IGBT - Field Stop II
NGTB60N65FL2WG

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.

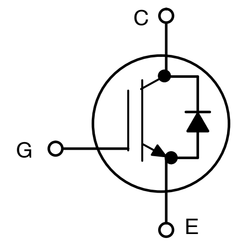
Features

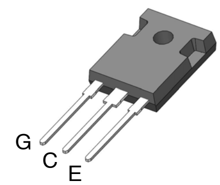
- Extremely Efficient Trench with Field Stop Technology
- T_{Jmax} = 175°C
- Soft Fast Reverse Recovery Diode
- Optimized for High Speed Switching
- 5 μs Short−Circuit Capability
- These are Pb−Free Devices

Typical Applications

- Solar Inverters
- Uninterruptible Power Supplies (UPS)
- Welding

60 A, 650 V
V_{CEsat} = 1.64 V
E_{off} = 0.66 mJ





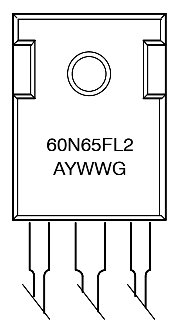
TO−247
CASE 340AM

ABSOLUTE MAXIMUM RATINGS

Rating	Symbol	Value	Unit
Collector−emitter Voltage	V_{CES}	650	V
Collector Current @ T_C = 25°C @ T_C = 100°C	I_C	 100 60	A
Diode Forward Current @ T_C = 25°C @ T_C = 100°C	I_F	 100 60	A
Diode Pulsed Current T_{PULSE} Limited by T_J Max	I_{FM}	240	A
Pulsed Collector Current, T_{pulse} Limited by T_{Jmax}	I_{CM}	240	A
Short−circuit Withstand Time V_{GE} = 15 V, V_{CE} = 400 V, $T_J \leq$ +150°C	t_{SC}	5	μs
Gate−emitter Voltage	V_{GE}	±20	V
Transient Gate−emitter Voltage (T_{PULSE} = 5 μs, D < 0.10)		±30	
Power Dissipation @ T_C = 25°C @ T_C = 100°C	P_D	 595 265	W
Operating Junction Temperature Range	T_J	−55 to +175	°C
Storage Temperature Range	T_{stg}	−55 to +175	°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



60N65FL2 = Specific Device Code
A = Assembly Location
Y = Year
WW = Work Week
G = Pb−Free Package

ORDERING INFORMATION

Device	Package	Shipping
NGTB60N65FL2WG	TO−247 (Pb−Free)	30 Units / Rail

THERMAL CHARACTERISTICS

Rating	Symbol	Value	Unit
Thermal resistance junction−to−case, for IGBT	$R_{\theta JC}$	0.28	°C/W
Thermal resistance junction−to−case, for Diode	$R_{\theta JC}$	0.62	°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	$V_{(BR)CES}$	650	–	–	V
Collector−emitter saturation voltage	V_{GE} = 15 V, I_C = 60 A V_{GE} = 15 V, I_C = 60 A, T_J = 175°C	V_{CEsat}	1.50 –	1.64 2.00	2.00 –	V
Gate−emitter threshold voltage	V_{GE} = V_{CE}, I_C = 350 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 = 175°C	I_{CES}	– –	– 5.0	0.1 –	mA
Gate leakage current, collector−emitter short−circuited	V_{GE} = 20 V , V_{CE} = 0 V	I_{GES}	–	–	200	nA
DYNAMIC CHARACTERISTIC						
Input capacitance	V_{CE} = 20 V, V_{GE} = 0 V, f = 1 MHz	C_{ies}	–	7193	–	pF
Output capacitance		C_{oes}	–	311	–	
Reverse transfer capacitance		C_{res}	–	202	–	
Gate charge total	V_{CE} = 480 V, I_C = 60 A, V_{GE} = 15 V	Q_g	–	318	–	nC
Gate to emitter charge		Q_{ge}	–	65	–	
Gate to collector charge		Q_{gc}	–	163	–	
SWITCHING CHARACTERISTIC, INDUCTIVE LOAD						
Turn−on delay time	T_J = 25°C V_{CC} = 400 V, I_C = 60 A R_g = 10 Ω V_{GE} = 0 V/ 15 V	$t_{d(on)}$	–	117	–	ns
Rise time		t_r	–	53	–	
Turn−off delay time		$t_{d(off)}$	–	265	–	
Fall time		t_f	–	75	–	
Turn−on switching loss		E_{on}	–	1.59	–	mJ
Turn−off switching loss		E_{off}	–	0.66	–	
Total switching loss		E_{ts}	–	2.25	–	
Turn−on delay time	T_J = 150°C V_{CC} = 400 V, I_C = 60 A R_g = 10 Ω V_{GE} = 0 V/ 15 V	$t_{d(on)}$	–	113	–	ns
Rise time		t_r	–	55	–	
Turn−off delay time		$t_{d(off)}$	–	277	–	
Fall time		t_f	–	1.0	–	
Turn−on switching loss		E_{on}	–	2.0	–	mJ
Turn−off switching loss		E_{off}	–	1.1	–	
Total switching loss		E_{ts}	–	3.1	–	
DIODE CHARACTERISTIC						
Forward voltage	V_{GE} = 0 V, I_F = 60 A V_{GE} = 0 V, I_F = 60 A, T_J = 175°C	V_F	1.50 –	2.13 2.26	2.80 –	V
Reverse recovery time	T_J = 25°C I_F = 60 A, V_R = 400 V di_F/dt = 200 A/μs	t_{rr}	–	96	–	ns
Reverse recovery charge		Q_{rr}	–	0.39	–	μC
Reverse recovery current		I_{rrm}	–	6.8	–	A
Reverse recovery time	T_J = 175°C I_F = 60 A, V_R = 400 V di_F/dt = 200 A/μs	t_{rr}	–	177	–	ns
Reverse recovery charge		Q_{rr}	–	1.53	–	μC
Reverse recovery current		I_{rrm}	–	13	–	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

