

IGBT - Field Stop 600 V, 40 A

FGH40N60SFDTU, FGH40N60SFDTU-F085

Description

Using Novel Field Stop IGBT Technology, ON Semiconductor's new series of Field Stop IGBTs offer the optimum performance for Automotive Chargers, Inverter, and other applications where low conduction and switching losses are essential.

Features

- High Current Capability
- Low Saturation Voltage: $V_{CE(sat)} = 2.3 \text{ V @ } I_C = 40 \text{ A}$
- High Input Impedance
- Fast Switching
- Qualified to Automotive Requirements of AEC-Q101 (FGH40N60SFDTU-F085)
- These Devices are Pb-Free and are RoHS Compliant

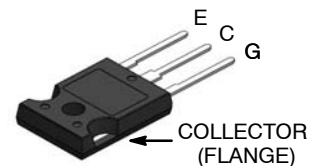
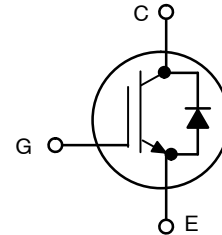
Applications

- Automotive Chargers, Converters, High Voltage Auxiliaries
- Inverters, PFC, UPS



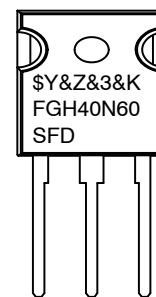
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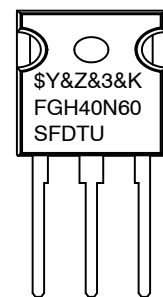


TO-247-3LD
CASE 340CK

MARKING DIAGRAM



Industrial



Automotive

\$Y	= ON Semiconductor Logo
&Z	= Assembly Plant Code
&3	= Numeric Date Code
&K	= Lot Code
FGH40N60SFD, FGH40N60SFDTU	= Specific Device Code

ORDERING INFORMATION

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

FGH40N60SFDTU, FGH40N60SFDTU-F085

ABSOLUTE MAXIMUM RATINGS

Description		Symbol	Ratings	Unit
Collector to Emitter Voltage		V_{CES}	600	V
Gate to Emitter Voltage		V_{GES}	± 20	V
Transient Gate-to-Emitter Voltage			± 30	V
Collector Current	$T_C = 25^{\circ}\text{C}$	I_C	80	A
	$T_C = 100^{\circ}\text{C}$		40	A
Pulsed Collector Current	$T_C = 25^{\circ}\text{C}$	I_{CM} (Note 1)	120	A
Maximum Power Dissipation	$T_C = 25^{\circ}\text{C}$	P_D	290	W
	$T_C = 100^{\circ}\text{C}$		116	W
Operating Junction Temperature		T_J	-55 to +150	$^{\circ}\text{C}$
Storage Temperature Range		T_{stg}	-55 to +150	$^{\circ}\text{C}$
Maximum Lead Temperature for Soldering, 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

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

PACKAGE MARKING AND ORDERING INFORMATION

Part Number	Top Mark	Package	Package Method	Reel Size	Tape Width	Quantity
FGH40N60SFDTU	FGH40N60SFD	TO-247	Tube	-	-	30
FGH40N60SFDTU-F085*	FGH40N60SFDTU	TO-247	Tube	-	-	30

*Qualified to Automotive Requirements of AEC-Q101

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}	$V_{GE} = 0\text{ V}, I_C = 250\text{ }\mu\text{A}$	600	-	-	V
Temperature Coefficient of Breakdown Voltage	$\Delta BV_{CES}/\Delta T_J$	$V_{GE} = 0\text{ V}, I_C = 250\text{ }\mu\text{A}$	-	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	$V_{GE(th)}$	$I_C = 250\text{ }\mu\text{A}, V_{CE} = V_{GE}$	4.0	4.7	6.5	V
Collector to Emitter Saturation Voltage	$V_{CE(sat)}$	$I_C = 40\text{ A}, V_{GE} = 15\text{ V}$	-	2.3	2.9	V
		$I_C = 40\text{ A}, V_{GE} = 15\text{ V}, T_C = 125^\circ\text{C}$	-	2.5	-	V

