



April 2015

FGH40T120SMDL4

1200 V, 40 A FS Trench IGBT

Features

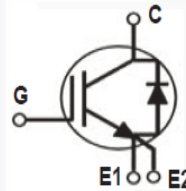
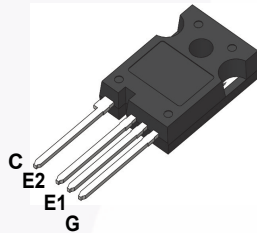
- FS Trench Technology, Positive Temperature Coefficient
- Excellent Switching Performance due to Kelvin Emitter Pin
- Low Saturation Voltage: $V_{CE(sat)} = 1.8 \text{ V} @ I_C = 40 \text{ A}$
- 100% of the Parts tested for $I_{LM}(1)$
- High Input Impedance
- RoHS Compliant

General Description

Using innovative field stop trench IGBT technology, Fairchild®'s new series of field stop trench IGBTs offer the optimum performance for hard switching application such as solar inverter, UPS, welder and PFC applications.

Applications

- Solar Inverter, Welder, UPS and PFC applications



E1: Kelvin Emitter
E2: Power Emitter

Absolute Maximum Ratings $T_C = 25^\circ\text{C}$ unless otherwise noted.

| Symbol | Description | FGH40T120SMDL4 | Unit |
|-------------|---|-----------------------------|------------------|
| V_{CES} | Collector to Emitter Voltage | 1200 | V |
| V_{GES} | Gate to Emitter Voltage | ± 25 | V |
| | Transient Gate to Emitter Voltage | ± 30 | |
| I_C | Collector Current | @ $T_C = 25^\circ\text{C}$ | A |
| | Collector Current | @ $T_C = 100^\circ\text{C}$ | |
| $I_{LM}(1)$ | Clamped Inductive Load Current | @ $T_C = 25^\circ\text{C}$ | A |
| $I_{CM}(2)$ | Pulsed Collector Current | | A |
| I_F | Diode Continuous Forward Current | @ $T_C = 25^\circ\text{C}$ | A |
| | Diode Continuous Forward Current | @ $T_C = 100^\circ\text{C}$ | |
| I_{FM} | Diode Maximum Forward Current | | A |
| P_D | Maximum Power Dissipation | @ $T_C = 25^\circ\text{C}$ | W |
| | Maximum Power Dissipation | @ $T_C = 100^\circ\text{C}$ | |
| T_J | Operating Junction Temperature | -55 to +175 | $^\circ\text{C}$ |
| T_{stg} | Storage Temperature Range | -55 to +175 | $^\circ\text{C}$ |
| T_L | Maximum Lead Temperature for Soldering, 1/8" from Case for 5 Seconds | 300 | $^\circ\text{C}$ |

Thermal Characteristics

| Symbol | Parameter | FGH40T120SMDL4 | Unit |
|-------------------------------|---|----------------|---------------------------|
| $R_{\theta JC}(\text{IGBT})$ | Thermal Resistance, Junction to Case | 0.27 | $^\circ\text{C}/\text{W}$ |
| $R_{\theta JC}(\text{Diode})$ | Thermal Resistance, Junction to Case | 0.89 | $^\circ\text{C}/\text{W}$ |
| $R_{\theta JA}$ | Thermal Resistance, Junction to Ambient | 40 | $^\circ\text{C}/\text{W}$ |

Notes:

1. $V_{CC} = 600 \text{ V}$, $V_{GE} = 15 \text{ V}$, $I_C = 160 \text{ A}$, $R_G = 20 \Omega$, inductive load.
2. Limited by T_{jmax} .

