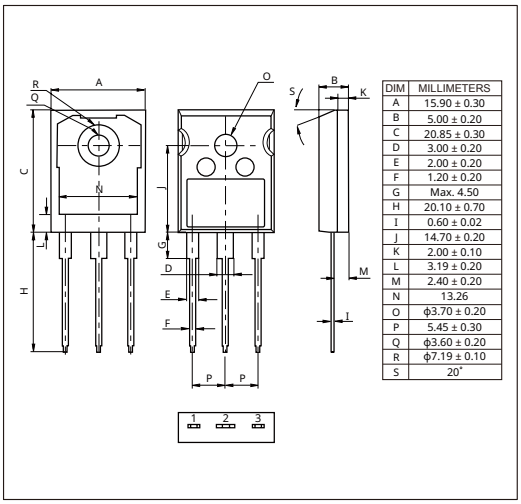
## 650V, 40A Field Stop Trench IGBTs

# KGF40N65KDCA

KEC Field Stop Trench IGBTs offer low swithcing losses, High energy efficiency and short circuit ruggedness. It is designed for applications such as motor control, uninterrupted power supplies(UPS), general inverters.

PACKAGE DIMENSION(TO-247)

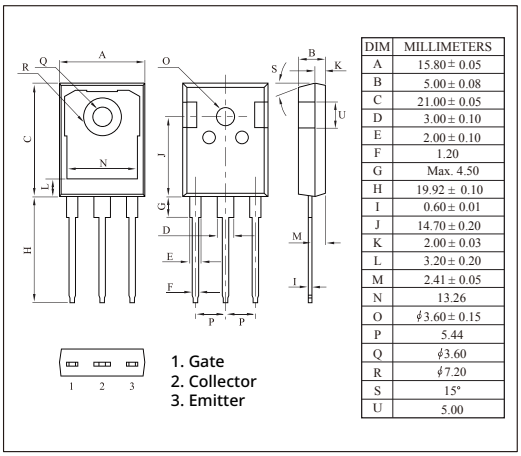



| DIM | MILLIMETERS |
|---|---|
| A | 15.90 ± 0.30 |
| B | 5.00 ± 0.20 |
| C | 20.85 ± 0.30 |
| D | 3.00 ± 0.20 |
| E | 2.00 ± 0.20 |
| F | 1.20 ± 0.20 |
| G | Max. 4.50 |
| H | 20.10 ± 0.70 |
| I | 0.60 ± 0.02 |
| J | 14.70 ± 0.20 |
| K | 2.00 ± 0.10 |
| L | 3.19 ± 0.20 |
| M | 2.40 ± 0.20 |
| N | 13.26 |
| O | ϕ3.70 ± 0.20 |
| P | 5.45 ± 0.30 |
| Q | ϕ3.60 ± 0.20 |
| R | ϕ7.19 ± 0.10 |
| S | 20° |

## FEATURES

- High speed switching
- High ruggedness, temperature stable behavior
- 650V breakdown voltage
- Maximum junction temperature: 175°C
- Short circuit withstand times > 3μs
- Extremely enhanced avalanche capability

PACKAGE DIMENSION(TO-247(E))

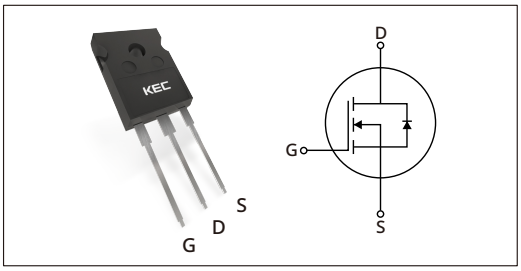



| DIM | MILLIMETERS |
|---|---|
| A | 15.80± 0.05 |
| B | 5.00± 0.08 |
| C | 21.00± 0.05 |
| D | 3.00± 0.10 |
| E | 2.00± 0.10 |
| F | 1.20 |
| G | Max. 4.50 |
| H | 19.92 ± 0.10 |
| I | 0.60± 0.01 |
| J | 14.70± 0.20 |
| K | 2.00± 0.03 |
| L | 3.20± 0.20 |
| M | 2.41± 0.05 |
| N | 13.26 |
| O | ϕ3.60± 0.15 |
| P | 5.44 |
| Q | ϕ3.60 |
| R | ϕ7.20 |
| S | 15° |
| U | 5.00 |

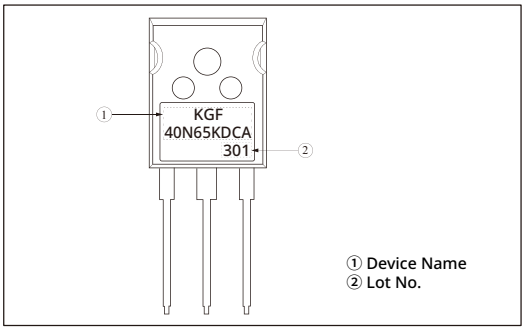
## APPLICATIONS

- Motor drives
- E-Tools
- General inverters
- Industrial SMPS
- Sewing Machine

PIN CONFIGURATION




MARKING CODE




## ORDERING INFORMATION

| PART NUMBER | QTY (PER TUBE) | QTY (PER CARTON BOX) |
|---|---|---|
| KGF40N65KDCA-U/P or U/H | 30 pcs | 1,800 pcs |
| KGF40N65KDCA-U/PE or U/HE | | |