DYNAMIC CHARACTERISTICS

Input Capacitance	C_{ies}	$V_{CE} = 30\text{ V}, V_{GE} = 0\text{ V}, f = 1\text{ MHz}$	-	1920	-	pF
Output Capacitance	C_{oes}		-	190	-	pF
Reverse Transfer Capacitance	C_{res}		-	65	-	pF

FGH40N60SFDTU, FGH40N60SFDTU-F085

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

Parameter	Symbol	Test Conditions	Min	Typ	Max	Unit
SWITCHING CHARACTERISTICS						
Turn-On Delay Time	$t_{d(on)}$	$V_{CC} = 400\text{ V}$, $I_C = 40\text{ A}$, $R_G = 10\ \Omega$, $V_{GE} = 15\text{ V}$, Inductive Load, $T_C = 25^\circ\text{C}$	–	21	–	ns
Rise Time	t_r		–	35	–	ns
Turn-Off Delay Time	$t_{d(off)}$		–	138	–	ns
Fall Time	t_f		–	18	54	ns
Turn-On Switching Loss	E_{on}		–	1.23	–	mJ
Turn-Off Switching Loss	E_{off}		–	0.38	–	mJ
Total Switching Loss	E_{ts}		–	1.61	–	mJ
Turn-On Delay Time	$t_{d(on)}$	$V_{CC} = 400\text{ V}$, $I_C = 40\text{ A}$, $R_G = 10\ \Omega$, $V_{GE} = 15\text{ V}$, Inductive Load, $T_C = 125^\circ\text{C}$	–	21	–	ns
Rise Time	t_r		–	39	–	ns
Turn-Off Delay Time	$t_{d(off)}$		–	144	–	ns
Fall Time	t_f		–	48	–	ns
Turn-On Switching Loss	E_{on}		–	1.58	–	mJ
Turn-Off Switching Loss	E_{off}		–	0.58	–	mJ
Total Switching Loss	E_{ts}		–	2.16	–	mJ
Total Gate Charge	Q_g	$V_{CE} = 400\text{ V}$, $I_C = 40\text{ A}$, $V_{GE} = 15\text{ V}$	–	121	–	nC
Gate to Emitter Charge	Q_{ge}		–	16	–	nC
Gate to Collector Charge	Q_{gc}		–	68	–	nC

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

Parameter	Symbol	Test Conditions	Min	Typ	Max	Unit
Diode Forward Voltage	V_{FM}	$I_F = 20\text{ A}$	$T_C = 25^\circ\text{C}$	–	1.80	V
			$T_C = 125^\circ\text{C}$	–	1.70	
Diode Reverse Recovery Time	t_{rr}	$I_F = 20\text{ A}$, $di_F/dt = 200\text{ A}/\mu\text{s}$	$T_C = 25^\circ\text{C}$	–	68	ns
			$T_C = 125^\circ\text{C}$	–	240	
Diode Reverse Recovery Charge	Q_{rr}		$T_C = 25^\circ\text{C}$	–	160	nC
			$T_C = 125^\circ\text{C}$	–	840	

