

## 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

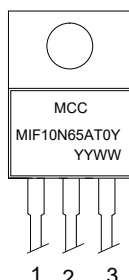
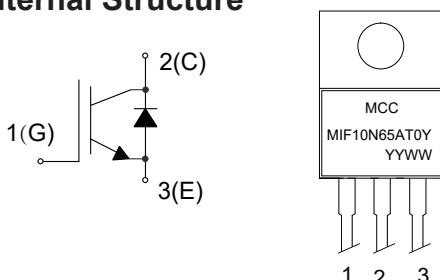
## Maximum Ratings

Parameter	Symbol	Rating	Unit
Collector-Emitter Voltage	$V_{CE}$	650	V
DC Collector Current <sup>(Note 3)</sup>	$I_C$	$T_C=25^\circ\text{C}$	15
		$T_C=100^\circ\text{C}$	8
Pulsed Collector Current, $V_{GE}=15\text{V}$ <sup>(Note 4)</sup>	$I_{C,pluse}$	40	A
Diode Forward Current <sup>(Note 3)</sup>	$I_F$	$T_C=25^\circ\text{C}$	15
		$T_C=100^\circ\text{C}$	8
Diode Pulsed Current <sup>(Note 4)</sup>	$I_{F,pluse}$	40	A
Gate-Emitter Voltage	$V_{GE}$	$\pm 20$	V
Transient Gate-Emitter Voltage <sup>(Note 5)</sup>		$\pm 30$	
Short Circuit Withstand Time <sup>(Note 6)</sup>	$t_{SC}$	5	$\mu\text{s}$
Power Dissipation, $T_C=25^\circ\text{C}$ , $T_J=175^\circ\text{C}$	$P_D$	31	W

Notes:

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.  $V_{GE}=15\text{V}$ ,  $V_{CE} \leq 400\text{V}$

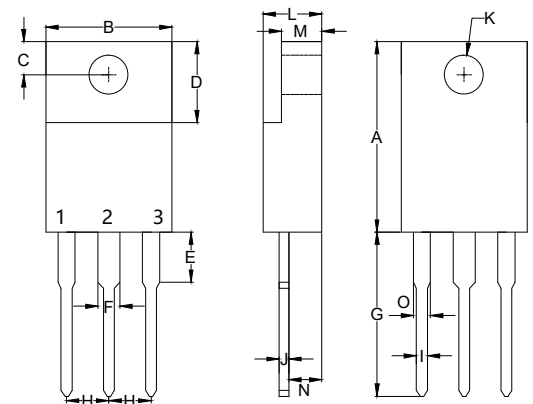
## Internal Structure



Device Code: MIF10N65AT0Y  
Date Code: YYWW: (Year & Week)

