

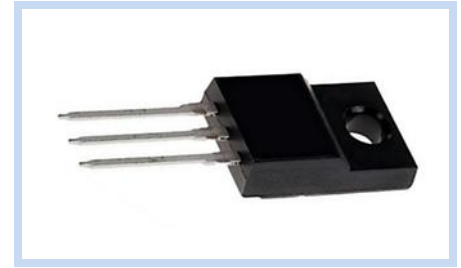
# Insulated Gate Bipolar Transistor 650V 14A 32W TO-220F

MIG65N14T220F

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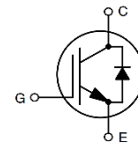
## FEATURE

- Trench Gate and Field Stop Processes IGBT
- Low Saturation Collector-to-Emitter Voltage and High Switching Speed
- Positive Saturation Collector-to-Emitter Voltage Temperature Coefficient
- Soft and Fast Recover Antiparallel Diode
- 10µs of Short - Circuit Withstand Time



## MECHANICAL DATA

- Case: TO-220F Package
- Terminals: Solderable per MIL-STD-202, Method 208



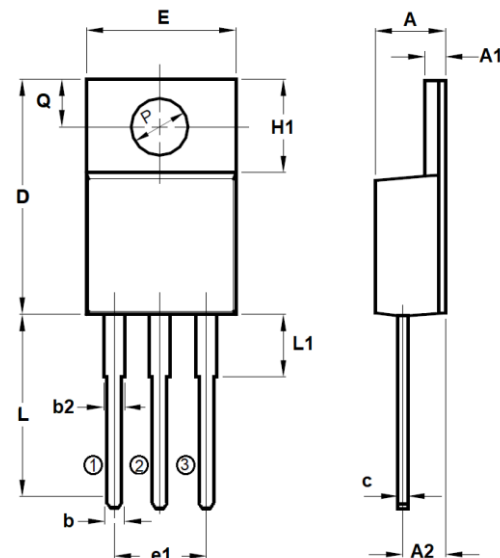
## MAXIMUM RATINGS

| Parameter                                    | Symbol          | Value                   | Unit               |
|--|-----------------|-------------------------|--------------------|
| Collector-to-Emitter Breakdown Voltage       | $V_{CES}$       | 650                     | V                  |
| Gate-to-Emitter Voltage                      | $V_{GE}$        | $\pm 30$                | V                  |
| Collector Current – Continuous               | $I_C$           | $T_C=25^\circ\text{C}$  | 14                 |
|  |                 | $T_C=100^\circ\text{C}$ | 7                  |
| Collector Current – Pulsed                   | $I_{CM}$        | 21                      | A                  |
| Power Dissipation                            | $P_D$           | $T_C=25^\circ\text{C}$  | 32                 |
|  |                 | $T_C=100^\circ\text{C}$ | 13                 |
| Thermal Resistance Junction to Ambient       | $R_{\theta JA}$ | 78                      | $^\circ\text{C/W}$ |
| Thermal Resistance Junction to Case For IGBT | $R_{\theta JC}$ | 3.9                     | $^\circ\text{C/W}$ |
| Operating Junction Temperature Range         | $T_J$           | -40 to 150              | $^\circ\text{C}$   |
| Storage Temperature Range                    | $T_{STG}$       | -55 to 150              | $^\circ\text{C}$   |

## DIMENSIONS

| Item | Min (mm) | Max (mm) |
|------|----------|----------|
| A    | 4.50     | 5.00     |
| A1   | 2.34     | 2.74     |
| A2   | 2.55     | 2.95     |
| b    | 0.70     | 0.95     |
| b2   | 1.00     | 1.50     |
| c    | 0.42     | 0.70     |
| D    | 15.67    | 16.07    |
| E    | 9.96     | 10.36    |
| e1   | 4.68     | 5.48     |
| H1   | 6.48     | 6.90     |
| L    | 12.08    | 13.48    |
| L1   | 2.35     | 3.65     |
| Q    | 3.10     | 3.50     |
| P    | 2.98     | 3.38     |

Note: 1: Gate(G), 2: Collector(C), 3: Emitter (E).



