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# AOD7B65M3

## 650V, 7A AlphaIGBT™

## With soft and fast recovery anti-parallel diode

### General Description

- Latest AlphaIGBT (α IGBT) technology
- 650V breakdown voltage
- Very fast and soft recovery freewheeling diode
- High efficient turn-on di/dt controllability
- Low $V_{CE(sat)}$ enables high efficiencies
- Low turn-off switching loss and softness
- Very good EMI behavior
- High short-circuit ruggedness

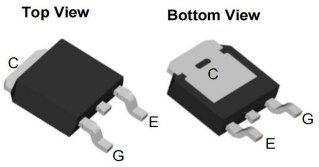
### Applications

- Motor Drives
- Home appliance applications such as refrigerators and washing machines
- Fan, Pumps, Vacuum Cleaner
- Other Hard Switching Applications

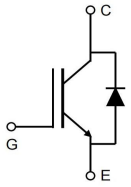
### Product Summary

| | |
|---|---|
| $V_{CE}$ | 650V |
| $I_C$ ($T_C$=100°C) | 7A |
| $V_{CE(sat)}$ ($T_J$=25°C) | 1.87V |

TO-252
DPAK




AOD7B65M3




| Orderable Part Number | Package Type | Form | Minimum Order Quantity |
|---|---|---|---|
| AOD7B65M3 | TO252 | Tape & Reel | 2500 |

**Absolute Maximum Ratings $T_A$=25°C unless otherwise noted**

| Parameter | | Symbol | AOD7B65M3 | Units |
|---|---|---|---|---|
| Collector-Emitter Voltage | | $V_{CE}$ | 650 | V |
| Gate-Emitter Voltage | | $V_{GE}$ | ±30 | V |
| Continuous Collector Current | $T_C$=25°C | $I_C$ | 14 | A |
| | $T_C$=100°C | | 7 | |
| Pulsed Collector Current, Limited by $T_{Jmax}$ | | $I_{CM}$ | 21 | A |
| Turn off SOA, $V_{CE} \leqslant$ 650V, Limited by $T_{Jmax}$ | | $I_{LM}$ | 21 | A |
| Continuous Diode Forward Current | $T_C$=25°C | $I_F$ | 10 | A |
| | $T_C$=100°C | | 5 | |
| Diode Pulsed Current, Limited by $T_{Jmax}$ | | $I_{FM}$ | 21 | A |
| Short circuit withstanding time 1) $V_{GE}$ = 15V, $V_{CC} \leqslant$ 400V, $T_J \leqslant$ 150°C | | $t_{SC}$ | 5 | μs |
| Power Dissipation | $T_C$=25°C | $P_D$ | 69 | W |
| | $T_C$=100°C | | 28 | |
| Junction and Storage Temperature Range | | $T_J$, $T_{STG}$ | -55 to 150 | °C |
| Maximum lead temperature for soldering purpose, 1/8" from case for 5 seconds | | $T_L$ | 300 | °C |

**Thermal Characteristics**

| Parameter | Symbol | AOD7B65M3 | Units |
|---|---|---|---|
| Maximum Junction-to-Ambient | $R_{\theta JA}$ | 55 | °C/W |
| Maximum IGBT Junction-to-Case | $R_{\theta JC}$ | 1.8 | °C/W |
| Maximum Diode Junction-to-Case | $R_{\theta JC}$ | 5.5 | °C/W |

1) Allowed number of short circuits: <1000; time between short circuits: >1s.

