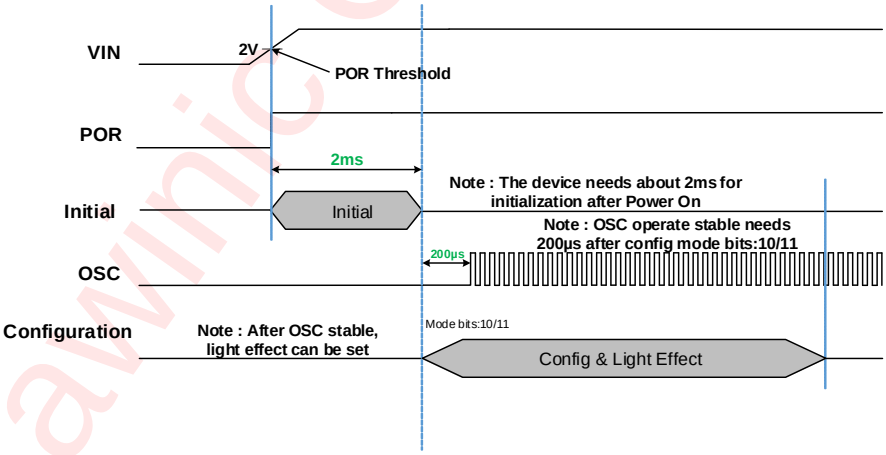
Soft Reset



Ext Torch/Flash



Ext IR



Int Torch/Flash

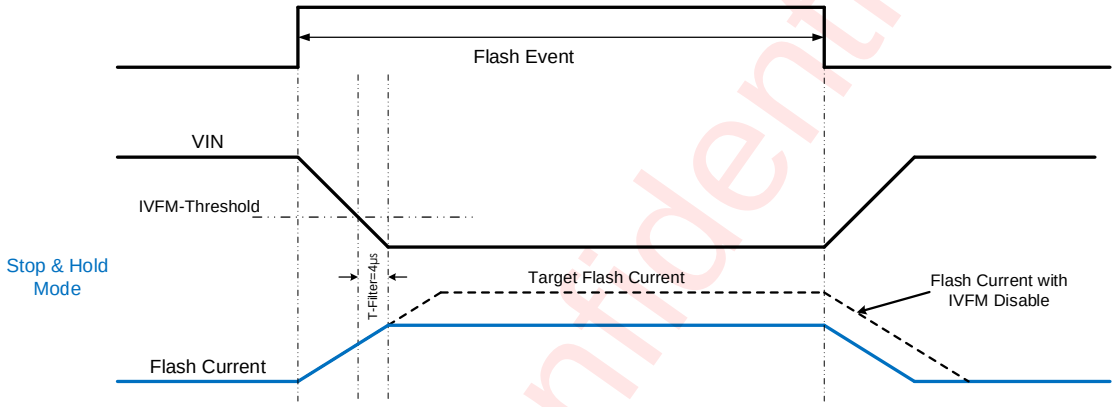
Soft Start-up

Turn on the AW36411 Torch and Flash modes can be done through the Enable Register. At turn-on the current source steps through each FLASH or TORCH level until the target LED current is reached. This gives the device a controlled turn-on and limits inrush current from the VIN supply. The target LED currents in Flash and Torch mode can be set by the LED Flash Brightness Register(0x03) and LED Torch Brightness Register(0x05) separately.

Input Voltage Flash Monitor (IVFM)

The AW36411 has the ability to adjust the flash current based upon the voltage level present at the IN pin utilizing the Input Voltage Flash Monitor (IVFM). The adjustable threshold ranges from 2.9V to 3.6V in 100mV steps as well as adjustable hysteresis, with Stop-and-Hold mode. The IVFM threshold and hysteresis are controlled by bits[5:3] and bit[2] respectively, in the IVFM Register(0x02). The Flags2 Register has the IVFM flag bit set when the input voltage crosses the IVFM threshold value. Additionally, the IVFM threshold sets the input voltage boundary that forces the AW36411 to either stop ramping the flash current during startup in Stop and Hold Mode.

- Stop and Hold Mode: Stops Current Ramp and holds the level for the remaining flash, If VIN falls below the IVFM threshold value.



