# 1200V, 50A, Trench FS II Fast IGBT

## General Description:

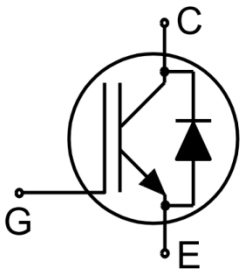
Using NCE's proprietary trench design and advanced FS (Field Stop) second generation technology, the 1200V Trench FSII IGBT offers superior conduction and switching performances, and easy parallel operation;

## 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

- Inverters
- Motor drives
- Converter




**Schematic diagram**

## Package Marking and Ordering Information

| Device | Device Package | Device Marking |
|---|---|---|
| NCE50TD120BT | TO-247 | NCE50TD120BT |


**TO-247**

## Absolute Maximum Ratings ($T_C$=25°C unless otherwise noted)

| Symbol | Parameter | Value | Units |
|---|---|---|---|
| $V_{CES}$ | Collector-Emitter Voltage | 1200 | V |
| $V_{GES}$ | Gate- Emitter Voltage | ±30 | V |
| $I_C$ | Collector Current | 100 | A |
| | Collector Current @$T_C$ = 100 °C | 50 | A |
| $I_{Cplus}$ | Pulsed Collector Current，$t_p$ limited by $T_{jmax}$ | 150 | A |
| - | turn off safe operating area，$V_{CE}$=1200V，Tj=150°C | 150 | A |
| $I_F$ | Diode Continuous Forward Current @$T_C$ = 100 °C | 50 | A |
| $I_{FM}$ | Diode Maximum Forward Current | 150 | A |
| $P_D$ | Power Dissipation @ $T_C$ = 25°C | 535 | W |
| | Power Dissipation @$T_C$ = 100 °C | 268 | W |
| $T_J$,$T_{stg}$ | Operating Junction and Storage Temperature Range | -55 to +175 | °C |
| $T_L$ | Maximum Temperature for Soldering | 260 | °C |
| $t_{sc}$ | Short circuit withstand time $V_{GE}$=15.0V, $V_{CC}$≤600V, Allowed number of short circuits<1000Time between short circuits:≥1.0s,$T_j$≤150°C | 10 | us |

## Thermal Characteristic

| Symbol | Parameter | Value | Units |
|---|---|---|---|
| $R_{\theta JC}$ | Thermal Resistance, Junction to case for IGBT | 0.28 | °C/W |
| $R_{\theta JC}$ | Thermal Resistance, Junction to case for Diode | 0.5 | °C/W |
| $R_{\theta JA}$ | Thermal Resistance, Junction to Ambient | 40 | °C/W |