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

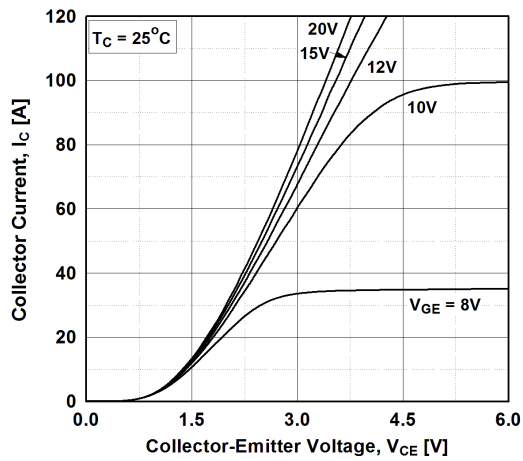


Figure 1. Typical Output Characteristics

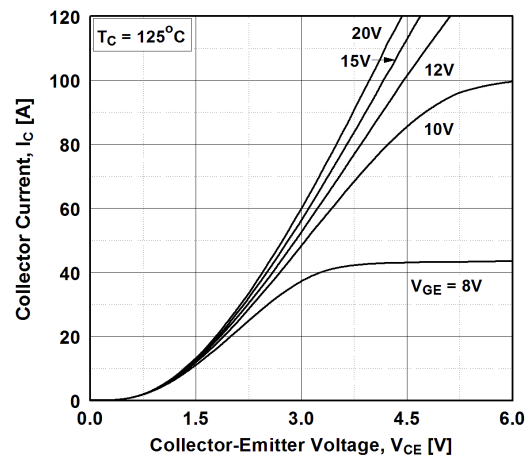


Figure 2. Typical Output Characteristics

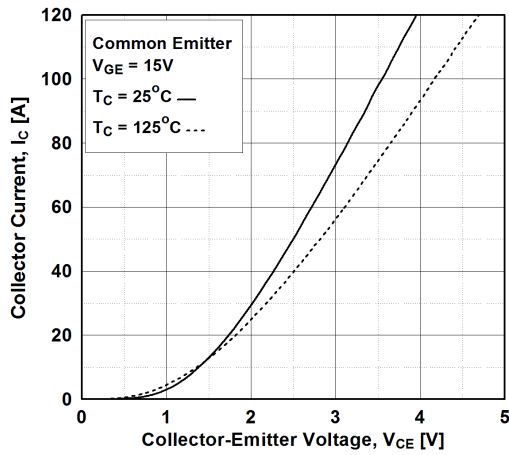


Figure 3. Typical Saturation Voltage Characteristics

