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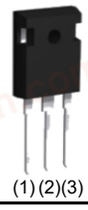
# RGH80TSX2EFHRC11

**1200V 49A Field Stop Trench IGBT** Datasheet

| | |
|---|---|
| $V_{CES}$ | 1200V |
| $I_C$ | 49A |
| $V_{CE(sat)}$ (Typ.) | 1.75V |
| $P_D$ | 300W |

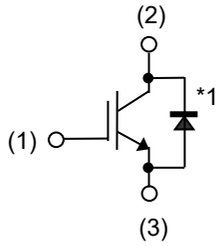
## ●Outline

TO-247N



(1)(2)(3)

## ●Inner Circuit




(1) Gate
(2) Collector
(3) Emitter

*1 Built in FRD

## ●Features

1) AEC-Q101 Qualified
2) Low Collector - Emitter Saturation Voltage
3) Low Switching Loss & Soft Switching
4) Built in Very Fast & Soft Recovery FRD
5) Pb - free Lead Plating ; RoHS Compliant

## ●Application

Automotive
On & Off Board Chargers
DC-DC Converters
PFC

## ●Packaging Specifications

| | | |
|---|---|---|
| Type | Packaging | Tube |
| | Reel Size (mm) | - |
| | Tape Width (mm) | - |
| | Basic Ordering Unit (pcs) | 450 |
| | Packing Code | C11 |
| | Marking | RGH80TSX2EF |

## ●Absolute Maximum Ratings (at $T_C$ = 25°C unless otherwise specified)

| Parameter | | Symbol | Value | Unit |
|---|---|---|---|---|
| Collector - Emitter Voltage | | $V_{CES}$ | 1200 | V |
| Gate - Emitter Voltage | | $V_{GES}$ | ±30 | V |
| Collector Current | $T_C$ = 25°C | $I_C$ | 78 | A |
| | $T_C$ = 100°C | $I_C$ | 49 | A |
| Pulsed Collector Current | | $I_{CP}$ *1 | 160 | A |
| Diode Forward Current | $T_C$ = 25°C | $I_F$ | 68 | A |
| | $T_C$ = 100°C | $I_F$ | 41 | A |
| Diode Pulsed Forward Current | | $I_{FP}$ *1 | 160 | A |
| Power Dissipation | $T_C$ = 25°C | $P_D$ | 300 | W |
| | $T_C$ = 100°C | $P_D$ | 150 | W |
| Operating Junction Temperature | | $T_j$ | -40 to +175 | °C |
| Storage Temperature | | $T_{stg}$ | -55 to +175 | °C |

*1 Pulse width limited by $T_{jmax.}$


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## ●Thermal Resistance

| Parameter | Symbol | Values | | | Unit |
|---|---|---|---|---|---|
| | | Min. | Typ. | Max. | |
| Thermal Resistance IGBT Junction - Case | $R_{\theta(j-c)}$ | - | - | 0.50 | °C/W |
| Thermal Resistance Diode Junction - Case | $R_{\theta(j-c)}$ | - | - | 0.65 | °C/W |

## ●IGBT Electrical Characteristics (at $T_j$ = 25°C unless otherwise specified)

| Parameter | Symbol | Conditions | Values | | | Unit |
|---|---|---|---|---|---|---|
| | | | Min. | Typ. | Max. | |
| Collector - Emitter Breakdown Voltage | $BV_{CES}$ | $I_C$ = 10μA, $V_{GE}$ = 0V | 1200 | - | - | V |
| Collector Cut - off Current | $I_{CES}$ | $V_{CE}$ = 1200V, $V_{GE}$ = 0V | - | - | 10 | μA |
| Gate - Emitter Leakage Current | $I_{GES}$ | $V_{GE}$ = ±30V, $V_{CE}$ = 0V | - | - | ±500 | nA |
| Gate - Emitter Threshold Voltage | $V_{GE(th)}$ | $V_{CE}$ = 5V, $I_C$ = 3.7mA | 4.5 | 5.5 | 6.5 | V |
| Collector - Emitter Saturation Voltage | $V_{CE(sat)}$ | $I_C$ = 40A, $V_{GE}$ = 15V, | | | | V |
| | | $T_j$ = 25°C | - | 1.75 | 2.15 | |
| | | $T_j$ = 175°C | - | 2.45 | - | |


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●**IGBT Electrical Characteristics** (at $T_j$ = 25°C unless otherwise specified)

| Parameter | Symbol | Conditions | Values | | | Unit |
|---|---|---|---|---|---|---|
| | | | Min. | Typ. | Max. | |
| Input Capacitance | $C_{ies}$ | $V_{CE}$ = 30V | - | 3547 | - | pF |
| Output Capacitance | $C_{oes}$ | $V_{GE}$ = 0V | - | 138 | - | |
| Reverse transfer Capacitance | $C_{res}$ | f = 1MHz | - | 29 | - | |
| Total Gate Charge | $Q_g$ | $V_{CE}$ = 600V | - | 132 | - | nC |
| Gate - Emitter Charge | $Q_{ge}$ | $I_C$ = 40A | - | 22 | - | |
| Gate - Collector Charge | $Q_{gc}$ | $V_{GE}$ = 15V | - | 51 | - | |
| Turn - on Delay Time | $t_{d(on)}$ | $I_C$ = 40A, $V_{CC}$ = 600V, $V_{GE}$ = 15V, $R_G$ = 10Ω, $T_j$ = 25°C Inductive Load *Eon does not include diode reverse recovery | - | 53 | - | ns |
| Rise Time | $t_r$ | | - | 19 | - | |
| Turn - off Delay Time | $t_{d(off)}$ | | - | 218 | - | |
| Fall Time | $t_f$ | | - | 101 | - | |
| Turn-on Switching Loss | $E_{on}$ | | - | 1.26 | - | mJ |
| Turn-off Switching Loss | $E_{off}$ | | - | 1.38 | - | |
| Turn - on Delay Time | $t_{d(on)}$ | $I_C$ = 40A, $V_{CC}$ = 600V, $V_{GE}$ = 15V, $R_G$ = 10Ω, $T_j$ = 175°C Inductive Load *Eon does not include diode reverse recovery | - | 50 | - | ns |
| Rise Time | $t_r$ | | - | 22 | - | |
| Turn - off Delay Time | $t_{d(off)}$ | | - | 240 | - | |
| Fall Time | $t_f$ | | - | 157 | - | |
| Turn-on Switching Loss | $E_{on}$ | | - | 1.32 | - | mJ |
| Turn-off Switching Loss | $E_{off}$ | | - | 1.82 | - | |
| Reverse Bias Safe Operating Area | RBSOA *2 | $I_C$ = 160A, $V_{CC}$ < 800V, $V_p$< 1200V, $V_{GE}$ = 15V, $t_p$ < 1us, $T_j$ = 175°C | FULL SQUARE | | | - |

