600V, 40A, Trench FS II IGBT

General Description:

Using NCE's proprietary trench design and advanced FS (field stop) second generation technology, the 600V Trench FSII IGBT offers superior conduction and switching performances, and easy parallel operation;

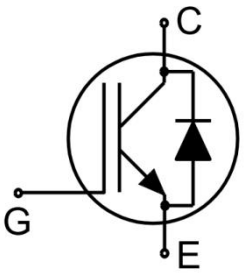
Features

Trench FSII Technology offering

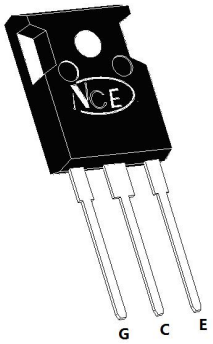
- Very low $V_{CE\ (sat)}$
- High speed switching
- Positive temperature coefficient in $V_{CE\ (sat)}$
- Very tight parameter distribution
- High ruggedness, temperature stable behavior

Application

- Uninterruptible Power Supplies (UPS)
- Welding Converters
- Inverters



Schematic diagram



TO-247-3L top view

Package Marking and Ordering Information

Device	V_{CE}	I_C	Device Marking	Device Package
NCE40TD60T	600V	40A	NCE40TD60T	TO-247-3L

Absolute Maximum Ratings (TC=25℃unless otherwise noted)

Symbol	Parameter	Rating	Units
V_{CES}	Collector-Emitter Voltage	600	V
V_{GES}	Gate- Emitter Voltage	±30	V
I_C	Collector Current	80	A
	Collector Current @T_C = 100 °C	40	A
I_{Cplus}	Pulsed Collector Current，t_p limited by T_{jmax}	160	A
-	turn off safe operating area，VCE=600V，Tj=150℃	160	A
I_C	Pulsed Collector Current	160	A
I_F	Diode Continuous Forward Current @T_C = 100 °C	40	A
I_{FM}	Diode Maximum Forward Current	150	A
P_D	Power Dissipation @ T_C = 25°C	306	W
	Power Dissipation @T_C = 100 °C	122	W
T_J,T_{stg}	Operating Junction and Storage Temperature Range	-55 to +150	℃
T_L	Maximum Temperature for Soldering	260	℃
t_{sc}	Short circuit withstand time V_{GE}=15.0V, V_{CC}≤400V, Allowed number of short circuits<1000Time between short circuits:≥1.0s,T_{vj}≤150℃	10	us

Thermal Characteristic

Symbol	Parameter	Typ.	Max.	Units
$R_{\theta JC}$	Thermal Resistance, Junction to case for IGBT	--	0.41	℃/W
$R_{\theta JC}$	Thermal Resistance, Junction to case for Diode	--	1.45	℃/W
$R_{\theta JA}$	Thermal Resistance, Junction to Ambient	--	40	℃/W

Electrical Characteristics (T_C=25℃unless otherwise noted)

