IGBT - FS, Trench
1200 V, 40 A

FGH40T120SMDL4

Description

Using innovative field stop trench IGBT technology, ON Semiconductor's new series of field stop trench IGBTs offer the optimum performance for hard switching application such as solar inverter, UPS, welder and PFC applications.

Features

- FS Trench Technology, Positive Temperature Coefficient
- Excellent Switching Performance due to Kelvin Emitter Pin
- Low Saturation Voltage: $V_{CE(sat)}$ = 1.8 V @ I_C = 40 A
- 100% of the Parts Tested for I_{LM}
- High Input Impedance
- This Device is Pb−Free and is RoHS Compliant

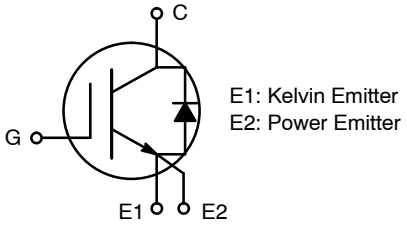
Applications

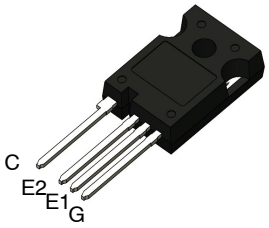
- Solar Inverter, Welder, UPS and PFC Applications

ON Semiconductor®

www.onsemi.com

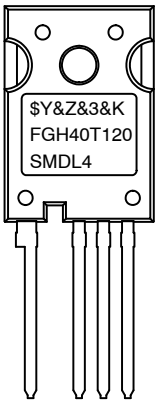
V_{CES}	I_C
1200 V	40 A





TO−247−4LD
CASE 340CJ

MARKING DIAGRAM



$Y	= ON Semiconductor Logo
&Z	= Assembly Plant Code
&3	= Numeric Date Code
&K	= Lot Code
FGH40T120SMDL4	= Specific Device Code

ORDERING INFORMATION

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

ABSOLUTE MAXIMUM RATINGS

Symbol	Description		FGH40T120SMDL4	Unit
V_{CES}	Collector to Emitter Voltage		1200	V
V_{GES}	Gate to Emitter Voltage		±25	V
	Transient Gate to Emitter Voltage		±30	V
I_C	Collector Current	T_C = 25°C	80	A
		T_C = 100°C	40	A
I_{LM} (Note 1)	Clamped Inductive Load Current	T_C = 25°C	160	A
I_{CM} (Note 2)	Pulsed Collector Current		160	A
I_F	Diode Continuous Forward Current	T_C = 25°C	80	A
	Diode Continuous Forward Current	T_C = 100°C	40	A
I_{FM}	Diode Maximum Forward Current		240	A
P_D	Maximum Power Dissipation	T_C = 25°C	555	W
		T_C = 100°C	277	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. V_{CC} = 600 V, V_{GE} = 15 V, I_C = 160 A, R_G = 20 Ω, Inductive Load.
2. Limited by Tjmax.

THERMAL CHARACTERISTICS

Symbol	Parameter	FGH75T65SQDT−F155	Unit
$R_{\theta JC}$ (IGBT)	Thermal Resistance, Junction to Case	0.27	°C/W
$R_{\theta JC}$ (Diode)	Thermal Resistance, Junction to Case	0.89	°C/W
$R_{\theta JA}$	Thermal Resistance, Junction to Ambient	40	°C/W

