

## 1200V, 100A, Trench FS II Fast IGBT

### General Description

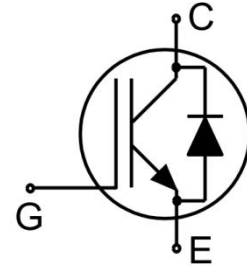
Using NCE's proprietary trench design and advanced FS (Field Stop) second generation technology, the 1200V Trench FSII IGBT offers superior conduction and switching performances, and easy parallel operation;

### Features

- Trench FSII Technology Offering
- Very low  $V_{CE(sat)}$
- High speed switching
- Positive temperature coefficient in  $V_{CE(sat)}$
- Very tight parameter distribution
- High ruggedness, temperature stable behavior

### Application

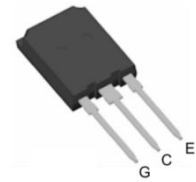
- PV power
- Three-level Solar String Inverter
- UPS



Schematic diagram

### Package Marking and Ordering Information

| Device         | Device Package | Device Marking |
|----------------|----------------|----------------|
| NCE100TD120VTP | TO-247P        | NCE100TD120VTP |



TO-247P

### Absolute Maximum Ratings ( $T_C=25^{\circ}\text{C}$ unless otherwise noted)

| Symbol         | Parameter                                                                       | Value       | Units              |
|----------------|---------------------------------------------------------------------------------|-------------|--------------------|
| $V_{CES}$      | Collector-Emitter Voltage                                                       | 1200        | V                  |
| $V_{GES}$      | Gate- Emitter Voltage                                                           | $\pm 30$    | V                  |
| $I_C$          | Collector Current                                                               | 200         | A                  |
|                | Collector Current @ $T_C = 100^{\circ}\text{C}$                                 | 100         | A                  |
| $I_{Cpuls}$    | Pulsed Collector Current, $t_p$ limited by $T_{Jmax}$                           | 400         | A                  |
| -              | Turn off safe operating area, $V_{CE}=1200\text{V}$ , $T_J=175^{\circ}\text{C}$ | 400         | A                  |
| $I_F$          | Diode Continuous Forward Current @ $T_C = 100^{\circ}\text{C}$                  | 100         | A                  |
| $I_{FM}$       | Diode Maximum Forward Current                                                   | 400         | A                  |
| $P_D$          | Power Dissipation @ $T_C = 25^{\circ}\text{C}$                                  | 937         | W                  |
|                | Power Dissipation @ $T_C = 100^{\circ}\text{C}$                                 | 468.5       | W                  |
| $T_J, T_{stg}$ | Operating Junction and Storage Temperature Range                                | -55 to +175 | $^{\circ}\text{C}$ |
| $T_L$          | Maximum Temperature for Soldering                                               | 260         | $^{\circ}\text{C}$ |

## Thermal Characteristic

| Symbol          | Parameter                                      | Value | Units                |
|-----------------|------------------------------------------------|-------|----------------------|
| $R_{\theta JC}$ | Thermal Resistance, Junction to case for IGBT  | 0.16  | $^{\circ}\text{C/W}$ |
| $R_{\theta JC}$ | Thermal Resistance, Junction to case for Diode | 0.37  | $^{\circ}\text{C/W}$ |
| $R_{\theta JA}$ | Thermal Resistance, Junction to Ambient        | 40    | $^{\circ}\text{C/W}$ |

