

N- Channel Enhancement mode MOSFET AND NPN BJT Complex Device

MBNN01S6R

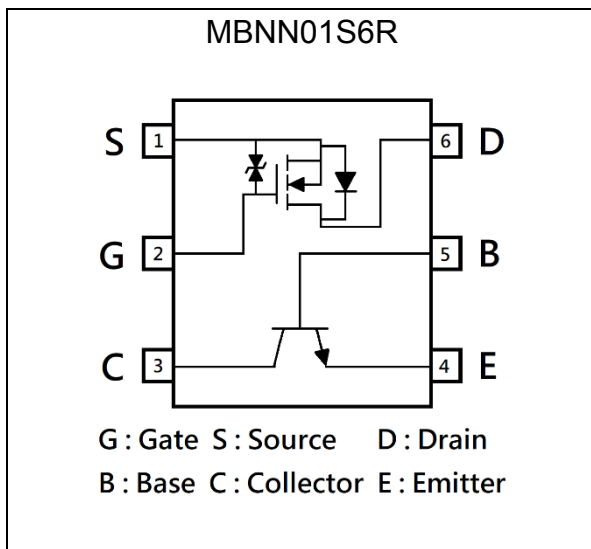
Features

- ESD protected gate, typical 2kV (HBM)
- High speed switching
- Easily designed drive circuits
- Low-voltage drive
- Easy to use in parallel
- The MBNN01S6R consists of a N-channel enhancement-mode MOSFET and a NPN BJT in a single SOT-363 package.

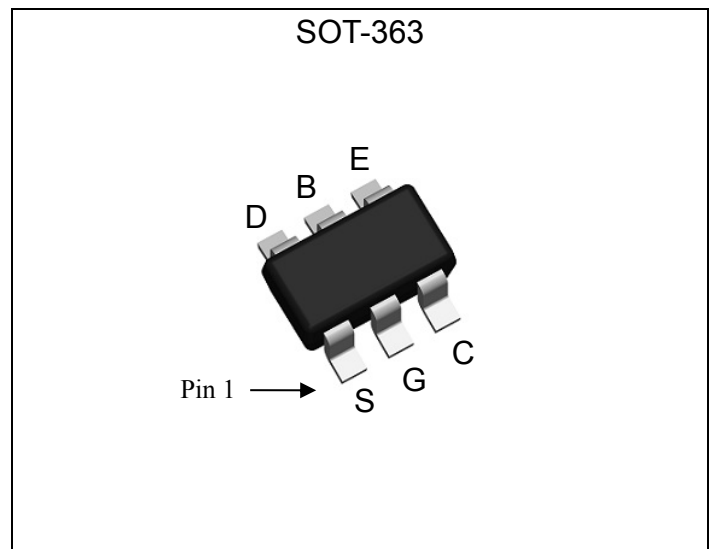
BV_{DSS}	60V
$I_D @ V_{GS}=4.5V, T_A=25^\circ C$	200mA
$R_{DS(ON) typ.} @ V_{GS}=4.5V, I_D=200mA$	1.3 Ω
$R_{DS(ON) typ.} @ V_{GS}=2.5V, I_D=100mA$	1.7 Ω

V_{CEO}	50V
I_C	200mA
$V_{CE(sat) max.} @ I_C=100mA, I_B=5mA$	300mV

Equivalent Circuit

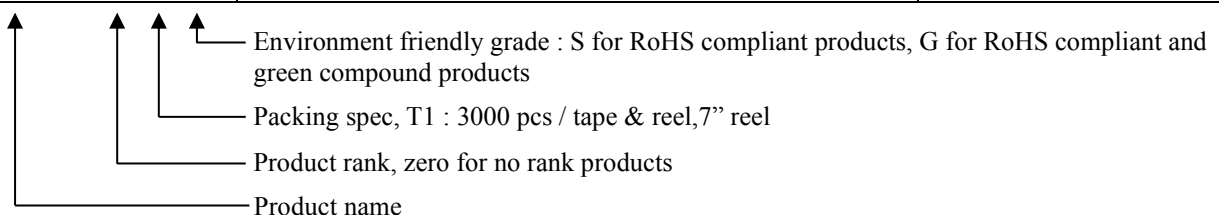


Outline



Ordering Information

Device	Package	Shipping
MBNN01S6R-0-T1-G	SOT-363 (Pb-free lead plating and halogen-free package)	3000 pcs / Tape & Reel



**Absolute Maximum Ratings (T_A=25°C)****NMOS**

Parameter	Symbol	Limits	Unit
Drain-Source Voltage	V _{DS}	60	V
Gate-Source Voltage	V _{GS}	±20	
Continuous Drain Current @ V _{GS} =4.5V, T _A =25°C	I _D	200	mA
Continuous Drain Current @ V _{GS} =4.5V, T _A =70°C		160	
Pulsed Drain Current *a	I _{DM}	800	
Continuous Body Diode Forward Current @ T _A =25°C	I _S	200	
ESD susceptibility *b	V _{ESD}	2000	V
Operating Junction and Storage Temperature Range	T _J , T _{stg}	-55~+150	°C

NPN

Parameter	Symbol	Limits	Unit
Collector-Base Voltage	V _{CB0}	60	V
Collector-Emitter Voltage	V _{CEO}	50	
Emitter-Base Voltage	V _{EBO}	7	
Collector Current	I _C	200	mA
Operating Junction Temperature Range	T _J	-55~+150	°C
Storage Temperature Range	T _{stg}	-55~+150	

Thermal Data

Parameter	Symbol	Steady State	Unit
Total Power Dissipation	P _D	250	mW
Thermal Resistance, Junction-to-ambient	R _{θJA}	500	°C/W

Note:

*a. Repetitive rating, pulse width limited by junction temperature T_{J(MAX)}=150°C. Ratings are based on low frequency and low duty cycles to keep initial T_J=25°C.

*b. Human body model, 1.5kΩ in series with 100pF.



N-Channel MOSFET Electrical Characteristics (T_A=25°C, unless otherwise specified)

Symbol	Min.	Typ.	Max.	Unit	Test Conditions
Static					
BV _{DSS}	60	-	-	V	V _{GS} =0V, I _D =250μA
V _{GS(th)}	0.5	-	1.5		V _{DS} =V _{GS} , I _D =250μA
G _{FS}	-	0.5	-	S	V _{DS} =5V, I _D =200mA
I _{GSS}	-	-	±10	μA	V _{GS} =±16V, V _{DS} =0V
I _{DSS}	-	-	1		V _{DS} =48V, V _{GS} =0V
R _{DS(ON)}	-	1.3	3	Ω	V _{GS} =4.5V, I _D =200mA
	-	1.7	5		V _{GS} =2.5V, I _D =100mA
Dynamic					
C _{iSS}	-	25	-	pF	V _{DS} =30V, V _{GS} =0V, f=1MHz
C _{oSS}	-	8	-		
C _{rSS}	-	7	-		
Q _g *1, 2	-	0.75	-	nC	V _{DS} =30V, I _D =200mA, V _{GS} =4.5V
Q _{gs} *1, 2	-	0.35	-		
Q _{gd} *1, 2	-	0.15	-		
t _{d(ON)} *1, 2	-	3	-	ns	V _{DS} =30V, I _D =200mA, V _{GS} =4.5V, R _{GS} =25 Ω
t _r *1, 2	-	16	-		
t _{d(OFF)} *1, 2	-	11	-		
t _f *1, 2	-	16	-		
Source-Drain Diode					
V _{SD} *1	-	0.8	1.2	V	I _S =200mA, V _{GS} =0V
t _{rr}	-	9	-	ns	I _F =200mA, dI _F /dt=100A/μs
Q _{rr}	-	2.7	-	nC	

