



General Description

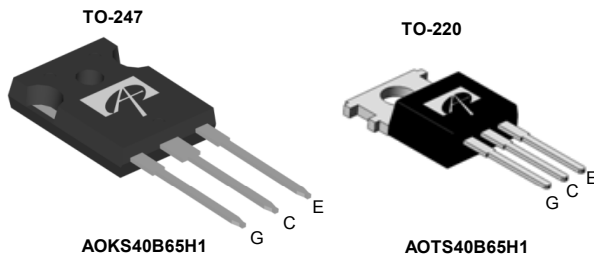
- Latest AlphaIGBT (α IGBT) technology
- 650V breakdown voltage
- High efficient turn-on di/dt controllability
- Very high switching speed
- Low turn-off switching loss and softness
- Very good EMI behavior
- Short-circuit ruggedness

Applications

- Power factor correction
- UPS & Solar Inverters
- Very High Switching Frequency Applications
- Welding Machines

Product Summary

| | |
|--|------|
| V_{CE} | 650V |
| I_C ($T_C=100^\circ\text{C}$) | 40A |
| $V_{CE(sat)}$ ($T_J=25^\circ\text{C}$) | 1.9V |



| Orderable Part Number | Package Type | Form | Minimum Order Quantity |
|-----------------------|--------------|------|------------------------|
| AOKS40B65H1 | TO247 | Tube | 240 |
| AOTS40B65H1 | TO220 | Tube | 1000 |

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

| Parameter | Symbol | AOKS40B65H1/AOTS40B65H1 | Units |
|---|----------------|-------------------------|-------|
| Collector-Emitter Voltage | V_{CE} | 650 | V |
| Gate-Emitter Voltage | V_{GE} | ±30 | V |
| Continuous Collector Current | I_C | $T_C=25^\circ\text{C}$ | 80 |
| | | $T_C=100^\circ\text{C}$ | 40 |
| Pulsed Collector Current, Limited by T_{Jmax} | I_{CM} | 120 | A |
| Turn off SOA, $V_{CE} \leq 650\text{V}$, Limited by T_{Jmax} | I_{LM} | 120 | A |
| Short circuit withstanding time ¹⁾ $V_{GE} = 15\text{V}$, $V_{CC} \leq 300\text{V}$, $T_J \leq 175^\circ\text{C}$ | t_{SC} | 5 | µs |
| Power Dissipation | P_D | $T_C=25^\circ\text{C}$ | 300 |
| | | $T_C=100^\circ\text{C}$ | 150 |
| Junction and Storage Temperature Range | T_J, T_{STG} | -55 to 175 | °C |
| Maximum lead temperature for soldering purpose, 1/8" from case for 5 seconds | T_L | 300 | °C |

Thermal Characteristics

| Parameter | Symbol | AOKS40B65H1/AOTS40B65H1 | Units |
|-------------------------------|-----------------|-------------------------|-------|
| Maximum Junction-to-Ambient | $R_{\theta JA}$ | 40 | °C/W |
| Maximum IGBT Junction-to-Case | $R_{\theta JC}$ | 0.5 | °C/W |

