

HIA50N65H-SA

650V N-Channel Trench Field Stop IGBT

Features

- Very Low $V_{CE(sat)}$
- Extremely low switching loss
- Excellent stability and uniformity
- Soft Fast Reverse Recovery Diode
- Maximum Junction temperature, $T_{J(max)}=175^{\circ}C$

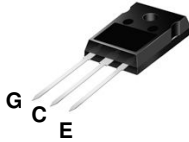
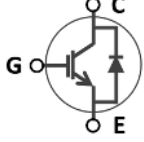
Application

- Solar converters
- Uninterruptible Power Supplies (UPS)
- Power Factor Correction (PFC)
- Welding converters
- High frequency Converters

Key Parameters

| Parameter | Value | Unit |
|---------------|-------|------|
| V_{CES} | 650 | V |
| I_C | 50 | A |
| $V_{CE(sat)}$ | 1.45 | V |
| E_{tot} | 1.60 | mJ |

Package & Internal Circuit

| TO-247 | SYMBOL |
|---|---|
|  |  |

Absolute Maximum Ratings

 $T_C=25^{\circ}C$ unless otherwise specified

| Symbol | Parameter | Value | Unit |
|-----------|---|-------------|-------------|
| V_{CES} | Collector-Emitter Voltage | 650 | V |
| V_{GE} | Gate-Emitter Voltage | ± 20 | V |
| I_C | Collector Current (@ $T_C = 25^{\circ}C$) (@ $T_C = 100^{\circ}C$) | 100 | A |
| | | 50 | A |
| I_{CM} | Pulsed Collector Current (Note. 1) | 200 | A |
| I_F | Diode Continuous Forward Current (@ $T_C = 25^{\circ}C$) (@ $T_C = 100^{\circ}C$) | 100 | A |
| | | 50 | A |
| I_{FM} | Diode Maximum Forward Current | 200 | A |
| P_D | Power Dissipation (@ $T_C = 25^{\circ}C$) (@ $T_C = 100^{\circ}C$) | 272 | W |
| | | 136 | W |
| T_J | Maximum Operating Junction Temperature | 175 | $^{\circ}C$ |
| T_{STG} | Storage Temperature Range | -55 to +175 | $^{\circ}C$ |

Thermal Resistance Characteristics

| Symbol | Parameter | Value | Unit |
|-----------------|--|-------|---------------|
| $R_{\theta JC}$ | IGBT Thermal Resistance, Junction-to-Case, Max. | 0.55 | $^{\circ}C/W$ |
| $R_{\theta JC}$ | Diode Thermal Resistance, Junction-to-Case, Max. | 0.60 | $^{\circ}C/W$ |
| $R_{\theta JA}$ | Thermal Resistance, Junction-to-Ambient, Max. | 40 | $^{\circ}C/W$ |

Notes : 1. Repetitive Rating, Pulse width limited by maximum junction temperature

Electrical Characteristics $T_J=25^\circ\text{C}$ unless otherwise specified

| Symbol | Parameter | Test Conditions | Min | Typ | Max | Unit |
|--------------------------------|--------------------------------------|--|--------|----------------------|----------------|---------------|
| Static Characteristics | | | | | | |
| BV_{CES} | Collector-Emitter Breakdown Voltage | $V_{GE} = 0\text{ V}, I_C = 250\ \mu\text{A}$ | 650 | - | - | V |
| I_{CES} | Zero Gate Voltage Collector Current | $V_{CE} = 650\text{ V}, V_{GE} = 0$ $T_J = 25^\circ\text{C}$ $T_J = 175^\circ\text{C}$ | - - | - 1500 | 50 - | μA |
| I_{GES} | Gate Leakage Current | $V_{GE} = \pm 20\text{ V}, V_{CE} = 0\text{ V}$ | - | - | ± 100 | nA |
| $V_{GE(th)}$ | Gate-Emitter Threshold Voltage | $V_{CE} = V_{GE}, I_C = 250\ \mu\text{A}$ | 4.1 | 4.9 | 5.7 | V |
| $V_{CE(SAT)}$ | Collector-Emitter Saturation Voltage | $V_{GE} = 15\text{ V}, I_C = 25\text{ A},$ $T_J = 25^\circ\text{C}$ $T_J = 175^\circ\text{C}$ | - - | 1.17 1.17 | - - | V |
| | | $V_{GE} = 15\text{ V}, I_C = 50\text{ A},$ $T_J = 25^\circ\text{C}$ $T_J = 150^\circ\text{C}$ $T_J = 175^\circ\text{C}$ | - - | 1.45 1.58 1.60 | 1.80 - - | |
| V_{FEC} | Diode Forward Voltage | $V_{GE} = 0\text{ V}, I_F = 25\text{ A},$ $T_J = 25^\circ\text{C}$ $T_J = 175^\circ\text{C}$ | - - | 1.45 1.49 | - - | V |
| | | $V_{GE} = 0\text{ V}, I_F = 50\text{ A},$ $T_J = 25^\circ\text{C}$ $T_J = 175^\circ\text{C}$ | - - | 1.80 2.00 | 2.40 - | |
| g_{fs} | Transconductance | $V_{CE} = 10\text{ V}, I_C = 50\text{ A}$ | - | 42.0 | - | S |
| Dynamic Characteristics | | | | | | |
| C_{ies} | Input Capacitance | $V_{CE} = 25\text{ V}, V_{GE} = 0\text{ V},$ $f = 1.0\text{ MHz}$ | - | 3,150 | - | pF |
| C_{oes} | Output Capacitance | | - | 140 | - | pF |
| C_{res} | Reverse Transfer Capacitance | | - | 36 | - | pF |
| Q_g | Total Gate Charge | $V_{CE} = 520\text{ V}, I_C = 50\text{ A},$ $V_{GE} = 15\text{ V}$ | - | 105 | - | nC |
| Q_{ge} | Gate-Emitter Charge | | - | 26 | - | nC |
| Q_{gc} | Gate-Collector Charge | | - | 46 | - | nC |
| t_{SC} | Short Circuit Withstand Time | $V_{CE} = 360\text{ V}, V_{GE} = 15\text{ V}$ | 5.0 | - | - | μs |