Package Marking and Ordering Information

| Device Marking | Device | Package | Reel Size | Tape Width | Quantity |
|----------------|----------------|------------|-----------|------------|----------|
| FGH40T120SMDL4 | FGH40T120SMDL4 | TO-247 A04 | - | - | 30 |

Electrical Characteristics of the IGBT T_C = 25°C unless otherwise noted

| Symbol | Parameter | Test Conditions | Min. | Typ. | Max. | Unit |
|----------------------------------|---|--|------|------|-----------|---------------|
| Off Characteristics | | | | | | |
| BV_{CES} | Collector to Emitter Breakdown Voltage | $V_{GE} = 0\text{ V}, I_C = 250\text{ }\mu\text{A}$ | 1200 | - | - | V |
| I_{CES} | Collector Cut-Off Current | $V_{CE} = V_{CES}, V_{GE} = 0\text{ V}$ | - | - | 250 | μA |
| I_{GES} | G-E Leakage Current | $V_{GE} = V_{GES}, V_{CE} = 0\text{ V}$ | - | - | ± 400 | nA |
| On Characteristics | | | | | | |
| $V_{GE(th)}$ | G-E Threshold Voltage | $I_C = 40\text{ mA}, V_{CE} = V_{GE}$ | 4.9 | 6.2 | 7.5 | V |
| $V_{CE(sat)}$ | Collector to Emitter Saturation Voltage | $I_C = 40\text{ A}, V_{GE} = 15\text{ V}, T_C = 25^\circ\text{C}$ | - | 1.8 | 2.4 | V |
| | | $I_C = 40\text{ A}, V_{GE} = 15\text{ V}, T_C = 175^\circ\text{C}$ | - | 2.0 | - | V |
| Dynamic Characteristics | | | | | | |
| C_{ies} | Input Capacitance | $V_{CE} = 30\text{ V}, V_{GE} = 0\text{ V}, f = 1\text{ MHz}$ | - | 4300 | - | pF |
| C_{oes} | Output Capacitance | | - | 180 | - | pF |
| C_{res} | Reverse Transfer Capacitance | | - | 100 | - | pF |
| Switching Characteristics | | | | | | |
| $t_{d(on)}$ | Turn-On Delay Time | $V_{CC} = 600\text{ V}, I_C = 40\text{ A}, R_G = 10\text{ }\Omega, V_{GE} = 15\text{ V}, \text{Inductive Load}, T_C = 25^\circ\text{C}$ | - | 44 | - | ns |
| t_r | Rise Time | | - | 42 | - | ns |
| $t_{d(off)}$ | Turn-Off Delay Time | | - | 464 | - | ns |
| t_f | Fall Time | | - | 24 | - | ns |
| E_{on} | Turn-On Switching Loss | | - | 2.24 | - | mJ |
| E_{off} | Turn-Off Switching Loss | | - | 1.02 | - | mJ |
| E_{ts} | Total Switching Loss | | - | 3.26 | - | mJ |
| $t_{d(on)}$ | Turn-On Delay Time | $V_{CC} = 600\text{ V}, I_C = 40\text{ A}, R_G = 10\text{ }\Omega, V_{GE} = 15\text{ V}, \text{Inductive Load}, T_C = 175^\circ\text{C}$ | - | 42 | - | ns |
| t_r | Rise Time | | - | 48 | - | ns |
| $t_{d(off)}$ | Turn-Off Delay Time | | - | 518 | - | ns |
| t_f | Fall Time | | - | 24 | - | ns |
| E_{on} | Turn-On Switching Loss | | - | 3.11 | - | mJ |
| E_{off} | Turn-Off Switching Loss | | - | 2.01 | - | mJ |
| E_{ts} | Total Switching Loss | | - | 5.12 | - | mJ |
| Q_g | Total Gate Charge | $V_{CE} = 600\text{ V}, I_C = 40\text{ A}, V_{GE} = 15\text{ V}$ | - | 370 | - | nC |
| Q_{ge} | Gate to Emitter Charge | | - | 23 | - | nC |
| Q_{gc} | Gate to Collector Charge | | - | 210 | - | nC |