PACKAGE MARKING AND ORDERING INFORMATION

Part Number	Top Mark	Package	Reel Size	Tape Width	Quantity
FGH40T120SMDL4	FGH40T120SMDL4	TO−247−4LD	−	−	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	1200	–	–	V
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 = 40 mA, V_{CE} = V_{GE}	4.9	6.2	7.5	V
$V_{CE(sat)}$	Collector to Emitter Saturation Voltage	I_C = 40 A, V_{GE} = 15 V, T_C = 25 °C	–	1.8	2.4	V
		I_C = 40 A, V_{GE} = 15 V, T_C = 175°C	–	2.0	–	V
DYNAMIC CHARACTERISTICS						
C_{ies}	Input Capacitance	V_{CE} = 30 V, V_{GE} = 0 V, f = 1MHz	–	4300	–	pF
C_{oes}	Output Capacitance		–	180	–	pF
C_{res}	Reverse Transfer Capacitance		–	100	–	pF
SWITCHING CHARACTERISTICS						
$T_{d(on)}$	Turn−On Delay Time	V_{CC} = 600 V, I_C = 40 A, R_G = 10 Ω, V_{GE} = 15 V, Inductive Load, T_C = 25°C	–	44	–	ns
T_r	Rise Time		–	42	–	ns
$T_{d(off)}$	Turn−Off Delay Time		–	464	–	ns
T_f	Fall Time		–	24	–	ns
E_{on}	Turn−On Switching Loss		–	2.24	–	mJ
E_{off}	Turn−Off Switching Loss		–	1.02	–	mJ
E_{ts}	Total Switching Loss		–	3.26	–	mJ
$T_{d(on)}$	Turn−On Delay Time	V_{CC} = 600 V, I_C = 40 A, R_G = 10 Ω, V_{GE} = 15 V, Inductive Load, T_C = 25°C	–	42	–	ns
T_r	Rise Time		–	48	–	ns
$T_{d(off)}$	Turn−Off Delay Time		–	518	–	ns
T_f	Fall Time		–	24	–	ns
E_{on}	Turn−On Switching Loss		–	3.11	–	mJ
E_{off}	Turn−Off Switching Loss		–	2.01	–	mJ
E_{ts}	Total Switching Loss		–	5.12	–	mJ
Q_g	Total Gate Charge	V_{CE} = 600 V, I_C = 40 A, V_{GE} = 15 V	–	370	–	nC
Q_{ge}	Gate to Emitter Charge		–	23	–	nC
Q_{gc}	Gate to Collector Charge		–	210	–	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 = 40 A	T_C = 25°C	–	3.8	4.8	V
			T_C = 175°C	–	2.7	–	
T_{rr}	Diode Reverse Recovery Time	V_R = 600 V, I_F = 40 A di_F/dt = 200 A/μs, T_C = 25°C		–	65	–	ns
I_{rr}	Diode Peak Reverse Recovery Current			–	7.2	–	A
Q_{rr}	Diode Reverse Recovery Charge			–	234	–	nC
T_{rr}	Diode Reverse Recovery Charge	V_R = 600 V, I_F = 40 A di_F/dt = 200 A/μs, T_C = 175°C		–	200	–	ns
I_{rr}	Diode Peak Reverse Recovery Current			–	18.0	–	A
Q_{rr}	Diode Reverse Recovery Charge			–	1800	–	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.

