LPQ3988

Automotive Ultra-Low Noise and High PSRR LDO

Features

- Compliance with automotive application
- AEC-Q100 certification:
  - Device temperature Level 1: -40℃ to 125℃
- Wide input voltage range: 2.0V to 5.5V
- High output voltage accuracy: ±1.5%(Typ)
- Ultra-high PSRR: 98dB @ 20mA/1kHz
- Ultra-low noise: 10μV_{RMS} @ 20mA
- Low current consumption: 24μA (Typ)
- Low dropout voltage:
  - 165mV at 250mA (V_{OUT} = 1.8V)
  - 480mV at 500mA (V_{OUT} = 1.8V)
- Integrated over-current protection
- Thermal shutdown
- Active-high EN pin
- Robust ESD capability:
  - Human Body Model: 4 kV
  - Charged Device Model: 1 kV
- Package: SOT23-5
- RoHS Compliant and 100% Lead (Pb)-Free

Applications

- Automotive rear camera
- ADAS
- Image sensor power supply
- Automotive infotainment
- Automotive body electronics

Description

The LPQ3988 is a low-dropout voltage regulator with very low noise and high PSRR in a small package for automotive application. The LPQ3988 can deliver output current up to 600mA. The output voltage could be selected to 1.8V, 2.8V, and 3.3V.

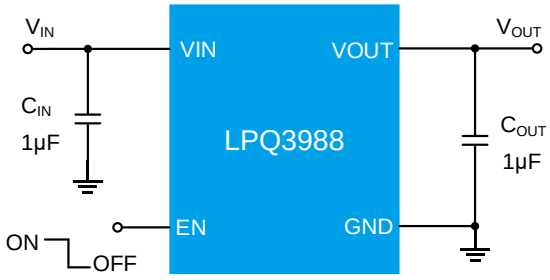
The LPQ3988 integrated over current protection and thermal shutdown in order to protect system abnormal.

The input and output capacitor as small as 1μF will be good enough for LPQ3988.

The LPQ3988 is available in normal SOT23-5 package.

SOT23-5

Application Diagram



Order Information

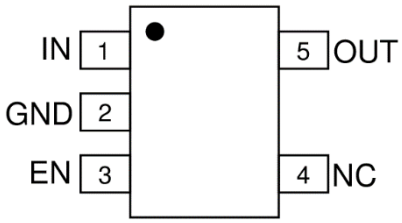
LPQ3988 - □□ □□ □

- F: Pb-Free
- Package Type: B5 : SOT23-5
- Output Voltage: 18: 1.8V, 28: 2.8V, 33: 3.3V

Device Information

Device	Marking	Moisture Sensitivity Level	Package	Shipping
LPQ3988-18B5F	LPS QCYWX	MSL3	SOT23-5	3K/REEL
LPQ3988-28B5F	LPS QHYWX	MSL3	SOT23-5	3K/REEL
LPQ3988-33B5F	LPS QEYWX	MSL3	SOT23-5	3K/REEL
Marking indication: Y: Production year, W: Production week, X: Production batch				

Pin Configuration



SOT23-5
(Top View)

Pin Description

Pin No.	Name	Description
1	IN	Input and power source. A small capacitor is recommended from this pin to ground.
2	GND	Ground.
3	EN	Active-high enable pin. 1: enable the device. 0 or floating: disable the device.
4	NC	Not connected.
5	OUT	Regulated output. A minimum 0.1μF ceramic capacitor is needed from it to ground.

