

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

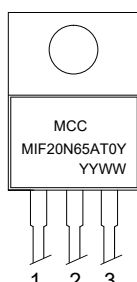
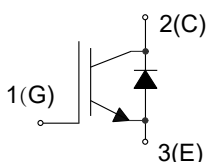
Maximum Ratings

| Parameter | Symbol | Rating | Unit |
|---|---------------|-------------------------|---------------|
| Collector-Emitter Voltage | V_{CE} | 650 | V |
| DC Collector Current ⁽³⁾ | I_C | $T_C=25^\circ\text{C}$ | 25 |
| | | $T_C=100^\circ\text{C}$ | 15 |
| Pulsed Collector Current ⁽⁴⁾ , $V_{GE}=15\text{V}$ | $I_{C,pluse}$ | 60 | A |
| Diode Forward Current ⁽³⁾ | I_F | $T_C=25^\circ\text{C}$ | 25 |
| | | $T_C=100^\circ\text{C}$ | 15 |
| 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, $T_j \leq 150^\circ\text{C}$ $V_{CE} \leq 600\text{V}$ | | 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 | 37 | 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. $V_{GE}=15\text{V}$, $V_{CE} \leq 400\text{V}$

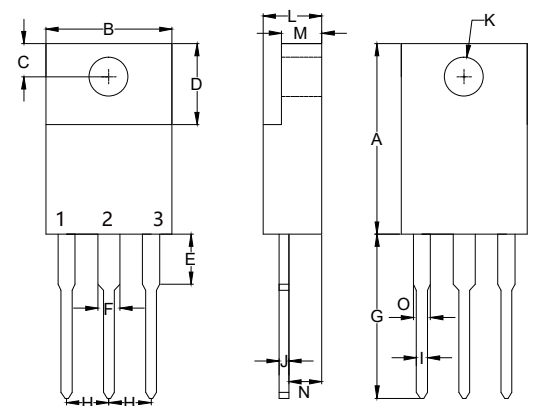
Internal Structure



Device Code: MIF20N65AT0Y
Date Code: YYWW (Year & Week)

Trench and Field Stop IGBT 650V 20A

ITO-220AB



| 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 | $V_{(BR)CES}$ | $V_{GE}=0V, I_C=250\mu A$ | 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 | | mJ |
| Turn-On Energy | E_{on} | | | 0.41 | | |
| 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 | | mJ |
| Turn-On Energy | E_{on} | | | 0.48 | | |
| 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 | | mJ |
| Turn-On Energy | E_{on} | | | 0.52 | | |
| 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) | $R_{th_{J-C}}$ | | | 4 | $^\circ C/W$ |
| Thermal Resistance from Junction to Case (Diode) | $R_{th_{J-C}}$ | | | 4.8 | $^\circ C/W$ |
| Thermal Resistance from Junction to Ambient | $R_{th_{J-A}}$ | | | 60 | $^\circ C/W$ |

Curve Characteristics

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

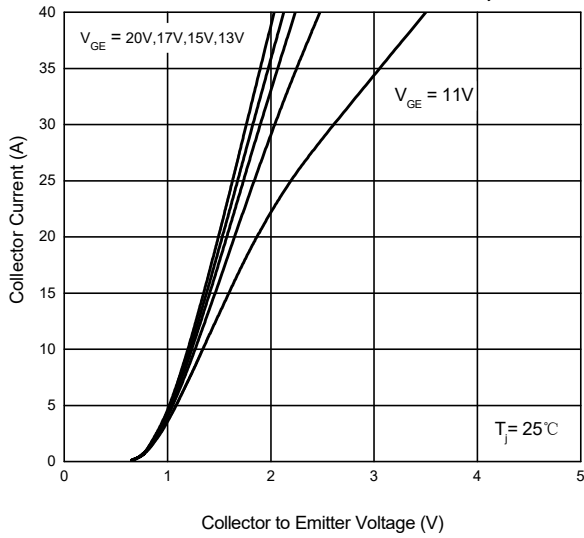


Fig. 2 - Typical Output Characteristic ($T_J=150^\circ\text{C}$)

