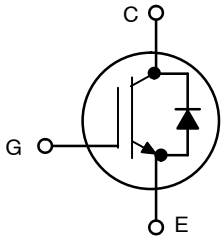
IGBT
NGTB45N60SWG

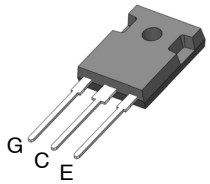
45 A, 600 V
V_{CEsat} = 2.2 V
E_{off} = 0.55 mJ

This Insulated Gate Bipolar Transistor (IGBT) features a robust and cost effective Field Stop (FS) 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 half bridge resonant applications. Incorporated into the device is a soft and fast co−packaged free wheeling diode with a low forward voltage.



Features

- Low Saturation Voltage using Trench with Fieldstop Technology
- Low Switching Loss Reduces System Power Dissipation
- Low Gate Charge
- Soft, Fast Free Wheeling Diode
- These are Pb−Free Devices



TO−247
CASE 340AM

Typical Applications

- Inductive Heating
- Soft Switching

ABSOLUTE MAXIMUM RATINGS

Rating	Symbol	Value	Unit
Collector−emitter Voltage	V_{CES}	600	V
Collector Current @ T_C = 25°C @ T_C = 100°C	I_C	 90 45	A
Pulsed Collector Current, T_{pulse} Limited by T_{Jmax}	I_{CM}	180	A
Diode Forward Current @ T_C = 25°C @ T_C = 100°C	I_F	 90 45	A
Diode Pulsed Current, T_{pulse} Limited by T_{Jmax}	I_{FM}	180	A
Gate−emitter Voltage	V_{GE}	±20	V
Power Dissipation @ T_C = 25°C @ T_C = 100°C	P_D	 250 50	W
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.

MARKING DIAGRAM

45N60S = Specific Device Code
A = Assembly Location
Y = Year
WW = Work Week
G = Pb−Free Package

ORDERING INFORMATION

Device	Package	Shipping
NGTB45N60SWG	TO−247 (Pb−Free)	30 Units / Rail

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October, 2021 − Rev. 2
Publication Order Number:
NGTB45N60SW/D

THERMAL CHARACTERISTICS

Rating	Symbol	Value	Unit
Thermal resistance junction−to−case, for IGBT	$R_{\theta JC}$	0.87	°C/W
Thermal resistance junction−to−case, for Diode	$R_{\theta JC}$	1.47	°C/W
Thermal resistance junction−to−ambient	$R_{\theta JA}$	40	°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	$V_{(BR)CES}$	600	–	–	V
Collector−emitter saturation voltage	V_{GE} = 15 V, I_C = 45 A V_{GE} = 15 V, I_C = 45 A, T_J = 150°C	V_{CEsat}	– –	2.2 2.6	2.4 –	V
Gate−emitter threshold voltage	V_{GE} = V_{CE}, I_C = 150 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} = 600 V V_{GE} = 0 V, V_{CE} = 600 V, T_J = 150°C	I_{CES}	– –	– –	0.2 2	mA
Gate leakage current, collector−emitter short−circuited	V_{GE} = 20 V , V_{CE} = 0 V	I_{GES}	–	–	100	nA
DYNAMIC CHARACTERISTIC						
Input capacitance	V_{CE} = 20 V, V_{GE} = 0 V, f = 1 MHz	C_{ies}	–	3100	–	pF
Output capacitance		C_{oes}	–	120	–	
Reverse transfer capacitance		C_{res}	–	80	–	
Gate charge total	V_{CE} = 480 V, I_C = 45 A, V_{GE} = 15 V	Q_g		134		nC
Gate to emitter charge		Q_{ge}		27		
Gate to collector charge		Q_{gc}		67		
SWITCHING CHARACTERISTIC, INDUCTIVE LOAD						
Turn−on delay time	T_J = 25°C V_{CC} = 400 V, I_C = 45 A R_g = 10 Ω V_{GE} = 0 V/ 15 V	$t_{d(on)}$		70		ns
Rise time		t_r		34		
Turn−off delay time		$t_{d(off)}$		144		
Fall time		t_f		68		
Turn−off switching loss		E_{off}		0.55		mJ
Turn−on delay time	T_J = 150°C V_{CC} = 400 V, I_C = 45 A R_g = 10 Ω V_{GE} = 0 V/ 15 V	$t_{d(on)}$		70		ns
Rise time		t_r		39		
Turn−off delay time		$t_{d(off)}$		151		
Fall time		t_f		88		
Turn−off switching loss		E_{off}		0.89		mJ
DIODE CHARACTERISTIC						
Forward voltage	V_{GE} = 0 V, I_F = 20 A V_{GE} = 0 V, I_F = 20 A, T_J = 150°C	V_F		1.1 1.03	1.4	V
Reverse recovery time	T_J = 25°C I_F = 25 A, V_R = 200 V di_F/dt = 200 A/μs	t_{rr}		376		ns
Reverse recovery charge		Q_{rr}		4145		nc
Reverse recovery current		I_{rrm}		22		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

