

Features

- High Speed Smooth Switching Device for Hard and Soft Switching
- Maximum Junction Temperature 175 °C
- Positive Temperature Coefficient
- High Ruggedness, Temperature Stable
- Halogen Free. "Green" Device (Note 1)
- Epoxy Meets UL 94 V-0 Flammability Rating
- Lead Free Finish/RoHS Compliant (Note 2) ("P" Suffix Designates RoHS Compliant. See Ordering Information)

Applications

- Inverter for motor drive
- Air Conditioning
- Uninterruptible power supply

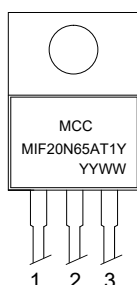
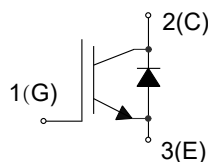
Maximum Ratings

Parameter	Symbol	Rating	Unit
Collector-Emitter Voltage	V_{CE}	650	V
DC Collector Current ⁽³⁾	I_C	$T_C=25^{\circ}\text{C}$ 40	A
		$T_C=100^{\circ}\text{C}$ 20	
Pulsed Collector Current ⁽⁴⁾ , $V_{GE}=15\text{V}$	$I_{C,pluse}$	60	A
Diode Forward Current ⁽³⁾	I_F	$T_C=25^{\circ}\text{C}$ 40	A
		$T_C=100^{\circ}\text{C}$ 20	
Diode Pulsed Current ⁽⁴⁾	$I_{F,pluse}$	60	A
Continuous Gate-Emitter Voltage	V_{GE}	± 20	V
Transient Gate-Emitter Voltage ⁽⁵⁾		± 30	
Turn off Safe Operation Area, $T_J \leq 150^{\circ}\text{C}$ $V_{CE} \leq 650\text{V}$		60	A
Short Circuit Withstand Time ^(Note6)	T_{SC}	5.0	us
Power Dissipation, $T_C=25^{\circ}\text{C}$, $T_J=175^{\circ}\text{C}$	P_D	55	W

Note:

1. Halogen free "Green" products are defined as those which contain <900ppm bromine, <900ppm chlorine (<1500ppm total Br + Cl) and <1000ppm antimony compounds.
2. High Temperature Solder Exemptions Applied, see EU Directive Annex 7a.
3. Limited by T_{Jmax} .
4. t_p limited by T_{Jmax} .
5. $t_p \leq 10\mu\text{s}$, Duty Cycle < 1%
6. $V_{GE}=15\text{V}$, $V_{CC}=400\text{V}$, $V_{CEM} \leq 650\text{V}$

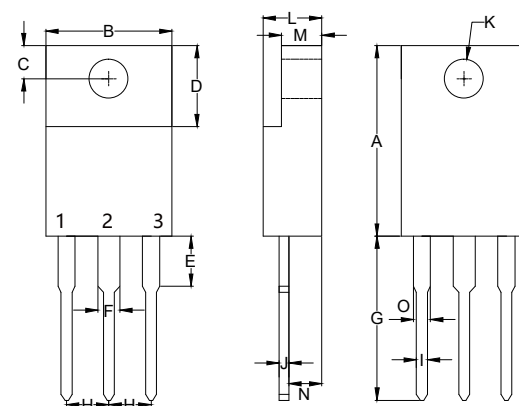
Internal Structure



Device Code: MIF20N65AT1Y
Date Code: YYWW (Year & Week)

Trench and Field Stop IGBT 650V 20A

ITO-220AB



DIMENSIONS

DIM	INCHES		MM		NOTE
	MIN	MAX	MIN	MAX	
A	0.567	0.642	14.40	16.30	
B	-----	0.421	-----	10.70	
C	0.085	0.128	2.15	3.25	
D	0.248	0.272	6.30	6.90	
E	-----	0.177	-----	4.50	
F	-----	0.071	-----	1.80	
G	0.500	0.539	12.70	14.20	
H	0.100		2.55		
I	-----	0.035	-----	0.90	
J	-----	0.032	-----	0.80	
K	0.102	0.150	2.60	3.80	Φ
L	-----	0.201	-----	5.10	
M	-----	0.140	-----	3.56	
N	0.083	0.126	2.10	3.20	
O	-----	0.071	-----	1.80	

