# 80A 650V Trench Fieldstop IGBT with SiC SBD SRE80N065FSGS8

## General Description

The SRE80N065FSGS8 is a Field Stop Trench IGBT with SiC SBD, which offers ultra low conduction loss, high energy efficiency for switching applications such as Inverter, PFC, Converter, etc.

The SRE80N065FSGS8 package is TO-247.

## Features

- High Breakdown Voltage to 715V@Tj=25° C
- Advanced Trench Fieldstop technology
  - Smooth and Optimized Switching
  - High Ruggedness, Temperature Stability
  - Easy Parallel Switching Capability due to Positive Temperature Coefficient in $V_{CE(SAT)}$
- Low Switching Loss
- Enhanced Avalanche Capability
- Non-Automotive Qualified

## Application

- PFC application
- Inverter & Solar
- Converter with high switching frequency

## Symbol

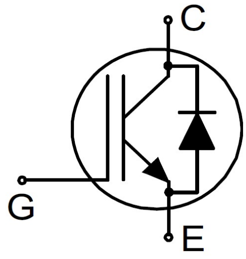
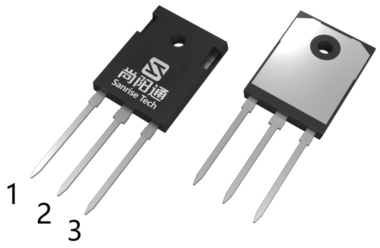


Figure 1 Symbol of SRE SRE80N065FSGS8

## Package Type

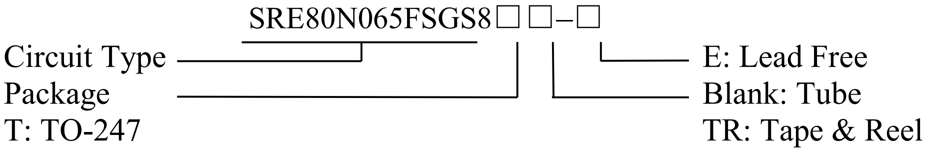


TO-247

Pin 1- Gate
Pin 2&backside- Collector
Pin 3-Emitter

Figure 2 Package Type of SRE80N065FSGS8

## Ordering Information


SRE80N065FSGS8□ □–□

Circuit Type
Package
T: TO-247

E: Lead Free
Blank: Tube
TR: Tape & Reel

| Package | Part Number | Marking ID | Packing Type |
|---|---|---|---|
| | Green | Green | |
| TO-247 | SRE80N065FSGS8T-GT | SRE80N065FSGS8TGT | Tube |

## Absolute Maximum Ratings

| Parameter | | Symbol | Rating | Unit |
|---|---|---|---|---|
| Collector-emitter voltage | | $V_{CES}$ | 650 | V |
| Gate-emitter Voltage | | $V_{GES}$ | ±20 | V |
| Transient Gate-emitter Voltage | | | ±30 | V |
| Continuous Collector Current | $T_C$=25°C | $I_C$ | 120 | A |
| | $T_C$=100°C | | 80 | |
| Pulsed Collector Current, Limited by $T_{Jmax}$ | | $I_{CM}$ | 320 | A |
| Diode Continuous Collector Current | $T_C$=25°C | $I_F$ | 120 | A |
| | $T_C$=100°C | | 80 | A |
| Diode Pulsed Current, Limited by $T_{Jmax}$ | | $I_{FM}$ | 240 | A |
| Power Dissipation | $T_C$=25°C | $P_{tot}$ | 394 | W |
| | $T_C$=100°C | | 197 | |
| Operating Junction Temperature Range | | $T_J$ | -40 ~ 175(1) | °C |
| Storage Temperature | | $T_{STG}$ | -55 ~ 150 | °C |
| Lead Temperature (Soldering, 10 sec) | | $T_{LEAD}$ | 260 | °C |

Note:

1. Reliability testing conducted at $T_{Jmax}$=175℃.

## Thermal Resistance

| Parameter | Symbol | Min. | Typ. | Max. | Unit |
|---|---|---|---|---|---|
| IGBT thermal Resistance，Junction-to-Case | $R_{thJC}$ | - | - | 0.38 | °C/W |
| Diode thermal Resistance，Junction-to-Case | $R_{thJC}$ | - | - | 0.90 | |
| Thermal Resistance，Junction-to-Ambient | $R_{thJA}$ | - | - | 40 | |

