

NBT6N65F



N-Channel Enhancement Type IGBT With FRD

Voltage: 650 Volts

Current: 6 Ampers

Package: TO-220FP

Features

- NH'S Advanced IGBT Technology
- Low Vcesat For Low On-State Loss
- Very Soft Ultra-Fast Recovery Antiparallel Diode
- High Frequency Operation For High Reliability

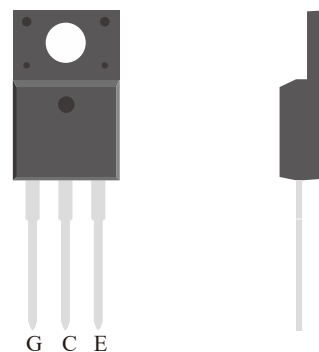
Typical Applications

- Power Factor Correction(PFC)
- Motor Drives
- Uninterruptible Power Supplies(UPS)
- High Frequency Inverters

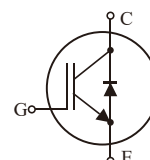
Product Summary

V _{CES} Min.@T _j	650	V
I _C Min.@100℃	6.0	A
V _{CE(sat)} @25℃	1.8	V

Diagram:



Polarity:



Absolute Maximum Ratings (Ta=25℃ Unless Otherwise Specified)

Parameter	Test Conditions	Symbol	Ratings	Unit
Collector-Emitter Voltage (V _{GS} =0)		V _{CES}	650	V
Gate-Emitter Voltage		V _{GES}	±22	V
Continuous Collector Current (Note 1)	Ta= 25 ℃ Ta= 100 ℃	I _C	12.0 6.0	A
Drain Current-Pulse (Note 1)	T _j < 150 ℃	I _{CM}	18	A
Maximum Power Dissipation Power	Ta= 25 ℃	P _D	25	W
Dissipation Derating Factor Above 25℃	Ta= 100 ℃		10	
Derating Factor		D _F	0.20	W/℃
Avalanche Current,Single Pulse (Note 1)	L= 10.0 mH	I _{AS}	10.8	A
Single Pulse Avalanche Energy (Note 1) Test Circuit & Waveform See Fig.23	L= 10.0 mH IAS= 10.8 A,RG= 10.0 Ω Starting T _j =25 ℃,VG= 15.0 V	E _{AS}	587	mJ

Thermal Characteristics (Ta=25℃ Unless Otherwise Specified)

Parameter	Test Conditions	Symbol	Typ.	Unit
Junction Temperature		T _J	-55 to 150	℃
Storage Temperature Range		T _{STD}	-55 to 150	℃
Thermal Resistance Junction To Ambient With Steady-State	Still Air Environment With Ta=25℃	R _{θJA}	62.5	℃/W
Thermal Resistance Junction-Case With Steady-State	Device Mounted On 75mm x 45mm x 2.5mm Alu. Heat.	R _{θJC}	5	

Notes: 1.Pulse Width Limited By Max. Junction Temperature. (See Fig. 20).

NBT6N65F

N-Channel Enhancement Type IGBT With FRD
Electrical Characteristics (Ta=25°C Unless Otherwise Specified)

Parameter	Test Conditions		Symbol	Min.	Typ.	Max.	Unit
Static Off Characteristics							
Collector To Emitter Voltage	VGE=0V, IC=1mA		BV _{CES}	650	--	--	V
Collector To Emitter Leakage Current	VCE= 650 V, VGE=0V, Tj=25°C		I _{CES}	--	0.1	10	uA
	VCE= 650 V, VGE=0V, Tj=125°C			--	0.2	1	mA
Gate To Emitter Leakage Current	VGE= 20 V, VCE=0V		I _{GES}	--	--	250	nA
Emitter To Gate Leakage Current	VGE= -20 V, VCE=0V		I _{EGS}	--	--	250	nA
Forward Transconductance	IC= 3.0 A, VCE= 15 V		g _{fs}	--	3	--	S
Static On Characteristics							
Gate Threshold Voltage	VGE= VCE, IC=250uA		V _{GE(TH)}	4.5	5.5	6.5	V
Collector-Emitter Saturation Voltage	IC= 3.0 A, VGE= 15.0 V, Tj=25°C		V _{CE(SAT)}	--	1.80	2.25	V
	IC= 3.0 A, VGE= 15.0 V, Tj=125°C			--	1.6	2.1	
Dynamic Characteristics							
Input Capacitance	VCE= 25 V		C _{ies}	--	260	--	pF
Output Capacitance	VGE= 0 V		C _{oes}	--	30	--	pF
Reverse Transfer Capacitance	F= 1 MHZ		C _{res}	--	9	--	pF
Switching Paramters (Test Circuit & Waveform See Fig.21)							
Turn-On Delay Time	VCE= 390 V	Tj=25°C	t _{d(on)}	--	22	--	ns
	IC= 3 A	Tj=150°C		--	24.2	--	
Turn-On Rise Time	VGE= 15.0 V	Tj=25°C	t _r	--	24	--	ns
	RG= 10 Ω	Tj=150°C		--	26.4	--	
Turn-Off Delay Time	Inductive Load	Tj=25°C	t _{d(off)}	--	84	--	ns
		Tj=150°C		--	109.2	--	
Tj=25°C		t _f	--	67	--	ns	
Tj=150°C			--	83.8	--		
Turn-On Switching Loss		Tj=25°C	E _{on}	--	14.0	--	μJ
		Tj=150°C		--	15.4	--	
Turn-Off Switching Loss		Tj=25°C	E _{off}	--	39.2	--	μJ
		Tj=150°C		--	49.0	--	
Total Switching Energy	Tj=25°C	E _{tot}	--	53.2	--	μJ	
	Tj=150°C		--	64.4	--		

