

FMBT3904DW1

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FMBT3904DW1

Dual NPN General Purpose Transistor

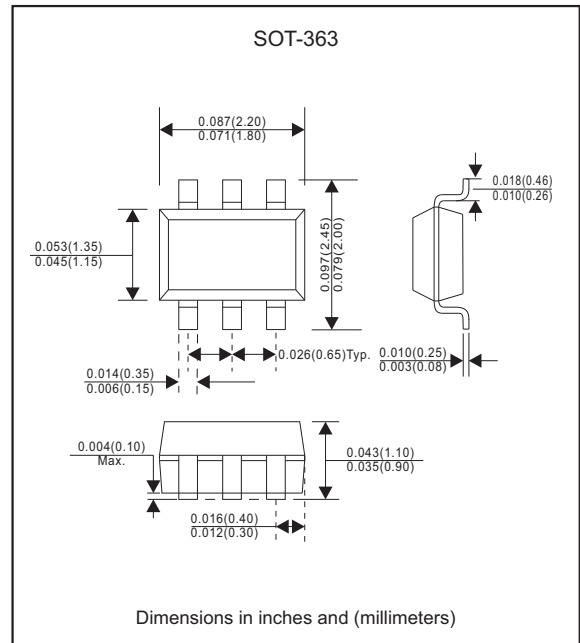
Features

- Low $V_{CE(sat)}$, $\leq 0.4V$
- Simplifies circuit design
- Reduces board space
- Reduces component count
- Lead-free parts meet RoHS requirements
- Suffix "-H" indicates Halogen-free part, ex.FMBT3904DW1-H

Mechanical data

- Epoxy:UL94-V0 rated flame retardant
- Case : Molded plastic, SOT-363
- Terminals : Solder plated, solderable per MIL-STD-750, Method 2026
- Polarity : See Diagram
- Mounting Position : Any
- Weight : Approximated 0.006 gram

Package outline



Maximum ratings (AT $T_A=25^{\circ}C$ unless otherwise noted)

Parameter	Symbol	Limits	Unit
Collector-base voltage	V_{CBO}	60	Vdc
Collector-emitter voltage	V_{CEO}	40	Vdc
Emitter-base voltage	V_{EBO}	6	Vdc
Collector current -continuous	I_C	200	mAdc

Thermal characteristics

Parameter	Symbol	Limits	Unit
Total device dissipation FR-5 board (Note 1) $T_A = 25^{\circ}C$	P_D	150	mW
Derate above $25^{\circ}C$		1.2	mW/ $^{\circ}C$
Thermal resistance junction to ambient (Note 1)	$R_{\theta JA}$	833	$^{\circ}C/W$
Operating junction temperature range	T_J	-55 to +150	$^{\circ}C$
Storage temperature range	T_{STG}	-55 to +150	$^{\circ}C$

Note 1: FR-5 = 1.0 X 0.75 X 0.062 in.

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Electrical characteristics (AT $T_A=25^{\circ}\text{C}$ unless otherwise noted)**Off characteristics**

Parameter	Conditions	Symbol	MIN.	TYP.	MAX.	Unit
Collector-base breakdown voltage	$I_C = 10\mu\text{A}$, $I_E = 0$	$V_{(BR)CBO}$	60			V
Collector-emitter breakdown voltage	$I_C = 1\text{mA}$, $I_B = 0$	$V_{(BR)CEO}$	40			V
Emitter-base breakdown voltage	$I_E = 10\mu\text{A}$, $I_C = 0$	$V_{(BR)EBO}$	6.0			V
Base cutoff current	$V_{CE} = 30\text{Vdc}$, $V_{EB} = 3.0\text{Vdc}$	I_{BL}			50	nA
Collector cutoff current	$V_{CE} = 30\text{Vdc}$, $V_{EB} = 3.0\text{Vdc}$	I_{CEX}			50	nA

On characteristics(Note 2)

