IGBT - Field Stop

600 V, 60 A

FGH60N60SMD

Description

Using novel field stop IGBT technology, ON Semiconductor's new series of field stop 2nd generation IGBTs offer the optimum performance for solar inverter, UPS, welder, telecom, ESS and PFC applications where low conduction and switching losses are essential.

Features

- Maximum Junction Temperature: T_J = 175°C
- Positive Temperature Co−efficient for easy Parallel Operating
- High Current Capability
- Low Saturation Voltage: $V_{CE(sat)}$ = 1.9 V (Typ.) @ I_C = 60 A
- High Input Impedance
- Fast Switching: E_{OFF} = 7.5 uJ/A
- Tightened Parameter Distribution
- This Device is Pb−Free and is RoHS Compliant

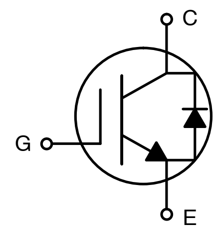
Applications

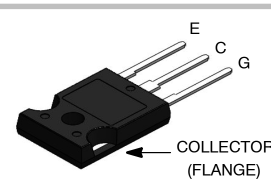
- Solar Inverter, UPS, Welder, PFC, Telecom, ESS

ON Semiconductor®

www.onsemi.com

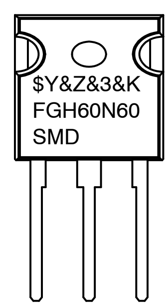
V_{CES}	I_C
600 V	60 A





TO−247−3LD
CASE 340CK

MARKING DIAGRAM



$Y	= ON Semiconductor Logo
&Z	= Assembly Plant Code
&3	= Numeric Date Code
&K	= Lot Code
FGH60N60SMD	= Specific Device Code

ORDERING INFORMATION

See detailed ordering and shipping information on page 2 of this data sheet.

ABSOLUTE MAXIMUM RATINGS

Symbol	Description		Ratings	Unit
V_{CES}	Collector to Emitter Voltage		600	V
V_{GES}	Gate to Emitter Voltage		±20	V
	Transient Gate to Emitter Voltage		±30	V
I_C	Collector Current	T_C = 25°C	120	A
		T_C = 100°C	60	A
I_{CM} (Note 1)	Pulsed Collector Current		180	A
I_F	Diode Forward Current	T_C = 25°C	60	A
		T_C = 100°C	30	A
I_{FM} (Note 1)	Pulsed Diode Maximum Forward Current		180	A
P_D	Maximum Power Dissipation	T_C = 25°C	600	W
		T_C = 100°C	300	W
T_J	Operating Junction Temperature		−55 to +175	°C
T_{STG}	Storage Temperature Range		−55 to +175	°C
T_L	Maximum Lead Temp. for Soldering Purposes, 1/8” from Case for 5 Seconds		300	°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.

1. Repetitive rating: Pulse width limited by max. junction temperature.

THERMAL CHARACTERISTICS

Symbol	Parameter	Typ.	Max.	Unit
$R_{\theta JC}$ (IGBT)	Thermal Resistance, Junction to Case	–	0.25	°C/W
$R_{\theta JC}$ (Diode)	Thermal Resistance, Junction to Case	–	1.1	°C/W
$R_{\theta JA}$	Thermal Resistance, Junction to Ambient	–	40	°C/W

PACKAGE MARKING AND ORDERING INFORMATION

Part Number	Top Mark	Package	Packing Method	Reel Size	Tape Width	Qty per Tube
FGH60N60SMD	FGH60N60SMD	TO−247	Tube	N/A	N/A	30

ELECTRICAL CHARACTERISTICS OF THE IGBT (T_C = 25°C unless otherwise noted)

