NGTB15N60S1EG

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. Incorporated into the device is a rugged co−packaged reverse recovery diode with a low forward voltage.

Features

- Low Saturation Voltage Resulting in Low Conduction Loss
- Low Switching Loss in Higher Frequency Applications
- Soft Fast Reverse Recovery Diode
- 5 μs 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 @ Tc = 25°C @ Tc = 100°C	I_C	 30 15	A
Pulsed collector current, T_{pulse} limited by T_{Jmax}	I_{CM}	120	A
Diode forward current @ Tc = 25°C @ Tc = 100°C	I_F	 30 15	A
Diode pulsed current, T_{pulse} limited by T_{Jmax}	I_{FM}	120	A
Gate−emitter voltage	V_{GE}	±20	V
Power dissipation @ Tc = 25°C @ Tc = 100°C	P_D	 117 47	W
Short circuit withstand time V_{GE} = 15 V, V_{CE} = 400 V, $T_J \le$ +150°C	t_{SC}	5	μs
Operating junction temperature range	T_J	−55 to +150	°C
Storage temperature range	T_{stg}	−55 to +150	°C
Lead temperature for soldering, 1/8” from case for 5 seconds	T_{SLD}	260	°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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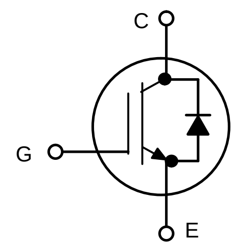
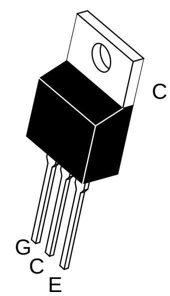
15 A, 650 V

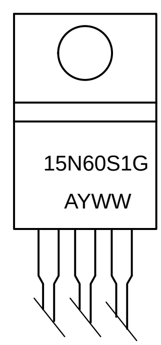
V_{CEsat} = 1.5 V





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
NGTB15N60S1EG	TO−220 (Pb−Free)	50 Units / Rail

THERMAL CHARACTERISTICS

Rating	Symbol	Value	Unit
Thermal resistance junction to case, for IGBT	$R_{\theta JC}$	0.5	°C/W
Thermal resistance junction to case, for Diode	$R_{\theta JC}$	2.3	°C/W
Thermal resistance junction to ambient	$R_{\theta JA}$	60	°C/W

ELECTRICAL CHARACTERISTICS (T_J = 25°C unless otherwise specified)

Parameter	Test Conditions	Symbol	Min	Typ	Max	Unit
STATIC CHARACTERISTIC						
Collector−emitter breakdown voltage, gate−emitter short−circuited	V_{GE} = 0 V, I_C = 500 μA V_{GE} = 0 V, I_C = 500 μA, T_J = −40°C	$V_{(BR)CES}$	650 −	720 660	− −	V
Collector−emitter saturation voltage	V_{GE} = 15 V , I_C = 15 A V_{GE} = 15 V , I_C = 15 A, T_J = 150°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 μA	$V_{GE(th)}$	4.5	5.5	6.5	V
Collector−emitter cut−off current, gate−emitter short−circuited	V_{GE} = 0 V, V_{CE} = 650 V V_{GE} = 0 V, V_{CE} = 650 V, T_J = 150°C	I_{CES}	− −	10 −	− 200	μA
Gate leakage current, collector−emitter short−circuited	V_{GE} = 20 V, V_{CE} = 0 V	I_{GES}	−	−	100	nA
Forward Transconductance	V_{CE} = 20 V, I_C = 15 A	g_{fs}	−	10.1	−	S
DYNAMIC CHARACTERISTIC						
Input capacitance	V_{CE} = 20 V, V_{GE} = 0 V, f = 1 MHz	C_{ies}	−	1950	−	pF
Output capacitance		C_{oes}	−	70	−	
Reverse transfer capacitance		C_{res}	−	42	−	
Gate charge total	V_{CE} = 480 V, I_C = 15 A, V_{GE} = 15 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°C V_{CC} = 400 V, I_C = 15 A R_g = 22 Ω V_{GE} = 0 V / 15 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°C V_{CC} = 400 V, I_C = 15 A R_g = 22 Ω V_{GE} = 0 V / 15 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	−	
DIODE CHARACTERISTIC						
Forward voltage	V_{GE} = 0 V, I_F = 15 A V_{GE} = 0 V, I_F = 15 A, T_J = 150°C	V_F	− −	1.65 1.75	1.85 −	V

ELECTRICAL CHARACTERISTICS (T_J = 25°C unless otherwise specified)

Parameter	Test Conditions	Symbol	Min	Typ	Max	Unit
DIODE CHARACTERISTIC						
Reverse recovery time	T_J = 25°C I_F = 15 A, V_R = 200 V di_F/dt = 200 A/μs	t_{rr}	−	270	−	ns
Reverse recovery charge		Q_{rr}	−	350	−	nc
Reverse recovery current		I_{rrm}	−	5	−	A
Reverse recovery time	T_J = 125°C I_F = 15 A, V_R = 200 V di_F/dt = 200 A/μs	t_{rr}	−	350	−	ns
Reverse recovery charge		Q_{rr}	−	1000	−	nc
Reverse recovery current		I_{rrm}	−	7.5	−	A

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.