IVFM Mode

Flash Timeout

The Flash Timeout period sets the maximum time of one flash event, whether a flash stop command is received or not. The AW36411 has 16 timeout levels ranging from 40ms to 1.6s (see ***TIMING CONFIGURATION REGISTER (0X08)*** for more detail). Flash Timeout applies to both Flash and IR modes. The mode bits are cleared and bit[0] is set in the Flags1 register(0x0A) upon a Flash Timeout. This fault flag can be reset to '0' by reading back the Flags1 Register (0x0A), 'or by setting the RESET bit to a '1', or by removing power to the AW36411.

Under Voltage Lockout (UVLO)

The AW36411 has an internal comparator that monitors the voltage at IN and forces the AW36411 into standby if the input voltage drops to 2.5V. If the UVLO monitor threshold is tripped, the UVLO flag bit is set in the Flags1 Register (0x0A). If the input voltage rises above 2.6V, the AW36411 is not available for operation until there is an I^2C read of the Flags1 Register (0x0A). Upon a read, the Flags1 register is cleared, and normal operation can resume if the input voltage is greater than 2.6V.

LED Short Fault

The LED Short Fault flags read back a '1' if the device is active in Flash or Torch mode and either active LED output experiences a short condition. An LED short condition is determined if the voltage at LED goes below 500mV (typ.) while the device is in Torch or Flash mode. There is a deglitch time of 256μs before the LED Short Fault flag is valid. The mode bits are cleared upon an LED Short Fault. The AW36411 is not available for operation until the LED Short Fault flags is cleared. The LED Short Faults can be reset to '0' by reading

back the Flags1 Register (0x0A), or by setting the RESET bit to a '1', or by removing power to the AW36411.

Thermal Shutdown (TSD)

When the AW36411 die temperature reaches 155°C, the thermal shutdown detection circuit trips, forcing the AW36411 enter standby mode and writing a '1' to the Thermal Shutdown Fault flag of the Flags1 Register (0x0A). The AW36411 is only allowed to restart after the Thermal Shutdown Fault flag is cleared. The Thermal Shutdown Faults can be reset to '0' by reading back the Flags1 Register (0x0A), or by setting the RESET bit to a '1', or by removing power to the AW36411. Upon restart, if the die temperature is still above 155°C, the AW36411 resets the Fault flag and re-enters standby mode.

Programming

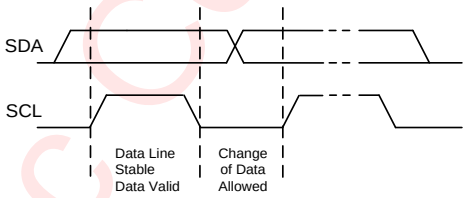
Control Truth Table

MODE1	MODE0	STROBE EN	TORCH EN	STROBE/TORCH PIN	ACTION
0	0	0	0	X	Standby
0	0	0	1	edge	Ext Torch
0	0	1	0	edge	Ext Flash
0	0	1	1	edge	Ext Flash
1	0	X	X	X	Int Torch
1	1	X	X	X	Int Flash
0	1	0	X	X	IRLED Standby
0	1	1	X	0	IRLED Standby
0	1	1	X	edge	IRLED Enabled

I²C Interface

Data Validation

When SCL is high level, SDA level must be constant. SDA can be changed only when SCL is low level.

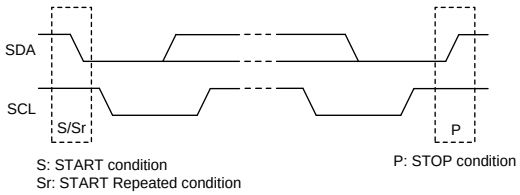


Data Validation Diagram

I²C Start/Stop

I²C start: SDA changes from high level to low level when SCL is high level.

I²C stop: SDA changes from low level to high level when SCL is high level.

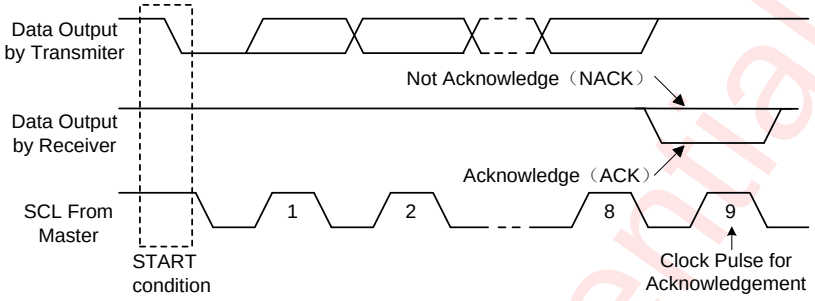


Start and Stop Conditions

ACK (Acknowledgement)

ACK means the successful transfer of I²C bus data. After master sends an 8-bit data, SDA must be released; SDA is pulled to GND by slave device when slave acknowledges.