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**Electrical Characteristics ($T_J$=25°C unless otherwise noted)**

| Symbol | Parameter | Conditions | | Min | Typ | Max | Units |
|---|---|---|---|---|---|---|---|
| **STATIC PARAMETERS** | | | | | | | |
| $BV_{CES}$ | Collector-Emitter Breakdown Voltage | $I_C$=1mA, $V_{GE}$=0V, $T_J$=25°C | | 650 | - | - | V |
| $V_{CE(sat)}$ | Collector-Emitter Saturation Voltage | $V_{GE}$=15V, $I_C$=7A | $T_J$=25°C | - | 1.87 | 2.35 | V |
| | | | $T_J$=125°C | - | 2.34 | - | |
| | | | $T_J$=150°C | - | 2.47 | - | |
| $V_F$ | Diode Forward Voltage | $V_{GE}$=0V, $I_C$=7A | $T_J$=25°C | - | 2.1 | 2.6 | V |
| | | | $T_J$=125°C | - | 2.04 | - | |
| | | | $T_J$=150°C | - | 2 | - | |
| $V_{GE(th)}$ | Gate-Emitter Threshold Voltage | $V_{CE}$=5V, $I_C$=1mA | | 4.5 | 5.1 | 5.9 | V |
| $I_{CES}$ | Zero Gate Voltage Collector Current | $V_{CE}$=650V, $V_{GE}$=0V | $T_J$=25°C | - | - | 10 | μA |
| | | | $T_J$=125°C | - | - | 500 | |
| | | | $T_J$=150°C | - | - | 1000 | |
| $I_{GES}$ | Gate-Emitter leakage current | $V_{CE}$=0V, $V_{GE}$=±30V | | - | - | ±100 | nA |
| $g_{FS}$ | Forward Transconductance | $V_{CE}$=20V, $I_C$=7A | | - | 3.6 | - | S |
| **DYNAMIC PARAMETERS** | | | | | | | |
| $C_{ies}$ | Input Capacitance | $V_{GE}$=0V, $V_{CC}$=25V, f=1MHz | | - | 348 | - | pF |
| $C_{oes}$ | Output Capacitance | | | - | 36 | - | pF |
| $C_{res}$ | Reverse Transfer Capacitance | | | - | 13 | - | pF |
| $Q_g$ | Total Gate Charge | $V_{GE}$=15V, $V_{CC}$=520V, $I_C$=7A | | - | 14 | - | nC |
| $Q_{ge}$ | Gate to Emitter Charge | | | - | 3.2 | - | nC |
| $Q_{gc}$ | Gate to Collector Charge | | | - | 6.7 | - | nC |
| $I_{C(SC)}$ | Short circuit collector current | $V_{GE}$=15V, $V_{CC}$=400V, $t_{sc}$≤5us, $T_J$≤150°C | | - | 30 | - | A |
