SC6850

High Performance Current Mode PWM Controller

Description

SC6850 is a highly integrated current mode PWM controller optimized for high performance, low standby power and cost effective offline flyback converter applications.

Making use of external resistor, SC6850 can change the maximum operating frequency. At full loading, the IC operates in fixed frequency mode. When the loading goes low, it operates in Green Mode for high power conversion efficiency at light load condition.

SC6850 offers comprehensive protection coverage with auto-recovery including Cycle-by-Cycle current limiting (OCP), VDD under voltage lockout (UVLO), VDD over voltage protection (OVP) and over temperature protection (OTP).

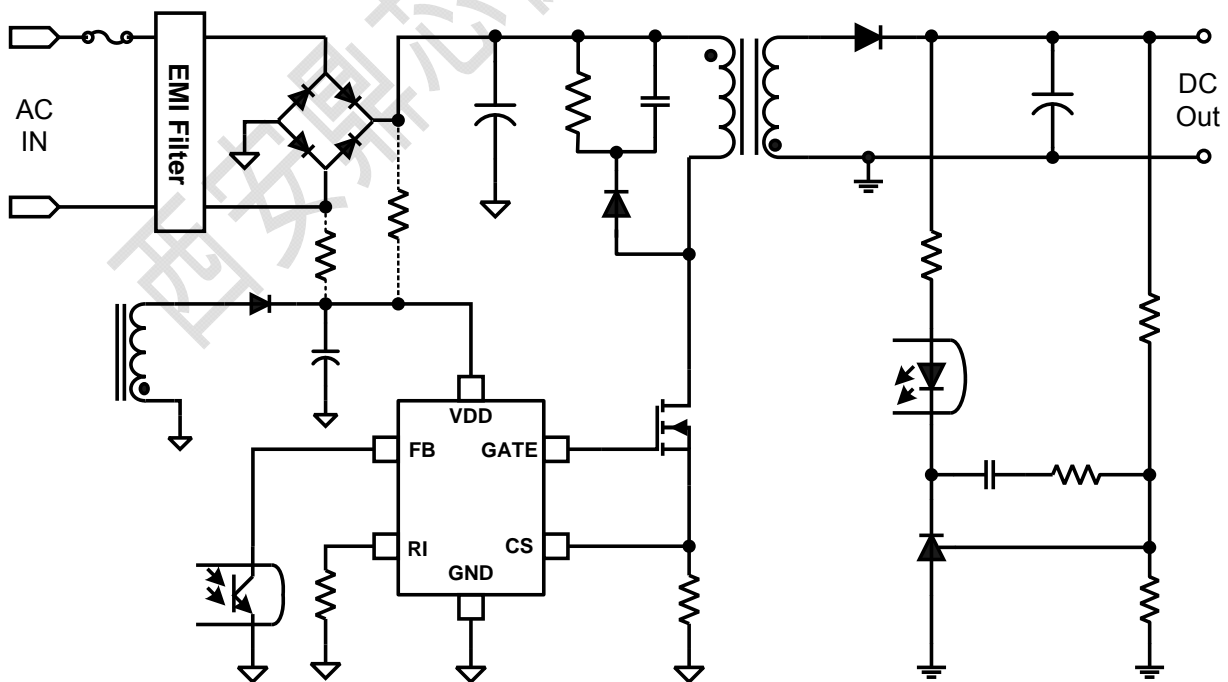SC6850 is offered in SOT23-6/SOP-8/DIP-8 Pb-free package.

Features

◆ Power-on Soft Startup
◆ External Programmable PWM switch Frequency
◆ Constant Output Power Control
◆ Low V_{DD} Startup Current (<5uA)
◆ Low Operation Current
◆ No Frequency Jitter
◆ Built-in Synchronized Slop Compensation
◆ Leading Edge Blanking On Current Sense
◆ VDD Under Voltage Lockout (UVLO)
◆ VDD Over Voltage Protection (OVP)
◆ Cycle-by-cycle Over Current Protection (OCP)
◆ Over Temperature Protection (OTP)
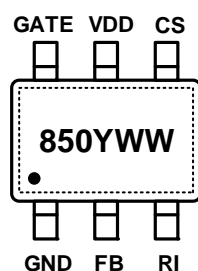
Applications

