

## 1200V, 40A, Trench FS II Fast IGBT

### General Description:

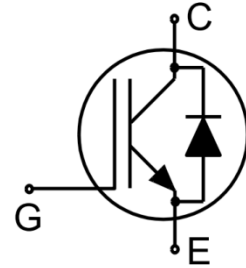
Using NCE's proprietary trench design and advanced FS (Field Stop) second generation technology, the 1200V Trench FSII IGBT offers superior conduction and switching performances, and easy parallel operation;

### 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

- UPS



Schematic diagram

### Package Marking and Ordering Information

Device	Device Package	Device Marking
NCE40TD120UT	TO-247	NCE40TD120UT



TO-247

### 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	80	A
	Collector Current @ $T_C = 100^\circ\text{C}$	40	A
$I_{Cpuls}$	Pulsed Collector Current, $t_p$ limited by $T_{jmax}$	120	A
-	turn off safe operating area, $V_{CE}=1200\text{V}$ , $T_j=150^\circ\text{C}$	120	A
$I_F$	Diode Continuous Forward Current @ $T_C = 100^\circ\text{C}$	40	A
$I_{FM}$	Diode Maximum Forward Current	120	A
$P_D$	Power Dissipation @ $T_C = 25^\circ\text{C}$	535	W
	Power Dissipation @ $T_C = 100^\circ\text{C}$	268	W
$T_J, T_{stg}$	Operating Junction and Storage Temperature Range	-55 to +175	$^\circ\text{C}$
$T_L$	Maximum Temperature for Soldering	260	$^\circ\text{C}$
$t_{sc}$	Short circuit withstand time $V_{GE}=15.0\text{V}$ , $V_{CC} \leq 600\text{V}$ , Allowed number of short circuits < 1000 Time between short circuits: $\geq 1.0\text{s}$ , $T_j \leq 150^\circ\text{C}$	5	$\mu\text{s}$

**Thermal Characteristic**

Symbol	Parameter	Value	Units
R <sub>θJC</sub>	Thermal Resistance, Junction to case for IGBT	0.28	°C/W
R <sub>θJC</sub>	Thermal Resistance, Junction to case for Diode	0.5	°C/W
R <sub>θJA</sub>	Thermal Resistance, Junction to Ambient	40	°C/W

**Electrical Characteristics (T<sub>C</sub>=25°C unless otherwise noted)**

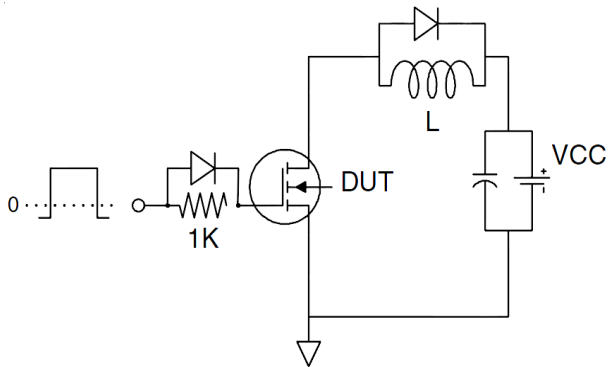
Symbol	Parameter	Test Conditions	Value			Units
			Min.	Typ.	Max.	
<b>Static Characteristics</b>						
V <sub>(BR)CES</sub>	Collector-Emitter Breakdown Voltage	V <sub>GE</sub> =0V, I <sub>CE</sub> =1mA	1200	--	--	V
I <sub>CES</sub>	Collector-Emitter Leakage Current	V <sub>GE</sub> =0V, V <sub>CE</sub> =1200V	--	--	5	μA
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 Source 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> =40A, T <sub>J</sub> =25°C	--	1.95	2.3	V
		V <sub>GE</sub> =15V, T <sub>J</sub> =150°C	--	2.3	--	V
V <sub>GE(th)</sub>	Gate Threshold Voltage	I <sub>C</sub> =1mA, V <sub>CE</sub> =V <sub>GE</sub>	5.0	--	6.5	V
<b>Dynamic Characteristics</b>						
C <sub>ies</sub>	Input Capacitance	V <sub>CE</sub> =30V, V <sub>GE</sub> =0V, f=1MHz	--	8789	--	pF
C <sub>oes</sub>	Output Capacitance		--	214	--	
C <sub>res</sub>	Reverse Transfer Capacitance		--	161	--	
Q <sub>g</sub>	Total Gate Charge	V <sub>CC</sub> =960V, I <sub>C</sub> =40A, V <sub>GE</sub> =15V	--	294	--	nC
Q <sub>ge</sub>	Gate to Emitter Charge		--	61	--	
Q <sub>gc</sub>	Gate to Collector Charge		--	127	--	
<b>Switching Characteristics</b>						
t <sub>d(ON)</sub>	Turn-on Delay Time	V <sub>CE</sub> =600V, I <sub>C</sub> =40A, V <sub>GE</sub> =0/15V, R <sub>g</sub> =8Ω 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		--	2.0	--	mJ
E <sub>off</sub>	Turn-Off Switching Loss		--	1.3	--	
E <sub>ts</sub>	Total Switching Loss		--	3.3	--	

