

600V, 40A, Trench FS II Fast IGBT

General Description:

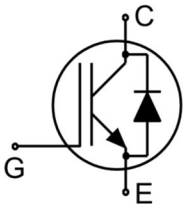
Using MJ's proprietary trench design and advanced FS (Field Stop) second generation technology, the 600V Trench FSII IGBT offers superior conduction and switching performances, and easy parallel operation;

Features

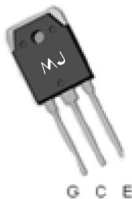
- ◆ Trench FSII Technology offering
- ◆ Very low $V_{CE(sat)}$
- ◆ High speed switching
- ◆ Positive temperature coefficient in $V_{CE(sat)}$
- ◆ Very tight parameter distribution
- ◆ High ruggedness, temperature stable behavior

Application

- ◆ Air Condition
- ◆ Inverters
- ◆ Motor drives



Schematic diagram



TO-3P

Package Marking and Ordering Information

| Device | Device Package | Device Marking |
|------------|----------------|----------------|
| MJ40TH60BP | TO-3P | MJ40TH60BP |

Absolute Maximum Ratings (Tc=25°C unless otherwise noted)

| Parameter | Symbol | Value | Units |
|--|----------------|-------------|-------|
| Collector-Emitter Voltage | V_{CES} | 600 | V |
| Gate- Emitter Voltage | V_{GES} | ±30 | V |
| Collector Current | I_C | 80 | A |
| Collector Current @Tc = 100 °C | I_C | 40 | A |
| Pulsed Collector Current, tp limited by Tjmax | I_{Cplus} | 120 | A |
| turn off safe operating area, VCE=600V, Tj=150°C | - | 120 | A |
| Diode Continuous Forward Current @Tc = 100 °C | I_F | 30 | A |
| Diode Maximum Forward Current | I_{FM} | 90 | A |
| Power Dissipation @ Tc = 25°C | P_D | 286 | W |
| Power Dissipation @Tc = 100 °C | P_D | 143 | W |
| Operating Junction and Storage Temperature Range | T_J, T_{stg} | -55 to +175 | °C |
| Maximum Temperature for Soldering | T_L | 260 | °C |
| Short circuit withstand time VGE=15.0V, VCC≤400V, Allowed number of short circuits<1000Time between short circuits:≥1.0s, Tj≤150°C | t_{sc} | 5 | us |

Thermal Characteristic

| Parameter | Symbol | Value | Units |
|--|-----------------|-------|----------------------|
| Thermal Resistance, Junction to case for IGBT | $R_{\theta JC}$ | 0.52 | $^{\circ}\text{C/W}$ |
| Thermal Resistance, Junction to case for Diode | $R_{\theta JC}$ | 2.12 | $^{\circ}\text{C/W}$ |
| Thermal Resistance, Junction to Ambient | $R_{\theta JA}$ | 40 | $^{\circ}\text{C/W}$ |

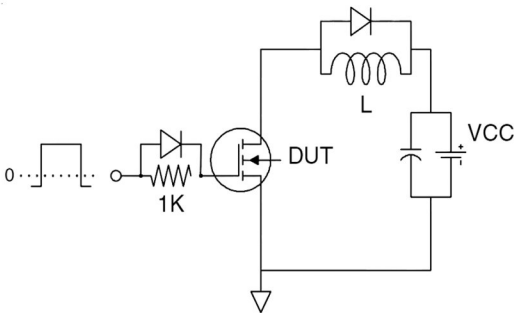
Electrical Characteristics (T_c=25°C unless otherwise noted)