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
OFF CHARACTERISTICS						
BV_{CES}	Collector to Emitter Breakdown Voltage	V_{GE} = 0 V, I_C = 250 μA	600	–	–	V
$\Delta BV_{CES} / \Delta T_J$	Temperature Coefficient of Breakdown Voltage	V_{GE} = 0 V, I_C = 250 μA	–	0.6	–	V/°C
I_{CES}	Collector Cut−Off Current	$V_{CE} = V_{CES}$, V_{GE} = 0 V	–	–	250	μA
I_{GES}	G−E Leakage Current	$V_{GE} = V_{GES}$, V_{CE} = 0 V	–	–	±400	nA
ON CHARACTERISTICS						
$V_{GE(th)}$	G−E Threshold Voltage	I_C = 250 μA, $V_{CE} = V_{GE}$	3.5	4.5	6.0	V
$V_{CE(sat)}$	Collector to Emitter Saturation Voltage	I_C = 60 A, V_{GE} = 15 V,	–	1.9	2.5	V
		I_C = 60 A, V_{GE} = 15 V, T_C = 175°C	–	2.1	–	V
DYNAMIC CHARACTERISTICS						
C_{ies}	Input Capacitance	V_{CE} = 30 V, V_{GE} = 0 V, f = 1 MHz	–	2915	–	pF
C_{oes}	Output Capacitance		–	270	–	pF
C_{res}	Reverse Transfer Capacitance		–	85	–	pF
SWITCHING CHARACTERISTICS						
$T_{d(on)}$	Turn−On Delay Time	V_{CC} = 400 V, I_C = 60 A, R_G = 3 Ω, V_{GE} = 15 V, Inductive Load, T_C = 25°C	–	18	27	ns
T_r	Rise Time		–	47	70	ns
$T_{d(off)}$	Turn−Off Delay Time		–	104	146	ns
T_f	Fall Time		–	50	68	ns
E_{on}	Turn−On Switching Loss		–	1.26	1.94	mJ
E_{off}	Turn−Off Switching Loss		–	0.45	0.6	mJ
E_{ts}	Total Switching Loss		–	1.71	2.54	mJ
$T_{d(on)}$	Turn−On Delay Time	V_{CC} = 400 V, I_C = 60 A, R_G = 3 Ω, V_{GE} = 15 V, Inductive Load, T_C = 175°C	–	18	–	ns
T_r	Rise Time		–	41	–	ns
$T_{d(off)}$	Turn−Off Delay Time		–	115	–	ns
T_f	Fall Time		–	48	–	ns
E_{on}	Turn−On Switching Loss		–	2.1	–	mJ
E_{off}	Turn−Off Switching Loss		–	0.78	–	mJ
E_{ts}	Total Switching Loss		–	2.88	–	mJ
Q_g	Total Gate Charge	V_{CE} = 400 V, I_C = 60 A, V_{GE} = 15 V	–	189	284	nC
Q_{ge}	Gate to Emitter Charge		–	20	30	nC
Q_{gc}	Gate to Collector Charge		–	91	137	nC

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.

ELECTRICAL CHARACTERISTICS OF THE DIODE (T_C = 25°C unless otherwise noted)

Symbol	Parameter	Test Conditions		Min	Typ	Max	Unit
V_{FM}	Diode Forward Voltage	I_F = 30 A	T_C = 25°C	–	2.1	2.7	V
			T_C = 175°C	–	1.7	–	
E_{rec}	Reverse Recovery Energy	I_F = 30 A, di_F/dt = 200 A/μs	T_C = 175°C	–	79	–	uJ
T_{rr}	Diode Reverse Recovery Time		T_C = 25°C	–	30	39	ns
			T_C = 175°C	–	72	–	
Q_{rr}	Diode Reverse Recovery Charge		T_C = 25°C	–	44	62	nC
			T_C = 175°C	–	238	–	

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 PERFORMANCE CHARACTERISTICS