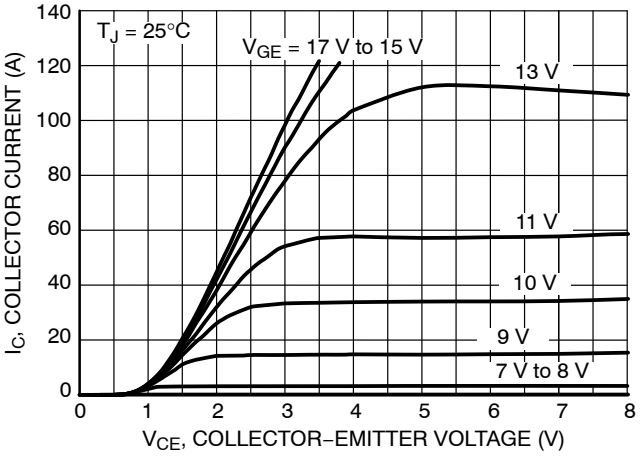


Figure 1. Output Characteristics

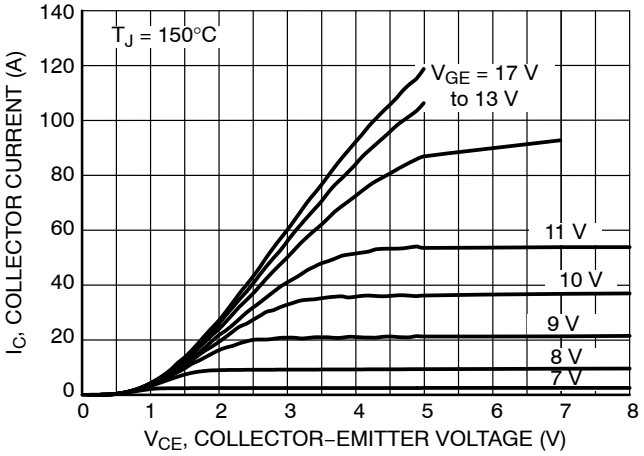


Figure 2. Output Characteristics

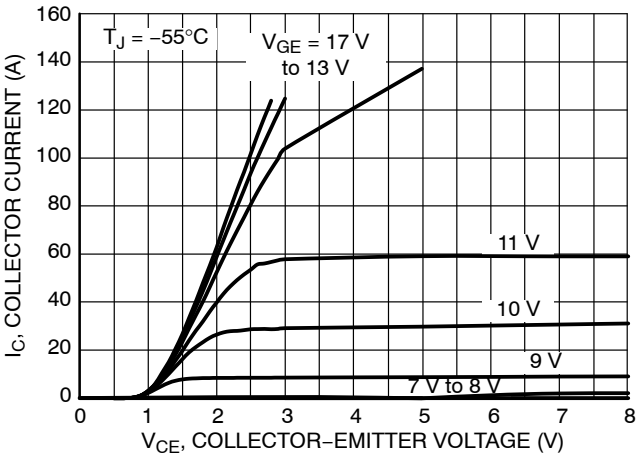


Figure 3. Output Characteristics

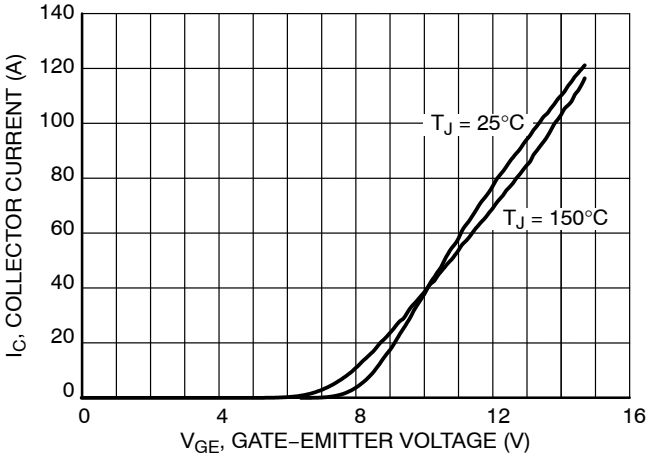


Figure 4. Typical Transfer Characteristics

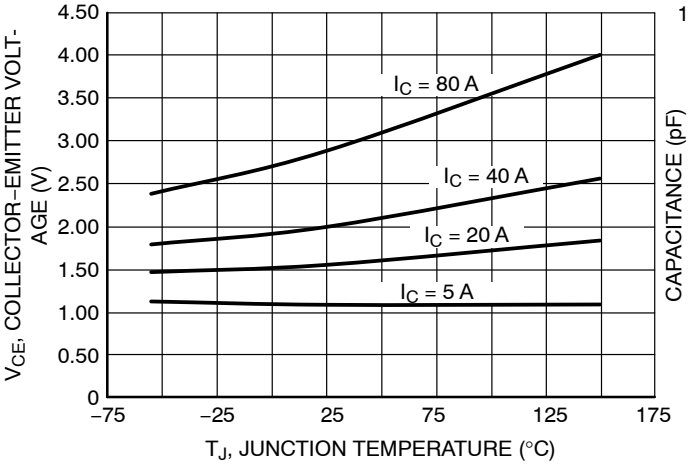