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

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

| Symbol | Parameter | Conditions | Min | Typ | Max | Units | |
|--|--------------------------------------|--|-------------------|------|-----------|----------|---------|
| STATIC PARAMETERS | | | | | | | |
| BV_{CES} | Collector-Emitter Breakdown Voltage | $I_C=1mA, V_{GE}=0V, T_J=25^\circ C$ | 650 | - | - | V | |
| $V_{CE(sat)}$ | Collector-Emitter Saturation Voltage | $V_{GE}=15V, I_C=40A$ | $T_J=25^\circ C$ | - | 1.9 | 2.4 | V |
| | | | $T_J=125^\circ C$ | - | 2.36 | - | |
| | | | $T_J=175^\circ C$ | - | 2.63 | - | |
| $V_{GE(th)}$ | Gate-Emitter Threshold Voltage | $V_{CE}=5V, I_C=1mA$ | - | 4.9 | - | V | |
| I_{CES} | Zero Gate Voltage Collector Current | $V_{CE}=650V, V_{GE}=0V$ | $T_J=25^\circ C$ | - | - | 10 | μA |
| | | | $T_J=125^\circ C$ | - | - | 500 | |
| | | | $T_J=175^\circ C$ | - | - | 10000 | |
| I_{GES} | Gate-Emitter leakage current | $V_{CE}=0V, V_{GE}=\pm 30V$ | - | - | ± 100 | nA | |
| g_{FS} | Forward Transconductance | $V_{CE}=20V, I_C=40A$ | - | 30 | - | S | |
| DYNAMIC PARAMETERS | | | | | | | |
| C_{ies} | Input Capacitance | $V_{GE}=0V, V_{CC}=25V, f=1MHz$ | - | 1789 | - | pF | |
| C_{oes} | Output Capacitance | | - | 129 | - | pF | |
| C_{res} | Reverse Transfer Capacitance | | - | 64 | - | pF | |
| Q_g | Total Gate Charge | $V_{GE}=15V, V_{CC}=520V, I_C=40A$ | - | 63 | - | nC | |
| Q_{ge} | Gate to Emitter Charge | | - | 18 | - | nC | |
| Q_{gc} | Gate to Collector Charge | | - | 25 | - | nC | |
| $I_{C(SC)}$ | Short circuit collector current | $V_{GE}=15V, V_{CC}=300V,$ $t_{sc} \leq 5\mu s, T_J \leq 175^\circ C$ | - | 256 | - | A | |
| R_g | Gate resistance | $V_{GE}=0V, V_{CC}=0V, f=1MHz$ | - | 14 | - | Ω | |
| SWITCHING PARAMETERS, (Load Inductive, T_J=25°C) | | | | | | | |
| $t_{D(on)}$ | Turn-On Delay Time | $T_J=25^\circ C$ $V_{GE}=15V, V_{CC}=400V, I_C=40A,$ $R_G=7.5\Omega$ Eon and Etotal include diode (AOK40B65H1) reverse recovery | - | 41 | - | ns | |
| t_r | Turn-On Rise Time | | - | 36 | - | ns | |
| $t_{D(off)}$ | Turn-Off Delay Time | | - | 130 | - | ns | |
| t_f | Turn-Off Fall Time | | - | 14 | - | ns | |
| E_{on} | Turn-On Energy | | - | 1.27 | - | mJ | |
| E_{off} | Turn-Off Energy | | - | 0.46 | - | mJ | |
| E_{total} | Total Switching Energy | | - | 1.73 | - | mJ | |
| SWITCHING PARAMETERS, (Load Inductive, T_J=175°C) | | | | | | | |
| $t_{D(on)}$ | Turn-On Delay Time | $T_J=175^\circ C$ $V_{GE}=15V, V_{CC}=400V, I_C=40A,$ $R_G=7.5\Omega$ Eon and Etotal include diode (AOK40B65H1) reverse recovery | - | 38 | - | ns | |
| t_r | Turn-On Rise Time | | - | 44 | - | ns | |
| $t_{D(off)}$ | Turn-Off Delay Time | | - | 155 | - | ns | |
| t_f | Turn-Off Fall Time | | - | 18 | - | ns | |
| E_{on} | Turn-On Energy | | - | 1.35 | - | mJ | |
| E_{off} | Turn-Off Energy | | - | 0.8 | - | mJ | |
| E_{total} | Total Switching Energy | | - | 2.15 | - | mJ | |

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TYPICAL ELECTRICAL AND THERMAL CHARACTERISTICS

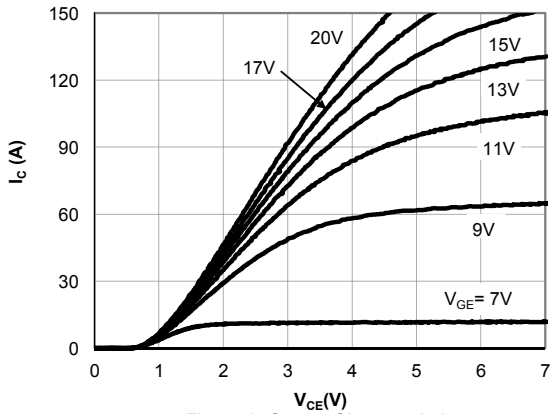


Figure 1: Output Characteristic
($T_j=25^\circ\text{C}$)

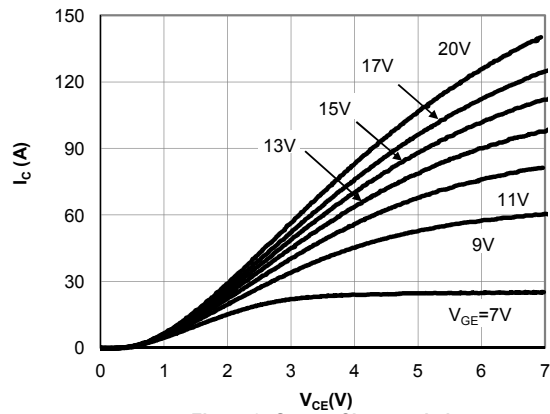


Figure 2: Output Characteristic
($T_j=175^\circ\text{C}$)

