

# PWG15N65TFD

IGBT 650V, 1.55V, 15A



重庆平伟半导体股份有限公司

## Features

- 650V Trench field-stop technology
- Low conduction and switching losses
- Positive temperature coefficient of forward voltage
- Qualified according to JEDEC criteria



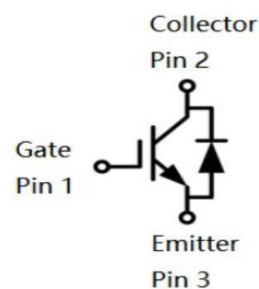
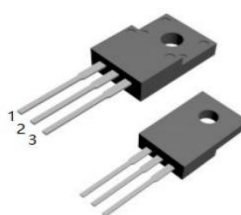
## Applications

- Solar Inverter, UPS, Welder, Telecom, ESS

## Product Summary

|               |       |
|---------------|-------|
| $V_{CE}$      | 650V  |
| $V_{CE(sat)}$ | 1.55V |
| $I_C$         | 15A   |

TO-220TF-3L



## Package Marking and Ordering Information

| Part #      | Marking     | Package     | Packing | Reel Size | Tape Width | Qty   |
|-------------|-------------|-------------|---------|-----------|------------|-------|
| PWG15N65TFD | PWG15N65TFD | TO-220TF-3L | Tube    | N/A       | N/A        | 50pcs |

## Absolute Maximum Ratings

| Parameter                                                                             | Symbol            | Value        | Unit               |
|---------------------------------------------------------------------------------------|-------------------|--------------|--------------------|
| Collector-emitter voltage                                                             | $V_{CES}$         | 650          | V                  |
| Collector current<br>$T_C=25^{\circ}\text{C}$<br>$T_C=100^{\circ}\text{C}$            | $I_C$             | 30<br>15     | A                  |
| Diode forward current<br>$T_C=25^{\circ}\text{C}$<br>$T_C=100^{\circ}\text{C}$        | $I_F$             | 30<br>15     | A                  |
| Pulsed collector current, $t_p$ limited by $T_{vjmax}$                                | $I_{C\ pulse}$    | 60           | A                  |
| Gate-emitter voltage                                                                  | $V_{GE}$          | $\pm 30$     | V                  |
| Power dissipation<br>$T_C=25^{\circ}\text{C}$                                         | $P_{tot}$         | 35           | W                  |
| Operating junction and storage temperature                                            | $T_{vj}, T_{stg}$ | $-55...+150$ | $^{\circ}\text{C}$ |
| Soldering temperature, wave soldering only allowed at leads (1.6mm from case for 10s) | $T_{sold}$        | 260          | $^{\circ}\text{C}$ |

## Thermal Resistance

| Parameter                                 | Symbol     | Value |      |      | Unit | Test Condition |
|-------------------------------------------|------------|-------|------|------|------|----------------|
|                                           |            | min.  | typ. | max. |      |                |
| Thermal resistance, junction-case.(IGBT)  | $R_{thJC}$ | -     | -    | 3.59 | °C/W | -              |
| Thermal resistance, junction-case.(Diode) | $R_{thJC}$ | -     | -    | 6.75 | °C/W | -              |
| Thermal resistance, junction-ambient      | $R_{thJA}$ | -     | -    | 72   | °C/W | -              |

## Electrical Characteristic (at $T_{vj}=25^{\circ}\text{C}$ , unless otherwise specified)

| Parameter | Symbol | Value |      |      | Unit | Test Condition |
|-----------|--------|-------|------|------|------|----------------|
|           |        | min.  | typ. | max. |      |                |

## Static Characteristic

|                                      |               |     |              |           |         |                                                                                         |
|--------------------------------------|---------------|-----|--------------|-----------|---------|-----------------------------------------------------------------------------------------|
| Collector-emitter breakdown voltage  | $BV_{CES}$    | 650 | -            | -         | V       | $V_{GE}=0V, I_C=250\mu A$                                                               |
| Gate threshold voltage               | $V_{GE(th)}$  | 5.0 | -            | 6.5       | V       | $V_{CE}=V_{GE}, I_C=1mA$                                                                |
| Zero gate voltage collector current  | $I_{CES}$     | -   | -            | 4<br>1000 | $\mu A$ | $V_{CE}=650V, V_{GE}=0V$<br>$T_{vj}=25^{\circ}\text{C}$<br>$T_{vj}=150^{\circ}\text{C}$ |
| Gate-emitter leakage current         | $I_{GES}$     | -   | -            | $\pm 200$ | nA      | $V_{GE}=\pm 30V, V_{CE}=0V$                                                             |
| Collector-emitter saturation voltage | $V_{CE(sat)}$ | -   | 1.55<br>1.83 | 2.00<br>- | V       | $V_{GE}=15V, I_C=15A$<br>$T_{vj}=25^{\circ}\text{C}$<br>$T_{vj}=150^{\circ}\text{C}$    |

