General Description

The SIC9803 is a dimmable high precision primary-side regulation isolated flyback controller with single-stage Active PFC, specially designed for offline constant current LED lighting. The controller with on-chip PFC circuit operates in CCM (Critical Conduction Mode) to achieve high power factor and reduce the power MOSFET switching loss. The controller precisely control the LED current without secondary side sense and feedback circuit including opto-coupler. It uses source driver architecture and pending internal charging circuit for low primary side switching loss, ultra fast VDD start up and LED turn on.

The SIC9803 uses compensation method to achieve excellent line regulation, and it still can be tuned externally for flexibility.The controller also has outstanding load regulation for driving wide range of LED numbers.

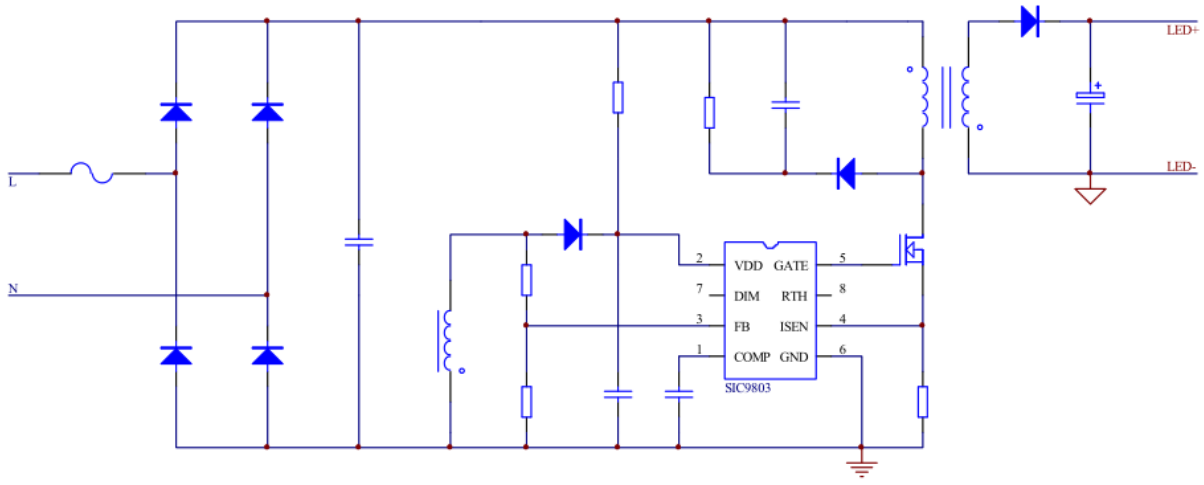
The SIC9803 offers rich protection functions to improve the system reliability, including LED short circuit protection, LED open circuit protection, VDD over voltage protection, VDD under voltage protection, ISEN resistor short circuit protection, ISEN resistor open circuit protection, cycle-by-cycle current limit and die over-temperature protection.All the protection features are auto-recovery.

The SIC9803 is available in SOP-8 package.

Features

- Single-Stage Active PFC for High Power Factor and Low THD
- Dimmable
- Excellent Line and Load Regulation
- Gate Driver Structure for Improved Efficiency
- Ultra-Low Start up Current
- LED Short and Open Circuit Protection
- Transformer Saturation Protection
- VDD Over-voltage and Under-voltage Protection
- Auto Recovery
- Primary Side Control Constant Current Operation
- ±3% LED Current Accuracy
- Critical Conduction Mode Operation
- High Resistance Feedback Resistor for Improved Efficiency
- Ultra-Low Operating Current
- ISEN Resistor Short and Open Circuit Protection
- Cycle-by-Cycle Current Limit
- Over Temperature Protection