Offline AC/DC flyback converter for

◆ AC/DC Adapter
◆ Battery charger
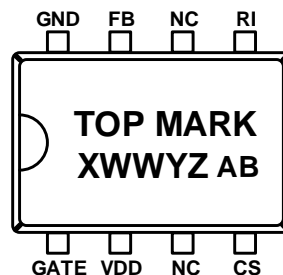◆ Open-frame SMPS

Typical Application

Pin Configuration

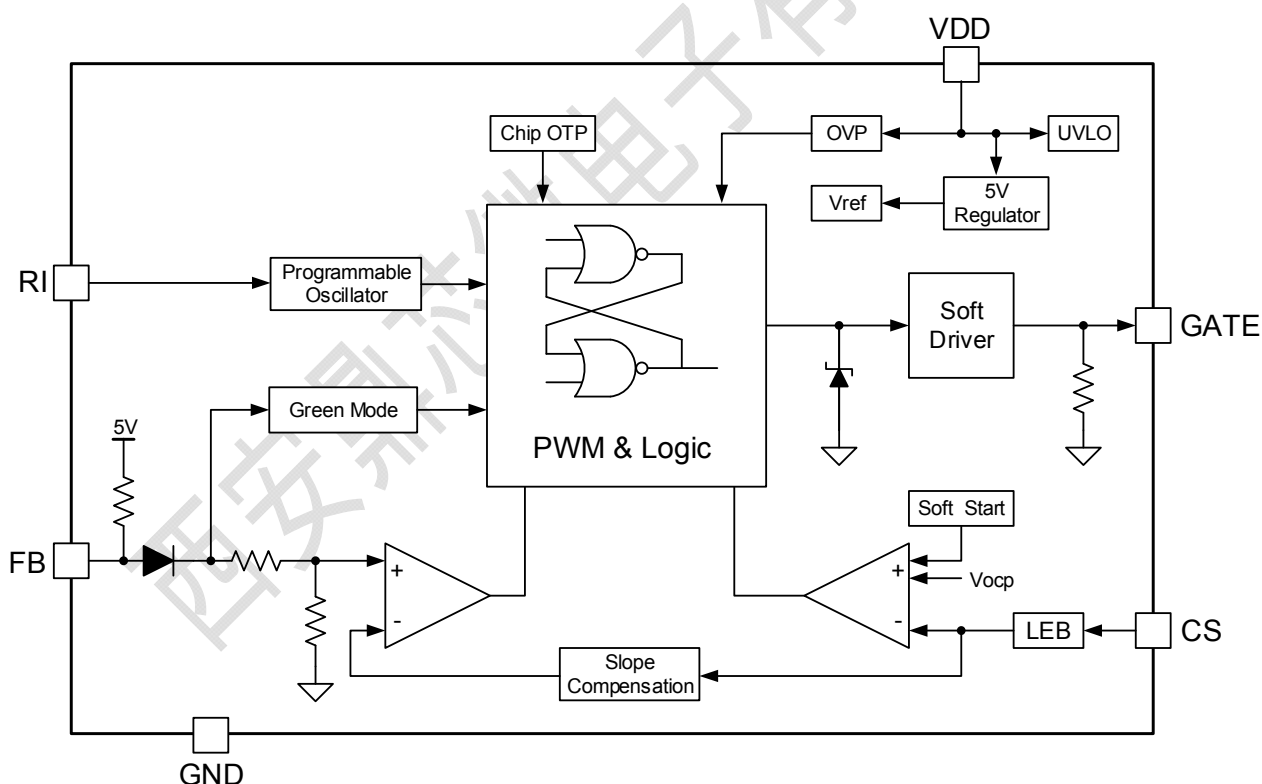SOT23-6 (TOP VIEW)   SOP-8/DIP-8 (TOP VIEW)

GATE   VDD   CS   GND   FB   NC   RI

850YWW   **TOP MARK**
                                       XWWYZ AB

GND   FB   RI   GATE VDD NC   CS

X: Version   WW: Week Code (01-52)   Y: Year Code   Z&AB: Internal code

Ordering Information

Part number	Package		TOP MARK	Shipping
SC6850	SOT23-6	Pb-free	850YWW	Tape & Reel
SC6850S	SOP-8	Pb-free	SC6850	Tape & Reel
SC6850T	DIP-8	Pb-free	SC6850T	Tube & Carton