## MAXIMUM RATING ($T_J$=25℃, unless otherwise specified)

| CHARACTERISTICS | | SYMBOL | VALUES | UNIT |
|---|---|---|---|---|
| Collector - Emitter Voltage, $T_J$≥25℃ | | $V_{CES}$ | 650 | V |
| Gate - Emitter Voltage | | $V_{GES}$ | ±20 | V |
| Transient Gate - Emitter Voltage @ tp≤0.5μs, D＜0.001 | | | ±30 | |
| Collector Current, limited by $T_{Jmax}$ | @$T_C$=25℃ | $I_C$ | 80 | A |
| | @$T_C$=100℃ | | 40 | |
| Pulsed Collector Current, $T_C$=25℃ (Note 1) | | $I_{CM}$ | 120 | A |
| Pulsed Collector Current, $T_C$=25℃ | | $I_{LM}$ | 120 | A |
| Diode Continuous Forward Current, limited by $T_{Jmax}$ | @$T_C$=25℃ (Note 2) | $I_F$ | 80 | A |
| | @$T_C$=100℃ | | 40 | |
| Diode Pulsed Forward Current, $T_C$=25℃ | | $I_{FM}$ | 120 | A |
| Short Circuit Withstand Time @ $V_{CC}$=400V, $V_{GE}$=15V, $T_{Jstrat}$=25℃ | | $t_{SC}$ | 3 | μs |
| Maximum Power Dissipation | @$T_C$=25℃ | $P_D$ | 208 | W |
| | @$T_C$=100℃ | | 104 | W |
| Operating Junction Temperature | | $T_J$ | 175 | ℃ |
| Storage Temperature Range | | $T_{stg}$ | -55 ~ 150 | ℃ |

Note 1) Pulse width limited by $T_{Jmax}$
Note 2) Value limited by bondwire

## THERMAL CHARACTERISTICS

| CHARACTERISTICS | SYMBOL | CONDITIONS | VALUES | | | UNIT |
|---|---|---|---|---|---|---|
| | | | MIN. | TYP. | MAX. | |
| Thermal resistance, junction to case(IGBT) | $R_{thJC}$ | - | - | - | 0.72 | ℃/W |
| Thermal resistance, junction to case(DIODE) | | - | - | - | 1.47 | ℃/W |
| Thermal resistance, junction to Ambient | $R_{thJA}$ | - | - | - | 40 | ℃/W |

## ELECTRICAL CHARACTERISTICS OF IGBT ($T_J$= 25°C, unless other wise specified)

| CHARACTERISTICS | SYMBOL | CONDITIONS | VALUES | | | UNIT |
|---|---|---|---|---|---|---|
| | | | MIN. | TYP. | MAX. | |
| **Static** | | | | | | |
| Collector-Emitter Breakdown Voltage | $BV_{CES}$ | $V_{GE}$=0V, $I_C$=250μA | 650 | - | - | V |
| Collector Cut-off Current | $I_{CES}$ | $V_{GE}$=0V, $V_{CE}$=650V | - | - | 250 | μA |
| Gate Leakage Current | $I_{GES}$ | $V_{CE}$=0V, $V_{GE}$=±20V | - | - | ±100 | nA |
| Gate Threshold Voltage | $V_{GE(th)}$ | $V_{GE}$=$V_{CE}$, $I_C$=4mA | 5.0 | 6.2 | 7.5 | V |
| Collector-Emitter Saturation Voltage | $V_{CE(sat)}$ | $V_{GE}$=15V, $I_C$=40A | - | 1.65 | 2.3 | V |
| | | $V_{GE}$=15V, $I_C$=80A | - | 2.3 | - | V |
| | | $V_{GE}$=15V, $I_C$=40A, $T_J$=$T_{Jmax}$ | - | 2.0 | - | V |
| **Dynamic** | | | | | | |
| Total Gate Charge | $Q_g$ | $V_{CC}$=400V, $I_C$=40A, $V_{GE}$=15V | - | 103 | - | nC |
| Gate-Emitter Charge | $Q_{ge}$ | | - | 18 | - | nC |
| Gate-Collector Charge | $Q_{gc}$ | | - | 54 | - | nC |
| Input Capacitance | $C_{ies}$ | $V_{CE}$=25V, $V_{GE}$=0V, f=1MHz | - | 2,430 | - | pF |
| Output Capacitance | $C_{oes}$ | | - | 104 | - | pF |
| Reverse Transfer Capacitance | $C_{res}$ | | - | 30 | - | pF |
| **Switching** | | | | | | |
| Turn-on Delay Time | $t_{d(on)}$ | $V_{CC}$=400V, $I_C$=40A, $V_{GE}$=15V, $R_G$=10Ω Inductive Load, $T_J$=25°C (Note 3) | - | 60 | - | ns |
| Rise Time | $t_r$ | | - | 26 | - | ns |
| Turn-off Delay Time | $t_{d(off)}$ | | - | 180 | - | ns |
| Fall Time | $t_f$ | | - | 27 | - | ns |
| Turn-on Switching Loss | $E_{on}$ | | - | 1.35 | - | mJ |
| Turn-off Switching Loss | $E_{off}$ | | - | 0.75 | - | mJ |
| Total Switching Loss | $E_{ts}$ | | - | 2.1 | - | mJ |

Note 3) Energy loss include tail current and DIODE reverse recovery

## ELECTRICAL CHARACTERISTICS OF DIODE

| CHARACTERISTICS | SYMBOL | CONDITIONS | VALUES | | | UNIT |
|---|---|---|---|---|---|---|
| | | | MIN. | TYP. | MAX. | |
| Forward Voltage | $V_F$ | $I_F$=40A | - | 1.98 | 2.3 | V |
| | | $I_F$=40A, $T_J$=$T_{Jmax}$ | - | 1.91 | - | |
| Diode Reverse Recovery Time | $t_{rr}$ | $V_{CC}$=400V<br>$I_F$=40A<br>$dI_F/dt$=200A/μs<br>$T_J$=25℃ | - | 175 | - | ns |
| Diode Peak Reverse Recovery Current | $I_{RRM}$ | | - | 3.8 | - | A |
| Diode Reverse Recovery Charge | $Q_{rr}$ | | - | 0.23 | - | μC |
| Reverse Recovery Energy | $E_{REC}$ | | - | 19.1 | - | μJ |