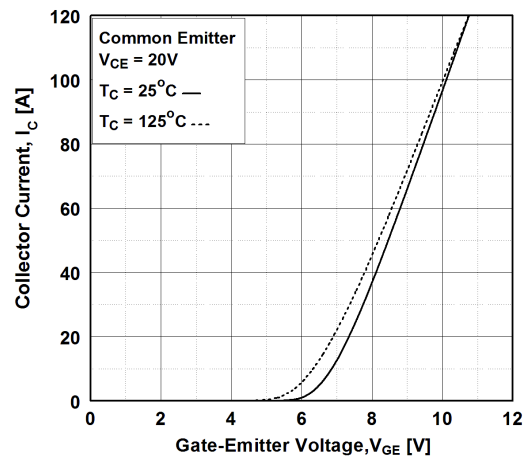


Figure 4. Transfer Characteristics

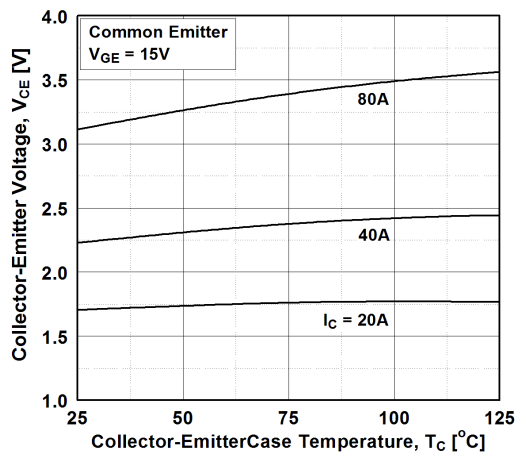


Figure 5. Saturation Voltage vs. Case Temperature at Variant Current Level

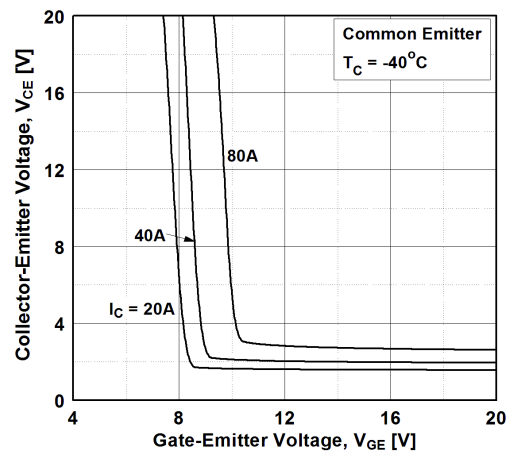


Figure 6. Saturation Voltage vs. V_{GE}

TYPICAL PERFORMANCE CHARACTERISTICS (continued)

