

IGBT - Field Stop, Trench

650 V, 60 A

FGH60T65SHD

Description

Using novel field stop IGBT technology, ON Semiconductor's new series of field stop 3rd 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: $V_{CE(sat)} = 1.6\text{ V (Typ.) @ } I_C = 60\text{ A}$
- 100% of the Parts Tested for I_{LM} (Note 1)
- High Input Impedance
- Fast Switching
- Tighten Parameter Distribution
- This Device is Pb-Free and is RoHS Compliant

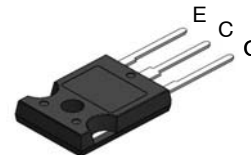
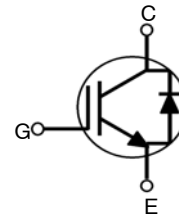
Applications

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



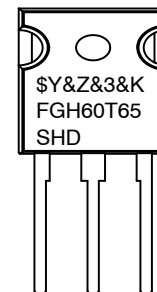
ON Semiconductor®

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TO-247-3LD
CASE 340CH

MARKING DIAGRAM



\$Y	= ON Semiconductor Logo
&Z	= Assembly Plant Code
&3	= Numeric Date Code
&K	= Lot Code
FGH60T65SHD	= Specific Device Code

ORDERING INFORMATION

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

FGH60T65SHD

ABSOLUTE MAXIMUM RATINGS

Description		Symbol	FGH60T65SHD-F155	Unit
Collector to Emitter Voltage		V_{CES}	650	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	120	A
Collector Current	$T_C = 100^\circ\text{C}$		60	A
Pulsed Collector Current (Note 1)	$T_C = 25^\circ\text{C}$	I_{LM}	180	A
Pulsed Collector Current (Note 2)		I_{CM}	180	A
Diode Forward Current	$T_C = 25^\circ\text{C}$	I_F	60	A
Diode Forward Current	$T_C = 100^\circ\text{C}$		30	A
Pulsed Diode Maximum Forward Current (Note 2)		I_{FM}	180	A
Maximum Power Dissipation	$T_C = 25^\circ\text{C}$	P_D	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.

- $V_{CC} = 400\text{ V}$, $V_{GE} = 15\text{ V}$, $I_C = 180\text{ A}$, $R_G = 27\ \Omega$, Inductive Load
- Repetitive Rating: Pulse width limited by max. junction temperature.

THERMAL CHARACTERISTICS

Parameter	Symbol	FGH60T65SHD-F155	Unit
Thermal Resistance, Junction to Case, Max. (IGBT)	$R_{\theta JC}$	0.43	$^\circ\text{C}/\text{W}$
Thermal Resistance, Junction to Case, Max. (Diode)	$R_{\theta JC}$	1.25	$^\circ\text{C}/\text{W}$
Thermal Resistance, Junction to Ambient, Max.	$R_{\theta JA}$	40	$^\circ\text{C}/\text{W}$

PACKAGE MARKING AND ORDERING INFORMATION

Device	Device Marking	Package	Packing Method	Reel Size	Tape Width	Quantity
FGH60T65SHD-F155	FGH60T65SHD	TO-247-3LD	Tube	-	-	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}	$V_{GE} = 0\text{ V}$, $I_C = 1\text{ mA}$	650	-	-	V
Temperature Coefficient of Breakdown Voltage	$\Delta BV_{CES} / \Delta T_J$	$I_C = 1\text{ mA}$, Referenced to 25°C		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	$V_{GE(th)}$	$I_C = 60\text{ mA}$, $V_{CE} = V_{GE}$	4.0	5.5	7.5	V
Collector to Emitter Saturation Voltage	$V_{CE(sat)}$	$I_C = 60\text{ A}$, $V_{GE} = 15\text{ V}$	-	1.6	2.1	V
		$I_C = 60\text{ A}$, $V_{GE} = 15\text{ V}$, $T_C = 175^\circ\text{C}$	-	2.14	-	V