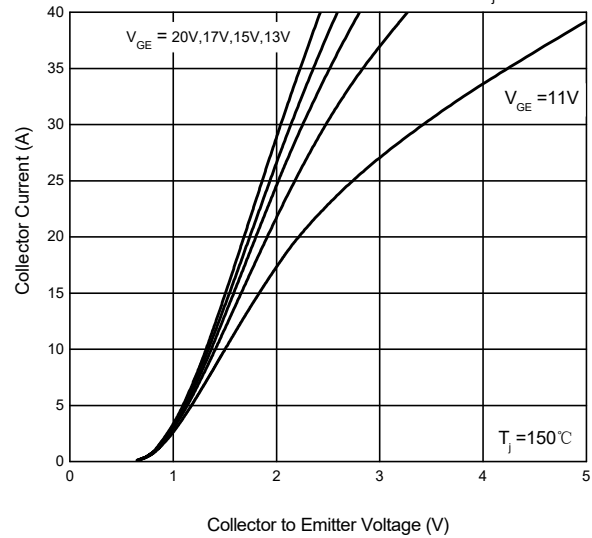


Fig. 3 - Typical Transfer Characteristic

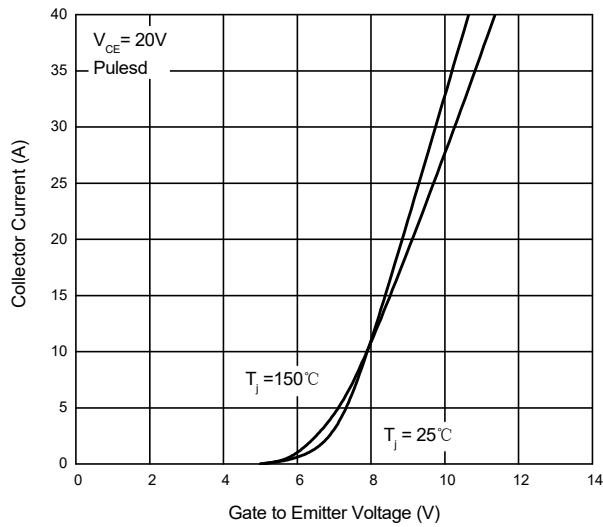


Fig. 4 - Diode Forward Current vs V_F

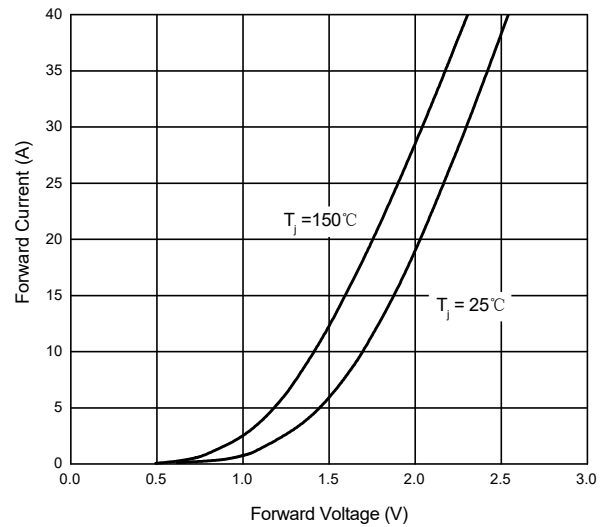


Fig. 5 - IGBT Switching Loss vs. I_C

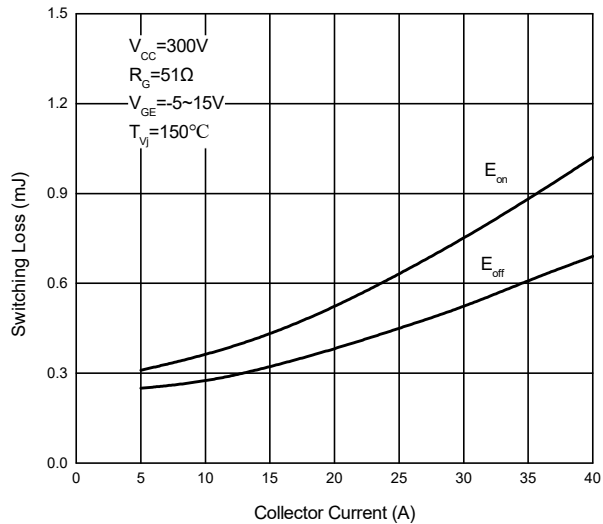
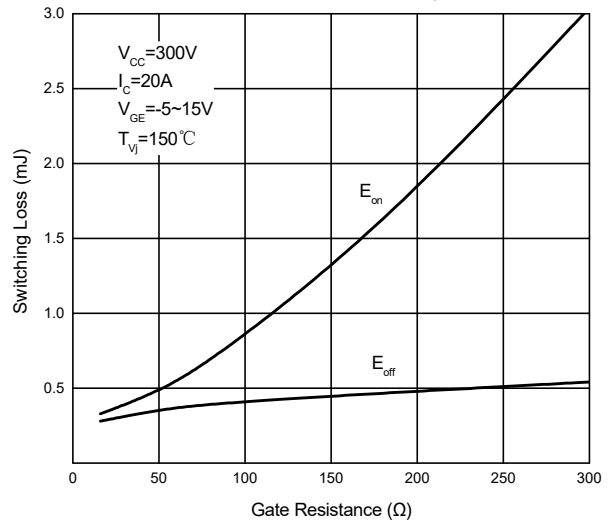