Block Diagram

SC6850   Safety-Chip

Pin Descriptions

Name	Pin		Description
	SOT23-6	SOP-8/DIP-8	
GND	1	8	Ground
FB	2	7	Feedback input pin
RI	3	5	This pin is to program the switching frequency. By connecting a resistor to ground to set the switching frequency.
CS	4	4	Current sense input, connected through a resistor to GND to set the primary side peak current
VDD	5	2	IC DC power supply input
GATE	6	1	Totem-pole gate driver output for power MOSFET
NC	-	3,6	Not connect

Absolute Maximum Ratings

Symbol	Parameter	Min.	Max.	Unit
V_{DD}	DC Supply Voltage		38	V
I_{DD}	VDD DC Clamp Current		10	mA
V_{FB}	FB Input Voltage	-0.7V	6	V
V_{CS}	CS Input Voltage	-0.7V	6	V
V_{RI}	RI Input Voltage	-0.7V	6	V
R_{JA}	SOT23-6 Thermal Resistance (Junction-to-Air)		200	℃/W
	SOP-8 Thermal Resistance (Junction-to-Air)		150	℃/W
	DIP-8 Thermal Resistance (Junction-to-Air)		75	℃/W
T_J	Operating Junction Temperature	-20	150	℃
T_{STG}	Storage Temperature Range	-55	160	℃
T_L	Lead Temperature (Wave Soldering or IR,10Seconds)		260	℃
ESD	Human Body Model,JEDEC:JESD22-A114		2.5	KV
	Machine Model, JEDEC:JESD22- A115		250	V

Stresses beyond those listed under "absolute maximum ratings" may cause permanent damage to the device. These are stress ratings only, 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-rated conditions for extended period may affect device's reliability.
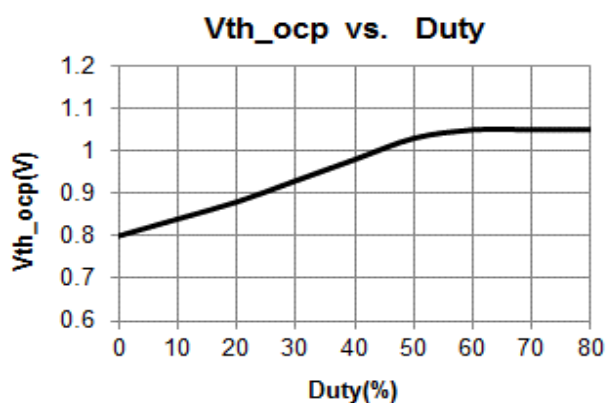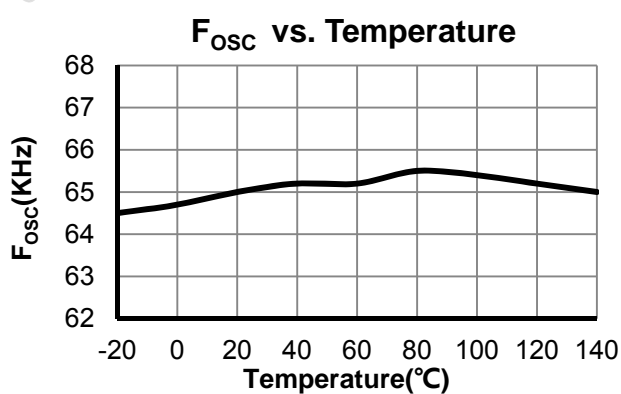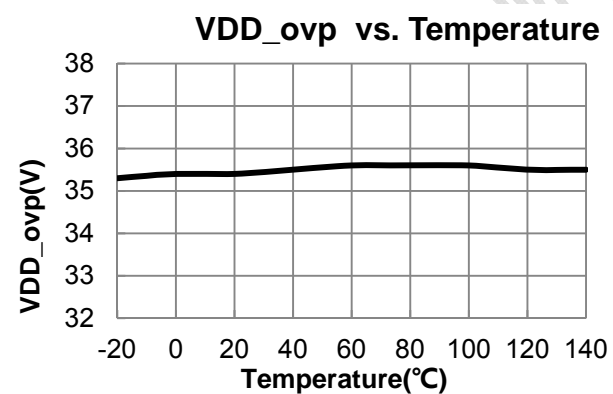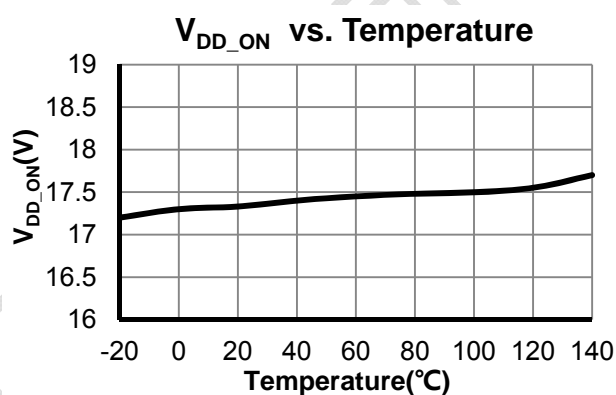
Recommended Operating Conditions