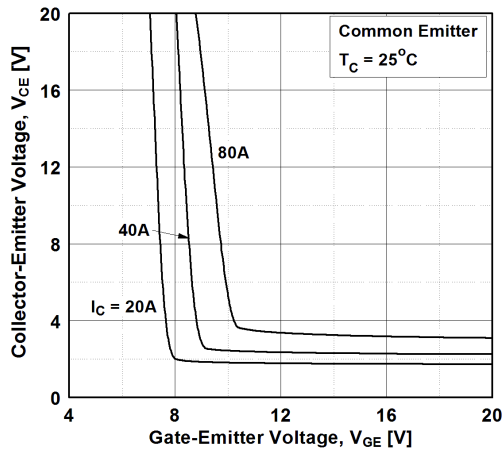


Figure 7. Saturation Voltage vs. V_{GE}

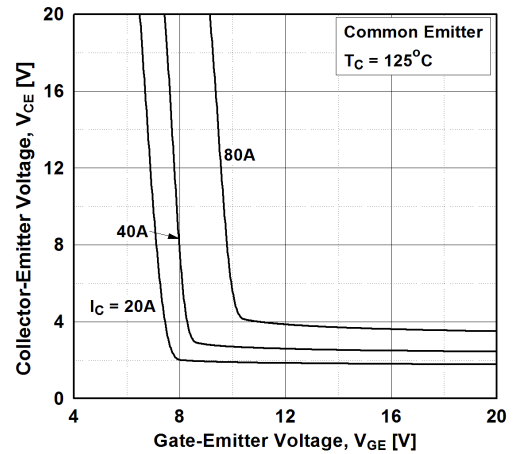


Figure 8. Saturation Voltage vs. V_{GE}

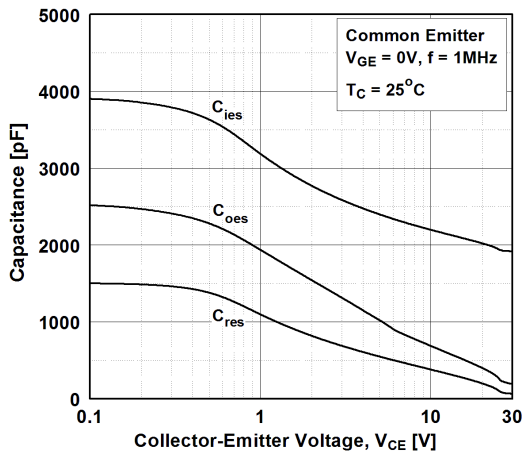


Figure 9. Capacitance Characteristics

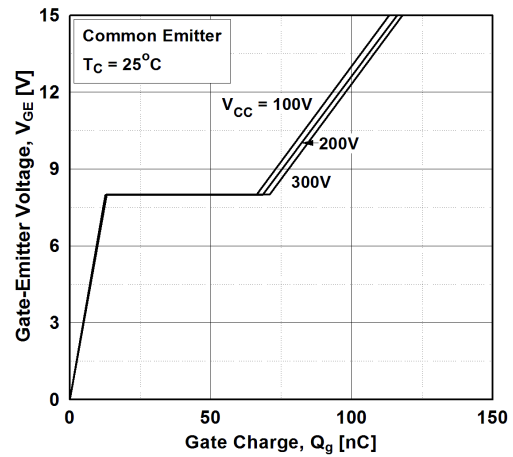


Figure 10. Gate Charge Characteristics

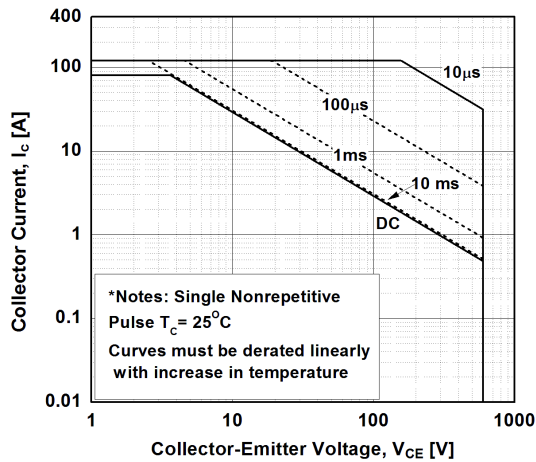


Figure 11. SOA Characteristics

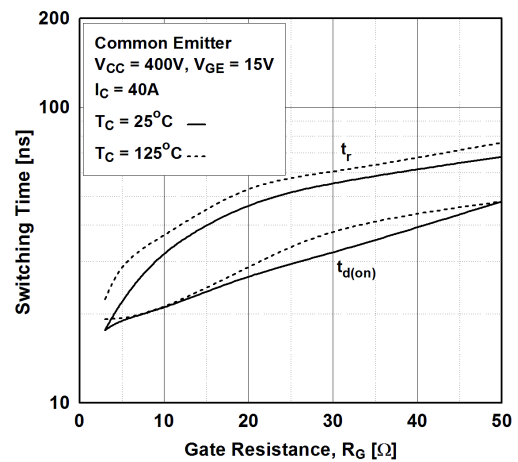


Figure 12. Turn-on Characteristics vs. Gate Resistance

TYPICAL PERFORMANCE CHARACTERISTICS (continued)