## Electrical Characteristics ( $T_c=25^{\circ}\text{C}$ unless otherwise noted)

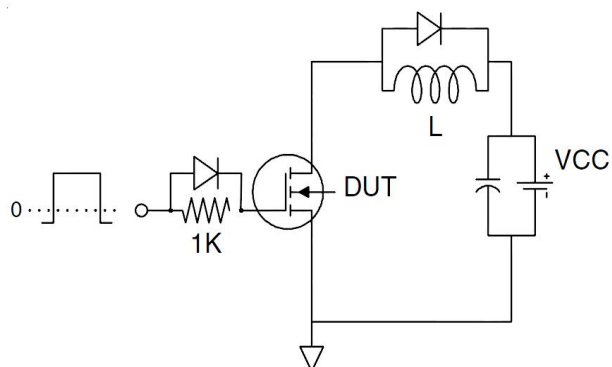
| Symbol                    | Parameter                            | Conditions                                                                                                          |                       | Value |       |      | Units |
|---------------------------|--------------------------------------|---------------------------------------------------------------------------------------------------------------------|-----------------------|-------|-------|------|-------|
|                           |                                      |                                                                                                                     |                       | Min.  | Typ.  | Max. |       |
| Static Characteristics    |                                      |                                                                                                                     |                       |       |       |      |       |
| V <sub>(BR)CES</sub>      | Collector-Emitter Breakdown Voltage  | V <sub>GE</sub> =0V, I <sub>CE</sub> =3mA                                                                           |                       | 1200  | --    | --   | V     |
| I <sub>CES</sub>          | Collector-Emitter Leakage Current    | V <sub>GE</sub> =0V, V <sub>CE</sub> =1200V                                                                         |                       | --    | --    | 600  | uA    |
| I <sub>GES(F)</sub>       | Gate to Emitter Forward Leakage      | V <sub>GE</sub> =+30V, V <sub>CE</sub> =0V                                                                          |                       | --    | --    | 200  | nA    |
| I <sub>GES(R)</sub>       | Gate to Emitter Reverse Leakage      | V <sub>GE</sub> = -30V, V <sub>CE</sub> =0V                                                                         |                       | --    | --    | 200  | nA    |
| V <sub>CE(sat)</sub>      | Collector-Emitter Saturation Voltage | I <sub>C</sub> =100A                                                                                                | T <sub>J</sub> =25°C  | --    | 1.70  | 1.95 | V     |
|                           |                                      | V <sub>GE</sub> =15V                                                                                                | T <sub>J</sub> =175°C | --    | 1.95  | --   | V     |
| V <sub>GE(th)</sub>       | Gate Threshold Voltage               | I <sub>C</sub> =3mA, V <sub>CE</sub> =V <sub>GE</sub>                                                               |                       | 4.5   | --    | 6.0  | V     |
| Dynamic Characteristics   |                                      |                                                                                                                     |                       |       |       |      |       |
| C <sub>ies</sub>          | Input Capacitance                    | V <sub>CE</sub> =30V, V <sub>GE</sub> =0V,<br>f=1MHz                                                                |                       | --    | 12670 | --   | pF    |
| C <sub>oes</sub>          | Output Capacitance                   |                                                                                                                     |                       | --    | 425   | --   |       |
| C <sub>res</sub>          | Reverse Transfer Capacitance         |                                                                                                                     |                       | --    | 352   | --   |       |
| Q <sub>g</sub>            | Total Gate Charge                    | V <sub>CC</sub> =960V, I <sub>C</sub> =100A,<br>V <sub>GE</sub> =15V                                                |                       | --    | 743   | --   | nC    |
| Q <sub>ge</sub>           | Gate to Emitter Charge               |                                                                                                                     |                       | --    | 89    | --   |       |
| Q <sub>gc</sub>           | Gate to Collector Charge             |                                                                                                                     |                       | --    | 478   | --   |       |
| Switching Characteristics |                                      |                                                                                                                     |                       |       |       |      |       |
| t <sub>d(ON)</sub>        | Turn-on Delay Time                   | V <sub>CE</sub> =600V, I <sub>C</sub> =100A,<br>V <sub>GE</sub> =0/15V, R <sub>g</sub> =8Ω<br>Inductive Load        |                       | --    | 19    | --   | ns    |
| t <sub>r</sub>            | Rise Time                            |                                                                                                                     |                       | --    | 17    | --   |       |
| t <sub>d(OFF)</sub>       | Turn-Off Delay Time                  |                                                                                                                     |                       | --    | 170   | --   |       |
| t <sub>f</sub>            | Fall Time                            |                                                                                                                     |                       | --    | 18    | --   |       |
| E <sub>on</sub>           | Turn-On Switching Loss               | V <sub>CE</sub> =600V, I <sub>C</sub> =100A,<br>V <sub>GE</sub> =0/15V, R <sub>g</sub> =8Ω<br>T <sub>J</sub> =175°C |                       | --    | 8.2   | --   | mJ    |
| E <sub>off</sub>          | Turn-Off Switching Loss              |                                                                                                                     |                       | --    | 3.7   | --   |       |
| E <sub>ts</sub>           | Total Switching Loss                 |                                                                                                                     |                       | --    | 11.9  | --   |       |
| E <sub>on</sub>           | Turn-On Switching Loss               | V <sub>CE</sub> =600V, I <sub>C</sub> =100A,<br>V <sub>GE</sub> =0/15V, R <sub>g</sub> =8Ω<br>T <sub>J</sub> =175°C |                       | --    | 10.3  | --   | mJ    |
| E <sub>off</sub>          | Turn-Off Switching Loss              |                                                                                                                     |                       | --    | 4.9   | --   |       |
| E <sub>ts</sub>           | Total Switching Loss                 |                                                                                                                     |                       | --    | 15.2  | --   |       |

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

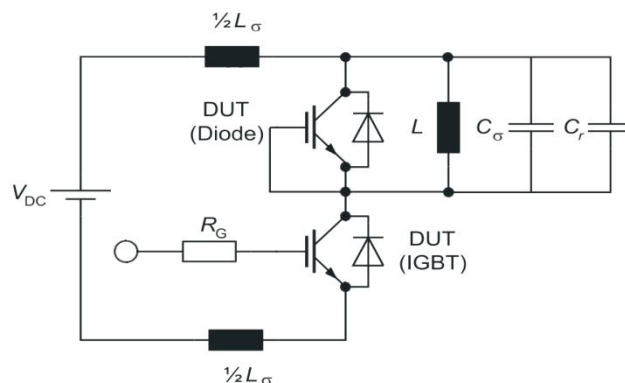
| Symbol    | Parameter                           | Conditions                       | Rating |      |      | Units   |
|-----------|-------------------------------------|----------------------------------|--------|------|------|---------|
|           |                                     |                                  | Min.   | Typ. | Max. |         |
| $V_{FM}$  | Diode Forward Voltage               | $I_F=100A$                       | --     | 2.2  | 2.8  | V       |
| $T_{rr}$  | Reverse Recovery Time               | $I_F=50A,$<br>$di/dt=950A/\mu s$ | --     | 190  | --   | ns      |
| $I_{RRM}$ | Diode Peak Reverse Recovery Current |                                  | --     | 30   | --   | A       |
| $Q_{rr}$  | Reverse Recovery Charge             |                                  | --     | 2.9  | --   | $\mu C$ |