Symbol	Parameter	Min.	Max.	Unit
V_{DD}	DC Supply Voltage	10	34.0	V
T_A	Operating Ambient Temperature	-20	85	℃
C_{VDD}	VDD Capacitor	4.7	10	uF
R_{ST_AC}	Start-up resistor Value (AC Side, Half Wave)	400	2000	KΩ
R_{ST_DC}	Start-up resistor Value (DC Side, Filter Capacitor)	2000	4000	KΩ

Electrical Characteristics (T_A = 25℃, V_{DD}=18V, RI=100KΩ, unless otherwise noted)

Symbol	Parameter	Conditions	Min.	Typ.	Max.	Unit
Supply Voltage (VDD)						
I_{DD_ST}	Startup current	$V_{DD}=V_{DD\_ON}$-1V		1.0	3.0	uA
I_{DD_OP}	Operation current	V_{FB}=3V		2.5	3.0	mA
I_{DD_stby}	Standby current	V_{CS}=0V,V_{FB}=0.5V		0.45	0.60	mA
V_{DD_ON}	Threshold voltage to startup	VDD Rising	16.0	17.0	18.0	V
V_{DD_OFF}	Threshold voltage to stop switching in normal mode	VDD Falling	7.0	8.0	9.0	V
$V_{Pull-up}$	Pull-up PMOS active			10		V
V_{DD_OVP}	Over voltage protection voltage		34.0	35.0	36.0	V
V_{DD_Clamp}		I_{DD}=10mA		38.0		V
Feedback Input Section(FB Pin)						
V_{FB_Open}	FB open loop voltage			4.7		V
A_V	PWM input gain ΔV_{FB}/ ΔV_{CS}			1.71		V/V
D_{MAX}	Max duty cycle	V_{FB}=3V,V_{CS}=0.3V	77	80	83	%
V_{Ref_Green}	The threshold exit Green Mode			1.5		V
I_{FB_Short}	FB pin short circuit current	Short FB pin to GND		0.3		mA
Z_{FB_IN}	Input Impedance			20		KΩ
Current Sense Input(CS Pin)						
T_{SS}	Soft start time			5		ms
T_{LEB}	Leading edge blanking time			300		ns
T_{D_OC}	Over current detection and control delay			90		ns
V_{TH_OC}	Current limiting threshold voltage with zero duty cycle			0.80		V
V_{OCP_Clamp}	CS voltage clamper			1.05		V
Oscillator						
F_{OSC}	Normal oscillation frequency	RI=100 KΩ	60	65	70	KHz
F_{DT}	Frequency variation vs. temperature deviation			5		%
F_{DV}	Frequency variation vs. V_{DD} deviation			1		%
RI_{range}	Operation RI range		50	100	150	KΩ
$V_{\_RI\_open}$	RI open load voltage			1.0		V

Symbol	Parameter	Conditions	Min.	Typ.	Max.	Unit
GATE Driver						
V_{Gate_L}	Gate low level	V_{DD}=14V, I_O=5mA			1	V
V_{Gate_H}	Gate high level	V_{DD}=14V, I_O=20mA	6			V
V_{Gate_Clamp}	Gate clamp voltage			13.5		V
T_R	Gate rising time	C_L=1000pF		260		nS
T_F	Gate falling time	C_L=1000pF		70		nS
In-chip OTP						
T_{OTP_EN}	OTP enter			150		℃
T_{OTP_EX}	OTP exit			120		℃

Performance Characteristics (T$_A$ = 25℃, V$_{DD}$=18V, RI=100KΩ, unless otherwise noted)