Parameter	Conditions	Symbol	MIN.	TYP.	MAX.	Unit
DC current gain	$I_C = 0.1\text{mA}$, $V_{CE} = 1.0\text{V}$	h_{FE}	40			
	$I_C = 1.0\text{mA}$, $V_{CE} = 1.0\text{V}$		70			
	$I_C = 10\text{mA}$, $V_{CE} = 1.0\text{V}$		100		300	
	$I_C = 50\text{mA}$, $V_{CE} = 1.0\text{V}$		60			
	$I_C = 100\text{mA}$, $V_{CE} = 1.0\text{V}$		30			
Collector-emitter saturation voltage	$I_C = 10\text{mA}$, $I_B = 1.0\text{mA}$	$V_{CE(sat)}$			0.2	V
	$I_C = 50\text{mA}$, $I_B = 5.0\text{mA}$				0.3	
Base-emitter saturation voltage	$I_C = 10\text{mA}$, $I_B = 1.0\text{mA}$	$V_{BE(sat)}$	0.65		0.85	V
	$I_C = 50\text{mA}$, $I_B = 5.0\text{mA}$				0.95	

Small-signal characteristics

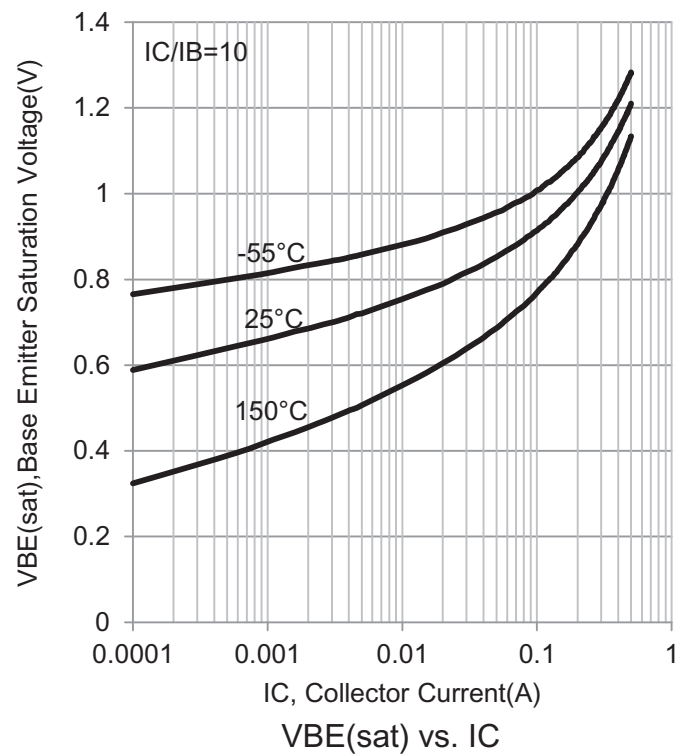
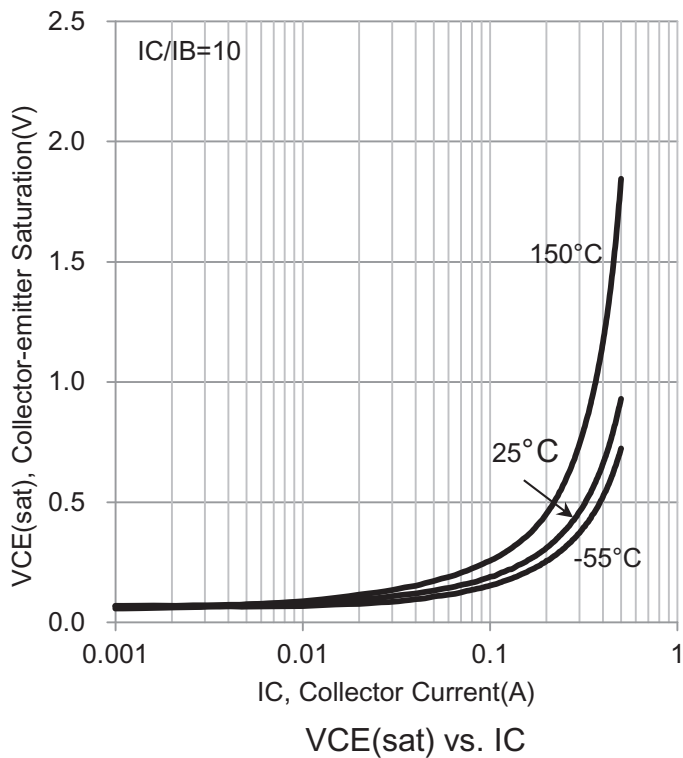
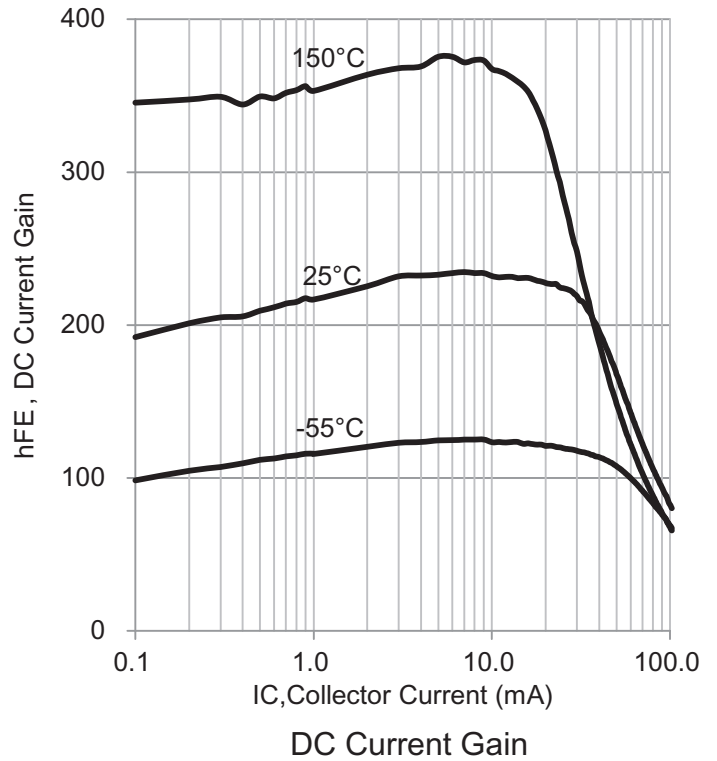
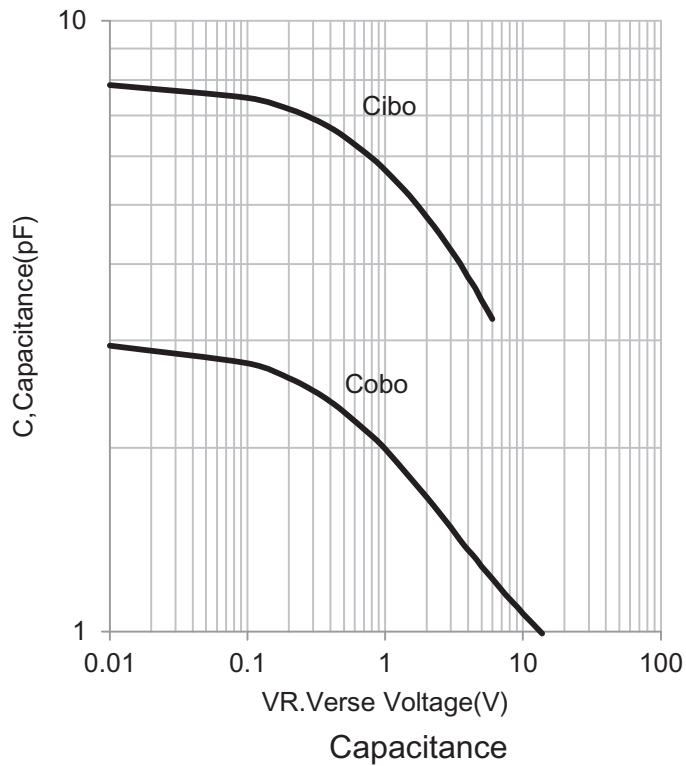
Parameter	Conditions	Symbol	MIN.	TYP.	MAX.	Unit