*2 Design assurance without measurement


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●**FRD Electrical Characteristics** (at $T_j$ = 25°C unless otherwise specified)

| Parameter | Symbol | Conditions | Values | | | Unit |
|---|---|---|---|---|---|---|
| | | | Min. | Typ. | Max. | |
| Diode Forward Voltage | $V_F$ | $I_F$ = 40A, $T_j$ = 25°C | - | 2.15 | 2.60 | V |
| | | $T_j$ = 175°C | - | 2.35 | - | |
| Diode Reverse Recovery Time | $t_{rr}$ | $I_F$ = 40A, $V_{CC}$ = 600V, $R_G$ = 10Ω, $T_j$ = 25°C | - | 175 | - | ns |
| Diode Peak Reverse Recovery Current | $I_{rr}$ | | - | 24.8 | - | A |
| Diode Reverse Recovery Charge | $Q_{rr}$ | | - | 1.8 | - | µC |
| Diode Reverse Recovery Energy | $E_{rr}$ | | - | 0.6 | - | mJ |
| Diode Reverse Recovery Time | $t_{rr}$ | $I_F$ = 40A, $V_{CC}$ = 600V, $R_G$ = 10Ω, $T_j$ = 175°C | - | 320 | - | ns |
| Diode Peak Reverse Recovery Current | $I_{rr}$ | | - | 32.8 | - | A |
| Diode Reverse Recovery Charge | $Q_{rr}$ | | - | 4.2 | - | µC |
| Diode Reverse Recovery Energy | $E_{rr}$ | | - | 1.7 | - | mJ |


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## ●Electrical Characteristic Curves

Fig.1 Power Dissipation vs. Case Temperature

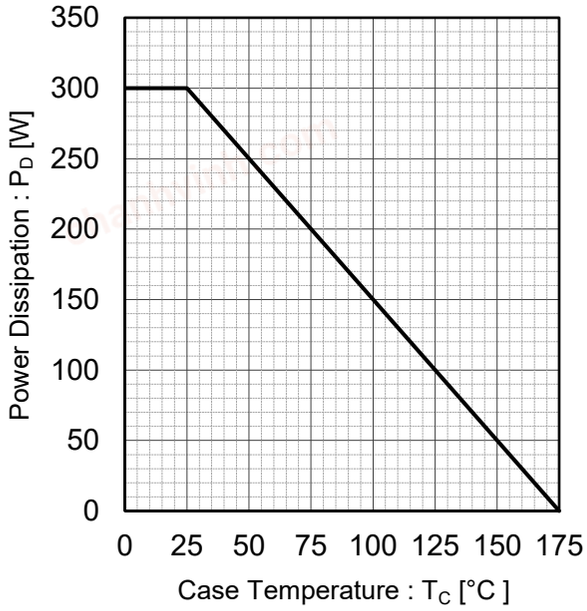



Fig.2 Collector Current vs. Case Temperature

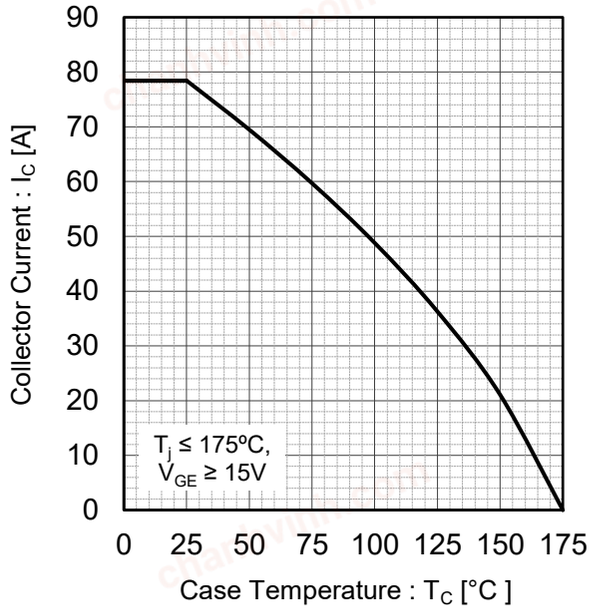



Fig.3 Forward Bias Safe Operating Area

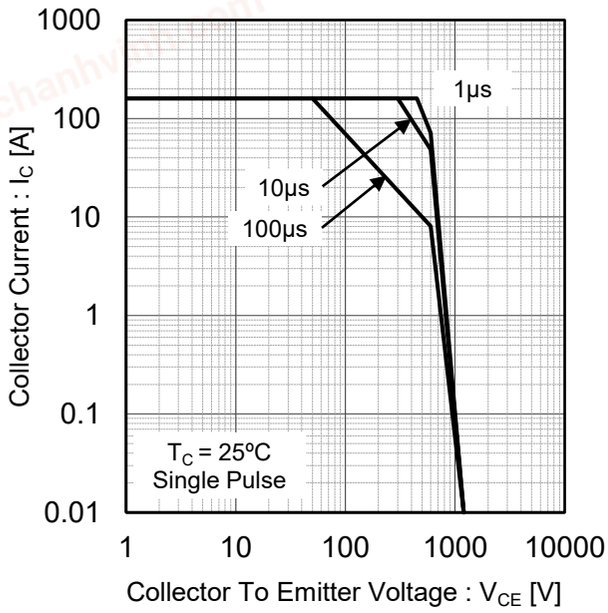
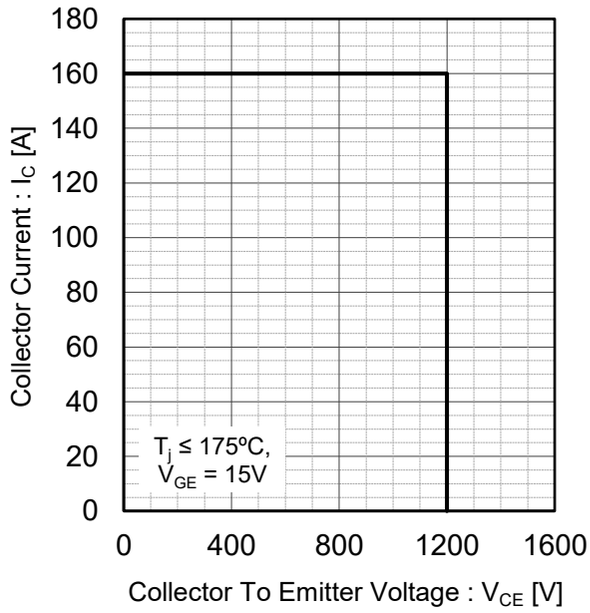



