

IGBT - Field Stop

600 V, 40 A

FGH40N60SMDF

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: $T_J = 175^{\circ}\text{C}$
- Positive Temperature Co-efficient for Easy Parallel Operating
- High Current Capability
- Low Saturation Voltage: $V_{CE(sat)} = 1.9\text{ V (Typ.) @ } I_C = 40\text{ A}$
- High Input Impedance
- Fast Switching: $E_{OFF} = 6.5\ \mu\text{J/A}$
- Tightened Parameter Distribution
- This Device is Pb-Free, Halogen Free/BFR Free and is RoHS Compliant

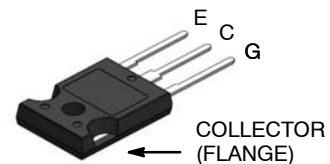
Applications

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



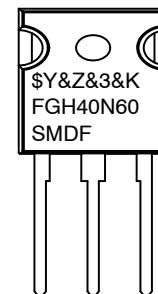
ON Semiconductor®

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TO-247-3LD
CASE 340CK

MARKING DIAGRAMS



\$Y	= ON Semiconductor Logo
&Z	= Assembly Plant Code
&3	= Numeric Date Code
&K	= Lot Code
FGH40N60SMDF	= Specific Device Code

ORDERING INFORMATION

See detailed ordering and shipping information in the package dimensions section on page 2 of this data sheet.

FGH40N60SMDF

ABSOLUTE MAXIMUM RATINGS ($T_C = 25^\circ\text{C}$, unless otherwise specified)

Parameter	Symbol	Ratings	Unit
Collector to Emitter Voltage	V_{CES}	600	V
Gate to Emitter Voltage	V_{GES}	± 20	V
Collector Current	I_C	$T_C = 25^\circ\text{C}$ 80	A
Collector Current		$T_C = 100^\circ\text{C}$ 40	A
Pulsed Collector Current (Note 1)	I_{CM}	$T_C = 25^\circ\text{C}$ 120	A
Maximum Power Dissipation	P_D	$T_C = 25^\circ\text{C}$ 349	W
Maximum Power Dissipation		$T_C = 100^\circ\text{C}$ 174	W
Operating Junction Temperature	T_J	-55 to +175	$^\circ\text{C}$
Storage Temperature Range	T_{stg}	-55 to +175	$^\circ\text{C}$
Maximum Lead Temp. for Soldering Purposes, 1/8" from Case for 5 Seconds	T_L	300	$^\circ\text{C}$

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.

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

THERMAL CHARACTERISTICS

Characteristic	Symbol	Value	Unit
Thermal Resistance, Junction to Case (IGBT)	$R_{\theta JC}$	0.43	$^\circ\text{C/W}$
Thermal Resistance, Junction to Case (Diode)	$R_{\theta JC}$	1.45	$^\circ\text{C/W}$
Thermal Resistance, Junction to Ambient	$R_{\theta JA}$	40	$^\circ\text{C/W}$

PACKAGE MARKING AND ORDERING INFORMATION

Device Marking	Device	Package	Reel Size	Tape Width	Quantity
FGH40N60SMDF	FGH40N60SMDF	TO-247-3LD	N/A	N/A	30

ELECTRICAL CHARACTERISTICS OF THE IGBT ($T_C = 25^\circ\text{C}$ unless otherwise noted)

Parameter	Symbol	Test Conditions	Min	Typ	Max	Unit
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OFF CHARACTERISTICS

Collector to Emitter Breakdown Voltage	BV_{CES}	$V_{GE} = 0\text{ V}, I_C = 250\ \mu\text{A}$	600	-	-	V
Temperature Coefficient of Breakdown Voltage	$\Delta BV_{CES} / \Delta T_J$	$V_{GE} = 0\text{ V}, I_C = 250\ \mu\text{A}$	-	0.6	-	$\text{V}/^\circ\text{C}$
Collector Cut-Off Current	I_{CES}	$V_{CE} = V_{CES}, V_{GE} = 0\text{ V}$	-	-	250	μA
G-E Leakage Current	I_{GES}	$V_{GE} = V_{GES}, V_{CE} = 0\text{ V}$	-	-	± 400	nA