When master reads, slave device sends 8-bit data, releases the SDA and waits for ACK from master. If ACK is sent and I²C stop is not sent by master, slave device sends the next data. If ACK is not send by master, slave device stops to send data and waits for I²C stop.



I²C ACK Timing

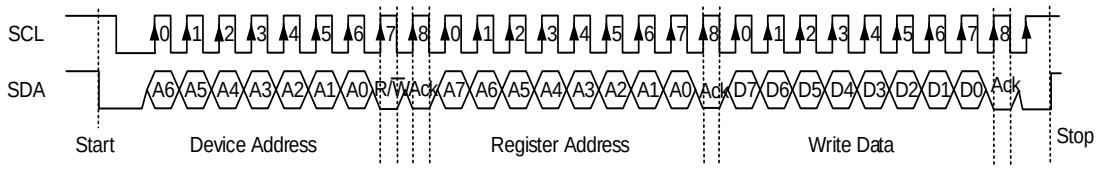
Write Cycle

One data bit is transferred during each clock pulse. Data is sampled during the high state of the serial clock (SCL). Consequently, throughout the clock's high period, the data should remain stable. Any changes on the SDA line during the high state of the SCL and in the middle of a transaction, aborts the current transaction. New data should be sent during the low SCL state. This protocol allows a single data line to transfer both command/control information and data using the synchronous serial clock.

Each data transaction is composed of a Start Condition, a number of byte transfers (set by the software) and a Stop Condition to terminate the transaction. Every byte written to the SDA bus must be 8 bits long and is transferred with the most significant bit first. After each byte, an Acknowledge signal must follow.

In a write process, the following steps should be followed:

a) Master device generates START condition. The "START" signal is generated by lowering the SDA signal while the SCL signal is high.
b) Master device sends slave address (7-bit) and the data direction bit (R/W = 0).
c) Slave device sends acknowledge signal if the slave address is correct.
d) Master sends control register address (8-bit)
e) Slave sends acknowledge signal
f) Master sends data byte to be written to the addressed register
g) Slave sends acknowledge signal
h) If master will send further data bytes the control register address will be incremented by one after acknowledge signal (repeat step f and g)
i) Master generates STOP condition to indicate write cycle end



I²C Write Timing

Read Cycle

In a read cycle, the following steps should be followed:

a) Master device generates START condition.

b) Master device sends slave address (7-bit) and the data direction bit (R/W = 0).

c) Slave device sends acknowledge signal if the slave address is correct.

d) Master sends control register address (8-bit).

e) Slave sends acknowledge signal.

f) Master generates STOP condition followed with START condition or REPEAT START condition.

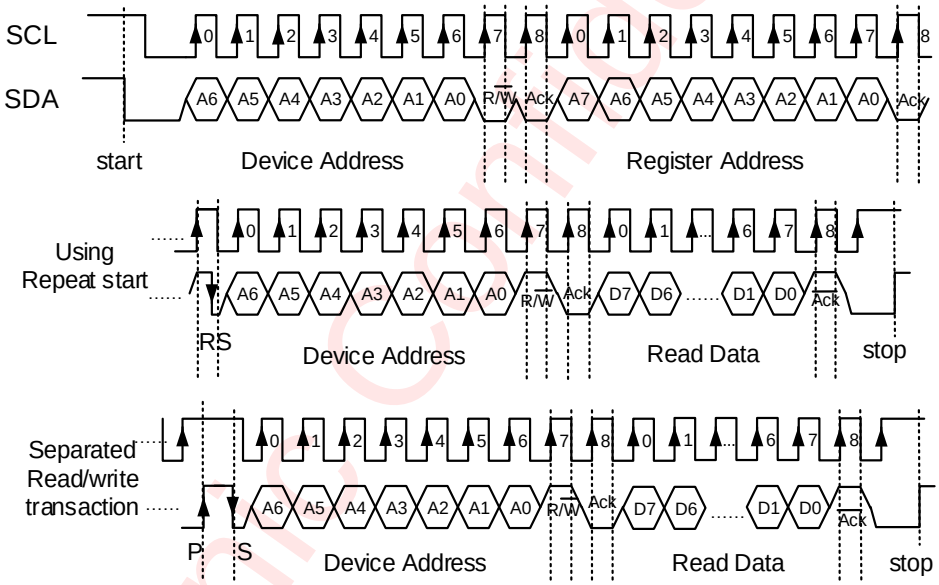
g) Master device sends slave address (7-bit) and the data direction bit (R/W = 1).

h) Slave device sends acknowledge signal if the slave address is correct.

i) Slave sends data byte from addressed register.

j) If the master device sends acknowledge signal, the slave device will increase the control register address by one, then send the next data from the new addressed register.

k) If the master device generates STOP condition, the read cycle is ended.