FGH60T65SHD

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}	$V_{CE} = 30\text{ V}, V_{GE} = 0\text{ V}, f = 1\text{ MHz}$	-	2980	-	pF
Output Capacitance	C_{oes}		-	110	-	pF
Reverse Transfer Capacitance	C_{res}		-	36	-	pF
SWITCHING CHARACTERISTICS						
Turn-On Delay Time	$t_{d(on)}$	$V_{CC} = 400\text{ V}, I_C = 60\text{ A},$ $R_G = 6\ \Omega, V_{GE} = 15\text{ V},$ Inductive Load, $T_C = 25^\circ\text{C}$	-	26	-	ns
Rise Time	t_r		-	48	-	ns
Turn-Off Delay Time	$t_{d(off)}$		-	87	-	ns
Fall Time	t_f		-	47	-	ns
Turn-On Switching Loss	E_{on}		-	1.69	-	mJ
Turn-Off Switching Loss	E_{off}		-	0.63	-	mJ
Total Switching Loss	E_{ts}		-	2.32	-	mJ
Turn-On Delay Time	$t_{d(on)}$	$V_{CC} = 400\text{ V}, I_C = 60\text{ A},$ $R_G = 6\ \Omega, V_{GE} = 15\text{ V},$ Inductive Load, $T_C = 175^\circ\text{C}$	-	25	-	ns
Rise Time	t_r		-	60	-	ns
Turn-Off Delay Time	$t_{d(off)}$		-	93	-	ns
Fall Time	t_f		-	72	-	ns
Turn-On Switching Loss	E_{on}		-	2.54	-	mJ
Turn-Off Switching Loss	E_{off}		-	1.04	-	mJ
Total Switching Loss	E_{ts}		-	3.58	-	mJ
Total Gate Charge	Q_g	$V_{CC} = 400\text{ V}, I_C = 60\text{ A},$ $V_{GE} = 15\text{ V}$	-	102	-	nC
Gate to Emitter Charge	Q_{ge}		-	18.4	-	nC
Gate to Collector Charge	Q_{gc}		-	37.5	-	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}	$I_F = 30\text{ A}$	$T_C = 25^\circ\text{C}$	-	2.3	2.7	V
			$T_C = 175^\circ\text{C}$	-	1.9	-	
Reverse Recovery Energy	E_{rec}	$I_F = 30\text{ A},$ $di_F/dt = 200\text{ A}/\mu\text{s}$	$T_C = 175^\circ\text{C}$	-	50	-	μJ
Diode Reverse Recovery Time	t_{rr}		$T_C = 25^\circ\text{C}$	-	34.6	-	ns
			$T_C = 175^\circ\text{C}$	-	197	-	
Diode Reverse Recovery Charge	Q_{rr}		$T_C = 25^\circ\text{C}$	-	58.6	-	nC
		$T_C = 175^\circ\text{C}$	-	810	-		

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.