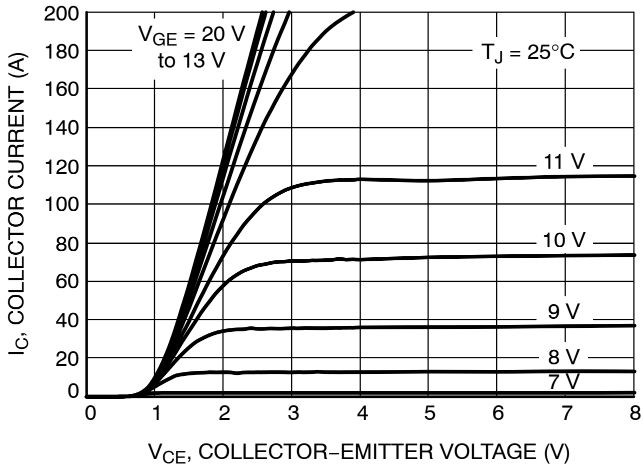


Figure 1. Output Characteristics

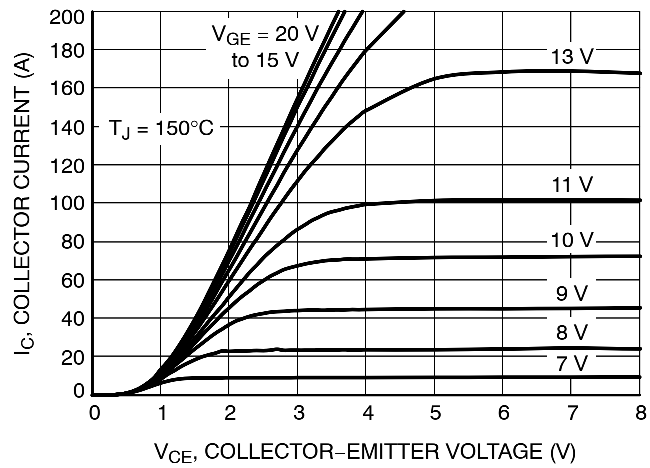


Figure 2. Output Characteristics

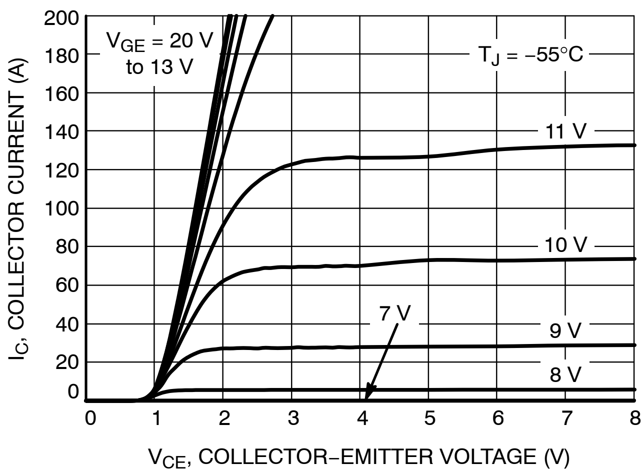


Figure 3. Output Characteristics

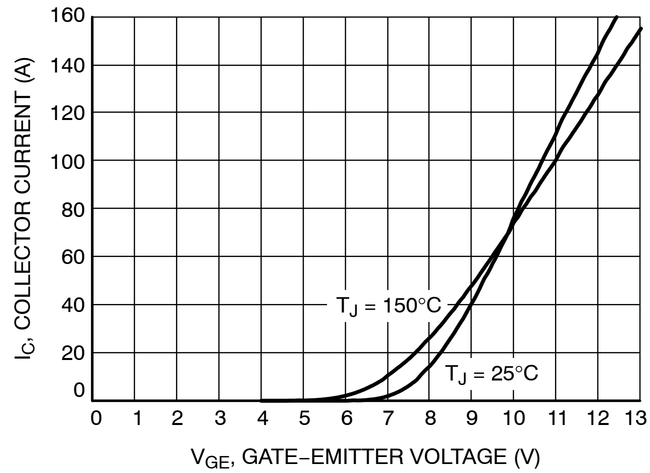


Figure 4. Typical Transfer Characteristics

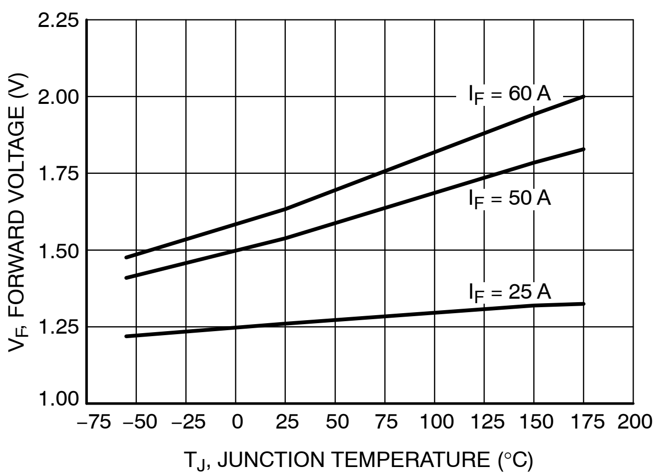


