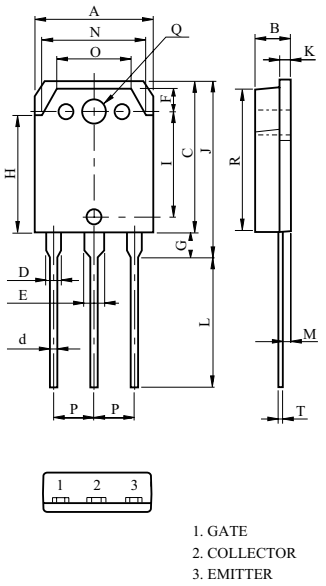
## General Description

KEC NPT IGBTs offer low switching losses, high energy efficiency and high avalanche ruggedness for soft switching application such as general inverters, etc.

### FEATURES

- High speed switching
- High system efficiency
- Soft current turn-off waveforms
- Extremely enhanced avalanche capability



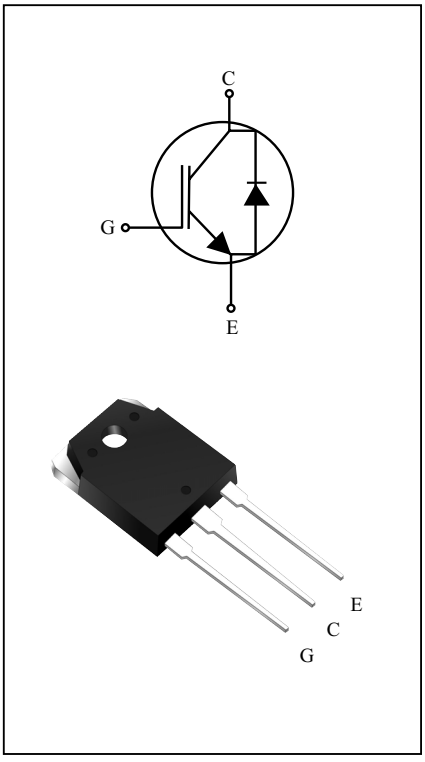

| DIM | MILLIMETERS |
|---|---|
| A | 15.60 ± 0.20 |
| B | 4.80 ± 0.20 |
| C | 19.90 ± 0.20 |
| D | 2.00 ± 0.20 |
| d | 1.00 ± 0.20 |
| E | 3.00 ± 0.20 |
| F | 3.80 ± 0.20 |
| G | 3.50 ± 0.20 |
| H | 13.90 ± 0.20 |
| I | 12.76 ± 0.20 |
| J | 23.40 ± 0.20 |
| K | 1.5+0.15-0.05 |
| L | 16.50 ± 0.30 |
| M | 1.40 ± 0.20 |
| N | 13.60 ± 0.20 |
| O | 9.60 ± 0.20 |
| P | 5.45 ± 0.30 |
| Q | ϕ 3.20 ± 0.10 |
| R | 18.70 ± 0.20 |
| T | 0.60+0.15-0.05 |

TO-3P(N)-E

### MAXIMUM RATING (Ta=25℃)

| CHARACTERISTIC | | SYMBOL | RATING | UNIT |
|---|---|---|---|---|
| Collector-Emitter Voltage | | $V_{CES}$ | 1200 | V |
| Gate-Emitter Voltage | | $V_{GES}$ | ±20 | V |
| Collector Current | @Tc=25℃ | $I_C$ | 50 | A |
| | @Tc=100℃ | | 30 | A |
| Pulsed Collector Current | | $I_{CM}$* | 90 | A |
| Diode Continuous Forward Current | @Tc=100℃ | $I_F$ | 30 | A |
| Diode Maximum Forward Current | | $I_{FM}$ | 150 | A |
| Maximum Power Dissipation | @Tc=25℃ | $P_D$ | 310 | W |
| | @Tc=100℃ | | 125 | W |
| Maximum Junction Temperature | | $T_j$ | 150 | ℃ |
| Storage Temperature Range | | $T_{stg}$ | -55 to + 150 | ℃ |

