IGBT – Power, Co-PAK N-Channel, Field Stop VII (FS7), SCR, TO247-3L

1200 V, 1.5 V, 60 A

FGHL60T120RWD

BV_{CES}	$V_{CE(SAT)}$	I_C
1200 V	1.5 V	60 A

Description

Using the novel field stop 7th generation IGBT technology and the Gen7 Diode in TO247 3−lead package, FGHL60T120RWD offers the optimum performance with low conduction losses and good switching controllability for a high efficiency operation in various applications like motor control, UPS, data center and high−power switch.

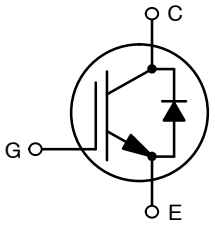
Features

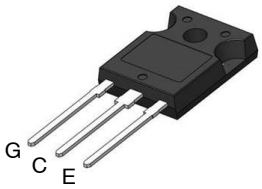
- Low Conduction Loss and Optimized Switching
- Maximum Junction Temperature − T_J = 175°C
- Positive Temperature Coefficient for Easy Parallel Operation
- High Current Capability
- 100% of the Parts are Dynamically Tested
- Short Circuit Rated
- RoHS Compliant

Applications

- Motor Control
- UPS
- General Application Requiring High Power Switch

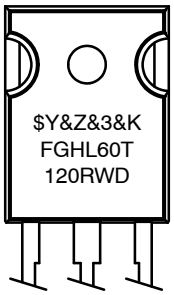
PIN CONNECTIONS





TO−247−3LD
CASE 340CX

MARKING DIAGRAM



$Y	= **onsemi** Logo
&Z	= Assembly Plant Code
&3	= 3−Digit Date Code
&K	= 2−Digit Lot Traceability Code
FGHL60T120RWD	= Specific Device Code

MAXIMUM RATINGS (T_J = 25°C unless otherwise noted)

Parameter		Symbol	Value	Unit
Collector−to−Emitter Voltage		V_{CES}	1200	V
Gate−to−Emitter Voltage		V_{GES}	±20	
Transient Gate−to−Emitter Voltage			±30	
Collector Current	T_C = 25°C (Note 1)	I_C	120	A
	T_C = 100°C		60	
Power Dissipation	T_C = 25°C	P_D	833	W
	T_C = 100°C		416	
Pulsed Collector Current	T_C = 25°C (Note 2) t_p = 10 μs	I_{CM}	180	A
Diode Forward Current	T_C = 25°C (Note 1)	I_F	120	
	T_C = 100°C		60	
Pulsed Diode Maximum Forward Current	T_C = 25°C, t_p = 10 μs	I_{FM}	180	
Operating Junction and Storage Temperature Range		T_J, T_{stg}	−55 to +175	°C
Lead Temperature for Soldering Purposes		T_L	260	

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. Value limit by bond wire.
2. Repetitive rating: Pulse width limited by max. junction temperature.

ORDERING INFORMATION

Device	Package	Shipping
FGHL60T120RWD	TO−247 (Pb−Free)	30 Units / Tube

THERMAL CHARACTERISTICS

Parameter	Symbol	Value	Unit
Thermal Resistance, Junction−to−Case for IGBT	$R_{\theta JC}$	0.18	°C/W
Thermal Resistance, Junction−to−Case for Diode	$R_{\theta JCD}$	0.33	
Thermal Resistance, Junction−to−Ambient	$R_{\theta JA}$	40	

