

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

- Soft Switching Applications
- Air Conditioning
- Motor Drive Inverter

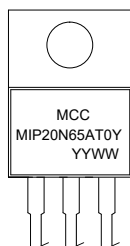
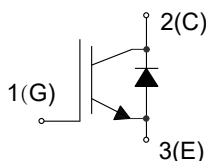
Maximum Ratings

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, $V_{CE} \leq 600\text{V}$, $T_J \leq 150^{\circ}\text{C}$		60	A
Short Circuit Withstand Time ⁽⁶⁾	T_{SC}	5	μs
Power Dissipation, $T_C=25^{\circ}\text{C}$, $T_J=175^{\circ}\text{C}$	P_D	120	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. $V_{GE}=15\text{V}$, $V_{CE} \leq 400\text{V}$

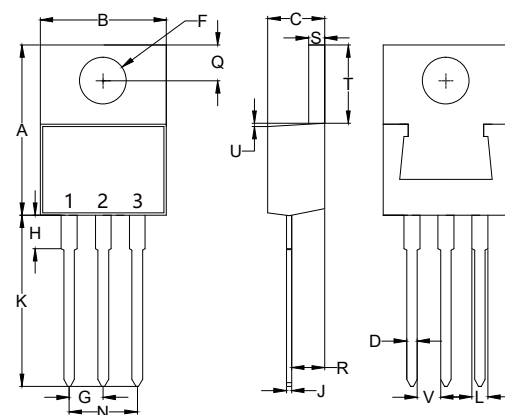
Internal Structure



Device Code: MIP20N65AT0Y
Date Code: YYWW: (Year & Week)

Trench and Field Stop IGBT 650V 20A

TO-220AB



DIM	INCHES		MM		NOTE
	MIN	MAX	MIN	MAX	
A	0.560	0.625	14.22	15.88	
B	0.380	0.429	9.65	10.90	
C	0.140	0.201	3.56	5.10	
D	0.020	0.045	0.51	1.14	
F	0.131	0.170	3.34	4.31	Φ
G	0.079	0.121	2.01	3.07	
H	-----	0.250	-----	6.35	
J	0.011	0.025	0.28	0.64	
K	0.500	0.580	12.70	14.73	
L	0.045	0.060	1.14	1.52	
N	0.158	0.242	4.02	6.14	
Q	0.087	0.135	2.22	3.43	
R	0.080	0.126	2.04	3.19	
S	0.045	0.055	1.14	1.39	
T	0.230	0.270	5.84	6.86	
U	-----	0.050	-----	1.27	
V	0.045	-----	1.15	-----	

Electrical Characteristics @ 25°C (Unless Otherwise Specified)

