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

- PV power
- Three-level Solar String Inverter
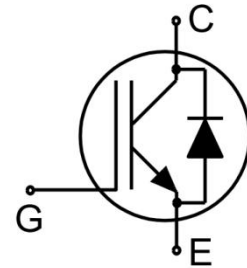
Schematic diagram

Package Marking and Ordering Information

Device	Device Package	Device Marking
NCE40TD120VT	TO-247	NCE40TD120VT

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	80	A
	Collector Current @T_C = 100 °C	40	A
I_{Cpuls}	Pulsed Collector Current，t_p limited by T_{jmax}	120	A
-	turn off safe operating area，V_{CE}=1200V，Tj=150°C	120	A
I_F	Diode Continuous Forward Current @T_C = 100 °C	40	A
I_{FM}	Diode Maximum Forward Current	120	A
P_D	Power Dissipation @ T_C = 25°C	468	W
	Power Dissipation @T_C = 100 °C	234	W
T_J, T_{stg}	Operating Junction and Storage Temperature Range	-55 to +175	°C
T_L	Maximum Temperature for Soldering	260	°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	0.61	°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	Min.	Typ.	Max.	Units
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=40A V_{GE}=15V, Tj=25°C	--	1.85	2.05	V
		Tj=150°C	--	2.05	--	V
$V_{GE(th)}$	Gate Threshold Voltage	I_C=1mA,V_{CE}=V_{GE}	4.5	--	6.5	V
Dynamic Characteristics						
C_{ies}	Input Capacitance	V_{CE}=30V,V_{GE}=0V, f=1MHz	--	5590	--	pF
C_{oes}	Output Capacitance		--	177	--	
C_{res}	Reverse Transfer Capacitance		--	134	--	
Q_g	Total Gate Charge	V_{CC}=960V, I_C=40A, V_{GE}=15V	--	298	--	nC
Q_{ge}	Gate to Emitter Charge		--	52	--	
Q_{gc}	Gate to Collector Charge		--	169	--	
Switching Characteristics						
$t_{d(ON)}$	Turn-on Delay Time	V_{CE}=600V,I_C=40A, 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		--	2.2	--	mJ
E_{off}	Turn-Off Switching Loss		--	1.3	--	
E_{ts}	Total Switching Loss		--	3.5	--	

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

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Units
V_{FM}	Diode Forward Voltage	I_F=40A	--	2.2	3.0	V
T_{rr}	Reverse Recovery Time	I_F=20A, di/dt=500A/us	--	180	--	ns
I_{RRM}	Diode Peak Reverse Recovery Current		--	10	--	A
Q_{rr}	Reverse Recovery Charge		--	2.4	--	uC
Pulse width t_{tp}≤380μs,δ≤2%						