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

| Symbol | Parameter | Test Conditions | Min. | Typ. | Max. | Unit |
|----------|-------------------------------------|--|------|------|------|------|
| V_{FM} | Diode Forward Voltage | $I_F = 40\text{ A}, T_C = 25^\circ\text{C}$ | - | 3.8 | 4.8 | V |
| | | $I_F = 40\text{ A}, T_C = 175^\circ\text{C}$ | - | 2.7 | - | V |
| t_{rr} | Diode Reverse Recovery Time | $V_R = 600\text{ V}, I_F = 40\text{ A},$ $di_F/dt = 200\text{ A/us}, T_C = 25^\circ\text{C}$ | - | 65 | - | ns |
| I_{rr} | Diode Peak Reverse Recovery Current | | - | 7.2 | - | A |
| Q_{rr} | Diode Reverse Recovery Charge | | - | 234 | - | nC |
| t_{rr} | Diode Reverse Recovery Time | $V_R = 600\text{ V}, I_F = 40\text{ A},$ $di_F/dt = 200\text{ A/us}, T_C = 175^\circ\text{C}$ | - | 200 | - | ns |
| I_{rr} | Diode Peak Reverse Recovery Current | | - | 18.0 | - | A |
| Q_{rr} | Diode Reverse Recovery Charge | | - | 1800 | - | nC |