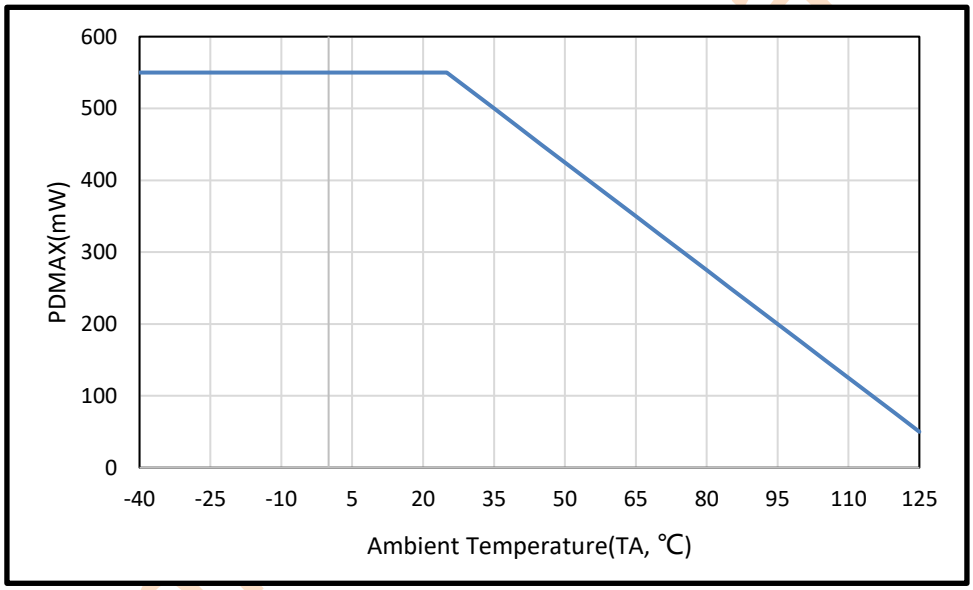
Absolute Maximum Ratings (Note 1)

- IN to GND ---------- -0.3V to 6V
- OUT to GND ---------- -0.3V to (V_{IN} + 0.3V) or 6V
- EN to GND ---------- -0.3V to 6V
- Output Current ---------- 700mA
- Maximum Junction Temperature (T_J) ---------- 160°C
- Maximum Soldering Temperature (At leads, 10 sec) ---------- 260°C

*Note 1: Stresses beyond 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 in the operational sections of the specifications is not implied. Exposure to absolute maximum rating conditions for extended periods may affect device reliability.

Thermal Information

- Thermal Resistance (θ_{JA}) (Note 2) ---------- 200 °C/W
- Maximum Power Dissipation (P_{DMAX})



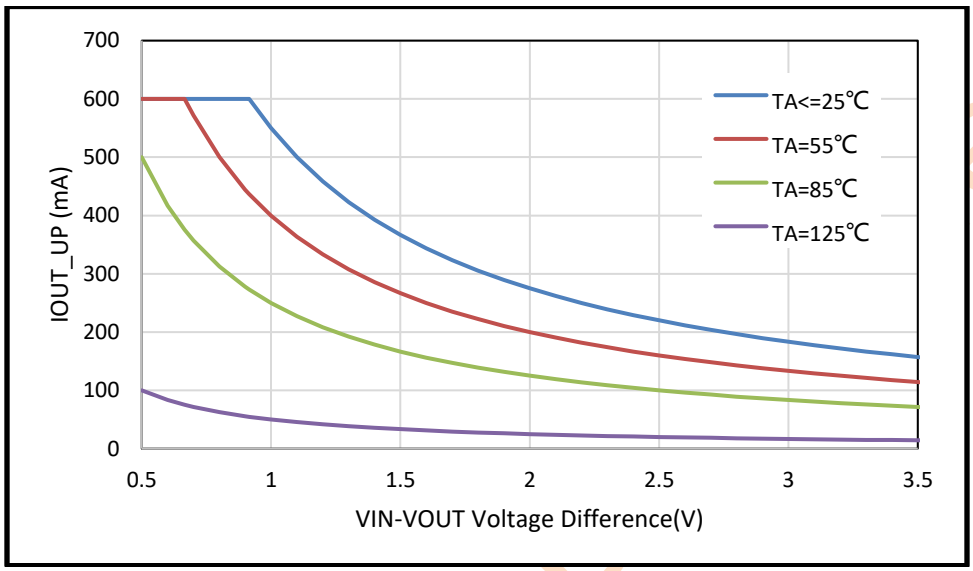
*Note 2: Measured using 2S2P JEDEC standard PCB with ambient temperature < 25°C

Electro-Static Discharge and Latch-up

- HBM (Human Body Model, JEDEC JS-001) ---------- 4000V
- CDM (Charged Device Model, JEDEC JS-002) ---------- 1000V

