Low-Power Off-line PSR LED Controller AP1686

General Description

The AP1686 is a high performance AC/DC power supply controller for LED lighting application. The device uses Pulse Frequency Modulation (PFM) method to build discontinuous conduction mode (DCM) flyback power supplies.

The AP1686 provides accurate constant voltage, constant current (CV/CC) regulation without requiring an opto-coupler and the secondary control circuitry. It also eliminates the need of loop compensation circuitry while maintaining good stability. The AP1686 can achieve excellent regulation and high average efficiency, yet meets no-load consumption less than 30mW.

It also has an adjustable built-in line compensation function to achieve tight CC.

The AP1686 is available in SOT-23-6 package.

Features

- Primary Side Control for Tight Constant Current and Constant Voltage
- 30mW No-load Input Power
- Bipolar Junction Transistor (BJT) Driving
- Open Circuit Protection
- Over Voltage Protection
- Short Circuit Protection
- SOT-23-6 Package

Applications

- LED Driver

SOT-23-6

Figure 1. Package Type of AP1686

Pin Configuration

K6 Package
(SOT-23-6)

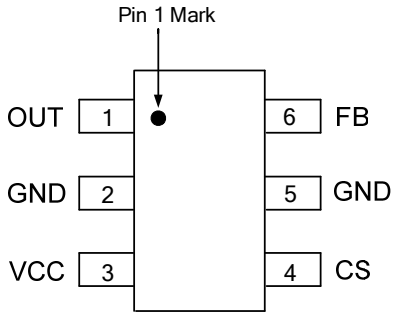


Figure 2. Pin Configuration of AP1686 (Top View)

Pin Description

Pin Number	Pin Name	Function
1	OUT	The OUT pin is used to turn on and turn off the power switch. When turning on the power switch, the OUT pin will output 30mA source current to support the base current of the power BJT. When turning off the power switch, the resistance between the OUT and GND will become to 5Ω
2, 5	GND	The GND pin is the ground of the IC. When the power BJT is turned off, a fast reverse sinking current to the gate of BJT will flow out from this pin. Attention should be paid to in the PCB layout
3	VCC	The VCC pin supplies the power for the IC. In order to get the correct operation of the IC, a capacitor with low ESR should be placed as close as possible to the VCC pin
4	CS	The CS is the current sense pin of the IC. The IC will turn off the power BJT according to the voltage on the CS pin. When the power BJT is on, a current is output from the CS pin which is proportional to the line voltage to realize the function of line compensation
6	FB	The CV and CC regulation are realized based on the voltage sampling of this pin

