

### General Description

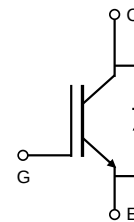
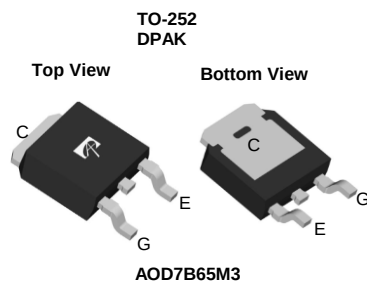
- Latest AlphaIGBT (α IGBT) technology
- 650V breakdown voltage
- Very fast and soft recovery freewheeling diode
- High efficient turn-on di/dt controllability
- Low  $V_{CE(sat)}$  enables high efficiencies
- Low turn-off switching loss and softness
- Very good EMI behavior
- High short-circuit ruggedness

### 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  |
| $I_C$ ( $T_C=100^\circ\text{C}$ )        | 7A    |
| $V_{CE(sat)}$ ( $T_J=25^\circ\text{C}$ ) | 1.87V |



| Orderable Part Number                                                                                                             | Package Type    | Form                          | Minimum Order Quantity |
|-----------------------------------------------------------------------------------------------------------------------------------|-----------------|-------------------------------|------------------------|
| AOD7B65M3                                                                                                                         | TO252           | Tape & Reel                   | 2500                   |
| <b>Absolute Maximum Ratings</b> $T_A=25^\circ\text{C}$ unless otherwise noted                                                     |                 |                               |                        |
| Parameter                                                                                                                         | Symbol          | AOD7B65M3                     | Units                  |
| Collector-Emitter Voltage                                                                                                         | $V_{CE}$        | 650                           | V                      |
| Gate-Emitter Voltage                                                                                                              | $V_{GE}$        | $\pm 30$                      | V                      |
| Continuous Collector Current                                                                                                      | $I_C$           | $T_C=25^\circ\text{C}$<br>14  | A                      |
|                                                                                                                                   |                 | $T_C=100^\circ\text{C}$<br>7  |                        |
| Pulsed Collector Current, Limited by $T_{Jmax}$                                                                                   | $I_{CM}$        | 21                            | A                      |
| Turn off SOA, $V_{CE} \leq 650\text{V}$ , Limited by $T_{Jmax}$                                                                   | $I_{LM}$        | 21                            | A                      |
| Continuous Diode Forward Current                                                                                                  | $I_F$           | $T_C=25^\circ\text{C}$<br>10  | A                      |
|                                                                                                                                   |                 | $T_C=100^\circ\text{C}$<br>5  |                        |
| Diode Pulsed Current, Limited by $T_{Jmax}$                                                                                       | $I_{FM}$        | 21                            | A                      |
| Short circuit withstanding time <sup>1)</sup><br>$V_{GE} = 15\text{V}$ , $V_{CC} \leq 400\text{V}$ , $T_J \leq 150^\circ\text{C}$ | $t_{SC}$        | 5                             | $\mu\text{s}$          |
| Power Dissipation                                                                                                                 | $P_D$           | $T_C=25^\circ\text{C}$<br>69  | W                      |
|                                                                                                                                   |                 | $T_C=100^\circ\text{C}$<br>28 |                        |
| Junction and Storage Temperature Range                                                                                            | $T_J, T_{STG}$  | -55 to 150                    | $^\circ\text{C}$       |
| Maximum lead temperature for soldering purpose, 1/8" from case for 5 seconds                                                      | $T_L$           | 300                           | $^\circ\text{C}$       |
| <b>Thermal Characteristics</b>                                                                                                    |                 |                               |                        |
| Parameter                                                                                                                         | Symbol          | AOD7B65M3                     | Units                  |
| Maximum Junction-to-Ambient                                                                                                       | $R_{\theta JA}$ | 55                            | $^\circ\text{C/W}$     |
| Maximum IGBT Junction-to-Case                                                                                                     | $R_{\theta JC}$ | 1.8                           | $^\circ\text{C/W}$     |
| Maximum Diode Junction-to-Case                                                                                                    | $R_{\theta JC}$ | 5.5                           | $^\circ\text{C/W}$     |

