



# SPT50N65F1A1T8TL

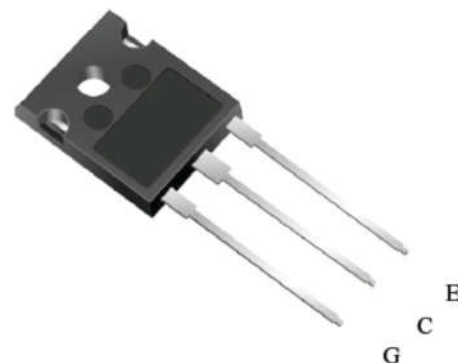
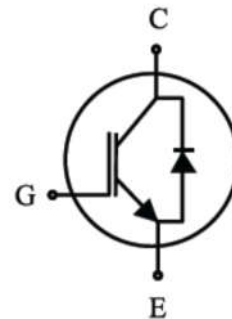
## 650V /50A Trench Field Stop IGBT

650V Trench Field Stop IGBTs offer low switching losses, high energy efficiency and high avalanche ruggedness for motion control, solar application and welding machine.

|                       |             |          |
|-----------------------|-------------|----------|
| $V_{CE}$              | <b>650</b>  | <b>V</b> |
| $I_C$                 | <b>50</b>   | <b>A</b> |
| $V_{CE(SAT)} I_C=50A$ | <b>1.65</b> | <b>V</b> |

### FEATURES

- High breakdown voltage up to 650V for improved reliability
- Trench-Stop Technology offering :
  - High speed switching
  - High ruggedness, temperature stable
  - Low  $V_{CEsat}$
  - Easy parallel switching capability due to positive temperature coefficient in  $V_{CEsat}$
- Enhanced avalanche capability



### APPLICATION

- Uninterruptible Power Supplies
- Inverter
- Welding Converters
- PFC applications
- Converter with high switching frequency

### Ordering Information

| Product          | Package | Packaging |
|------------------|---------|-----------|
| SPT50N65F1A1T8TL | TO-247  | Tube      |



## Maximum Ratings (T<sub>j</sub>= 25°C unless otherwise specified)

| Parameter   | Symbol           | Value      | Unit |
|---|------------------|------------|------|
| Collector-Emitter Breakdown Voltage   | V <sub>CE</sub>  | 650        | V    |
| DC collector current, limited by T <sub>j</sub> max<br>T <sub>C</sub> = 25°C<br>T <sub>C</sub> = 100°C  | I <sub>C</sub>   | 100<br>50  | A    |
| Diode Forward current, limited by T <sub>j</sub> max<br>T <sub>C</sub> = 25°C<br>T <sub>C</sub> = 100°C | I <sub>F</sub>   | 100<br>50  | A    |
| Turn off safe operating area V <sub>CE</sub> ≤ 650V,<br>T <sub>j</sub> ≤ 150°C                          |                  | 200        | A    |
| Power dissipation , T <sub>j</sub> =25°C  | P <sub>tot</sub> | 260        | W    |
| Operating junction temperature T <sub>j</sub>   |                  | -40...+150 | °C   |
| Storage temperature   | T <sub>s</sub>   | -55...+150 | °C   |
| Soldering temperature, wave soldering<br>1.6mm (0.063in.) from case for 10s                             |                  | 260        | °C   |

## Thermal Resistance

| Parameter                                    | Symbol              | Max. Value | Unit |
|--|---------------------|------------|------|
| IGBT thermal resistance,<br>junction - case  | R <sub>θ(j-c)</sub> | 0.48       | K/W  |
| Diode thermal resistance,<br>junction - case | R <sub>θ(j-c)</sub> | 1.1        | K/W  |
| Thermal resistance,<br>junction - ambient    | R <sub>θ(j-a)</sub> | 40         | K/W  |