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

Parameter	Symbol	Test Conditions	Min	Typ	Max	Unit
OFF CHARACTERISTICS						
Collector−to−Emitter Breakdown Voltage	BV_{CES}	V_{GE} = 0 V, I_C = 5 mA	1200			V
Collector−to−Emitter Breakdown Voltage Temperature Coefficient	$\frac{\Delta BV_{CES}}{\Delta T_J}$			1225		mV/°C
Zero Gate Voltage Collector Current	I_{CES}	V_{GE} = 0 V, V_{CE} = V_{CES}			40	μA
Gate−to−Emitter Leakage Current	I_{GES}	V_{GE} = 20 V, V_{CE} = 0 V			±400	nA
ON CHARACTERISTICS						
Gate Threshold Voltage	$V_{GE(th)}$	V_{GE} = V_{CE}, I_C = 60 mA, T_J = 25°C	4.9	5.94	6.7	V
Collector−to−Emitter Saturation Voltage	$V_{CE(sat)}$	V_{GE} = 15 V, I_C = 60 A, T_J = 25°C	1.2	1.48	1.8	
		V_{GE} = 15 V, I_C = 60 A, T_J = 175°C		1.81		
DYNAMIC CHARACTERISTICS						
Input Capacitance	C_{ies}	V_{CE} = 30 V, V_{GE} = 0 V, f = 1 MHz		7128		pF
Output Capacitance	C_{oes}			252		
Reverse Transfer Capacitance	C_{res}			25.3		
Total Gate Charge	Q_g	V_{CE} = 600 V, V_{GE} = 15 V, I_C = 60 A		256		nC
Gate−to−Emitter Charge	Q_{ge}			64.1		
Gate−to−Collector Charge	Q_{gc}			102		
SWITCHING CHARACTERISTICS						
Turn−on Delay Time	$t_{d(on)}$	V_{CE} = 600 V, V_{GE} = 0/15 V I_C = 30 A R_G = 4.7 Ω T_J = 25°C		48		ns
Turn−off Delay Time	$t_{d(off)}$			290		
Rise Time	t_r			30		
Fall Time	t_f			138		
Turn−on Switching Loss	E_{on}			1.9		mJ
Turn−off Switching Loss	E_{off}			1.8		
Total Switching Loss	E_{ts}			3.7		
Turn−on Delay Time	$t_{d(on)}$	V_{CE} = 600 V, V_{GE} = 0/15 V I_C = 60 A R_G = 4.7 Ω T_J = 25°C		51		ns
Turn−off Delay Time	$t_{d(off)}$			250		
Rise Time	t_r			64		
Fall Time	t_f			139		
Turn−on Switching Loss	E_{on}			4.5		mJ
Turn−off Switching Loss	E_{off}			3.4		
Total Switching Loss	E_{ts}			8.0		

ELECTRICAL CHARACTERISTICS OF IGBT (T_J = 25°C unless otherwise noted) (continued)

Parameter	Symbol	Test Conditions	Min	Typ	Max	Unit
SWITCHING CHARACTERISTICS						
Turn−on Delay Time	$t_{d(on)}$	V_{CE} = 600 V, V_{GE} = 0/15 V I_C = 30 A R_G = 4.7 Ω T_J = 175°C		45		ns
Turn−off Delay Time	$t_{d(off)}$			328		
Rise Time	t_r			35		
Fall Time	t_f			228		
Turn−on Switching Loss	E_{on}			3.3		mJ
Turn−off Switching Loss	E_{off}			2.4		
Total Switching Loss	E_{ts}			5.7		
Turn−on Delay Time	$t_{d(on)}$	V_{CE} = 600 V, V_{GE} = 0/15 V I_C = 60 A R_G = 4.7 Ω T_J = 175°C		52		ns
Turn−off Delay Time	$t_{d(off)}$			296		
Rise Time	t_r			68		
Fall Time	t_f			224		
Turn−on Switching Loss	E_{on}			6.9		mJ
Turn−off Switching Loss	E_{off}			5.1		
Total Switching Loss	E_{ts}			12.0		
DIODE CHARACTERISTICS						
Forward Voltage	V_F	I_F = 60 A, T_J = 25°C	1.46	1.74	2.08	V
		I_F = 60 A, T_J = 175°C		1.7		
DIODE SWITCHING CHARACTERISTICS, INDUCTIVE LOAD						
Reverse Recovery Time	t_{rr}	V_R = 600 V, I_F = 30 A, dI_F/dt = 500 A/μs, T_J = 25°C		183		ns
Reverse Recovery Charge	Q_{rr}			1815		nC
Reverse Recovery Energy	E_{REC}			0.5		mJ
Peak Reverse Recovery Current	I_{RRM}			19.9		A
Reverse Recovery Time	t_{rr}	V_R = 600 V, I_F = 60 A, dI_F/dt = 500 A/μs, T_J = 25°C		257		ns
Reverse Recovery Charge	Q_{rr}			2651		nC
Reverse Recovery Energy	E_{REC}			0.9		mJ
Peak Reverse Recovery Current	I_{RRM}			20.6		A
Reverse Recovery Time	t_{rr}	V_R = 600 V, I_F = 30 A, dI_F/dt = 500 A/μs, T_J = 175°C		279		ns
Reverse Recovery Charge	Q_{rr}			4008		nC
Reverse Recovery Energy	E_{REC}			1.4		mJ
Peak Reverse Recovery Current	I_{RRM}			28.7		A
Reverse Recovery Time	t_{rr}	V_R = 600 V, I_F = 60 A, dI_F/dt = 500 A/μs, T_J = 175°C		420		ns
Reverse Recovery Charge	Q_{rr}			6392		nC
Reverse Recovery Energy	E_{REC}			2.5		mJ
Peak Reverse Recovery Current	I_{RRM}			30.3		A

