

NGTG15N60S1EG

IGBT - Short-Circuit Rated

This Insulated Gate Bipolar Transistor (IGBT) features a robust and cost effective Non-Punch Through (NPT) Trench construction, and provides superior performance in demanding switching applications. Offering both low on state voltage and minimal switching loss, the IGBT is well suited for motor drive control and other hard switching applications.

Features

- Low Saturation Voltage Resulting in Low Conduction Loss
- Low Switching Loss in Higher Frequency Applications
- 5 μ s Short Circuit Capability
- Excellent Current versus Package Size Performance Density
- This is a Pb-Free Device

Typical Applications

- White Goods Appliance Motor Control
- General Purpose Inverter
- AC and DC Motor Control

ABSOLUTE MAXIMUM RATINGS

Rating	Symbol	Value	Unit
Collector-emitter voltage	V_{CES}	650	V
Collector current @ $T_c = 25^\circ\text{C}$ @ $T_c = 100^\circ\text{C}$	I_c	30 15	A
Pulsed collector current, T_{pulse} limited by $T_{J\text{max}}$	I_{CM}	120	A
Gate-emitter voltage	V_{GE}	± 20	V
Power dissipation @ $T_c = 25^\circ\text{C}$ @ $T_c = 100^\circ\text{C}$	P_D	117 47	W
Short circuit withstand time $V_{GE} = 15\text{ V}$, $V_{CE} = 400\text{ V}$, $T_J \leq +150^\circ\text{C}$	t_{SC}	5	μs
Operating junction temperature range	T_J	-55 to $+150$	$^\circ\text{C}$
Storage temperature range	T_{stg}	-55 to $+150$	$^\circ\text{C}$
Lead temperature for soldering, 1/8" from case for 5 seconds	T_{SLD}	260	$^\circ\text{C}$

Stresses exceeding those listed in the Maximum Ratings table may damage the device. If any of these limits are exceeded, device functionality should not be assumed, damage may occur and reliability may be affected.

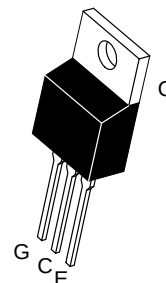
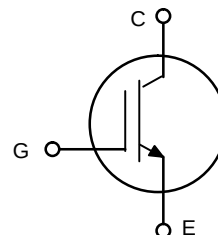


ON Semiconductor®

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15 A, 650 V

$V_{CEsat} = 1.5\text{ V}$



TO-220
CASE 221A
STYLE 9

MARKING DIAGRAM



A = Assembly Location
Y = Year
WW = Work Week
G = Pb-Free Package

ORDERING INFORMATION

Device	Package	Shipping
NGTG15N60S1EG	TO-220 (Pb-Free)	50 Units / Rail

NGTG15N60S1EG

THERMAL CHARACTERISTICS

Rating	Symbol	Value	Unit
Thermal resistance junction to case, for IGBT	$R_{\theta JC}$	1.06	$^{\circ}\text{C/W}$
Thermal resistance junction to ambient	$R_{\theta JA}$	60	$^{\circ}\text{C/W}$

ELECTRICAL CHARACTERISTICS ($T_J = 25^{\circ}\text{C}$ unless otherwise specified)

Parameter	Test Conditions	Symbol	Min	Typ	Max	Unit
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STATIC CHARACTERISTIC

Collector-emitter breakdown voltage, gate-emitter short-circuited	$V_{GE} = 0\text{ V}, I_C = 500\text{ }\mu\text{A}$	$V_{(BR)CES}$	650	–	–	V
Collector-emitter saturation voltage	$V_{GE} = 15\text{ V}, I_C = 15\text{ A}$ $V_{GE} = 15\text{ V}, I_C = 15\text{ A}, T_J = 150^{\circ}\text{C}$	V_{CEsat}	1.3 1.55	1.5 1.75	1.7 1.95	V
Gate-emitter threshold voltage	$V_{GE} = V_{CE}, I_C = 250\text{ }\mu\text{A}$	$V_{GE(th)}$	4.5	5.5	6.5	V
Collector-emitter cut-off current, gate-emitter short-circuited	$V_{GE} = 0\text{ V}, V_{CE} = 600\text{ V}$ $V_{GE} = 0\text{ V}, V_{CE} = 600\text{ V}, T_J = 150^{\circ}\text{C}$	I_{CES}	–	10 –	– 200	μA
Gate leakage current, collector-emitter short-circuited	$V_{GE} = 20\text{ V}, V_{CE} = 0\text{ V}$	I_{GES}	–	–	100	nA
Forward Transconductance	$V_{CE} = 20\text{ V}, I_C = 15\text{ A}$	g_{fs}	–	10.1	–	S