Typical Performance Characteristics

Figure 1. Typical Output Characteristics

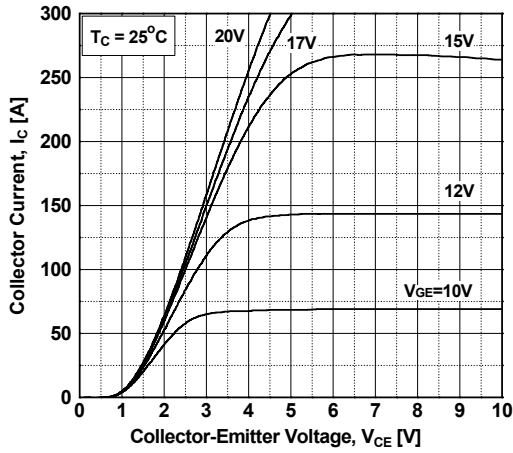


Figure 2. Typical Output Characteristics

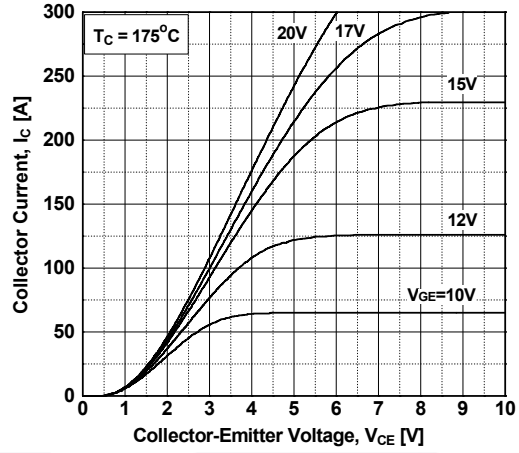


Figure 3. Typical Saturation Voltage Characteristics

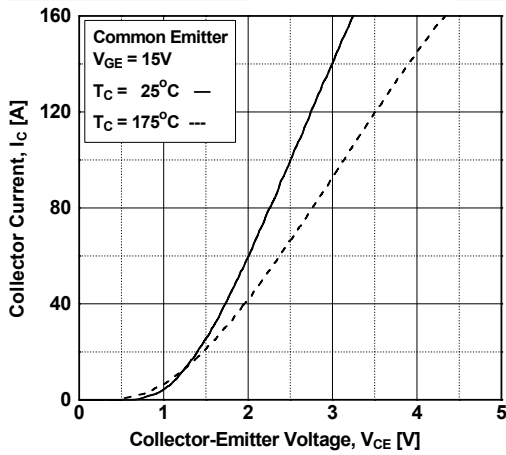


Figure 4. Saturation Voltage vs. Case Temperature at Variant Current Level

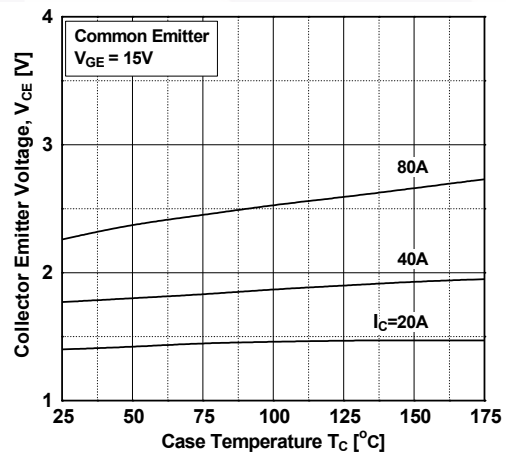


Figure 5. Saturation Voltage vs. Vge

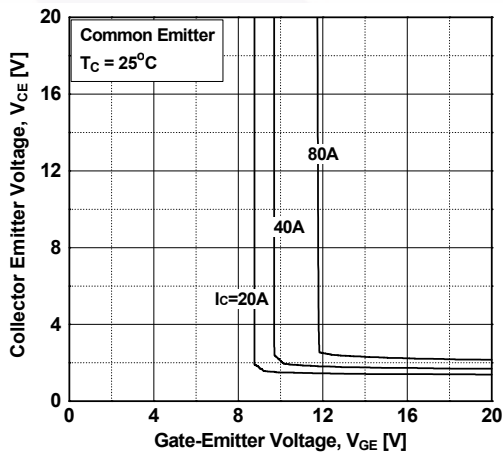
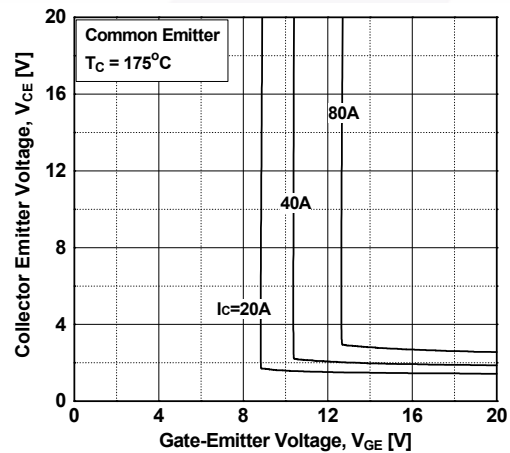