Typical Application



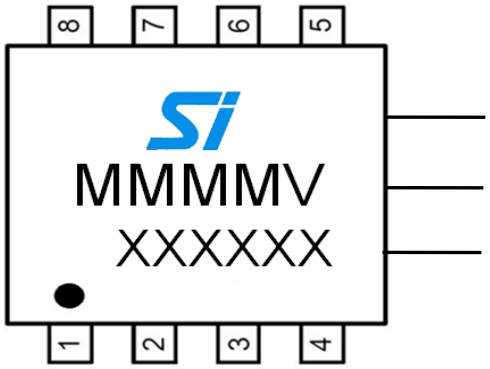
Recommended Operation Conditions

Symbol	Products	Range	Unit
V_{DD}	Power Voltage	8.5-18	V

Ordering Information

Part Number	Package	Package Method	Marking
SIC9803	**SOP-8**	**Tape** **4,000pcs/Roll**	**Si** **9803** **YMXXXX**

Pin Assignment



SOP-8 Products

"Si"-Logo of SI Semiconductors

MMMM--Part Number (4 digits)； V： Version(1 digit, optional)

XXXXXX--Date Code (6 digits)

Pin Description：

Pin	Pin Name	Description
1	COMP	Loop Compensation Node. This pin connects a capacitor to GND for stabilization the control loop, achieve accurate LED current, high Power Factor and low THD.
2	VDD	Power Supply pin.
3	FB	Feedback Voltage Input pin. This pin detects the output information through the auxiliary winding. It is also used for line regulation compensation.
4	ISEN	Current Sense pin. This pin connects a resistor to GND to sense the transformer primary side current.
5	GATE	External power MOSFET gate driver.
6	GND	Ground.
7	DIM	Enable switch, analog and PWM dimming input.
8	RTH	Temperature regulation PIN. This pin connects a resistance to GND, or keep floating for not setting.

Absolute Maximum Ratings

Parameter	Symbol	Parameter Range	Parameter
Voltage on PIN VDD	V_{DD}	-0.3～25	V
Maximum Clamping Current for PIN VDD	I_{CC_MAX}	5	mA
Voltage on PIN COMP	V_{COMP}	-0.3～6	V
Voltage on PIN FB	V_{FB}	-0.3～6	V
Voltage on PIN ISEN	V_{ISEN}	-0.3～6	V
Voltage on PIN External Power MOSFET gate driver	V_{GATE}	-0.3～25	V
Voltage on PIN DIM	V_{DIM}	-0.3～6	V
Voltage on PIN RTH	V_{RTH}	-0.3～6	V
Maximum Power Dissipation(Ta=25℃)	P_{tot}	0.45	W
Thermal Resistance Junction-ambient	R_{thj-a}	145	℃/W
Operating Junction Temperature	T_J	-40～150	℃
Storage Temperature Range	T_{STG}	-55～150	℃
ESD		2,000	V

Note: Absolute Maximum Ratings indicate limits beyond which damage to the device may occur. Exposure to Absolute Maximum Rating conditions for extended periods may affect device reliability。

Electronic Characteristics

T_C =25°C,V_{DD} =15V,unless otherwise specified

Parameter	Symbol	Test Conditions	Min	Typ	Max	Unit
VDD Turn On Threshold Voltage	V_{DD_ON}	VDD Rising		16.7		V
VDD Turn Off Threshold Voltage	V_{DD_UVLO}	VDD Falling		7.5		V
VDD Start Up Current	I_{ST}	VDD= V_{DD_ON}-1V		33	50	uA
VDD Operating Current	I_{OP}	F =10KHZ		1	2	mA
VDD Clamp Voltage	V_{DD_CLAMP}	1mA		23		V
FB Falling Edge Threshold Voltage	V_{FB_FALL}	FB Falling		0.1		V
FB Hysteresis Voltage	V_{FB_HYS}	FB Rising		0.08		V
FB Over Voltage Protection Threshold	V_{FB_OVP}			1.6		V
Minimum Degaussing time	T_{OFF_MIN}			4.5		us
Maximum Degaussing time	T_{OFF_MAX}			100		us
Maximum On time	T_{ON_MAX}			25		us
ISEN Peak Voltage Limitation	V_{ISEN_LMIT}			1		V
Leading Edge Blanking Time for Current Sense	T_{LEB}			350		ns
Switch off Delay Time	T_{DELAY}			200		ns
Internal Reference Voltage	V_{REF}		194	200	206	mV