Fig 1. Power dissipation
as a function of case temperature

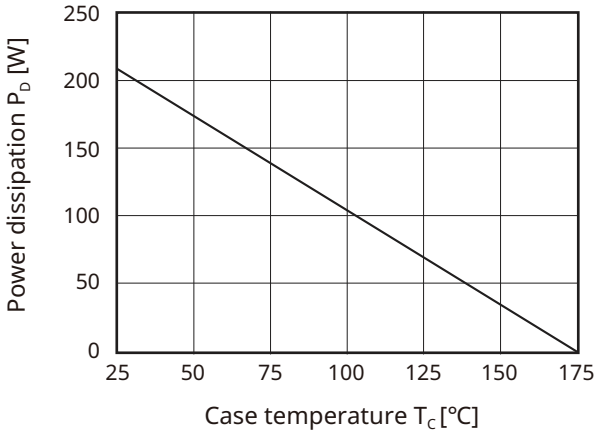



Fig 2. Typical output characteristic ($I_C$ vs $V_{CE}$)
@$T_J$=25℃

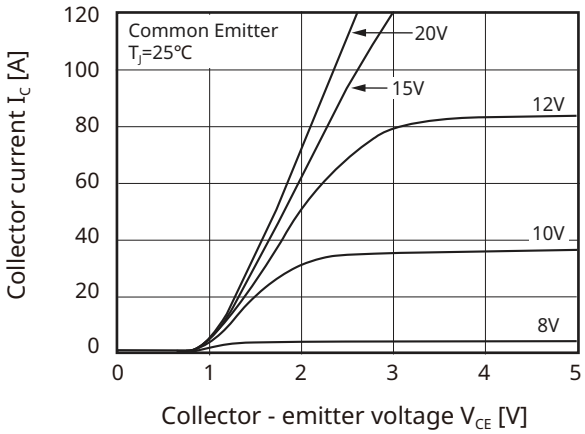



Fig 3. Typical output characteristic ($I_C$ vs $V_{CE}$)
@$T_J$=$T_{Jmax}$

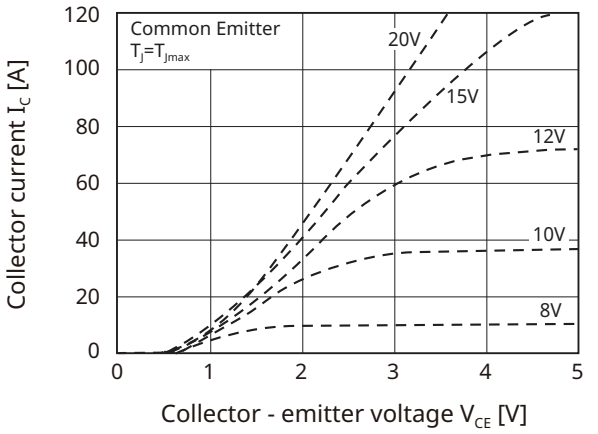



Fig 4. Typical saturation voltage characteristic
($I_C$ vs $V_{CE}$)

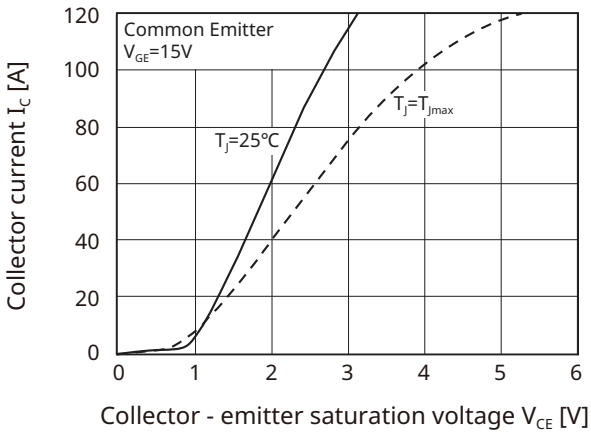



Fig 5. Typical collector-emitter saturation
voltage as a function of junction temperature

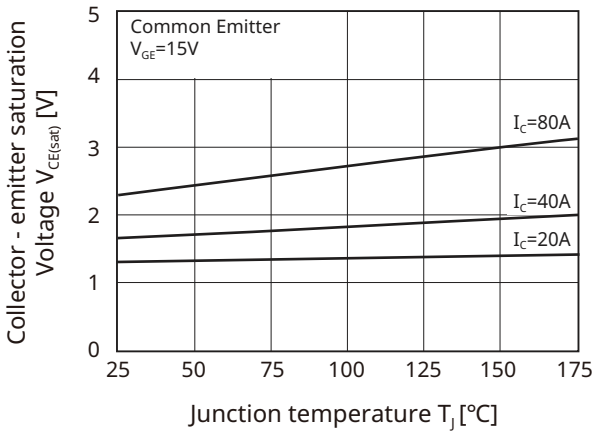



Fig 6. Typical gate-emitter threshold
voltage as a function of junction temperature

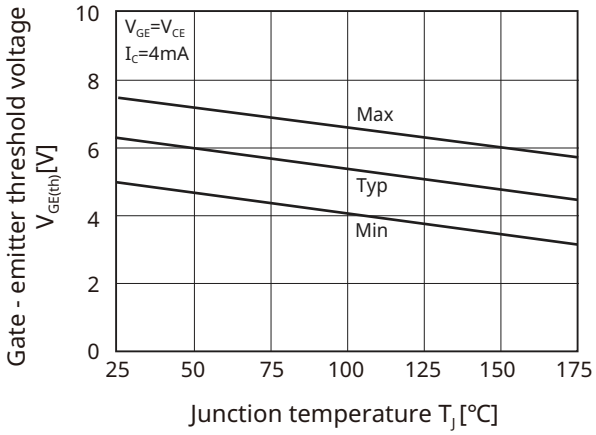


Fig 7. Typical collector-emitter saturation voltage as a function of gate-emitter voltage