# Trench and Field Stop IGBT 650V 10A

## 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
<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	$V_{CE(sat)}$	$V_{GE}=15V, I_C=10A, T_J=25^\circ C$		1.40	1.70	V
		$V_{GE}=15V, I_C=10A, T_J=125^\circ C$		1.55		
		$V_{GE}=15V, I_C=10A, T_J=150^\circ C$		1.60		
G-E Threshold Voltage	$V_{GE(th)}$	$I_C=1mA, V_{CE}=V_{GE}$	4.4	5.2	6.0	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	$C_{ies}$	$V_{CE}=25V, V_{GE}=0V, f=1MHz$		0.89		nF
Reverse Transfer Capacitance	$C_{oes}$			0.04		
Reverse Transfer Capacitance	$C_{res}$			0.01		
Gate Charge	$Q_g$	$V_{CC}=300V, I_C=10A, V_{GE}=15V$		0.059		$\mu C$
<b>IGBT Switching Characteristics</b>						
Turn-On Delay Time	$t_{d(on)}$	$V_{CC}=300V, I_C=10A, V_{GE}=-5\sim 15V, R_G=51\Omega, T_J=25^\circ C$		10		ns
Rise Time	$t_r$			26		
Turn-Off Delay Time	$t_{d(off)}$			68		
Fall Time	$t_f$			135		
Turn-On Energy	$E_{on}$			0.36		mJ
Turn-Off Energy	$E_{off}$			0.17		
Turn-On Delay Time	$t_{d(on)}$	$V_{CC}=300V, I_C=10A, V_{GE}=-5\sim 15V, R_G=51\Omega, T_J=125^\circ C$		14		ns
Rise Time	$t_r$			35		
Turn-Off Delay Time	$t_{d(off)}$			68		
Fall Time	$t_f$			162		
Turn-On Energy	$E_{on}$			0.42		mJ
Turn-Off Energy	$E_{off}$			0.29		
Turn-On Delay Time	$t_{d(on)}$	$V_{CC}=300V, I_C=10A, V_{GE}=-5\sim 15V, R_G=51\Omega, T_J=150^\circ C$		16		ns
Rise Time	$t_r$			41		
Turn-Off Delay Time	$t_{d(off)}$			69		
Fall Time	$t_f$			181		
Turn-On Energy	$E_{on}$			0.46		mJ
Turn-Off Energy	$E_{off}$			0.33		
Short Circuit Collector Current	$I_{C(SC)}$	$V_{CC}=400V, V_{GE}=15V, T_{sc}\leq 5\mu s, T_{j,start}=25^\circ C$		110		A

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

Parameter	Symbol	Test Conditions	Min	Typ	Max	Unit
<b>Diode Characteristics</b>						
Diode Forward Voltage	$V_F$	$V_{GE}=0V, I_F=10A, T_J=25^\circ C$		1.70	2.20	V
		$V_{GE}=0V, I_F=10A, T_J=125^\circ C$		1.50		
		$V_{GE}=0V, I_F=10A, T_J=150^\circ C$		1.40		
Reverse Recovery Current	$I_{rr}$	$V_R=300V, I_F=10A,$ $di_F/dt=-365A/\mu s, T_J=25^\circ C$		6		A
Reverse Recovery time	$t_{rr}$			176		ns
Reverse Recovery Charge	$Q_{rr}$			0.12		$\mu C$
Reverse Recovery Energy	$E_{rec}$			0.05		mJ
Reverse Recovery Current	$I_{rr}$	$V_R=300V, I_F=10A,$ $di_F/dt=-365A/\mu s, T_J=125^\circ C$		7		A
Reverse Recovery time	$t_{rr}$			189		ns
Reverse Recovery Charge	$Q_{rr}$			0.48		$\mu C$
Reverse Recovery Energy	$E_{rec}$			0.09		mJ
Reverse Recovery Current	$I_{rr}$	$V_R=300V, I_F=10A,$ $di_F/dt=-365A/\mu s, T_J=150^\circ C$		8		A
Reverse Recovery time	$t_{rr}$			195		ns
Reverse Recovery Charge	$Q_{rr}$			0.62		$\mu C$
Reverse Recovery Energy	$E_{rec}$			0.11		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)	$R_{th_{J-C}}$			4.8	$^\circ C/W$
Thermal Resistance from Junction to Case (Diode)	$R_{th_{J-C}}$			6.0	$^\circ C/W$
Thermal Resistance from Junction to Ambient	$R_{th_{J-A}}$			60	$^\circ C/W$

## Curve Characteristics

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

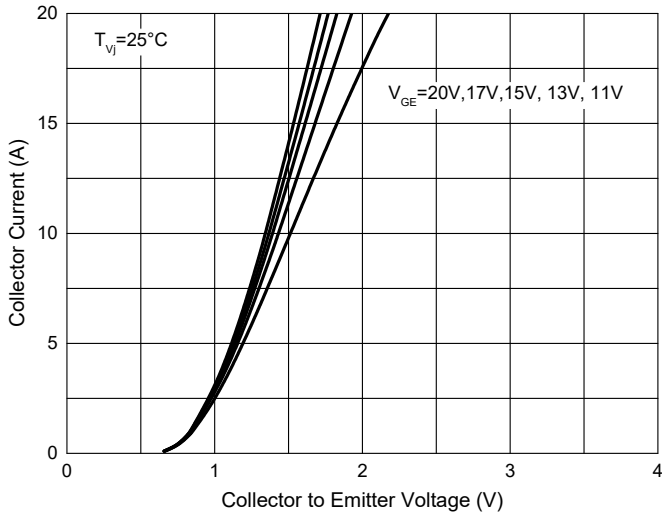


Fig. 2 - Typical Output Characteristic ( $T_J=150^\circ\text{C}$ )