Fig.4 Reverse Bias Safe Operating Area





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## ●Electrical Characteristic Curves

Fig.5 Typical Output Characteristics

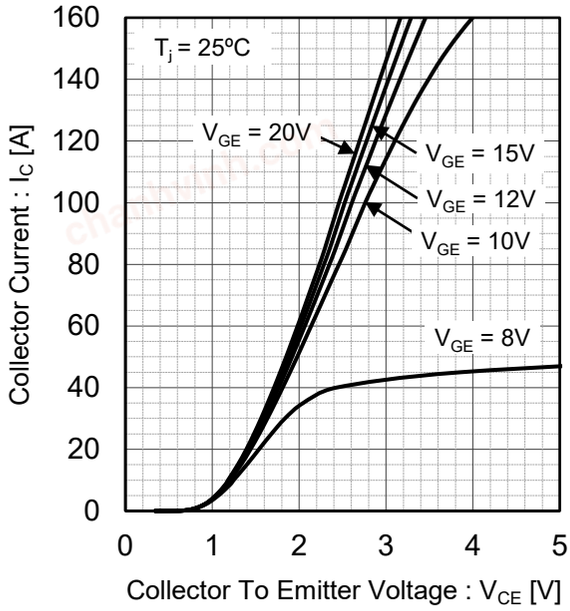



Fig.6 Typical Output Characteristics

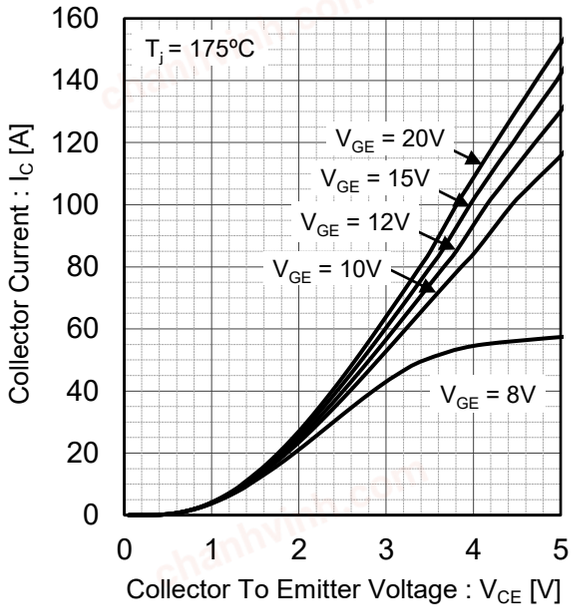



Fig.7 Typical Transfer Characteristics

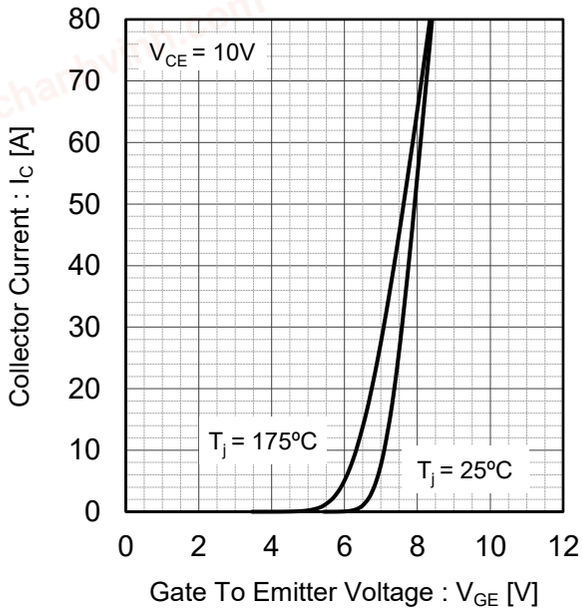
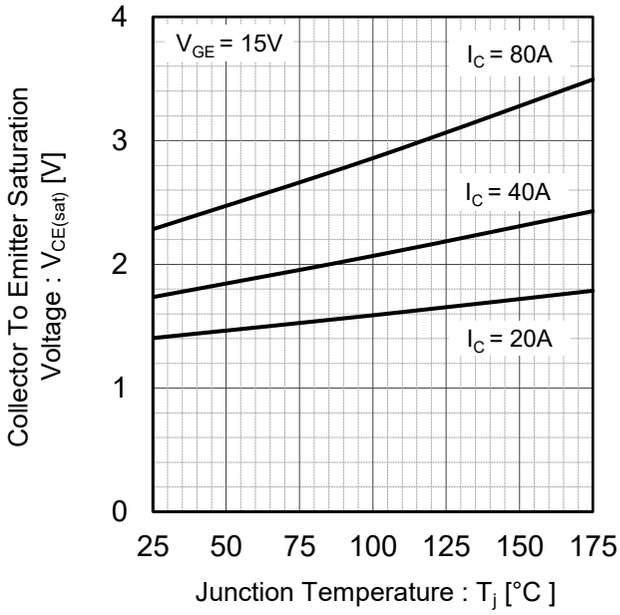



Fig.8 Typical Collector To Emitter Saturation Voltage vs. Junction Temperature





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## ●Electrical Characteristic Curves