Note:

*1. Pulse Test : Pulse Width ≤300μs, Duty Cycle≤2%

*2. Independent of operating temperature



NPN Electrical Characteristics (T_A=25°C, unless otherwise specified)

Symbol	Min.	Typ.	Max.	Unit	Test Conditions
BV _{CBO}	60	-	-	V	I _C =100μA
BV _{CEO}	50	-	-		I _C =1mA
BV _{EBO}	7	-	-		I _E =50μA
I _{CBO}	-	-	100	nA	V _{CB} =60V
I _{EBO}	-	-	100		V _{EB} =7V
*V _{CE(sat)}	-	-	100	mV	I _C =10mA, I _B =500μA
*V _{CE(sat)}	-	-	300		I _C =100mA, I _B =5mA
*V _{BE(sat)}	-	-	800		I _C =10mA, I _B =500μA
*V _{BE(sat)}	-	-	1000		I _C =100mA, I _B =5mA
*V _{BE(ON)}	580	-	700		V _{CE} =5V, I _C =2mA
*V _{BE(ON)}	-	-	770		V _{CE} =5V, I _C =10mA
*h _{FE}	200	-	450		V _{CE} =5V, I _C =2mA
f _T	80	180	-	MHz	V _{CE} =12V, I _C =2mA, f=100MHz
C _{ob}	-	2	3.5	pF	V _{CB} =12V, f=1MHz

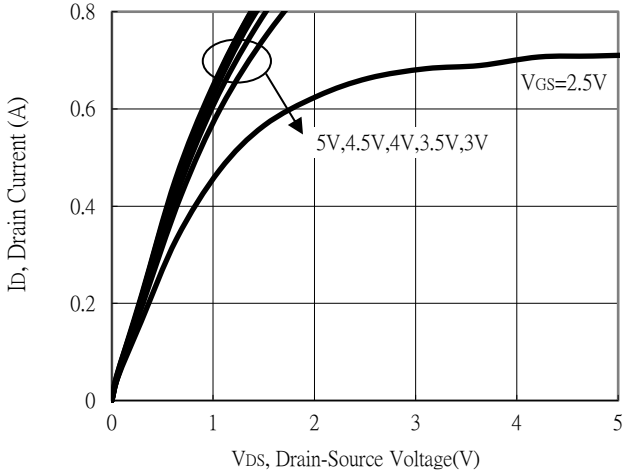
Note:

- *1. Pulse Test : Pulse Width ≤380μs, Duty Cycle≤2%
- *2. Independent of operating temperature

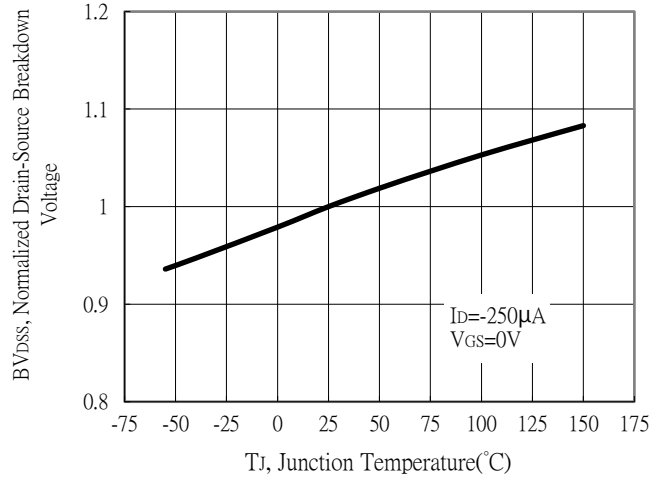


Typical Characteristics : NMOS

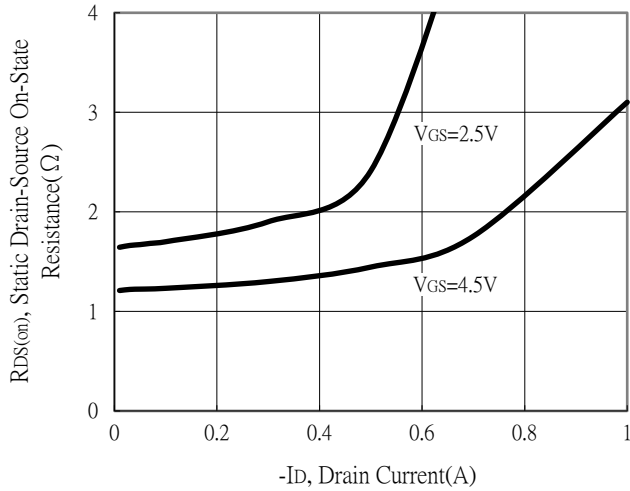
Typical Output Characteristics



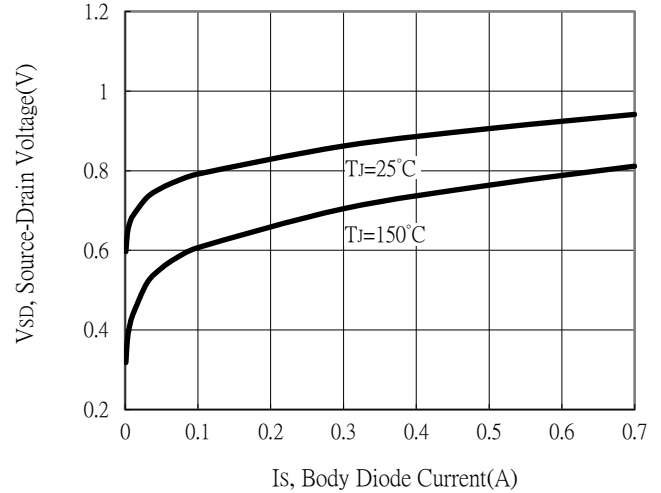
Breakdown Voltage vs Junction Temperature



