TAIWAN SEMICONDUCTOR

RoHS COMPLIANCE

TS19702

High Power Factor Corrector LED Driver

SOT-26

Pin Definition:

1. VCC
2. Ground
3. Output
4. Dimming
5. Compensation
6. Current Sense

Description

The TS19702 is a highly-integrated, low startup current, average current mode, one cycle control PFC and fixed switching frequency PWM controller. These functions enable the LED driver to easily meet the accuracy average LED current and high power factor requirements. The integrated functions also include the LED short protection, open protection, and internal over temperature protection. The COMP pin controls the duty by connected an RC compensation network to ground and forming the closed loop feedback control. To protect the external power MOSFET from being damaged by supply over voltage, the TS19702 Output pin voltage is clamped to about 15V.

Features

- High Power Factor by One Cycle Control
- Accuracy Constant Current
- Low BOM Cost
- Linear Dimming on DIM Pin
- Average Current / Fixed Frequency Control
- Gate Output Voltage Clamp
- LED Open Protection (OVP)
- LED Short Protection (SCP)
- Over Current Protection (OCP)
- Internal OTP Protection
- 300mA Driving Capability for Output Pin

Application

- E27, T5, T8 LED lighting
- LED Lighting Applications

Ordering Information

Part No.	Package	Packing
TS19702CX6 RFG	SOT-26	3Kpcs / 7” Reel

Note: “G” denote for Halogen Free Product

Absolute Maximum Rating (Ta = 25°C unless otherwise noted)

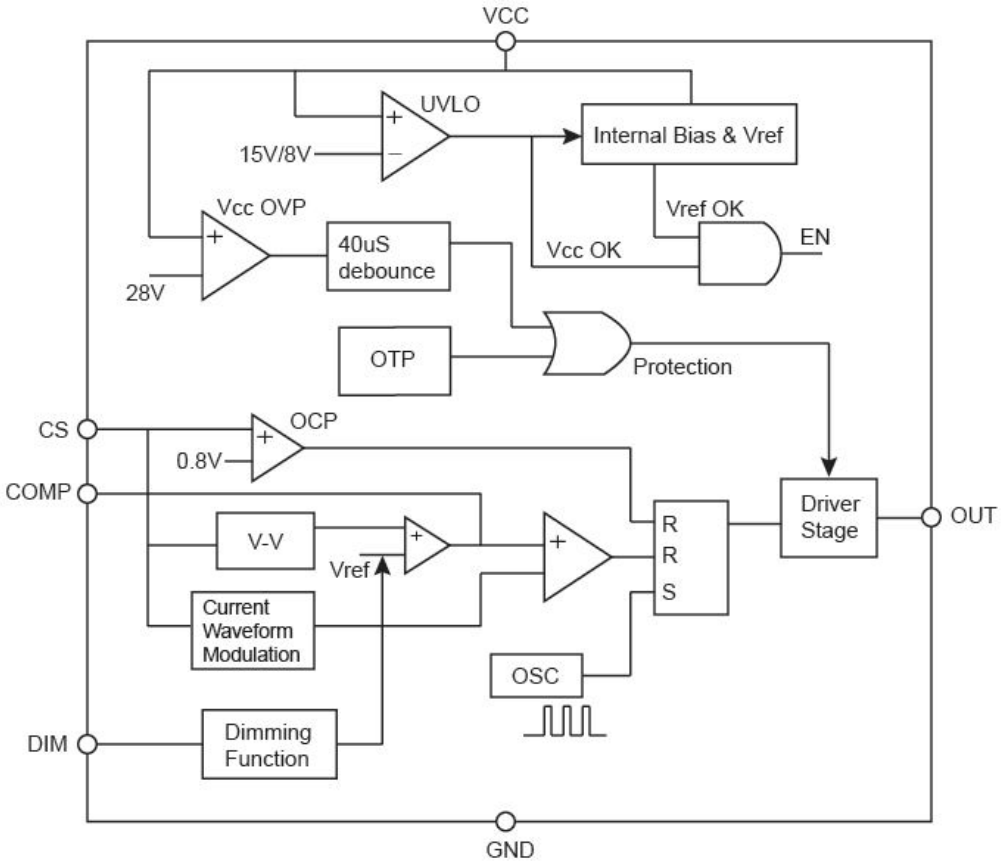
Parameter	Symbol	Limit	Unit
Supply Voltage	V_{CC}	30	V
Compensation Voltage	V_{COMP}	-0.3 ~ 7	V
Dimming Pin	V_{DIM}	-0.3 ~ 7	V
Current Sense Pin	V_{CS}	-0.3 ~ 7	V
Output Pin	V_{OUT}	15	V
Power Dissipation @ T_A=85ºC	P_D	250	mW
Operating Ambient Temperature	T_{OPR}	-20 ~ +85	°C
Junction Temperature	T_J	+150	°C
Storage Temperature Range	T_{STG}	-65 ~ +150	°C
Thermal Resistance - Junction to Ambient	$R\Theta_{JA}$	250	°C/W
ESD Voltage Protection	HBM	2	KV
	MM	200	V