Recommended Operating Conditions

- Input and supply voltage on IN ---------- 2.5V to 5.5V
- Input and Output capacitor ---------- >= 1μF
- Operating ambient temperature ---------- -40°C to 125°C
- Output current upper-limit (I_{OUT_UP})

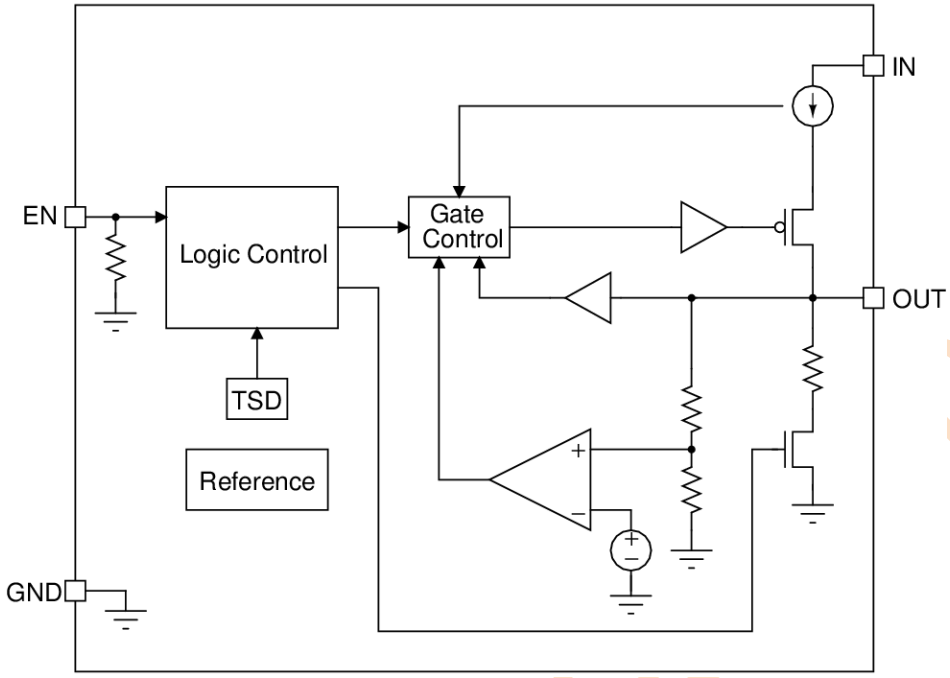


Electrical Characteristics

The parameters are specified under conditions: V_{IN} is equal to the greater value between $V_{OUT(NOM)}$ + 0.5V and 2.0V, -40°C ≤ T_a ≤ 125°C, I_{OUT} = 10mA, C_{IN} = C_{OUT} = 1μF, unless otherwise noted. Typical values are at T_a = 25°C.