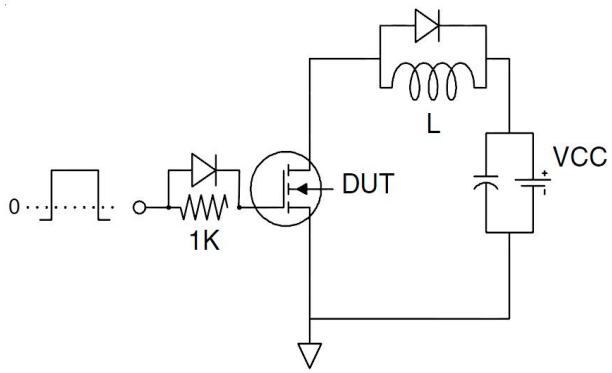
Symbol	Parameter	Test Conditions	Rating			Units
			Min.	Typ.	Max.	
OFF Characteristics						
$V_{(BR)CES}$	Collector-EmitterBreakdown Voltage	V_{GE}=0V,I_{CE}=1mA	600	--	--	V
I_{CES}	Collector-Emitter Leakage Current	V_{GE} =0V,V_{CE}=600V	--	--	4	uA
$I_{GES(F)}$	Gate to Emitter Forward Leakage	V_{GE}=+30V,V_{CE}=0V	--	--	100	nA
$I_{GES(R)}$	Gate to Source Reverse Leakage	V_{GE}=-30V,V_{CE} =0V	--	--	100	nA
ON Characteristics						
$V_{CE(sat)}$	Collector-Emitter Saturation Voltage	I_C=40A,V_{GE}=15V	--	1.7	1.9	V
$V_{GE(th)}$	Gate Threshold Voltage	I_C=1mA,V_{CE}=V_{GE}	4.0	5.0	6.0	V
Dynamic Characteristics						
C_{ies}	Input Capacitance	V_{CE}=25V,V_{GE}=0V, f=1MHz	--	1900	--	pF
C_{oes}	Output Capacitance		--	151	--	
C_{res}	Reverse Transfer Capacitance		--	90	--	
Q_{Gate}	Gate charge	V_{CC}=480V, I_C=40A V_{GE}=15V	--	195	--	nC
$I_{C(SC)}$	Short circuit collector current Max.1000 short circuits Time between short circuits: ≥1.0s	V_{GE}=15V,V_{CC}≤400V, t_{SC}≤10us,Tj≤150℃	--	190	--	A
Switching Characteristics						
$t_{d(ON)}$	Turn-on Delay Time	V_{CE}=400V,I_C=40A V_{GE}=0/15V, R_g=8Ω Inductive Load	--	21	--	ns
t_r	Rise Time		--	34	--	
$t_{d(OFF)}$	Turn-Off Delay Time		--	203	--	
t_f	Fall Time		--	23	--	
E_{on}	Turn-On Switching Loss		--	1.12	--	mJ
E_{off}	Turn-Off Switching Loss		--	0.61	--	
E_{ts}	Total Switching Loss		--	1.73	--	

Electrical Characteristics of the Diode（T_C= 25℃ unless otherwise specified）：

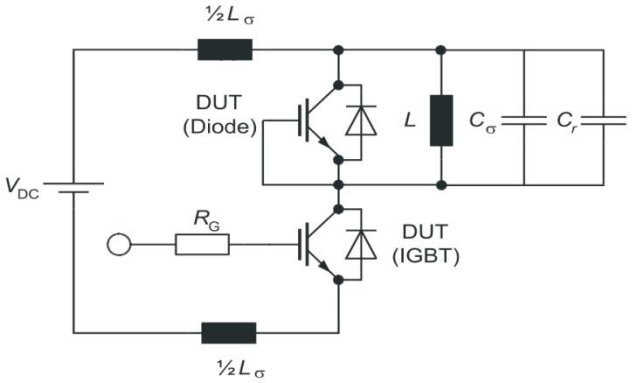
Symbol	Parameter	Test Conditions	Rating			Units
			Min.	Typ.	Max.	
V_{FM}	Diode Forward Voltage	I_F=20A	--	1.6	2.0	V
T_{rr}	Reverse Recovery Time	V_{ce}=400V, I_F=20A, di/dt=1000A/uS	--	151	--	ns
I_{RRM}	Diode Peak Reverse Recovery Current		--	15.5	--	A
Q_{rr}	Reverse Recovery Charge		--	1.23	--	uC
Pulse width t_{tp}≤380μs,δ≤2%						