I$_{DD\_ST}$ vs. Temperature

I$_{DD\_OP}$ vs. Temperature

V$_{DD\_OFF}$ vs. Temperature

V$_{DD\_ON}$ vs. Temperature

VDD_ovp vs. Temperature

F$_{OSC}$ vs. Temperature

Vth_ocp vs. Duty
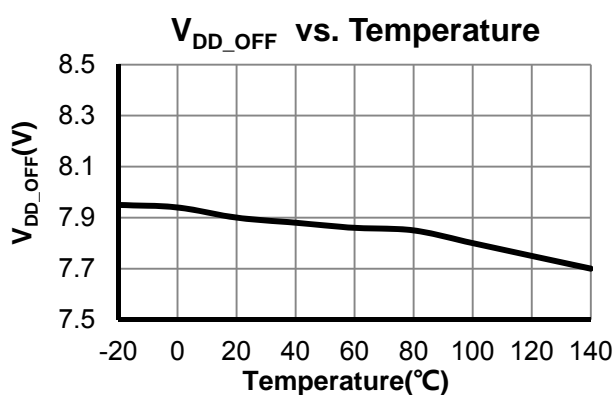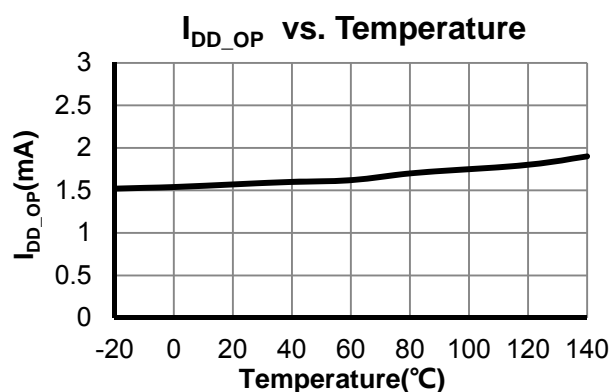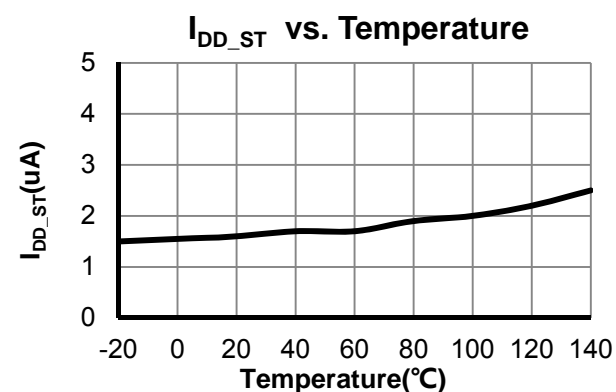
Functional Description

SC6850 is a highly integrated current mode PWM Power Controller optimized for high performance, extra low standby power consumption and cost effective offline flyback converter applications. The "Green Mode" control greatly reduces the power consumption and helps the design easier to meet the international power conservation requirements.

Startup Current and Start up Control

Startup current of SC6850 is designed to be very low so that VDD could be charged up above V_{DD_ON} and device starts up quickly. A large value startup resistor can therefore be used to minimize the power loss yet achieve a reliable startup in application.

Operating Current

The Operating current of SC6850 is low at 2.5mA (typical). Good efficiency is achieved with SC6850 low operation current together with the 'Green Mode' control features.

Soft Start

SC6850 features an internal 5ms (typical) soft start to soften the electrical stress occurring in the power supply during startup. It is activated during the power on sequence. As soon as VDD reaches V_{DD_ON}, the CS peak voltage is gradually increased from 0.05V to the maximum level. Every restart up is followed by a soft start.

Internal Bias and OSC Operation

A resistor connected between RI pin and GND pin sets that the internal constant current source charge or discharge to the internal fixed capacitor. The charge time and discharge time decides the internal clock frequency. Increasing the resistance will reduce the input current and the switching frequency. The relationship between RI and PWM switching frequency follows the below equation within the RI allowed range.

$$F_{OSC} = \frac{100}{RI(KHz)}(KHz)$$

For example, a 100KΩ resistor RI could set 65KHz PWM switching frequency. The suggested operating frequency range of SC6850 is from 50 KHz to 150 KHz.

Multi-mode Operation for High Efficiency

SC6850 is a multi-mode controller. The controller changes the mode of operation according to the FB pin voltage. At the normal operating condition, the IC operates in traditional fix frequency 65KHz （RI=100K）PWM mode. The most of the power dissipation in a switching mode power supply is from switching loss of the MOSFET, the core loss of the transformer and the loss of the snubber circuit. The magnitude of power loss is in proportion to the switching frequency. Lower switching frequency leads to the reduction on the power loss and thus conserves the energy. As the output load current is decreased, SC6850 enter into Green Mode smoothly from the PWM mode at light load condition. In this mode, the switching frequency will start to linearly decrease from 65KHz (RI=100K). It's minimum operation frequency can reach to 13KHz.