Electrical Characteristics @ 25°C (Unless Otherwise Specified)

Parameter	Symbol	Test Conditions	Min	Typ	Max	Unit
IGBT Static Characteristics						
Collector-Emitter Breakdown Voltage	$V_{(BR)CES}$	$V_{GE}=0V, I_C=1mA$	650			V
Collector-Emitter Saturation Voltage	$V_{CE(sat)}$	$V_{GE}=15V, I_C=20A, T_J=25^{\circ}C$		1.6	1.9	V
		$V_{GE}=15V, I_C=20A, T_J=125^{\circ}C$		1.8		
		$V_{GE}=15V, I_C=20A, T_J=150^{\circ}C$		1.9		
G-E Threshold Voltage	$V_{GE(th)}$	$I_C=250\mu A, V_{CE}=V_{GE}$	4.0	5.0	6.5	V
C-E Leakage Current	I_{CES}	$V_{CE}=650V, V_{GE}=0V, T_J=25^{\circ}C$			1.0	mA
		$V_{CE}=650V, V_{GE}=0V, T_J=150^{\circ}C$			5.0	
G-E Leakage Current	I_{GES}	$V_{CE}=0V, V_{GE}=\pm 20V$			± 200	nA
Dynamic Characteristics						
Input Capacitance	C_{ies}	$V_{CE}=25V, V_{GE}=0V, f=1MHz$		1.05		nF
Reverse Transfer Capacitance	C_{res}			0.02		
Gate Charge	Q_G	$V_{CC}=300V, I_C=20A, V_{GE}=15V$		0.09		μC
IGBT Switching Characteristics						
Turn-On Delay Time	$t_{d(on)}$	$V_{CC}=300V, I_C=20A,$ $V_{GE}=-5V\sim 15V,$ $R_G=20\Omega, T_J=25^{\circ}C$		46		ns
Rise Time	t_r			47		
Turn-Off Delay Time	$t_{d(off)}$			80		
Fall Time	t_f			74		
Turn-On Energy	E_{on}	$V_{CC}=300V, I_C=20A,$ $V_{GE}=-5V\sim 15V,$ $R_G=20\Omega, T_J=25^{\circ}C$		0.36		mJ
Turn-Off Energy	E_{off}			0.25		
Turn-On Delay Time	$t_{d(on)}$			39		ns
Rise Time	t_r			53		
Turn-Off Delay Time	$t_{d(off)}$			95		
Fall Time	t_f			131		
Turn-On Energy	E_{on}	$V_{CC}=300V, I_C=20A,$ $V_{GE}=-5V\sim 15V,$ $R_G=20\Omega, T_J=125^{\circ}C$		0.39		mJ
Turn-Off Energy	E_{off}			0.37		
Turn-On Delay Time	$t_{d(on)}$			40		ns
Rise Time	t_r			55		
Turn-Off Delay Time	$t_{d(off)}$			95		
Fall Time	t_f			138		
Turn-On Energy	E_{on}	$V_{CC}=300V, I_C=20A,$ $V_{GE}=-5V\sim 15V,$ $R_G=20\Omega, T_J=150^{\circ}C$		0.41		mJ
Turn-Off Energy	E_{off}			0.40		

Electrical Characteristics @ 25°C (Unless Otherwise Specified)