| $R_g$ | Gate resistance | $V_{GE}$=0V, $V_{CC}$=0V, f=1MHz | | - | 6 | - | Ω |
| **SWITCHING PARAMETERS, (Load Inductive, $T_J$=25°C)** | | | | | | | |
| $t_{D(on)}$ | Turn-On DelayTime | $T_J$=25°C, $V_{GE}$=15V, $V_{CC}$=400V, $I_C$=7A, $R_G$=43Ω | | - | 6 | - | ns |
| $t_r$ | Turn-On Rise Time | | | - | 14 | - | ns |
| $t_{D(off)}$ | Turn-Off Delay Time | | | - | 79 | - | ns |
| $t_f$ | Turn-Off Fall Time | | | - | 20 | - | ns |
| $E_{on}$ | Turn-On Energy | | | - | 0.108 | - | mJ |
| $E_{off}$ | Turn-Off Energy | | | - | 0.099 | - | mJ |
| $E_{total}$ | Total Switching Energy | | | - | 0.208 | - | mJ |
| $t_{rr}$ | Diode Reverse Recovery Time | $T_J$=25°C, $I_F$=7A, dI/dt=200A/μs, $V_{CC}$=400V | | - | 212 | - | ns |
| $Q_{rr}$ | Diode Reverse Recovery Charge | | | - | 0.29 | - | μC |
| $I_{rm}$ | Diode Peak Reverse Recovery Current | | | - | 3 | - | A |
| **SWITCHING PARAMETERS, (Load Inductive, $T_J$=150°C)** | | | | | | | |
| $t_{D(on)}$ | Turn-On DelayTime | $T_J$=150°C, $V_{GE}$=15V, $V_{CC}$=400V, $I_C$=7A, $R_G$=43Ω | | - | 6 | - | ns |
| $t_r$ | Turn-On Rise Time | | | - | 15 | - | ns |
| $t_{D(off)}$ | Turn-Off Delay Time | | | - | 94 | - | ns |
| $t_f$ | Turn-Off Fall Time | | | - | 42 | - | ns |
| $E_{on}$ | Turn-On Energy | | | - | 0.113 | - | mJ |
| $E_{off}$ | Turn-Off Energy | | | - | 0.16 | - | mJ |
| $E_{total}$ | Total Switching Energy | | | - | 0.273 | - | mJ |
| $t_{rr}$ | Diode Reverse Recovery Time | $T_J$=150°C, $I_F$=7A, dI/dt=200A/μs, $V_{CC}$=400V | | - | 273 | - | ns |
| $Q_{rr}$ | Diode Reverse Recovery Charge | | | - | 0.45 | - | μC |
| $I_{rm}$ | Diode Peak Reverse Recovery Current | | | - | 3.5 | - | A |