DYNAMIC CHARACTERISTIC

Input capacitance	$V_{CE} = 20\text{ V}, V_{GE} = 0\text{ V}, f = 1\text{ MHz}$	C_{ies}	–	1950	–	pF
Output capacitance		C_{oes}	–	70	–	
Reverse transfer capacitance		C_{res}	–	48	–	
Gate charge total	$V_{CE} = 480\text{ V}, I_C = 15\text{ A}, V_{GE} = 15\text{ V}$	Q_g	–	88	–	nC
Gate to emitter charge		Q_{ge}	–	16	–	
Gate to collector charge		Q_{gc}	–	42	–	

SWITCHING CHARACTERISTIC , INDUCTIVE LOAD

Turn-on delay time	$T_J = 25^{\circ}\text{C}$ $V_{CC} = 400\text{ V}, I_C = 15\text{ A}$ $R_g = 22\text{ }\Omega$ $V_{GE} = 0\text{ V} / 15\text{ V}^*$	$t_{d(on)}$	–	65	–	ns
Rise time		t_r	–	28	–	
Turn-off delay time		$t_{d(off)}$	–	170	–	
Fall time		t_f	–	140	–	
Turn-on switching loss		E_{on}	–	0.550	–	mJ
Turn-off switching loss		E_{off}	–	0.350	–	
Total switching loss		E_{ts}	–	0.900	–	
Turn-on delay time	$T_J = 150^{\circ}\text{C}$ $V_{CC} = 400\text{ V}, I_C = 15\text{ A}$ $R_g = 22\text{ }\Omega$ $V_{GE} = 0\text{ V} / 15\text{ V}^*$	$t_{d(on)}$	–	65	–	ns
Rise time		t_r	–	28	–	
Turn-off delay time		$t_{d(off)}$	–	180	–	
Fall time		t_f	–	260	–	
Turn-on switching loss		E_{on}	–	0.650	–	mJ
Turn-off switching loss		E_{off}	–	0.600	–	
Total switching loss		E_{ts}	–	1.250	–	

Product parametric performance is indicated in the Electrical Characteristics for the listed test conditions, unless otherwise noted. Product performance may not be indicated by the Electrical Characteristics if operated under different conditions.

*Includes diode reverse recovery loss using NGTB15N60S1EG.