PbFreeProduct

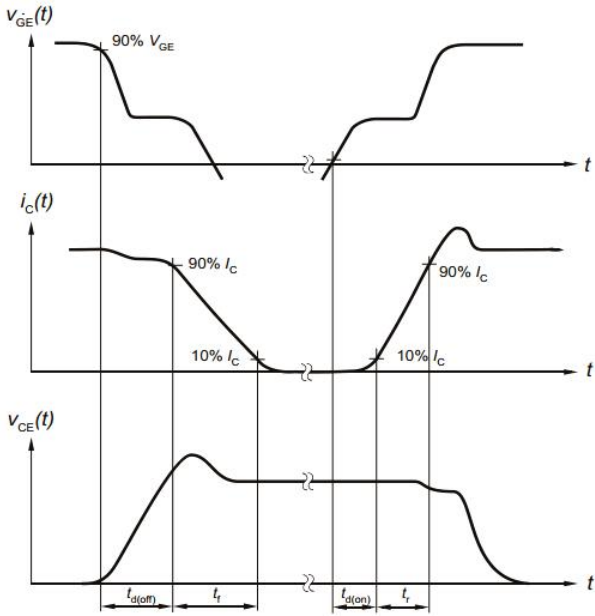## Test Circuit

1) Gate Charge Test Circuit
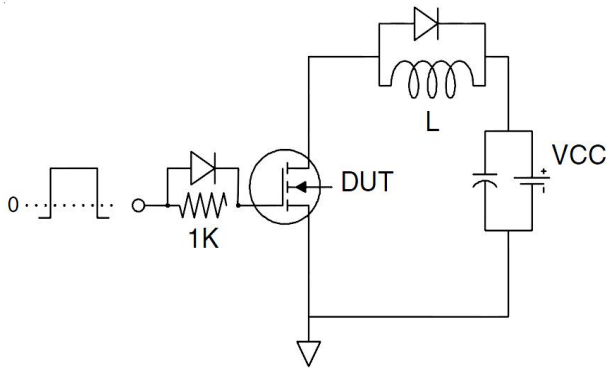
2) Switch Time Test Circuit
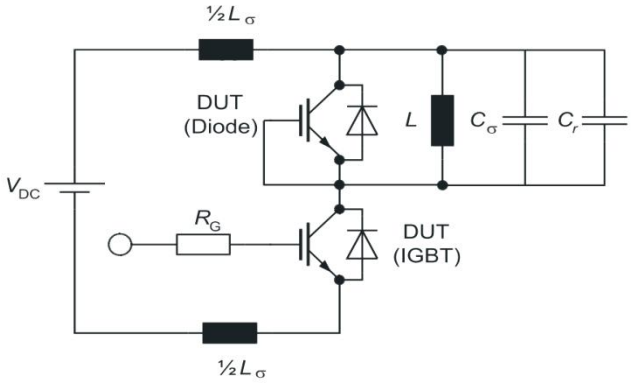
Switching characteristics

1) Definition of switching times

2) Definition of switching losses

$$E_{off} = \int_{t_1}^{t_2} V_{CE} \times I_C \times dt$$

$$E_{on} = \int_{t_3}^{t_4} V_{CE} \times I_C \times dt$$
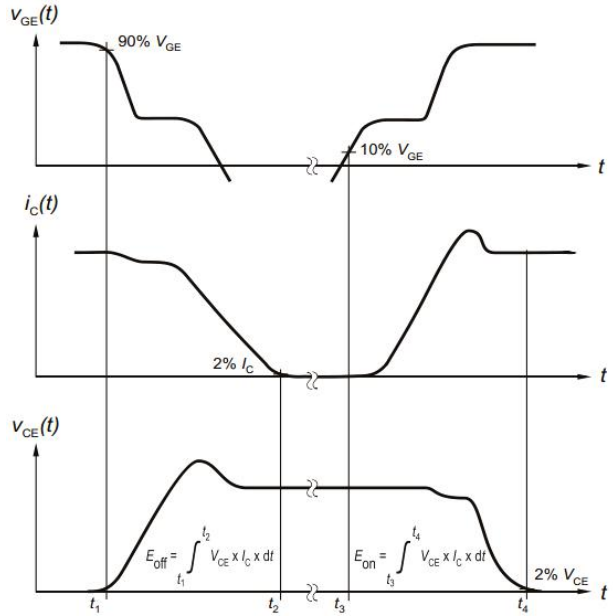
3) Definition of diode switching characteristics

$$t_{rr} = t_a + t_b$$
$$Q_{rr} = Q_S + Q_F$$
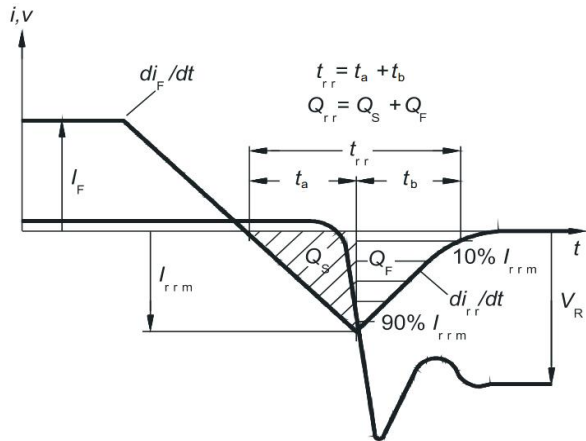
Typical Electrical and Thermal Characteristics

Figure 1 Output Characteristics

V_{GE}=17V
15V
13V
11V
9V
7V

I_C, Collector Current (A)

V_{CE}, Collector-Emitter Voltage (V)
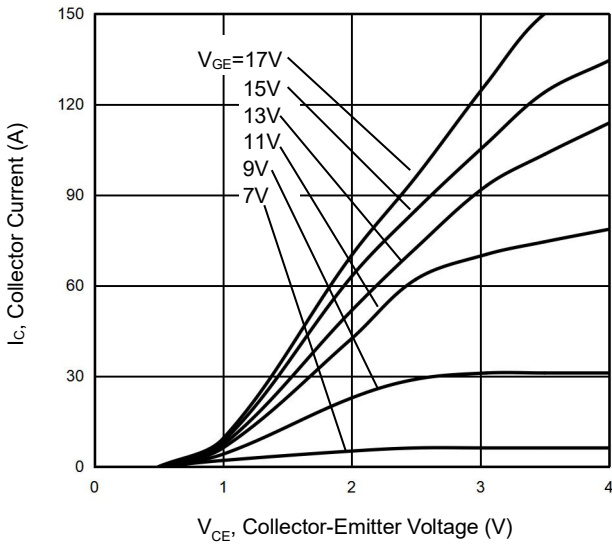
Figure 2 Transfer Characteristics