NBT6N65F



N-Channel Enhancement Type IGBT With FRD

Electrical Characteristics (Ta=25°C Unless Otherwise Specified)

Parameter	Test Conditions		Symbol	Min.	Typ.	Max.	Unit
Gate Charge Paramters (Test Circuit & Waveform See Fig.22)							
Total Gate Charge	VCE= 390 V		Q _g	--	9	--	nC
Gate-Emitter Charge	VGE= 15 V		Q _{ge}	--	3.5	--	nC
Gate-Collector Charge	IC= 3.0 A		Q _{gc}	--	1.2	--	nC
Collector-Emitter Diode Characteristics And Maximum Ratings (Test Circuit & Waveform See Fig.24)							
Max. Diode Forward Cuurent	Tj= 25 °C		I _F	--	--	12.0	A
tp Limited by Tj(max)	Tj= 100 °C			--	--	6.0	
Max. Pulsed Forward Cuurent			I _{SM}	--	--	18	A
Diode Forward Voltage	IF= 6.0 A,VGE=-0V		V _F	--	1.45	1.95	V
Reverse Recovery Time	IF= 3.0 A di/dt= 100 A/us	Tj=25°C	t _{rr}	--	21	--	ns
		Tj=175°C		--	23.7	--	
Reverse Recovery Charge	VGE= 0.0 V VCE= 40 V	Tj=25°C	Q _{rr}	--	14	--	nC
		Tj=175°C		--	16.1	--	
Reverse Recovery Current		Tj=25°C	I _{rrm}	--	1.0	--	A
		Tj=175°C		--	1.4	--	
Reverse Recovery Energy		Tj=25°C	E _{rr}	--	0.4	--	μJ
		Tj=175°C		--	0.7	--	