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

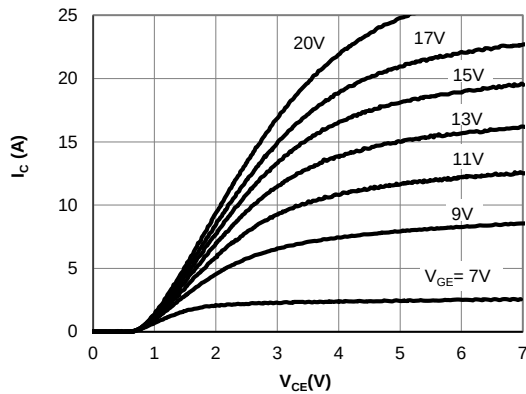
**Electrical Characteristics (T<sub>J</sub>=25°C unless otherwise noted)**

| Symbol                                                      | Parameter                            | Conditions                                                                 | Min                | Typ   | Max       | Units    |         |
|-------------------------------------------------------------|--------------------------------------|----------------------------------------------------------------------------|--------------------|-------|-----------|----------|---------|
| STATIC PARAMETERS                                           |                                      |                                                                            |                    |       |           |          |         |
| $BV_{CES}$                                                  | Collector-Emitter Breakdown Voltage  | $I_C=1mA, V_{GE}=0V, T_J=25^{\circ}C$                                      | 650                | -     | -         | V        |         |
| $V_{CE(sat)}$                                               | Collector-Emitter Saturation Voltage | $V_{GE}=15V, I_C=7A$                                                       | $T_J=25^{\circ}C$  | -     | 1.87      | 2.35     | V       |
|                                                             |                                      |                                                                            | $T_J=125^{\circ}C$ | -     | 2.34      | -        |         |
|                                                             |                                      |                                                                            | $T_J=150^{\circ}C$ | -     | 2.47      | -        |         |
| $V_F$                                                       | Diode Forward Voltage                | $V_{GE}=0V, I_C=7A$                                                        | $T_J=25^{\circ}C$  | -     | 2.1       | 2.6      | V       |
|                                                             |                                      |                                                                            | $T_J=125^{\circ}C$ | -     | 2.04      | -        |         |
|                                                             |                                      |                                                                            | $T_J=150^{\circ}C$ | -     | 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  | $V_{CE}=650V, V_{GE}=0V$                                                   | $T_J=25^{\circ}C$  | -     | -         | 10       | $\mu A$ |
|                                                             |                                      |                                                                            | $T_J=125^{\circ}C$ | -     | -         | 500      |         |
|                                                             |                                      |                                                                            | $T_J=150^{\circ}C$ | -     | -         | 1000     |         |
| $I_{GES}$                                                   | Gate-Emitter leakage current         | $V_{CE}=0V, V_{GE}=\pm 30V$                                                | -                  | -     | $\pm 100$ | 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      | $V_{GE}=15V, V_{CC}=400V,$<br>$t_{sc}\leq 5\mu s, T_J\leq 150^{\circ}C$    | -                  | 30    | -         | A        |         |
| $R_g$                                                       | Gate resistance                      | $V_{GE}=0V, V_{CC}=0V, f=1MHz$                                             | -                  | 6     | -         | $\Omega$ |         |
| SWITCHING PARAMETERS, (Load Inductive, $T_J=25^{\circ}C$ )  |                                      |                                                                            |                    |       |           |          |         |
| $t_{D(on)}$                                                 | Turn-On DelayTime                    | $T_J=25^{\circ}C$<br>$V_{GE}=15V, V_{CC}=400V, I_C=7A,$<br>$R_G=43\Omega$  | -                  | 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          | $T_J=25^{\circ}C$<br>$I_F=7A, dI/dt=200A/\mu s, V_{CC}=400V$               | -                  | 212   | -         | ns       |         |
| $Q_{rr}$                                                    | Diode Reverse Recovery Charge        |                                                                            | -                  | 0.29  | -         | $\mu C$  |         |
| $I_{rm}$                                                    | Diode Peak Reverse Recovery Current  |                                                                            | -                  | 3     | -         | A        |         |
| SWITCHING PARAMETERS, (Load Inductive, $T_J=150^{\circ}C$ ) |                                      |                                                                            |                    |       |           |          |         |
| $t_{D(on)}$                                                 | Turn-On DelayTime                    | $T_J=150^{\circ}C$<br>$V_{GE}=15V, V_{CC}=400V, I_C=7A,$<br>$R_G=43\Omega$ | -                  | 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          | $T_J=150^{\circ}C$<br>$I_F=7A, dI/dt=200A/\mu s, V_{CC}=400V$              | -                  | 273   | -         | ns       |         |
| $Q_{rr}$                                                    | Diode Reverse Recovery Charge        |                                                                            | -                  | 0.45  | -         | $\mu C$  |         |
| $I_{rm}$                                                    | Diode Peak Reverse Recovery Current  |                                                                            | -                  | 3.5   | -         | A        |         |