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 CHARACTERISTICS

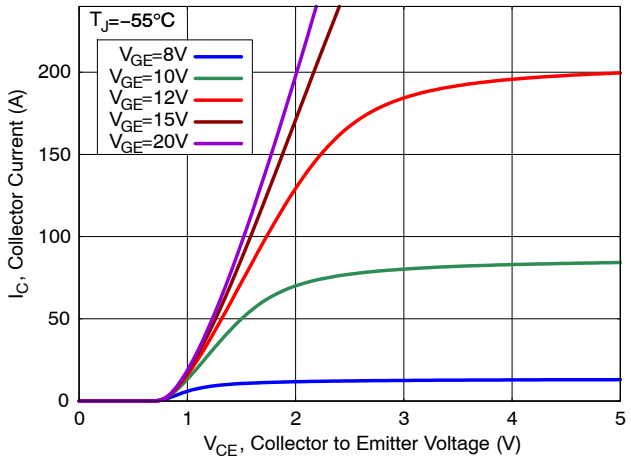


Figure 1. Output Characteristics

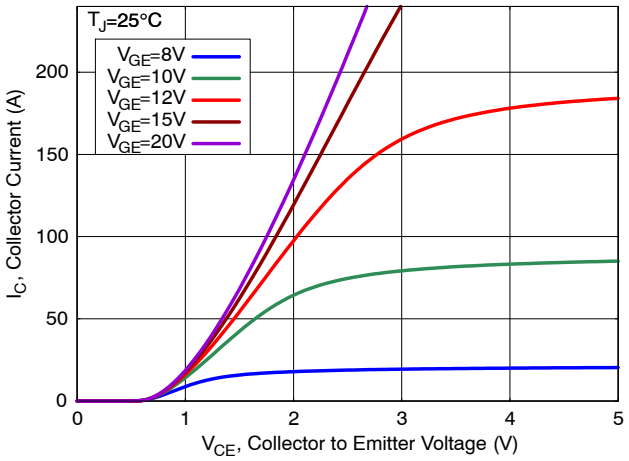


Figure 2. Output Characteristics

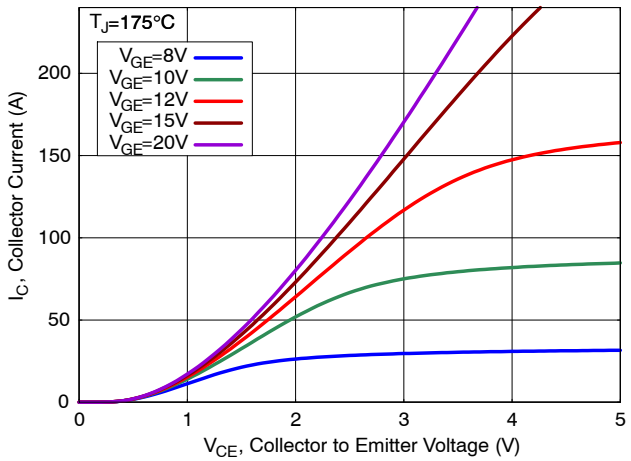


Figure 3. Output Characteristics

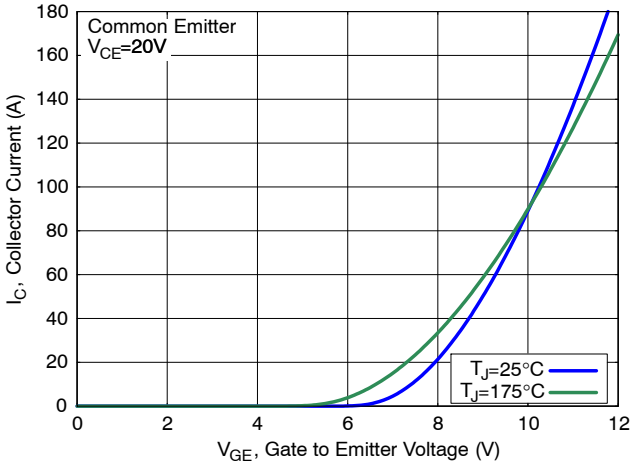


Figure 4. Transfer Characteristics