Current Sensing and Leading Edge Blanking

Cycle-by-Cycle current limiting is offered in SC6850 current mode PWM control. The switch current is detected by a sense resistor into the CS pin. An internal leading edge blanking circuit chops off the sensed voltage spike at initial power MOSFET on state due to snubber diode reverse recovery and surge gate current of power MOSFET. The current limiting comparator is disabled and cannot turn off the power MOSFET during the blanking period. The PWM duty cycle is determined by the current sense input voltage and the FB input voltage.

Internal Synchronized Slope Compensation

Built-in slope compensation circuit adds voltage ramp into the current sense input voltage for PWM generation. This greatly improves the close loop stability at CCM and prevents the sub-harmonic oscillation and thus reduces the

output ripple voltage.

Protection Controls

Good power supply system reliability is achieved with auto-recovery protection features including Cycle-by-Cycle current limiting (OCP), Under Voltage Lockout on VDD (UVLO), VDD Over Voltage Protection (OVP) and Over Temperature Protection (OTP). Another, SC6850 built in constant output power control and OCP compensation over the universal input voltage range.
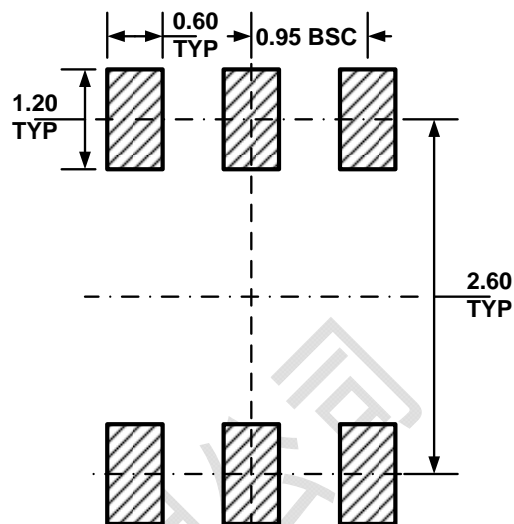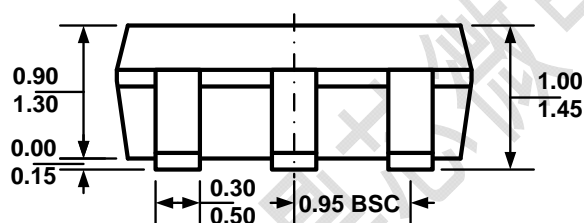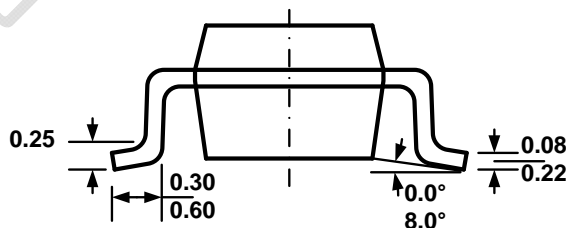
Package Information

