

## Features

- High Speed Smooth Switching Device for Hard and Soft Switching
- Positive Temperature Coefficient
- High Ruggedness, Good Thermal Stability
- 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

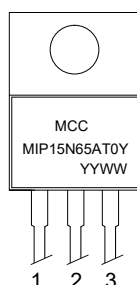
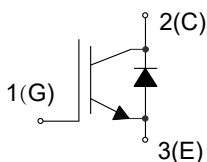
## Maximum Ratings

Parameter	Symbol	Rating	Unit
Collector-Emitter Voltage	$V_{CE}$	650	V
DC Collector Current <sup>(3)</sup>	$I_C$	$T_C=25^\circ\text{C}$	30
		$T_C=100^\circ\text{C}$	15
Pulsed Collector Current, $V_{GE}=15\text{V}^{(4)}$	$I_{C,pluse}$	45	A
Diode Forward Current <sup>(3)</sup>	$I_F$	$T_C=25^\circ\text{C}$	30
		$T_C=100^\circ\text{C}$	15
Diode Pulsed Current <sup>(4)</sup>	$I_{F,pluse}$	45	A
Continuous Gate-Emitter Voltage	$V_{GE}$	$\pm 20$	V
Transient Gate-Emitter Voltage <sup>(5)</sup>		$\pm 30$	
Turn off Safe Operation Area, $V_{CE} \leq 600\text{V}, T_j \leq 150^\circ\text{C}$		45	A
Short Circuit Withstand Time <sup>(6)</sup>	$T_{SC}$	5	$\mu\text{s}$
Power Dissipation, $T_C=25^\circ\text{C}, T_j=175^\circ\text{C}$	$P_D$	110	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.  $V_{GE}=15\text{V}, V_{CE} \leq 400\text{V}$

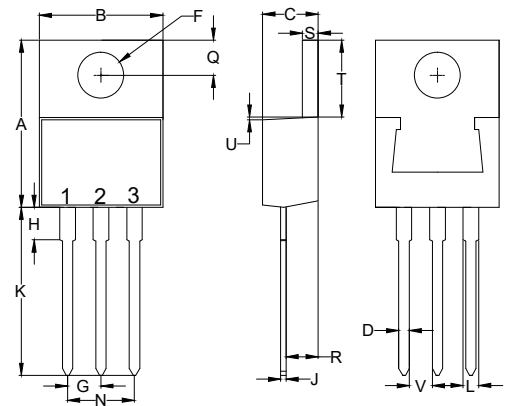
## Internal Structure



Device Code: MIP15N65AT0Y  
Date Code: YYWW (Year & Week)