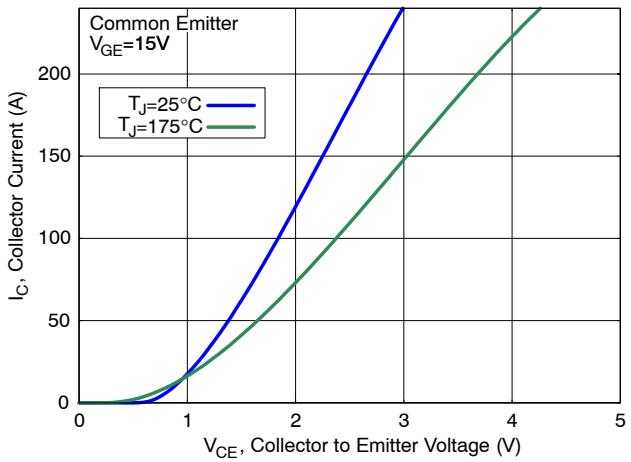


Figure 5. Saturation Characteristics

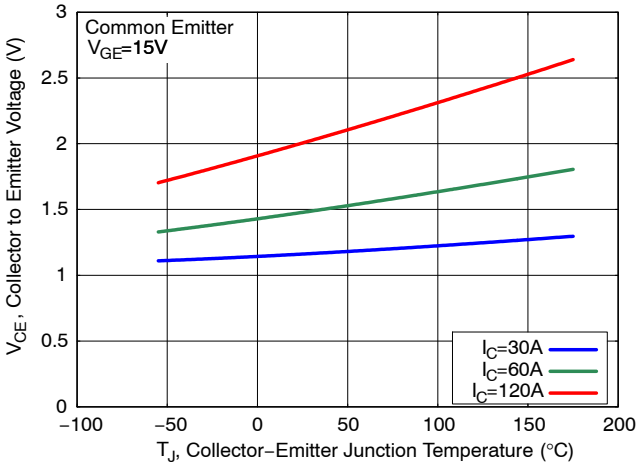


Figure 6. Saturation Voltage vs. Junction Temperature

TYPICAL CHARACTERISTICS

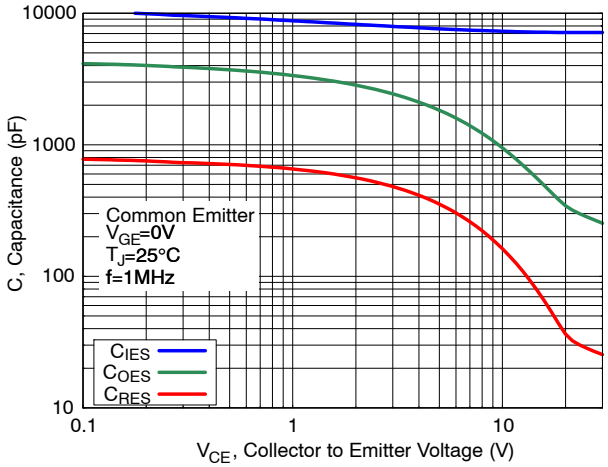


Figure 7. Capacitance Characteristics

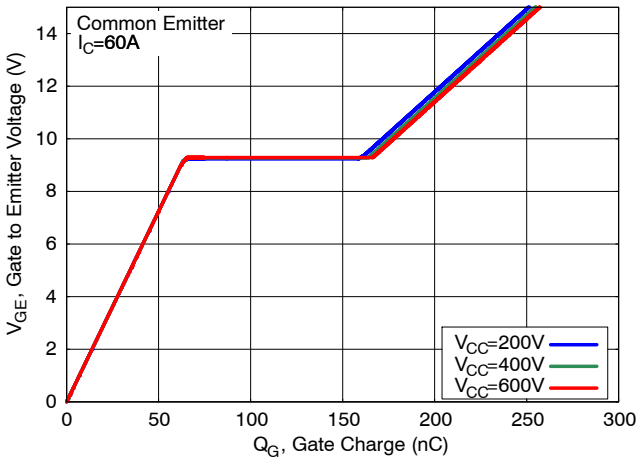


Figure 8. Gate Charge Characteristics

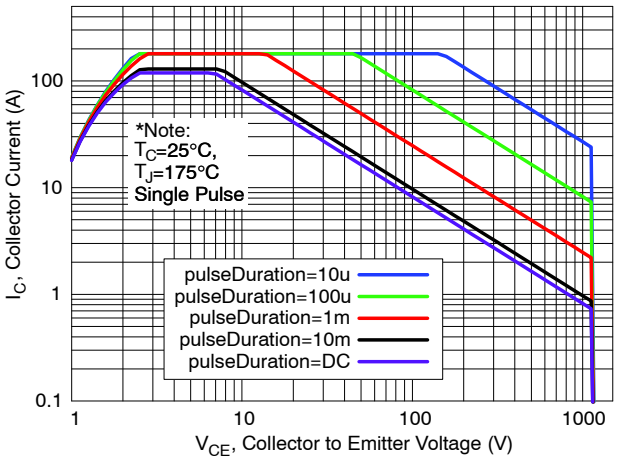