Parameter	Symbol	Test Conditions	Min	Typ	Max	Unit
COMP Low Clamp Voltage	V_{COMP_L0}			1.5		
COMP Linear Operating Voltage Range	V_{COMP}		1.5		3.5	V
COMP High Clamp Voltage	V_{COMP_OVP}			3.6		V
Dimming Turn ON Voltage	V_{DIM_ON}	DIM Rising		0.9		V
Dimming Hysteresis Voltage	V_{DIM_HYS}	DIM Falling		0.2		V
Lowest Dimming Saturation Voltage	V_{DIM_MIN}			1.0		V
Maximum Dimming Saturation Voltage	V_{DIM_MAX}			3.0		V
Voltage on PIN DIM floating	V_{DIM_OPEN}			5		V
DIM on pull resistor	$V_{DIM\_PULL\ UP}$			600		KΩ
Maximum Sourcing Current for PIN Gate	I_{SOURCE_MAX}			200		mA
Maximum Sinking Current for PIN Gate	I_{SINK_MAX}			600		mA
Over-temperature Protection	T_{REG}			150		℃

Applications Information

Functional Description

The SIC9803 is a high precision primary-side regulation isolated flyback controller with single-stage Active PFC, specially designed for offline constant current LED lighting,can achieve high power faction ,low THD and high efficiency.

Start-up

After system powered up, the VDD pin capacitor is charged up by the start up resistor. When the VDD pin voltage reaches the turn on threshold, the internal circuits start working. The COMP pin voltage is pulled up to 1.5V quickly, then the SIC9803 starts the MOSFET driver. The system works at 10kHz frequency at the beginning, the COMP voltage rises up gradually, and the transformer primary peak current also rises up. The LED current hence achieves a soft start without overshoot. After the output voltage is built up, the VDD power is supplied by the auxiliary winding.

Constant Current Control

The SIC9803 uses compensation method to achieve excellent line regulation, and it still can be tuned externally for flexibility. Output current is given by:

$$I_{OUT} \approx \frac{V_{REF}}{2 \times R_{ISEN}} \times \frac{N_P}{N_S}$$

Where,
Np is turns of transformer primary winding;
Ns is turns of transformer secondary winding;

V_{REF} is the internal reference voltage, typical is 200mV;
R_{ISEN} is current detection resistor.

Feedback Network

The SIC9803 detect the output zero current through feedback network,the FB sense down threshold is set at 0.1V, Hysteresis voltage is 0.08V.The FB sense is also used to detect output OVP,threshold is 1.6V.
The ratio of FB upper resistor to lower resistor can be set :

$$\frac{R_{FBL}}{R_{FBL}+R_{FBH}}=\frac{1.6V}{V_{OVP\_FB}}\times\frac{N_S}{N_A}$$

Where,
R_{FBL}:the lower resistor of the feedback network;
R_{FBH}:the upper resistor of the feedback network;
V_{OVP}:output over voltage setting point;
N_S is turns of transformer secondary winding
The FB upper resistor can be set to around 300KΩ to improve the system efficiency. It is also used for fine tuning the LED current line compensation.

Dimming function

SIC9803 with an adjustable light interface, through a simple peripheral circuit, can be compatible with DC dimming, PWM dimming and TRIAC dimming. DIM voltage linear dimming range is 3V - 1V, in this range, the output current is higher if the DIM voltage is higher. When the voltage on DIM is less than 0.7V, the signal for Gate will be closed, and the voltage on PIN COMP will pull down to 1.5V, the output current is will be zero. When DIM is greater than 3V, the chip is in normal working condition, and the output current is 100%.

Please connect a 100pF filter capacitor from PIN DIM to the ground if the Dimming is no need.

LED Over Temperature Protection

When SIC9803's temperature are too high the output current will be decrease. The output power and thermal dissipation are also reduced. The system temperature is regulated and the system reliability is improved. The thermal regulation temperature is set to 150℃ internally.