NBT6N65F



N-Channel Enhancement Type IGBT With FRD

Typical Characteristics Curves

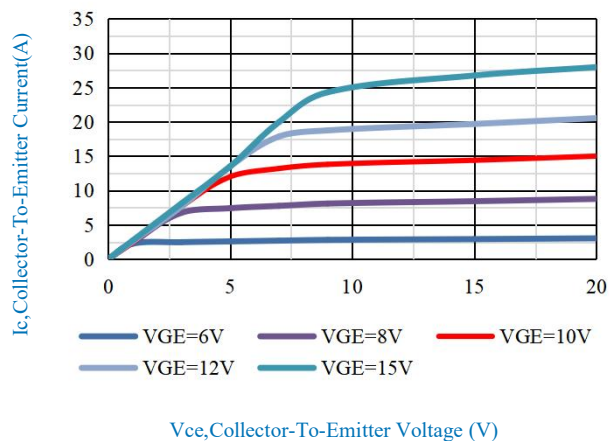


Fig.1-Output Characteristics@ $T_j=25^\circ\text{C}$

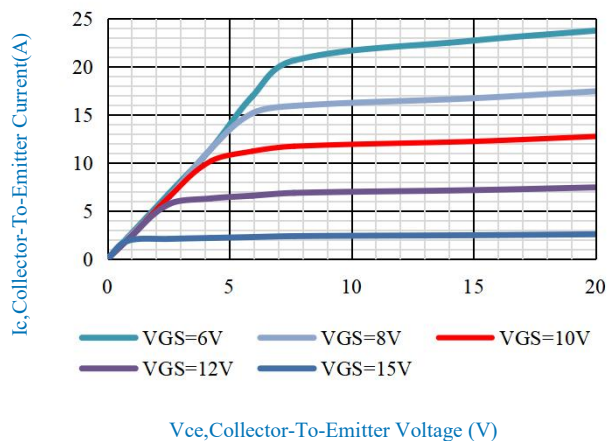


Fig.2-Output Characteristics@ $T_j=150^\circ\text{C}$

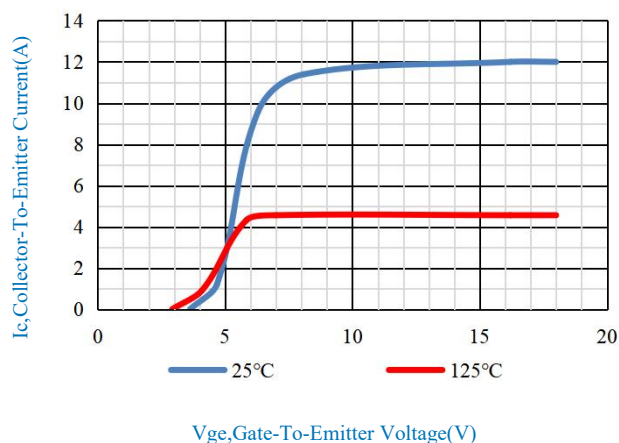


Fig.3-Transfer Characteristics

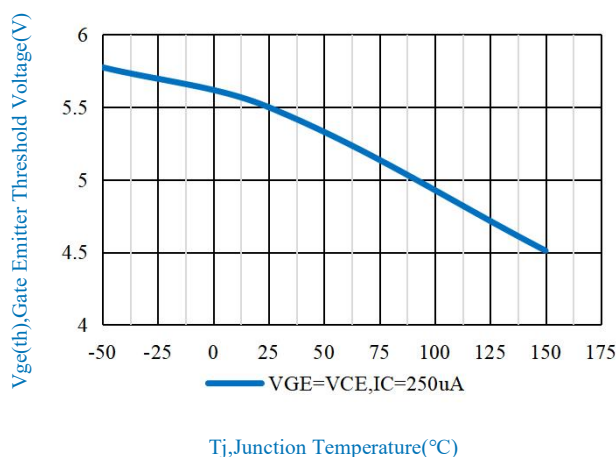


Fig.4-Gate Emitter Threshold Voltage Vs. Junction Temperature

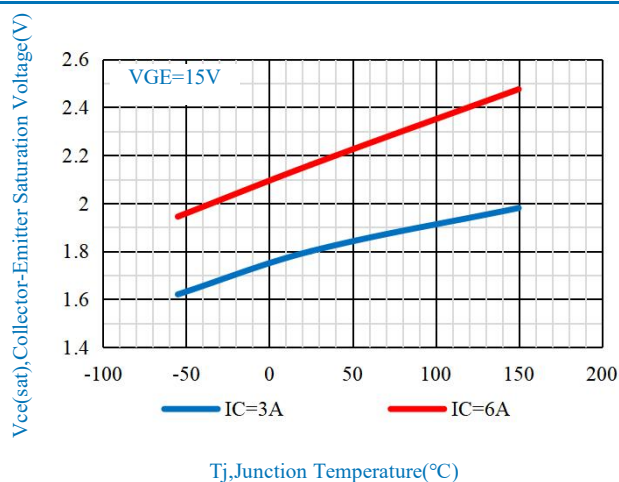


Fig.5-Saturation Voltage vs. Junction Temperature

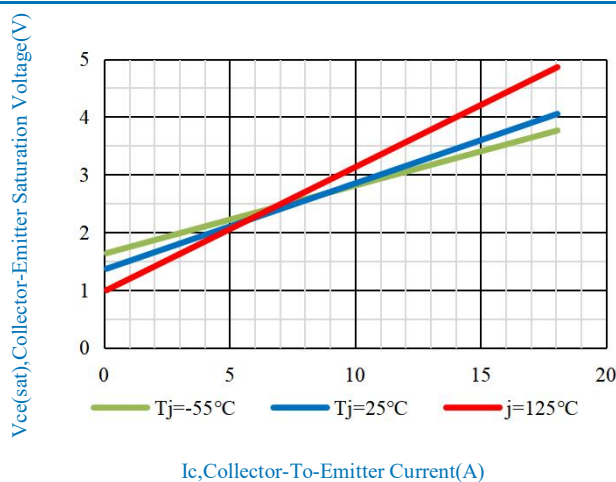


Fig.6-Saturation Voltage vs. Collector-To-Emitter Current

N-Channel Enhancement Type IGBT With FRD

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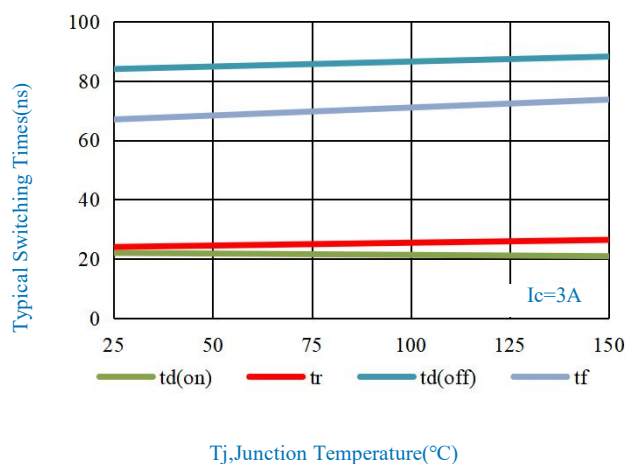