Electrical Characteristics (V_{CC}=15 , T_A=25℃, unless otherwise specified.)

Parameter	Symbol	Min.	Typ.	Max.	Unit
Supply Voltage					
Startup Current (VCC=UVLO on - 1V)	I_{START}	--	8	15	uA
Operating Current (with 1nF load on OUT pin), Vcomp = 2.5V	I_{OPR}	--	2	3	mA
Operating Current (with 1nF load on OUT pin), Protection Tripped (OCP, OVP, SCP, OTP)	I_{OPR}	--	0.7	1	mA
UVLO(off)	$UVLO_{OFF}$	7	8	9	V
UVLO(on)	$UVLO_{ON}$	14	15	16	V
OVP Level on VCC Pin	V_{OVP}	26.5	28	29.5	V
OVP De-Bounce Time	T_{OVP}	--	40	--	us
Voltage Feedback					
Feedback Reference Voltage	V_{FB}	0.196	0.200	0.204	V
Tran-Conductance		--	120	--	uS
Output Sink Current	I_{SINK}	--	12	--	uA
Output Source Current	I_{SOURCE}	--	12	--	uA
Current Sensing					
Input Over Voltage Protection	$V_{IN-PROTECT}$	0.7	0.80	0.9	V
Open Loop Voltage, CS Pin Open	V_{CS}	--	5	--	V
Leading-Edge Blanking Time	T_{LE}	--	410	--	nS
Delay to Output	$T_{O-DELAY}$	--	100	220	nS
Switching Frequency					
Switching Frequency	F_{SW}	42	45	48	KHz
Maximum Duty	$D_{(MAX)}$	90	--	--	%
Frequency Jitter Range		--	+/-4	--	%
Temp. Stability (-40℃ ~ 125℃)	$TEMP_{STB}$	--	--	6	%
Voltage Stability (VCC = 11V~25V)	V_{STB}	--	--	1	%
GATE DRIVER OUTPUT					
Rising Time, Load Capacitance =1000pF	T_{RISING}	--	160	320	nS
Falling Time, Load Capacitance =1000pF	$T_{FALLING}$	--	80	160	nS
VGATE-Clamp (VCC=25V)	V_{GATE}	--	13.5	15	V
DIM INPUT SECTION					
Saturation Threshold Voltage	SAT_{TH}	3.0	--	--	V
Linear Dimming Range	DIM	0.3	--	3.0	V
LED Current off Threshold Voltage	$IOFF_{TH}$	--	--	0.3	V
Current Source	CS	290	300	310	uA
OTP SECTION					
OTP Trip Point	OTP_{TP}	140	150	160	°C
OTP Release Point	OTP_{RP}	120	130	140	°C
OTP Threshold Level	OTP_{TH}	--	20	--	°C
OTP De-Bounce Time	OTP_{DBT}	40	80	120	uS

Note 1: OCP, SCP, OTP: Auto Recovery Type
Note 2: OVP, Auto Recovery Type (Latch off type optional)