FGH60T65SHD

TYPICAL PERFORMANCE CHARACTERISTICS

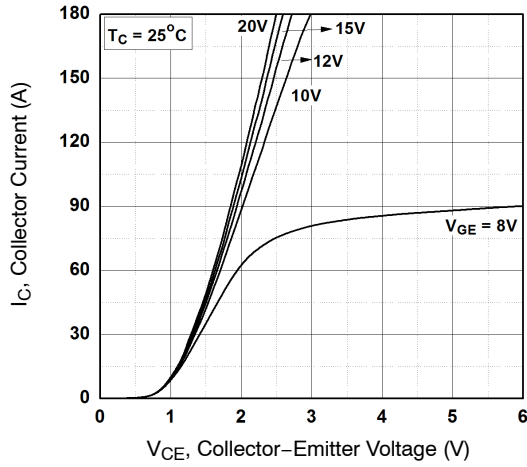


Figure 1. Typical Output Characteristics

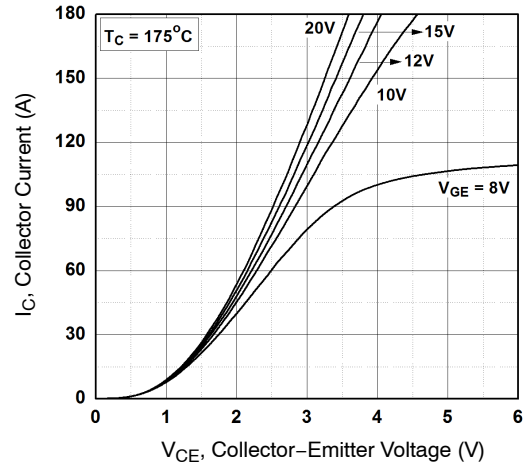


Figure 2. Typical Output Characteristics

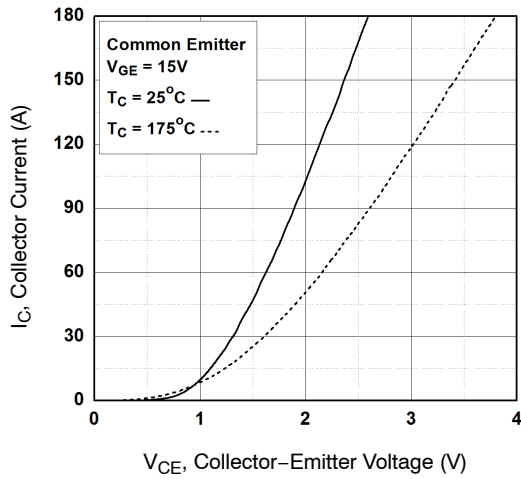


Figure 3. Typical Saturation Voltage Characteristics

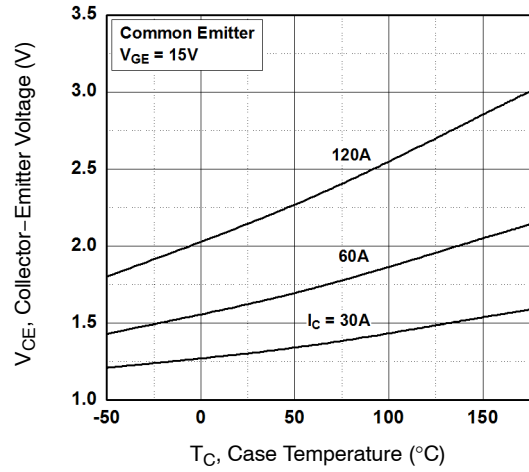


Figure 4. Saturation Voltage vs. Case Temperature at Variant Current Level

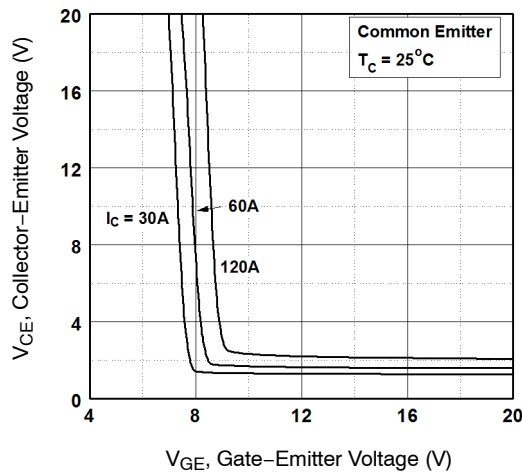


Figure 5. Saturation Voltage vs V_{GE}

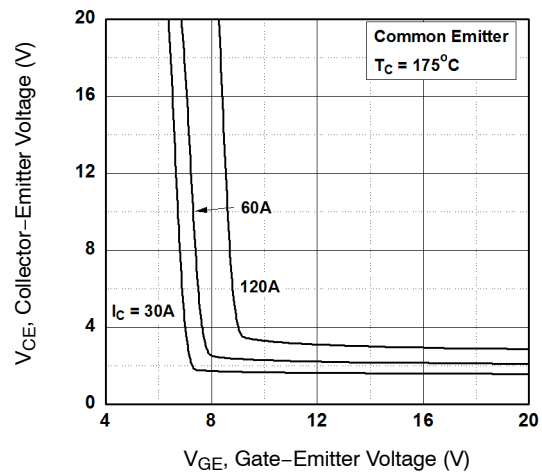


Figure 6. Saturation Voltage vs V_{GE}

TYPICAL PERFORMANCE CHARACTERISTICS (continued)