Fig.7-Typical Switching Times Vs. Junction Temperature

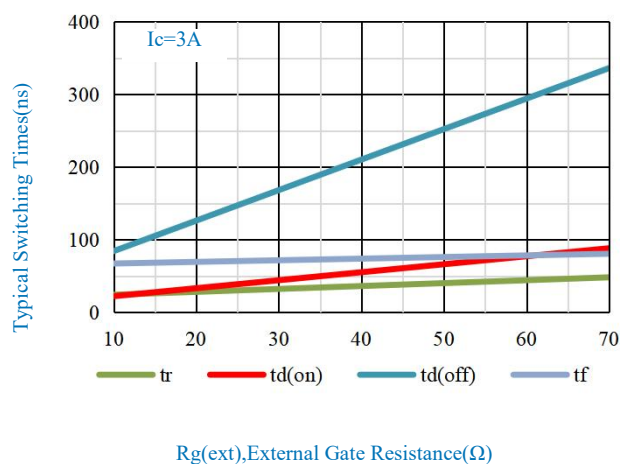


Fig.8-Typical Switching Times Vs. External Gate Resistance

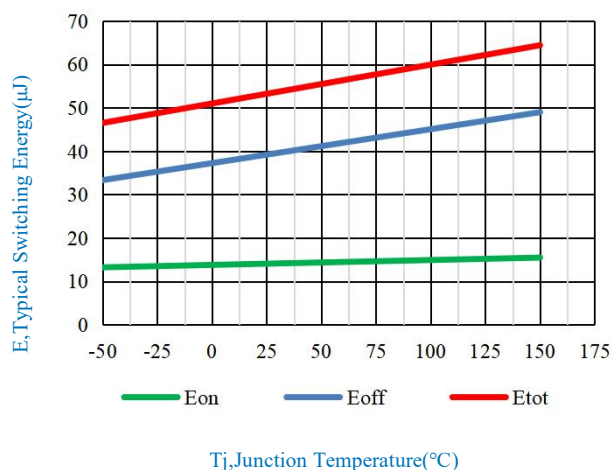


Fig.9-Typical Switching Energy Vs. Junction Temperature

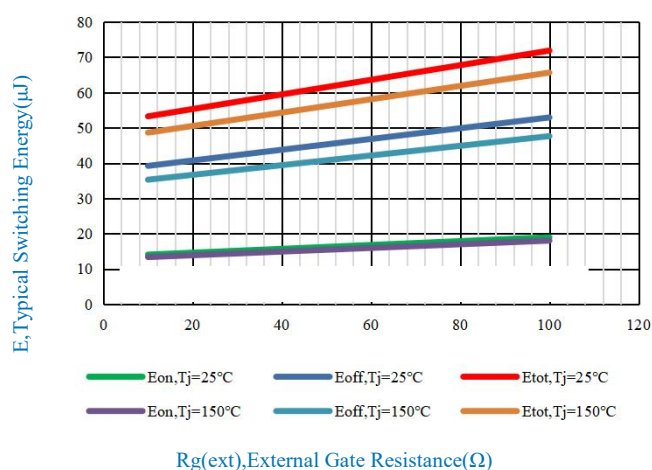


Fig.10-Typical Switching Energy Vs. External Gate Resistance

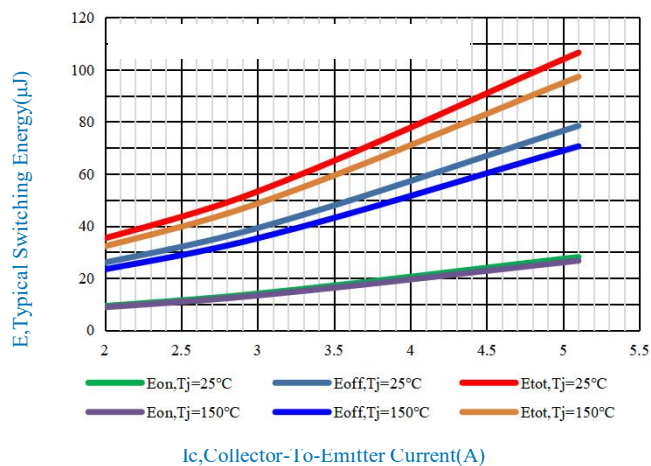


Fig.11-Typical Switching Energy Vs. Collector-To-Emitter Current

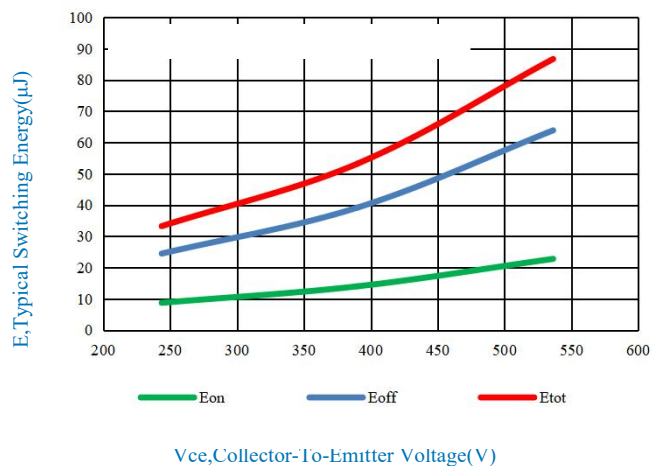