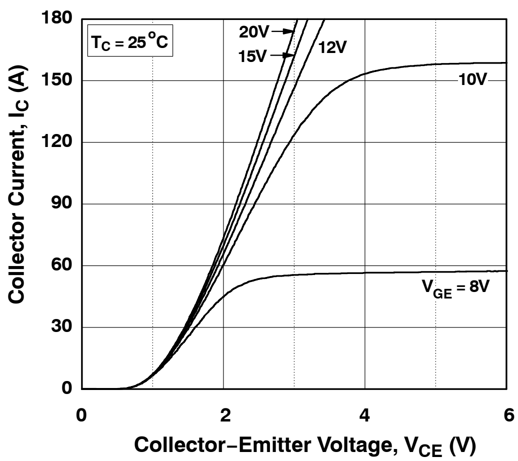


Figure 1. Typical Output Characteristics

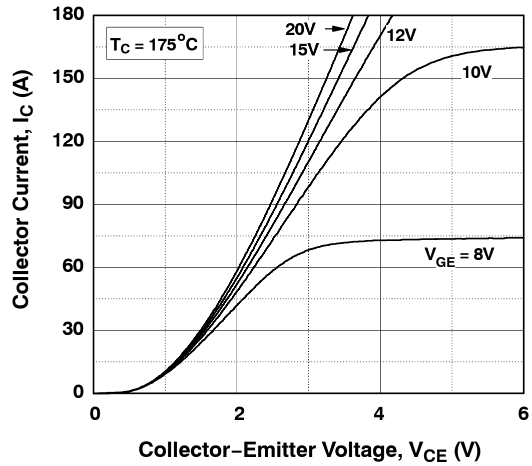


Figure 2. Typical Output Characteristics

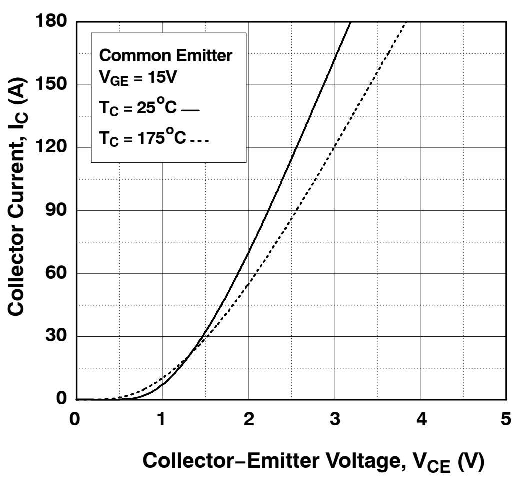


Figure 3. Typical Saturation Voltage Characteristics

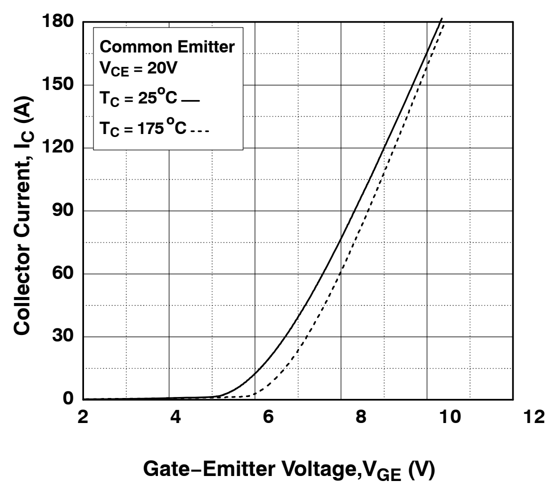


Figure 4. Transfer Characteristics

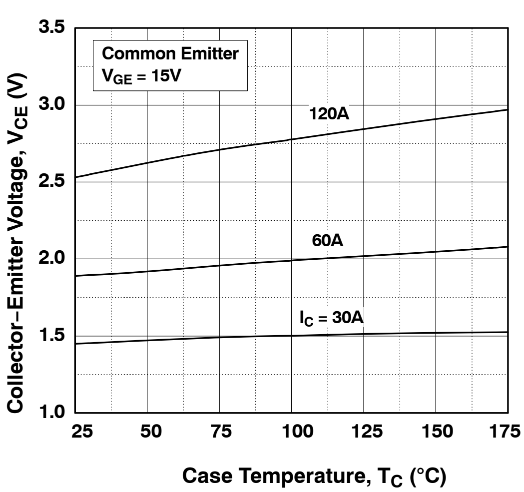


Figure 5. Saturation Voltage vs. Case Temperature at Variant Current Level

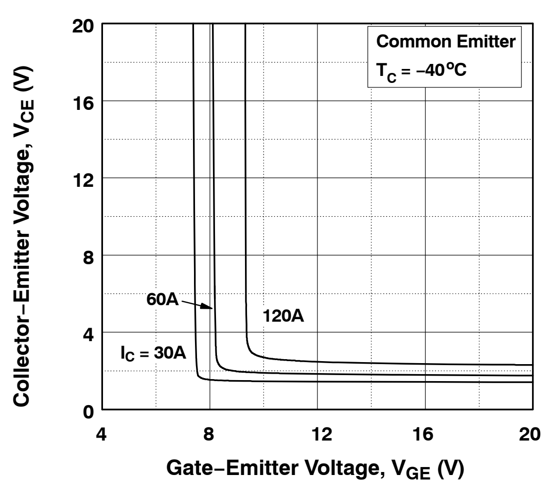


Figure 6. Saturation Voltage vs. V_{GE}

TYPICAL PERFORMANCE CHARACTERISTICS (Continued)