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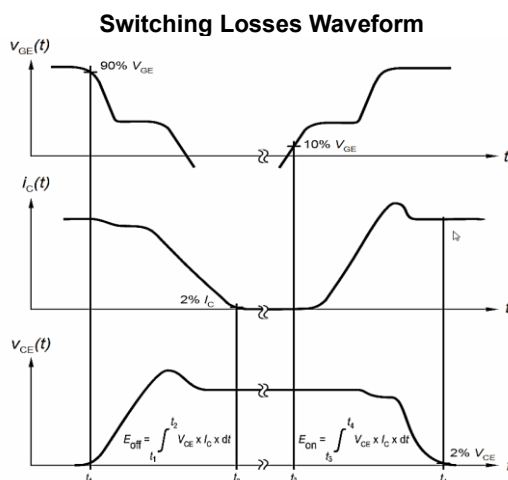
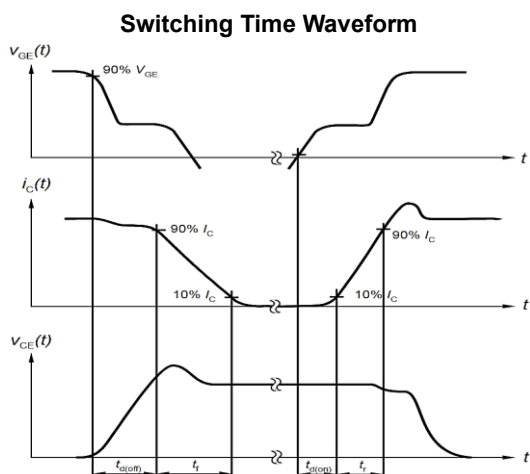
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## ELECTRICAL CHARACTERISTICS

| Static Characteristics               | Conditions  | Symbol        | Min | Typ. | Max  | Unit    |
|--------------------------------------|---|---------------|-----|------|------|---------|
| Collector-Emitter Breakdown Voltage  | $V_{GE}=0V, I_C=1mA$  | $BV_{CES}$    | 650 | --   | --   | V       |
| Zero Gate Voltage Collector Current  | $V_{CS}=1200V, V_{GE}=0V$   | $I_{CES}$     | --  | --   | 1    | $\mu A$ |
| Gate-Body Leakage Current, Forward   | $V_{GE}=30V, V_{CS}=0V$   | $I_{GESF}$    | --  | --   | 200  | nA      |
| Gate-Body Leakage Current, Reverse   | $V_{GE}=-30V, V_{CS}=0V$  | $I_{GESR}$    | --  | --   | -200 | nA      |
| Collector-Emitter Saturation Voltage | $V_{GE}=15V, I_C=7A$  | $V_{CE(SAT)}$ | --  | 1.5  | 2    | V       |
| Gate Threshold Voltage               | $V_{GE}=V_{DS}, I_C=1mA$  | $V_{GE(th)}$  | 4.5 | --   | 6.5  | V       |
| Diode Forward Voltage                | $I_F=7A$  | $V_F$         | --  | 1.5  | 2    | V       |
| Dynamic Characteristics              | Conditions  | Symbol        | Min | Typ. | Max  | Unit    |
| Total Gate Charge                    | $V_{CC}=480V, V_{GE}=15V, I_C=7A$   | $Q_g$         | --  | 14.9 | --   | nC      |
| Gate-Emitter Charge                  |   | $Q_{ge}$      | --  | 3.1  | --   |         |
| Gate-Collector Charge                |   | $Q_{gc}$      | --  | 7.4  | --   |         |
| Input Capacitance                    | $V_{CE}=25V, V_{GE}=0V, F=1MHz$   | $C_{ies}$     | --  | 410  | --   | pF      |
| Output Capacitance                   |   | $C_{oes}$     | --  | 19   | --   |         |
| Reverse Transfer Capacitance         |   | $C_{res}$     | --  | 3.8  | --   |         |
| Switching Characteristics            | Conditions  | Symbol        | Min | Typ. | Max  | Unit    |
| Turn-On Delay Time                   | $V_{CC}=400V, V_{GE}=15V, R_G=5\Omega$<br>$I_C=7A, T_C=25^\circ C,$<br>Inductive Load | $T_{d(on)}$   | --  | 23   | --   | ns      |
| Rise Time                            |   | $T_r$         | --  | 14   | --   |         |
| Turn-Off Delay Time                  |   | $T_{d(off)}$  | --  | 43   | --   |         |
| Fall Time                            |   | $T_f$         | --  | 80   | --   |         |
| Turn-On Switching Loss               |   | $E_{on}$      | --  | 17   | --   | $\mu J$ |
| Turn-Off Switching Loss              |   | $E_{off}$     | --  | 17   | --   |         |
| Reverse Recovery Time                | $I_F=7A, di_F/dt = 100A/\mu s$  | $t_{rr}$      | --  | 44   | --   | ns      |
| Reverse Recovery Charge              |   | $Q_{rr}$      | --  | 0.2  | --   | $\mu C$ |
| Peak Reverse Recovery Current        |   | $I_{rr}$      | --  | 7.17 | --   | A       |

