

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

### General Description:

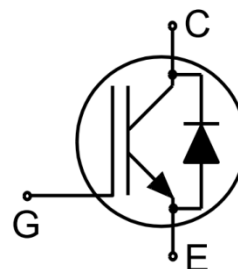
Using NCE's proprietary trench design and advanced FS (Field Stop) second generation technology, the 1200V Trench FSII IGBT offers superior conduction and switching performances, and easy parallel operation;

### 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

- Inductive Cooking
- Soft Switching Applications



Schematic diagram

### Package Marking and Ordering Information

Device	Device Package	Device Marking
NCE40TD120LP	TO-3PN	NCE40TD120LP



TO-3PN

### 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 @ $T_C = 25^{\circ}\text{C}$	468	W
	Power Dissipation @ $T_C = 100^{\circ}\text{C}$	234	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	0.32	°C/W
$R_{\theta JC}$	Thermal Resistance, Junction to case for Diode	0.86	°C/W
$R_{\theta JA}$	Thermal Resistance, Junction to Ambient	40	°C/W

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

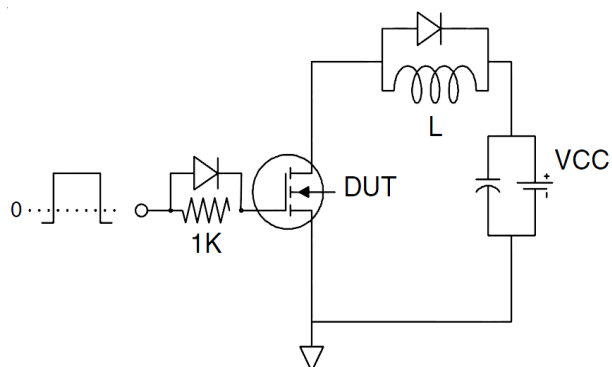
Symbol	Parameter	Test Conditions		Value			Units
				Min.	Typ.	Max.	
Static Characteristics							
V <sub>(BR)CES</sub>	Collector-Emitter Breakdown Voltage	V <sub>GE</sub> =0V,I <sub>CE</sub> =1mA		1200	--	--	V
I <sub>CES</sub>	Collector-Emitter Leakage Current	V <sub>GE</sub> =0V,V <sub>CE</sub> =1200V		--	--	5	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 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	--	1.50	1.75	V
		V <sub>GE</sub> =15V	T <sub>J</sub> =150°C	--	1.75	--	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
Dynamic Characteristics							
C <sub>ies</sub>	Input Capacitance	V <sub>CE</sub> =30V,V <sub>GE</sub> =0V, f=1MHz		--	5590	--	pF
C <sub>oes</sub>	Output Capacitance			--	177	--	
C <sub>res</sub>	Reverse Transfer Capacitance			--	134	--	
Q <sub>g</sub>	Total Gate Charge	V <sub>CC</sub> =960V, I <sub>C</sub> =40A, V <sub>GE</sub> =15V		--	298	--	nC
Q <sub>ge</sub>	Gate to Emitter Charge			--	52	--	
Q <sub>gc</sub>	Gate to Collector Charge			--	169	--	
Switching Characteristics							
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			--	2.4	--	mJ
E <sub>off</sub>	Turn-Off Switching Loss			--	1.8	--	
E <sub>ts</sub>	Total Switching Loss			--	4.2	--	

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

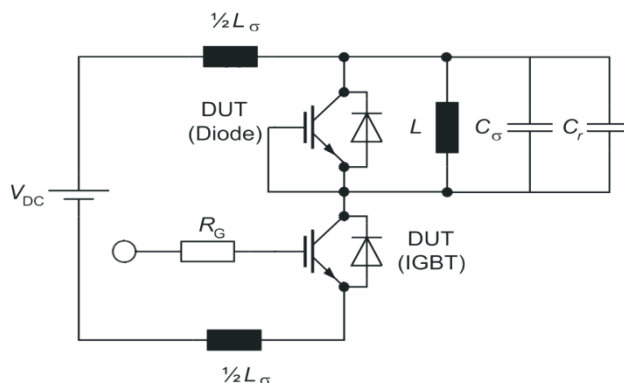
Symbol	Parameter	Test Conditions	Rating			Units
			Min.	Typ.	Max.	
V <sub>FM</sub>	Diode Forward Voltage	I <sub>F</sub> =20A	--	2.5	3.4	V
T <sub>rr</sub>	Reverse Recovery Time	I <sub>F</sub> =20A, di/dt=200A/us	--	120	--	ns
I <sub>RRM</sub>	Diode Peak Reverse Recovery Current		--	12	--	A
Q <sub>rr</sub>	Reverse Recovery Charge		--	0.72	--	uC
Pulse width t <sub>tp</sub> ≤380μs,δ≤2%						