Fig.9 Typical Collector To Emitter Saturation Voltage vs. Gate To Emitter Voltage

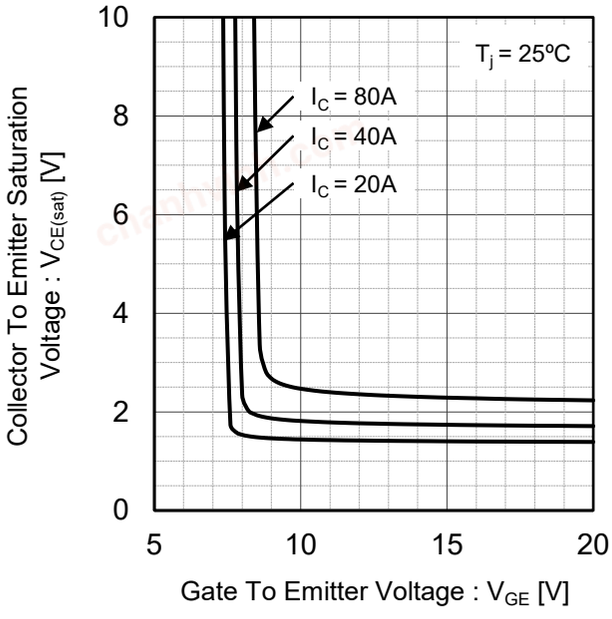



Fig.10 Typical Collector To Emitter Saturation Voltage vs. Gate To Emitter Voltage

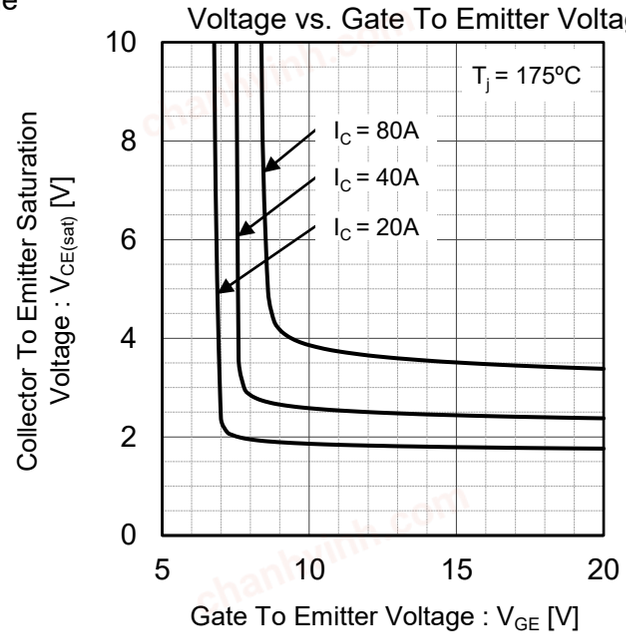



Fig.11 Typical Capacitance vs. Collector To Emitter Voltage

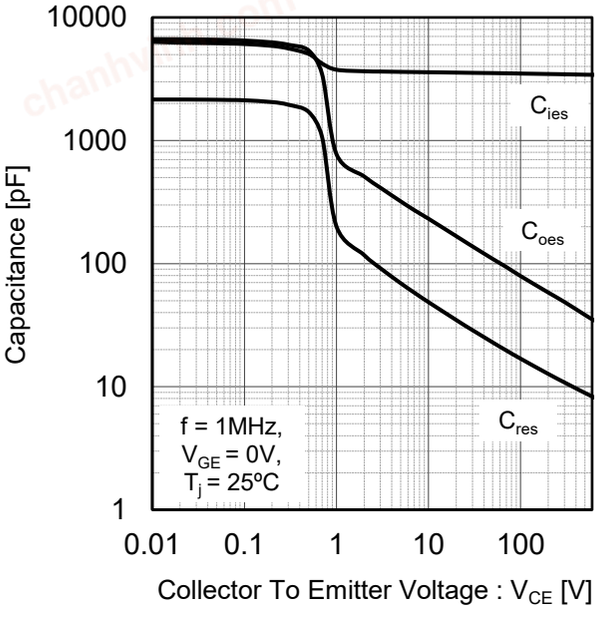
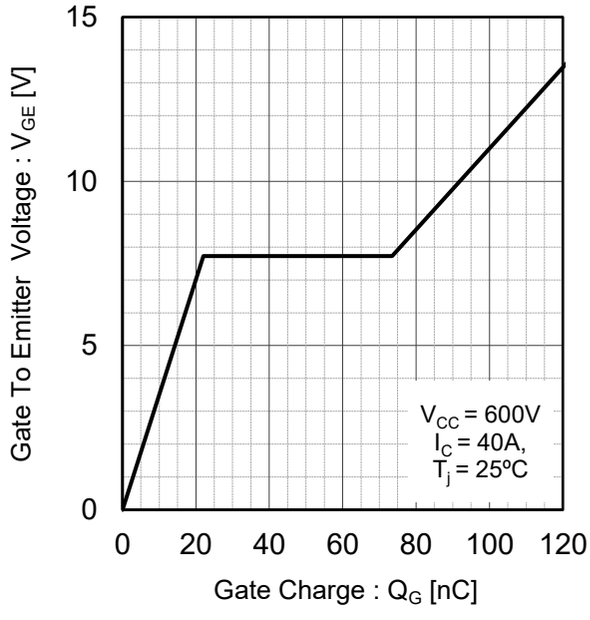



Fig.12 Typical Gate Charge





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## ●Electrical Characteristic Curves