*Repetitive rating : Pulse width limited by max. junction temperature




### THERMAL CHARACTERISTIC

| CHARACTERISTIC | SYMBOL | MAX. | UNIT |
|---|---|---|---|
| Thermal Resistance, Junction to Case (IGBT) | $R_{thJC}$ | 0.4 | ℃/W |
| Thermal Resistance, Junction to Case (DIODE) | $R_{thJC}$ | 2.8 | ℃/W |
| Thermal Resistance, Junction to Ambient | $R_{thJA}$ | 40 | ℃/W |

**ELECTRICAL CHARACTERISTICS** (Ta=25℃)

| CHARACTERISTIC | SYMBOL | TEST CONDITION | MIN. | TYP. | MAX. | UNIT |
|---|---|---|---|---|---|---|
| **Static** | | | | | | |
| Collector-Emitter Breakdown Voltage | $BV_{CES}$ | $V_{GE}$=0V , $I_C$=1mA | 1200 | - | - | V |
| Collector Cut-off Current | $I_{CES}$ | $V_{GE}$=0V, $V_{CE}$=1200V | - | - | 1.0 | mA |
| Gate Leakage Current | $I_{GES}$ | $V_{CE}$=0V, $V_{GE}$=±20V | - | - | ±100 | nA |
| Gate Threshold Voltage | $V_{GE(th)}$ | $V_{GE}$=$V_{CE}$, $I_C$=25mA | 4.0 | 5.5 | 7.0 | V |
| Collector-Emitter Saturation Voltage | $V_{CE(sat)}$ | $V_{GE}$=15V, $I_C$=30A | - | 1.95 | 2.30 | V |
| | | $V_{GE}$=15V, $I_C$=30A, $T_C$ = 125℃ | - | 2.25 | - | V |
| | | $V_{GE}$=15V, $I_C$=60A | - | 2.50 | - | V |
| **Dynamic** | | | | | | |
| Total Gate Charge | $Q_g$ | $V_{CC}$=600V, $V_{GE}$=15V, $I_C$= 30A | - | 200 | 300 | nC |
| Gate-Emitter Charge | $Q_{ge}$ | | - | 20 | - | nC |
| Gate-Collector Charge | $Q_{gc}$ | | - | 80 | - | nC |
| Turn-On Delay Time | $t_{d(on)}$ | $V_{CC}$=600V, $I_C$=30A, $V_{GE}$=15V,$R_G$=10Ω Inductive Load, $T_C$ = 25℃ | - | 60 | - | ns |
| Rise Time | $t_r$ | | - | 50 | - | ns |
| Turn-Off Delay Time | $t_{d(off)}$ | | - | 280 | - | ns |
| Fall Time | $t_f$ | | - | 90 | - | ns |
| Turn-On Switching Loss | $E_{on}$ | | - | 4.3 | 6.1 | mJ |
| Turn-Off Switching Loss | $E_{off}$ | | - | 1.07 | 1.4 | mJ |
| Total Switching Loss | $E_{ts}$ | | - | 5.37 | 7.5 | mJ |
| Turn-On Delay Time | $t_{d(on)}$ | $V_{CC}$=600V, $I_C$=30A, $V_{GE}$=15V, $R_G$=10Ω Inductive Load, $T_C$ = 125℃ | - | 55 | - | ns |
| Rise Time | $t_r$ | | - | 50 | - | ns |
| Turn-Off Delay Time | $t_{d(off)}$ | | - | 290 | - | ns |
| Fall Time | $t_f$ | | - | 130 | - | ns |
| Turn-On Switching Loss | $E_{on}$ | | - | 5.0 | 6.3 | mJ |
| Turn-Off Switching Loss | $E_{off}$ | | - | 1.6 | 2.1 | mJ |
| Total Switching Loss | $E_{ts}$ | | - | 6.6 | 8.4 | mJ |
| Input Capacitance | $C_{ies}$ | $V_{CE}$=30V, $V_{GE}$=0V, f=1MHz | - | 3100 | - | pF |
| Ouput Capacitance | $C_{oes}$ | | - | 100 | - | pF |
| Reverse Transfer Capacitance | $C_{res}$ | | - | 80 | - | pF |