TYPICAL PERFORMANCE CHARACTERISTICS

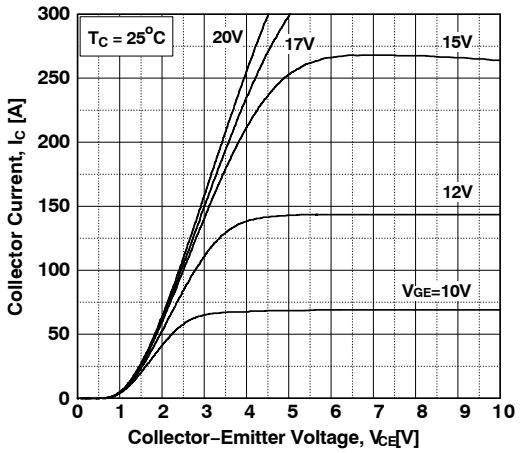


Figure 1. Typical Output Characteristics

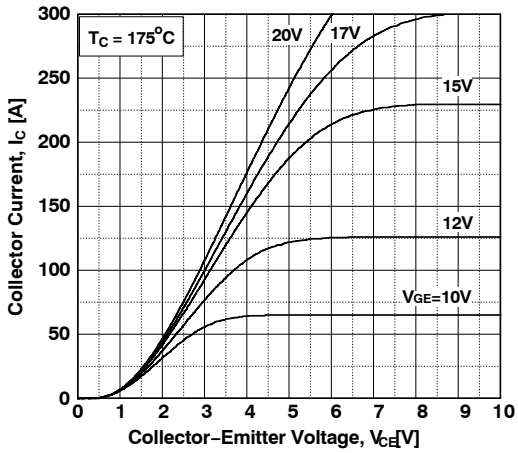


Figure 2. Typical Output Characteristics

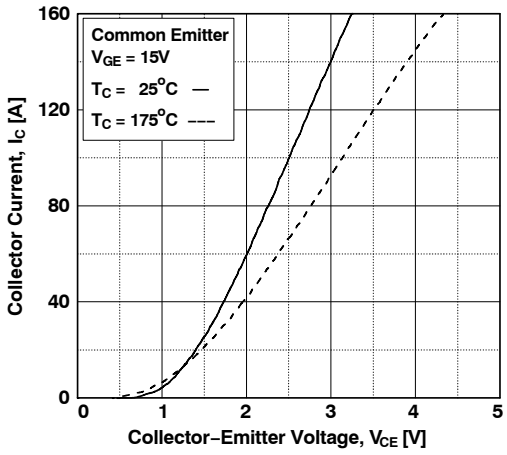


Figure 3. Typical Saturation Voltage Characteristics

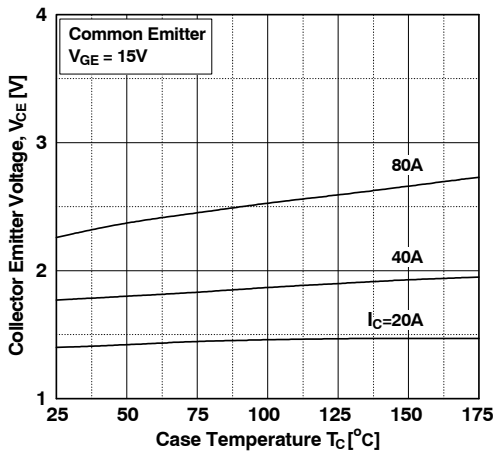


Figure 4. Saturation Voltage vs. Case Temperature at Variant Current Level

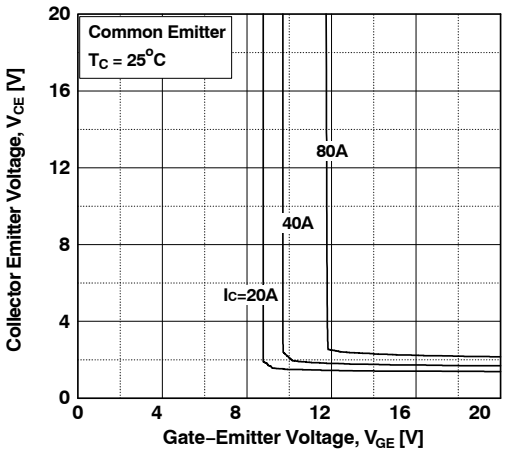


Figure 5. Saturation Voltage vs. V_{GE}

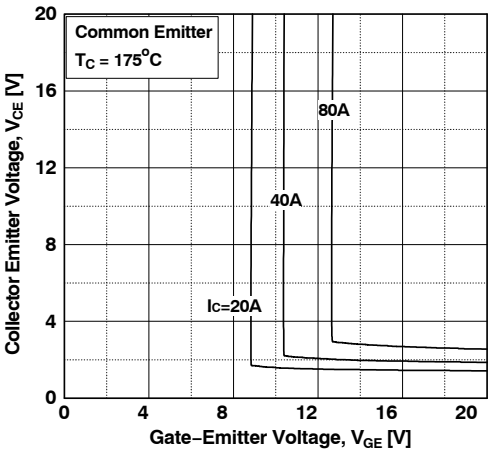


Figure 6. Saturation Voltage vs. V_{GE}

TYPICAL PERFORMANCE CHARACTERISTICS (Continued)