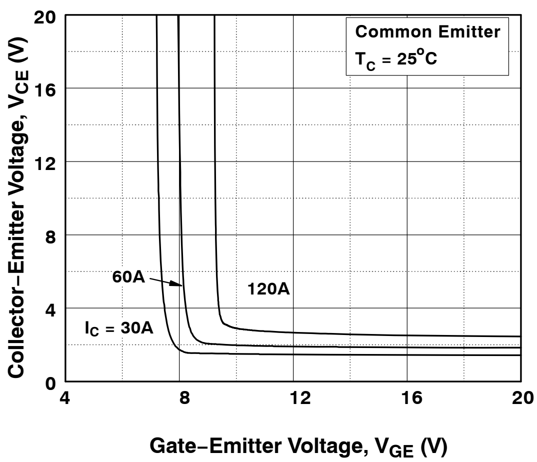


Figure 7. Saturation Voltage vs. V_{GE}

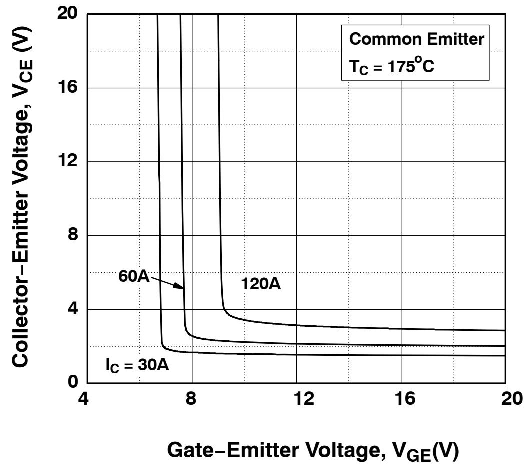


Figure 8. Saturation Voltage vs. V_{GE}

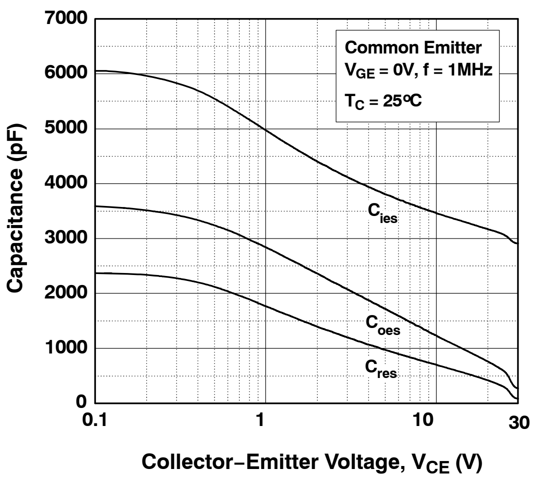


Figure 9. Capacitance Characteristics

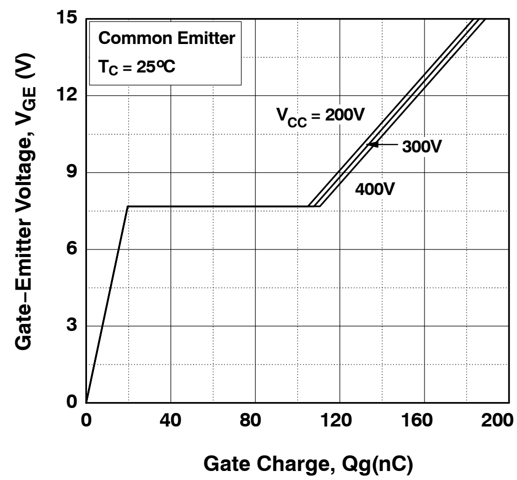


Figure 10. Gate Charge Characteristics

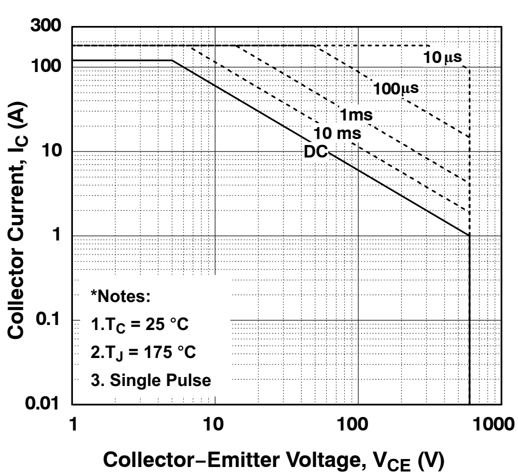


Figure 11. SOA Characteristics

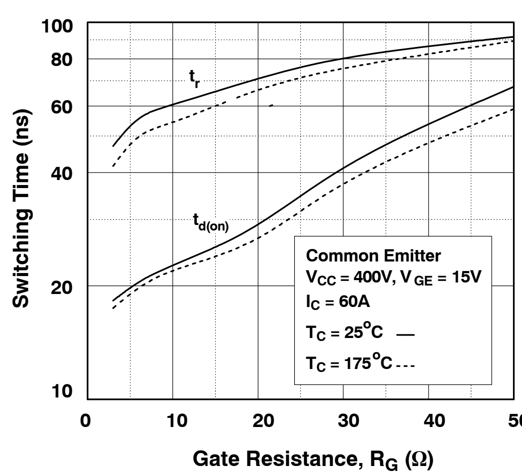


Figure 12. Turn−on Characteristics vs. Gate Resistance

TYPICAL PERFORMANCE CHARACTERISTICS (Continued)