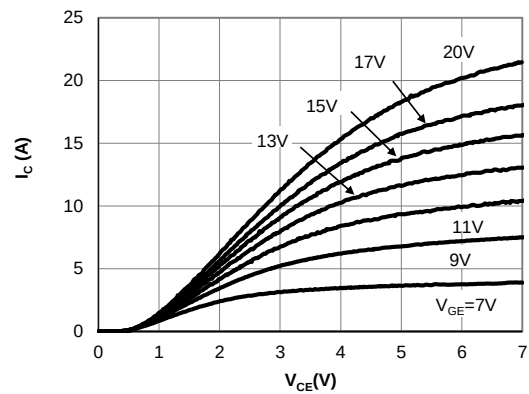
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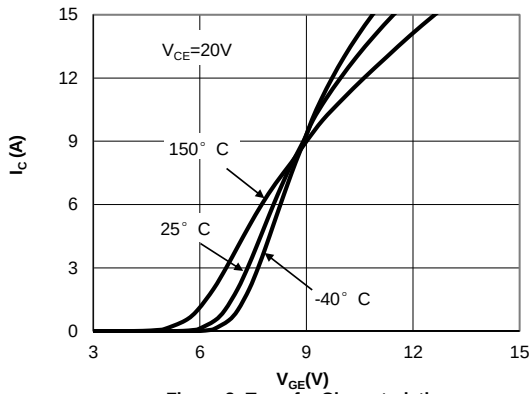
**TYPICAL ELECTRICAL AND THERMAL CHARACTERISTICS**



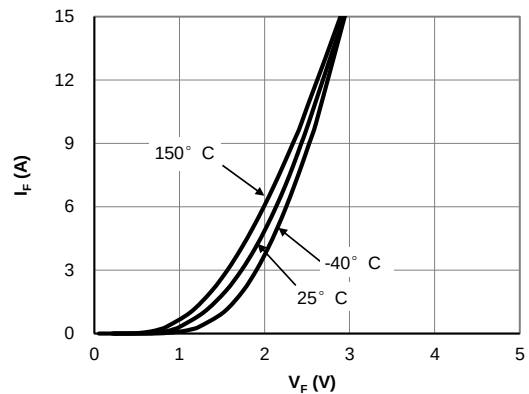
**Figure 1: Output Characteristic**  
( $T_j=25^\circ\text{C}$ )