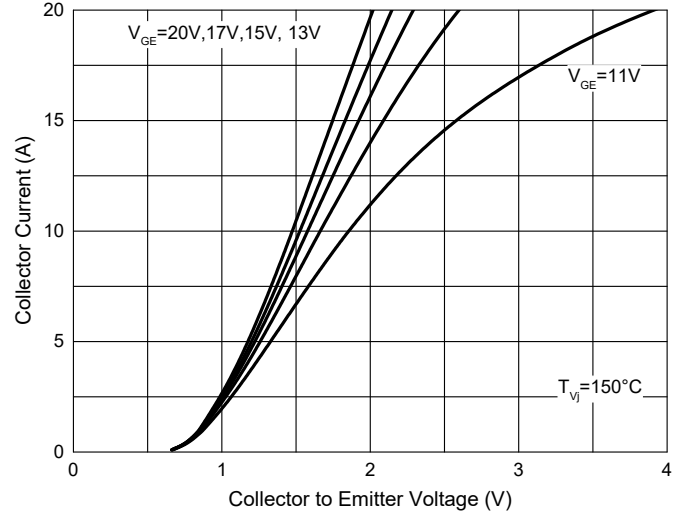


Fig. 3 - Typical Transfer Characteristic

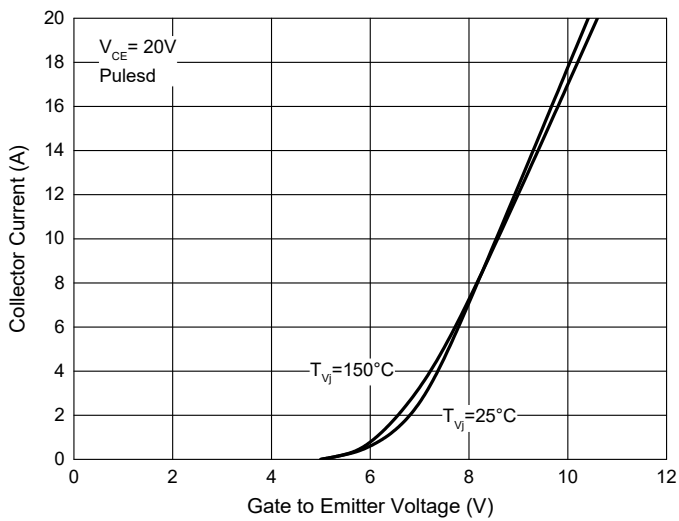


Fig. 4 - Diode Forward Current Characteristics