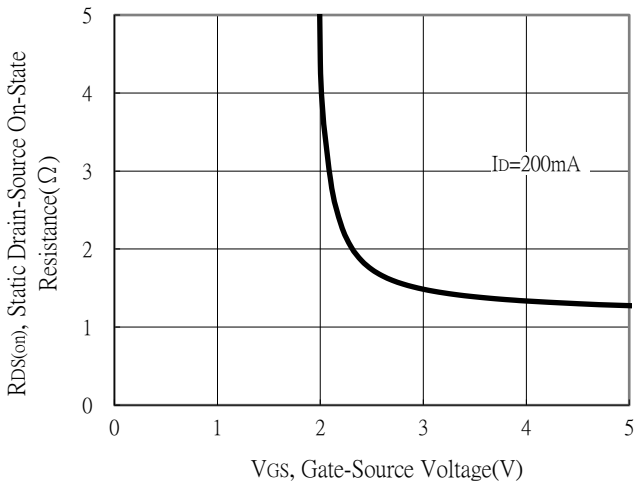
Static Drain-Source On-State resistance vs Drain Current



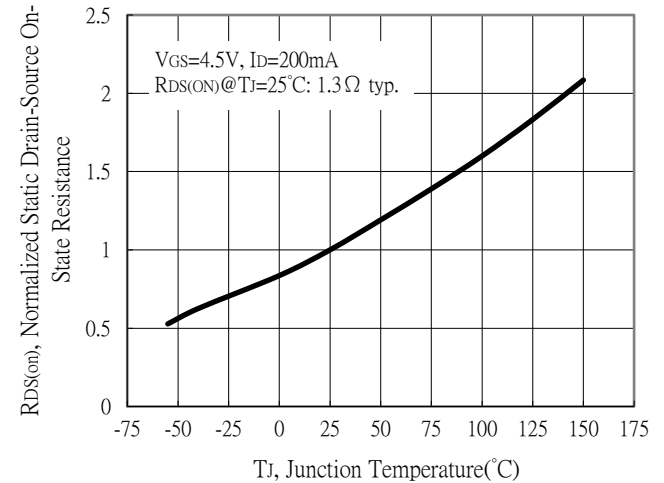
Body Diode Current vs Source-Drain Voltage



Static Drain-Source On-State Resistance vs Gate-Source Voltage

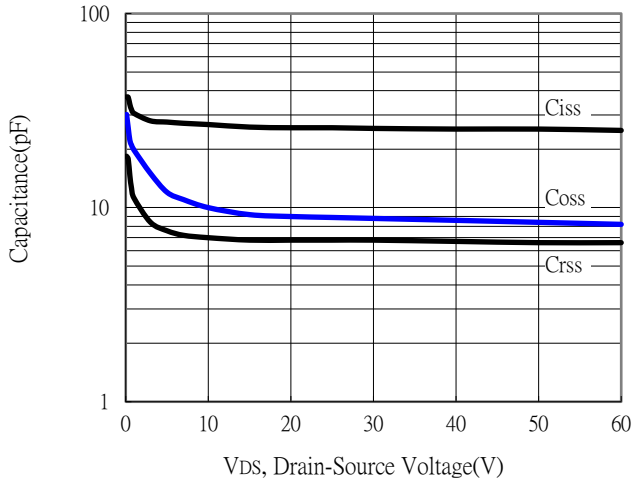


Drain-Source On-State Resistance vs Junction Temperature

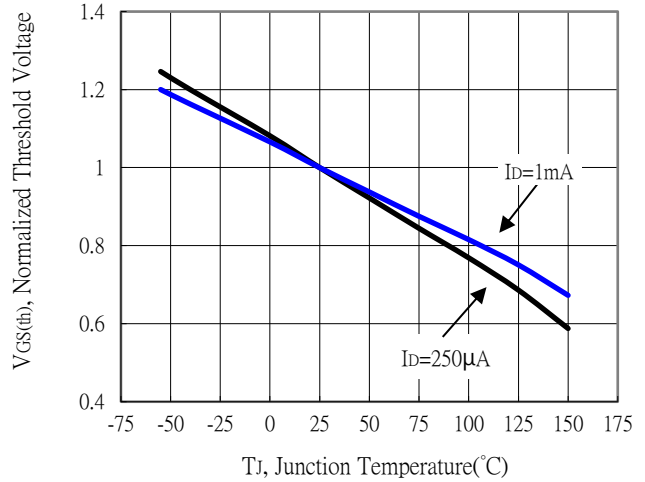


Typical Characteristics : NMOS (Cont.)

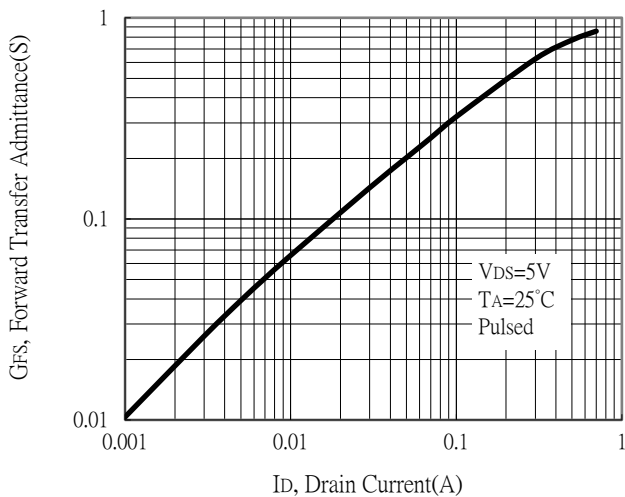
Capacitance vs Drain-to-Source Voltage



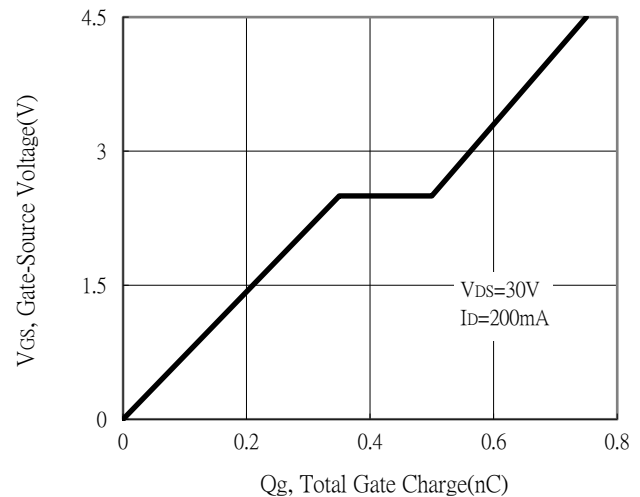
Threshold Voltage vs Junction Temperature



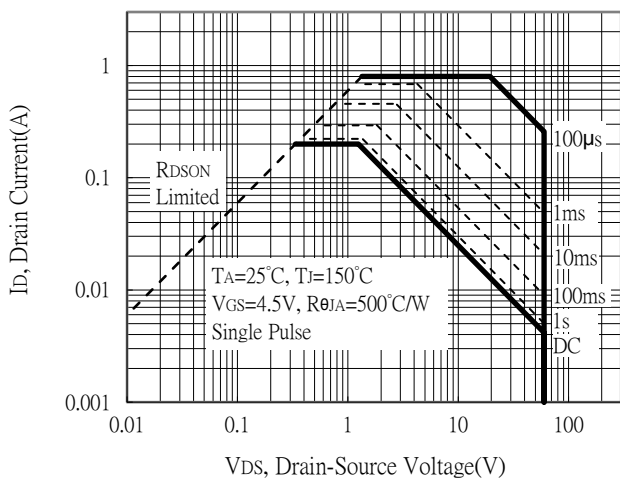
Forward Transfer Admittance vs Drain Current