# Trench and Field Stop IGBT 650V 15A

## TO-220AB



### DIMENSIONS

DIM	INCHES		MM		NOTE
	MIN	MAX	MIN	MAX	
A	0.560	0.625	14.22	15.88	
B	0.380	0.420	9.65	10.67	
C	0.140	0.190	3.56	4.82	
D	0.020	0.045	0.51	1.14	
F	0.139	0.161	3.53	4.09	$\Phi$
G	0.090	0.110	2.29	2.79	
H	-----	0.250	-----	6.35	
J	0.012	0.025	0.30	0.64	
K	0.500	0.580	12.70	14.73	
L	0.045	0.060	1.14	1.52	
N	0.190	0.210	4.83	5.33	
Q	0.100	0.135	2.54	3.43	
R	0.080	0.115	2.04	2.92	
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
<b>IGBT Static Characteristics</b>						
Collector-Emitter Breakdown Voltage	$V_{(BR)CES}$	$V_{GE}=0V, I_C=250\mu A$	650			V
Collector-Emitter Saturation Voltage	$V_{CE(sat)}$	$V_{GE}=15V, I_C=15A, T_j=25^\circ C$		1.4	1.70	V
		$V_{GE}=15V, I_C=15A, T_j=125^\circ C$		1.55		
		$V_{GE}=15V, I_C=15A, T_j=150^\circ C$		1.6		
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	$I_{GES}$	$V_{CE}=0V, V_{GE}=\pm 20V$			$\pm 200$	nA
<b>Dynamic Characteristics</b>						
Input Capacitance	$C_{ies}$	$V_{CE}=25V, V_{GE}=0V, f=1MHz$		0.88		nF
Output Capacitance	$C_{oes}$			0.04		
Reverse Transfer Capacitance	$C_{res}$			0.01		
Gate Charge	$Q_G$	$V_{CC}=300V, I_C=15A, V_{GE}=15V$		0.069		$\mu C$
<b>IGBT Switching Characteristics</b>						
Turn-On Delay Time	$t_{d(on)}$	$V_{CC}=300V, I_C=15A, V_{GE}=-5V\sim 15V, R_G=51\Omega, T_j=25^\circ C$		10		ns
Rise Time	$t_r$			28		
Turn-Off Delay Time	$t_{d(off)}$			68		
Fall Time	$t_f$			138		
Turn-On Energy	$E_{on}$			0.33		mJ
Turn-Off Energy	$E_{off}$			0.16		
Turn-On Delay Time	$t_{d(on)}$	$V_{CC}=300V, I_C=15A, V_{GE}=-5V\sim 15V, R_G=51\Omega, T_j=125^\circ C$		14		ns
Rise Time	$t_r$			36		
Turn-Off Delay Time	$t_{d(off)}$			69		
Fall Time	$t_f$			161		
Turn-On Energy	$E_{on}$			0.38		mJ
Turn-Off Energy	$E_{off}$			0.27		
Turn-On Delay Time	$t_{d(on)}$	$V_{CC}=300V, I_C=15A, V_{GE}=-5V\sim 15V, R_G=51\Omega, T_j=150^\circ C$		16		ns
Rise Time	$t_r$			43		
Turn-Off Delay Time	$t_{d(off)}$			69		
Fall Time	$t_f$			182		
Turn-On Energy	$E_{on}$			0.43		mJ
Turn-Off Energy	$E_{off}$			0.32		
Short Circuit Collector Current	$I_{C(SC)}$	$V_{GE}=15V, t_{SC}\leq 5\mu s, V_{CC}=400V, T_{j,start}=25^\circ C$		110		A

**Electrical Characteristics @ 25°C (Unless Otherwise Specified)**

Parameter	Symbol	Test Conditions	Min	Typ	Max	Unit
<b>Diode Characteristics</b>						
Diode Forward Voltage	$V_F$	$V_{GE}=0V, I_F=15A, T_j=25^\circ C$		1.9	2.4	V
		$V_{GE}=0V, I_F=15A, T_j=125^\circ C$		1.7		
		$V_{GE}=0V, I_F=15A, T_j=150^\circ C$		1.6		
Reverse Recovery Current	$I_{rr}$	$V_R=300V, I_F=15A,$ $di_F/dt=-380A/\mu s, T_j=25^\circ C$		6		A
Diode Reverse Recovery Time	$t_{rr}$			197		ns
Reverse Recovery Charge	$Q_{rr}$			0.24		$\mu C$
Reverse Recovery Energy	$E_{rec}$			0.06		mJ
Reverse Recovery Current	$I_{rr}$	$V_R=300V, I_F=15A,$ $di_F/dt=-380A/\mu s, T_j=125^\circ C$		7		A
Diode Reverse Recovery Time	$t_{rr}$			213		ns
Reverse Recovery Charge	$Q_{rr}$			0.58		$\mu C$
Reverse Recovery Energy	$E_{rec}$			0.11		mJ
Reverse Recovery Current	$I_{rr}$	$V_R=300V, I_F=15A,$ $di_F/dt=-380A/\mu s, T_j=150^\circ C$		8		A
Diode Reverse Recovery Time	$t_{rr}$			221		ns
Reverse Recovery Charge	$Q_{rr}$			0.71		$\mu C$
Reverse Recovery Energy	$E_{rec}$			0.14		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)	$R_{th_{J-C}}$			1.35	$^\circ C/W$
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 ( $T_j=25^\circ\text{C}$ )

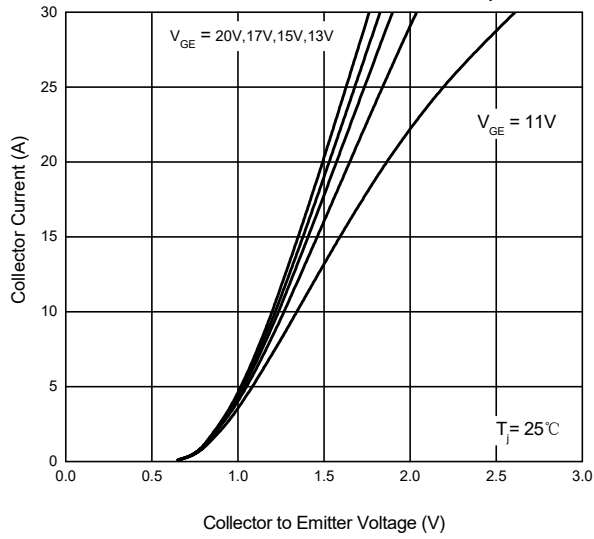


Fig. 2 - Typical Output Characteristic ( $T_j=150^\circ\text{C}$ )