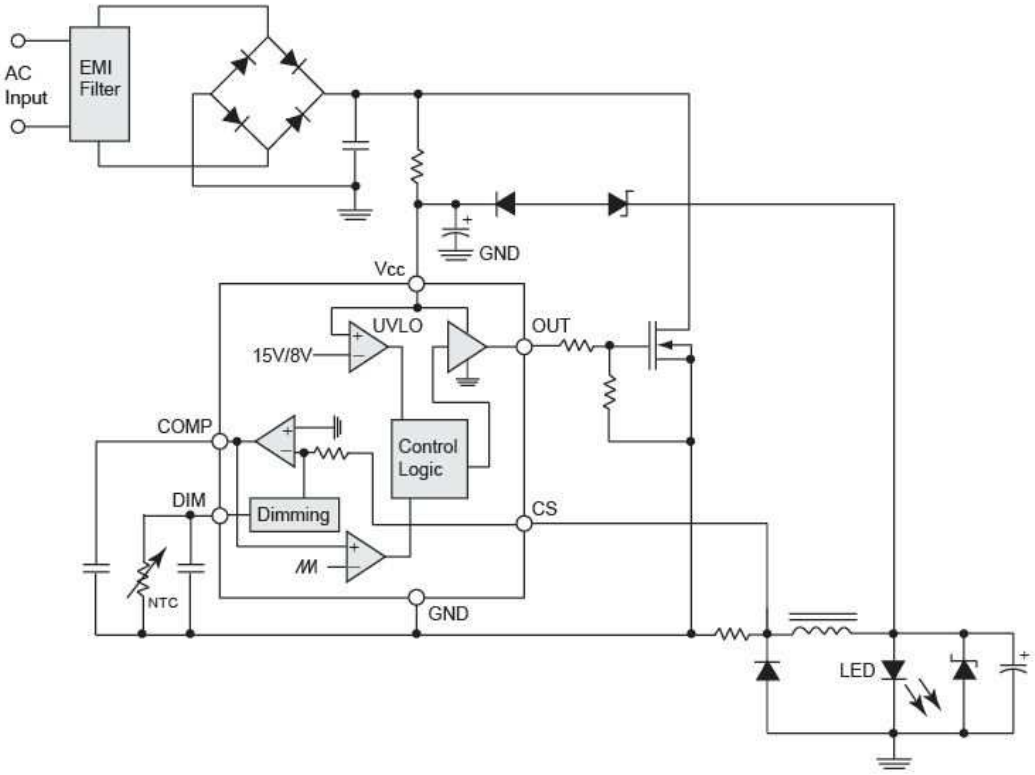
Function Block



Pin Description

Pin No.	Name	Function
1	VCC	Power supply pin
2	GND	Ground pin
3	OUT	The output driver for driving the external MOSFET
4	DIM	Dimming control pin by input a DC voltage
5	COMP	Feedback compensation network
6	CS	Current sense pin, connect to sense the MOSFET current

Application Circuit



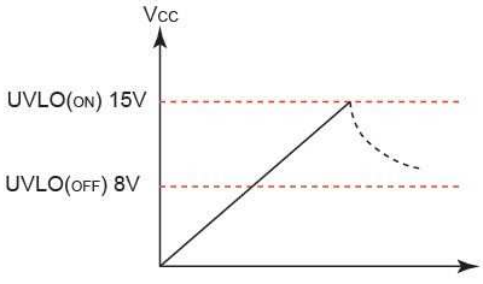
Application Information

Start-up Current

The typical start-up current is around 8uA. Very low start-up current allows the PWM controller to increase the value of start-up resistor and then reduce the power dissipation on it.

UVLO (Under Voltage Lockout)

A hysteresis UVLO comparator is implemented in TS19702, then the turn-on and turn-off thresholds level are fixed at 15V and 8V respectively. This hysteresis shown in Fig.11 ensures that the start-up capacitor will be adequate to supply the chip during start-up. For quickly startup the LED driver, the start-up resistor should be matched with the startup capacitor. Due to the low UVLO on level, so the turn-on delay time will also never greater than the general PWM IC.



Oscillator

The maximum duty-cycle of internal oscillator is up to 90% for driving high LED voltage string. The frequency of the oscillator is fixed to 45KHz by internal setting.