V_{CE}=20V

25°C

150°C

I_C, Collector Current (A)

V_{GE}, Gate-Emitter Voltage (V)
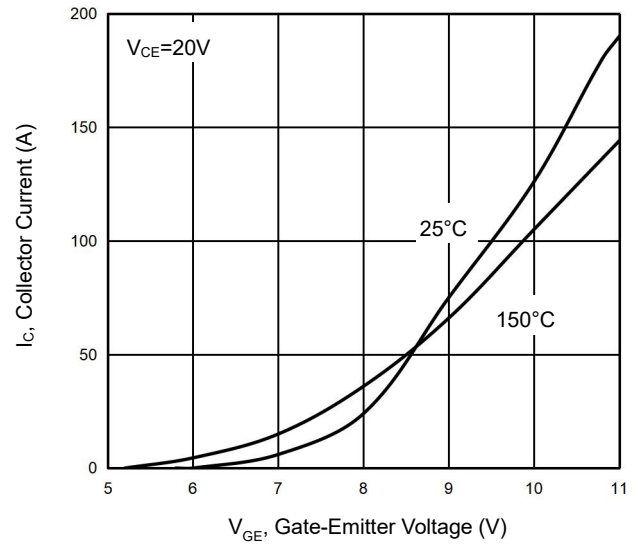
Figure 3 $V_{CE(sat)}$ vs. Case Temperature

V_{GE}=15V

I_C=80A

I_C=40A

I_C=20A

V_{CE}, Collector-Emitter Saturation Voltage (V)

T_J, Junction Temperature (°C)
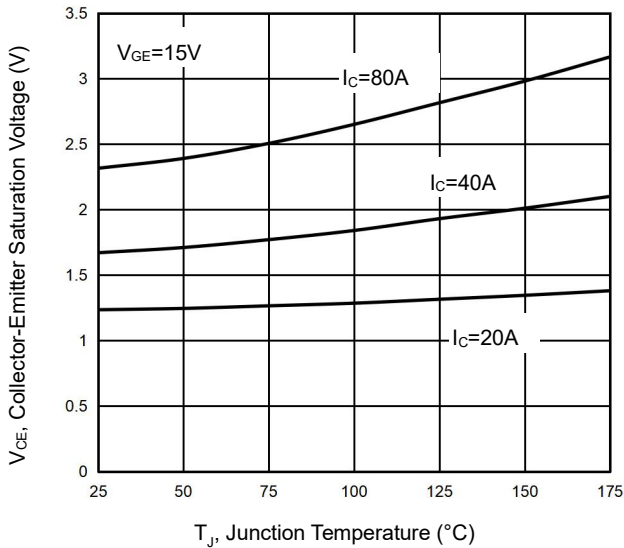
Figure 4 Saturation Voltage vs. V_{GE}

80A

20A

40A

V_{CE}, Collector-Emitter Saturation Voltage (V)

V_{GE}, Gate-Emitter Voltage (V)
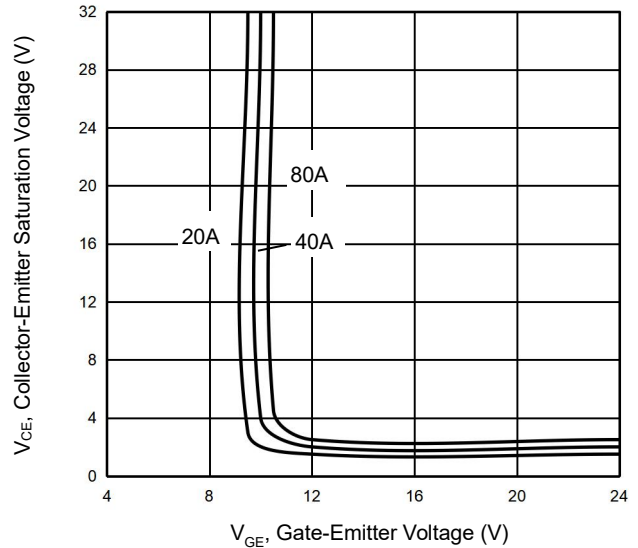
Figure 5 Capacitance Characteristics

C_{ies}

C_{oes}

C_{res}

Capacitance (pF)