Current-gain-bandwidth product	$I_C = 10\text{mA}$, $V_{CE} = 20\text{V}$, $f = 100\text{MHz}$	f_T	300			MHz
Output capacitance	$V_{CB} = 5.0\text{V}$, $I_E = 0$, $f = 1.0\text{MHz}$	C_{obo}			4.0	pF
Input capacitance	$V_{EB} = 0.5\text{V}$, $I_C = 0$, $f = 1.0\text{MHz}$	C_{ibo}			8.0	pF
Input impedance	$V_{CE} = 10\text{V}$, $I_C = 1.0\text{mA}$, $f = 1.0\text{KHz}$	h_{ie}	1.0		10	k Ω
Voltage feedback ratio	$V_{CE} = 10\text{V}$, $I_C = 1.0\text{mA}$, $f = 1.0\text{KHz}$	h_{re}	0.5		8.0	$\times 10^{-4}$
Small-signal current gain	$V_{CE} = 10\text{V}$, $I_C = 1.0\text{mA}$, $f = 1.0\text{KHz}$	h_{fe}	100		400	
Output admittance	$V_{CE} = 10\text{V}$, $I_C = 1.0\text{mA}$, $f = 1.0\text{KHz}$	h_{oe}	1.0		40	μmhos
Noise figure	$V_{CE} = 5.0\text{V}$, $I_C = 100\mu\text{A}$, $R_s = 1.0\text{k}\Omega$, $f = 1.0\text{KHz}$	N_F			5.0	dB