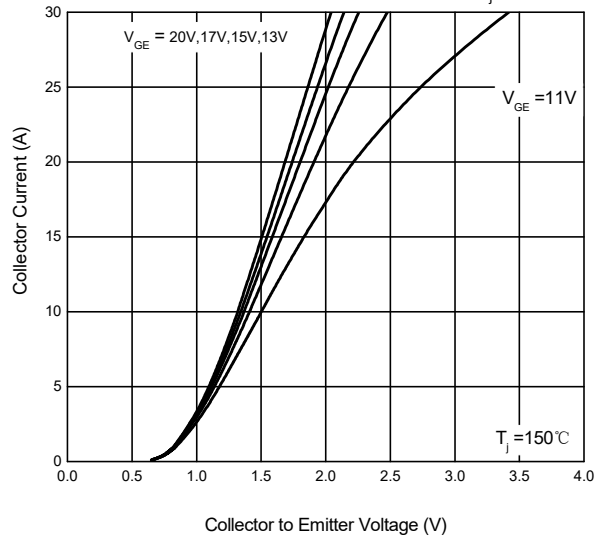


Fig. 3 - IGBT Typical Transfer Characteristic

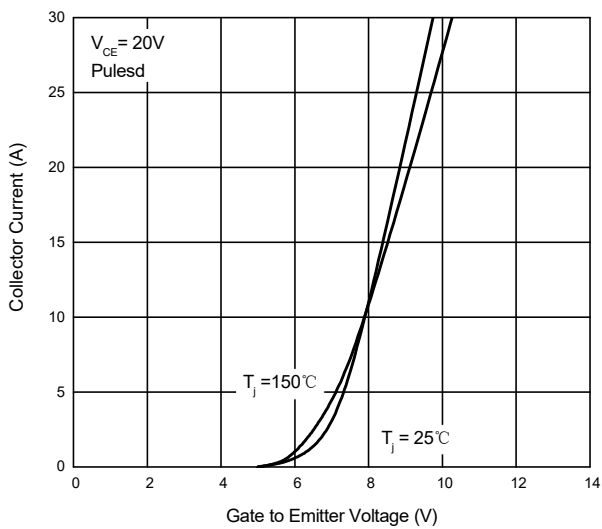


Fig. 4 - Diode Forward Current vs  $V_F$

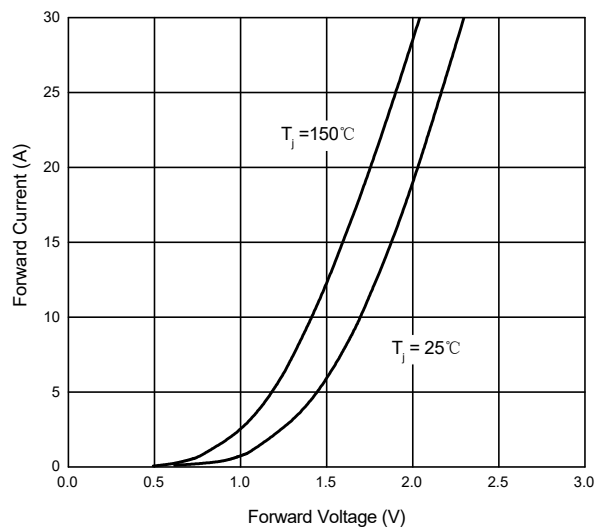


Fig. 5 - IGBT Switching Loss vs.  $I_C$

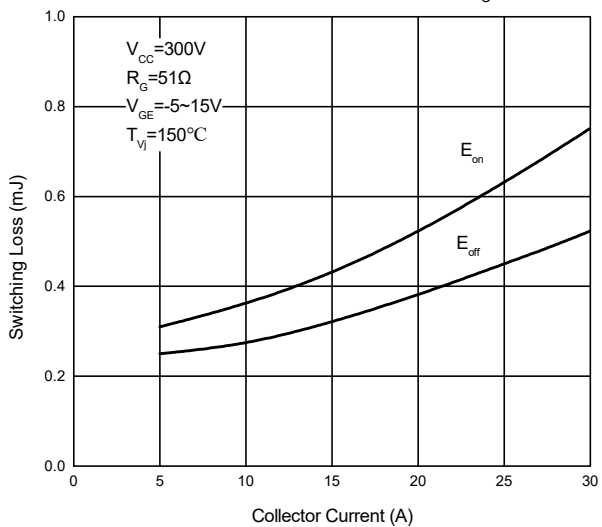
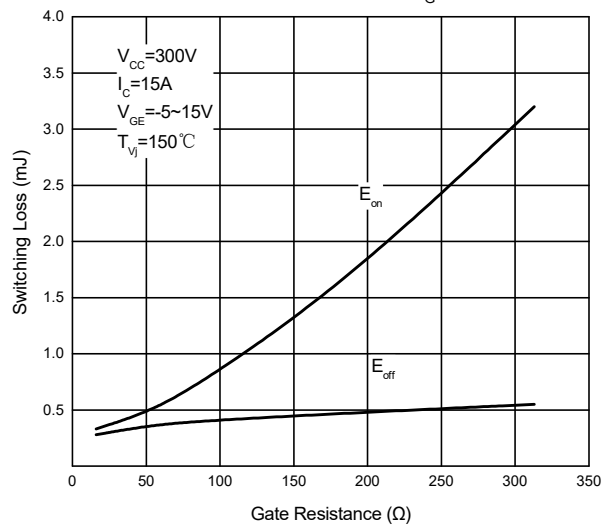