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## TYPICAL ELECTRICAL AND THERMAL CHARACTERISTICS

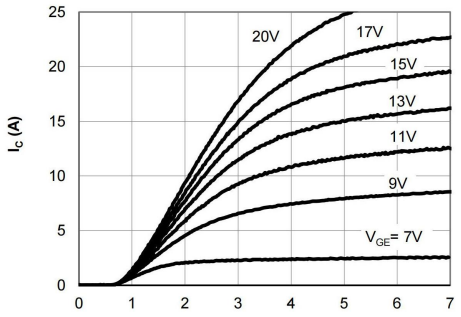



Figure 1: Output Characteristic ($T_j$=25°C )

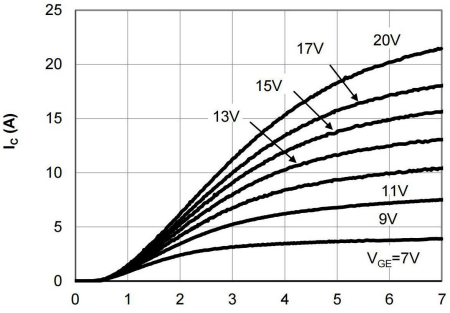



Figure 2: Output Characteristic ($T_j$=150°C )

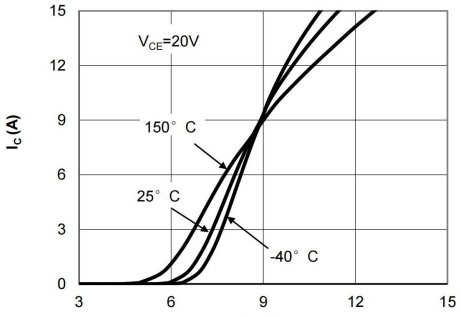



Figure 3: Transfer Characteristic

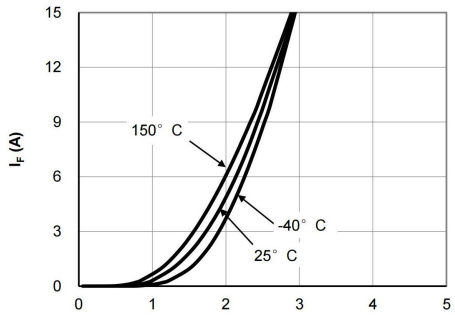



Figure 4: Diode Characteristic

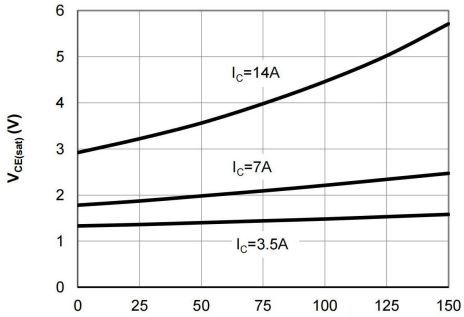



Figure 5: Collector-Emitter Saturation Voltage vs. Junction Temperature

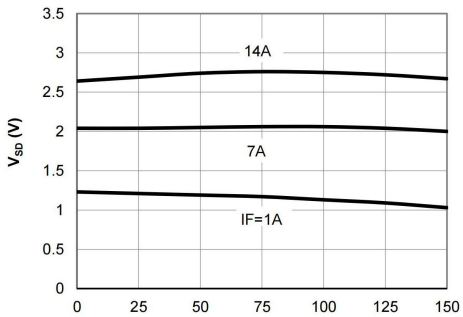



Figure 6: Diode Forward voltage vs. Junction Temperature

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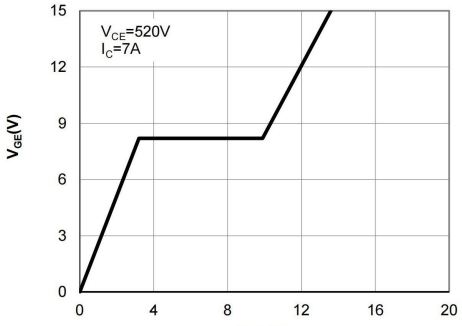



Figure 7: Gate-Charge Characteristics

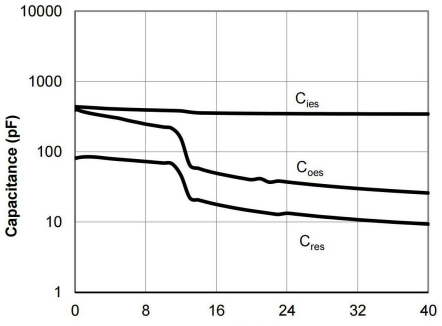



Figure 8: Capacitance Characteristic

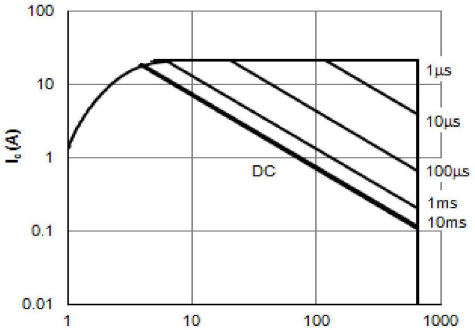



Figure 9: Forward Bias Safe Operating Area
($T_C$=25°C, $V_{GE}$=15V)