LEB (Leading-Edge Blanking)

Each time the power MOSFET is switched on, a turn-on spike will inevitably occur at the sense resistor. To avoid fault trigger, a 410ns leading-edge blanking time is built in. Conventional RC filtering can therefore be omitted. During this blanking period, the current-limit comparator is disabled and can not switch off the gate driver.

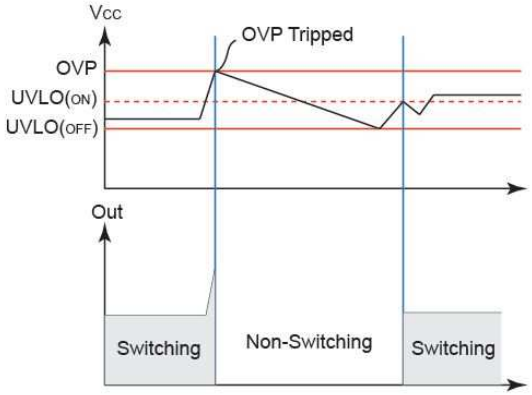
Application Information (Continue)

OCP (Over Current Protection)

The TS19702 has an over current protection function on CS pin. An internal circuit detects the current level, when the current is larger than a threshold level, the gate output will keep on low level. Then VCC decreases below UVLO off level, the controller resets again.

OVP (Over Voltage Protection) on VCC

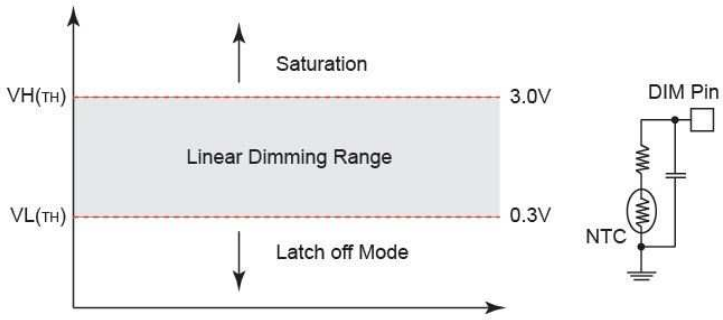
To prevent the LED driver from being damaged, the TS19702 is implemented an OVP function on VCC. When the VCC voltage is higher than the OVP threshold voltage 28V, the output gate driver circuit will be shut down immediately to stop the switching of power MOSFET. The VCC pin OVP function is an auto recovery type protection (latch off type optional). If the OVP condition happens, the pulses will be stopped and never recovery unless the VCC pin voltage is down to the UVLO off level. The TS19702 is working in an auto-recovery mode as shown in below figure



Gate Clamp/Soft Driving

Driver is clamped to 15V by an internal clamping circuit. Those damages usually come from undesired over-voltage gate signals. Under the conditions listed below, the gate output will turn off immediately to protect the power circuit. The TS19702 also has soft driving function to minimize EMI.

Over Temperature Protection/Dimming Function



The typical application for DIM pin is shown in above Fig. The NTC thermistor is setting as an external OTP protection. In the DIM pin, there is one comparator for latch-off mode protection. While the voltage on this pin is lower than 0.3V, the TS19702 will shut down. When the voltage is in the range of 0.3 to 3.0V, the TS19702 is operating on the linear dimming range. While the voltage is higher than 3.0V, the TS19702 is operating on the normal status. It also could let this Pin open when the function is not required for the user.

