

IGBT - Ultra Field Stop

1200 V, 40 A, $V_{CE(Sat)} = 1.55V$, TO247 4L

FGH4L40T120LQD

This Insulated Gate Bipolar Transistor (IGBT) features a robust and cost-effective Ultra Field Stop Trench construction, and provides superior performance in demanding switching applications, offering both low on-state voltage and minimal switching loss. The IGBT is well suited for motor driver applications. Incorporated into the device is a soft and fast co-packaged free-wheeling diode with a low forward voltage.

Features

- Extremely Efficient Trench with Field Stop Technology
- Maximum Junction Temperature: $T_J = 175^{\circ}C$
- Fast and Soft Reverse Recovery Diode
- Optimized for Low $V_{CE(Sat)}$

Typical Applications

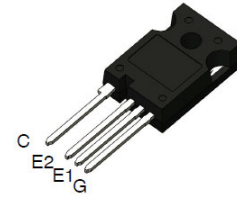
- Solar Inverter and UPS
- Industrial Switching
- Welding

MAXIMUM RATINGS

Rating	Symbol	Value	Unit
Collector-Emitter Voltage	V_{CE}	1200	V
Gate-Emitter Voltage Transient Gate-Emitter Voltage	V_{GE}	± 20 ± 30	V
Collector Current @ $T_C = 25^{\circ}C$ (Note 1) @ $T_C = 100^{\circ}C$	I_C	80 40	A
Pulsed Collector Current (Note 2)	I_{LM}	160	A
Pulsed Collector Current (Note 3)	I_{CM}	160	A
Diode Forward Current @ $T_C = 25^{\circ}C$ (Note 1) @ $T_C = 100^{\circ}C$	I_F	80 40	A
Maximum Power Dissipation @ $T_C = 25^{\circ}C$ @ $T_C = 100^{\circ}C$	P_D	306 153	W
Operating Junction and Storage Temperature Range	T_J, T_{STG}	-55 to +175	$^{\circ}C$
Maximum Lead Temp. for Soldering Purposes (1/8" from case for 5 s)	T_L	260	$^{\circ}C$

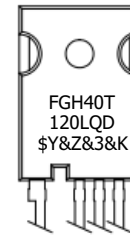
Stresses exceeding those listed in the Maximum Ratings table may damage the device. If any of these limits are exceeded, device functionality should not be assumed, damage may occur and reliability may be affected.

1. Value limit by bond wire
2. $V_{CC} = 600V$, $V_{GE} = 15V$, $I_C = 160A$, $R_G = 15\Omega$, Inductive Load, 100% Tested
3. Repetitive rating: Pulse width limited by max. junction temperature



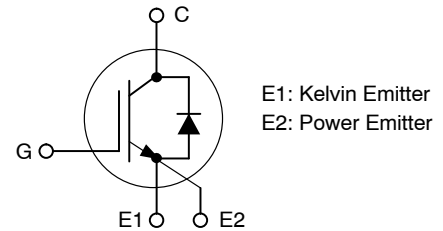
TO-247-4LD
CASE 340CJ

MARKING DIAGRAM



FGH40T120LQD = Specific Device Code
 $\$Y$ = onsemi Logo
 $\&Z$ = Assembly Plant Code
 $\&3$ = 3-Digit Date Code
 $\&K$ = 2-Digit Lot Traceability Code

PIN CONNECTIONS



ORDERING INFORMATION

Device	Package	Shipping
FGH4L40T120LQD	TO-247	30 Units / Rail

FGH4L40T120LQD

THEMAL CHARACTERISTICS

Rating	Symbol	Min	Typ	Max	Unit
Thermal resistance junction-to-case, for IGBT	$R_{\theta JC}$	-	0.38	0.49	$^{\circ}\text{C}/\text{W}$
Thermal resistance junction-to-case, for Diode	$R_{\theta JC}$	-	0.64	0.84	$^{\circ}\text{C}/\text{W}$
Thermal resistance junction-to-ambient	$R_{\theta JA}$	-	-	40	$^{\circ}\text{C}/\text{W}$