Electrical Characteristics $T_J=25^\circ\text{C}$ unless otherwise specified

| Symbol | Parameter | Test Conditions | Min | Typ | Max | Unit |
|---|--------------------------------|---|-----|------|-----|---------------|
| Switching Characteristics | | | | | | |
| $t_{d(on)}$ | Turn-On Time | $V_{CE} = 400\text{ V}, I_C = 50\text{ A},$ $R_G = 10\ \Omega, V_{GE} = 0 / 15\text{ V}$ (Note. 2) | - | 67 | - | ns |
| t_r | Turn-On Rise Time | | - | 25 | - | ns |
| $t_{d(off)}$ | Turn-Off Delay Time | | - | 142 | - | ns |
| t_f | Turn-Off Fall Time | | - | 32 | - | ns |
| E_{on} | Turn-On Energy Loss | | - | 0.55 | - | mJ |
| E_{off} | Turn-Off Energy Loss | | - | 1.05 | - | mJ |
| E_{tot} | Total Energy Loss | | - | 1.60 | - | mJ |
| $t_{d(on)}$ | Turn-On Time | $V_{CE} = 400\text{ V}, I_C = 50\text{ A},$ $R_G = 10\ \Omega, V_{GE} = 0 / 15\text{ V}$ $T_J = 150\ ^\circ\text{C}$ (Note. 2) | - | 72 | - | ns |
| t_r | Turn-On Rise Time | | - | 25 | - | ns |
| $t_{d(off)}$ | Turn-Off Delay Time | | - | 156 | - | ns |
| t_f | Turn-Off Fall Time | | - | 42 | - | ns |
| E_{on} | Turn-On Energy Loss | | - | 0.66 | - | mJ |
| E_{off} | Turn-Off Energy Loss | | - | 1.25 | - | mJ |
| E_{tot} | Total Energy Loss | | - | 1.91 | - | mJ |
| Diode Reverse Recovery Characteristics | | | | | | |
| t_{rr} | Diode Reverse Recovery Time | $V_R = 400\text{ V}, I_F = 50\text{ A},$ $di/dt = 1100\text{ A}/\mu\text{s}$ | - | 83 | - | ns |
| I_{rr} | Diode Reverse Recovery Current | | - | 18 | - | A |
| Q_{rr} | Diode Reverse Recovery Charge | | - | 0.75 | - | μC |
| t_{rr} | Diode Reverse Recovery Time | $V_R = 400\text{ V}, I_F = 50\text{ A},$ $T_J = 150^\circ\text{C}$ $di/dt = 1100\text{ A}/\mu\text{s}$ | - | 115 | - | ns |
| I_{rr} | Diode Reverse Recovery Current | | - | 22 | - | A |
| Q_{rr} | Diode Reverse Recovery Charge | | - | 1.27 | - | μC |

Notes : 2. Include tail current and diode reverse recovery.

IGBT Static Characteristics Figure.

Figure.1 Saturation Voltage characteristics ,Junction Temperature(T_j) 25°C

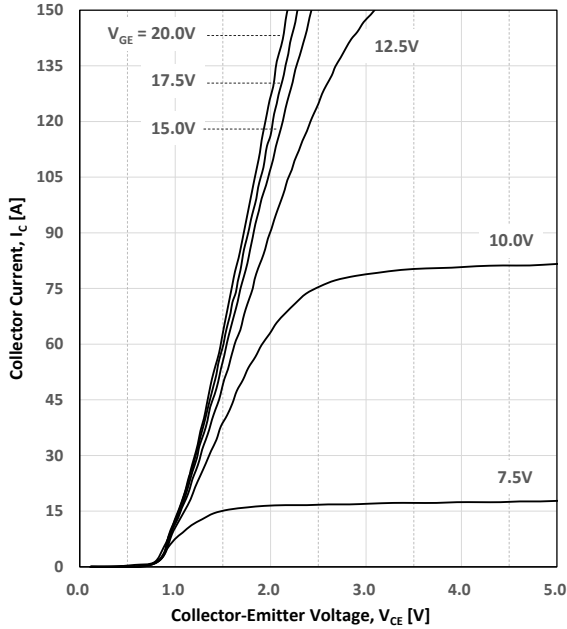


Figure.2 Saturation Voltage characteristics ,Junction Temperature(T_j) 150°C

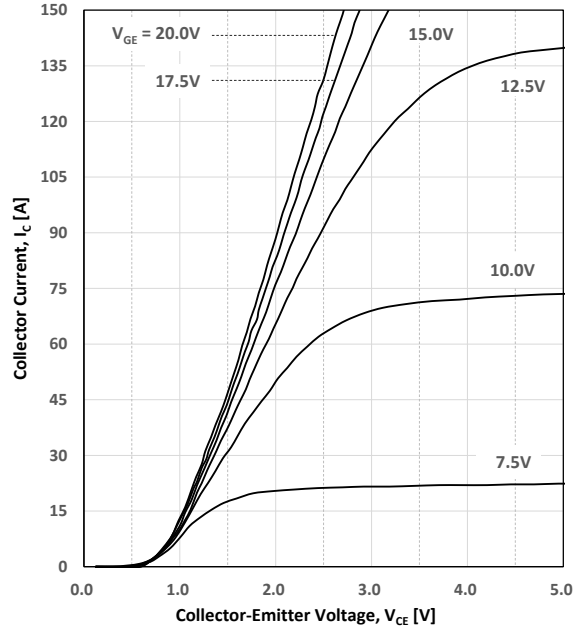


Figure.3 Saturation Voltage characteristics as Junction Temperature, $V_{GE}=15V$