Figure 6. Saturation Voltage vs. Vge



Typical Performance Characteristics

Figure 7. Capacitance Characteristics

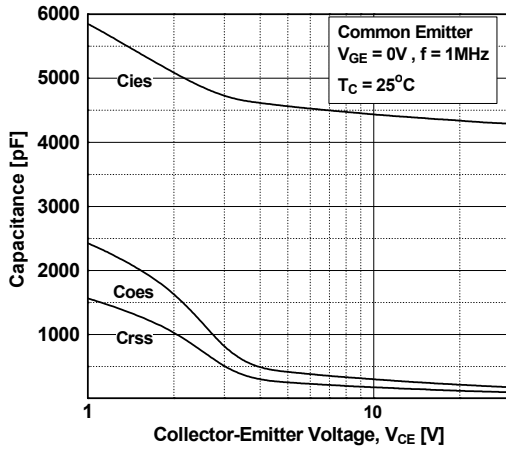


Figure 8. Gate Charge Characteristics

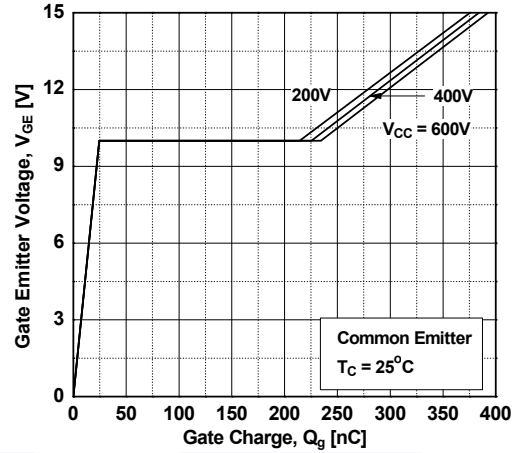


Figure 9. Turn-on Characteristics vs. Gate Resistance

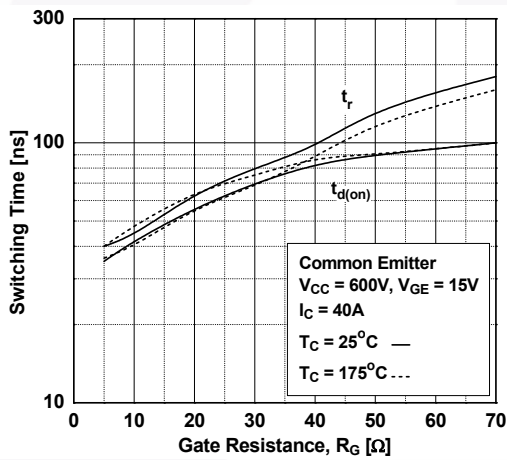


Figure 10. Turn-off Characteristics vs. Gate Resistance

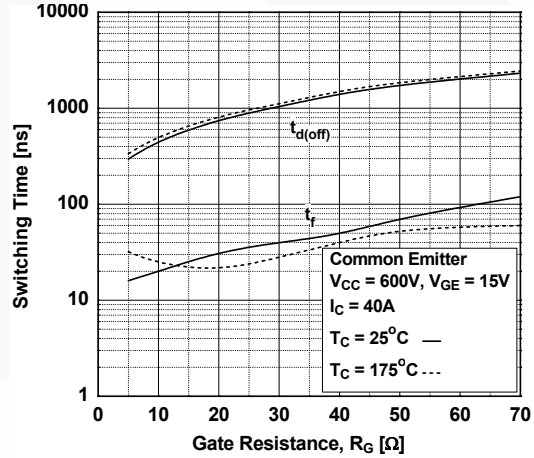


Figure 11. Switching Loss vs. Gate Resistance

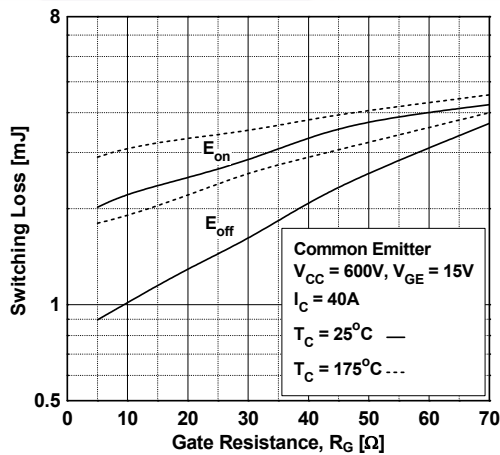
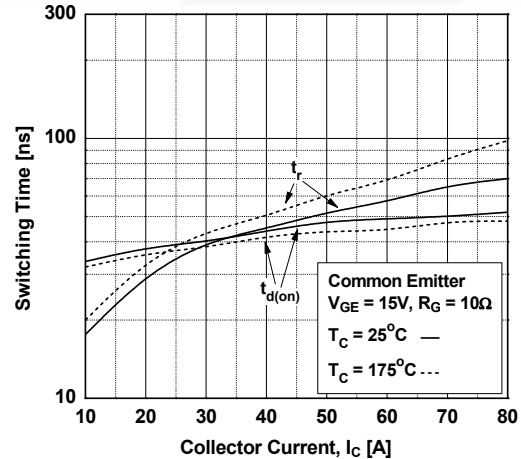