Fig.12-Typical Switching Energy Vs. Collector-To-Emitter Voltage

NBT6N65F



N-Channel Enhancement Type IGBT With FRD

Typical Characteristics Curves

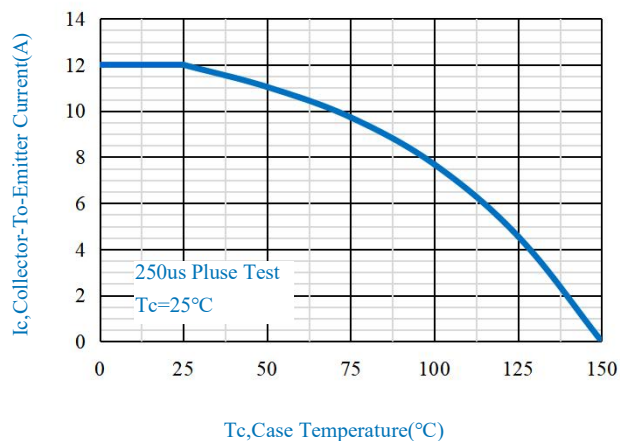


Fig.13-Maximum Continuous Collector Current Vs. Case Temperature

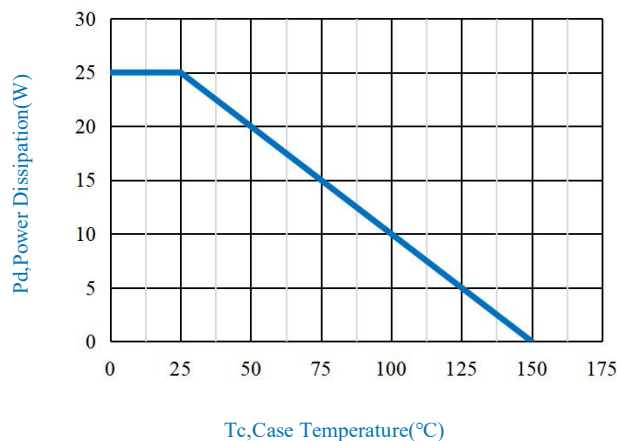


Fig.14-Maximum Power Dissipation Vs. Case Temperature

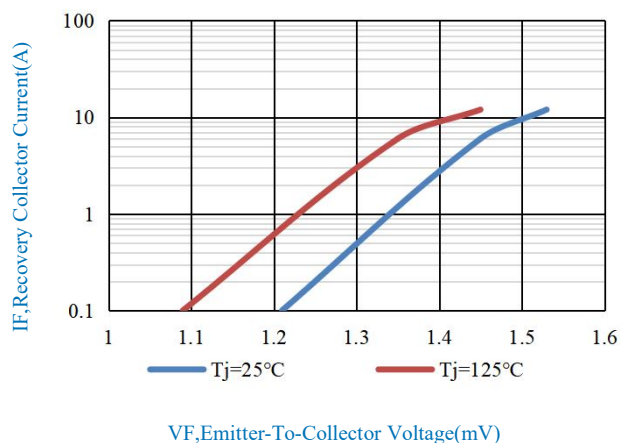


Fig.15-Emitter-To-Collector Diode Forward Voltage

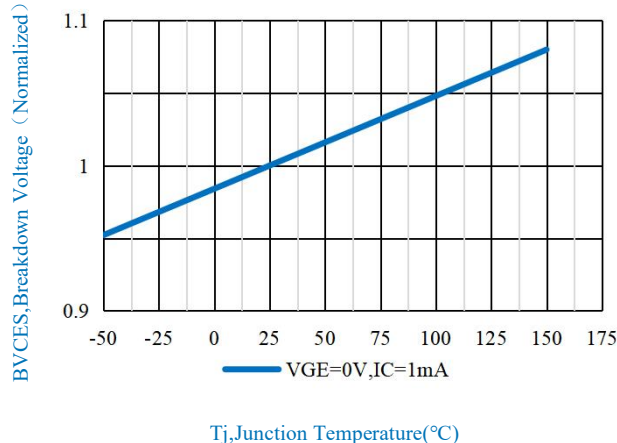