Figure 5. V_F vs. T_J

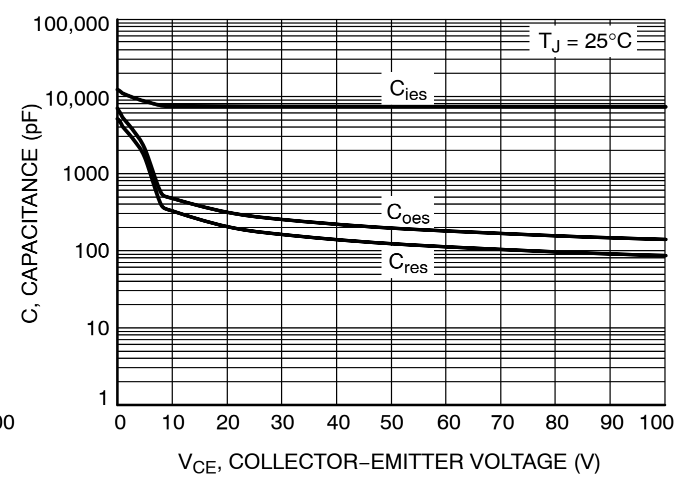


Figure 6. Typical Capacitance

TYPICAL CHARACTERISTICS

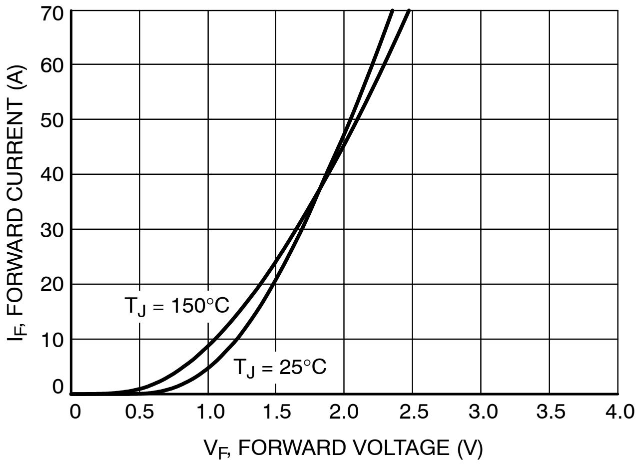


Figure 7. Diode Forward Characteristics

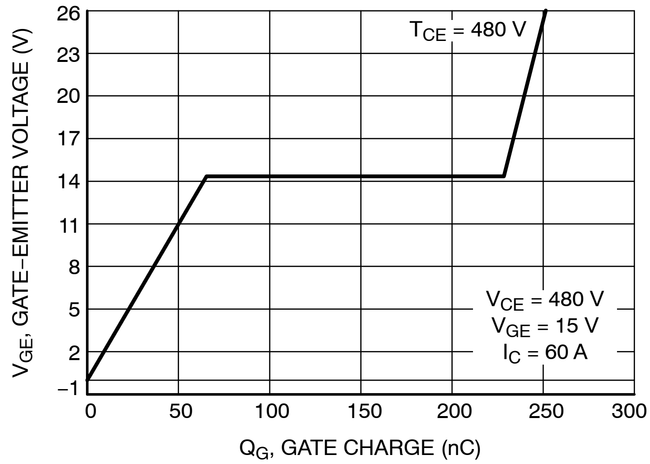


Figure 8. Typical Gate Charge

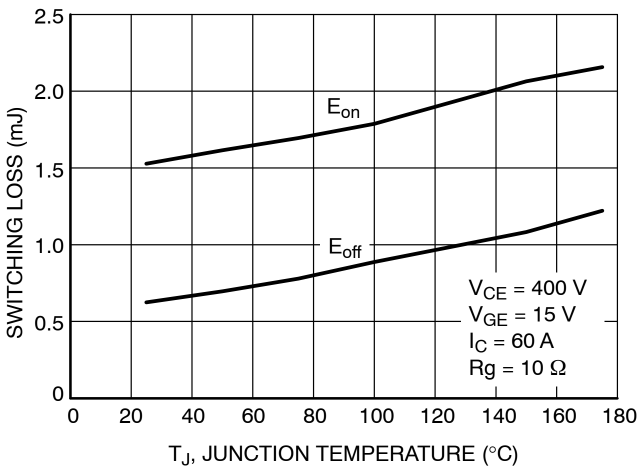