## Test Circuit

### 1) Gate Charge Test Circuit

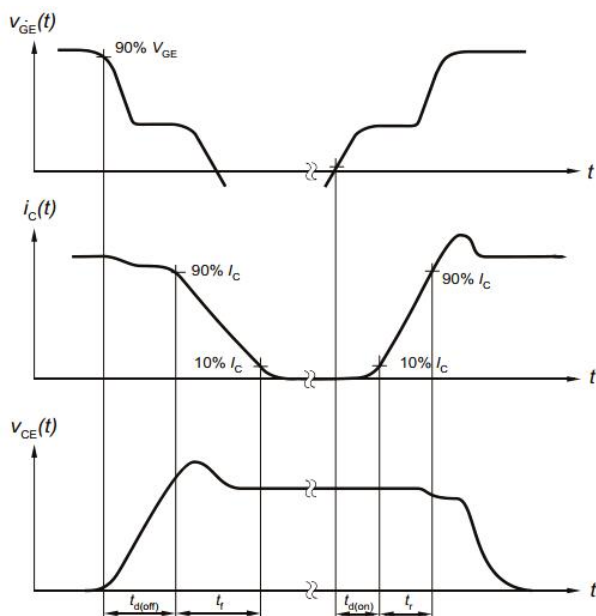


### 2) Switch Time Test Circuit

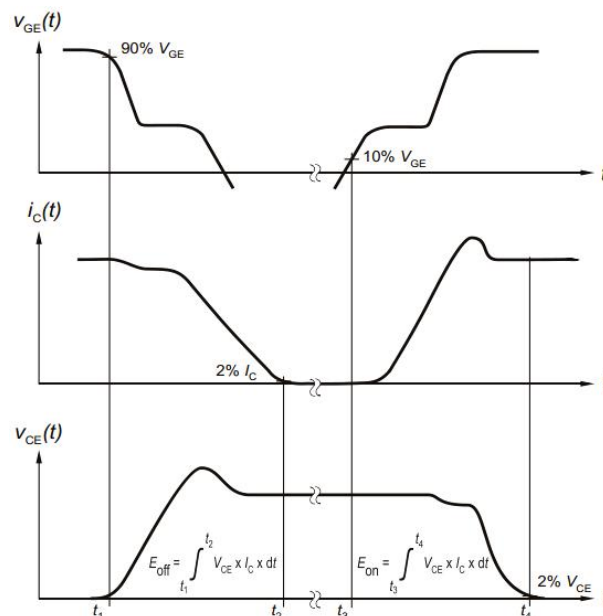


## Switching characteristics

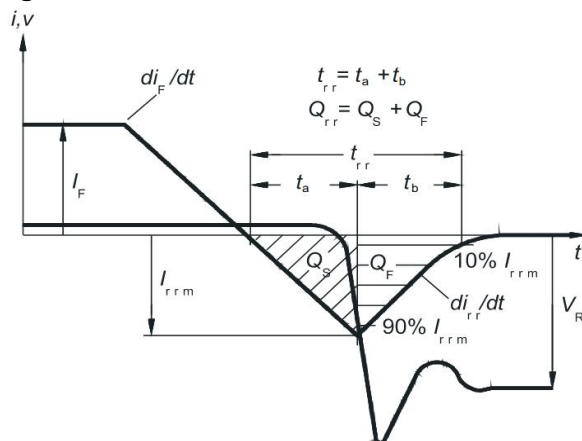
### 1) Definition of switching times



### 2) Definition of switching losses



### 3) Definition of diode switching characteristics



## Typical Electrical and Thermal Characteristics

Figure 1 Output Characteristics