Switching characteristics

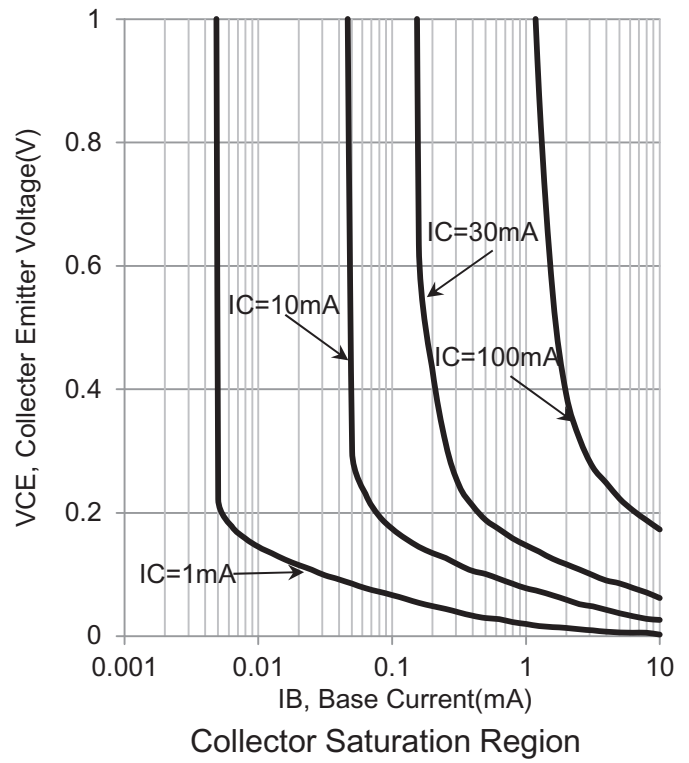
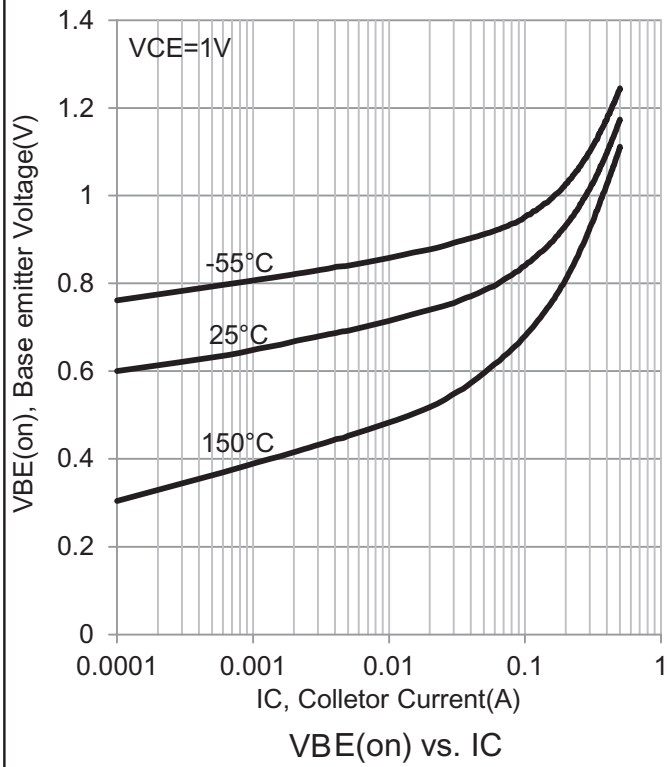
Parameter	Conditions	Symbol	MIN.	TYP.	MAX.	Unit
Delay time	$V_{CC} = 3.0\text{V}$, $V_{BE} = 0.5\text{V}$, $I_C = 10\text{mA}$, $I_{B1} = 1.0\text{mA}$	t_d			35	ns
Rise time		t_r			35	
Storage time	$V_{CC} = 3.0\text{V}$, $I_C = 10\text{mA}$, $I_{B1} = I_{B2} = 1.0\text{mA}$	t_s			200	
Fall time		t_f			50	