ON CHARACTERISTICS

G-E Threshold Voltage	$V_{GE(th)}$	$I_C = 250\ \mu\text{A}, V_{CE} = V_{GE}$	3.5	4.6	6.0	V
Collector to Emitter Saturation Voltage	$V_{CE(sat)}$	$I_C = 40\text{ A}, V_{GE} = 15\text{ V}$	-	1.9	2.5	V
		$I_C = 40\text{ A}, V_{GE} = 15\text{ V}, T_C = 150^\circ\text{C}$	-	2.1	-	V

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ELECTRICAL CHARACTERISTICS OF THE IGBT ($T_C = 25^\circ\text{C}$ unless otherwise noted) (continued)

Parameter	Symbol	Test Conditions	Min	Typ	Max	Unit
DYNAMIC CHARACTERISTICS						
Input Capacitance	C_{ies}	$V_{CE} = 30\text{ V}, V_{GE} = 0\text{ V}, f = 1\text{ MHz}$	–	1880	–	pF
Output Capacitance	C_{oes}		–	180	–	pF
Reverse Transfer Capacitance	C_{res}		–	50	–	pF
SWITCHING CHARACTERISTICS						
Turn-On Delay Time	$t_{d(on)}$	$V_{CC} = 400\text{ V}, I_C = 40\text{ A},$ $R_G = 6\ \Omega, V_{GE} = 15\text{ V},$ Inductive Load, $T_C = 25^\circ\text{C}$	–	12	–	ns
Rise Time	t_r		–	20	–	ns
Turn-Off Delay Time	$t_{d(off)}$		–	92	–	ns
Fall Time	t_f		–	13	20	ns
Turn-On Switching Loss	E_{on}		–	1.3	–	mJ
Turn-Off Switching Loss	E_{off}		–	0.26	–	mJ
Total Switching Loss	E_{ts}		–	1.56	–	mJ
Turn-On Delay Time	$t_{d(on)}$	$V_{CC} = 400\text{ V}, I_C = 40\text{ A},$ $R_G = 6\ \Omega, V_{GE} = 15\text{ V},$ Inductive Load, $T_C = 150^\circ\text{C}$	–	12	–	ns
Rise Time	t_r		–	19	–	ns
Turn-Off Delay Time	$t_{d(off)}$		–	97	–	ns
Fall Time	t_f		–	14	21	ns
Turn-On Switching Loss	E_{on}		–	2.09	–	mJ
Turn-Off Switching Loss	E_{off}		–	0.44	–	mJ
Total Switching Loss	E_{ts}		–	2.53	–	mJ
Total Gate Charge	Q_g	$V_{CE} = 400\text{ V}, I_C = 40\text{ A},$ $V_{GE} = 15\text{ V}$	–	119	–	nC
Gate to Emitter Charge	Q_{ge}		–	13	–	nC
Gate to Collector Charge	Q_{gc}		–	58	–	nC

ELECTRICAL CHARACTERISTICS OF THE DIODE ($T_C = 25^\circ\text{C}$ unless otherwise noted)

Parameter	Symbol	Test Conditions	Min	Typ	Max	Unit	
Diode Forward Voltage	V_{FM}	$I_F = 20\text{ A}$	$T_C = 25^\circ\text{C}$	–	1.3	1.7	V
			$T_C = 150^\circ\text{C}$	–	1.2	–	
Diode Reverse Recovery Time	t_{rr}	$I_F = 20\text{ A},$ $di_F/dt = 200\text{ A}/\mu\text{s}$	$T_C = 25^\circ\text{C}$	–	70	90	ns
			$T_C = 150^\circ\text{C}$	–	126	–	
Diode Reverse Recovery Charge	Q_{rr}		$T_C = 25^\circ\text{C}$	–	207	290	nC
			$T_C = 150^\circ\text{C}$	–	638	–	

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.