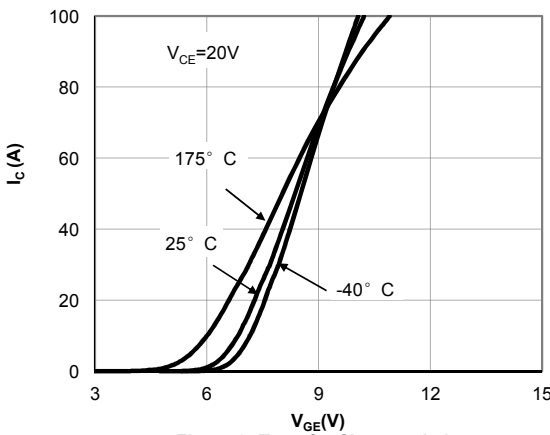


Figure 3: Transfer Characteristic

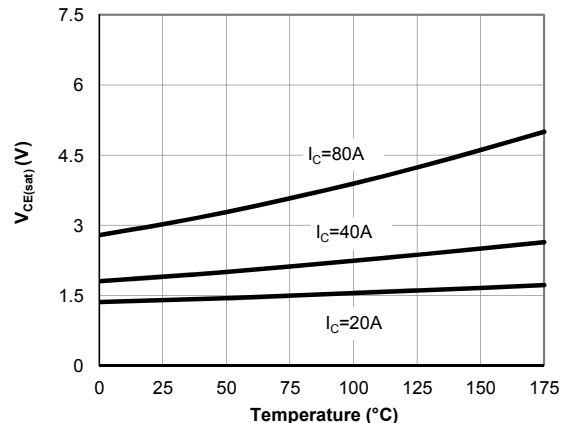


Figure 4: Collector-Emitter Saturation Voltage vs. Junction Temperature

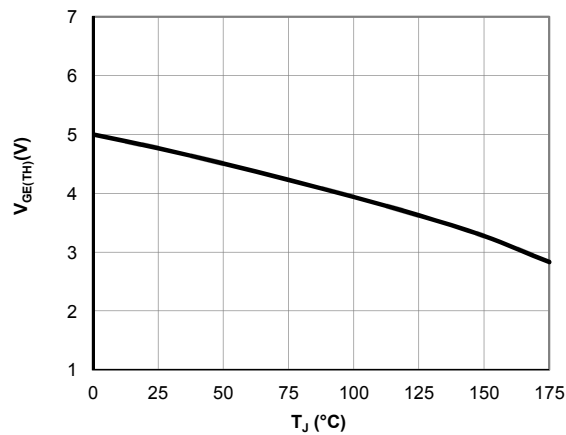
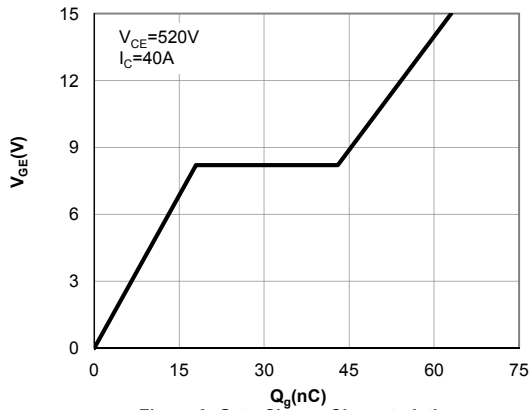
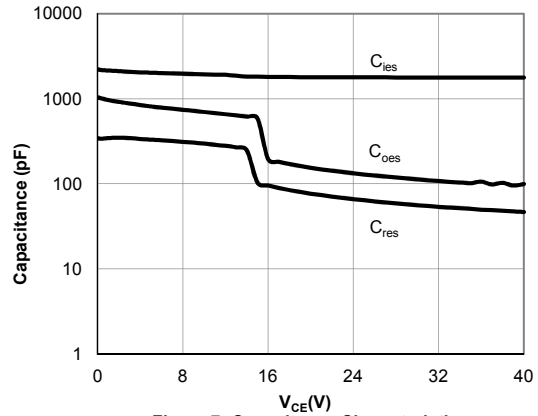
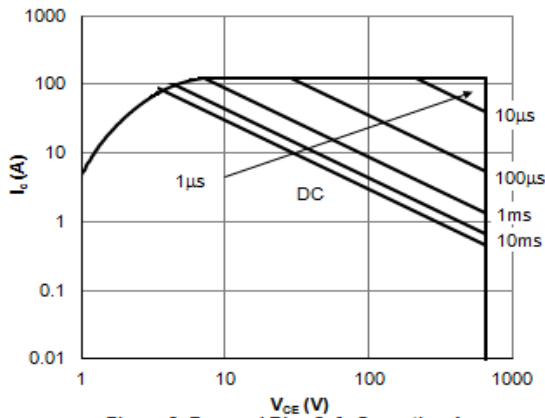
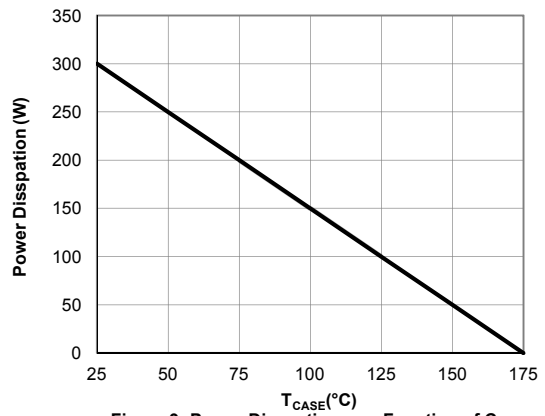
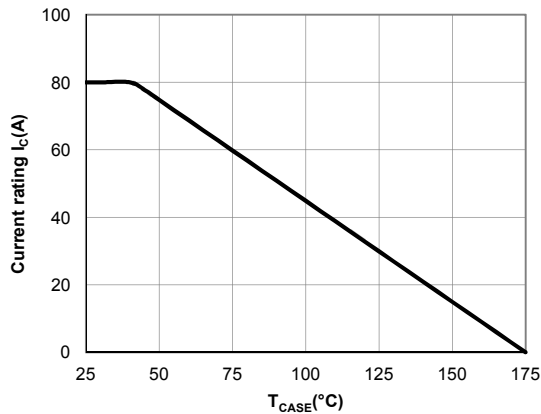
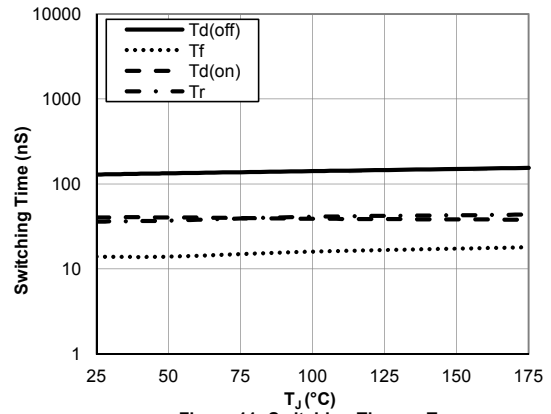


Figure 5: $V_{GE(TH)}$ vs. T_j