Note:

1.  $T_C = 25^\circ C$  unless otherwise noted
2. Pulse width < 300 $\mu s$ , Duty cycle < 2%



# Insulated Gate Bipolar Transistor

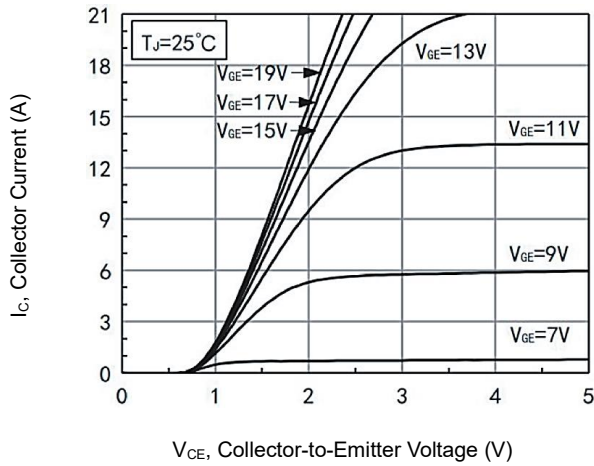
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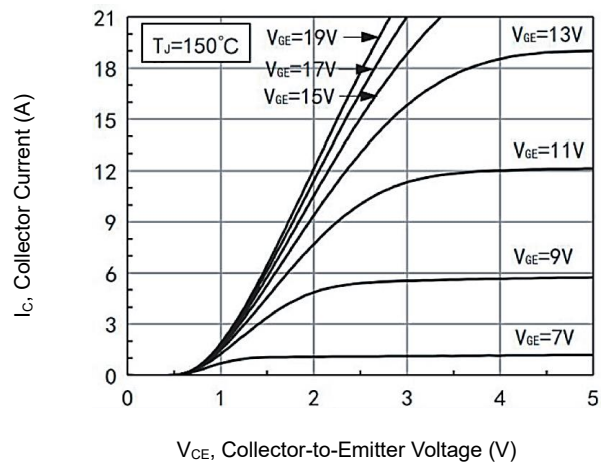
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### CHARACTERISTIC CURVES