Figure 12. Turn-on Characteristics vs. Collector Current



Typical Performance Characteristics

Figure 13. Turn-off Characteristics vs. Collector Current

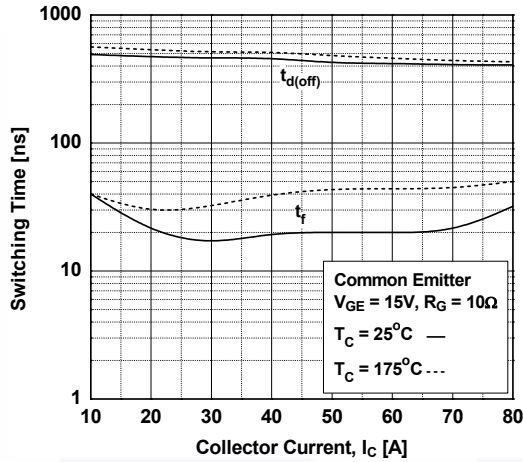


Figure 14. Switching Loss vs. Collector Current

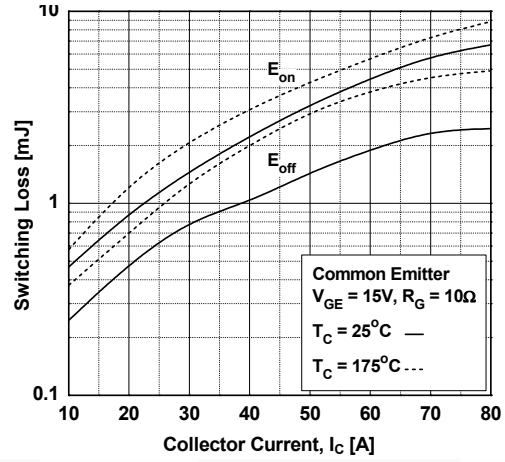


Figure 15. Load Current vs. Frequency

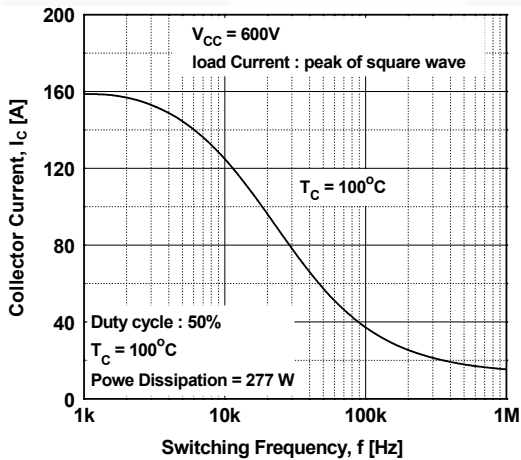


Figure 16. SOA Characteristics

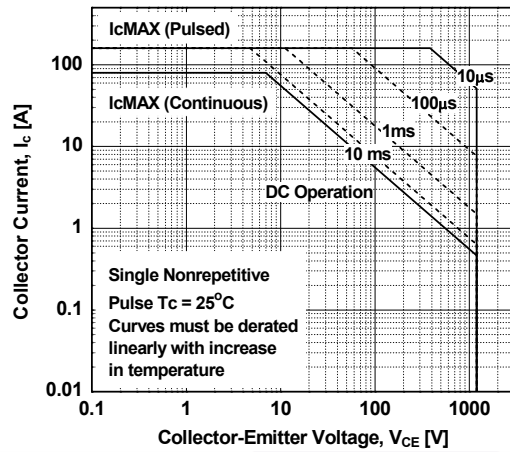


Figure 17. Forward Characteristics

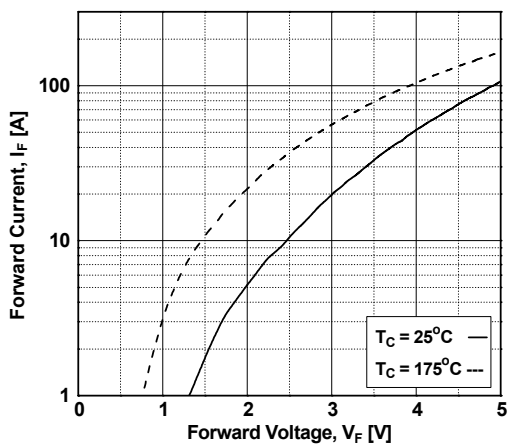
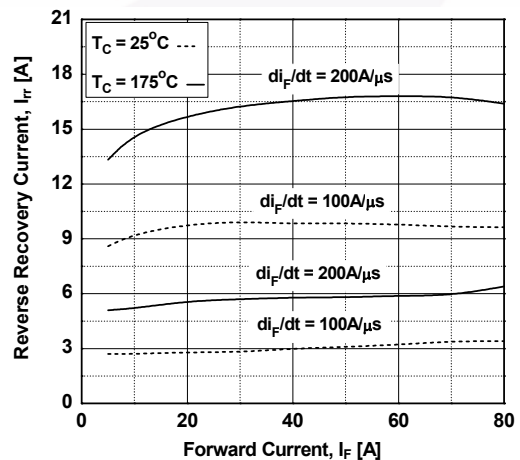