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Figure 6: Gate-Charge Characteristics

Figure 7: Capacitance Characteristic

Figure 8: Forward Bias Safe Operating Area
 ($T_C=25^\circ\text{C}, V_{GE}=15\text{V}$)

Figure 9: Power Dissipation as a Function of Case

Figure 10: Current De-rating

Figure 11: Switching Time vs. T_J
 ($V_{GE}=15\text{V}, V_{CE}=400\text{V}, I_C=40\text{A}, R_g=7.5\Omega$)

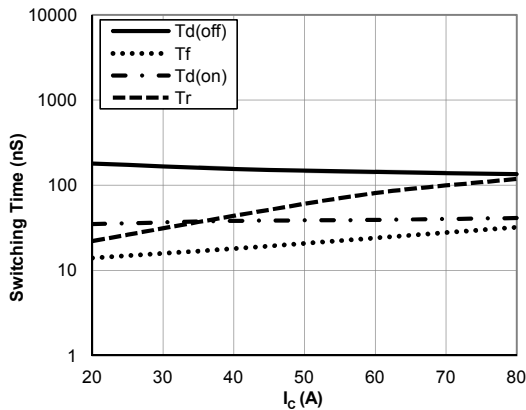
TYPICAL ELECTRICAL AND THERMAL CHARACTERISTICS