I²C Read Timing

Register Configuration

Register List

Register name	Address(HEX)	Read/Write	Default Value
Chip ID Register	0x00	Read	0x30
Enable Register	0x01	Read/Write	0x80
IVFM Register	0x02	Read/Write	0x01
LED Flash Brightness Register	0x03	Read/Write	0x7F
LED Torch Brightness Register	0x05	Read/Write	0x7F
Reset Configuration Register	0x07	Read/Write	0x09
Timing Configuration Register	0x08	Read/Write	0x1A
Flags1 Register	0x0A	Read	0x00
Flags2 Register	0x0B	Read	0x00
Device ID Register	0x0C	Read	0x22

Register Detailed Description

✧ Chip ID Register (0x00)

Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
Chip ID: "00110000"							

✧ Enable Register (0x01)

Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
RFU	**Strobe Type** 0=Level Triggered (Default) 1=Edge Triggered	**Strobe Enable** 0=Disabled (Default) 1=Enabled	**Torch Enable** 0=Disabled (Default) 1=Enabled	**Mode Bits: M1, M0** 00=Standby (Default) 01=IR Drive 10=Torch 11=Flash		**LED Enable** 00=OFF(Default) 11=ON 01 and 10 are not valid settings	

Note: In Edge or Level Strobe Mode, it is recommended that the trigger pulse width be set greater than 1ms to ensure proper turn-on of the device. In Edge triggered mode, the strobe must have an ascending edge and light up the LED on the falling edge.

✧ IVFM Register (0x02)

Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
RFU	**UVLO Circuitry** 0=Disabled (Default) 1=Enabled	**IVFM Levels** 000=2.9 V (Default) 001=3.0 V 010=3.1 V 011=3.2 V 100=3.3 V 101=3.4 V 110=3.5 V 111=3.6 V			**RFU**	**RFU**	**IVFM Enable** 0=Disabled 1=Enable (Default)

✧ LED Flash Brightness Register (0x03)

Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
LED Flash Brightness Levels I_{FLASH}(mA)≈(Brightness Code*5.87mA)+2.94mA 00000000=2.94 mA …… 01111111=748.43 mA (Default) …… 11111111=1.5 A							

✧ LED Torch Brightness Register (0x05)

Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
LED Torch Brightness Levels I_{TORCH}(mA)≈(Brightness Code*1.47mA)+0.73mA 00000000=0.73 mA …… 01111111=187.42 mA (Default) …… 11111111=375 mA							

✧ Reset Configuration Register (0x07)

Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
Software Reset Bit 0=Not Reset (Default) 1=Reset	**RFU**	**RFU**	**RFU**	**LED Pin Short Fault Detect** 0=Disabled 1=Enabled (Default)	**RFU**	**RFU**	**RFU**

✧ Timing Configuration Register (0x08)

Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
RFU	**Torch Current Ramp time** 000=No Ramp 001=1 ms (Default) 010=32 ms 011=64 ms 100=128 ms 101=256 ms 110=512 ms 111=1024 ms			**Flash Time-out Duration** 0000=40 ms 0001=80 ms 0010=120 ms 0011=160 ms 0100=200 ms 0101=240 ms 0110=280 ms 0111=320 ms 1000=360 ms 1001=400 ms 1010=600 ms (Default) 1011=800 ms 1100=1000 ms 1101=1200 ms 1110=1400 ms 1111=1600 ms			

✧ Flags1 Register (0x0A)

Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
RFU	RFU	LED Short Fault	LED Short Fault	RFU	Thermal Shutdown (TSD) Fault	UVLO Fault	Flash Time-Out Flag

✧ Flags2 Register (0x0B)

Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
RFU	RFU	RFU	RFU	RFU	IVFM Trip Flag	RFU	RFU

✧ Device ID Register (0x0C)

Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
RFU	RFU	Device ID “100”			Silicon Revision Bits “010”		

Application Information

The AW36411 can drive a flash LED at current up to 1.5A. Below are some peripheral selection guidelines.