Parameter	Symbol	Test Conditions	Min	Typ	Max	Unit
Diode Characteristics						
Diode Forward Voltage	V_F	$V_{GE}=0V, I_F=20A, T_j=25^{\circ}C$		1.75	2.3	V
		$V_{GE}=0V, I_F=20A, T_j=125^{\circ}C$		1.65		
		$V_{GE}=0V, I_F=20A, T_j=150^{\circ}C$		1.6		
Reverse Recovery Current	I_{rr}	$V_R=300V, I_F=20A,$ $di_F/dt=-360A/\mu s, T_j=25^{\circ}C$		6.0		A
Diode Reverse Recovery Time	t_{rr}			200		ns
Reverse Recovery Charge	Q_{rr}			0.25		μC
Reverse Recovery Energy	E_{rec}			0.07		mJ
Reverse Recovery Current	I_{rr}	$V_R=300V, I_F=20A,$ $di_F/dt=-360A/\mu s, T_j=125^{\circ}C$		8.0		A
Diode Reverse Recovery Time	t_{rr}			218		ns
Reverse Recovery Charge	Q_{rr}			0.59		μC
Reverse Recovery Energy	E_{rec}			0.13		mJ
Reverse Recovery Current	I_{rr}	$V_R=300V, I_F=20A,$ $di_F/dt=-360A/\mu s, T_j=150^{\circ}C$		9.0		A
Diode Reverse Recovery Time	t_{rr}			227		ns
Reverse Recovery Charge	Q_{rr}			0.78		μC
Reverse Recovery Energy	E_{rec}			0.16		mJ

Thermal characteristics

Parameter	Symbol	Min	Typ	Max	Units
Operating Junction Temperature Range	T_j	-40		175	$^{\circ}C$
Storage Temperature Range	T_{stg}	-55		150	$^{\circ}C$
Thermal Resistance from Junction to Case (IGBT)	$R_{th_{J-C}}$			2.7	$^{\circ}C/W$
Thermal Resistance from Junction to Case (Diode)	$R_{th_{J-C}}$			4.8	$^{\circ}C/W$
Thermal Resistance from Junction to Ambient	$R_{th_{J-A}}$			40	$^{\circ}C/W$

Curve Characteristics

Fig. 1 - Typical Output Characteristic($T_J=25^\circ\text{C}$)

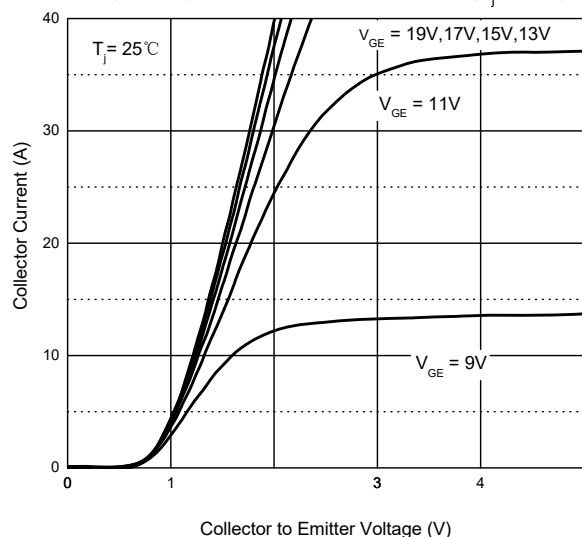


Fig. 2 - Typical Output Characteristic ($T_J=150^\circ\text{C}$)