| Parameter | Symbol | Test Conditions | | Value | | | Units |
|---|----------------------|---|-----------------------|-------|------|-----|-------|
| | | | | Min | Typ | Max | |
| Static Characteristics | | | | | | | |
| Collector-Emitter Breakdown Voltage | V _{(BR)CES} | V _{GE} =0V,I _{CE} =1mA | | 600 | - | - | V |
| Collector-Emitter Leakage Current | I _{CES} | V _{GE} =0V,V _{CE} =600V | | - | - | 4 | μA |
| Gate to Emitter Forward Leakage | I _{GES(F)} | V _{GE} =+30V,V _{CE} =0V | | - | - | 200 | nA |
| Gate to Source Reverse Leakage | I _{GES(R)} | V _{GE} =-30V,V _{CE} =0V | | - | - | 200 | nA |
| Collector-Emitter Saturation Voltage | V _{CE(sat)} | I _C =40A V _{GE} =15V | T _J =25°C | - | 1.7 | 1.9 | V |
| | | | T _J =150°C | - | 1.9 | - | V |
| Gate Threshold Voltage | V _{GE(th)} | I _C =1mA, V _{CE} =V _{GE} | | 4.0 | 5.0 | 6.0 | V |
| Dynamic Characteristics | | | | | | | |
| Input Capacitance | C _{ies} | V _{CE} =25V,V _{GE} =0V, f=1MHz | | - | 4894 | - | pF |
| Output Capacitance | C _{Oss} | | | - | 136 | - | pF |
| Reverse Transfer Capacitance | C _{rss} | | | - | 94 | - | pF |
| Total Gate Charge | Q _g | V _{CC} =480V, I _C =40A V _{GE} =15V | | - | 176 | - | nC |
| Gate to Emitter Charge | Q _{ge} | | | - | 38 | - | nC |
| Gate to Collector Charge | Q _{gc} | | | - | 73 | - | nC |
| Short circuit collector current Max.1000 short circuits Time between short circuits: ≥1.0s | I _{C(SC)} | V _{GE} =15V,V _{CC} ≤400V, t _{sc} ≤5us,T _J ≤150°C | | - | 250 | - | A |
| Switching Characteristics | | | | | | | |
| Turn-on Delay Time | t _{d(ON)} | V _{CE} =400V,I _C =40A V _{GE} =0/15V, R _g =5Ω Inductive Load | | - | 19 | - | ns |
| Rise Time | t _r | | | - | 17 | - | ns |
| Turn-Off Delay Time | t _{d(OFF)} | | | - | 168 | - | ns |
| Fall Time | t _f | | | - | 16 | - | ns |
| Turn-On Switching Loss | E _{on} | | | - | 0.58 | - | mJ |
| Turn-Off Switching Loss | E _{off} | | | - | 0.48 | - | mJ |
| Turn-Off Switching Loss | E _{ts} | | | - | 1.06 | - | mJ |

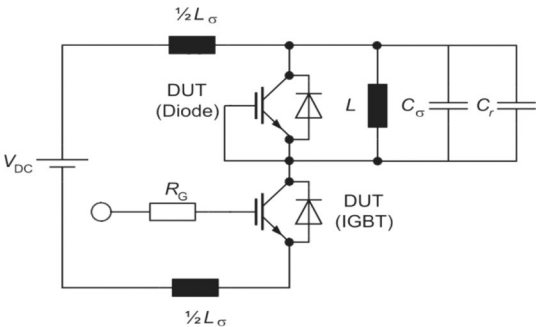
Electrical Characteristics of the Diode (Tc= 25°C unless otherwise specified):

| Parameter | Symbol | Test Conditions | Rating | | | Units |
|-------------------------------------|------------------|-----------------------------------|--------|------|-----|-------|
| | | | Min | Typ | Max | |
| Diode Forward Voltage | V _{FM} | I _F =30A | - | 1.65 | 2.0 | V |
| Reverse Recovery Time | T _{rr} | I _F =30A,di/dt=200A/uS | - | 170 | - | ns |
| Diode Peak Reverse Recovery Current | I _{RRM} | | - | 6.5 | - | A |
| Reverse Transfer Capacitance | Q _{rr} | | - | 0.7 | - | uC |
| Pulse width ttp≤380μs,δ≤2% | | | | | | |