TYPICAL CHARACTERISTICS

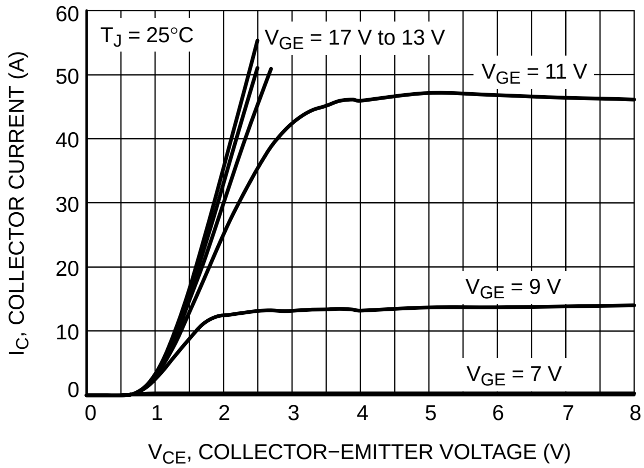


Figure 1. Output Characteristics

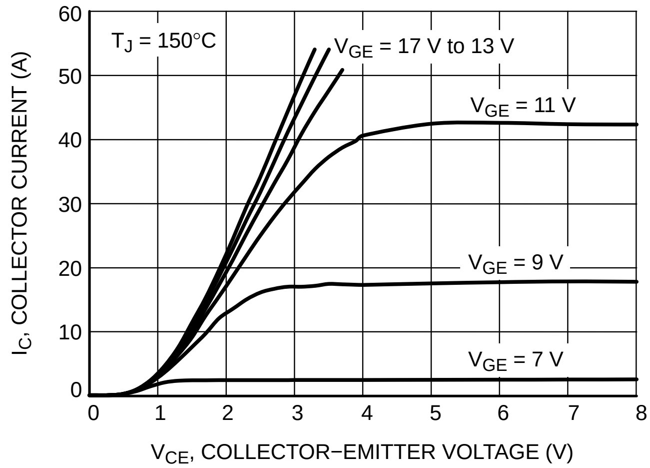


Figure 2. Output Characteristics

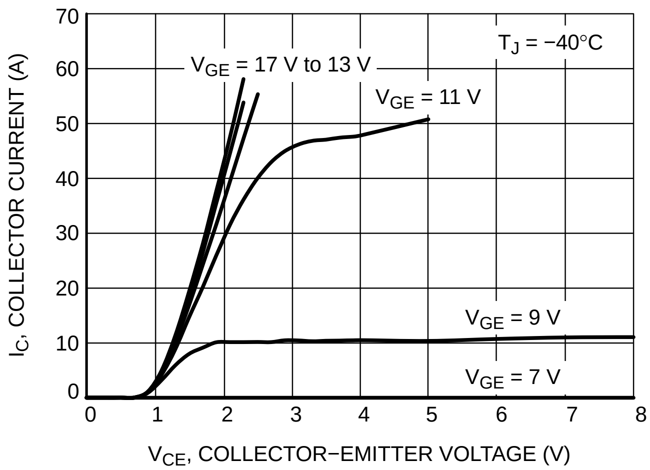


Figure 3. Output Characteristics

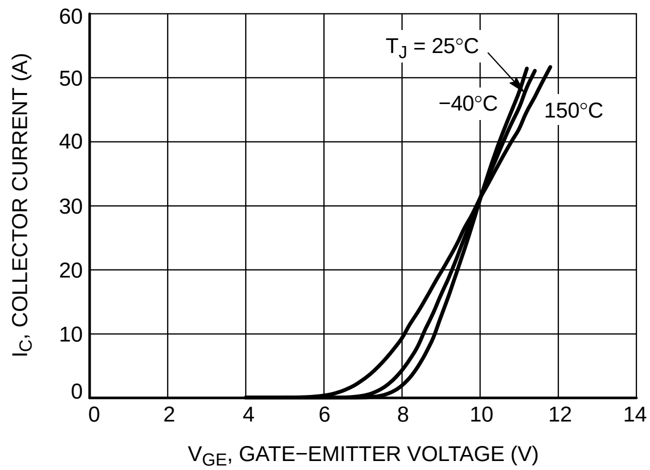