## Electrical Characteristics

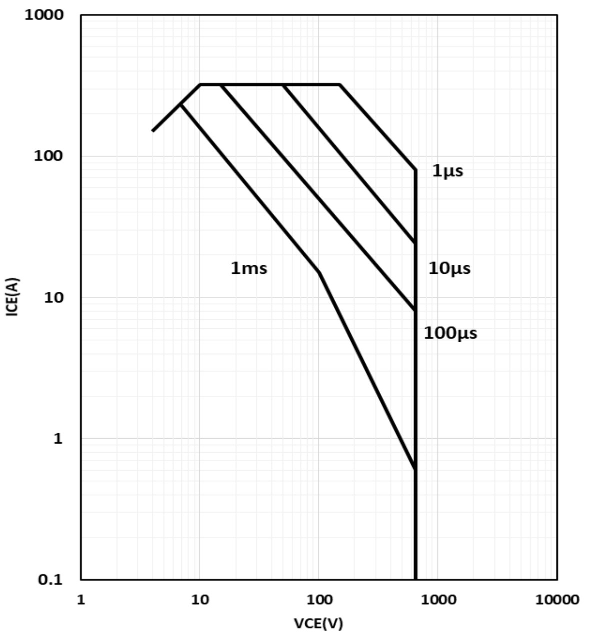
$T_J$ = 25°C, unless otherwise specified.

| Parameter | Symbol | Test Conditions | Min | Typ | Max | Unit |
|---|---|---|---|---|---|---|
| **Statistic Characteristics** | | | | | | |
| Collector-emitter Breakdown Voltage | $BV_{CES}$ | $V_{GE}$=0V, $I_C$=250uA | 650 | | | V |
| Gate Threshold Voltage | $V_{GE(th)}$ | $V_{CE}$=$V_{GE}$, $I_C$=1.6mA | 4.7 | 5.6 | 6.5 | V |
| Collector-emitter saturation voltage | $V_{CEsat}$ | $V_{GE}$=15V, $I_C$=80A, $T_J$=25°C | | 1.77 | 2.2 | V |
| | | $T_J$=125°C | | 2.31 | | V |
| | | $T_J$=150°C | | 2.44 | | V |
| Zero Gate Voltage Collector Current | $I_{CES}$ | $V_{CE}$=650V,$V_{GE}$=0V $T_J$=25°C | | 0.1 | 40 | uA |
| | | $T_J$=150°C | | | 1 | mA |
| Gate-emitter Leakage Current Forward | $I_{GESF}$ | $V_{GE}$=20V, $V_{CE}$=0V | | | 100 | nA |
| Gate-emitter Leakage Current Reverse | $I_{GESR}$ | $V_{GE}$=-20V, $V_{CE}$=0V | | | -100 | nA |
| **Dynamic Characteristics** | | | | | | |
| Input Capacitance | $C_{IES}$ | $V_{CE}$=25V, $V_{GE}$=0V, f=100 KHz | | 4993 | | pF |
| Output Capacitance | $C_{OES}$ | | | 221 | | |
| Reverse Transfer Capacitance | $C_{RES}$ | | | 39 | | |
| Gate Resistance | $R_G$ | f=1MHz,Open Drain | | 2.07 | | Ω |
| Turn-on Delay Time | $t_{d(on)}$ | $T_J$=25°C<br>$V_{CC}$=400V, $I_C$=40A<br>$R_G$=10Ω, $V_{GE}$=0/15V | | 42 | | ns |
| Rise Time | $t_r$ | | | 38 | | ns |
| Turn-off Delay Time | $t_{d(off)}$ | | | 171 | | ns |
| Fall Time | $t_f$ | | | 25 | | ns |
| Turn-on energy | $E_{on}$ | | | 0.82 | | mJ |
| Turn-off energy | $E_{off}$ | | | 0.19 | | mJ |
| Total switching energy | $E_{ts}$ | | | 1.01 | | mJ |
| Turn-on Delay Time | $t_{d(on)}$ | $T_J$=25°C<br>$V_{CC}$=400V,$I_C$=80A<br>$R_G$=10Ω, $_{GE}$=0/15V | | 50 | | ns |
| Rise Time | $t_r$ | | | 80 | | ns |
| Turn-off Delay Time | $t_{d(off)}$ | | | 157 | | ns |
| Fall Time | $t_f$ | | | 50 | | ns |
| Turn-on energy | $E_{on}$ | | | 2.63 | | mJ |
| Turn-off energy | $E_{off}$ | | | 0.70 | | mJ |
| Total switching energy | $E_{ts}$ | | | 3.33 | | mJ |
| Gate to Emitter Charge | $Q_{GE}$ | $V_{CC}$=400V,$I_C$=80A<br>$V_{GE}$=0 to 15V | | 42 | | nC |
| Gate to Collector Charge | $Q_{GC}$ | | | 47 | | |
| Gate Charge Total | $Q_G$ | | | 93 | | |