Test Circuit

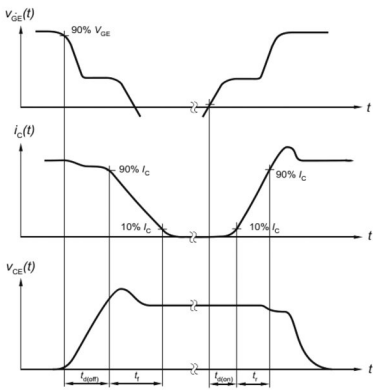


Gate Charge Test Circuit

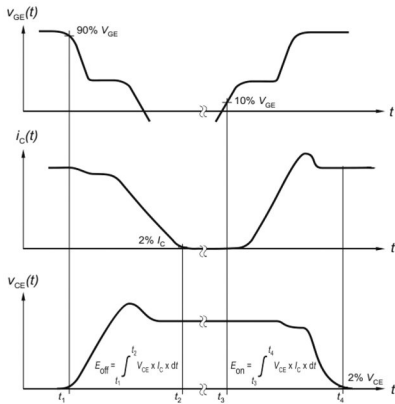


Switch Time Test Circuit

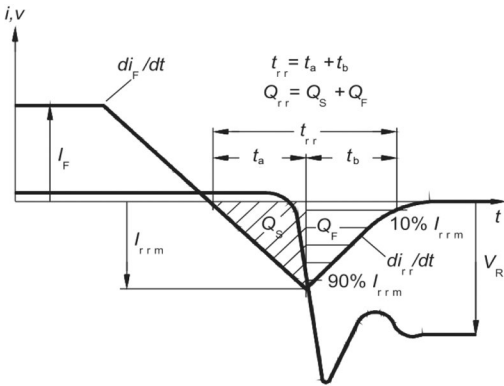
Switching characteristics



definition of switching times



definition of switching losses



Definition of diode switching characteristics

Typical Electrical and Thermal Characteristics

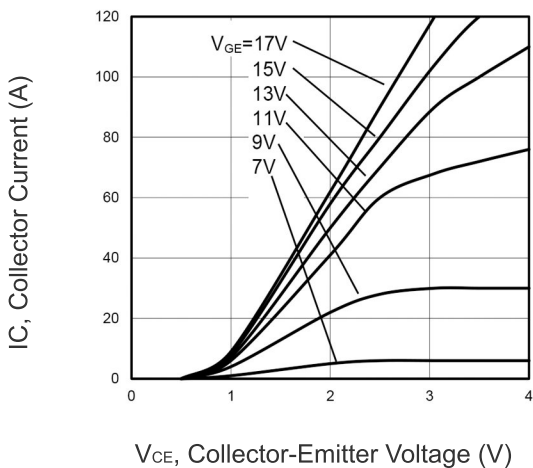


Figure 1 Output Characteristics

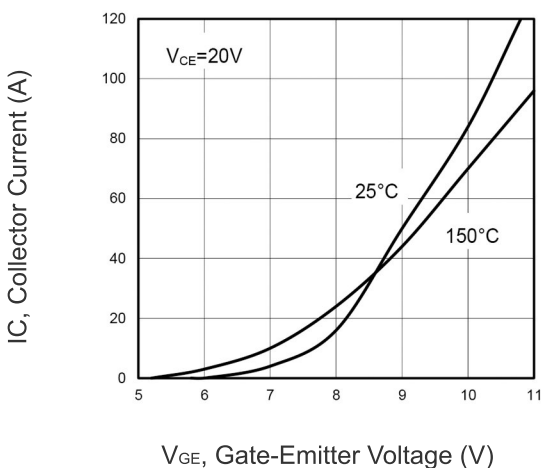