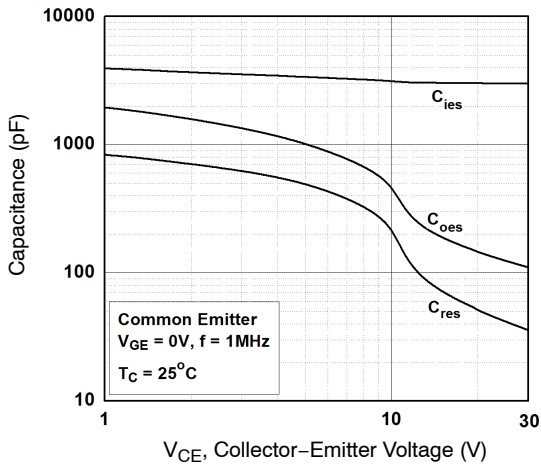


Figure 7. Capacitance Characteristics

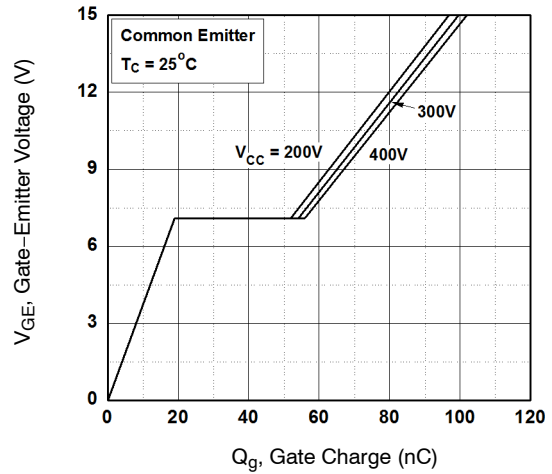


Figure 8. Gate Charge Characteristics

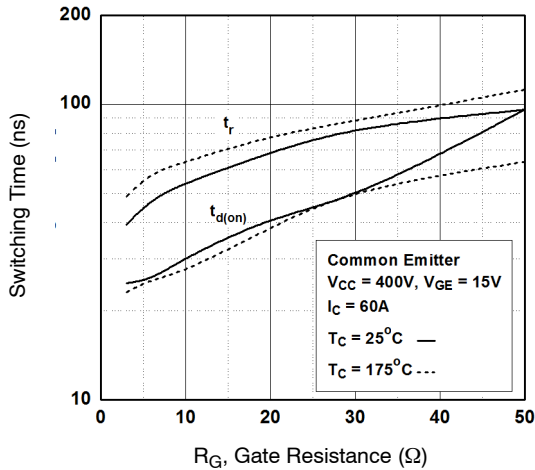


Figure 9. Turn-On Characteristics vs. Gate Resistance

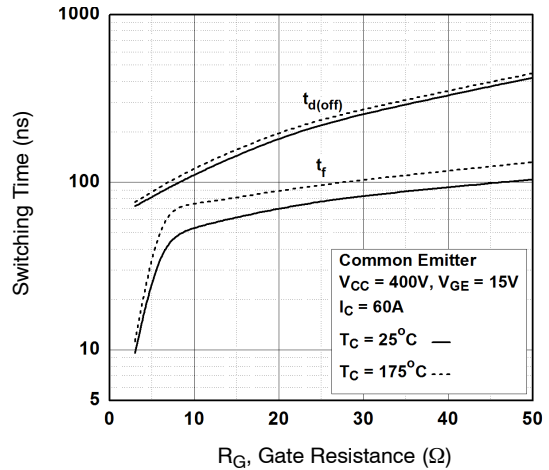