**Electrical Characteristics of the Diode(T<sub>C</sub>= 25°C unless otherwise specified):**

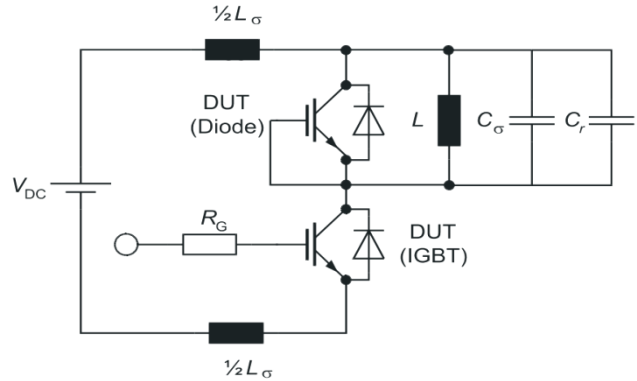
Symbol	Parameter	Test Conditions	Rating			Units
			Min.	Typ.	Max.	
V <sub>FM</sub>	Diode Forward Voltage	I <sub>F</sub> =40A	--	2.1	2.8	V
T <sub>rr</sub>	Reverse Recovery Time	I <sub>F</sub> =20A, di/dt=700A/us	--	150	--	ns
I <sub>RRM</sub>	Diode Peak Reverse Recovery Current		--	10	--	A
Q <sub>rr</sub>	Reverse Recovery Charge		--	2.2	--	μC
Pulse width t <sub>tp</sub> ≤380μs, δ≤2%						