## Dynamic Characteristic

|                              |           |   |     |   |    |                                        |
|------------------------------|-----------|---|-----|---|----|----------------------------------------|
| Input capacitance            | $C_{ies}$ | - | 898 | - | pF | $V_{GE}=0V, V_{CE}=25V,$<br>$f=1MHz$   |
| Output capacitance           | $C_{oes}$ | - | 42  | - |    |                                        |
| Reverse transfer capacitance | $C_{res}$ | - | 10  | - |    |                                        |
| Gate total charge            | $Q_G$     | - | 37  | - | nC | $V_{CE}=520V, I_C=15A$<br>$V_{GE}=15V$ |
| Gate-collector charge        | $Q_{gc}$  | - | 17  | - |    |                                        |
| Gate-emitter charge          | $Q_{ge}$  | - | 10  | - |    |                                        |

## Switching Characteristic, Inductive Load

| Parameter                                    | Symbol              | Value |      |      | Unit | Test Condition                                                                                                                              |
|----------------------------------------------|---------------------|-------|------|------|------|---------------------------------------------------------------------------------------------------------------------------------------------|
|                                              |                     | min.  | typ. | max. |      |                                                                                                                                             |
| IGBT Characteristic,at T <sub>vj</sub> =25°C |                     |       |      |      |      |                                                                                                                                             |
| Turn-on delay time                           | t <sub>d(on)</sub>  | -     | 17   | -    | ns   | I <sub>C</sub> =15A,<br>V <sub>CE</sub> =400V,<br>V <sub>GE</sub> =15V,<br>R <sub>G</sub> =10Ω,<br>T <sub>vj</sub> =25°C,<br>Inductive load |
| Rise time                                    | t <sub>r</sub>      | -     | 22   | -    |      |                                                                                                                                             |
| Turn-off delay time                          | t <sub>d(off)</sub> | -     | 84   | -    |      |                                                                                                                                             |
| Fall time                                    | t <sub>f</sub>      | -     | 111  | -    |      |                                                                                                                                             |
| Turn-on energy                               | E <sub>on</sub>     | -     | 0.24 | -    | mJ   |                                                                                                                                             |
| Turn-off energy                              | E <sub>off</sub>    | -     | 0.38 | -    |      |                                                                                                                                             |
| Total switching energy                       | E <sub>ts</sub>     | -     | 0.62 | -    |      |                                                                                                                                             |

## Switching Characteristic, Inductive Load

| Parameter                                      | Symbol              | Value |      |      | Unit | Test Condition                                                                                                                               |
|------------------------------------------------|---------------------|-------|------|------|------|----------------------------------------------------------------------------------------------------------------------------------------------|
|                                                |                     | min.  | typ. | max. |      |                                                                                                                                              |
| IGBT Characteristic, at T <sub>vj</sub> =150°C |                     |       |      |      |      |                                                                                                                                              |
| Turn-on delay time                             | t <sub>d(on)</sub>  | -     | 28   | -    | ns   | I <sub>C</sub> =15A,<br>V <sub>CC</sub> =400V,<br>V <sub>GE</sub> =15V,<br>R <sub>G</sub> =10Ω,<br>T <sub>vj</sub> =150°C,<br>Inductive load |
| Rise time                                      | t <sub>r</sub>      | -     | 36   | -    |      |                                                                                                                                              |
| Turn-off delay time                            | t <sub>d(off)</sub> | -     | 125  | -    |      |                                                                                                                                              |
| Fall time                                      | t <sub>f</sub>      | -     | 157  | -    |      |                                                                                                                                              |
| Turn-on energy                                 | E <sub>on</sub>     | -     | 0.40 | -    | mJ   |                                                                                                                                              |
| Turn-off energy                                | E <sub>off</sub>    | -     | 0.85 | -    |      |                                                                                                                                              |
| Total switching energy                         | E <sub>ts</sub>     | -     | 1.25 | -    |      |                                                                                                                                              |