| Parameter | Symbol | Test Conditions | Min. | Typ. | Max. | Unit |
|---|---|---|---|---|---|---|
| **Reverse Diode Characteristics** | | | | | | |
| Forward Voltage | VF | IF=40A, $T_J$=25°C | - | 1.53 | 2.0 | V |
| | | IF=40A, $T_J$=125°C | - | 1.77 | - | |
| | | IF=40A, $T_J$ =175°C | - | 1.98 | - | |
| | | IF=80A, $T_J$=25°C | - | 2.1 | 2.50 | V |
| | | IF=80A, $T_J$=125°C | - | 2.7 | - | |
| | | IF=80A, $T_J$ =175°C | - | 3.16 | - | |
| Total Capacitance | C | VR=1V, f=1MHz | - | 1210 | - | pF |
| | | VR=200V, f=1MHz | - | 124 | - | |
| | | VR=400V, f=1MHz | - | 90 | - | |
| Total Capacitive Charge | $Q_C$ | VR=400V, IF=30A<br>dIF/dt=200A/us | - | 45 | - | nC |
| Reverse Recovery Time | $t_{rr}$ | $T_J$=25°C<br>$V_R$=400V, $I_F$=40A<br>$dI_F/dt$=900A/µs | | 33 | | ns |
| Reverse Recovery Charge | $Q_{rr}$ | | | 0.1 | | uC |
| Peak Reverse Recovery Current | $I_{rrm}$ | | | 6.6 | | A |
| Diode peak rate of fall of reverse recovery current during $t_b$ | $di_{rr}/dt$ | | | -300 | | A/µs |
| Reverse Recovery Time | $t_{rr}$ | $T_J$=25°C<br>$V_R$=400V, $I_F$=80A<br>$dI_F/dt$=850A/µs | | 50 | | ns |
| Reverse Recovery Charge | $Q_{rr}$ | | | 0.17 | | uC |
| Peak Reverse Recovery Current | $I_{rrm}$ | | | 10 | | A |
| Diode peak rate of fall of reverse recovery current during $t_b$ | $di_{rr}/dt$ | | | -280 | | A/µs |

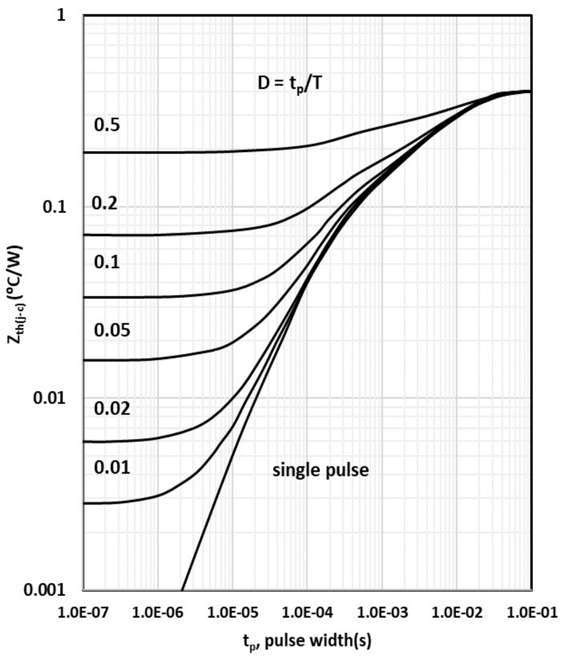
## Typical Performance Characteristics

Figure 3: IGBT forward bias safe operating area (FBSOA)



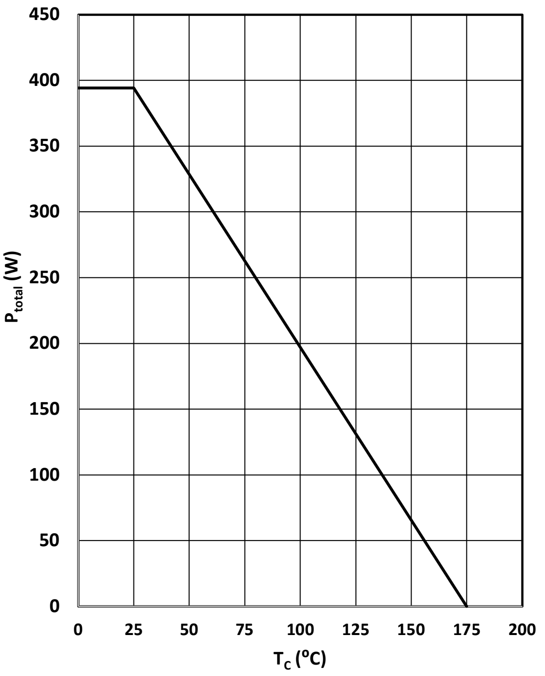
$I_C = f(V_{CE})$; $V_{GE} \geq 15/0V$; $T_j \leq 175°C$

Figure 4: IGBT transient thermal impedance



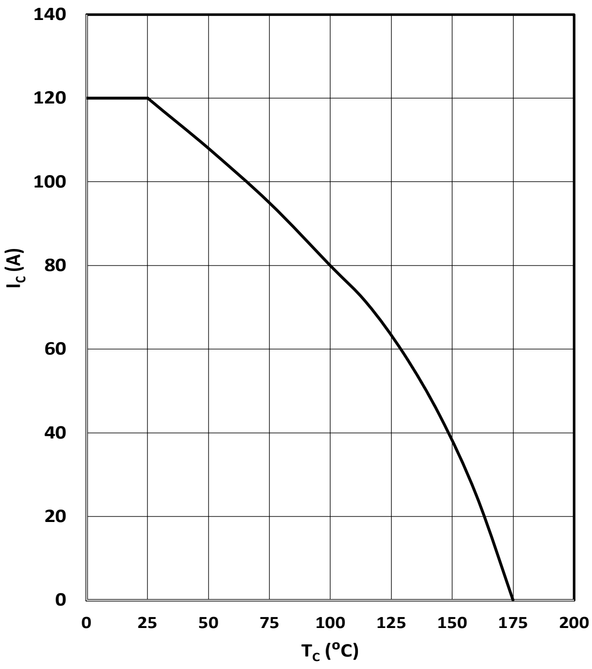
$R_{th(J\text{-}C)} = f(t_p)$; duty cycle: $D = t_p/T$