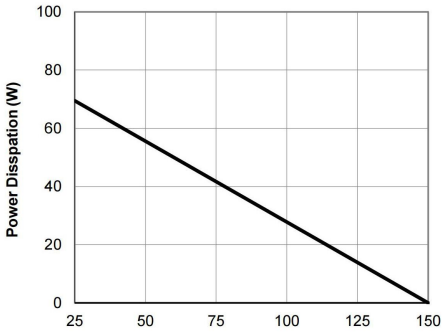



Figure 10: Power Disspation as a Function of Case

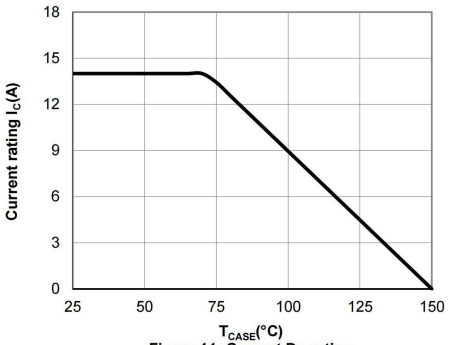



Figure 11: Current De-rating

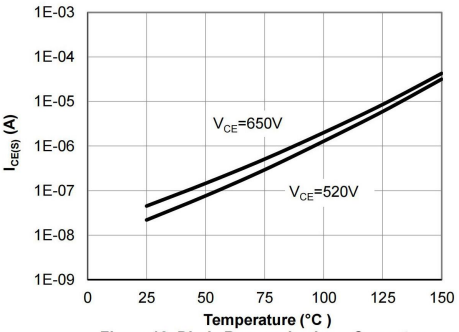



Figure 12: Diode Reverse Leakage Current vs. Junction Temperature

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## TYPICAL ELECTRICAL AND THERMAL CHARACTERISTICS

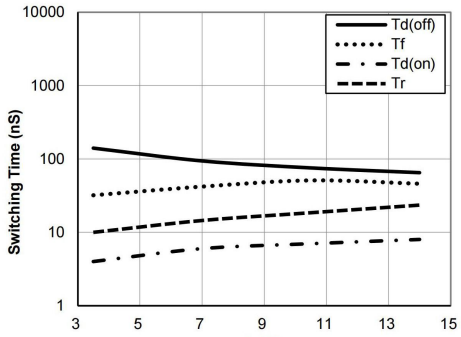



Figure 13: Switching Time vs. $I_C$
($T_j$=150°C,$V_{GE}$=15V,$V_{CE}$=400V,$R_g$=43Ω)

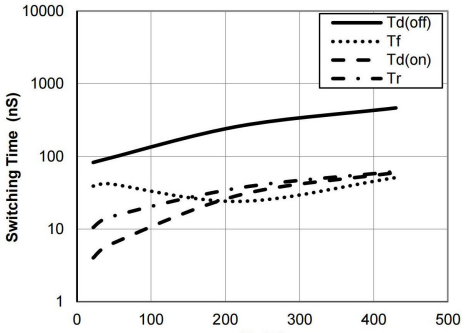



Figure 14: Switching Time vs. $R_g$
($T_j$=150°C,$V_{GE}$=15V,$V_{CE}$=400V,$I_C$=7A)

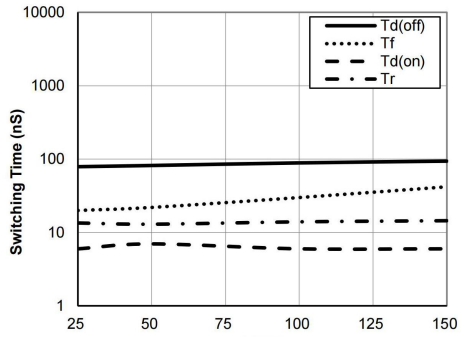



Figure 15: Switching Time vs.$T_j$
($V_{GE}$=15V,$V_{CE}$=400V,$I_C$=7A,$R_g$=43Ω)

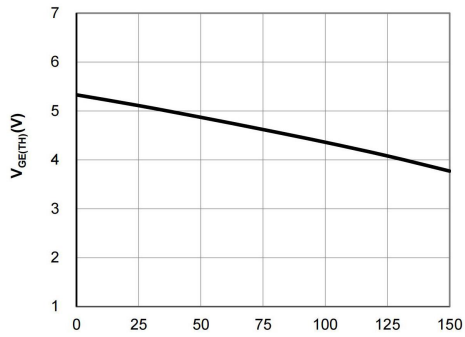



Figure 16: $V_{GE(TH)}$ vs. $T_j$

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## TYPICAL ELECTRICAL AND THERMAL CHARACTERISTICS

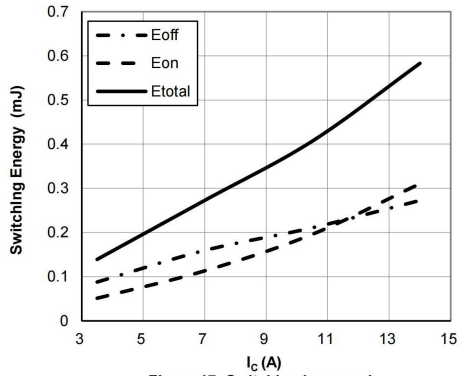



Figure 17: Switching Loss vs. $I_C$
($T_j$=150°C,$V_{GE}$=15V,$V_{CE}$=400V,$R_g$=43Ω)