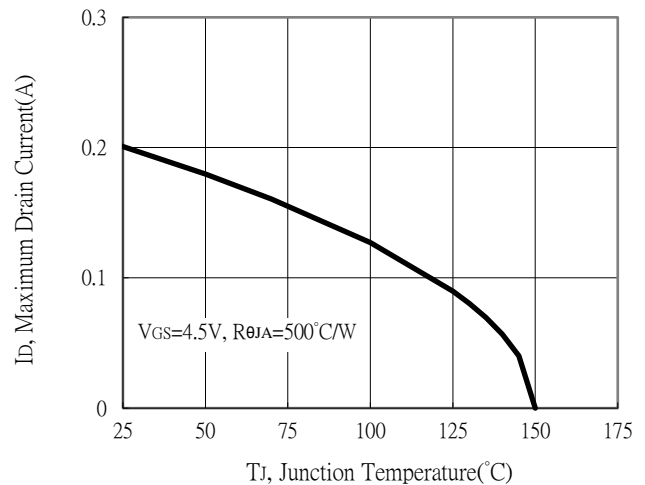
Gate Charge Characteristics



Maximum Safe Operating Area

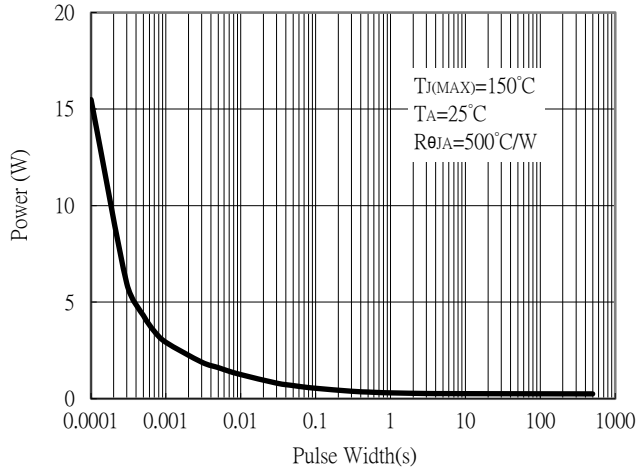


Maximum Drain Current vs Junction Temperature

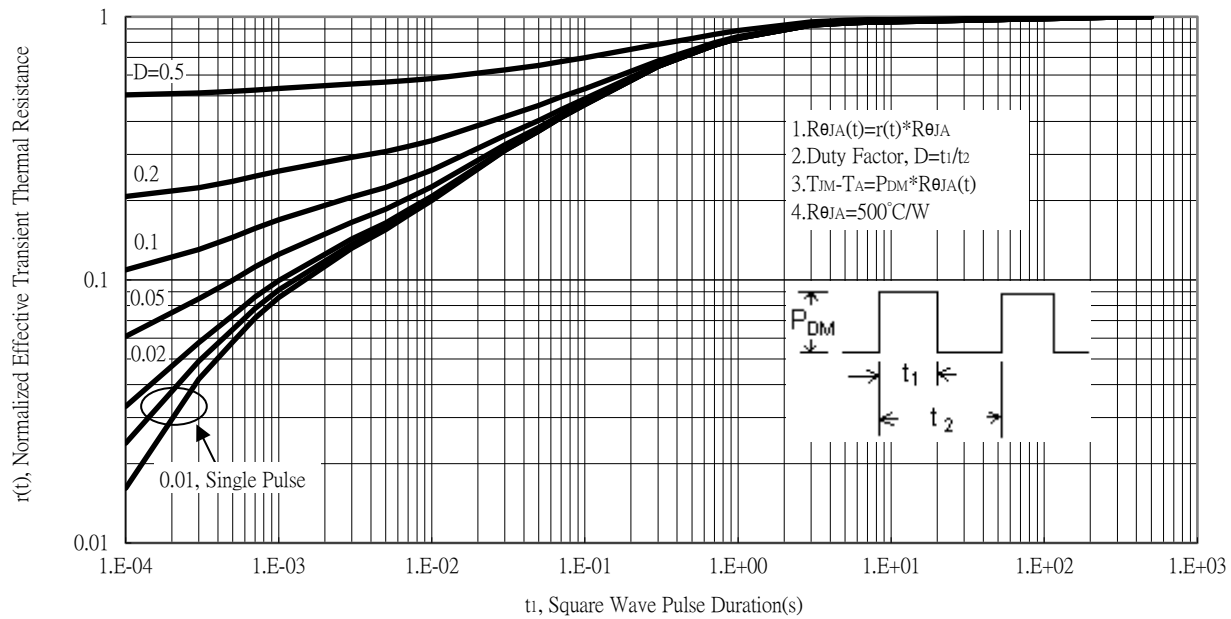


Typical Characteristics : NMOS (Cont.)

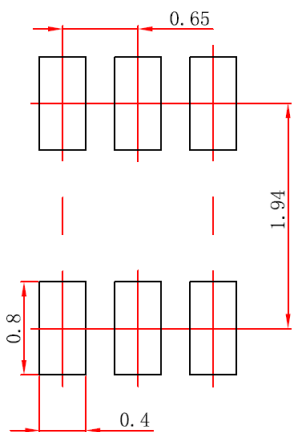
Single Pulse Power Rating, Junction to Ambient