Figure 5: Power Dissipation



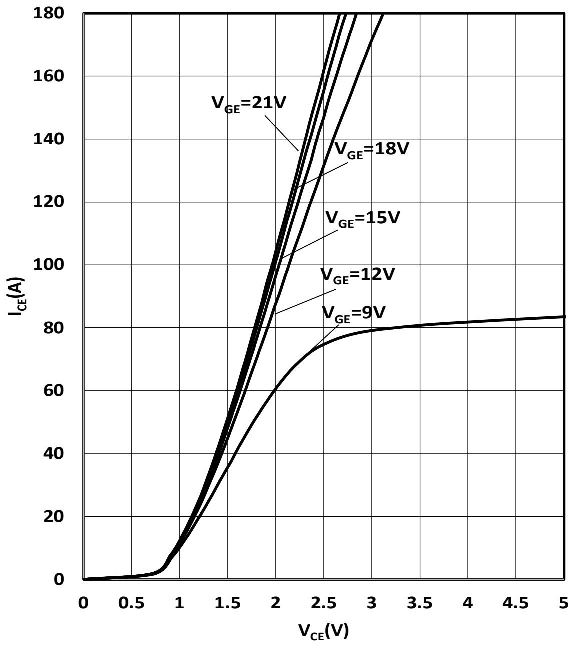
$P_{tot} = f(T_c)$

Figure 6: Collector current vs. temperature



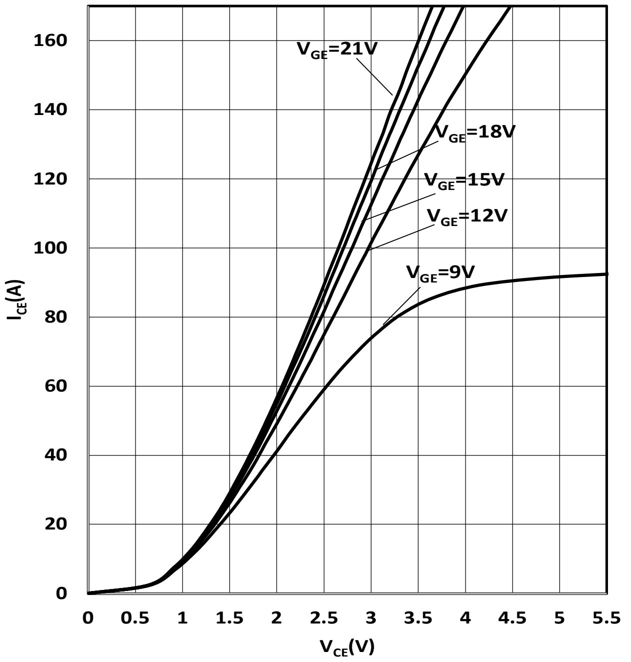
$I_c = f(T_j)$; $V_{GE} \geq 15/0V$; $T_j \leq 175°C$

Figure 7: Typ. Output Characteristics



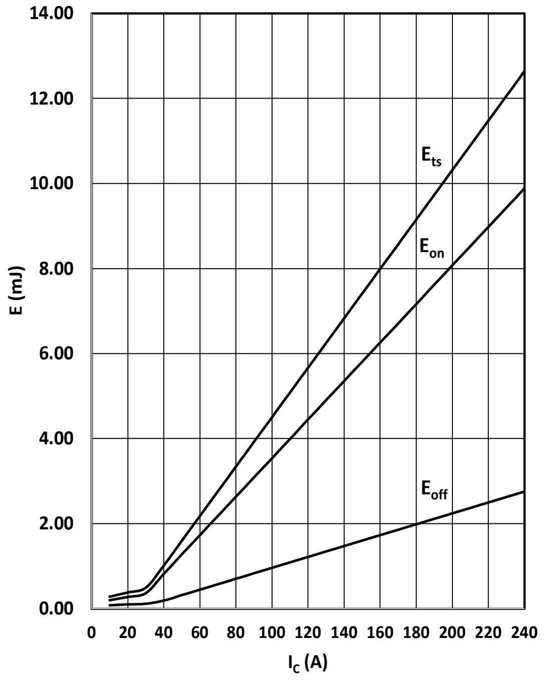
$I_C = f(V_{CE})$; Tj= 25ºC; parameter: $V_{GE}$