**ELECTRICAL CHARACTERISTIC OF DIODE**

| CHARACTERISTIC | SYMBOL | TEST CONDITION | | MIN. | TYP. | MAX. | UNIT |
|---|---|---|---|---|---|---|---|
| Diode Forward Voltage | $V_F$ | $I_F$ = 30A | $T_C$=25℃ | - | 1.9 | 2.5 | V |
| | | | $T_C$=125℃ | - | 2.05 | - | |
| Diode Reverse Recovery Time | $t_{rr}$ | $I_F$ = 30A<br>di/dt = 200A/ μs | $T_C$=25℃ | - | 250 | 330 | ns |
| | | | $T_C$=125℃ | - | 320 | - | |
| Diode Peak Reverse Recovery Current | $I_{rr}$ | | $T_C$=25℃ | - | 29 | 35 | A |
| | | | $T_C$=125℃ | - | 33 | - | |
| Diode Reverse Recovery Charge | $Q_{rr}$ | | $T_C$=25℃ | - | 3200 | 4700 | nC |
| | | | $T_C$=125℃ | - | 4750 | - | |

**Typical Performance Characteristics**

Fig 1. Saturation Voltage Characteristics

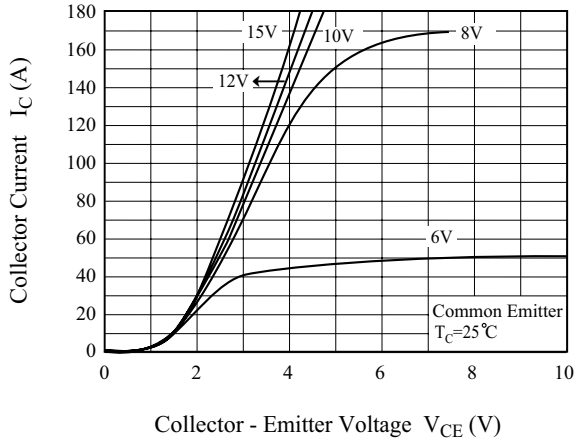



Fig 2. Saturation Voltage Characteristics

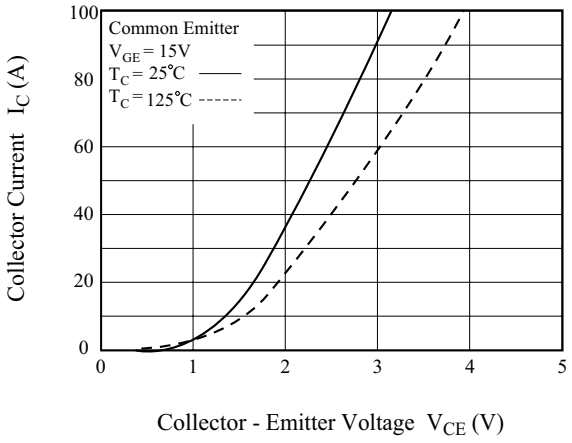



Fig 3. Saturation Voltage vs. Case Temperature

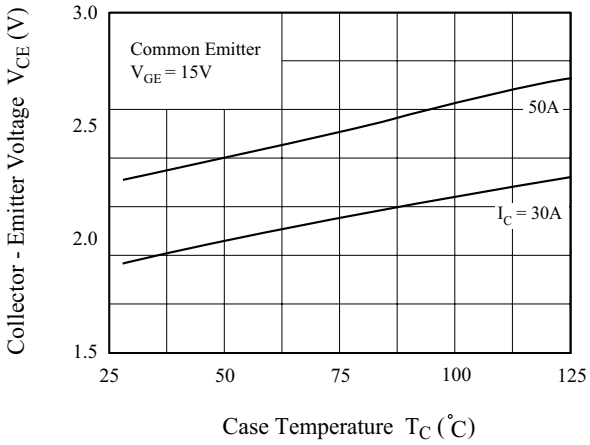



Fig 4. Saturation Voltage vs. $V_{GE}$

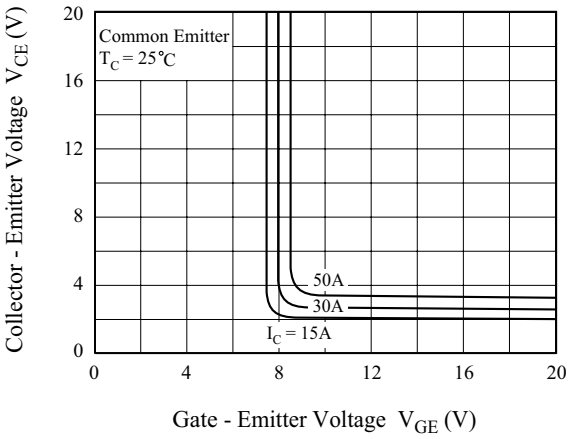



Fig 5. Saturation Voltage vs. $V_{GE}$

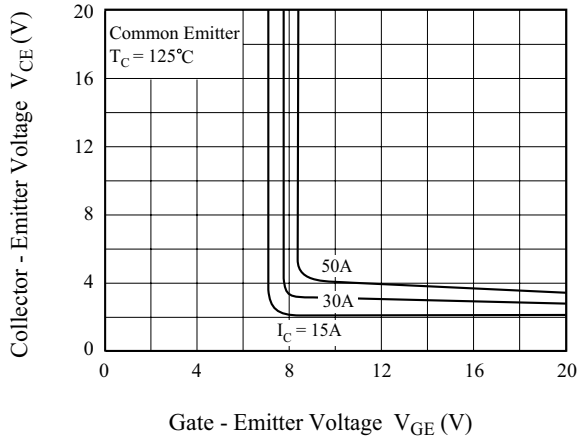
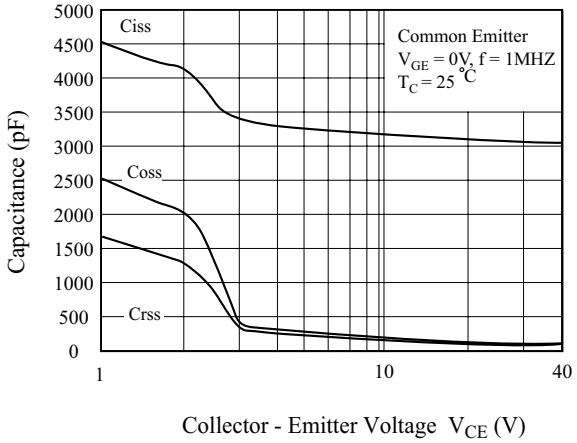