## ELECTRICAL CHARACTERISTICS OF THE DIODE, at $T_{vj}=25^{\circ}\text{C}$

|                         |          |   |      |      |    |                          |
|-------------------------|----------|---|------|------|----|--------------------------|
| Diode forward voltage   | $V_F$    | - | 1.77 | 2.10 | V  | $I_F=15\text{A}$         |
| Reverse recovery time   | $T_{rr}$ | - | 88   | 106  | ns | $I_F=15\text{A},$        |
| Reverse recovery charge | $Q_{rr}$ | - | 166  | -    | nC | $dI_F/dt=200\text{A/us}$ |

## Typical Performance Characteristics

Fig 1: Output Characteristics

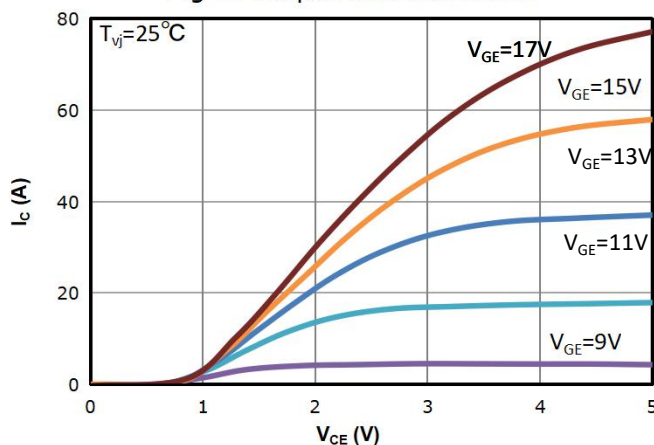


Fig 2: Output Characteristics

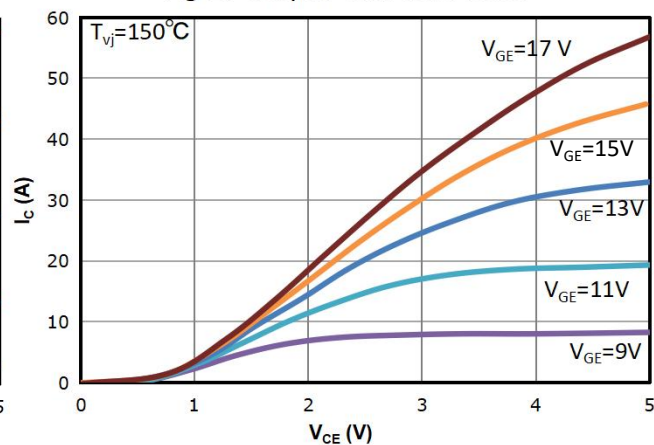


Fig 3: Transfer Characteristics

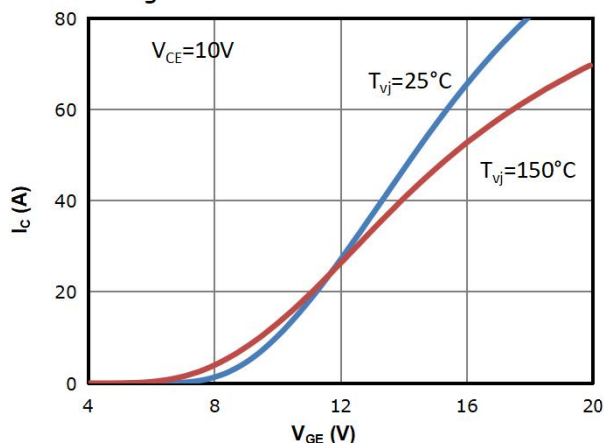


Fig 4: Typical Saturation Voltage Characteristic

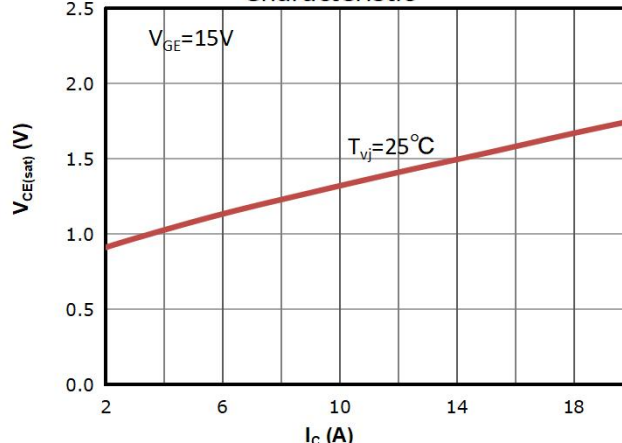


Fig 5:  $V_{CE(sat)}$  vs. Gate Voltage

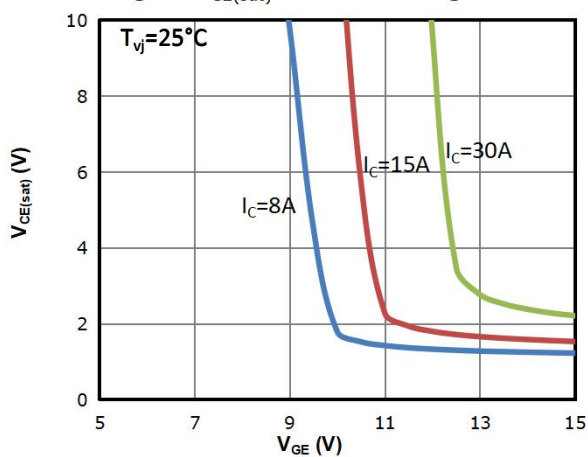


