

Features

- AEC-Q101 Qualified
- Integrated Fast & Soft Recovery anti-Parallel FWD
- High breakdown voltage to 1200V for improved reliability
- High Short Circuit Capability (10 μ s)
- Positive temperature coefficient
- Maximum junction temperature 175 $^{\circ}$ C
- 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
- AC and DC servo drive amplifier
- PTC heater

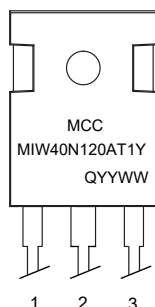
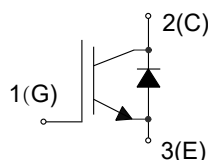
Maximum Ratings

Parameter	Symbol	Rating	Unit
Collector-Emitter Voltage	V_{CE}	1200	V
DC Collector Current ^(Note 3)	I_C	$T_C=25^{\circ}\text{C}$ 80	A
		$T_C=100^{\circ}\text{C}$ 40	
Pulsed Collector Current $V_{GE}=15\text{V}$ (Note 4)	$I_{C,pluse}$	120	A
Diode Forward Current ^(Note 3)	I_F	$T_C=25^{\circ}\text{C}$ 80	A
		$T_C=100^{\circ}\text{C}$ 40	
Diode Pulsed Current ^(Note 4)	$I_{F,pluse}$	120	A
Gate-Emitter Voltage	V_{GE}	± 20	V
Transient Gate-Emitter Voltage ^(Note 5)		± 30	
Turn off Safe Operating Area $V_{CEM} \leq 1200\text{V}, T_j < 150^{\circ}\text{C}$		120	A
Short Circuit Withstand Time ^(Note 6)	t_{sc}	10	μs
Power Dissipation	P_D	$T_C=25^{\circ}\text{C}$ 319	W
		$T_C=100^{\circ}\text{C}$ 159	

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. $V_{GE} = 15\text{V}$, $V_{CC} = 600\text{V}$, $V_{CEM} \leq 1200\text{V}$

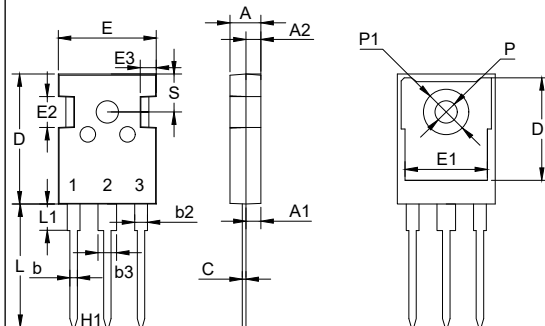
Internal Structure



Device Code: MIW40N120AT1Y
Date Code: QYYWW (Year & Week)

Trench and Field Stop IGBT 1200V 40A

TO-247AB



DIMENSIONS

DIM	INCHES		MM		NOTE
	MIN	MAX	MIN	MAX	
A	0.189	0.205	4.80	5.20	
A1	0.087	0.103	2.21	2.61	
A2	0.073	0.085	1.85	2.15	
b	0.039	0.055	1.00	1.40	
b2	0.075	0.087	1.91	2.21	
C	0.020	0.028	0.50	0.70	
D	0.815	0.839	20.70	21.30	
D1	0.640	0.663	16.25	16.85	
E	0.610	0.634	15.50	16.10	
E1	0.512	0.535	13.00	13.60	
E2	0.189	0.205	4.80	5.20	
E3	0.091	0.106	2.30	2.70	
L	0.772	0.796	19.62	20.22	
L1	-	0.169	-	4.30	
P	0.134	0.150	3.40	3.80	Φ
P1		0.287	-	7.30	Φ
S	0.242		6.15		TYP
H1	0.214		5.44		TYP
b3	0.110	0.126	2.80	3.20	

Electrical Characteristics of the IGBT @ 25°C (Unless Otherwise Specified)