Figure 10. Turn-Off Characteristics vs. Gate Resistance

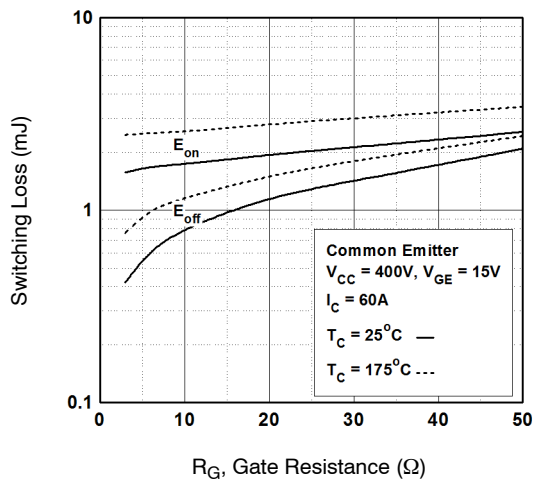


Figure 11. Switching Loss vs. Gate Resistance

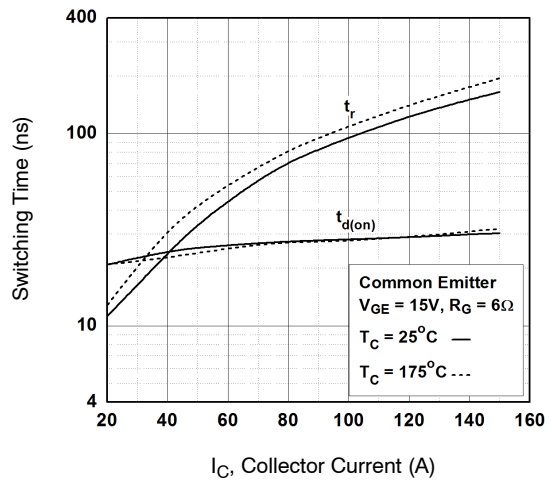


Figure 12. Turn-On Characteristics vs. Collector Current

TYPICAL PERFORMANCE CHARACTERISTICS (continued)