Electrical Characteristics Curve

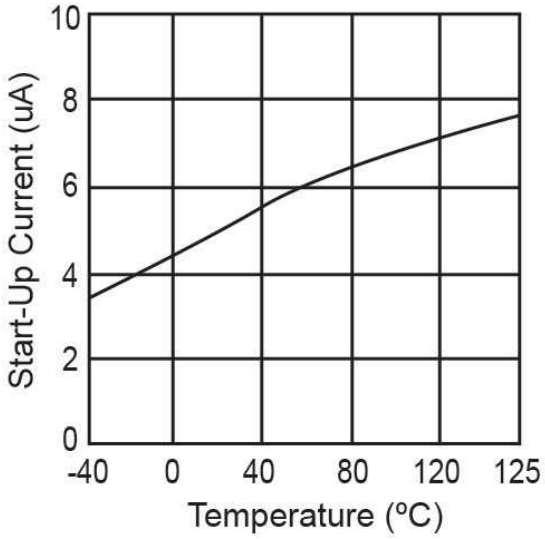


Figure 1. Star-Up current vs. Temperature

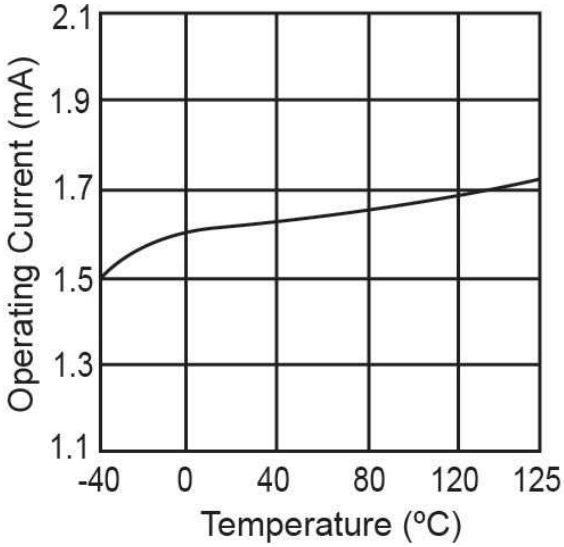


Figure 2. Operating Current vs. Temperature

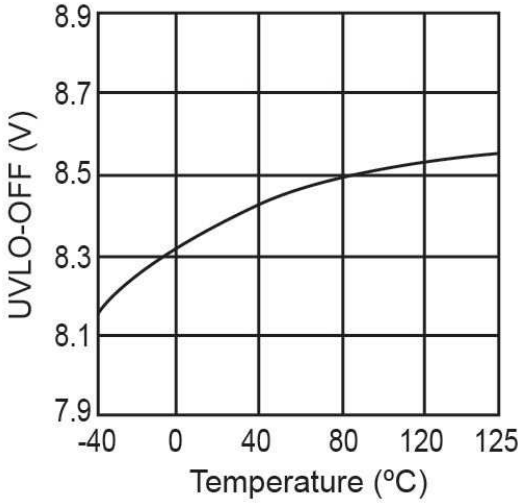


Figure 3. UVLO-OFF vs. Temperature

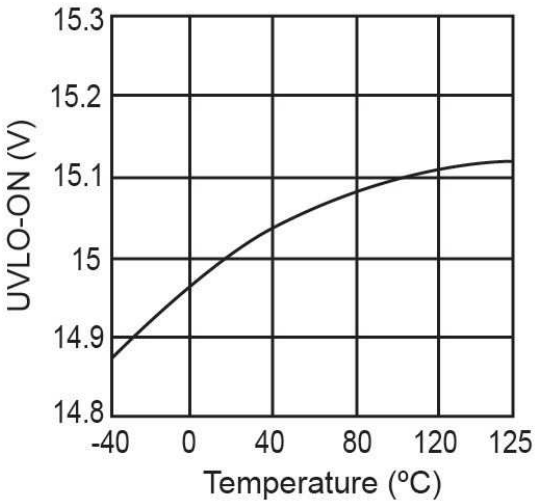