Figure 4. Typical Transfer Characteristics

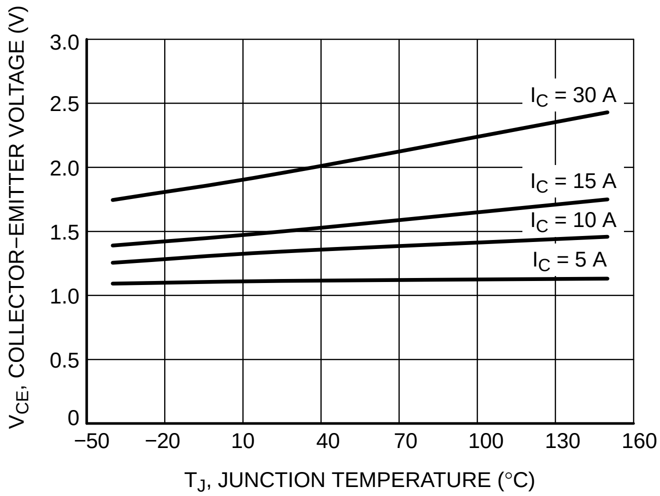


Figure 5. $V_{CE(sat)}$ vs. T_J

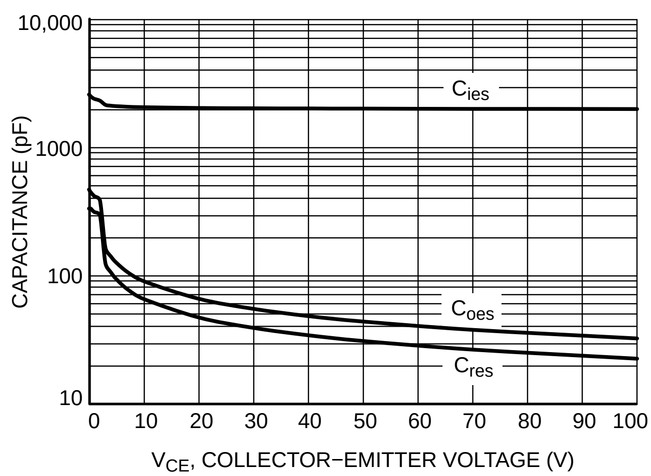


Figure 6. Typical Capacitance

TYPICAL CHARACTERISTICS

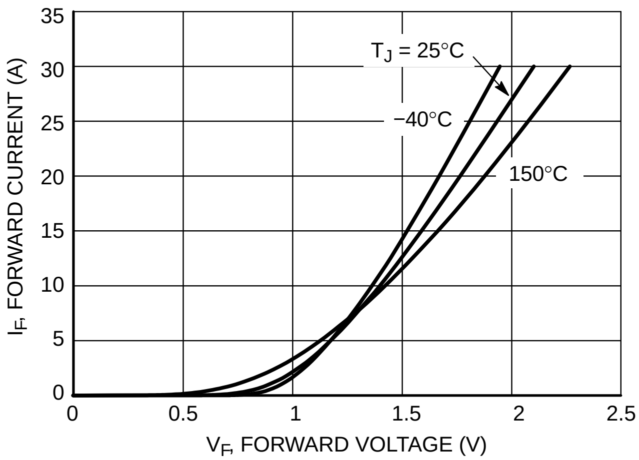


Figure 7. Diode Forward Characteristics

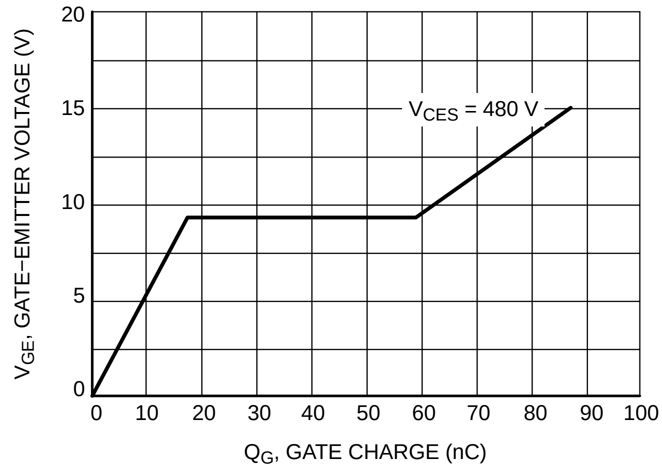