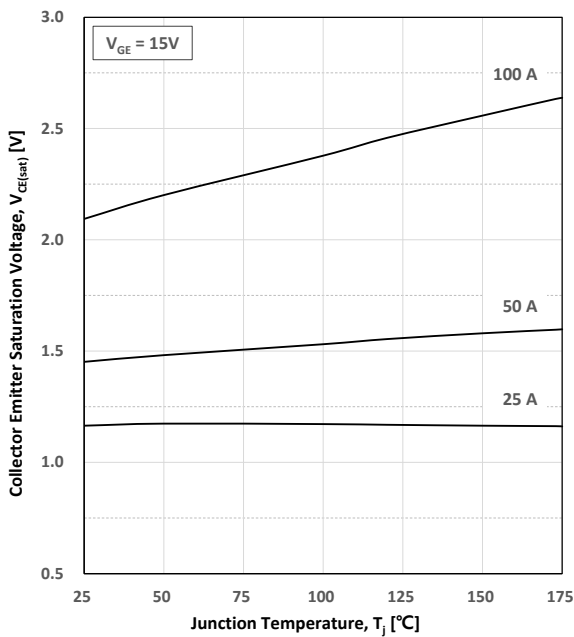


Figure.4 Transconductance characteristics as Junction Temperature

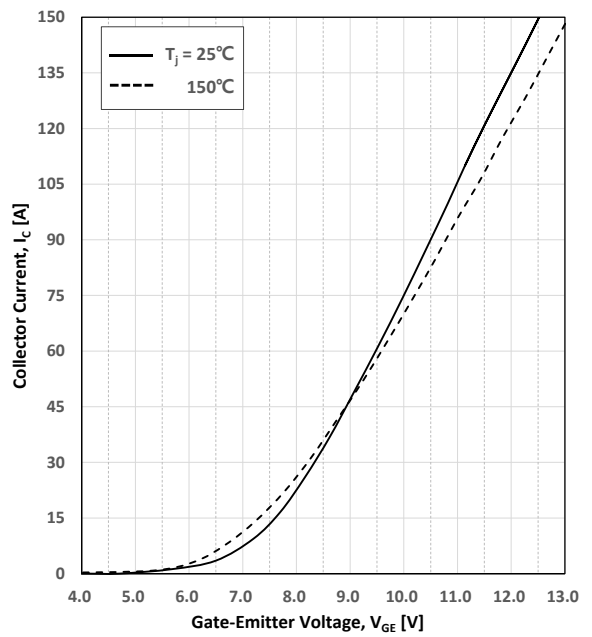


Figure.5 Threshold Voltage characteristics as Junction Temperature

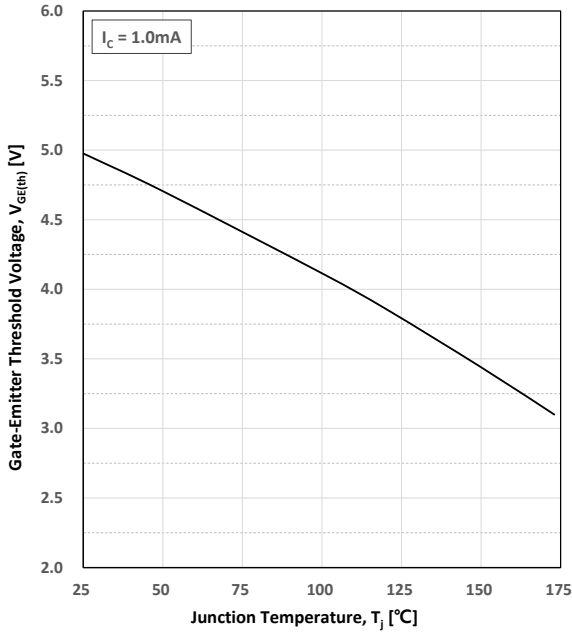
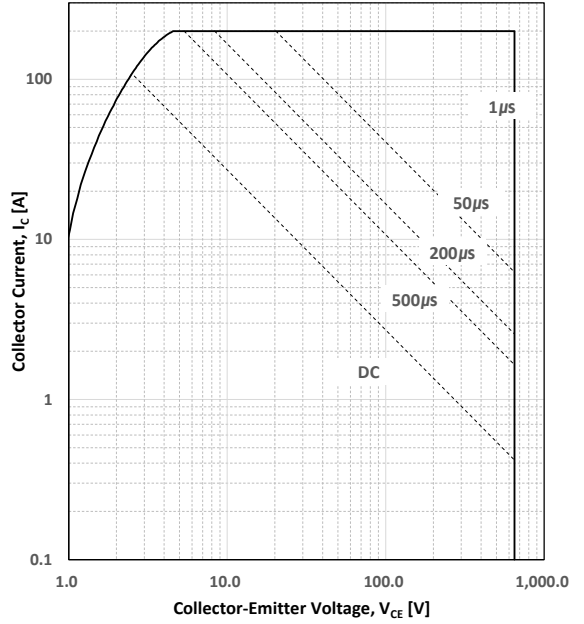


Figure.6 Forward Bias Safe Operating Area ($T_C=25^\circ C, T_J \le 175^\circ C, V_{GE}=15V, t_p=1\mu s, D=0$)



IGBT Dynamic Characteristics Figure.

Figure.7 Capacitance characteristics ($f=1MHz$)

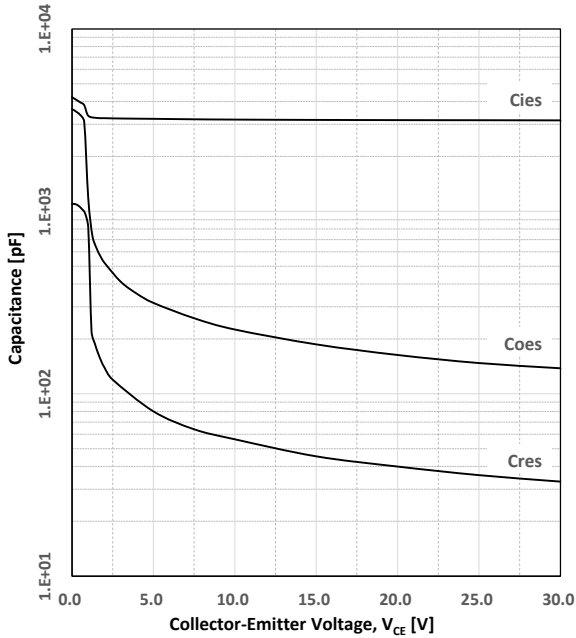
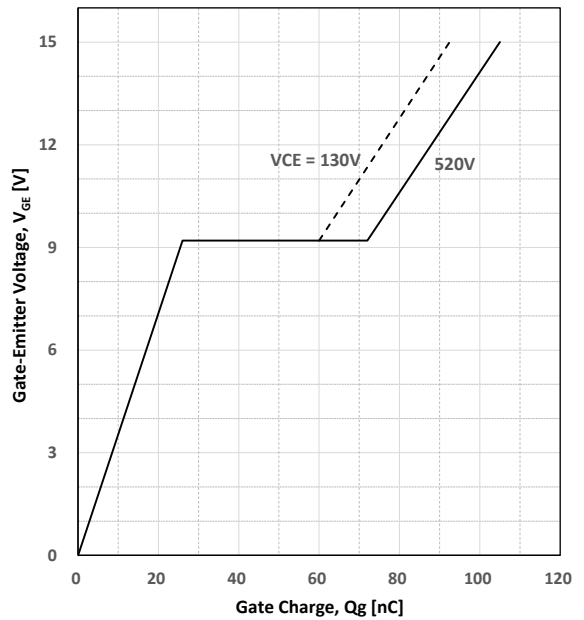


Figure.8 Gate Charge characteristics ($I_c=50A$)



IGBT Switching Characteristics Figure.