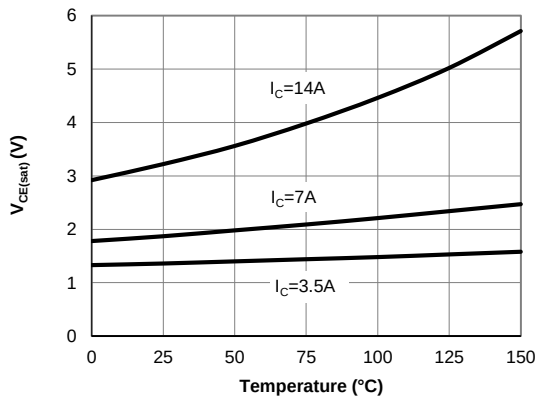
**Figure 2: Output Characteristic**  
( $T_j=150^\circ\text{C}$ )



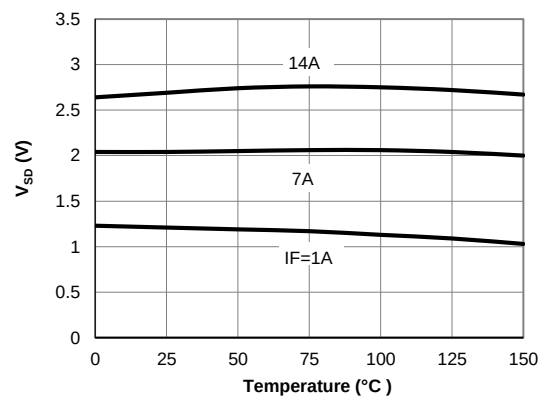
**Figure 3: Transfer Characteristic**



**Figure 4: Diode Characteristic**



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



**Figure 6: Diode Forward voltage vs. Junction Temperature**

**TYPICAL ELECTRICAL AND THERMAL CHARACTERISTICS**

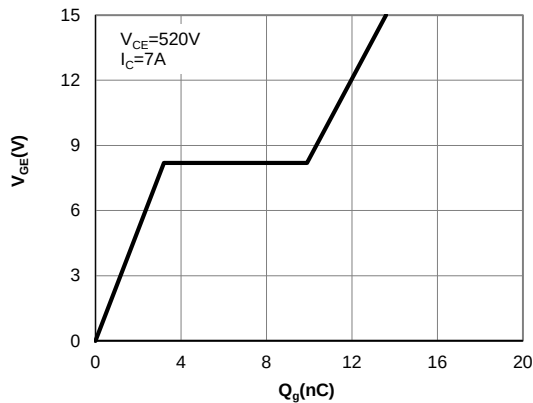


Figure 7: Gate-Charge Characteristics

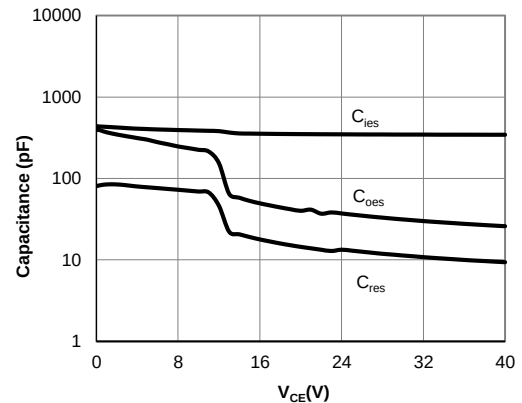


Figure 8: Capacitance Characteristic

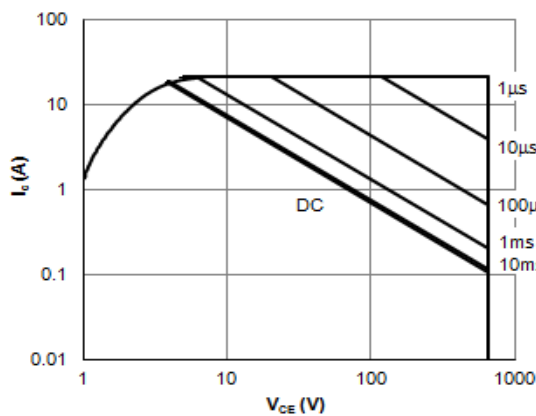


Figure 9: Forward Bias Safe Operating Area  
( $T_C=25^{\circ}\text{C}$ ,  $V_{GS}=15\text{V}$ )