Fig.13 Typical Switching Time vs. Collector Current

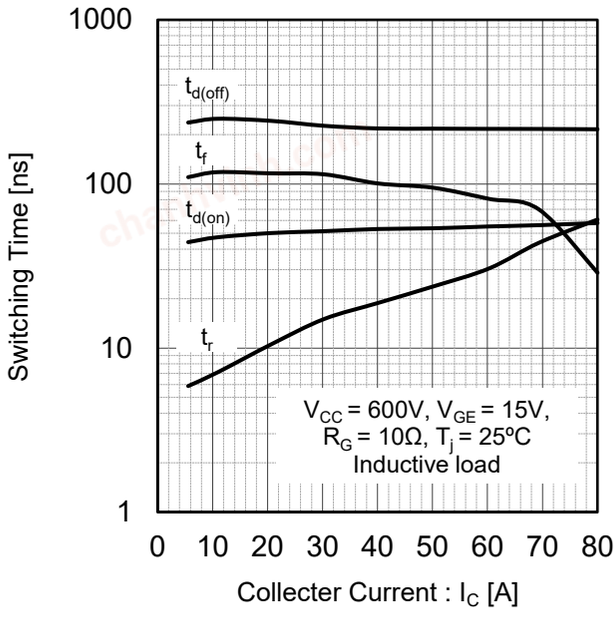



Fig.14 Typical Switching Time vs. Gate Resistance

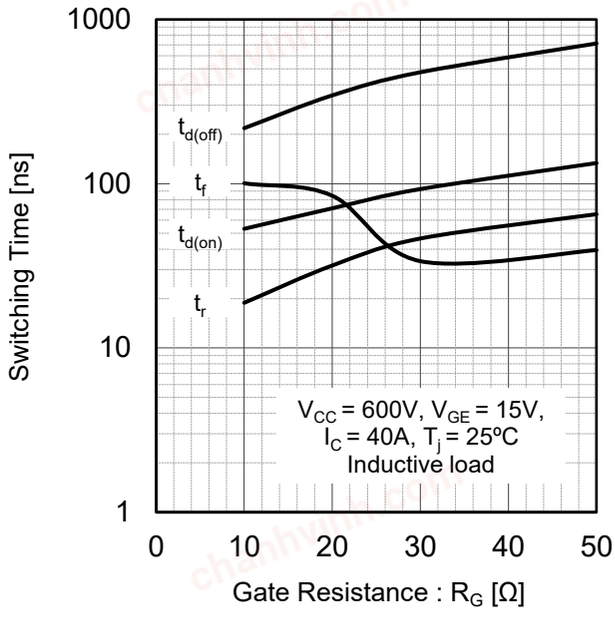



Fig.15 Typical Switching Energy Losses vs. Collector Current

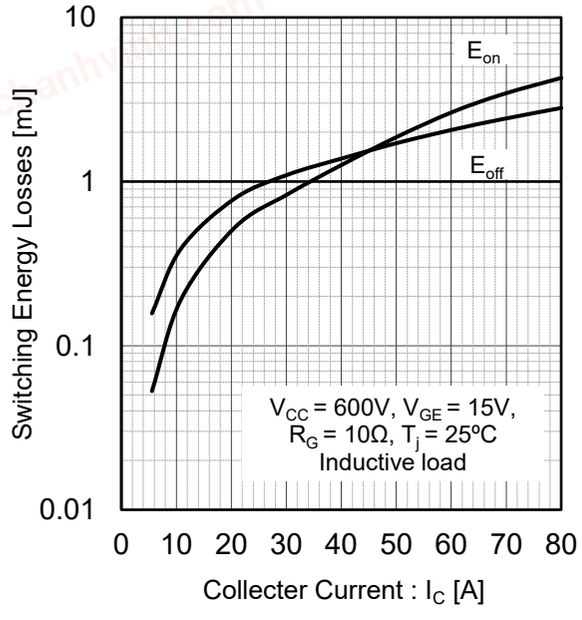
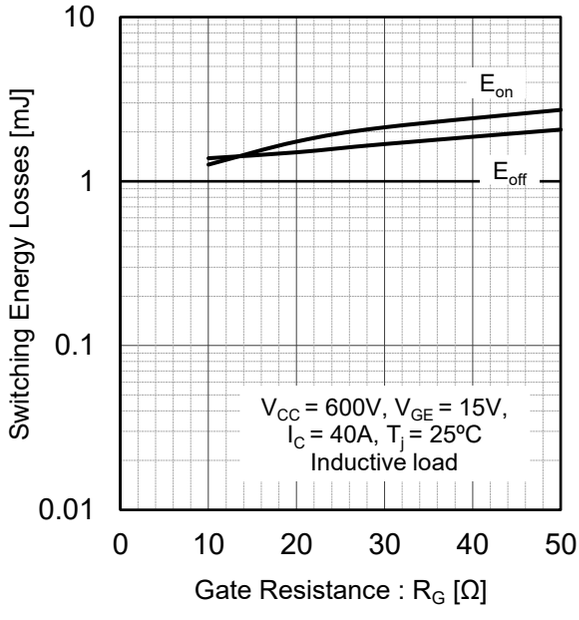



Fig.16 Typical Switching Energy Losses vs. Gate Resistance





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## ●Electrical Characteristic Curves