Figure 9. Switching Loss vs. Temperature

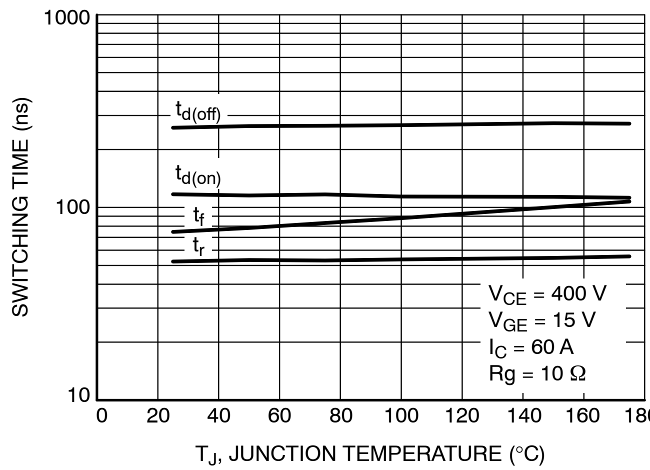


Figure 10. Switching Time vs. Temperature

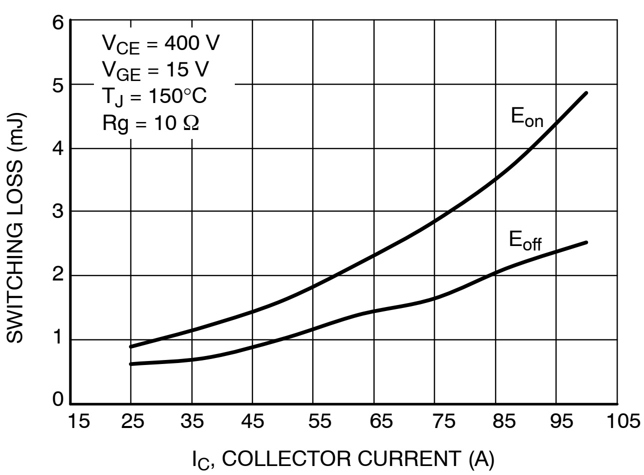


Figure 11. Switching Loss vs. I_C

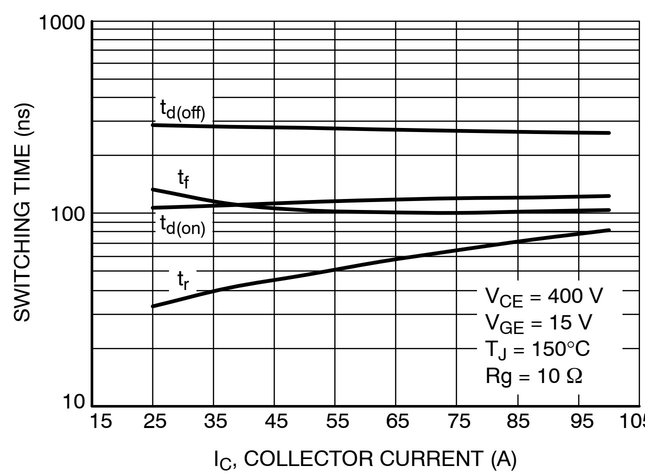


Figure 12. Switching Time vs. I_C

TYPICAL CHARACTERISTICS

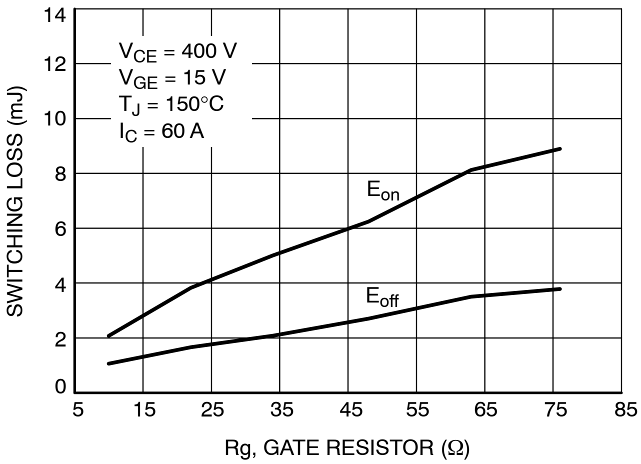


Figure 13. Switching Loss vs. Rg