Parameter	Symbol	Test Conditions	Min	Typ.	Max	Units
Output Voltage at 25°C	V_{OUT}	VIN = 2.8V, LPQ3988-18B5F	1.77	1.80	1.83	V
		VIN = 3.8V, LPQ3988-28B5F	2.76	2.80	2.84	V
		VIN = 4.3V, LPQ3988-33B5F	3.24	3.30	3.36	V
Output voltage accuracy		$V_{OUT(NOM)}$ = 3.3V, T_J = 25°C	-1.5		1.5	%
Output voltage accuracy over temperature		$V_{OUT(NOM)}$ = 3.3V, -40°C ≤ T_a ≤ 125°C	-2.0		2.0	%
Input quiescent current	I_Q	V_{IN} = 2V to 5.5V, V_{EN} = V_{IN}, no load		24		μA
Ground Current	I_G	V_{IN} = 3.8V to 5.5V, V_{EN} = V_{IN}, 300mA load		TBD		μA
Input shutdown current	I_{SHDN}	V_{IN} = $V_{OUT(NOM)}$ + 0.5V to 5.5V, V_{EN} = 0V, no load			1	μA
Line regulation	$\frac{\Delta V_{OUT}}{\Delta V_{IN} \times V_{OUT}}$	I_{OUT} = 1mA, V_{IN} = ($V_{OUT(NOM)}$ + 0.5V) to 5.5V, T_A = 25°C		0.002		%/V
Load regulation	ΔV_{LOAD}	I_{OUT} = 1mA to 600mA, V_{IN} = $V_{OUT(NOM)}$ + 1V, T_A = 25°C		12		mV
Dropout voltage	V_{DROP}	$V_{OUT(NOM)}$ = 3.3V, I_{OUT} = 100mA,		70		mV
		$V_{OUT(NOM)}$ = 3.3V, I_{OUT} = 300mA,		200		mV
		$V_{OUT(NOM)}$ = 3.3V, I_{OUT} = 600mA,		500		mV
Output current limit	I_{LIM}	$V_{OUT(NOM)}$ = 3.3V, V_{IN} = $V_{OUT(NOM)}$ + 1V, V_{OUT} = 0.9 × $V_{OUT(NOM)}$		960		mA
Output voltage noise	V_{NOISE}	BW = 10Hz to 100kHz, I_{OUT} = 20mA		10		μV_{RMS}
Power supply rejection ratio	PSRR	V_{IN} = $V_{OUT(NOM)}$ + 1V, I_{OUT} = 20mA, f = 1kHz, ΔV_{RIPPLE} = 0.2 × V_{PP}		98		dB
EN logic high voltage level	V_{IH}		1.1			V
EN logic low voltage level	V_{IL}				0.4	V
EN pull-up current	I_{EN_PU}	VIN=EN=5.5V		200		nA
Thermal Shutdown Threshold	T_{SD}			160		℃
Thermal Shutdown Hysteresis	ΔT_{SD}			30		℃
Output discharge resistance	R_{DIS}	V_{EN} = 0V		300		Ω

Functional Block Diagram



Function Description

Overview

The LPQ3988 is a Low dropout voltage regulator with ultra-low noise and ultra-high PSRR. It has fixed output voltage with good transient performance and no external setting resistors needed. The product is available in traditional SOT23-5.

Selectable output voltage

The product will output fixed voltage as long as the input voltage is higher than $V_{OUT(NOM)}$ + V_{DROP}. $V_{OUT(NOM)}$, the output voltage, can be selected.

Enable function

The EN pin is an active high Logic input pin that is compatible with 1.8V control logic. The internal power element is turned off when EN pin is tied low.

When the EN pin is pulled high, the LPQ3988 will be activated and output voltage according to setting.

Auto discharge

The LPQ3988 has a quick discharge function. When the device is disabled by pulled down EN pin, a discharge resistor is connected between OUT and GND. The resistance is 300Ω (typical).

Power Supply Rejection Ratio

The LPQ3988 is working with ultra-high Power Supply Rejection Ratio (PSRR). By selecting proper output capacitor and PCB layout, the PSRR could even be tuned to higher.

Over current protection

The device features a current limit function when the over current event is detected to reach 960mA (Typ). The output current will be clamped and output voltage will drop accordingly, as in the *Electrical Characteristics Table*.

Application Information

Capacitor consideration

External capacitors on IN and OUT are recommended in application, 1μF for C_{OUT} and C_{IN} at least. Closer placement of the capacitors to the device, both IN and OUT, would be better for stability.

Power Dissipation

The internal power dissipation from the power MOSFET, when it is turned on, is the main source of junction temperature rising. In this case, the power dissipation and the junction temperature in conducting mode can be calculated as following:

$$P_D = (V_{IN} - V_{OUT}) \times I_{OUT}$$

P_D: Power Dissipation (W)

V_{IN}: Input voltage (V)

V_{OUT}: Output voltage (V)

I_{OUT}: Output current (A)

$$T_J = P_D \times \theta_{JA} + T_A$$

T_J: Junction temperature (°C)