Fig.17 Typical Switching Time vs. Collector Current

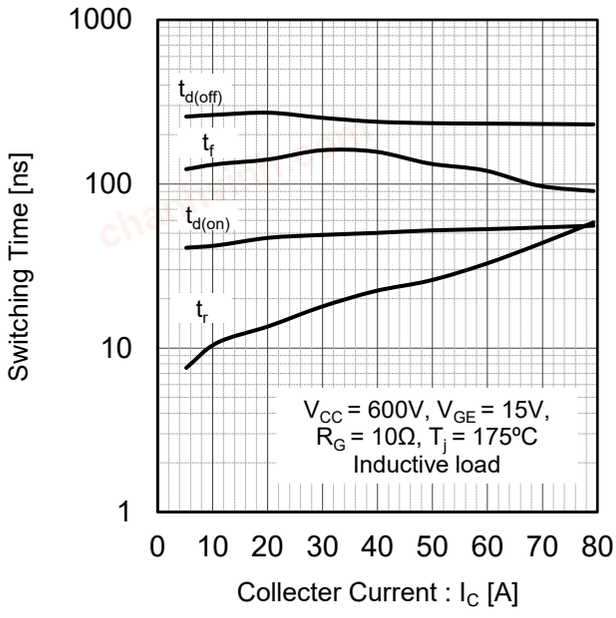



Fig.18 Typical Switching Time vs. Gate Resistance

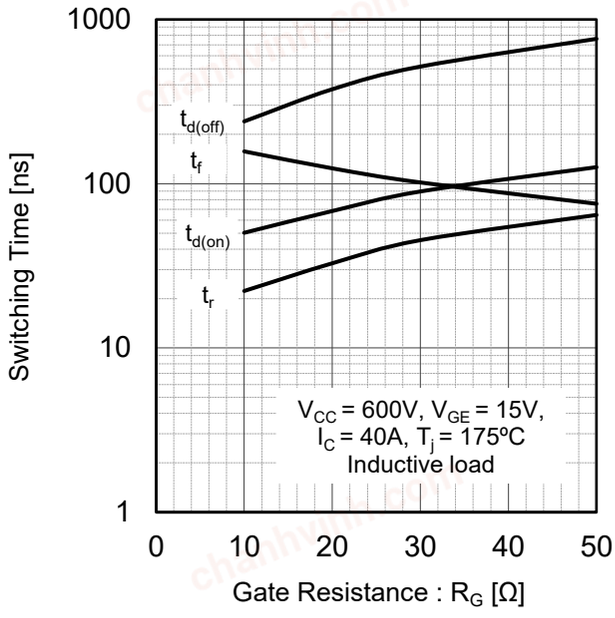



Fig.19 Typical Switching Energy Losses vs. Collector Current

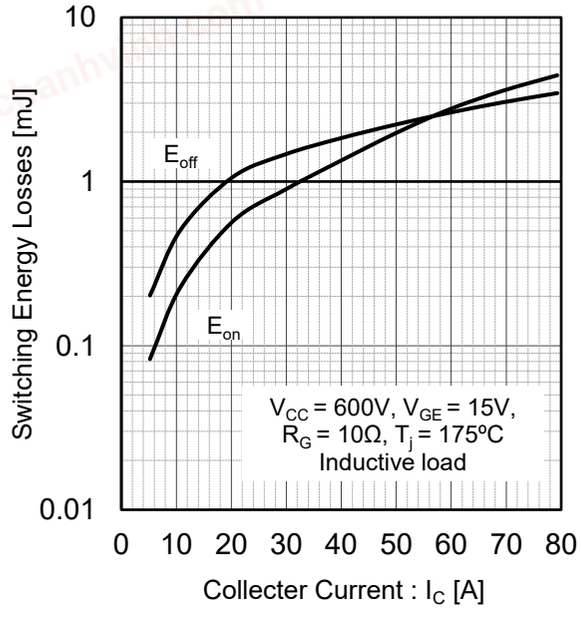
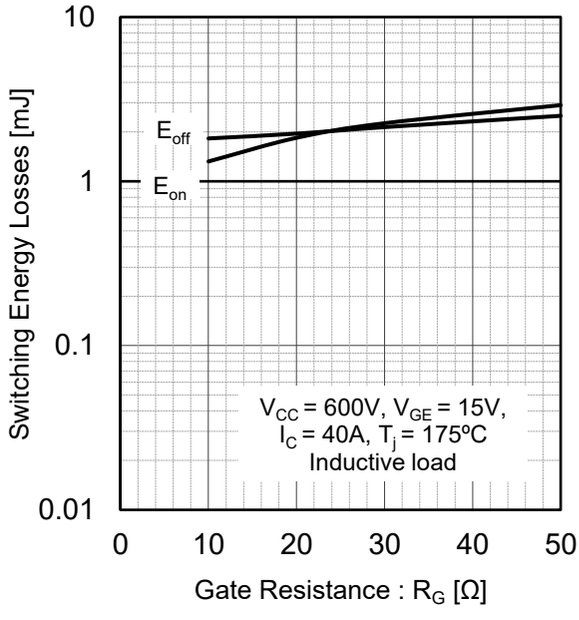



Fig.20 Typical Switching Energy Losses vs. Gate Resistance





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## ●Electrical Characteristic Curves