Figure 4. UVLO-ON vs. Temperature

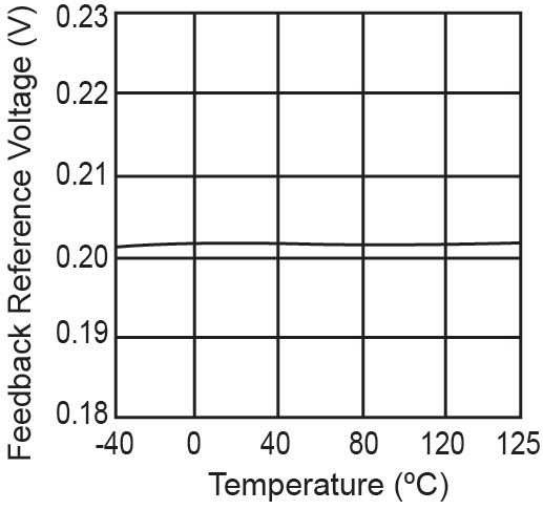


Figure 5. FB V_{REF} vs. Temperature

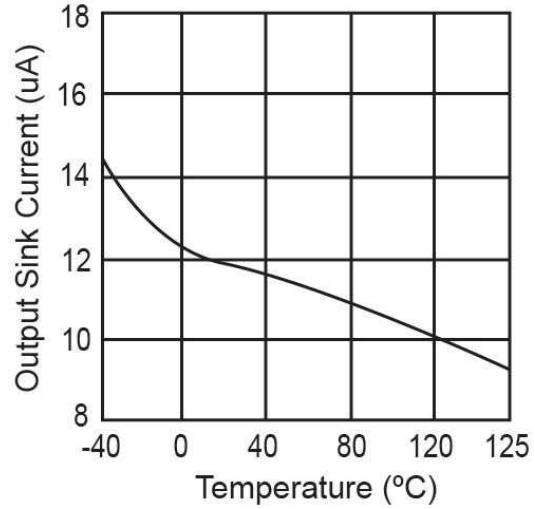


Figure 6. Output Sink Current vs. Temperature

Electrical Characteristics Curve

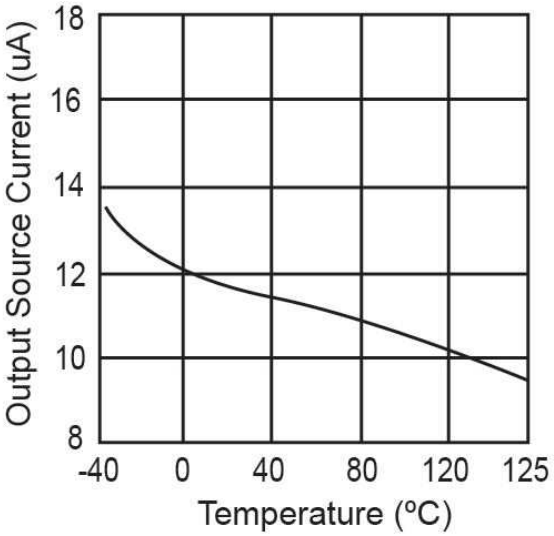


Figure 7. Output Source Current vs. Temp.

