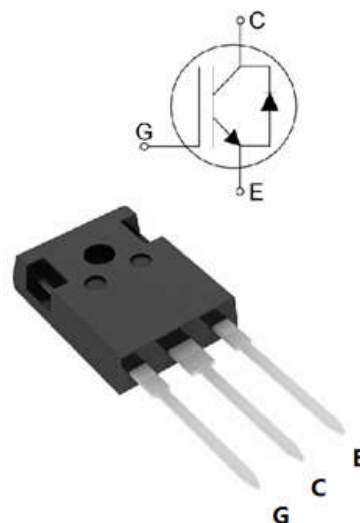


SPTECH 650V Trench Field Stop IGBTs offer low switching losses, high energy efficiency and high avalanche ruggedness for motion control, solar application and welding machine.

|                             |             |          |
|-----------------------------|-------------|----------|
| $V_{CE}$                    | <b>650</b>  | <b>V</b> |
| $I_C$                       | <b>60</b>   | <b>A</b> |
| $V_{CE(SAT)} \quad I_C=60A$ | <b>1.85</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

| Product       | Package | Packaging |
|---------------|---------|-----------|
| SPT 60N65F1A1 | TO247   | 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>jmax</sub><br>T <sub>C</sub> = 25°C<br>T <sub>C</sub> = 100°C  | I <sub>C</sub>   | 120<br>60  | A    |
| Diode Forward current, limited by T <sub>jmax</sub><br>T <sub>C</sub> = 25°C<br>T <sub>C</sub> = 100°C | I <sub>F</sub>   | 120<br>60  | A    |
| Continuous Gate-emitter voltage                                                                        | V <sub>GE</sub>  | ±20        | V    |
| Transient Gate-emitter voltage                                                                         | V <sub>GE</sub>  | ±30        | V    |
| Turn off safe operating area V <sub>CE</sub> ≤ 650V,<br>T <sub>j</sub> ≤ 150°C                         | -                | 180        | A    |
| Pulse collector current, V <sub>GE</sub> = 15V,<br>t <sub>p</sub> limited by T <sub>jmax</sub>         | I <sub>CM</sub>  | 180        | 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> =60A                                                       | -   | 1.85 | 2.2        | V    |
|                                      |                      | T <sub>j</sub> = 25°C<br>T <sub>j</sub> = 150°C                                                 | -   | 2.25 |            | 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> = 60A                                                     | -   | 52   | -          | 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> = 60A,<br>V <sub>GE</sub> = 15V | -   | 158  | -   | nC   |



## Switching Characteristic, Inductive Load

| Parameter                               | Symbol       | Conditions                                                                                      | Min | Typ  | Max | Unit |
|-----------------------------------------|--------------|-------------------------------------------------------------------------------------------------|-----|------|-----|------|
| <b>Dynamic</b> $T_j=25^{\circ}\text{C}$ |              |                                                                                                 |     |      |     |      |
| Turn-on Delay Time                      | $t_{d(on)}$  | $V_{CC} = 400\text{V}, I_C = 60.0\text{A},$<br>$V_{GE} = 0.0/15.0\text{V},$<br>$R_g = 12\Omega$ | -   | 56   | -   | ns   |
| Rise Time                               | $t_r$        |                                                                                                 | -   | 79   | -   | ns   |
| Turn-off Delay Time                     | $t_{d(off)}$ |                                                                                                 | -   | 165  | -   | ns   |
| Fall Time                               | $t_f$        |                                                                                                 | -   | 81   | -   | ns   |
| Turn-on Energy                          | $E_{on}$     |                                                                                                 | -   | 2.2  | -   | mJ   |
| Turn-off Energy                         | $E_{off}$    |                                                                                                 | -   | 0.89 | -   | 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    | $V_{FM}$ | $I_F = 60\text{A}$                                                                | -   | 2.9 | -   | 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