Fig.21 Typical Diode Forward Current vs. Forward Voltage

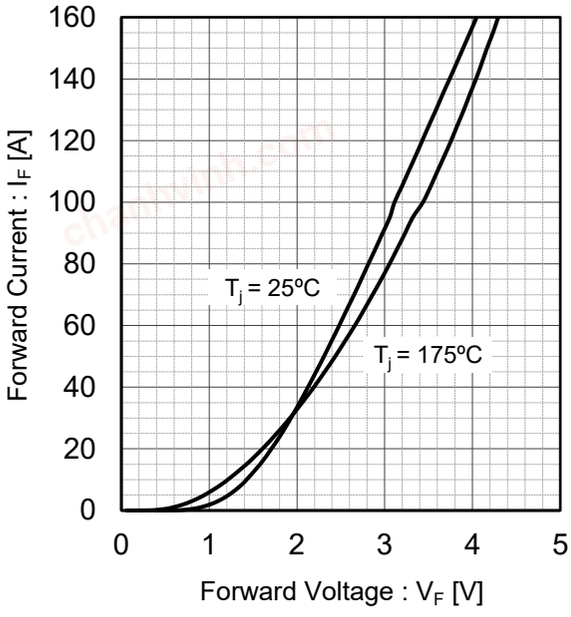



Fig.22 Typical Diode Reverce Recovery Time vs. Forward Current

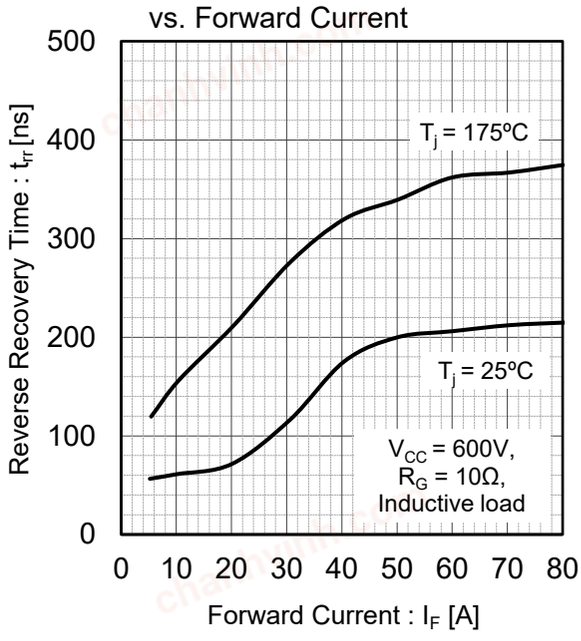



Fig.23 Typical Diode Reverse Recovery Current vs. Forward Current

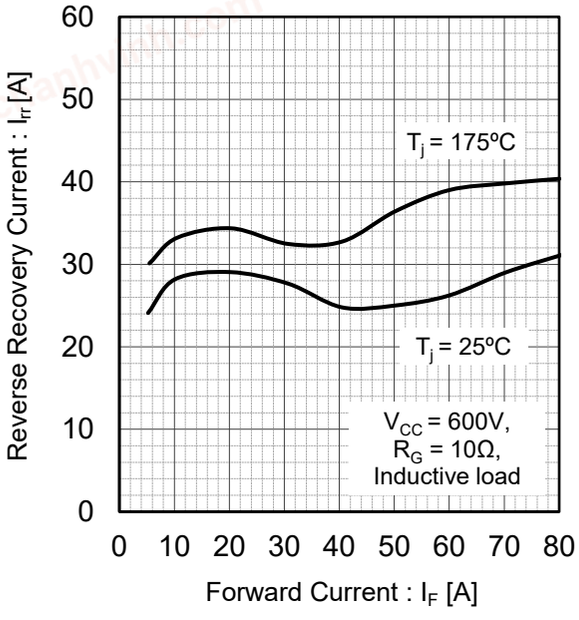
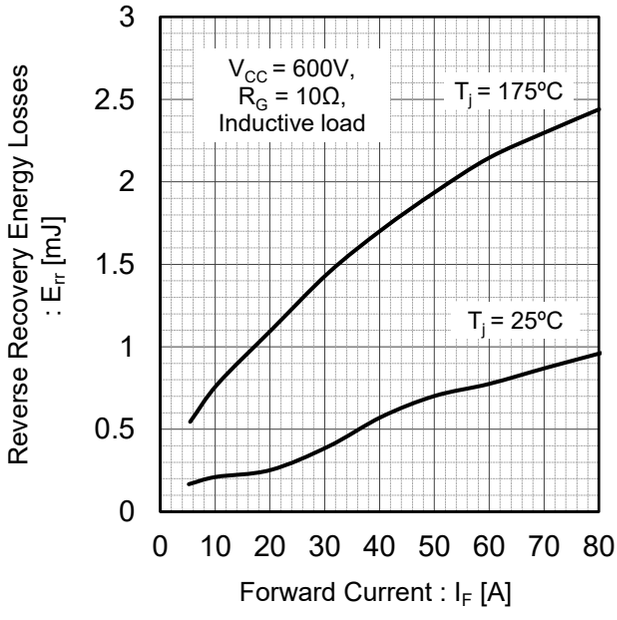



Fig.24 Typical Diode Reverse Recovery Energy Losses vs. Forward Current





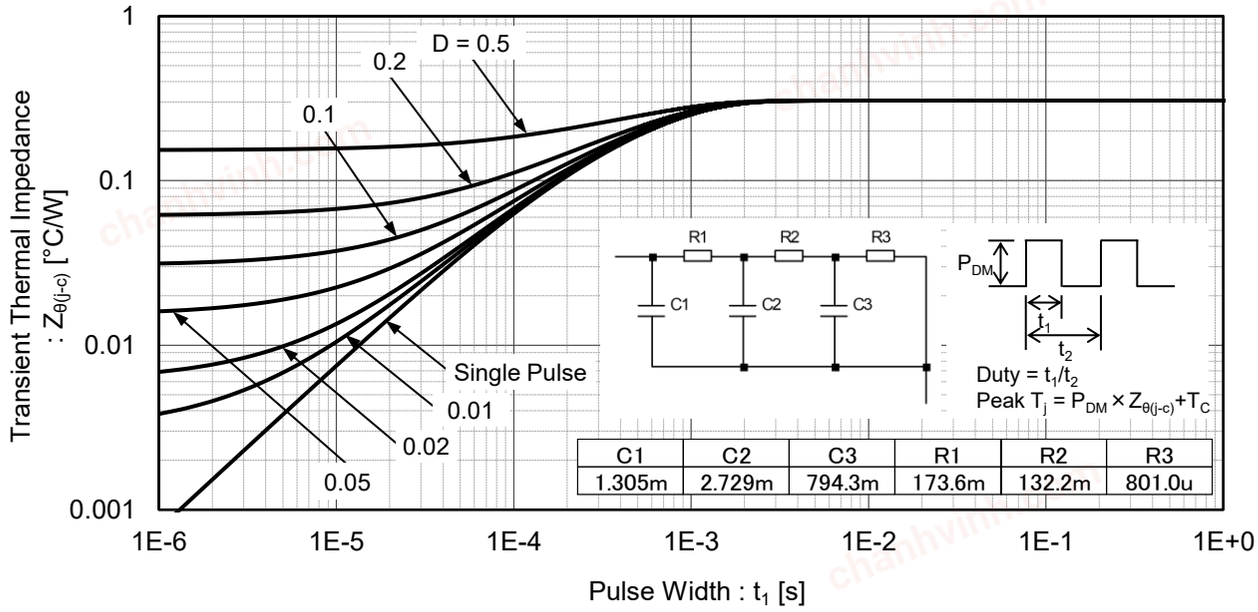
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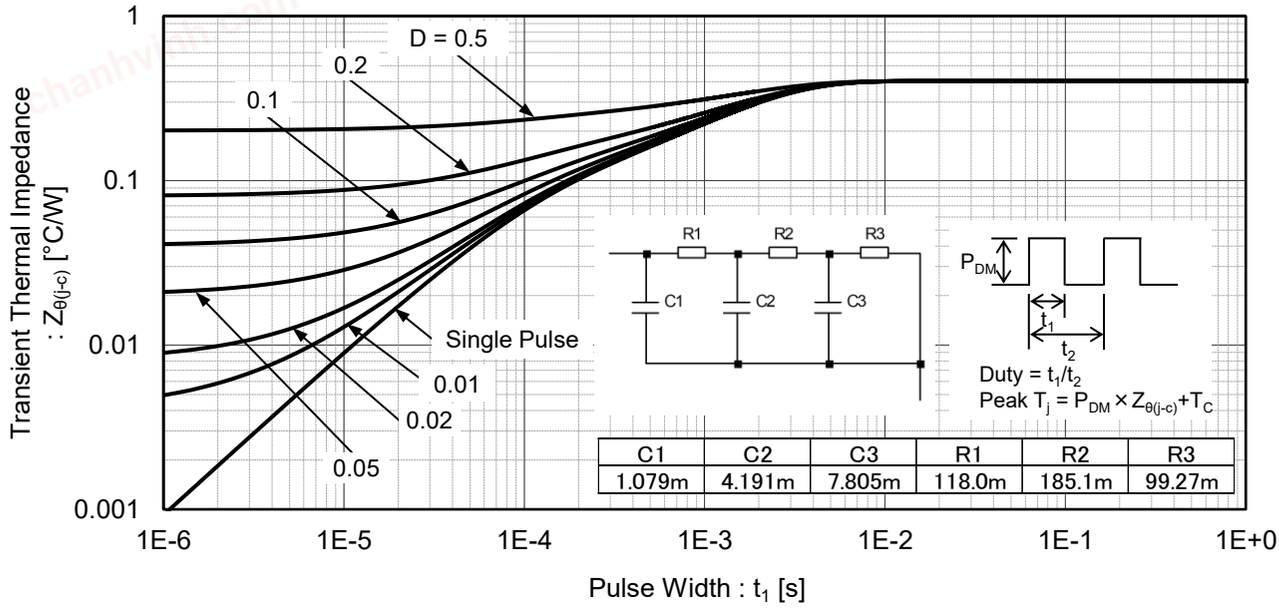
## ●Electrical Characteristic Curves