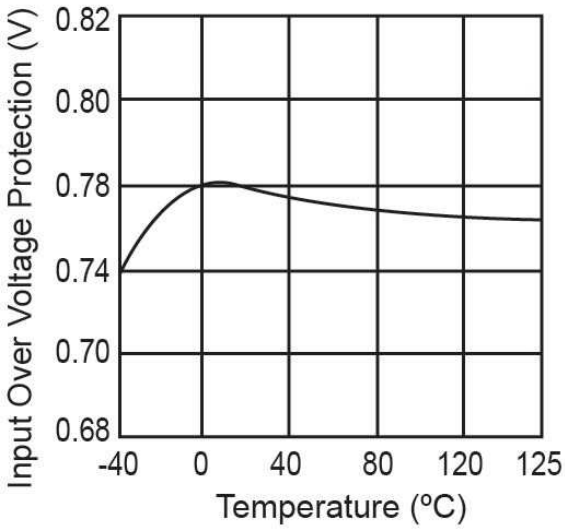


Figure 8. Input Over Voltage vs. Temperature

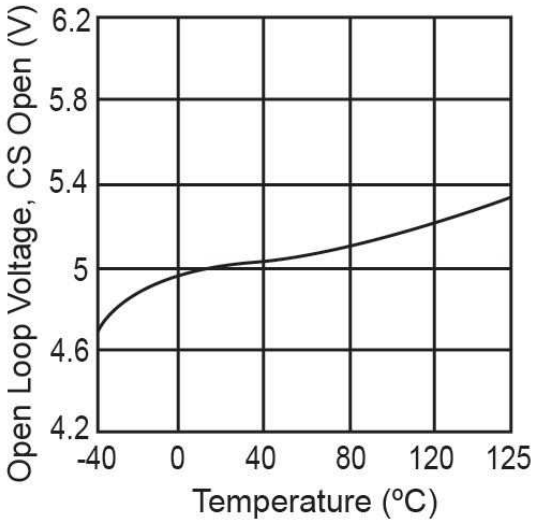


Figure 9. Open Loop Voltage vs. Temperature

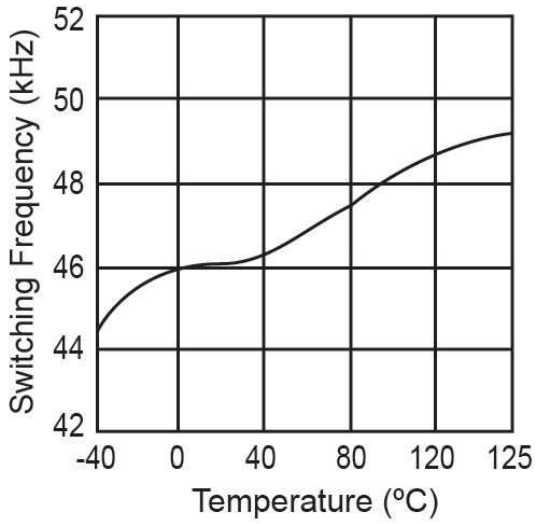
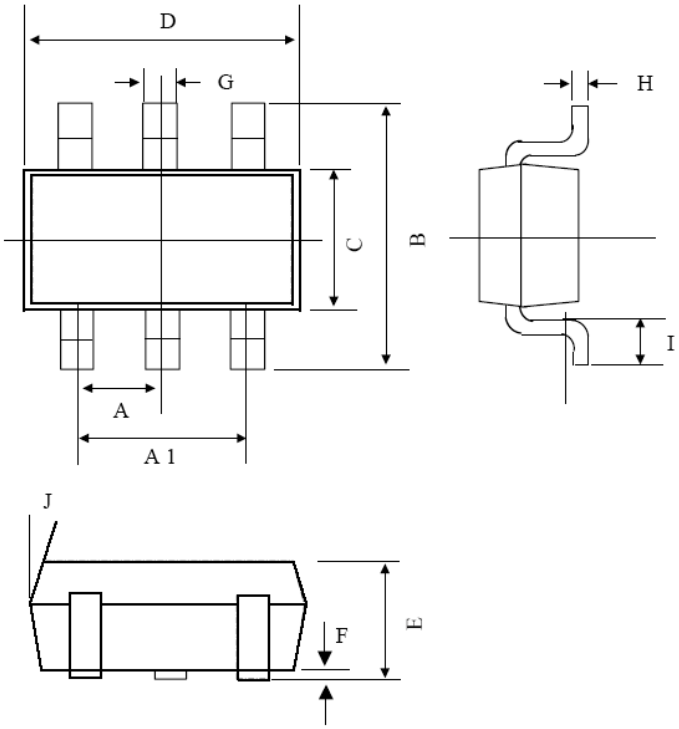


Figure 10. Switching Frequency vs. Temp.

SOT-26 Mechanical Drawing



SOT-26 DIMENSION						
DIM	MILLIMETERS			INCHES		
	MIN	TYP	MAX	MIN	TYP	MAX
A	0.95 BSC			0.0374 BSC		
A1	1.9 BSC			0.0748 BSC		
B	2.60	2.80	3.00	0.1024	0.1102	0.1181
C	1.40	1.50	1.70	0.0551	0.0591	0.0669
D	2.80	2.90	3.10	0.1101	0.1142	0.1220
E	1.00	1.10	1.20	0.0394	0.0433	0.0472
F	0.00	--	0.10	0.00		0.0039
G	0.35	0.40	0.50	0.0138	0.0157	0.0197
H	0.10	0.15	0.20	0.0039	0.0059	0.0079
I	0.30	--	0.60	0.0118	--	0.0236
J	5º	--	10º	5º	--	10º

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