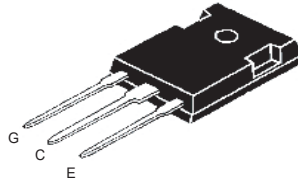


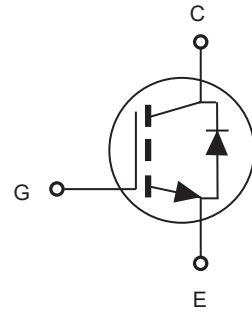
650V 20A Insulated Gate Bipolar Transistors

FEATURES

- $V_{CES} = 650V$, $I_C = 20A$ ($T_C = 100^\circ C$).
- Trench Gate and Field Stop Processes IGBT.
- Low $V_{CE(sat)}$ and High Switching Speed.
- Positive $V_{CE(sat)}$ Temperature Coefficient.
- 10us of Short - circuit Withstand Time.
- Soft and Fast Recover Antiparallel Diode.



TO-247



ABSOLUTE MAXIMUM RATINGS $T_C = 25^\circ C$ unless otherwise noted

| Parameter | Symbol | Limit | Units |
|--|-----------|------------|------------|
| Collector-to-Emitter Breakdown Voltage | V_{CES} | 650 | V |
| Gate-to-Emitter Voltage | V_{GE} | ± 30 | V |
| Continuous Collector Current @ $T_C = 25^\circ C$ @ $T_C = 100^\circ C$ | I_C | 40 | A |
| | | 20 | A |
| Pulsed Collector Current | I_{CM} | 60 | A |
| Maximum Power Dissipation @ $T_C = 25^\circ C$ @ $T_C = 100^\circ C$ | P_D | 139 | W |
| | | 56 | W |
| Operating Junction Temperature | T_J | -40 to 150 | $^\circ C$ |
| Storage Temperature Range | T_{STG} | -55 to 150 | $^\circ C$ |

Thermal Characteristics

| Parameter | Symbol | Limit | Units |
|---|-----------------|-------|--------------|
| Thermal Resistance, Junction-to-Case for IGBT | $R_{\theta JC}$ | 0.9 | $^\circ C/W$ |
| Thermal Resistance, Junction-to-Ambient | $R_{\theta JA}$ | 40 | $^\circ C/W$ |

Electrical Characteristics $T_C = 25^\circ\text{C}$ unless otherwise noted

| Parameter | Symbol | Test Condition | Min | Typ | Max | Units |
|--------------------------------------|---------------|--|-----|-------|------|---------|
| Collector-Emitter Breakdown Voltage | BV_{CES} | $V_{GE} = 0V, I_C = 1mA$ | 650 | | | V |
| Zero Gate Voltage Collector Current | I_{CES} | $V_{CE} = 650V, V_{GE} = 0V$ | | | 1 | μA |
| Gate Body Leakage Current, Forward | I_{GESF} | $V_{GE} = 30V, V_{CE} = 0V$ | | | 200 | nA |
| Gate Body Leakage Current, Reverse | I_{GESR} | $V_{GE} = -30V, V_{CE} = 0V$ | | | -200 | nA |
| Gate Threshold Voltage | $V_{GE(th)}$ | $V_{GE} = V_{CE}, I_C = 1mA$ | 4.5 | | 6.5 | V |
| Collector-Emitter saturation Voltage | $V_{CE(sat)}$ | $V_{GE} = 15V, I_C = 20A$ | | 1.5 | 2 | V |
| Input Capacitance | C_{ies} | $V_{CE} = 25V, V_{GE} = 0V,$ $f = 1MHz$ | | 2381 | | pF |
| Output Capacitance | C_{oes} | | | 69 | | pF |
| Reverse Transfer Capacitance | C_{res} | | | 20 | | pF |
| Turn-On Delay Time | $t_{d(on)}$ | | | 28 | | ns |
| Turn-On Rise Time | t_r | $V_{CC} = 400V, I_C = 20A,$ $V_{GE} = 15V, R_{GEN} = 5\Omega$ Inductive Load $T_a = 25^\circ\text{C}$ | | 33 | | ns |
| Turn-Off Delay Time | $t_{d(off)}$ | | | 85 | | ns |
| Turn-Off Fall Time | t_f | | | 26 | | ns |
| Turn-On Switching Loss | E_{on} | | | 0.061 | | mJ |
| Turn-Off Switching Loss | E_{off} | | | 0.045 | | mJ |
| Total Gate Charge | Q_g | | | | 62 | |
| Gate-Emitter Charge | Q_{ge} | $V_{CC} = 480V, I_C = 20A,$ $V_{GE} = 15V$ | | 17 | | nC |
| Gate-Collector Charge | Q_{gc} | | | 22 | | nC |