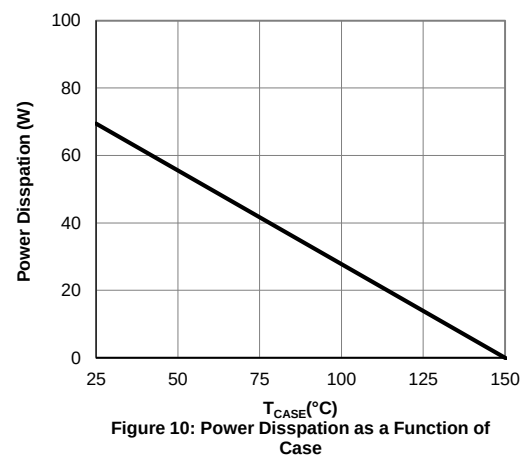


Figure 10: Power Dissipation as a Function of Case

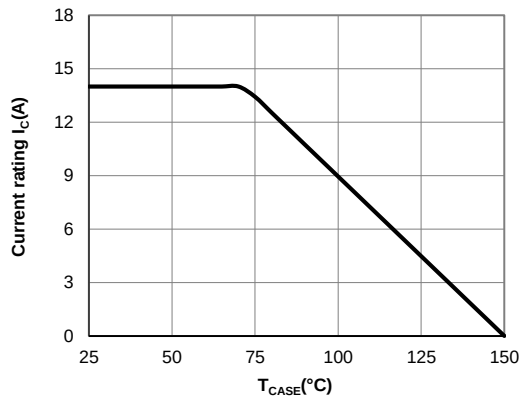


Figure 11: Current De-rating

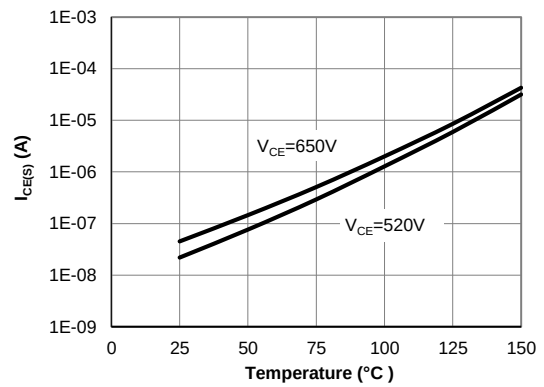
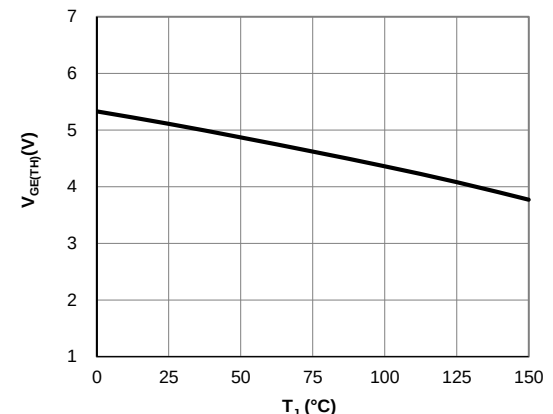