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TYPICAL PERFORMANCE CHARACTERISTICS

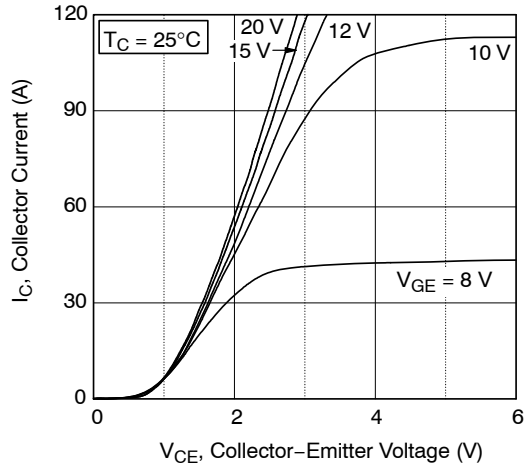


Figure 1. Typical Output Characteristics

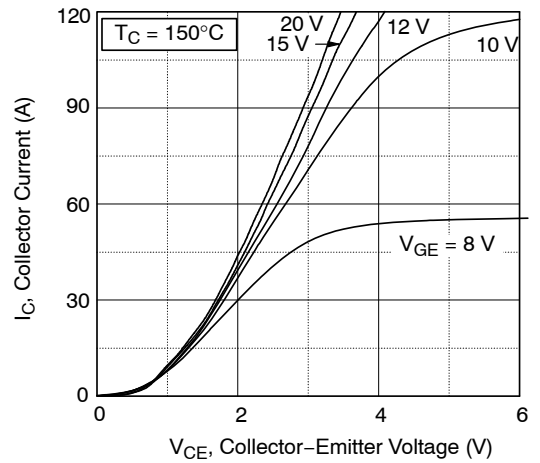


Figure 2. Typical Output Characteristics

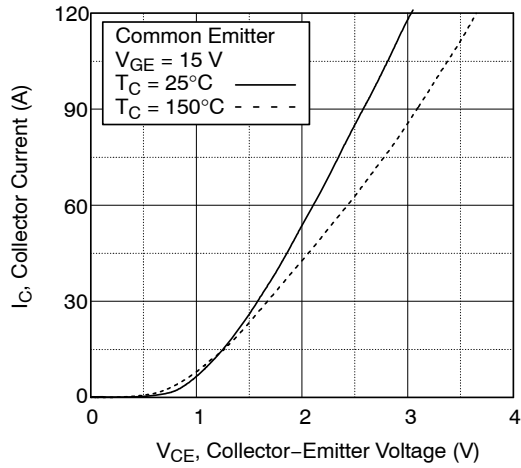


Figure 3. Typical Saturation Voltage Characteristics