Figure.9 Switching Times as Gate Resistance
($V_{CE}=400V$, $I_C=50A$, $V_{GE}=15V$, $T_J=25^\circ C$)

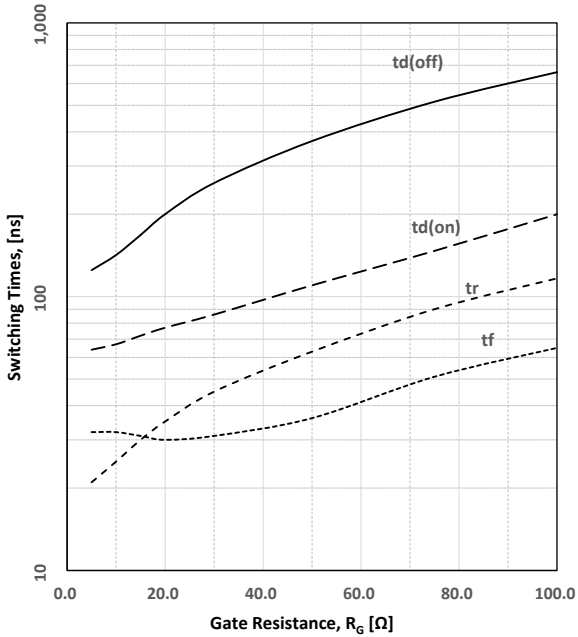


Figure.10 Switching Loss as Gate Resistance
($V_{CE}=400V$, $I_C=50A$, $V_{GE}=15V$, $T_J=25^\circ C$)

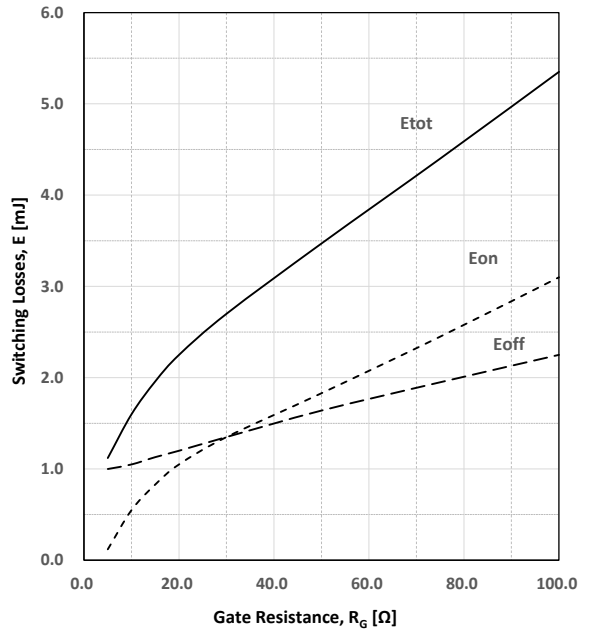


Figure.11 Switching Times as Collector Current
($V_{CE}=400V$, $V_{GE}=15V$, $R_g=10\Omega$, $T_J=25^\circ C$)

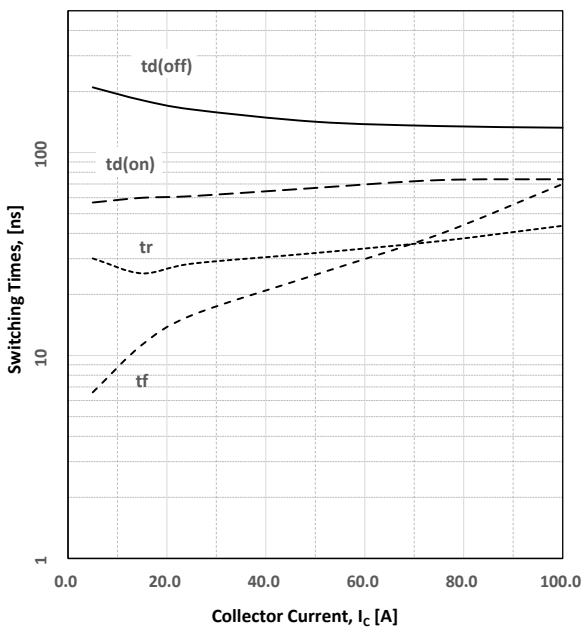


Figure.12 Switching Loss as Collector Current
($V_{CE}=400V$, $V_{GE}=15V$, $R_g=10\Omega$, $T_J=25^\circ C$)

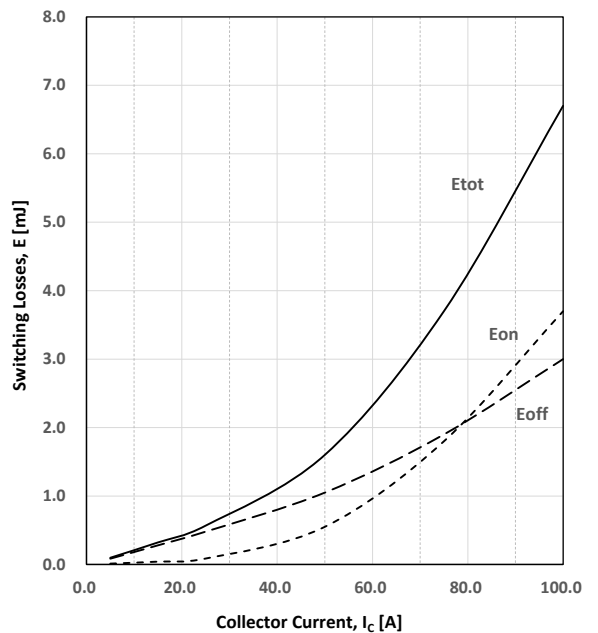


Figure.13 Switching Times as Collector Voltage
 ($I_C=50A$, $V_{GE}=15V$, $R_g=10\Omega$, $T_J=25^\circ C$)

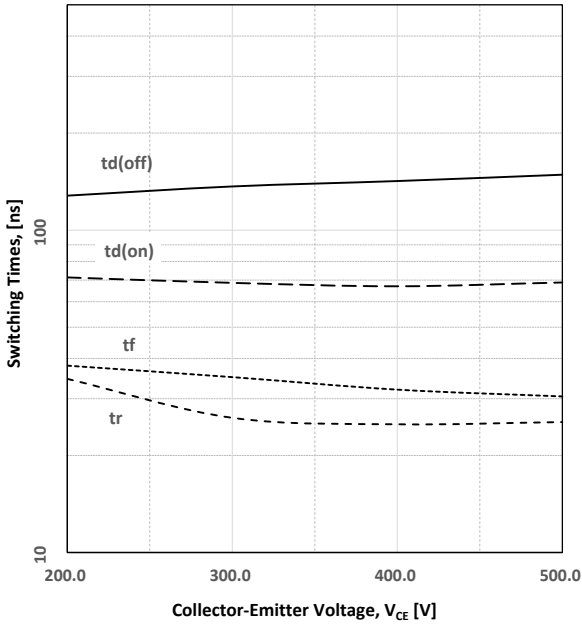


Figure.14 Switching Loss as Collector Voltage
 ($I_C=50A$, $V_{GE}=15V$, $R_g=10\Omega$, $T_J=25^\circ C$)