Figure 8. Typical Gate Charge

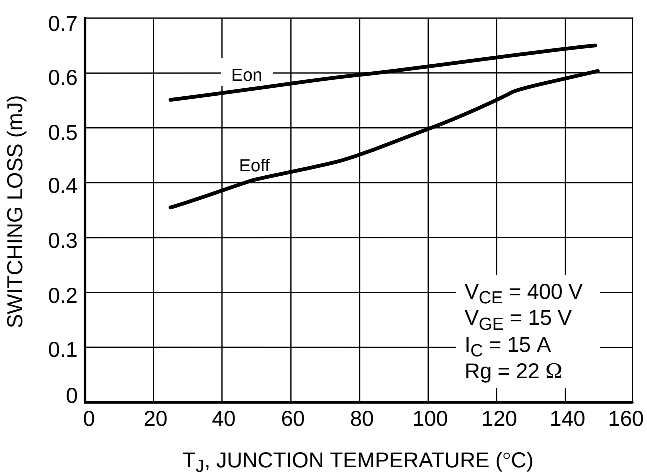


Figure 9. Switching Loss vs. Temperature

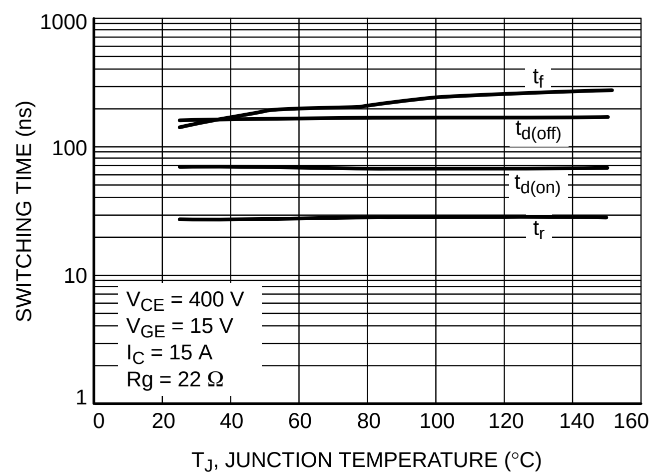


Figure 10. Switching Time vs. Temperature

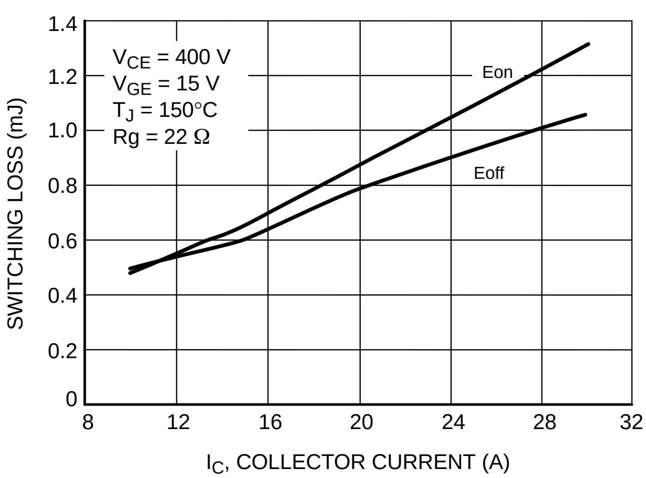


Figure 11. Switching Loss vs. I_C

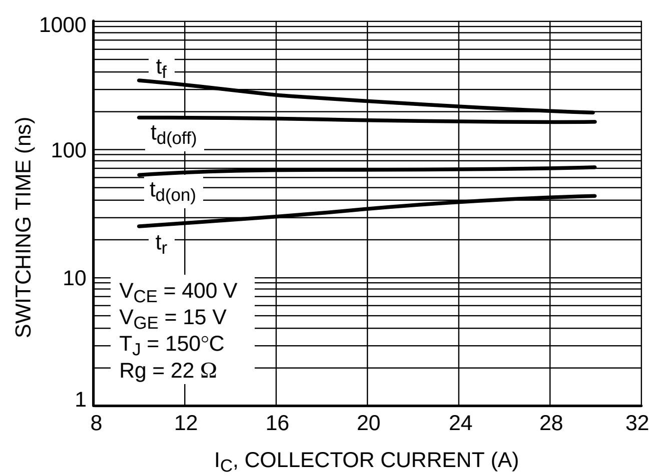