Parameter	Symbol	Test Conditions	Min	Typ	Max	Unit
IGBT Static Characteristics						
Collector-Emitter Breakdown Voltage	$V_{(BR)CES}$	$V_{GE}=0V, I_C=250\mu A$	1200			V
Collector-Emitter Saturation Voltage	$V_{CE(sat)}$	$V_{GE}=15V, I_C=40A, T_J=25^\circ C$		1.65	1.95	V
		$V_{GE}=15V, I_C=40A, T_J=125^\circ C$		1.95		
		$V_{GE}=15V, I_C=40A, T_J=150^\circ C$		2.05		
G-E Threshold Voltage	$V_{GE(th)}$	$I_C=1.0mA, V_{CE}=V_{GE}$	5.2	5.8	6.5	V
C-E Leakage Current	I_{CES}	$V_{CE}=1200V, V_{GE}=0V, T_J=25^\circ C$			0.25	mA
		$V_{CE}=1200V, V_{GE}=0V, T_J=150^\circ C$			4	
G-E Leakage Current	I_{GES}	$V_{CE}=0V, V_{GE}=\pm 20V$			100	nA
Dynamic Characteristics						
Input Capacitance	C_{ies}	$V_{CE}=25V, V_{GE}=0V, f=1MHz$		6.76		nF
Reverse Transfer Capacitance	C_{res}			0.07		
Gate Charge	C_{oes}			0.19		
Gate Charge	Q_g	$V_{GE}=15V, I_C=40A, V_{cc}=600V$		0.27		uC
IGBT Switching Characteristics						
Turn-On Delay Time	$t_{d(on)}$	$V_{CC}=600V, I_C=40A, V_{GE}=-5V\sim 15V, R_G=20\Omega, T_J=25^\circ C$		93		ns
Rise Time	t_r			93		
Turn-Off Delay Time	$t_{d(off)}$			269		
Fall Time	t_f			190		
Turn-On Energy	E_{on}			3.92		mJ
Turn-Off Energy	E_{off}			2.53		
Turn-On Delay Time	$t_{d(on)}$	$V_{CC}=600V, I_C=40A, V_{GE}=-5V\sim 15V, R_G=20\Omega, T_J=125^\circ C$		87		ns
Rise Time	t_r			96		
Turn-Off Delay Time	$t_{d(off)}$			288		
Fall Time	t_f			277		
Turn-On Energy	E_{on}			4.33		mJ
Turn-Off Energy	E_{off}			3.32		
Turn-On Delay Time	$t_{d(on)}$	$V_{CC}=600V, I_C=40A, V_{GE}=-5V\sim 15V, R_G=20\Omega, T_J=150^\circ C$		84		ns
Rise Time	t_r			99		
Turn-Off Delay Time	$t_{d(off)}$			300		
Fall Time	t_f			313		
Turn-On Energy	E_{on}			4.44		mJ
Turn-Off Energy	E_{off}			3.58		

Electrical Characteristics of the Diode @ 25°C (Unless Otherwise Specified)

Parameter	Symbol	Test Conditions	Min	Typ	Max	Unit
Diode Characteristics						
Diode Forward Voltage	V_F	$V_{GE}=0V, I_F=40A, T_J=25^{\circ}C$		2.40	3.00	V
		$V_{GE}=0V, I_F=40A, T_J=125^{\circ}C$		2.30		
		$V_{GE}=0V, I_F=40A, T_J=150^{\circ}C$		2.20		
Reverse Recovery Current	I_{rr}	$V_R=600V, I_F=40A,$ $di_F/dt=-350A/\mu s, T_J=25^{\circ}C$		40		A
Diode Reverse Recovery Time	t_{rr}			215		ns
Reverse Recovery Charge	Q_{rr}			1.22		μC
Reverse Recovery Energy	E_{rec}			0.43		mJ
Reverse Recovery Current	I_{rr}	$V_R=600V, I_F=40A,$ $di_F/dt=-350A/\mu s, T_J=125^{\circ}C$		41		A
Diode Reverse Recovery Time	t_{rr}			317		ns
Reverse Recovery Charge	Q_{rr}			2.64		μC
Reverse Recovery Energy	E_{rec}			1.05		mJ
Reverse Recovery Current	I_{rr}	$V_R=600V, I_F=40A,$ $di_F/dt=-350A/\mu s, T_J=150^{\circ}C$		42		A
Diode Reverse Recovery Time	t_{rr}			369		ns
Reverse Recovery Charge	Q_{rr}			3.44		μC
Reverse Recovery Energy	E_{rec}			1.34		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)	$R_{th_{J-C}}$			0.47	$^{\circ}C/W$
Thermal Resistance from Junction to Case (Diode)	$R_{th_{J-C}}$			1.00	$^{\circ}C/W$
Thermal Resistance from Junction to Ambient	$R_{th_{J-A}}$			40	$^{\circ}C/W$