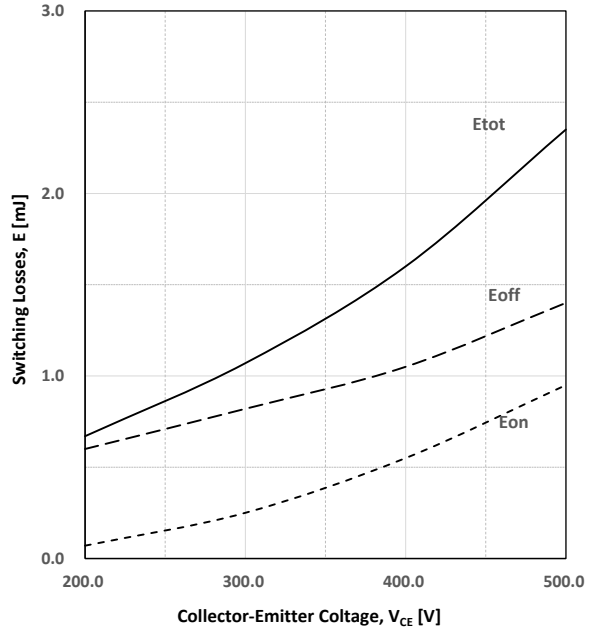


Figure.15 Switching Times as Gate Resistance
 ($V_{CE}=400V$, $I_C=50A$, $V_{GE}=15V$, $T_J=150^\circ C$)

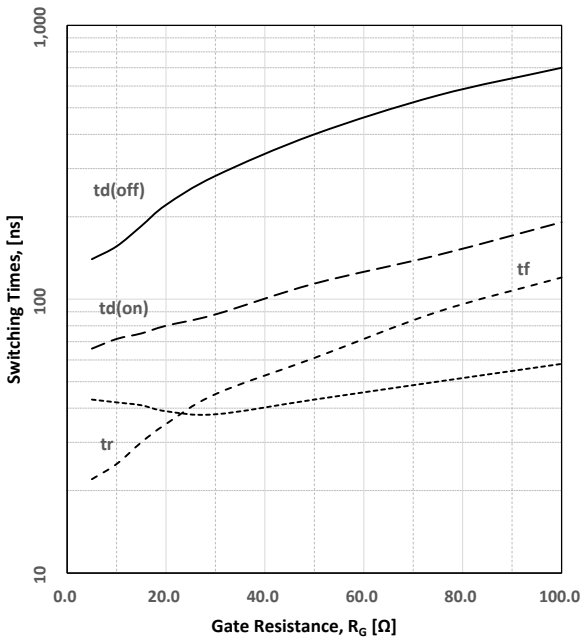


Figure.16 Switching Loss as Gate Resistance
 ($V_{CE}=400V$, $I_C=50A$, $V_{GE}=15V$, $T_J=150^\circ C$)

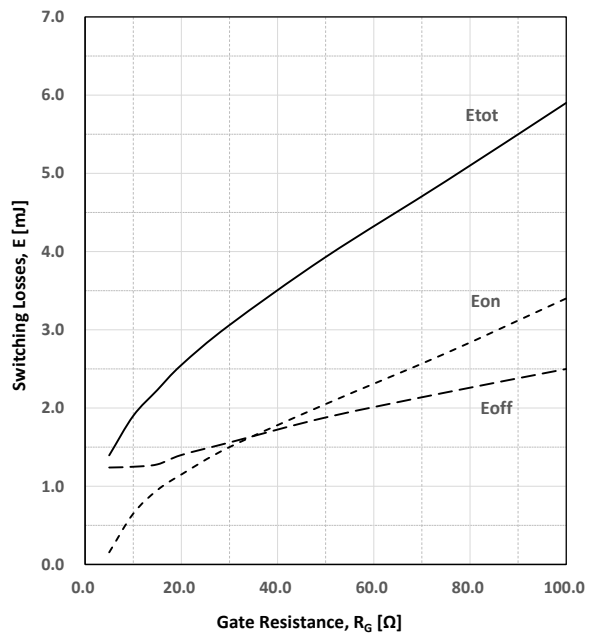


Figure.17 Switching Times as Collector Current
 ($V_{CE}=400V$, $V_{GE}=15V$, $R_g=10\Omega$, $T_J=150^\circ C$)

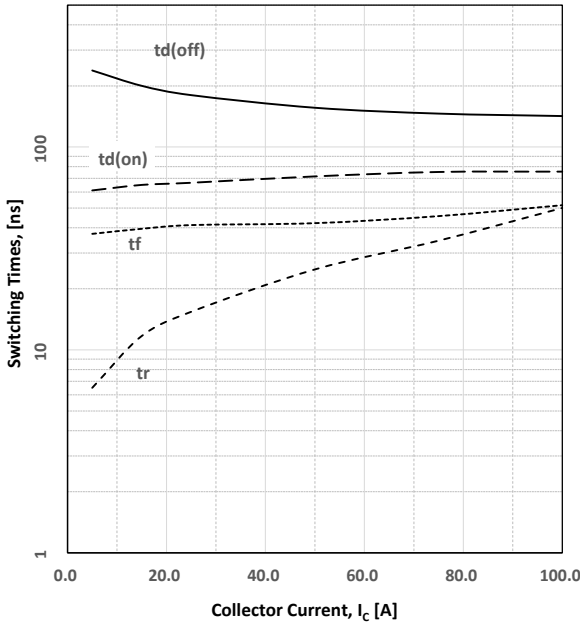


Figure.18 Switching Loss as Collector Current
 ($V_{CE}=400V$, $V_{GE}=15V$, $R_g=10\Omega$, $T_J=150^\circ C$)

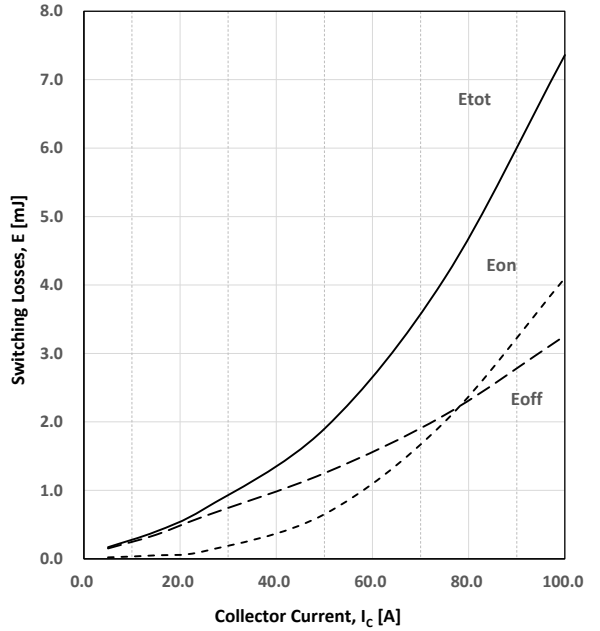


Figure.19 Switching Times as Collector Voltage
 ($I_C=50A$, $V_{GE}=15V$, $R_g=10\Omega$, $T_J=150^\circ C$)