V_{CE}, Collector-Emitter Voltage (V)
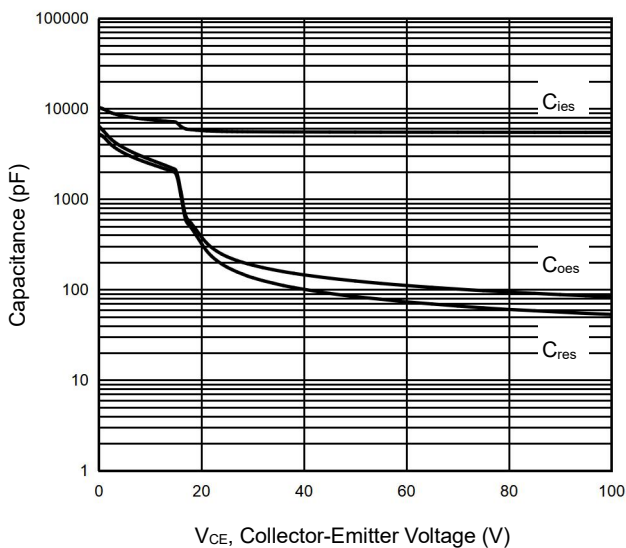
Figure 6 Gate Charge Wave Form

V_{CC}=960V

V_{GE}, Gate-Emitter Voltage (V)

Q_G, Total Gate Charge (nC)
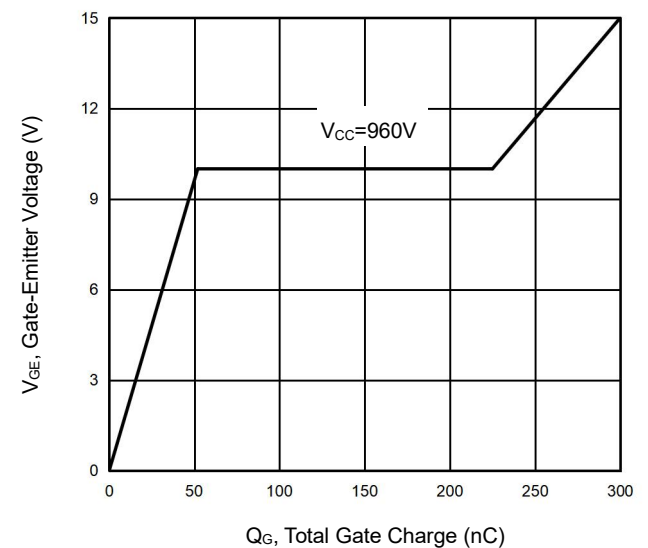
TO-247 Package Information
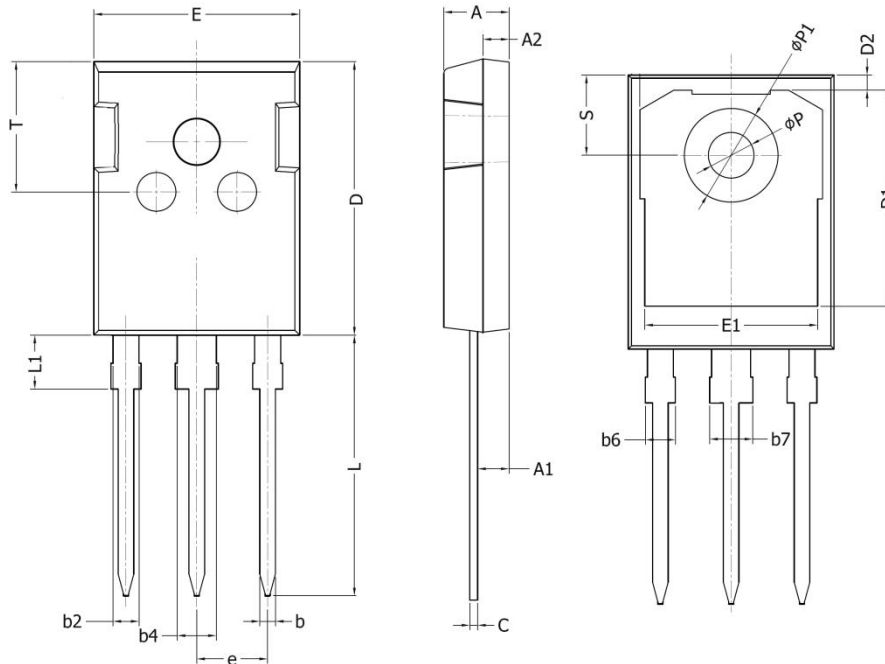
Symbol	Dimensions In Millimeters		Dimensions In Inches	
	Min.	Max.	Min.	Max.
A	4.90	5.10	0.193	0.201
A1	2.31	2.51	0.091	0.099
A2	1.9	2.1	0.075	0.083
b	1.16	1.26	0.046	0.050
b2	1.96	2.06	0.077	0.081
b4	2.96	3.06	0.117	0.120
b6	-	2.25	-	0.089
b7	-	3.25	-	0.128
C	0.59	0.66	0.023	0.026
D	20.90	21.10	0.823	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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