## Test Circuit

### 1) Gate Charge Test Circuit

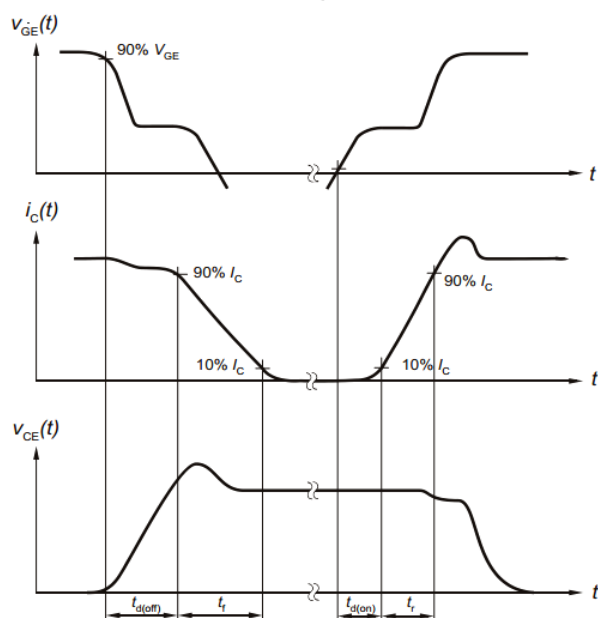


### 2) Switch Time Test Circuit

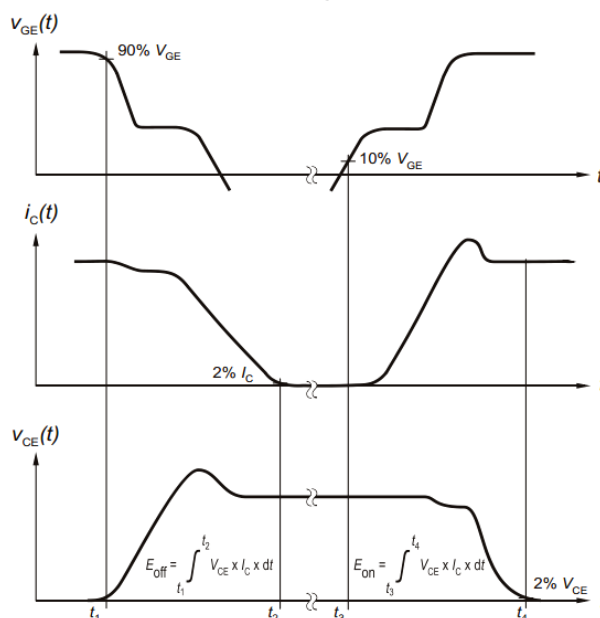


## Switching characteristics

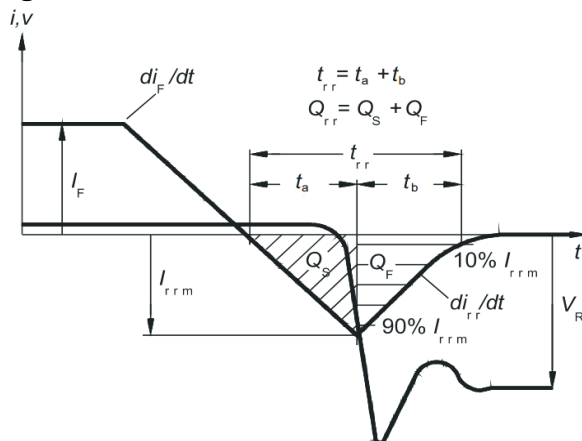
### 1) Definition of switching times



### 2) Definition of switching losses



### 3) Definition of diode switching characteristics



## Typical Electrical and Thermal Characteristics

Figure 1 Output Characteristics

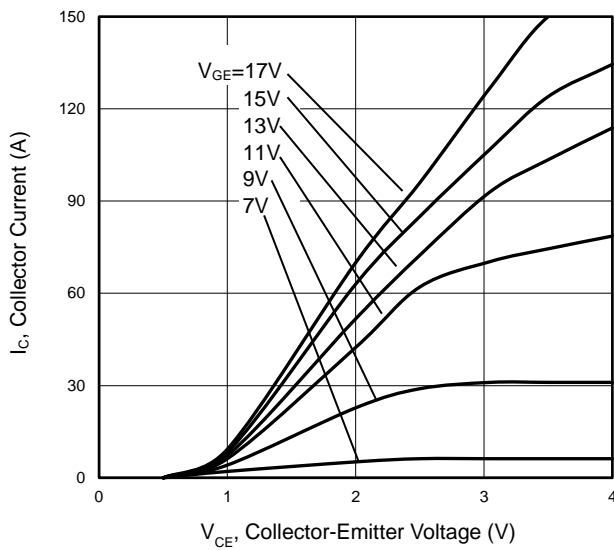


Figure 2 Transfer Characteristics

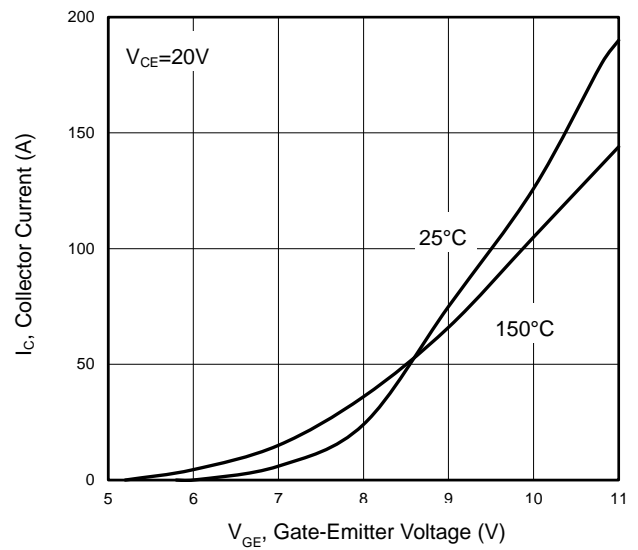