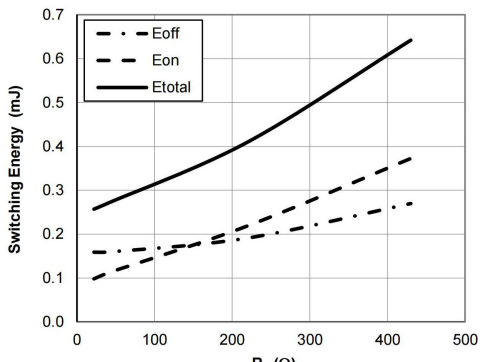



Figure 18: Switching Loss vs. $R_g$
($T_j$=150°C,$V_{GE}$=15V,$V_{CE}$=400V,$I_C$=7A)

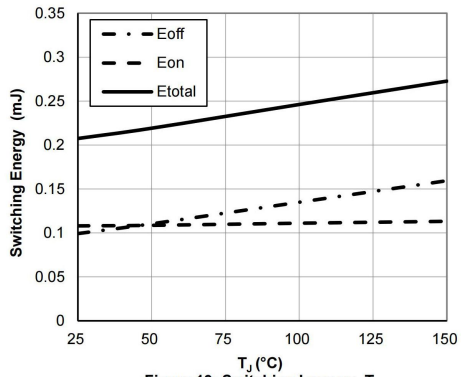



Figure 19: Switching Loss vs. $T_j$
($V_{GE}$=15V,$V_{CE}$=400V,$I_C$=7A,$R_g$=43Ω)

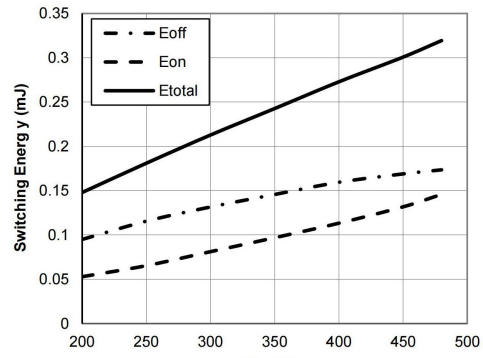



Figure 20: Switching Loss vs. $V_{CE}$
($T_j$=150°C,$V_{GE}$=15V,$I_C$=7A,$R_g$=43Ω)

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**TYPICAL ELECTRICAL AND THERMAL CHARACTERISTICS**

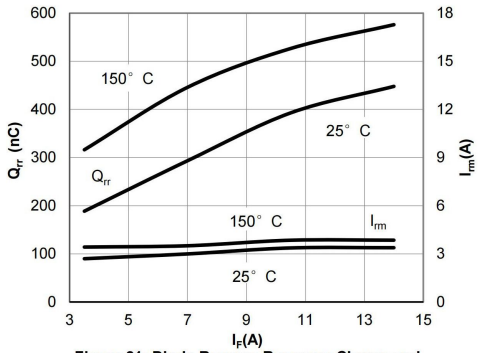



**Figure 21: Diode Reverse Recovery Charge and Peak Current vs. Conduction Current ($V_{GE}$=15V,$V_{CE}$=400V,di/dt=200A/μs)**

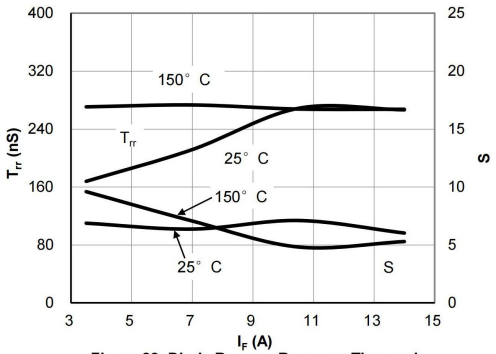



**Figure 22: Diode Reverse Recovery Time and Softness Factor vs. Conduction Current ($V_{GE}$=15V,$V_{CE}$=400V,di/dt=200A/μs)**