Functional Block Diagram

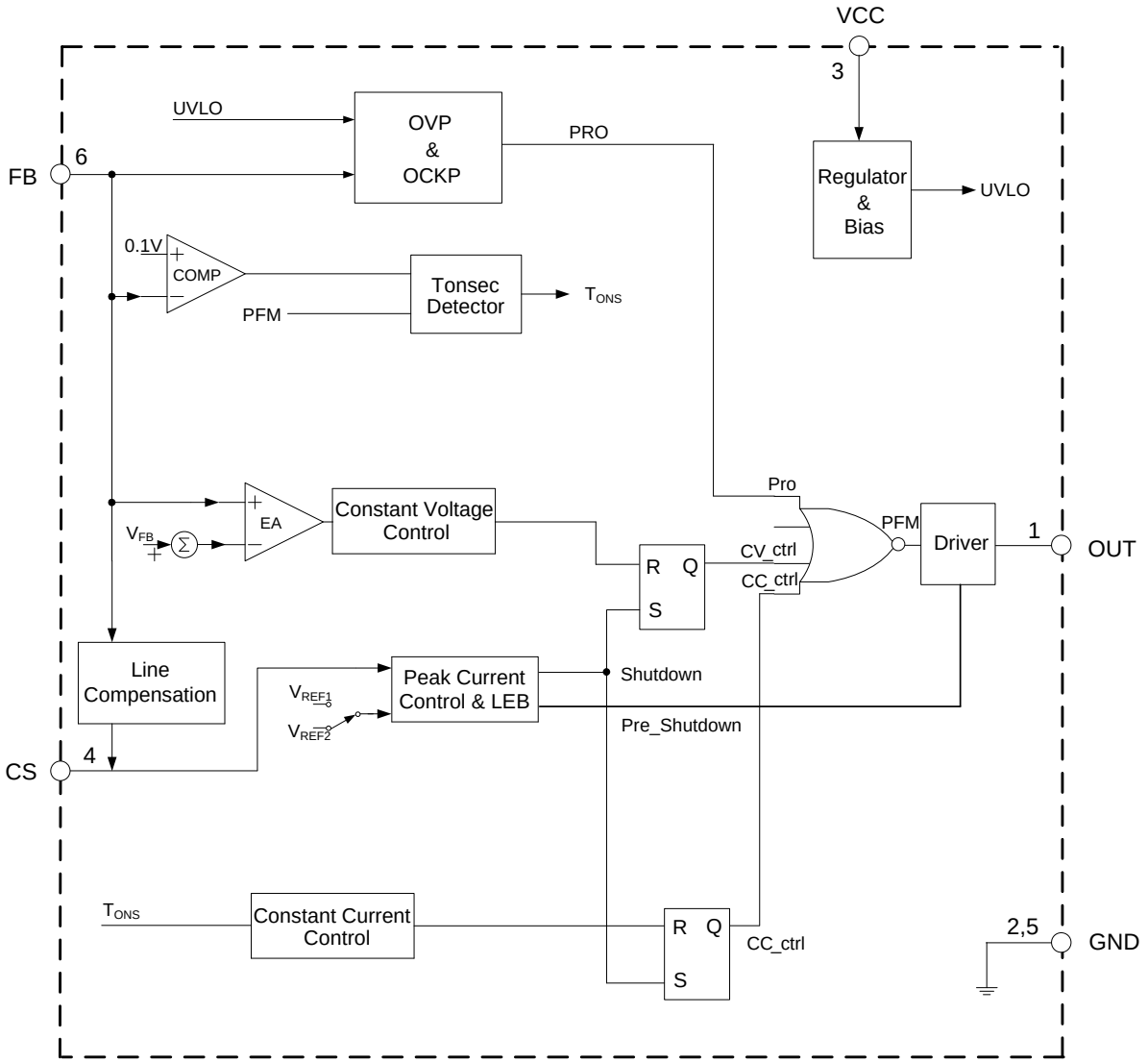
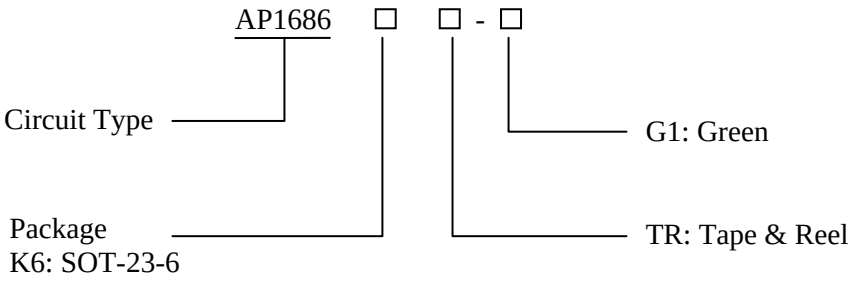


Figure 3. Functional Block Diagram of AP1686

Low-Power Off-line PSR LED Controller AP1686

Ordering Information



Package	Temperature Range	Part Number	Marking ID	Packing Type
SOT-23-6	-40 to 85°C	AP1686K6TR-G1	GBQ	Tape & Reel

BCD Semiconductor's Pb-free products, as designated with "G1" suffix in the part number, are RoHS compliant and green.

Absolute Maximum Ratings (Note 1)

Parameter	Symbol	Value	Unit
Supply Voltage	V_{CC}	-0.3 to 30	V
CS to GND Voltage		-0.3 to 7	V
FB Input Voltage	V_{FB}	-40 to 7.5	V
Source Current at OUT Pin	I_{SOURCE}	Internally Limited	A
Operating Junction Temperature	T_J	150	ºC
Storage Temperature	T_{STG}	-65 to 150	ºC
Lead Temperature (Soldering, 10 sec)	T_{LEAD}	300	ºC
Thermal Resistance (Junction to Ambient)	θ_{JA}	200	ºC/W
ESD (Human Body Model)		2000	V

Note 1: Stresses greater than those listed under “Absolute Maximum Ratings” may cause permanent damage to the device. These are stress ratings only, and functional operation of the device at these or any other conditions beyond those indicated under “Recommended Operating Conditions” is not implied. Exposure to “Absolute Maximum Ratings” for extended periods may affect device reliability.

Electrical Characteristics

V_{CC} =15V, T_A=25°C, unless otherwise specified.