Fig.16-Breakdown Voltage Vs. Junction Temperature

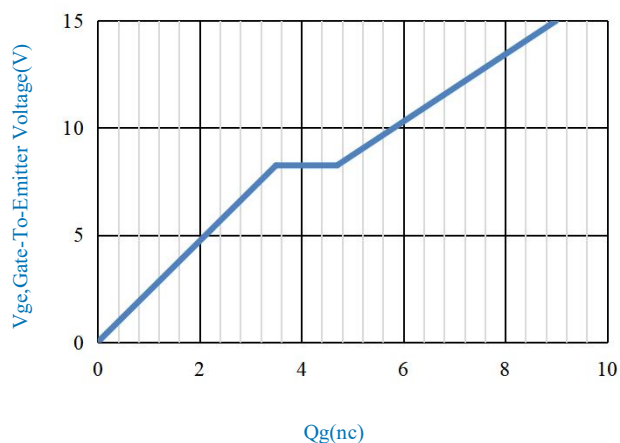


Fig.17-Gate Charge Waveform

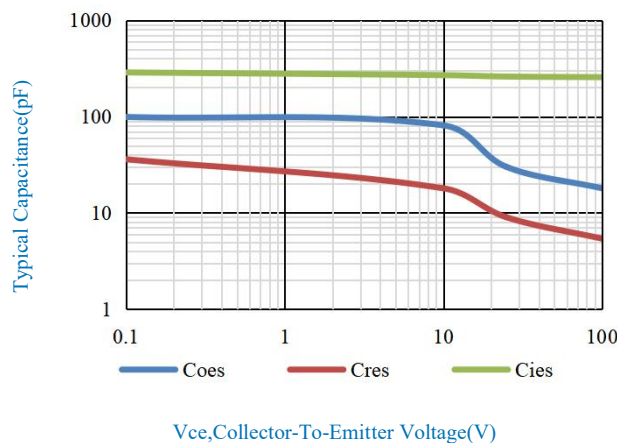


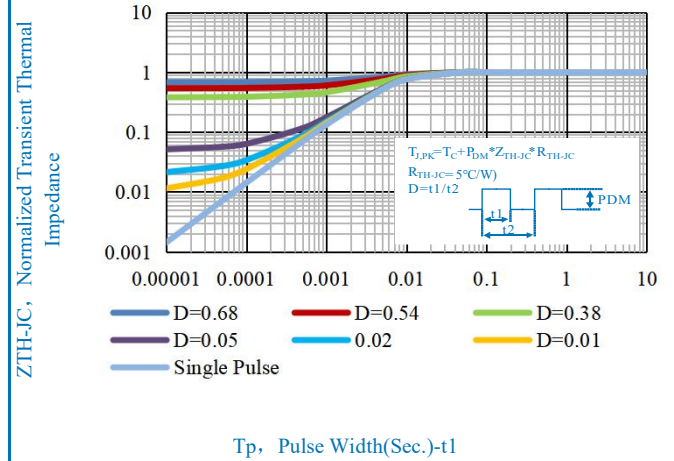
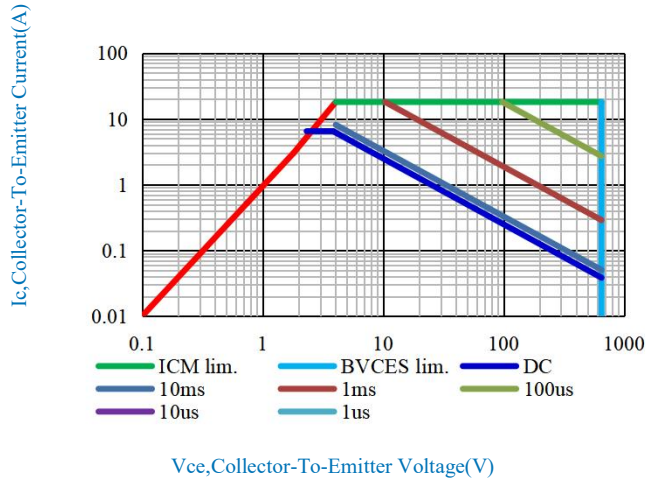
Fig.18-Typical Capacitance Vs. Collector-To-Emitter Voltage

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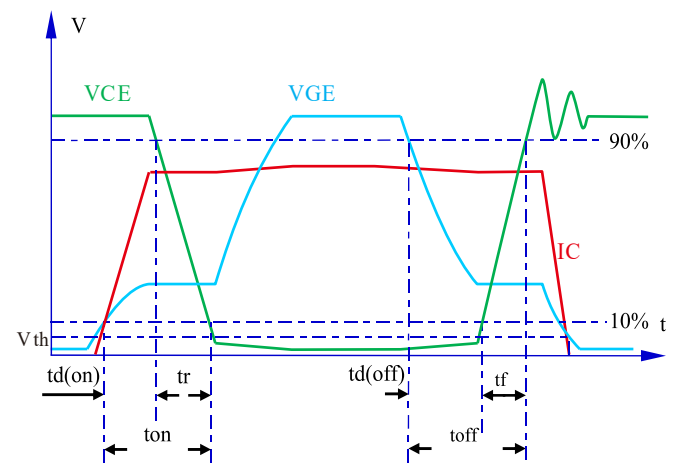
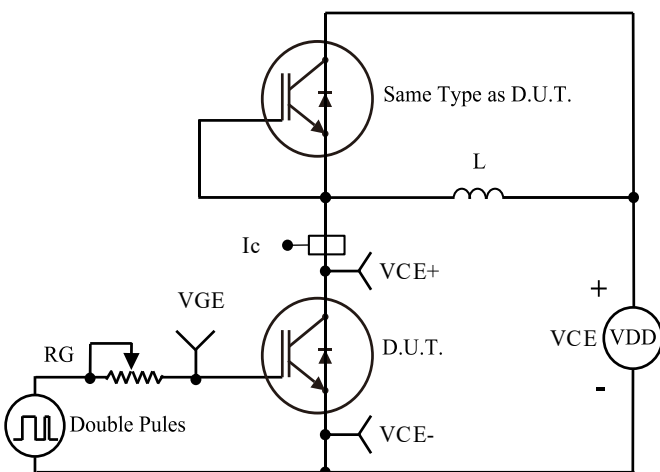


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Typical Characteristics Curves