Figure 12: Switching Time vs. I_c
 ($T_j=175^\circ\text{C}, V_{GE}=15\text{V}, V_{CE}=400\text{V}, R_g=7.5\Omega$)

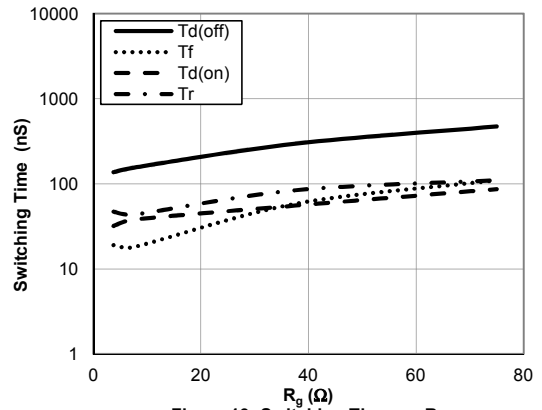


Figure 13: Switching Time vs. R_g
 ($T_j=175^\circ\text{C}, V_{GE}=15\text{V}, V_{CE}=400\text{V}, I_c=40\text{A}$)

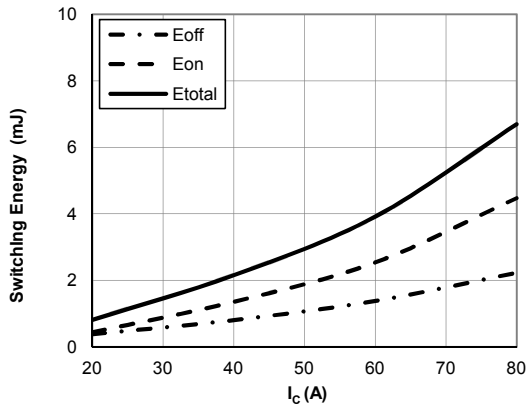


Figure 14: Switching Loss vs. I_c
 ($T_j=175^\circ\text{C}, V_{GE}=15\text{V}, V_{CE}=400\text{V}, R_g=7.5\Omega$)

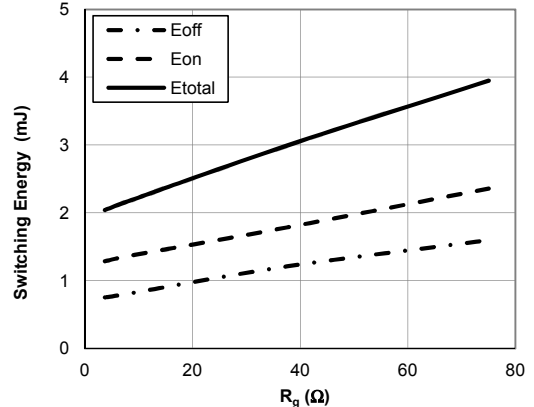


Figure 15: Switching Loss vs. R_g
 ($T_j=175^\circ\text{C}, V_{GE}=15\text{V}, V_{CE}=400\text{V}, I_c=40\text{A}$)

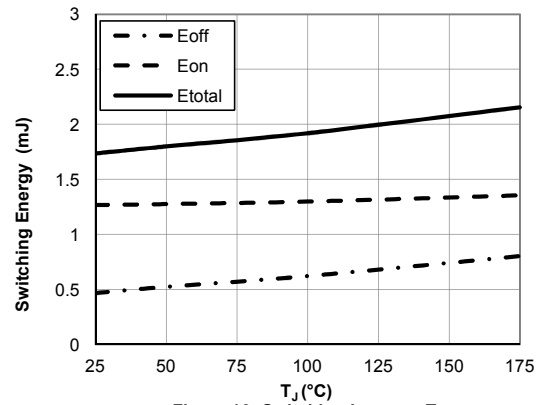


Figure 16: Switching Loss vs. T_j
 ($V_{GE}=15\text{V}, V_{CE}=400\text{V}, I_c=40\text{A}, R_g=7.5\Omega$)

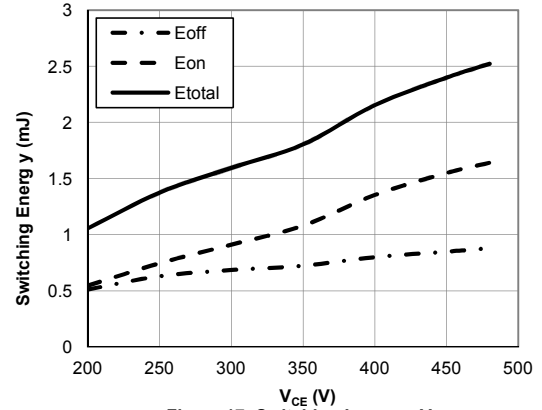


Figure 17: Switching Loss vs. V_{CE}
 ($T_j=175^\circ\text{C}, V_{GE}=15\text{V}, I_c=40\text{A}, R_g=7.5\Omega$)