SOT23-6
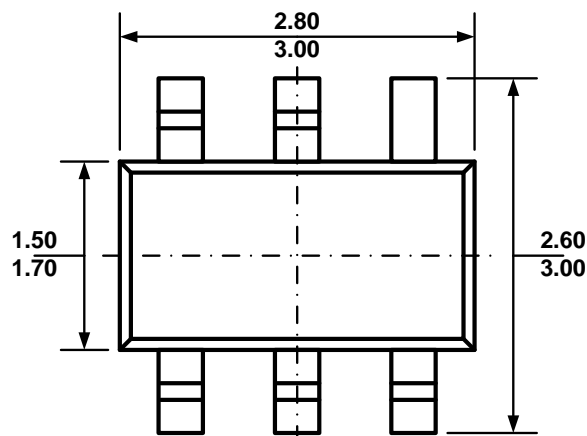
TOP VIEW

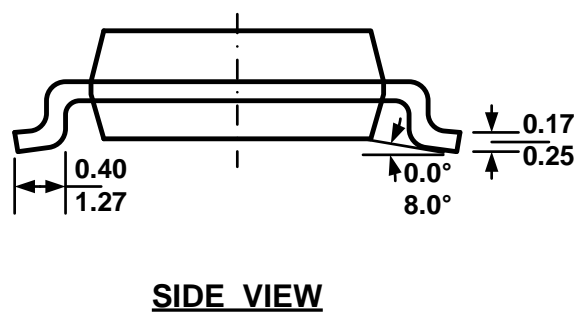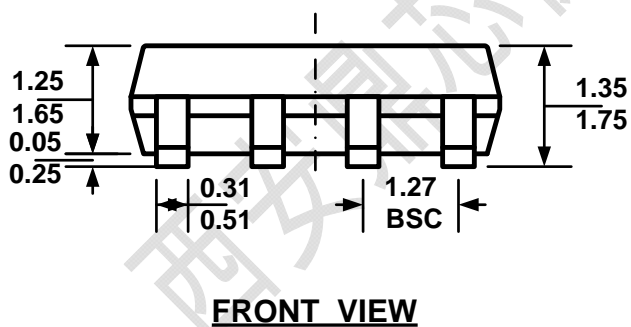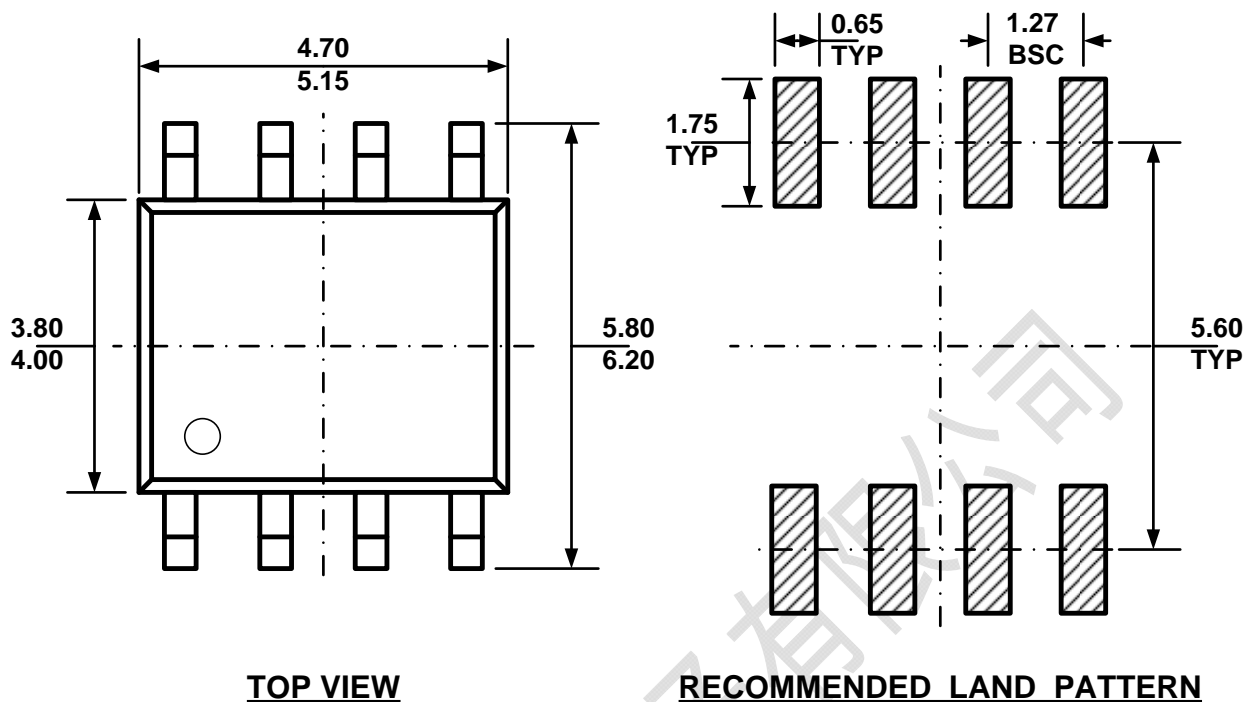**RECOMMENDED LAND PATTERN**

FRONT VIEW

SIDE VIEW

Note:

1. All dimensions are in millimeters
2. Package length does not include mold flash protrusion or gate burr
3. Package WIDTH does not include mold flash protrusion
4. Drawing is not to scale
5. Pin 1 is lower left pin when reading top mark from left to right