TYPICAL CHARACTERISTICS

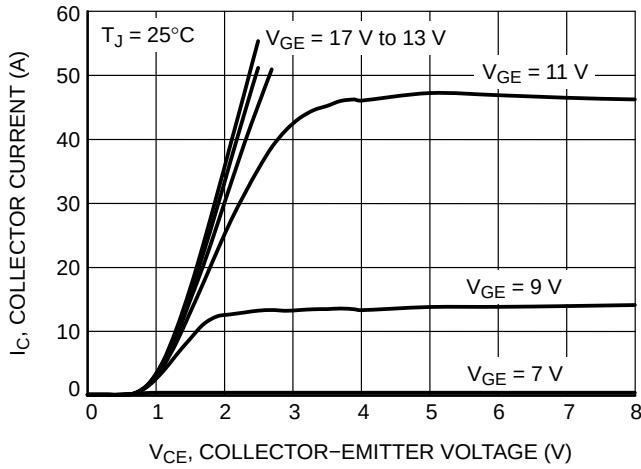


Figure 1. Output Characteristics

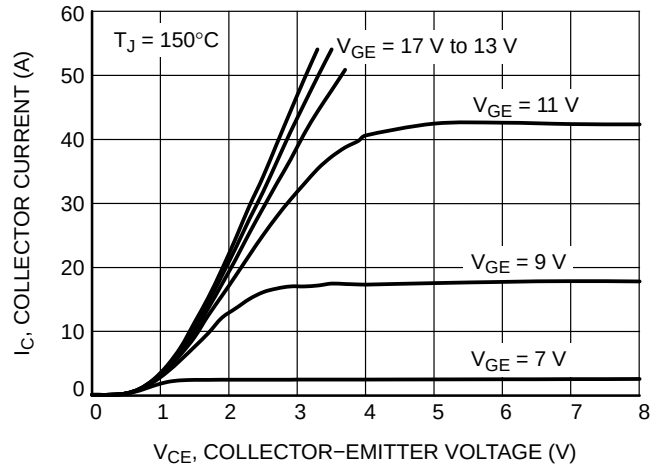


Figure 2. Output Characteristics

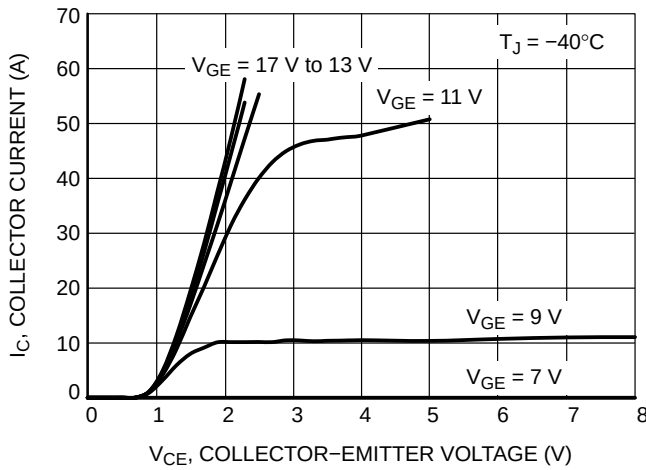


Figure 3. Output Characteristics

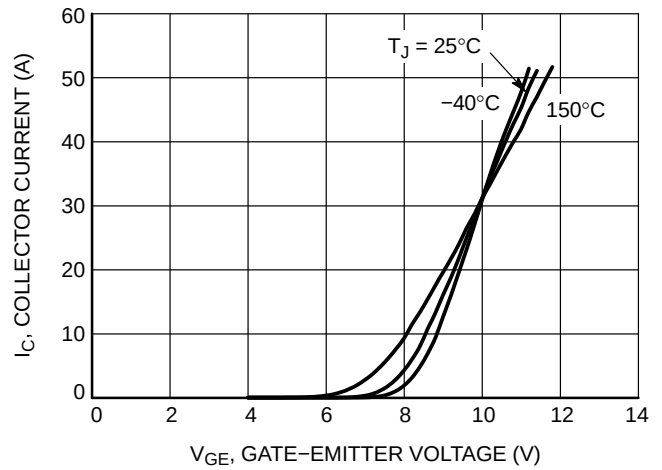


Figure 4. Typical Transfer Characteristics

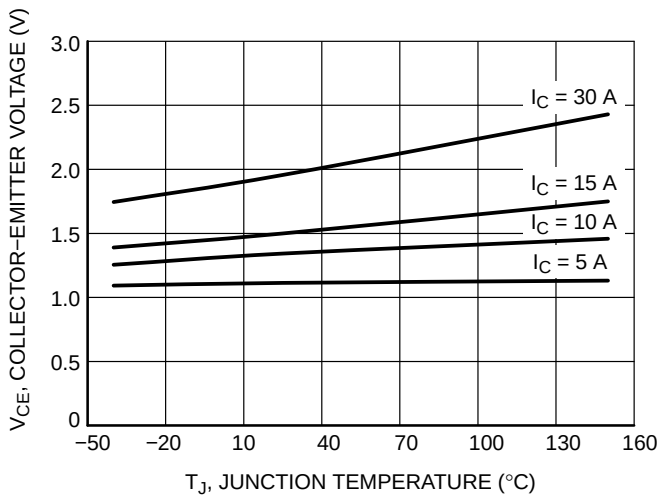