Figure 5. $V_{CE(sat)}$ vs. T_J

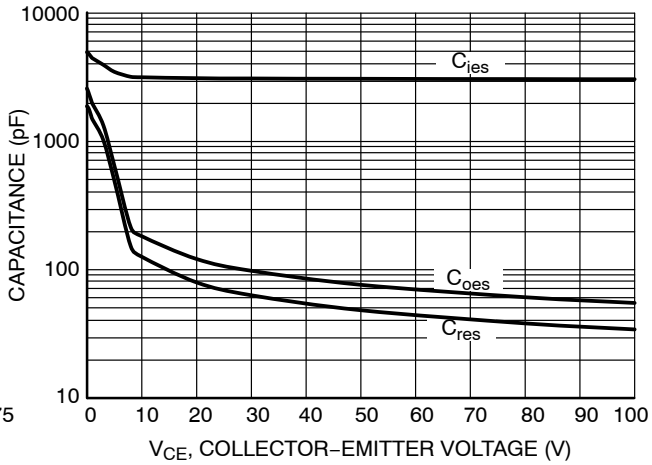


Figure 6. Typical Capacitance

TYPICAL CHARACTERISTICS

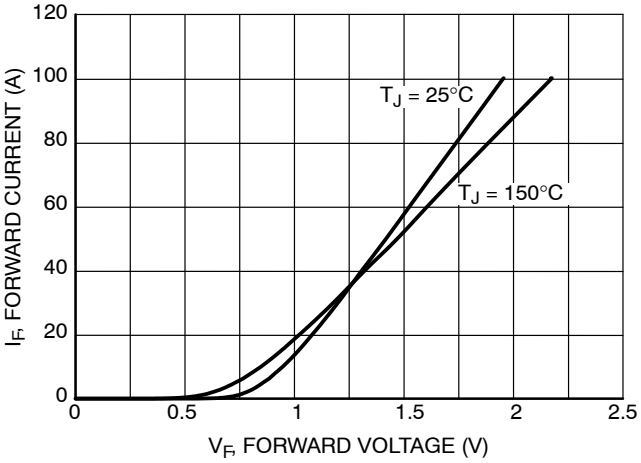


Figure 7. Diode Forward Characteristics

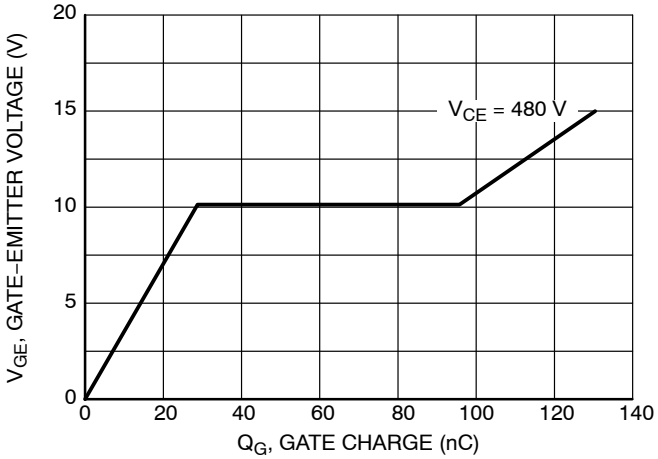


Figure 8. Typical Gate Charge

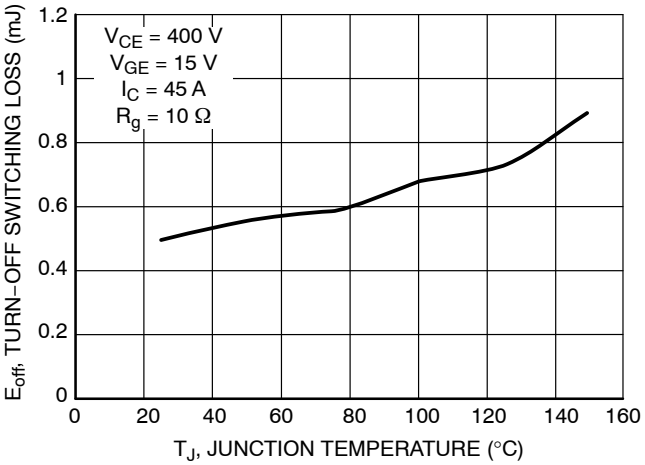


Figure 9. Switching Loss vs. Temperature