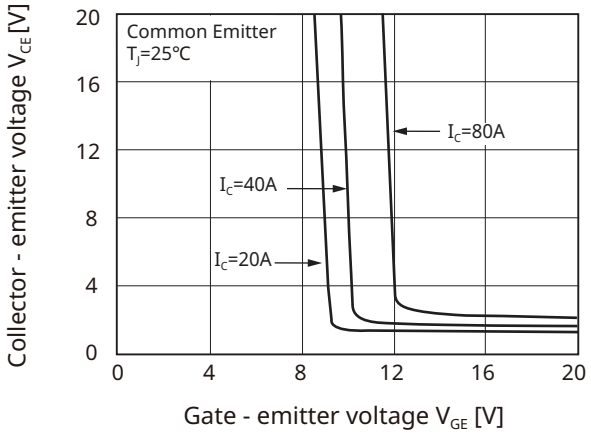



Fig 8. Typical collector-emitter saturation voltage as a function of gate-emitter voltage

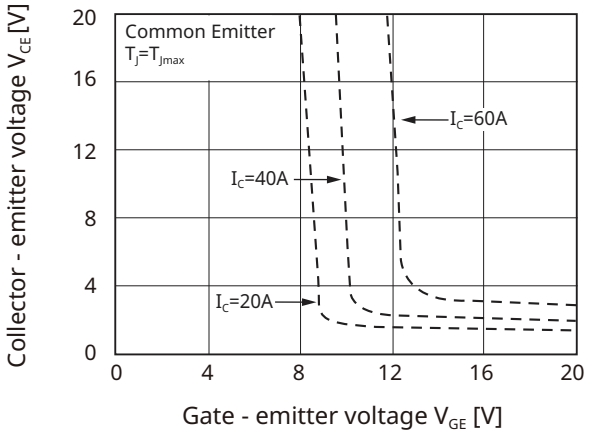



Fig 9. Typical capacitance as a function of collector-emitter voltage

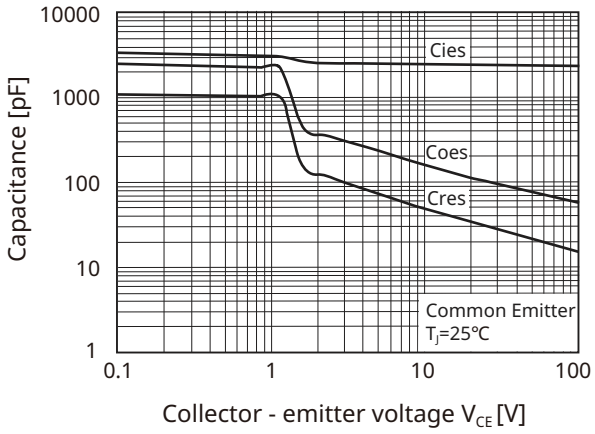



Fig 10. Typical gate charge

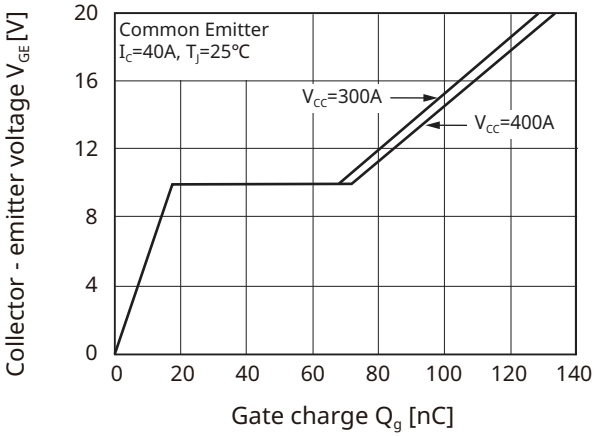



Fig 11. Typical turn-on characteristics as a function of gate resistance

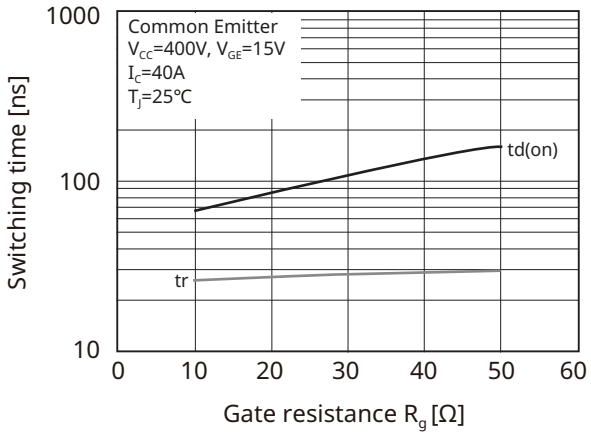



Fig 12. Typical turn-on characteristics as a function of gate resistance

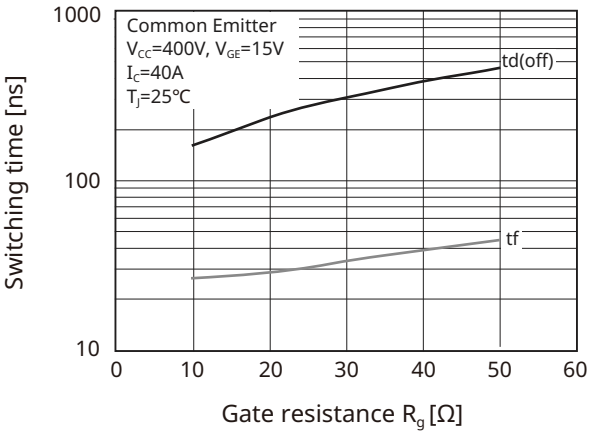


Fig 13. Typical turn-on characteristics as a function of collector current