Figure 9. SOA Characteristics

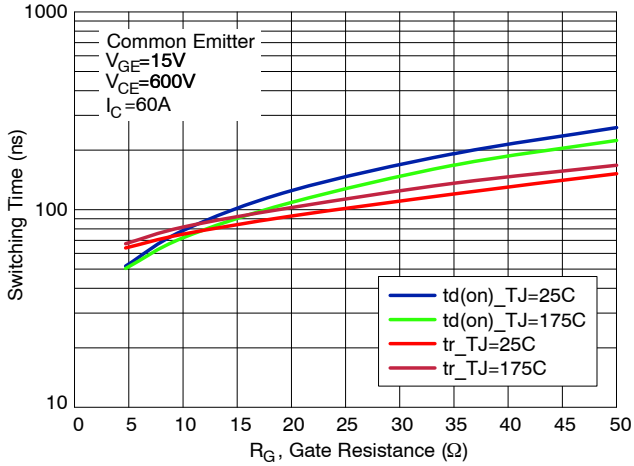


Figure 10. Turn−On Switching Time vs. Gate Resistance

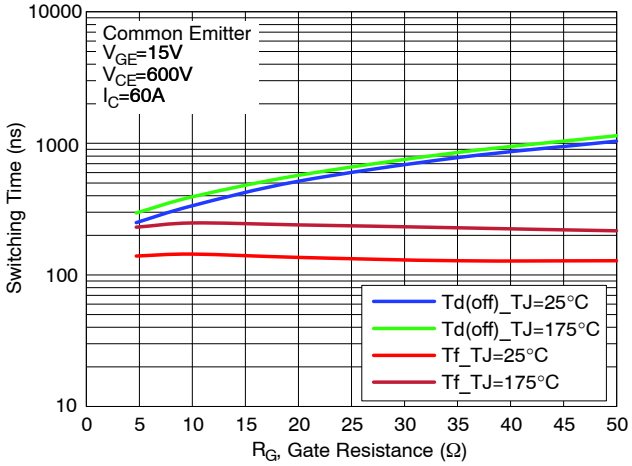


Figure 11. Turn−Off Switching Time vs. Gate Resistance

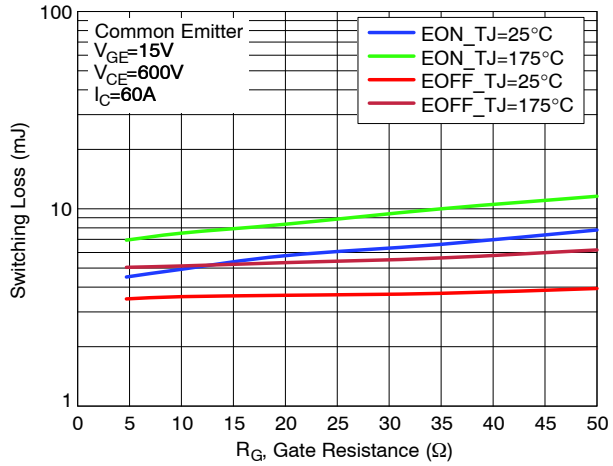


Figure 12. Switching Loss vs. Gate Resistance

TYPICAL CHARACTERISTICS

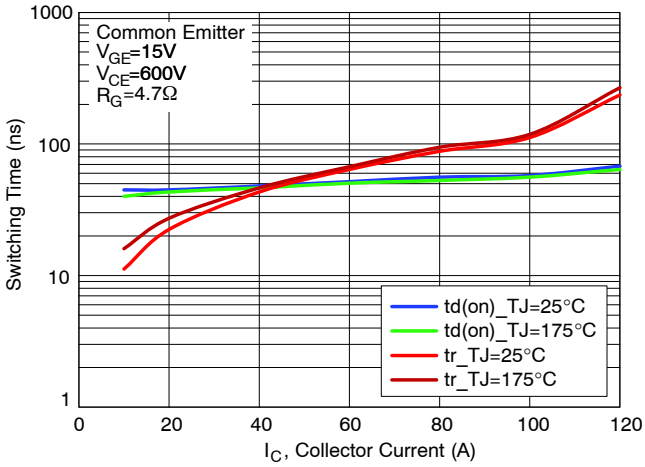