Figure 18. Reverse Recovery Current



Typical Performance Characteristics

Figure 19. Reverse Recovery Time

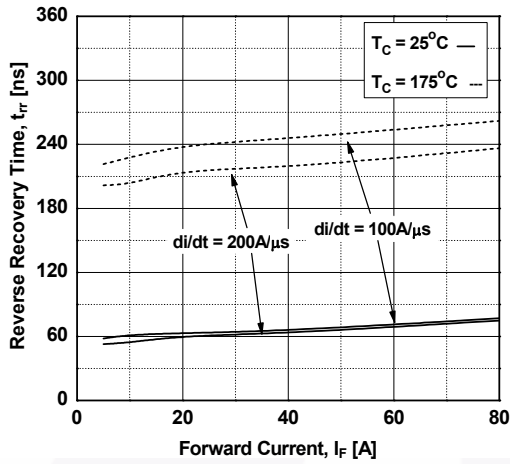


Figure 20. Stored Charge

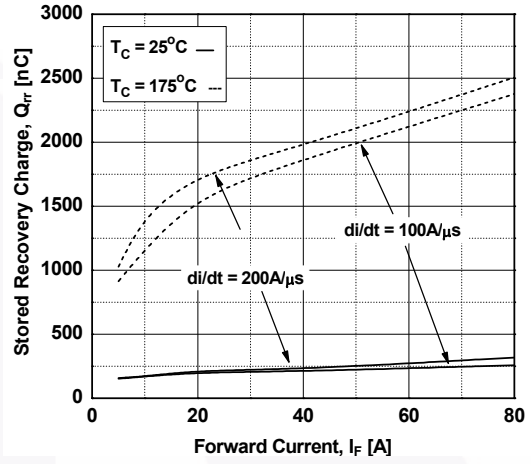


Figure 21. Transient Thermal Impedance of IGBT