LED Open Protection

The output voltage can be detected by the FB pin. When the FB voltage is higher than 1.6V, the LED open protection is triggered and the power MOSFET gate driver stops switching. After several seconds, the gate driver starts switching again.

LED Short Protection

The SIC9803 judges LED short from the FB voltage. During a shorted LED condition, SIC9803 reduces the

internal command current to a very low level and slows down the switching frequency to 10 kHz to decrease the output current. Meanwhile, the output voltage is low and the VDD pin cannot be charged up by the output voltage, so the VDD pin voltage will gradually decrease and finally reaches the UVLO threshold. After the system enters into fault condition, the VDD voltage will decrease until it reaches UVLO threshold. Then the system will re-start again. If the fault condition is removed, the system will resume normal operation.

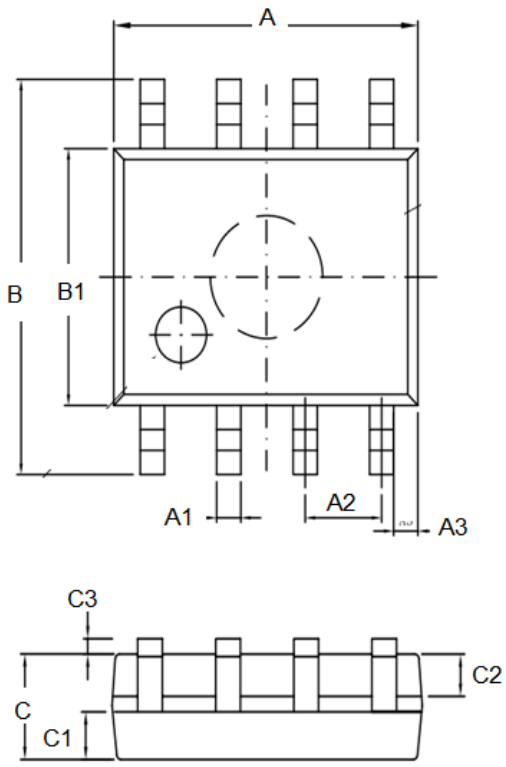
PCB Layout Guidelines:

Bypass Capacitor: The bypass capacitor on VDD pin should be as close as possible to the VDD and GND pins.
Ground Path: The power ground path for current sense resistor should be short and wide, and it should be as close as possible to the IC ground (pin 8) , otherwise the LED output current accuracy maybe affected. The IC signal ground for COMP and FB components should be connected to the IC GND pin with short traces and should be away from the power ground path.
The Area of Power Loop: The area of main current loop should be as small as possible to reduce EMI radiation.
FB Pin: The feedback resistor divider should be as close as possible to the FB pin, and the trace must keeps away from dynamic node of the inductor, otherwise the FB pin OVP function might have risk to be mis-triggered by the system noise.