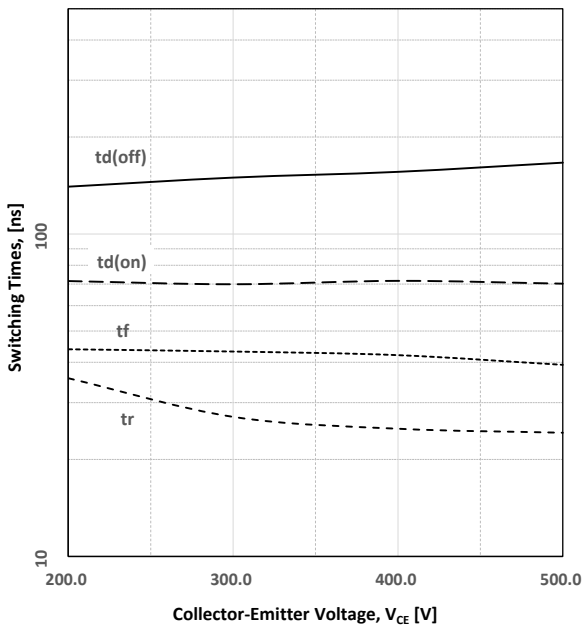


Figure.20 Switching Loss as Collector Voltage
 ($I_C=50A$, $V_{GE}=15V$, $R_g=10\Omega$, $T_J=150^\circ C$)

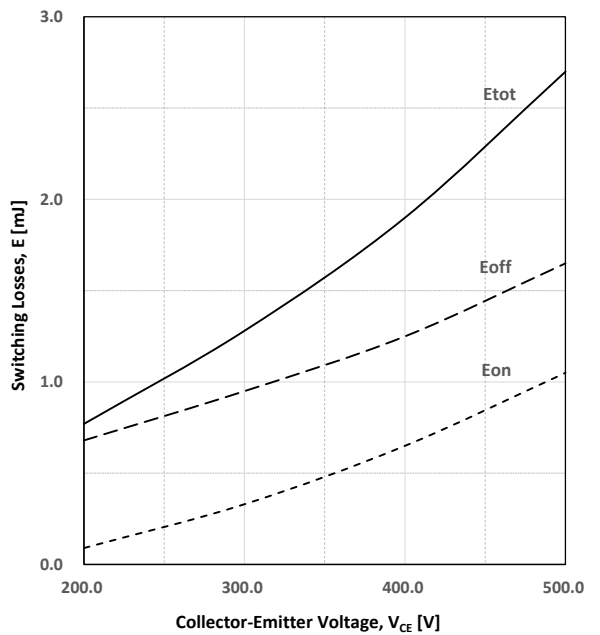


Figure.21 Switching Times as Junction Temp.
 ($V_{CE}=400V$, $I_C=50A$, $V_{GE}=15V$, $R_g=10\Omega$)

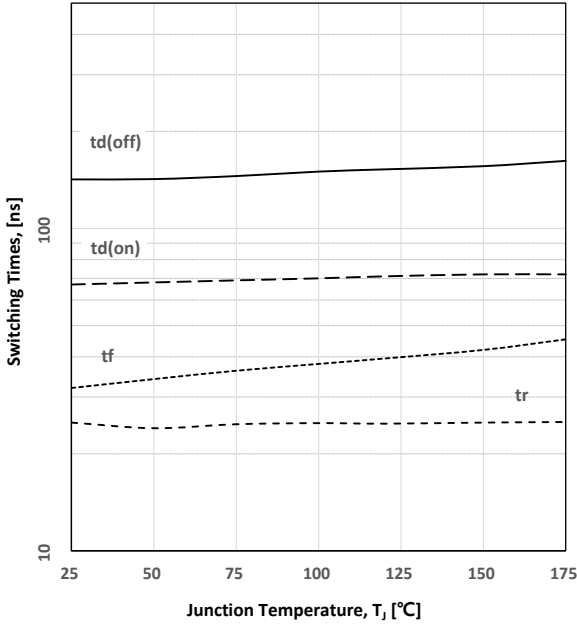
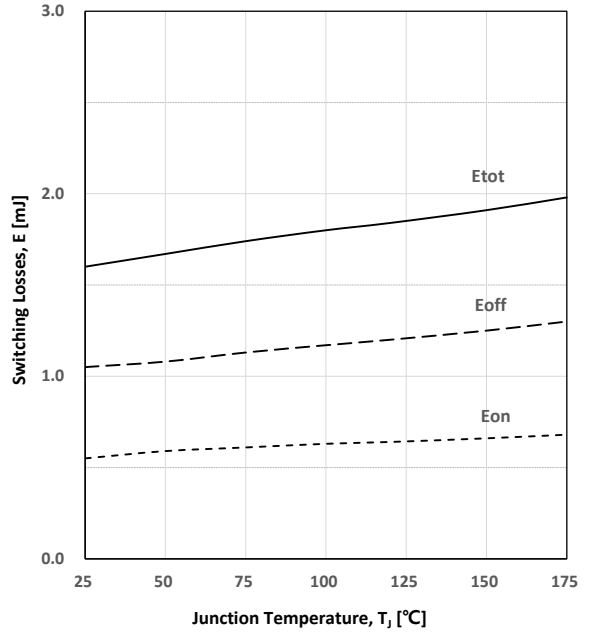
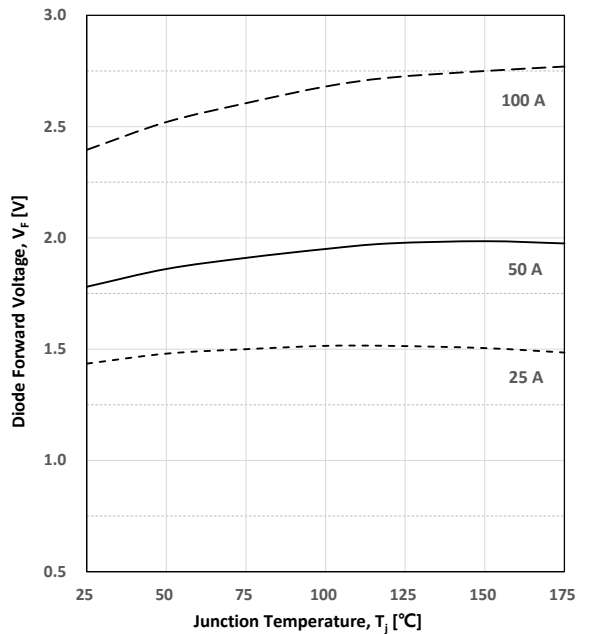
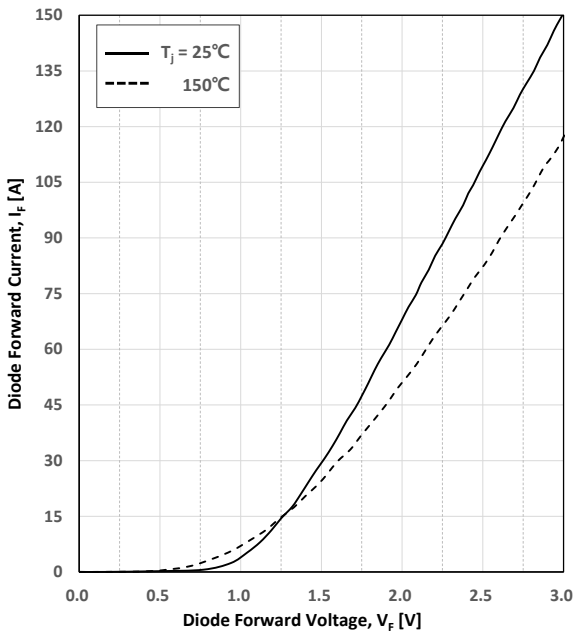


Figure.22 Switching Loss as Junction Temp.
 ($V_{CE}=400V$, $I_C=50A$, $V_{GE}=15V$, $R_g=10\Omega$)



Diode Static Characteristics Figure.