Parameter	Symbol	Test Conditions	Min	Typ	Max	Unit
IGBT Static Characteristics						
Collector-Emitter Breakdown Voltage	$V_{(BR)CES}$	$V_{GE}=0V, I_C=250\mu A$	650			V
Collector-Emitter Saturation Voltage	$V_{CE(sat)}$	$V_{GE}=15V, I_C=20A, T_J=25^\circ C$		1.6	1.95	V
		$V_{GE}=15V, I_C=20A, T_J=125^\circ C$		1.75		
		$V_{GE}=15V, I_C=20A, T_J=150^\circ C$		1.8		
G-E Threshold Voltage	$V_{GE(th)}$	$I_C=1mA, V_{CE}=V_{GE}$	5.0	5.8	6.5	V
C-E Leakage Current	I_{CES}	$V_{CE}=650V, V_{GE}=0V, T_J=25^\circ C$			0.25	mA
		$V_{CE}=650V, V_{GE}=0V, T_J=150^\circ C$			1	
G-E Leakage Current	I_{GES}	$V_{CE}=0V, V_{GE}=\pm 20V$			± 200	nA
Dynamic Characteristics						
Input Capacitance	C_{ies}	$V_{CE}=25V, V_{GE}=0V, f=1MHz$		0.90		nF
Output Capacitance	C_{oes}			0.04		
Reverse Transfer Capacitance	C_{res}			0.01		
Gate Charge	Q_G	$V_{CC}=300V, I_C=20A, V_{GE}=15V$		0.085		μC
IGBT Switching Characteristics						
Turn-On Delay Time	$t_{d(on)}$	$V_{CC}=300V, I_C=20A,$ $V_{GE}=-5V\sim 15V,$ $R_G=51\Omega, T_J=25^\circ C$		12		ns
Rise Time	t_r			33		
Turn-Off Delay Time	$t_{d(off)}$			68		
Fall Time	t_f			129		
Turn-On Energy	E_{on}	$V_{CC}=300V, I_C=20A,$ $V_{GE}=-5V\sim 15V,$ $R_G=51\Omega, T_J=25^\circ C$		0.41		mJ
Turn-Off Energy	E_{off}			0.22		
Turn-On Delay Time	$t_{d(on)}$	$V_{CC}=300V, I_C=20A,$ $V_{GE}=-5V\sim 15V,$ $R_G=51\Omega, T_J=125^\circ C$		16		ns
Rise Time	t_r			41		
Turn-Off Delay Time	$t_{d(off)}$			69		
Fall Time	t_f			154		
Turn-On Energy	E_{on}	$V_{CC}=300V, I_C=20A,$ $V_{GE}=-5V\sim 15V,$ $R_G=51\Omega, T_J=125^\circ C$		0.48		mJ
Turn-Off Energy	E_{off}			0.35		
Turn-On Delay Time	$t_{d(on)}$	$V_{CC}=300V, I_C=20A,$ $V_{GE}=-5V\sim 15V,$ $R_G=51\Omega, T_J=150^\circ C$		18		ns
Rise Time	t_r			49		
Turn-Off Delay Time	$t_{d(off)}$			69		
Fall Time	t_f			173		
Turn-On Energy	E_{on}			0.52		mJ
Turn-Off Energy	E_{off}			0.38		
Short Circuit Collector Current	$I_{C(SC)}$	$V_{GE}=15V, t_{SC}\leq 5\mu s, V_{CC}=400V, T_{J,start}=25^\circ C$		115		A

Electrical Characteristics @ 25°C (Unless Otherwise Specified)

Parameter	Symbol	Test Conditions	Min	Typ	Max	Unit
Diode Characteristics						
Diode Forward Voltage	V_F	$V_{GE}=0V, I_F=20A, T_j=25^{\circ}C$		2	2.5	V
		$V_{GE}=0V, I_F=20A, T_j=125^{\circ}C$		1.8		
		$V_{GE}=0V, I_F=20A, T_j=150^{\circ}C$		1.7		
Reverse Recovery Current	I_{rr}	$V_R=300V, I_F=20A,$ $di_F/dt=-360A/\mu s, T_j=25^{\circ}C$		6		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		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		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)	$R_{th_{J-C}}$			1.25	$^{\circ}C/W$
Thermal Resistance from Junction to Case (Diode)	$R_{th_{J-C}}$			1.5	$^{\circ}C/W$
Thermal Resistance from Junction to Ambient	$R_{th_{J-A}}$			60	$^{\circ}C/W$

Curve Characteristics

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

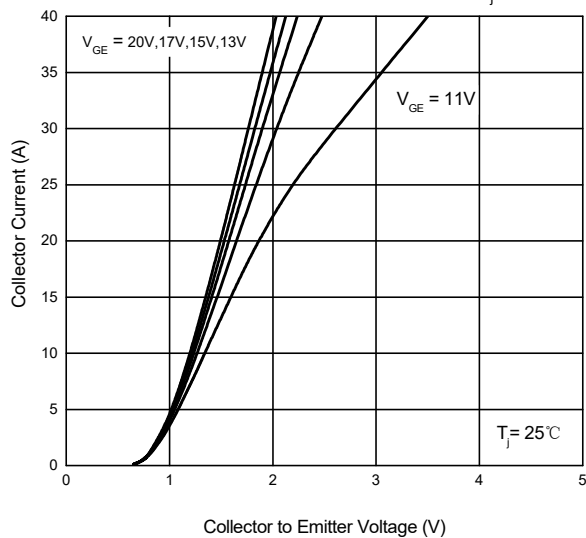


Fig. 2 - Typical Output Characteristic ($T_J=150^\circ\text{C}$)