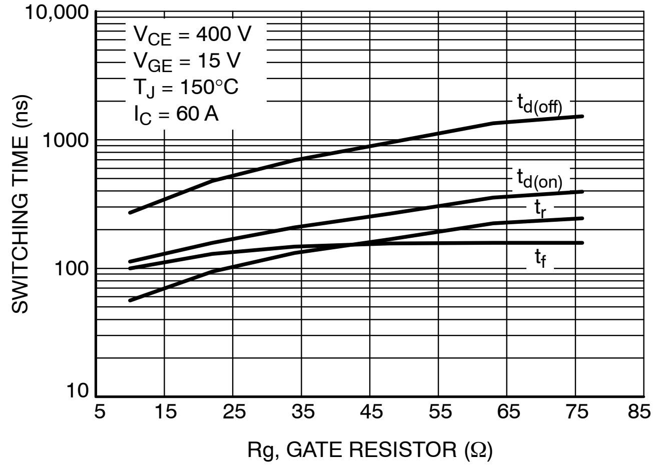


Figure 14. Switching Time vs. Rg

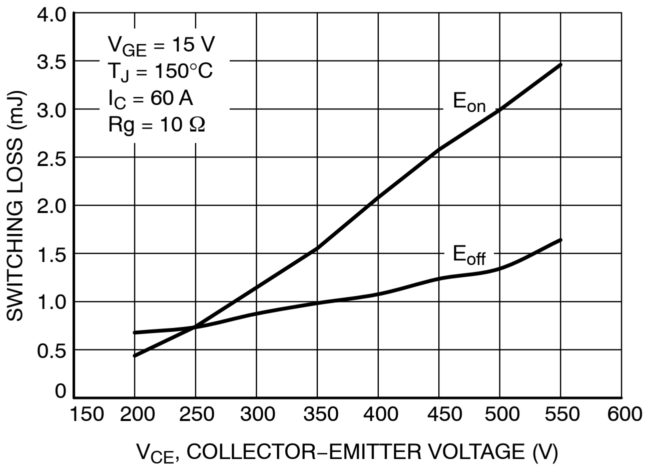


Figure 15. Switching Loss vs. V_{CE}

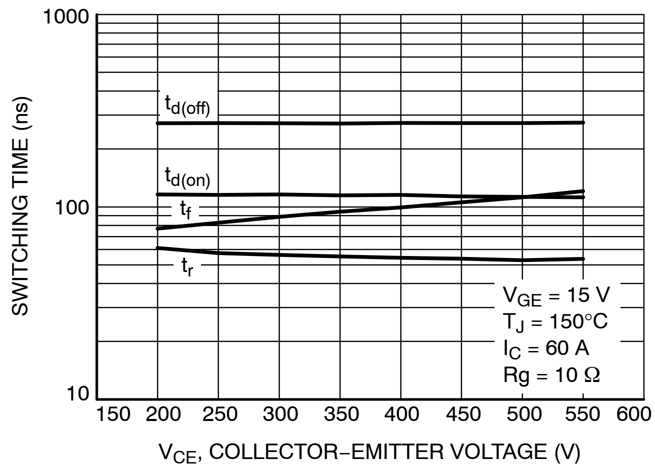


Figure 16. Switching Time vs. V_{CE}

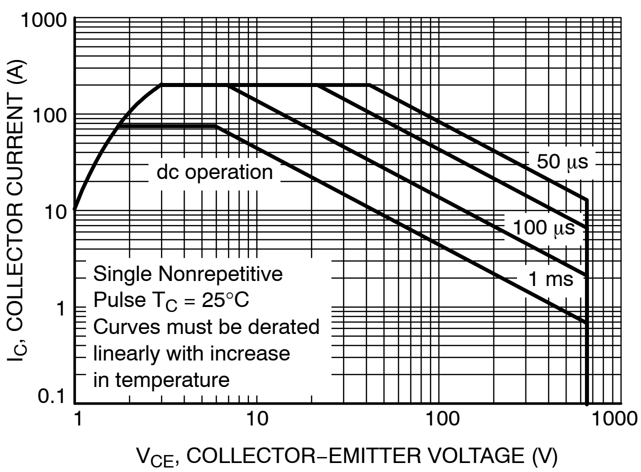


Figure 17. Safe Operating Area

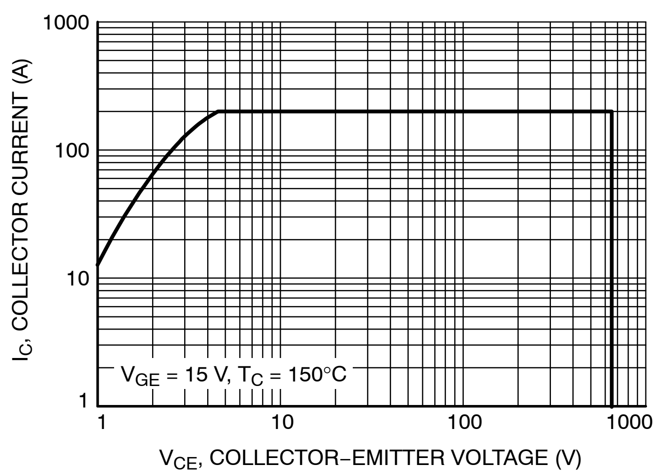