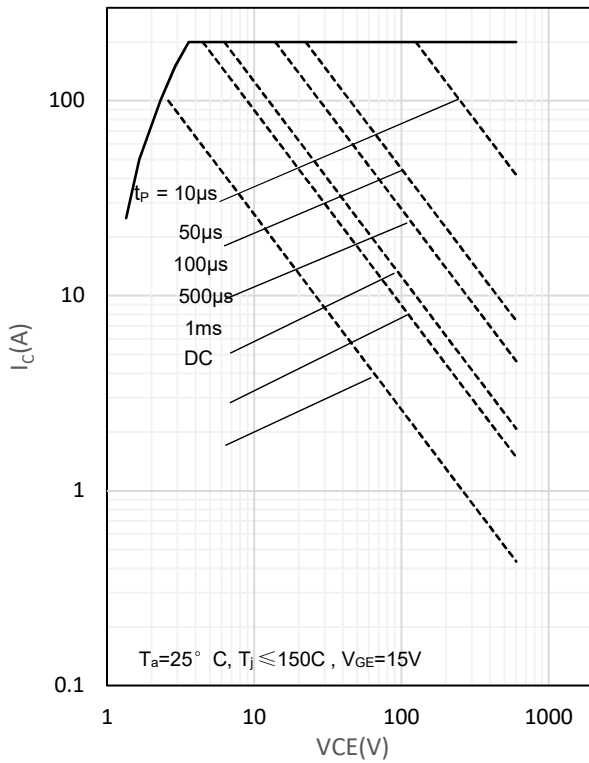


Fig. 2 Power dissipation as a function of  $T_C$

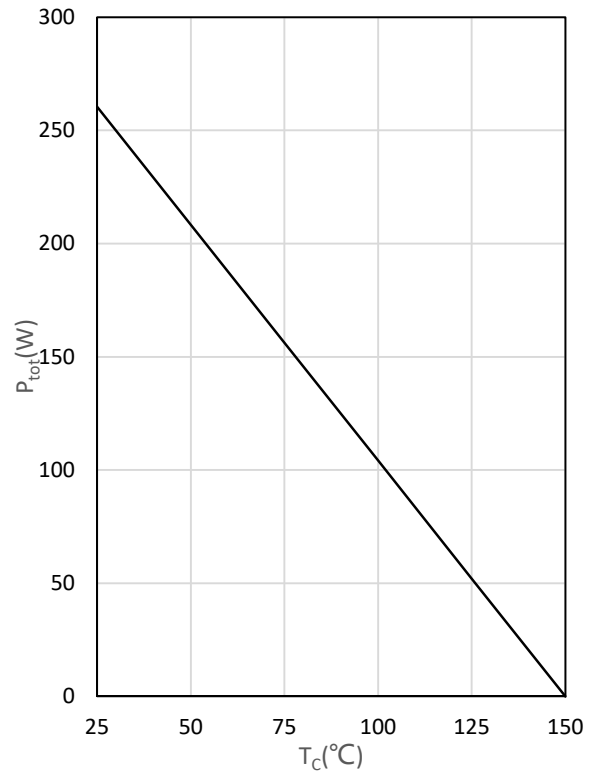


Fig. 3 Output characteristics

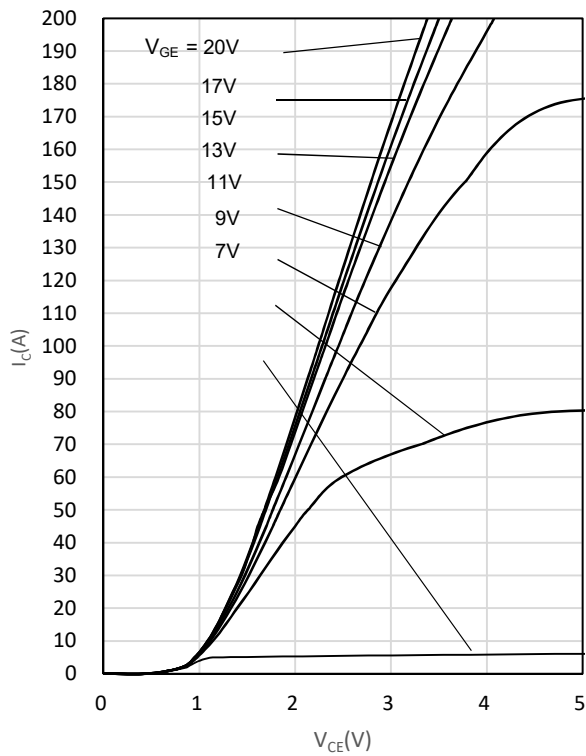


Fig. 4 Saturation voltage characteristics