## Electrical Characteristics (T<sub>j</sub>= 25°C unless otherwise specified)

| Parameter                            | Symbol               | Conditions  | Min | Typ  | Max        | Unit |
|--------------------------------------|----------------------|---|-----|------|------------|------|
| <b>Static</b>                        |                      |   |     |      |            |      |
| Collector-Emitter Breakdown Voltage  | BV <sub>CES</sub>    | V <sub>GE</sub> =0V, I <sub>C</sub> =250uA  | 650 |      | -          | V    |
|                                      |                      | V <sub>GE</sub> =0V, I <sub>C</sub> =1mA  | 650 |      |            | V    |
| Gate Threshold Voltage               | V <sub>GE(th)</sub>  | V <sub>GE</sub> =V <sub>CE</sub> , I <sub>C</sub> =250uA  | 4.0 | 5.0  | 6.0        | V    |
| Collector-Emitter Saturation Voltage | V <sub>CE(sat)</sub> | V <sub>GE</sub> =15V, I <sub>C</sub> =50A   | -   | 1.65 | 2.0        | V    |
|                                      |                      | T <sub>j</sub> = 25°C<br>T <sub>j</sub> = 150°C   | -   | 2.05 |            | V    |
| Zero gate voltage collector current  | I <sub>CES</sub>     | V <sub>CE</sub> = 650V, V <sub>GE</sub> = 0V<br>T <sub>j</sub> = 25°C<br>T <sub>j</sub> = 150°C |     | 0.1  | 40<br>1000 | μA   |
| Gate-emitter leakage current         | I <sub>GES</sub>     | V <sub>CE</sub> = 0V, V <sub>GE</sub> = 20V   |     |      | 100        | nA   |
| Transconductance                     | g <sub>fs</sub>      | V <sub>CE</sub> = 20V, I <sub>C</sub> = 50A   | -   | 50   | -          | S    |

| Parameter                    | Symbol           | Conditions   | Min | Typ  | Max | Unit |
|------------------------------|------------------|--|-----|------|-----|------|
| <b>Dynamic</b>               |                  |  |     |      |     |      |
| Input capacitance            | C <sub>ies</sub> | V <sub>CE</sub> = 30V, V <sub>GE</sub> = 0V,<br>f = 1MHz               |     | 3800 |     | pF   |
| Output capacitance           | C <sub>oes</sub> |  |     | 130  |     |      |
| Reverse transfer capacitance | C <sub>res</sub> |  |     | 70   |     |      |
| Gate charge                  | Q <sub>G</sub>   | V <sub>CC</sub> = 520V, I <sub>C</sub> = 50A,<br>V <sub>GE</sub> = 15V | -   | 162  | -   | nC   |



## Switching Characteristic, Inductive Load

| Parameter   | Symbol              | Conditions  | Min | Typ  | Max | Unit |
|---|---------------------|---|-----|------|-----|------|
| <b>Dynamic <math>T_j=25^\circ\text{C}</math></b>  |                     |   |     |      |     |      |
| Turn-on Delay Time                                | $t_{d(\text{on})}$  | $V_{CC} = 400\text{V}, I_C = 50.0\text{A},$<br>$V_{GE} = 0.0/15.0\text{V},$<br>$R_g=12\Omega$ | -   | 60   | -   | ns   |
| Rise Time   | $t_r$               |   | -   | 55   | -   | ns   |
| Turn-off Delay Time                               | $t_{d(\text{off})}$ |   | -   | 170  | -   | ns   |
| Fall Time   | $t_f$               |   | -   | 80   | -   | ns   |
| Turn-on Energy                                    | $E_{\text{on}}$     |   | -   | 2.2  | -   | mJ   |
| Turn-off Energy                                   | $E_{\text{off}}$    |   | -   | 0.6  | -   | mJ   |
| <b>Dynamic <math>T_j=150^\circ\text{C}</math></b> |                     |   |     |      |     |      |
| Turn-on Delay Time                                | $t_{d(\text{on})}$  | $V_{CC} = 400\text{V}, I_C = 50.0\text{A},$<br>$V_{GE} = 0.0/15.0\text{V},$<br>$R_g=12\Omega$ | -   | 60   | -   | ns   |
| Rise Time   | $t_r$               |   | -   | 60   | -   | ns   |
| Turn-off Delay Time                               | $t_{d(\text{off})}$ |   | -   | 172  | -   | ns   |
| Fall Time   | $t_f$               |   | -   | 90   | -   | ns   |
| Turn-on Energy                                    | $E_{\text{on}}$     |   | -   | 2.35 | -   | mJ   |
| Turn-off Energy                                   | $E_{\text{off}}$    |   | -   | 0.82 | -   | mJ   |