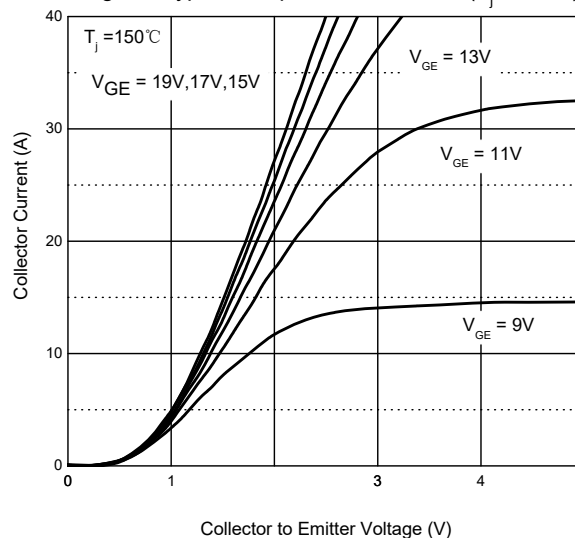


Fig. 3 - Typical Transfer Characteristic

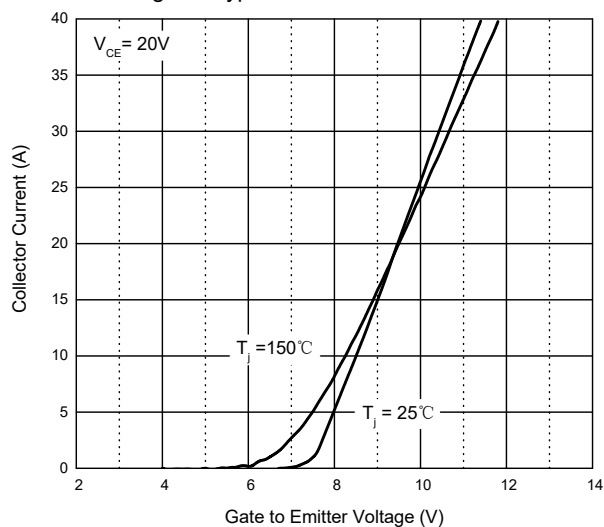


Fig. 4 - Diode Forward Current vs. Forward Voltage

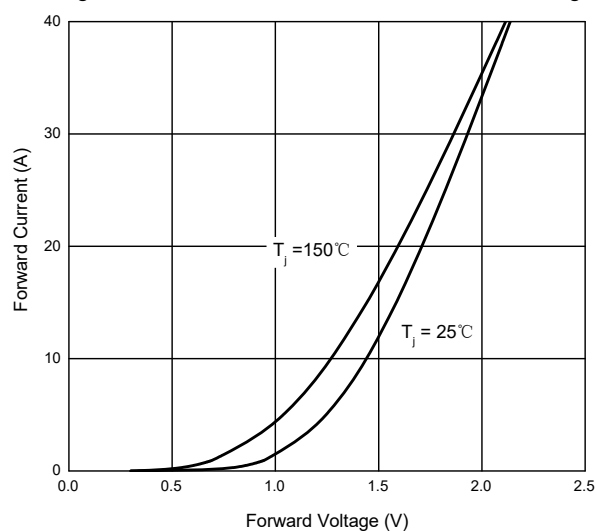


Fig. 5 - Diode VF vs. Junction Temperature

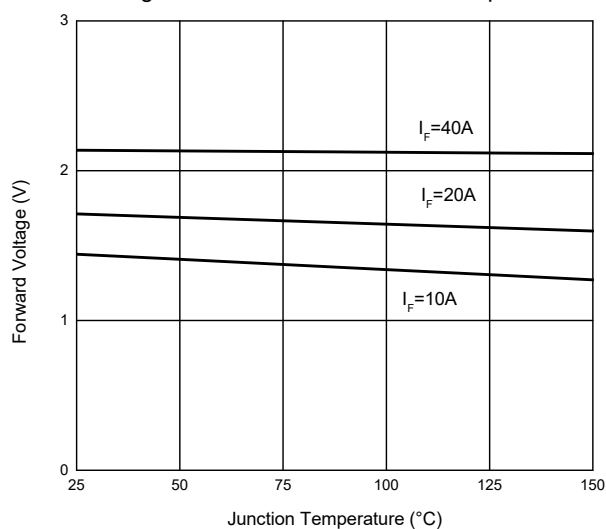
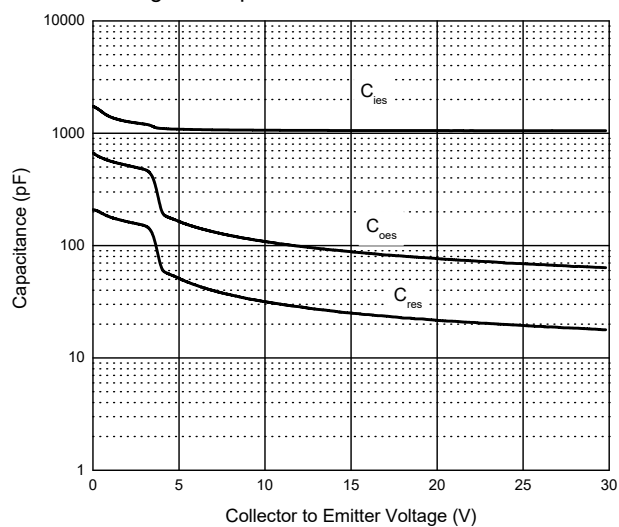