Figure.23 Diode Forward current characteristics as Junction Temperature and Forward current



Diode Reverse Recovery Characteristics Figure.

Figure.24 Reverse Recovery Current as di/dt ($V_R=400V$, $I_F=50A$)

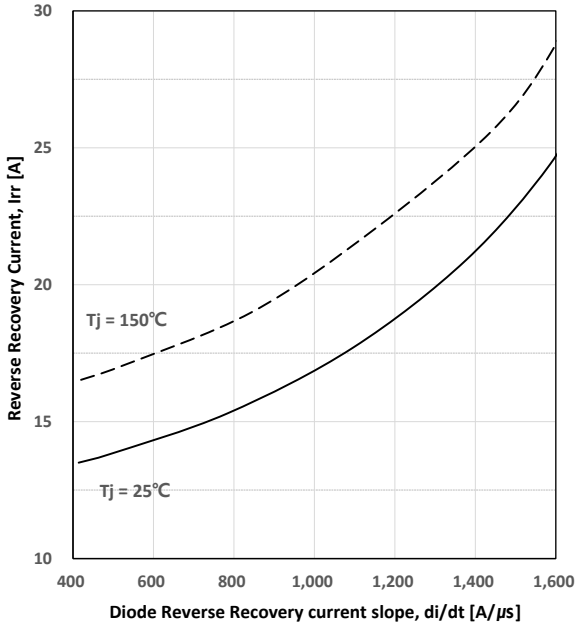


Figure.25 Reverse Recovery Time as di/dt ($V_R=400V$, $I_F=50A$)

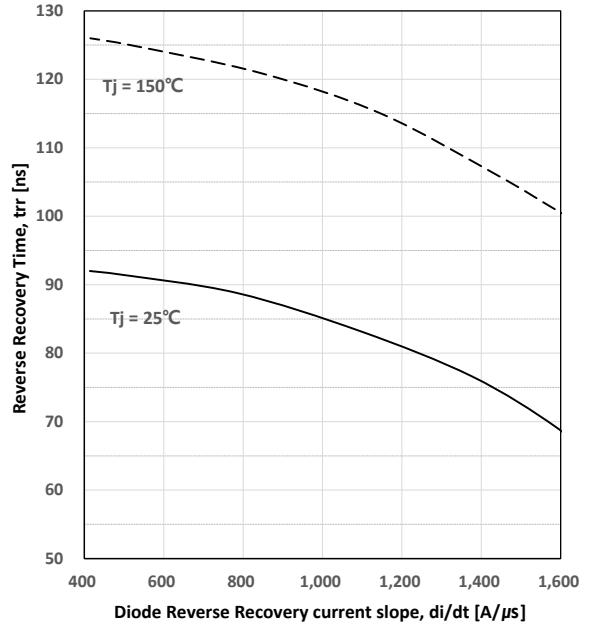
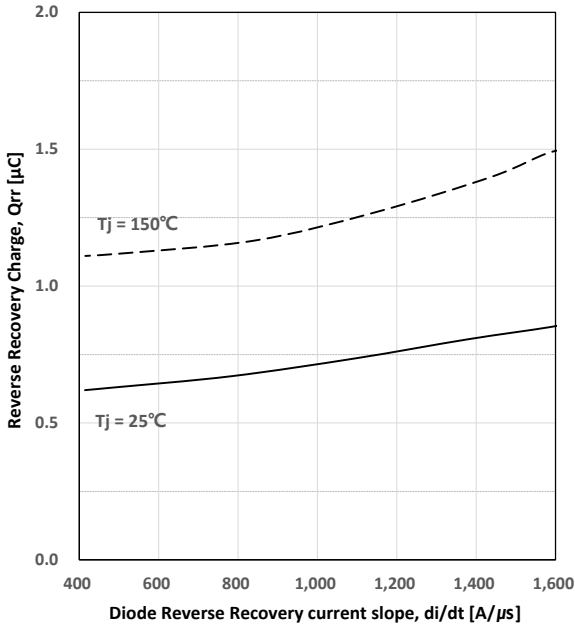


Figure.26 Reverse Recovery Charge as di/dt ($V_R=400V$, $I_F=50A$)



Transient Thermal Impedance Figure.