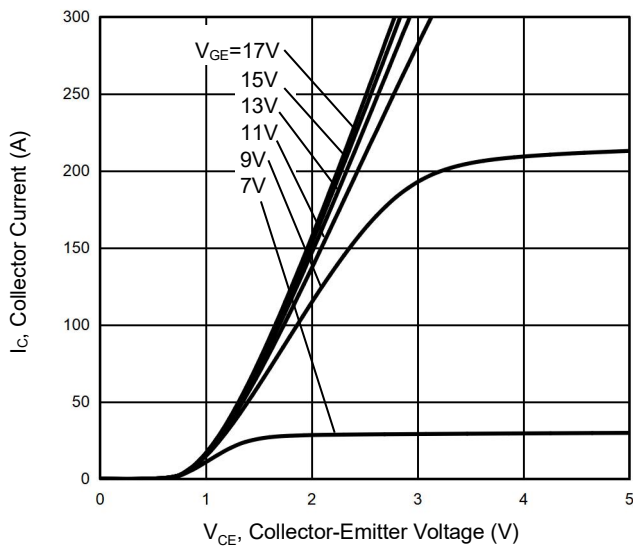


Figure 2 Transfer Characteristics

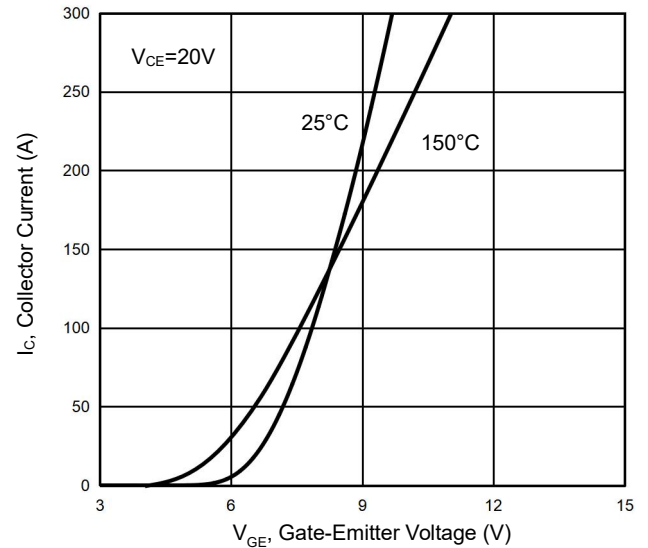


Figure 3  $V_{CE(sat)}$  vs. Case Temperature

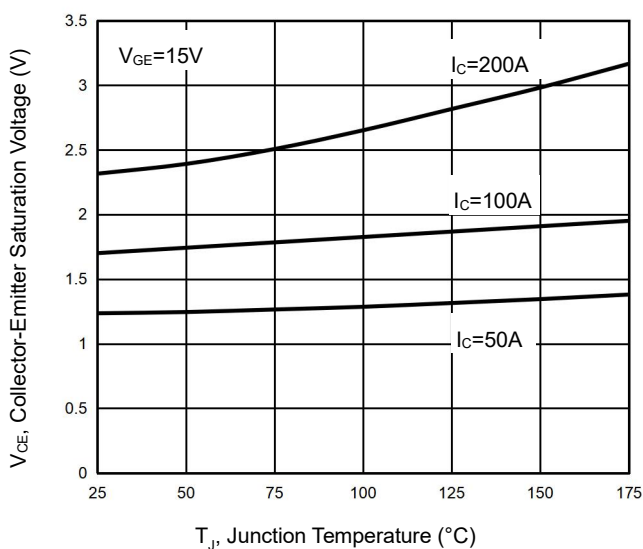


Figure 4 Saturation Voltage vs.  $V_{GE}$

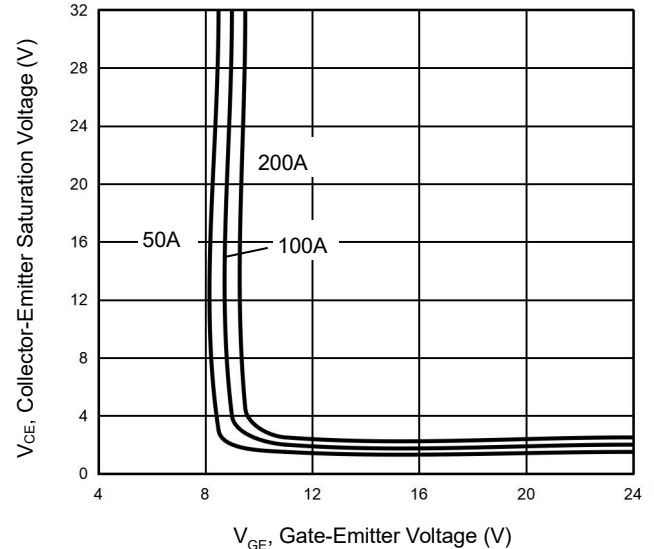


Figure 5 Capacitance Characteristics

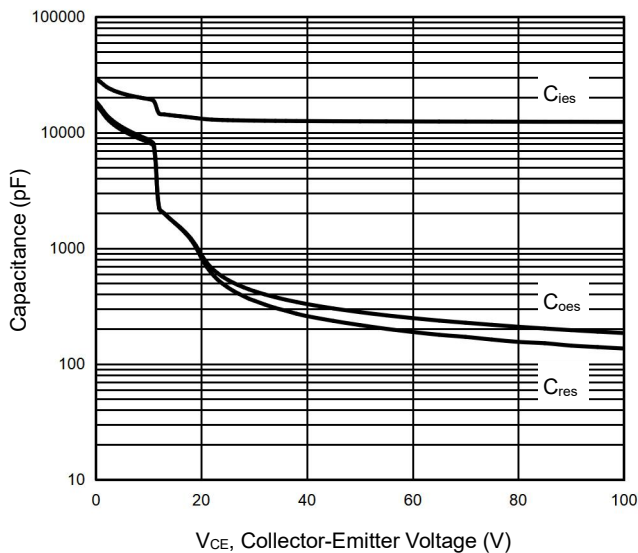
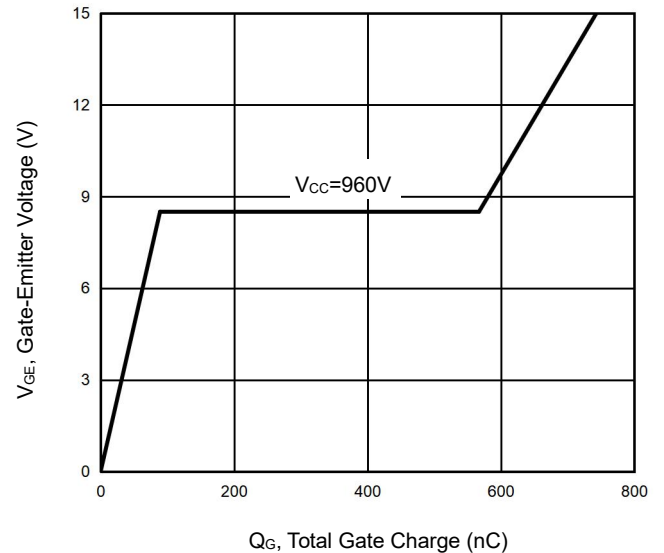