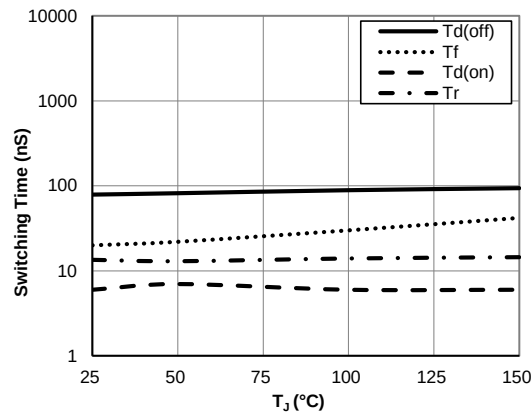
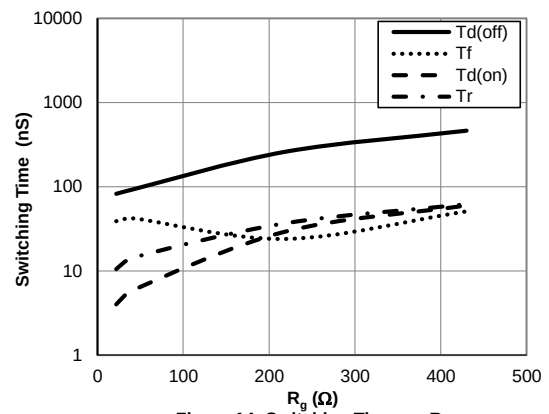
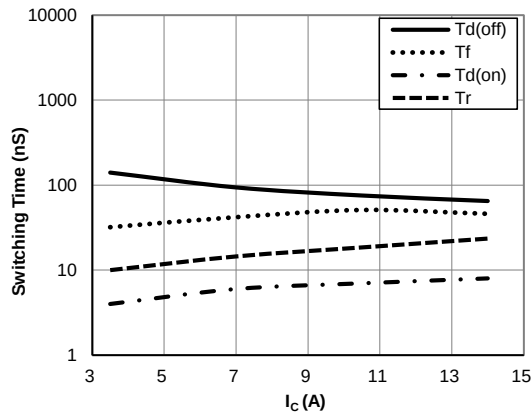
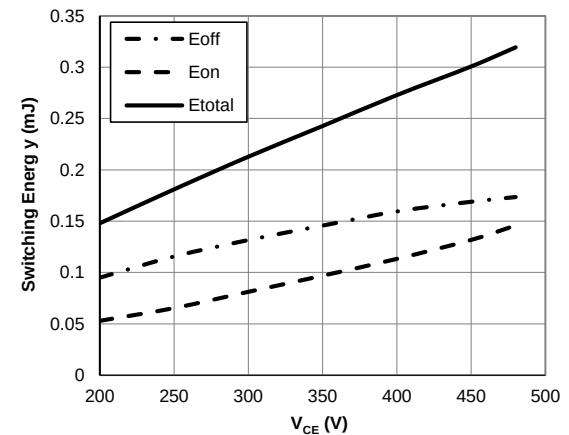
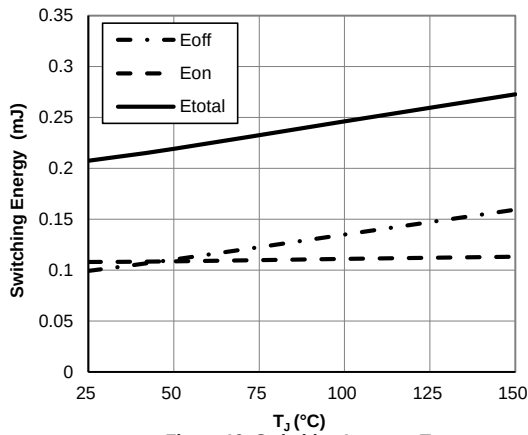
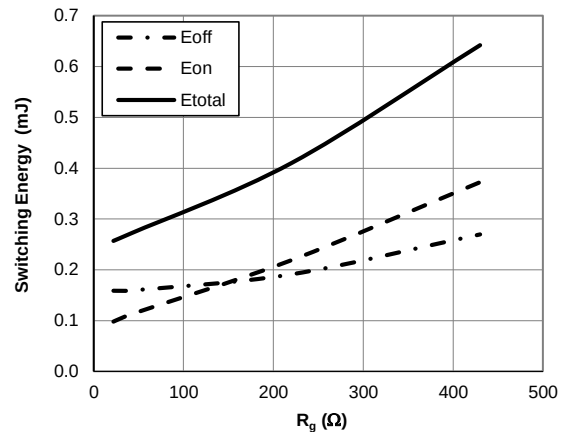
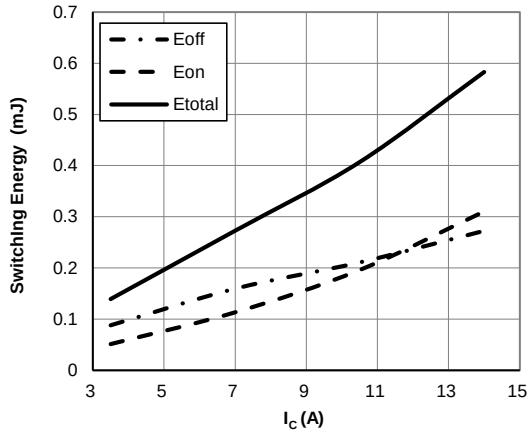