Figure 2 Transfer Characteristics

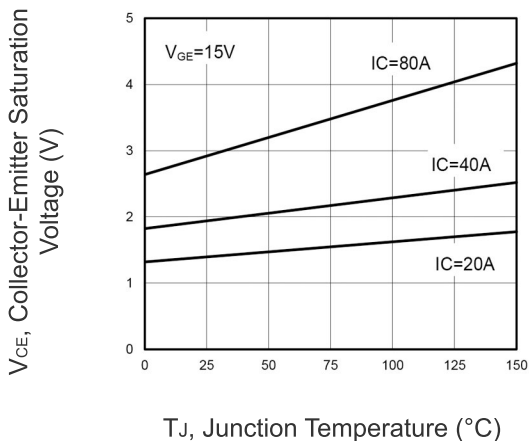


Figure 3 V_{CEsat} vs. Case Temperature

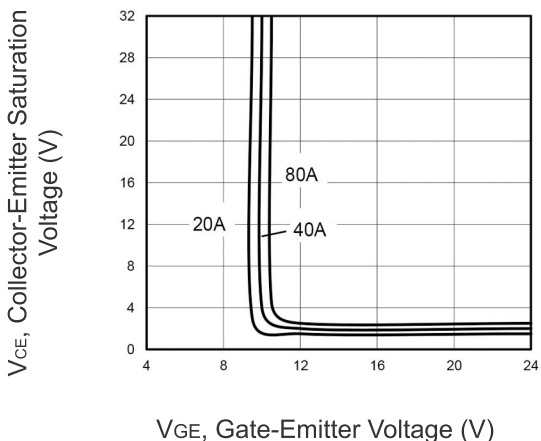


Figure 4 Saturation Voltage vs. V_{GE}

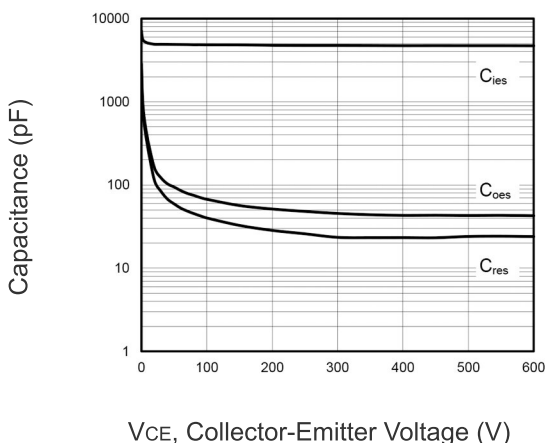


Figure 5 Capacitance Characteristics

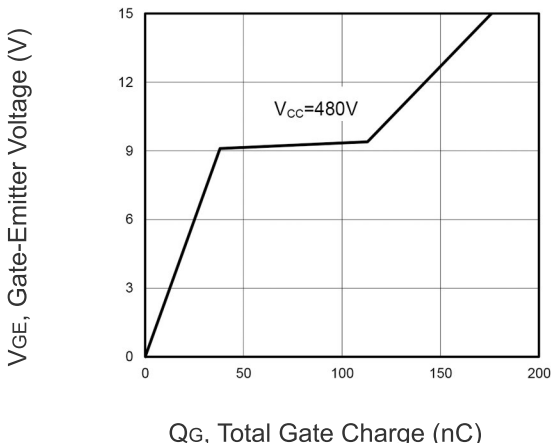


Figure 6 Gate charge waveform

Typical Electrical and Thermal Characteristics

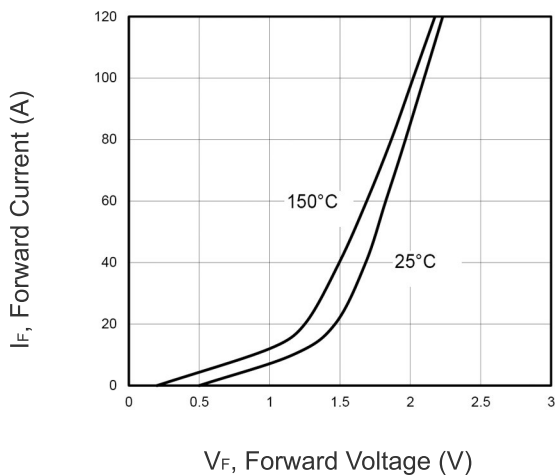


Figure 7 Forward Characteristics

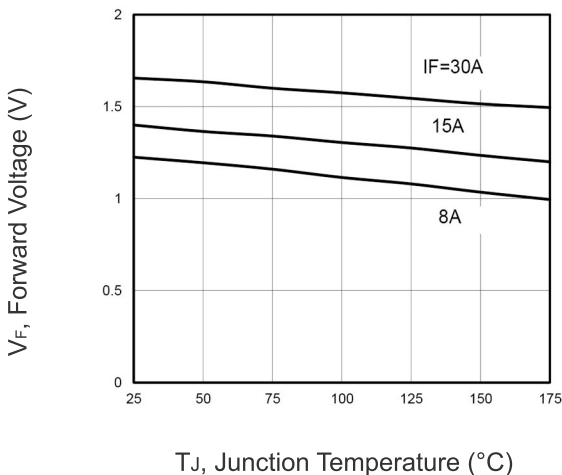