Figure 5. $V_{CE(sat)}$ vs. T_J

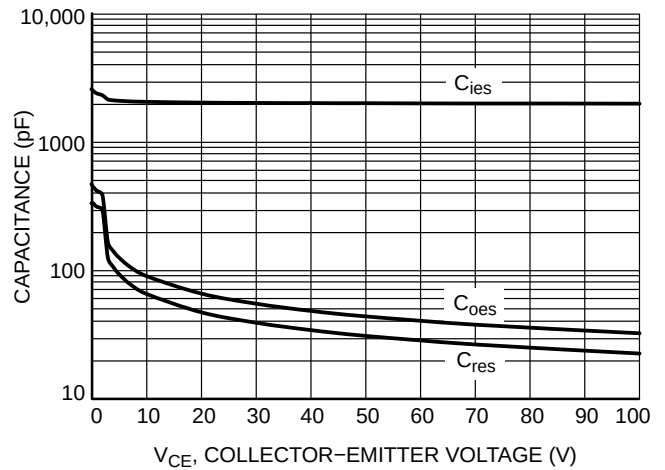


Figure 6. Typical Capacitance

NGTG15N60S1EG

TYPICAL CHARACTERISTICS

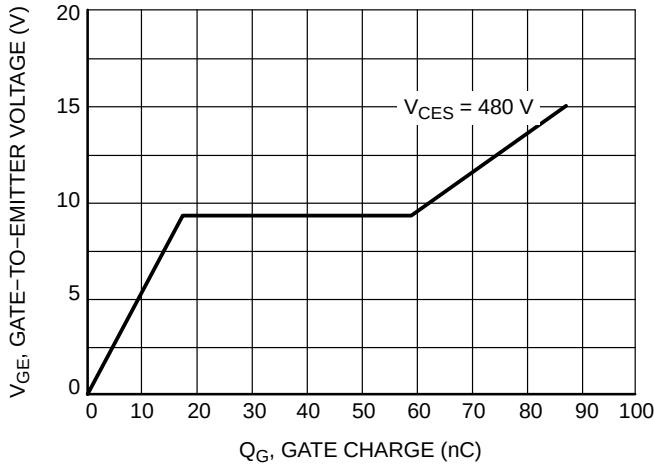


Figure 7. Typical Gate Charge

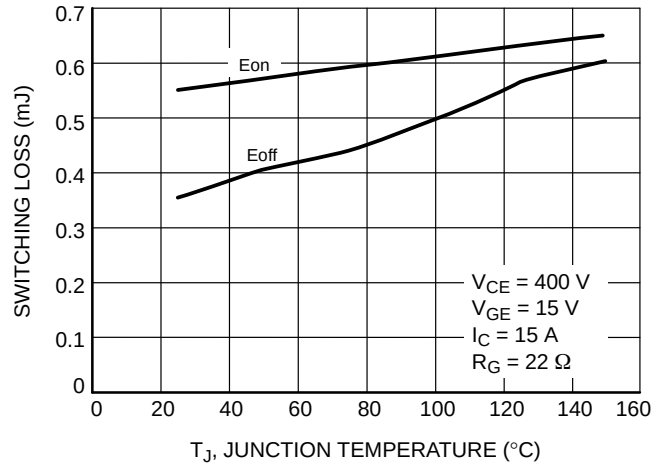


Figure 8. Switching Loss vs. Temperature

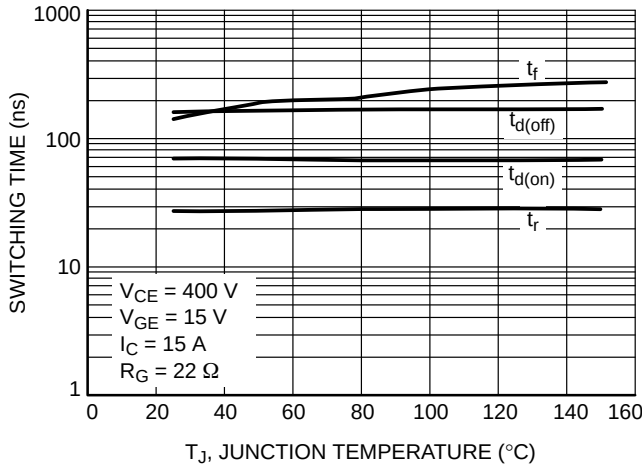