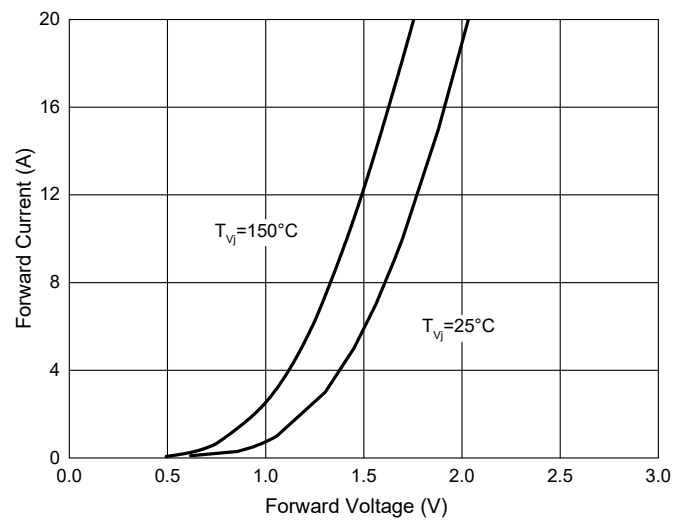


Fig. 5 - IGBT Switching Loss vs  $I_C$

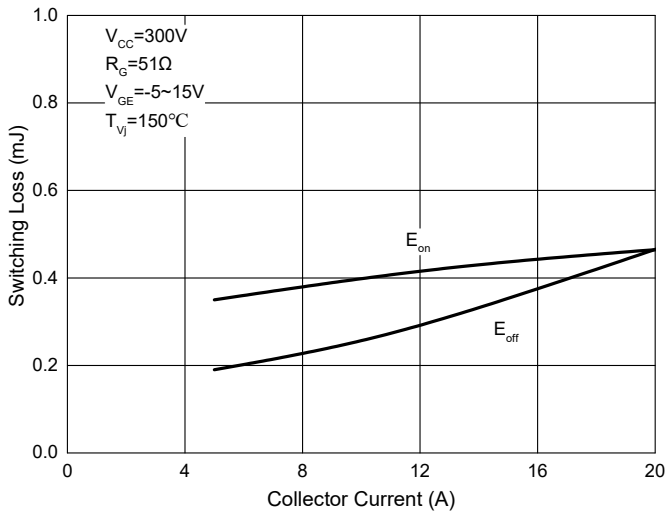
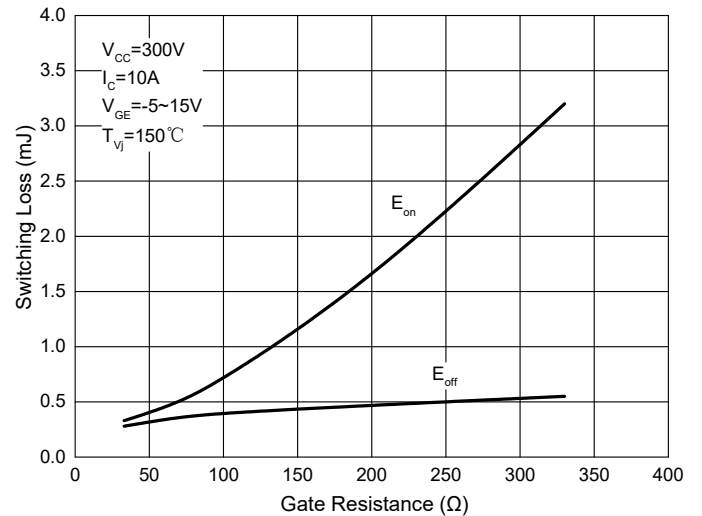