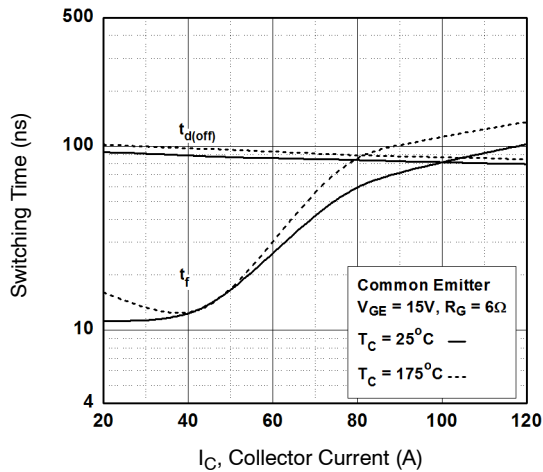


Figure 13. Turn-Off Characteristics vs. Collector Current

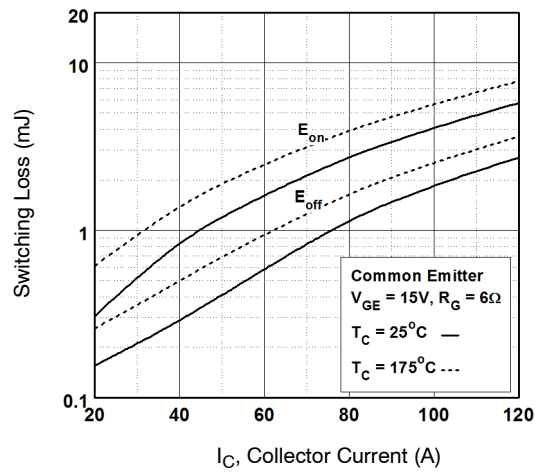


Figure 14. Switching Loss vs. Collector Current

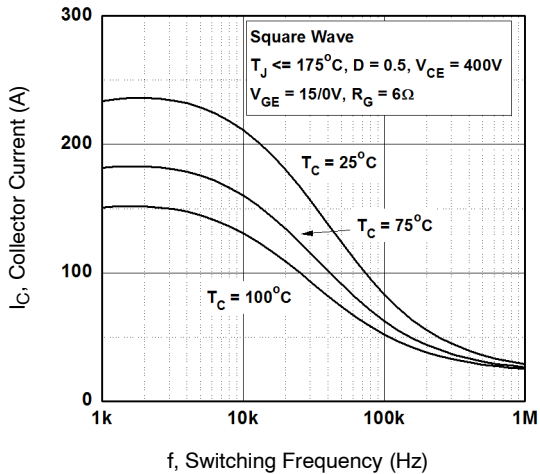


Figure 15. Load Current vs. Frequency

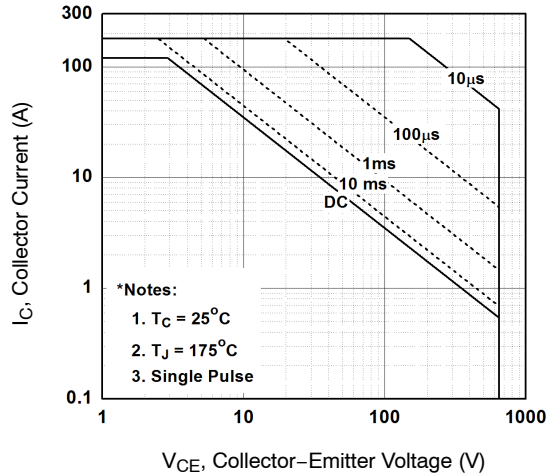


Figure 16. SOA Characteristics

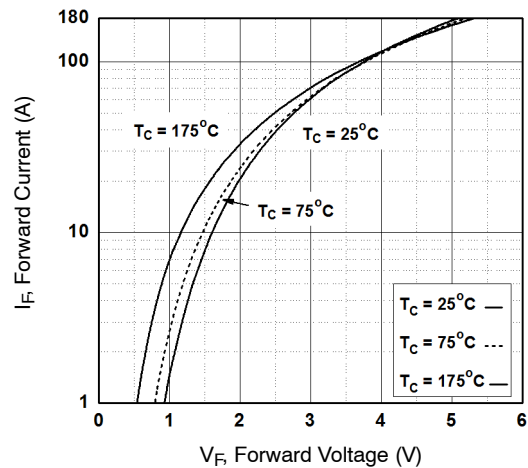


Figure 17. Forward Characteristics

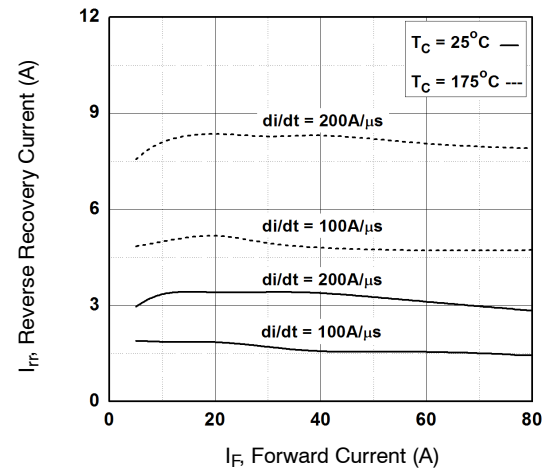


Figure 18. Reverse Recovery Current

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TYPICAL PERFORMANCE CHARACTERISTICS (continued)