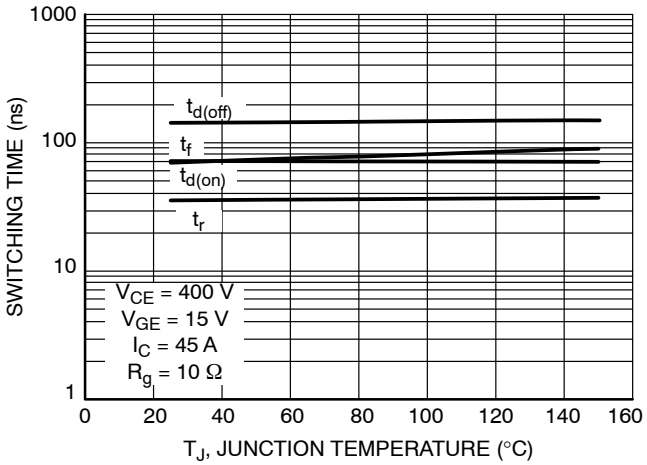


Figure 10. Switching Time vs. Temperature

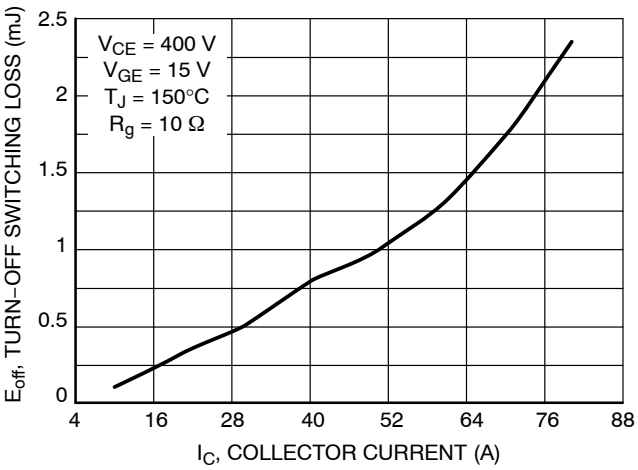


Figure 11. Switching Loss vs. I_C

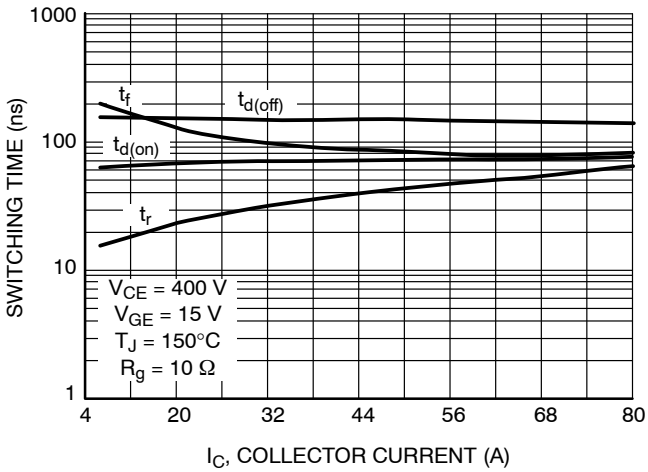


Figure 12. Switching Time vs. Current

TYPICAL CHARACTERISTICS

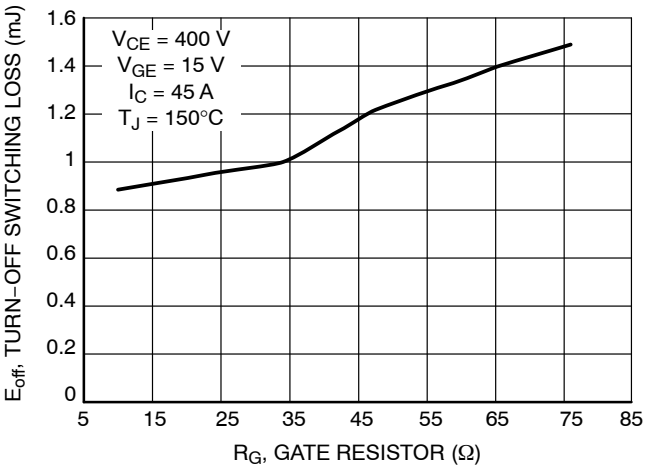


Figure 13. Switching Loss vs. R_G

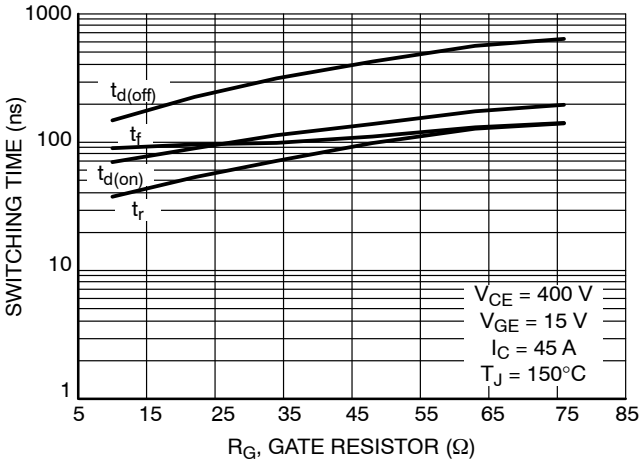