Fig. 6 - IGBT Switch Loss vs R_G



Curve Characteristics

Fig. 7 - Diode Switching Loss vs I_F

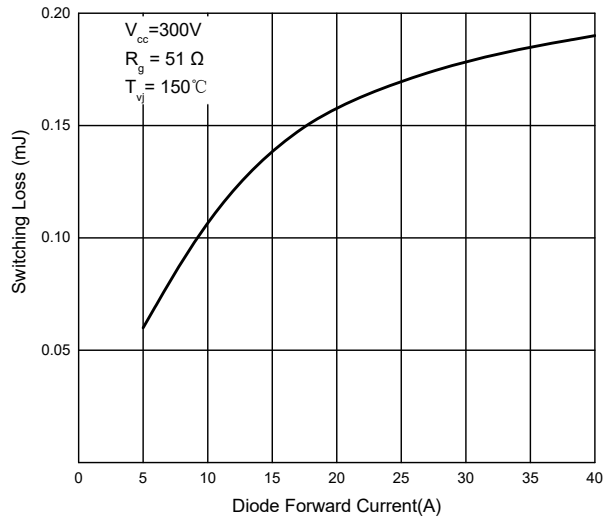


Fig. 8 - Diode Switching Loss vs R_G

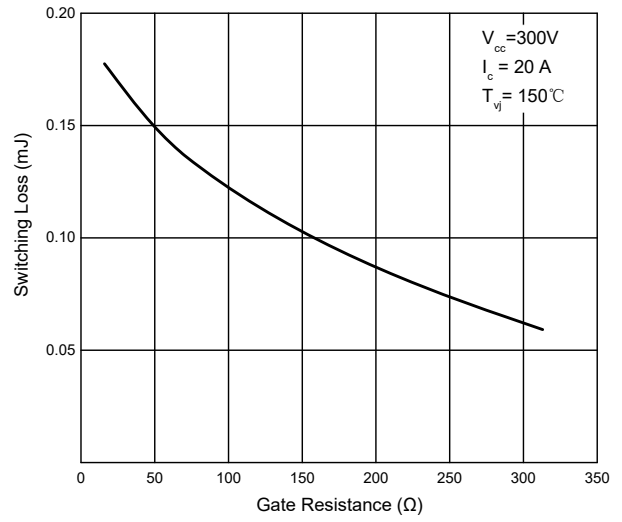


Fig. 9 - IGBT Transient Thermal Impedance

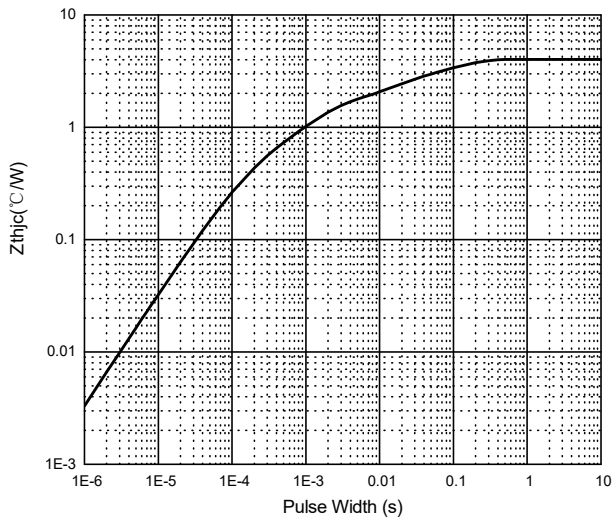


Fig. 10 - Diode Transient Thermal Impedance

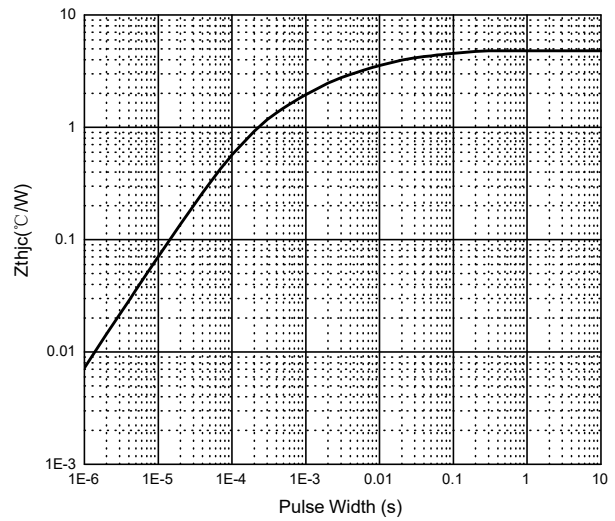
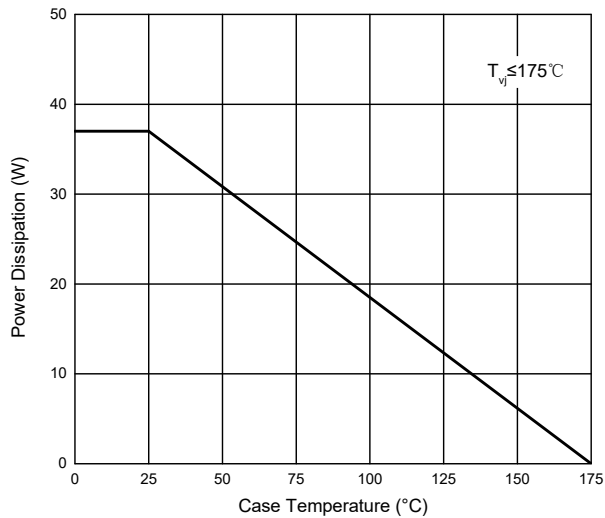


Fig. 11 - Power Derating



Ordering Information

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

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