Figure 12. Switching Time vs. I_C

TYPICAL CHARACTERISTICS

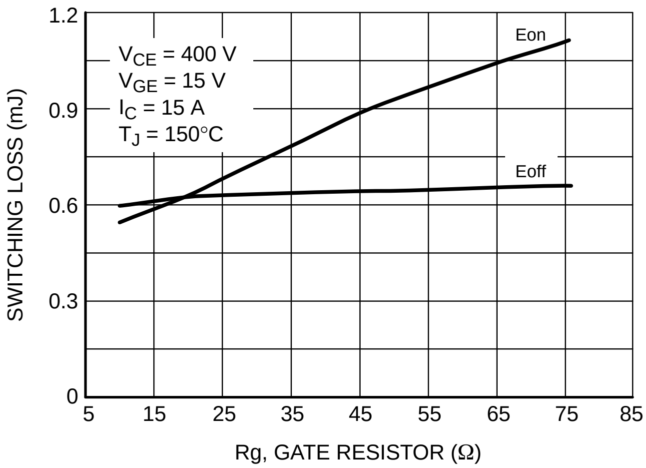


Figure 13. Switching Time vs. Rg

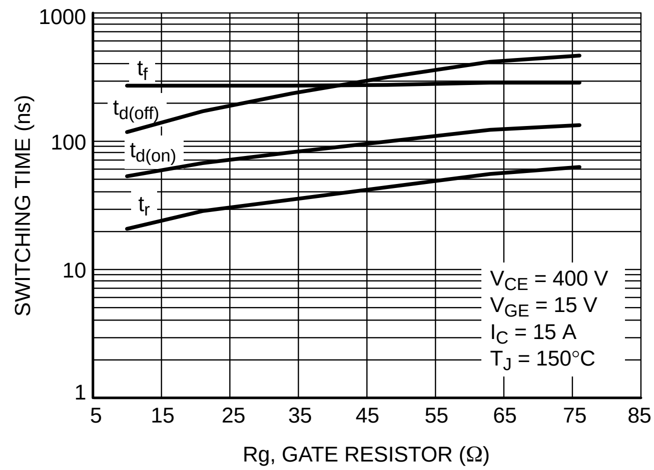


Figure 14. Switching Time vs. Rg

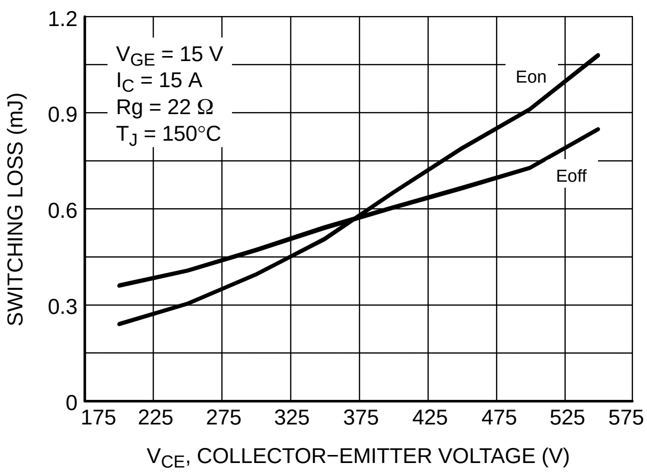


Figure 15. Switching Loss vs. V_{CE}