Figure 6 Gate Charge Wave Form



## Typical Electrical and Thermal Characteristics

Figure 7 Forward Characteristics

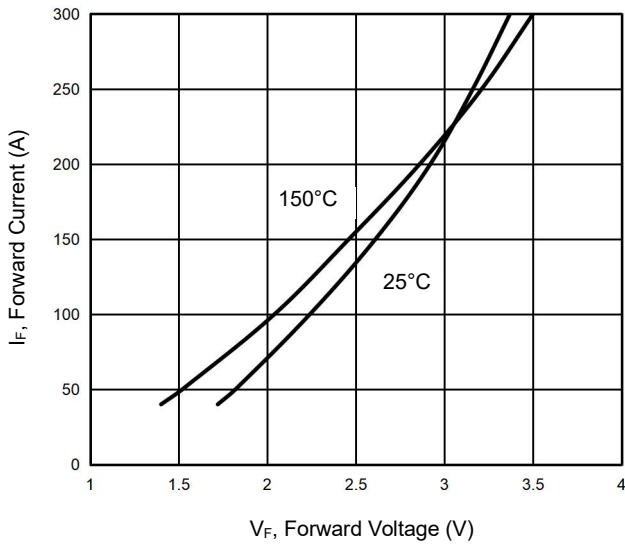


Figure 8  $V_F$  vs. Temperature

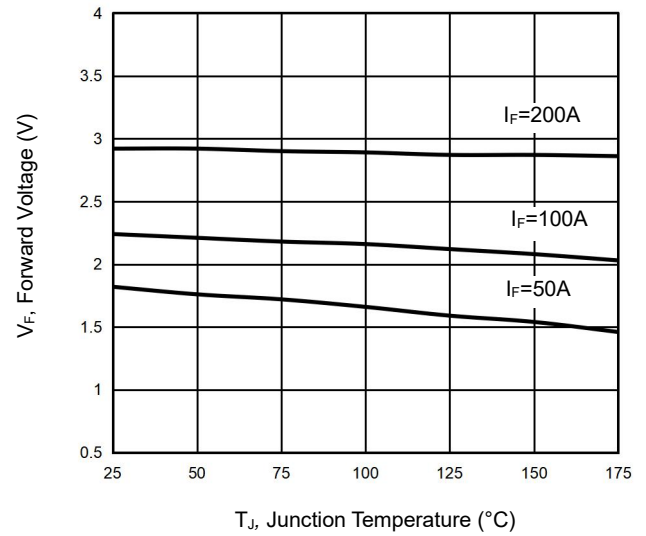


Figure 9 Switching Energy vs. Temperature

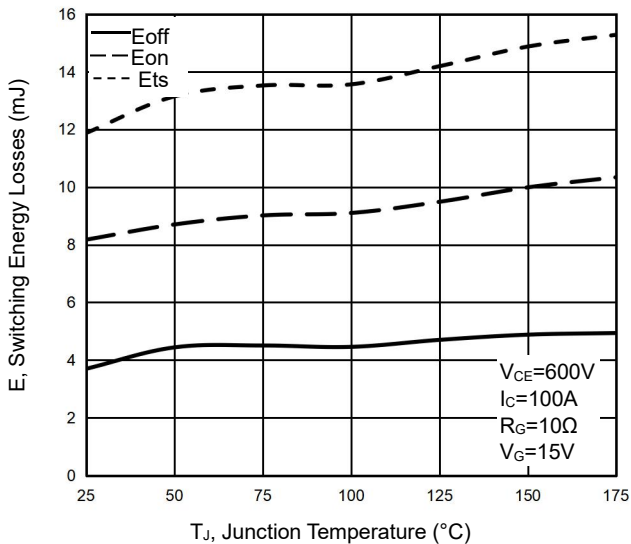


Figure 10 Forward Bias Safe Operating Area

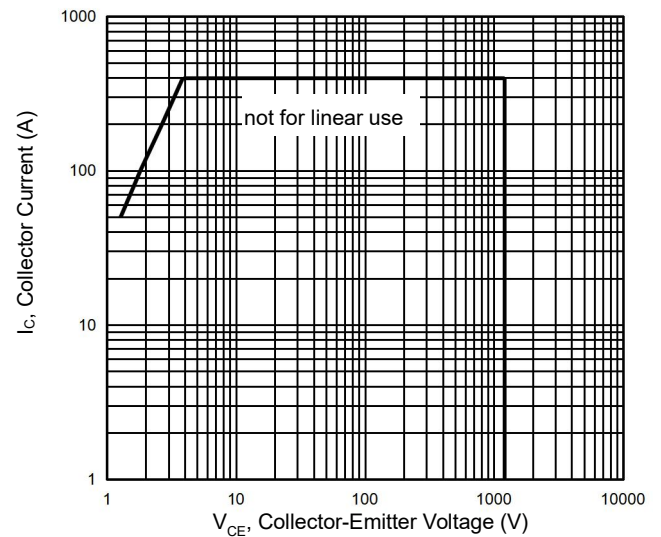


Figure 11 Gate-Emitter Threshold Voltage as a Function of Junction Temperature

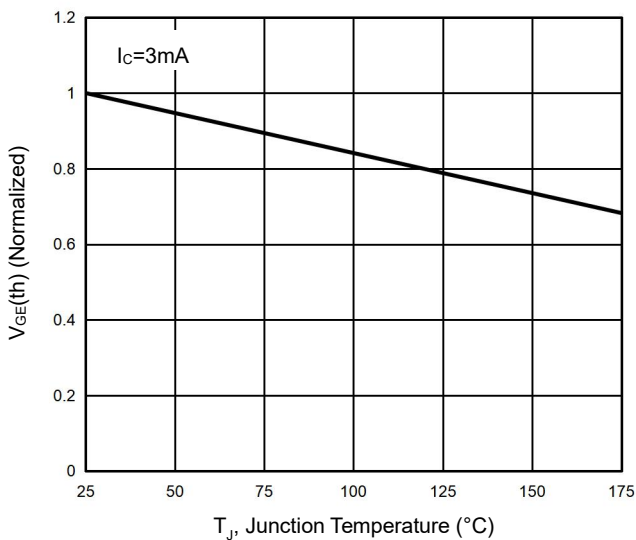
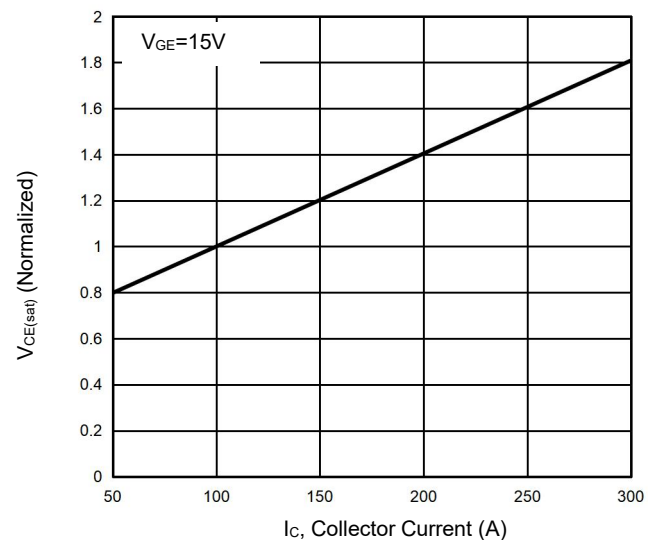


Figure 12 Typical Collector-Emitter Saturation Voltage as a function of Collector Current