Figure 8: Typ. Output Characteristics



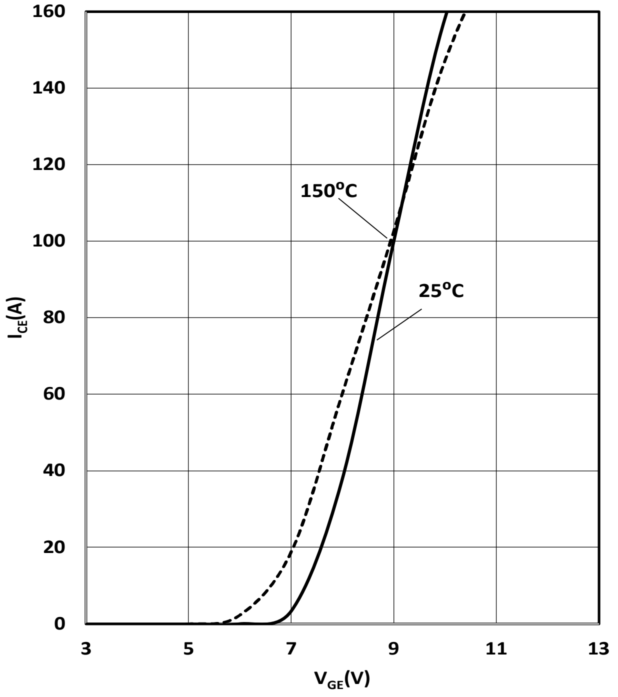
$I_C = f(V_{CE})$; Tj= 150ºC; parameter: $V_{GE}$

Figure 9: Typical switching energy losses as a function of collector current



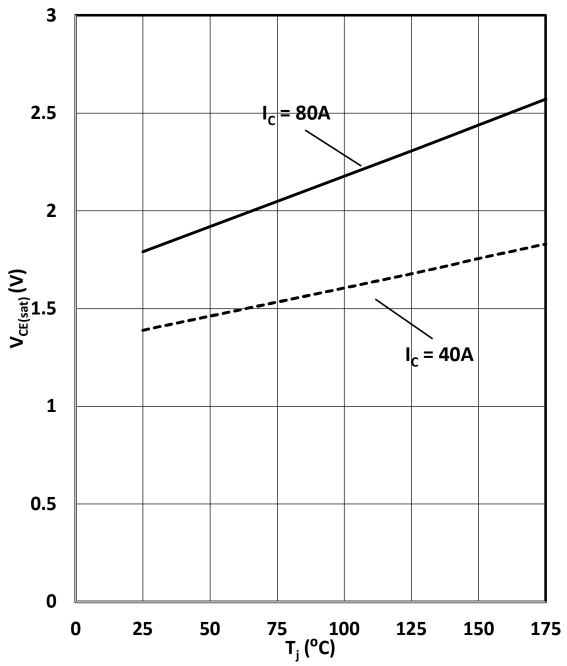
E=f(Ic); $V_{CE}$=400V; Tj=25ºC; $R_G$=10Ω

Figure10: Typ. Transfer characteristic



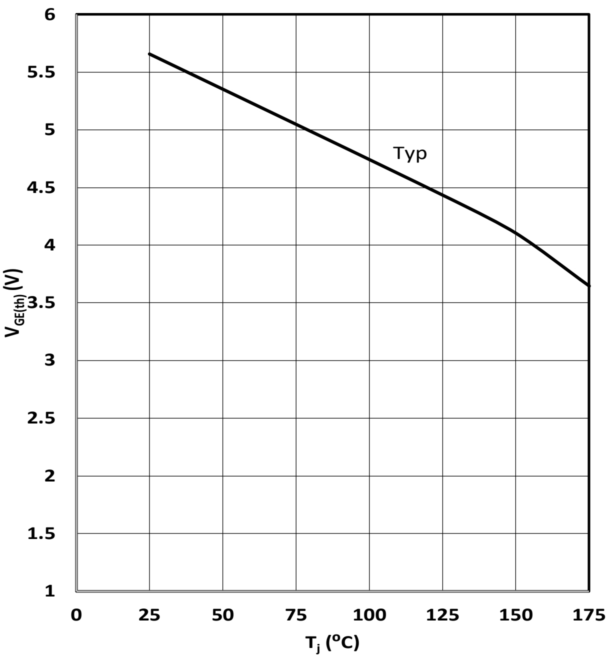
$I_C = f(V_{GE})$; Tj= 25ºC vs 150ºC; ($V_{CE}$=20V)