Figure 13. Turn−On Switching Time vs. Collector Current

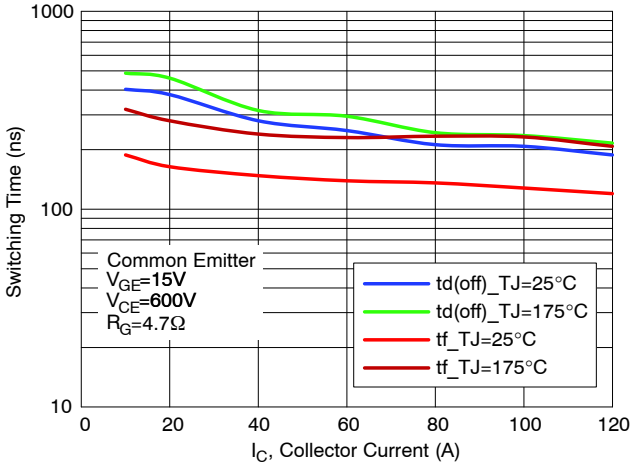


Figure 14. Turn−Off Switching Time vs. Collector Current

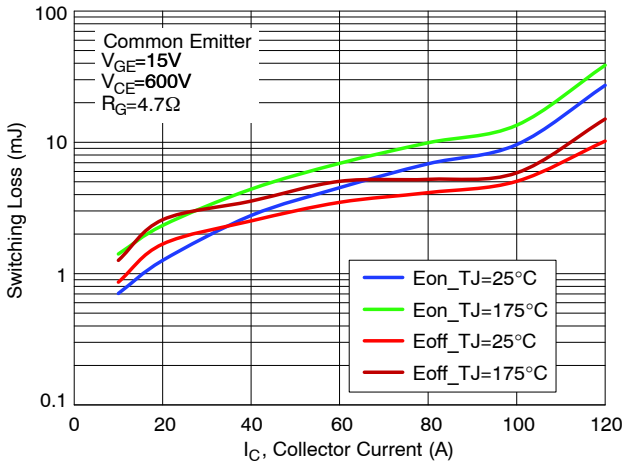


Figure 15. Switching Loss vs. Collector Current

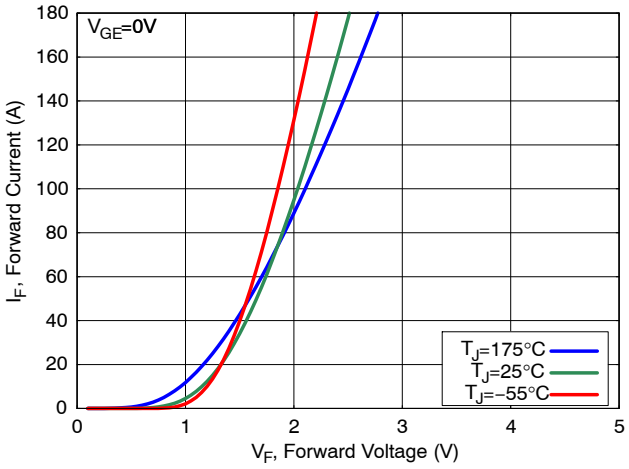


Figure 16. Diode Forward Characteristics

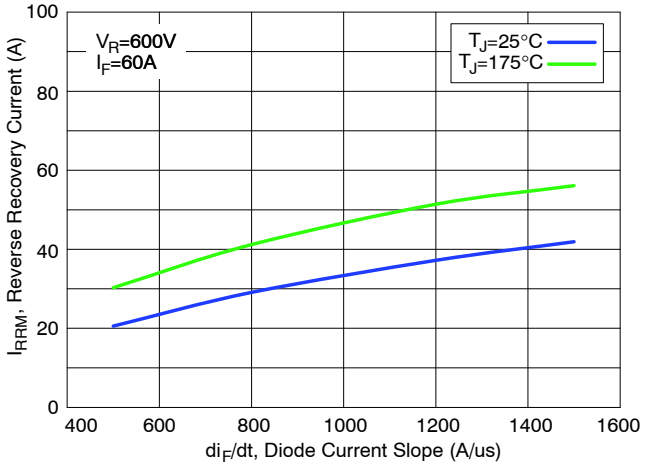


Figure 17. Diode Reverse Recovery Current