## Typical Electrical and Thermal Characteristics

Figure 13 Switching Loss vs.  $R_G$

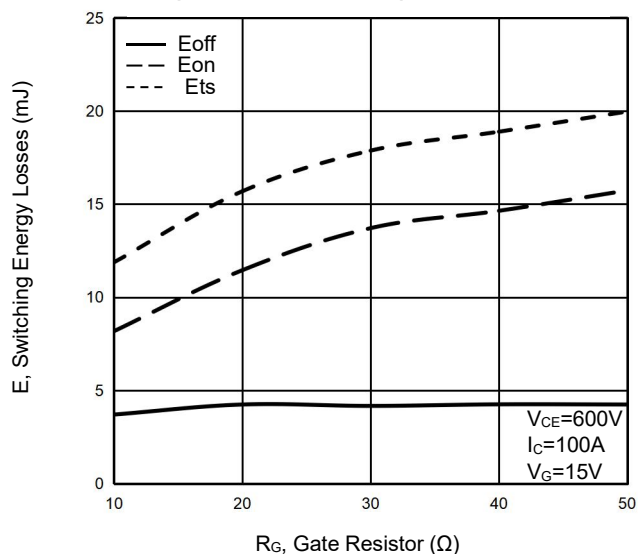


Figure 14 Switching Loss vs. Collector Current

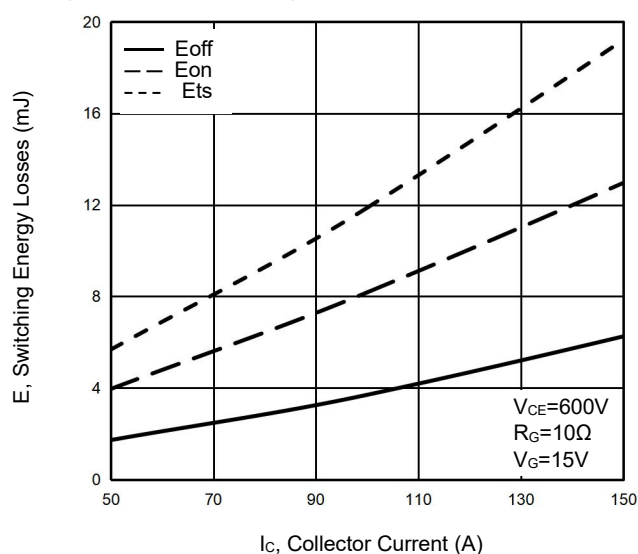


Figure 15 Switching Loss vs. Collector Current