Figure.27 IGBT Transient Thermal Impedance

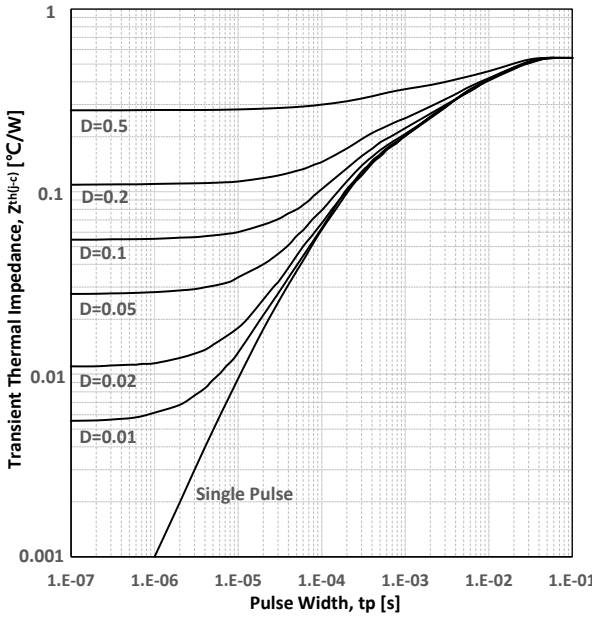
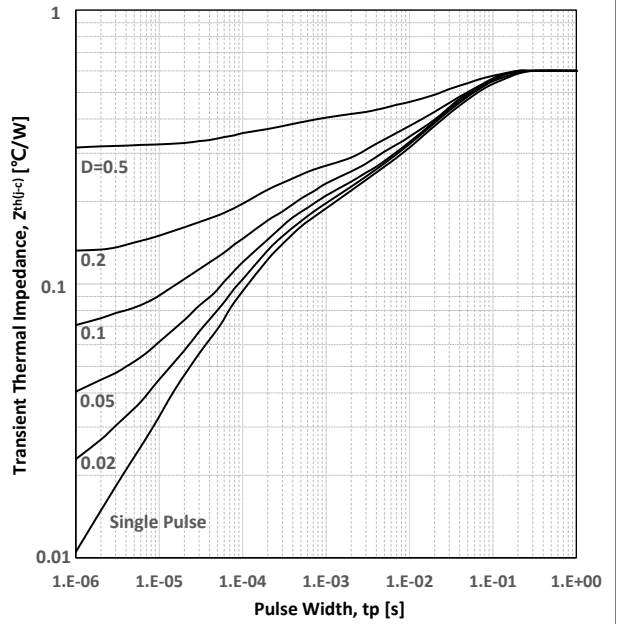
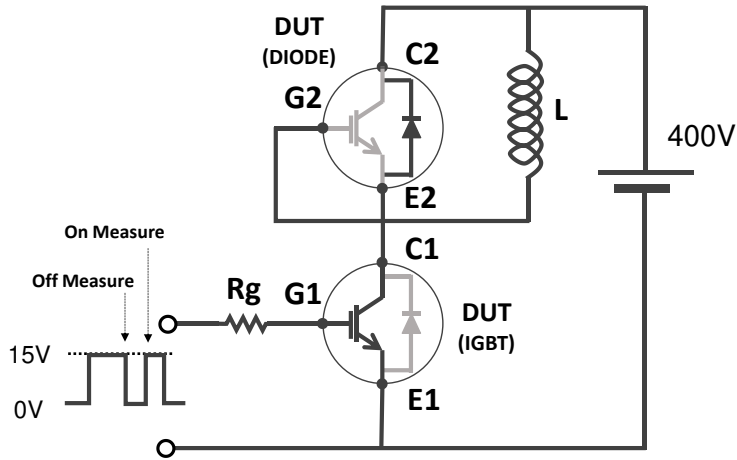


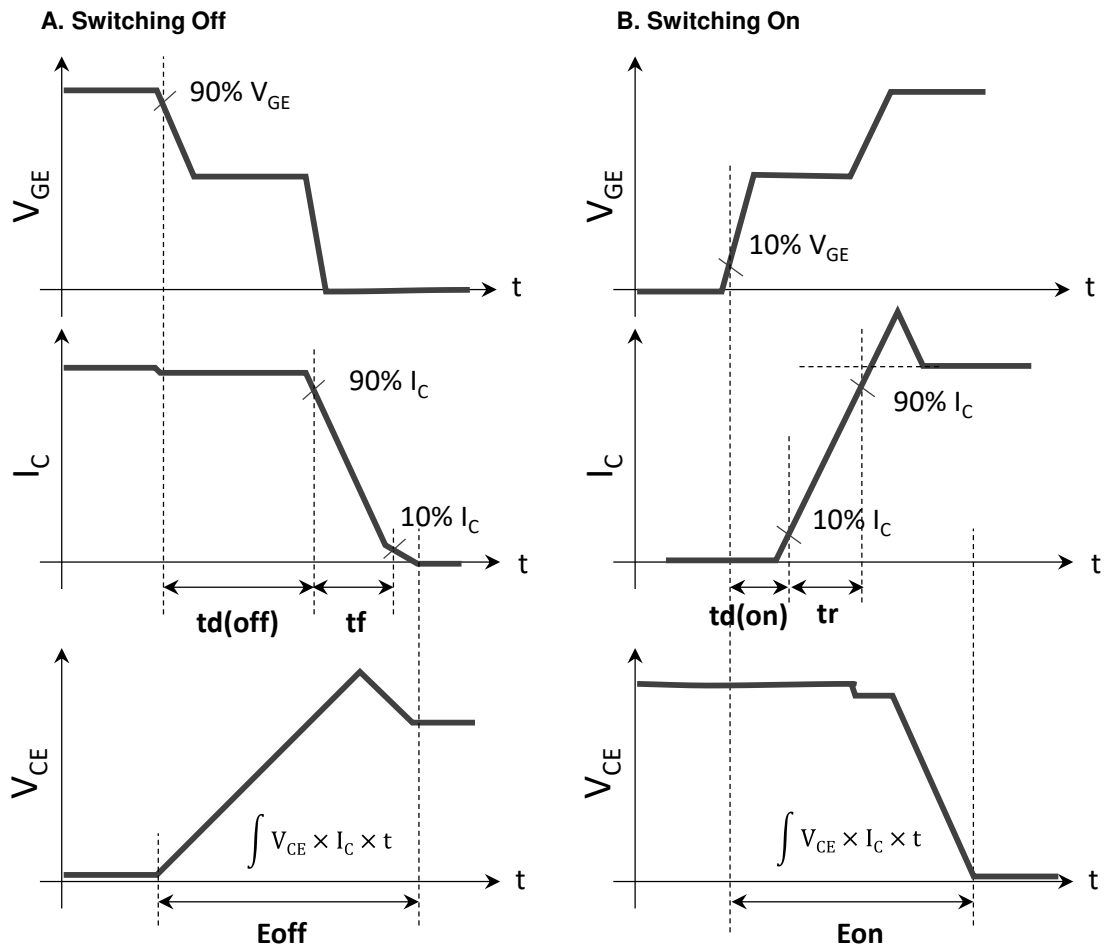
Figure.28 FRD Transient Thermal Impedance



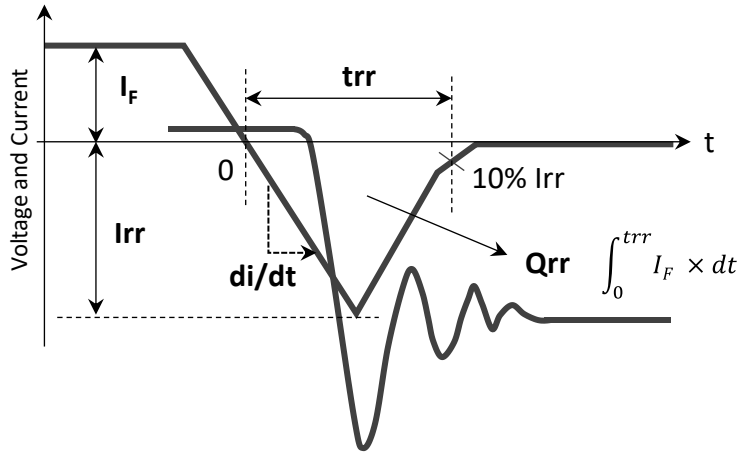
Ref. 1) Switching Test Circuit



Ref. 2) Definition of switching time and loss



Ref. 3) Definition of Diode switching time



Package Dimension : TO-247