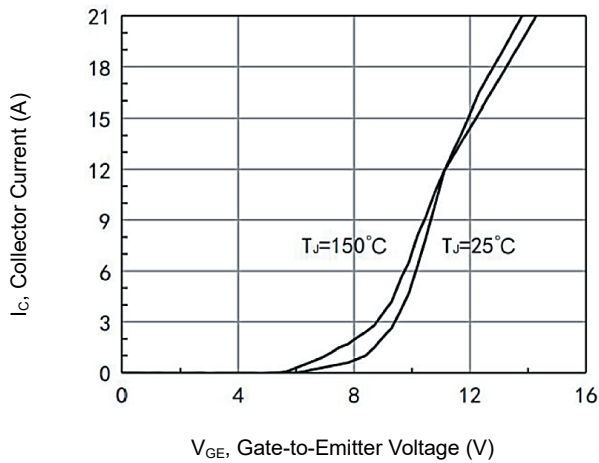
Output Characteristics



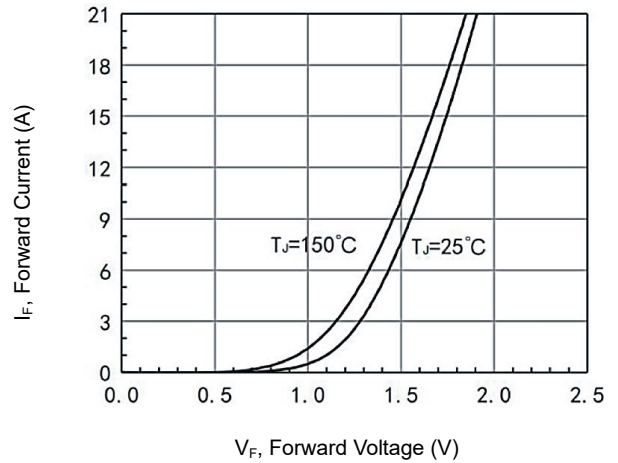
Output Characteristics



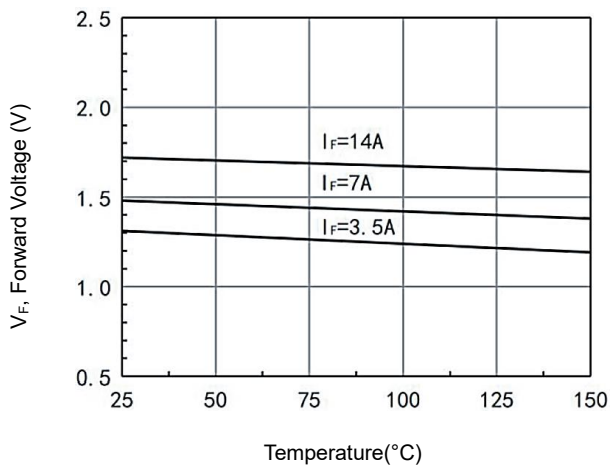
Transfer Characteristics



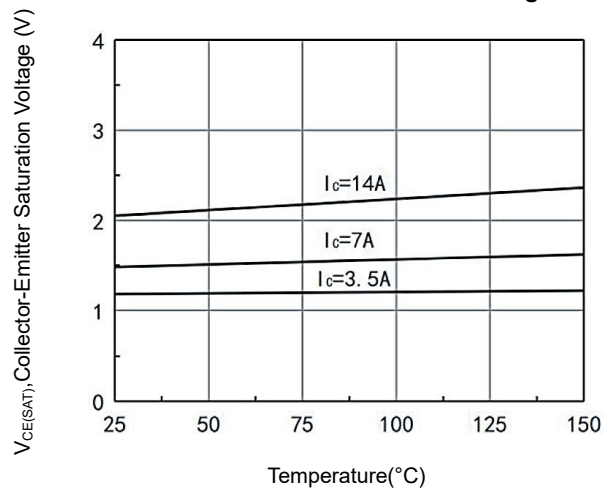
Diode Forward Characteristics



Forward Voltage Variation



Collector-Emitter Saturation Voltage



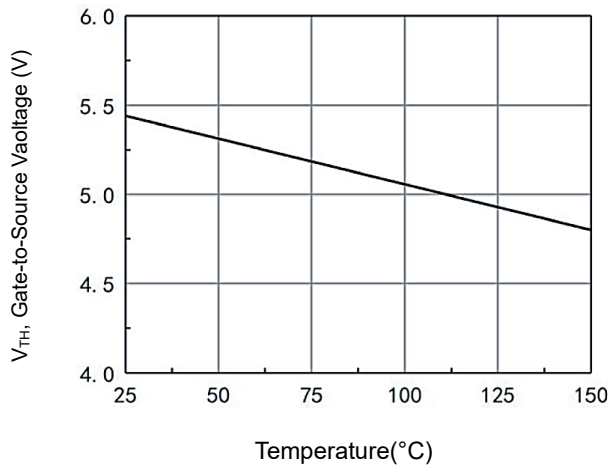
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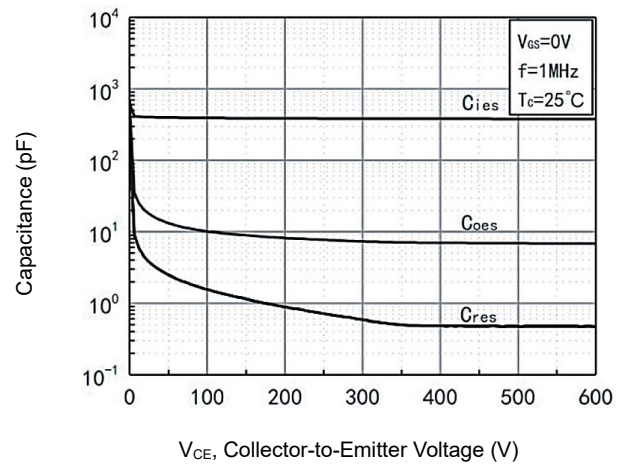
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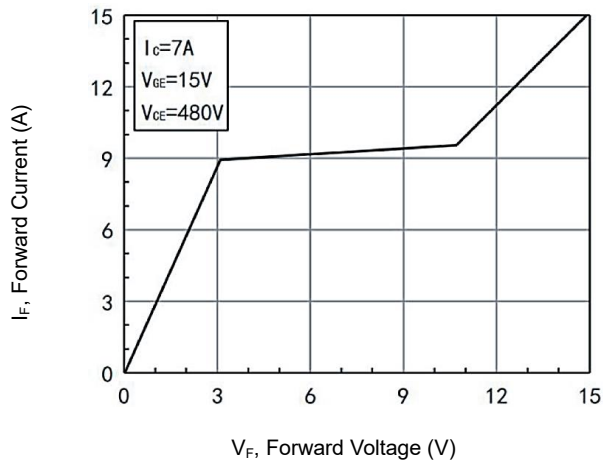
Gate Threshold Voltage Variation