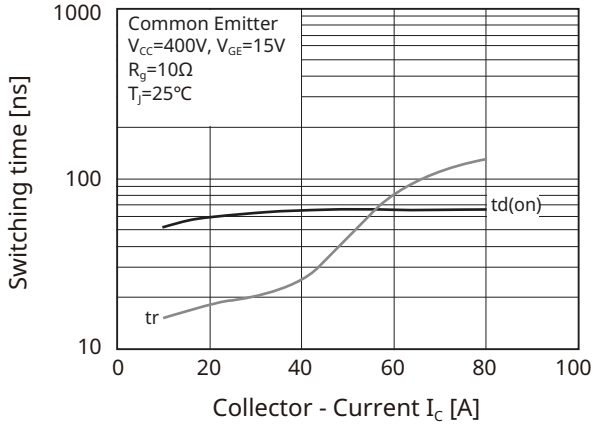



Fig 14. Typical turn-on characteristics as a function of collector current

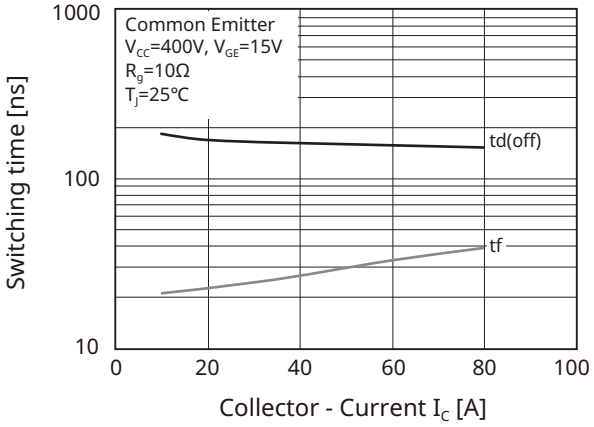



Fig 15. Typical switching energy losses as a function gate resistance

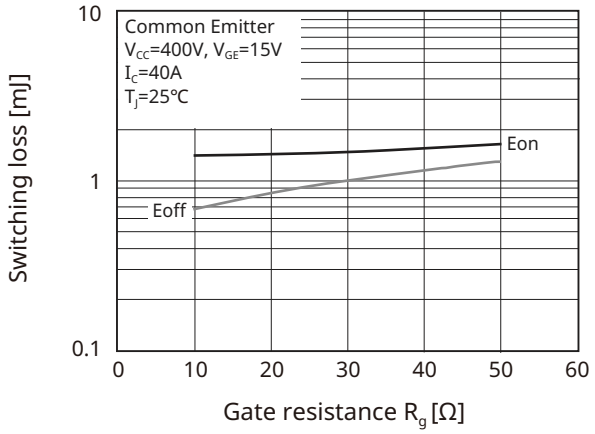



Fig 16. Typical switching energy losses as a function of collector current

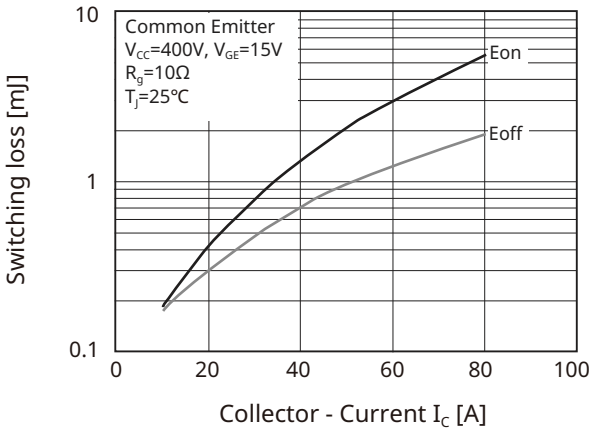



Fig 17. Typical diode fordward current as a function of forward voltage

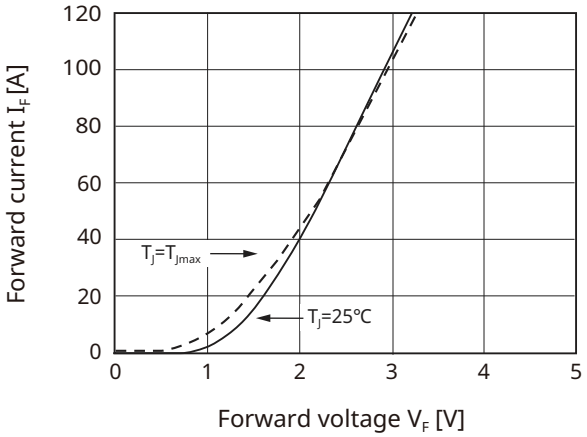



Fig 18. Typical diode forward voltage as a function of junction temperature

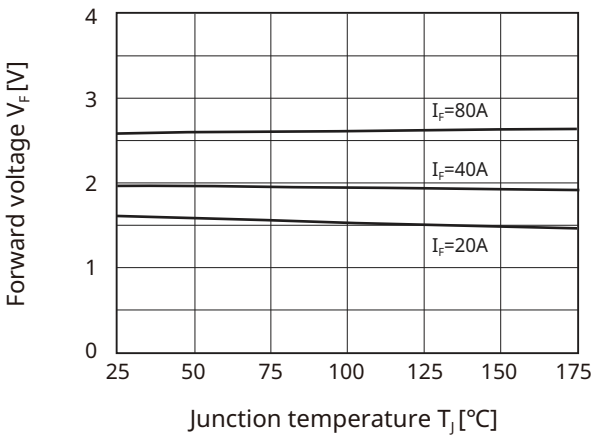


Fig 19. Typical reverse recovery time as a function of diode current slope