Parameter		Symbol	Conditions	Min	Typ	Max	Unit
UVLO SECTION							
Startup Threshold		V_{TH} (ST)		13	15.5	18	V
Minimal Operating Voltage		V_{OPR}(MIN)		3	3.5	4.5	V
STANDBY CURRENT SECTION							
Startup Current		I_{ST}	V_{CC}=V_{TH} (ST)-1V, Before startup	0	0.2	0.6	μA
Operating Current		I_{CC}(OPR)	Static current	250	400	600	
DRIVE OUTPUT SECTION							
Output Current	Sink	I_{SINK}	Apply 1V @OUT pin	200	300	500	mA
	Source	I_{SOURCE}		24	30	45	mA
CURRENT SENSE SECTION							
Current Sense Threshold Voltage		V_{CS}		440	500	550	mV
Equivalent Current Sense Voltage Accuracy (Note 2)		$\frac{\Delta Vcs,eq}{Vcs,eq}$				4	%
Leading Edge Blanking		t_{LEB}	The minimum power switch turn on time	300	475	720	ns
FEEDBACK INPUT SECTION							
Input Resistance of FB Pin		R_{FB}	V_{FB}=4V	1	1.6	2	MΩ
Feedback Threshold		V_{FB}		3.7	3.974	4.21	V
LINE COMPENSATION SECTION							
Line Compensation Transconductance (Note 2)		g_m		1.14	1.43	1.72	μS
PROTECTION SECTION							
Over Voltage Protection		V_{FB}(OVP)		6.5	7.5	8.5	V
Maximum On Time of Primary Side		tonp (MAX)		11	18	50	μs

Note 2: The output current is given by $I_{OUT} = \frac{Vcs,eq}{Rcs} \times \frac{Np}{Ns}$