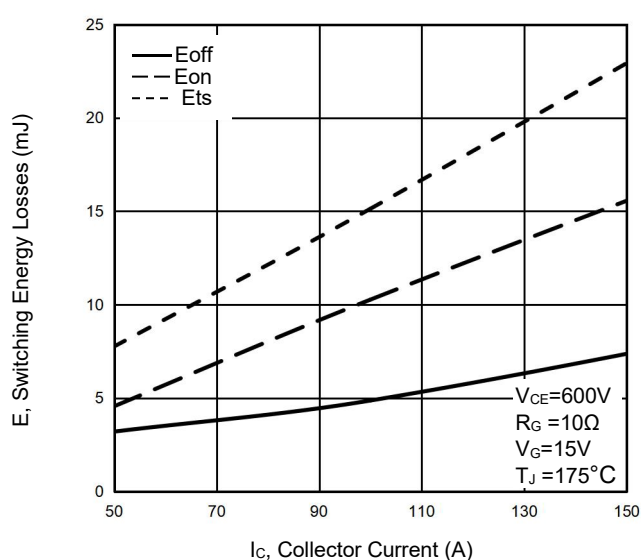


Figure 16  $P_{tot}$  vs. Case Temperature

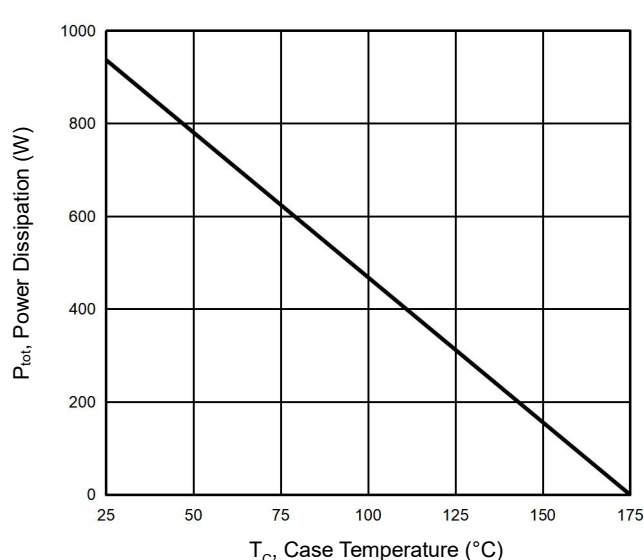


Figure 17  $V_{CES}$  vs. Case Temperature

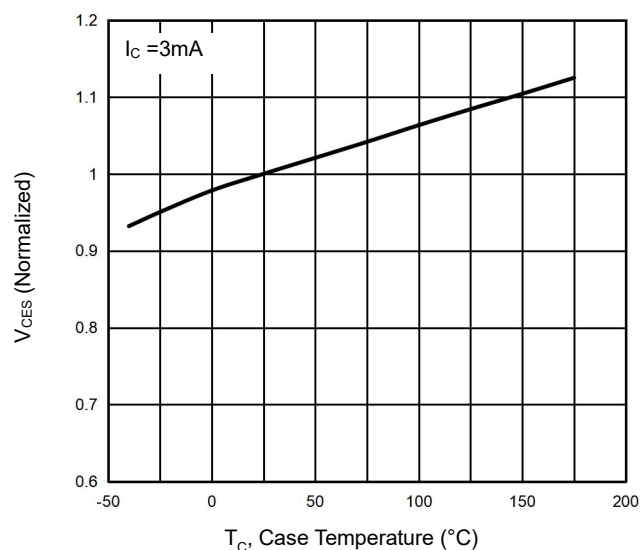
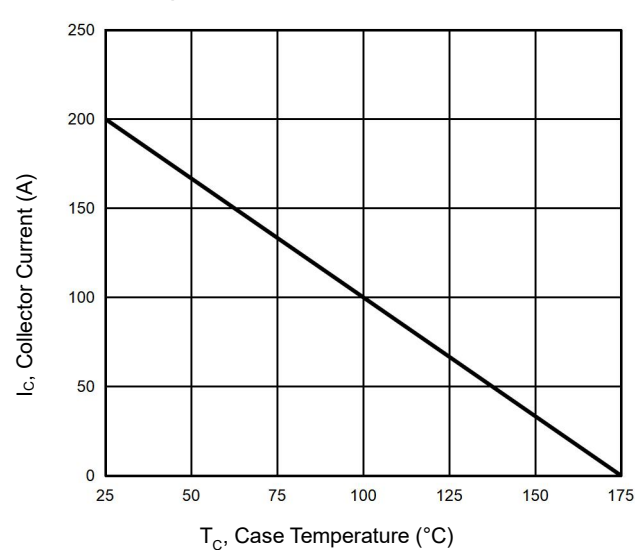
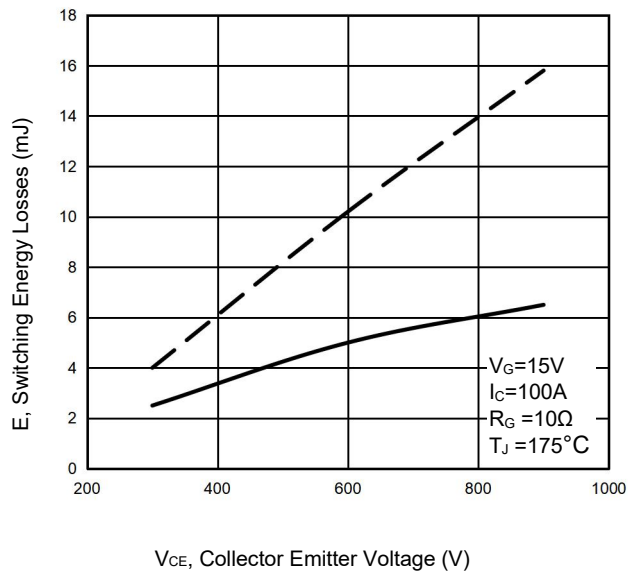