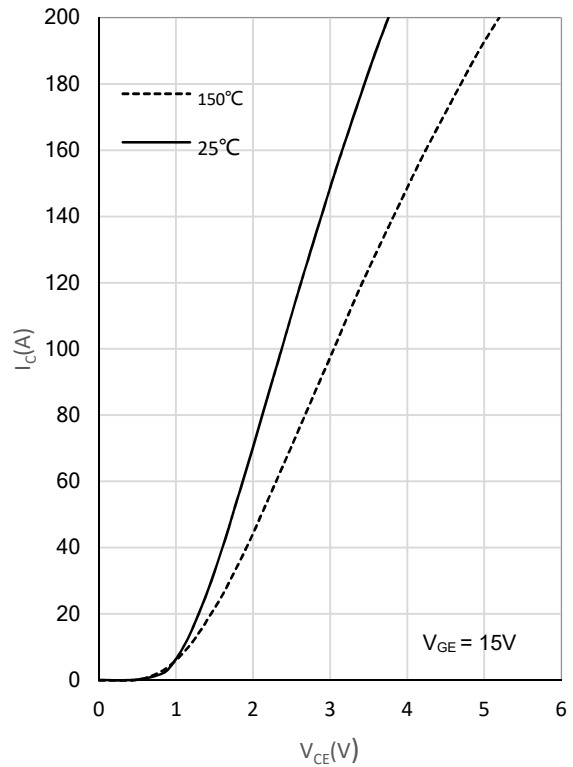




Fig. 5 Switching times vs. gate resistor

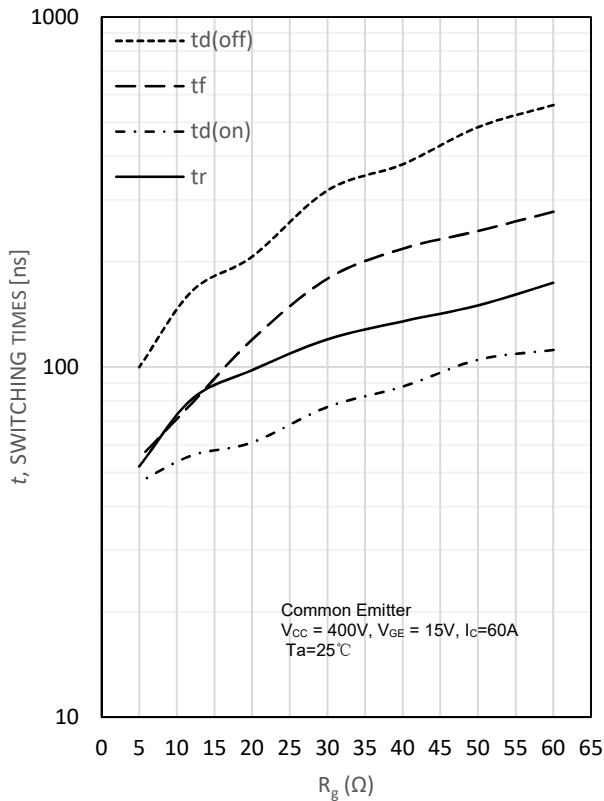


Fig. 6 Switching times vs. collector current

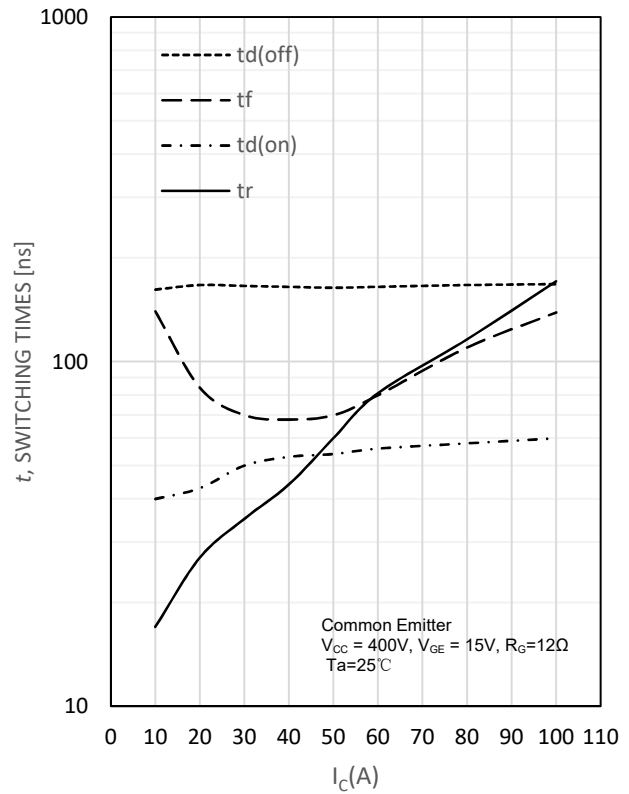