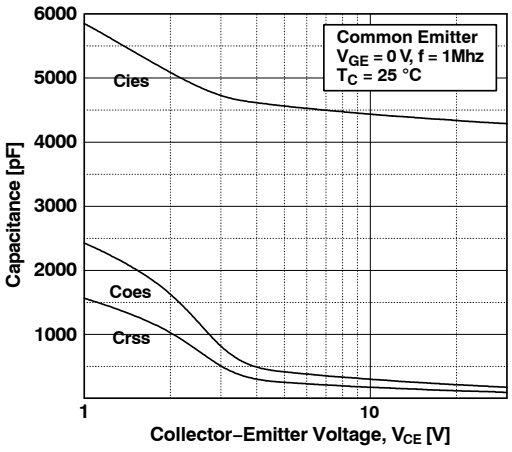


Figure 7. Capacitance Characteristics

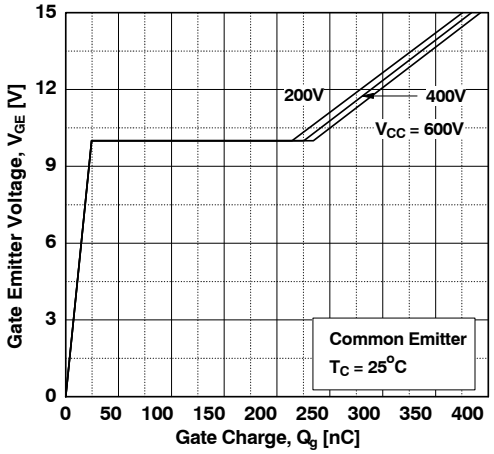


Figure 8. Gate Charge Characteristics

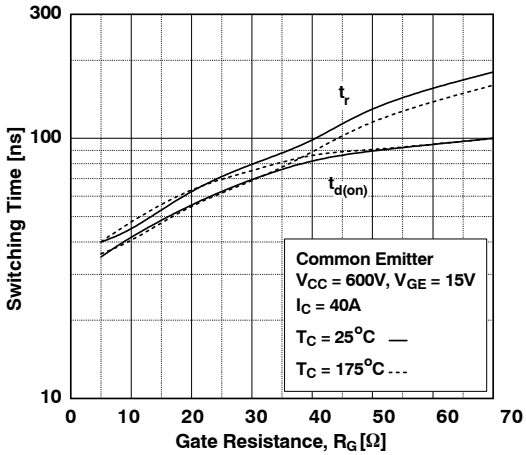


Figure 9. Turn−on Characteristics vs. Gate Resistance

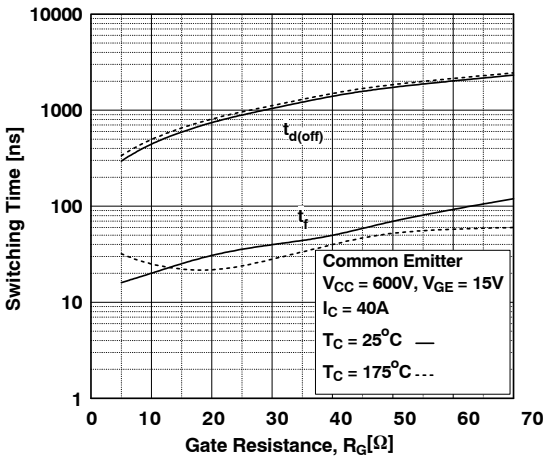