Test Circuit

1) Gate Charge Test Circuit

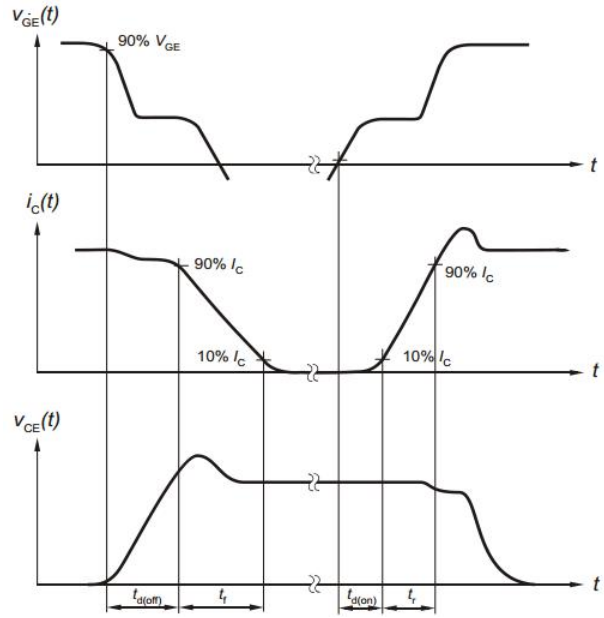


2) Switch Time Test Circuit

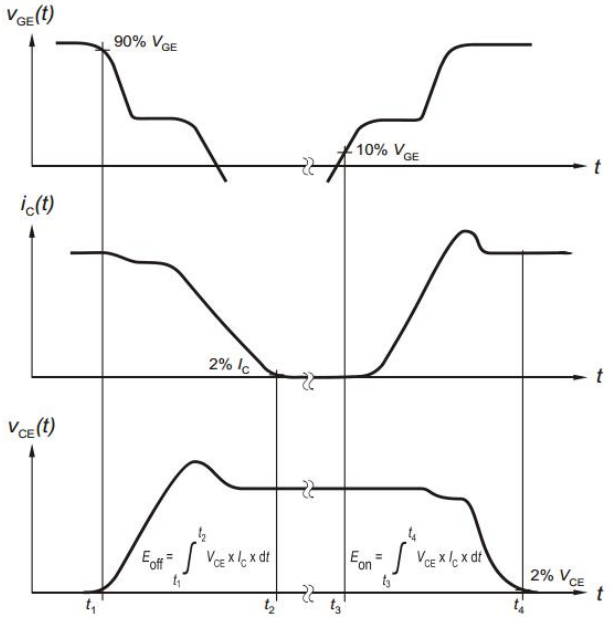


Switching characteristics

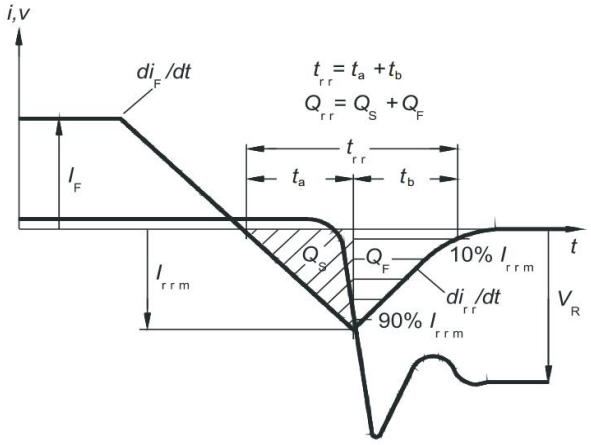
1) definition of switching times



2) definition of switching losses



3) Definition of diode switching characteristics



Typical Electrical and Thermal Characteristics

Figure 1 Output Characteristics