Fig 6:  $V_{CE(sat)}$  vs. Temperature

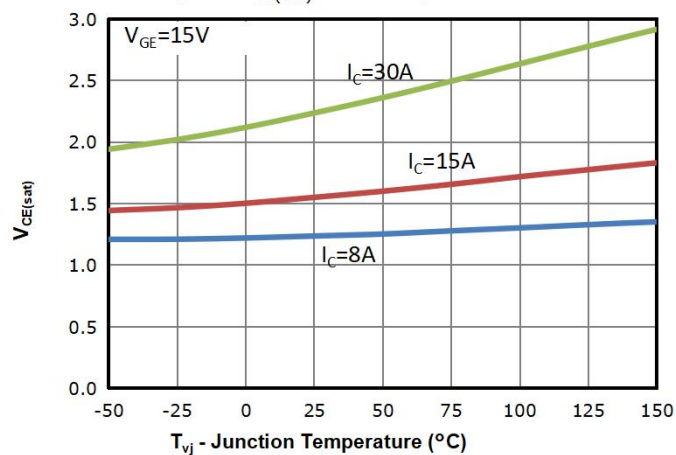


Fig 7:  $V_{GE(th)}$  vs. Temperature

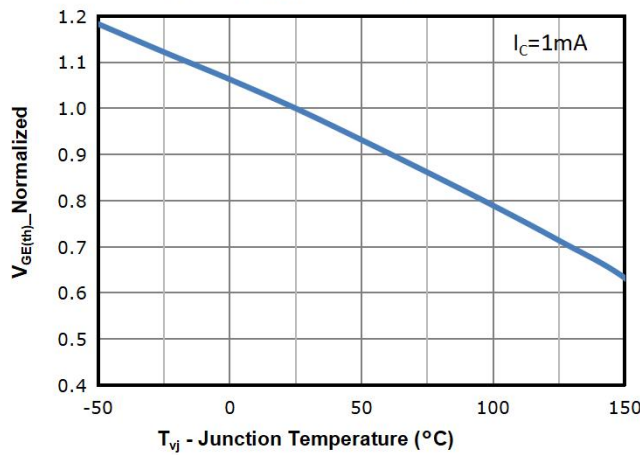


Fig 8:  $BV_{ces}$  vs. Temperature

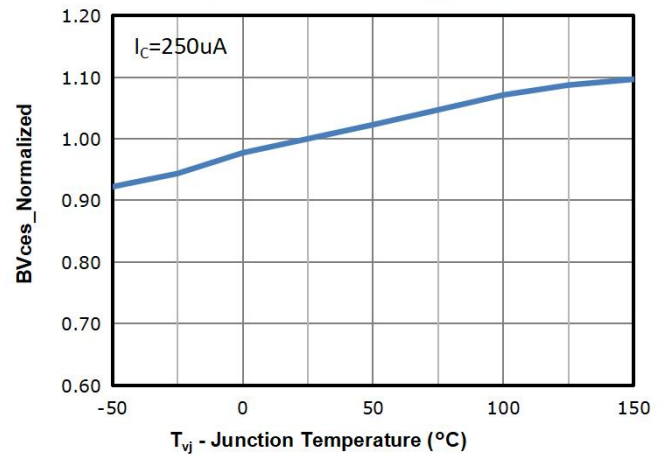


Fig 9: Forward characteristic

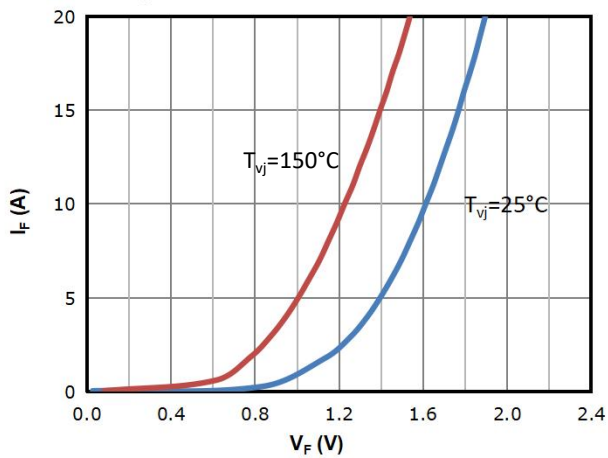


Fig 10:  $V_F$  vs. Temperature

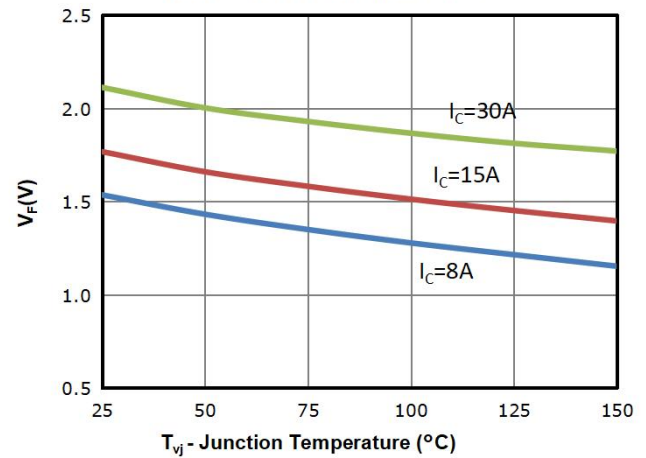


Fig 11: Capacitance Characteristics

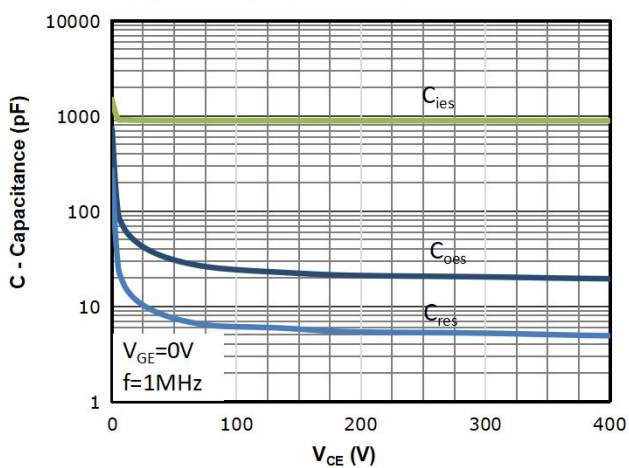