Figure 10. Turn−off Characteristics vs. Gate Resistance

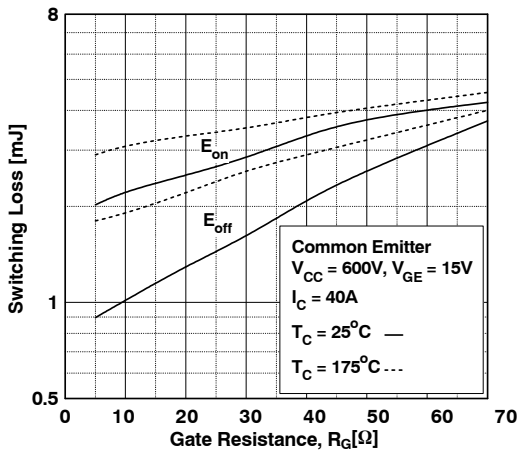


Figure 11. Switching Loss vs. Gate Resistance

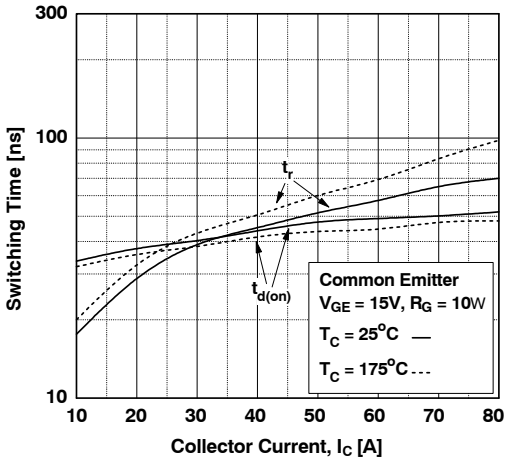


Figure 12. Turn−on Characteristics vs. Collector Current

TYPICAL PERFORMANCE CHARACTERISTICS (Continued)