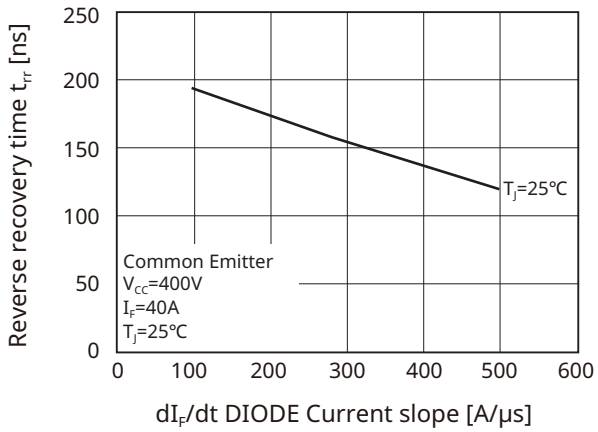



Fig 20. Typical reverse recovery current as a function of diode current slope

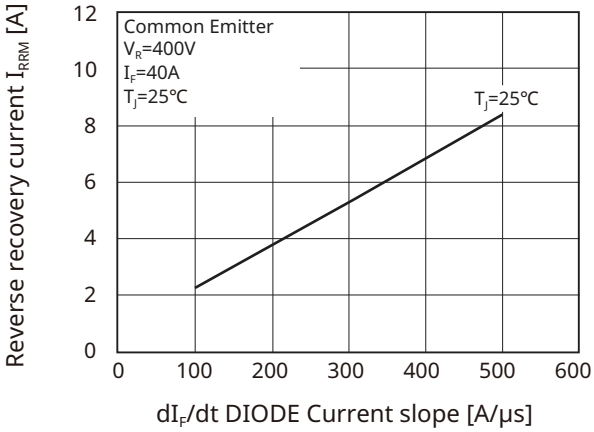



Fig 21. Typical reverse recovery charge as a function of diode current slope

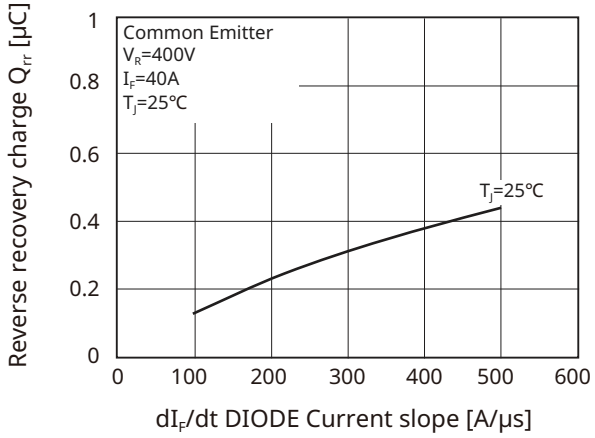



Fig 22. Typical reverse recovery time as a function of diode current slope

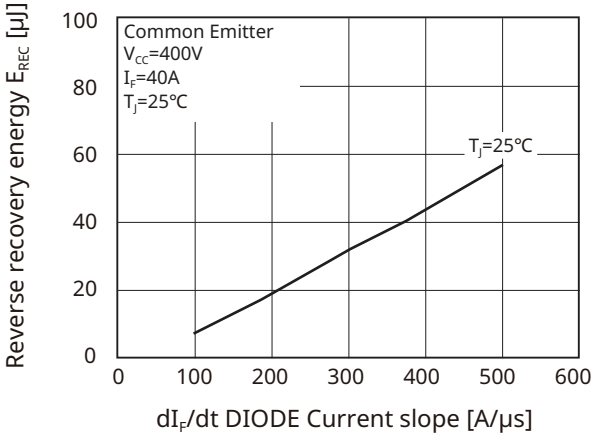



Fig 23. Typical diode current slope as a function of gate resistance

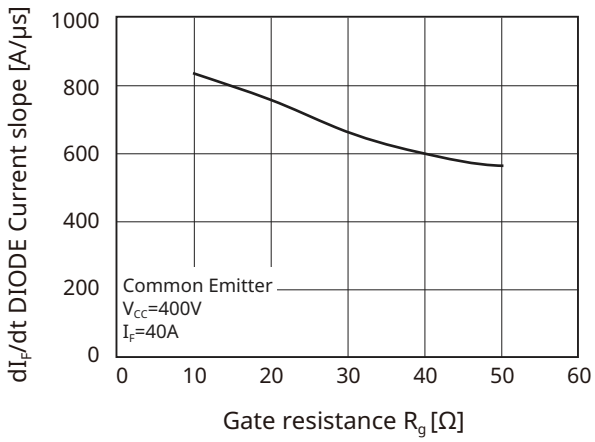



Fig 24. Short circuit collector current as a function of gate-emitter voltage

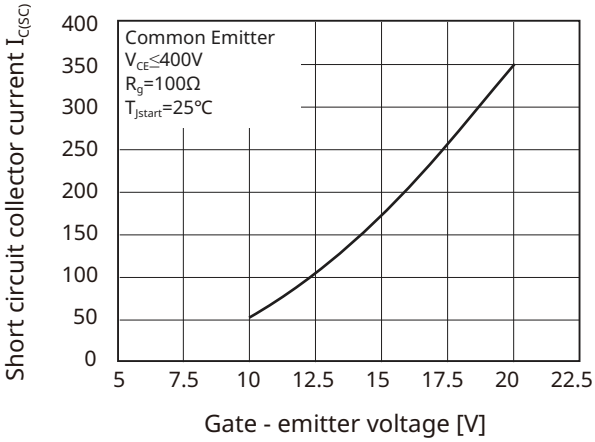
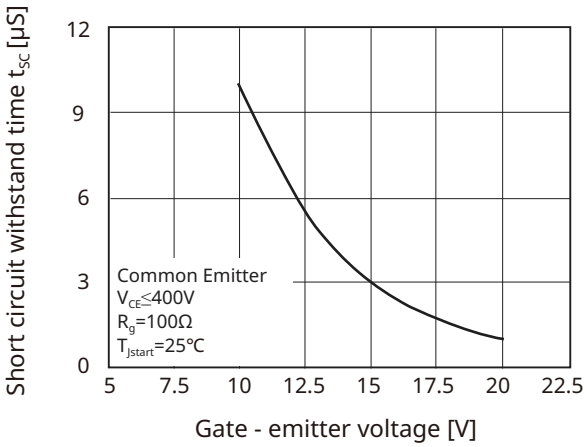