Fig 12: Gate Charge Characteristics

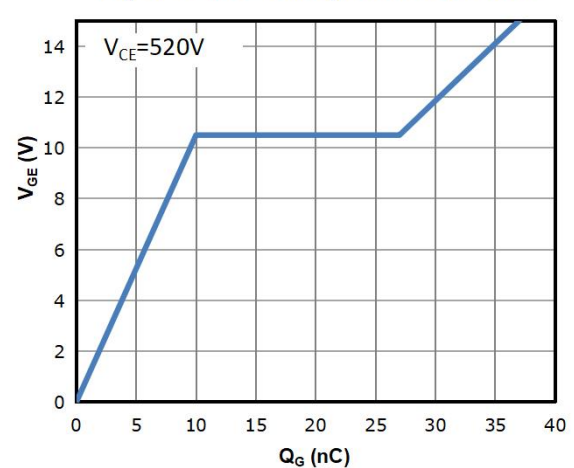


Fig 13: Typical Switching Time vs.  $R_G$

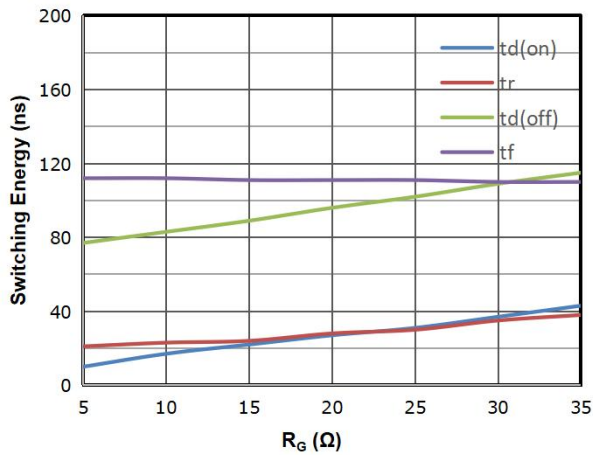


Fig 14: Typical Switching Energy vs.  $R_G$

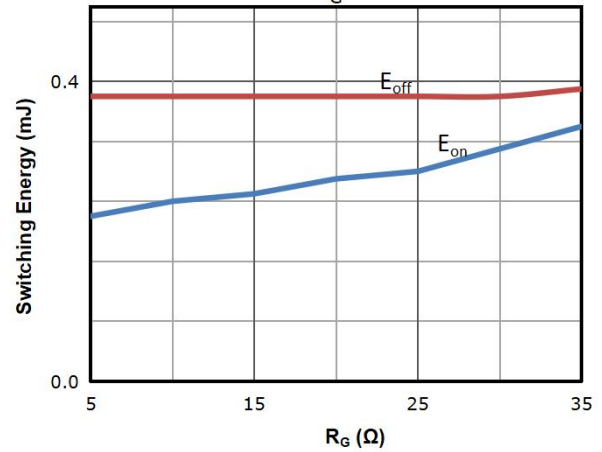


Fig 15: IGBT Max. Transient Thermal Impedance

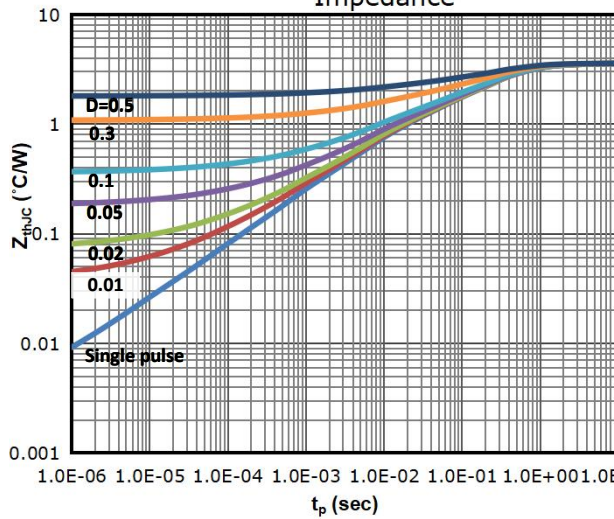


Fig 16: Diode Max. Transient Thermal Impedance

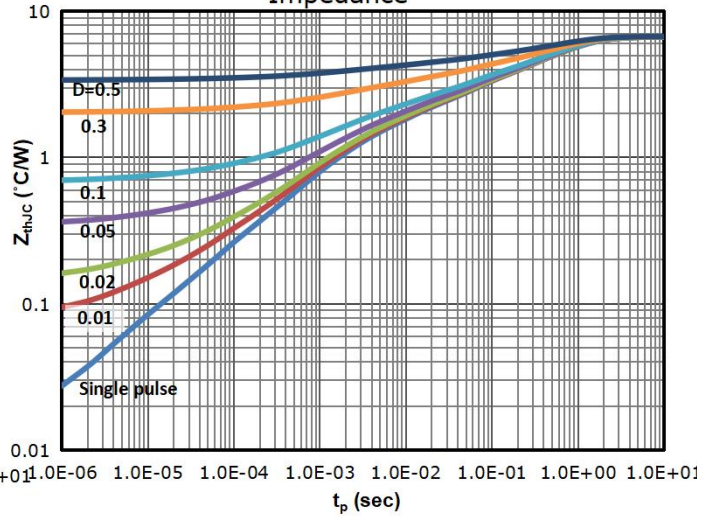
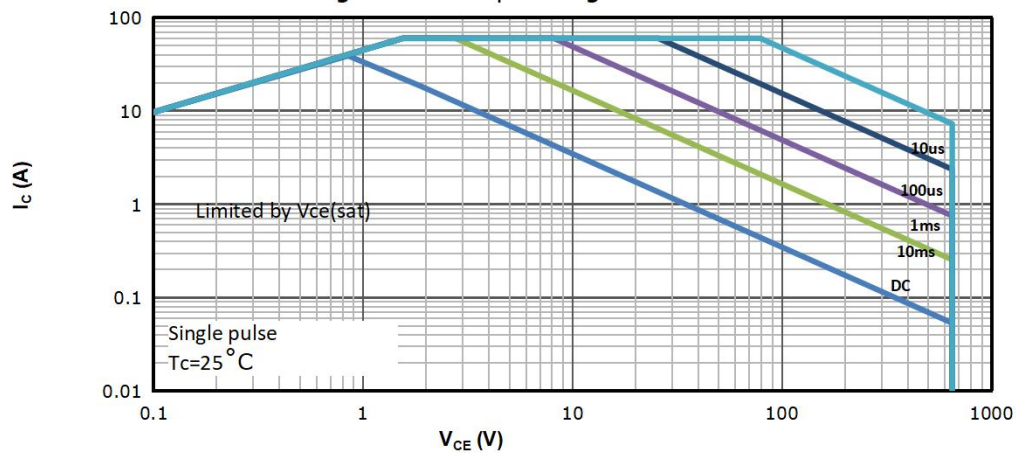