Curve Characteristics

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

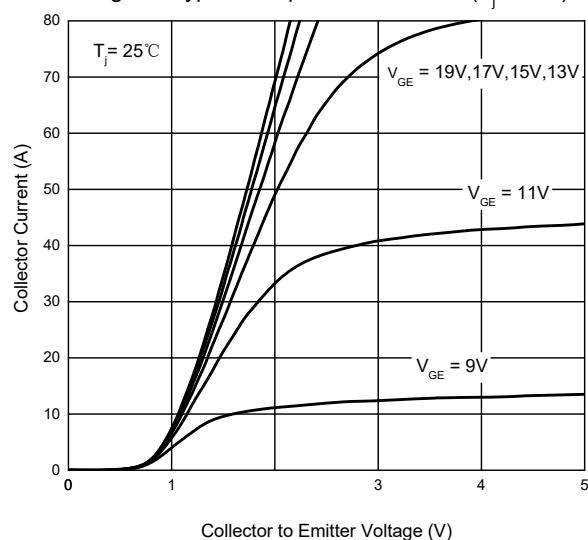


Fig. 2 - Typical Output Characteristic ($T_j=150^\circ\text{C}$)

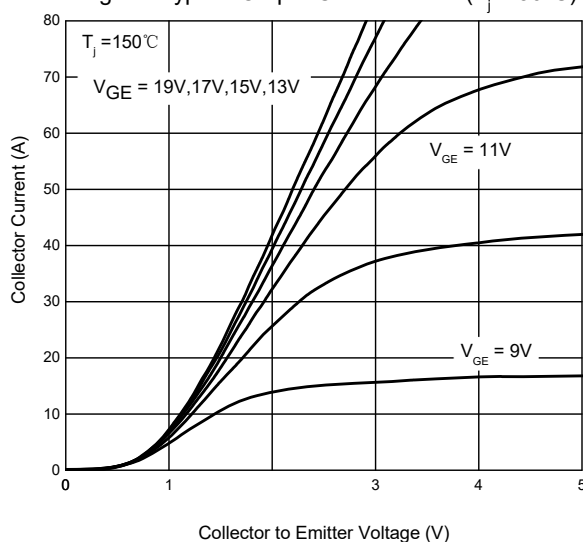


Fig. 3 - Typical Transfer Characteristic

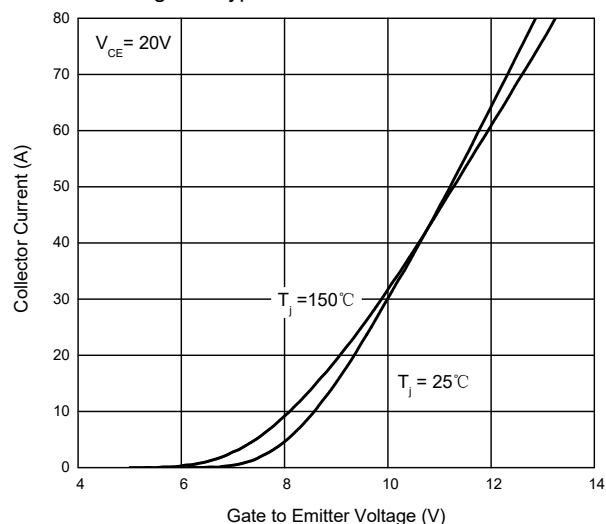


Fig. 4 - Diode Forward Current vs. Forward Voltage

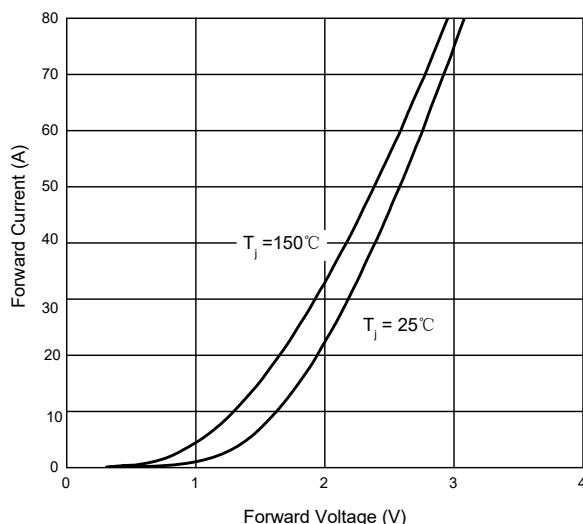


Fig. 5 - Diode VF vs. Junction Temperature

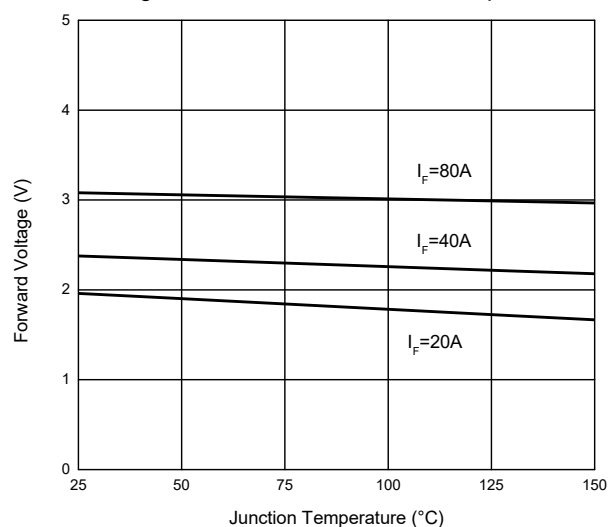
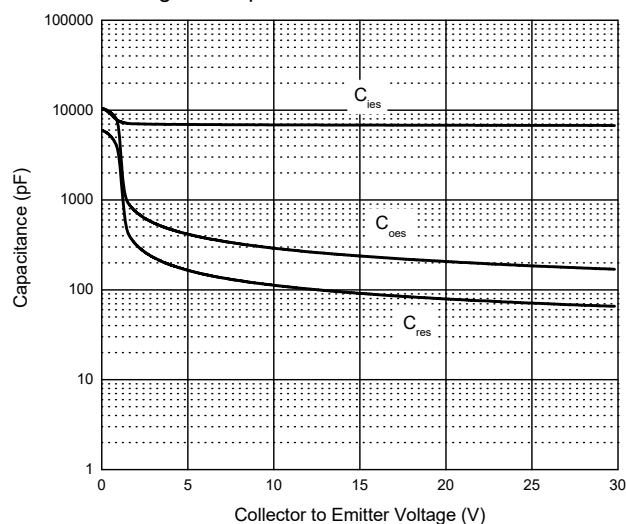