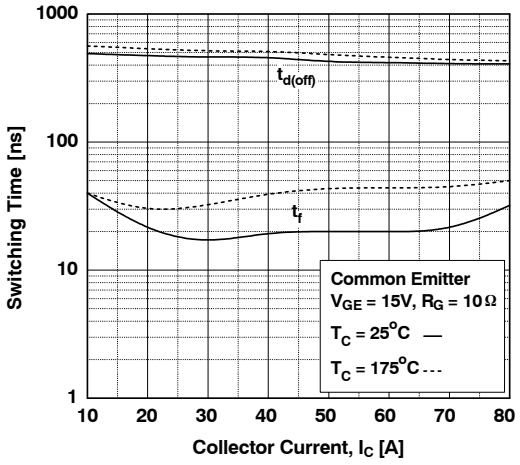


Figure 13. Turn−off Characteristics vs. Collector Current

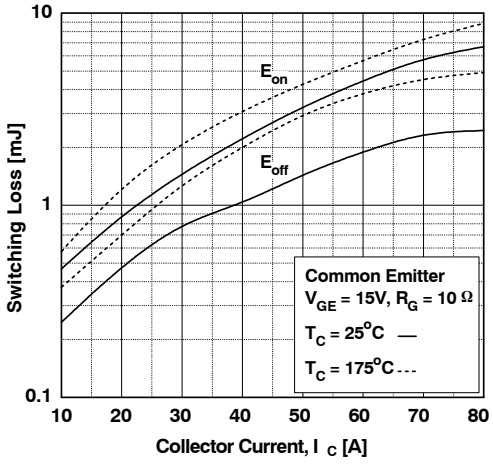


Figure 14. Switching Loss vs. Collector Current

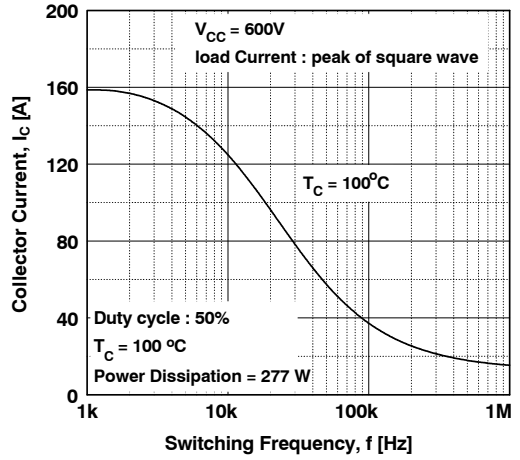


Figure 15. Load Current vs. Frequency

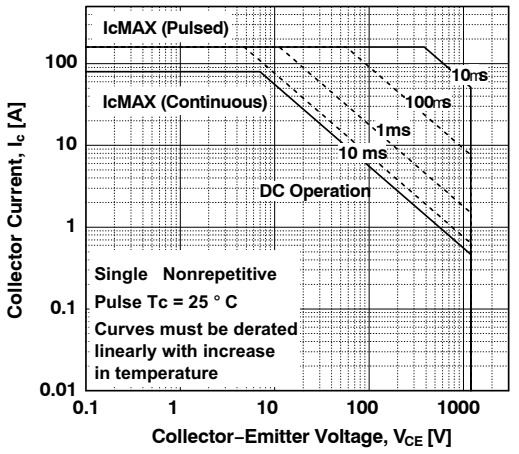


Figure 16. SOA Characteristics

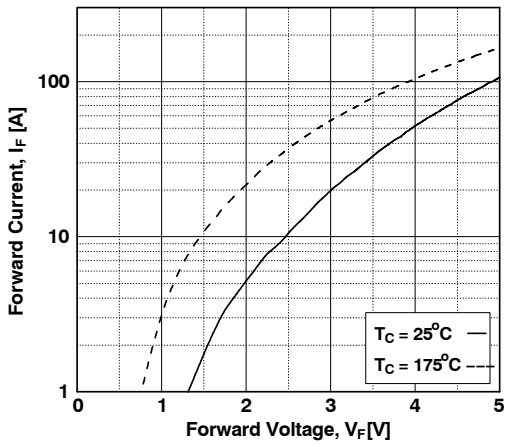


Figure 17. Forward Characteristics

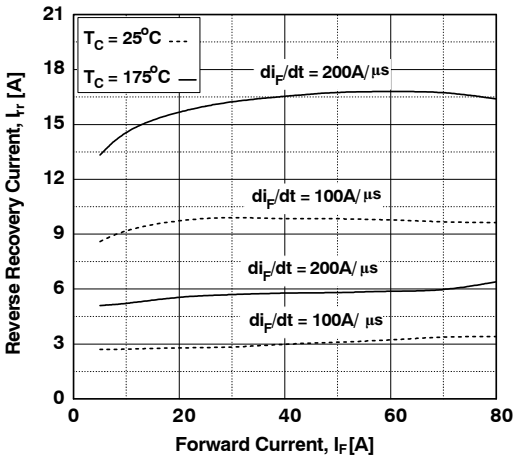


Figure 18. Reverse Recovery Current

TYPICAL PERFORMANCE CHARACTERISTICS (Continued)