Package Information

SOP-8

TOP VIEW

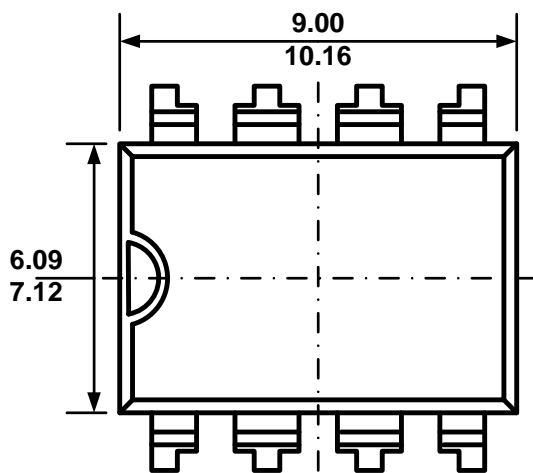**RECOMMENDED LAND PATTERN**

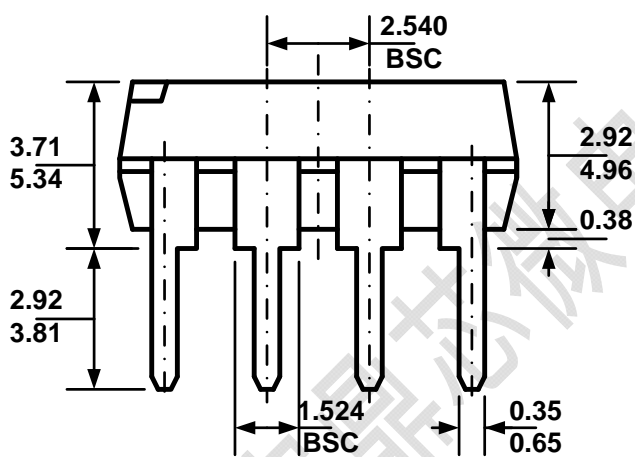**FRONT VIEW**

SIDE VIEW

Note:

1. All dimensions are in millimeters
2. Package length does not include mold flash protrusion or gate burr
3. Package WIDTH does not include mold flash protrusion
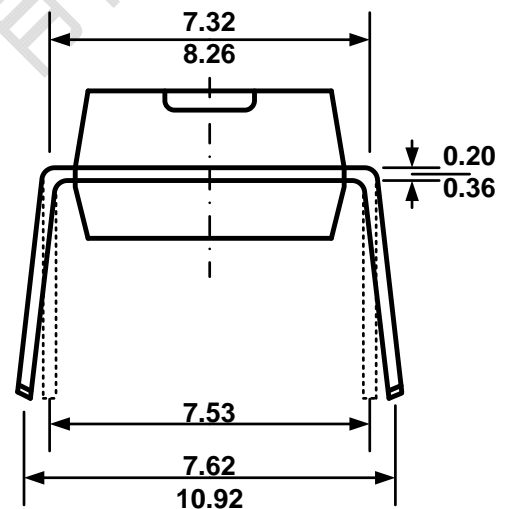4. Drawing is not to scale

Package Information

DIP-8

TOP VIEW

FRONT VIEW

SIDE VIEW

Note:

1. All dimensions are in millimeters
2. Package length does not include mold flash protrusion or gate burr
3. Package WIDTH does not include mold flash protrusion
4. Drawing is not to scale

Important Notice

Right to Make Changes

Safety-Chip Micro reserves the right to make corrections, modifications, enhancements, improvements and other changes to its products and services at any time and to discontinue any product or service without notice. Customers should obtain the latest relevant information before placing orders and should verify that such information is current and complete.

Warranty Information

Safety-Chip Micro warrants performance of its hardware products to the specifications applicable at the time of sale in accordance with its standard warranty. Testing and other quality control techniques are used to the extent it deems necessary to support this warranty. Except where mandated by government requirements, testing of all parameters of each product is not necessarily performed. Safety-Chip Micro assumes no liability for application assistance or customer product design. Customers are responsible for their products and applications using Safety-Chip's components, data sheet and application notes. To minimize the risks associated with customer products and applications, customers should provide adequate design and operating safeguards.

Life Support

Safety-Chip's products are not designed to be used as components in devices intended to support or sustain human life. Safety-Chip Micro will not be held liable for any damages or claims resulting from the use of its products in medical applications.

Military and Aerospace

Safety-Chip's products are not designed for use in Military and Aerospace applications. Safety-Chip Micro will not be held liable for any damages or claims resulting from the use of its products in Military and Aerospace applications.