## Electrical Characteristics of the DIODE ( $T_j= 25^\circ\text{C}$ unless otherwise specified)

| Parameter                | Symbol   | Conditions  | Min | Typ | Max | Unit |
|--------------------------|----------|---|-----|-----|-----|------|
| <b>Dynamic</b>           |          |   |     |     |     |      |
| Diode Forward Voltage    | $V_{FM}$ | $I_F = 50\text{A}$  | -   | 2.4 | -   | v    |
| Reverse Recovery Time    | $T_{rr}$ | $I_F= 40\text{A},$<br>$V_R = 300\text{V},$<br>$di/dt= 600\text{A}/\mu\text{s},$ | -   | 90  | -   | ns   |
| Reverse Recovery Current | $I_{rr}$ |   | -   | 17  | -   | A    |
| Reverse Recovery Charge  | $Q_{rr}$ |   | -   | 900 | -   | nC   |

Fig. 1 FBSOA characteristics

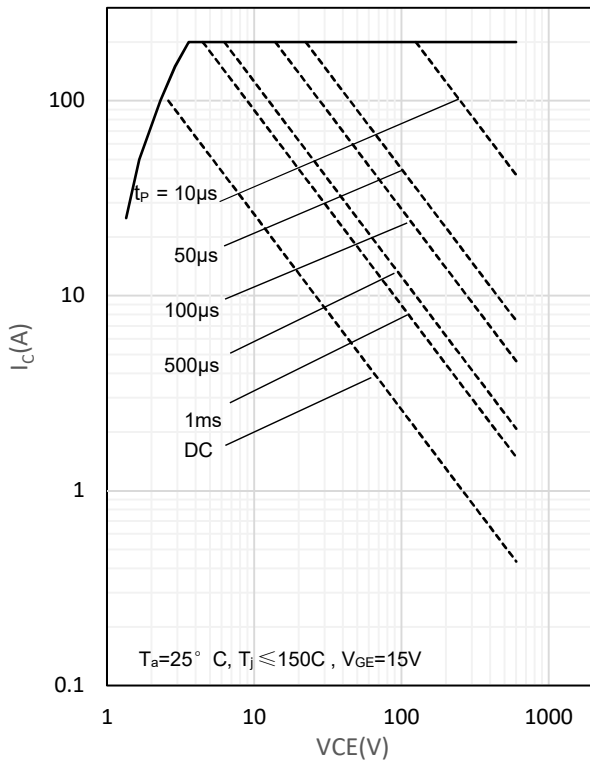