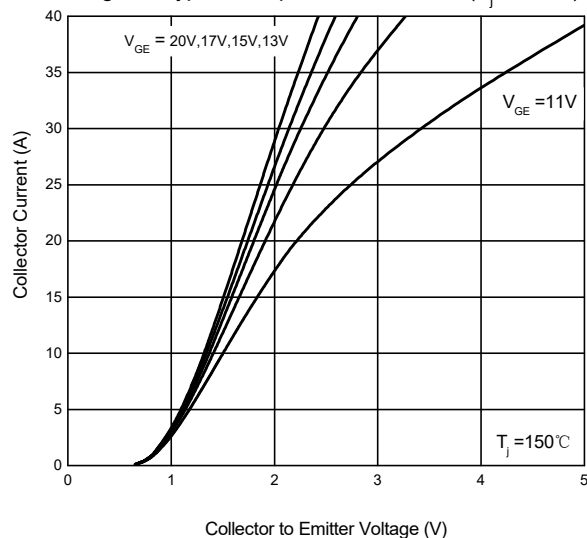


Fig. 3 - Typical Transfer Characteristic

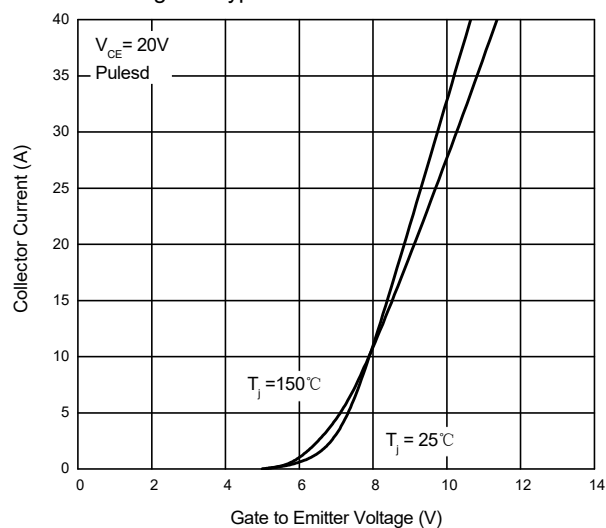


Fig. 4 - Diode Forward Current vs V_F

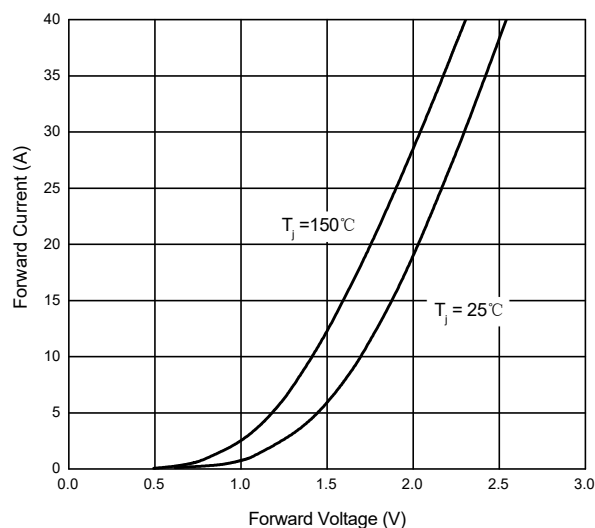


Fig. 5 - IGBT Switching Loss vs. I_C

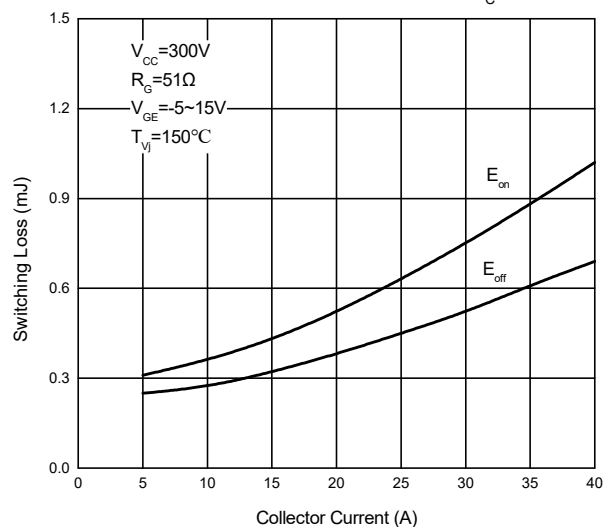
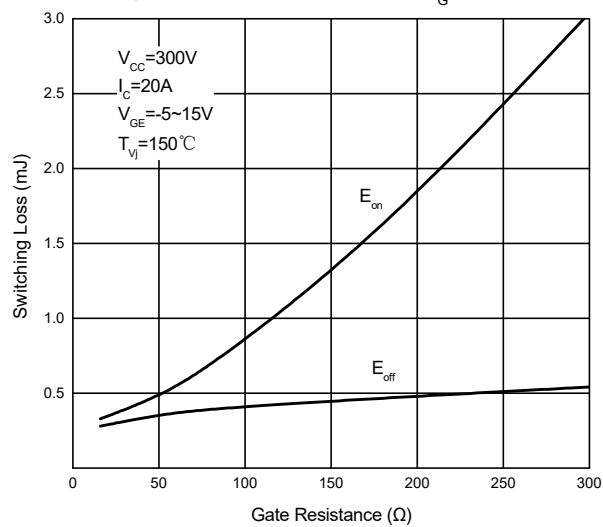