Test Circuit & Waveform



NBT6N65F



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Test Circuit & Waveform

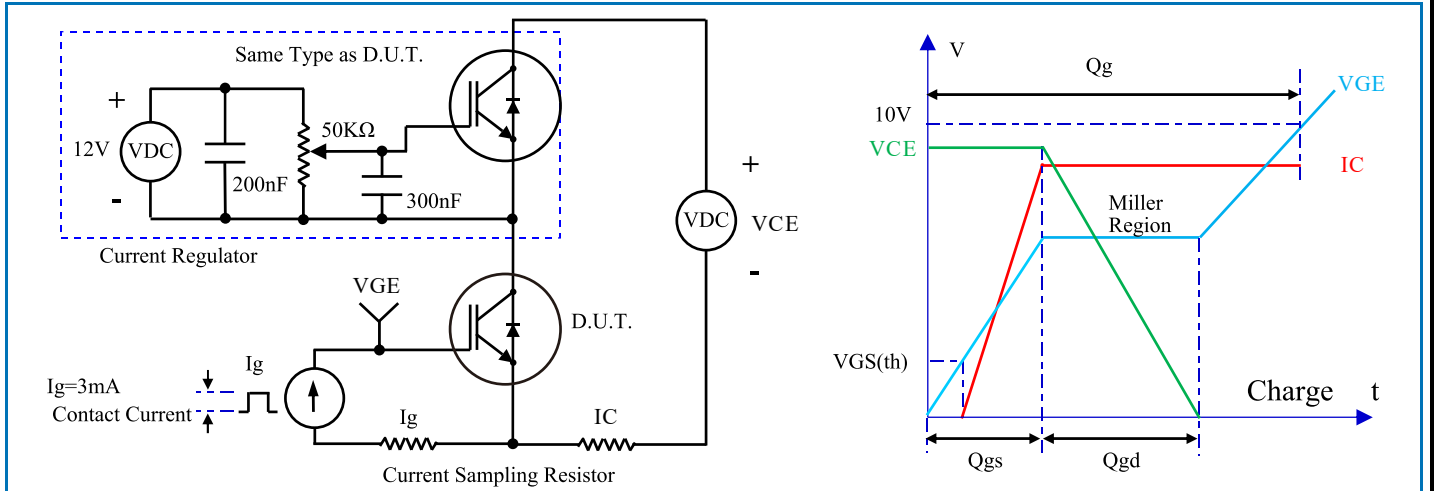


Fig.22- Gate Charge Test Circuit & Waveform

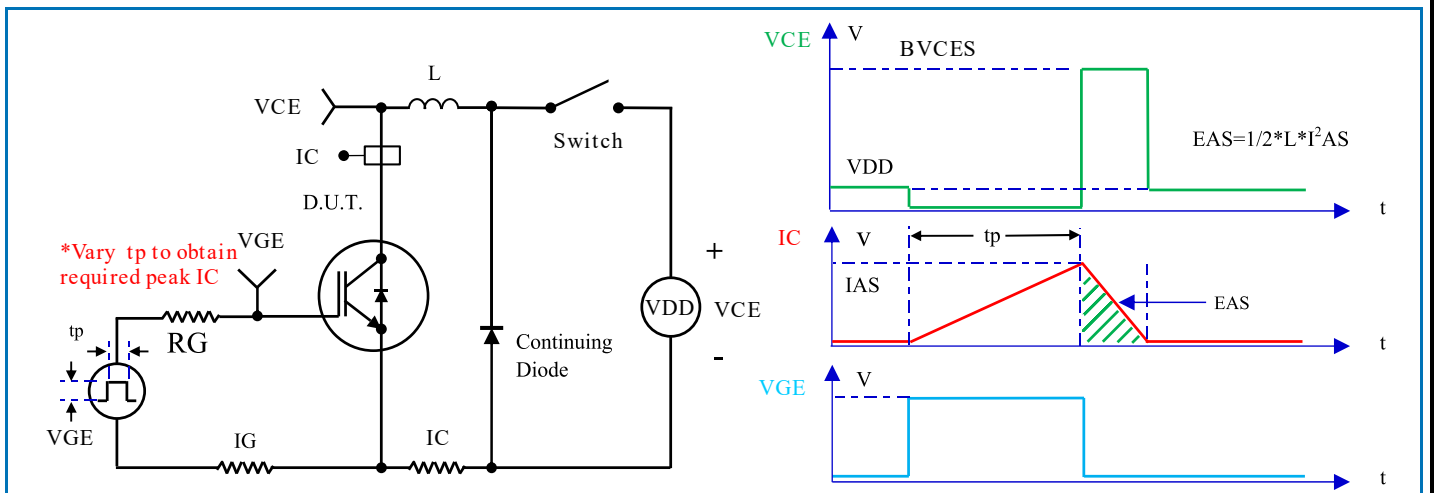


Fig.23- Unclamped Inductive Switching (UIS) Test Circuit & Waveform

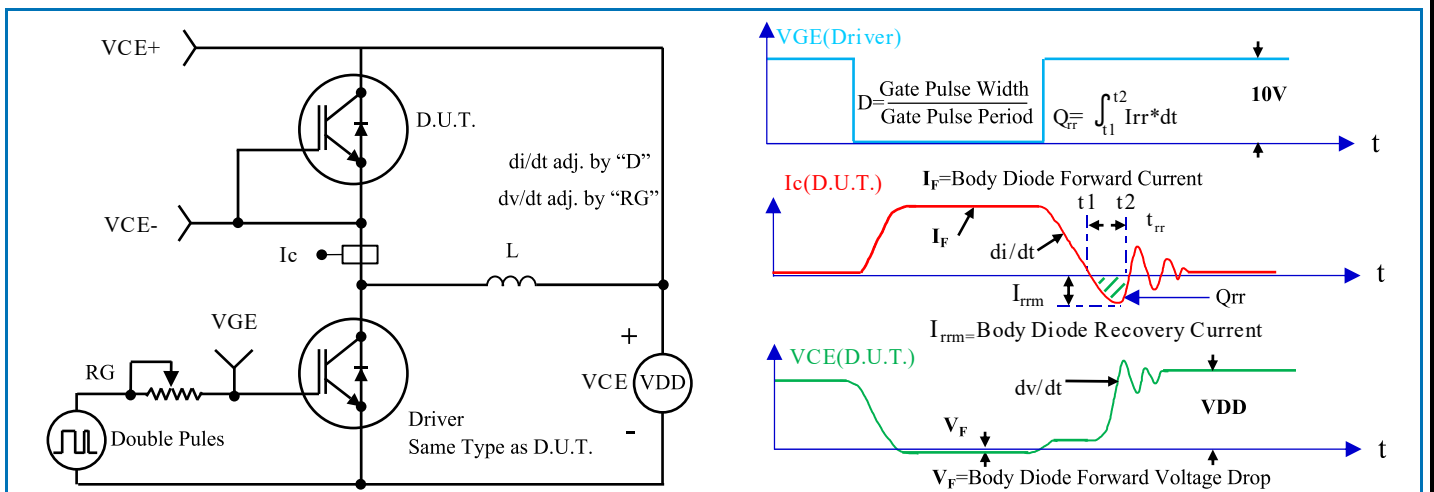


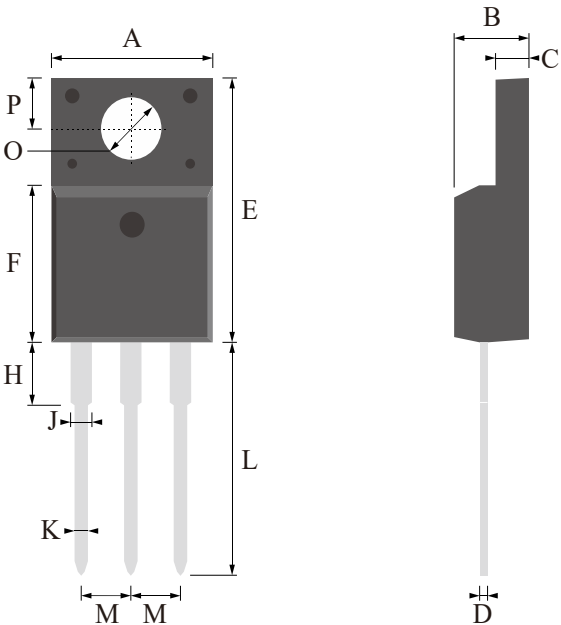
Fig.24- Diode Recovery Test Circuit & Waveform

NBT6N65F

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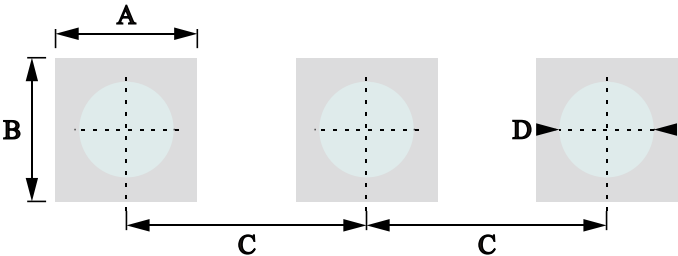
OUTLINE DRAWINGS



TO-220FP

OUTLINE DIMENSIONS						
Dim.	Milimeters			Inches		
	Min.	Typ.	Max.	Min.	Typ.	Max.
A	9.25	-	10.75	0.3642	-	0.4232
B	4.20	-	5.20	0.1654	-	0.2047
C	2.30	-	2.90	0.0906	-	0.1142
D	0.35	-	0.75	0.0138	-	0.0295
E	14.80	-	16.80	0.5827	-	0.6614
F	8.25	-	9.75	0.3248	-	0.3839
L	12.15	-	14.15	0.4783	-	0.5571
H	2.60	-	3.30	0.1024	-	0.1299
J	1.10	-	1.60	0.0433	-	0.0630
K	0.60	-	1.00	0.0236	-	0.0394
M	2.20	-	3.00	0.0866	-	0.1181
O	2.70	-	3.50	0.1063	-	0.1378
P	3.20	-	3.80	0.1260	-	0.1496

RECOMMEDND LAYOUT DRAWINGS



TO-220FP

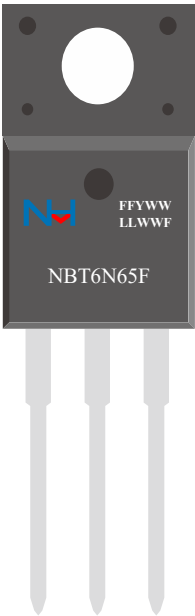
OUTLINE DIMENSIONS						
Dim.	Milimeters			Inches		
	Min.	Typ.	Max.	Min.	Typ.	Max.
A	-	1.60	-	-	0.0630	-
B	-	1.60	-	-	0.0630	-
C	-	2.54	-	-	0.1000	-
D	-	1.00	-	-	0.0394	-

NBT6N65F

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MARKING INFORMATION



MARKING INSTRUCTIONS

NH=Niuhang Trademark
FF=Product Line Code,According To Actual Changes