Fig. 2 Power dissipation as a function of  $T_c$

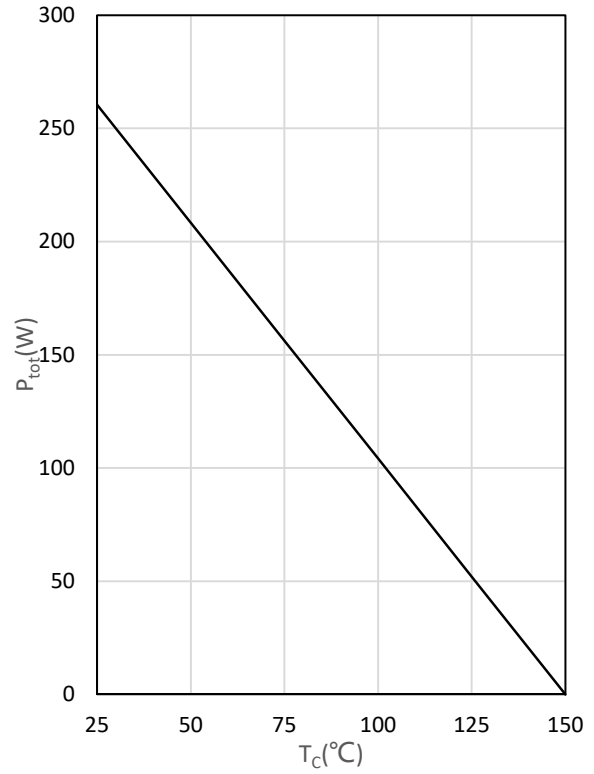


Fig. 3 Output characteristics

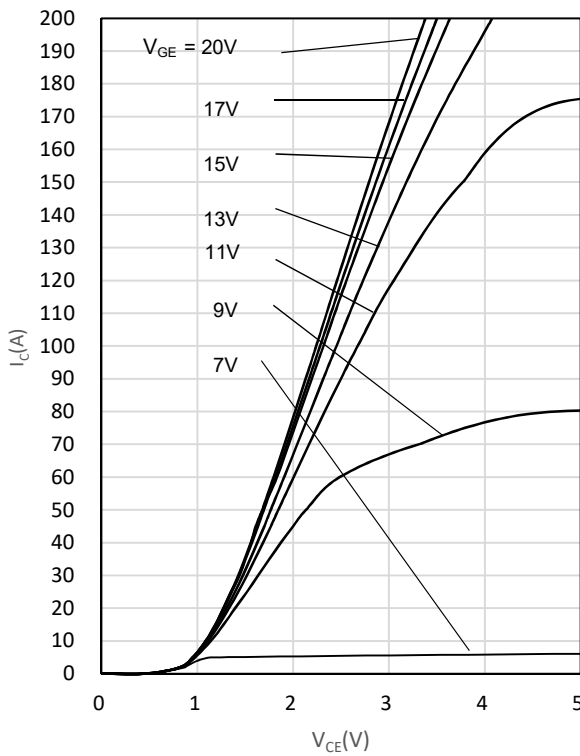


Fig. 4 Saturation voltage characteristics

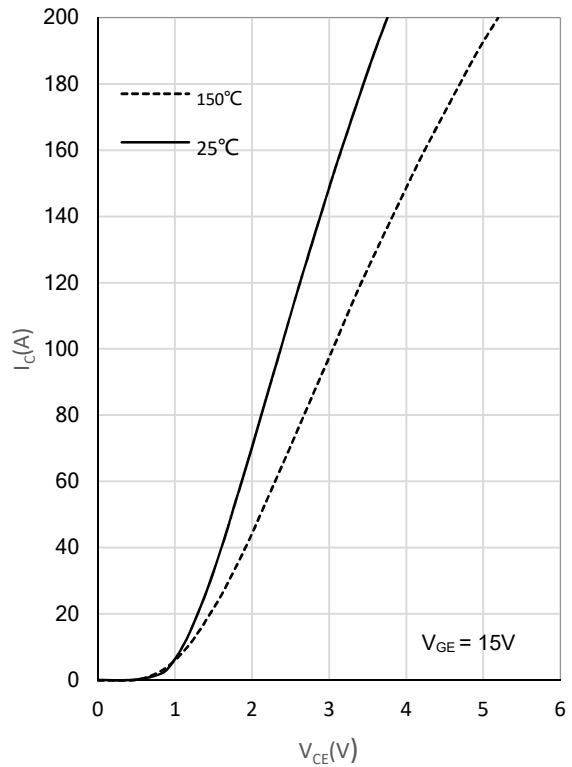


Fig. 5 Switching times vs. gate resistor

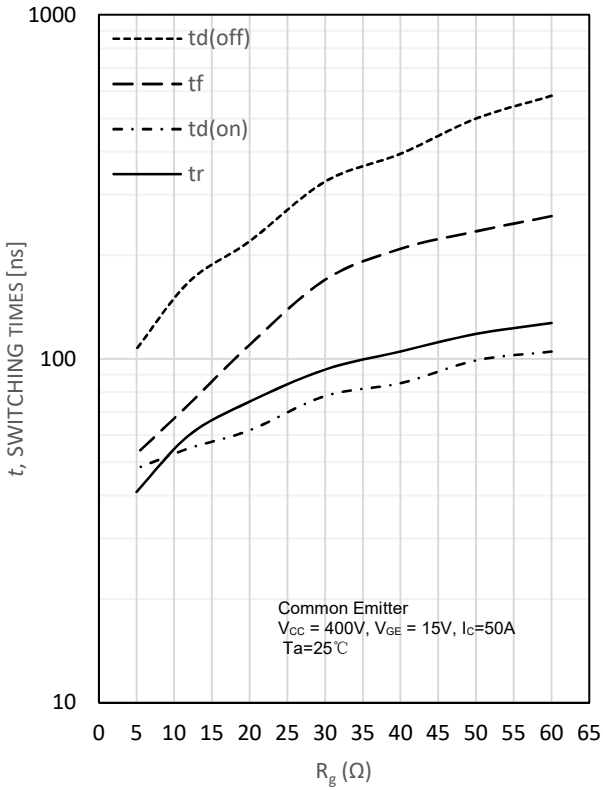


Fig. 6 Switching times vs. collector current