### Test Circuit

#### 1) Gate Charge Test Circuit

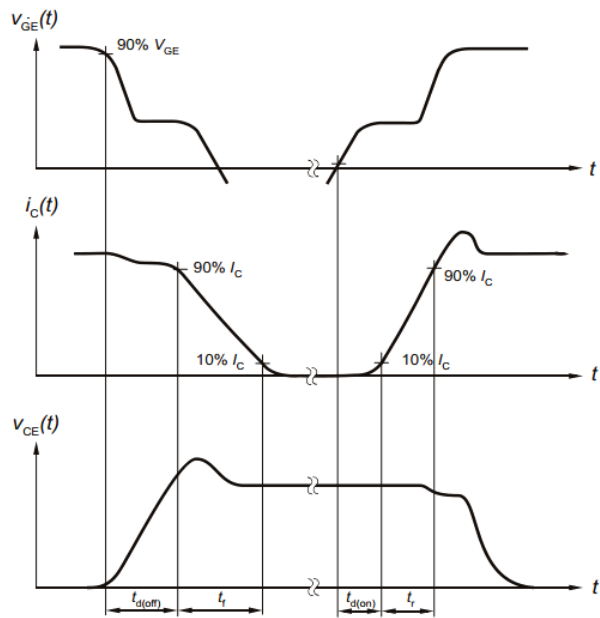


#### 2) Switch Time Test Circuit

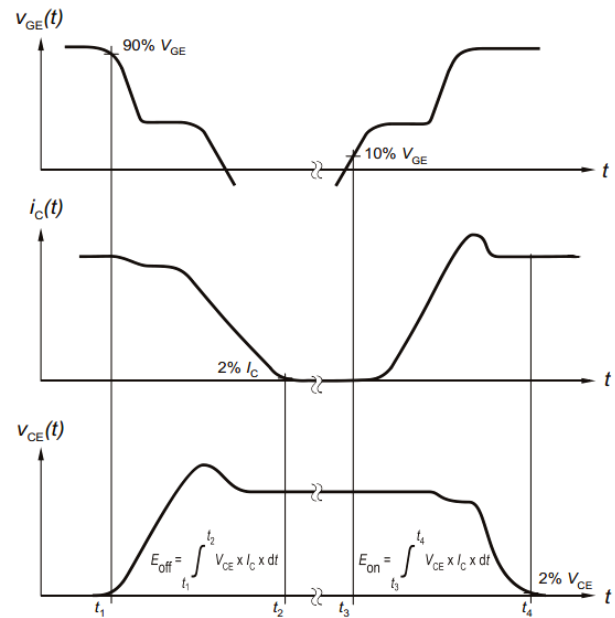


### Switching characteristics

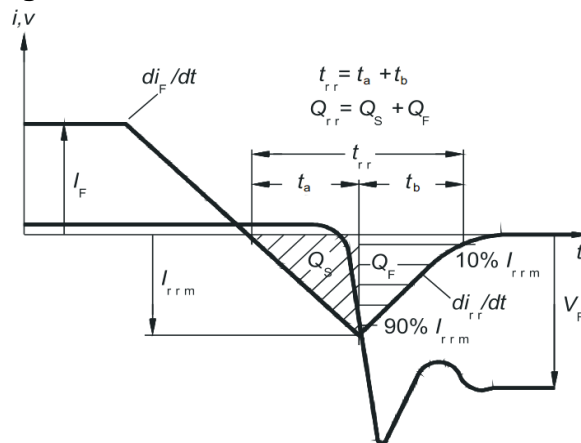
#### 1) Definition of switching times



#### 2) Definition of switching losses



#### 3) Definition of diode