Fig. 7 Switching loss vs. gate resistor

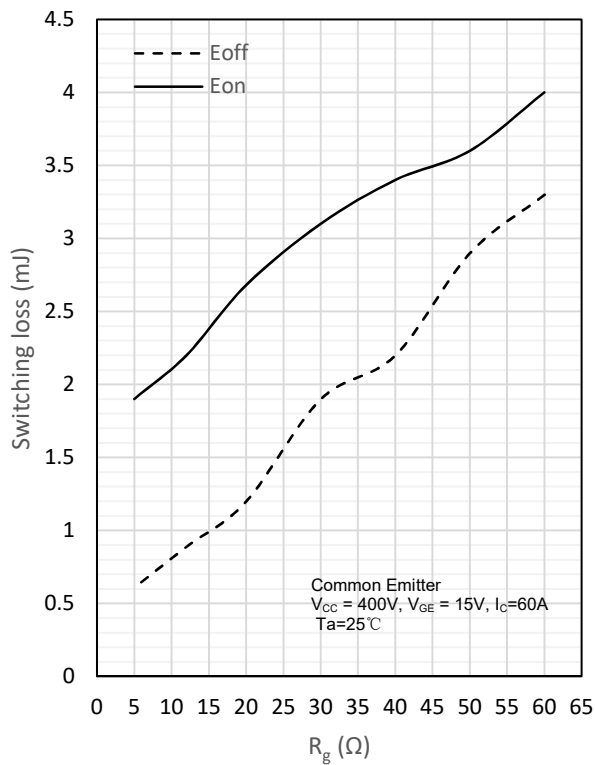


Fig. 8 Switching loss vs. collector current

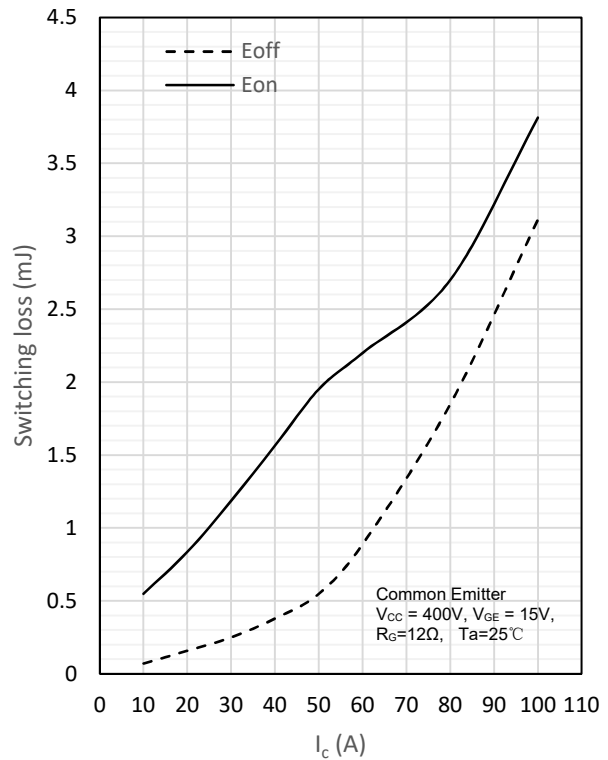




Fig. 9 Gate charge characteristics

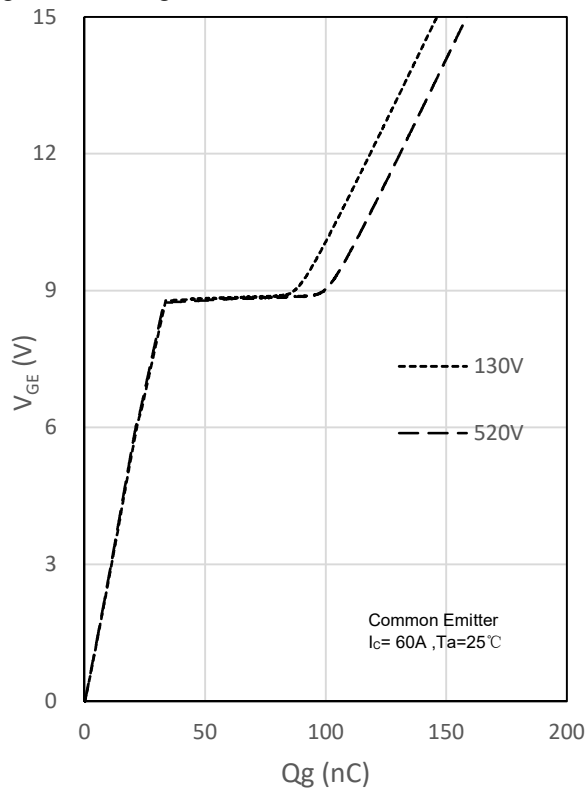