Typical Performance Characteristics

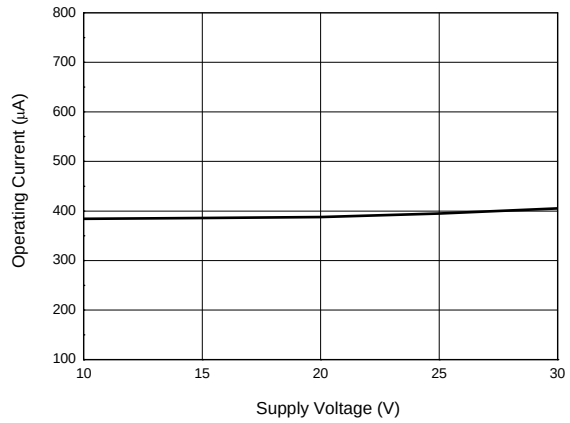


Figure 4. Operating Current vs. Supply Voltage

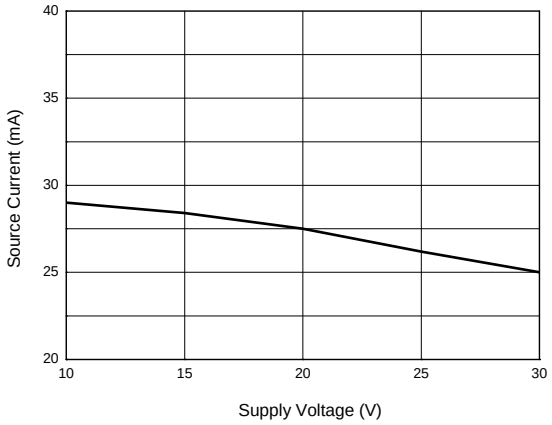


Figure 5. Source Current vs. Supply Voltage

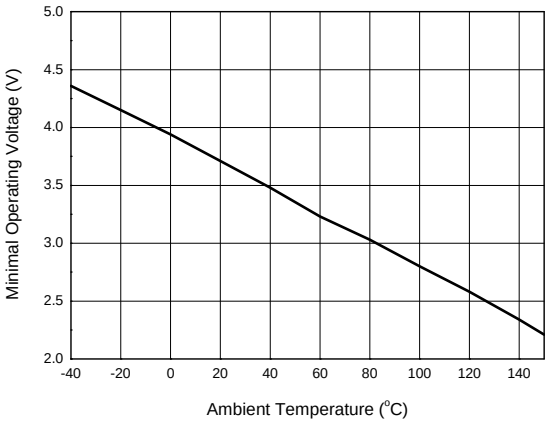


Figure 6. Minimal Operating Voltage vs. Ambient Temperature

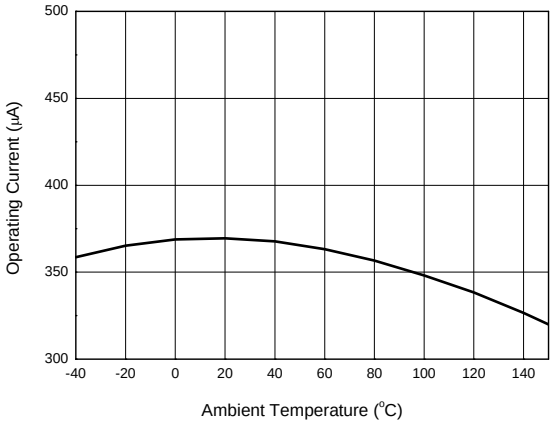


Figure 7. Operating Current vs. Ambient Temperature

Typical Performance Characteristics (Continued)

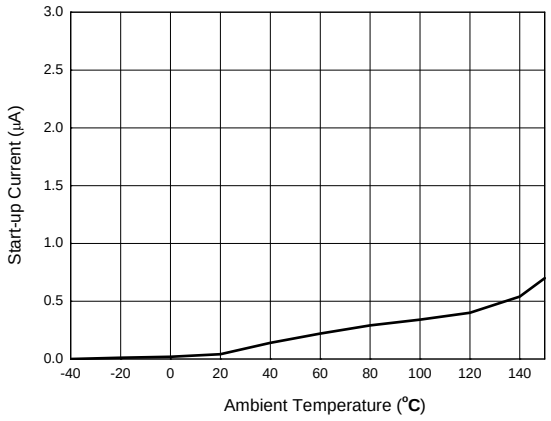


Figure 8. Start-up Current vs. Ambient Temperature

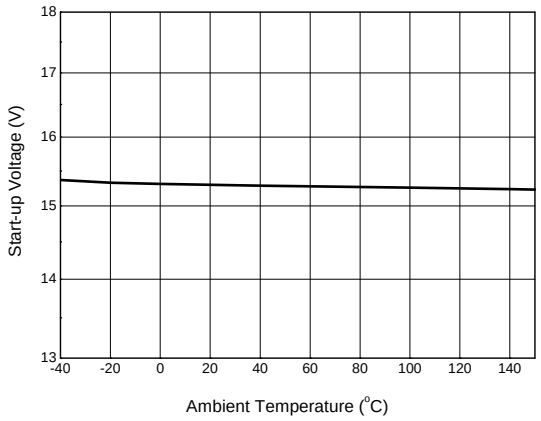


Figure 9. Start-up Voltage vs. Ambient Temperature

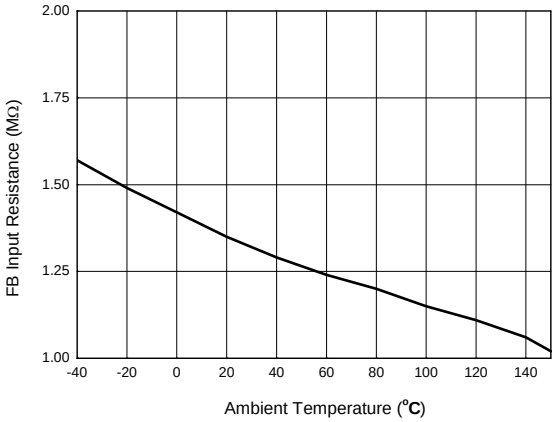


Figure 10. FB Input Resistance vs. Ambient Temperature

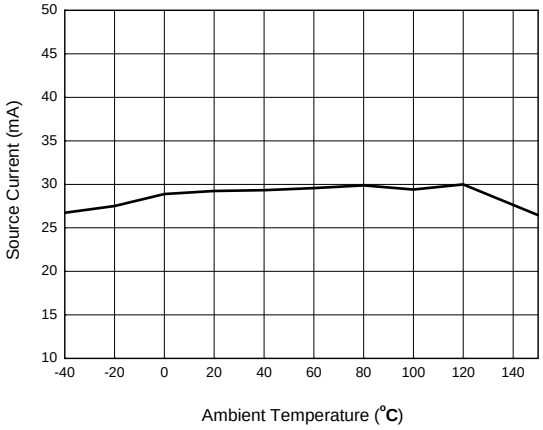


Figure 11. Source Current vs. Ambient Temperature

Typical Performance Characteristics (Continued)