Fig. 6 - IGBT Switch Loss VS R_G



Curve Characteristics

Fig. 7 - Diode Switching Loss vs I_F

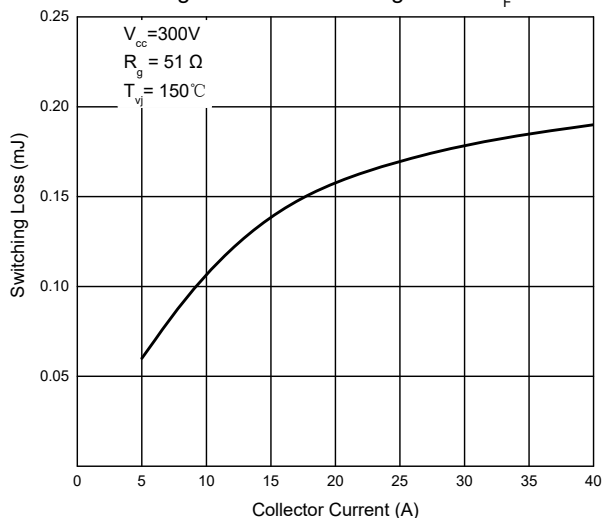


Fig. 8 - Diode Switching Loss vs R_G

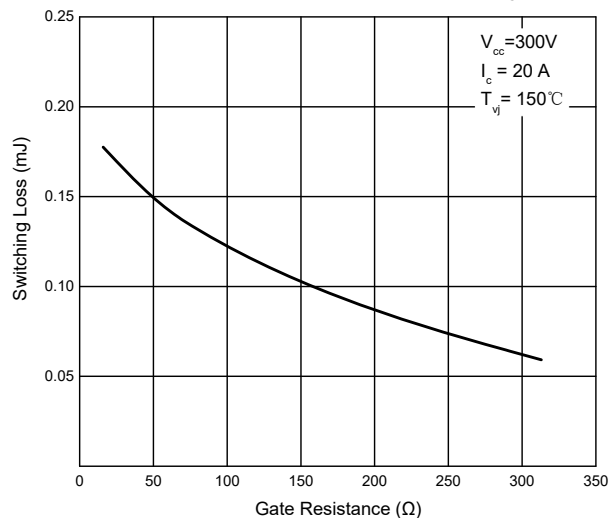


Fig. 9 - IGBT Transient Thermal Impedance

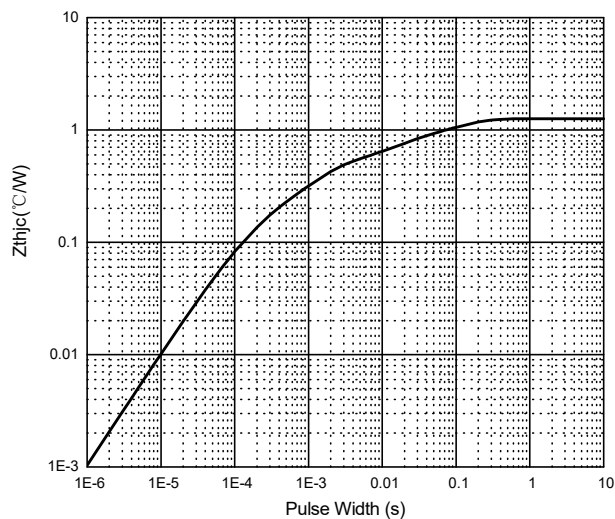


Fig. 10 - Diode Transient Thermal Impedance