Figure 9. Switching Time vs. Temperature

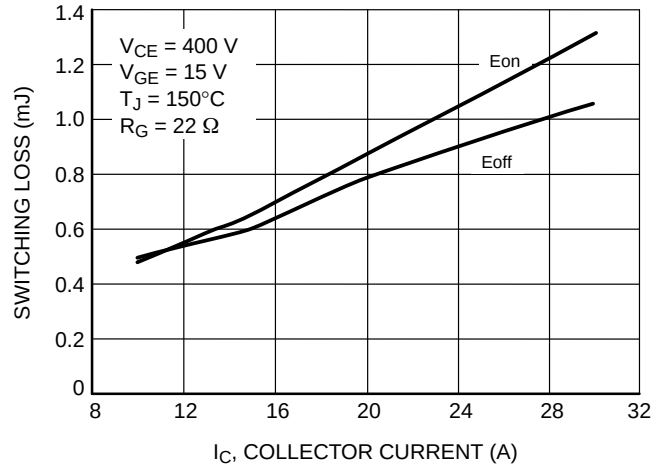


Figure 10. Switching Loss vs. I_C

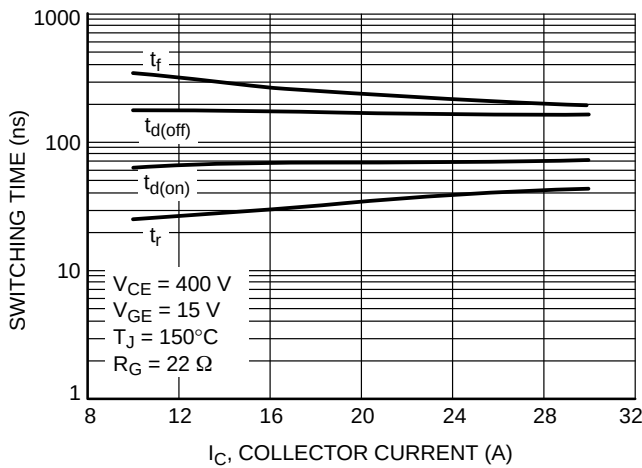


Figure 11. Switching Time vs. I_C

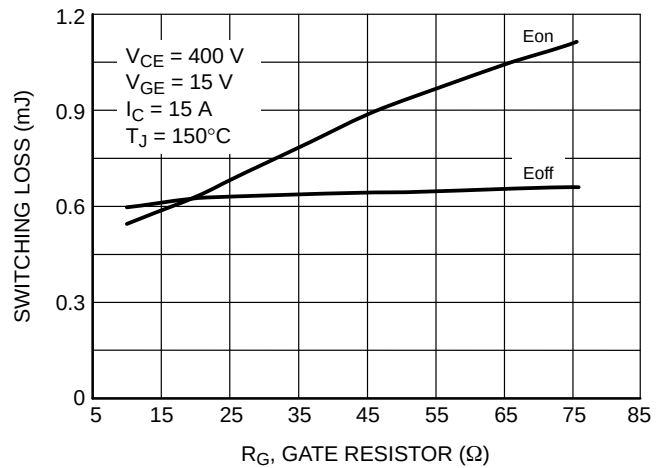


Figure 12. Switching Time vs. R_G

NGTG15N60S1EG

TYPICAL CHARACTERISTICS

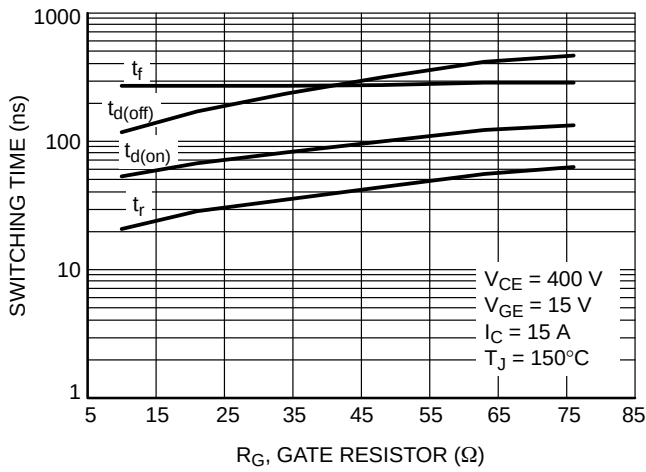