Fig. 6 - Capacitance Characteristics



Curve Characteristics

Fig. 7 - IGBT Switching Loss vs. I_C

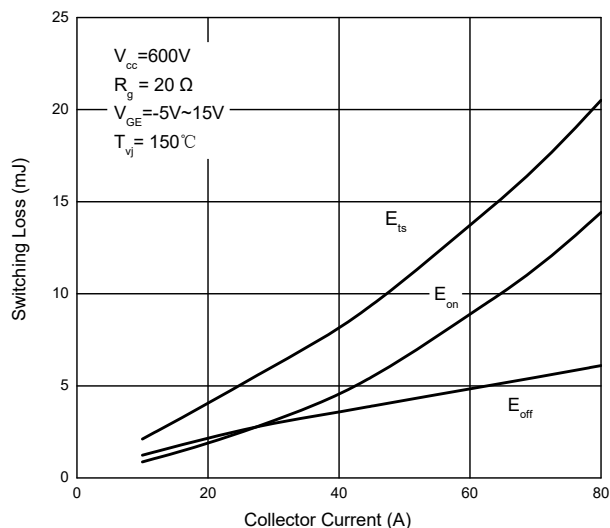


Fig. 8- IGBT Switching Loss vs. R_g

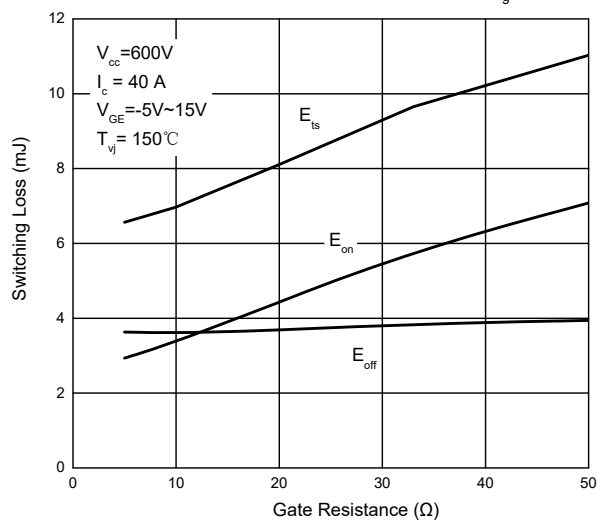


Fig. 9 -IGBT Switching Loss vs. Junction Temperature