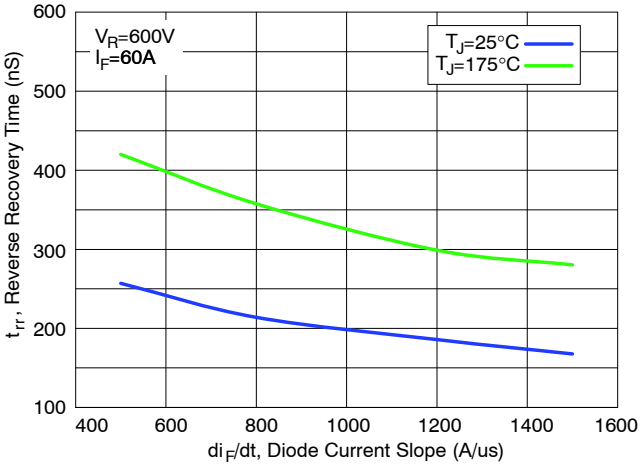


Figure 18. Diode Reverse Recovery Time

TYPICAL CHARACTERISTICS

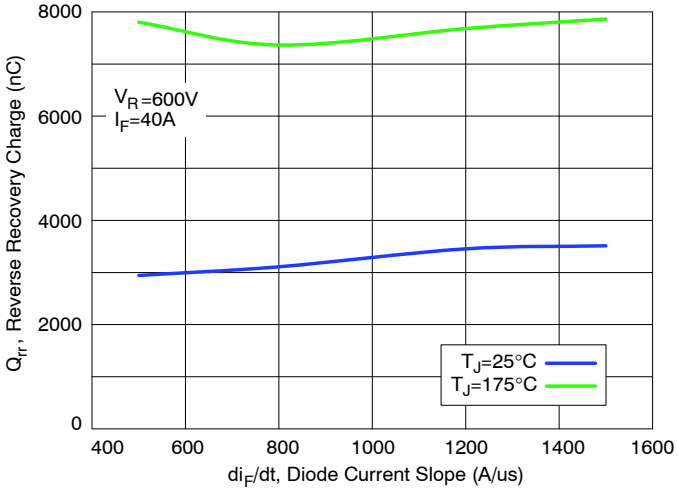


Figure 19. Diode Stored Charge Characteristics

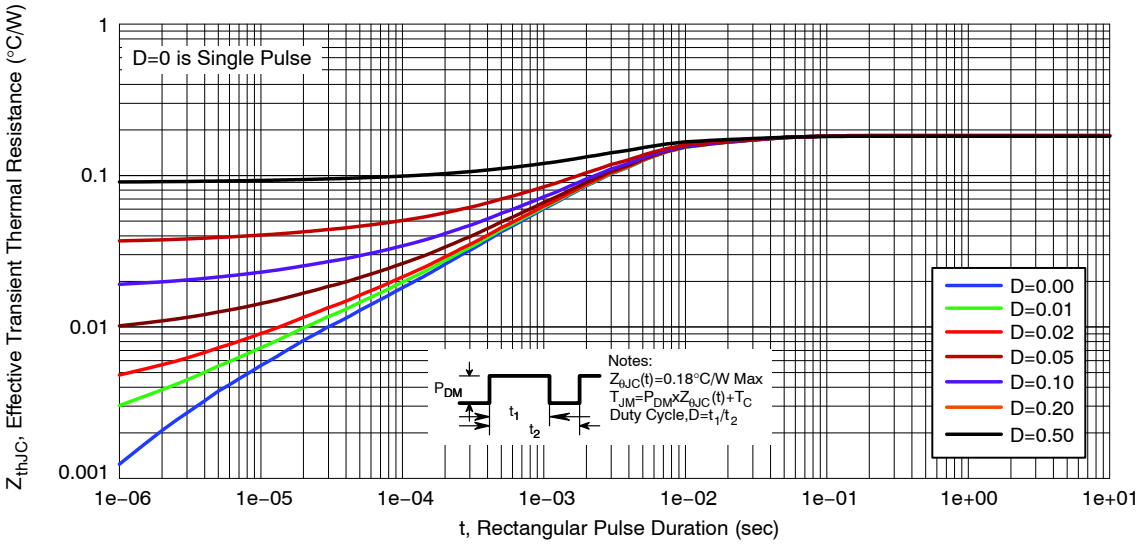


Figure 20. Transient Thermal Impedance of IGBT

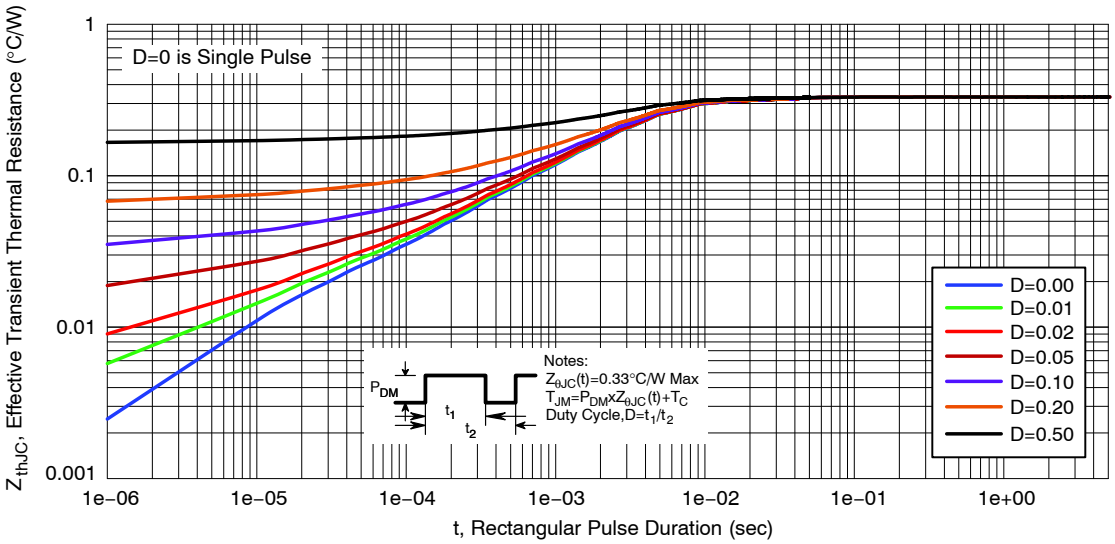
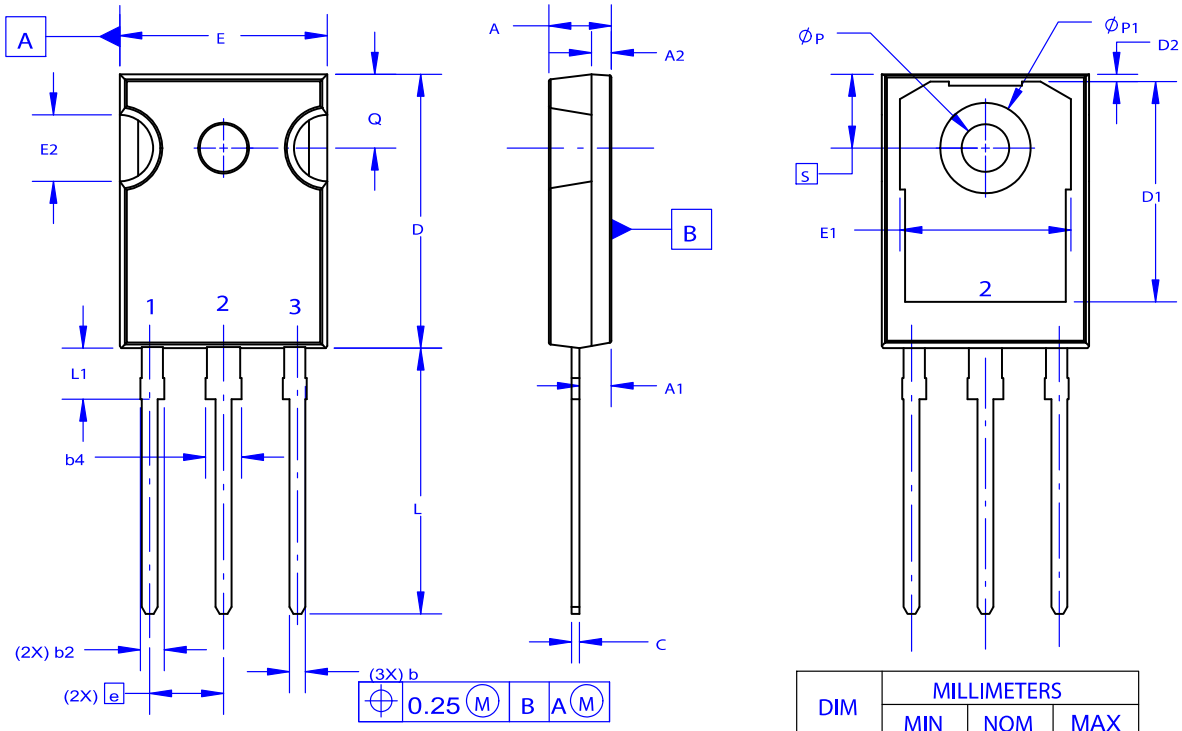


Figure 21. Transient Thermal Impedance of Diode

PACKAGE DIMENSIONS

TO−247−3LD
CASE 340CX
ISSUE A



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
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
ØP	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	~	~
ØP1	6.60	6.80	7.00

PUBLICATION ORDERING INFORMATION

LITERATURE FULFILLMENT:
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