Fig 6. Capacitance Characteristics



**Typical Performance Characteristics (Continued)**

Fig 7. Turn-On Characteristics vs. Gate Resistance

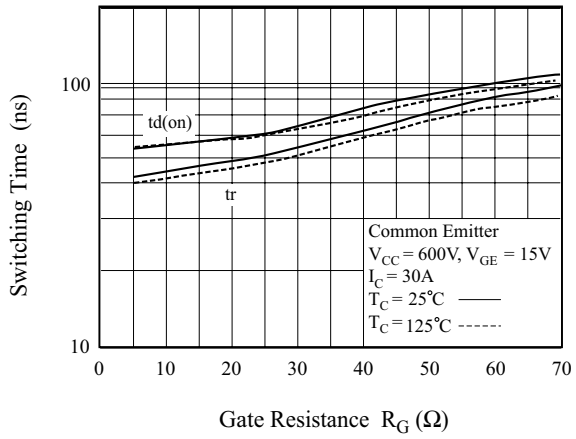



Fig 8. Turn-Off Characteristics vs. Gate Resistance

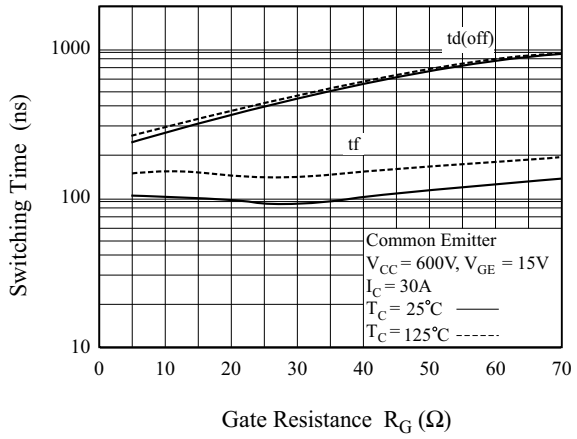



Fig 9. Switching Loss vs. Gate Resistance

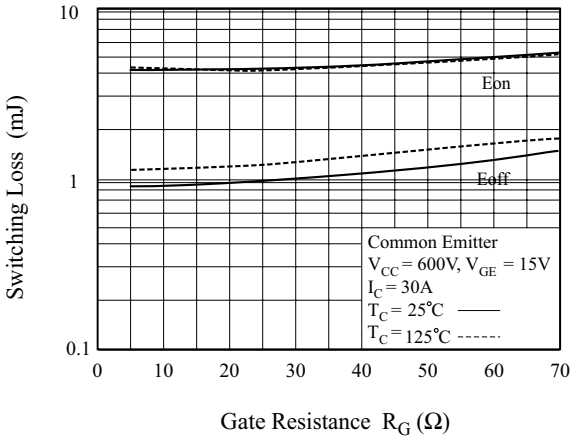



Fig 10. Turn-On Characteristics vs. Collector Current

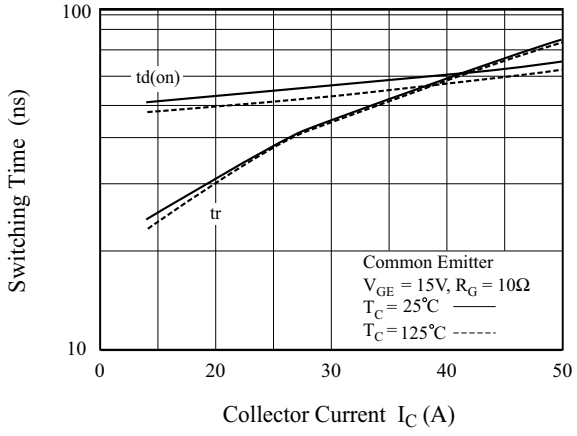



Fig 11. Turn-Off Characteristics vs. Collector Current

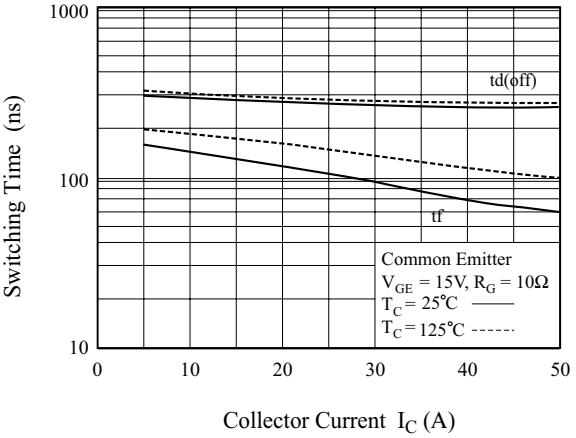
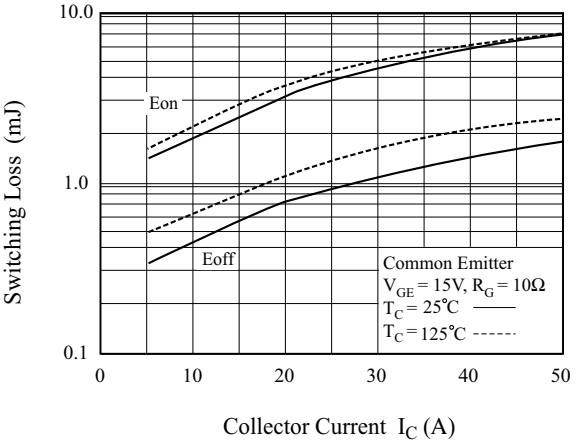