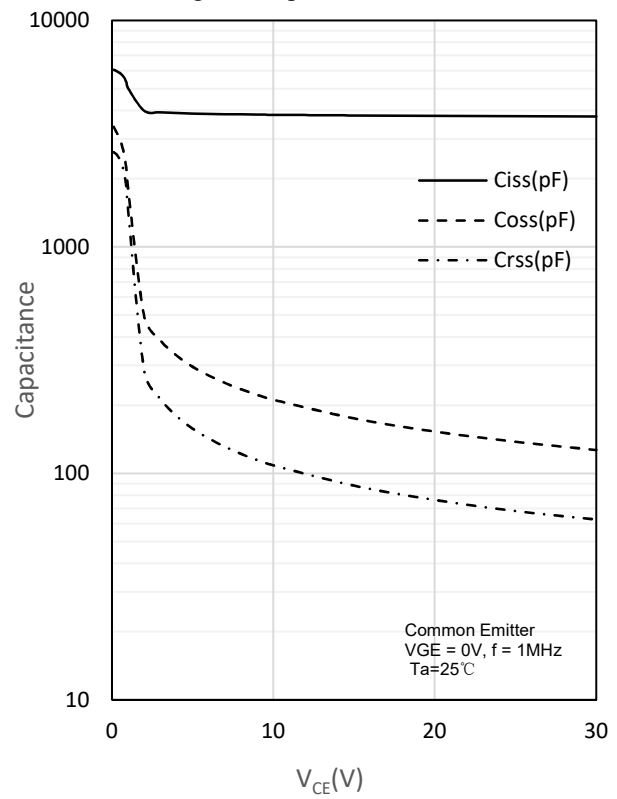
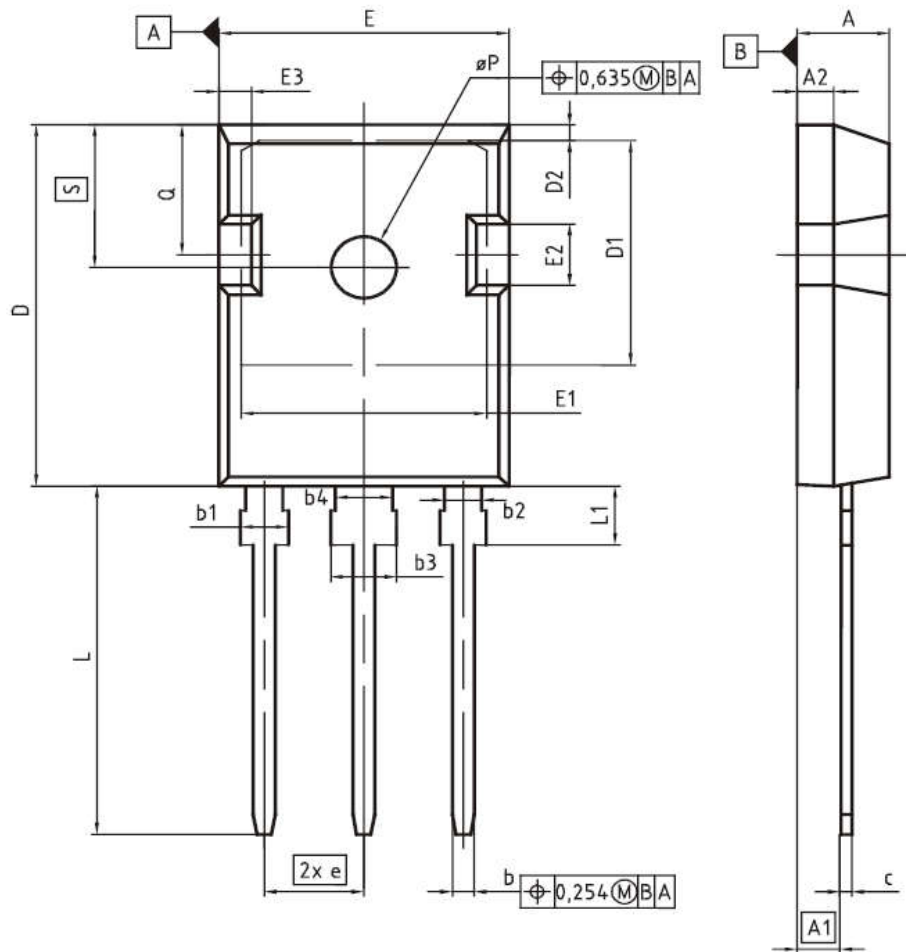


Fig. 10 Capacitance characteristics



**SPTECH**

深圳市质超微电子有限公司

**SPT60N65F1A1****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 |