switching characteristics



Typical Electrical and Thermal Characteristics

Figure 1 Output Characteristics

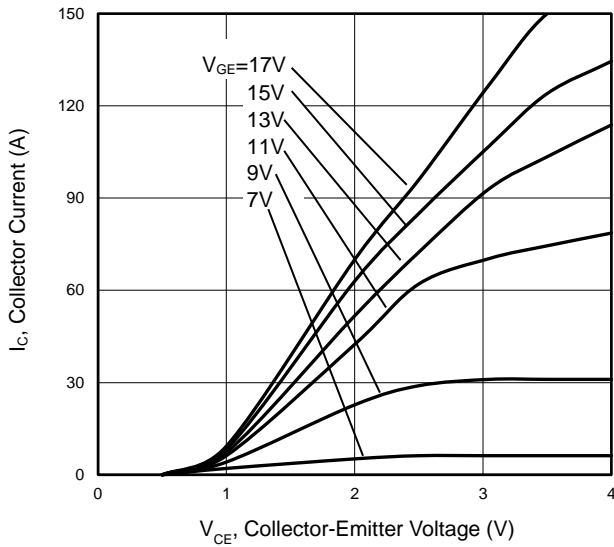


Figure 2 Transfer Characteristics

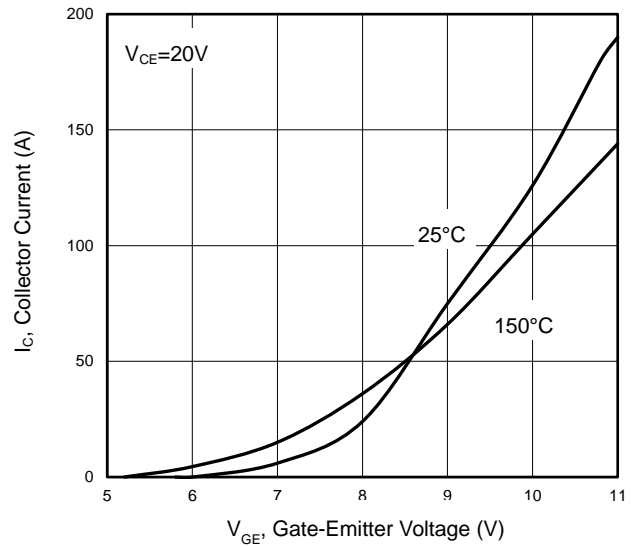


Figure 3  $V_{CE(sat)}$  vs. Case Temperature

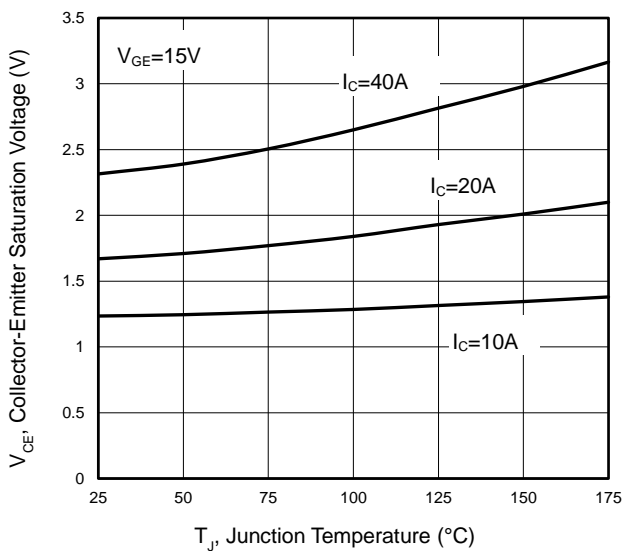


Figure 4 Saturation Voltage vs.  $V_{GE}$