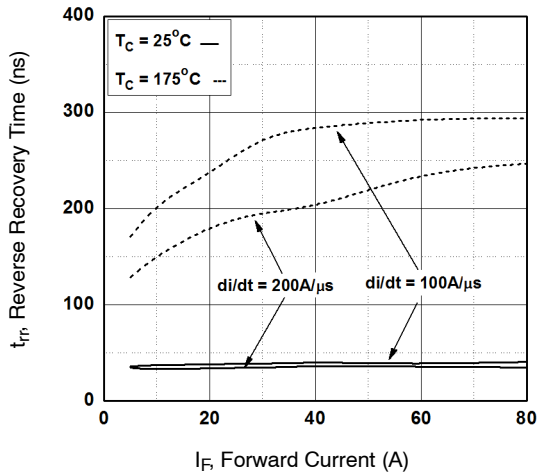


Figure 19. Reverse Recovery Time

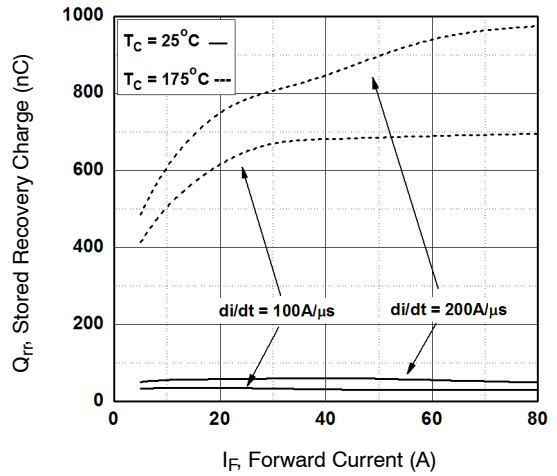


Figure 20. Stored Charge

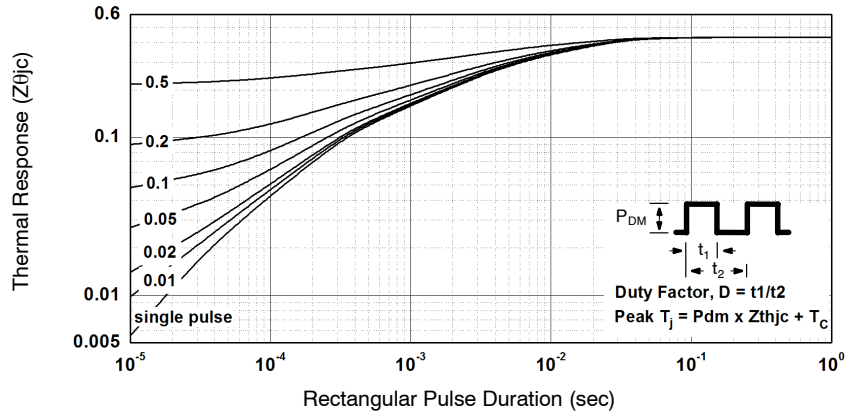


Figure 21. Transient Thermal Impedance of IGBT

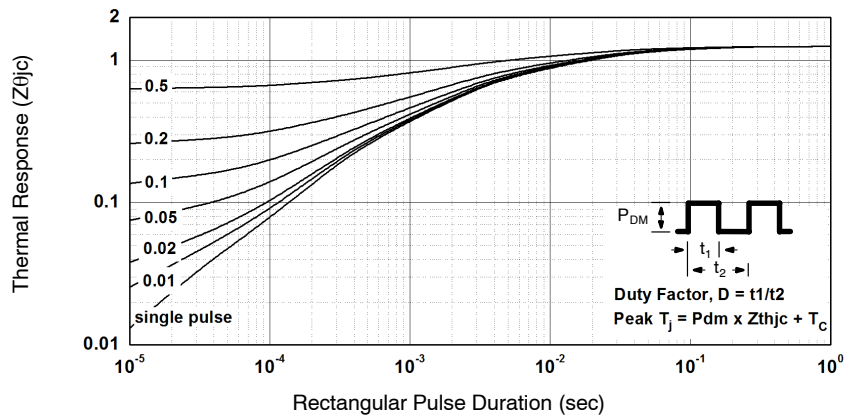


Figure 22. Transient Thermal Impedance of Diode

MECHANICAL CASE OUTLINE

PACKAGE DIMENSIONS

ON Semiconductor®



TO-247-3LD
CASE 340CH
ISSUE A

DATE 09 OCT 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
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.

DIM	MILLIMETERS		
	MIN	NOM	MAX
A	4.58	4.70	4.82
A1	2.29	2.475	2.66
A2	1.40	1.50	1.60
D	20.32	20.57	20.82
E	15.37	15.62	15.87
E2	4.96	5.08	5.20
e	~	5.56	~
L	19.75	20.00	20.25
L1	3.69	3.81	3.93
ϕP	3.51	3.58	3.65
Q	5.34	5.46	5.58
S	5.34	5.46	5.58
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
D1	13.08	~	~
D2	0.51	0.93	1.35
E1	12.81	~	~
$\phi P1$	6.61	6.73	6.85

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