Fig.25 Typical IGBT Transient Thermal Impedance




| C1 | C2 | C3 | R1 | R2 | R3 |
|---|---|---|---|---|---|
| 1.305m | 2.729m | 794.3m | 173.6m | 132.2m | 801.0u |

Fig.26 Typical Diode Transient Thermal Impedance




| C1 | C2 | C3 | R1 | R2 | R3 |
|---|---|---|---|---|---|
| 1.079m | 4.191m | 7.805m | 118.0m | 185.1m | 99.27m |


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## ●Inductive Load Switching Circuit and Waveform

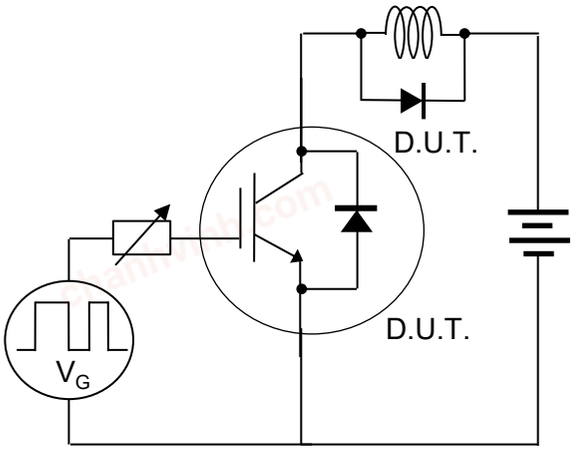



Fig.27 Inductive Load Circuit

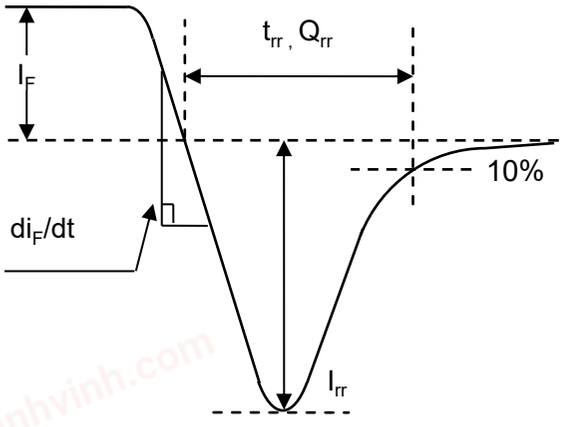



Fig.28 Diode Reverse Recovery Waveform

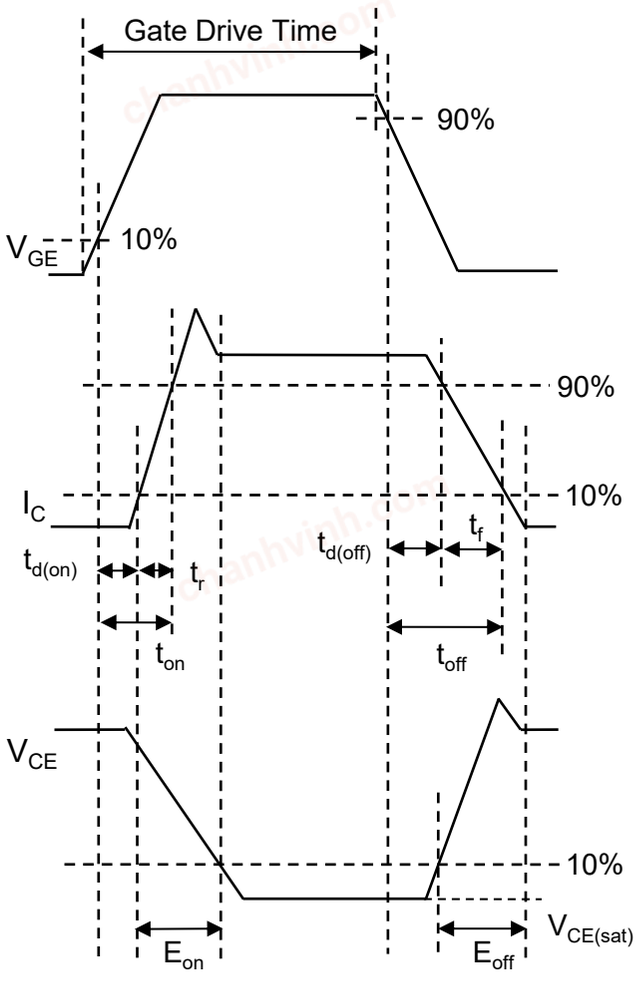



Fig.29 Inductive Load Waveform


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