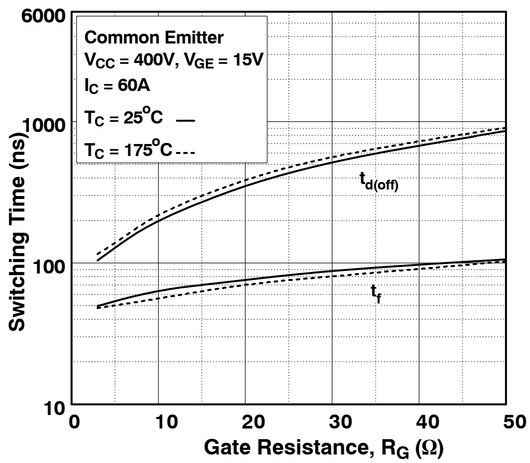


Figure 13. Turn−off Characteristics vs. Gate Resistance

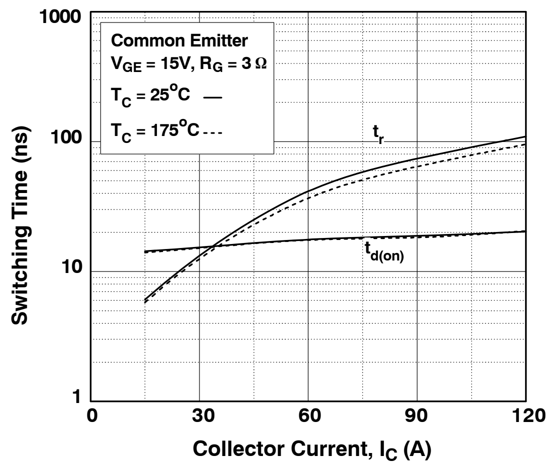


Figure 14. Turn−on Characteristics vs. Collector Current

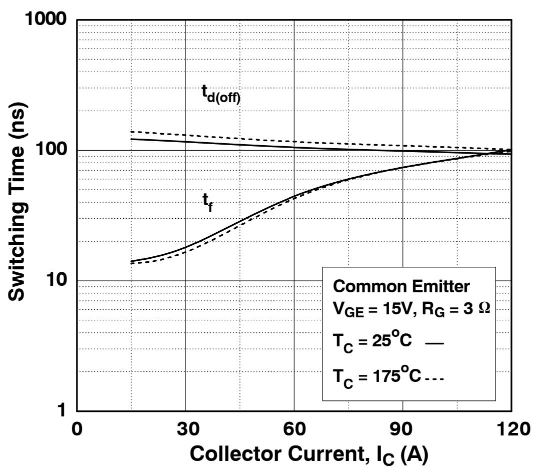


Figure 15. Turn−off Characteristics vs. Collector Current

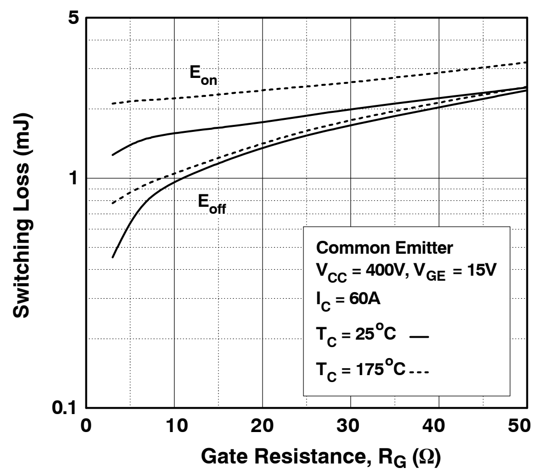


Figure 16. Switching Loss vs. Gate Resistance

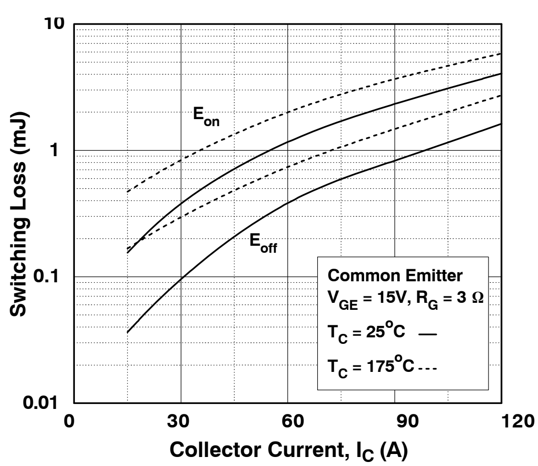


Figure 17. Switching Loss vs. Collector Current

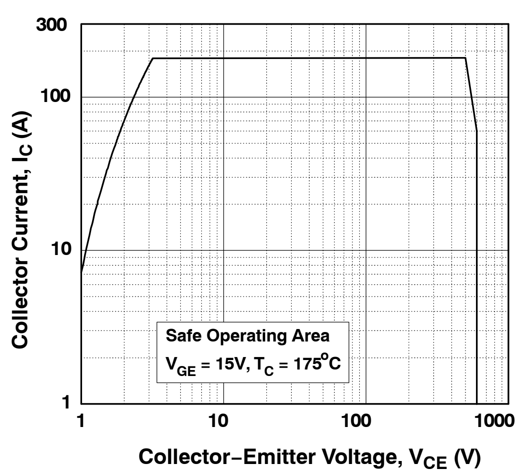


Figure 18. Turn Off Switching SOA Characteristics

TYPICAL PERFORMANCE CHARACTERISTICS (Continued)