Figure 14. Switching Time vs. R_G

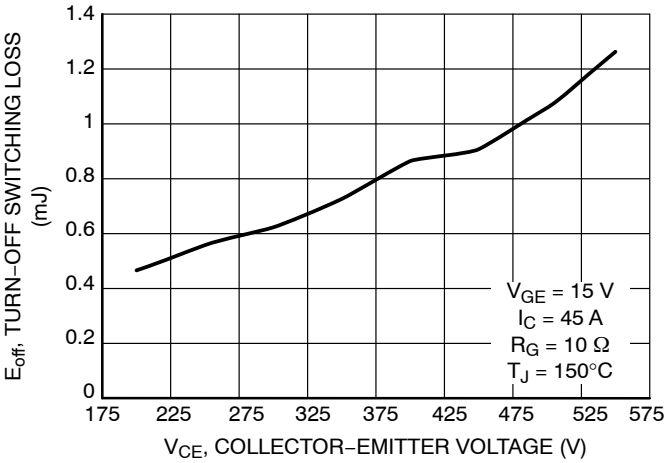


Figure 15. Switching Loss vs. V_{CE}

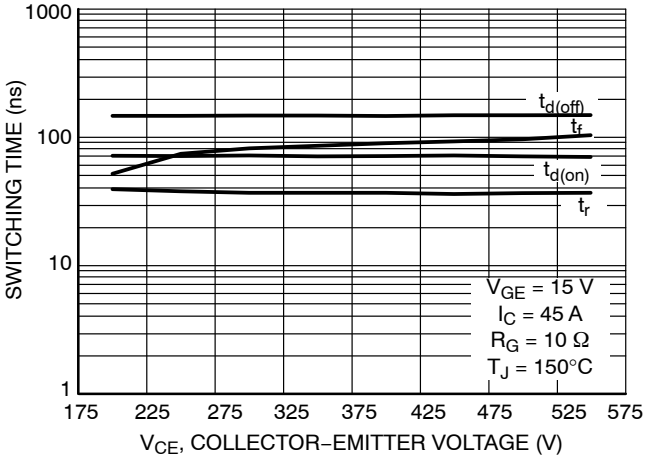


Figure 16. Switching Time vs. V_{CE}

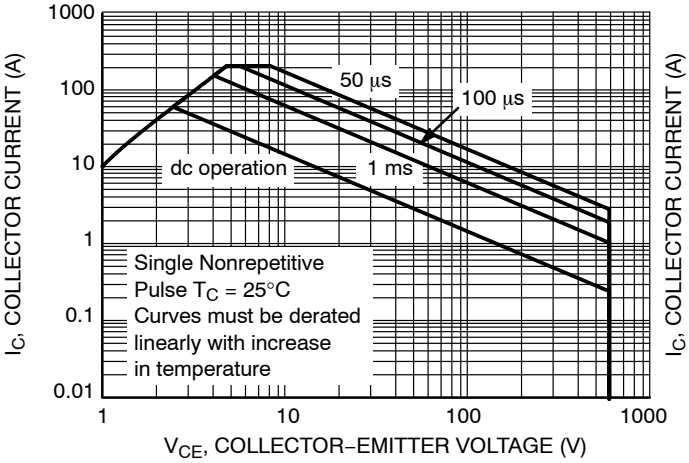


Figure 17. Safe Operating Area

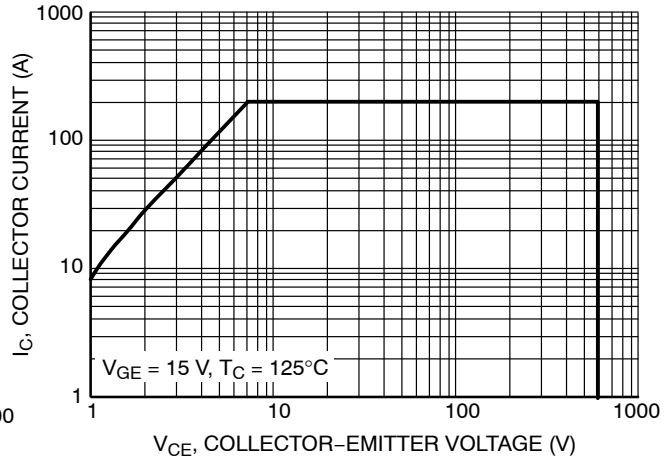
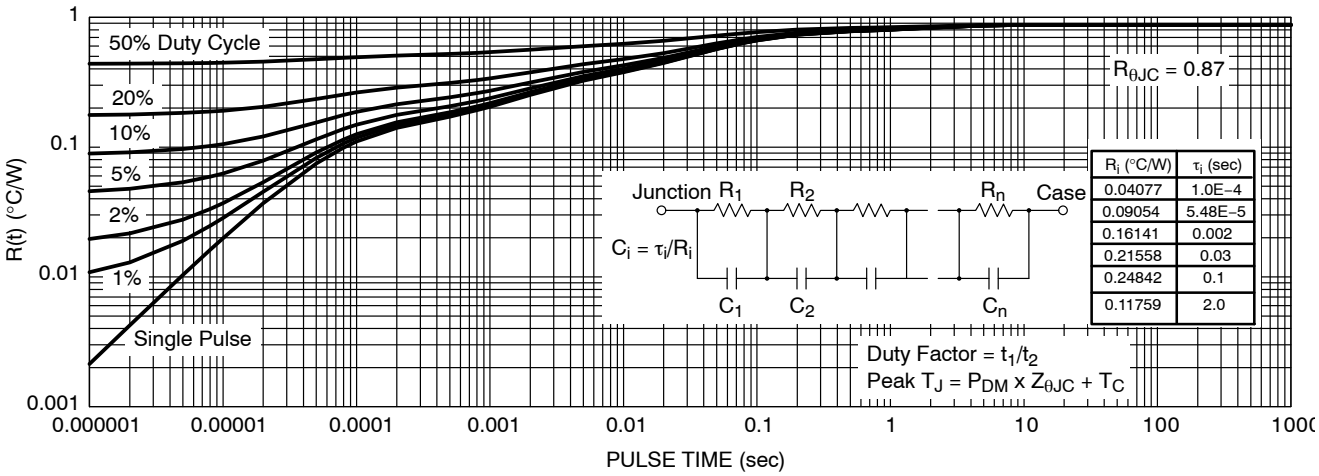