Transient Thermal Response Curves



Recommended Soldering Footprint

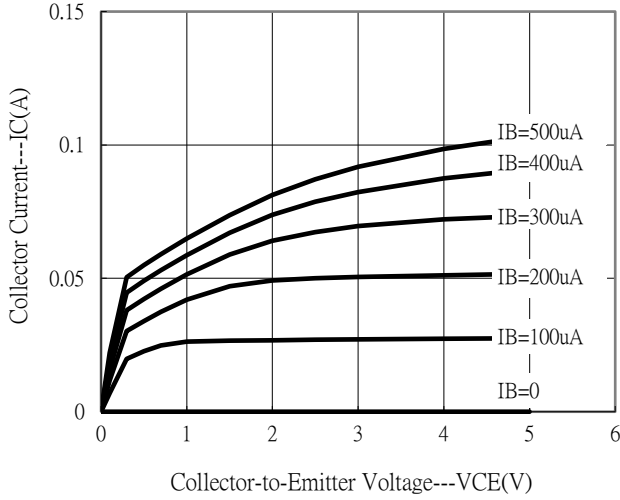


Unit : mm

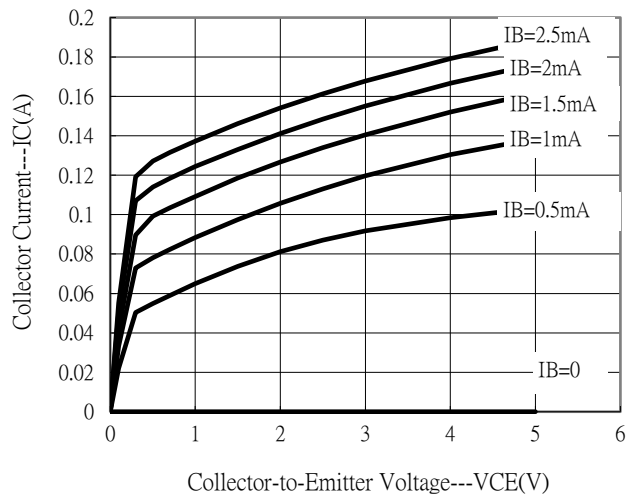


Typical Characteristics : NPN

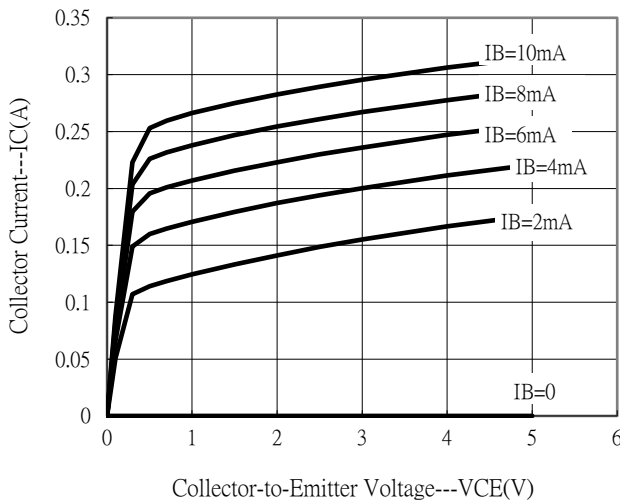
Output Characteristics



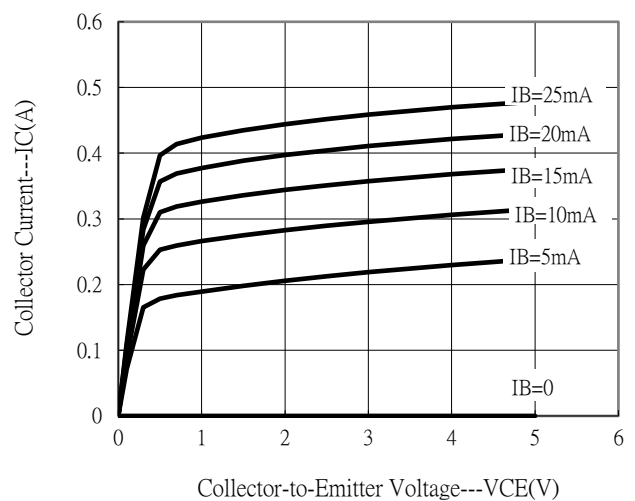
Output Characteristics



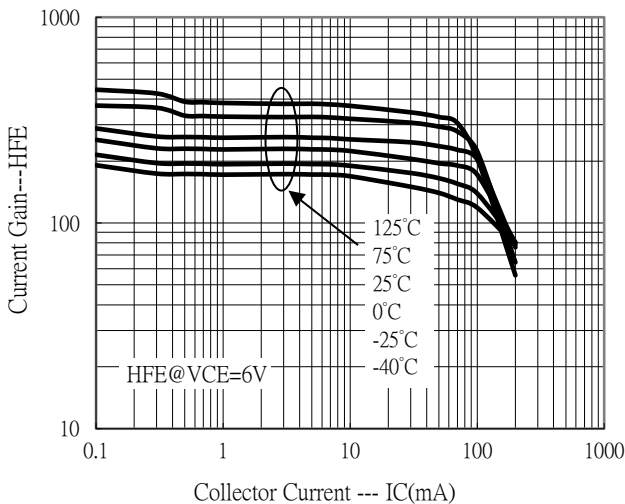
Output Characteristics



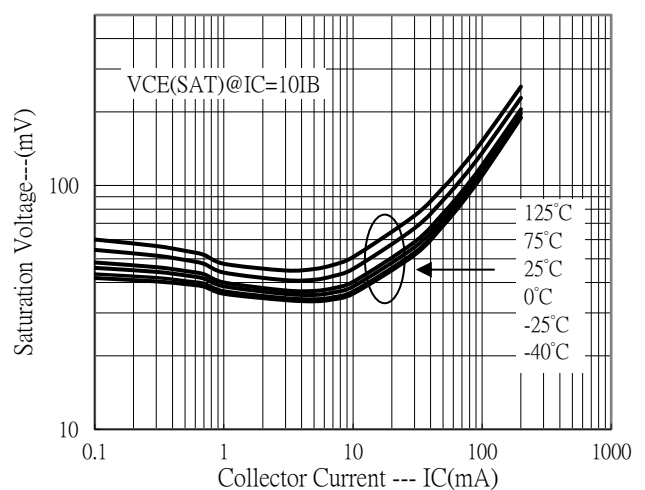
Output Characteristics



Current Gain vs Collector Current

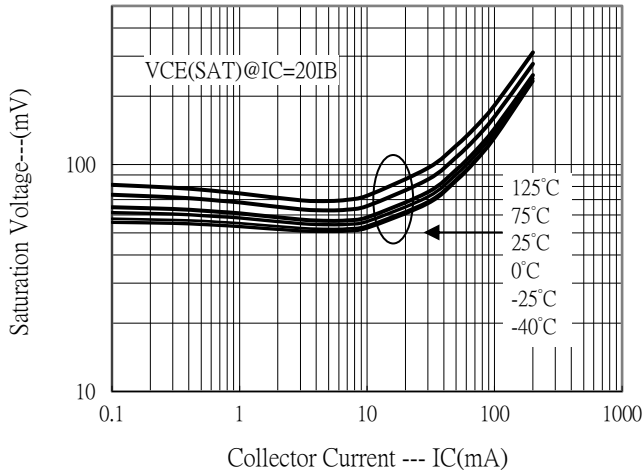


Saturation Voltage vs Collector Current

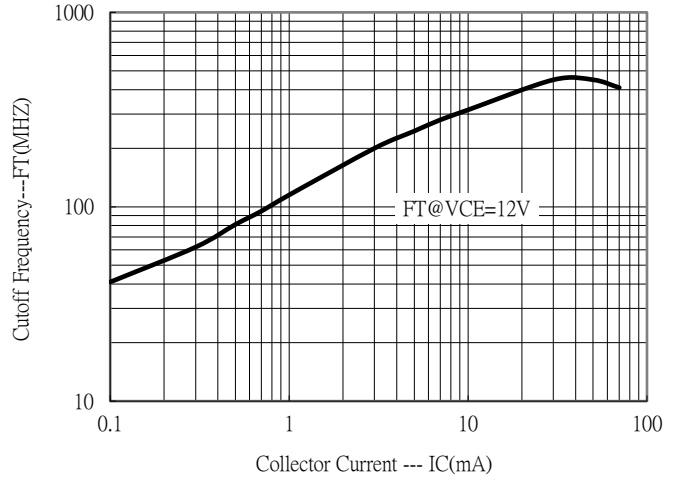


Typical Characteristics : NPN (Cont.)