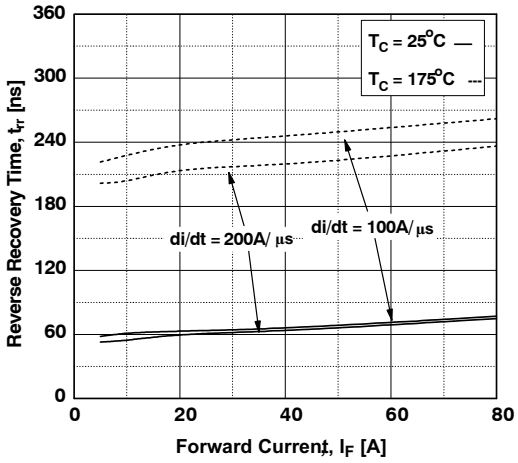


Figure 19. Reverse Recovery Time

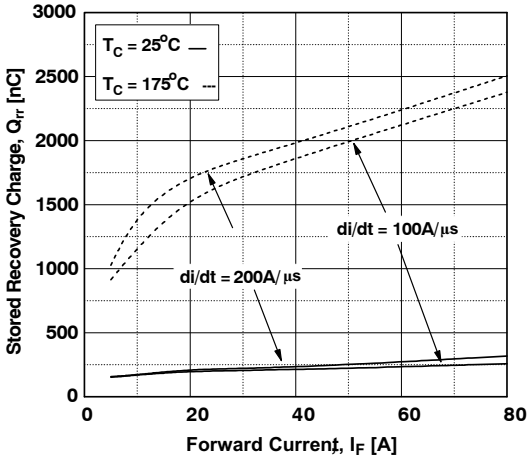


Figure 20. Stored Charge

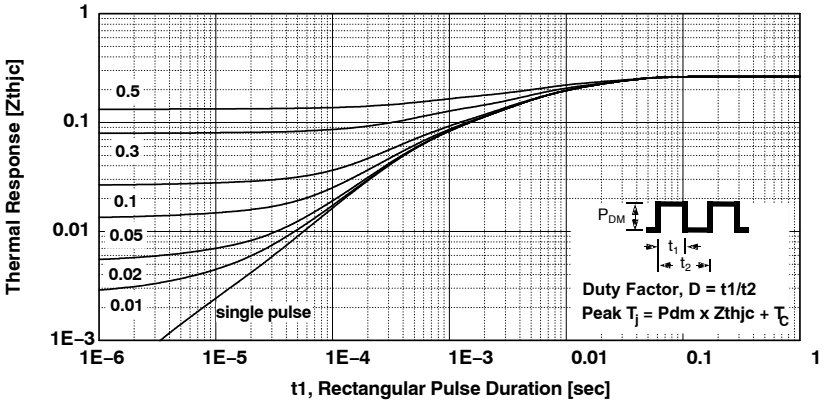


Figure 21. Transient Thermal Impedance of IGBT

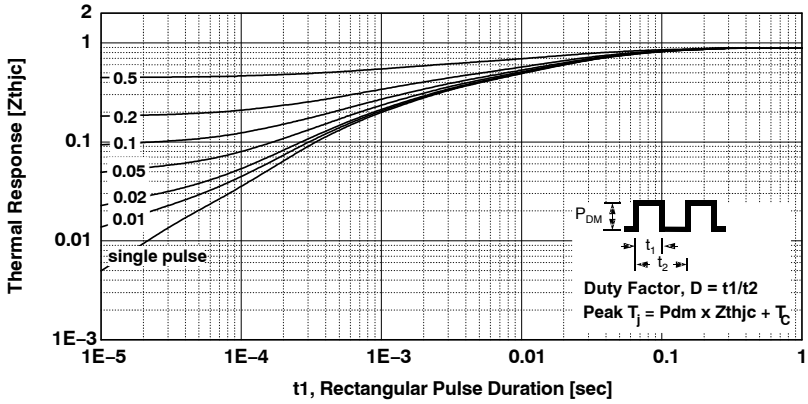


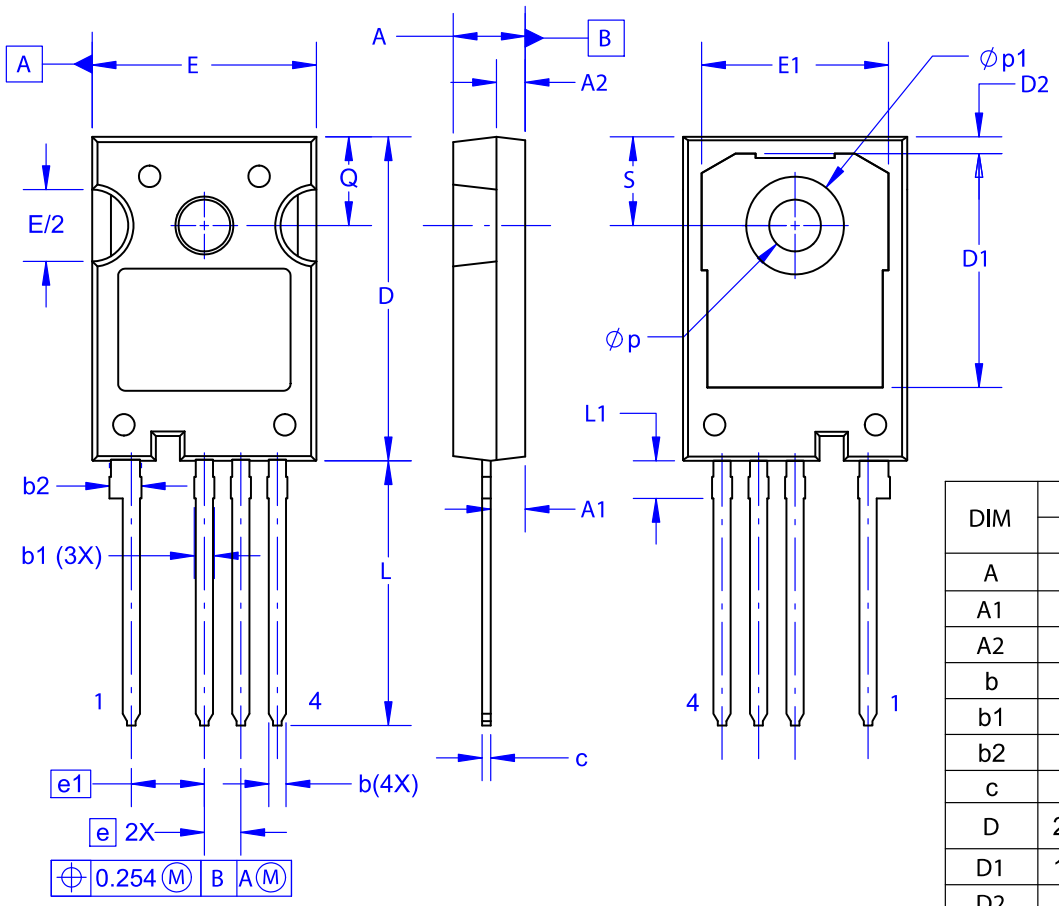
Figure 22. Transient Thermal Impedance of Diode

MECHANICAL CASE OUTLINE
PACKAGE DIMENSIONS

ON Semiconductor®

TO−247−4LD
CASE 340CJ
ISSUE A

DATE 16 SEP 2019



DIM	MILLIMETERS		
	MIN	NOM	MAX
A	4.80	5.00	5.20
A1	2.10	2.40	2.70
A2	1.80	2.00	2.20
b	1.07	1.20	1.33
b1	1.20	1.40	1.60
b2	2.02	2.22	2.42
c	0.50	0.60	0.70
D	22.34	22.54	22.74
D1	16.00	16.25	16.50
D2	0.97	1.17	1.37
e	2.54 BSC		
e1	5.08 BSC		
E	15.40	15.60	15.80
E1	12.80	13.00	13.20
E/2	4.80	5.00	5.20
L	18.22	18.42	18.62
L1	2.42	2.62	2.82
p	3.40	3.60	3.80
p1	6.60	6.80	7.00
Q	5.97	6.17	6.37
S	5.97	6.17	6.37

NOTES:

A. NO INDUSTRY STANDARD APPLIES TO THIS PACKAGE.
B. DIMENSIONS ARE EXCLUSIVE OF BURRS,MOLD FLASH,AND TIE BAR EXTRUSIONS.
C. ALL DIMENSIONS ARE IN MILLIMETERS.
D. DRAWING CONFORMS TO ASME Y14.5-2009.

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