Fig. 6 - Capacitance Characteristics



Curve Characteristics

Fig. 7 - IGBT Switching Loss vs. I_c

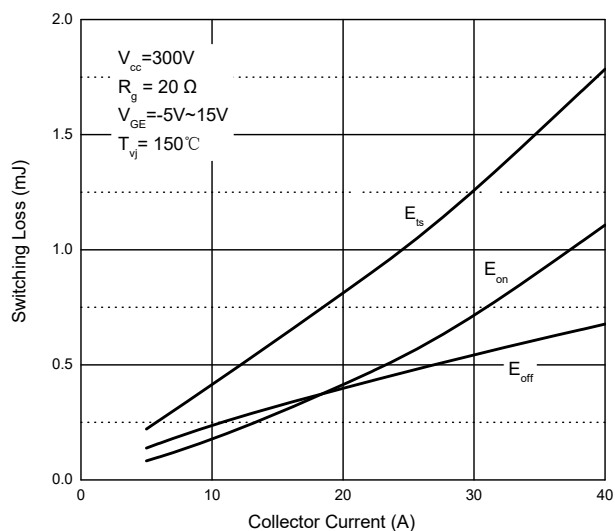


Fig. 8- IGBT Switching Loss vs. R_g

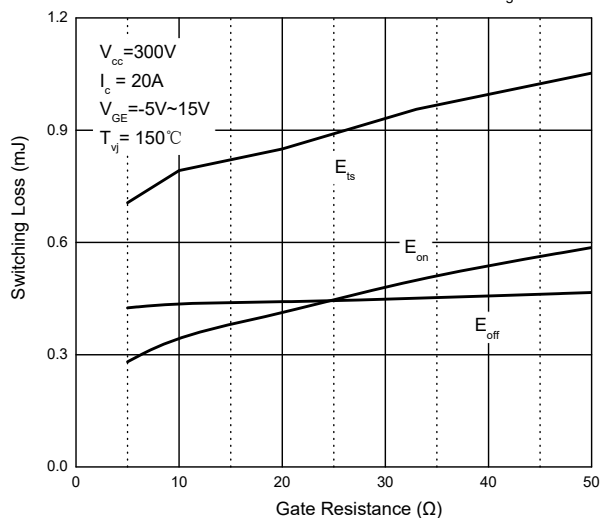


Fig. 9 -IGBT Switching Loss vs. Junction Temperature