Electrical Characteristics of Diode $T_C = 25^\circ\text{C}$ unless otherwise noted

| Parameter | Symbol | Test Condition | Min | Typ | Max | Units |
|-------------------------------------|----------|---|-----|-----|-----|---------|
| Diode Forward Voltage | V_F | $I_F = 20A$ | | 1.6 | 2.1 | V |
| Diode Reverse Recovery Time | t_{rr} | $I_F = 20A$ $di_F / dt = 100A / \mu s$ | | 50 | | ns |
| Diode peak Reverse Recovery Current | I_{rr} | | | 9.7 | | A |
| Diode Reverse Recovery Charge | Q_{rr} | | | 0.3 | | μC |

Notes :Pulse width $\leq 300\mu s$, Duty Cycle $\leq 2\%$.

TYPICAL PERFORMANCE CHARACTERISTICS

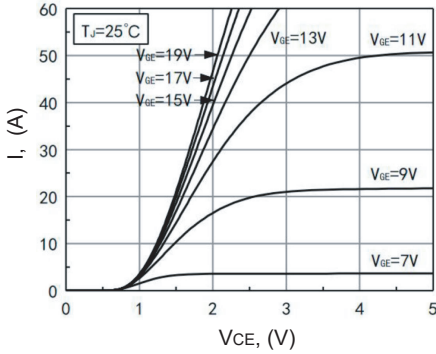


Figure 1. Output Characteristics