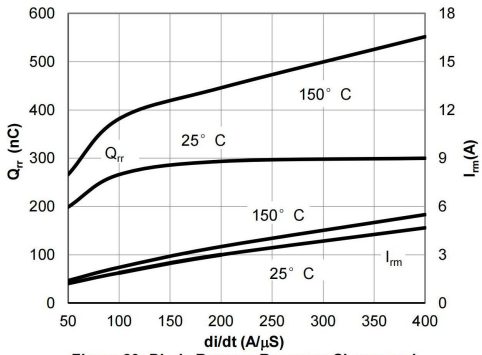



**Figure 23: Diode Reverse Recovery Charge and Peak Current vs. di/dt ($V_{GE}$=15V,$V_{CE}$=400V,$I_F$=7A)**

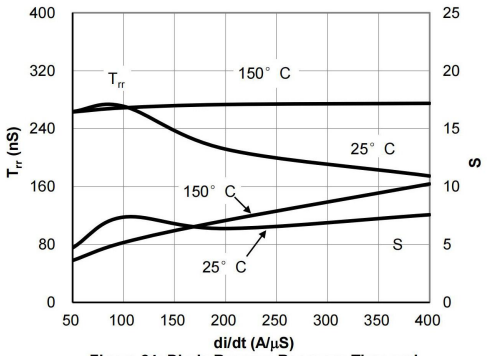



**Figure 24: Diode Reverse Recovery Time and Softness Factor vs. di/dt ($V_{GE}$=15V,$V_{CE}$=400V,$I_F$=7A)**

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## TYPICAL ELECTRICAL AND THERMAL CHARACTERISTICS

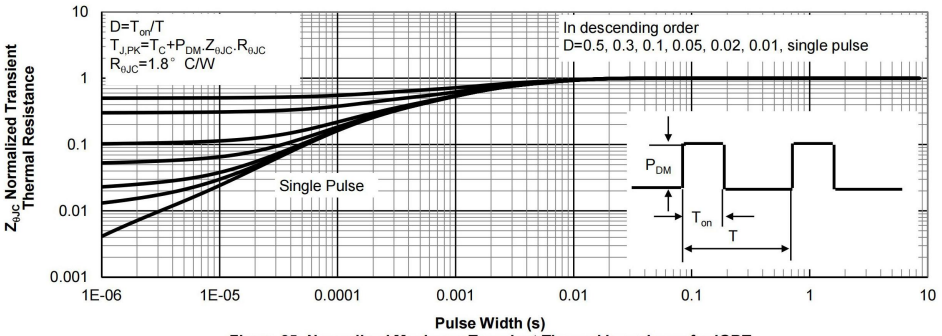