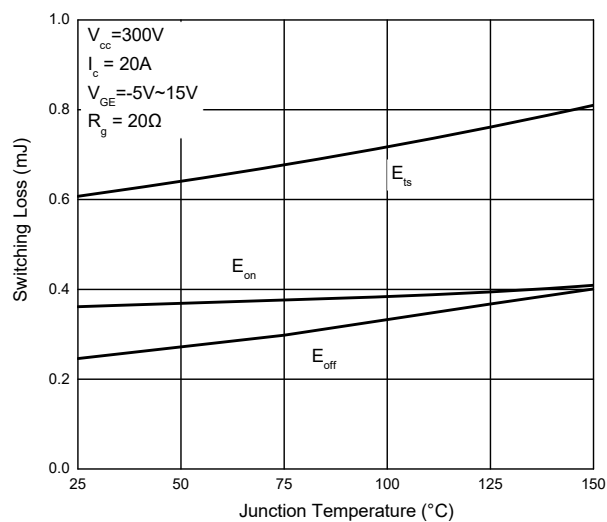


Fig. 10 - Switching Loss vs. V_{CE}

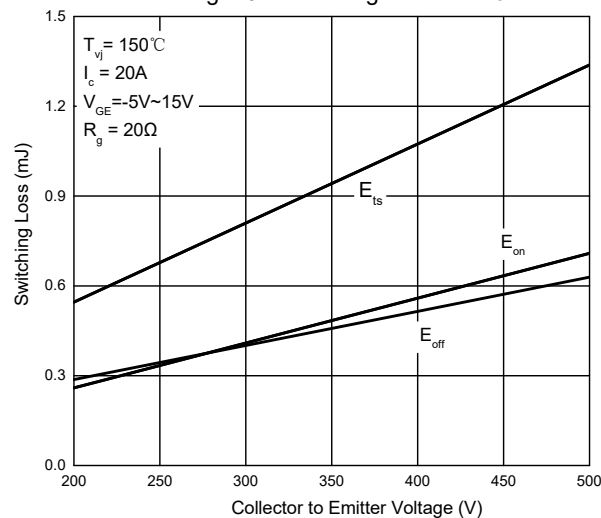


Fig. 11 - $V_{CE(sat)}$ vs. Junction Temperature

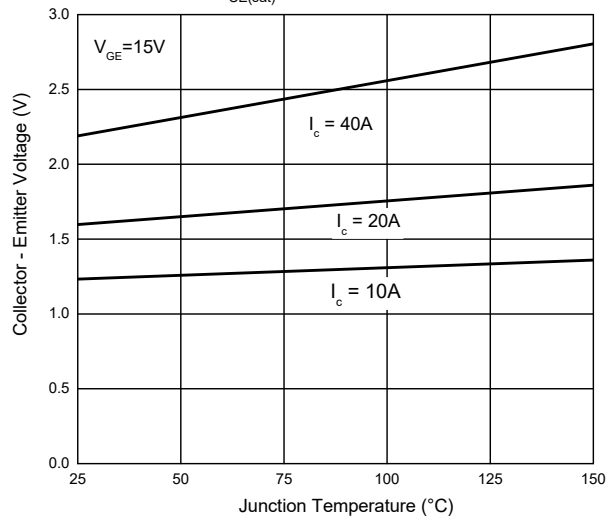
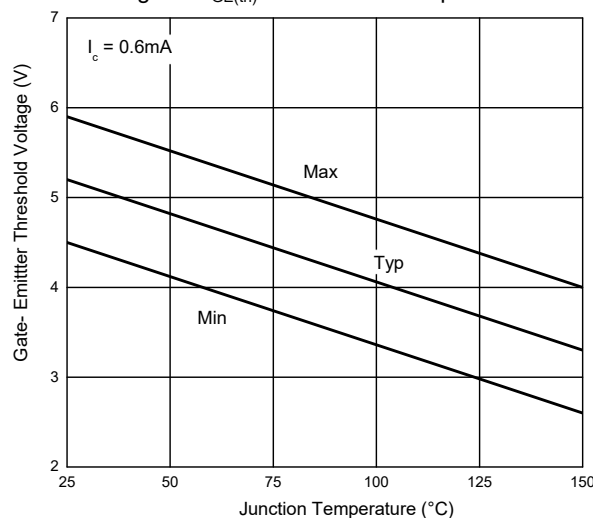