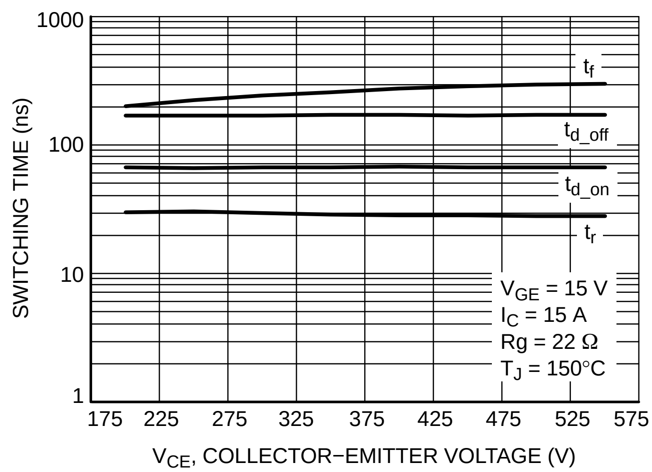


Figure 16. Switching Time vs. V_{CE}

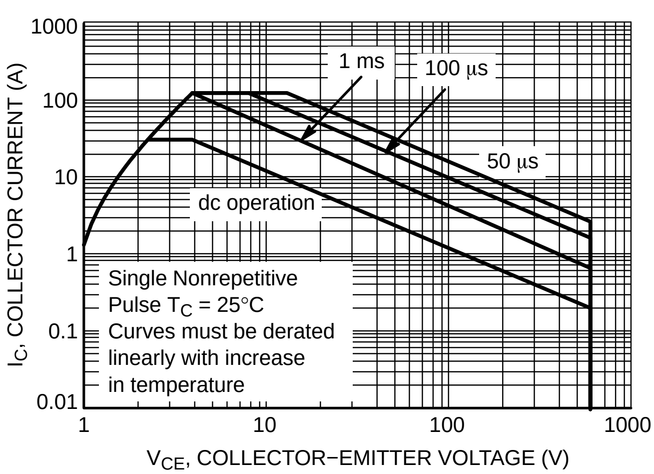


Figure 17. Safe Operating Area

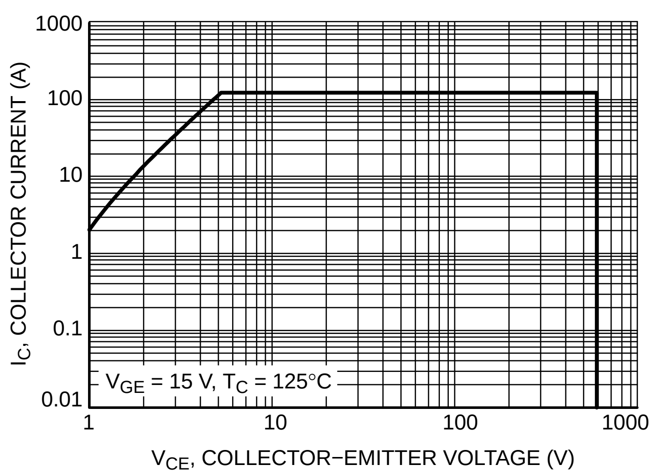
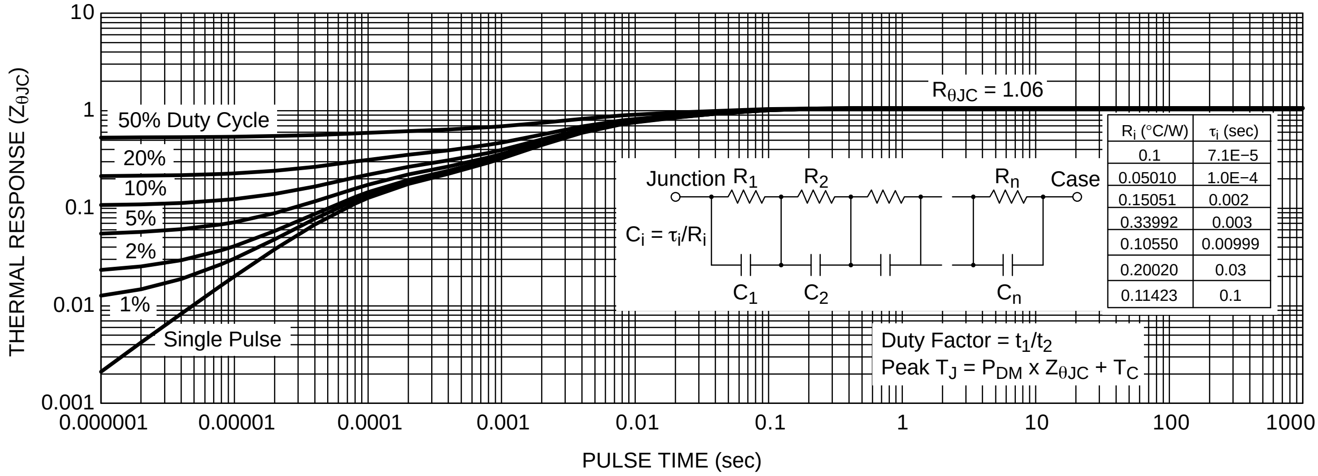


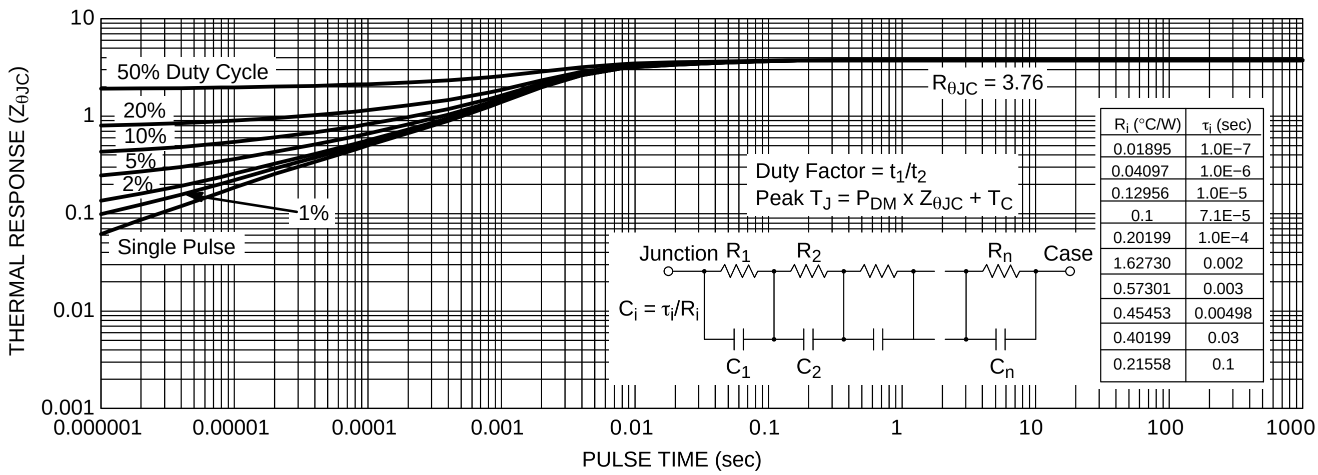
Figure 18. Reverse Bias Safe Operating Area