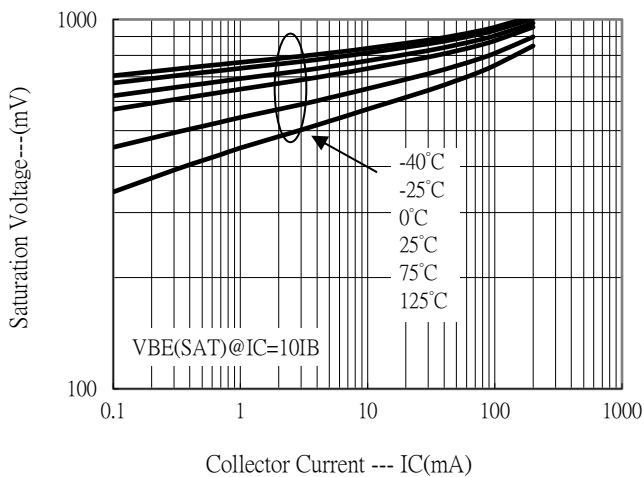
Saturation Voltage vs Collector Current



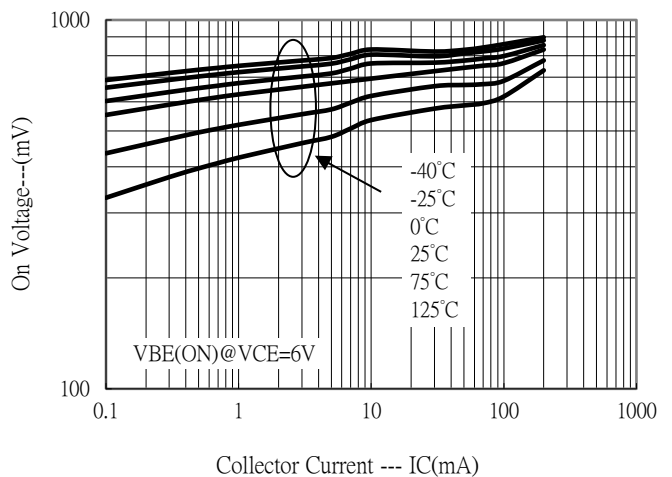
Cutoff Frequency vs Collector Current



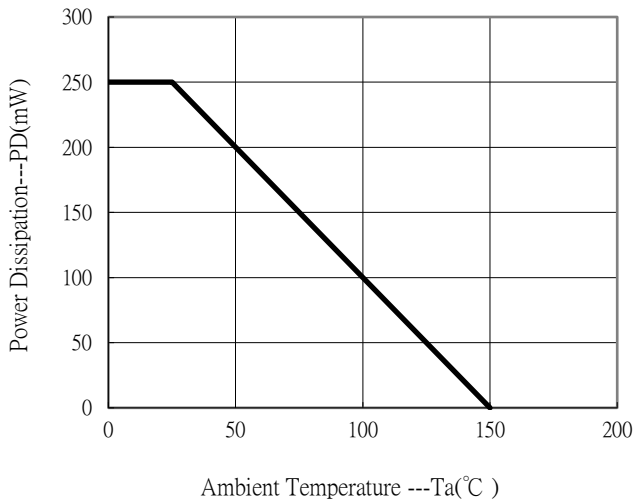
Saturation Voltage vs Collector Current



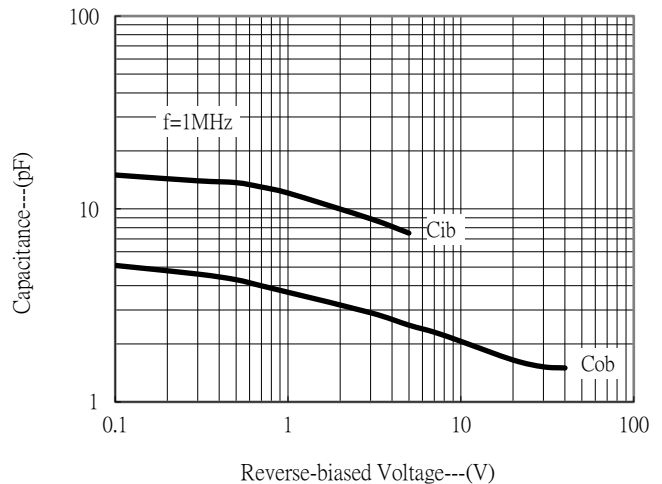
On Voltage vs Collector Current



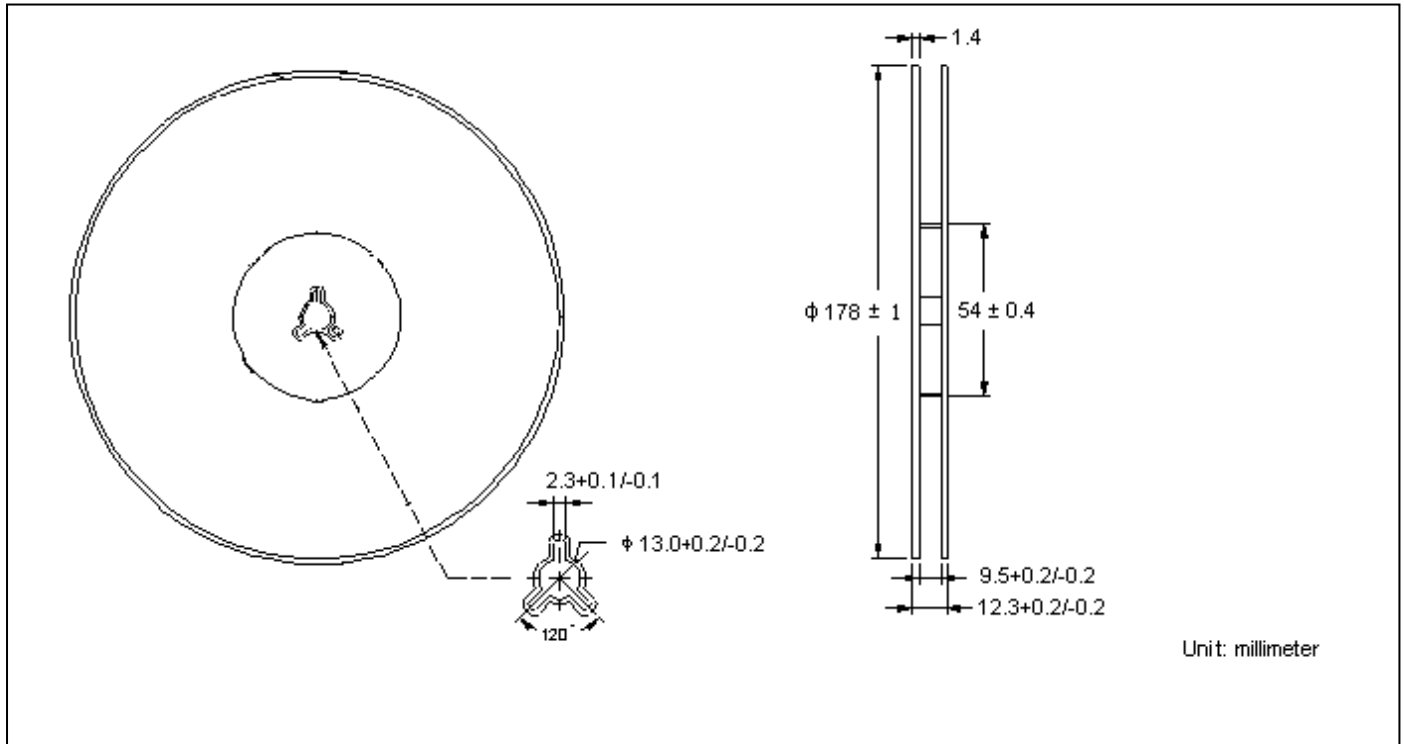
Power Derating Curve



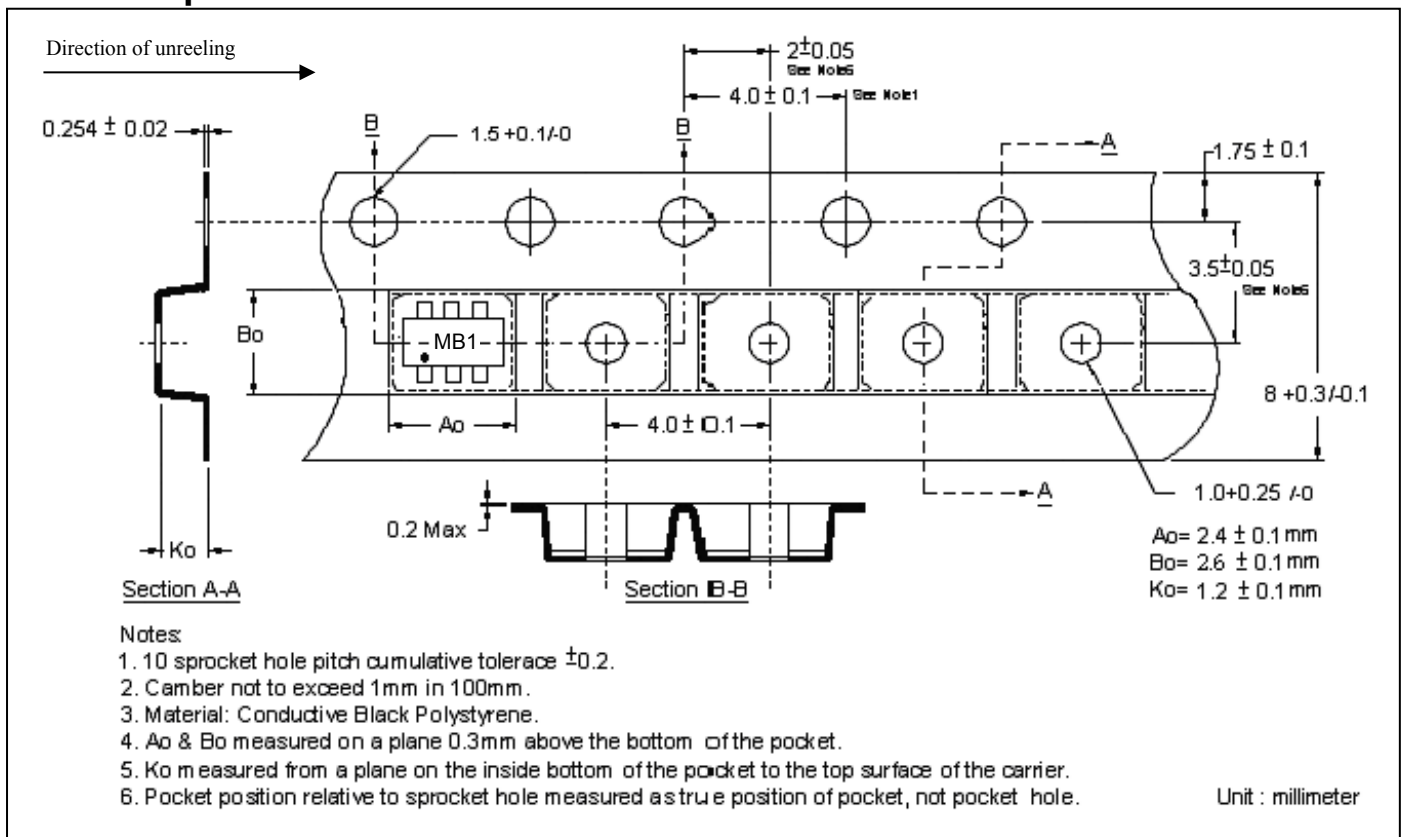
Capacitance Characteristics



Reel Dimension



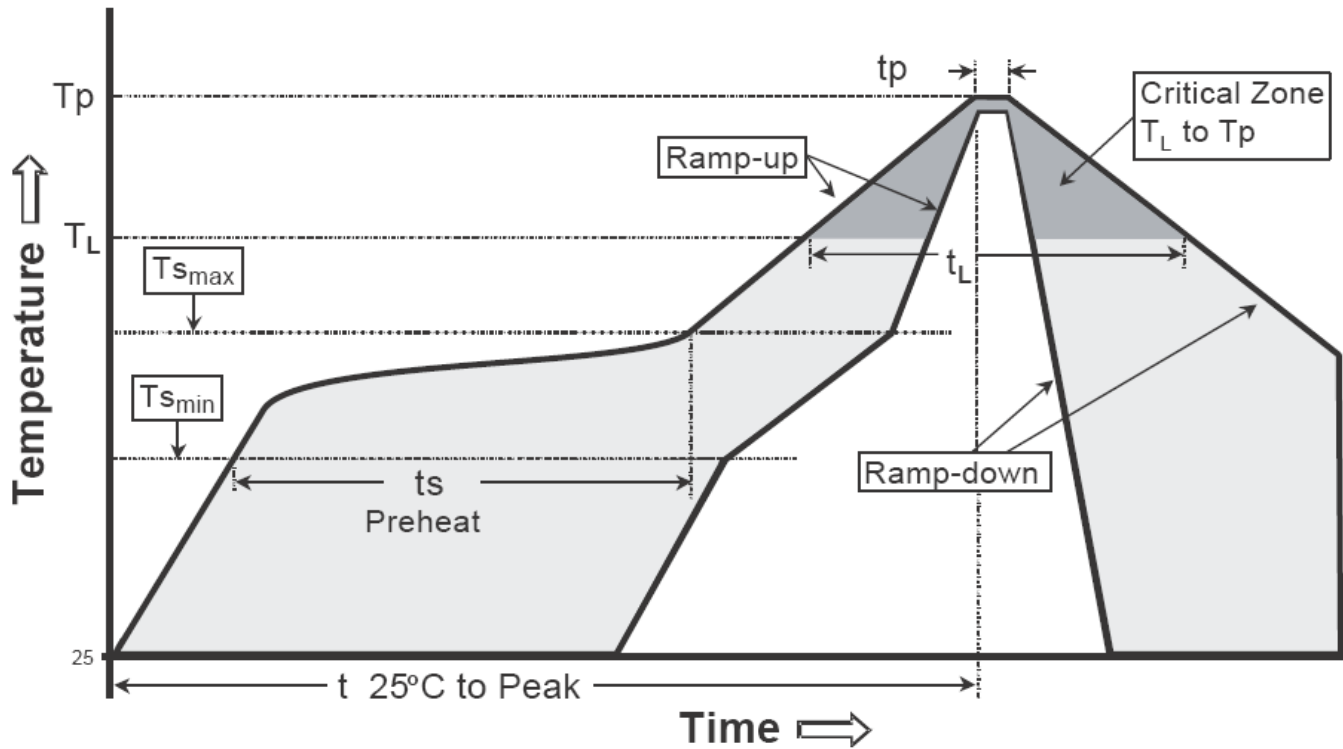
Carrier Tape Dimension



Recommended wave soldering condition

Product	Peak Temperature	Soldering Time
Pb-free devices	260 +0/-5 °C	5 +1/-1 seconds

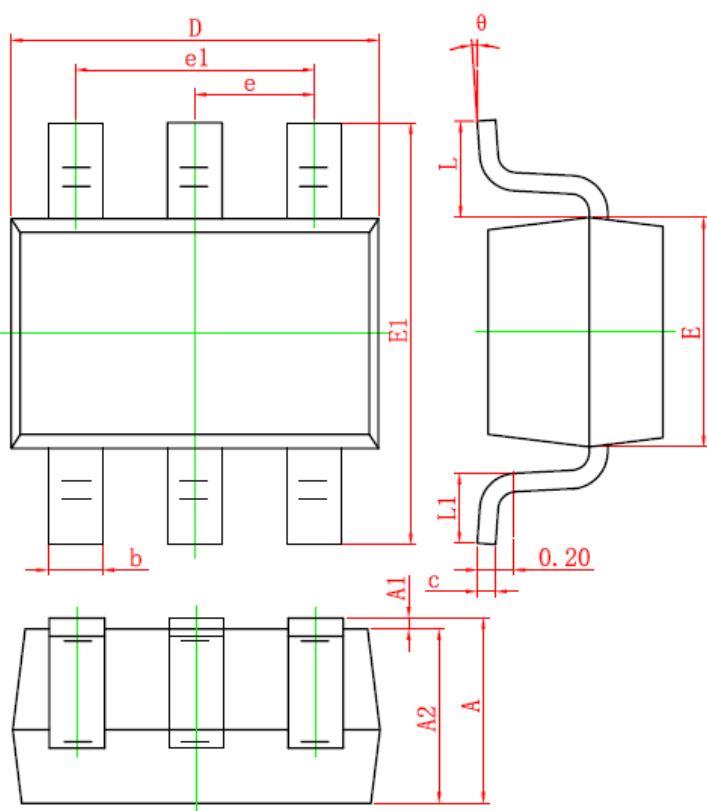
Recommended temperature profile for IR reflow



Profile feature	Sn-Pb eutectic Assembly	Pb-free Assembly
Average ramp-up rate (Ts max to Tp)	3°C/second max.	3°C/second max.
Preheat		
-Temperature Min(Ts min)	100°C	150°C
-Temperature Max(Ts max)	150°C	200°C
-Time(ts min to ts max)	60-120 seconds	60-180 seconds
Time maintained above:		
-Temperature (Tl)	183°C	217°C
- Time (tL)	60-150 seconds	60-150 seconds
Peak Temperature(Tp)	240 +0/-5 °C	260 +0/-5 °C