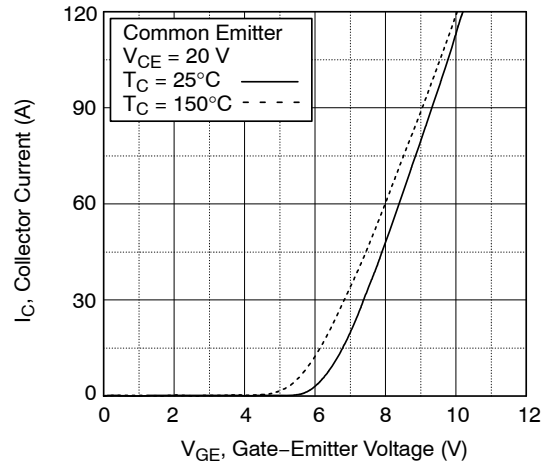


Figure 4. Transfer Characteristics

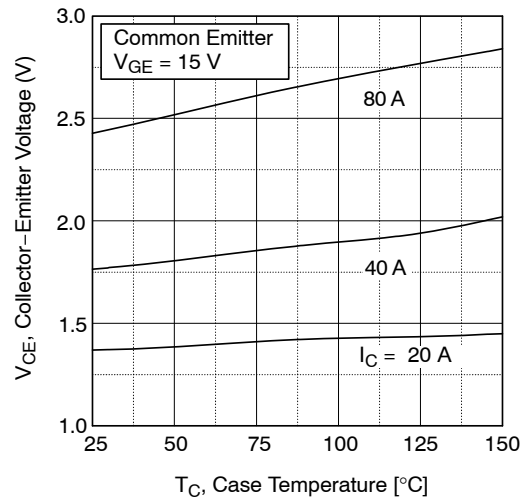


Figure 5. Saturation Voltage vs. Case Temperature at Variant Current Level

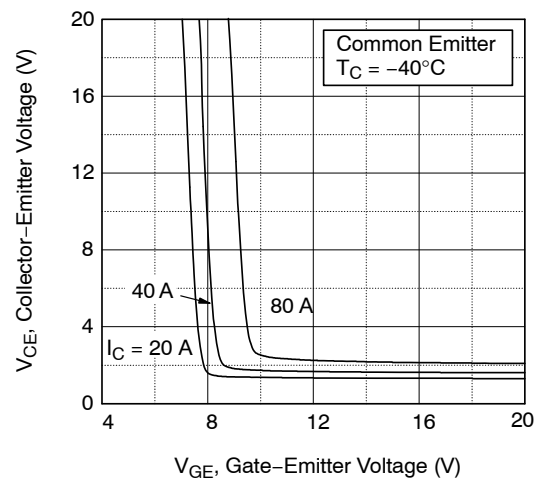


Figure 6. Saturation Voltage vs V_{GE}

TYPICAL PERFORMANCE CHARACTERISTICS (continued)