Figure 12: Diode Reverse Leakage Current vs. Junction Temperature

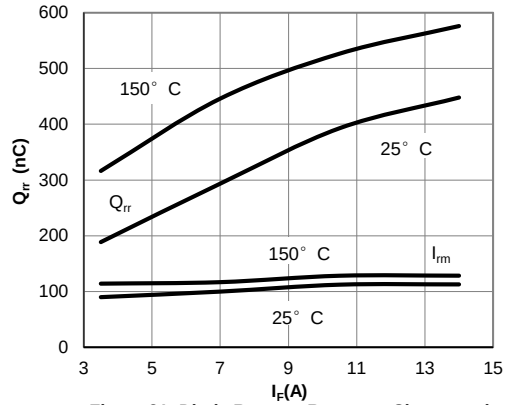
**TYPICAL ELECTRICAL AND THERMAL CHARACTERISTICS**



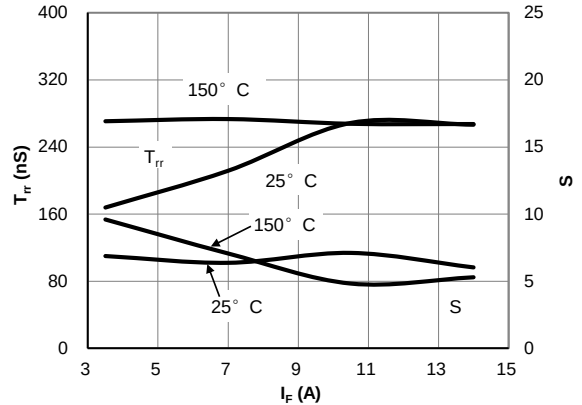
**TYPICAL ELECTRICAL AND THERMAL CHARACTERISTICS**



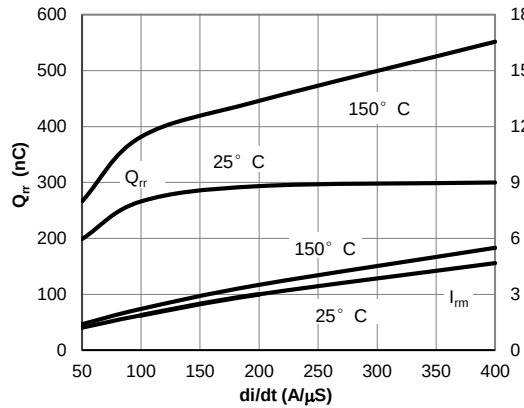
**TYPICAL ELECTRICAL AND THERMAL CHARACTERISTICS**