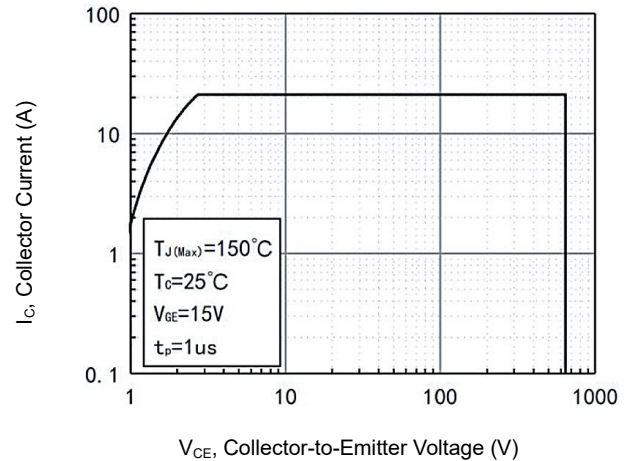
Capacitance Characteristics



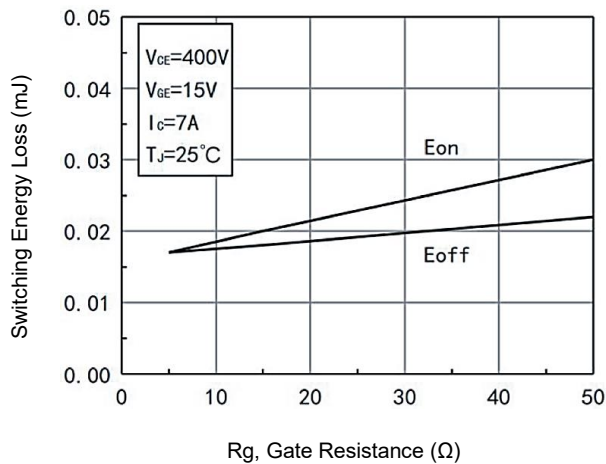
Gate-Charge Characteristics



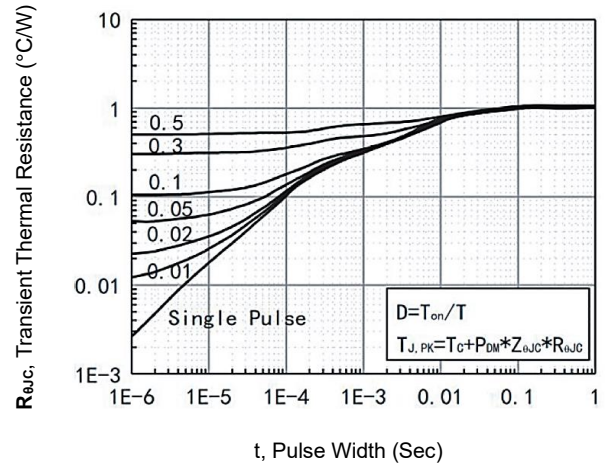
Forward Bias Safe Operating Area



Switching Energy Loss vs Gate Resistances



Transient Thermal Resistance



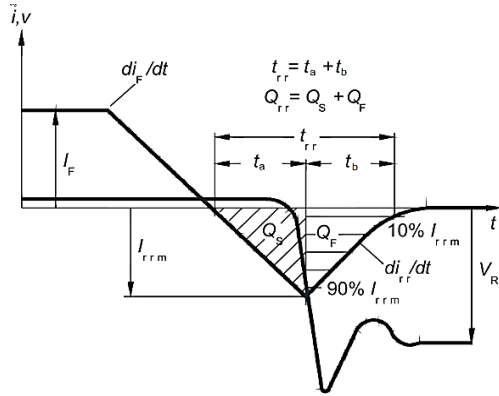
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## TEST CONDITION

Diode Switching Characteristics



Switching Test Circuit