Figure 8 V_F vs. Temperature

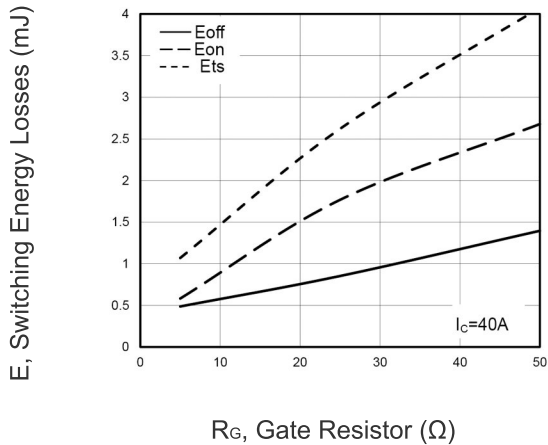


Figure 9 Typical Switching Times as a Function of Gate Resistor

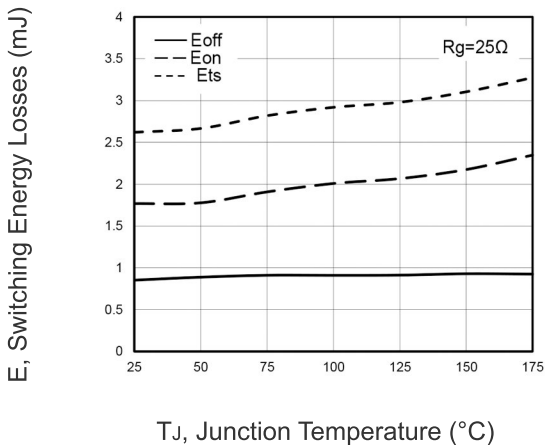


Figure 10 Typical Switching Times as a Function of Junction Temperature

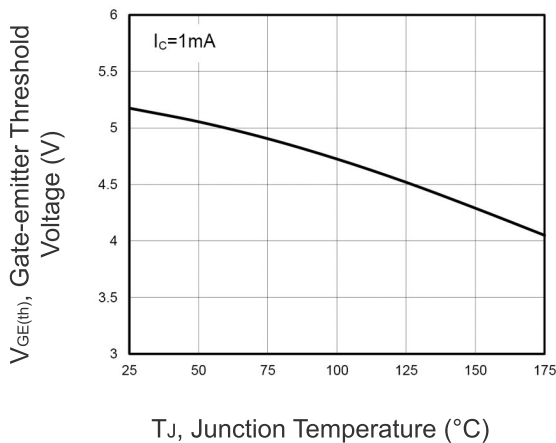


Figure 11 Gate-emitter Threshold Voltage as a Function of Junction Temperature

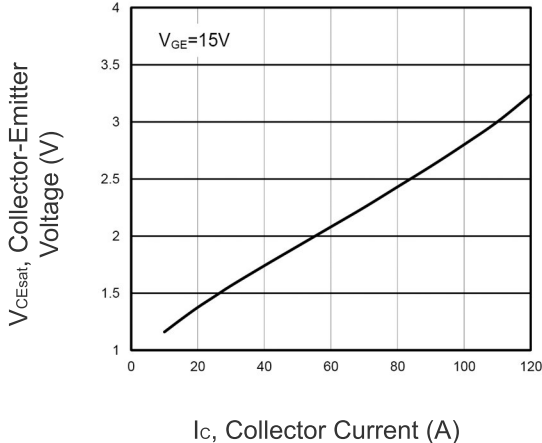


Figure 12 Typical Collector-emitter Saturation Voltage as a function of Collector Current