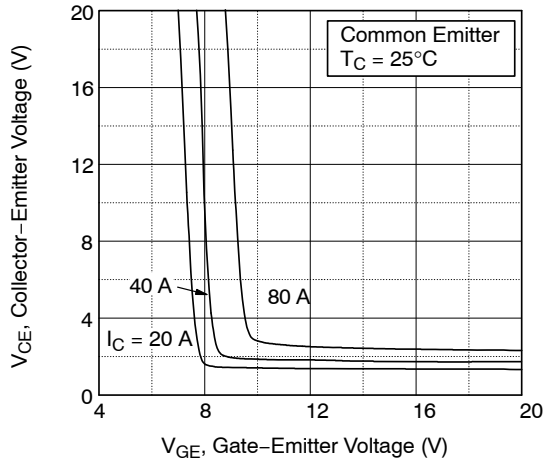


Figure 7. Saturation Voltage vs. V_{GE}

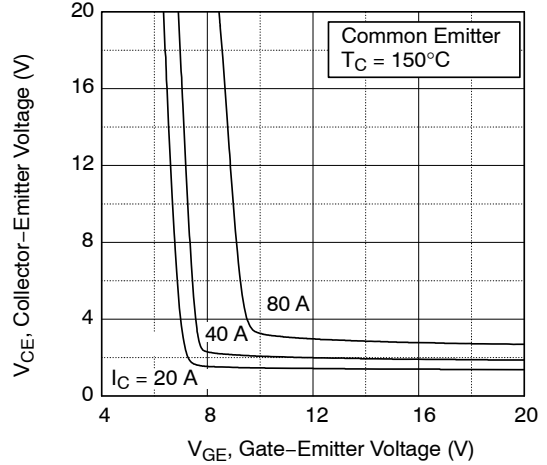


Figure 8. Saturation Voltage vs. V_{GE}

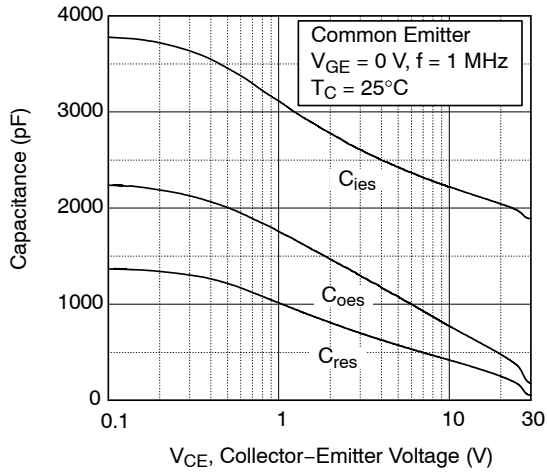


Figure 9. Capacitance Characteristics

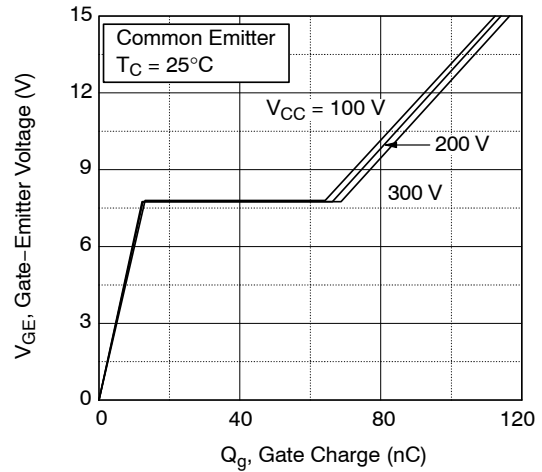


Figure 10. Gate Charge Characteristics

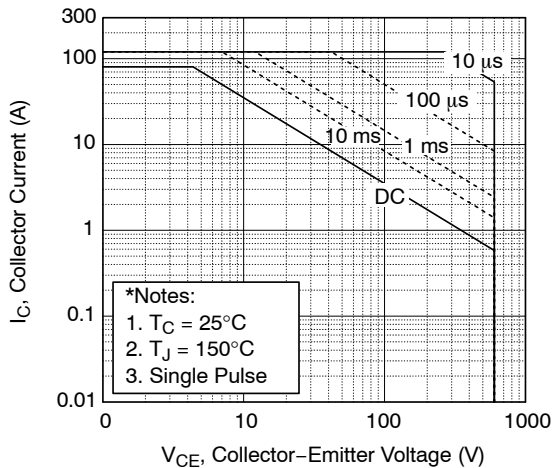


Figure 11. SOA Characteristics

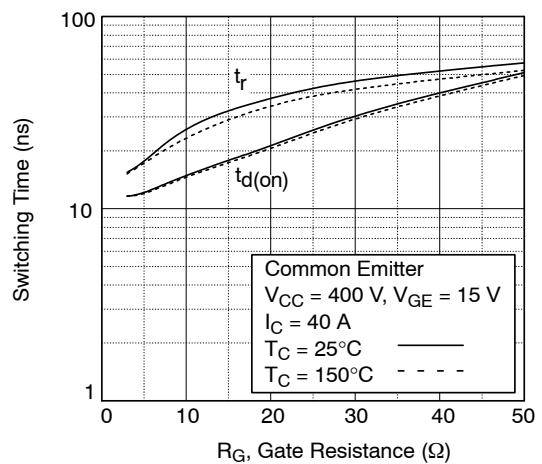


Figure 12. Turn-On Characteristics vs. Gate Resistance

TYPICAL PERFORMANCE CHARACTERISTICS (continued)