Time within 5°C of actual peak temperature(tp)	10-30 seconds	20-40 seconds
Ramp down rate	6°C/second max.	6°C/second max.
Time 25 °C to peak temperature	6 minutes max.	8 minutes max.

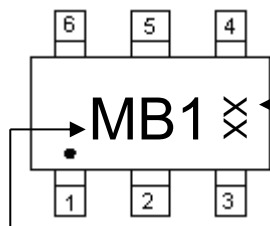
Note : All temperatures refer to topside of the package, measured on the package body surface.

SOT-363 Dimension



The diagram shows three views of the SOT-363 package: a top view, a side view, and a bottom view. Dimensions are labeled with letters and numbers: D (total width), e1 (lead pitch), e (lead width), E1 (total height), E (package height), L (lead length), L1 (lead thickness), A1 (lead height), A2 (package height), A (total height), b (lead width), c (lead thickness), and θ (lead angle). A specific lead thickness of 0.20 is indicated.

Marking:



The marking diagram shows a rectangular package with six pins numbered 1 to 6. The top surface is marked with 'MB1' and a cross symbol. A dot is located to the left of 'MB1'. Arrows point from the text 'Date Code:' and 'Device Code' to their respective locations on the package.

Date Code:
 Year + Month
 Year : 9→2019,
 0→2020, ..., etc
 Month : 1→Jan