Figure 13. Switching Time vs. R_G

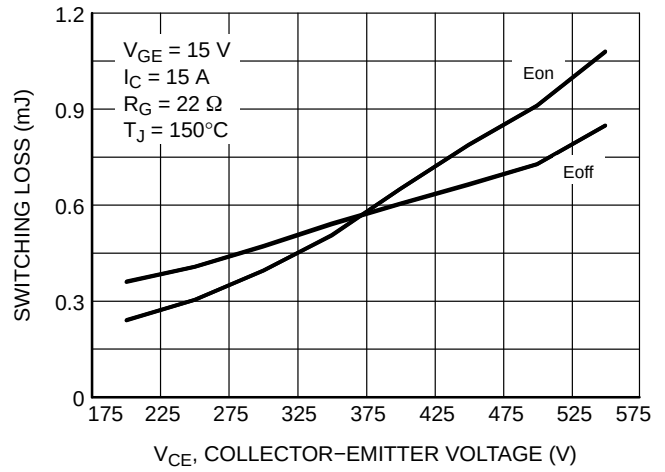


Figure 14. Switching Loss vs. V_{CE}

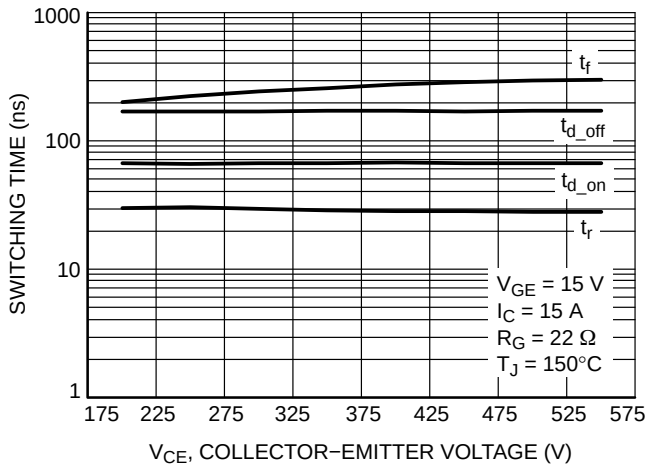


Figure 15. Switching Time vs. V_{CE}

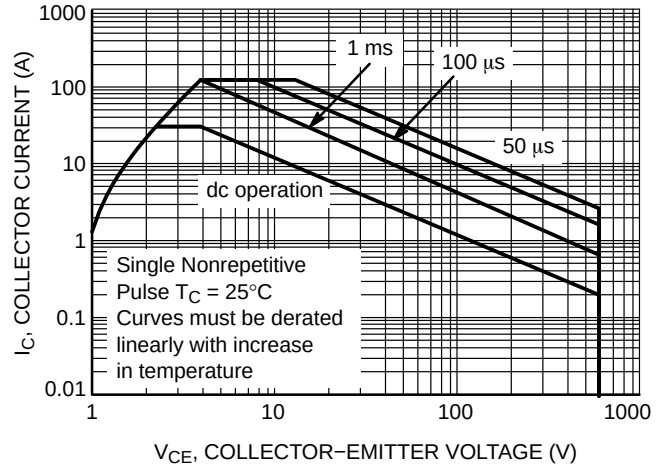


Figure 16. Safe Operating Area

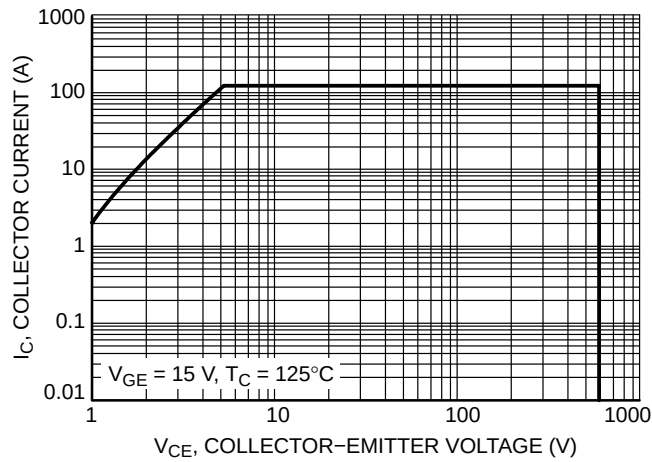


Figure 17. Reverse Bias Safe Operating Area

NGTG15N60S1EG