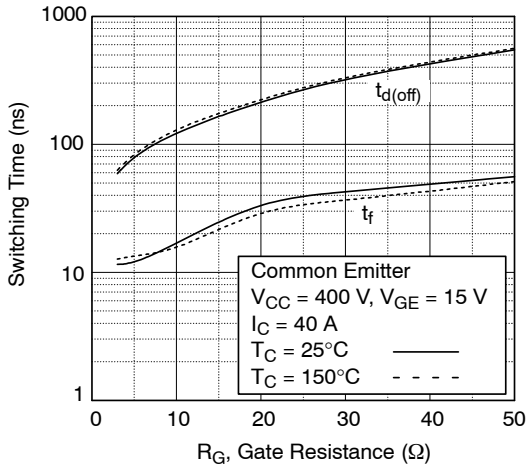


Figure 13. Turn-Off Characteristics vs. Gate Resistance

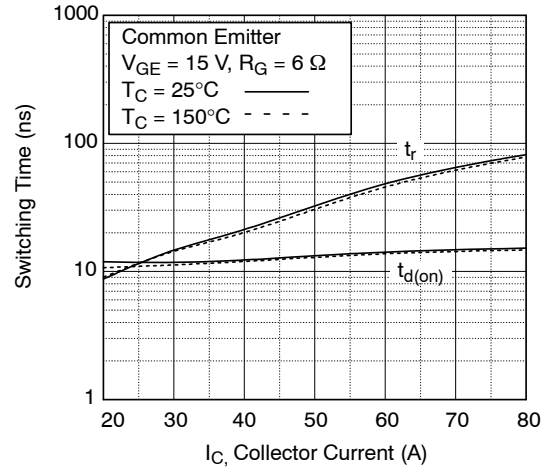


Figure 14. Turn-On Characteristics vs. Collector Current

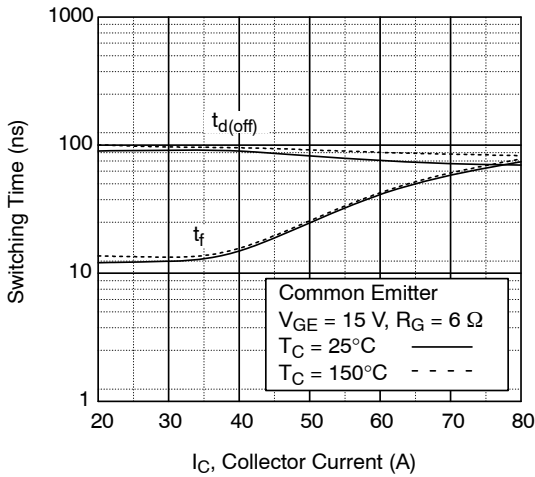


Figure 15. Turn-Off Characteristics vs. Collector Current

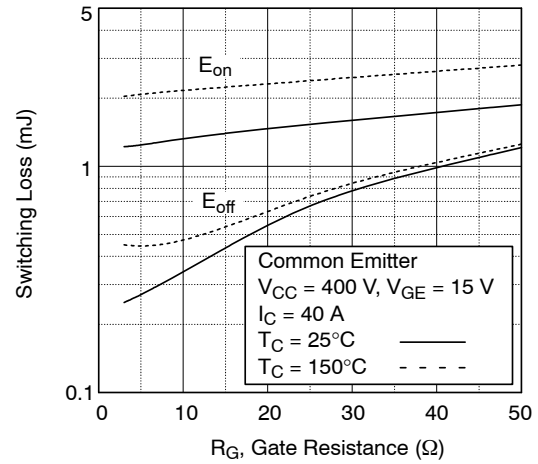


Figure 16. Switching Loss vs. Gate Resistance

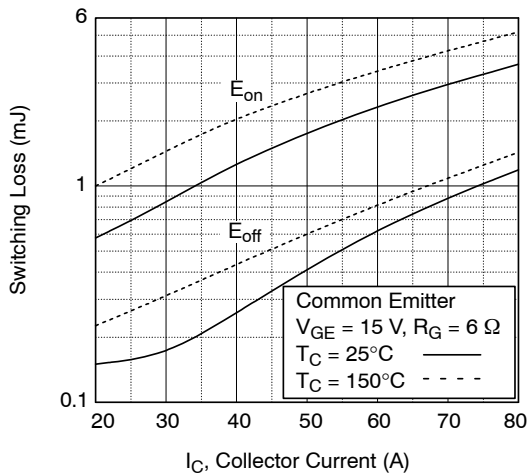


Figure 17. Switching Loss vs. Collector Current

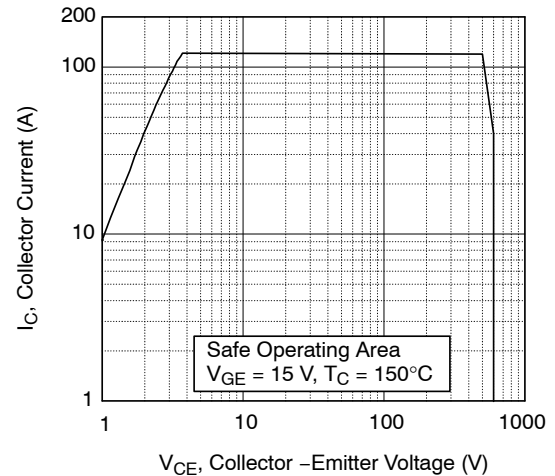


Figure 18. Turn-Off Switching SOA Characteristics

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TYPICAL PERFORMANCE CHARACTERISTICS (continued)