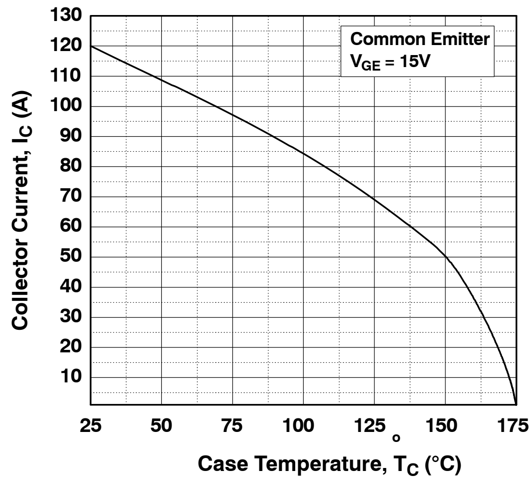


Figure 19. Current Derating

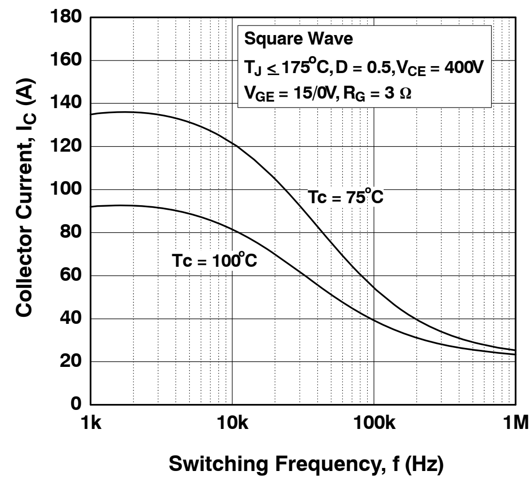


Figure 20. Load Current vs. Frequency

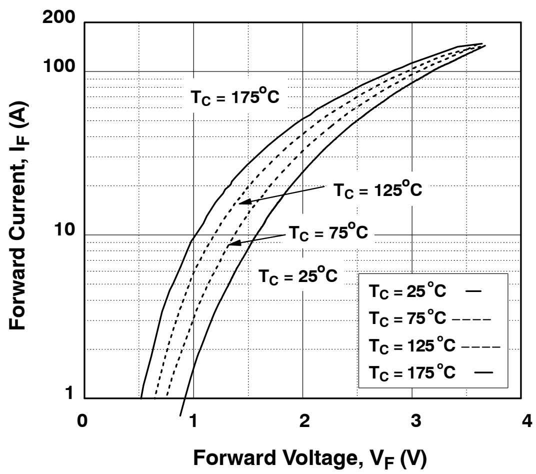


Figure 21. Forward Characteristics

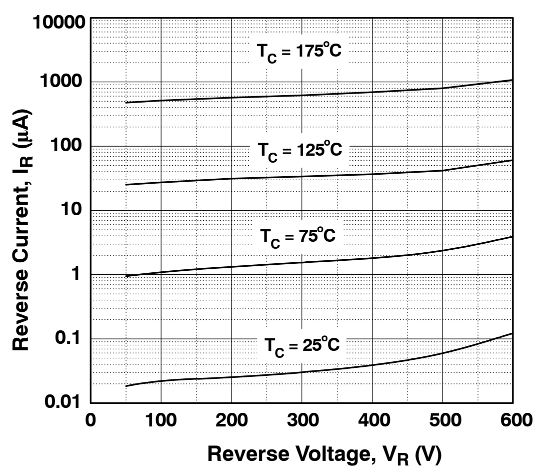


Figure 22. Reverse Current

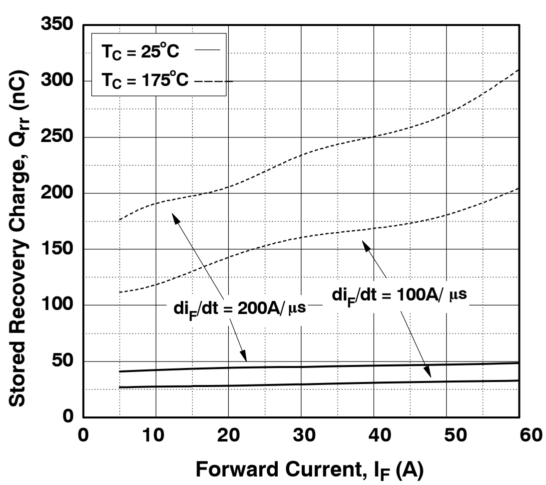


Figure 23. Stored Charge

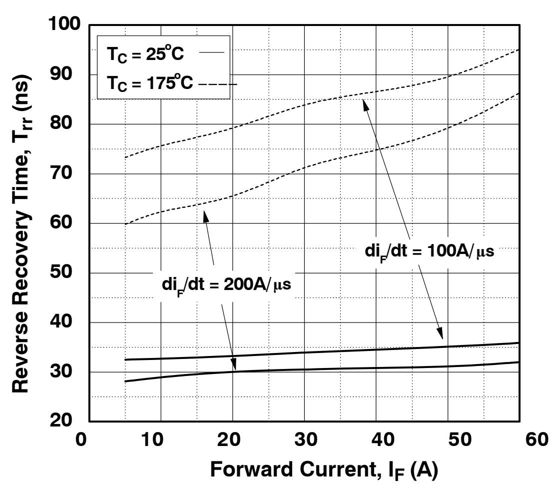


Figure 24. Reverse Recovery Time

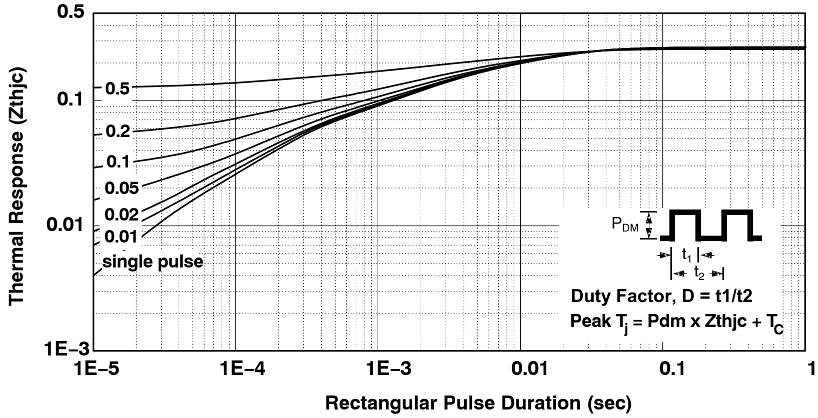


Figure 25. Transient Thermal Impedance of IGBT

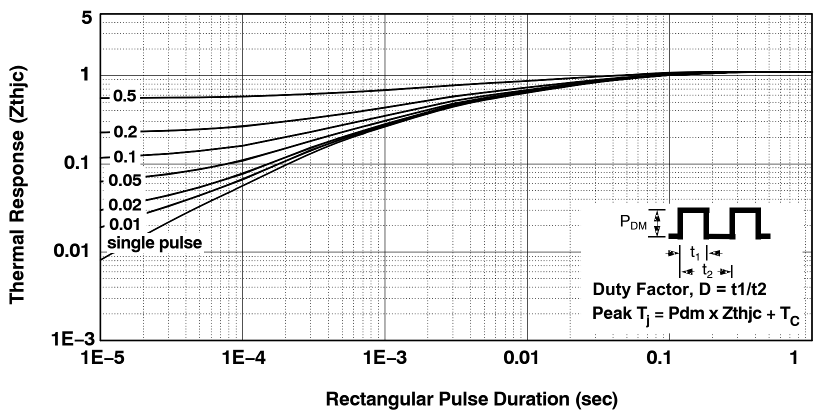