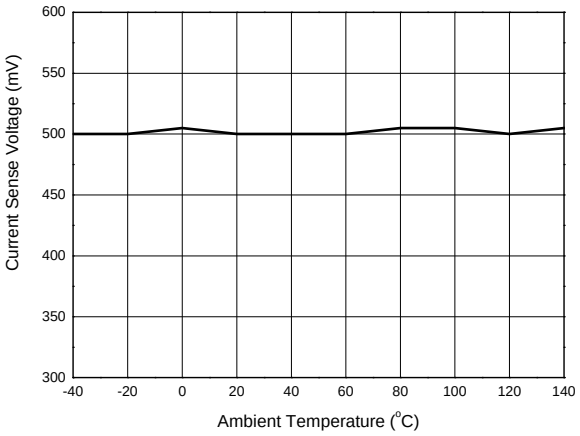


Figure 12. Current Sense Voltage vs. Ambient Temperature

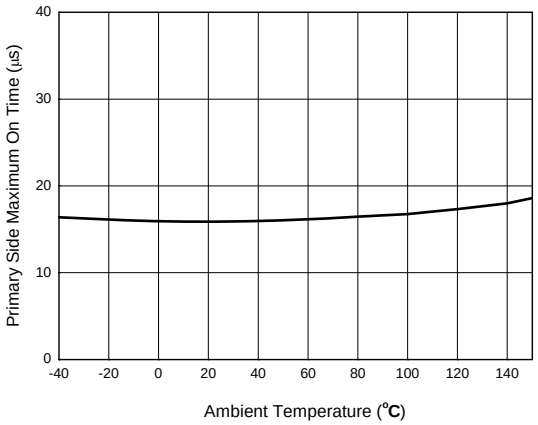


Figure 13. Primary Side Maximum On Time vs. Ambient Temperature

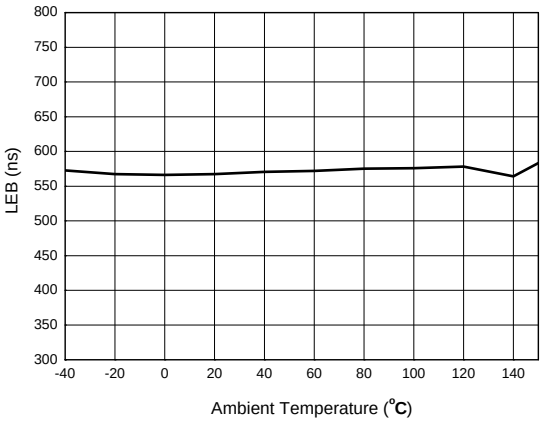


Figure 14. LEB vs. Ambient Temperature