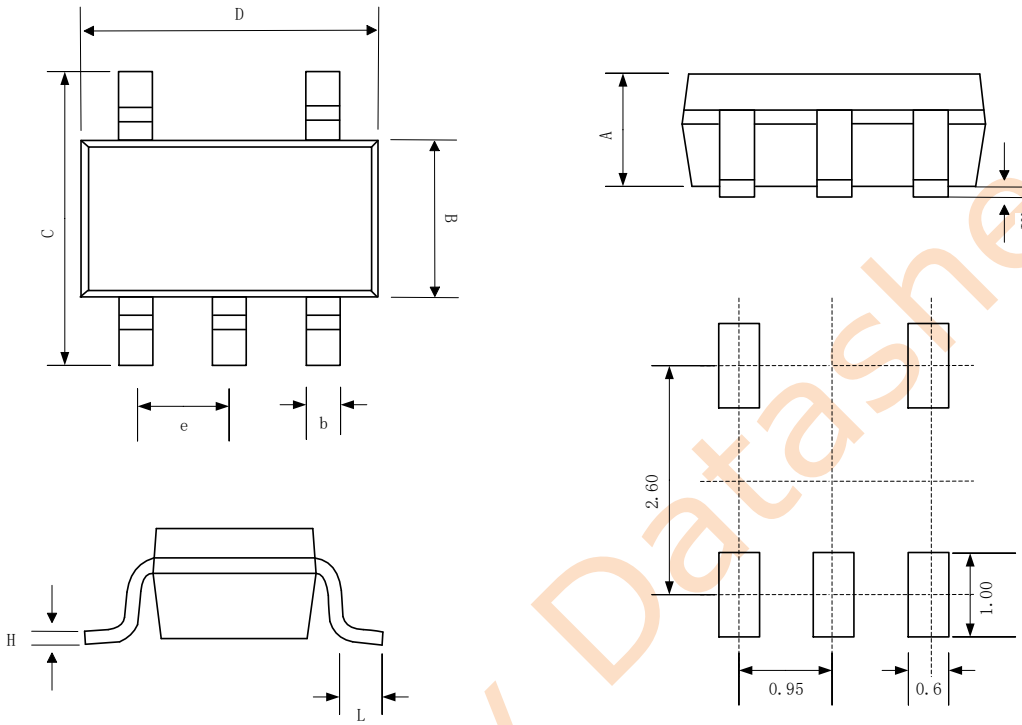
θ_{JA}: Package thermal resistance (°C /W) (Note 4)

T_A: Ambient temperature (°C)

***Note 4: The calculation base on thermal resistance is only valid in Lab condition. The value of θ_{JA} could change in customer PCB environment.**

Package Information

SOT23-5



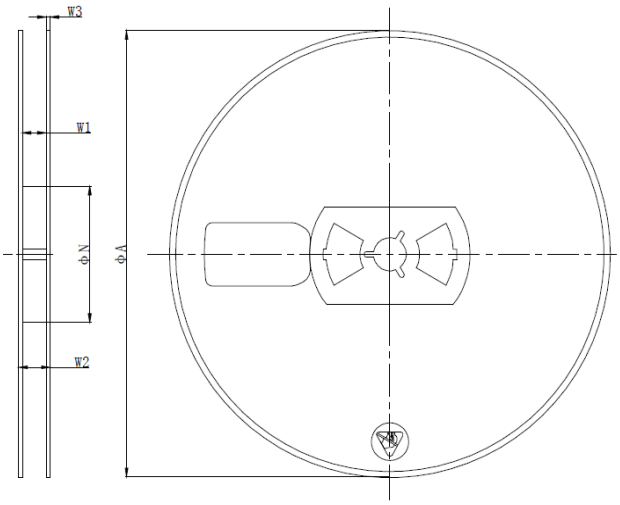
Recommended Land Pattern

SYMBOL	MILLIMETER		
	MIN	NOM	MAX
A	0.889	1.100	1.295
A1	0.000	0.050	0.152
B	1.397	1.600	1.803
b	0.28	0.35	0.559
C	2.591	2.800	3.000
D	2.692	2.920	3.120
e	0.95BSC		
H	0.080	0.152	0.254
L	0.300	0.450	0.610