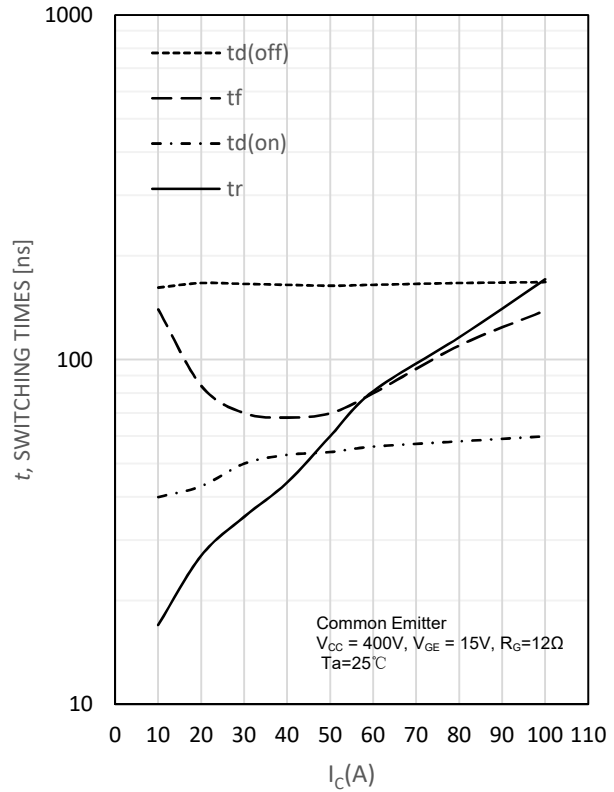


Fig. 7 Switching loss vs. gate resistor

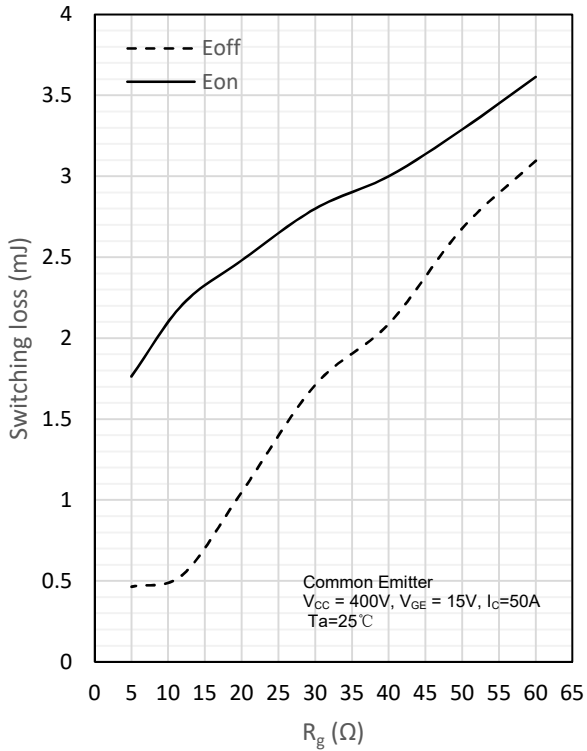


Fig. 8 Switching loss vs. collector current

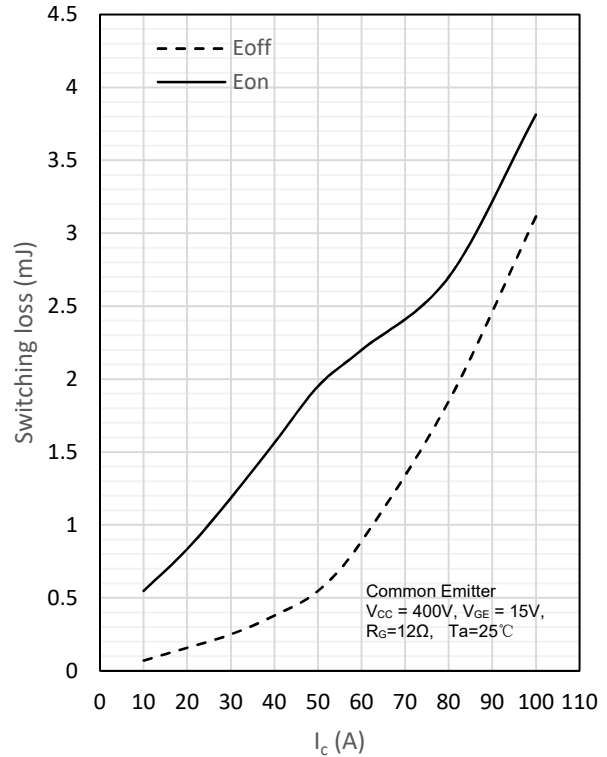


Fig. 9 Gate charge characteristics

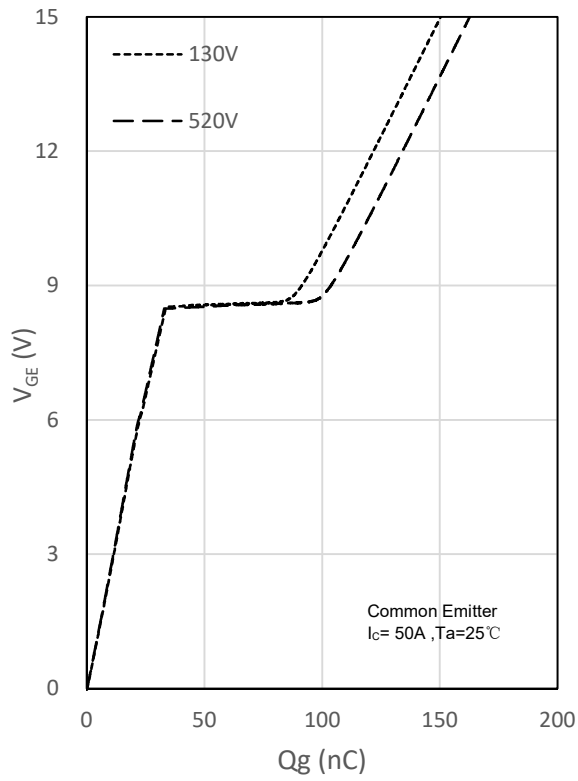
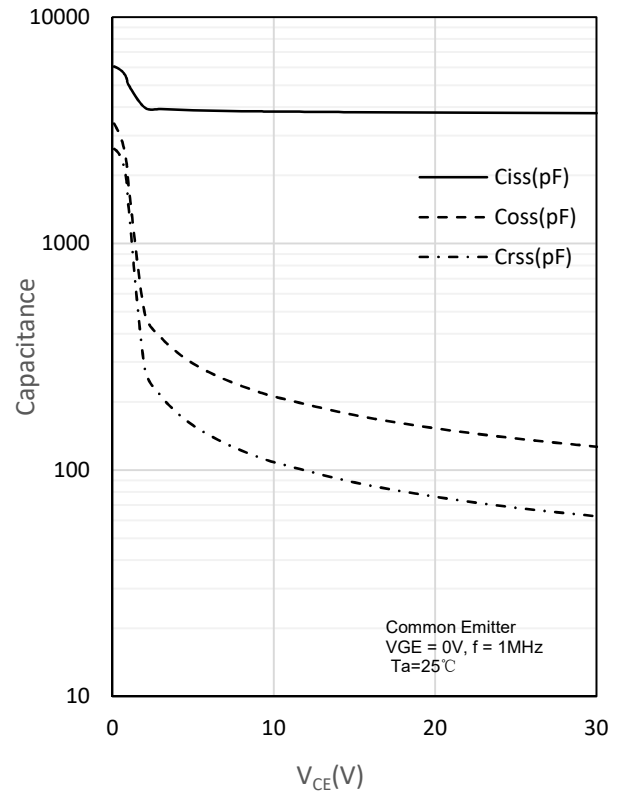
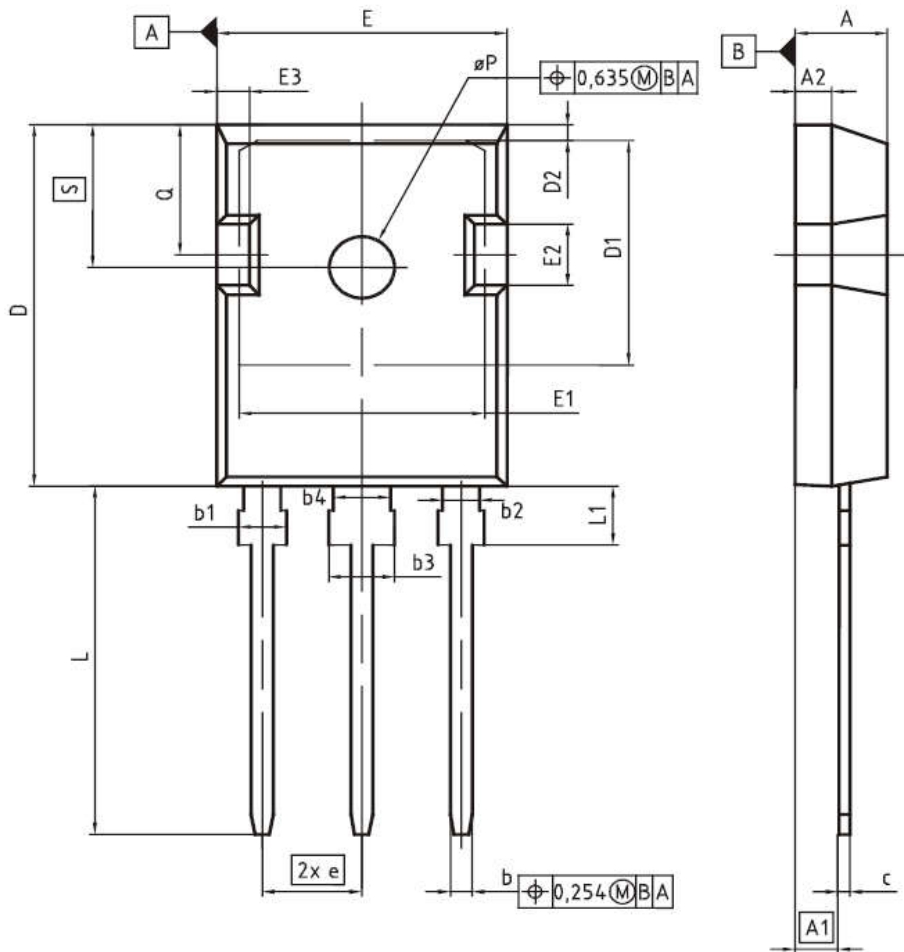