Figure 19: Typ. Collector Voltage vs. Temperature



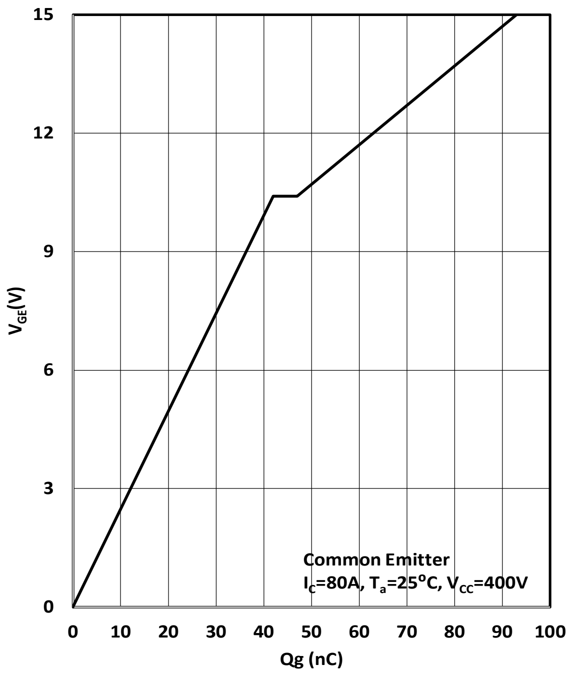
$V_{CE}$ =f($T_j$); $V_{GE}$=15V

Figure 20: Typ. emitter threshold voltage as a function of junction temperature



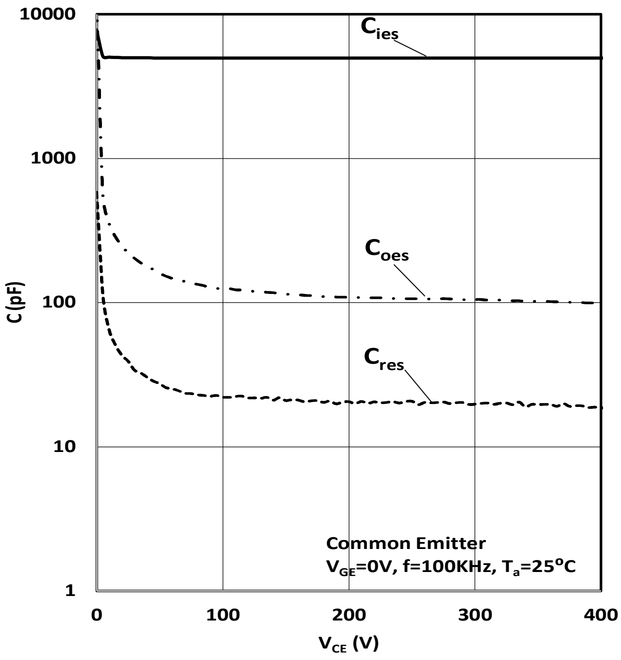
$V_{GE}$ =f($T_j$); $I_{CE}$ = 1.6mA

Figure 21: Typ. Gate Charge



$V_{GE}$= f($Q_{gate}$ ), $I_C$=80A

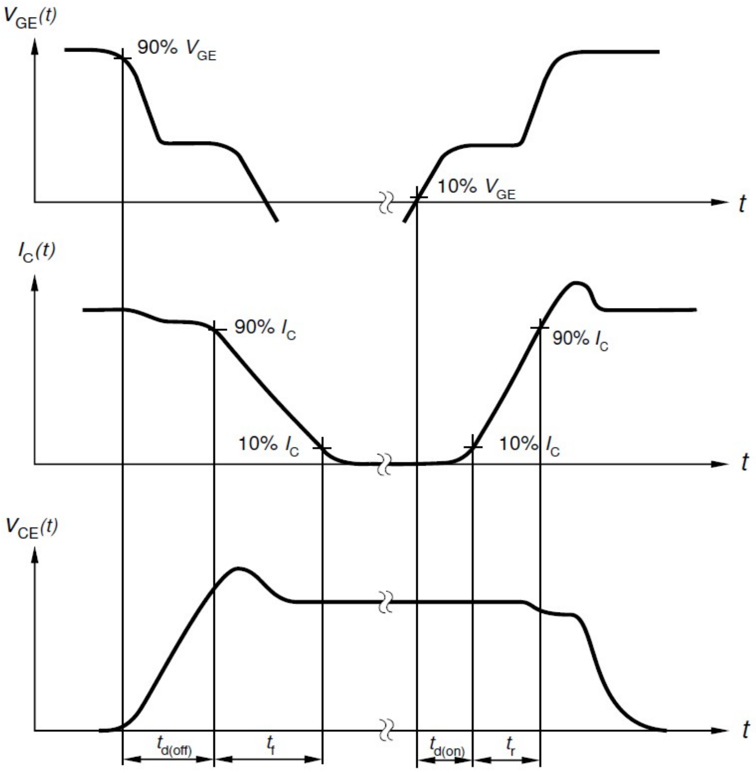
Figure 22: Typ. Capacitances



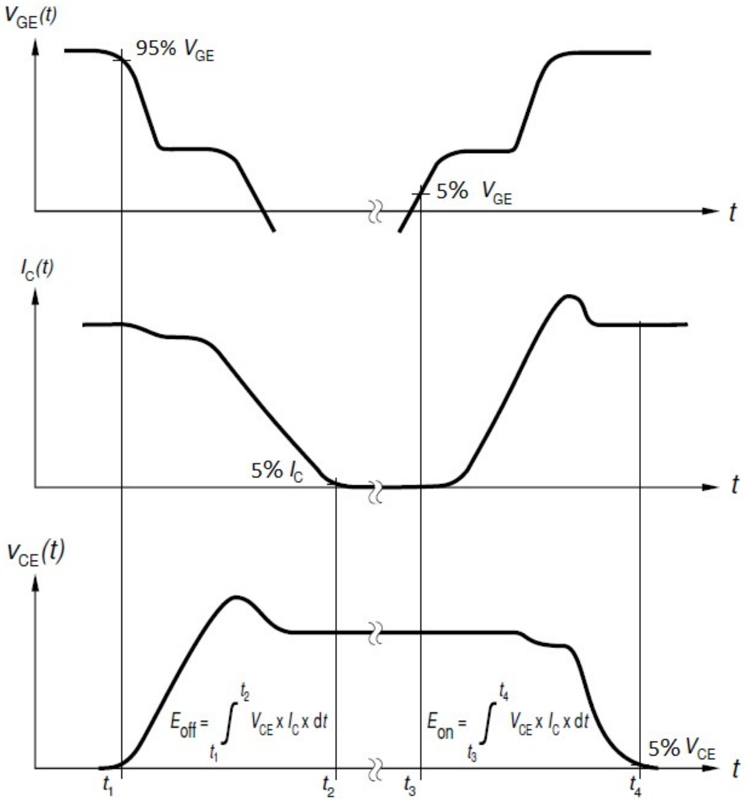
C=f($V_{CE}$); $V_{GE}$=0; f=100KHz

# Test Circuits

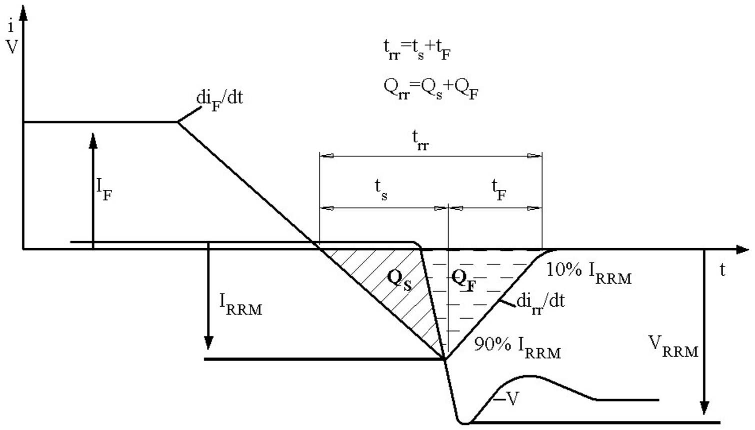
## 1. Definition Switching times



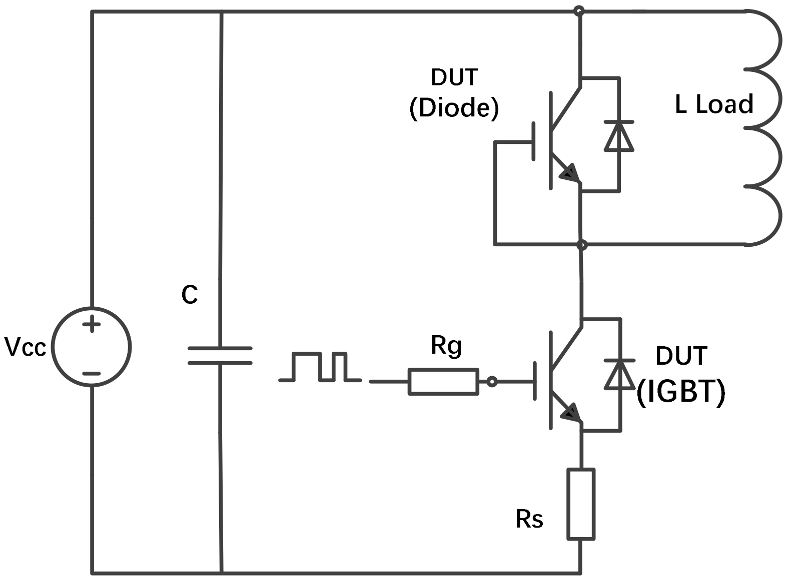