Typical Application

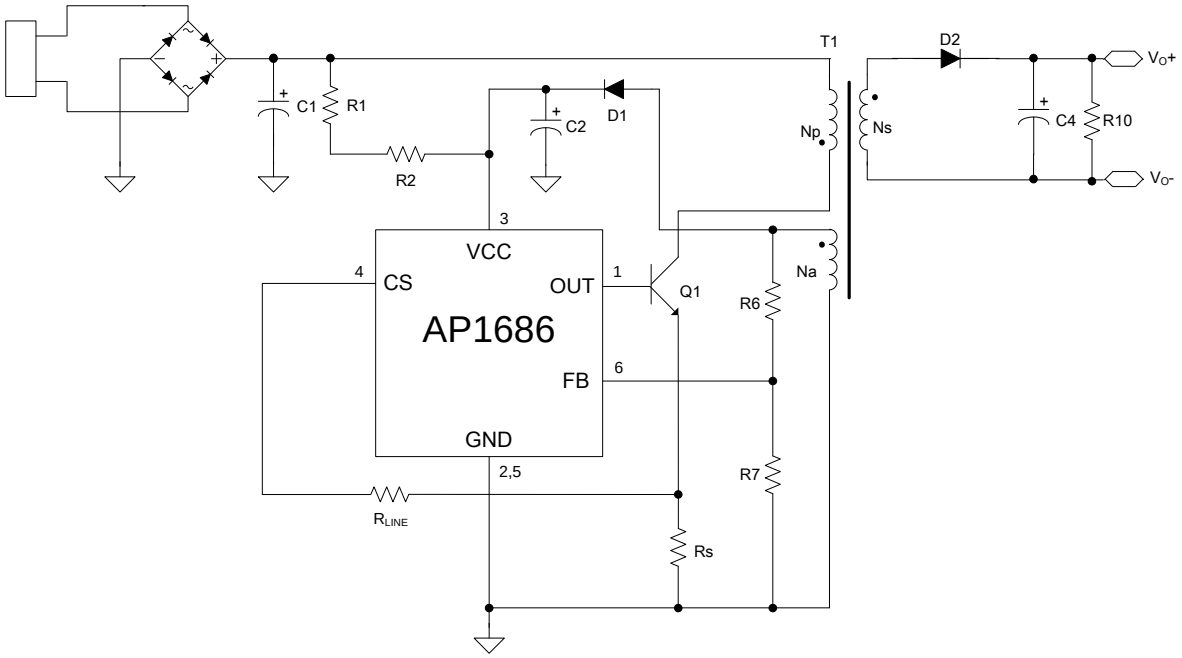
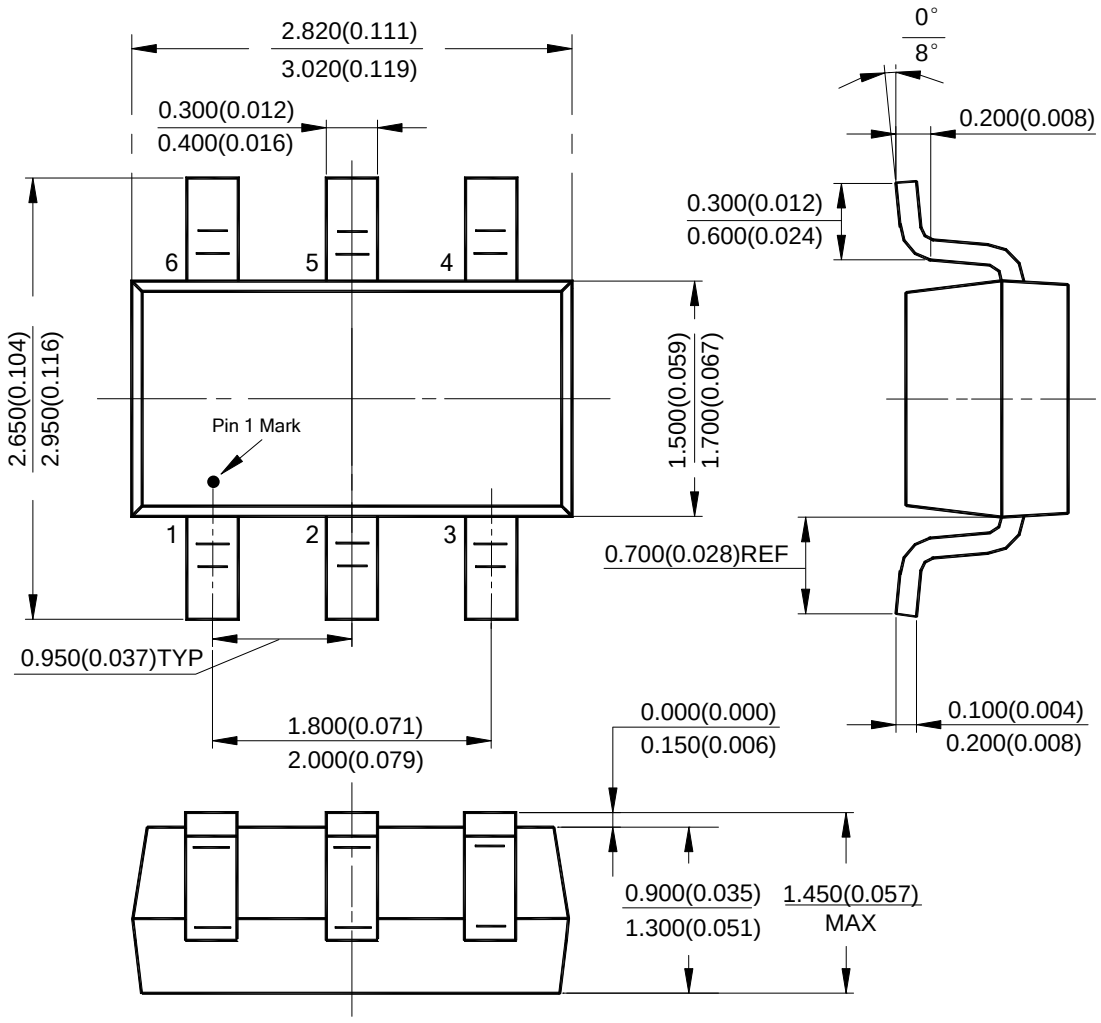


Figure 15. Typical LED Driver Application

Mechanical Dimensions

SOT-23-6 **Unit: mm(inch)**



BCD Semiconductor Manufacturing Limited

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