Input Capacitor Selection

Choosing the correct size and type of input capacitor helps reduce noise on the input pin that can feed through and disrupt internal analog signals. In the typical application circuit a 10-μF ceramic input capacitor works well. It is important to place the input capacitor as close as possible to the AW36411 input (IN) pin. This reduces the series resistance and inductance that can inject noise into the device due to the input switching currents. Table 1 lists various input capacitors recommended for use with the AW36411.

Table 1 Recommended Input Capacitors (X5R/X7R Dielectric)

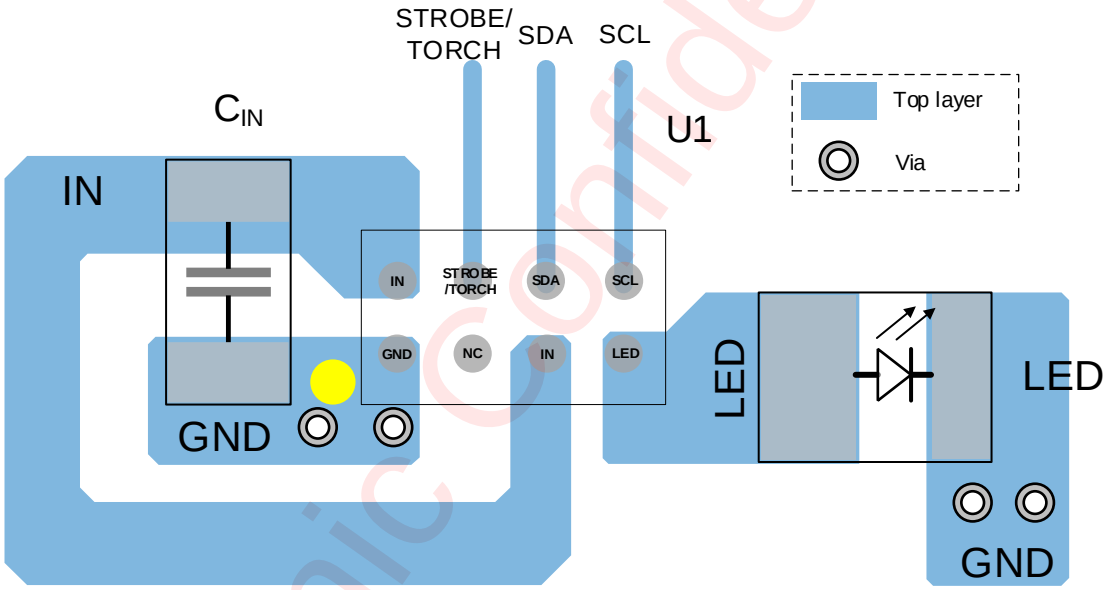
MANUFACTURER	PART NUMBER	VALUE	CASE	VOLTAGE RATING
TDK	C1608JB0J106M	10μF	0603	6.3V
TDK	C2012JB1A106M	10μF	0805	10V
Murata	GRM188R60J106M	10μF	0603	6.3V
Murata	GRM21BR61A106KE19	10μF	0805	10V

PCB Layout Consideration

Layout Guidelines

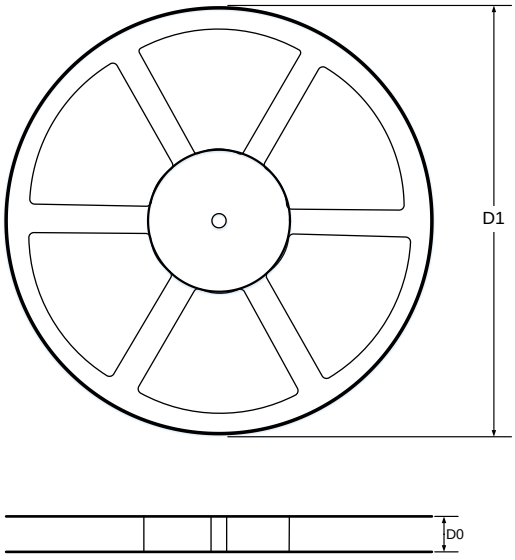
The PCB layout of the high power signal channel LED driver AW36410 is important. The following steps should be used as a reference to ensure the device is stable and maintains proper LED current regulation across its intended operating voltage and current range.