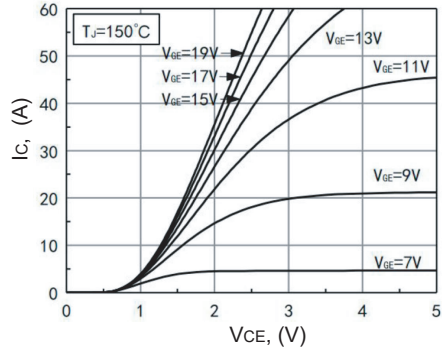


Figure 2. Output Characteristics

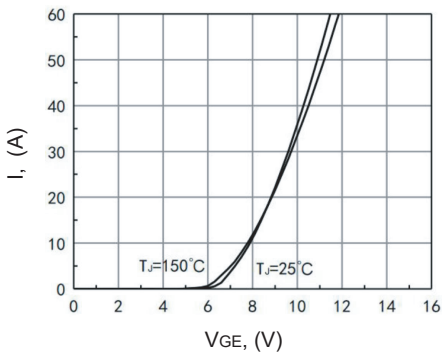


Figure 3. Typical Transfer Characteristics

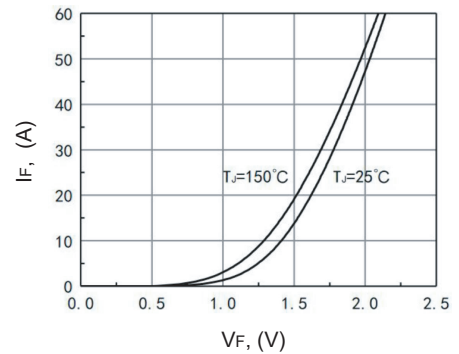


Figure 4. Saturation Voltage vs Tc Characteristics

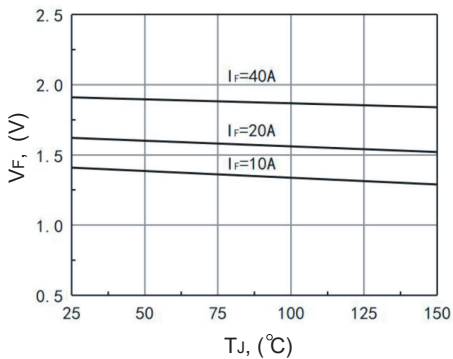


Figure 5. Forward Voltage vs Junction Temperature

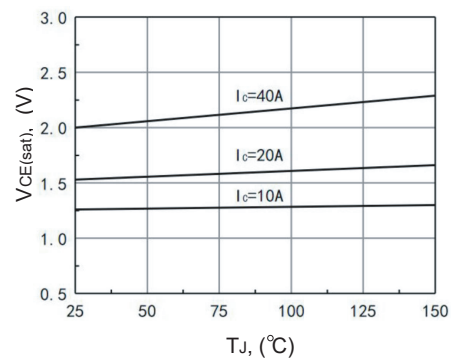


Figure 6. Typical $V_{CE(sat)}$ vs T_J Characteristics

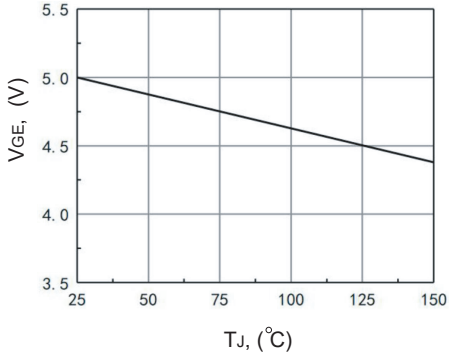


Figure 7. $V_{GE(th)}$ vs T_J Characteristics

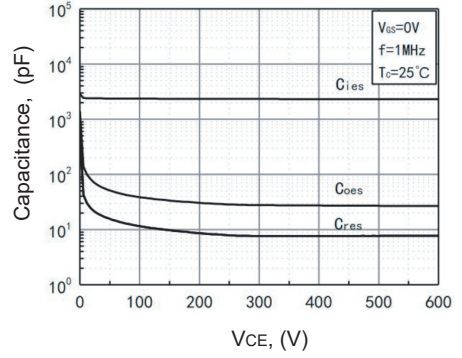


Figure 8. Capacitance Characteristics

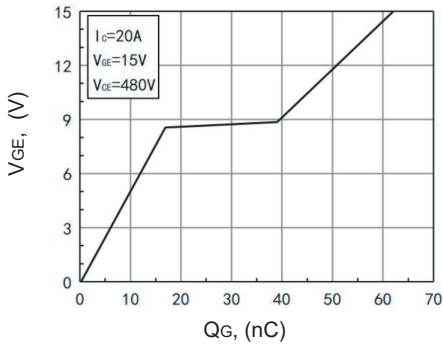


Figure 9. Gate Charge Wave Form