Figure 18. Reverse Bias Safe Operating Area

TYPICAL CHARACTERISTICS

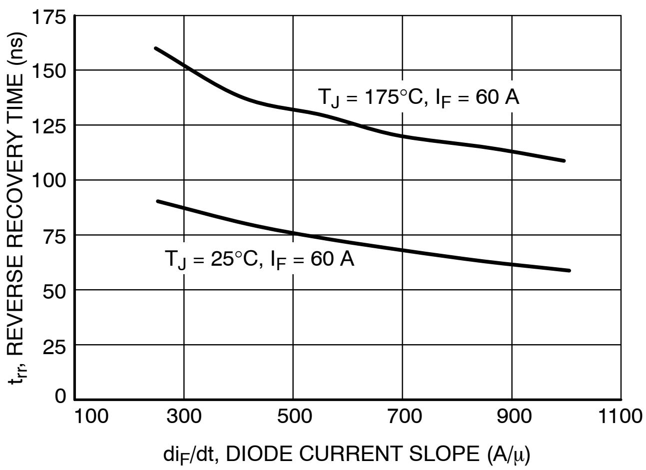


Figure 19. t_{rr} vs. di_F/dt (V_R = 400 V)

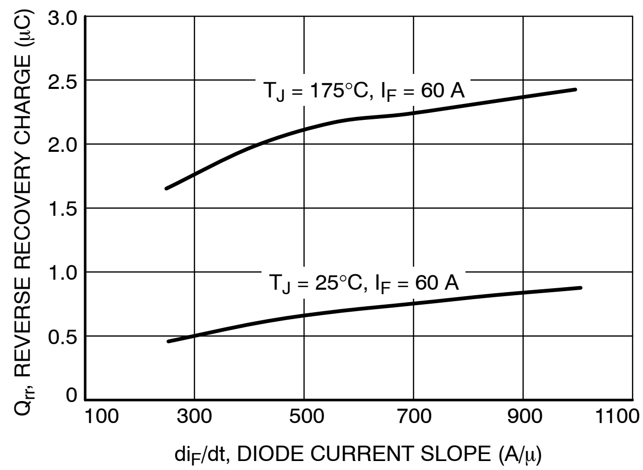


Figure 20. Q_{rr} vs. di_F/dt (V_R = 400 V)

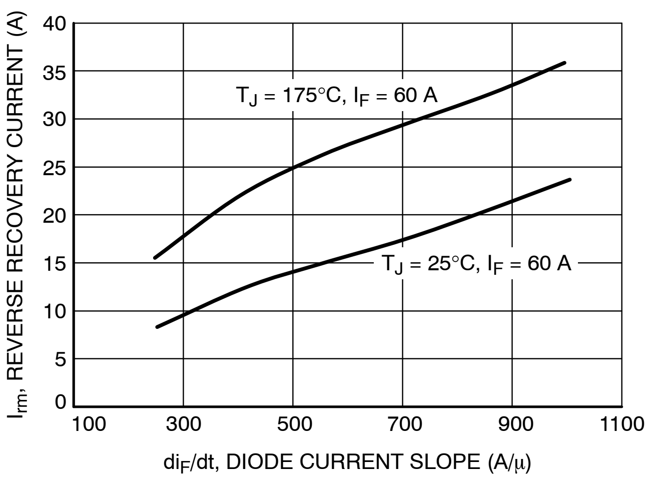


Figure 21. I_{rm} vs. di_F/dt (V_R = 400 V)