Figure 3  $V_{CE(sat)}$  vs. Case Temperature

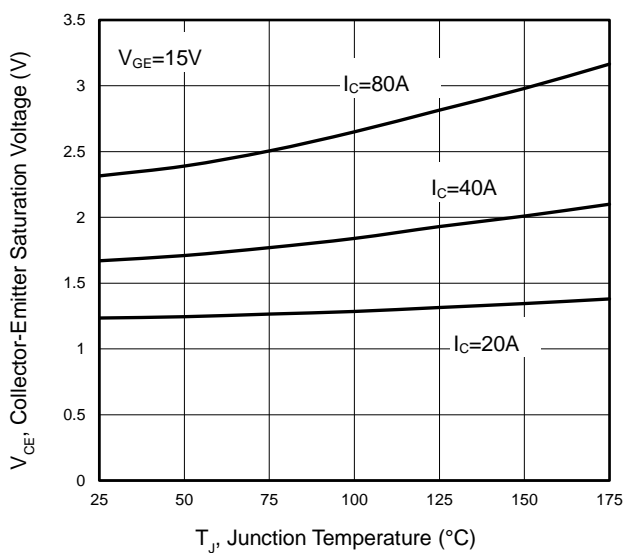


Figure 4 Saturation Voltage vs.  $V_{GE}$

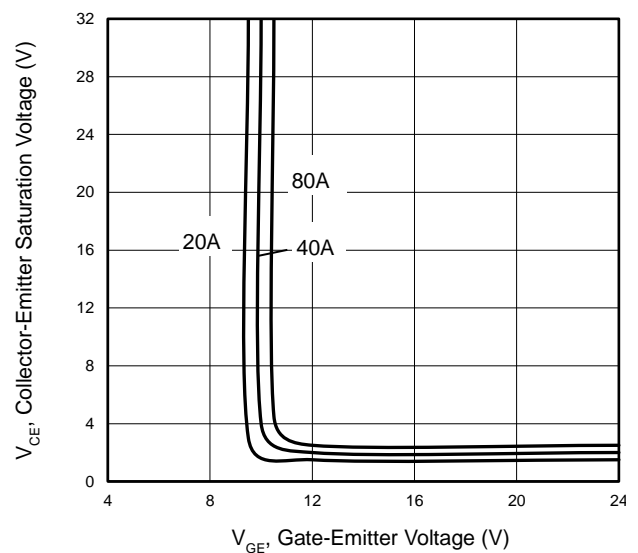


Figure 5 Capacitance Characteristics

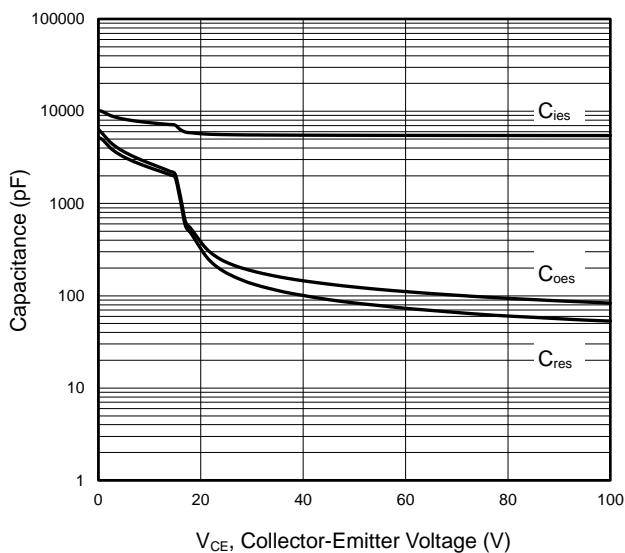
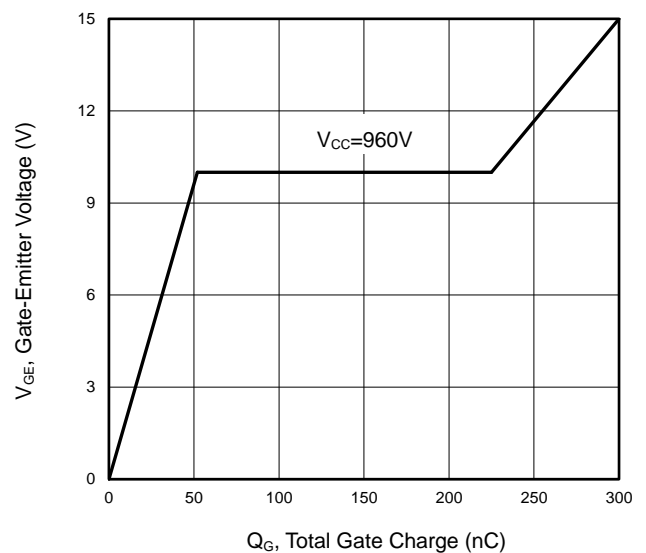
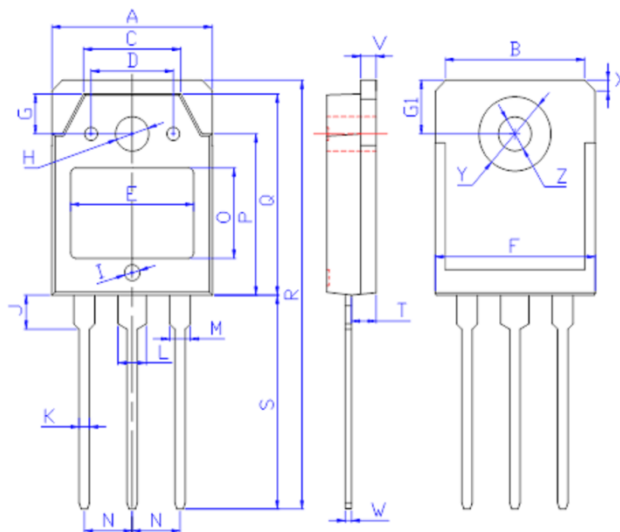


Figure 6 Gate Charge Wave Form



## TO-3PN Package Information



Symbol	Dimensions In Millimeters		Dimensions In Inches	
	Min.	Max.	Min.	Max.
A	15.30	15.90	0.60	0.63
B	13.30	13.90	0.52	0.55
C	9.20	9.80	0.36	0.39
D	7.70	8.30	0.30	0.33
E	11.55	12.15	0.45	0.48
F	15.35	15.95	0.60	0.63
G	3.50	4.10	0.14	0.16
G1	4.70	5.30	0.19	0.21
H	3.20	3.80	0.13	0.15
I	1.20	1.80	0.05	0.07
J	2.90	3.50	0.11	0.14
K	0.85	1.15	0.03	0.05
L	2.95	3.25	0.12	0.13
M	1.95	2.25	0.08	0.09
N	5.15	5.75	0.20	0.23
O	8.10	8.70	0.32	0.34
P	13.60	14.20	0.54	0.56
Q	18.40	19.00	0.72	0.75
R	39.40	40.60	1.55	1.60
S	19.60	20.40	0.77	0.80
T	2.10	2.70	0.08	0.11
V	1.35	1.65	0.05	0.06
W	0.45	0.75	0.02	0.03
X	1.40	2.20	0.06	0.09
Y	6.70	7.30	0.26	0.29
Z	2.90	3.50	0.11	0.14

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