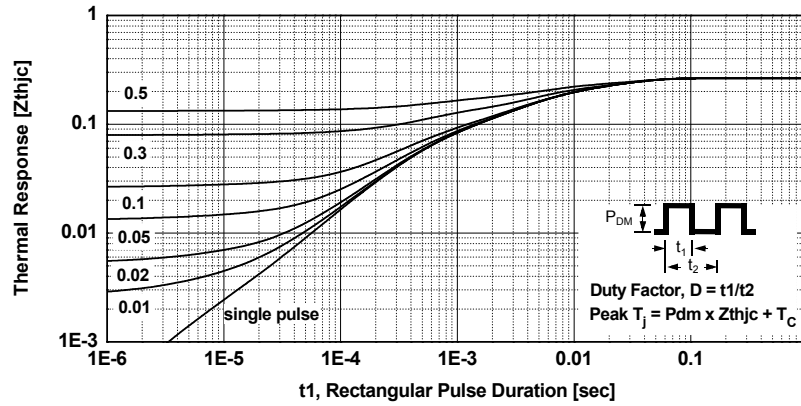
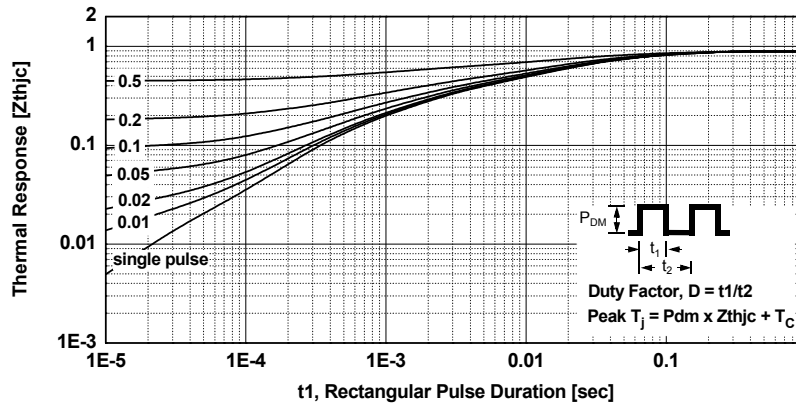
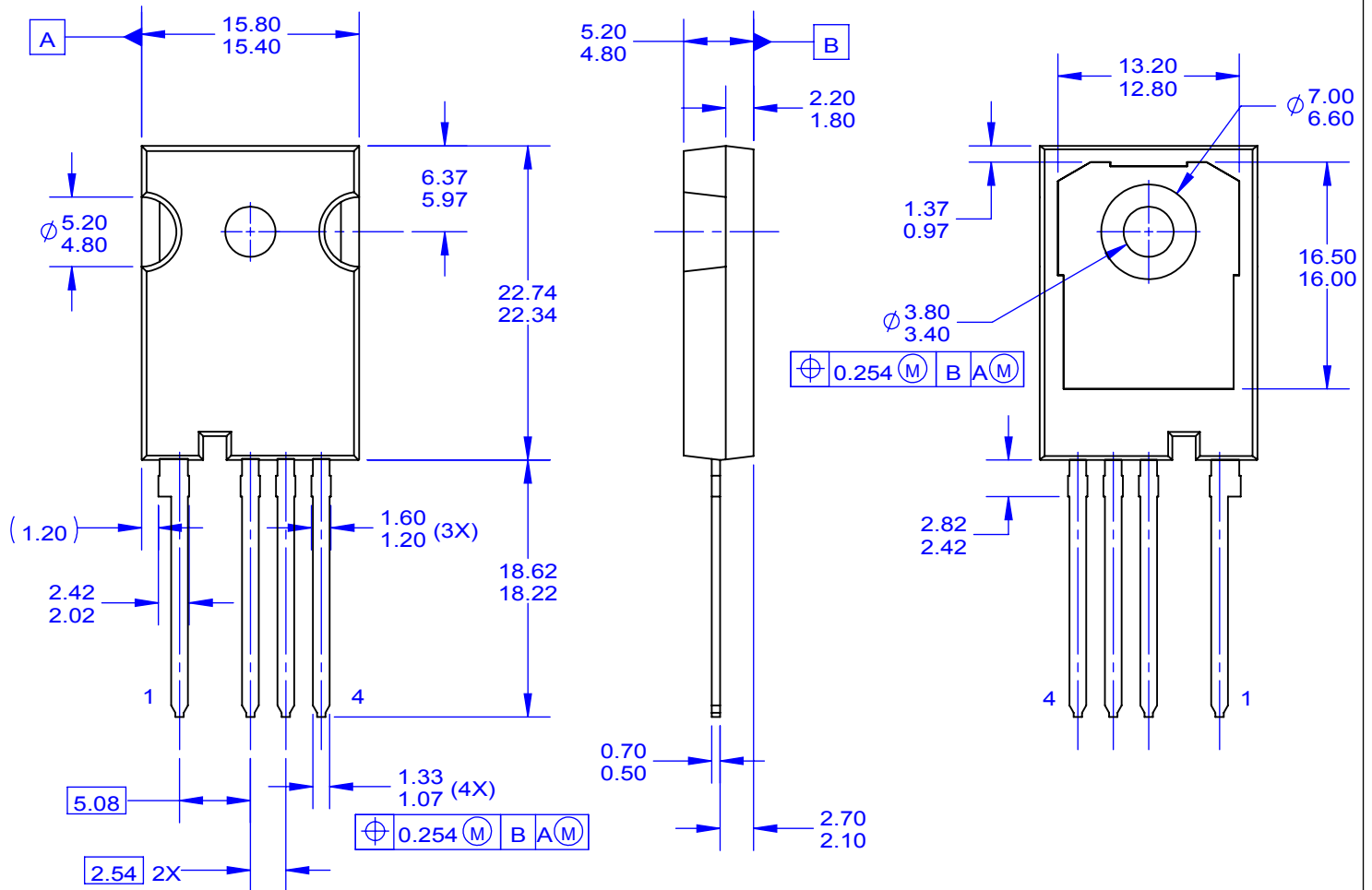


Figure 22. Transient Thermal Impedance of Diode





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