1. Place C_{IN} on the top layer (same layer as the AW36411) and as close to the device as possible. Connecting the input capacitor through short, wide traces to both the IN and GND pins reduces the inductive voltage spikes that occur during switching which can corrupt the V_{IN} line.
2. Terminate the Flash LED cathodes directly to the GND pin of the AW36411. If possible, route the LED returns with a dedicated path so as to keep the high amplitude LED currents out of the GND plane. For Flash LEDs that are routed relatively far away from the AW36411, a good approach is to sandwich the forward and return current paths over the top of each other on two layers. This helps reduce the inductance of the LED current paths.

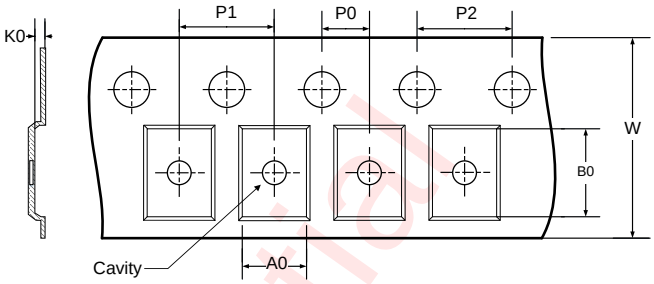


Tape and Reel Information

REEL DIMENSIONS

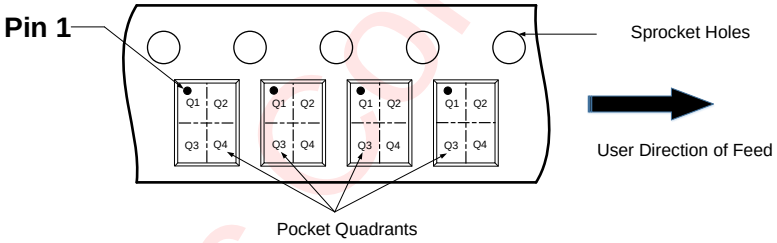


TAPE DIMENSIONS



A0：Dimension designed to accommodate the component width
B0：Dimension designed to accommodate the component length
K0：Dimension designed to accommodate the component thickness
W：Overall width of the carrier tape
P0：Pitch between successive cavity centers and sprocket hole
P1：Pitch between successive cavity centers
P2：Pitch between sprocket hole
D1：Reel Diameter
D0：Reel Width

QUADRANT ASSIGNMENTS FOR PIN 1 ORIENTATION IN TAPE



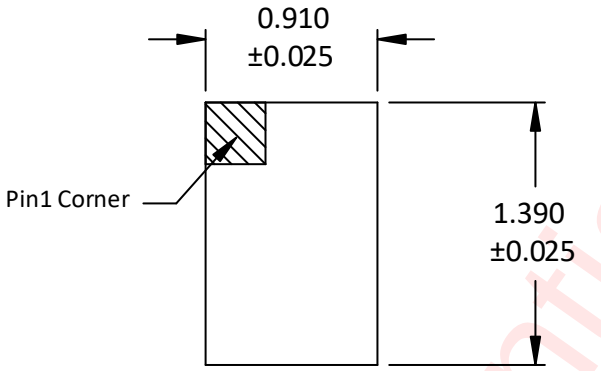
Note：The above picture is for reference only. Please refer to the value in the table below for the actual size

DIMENSIONS AND PIN1 ORIENTATION

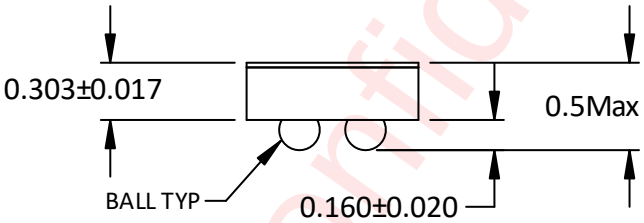
D1 (mm)	D0 (mm)	A0 (mm)	B0 (mm)	K0 (mm)	P0 (mm)	P1 (mm)	P2 (mm)	W (mm)	Pin1 Quadrant
179	8.6	1.04	1.54	0.56	2	4	4	8	Q1