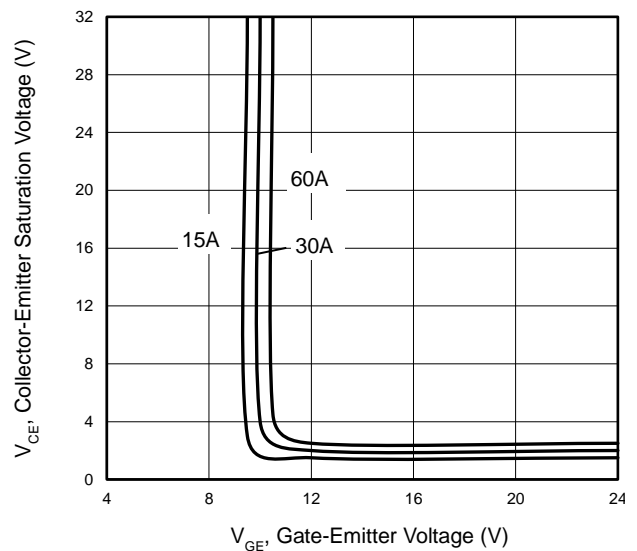


Figure 5 Capacitance Characteristics

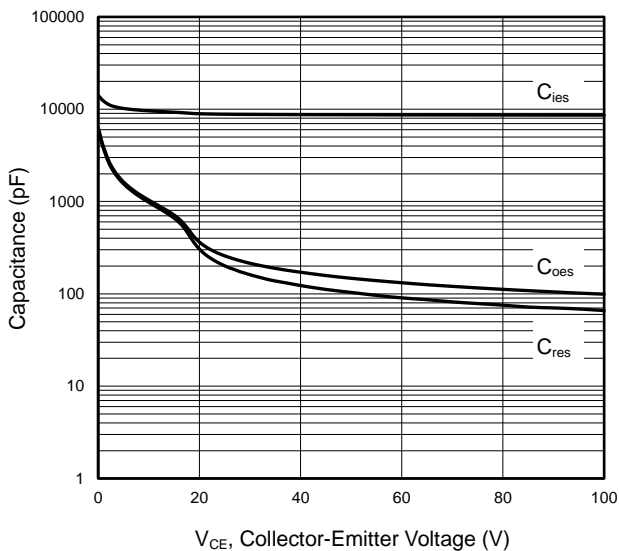
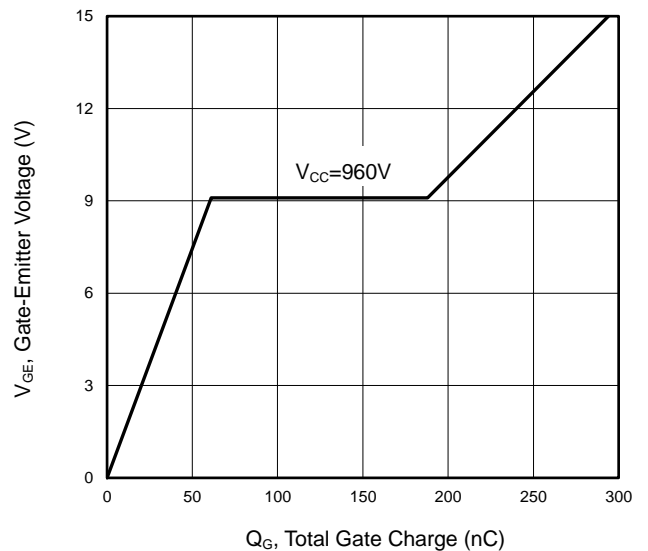
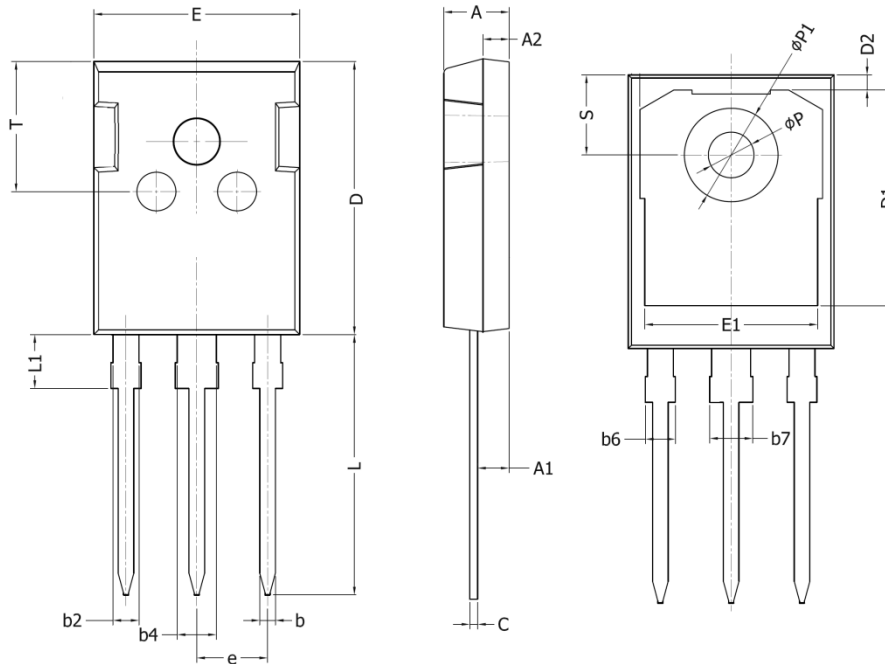


Figure 6 Gate Charge Wave Form



## 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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