Fig. 6 - IGBT Switch Loss vs.  $R_G$



**Curve Characteristics**

Fig. 7 - Diode Switching Loss vs  $I_F$

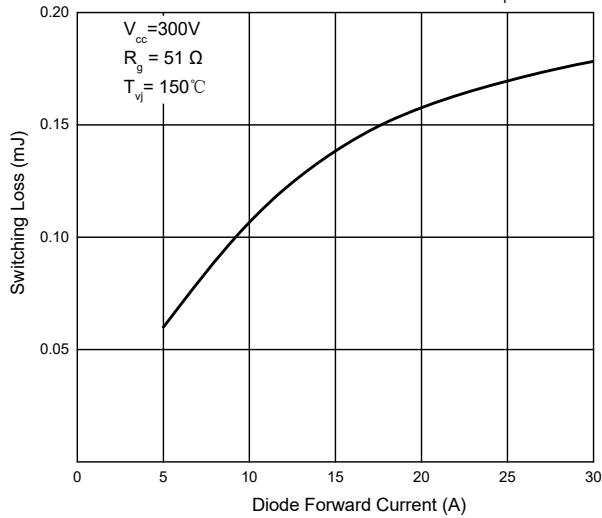


Fig. 8 - Diode Switching Loss vs  $R_G$

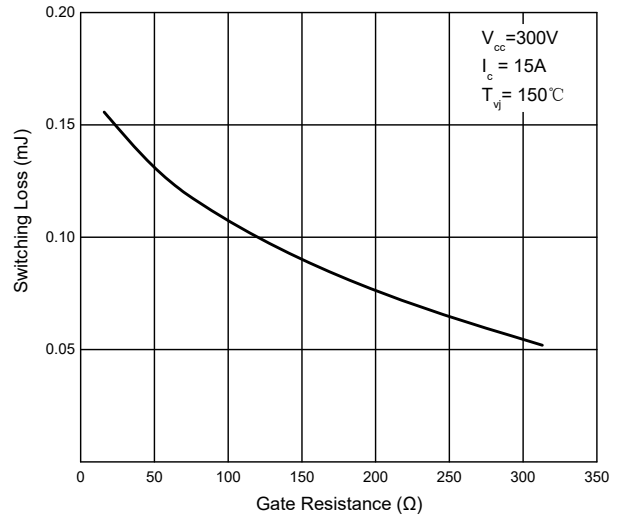


Fig. 9 - IGBT Transient Thermal Impedance

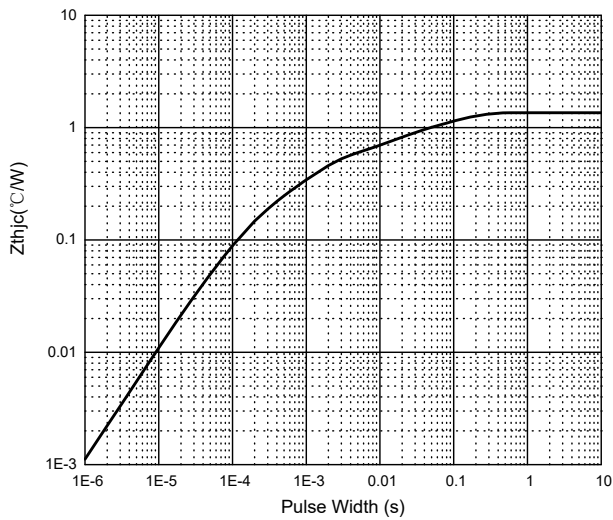


Fig. 10 - Diode Transient Thermal Impedance