Fig. 12 $V_{GE(th)}$ vs. Junction Temperature



Curve Characteristics

Fig. 13 - IGBT Transient Thermal Impedance

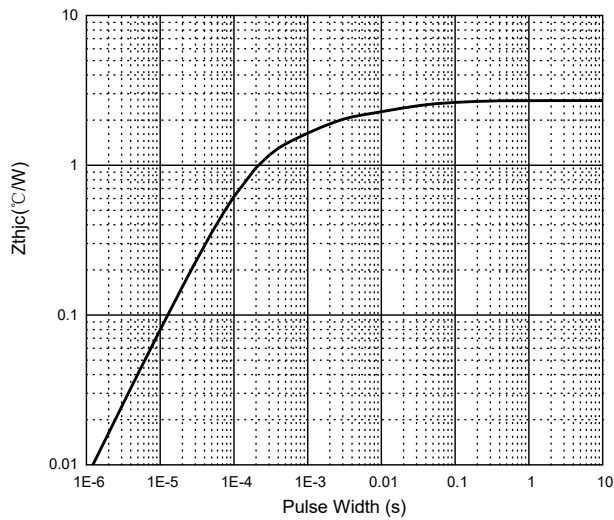


Fig. 14 - Diode Transient Thermal Impedance

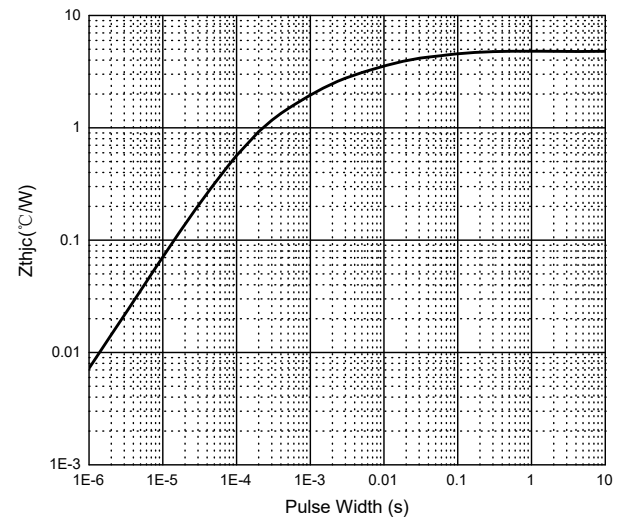


Fig. 15 - Collector Current vs. Case Temperature

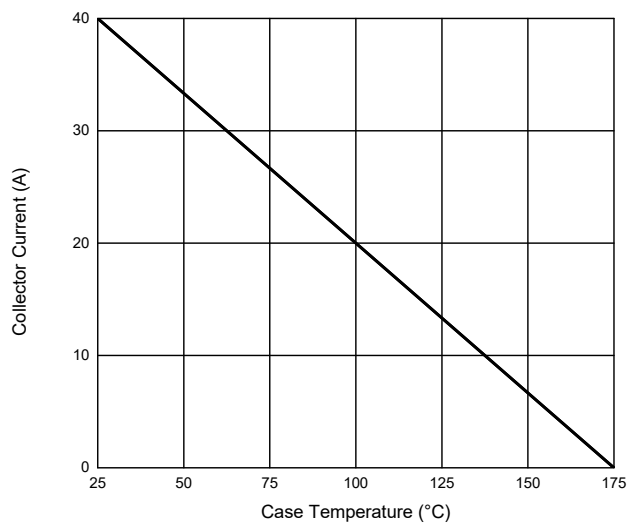
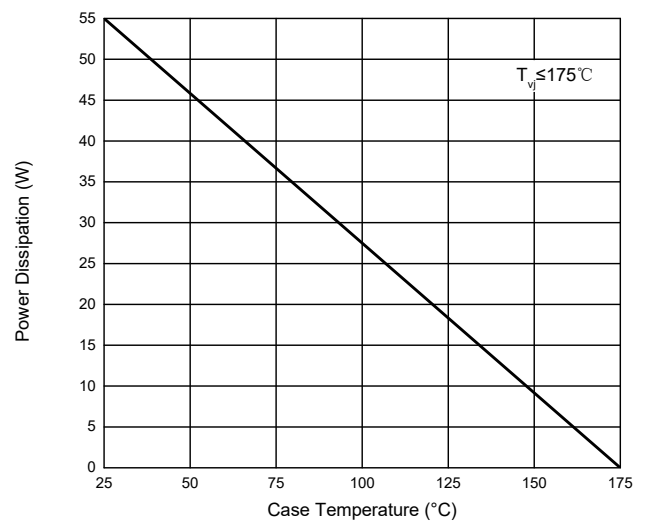


Fig. 16 - Power Derating



Ordering Information

Device	Packing
Part Number-BP	Bulk:50pcs/Tube, 1Kpcs/Box, 5Kpcs/Carton

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