TYPICAL CHARACTERISTICS



R_i (°C/W)	τ_i (sec)
0.1	7.1E−5
0.05010	1.0E−4
0.15051	0.002
0.33992	0.003
0.10550	0.00999
0.20020	0.03
0.11423	0.1

Figure 19. IGBT Transient Thermal Impedance



R_i (°C/W)	τ_i (sec)
0.01895	1.0E−7
0.04097	1.0E−6
0.12956	1.0E−5
0.1	7.1E−5
0.20199	1.0E−4
1.62730	0.002
0.57301	0.003
0.45453	0.00498
0.40199	0.03
0.21558	0.1

Figure 20. Diode Transient Thermal Impedance

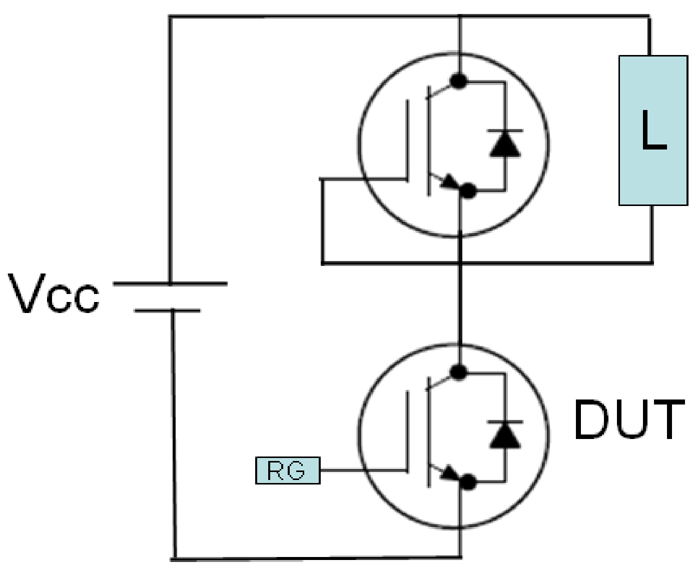


Figure 21. Test Circuit for Switching Characteristics