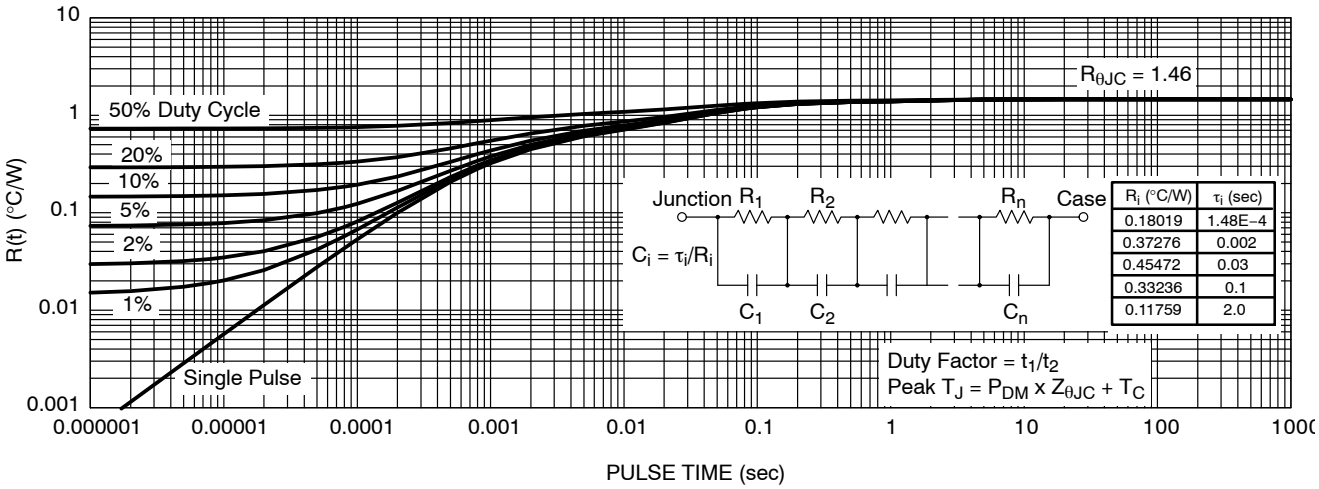
Figure 18. Reverse Bias Safe Operating Area

TYPICAL CHARACTERISTICS



R_i (°C/W)	τ_i (sec)
0.04077	1.0E−4
0.09054	5.48E−5
0.16141	0.002
0.21558	0.03
0.24842	0.1
0.11759	2.0

Figure 19. IGBT Transient Thermal Impedance



R_i (°C/W)	τ_i (sec)
0.18019	1.48E−4
0.37276	0.002
0.45472	0.03
0.33236	0.1
0.11759	2.0