Figure 18  $I_C$  vs. Temperature

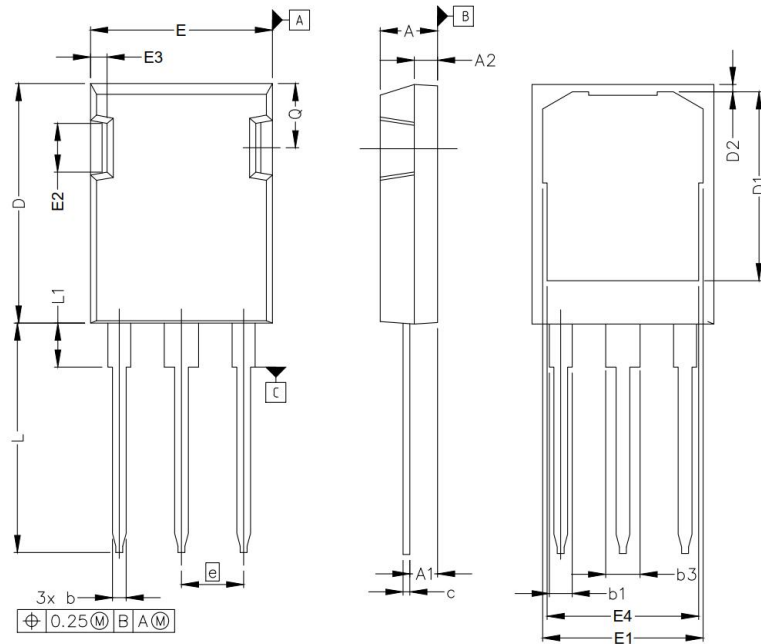


## Typical Electrical and Thermal Characteristics

Figure 19 Switching Loss vs.  $V_{CE}$



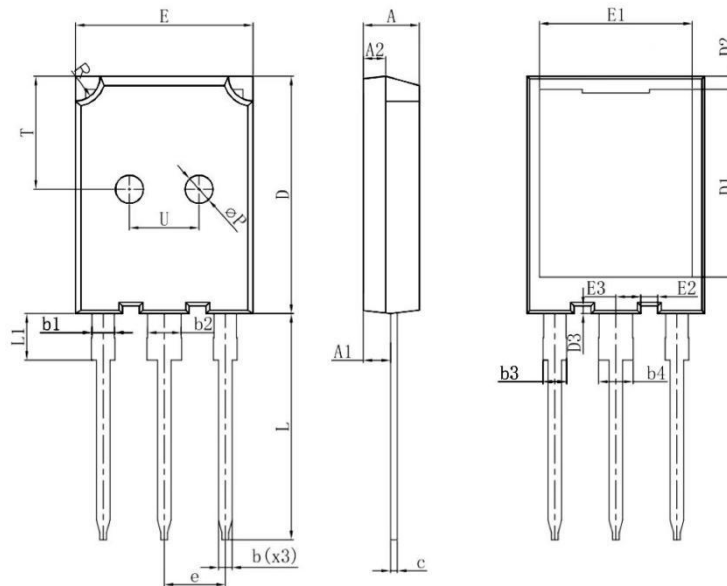
## TO-247P-B Package Information



| Symbol | Dimensions In Millimeters |       | Dimensions In Inches |      |
|--------|---------------------------|-------|----------------------|------|
|        | Min.                      | Max.  | Min.                 | Max. |
| A      | 4.83                      | 5.21  | 0.19                 | 0.21 |
| A1     | 2.29                      | 2.54  | 0.09                 | 0.10 |
| A2     | 1.91                      | 2.16  | 0.08                 | 0.09 |
| b      | 1.07                      | 1.33  | 0.04                 | 0.05 |
| b1     | 1.91                      | 2.41  | 0.08                 | 0.09 |
| b3     | 2.87                      | 3.38  | 0.11                 | 0.13 |
| c      | 0.55                      | 0.68  | 0.02                 | 0.03 |
| D      | 20.80                     | 21.10 | 0.82                 | 0.83 |
| D1     | 16.25                     | 17.65 | 0.64                 | 0.69 |
| D2     | 0.50                      | 0.80  | 0.02                 | 0.03 |
| E      | 15.75                     | 16.13 | 0.62                 | 0.64 |
| E1     | 13.10                     | 14.15 | 0.52                 | 0.56 |
| E2     | 3.68                      | 5.10  | 0.14                 | 0.20 |
| E3     | 1.00                      | 1.90  | 0.04                 | 0.07 |
| E4     | 12.38                     | 13.43 | 0.49                 | 0.53 |
| e      | 5.44 BSC                  |       | 0.21 BSC             |      |
| L      | 19.81                     | 20.32 | 0.78                 | 0.80 |
| L1     | 3.70                      | 4.00  | 0.15                 | 0.16 |
| Q      | 5.49                      | 6.00  | 0.22                 | 0.24 |



## TO-247P-E Package Information



| Symbol | Dimensions In Millimeters |       | Dimensions In Inches |      |
|--------|---------------------------|-------|----------------------|------|
|        | Min.                      | Max.  | Min.                 | Max. |
| A      | 4.90                      | 5.10  | 0.19                 | 0.20 |
| A1     | 2.31                      | 2.51  | 0.09                 | 0.10 |
| A2     | 1.90                      | 2.10  | 0.07                 | 0.08 |
| b      | 1.10                      | 1.30  | 0.04                 | 0.05 |
| b1     | 1.90                      | 2.10  | 0.07                 | 0.08 |
| b2     | 2.90                      | 3.10  | 0.11                 | 0.12 |
| b3     | --                        | 2.25  | --                   | 0.09 |
| b4     | --                        | 3.25  | --                   | 0.13 |
| c      | 0.55                      | 0.65  | 0.02                 | 0.03 |
| D      | 20.90                     | 21.10 | 0.82                 | 0.83 |
| D1     | 16.55                     | 17.15 | 0.65                 | 0.68 |
| D2     | 1.05                      | 1.35  | 0.04                 | 0.05 |
| D3     | 0.58                      | 0.78  | 0.02                 | 0.03 |
| E      | 15.70                     | 15.90 | 0.62                 | 0.63 |
| E1     | 13.40                     | 13.80 | 0.53                 | 0.54 |
| E2     | 1.40                      | 1.60  | 0.06                 | 0.07 |
| E3     | 2.12                      | 2.32  | 0.08                 | 0.09 |
| e      | 5.436 BSC                 |       | 0.21 BSC             |      |
| L      | 19.90                     | 20.10 | 0.78                 | 0.79 |
| L1     | 3.94                      | 4.30  | 0.16                 | 0.17 |
| ∅ P    | 2.40                      | 2.60  | 0.09                 | 0.10 |
| R      | 2.10                      | 2.30  | 0.08                 | 0.09 |
| T      | 9.80                      | 10.20 | 0.39                 | 0.40 |
| U      | 6.00                      | 6.40  | 0.24                 | 0.25 |

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