## Electrical Characteristics ($T_C$=25°C unless otherwise noted)

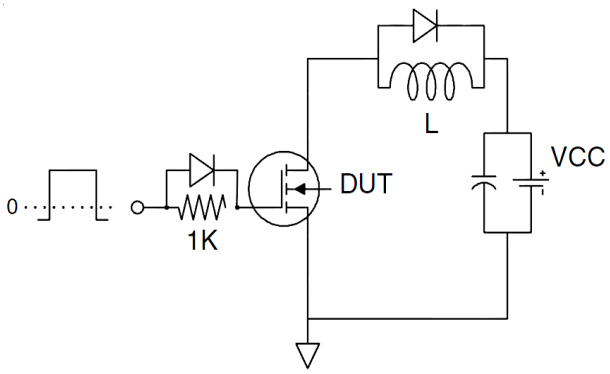
| Symbol | Parameter | Test Conditions | Value | | | Units |
|---|---|---|---|---|---|---|
| | | | Min. | Typ. | Max. | |
| **Static Characteristics** | | | | | | |
| $V_{(BR)CES}$ | Collector-Emitter Breakdown Voltage | $V_{GE}$=0V,$I_{CE}$=1mA | 1200 | -- | -- | V |
| $I_{CES}$ | Collector-Emitter Leakage Current | $V_{GE}$ =0V,$V_{CE}$=1200V | -- | -- | 5 | uA |
| $I_{GES(F)}$ | Gate to Emitter Forward Leakage | $V_{GE}$=+30V,$V_{CE}$=0V | -- | -- | 200 | nA |
| $I_{GES(R)}$ | Gate to Source Reverse Leakage | $V_{GE}$=-30V,$V_{CE}$ =0V | -- | -- | 200 | nA |
| $V_{CE(sat)}$ | Collector-Emitter Saturation Voltage | $I_C$=50A, Tj=25°C | -- | 1.55 | 1.8 | V |
| | | $V_{GE}$=15V, Tj=150°C | -- | 1.8 | -- | V |
| $V_{GE(th)}$ | Gate Threshold Voltage | $I_C$=1mA,$V_{CE}$=$V_{GE}$ | 5.0 | -- | 6.5 | V |
| $I_{C(SC)}$ | Short circuit collector current Max.1000 short circuits Time between short circuits: ≥1.0s | $V_{GE}$=15V,$V_{CC}$≤600V, $t_{SC}$≤10us,Tj≤150°C | -- | 300 | -- | A |
| **Dynamic Characteristics** | | | | | | |
| $C_{ies}$ | Input Capacitance | $V_{CE}$=30V,$V_{GE}$=0V, f=1MHz | -- | 6500 | -- | pF |
| $C_{oes}$ | Output Capacitance | | -- | 218 | -- | |
| $C_{res}$ | Reverse Transfer Capacitance | | -- | 180 | -- | |
| $Q_g$ | Total Gate Charge | $V_{CC}$=960V, $I_C$=50A, $V_{GE}$=15V | -- | 381 | -- | nC |
| $Q_{ge}$ | Gate to Emitter Charge | | -- | 46 | -- | |
| $Q_{gc}$ | Gate to Collector Charge | | -- | 195 | -- | |
| **Switching Characteristics** | | | | | | |
| $t_{d(ON)}$ | Turn-on Delay Time | $V_{CE}$=600V,$I_C$=50A, $V_{GE}$=0/15V, $R_g$=8Ω Inductive Load | -- | 19 | -- | ns |
| $t_r$ | Rise Time | | -- | 17 | -- | |
| $t_{d(OFF)}$ | Turn-Off Delay Time | | -- | 170 | -- | |
| $t_f$ | Fall Time | | -- | 18 | -- | |
| $E_{on}$ | Turn-On Switching Loss | | -- | 2.8 | -- | mJ |
| $E_{off}$ | Turn-Off Switching Loss | | -- | 2.0 | -- | |
| $E_{ts}$ | Total Switching Loss | | -- | 4.8 | -- | |

## Electrical Characteristics of the Diode($T_C$= 25°C unless otherwise specified)：

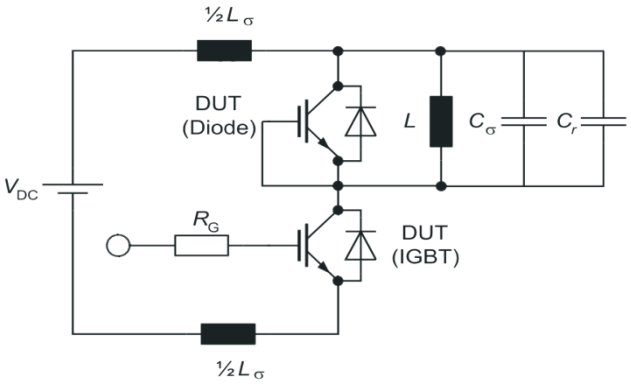
| Symbol | Parameter | Test Conditions | Rating | | | Units |
|---|---|---|---|---|---|---|
| | | | Min. | Typ. | Max. | |
| $V_{FM}$ | Diode Forward Voltage | $I_F$=50A | -- | 2.2 | 2.8 | V |
| $T_{rr}$ | Reverse Recovery Time | $I_F$=25A, di/dt=700A/us | -- | 150 | -- | ns |
| $I_{RRM}$ | Diode Peak Reverse Recovery Current | | -- | 10 | -- | A |
| $Q_{rr}$ | Reverse Recovery Charge | | -- | 2.2 | -- | uC |
| Pulse width $t_{tp}$≤380μs,δ≤2% | | | | | | |