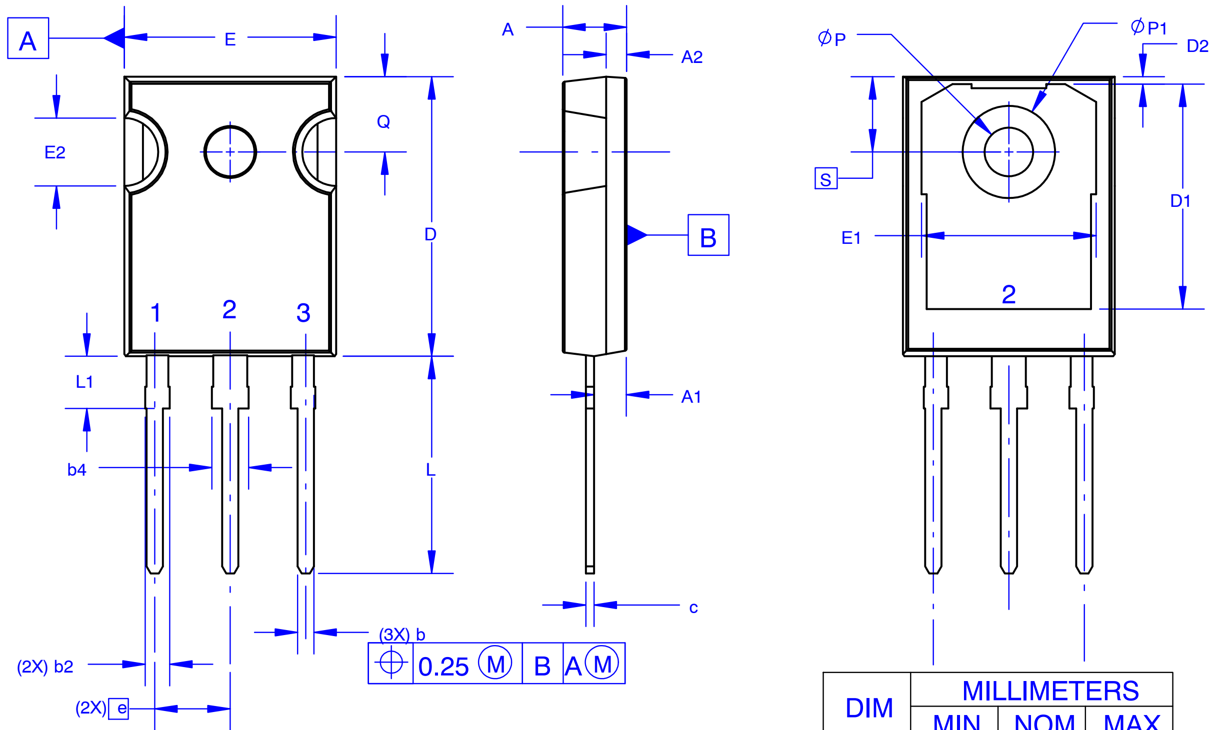


Figure 26. Transient Thermal Impedance of Diode

TO−247−3LD SHORT LEAD
CASE 340CK
ISSUE A

DATE 31 JAN 2019



NOTES: UNLESS OTHERWISE SPECIFIED.

A. DIMENSIONS ARE EXCLUSIVE OF BURRS, MOLD FLASH, AND TIE BAR EXTRUSIONS.
B. ALL DIMENSIONS ARE IN MILLIMETERS.
C. DRAWING CONFORMS TO ASME Y14.5 - 2009.
D. DIMENSION A1 TO BE MEASURED IN THE REGION DEFINED BY L1.
E. LEAD FINISH IS UNCONTROLLED IN THE REGION DEFINED BY L1.

DIM	MILLIMETERS		
	MIN	NOM	MAX
A	4.58	4.70	4.82
A1	2.20	2.40	2.60
A2	1.40	1.50	1.60
b	1.17	1.26	1.35
b2	1.53	1.65	1.77
b4	2.42	2.54	2.66
c	0.51	0.61	0.71
D	20.32	20.57	20.82
D1	13.08	~	~
D2	0.51	0.93	1.35
E	15.37	15.62	15.87
E1	12.81	~	~
E2	4.96	5.08	5.20
e	~	5.56	~
L	15.75	16.00	16.25
L1	3.69	3.81	3.93
ØP	3.51	3.58	3.65
ØP1	6.60	6.80	7.00
Q	5.34	5.46	5.58
S	5.34	5.46	5.58

GENERIC MARKING DIAGRAM*

AYWWZZ
XXXXXXX
XXXXXXX

XXXX = Specific Device Code
A = Assembly Location
Y = Year
WW = Work Week
ZZ = Assembly Lot Code

*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−247−3LD SHORT LEAD	PAGE 1 OF 1

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