Fig. 6 - IGBT Switch Loss vs  $R_G$



## Curve Characteristics

Fig. 7 - Diode Switching Loss vs  $I_F$

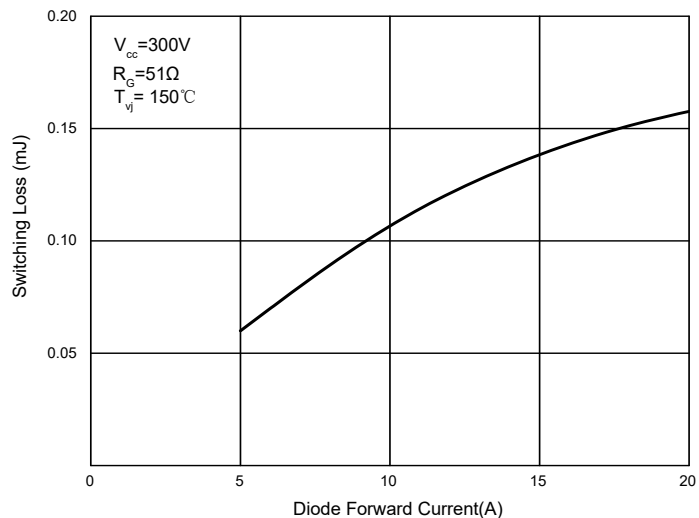


Fig. 8- Capacitance Characteristics

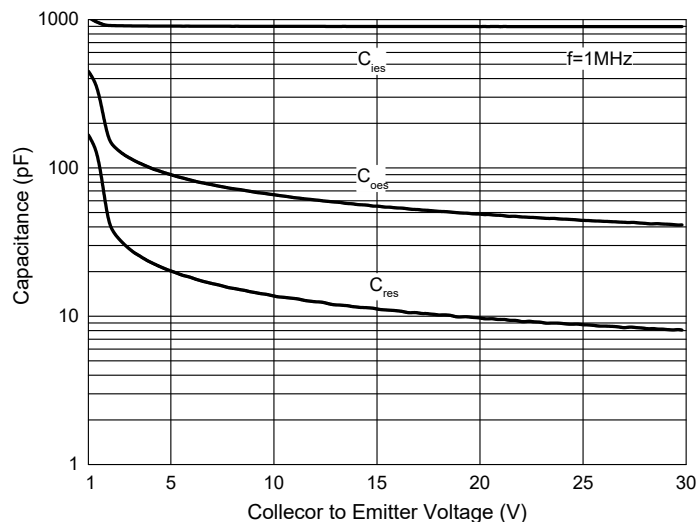


Fig. 9 - IGBT Transient Thermal Impedance

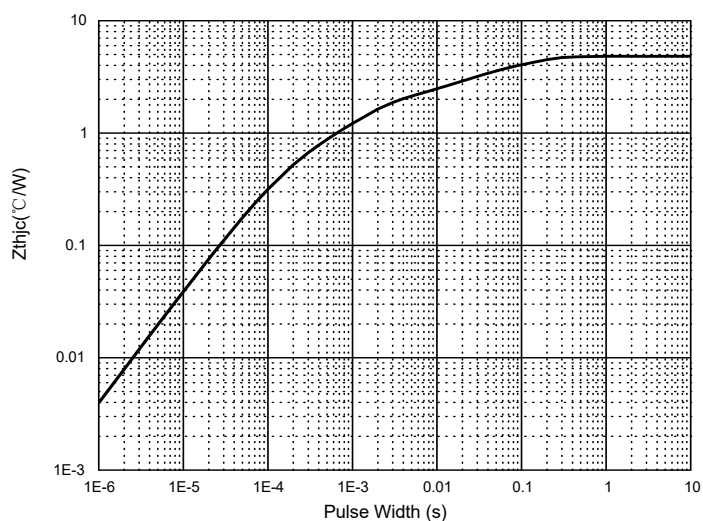
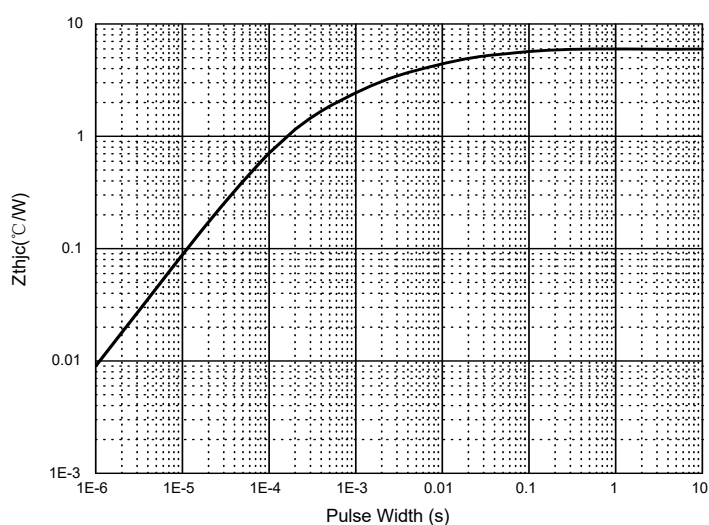


Fig. 10 - Diode Transient Thermal Impedance



## Ordering Information

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

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