Fig 12. Switching Loss vs. Collector Current



**Typical Performance Characteristics (Continued)**

Fig 13. Gate Charge Characteristics

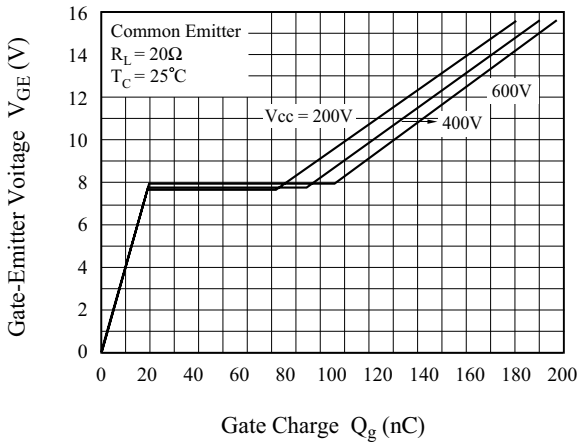



Fig 14. SOA Characteristics

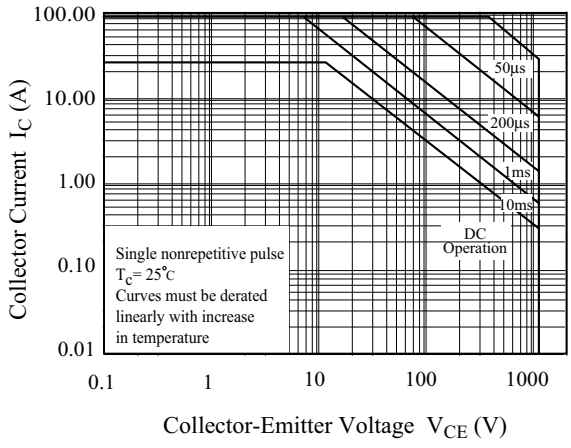



Fig 15. Turn-Off SOA

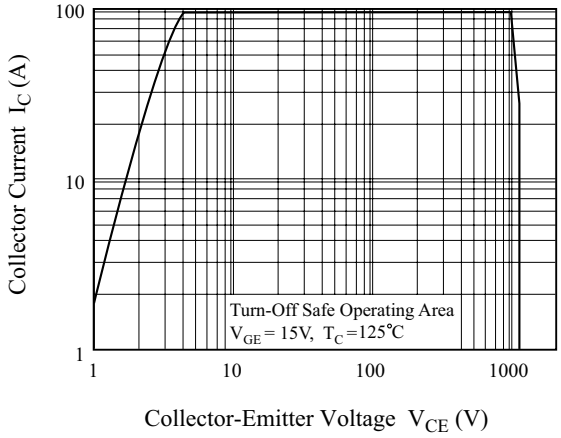