Figure 20. Diode Transient Thermal Impedance

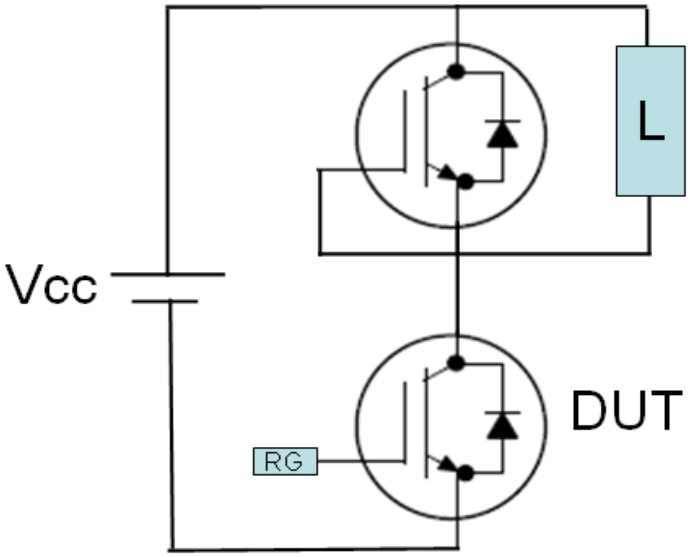


Figure 21. Test Circuit for Switching Characteristics

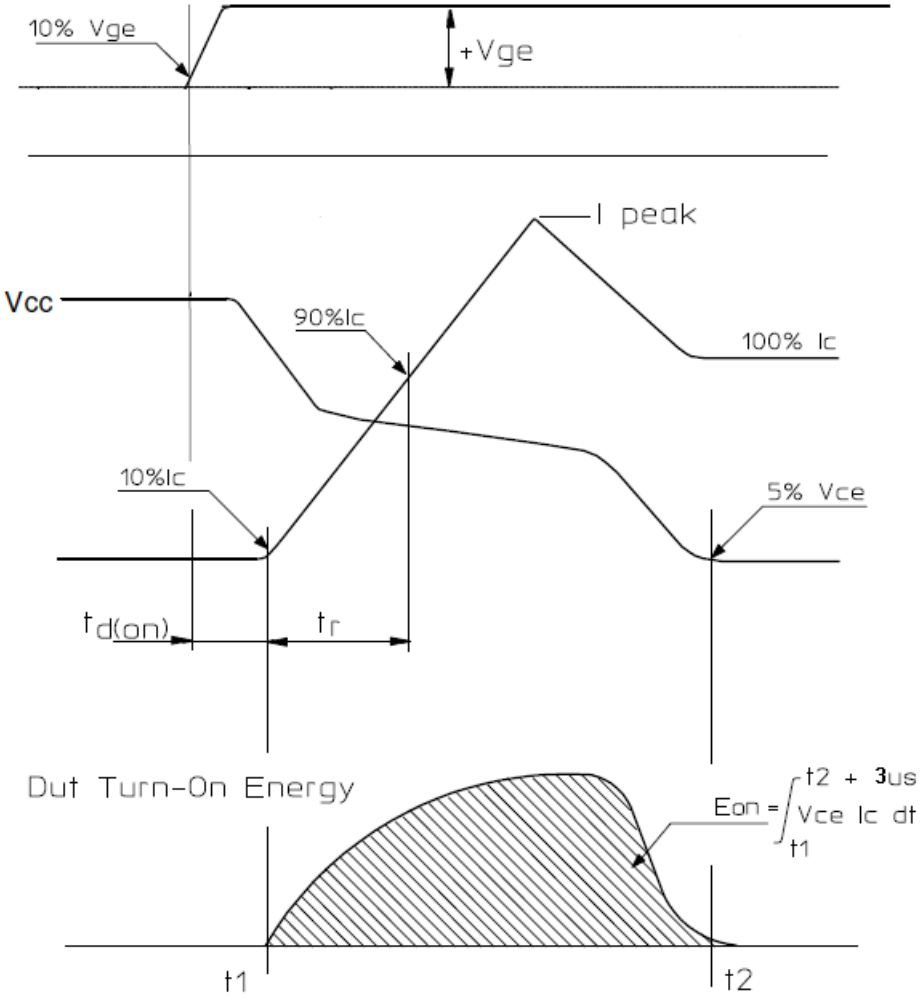


Figure 22. Definition of Turn On Waveform

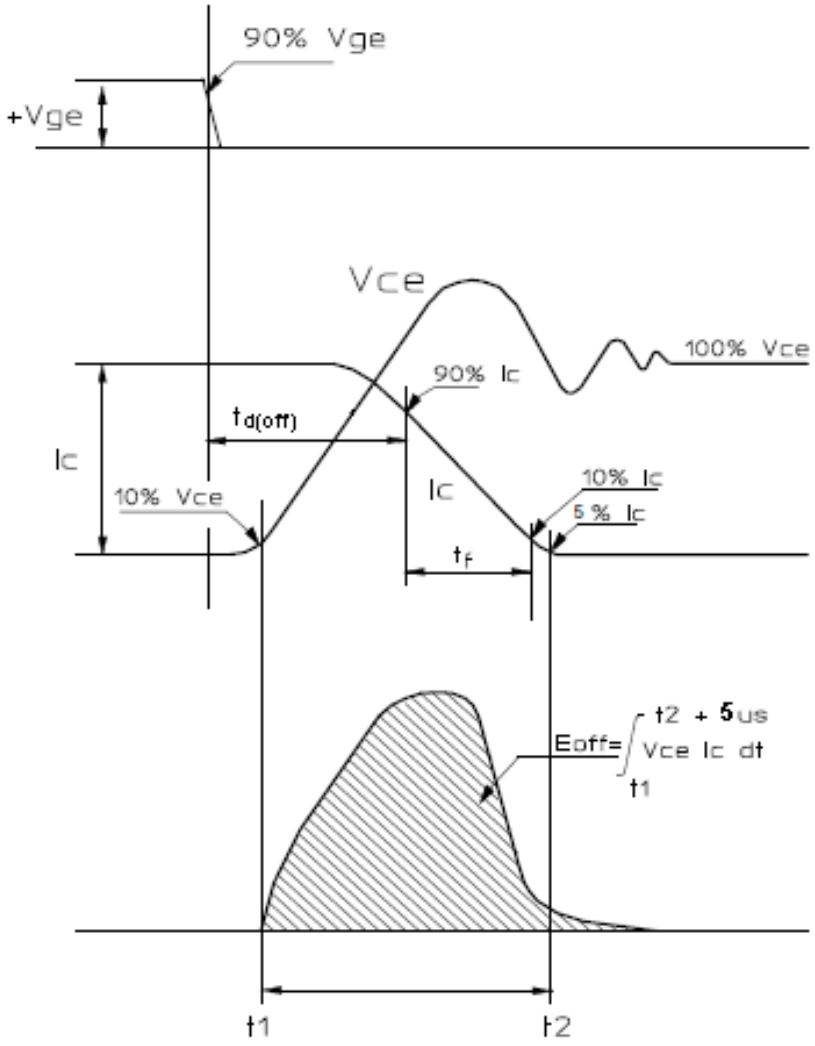
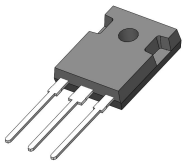
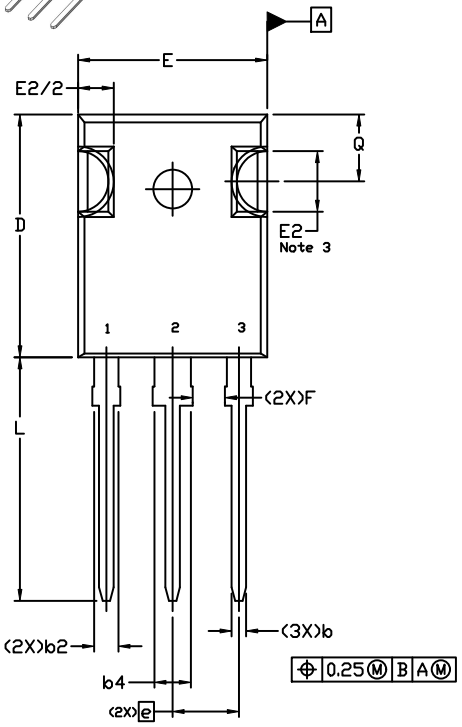