**Figure 25: Normalized Maximum Transient Thermal Impedance for IGBT**

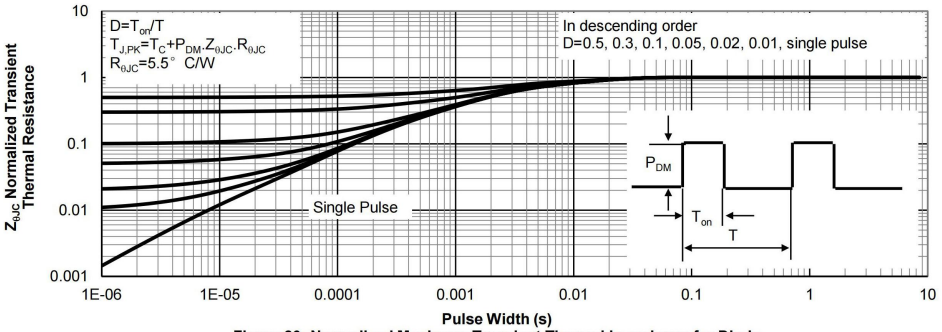



**Figure 26: Normalized Maximum Transient Thermal Impedance for Diode**

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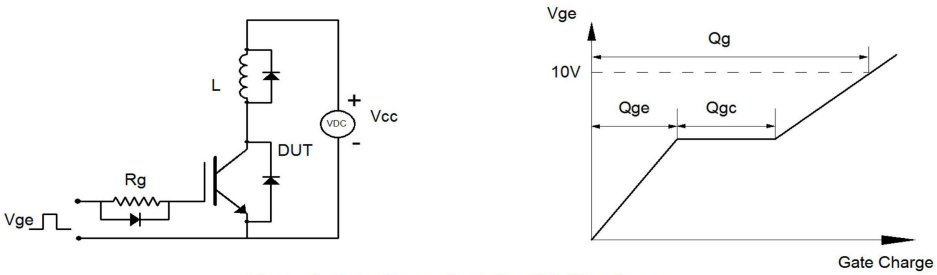



Figure A: Gate Charge Test Circuit & Waveforms

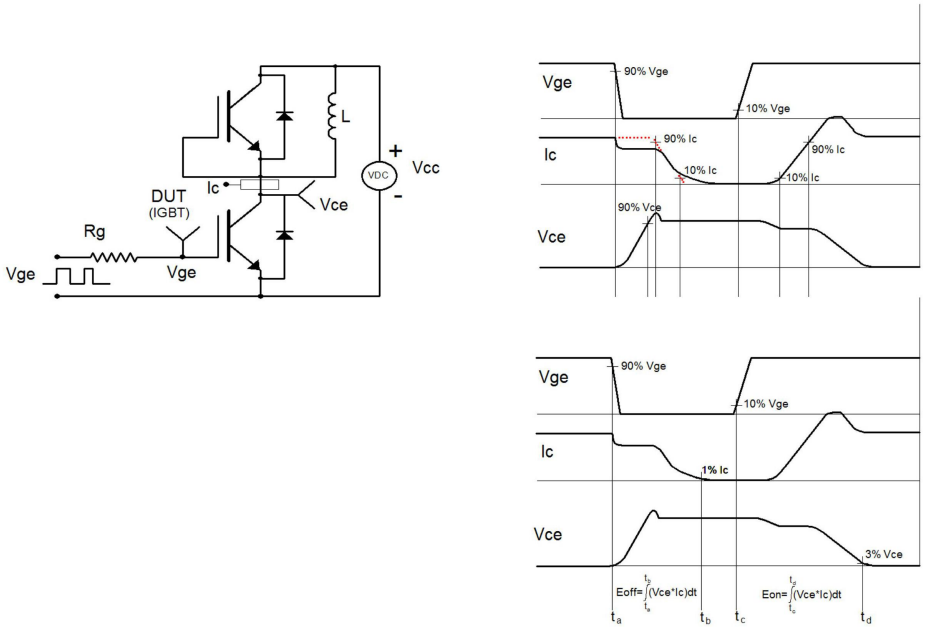



Figure B: Inductive Switching Test Circuit & Waveforms

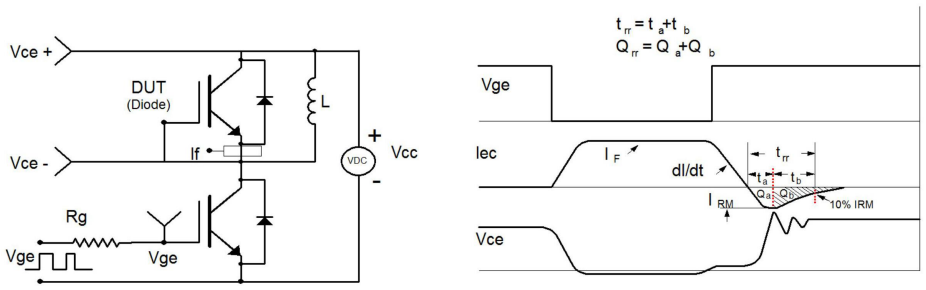



Figure C: Diode Recovery Test Circuit & Waveforms