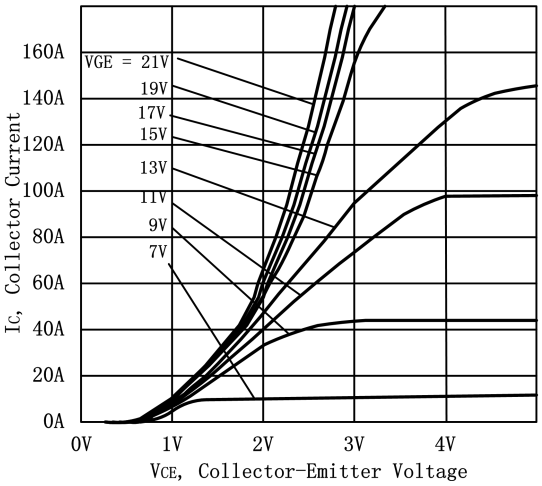


Figure 2. Transfer Characteristics

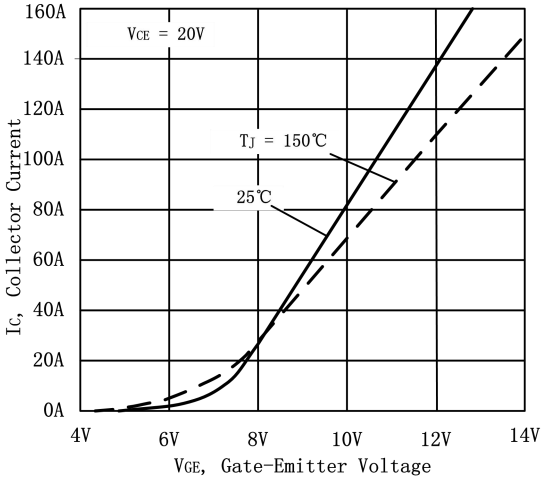


Figure 3 V_{CEsat} vs. Case Temperature

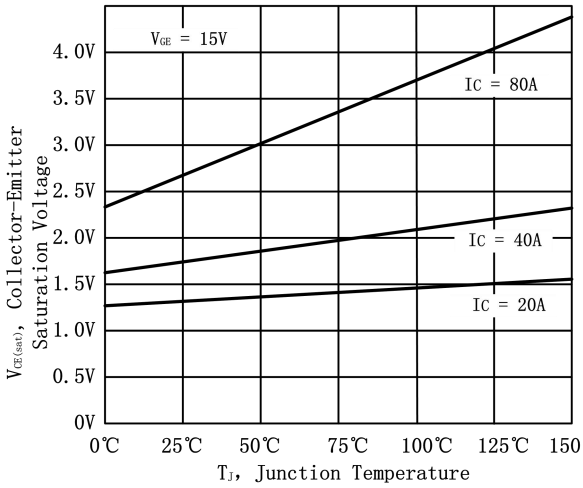


Figure 4 Saturation Voltage vs. VGE

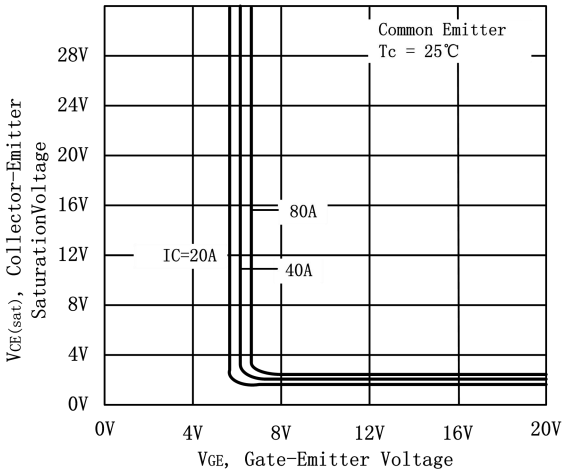


Figure 5 Capacitance Characteristics

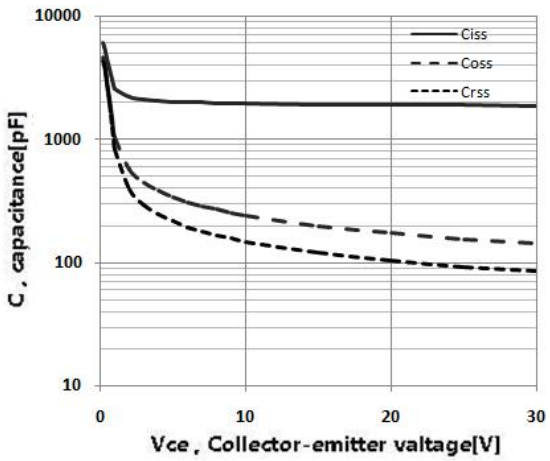
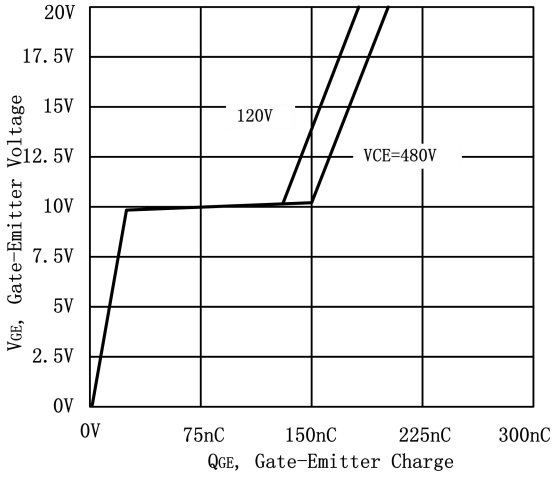