## Test Circuit

### 1) Gate Charge Test Circuit

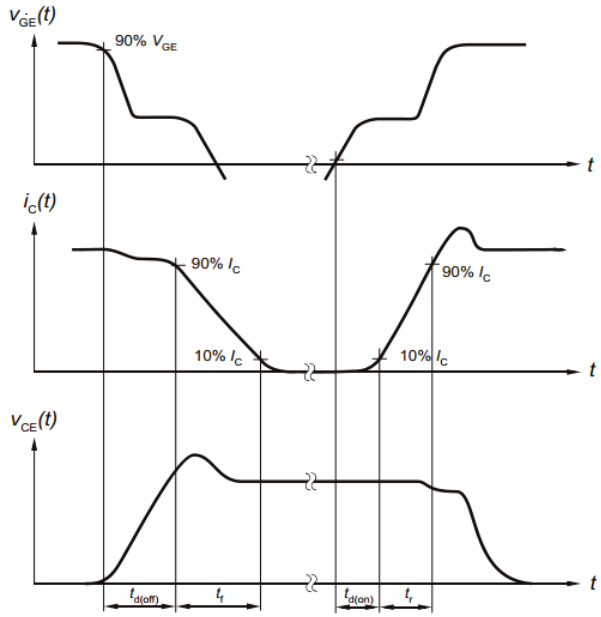



### 2) Switch Time Test Circuit

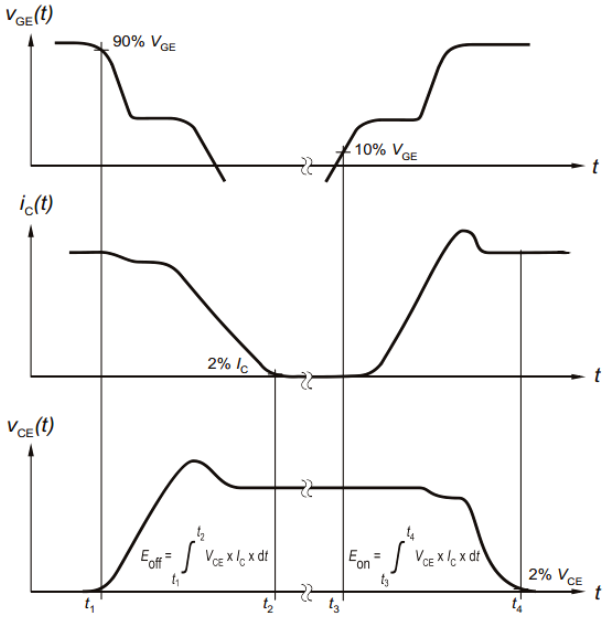



## Switching characteristics

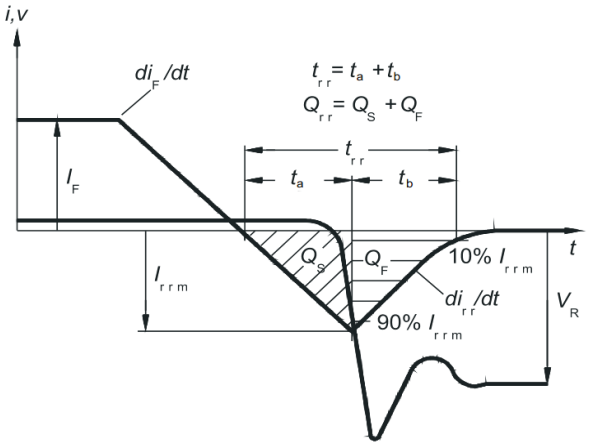
### 1) Definition of switching times




### 2) Definition of switching losses

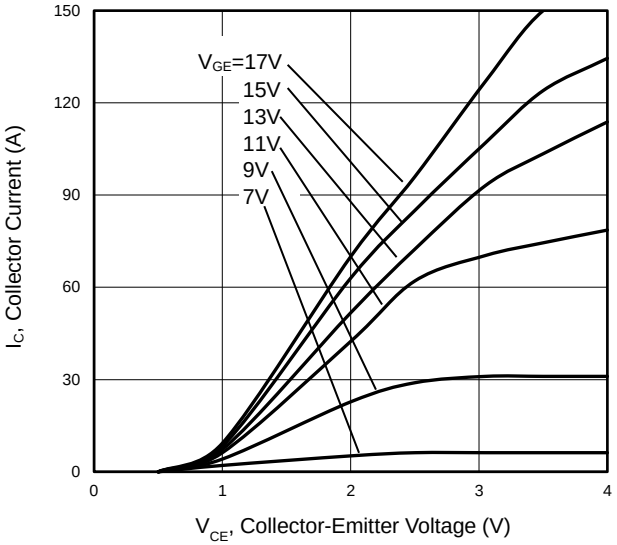



### 3) Definition of diode switching characteristics

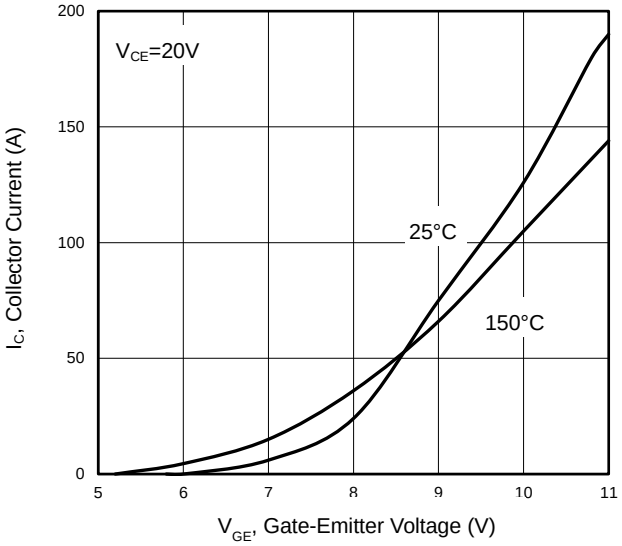


## Typical Electrical and Thermal Characteristics

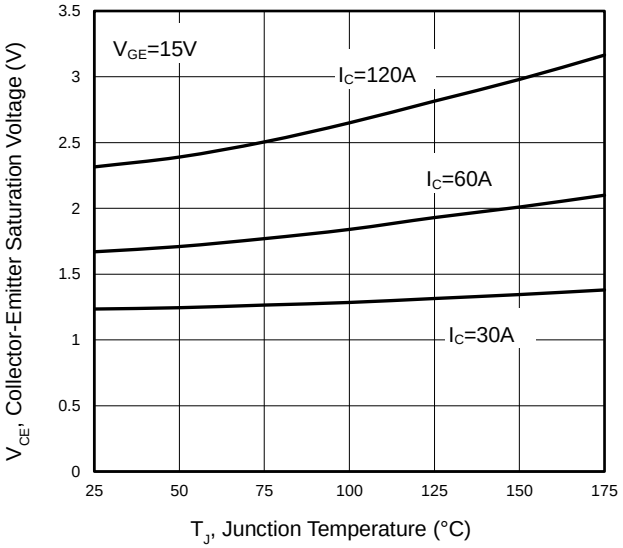
### Figure 1 Output Characteristics



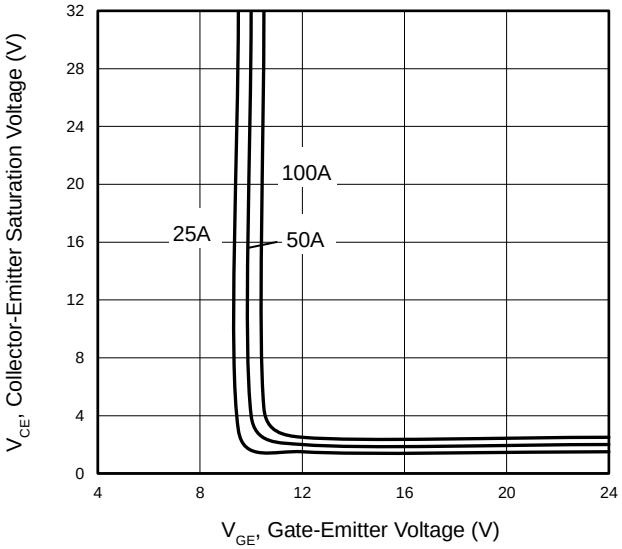