Fig. 10 Capacitance characteristics



## PG-TO247-3



| DIM | MILLIMETERS |       | INCHES      |       |
|-----|-------------|-------|-------------|-------|
|     | MIN         | MAX   | MIN         | MAX   |
| A   | 4.83        | 5.21  | 0.190       | 0.205 |
| A1  | 2.27        | 2.54  | 0.089       | 0.100 |
| A2  | 1.85        | 2.16  | 0.073       | 0.085 |
| b   | 1.07        | 1.33  | 0.042       | 0.052 |
| b1  | 1.90        | 2.41  | 0.075       | 0.095 |
| b2  | 1.90        | 2.16  | 0.075       | 0.085 |
| b3  | 2.87        | 3.38  | 0.113       | 0.133 |
| b4  | 2.87        | 3.13  | 0.113       | 0.123 |
| c   | 0.55        | 0.68  | 0.022       | 0.027 |
| D   | 20.80       | 21.10 | 0.819       | 0.831 |
| D1  | 16.25       | 17.65 | 0.640       | 0.695 |
| D2  | 0.95        | 1.35  | 0.037       | 0.053 |
| E   | 15.70       | 16.13 | 0.618       | 0.635 |
| E1  | 13.10       | 14.15 | 0.516       | 0.557 |
| E2  | 3.68        | 5.10  | 0.145       | 0.201 |
| E3  | 1.00        | 2.60  | 0.039       | 0.102 |
| e   | 5.44 (BSC)  |       | 0.214 (BSC) |       |
| N   | 3           |       | 3           |       |
| L   | 19.80       | 20.32 | 0.780       | 0.800 |
| L1  | 4.10        | 4.47  | 0.161       | 0.176 |
| øP  | 3.50        | 3.70  | 0.138       | 0.146 |
| Q   | 5.49        | 6.00  | 0.216       | 0.236 |
| S   | 6.04        | 6.30  | 0.238       | 0.248 |