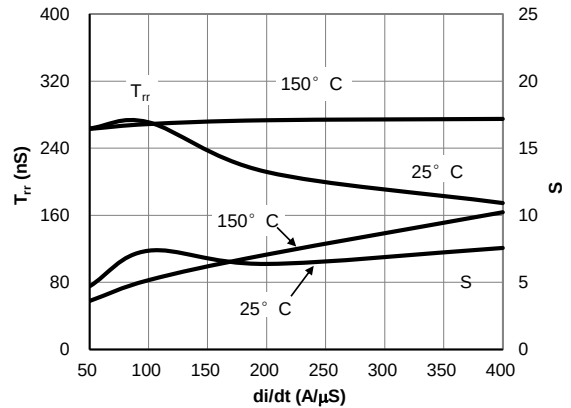
**Figure 21: Diode Reverse Recovery Charge and Peak Current vs. Conduction Current**  
( $V_{GE}=15V, V_{CE}=400V, di/dt=200A/\mu s$ )



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

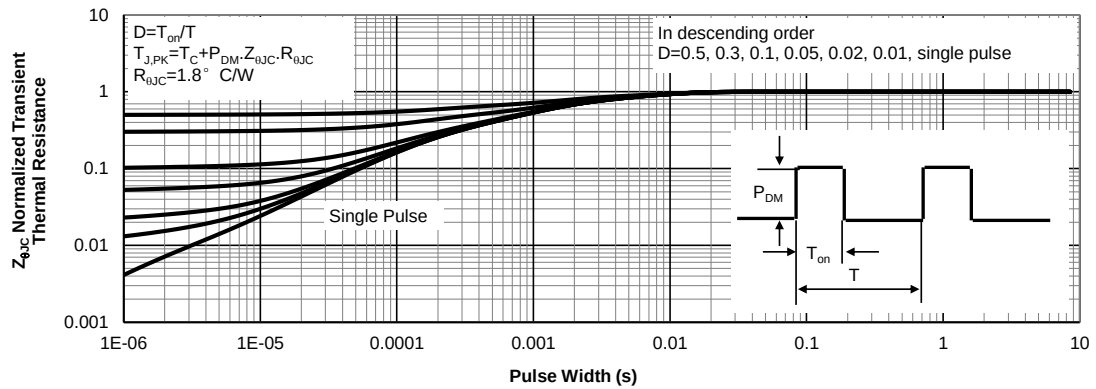


**Figure 23: Diode Reverse Recovery Charge and Peak Current vs. di/dt**  
( $V_{GE}=15V, V_{CE}=400V, I_F=7A$ )

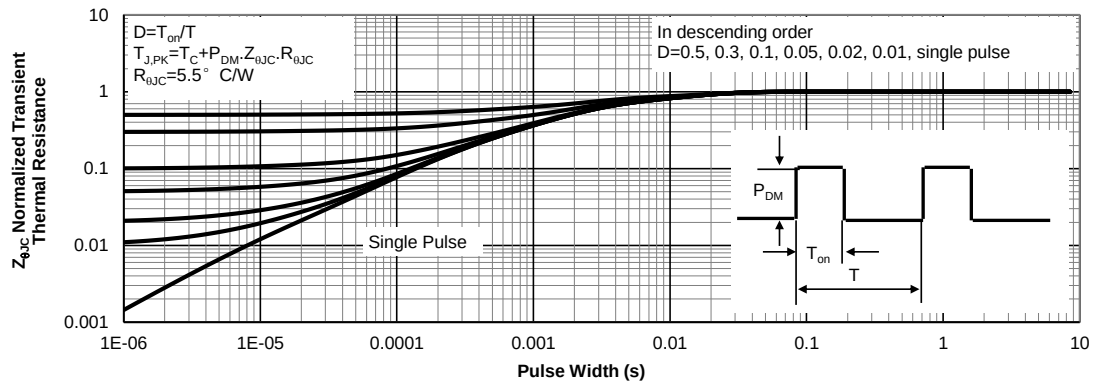


**Figure 24: Diode Reverse Recovery Time and Softness Factor vs. di/dt**  
( $V_{GE}=15V, V_{CE}=400V, I_F=7A$ )

**TYPICAL ELECTRICAL AND THERMAL CHARACTERISTICS**



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



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