TYPICAL CHARACTERISTICS

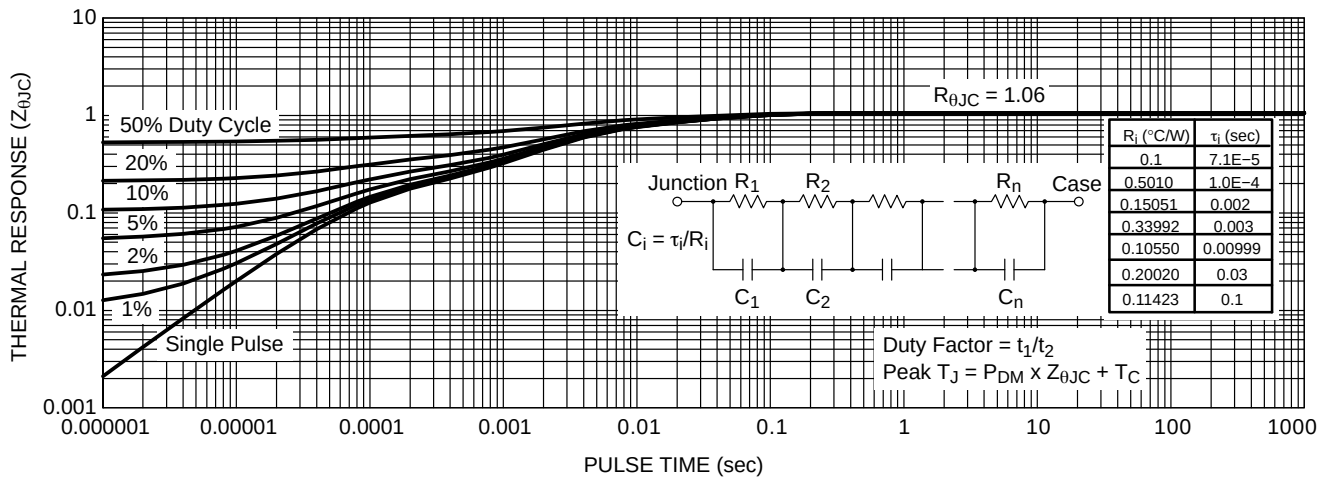


Figure 18. IGBT Transient Thermal Impedance

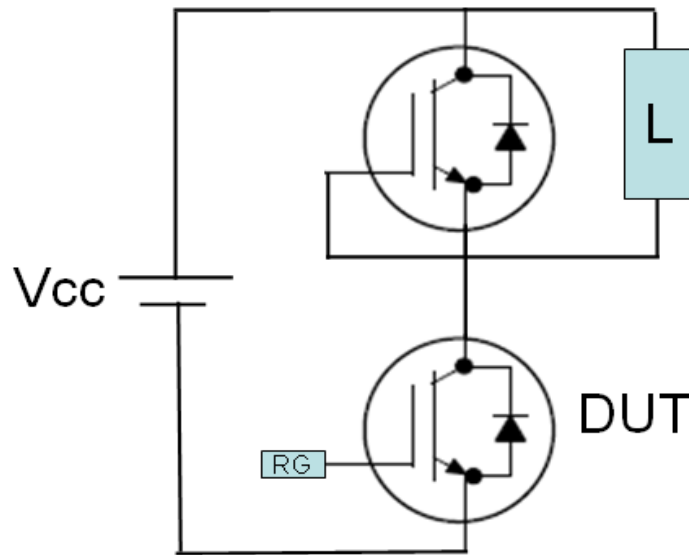


Figure 19. Test Circuit for Switching Characteristics

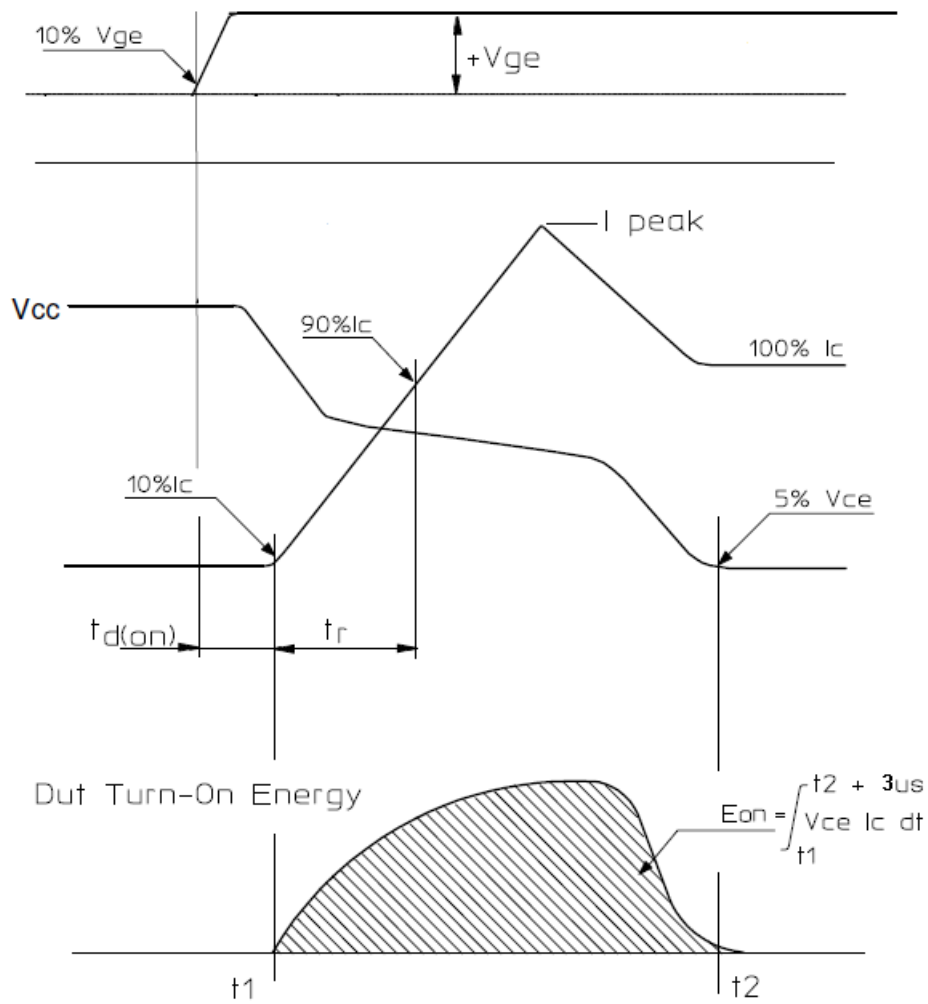


Figure 20. Definition of Turn On Waveform

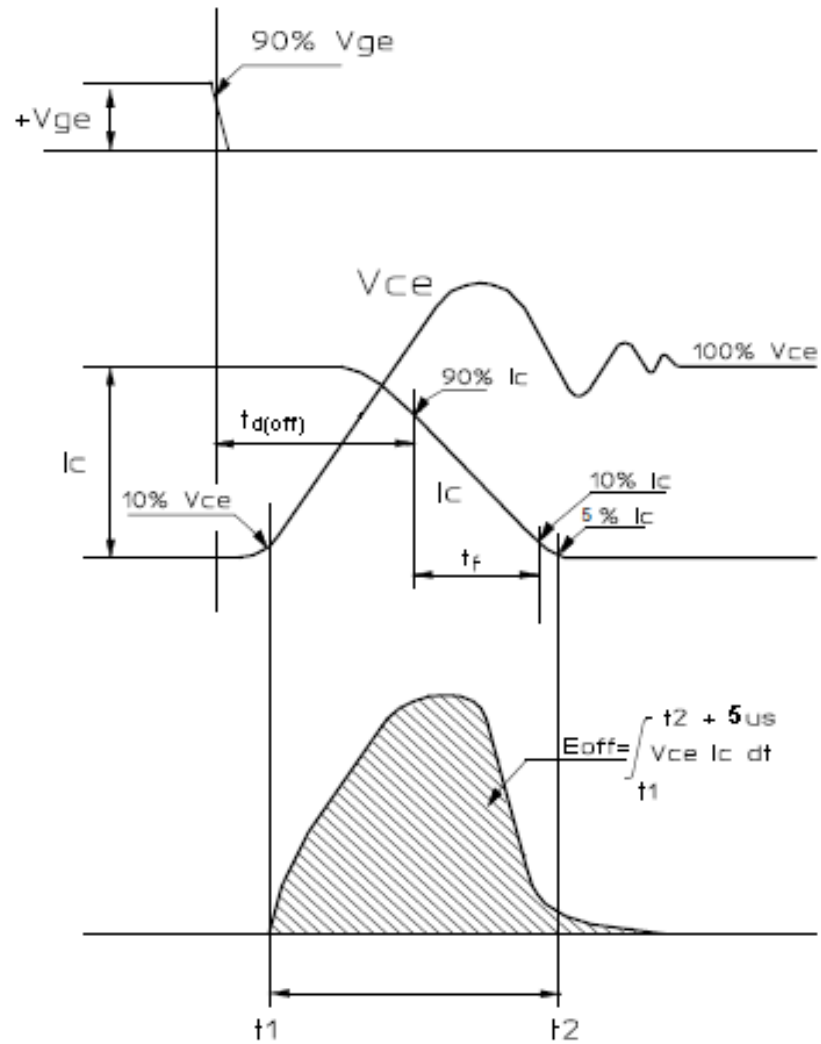
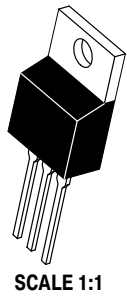