### Figure 2 Transfer Characteristics



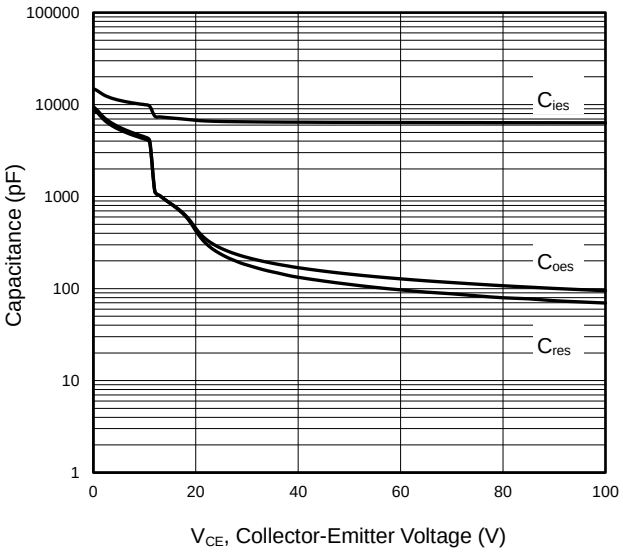

### Figure 3 $V_{CE(sat)}$ vs. Case Temperature



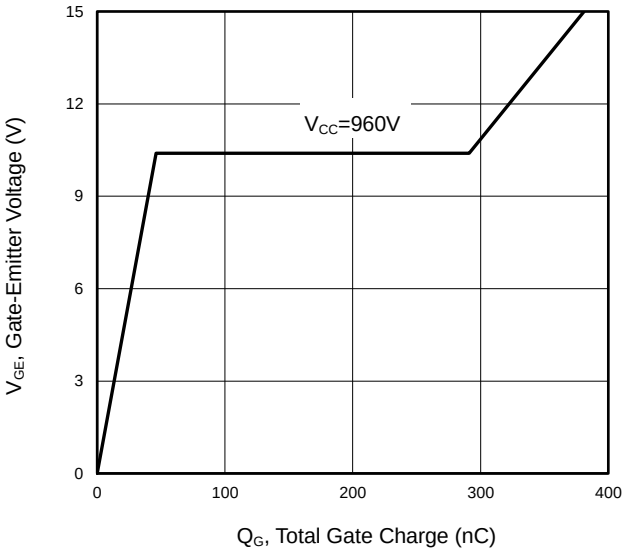

### Figure 4 Saturation Voltage vs. $V_{GE}$



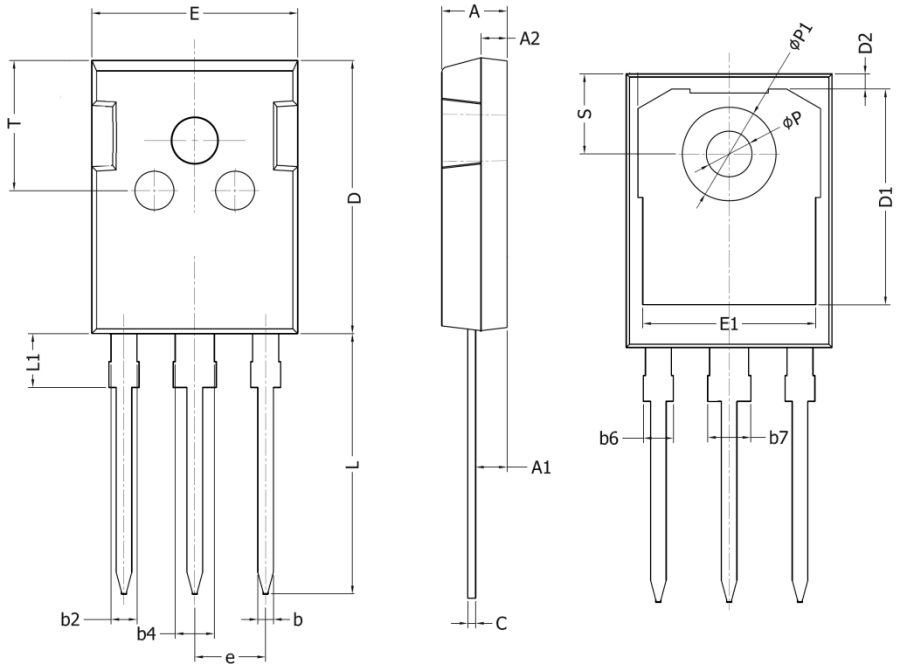

### Figure 5 Capacitance Characteristics




### Figure 6 Gate Charge Wave Form



# TO-247 Package Information




| Symbol | Dimensions In Millimeters | | Dimensions In Inches | |
|---|---|---|---|---|
| | Min. | Max. | Min. | Max. |
| A | 4.90 | 5.10 | 0.193 | 0.201 |
| A1 | 2.31 | 2.51 | 0.091 | 0.099 |
| A2 | 1.9 | 2.1 | 0.075 | 0.083 |
| b | 1.16 | 1.26 | 0.046 | 0.050 |
| b2 | 1.96 | 2.06 | 0.077 | 0.081 |
| b4 | 2.96 | 3.06 | 0.117 | 0.120 |
| b6 | - | 2.25 | - | 0.089 |
| b7 | - | 3.25 | - | 0.128 |
| C | 0.59 | 0.66 | 0.023 | 0.026 |
| D | 20.90 | 21.10 | 0.823 | 0.831 |
| D1 | 16.25 | 16.85 | 0.640 | 0.663 |
| D2 | 1.05 | 1.35 | 0.041 | 0.053 |
| E | 15.70 | 15.90 | 0.618 | 0.626 |
| E1 | 13.10 | 13.50 | 0.516 | 0.531 |
| e | 5.436 BSC | | 0.214 BSC | |
| L | 19.80 | 20.10 | 0.780 | 0.791 |
| L1 | - | 4.30 | - | 0.169 |
| P | 3.40 | 3.60 | 0.134 | 0.142 |
| P1 | 7.00 | 7.40 | 0.276 | 0.291 |
| S | 6.05 | 6.25 | 0.238 | 0.246 |
| T | 9.80 | 10.20 | 0.386 | 0.402 |

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