SOP-8 封装机械尺寸
SOP-8 MECHANICAL DATA

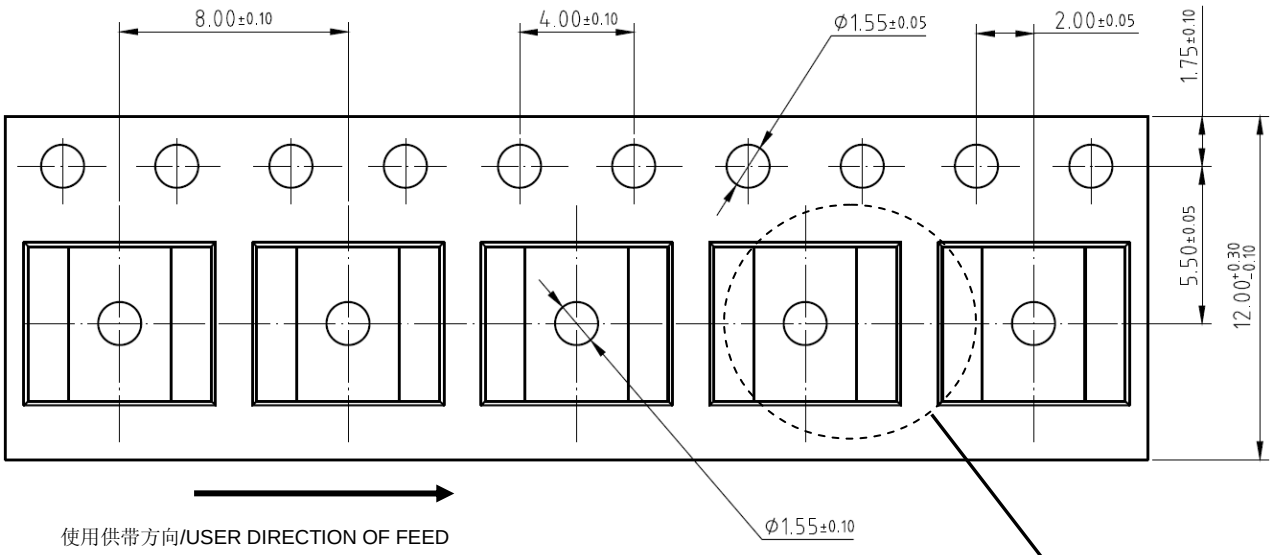
单位:毫米/UNIT：mm

符号 SYMBOL	最小值 min	典型值 nom	最大值 max	符号 SYMBOL	最小值 min	典型值 nom	最大值 max
A	4.80		5.10	C	1.30		1.50
A1	0.37		0.47	C1	0.55		0.75
A2		1.27 TYP		C2	0.55		0.65
A3		0.41 TYP		C3	0.05		0.25
B	5.80		6.20	C4	0.19	0.20TYP	0.23
B1	3.80		4.00	D		1.05TYP	
B2		5.0TYP		D1	0.40		0.62

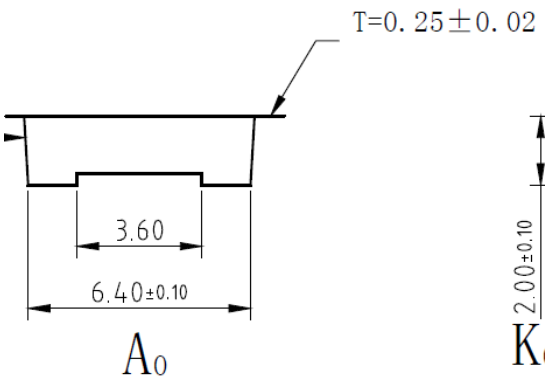


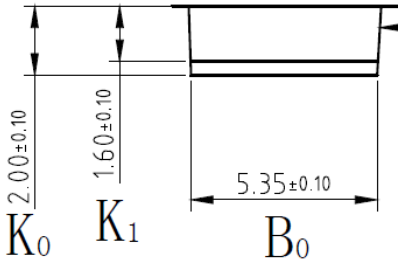
SOP8 (13")编带规格
SOP8 (13")TAPE AND REEL DATA