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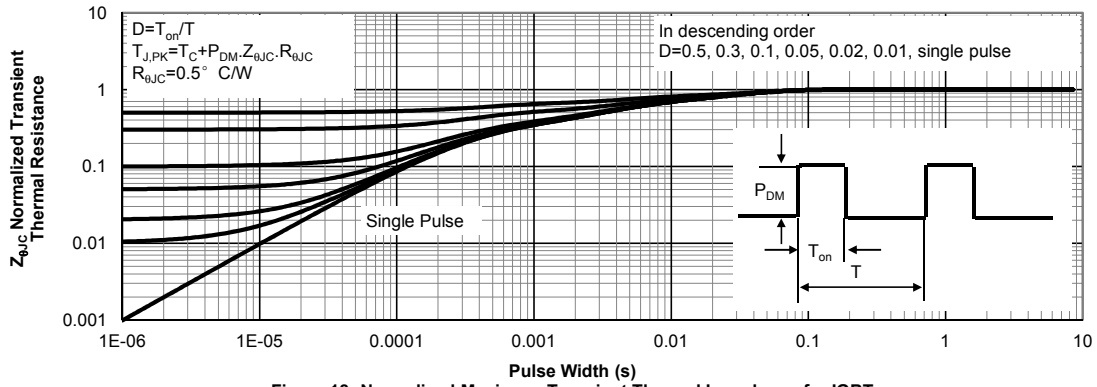


Figure 18: Normalized Maximum Transient Thermal Impedance for IGBT

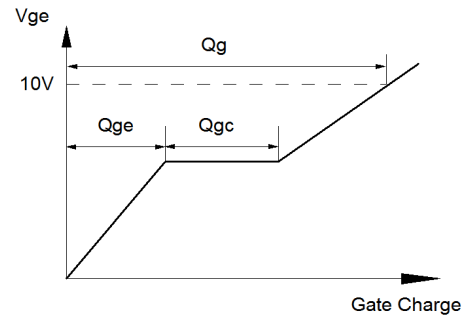
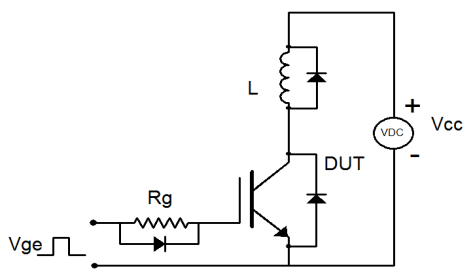


Figure A: Gate Charge Test Circuit & Waveforms

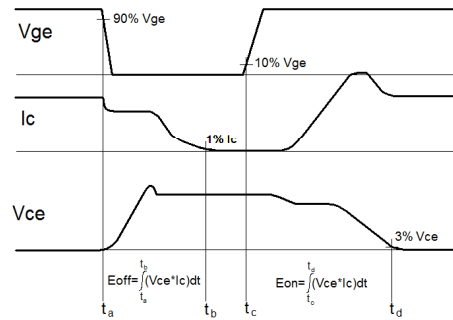
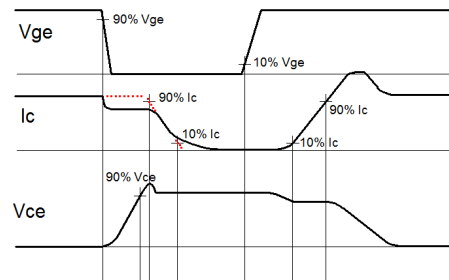
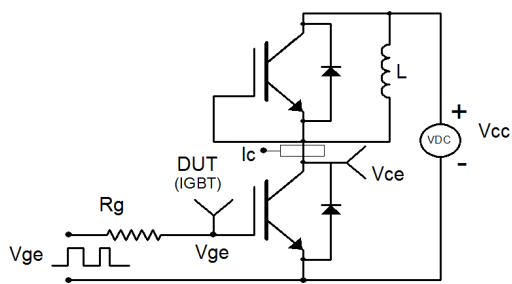


Figure B: Inductive Switching Test Circuit & Waveforms