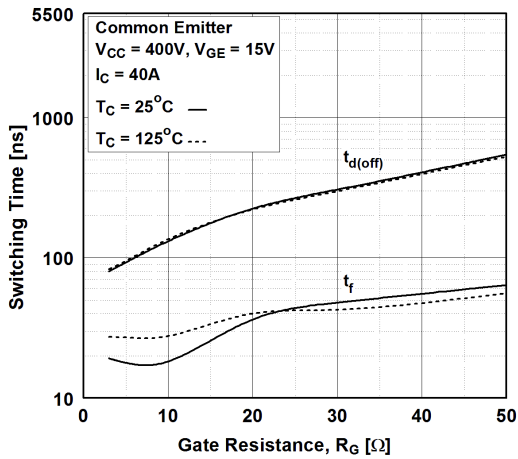


Figure 13. Turn-Off Characteristics vs. Gate Resistance

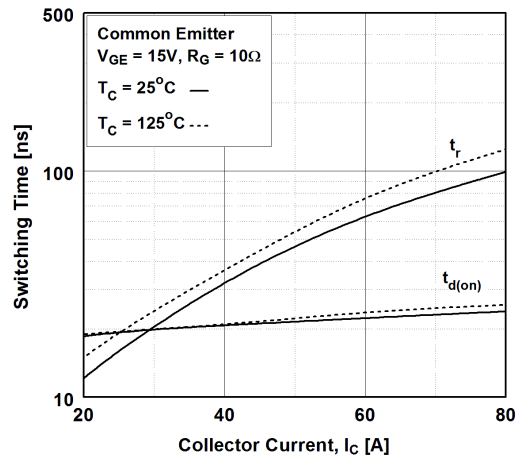


Figure 14. Turn-On Characteristics vs. Collector Current

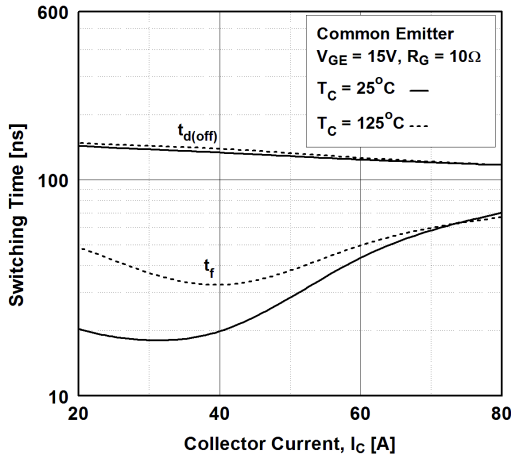


Figure 15. Turn-Off Characteristics vs. Collector Current

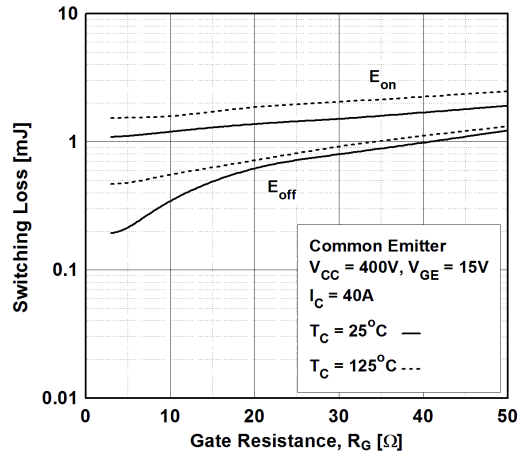


Figure 16. Switching Loss vs. Gate Resistance

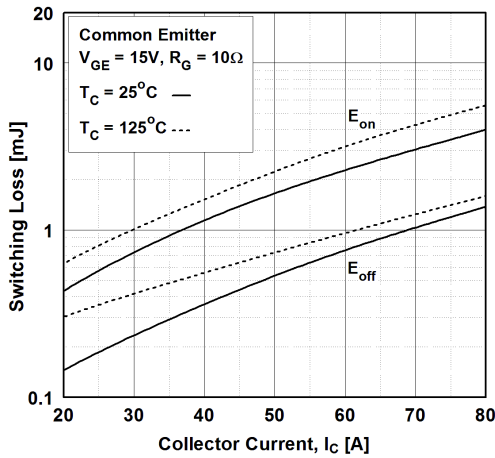


Figure 17. Switching Loss vs. Collector Current

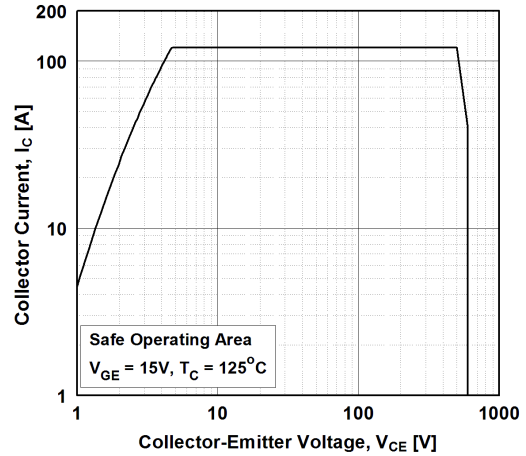


Figure 18. Turn-Off Switching SOA Characteristics

TYPICAL PERFORMANCE CHARACTERISTICS (continued)