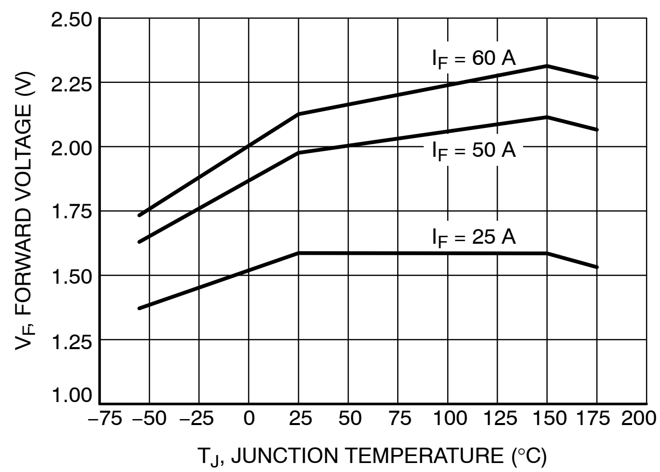
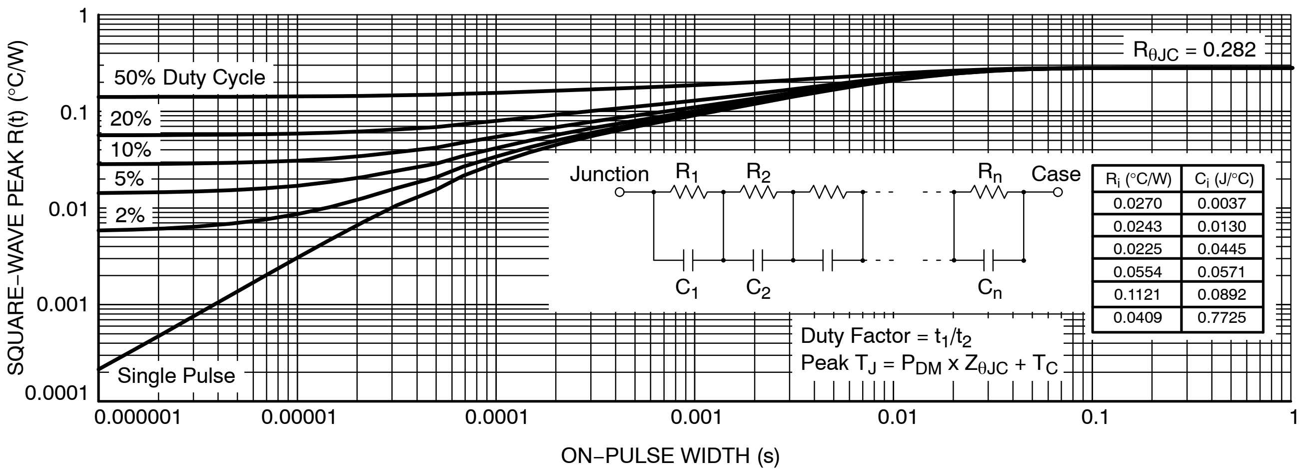


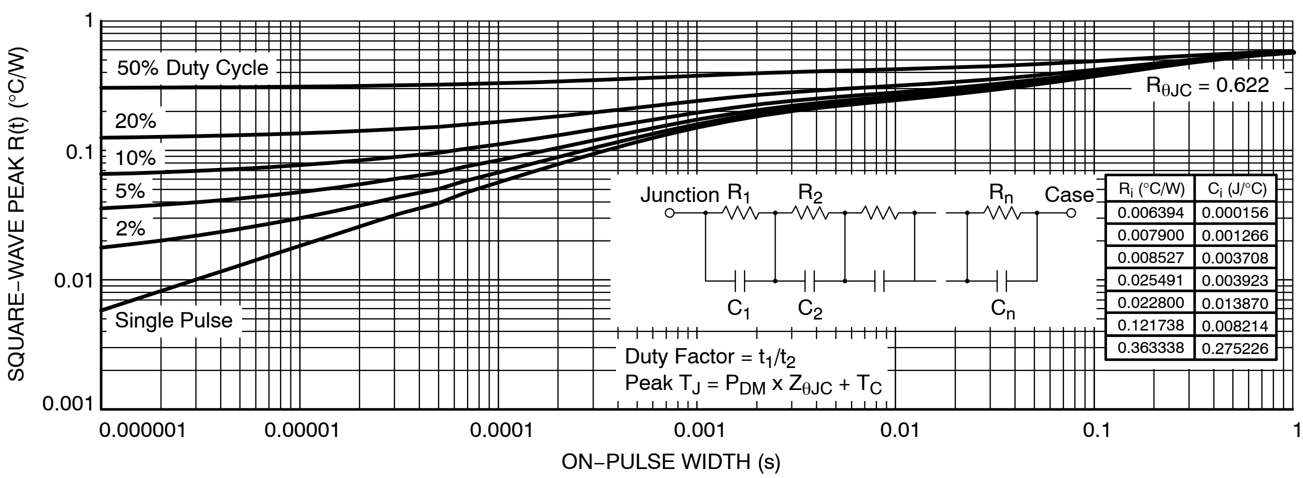
Figure 22. V_F vs. T_J

TYPICAL CHARACTERISTICS



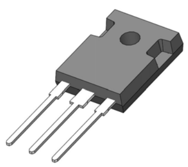
R_i (°C/W)	C_i (J/°C)
0.0270	0.0037
0.0243	0.0130
0.0225	0.0445
0.0554	0.0571
0.1121	0.0892
0.0409	0.7725