Figure 23. Definition of Turn Off Waveform

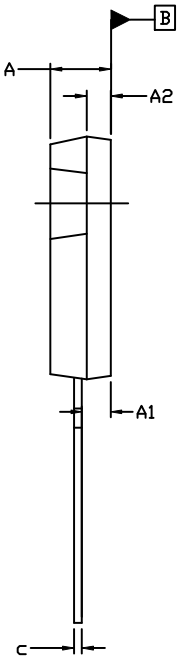
TO−247
CASE 340AM
ISSUE C

DATE 07 SEP 2021

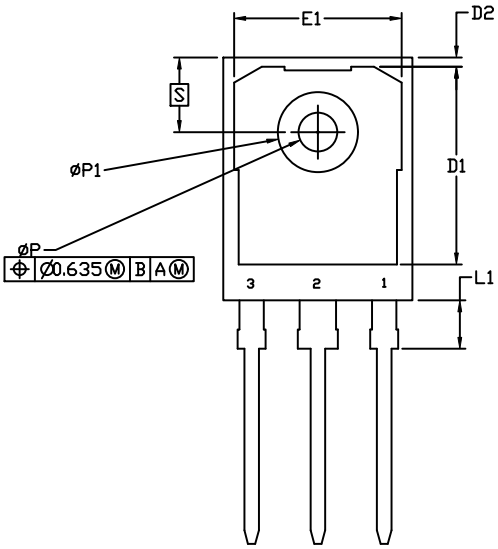




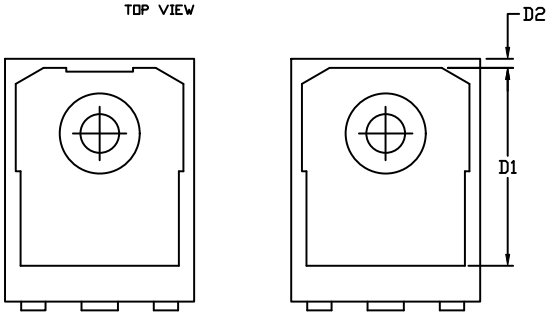
TOP VIEW



SIDE VIEW



BACK VIEW



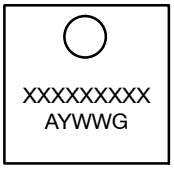
NOTE 4 HEATSINK SHAPES

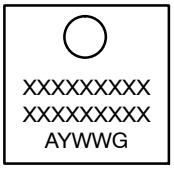
NOTES:

1. DIMENSIONING AND TOLERANCE AS PER ASME Y14.5M, 2009.
2. ALL DIMENSION ARE IN MILLIMETERS.
3. SLOT REQUIRED, NOTCH MAY BE ROUNDED.
4. OPTIONAL BACK SIDE HEATSINK SHAPE.
5. DIMENSIONS ARE EXCLUSIVE OF BURRS AND MOLD FLASH. DIMENSIONS D AND E ARE MEASURED AT THE OUTERMOST EXTREME OF THE PLASTIC BODY.
6. DIMENSIONS A1 TO BE MEASURED IN THE REGION DEFINED BY L1.
7. LEAD FINISH IS UNCONTROLLED IN THE REGION DEFINED BY L1.

DIM	MILLIMETERS		
	MIN	NOM	MAX
A	4.70	5.00	5.30
A1	2.20	2.40	2.60
A2	1.80	2.00	2.20
b	1.07	1.20	1.33
b2	1.65	2.12	2.35
b4	2.60	3.12	3.40
c	0.45	0.60	0.75
D	20.80	21.00	21.34
D1	16.30	---	---
D2	0.75	---	---
E	15.50	16.00	16.25
E1	13.80	---	---
E2	4.32	4.90	5.49
e	5.45 BSC		
F	2.655	---	---
L	19.80	20.00	20.80
L1	3.81	4.20	4.35
P	3.55	3.60	3.65
P1	6.60	---	---
Q	5.40	6.00	6.20
S	6.15 BSC		

GENERIC MARKING DIAGRAMS*





XXXX = Specific Device Code
A = Assembly Location
Y = Year
WW = Work Week
G = Pb−Free Package

*This information is generic. Please refer to device data sheet for actual part marking. Pb−Free indicator, “G” or microdot “▪”, may or may not be present. Some products may not follow the Generic Marking.

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DESCRIPTION:	TO−247	PAGE 1 OF 1

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