Fig 25. Short circuit withstand time
as a function of gate-emitter voltage



## Condition

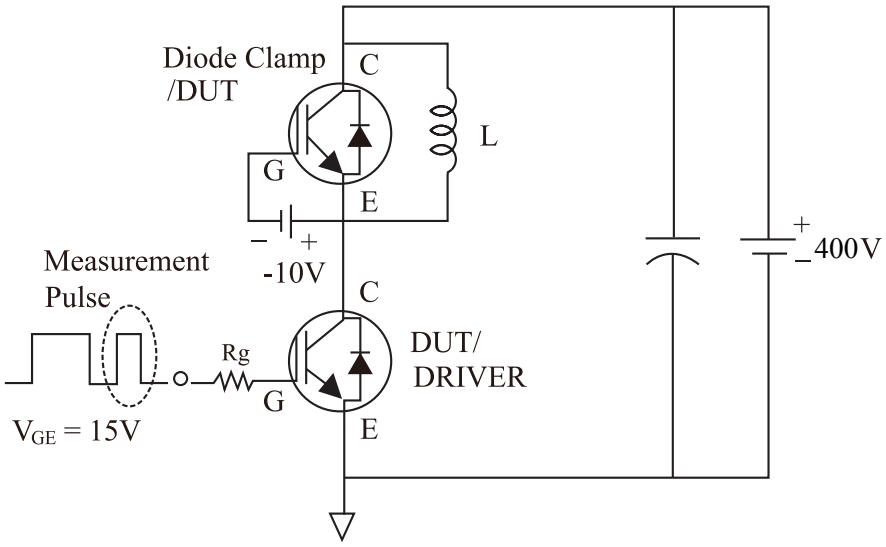



Figure a. Switching test circuit

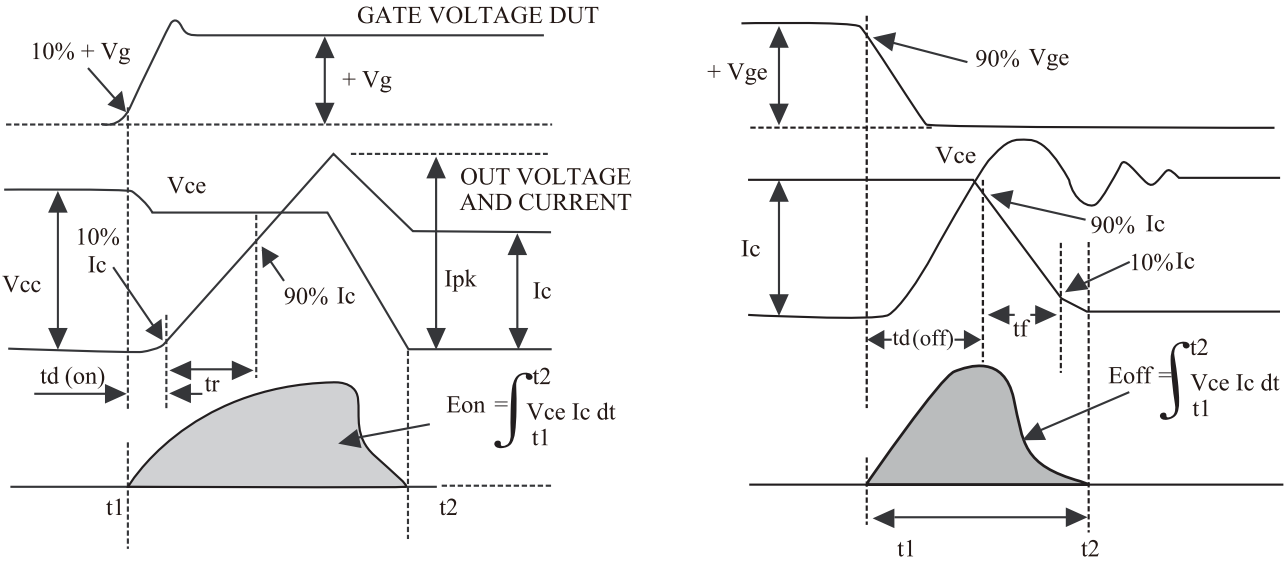



Figure b. Definition switching time & losses

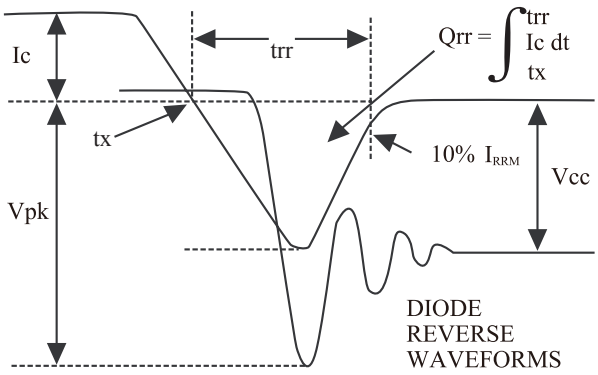
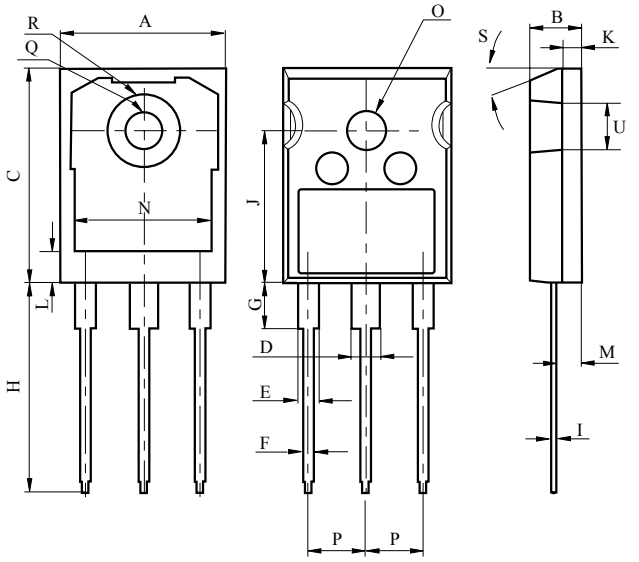



Figure c. Definition of diode switching characteristics

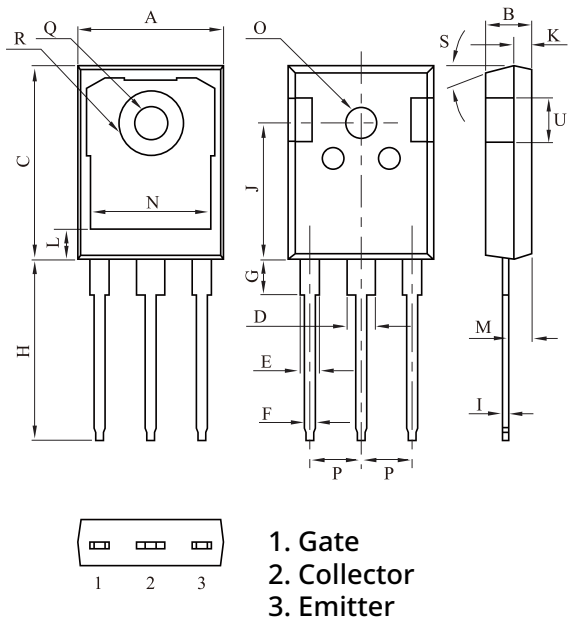
## PACKAGE INFORMATION(TO-247)




1. Gate
2. Collector
3. Emitter

| DIM | MILLIMETERS |
|---|---|
| A | 15.90 ± 0.30 |
| B | 5.00 ± 0.20 |
| C | 20.85 ± 0.30 |
| D | 3.00 ± 0.20 |
| E | 2.00 ± 0.20 |
| F | 1.20 ± 0.20 |
| G | Max. 4.50 |
| H | 20.10 ± 0.70 |
| I | 0.60 ± 0.02 |
| J | 14.70 ± 0.20 |
| K | 2.00 ± 0.10 |
| L | 3.19 ± 0.20 |
| M | 2.40 ± 0.20 |
| N | 13.26 |
| O | ϕ3.70 ± 0.20 |
| P | 5.45 ± 0.30 |
| Q | ϕ3.60 ± 0.20 |
| R | ϕ7.19 ± 0.10 |
| S | 20° |
| U | 4.57 |

## PACKAGE DIMENSION(TO-247(E))




1. Gate
2. Collector
3. Emitter

| DIM | MILLIMETERS |
|---|---|
| A | 15.80 ± 0.05 |
| B | 5.00 ± 0.08 |
| C | 21.00 ± 0.05 |
| D | 3.00 ± 0.10 |
| E | 2.00 ± 0.10 |
| F | 1.20 |
| G | Max. 4.50 |
| H | 19.92 ± 0.10 |
| I | 0.60 ± 0.01 |
| J | 14.70 ± 0.20 |
| K | 2.00 ± 0.03 |
| L | 3.20 ± 0.20 |
| M | 2.41 ± 0.05 |
| N | 13.26 |
| O | ϕ3.60 ± 0.15 |
| P | 5.44 |
| Q | ϕ3.60 |
| R | ϕ7.20 |
| S | 15° |
| U | 5.00 |

# PRECAUTION ON USING KEC PRODUCTS

1. The products described in this data are intended to be used in general-purpose electronic equipment.
(Office equipment, telecommunication equipment, measuring equipment, home appliances)

2. When you intend to use these products with equipment or device which require an extremely high of reliability and special applications (such as automobile, air travel aerospace, transportation equipment, life support, system and safety devices) in which special quality and reliability and the failure or malfunction of products may directly jeopardize or harm the human body or damage to property and any application other than the standard application intended, please be sure to consult with our sales representative in advance.

3. On designing your application, please use product within the ranges guaranteed by KEC for maximum rating, operating supply voltage range, heat radiation characteristics and other characteristics. User shall be responsible for failure or damage when used beyond the guaranteed ranges.

4. The technical information described in this data is limited to showing representative characteristics and applied circuit examples of the products and it does not constitute the warranting of industrial property, the granting of relative rights, or the granting of any license.

5. What are described in the data may be changed without any prior notice to reflect new technical development. Please confirm that you have received the latest product standards or specification before final design, purchase or use.

6. Although KEC is continuously working to improve product reliability and quality, semiconductors can break down and malfunction due to various factors. Therefore, in order to prevent personal injury or fire arising from failure, please take safety measures such as complying with the derating characteristics, implementing redundant and fire prevention designs, and utilizing backups and fail-safe procedures. KEC shall have no responsibility for any damages arising out of the use of our Products beyond the rating specified by KEC.

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