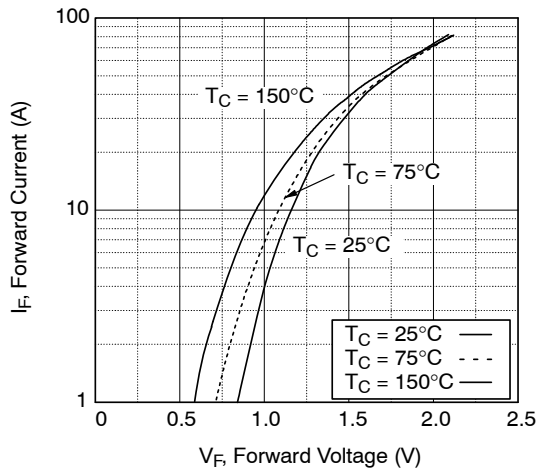


Figure 19. Forward Characteristics

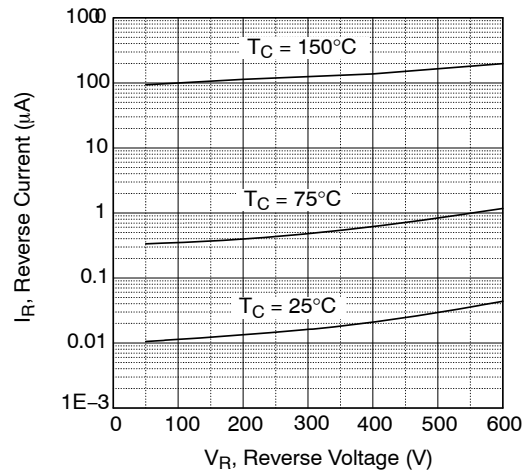


Figure 20. Reverse Current

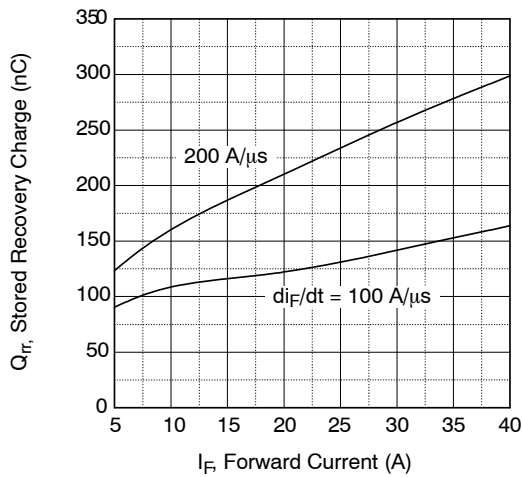


Figure 21. Stored Charge

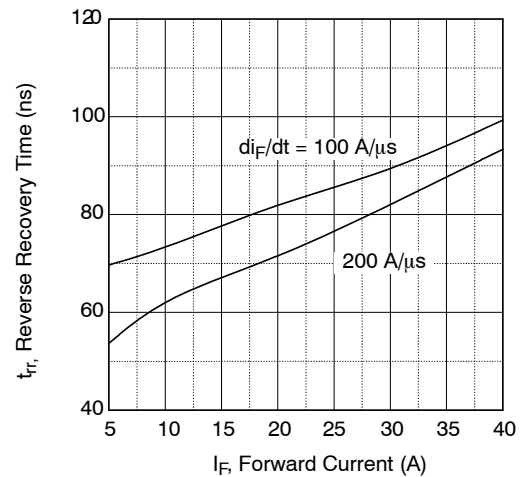


Figure 22. Reverse Recovery Time

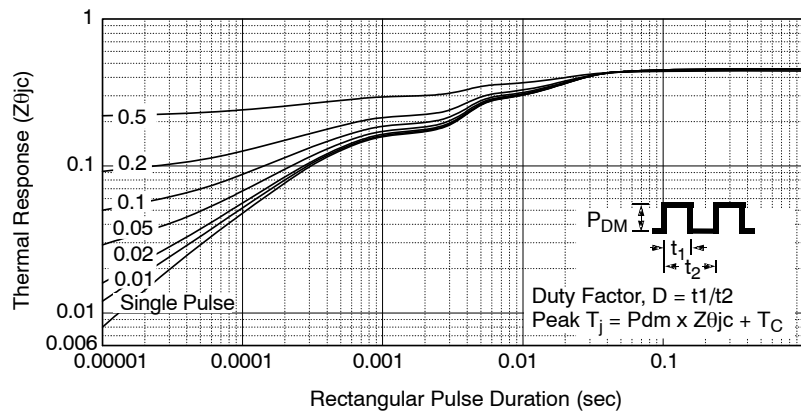
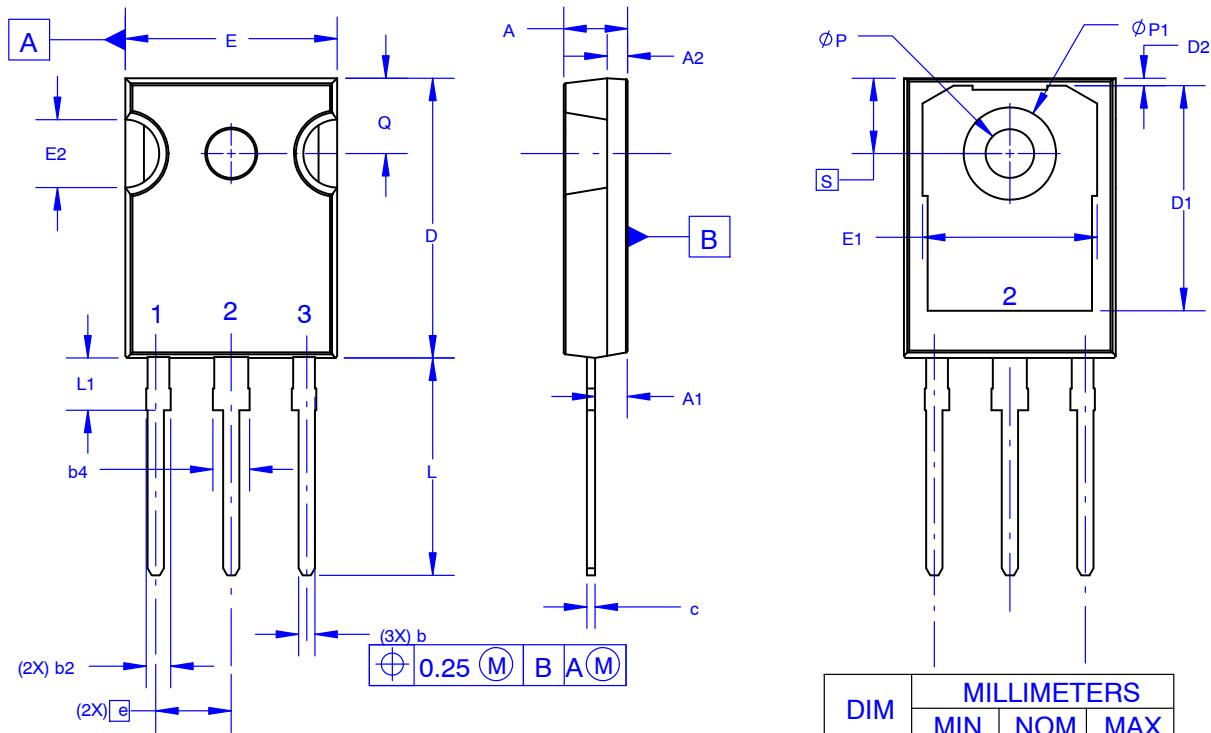


Figure 23. Transient Thermal Impedance of IGBT

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.

GENERIC MARKING DIAGRAM*



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.

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
∅P	3.51	3.58	3.65
∅P1	6.60	6.80	7.00
Q	5.34	5.46	5.58
S	5.34	5.46	5.58

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