All dimensions are nominal

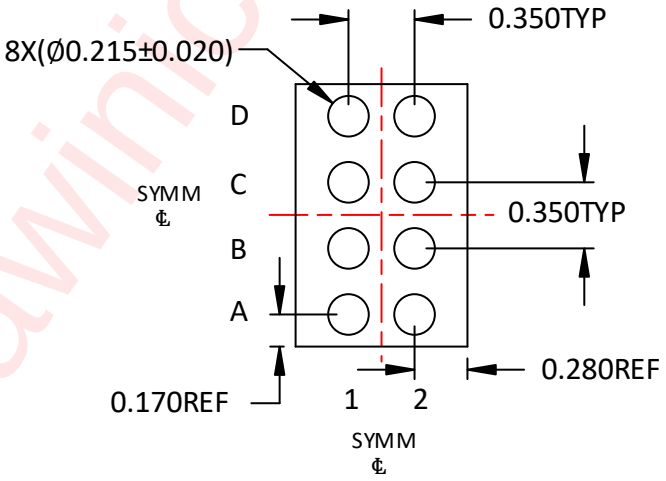
Package Description



Top View



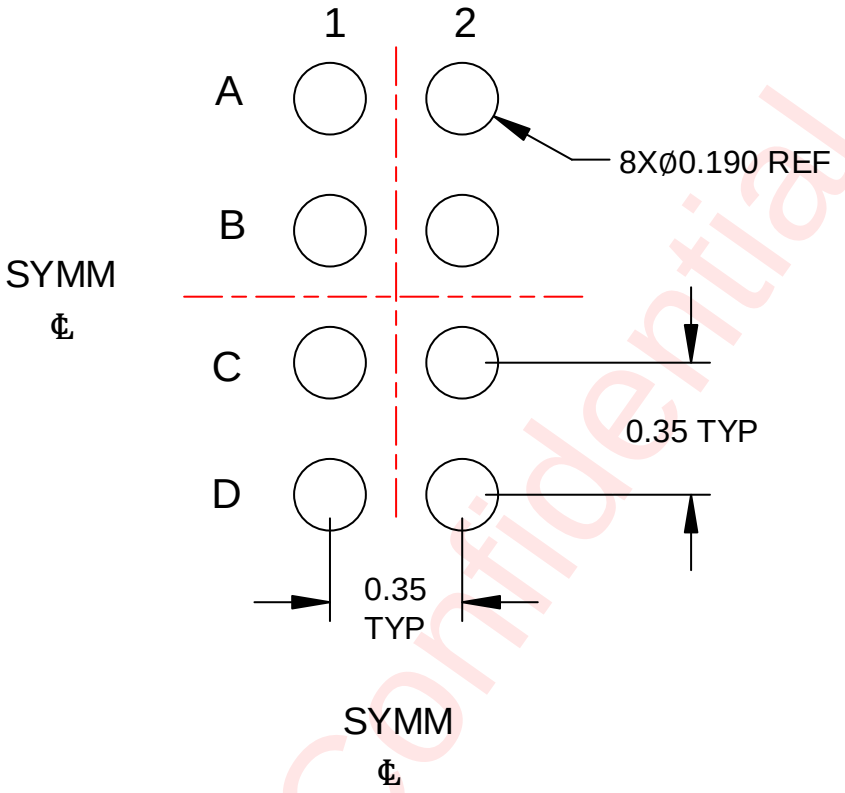
Side View

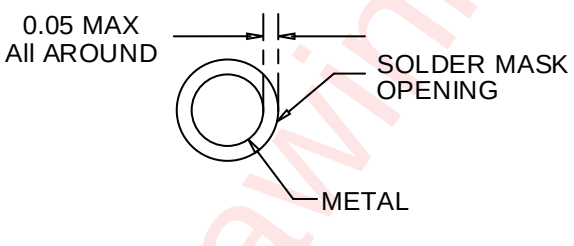


Bottom View

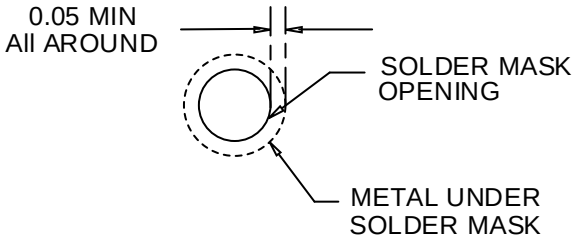
Unit:mm

Land Pattern Data





NON-SOLDER MASK DEFINED



SOLDER MASK DEFINED

Unit: mm

Revision History

Version	Date	Change Record
V1.0	May.2023	Officially released

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