 2→Feb, ..., 9→
 Sep, A→Oct, B
 →Nov, C→Dec

Device Code

6-Lead SOT-363 Plastic Surface Mounted Package
 CYStek Package Code: S6R

Style:
 Pin 1. Source (S)
 Pin 2. Gate (G)
 Pin 3. Collector (C)
 Pin 4. Emitter (E)
 Pin 5. Base (B)
 Pin 6. Drain (D)

DIM	Millimeters		Inches		DIM	Millimeters		Inches	
	Min.	Max.	Min.	Max.		Min.	Max.	Min.	Max.
A	0.900	1.100	0.035	0.043	E1	2.150	2.450	0.085	0.096
A1	0.000	0.100	0.000	0.004	e	0.650	TYP	0.026	TYP
A2	0.900	1.000	0.035	0.039	e1	1.200	1.400	0.047	0.055
b	0.150	0.350	0.006	0.014	L	0.525	REF	0.021	REF
c	0.080	0.150	0.003	0.006	L1	0.260	0.460	0.010	0.018
D	2.000	2.200	0.079	0.087	θ	0°	8°	0°	8°
E	1.150	1.350	0.045	0.053					

Notes : 1. Controlling dimension : millimeters.
 2. Maximum lead thickness includes lead finish thickness, and minimum lead thickness is the minimum thickness of base material.
 3. If there is any question with packing specification or packing method, please contact your local CYStek sales office.

Material :

- Lead : Pure tin plated.
- Mold Compound : Epoxy resin family, flammability solid burning class:UL94V-0.

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