Note 2: Pulse test: Pulse width $\leq 300\mu\text{s}$, Duty cycle $\leq 2.0\%$.

Rating and characteristic curves (FMBT3904DW1)

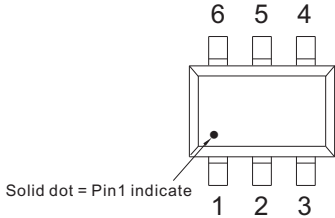
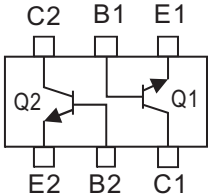


Rating and characteristic curves (FMBT3904DW1)



FMBT3904DW1

Pinning information

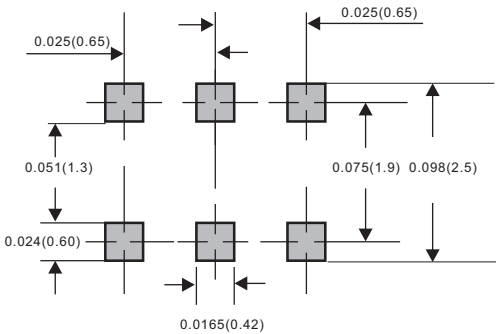
Pin	Simplified outline	Symbol
Pin1 Emitter 2 Pin2 Base 2 Pin3 Collector 1 Pin4 Emitter 1 Pin5 Base 1 Pin6 Collector 2	 Solid dot = Pin1 indicate	