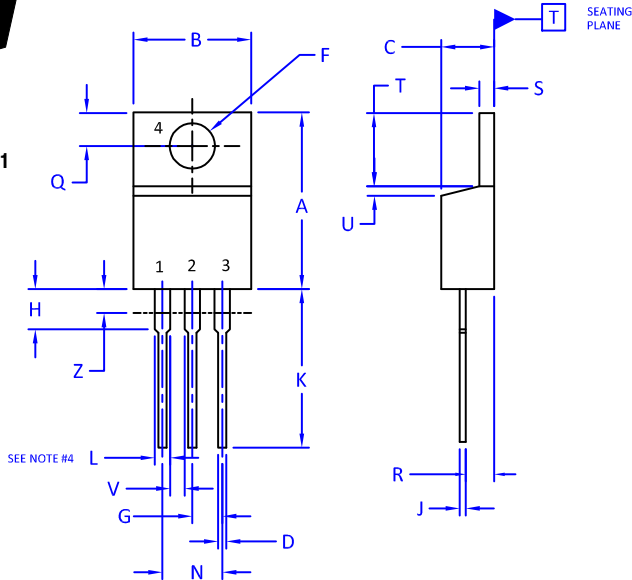
Figure 21. Definition of Turn Off Waveform

MECHANICAL CASE OUTLINE PACKAGE DIMENSIONS



TO-220 CASE 221A ISSUE AK

DATE 13 JAN 2022



NOTES:

1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 2009.
2. CONTROLLING DIMENSION: INCHES
3. DIMENSION Z DEFINES A ZONE WHERE ALL BODY AND LEAD IRREGULARITIES ARE ALLOWED.
4. MAX WIDTH FOR F102 DEVICE = 1.35MM

DIM	INCHES		MILLIMETERS	
	MIN.	MAX.	MIN.	MAX.
A	0.570	0.620	14.48	15.75
B	0.380	0.415	9.66	10.53
C	0.160	0.190	4.07	4.83
D	0.025	0.038	0.64	0.96
F	0.142	0.161	3.60	4.09
G	0.095	0.105	2.42	2.66
H	0.110	0.161	2.80	4.10
J	0.014	0.024	0.36	0.61
K	0.500	0.562	12.70	14.27
L	0.045	0.060	1.15	1.52
N	0.190	0.210	4.83	5.33
Q	0.100	0.120	2.54	3.04
R	0.080	0.110	2.04	2.79
S	0.045	0.055	1.15	1.41
T	0.235	0.255	5.97	6.47
U	0.000	0.050	0.00	1.27
V	0.045	----	1.15	---
Z	----	0.080	---	2.04

STYLE 1:
PIN 1. BASE
2. COLLECTOR
3. EMITTER
4. COLLECTOR

STYLE 2:
PIN 1. BASE
2. EMITTER
3. COLLECTOR
4. EMITTER

STYLE 3:
PIN 1. CATHODE
2. ANODE
3. GATE
4. ANODE

STYLE 4:
PIN 1. MAIN TERMINAL 1
2. MAIN TERMINAL 2
3. GATE
4. MAIN TERMINAL 2

STYLE 5:
PIN 1. GATE
2. DRAIN
3. SOURCE
4. DRAIN

STYLE 6:
PIN 1. ANODE
2. CATHODE
3. ANODE
4. CATHODE

STYLE 7:
PIN 1. CATHODE
2. ANODE
3. CATHODE
4. ANODE

STYLE 8:
PIN 1. CATHODE
2. ANODE
3. EXTERNAL TRIP/DELAY
4. ANODE

STYLE 9:
PIN 1. GATE
2. COLLECTOR
3. EMITTER
4. COLLECTOR

STYLE 10:
PIN 1. GATE
2. SOURCE
3. DRAIN
4. SOURCE

STYLE 11:
PIN 1. DRAIN
2. SOURCE
3. GATE
4. SOURCE

STYLE 12:
PIN 1. MAIN TERMINAL 1
2. MAIN TERMINAL 2
3. GATE
4. NOT CONNECTED

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DESCRIPTION: TO-220

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