Tape and Reel Information

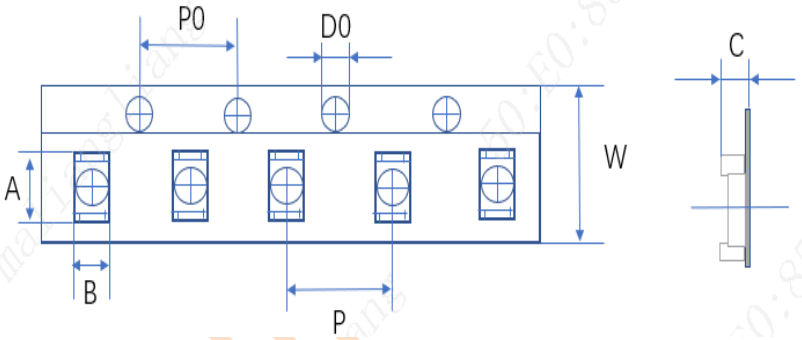
SOT23-5

REEL DIMENSIONS



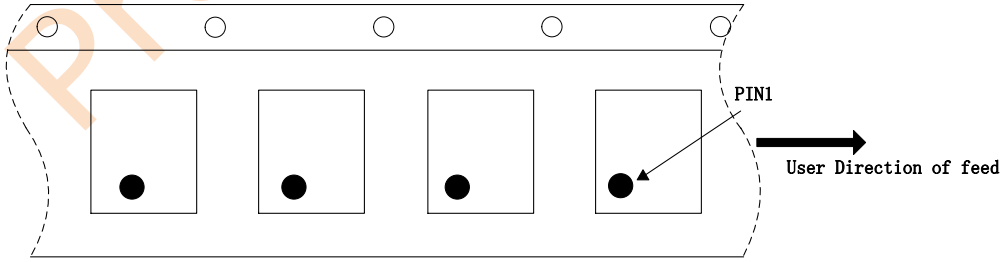
SYMBOL	Dimensions In Millimeters		
	MIN	NOM	MAX
ΦA	176.00	180.00	184.00
W2	10.00	12.00	14.00

TAPE DIMENSIONS



SYMBOL	Dimensions In Millimeters		
	MIN	NOM	MAX
A	3.00	3.20	3.40
B	3.06	3.26	3.46
P0	3.90	4.00	4.10
P	3.90	4.00	4.10
D0	1.35	1.50	1.65
W	7.70	8.00	8.30
C	1.20	1.40	1.60

PIN1 AND TAPE FEEDING DIRECTION



Classification of IR Reflow Profile

Profile Feature	Sn-Pb Eutectic Assembly	Pb-Free Assembly
Preheat/Soak		
Temperature Min(T_{SMIN})	100℃	150℃
Temperature Max(T_{SMAX})	150℃	200℃
Time(T_S) from (T_{SMIN} to T_{SMAX})	60~120 seconds	60~120 seconds
Ramp-up rate (T_L to T_P)	3℃/second max	3℃/second max
Liquidous temperature(T_L)	183℃	217℃
Time(t_L) maintained above T_L	60~150 seconds	60~150 seconds
Peak package body temperature (T_P)	For users T_P must not exceed the Classification temp in Table 1. For suppliers T_P must equal or exceed the Classification temp in Table 1.	For users T_P must not exceed the Classification temp in Table 2. For suppliers T_P must equal or exceed the Classification temp in Table 2.
Time(t_P)* within 5℃ of the specified classification temperature(T_C), see Figure1	20* seconds	30* seconds
Ramp-down rate (T_P to T_L)	6℃/second max	6℃/second max
Time 25℃ to peak temperature	6 minutes max	8minutes max
* Tolerance for peak profile temperature (T_P) is defined as a supplier minimum and a user maximum.		