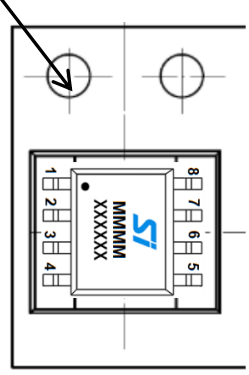
单位:毫米/UNIT：mm



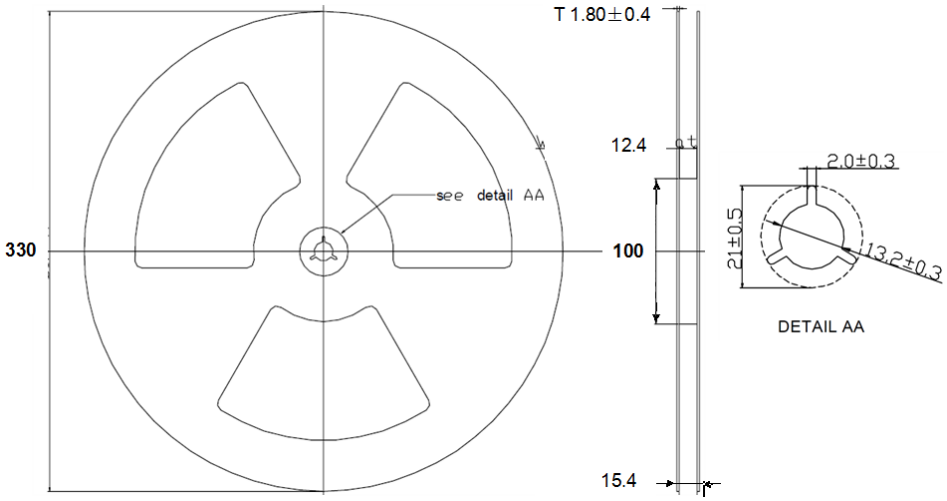
使用供带方向/USER DIRECTION OF FEED





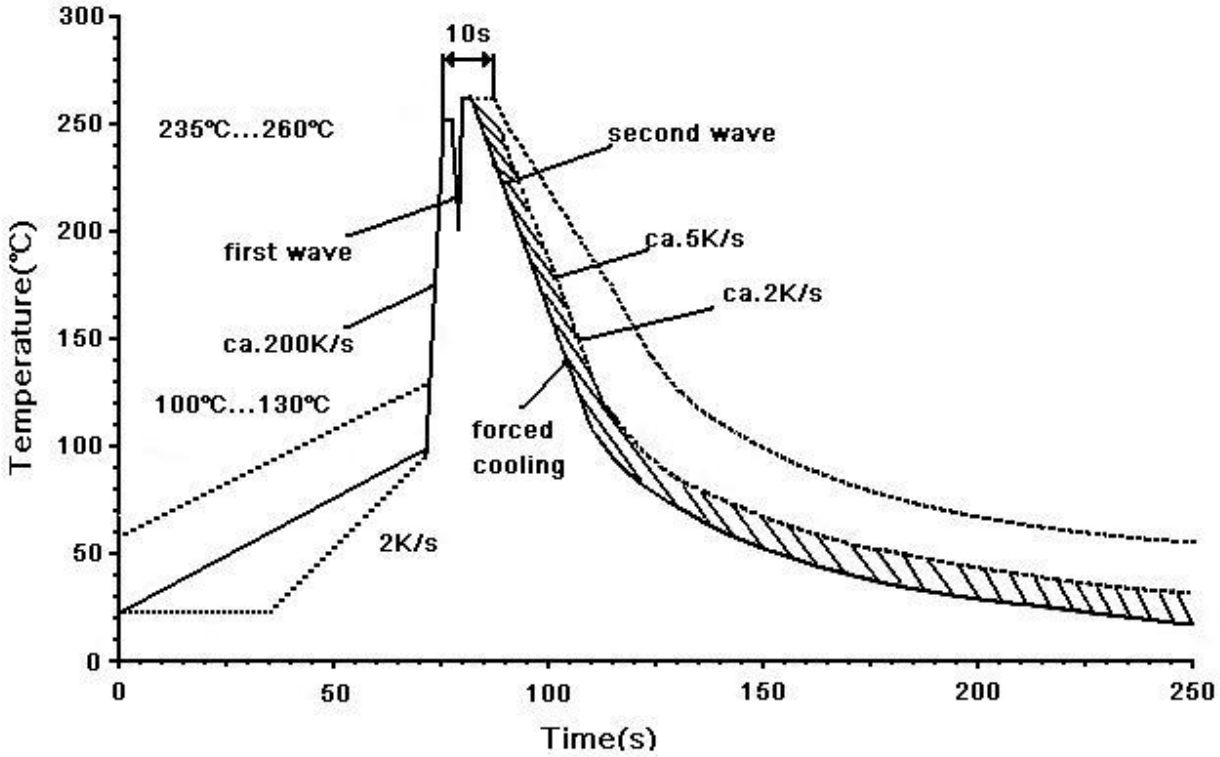


器件定位示意图/UNIT ORIENTATION

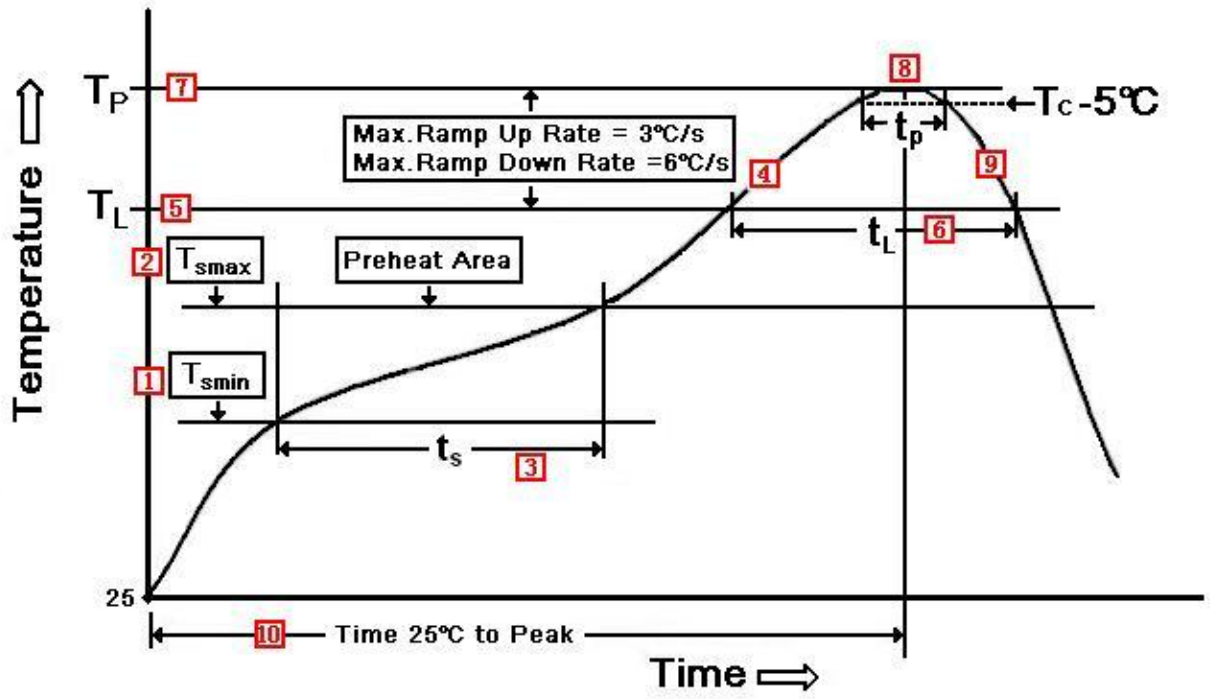


13"卷盘/REEL

SI Guidelines for wave-soldering



SI Reflow Soldering



Tabular form for soldering profile data:

Key	Par.	Profile Feature	Pb free Process
R.1	Tsmin	Minimum pre-heating temperature	150℃
R.2	Tsmax	Maximal pre-heating temperature	200℃
R.3	ts	Pre-heating duration(Tsmin to Tsmax)	120sec
R.4	dT/dt up	Average ramp-up rate(Tsmax to Tp)	3℃/sec max.
R.5	TL	Liquidus temperature	217℃
R.6	t_L	Time duration at liquidus	Min.90sec.
R.7	T_P	Peak package body temperature	Min.250℃ for package<320mm3 Min.245℃ for package>350mm3
R.8	t_P	Time within 5℃ of the specified classification temperature T_C	Min.30sec.
R.9	dT/dt down	Average ramp-down rate(T_P to Tsmax)	6℃/sec max.
R.10	Tpeak	Time 25℃ to peak temperature	8minutes max.

Revision history

Revision	Release data	Description
2.1	2018-2-26	Add information about wave soldering and reflow soldering