Marking

Type number	Marking code
FMBT3904DW1	MA, K6N

Suggested solder pad layout

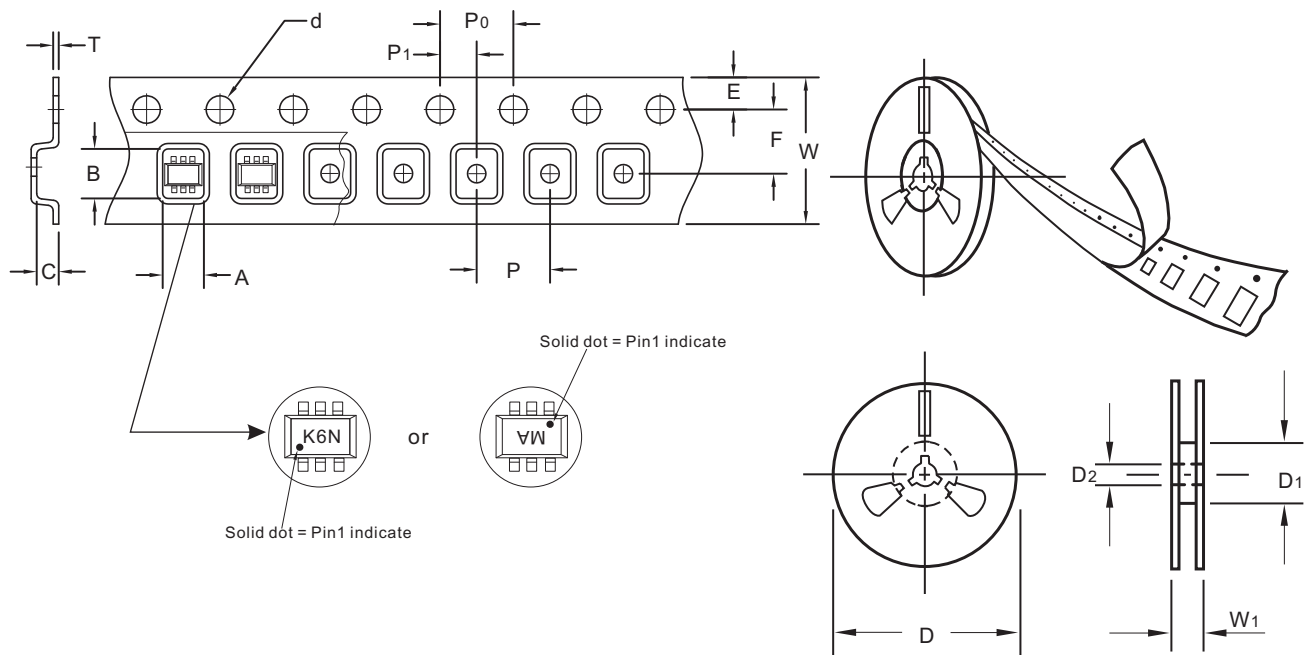
SOT-363



Dimensions in inches and (millimeters)

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Packing information



unit:mm

Item	Symbol	Tolerance	SOT-363
Carrier width	A	0.1	2.25
Carrier length	B	0.1	2.55
Carrier depth	C	0.1	1.20
Sprocket hole	d	0.1	1.50
13" Reel outside diameter	D	2.0	-
13" Reel inner diameter	D ₁	min	-
7" Reel outside diameter	D	2.0	178.00
7" Reel inner diameter	D ₁	min	54.40
Feed hole diameter	D ₂	0.5	13.00
Sprocket hole position	E	0.1	1.75
Punch hole position	F	0.1	3.50
Punch hole pitch	P	0.1	4.00
Sprocket hole pitch	P ₀	0.1	4.00
Embossment center	P ₁	0.1	2.00
Overall tape thickness	T	0.1	0.23
Tape width	W	0.3	8.00
Reel width	W ₁	1.0	12.3

Note: Devices are packed in accordance with EIA standard RS-481-A and specifications listed above.