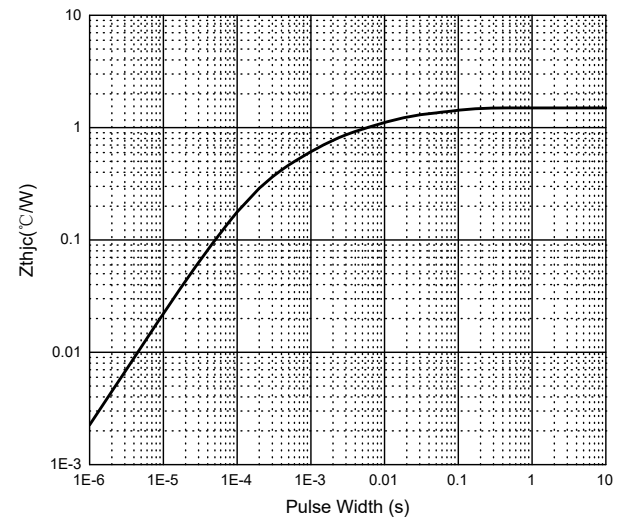


Fig. 11 - Collector Current vs Case Temperature

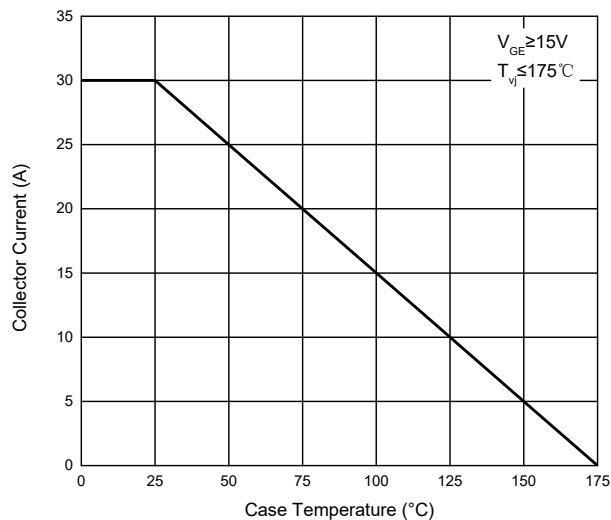
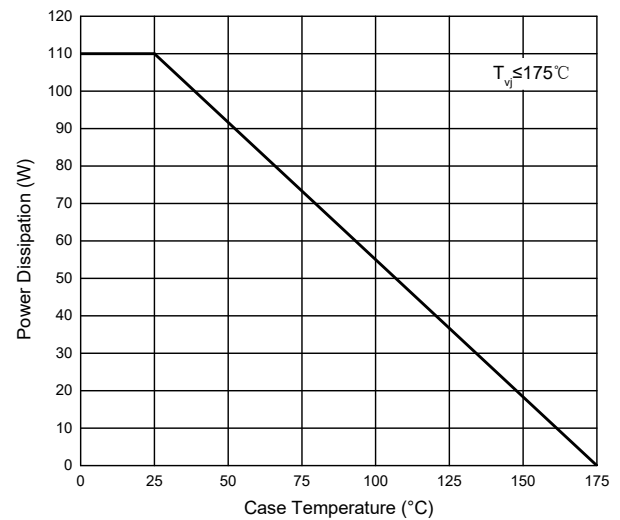


Fig. 12 - Power Derating



## Ordering Information

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

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