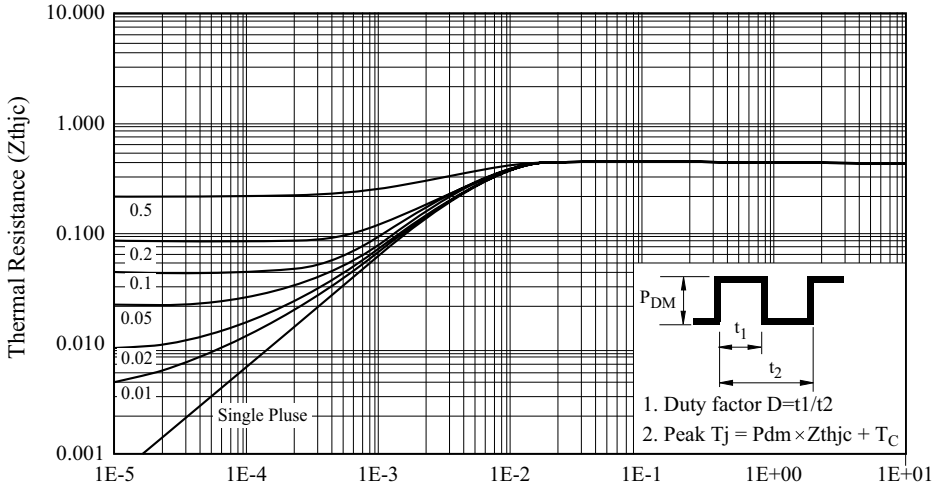



Fig 16. Transient Thermal Impedance of IGBT



**Typical Performance Characteristics**

Fig 17. Forward Characteristics

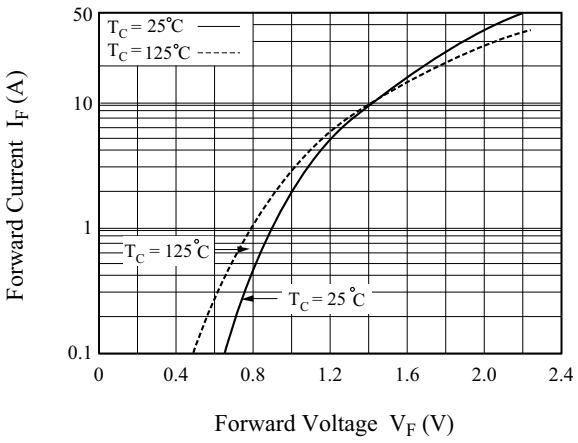



Fig 18. Reverse Recovery Current

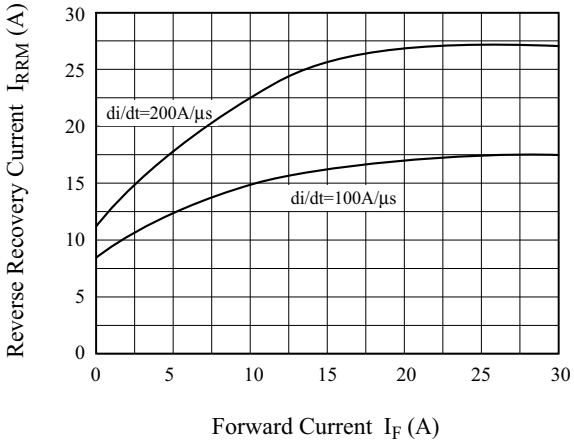
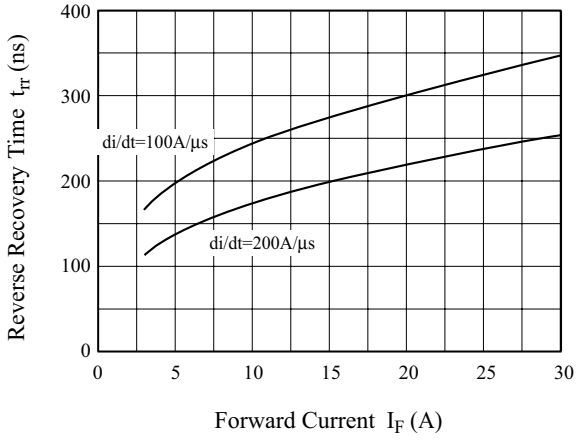