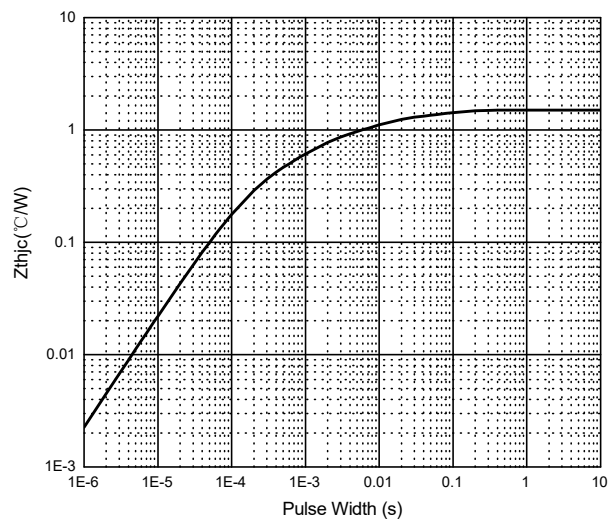


Fig. 11 - Collector Current vs Case Temperature

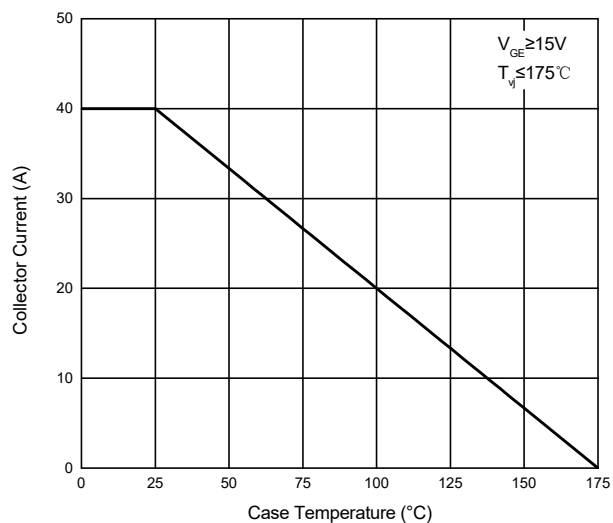
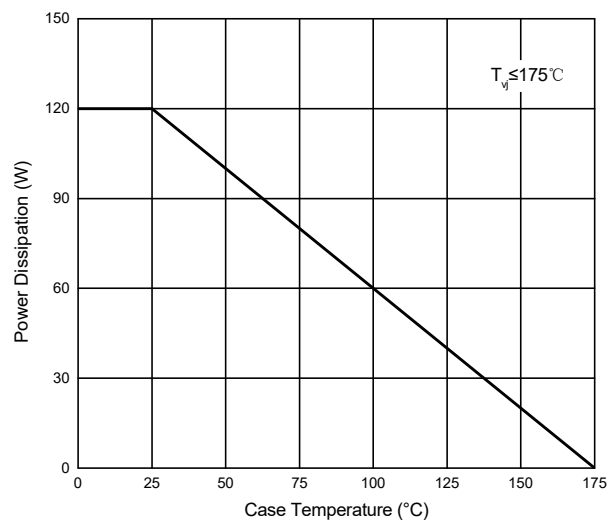


Fig. 12 - Power Derating



Ordering Information

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

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