Figure 23. IGBT Transient Thermal Impedance



R_i (°C/W)	C_i (J/°C)
0.006394	0.000156
0.007900	0.001266
0.008527	0.003708
0.025491	0.003923
0.022800	0.013870
0.121738	0.008214
0.363338	0.275226

Figure 24. Diode Transient Thermal Impedance



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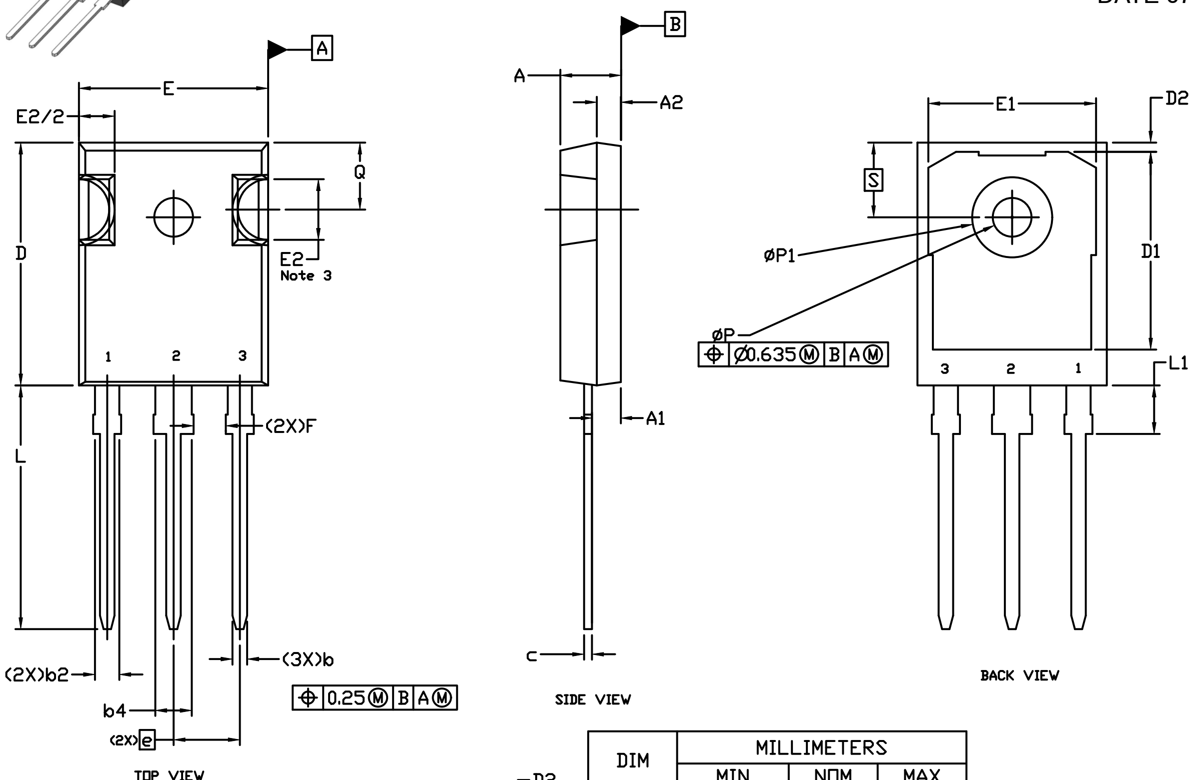
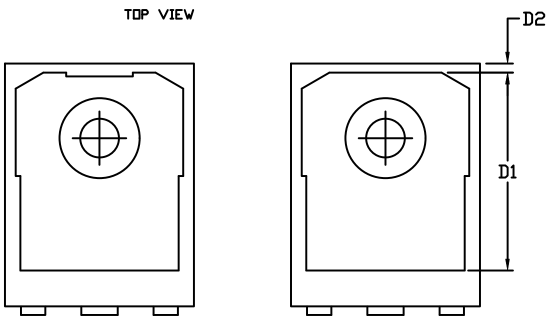
ISSUE C

DATE 07 SEP 2021





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*

XXXXXXXXX
AYWWG

XXXXXXXXX
XXXXXXXXX
AYWWG

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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