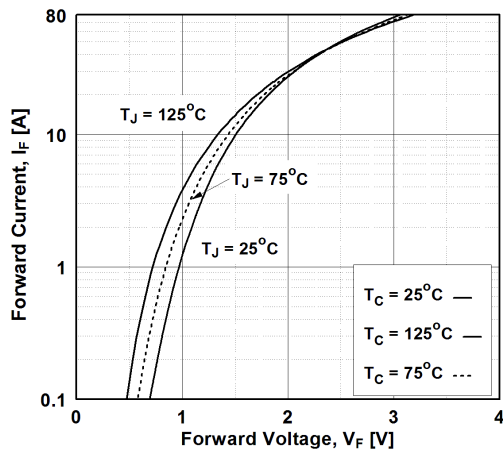


Figure 19. Forward Characteristics

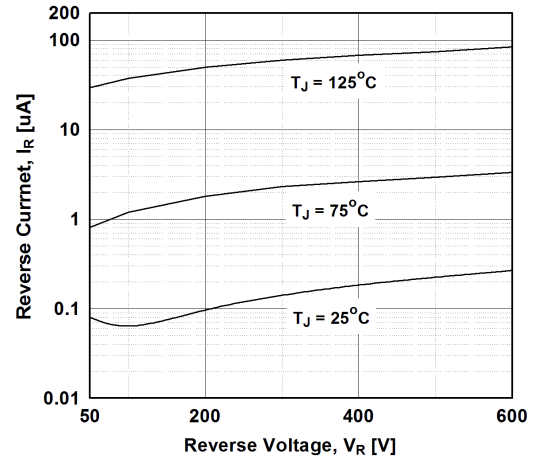


Figure 20. Reverse Current

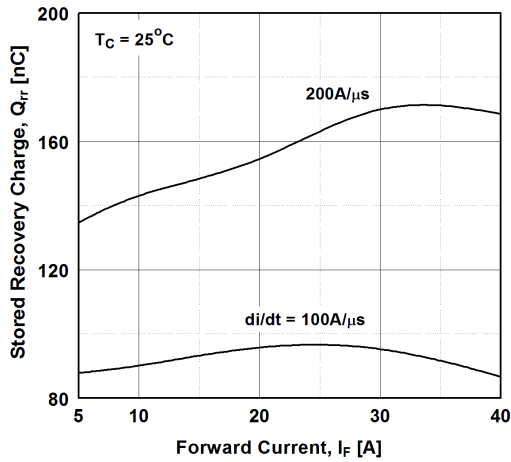


Figure 21. Stored Charge

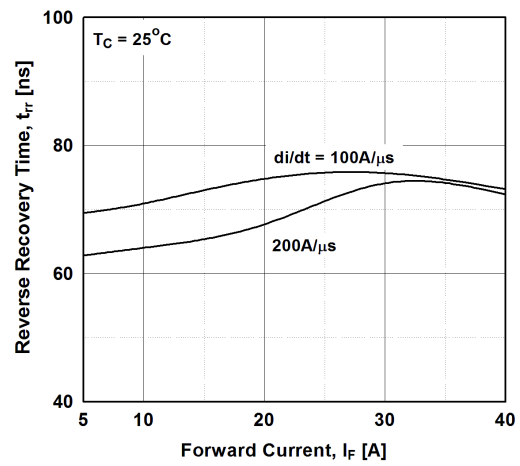


Figure 22. Reverse Recovery Time

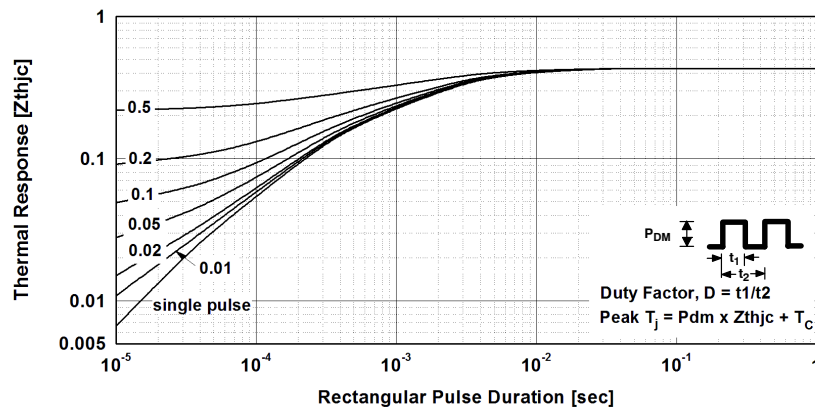
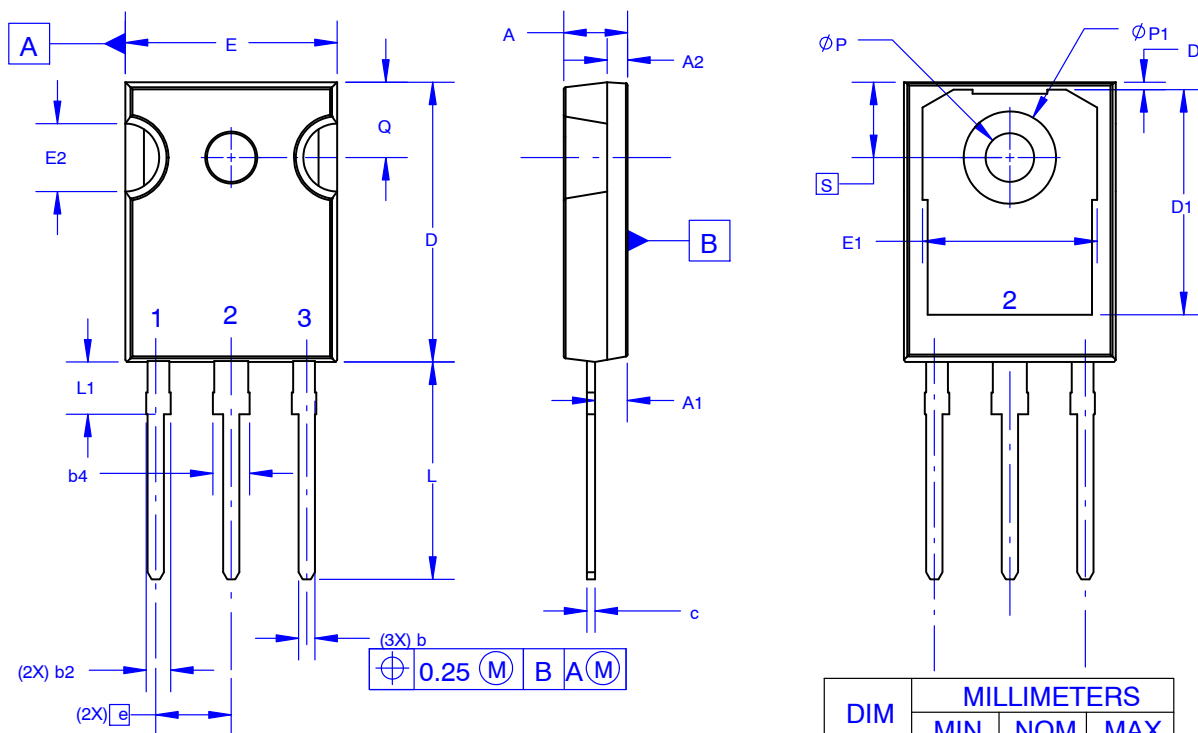


Figure 23. Transient Thermal Impedance of IGBT

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

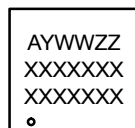
DATE 31 JAN 2019



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
ϕP	3.51	3.58	3.65
$\phi P1$	6.60	6.80	7.00
Q	5.34	5.46	5.58
S	5.34	5.46	5.58

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DESCRIPTION:	TO-247-3LD SHORT LEAD	PAGE 1 OF 1

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