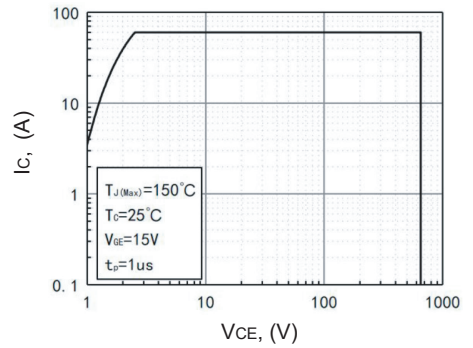


Figure 10. Forward Bias Safe Operating Area

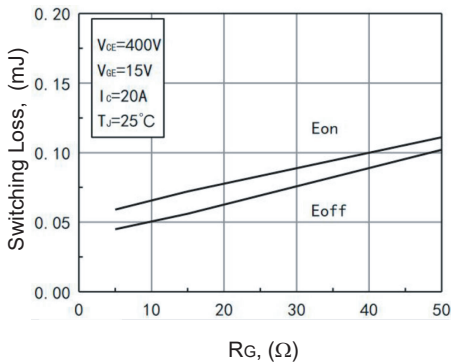


Figure 11. Switching Loss vs Gate Resistances

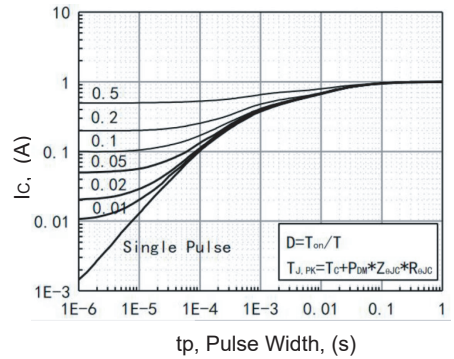
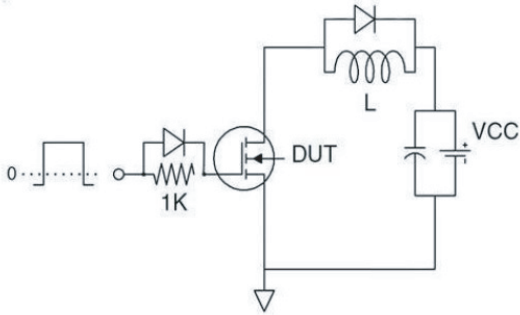
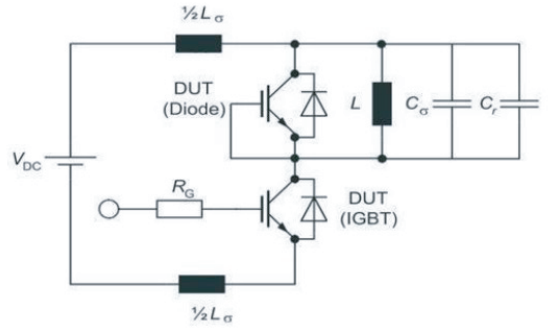


Figure 12. Transient Thermal Resistances

TEST CIRCUIT

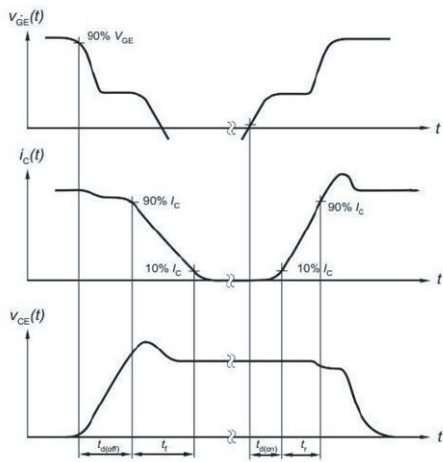


Gate Charge Test Circuit

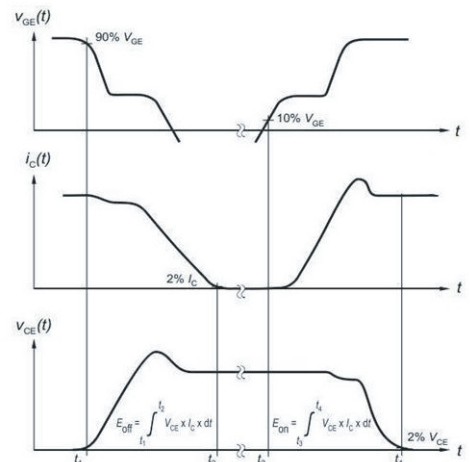


Switch Time Test Circuit

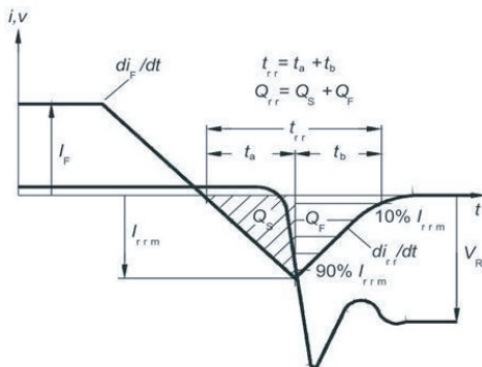
SWITCHING CHARACTERISTICS



Definition of switching times



Definition of switching losses



Definition of diode switching characteristics