Table 1Sn-Pb Eutectic Process - Classification Temperatures (T_C)

Package Thickness	Volume mm^3 <350	Volume mm^3 ≥350
<2.5mm	235℃	220℃
≥2.5mm	220℃	220℃

Table 2 Pb-Free Process - Classification Temperatures (T_C)

Package Thickness	Volume mm^3 <350	Volume mm^3 350~2000	Volume mm^3 ≥350
<1.6mm	260℃	260℃	260℃
1.6mm~2.5mm	260℃	250℃	245℃
>2.5mm	250℃	245℃	245℃

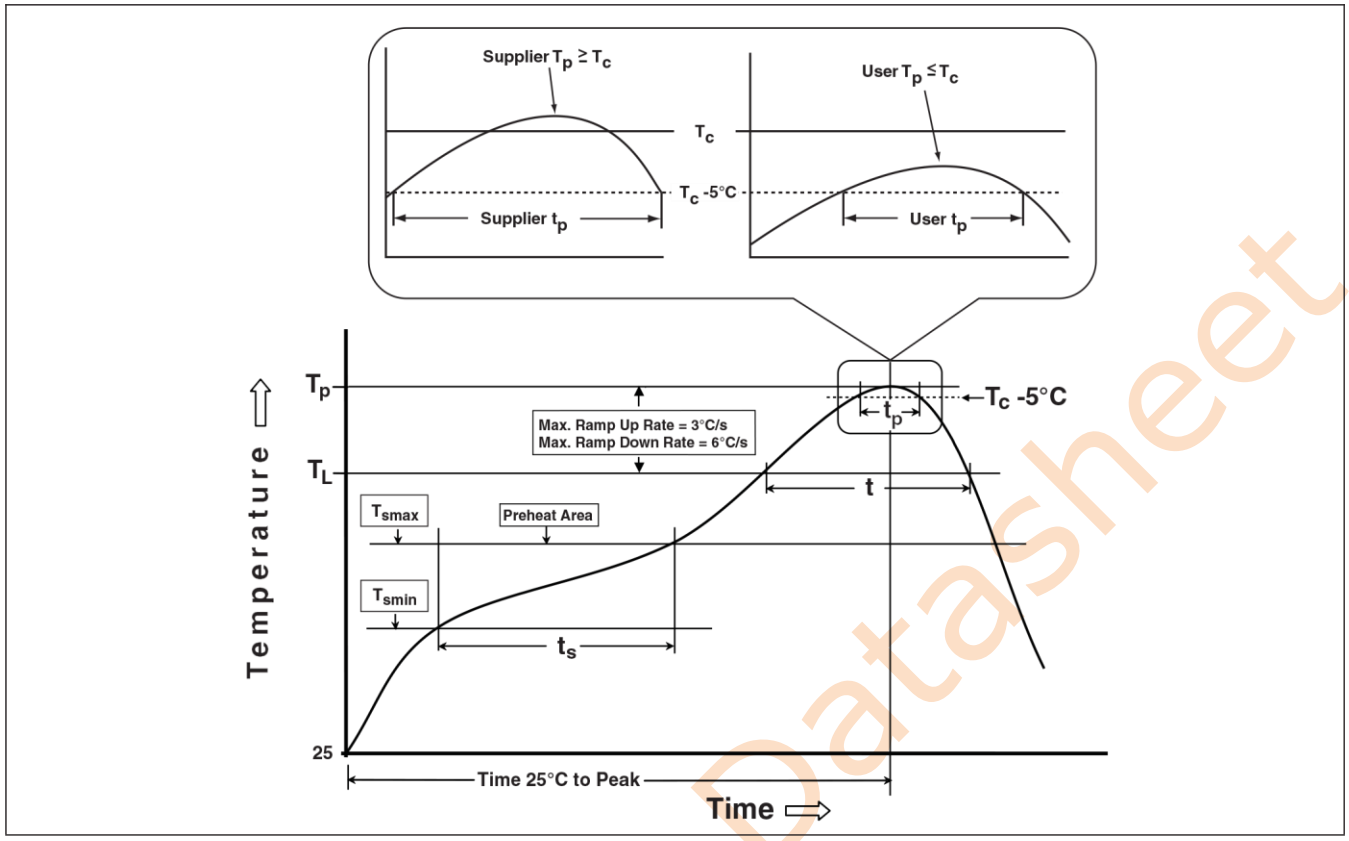


Figure1Classification Profile (Not to scale)

Products conform to "JEDEC J-STD-020C" standards;

Products shipped conform to "Rohs" standards;

Moisture Sensitivity Level：MSL3（CONDITION：≦30 °C/60%RH、Time control:168 hours）;