Fig 19. Reverse Recovery Time



**Definition Switching Time & Loss.**

Fig 21. Switching Test Circuit

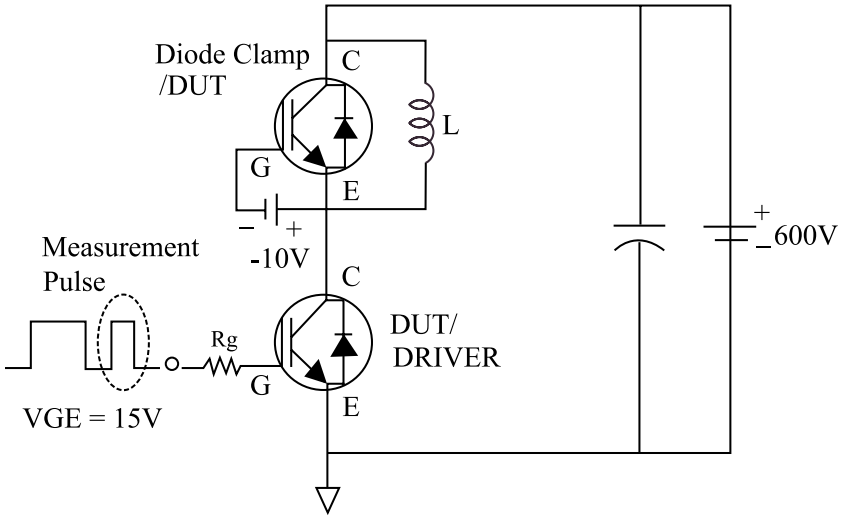
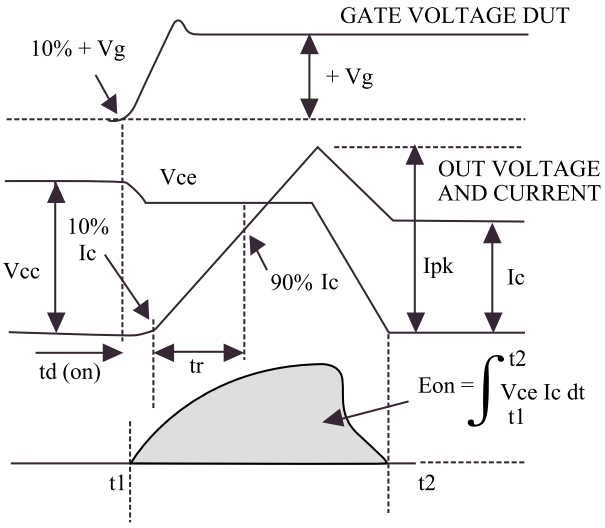



Fig 22. Definition Switching Time & Loss



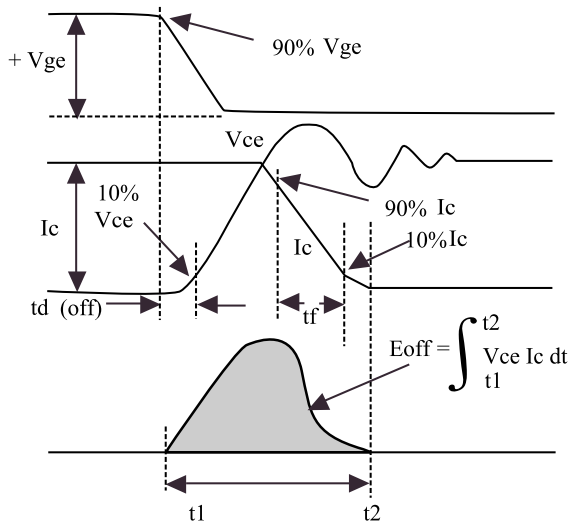




Fig 23. Definition Diode Switching Time