Typical Electrical and Thermal Characteristics

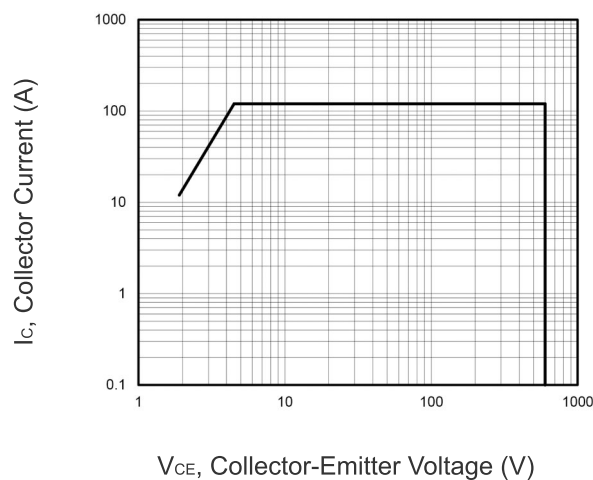
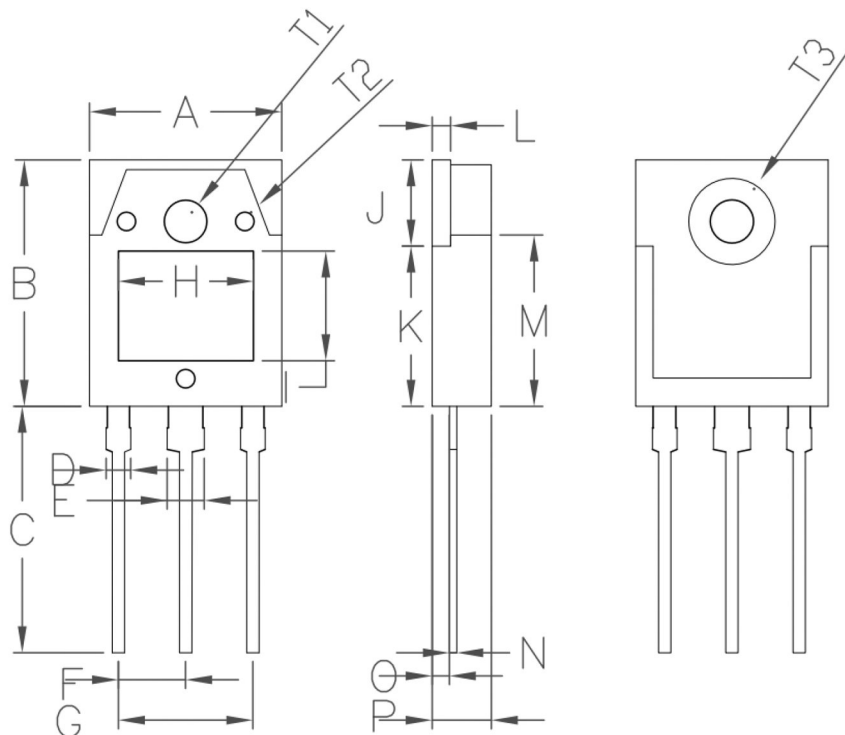


Figure 13 Forward Bias Safe Operating Area

TO-3P-3L Package Information



| Symbol | Dimensions In Millimeters | | Dimensions In Inches | |
|--------|---------------------------|-------|----------------------|------|
| | Min. | Max. | Min. | Max. |
| A | 15.50 | 15.70 | 0.61 | 0.62 |
| B | 19.70 | 20.10 | 0.78 | 0.79 |
| C | 20.10 | 20.50 | 0.79 | 0.81 |
| D | 2.00 | | 0.08 | |
| E | 3.00 | | 0.12 | |
| F | 5.45 | | 0.21 | |
| G | 10.90 | | 0.43 | |
| H | 10.80 | 11.00 | 0.43 | 0.43 |
| I | 8.80 | 9.00 | 0.35 | 0.35 |
| J | 6.85 | 7.15 | 0.27 | 0.28 |
| K | 12.75 | 13.05 | 0.50 | 0.51 |
| L | 1.49 | 1.51 | 0.06 | 0.06 |
| M | 13.70 | 14.00 | 0.54 | 0.55 |
| N | 0.59 | 0.61 | 0.02 | 0.02 |
| O | 1.32 | 1.48 | 0.05 | 0.06 |
| P | 4.70 | 4.90 | 0.19 | 0.19 |
| S | 4° | | 0.16° | |
| T1 | 3.50 | | 0.14 | |
| T2 | 1.50 | | 0.06 | |
| T3 | 7.00 | | 0.28 | |

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