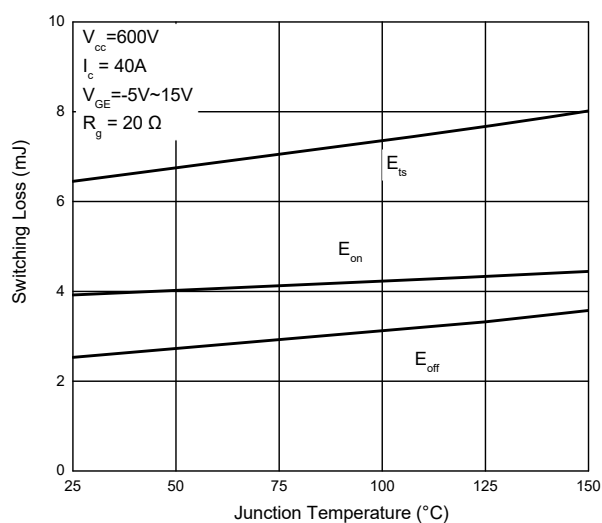


Fig. 10 - Switching Loss vs. VCE

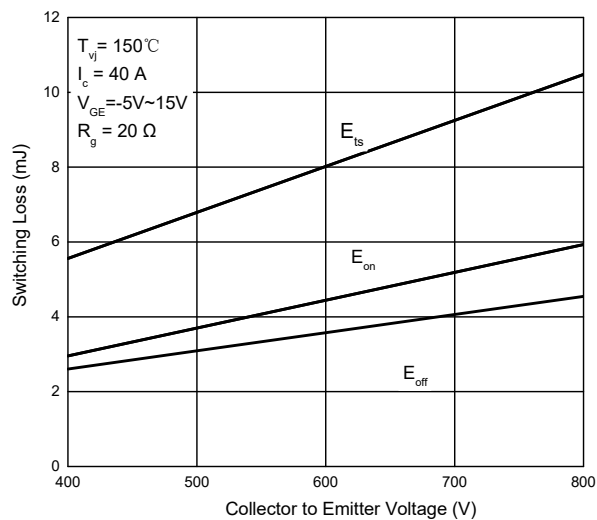


Fig. 11 - $V_{CE(sat)}$ vs. Junction Temperature

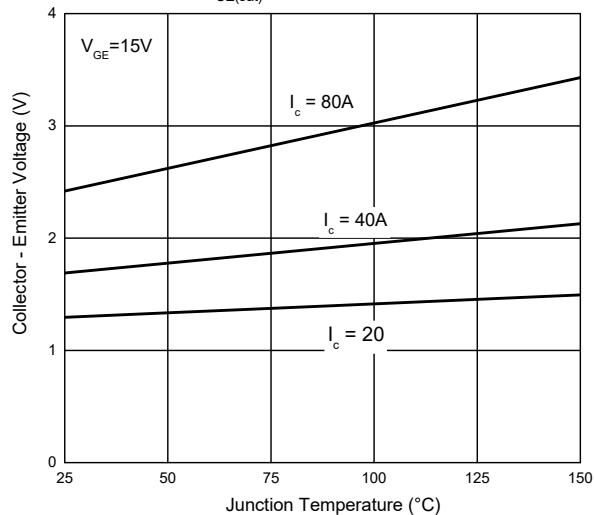
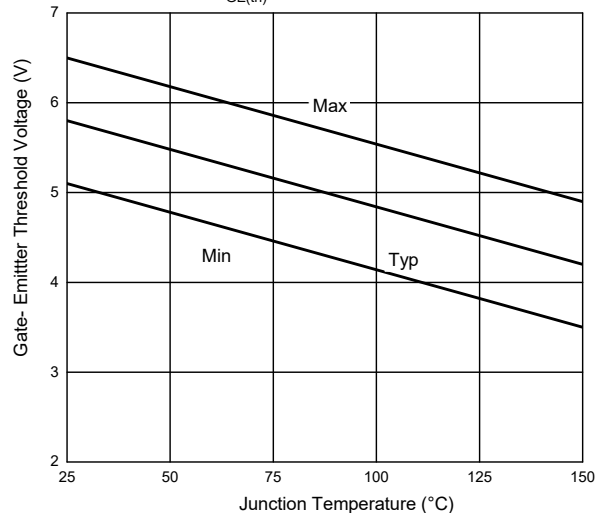