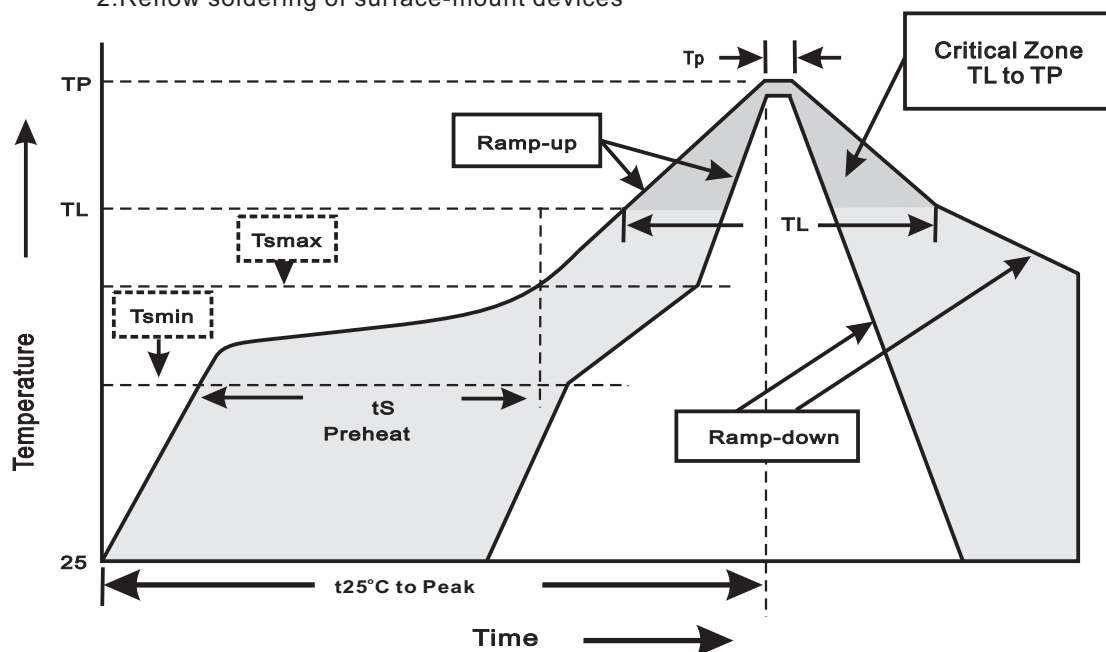
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Reel packing

PACKAGE	REEL SIZE	REEL (pcs)	COMPONENT SPACING (m/m)	BOX (pcs)	INNER BOX (m/m)	REEL DIA, (m/m)	CARTON SIZE (m/m)	CARTON (pcs)	APPROX. GROSS WEIGHT (kg)
SOT-363	7"	3,000	4.0	30,000	183*123*183	178	382*257*387	240,000	9.5

Suggested thermal profiles for soldering processes

- 1.Storage environment: Temperature=5°C~40°C Humidity=55%±25%
- 2.Reflow soldering of surface-mount devices



3.Reflow soldering

Profile Feature	Soldering Condition
Average ramp-up rate(T _L to T _P)	<3°C/sec
Preheat -Temperature Min(T _{smmin}) -Temperature Max(T _{smmax}) -Time(min to max)(t _s)	150°C 200°C 60~120sec
T _{smmax} to T _L -Ramp-upRate	<3°C/sec
Time maintained above: -Temperature(T _L) -Time(t _L)	217°C 60~260sec
Peak Temperature(T _P)	255°C-0/+5°C
Time within 5°C of actual Peak Temperature(tp)	10~30sec
Ramp-down Rate	<6°C/sec
Time 25°C to Peak Temperature	<6minutes

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High reliability test capabilities

Item Test	Conditions
1. Steady State Operating Life	T _A =25°C P _D =150mW Test Duration:1000hrs
2. High Temperature Reverse Bias	T _J =150°C, V _{CE} =80% related volage, Test Duration:1000hrs
3. Temperature Cycle	-55°C(15min) to 150°C(15min)Air to Air Transition Time<20sec Test Cycles: 1000cycle
4. Autoclave	P=2atm Ta=121°C RH=100% Test Duration: 96hrs
5. High Temperature Storage Life	T _A =150°C Test Duration: 1000hrs
6. Solderability	245°C,Test Duration: 5sec
7. High Temperature High Humidity Reverse Bias	T _A =85°C, 85%RH, V _{CE} =80% related volage, Test Duration: 1000hrs
8. Resistance to Soldering Heat	260°C,Test Duration: 10sec