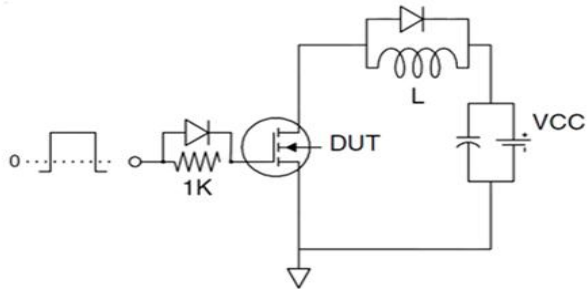
Fig 17: Safe Operating Area



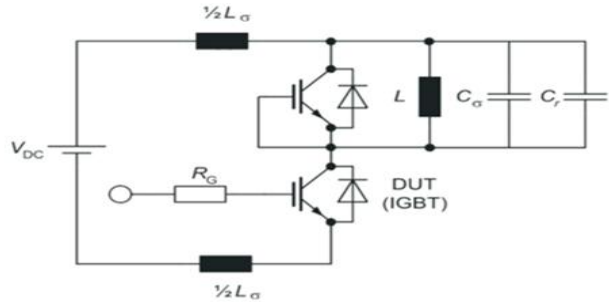


## Test Circuit

### 1) Gate Charge Test Circuit

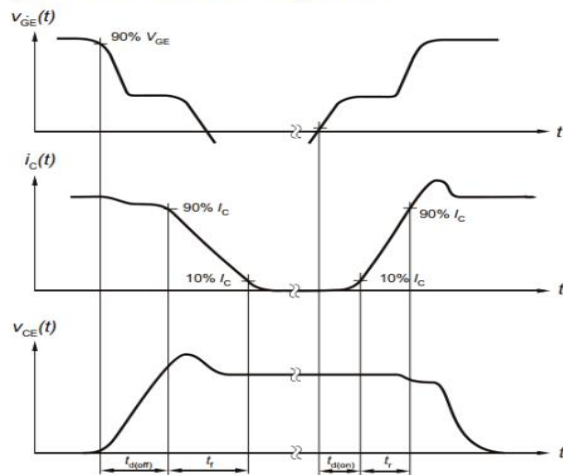


### 2) Switch Time Test Circuit

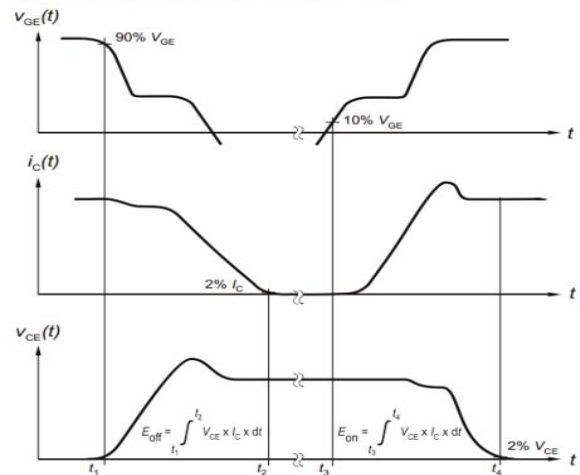


## Switching characteristics

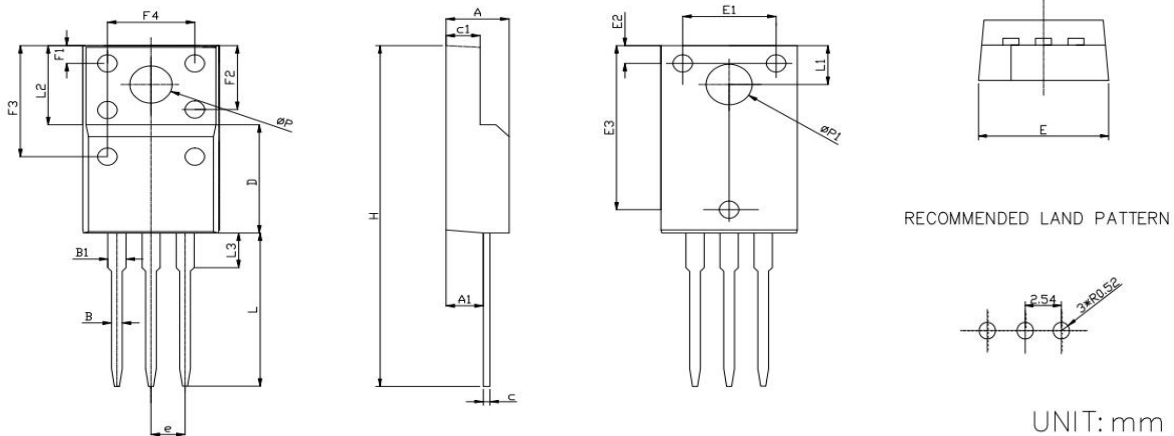
### 1) Definition of switching times



### 2) Definition of switching losses



## Package Outline: TO-220TF-3L



| SYMBOL | MILLIMETERS |       | INCHES |       |
|--------|-------------|-------|--------|-------|
|        | MIN         | MAX   | MIN    | MAX   |
| A      | 4.50        | 4.90  | 0.177  | 0.193 |
| A1     | 2.63        | 2.89  | 0.104  | 0.114 |
| B      | 0.75        | 0.90  | 0.030  | 0.035 |
| B1     | 1.15        | 1.55  | 0.045  | 0.061 |
| C      | 0.40        | 0.60  | 0.016  | 0.024 |
| C1     | 2.34        | 2.74  | 0.092  | 0.108 |
| D      | 8.87        | 9.47  | 0.349  | 0.373 |
| e      | 2.54        |       | 0.100  |       |
| E      | 9.86        | 10.46 | 0.388  | 0.412 |
| E1     | 6.86        | 7.06  | 0.270  | 0.278 |
| E2     | 1.40        | 1.60  | 0.055  |       |
| E3     | 13.80       | 14.00 | 0.543  | 0.551 |
| F1     | 1.40        | 1.60  | 0.055  |       |
| F2     | 5.15        | 5.65  | 0.203  | 0.222 |
| F3     | 9.10        | 9.70  | 0.358  | 0.382 |
| F4     | 6.70        | 7.30  | 0.264  | 0.287 |
| H      | 28.50       | 29.50 | 1.122  | 1.161 |
| L      | 12.58       | 13.38 | 0.495  | 0.527 |
| L1     | 3.15        | 3.45  | 0.124  | 0.136 |
| L2     | 6.70        |       | 0.264  |       |
| L3     | 2.63        | 3.23  | 0.104  | 0.127 |
| φP     | 2.90        | 3.48  | 0.114  | 0.137 |
| φP1    | 3.15        | 3.75  | 0.124  | 0.148 |

## Disclaimer



Any and all semiconductor products have certain probability to fail or malfunction, which may result in personal injury, death or property damage. Customer are solely responsible for providing adequate safe measures when design their systems.

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