## 2. Definition Switching losses



## 3. Definition Diode Switching Characteristics

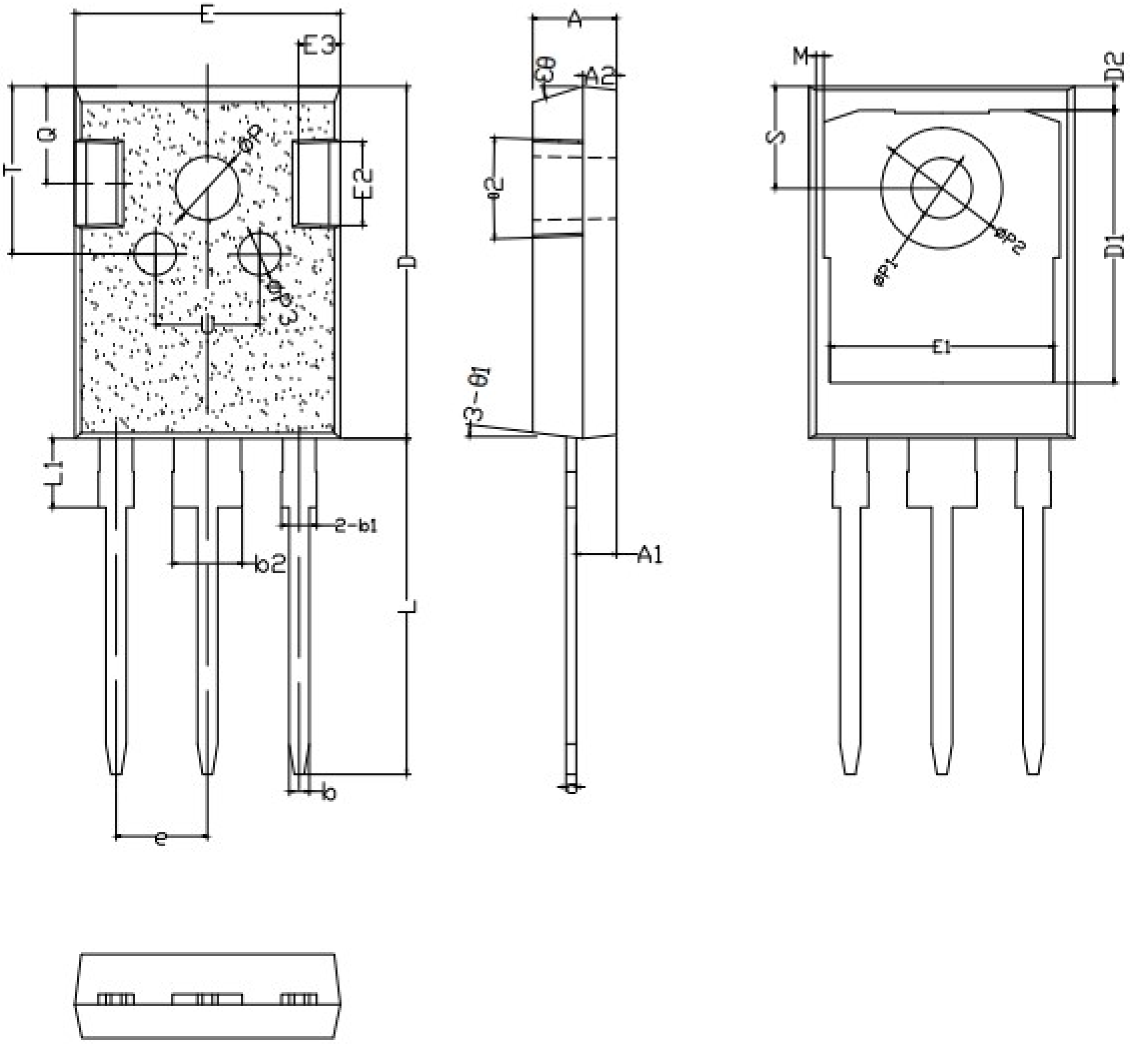


## 4. Dynamic test circuit



## Mechanical Dimensions

**TO-247** **Unit: mm**



## Mechanical Dimensions

| Symbol | Dimensions (mm) | | | Symbol | Dimensions (mm) | | |
|---|---|---|---|---|---|---|---|
| | Min. | Typ. | Max. | | Min. | Typ. | Max. |
| **A** | 4.90 | 5.00 | 5.10 | **e** | 5.40 | 5.44 | 5.48 |
| **A1** | 2.31 | 2.41 | 2.51 | **L** | 19.80 | 19.98 | 20.15 |
| **A2** | 1.90 | 2.00 | 2.10 | **L1** | - | - | 4.30 |
| **b** | 1.15 | 1.20 | 1.25 | ΦP | 3.60 | 3.70 | 3.80 |
| **b1** | 1.95 | 2.10 | 2.25 | ΦP1 | 3.40 | 3.50 | 3.60 |
| **b2** | 2.95 | 3.10 | 3.25 | ΦP2 | 6.90 | 7.10 | 7.30 |
| **c** | 0.55 | 0.60 | 0.65 | ΦP3 | 2.40 | 2.50 | 2.60 |
| **D** | 20.90 | 21.00 | 21.10 | **Q** | 5.60 | 5.80 | 6.00 |
| **D1** | 16.35 | 16.55 | 16.75 | **S** | 6.05 | 6.15 | 6.25 |
| **D2** | 1.05 | 1.20 | 1.35 | **T** | 9.80 | 10.00 | 10.20 |
| **E** | 15.70 | 15.80 | 15.90 | **U** | 6.00 | 6.20 | 6.40 |
| **E1** | 13.10 | 13.25 | 13.40 | **Θ1** | 5° | 7° | 9° |
| **E2** | 4.85 | 4.95 | 5.10 | **Θ2** | 1° | 3° | 5° |
| **E3** | 2.40 | 2.50 | 2.60 | **Θ3** | 13° | 15° | 17° |

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