Fig. 12 - $V_{GE(th)}$ vs. Junction Temperature



Curve Characteristics

Fig. 13 - Switching Time vs. Collect Current

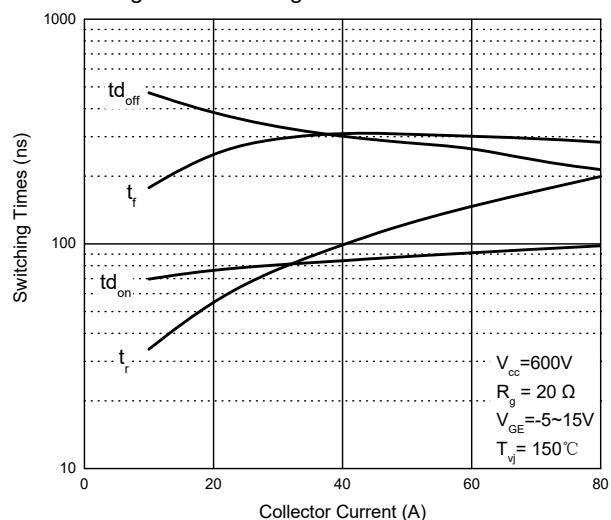


Fig. 14 - Switching Time vs. Gate Resistance

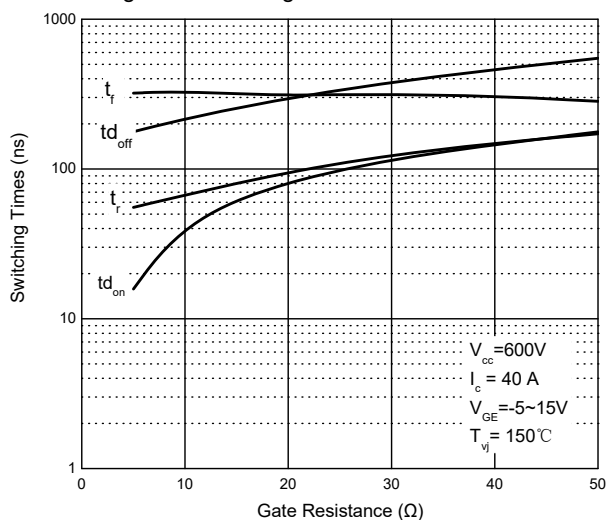


Fig. 15 - Switching Time vs. Juction temperature

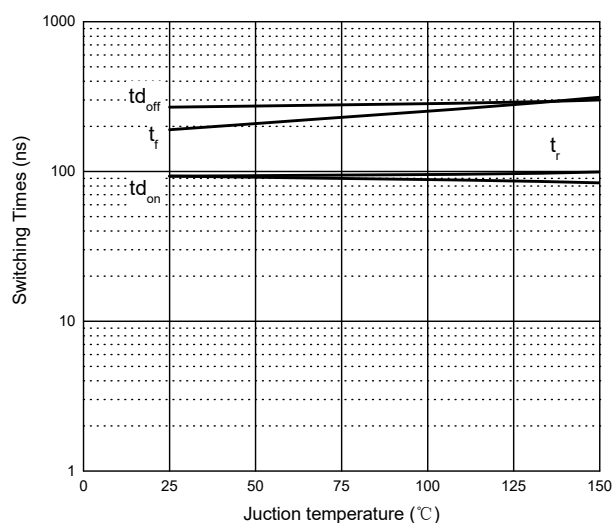


Fig. 16 - IGBT Transient Thermal Impedance

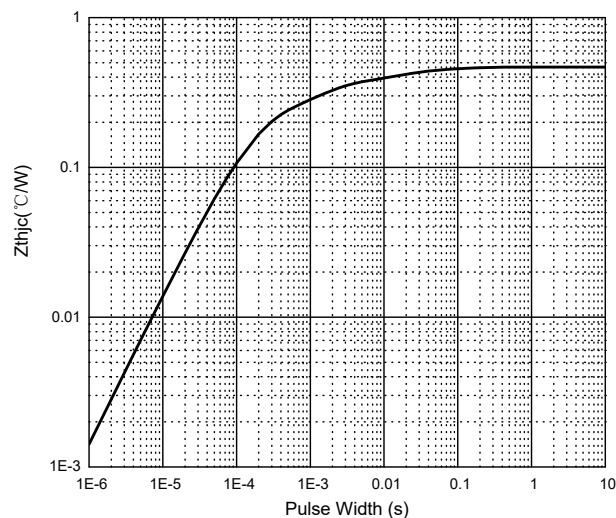