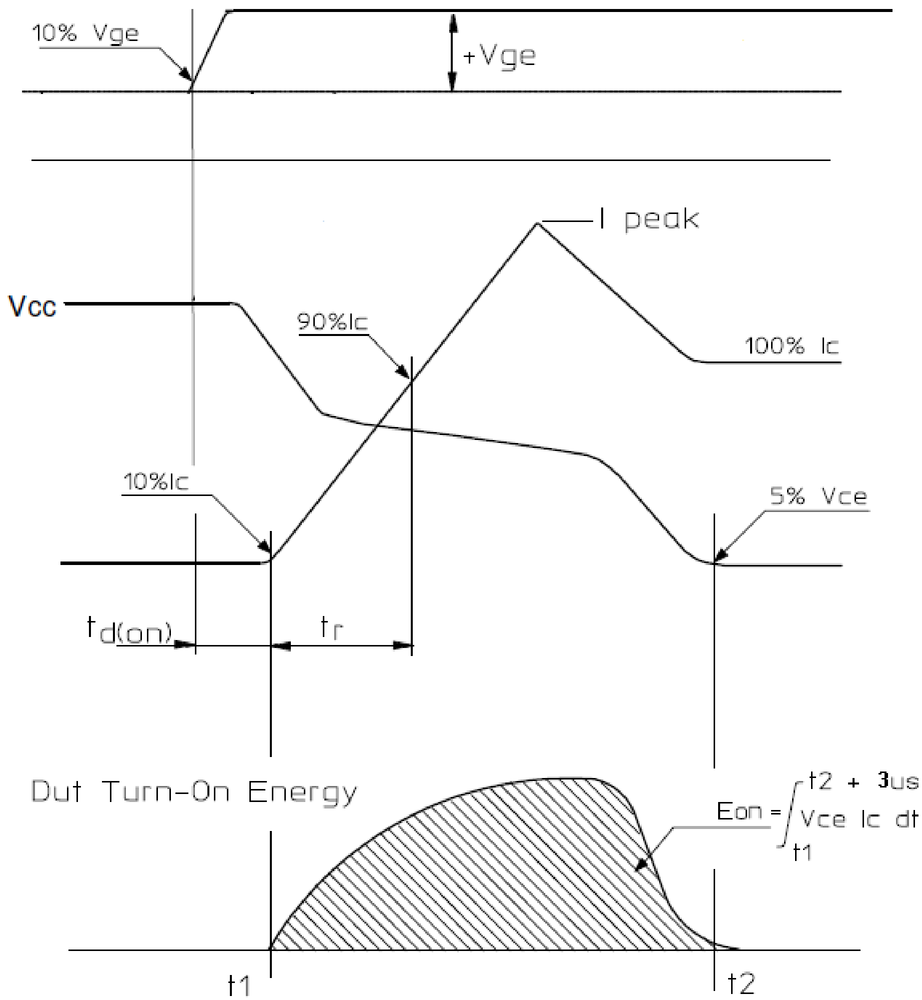


Figure 22. Definition of Turn On Waveform

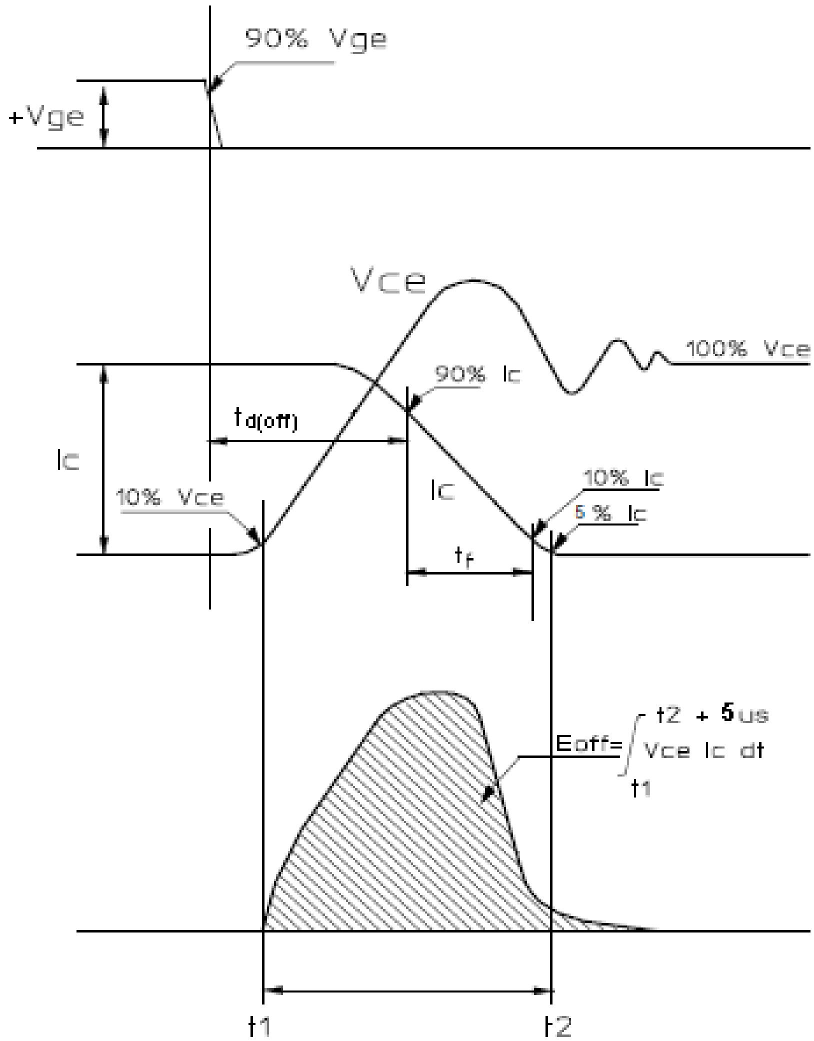
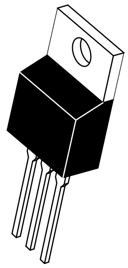


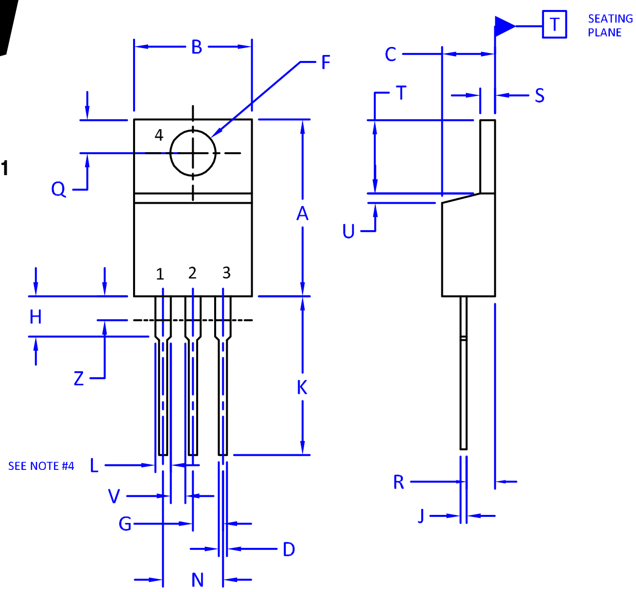
Figure 23. Definition of Turn Off Waveform

TO−220
CASE 221A
ISSUE AK

DATE 13 JAN 2022



SCALE 1:1



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

	INCHES		MILLIMETERS	
DIM	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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