Figure 6 Gate charge waveform



Typical Electrical and Thermal Characteristics（continued）

Figure 7. Forward Characteristics

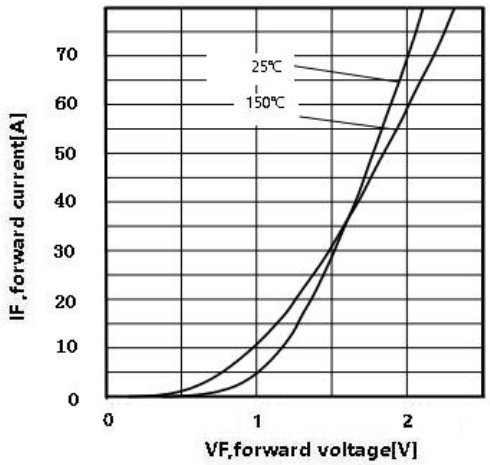


Figure 8 V_F vs. temperature

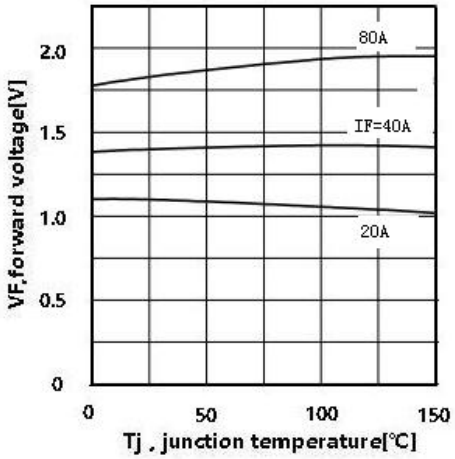
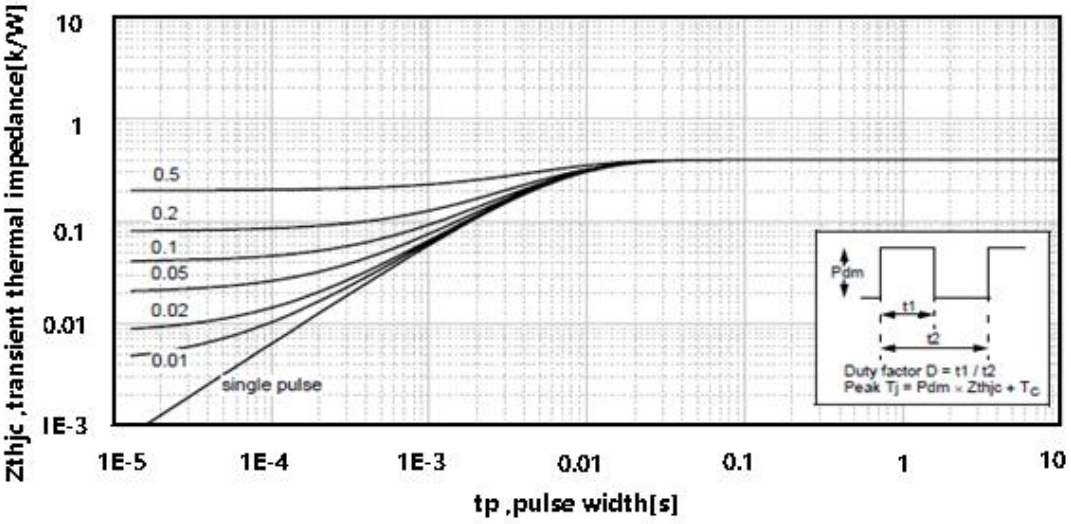
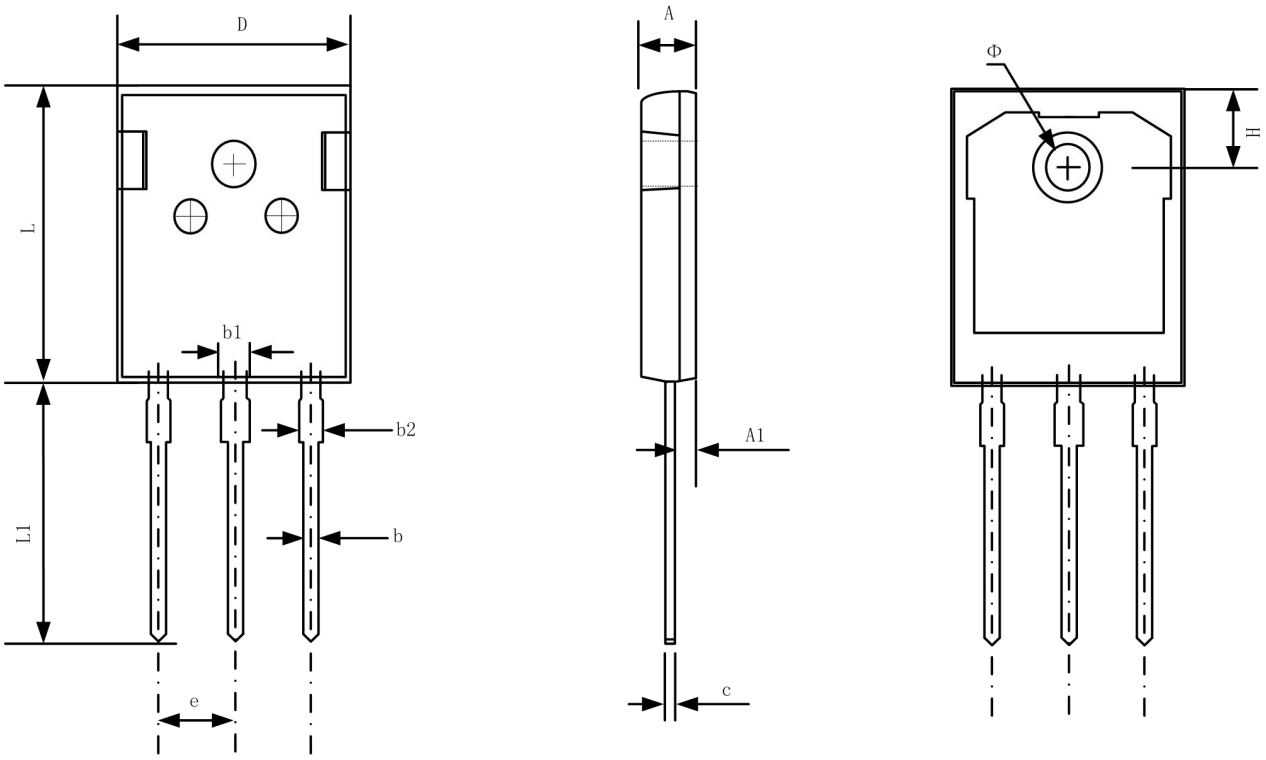


Figure 9. Transient Thermal Impedance of IGBT



TO-247-3L Package Information



Symbol	Dimensions In Millimeters		Dimensions In Inches	
	Min.	Max.	Min.	Max.
A	4.800	5.200	0.189	0.205
A1	2.210	2.610	0.087	0.103
b	1.700	1.900	0.067	0.075
b1	2.800	3.200	0.110	0.126
b2	1.800	2.200	0.071	0.087
c	0.500	0.700	0.020	0.028
D	15.600	16.000	0.614	0.630
L	20.800	21.200	0.819	0.835
L1	19.620	20.220	0.772	0.796
Φ	3.450	3.750	0.136	0.148
e	5.440 TYP		0.214 TYP	
H	6.150 REF		0.242 REF	

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