Fig. 17 - Diode Transient Thermal Impedance

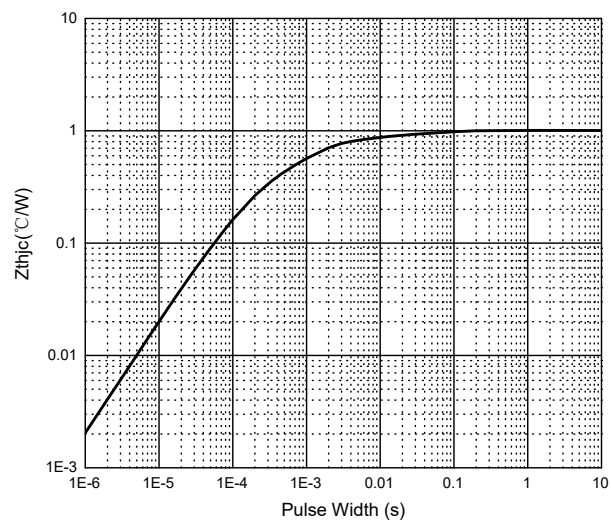
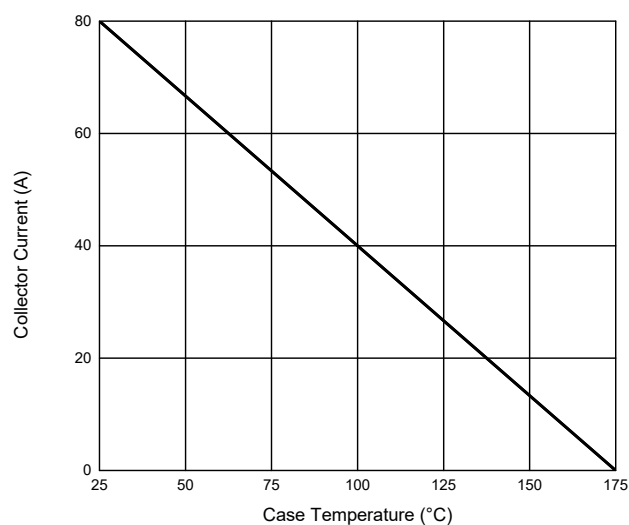
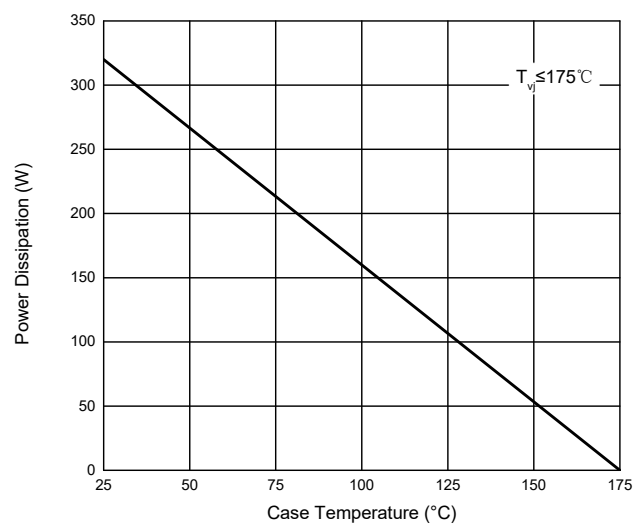


Fig. 18 - Collector Current vs. Case Temperature



Curve Characteristics

Fig. 19 - Power Derating



Ordering Information

Device	Packing
Part Number-BP	Tube: 30pcs/Tube, 360pcs/Box, 1800pcs/Ctn

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