YWW=Date Code,According To Actual Changes
LLWWF=Inernal Code,According To Actual Changes
NBT6N65F=Model

PACKING INFORMATION

Package Type	Package Code	Product Weight Approx(g/Pcs)	Package Method	Quantity (Pcs/Min. Pack.)	Quantity (Pcs/Inner Box)	Quantity (Pcs/Carton)
TO-220FP	P1	2.048	Tube	50	1000	5000

NBT6N65F



N-Channel Enhancement Type IGBT With FRD

Recommended wave soldering condition

Product	Peak Temperature	Soldering Time
Pb-free devices	260 +0/-5 °C	5 +1/-1 seconds

Recommended temperature profile for IR reflow

	Profile feature	Sn-Pb eutectic Assembly	Pb-free Assembly
	Average ramp-up rate (TSmax to TP)	3°C/second max.	3°C/second max.
	Preheat-Temperature Min (TS min) -Temperature Max (TS max) -Time(ts min to ts max)	100°C 150°C 60-120 seconds	150°C 200°C 60-180 seconds
	Time maintained above: -Temperature (TL) - Time (tL)	183°C 60-150 seconds	217°C 60-150 seconds
	Peak Temperature(TP)	240 +0/-5 °C	260 +0/-5 °C
	Time within 5°C of actual peak temperature (tp)	10-30 seconds	20-40 seconds
	Ramp down rate	6°C/second max.	6°C/second max.
	Time 25 °C to peak temperature	6 minutes max.	8 minutes max.

Note : All temperatures refer to topside of the package, measured on the package body surface.

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Specification Revision History

Rev.	Date	Changed Items	Pre-Changed Content	Changed Content
A/1	2025-10-20	First Issue		
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