ELECTRICAL CHARACTERISTICS ($T_J = 25^{\circ}\text{C}$ unless otherwise specified)

Parameter	Test Conditions	Symbol	Min	Typ	Max	Unit
OFF CHARACTERISTIC						
Collector-Emitter Breakdown Voltage	$V_{GE} = 0\text{ V}, I_C = 1\text{ mA}$	BV_{CES}	1200	-	-	V
Temperature Coefficient of Breakdown Voltage	$V_{GE} = 0\text{ V}, I_C = 1\text{ mA}$	$\Delta BV_{CES}/\Delta T_J$	-	1.3	-	$\text{V}/^{\circ}\text{C}$
Collector-Emitter Cut-Off Current	$V_{GE} = 0\text{ V}, V_{CE} = 1200\text{ V}$	I_{CES}	-	-	40	μA
Gate Leakage Current	$V_{GE} = 20\text{ V}, V_{CE} = 0\text{ V}$	I_{GES}	-	-	200	nA

ON CHARACTERISTIC

Gate-Emitter Threshold Voltage	$V_{GE} = V_{CE}, I_C = 40\text{ mA}$	$V_{GE(th)}$	5.5	6.5	7.5	V
Collector-Emitter Saturation Voltage	$V_{GE} = 15\text{ V}, I_C = 40\text{ A}, T_J = 25^{\circ}\text{C}$	$V_{CE(sat)}$	-	1.55	1.80	V
	$V_{GE} = 15\text{ V}, I_C = 40\text{ A}, T_J = 175^{\circ}\text{C}$		-	2	-	

DYNAMIC CHARACTERISTIC

Input Capacitance	$V_{CE} = 30\text{ V}, V_{GE} = 0\text{ V}, f = 1\text{ MHz}$	C_{ies}	-	5079	-	pF
Output Capacitance		C_{oes}	-	113	-	
Reverse Transfer Capacitance		C_{res}	-	62	-	
Gate Charge Total	$V_{CC} = 600\text{ V}, I_C = 40\text{ A}, V_{GE} = 15\text{ V}$	Q_g	-	227	-	nC
Gate-to-Emitter Charge		Q_{ge}	-	40	-	
Gate-to-Collector Charge		Q_{gc}	-	108	-	

SWITCHING CHARACTERISTIC, INDUCTIVE LOAD

Turn-on Delay Time	$T_J = 25^{\circ}\text{C}$ $V_{CC} = 600\text{ V}, I_C = 20\text{ A}$ $R_g = 10\ \Omega$ $V_{GE} = 15\text{ V}$ Inductive Load	$t_{d(on)}$	-	38	-	ns	
Rise Time		t_r	-	13	-		
Turn-off Delay Time		$t_{d(off)}$	-	227	-		
Fall Time			t_f	-	51	-	mJ
Turn-on Switching Loss		E_{on}	-	0.63	-		
Turn-off Switching Loss		E_{off}	-	0.77	-		
Total Switching Loss		E_{ts}	-	1.40	-		
Turn-on Delay Time	$T_J = 25^{\circ}\text{C}$ $V_{CC} = 600\text{ V}, I_C = 40\text{ A}$ $R_g = 10\ \Omega$ $V_{GE} = 15\text{ V}$ Inductive Load	$t_{d(on)}$	-	42	-	ns	
Rise Time		t_r	-	19	-		
Turn-off Delay Time		$t_{d(off)}$	-	218	-		
Fall Time			t_f	-	80	-	mJ
Turn-on Switching Loss		E_{on}	-	1.04	-		
Turn-off Switching Loss		E_{off}	-	1.35	-		
Total Switching Loss		E_{ts}	-	2.39	-		

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ELECTRICAL CHARACTERISTICS ($T_J = 25^\circ\text{C}$ unless otherwise specified)

Parameter	Test Conditions	Symbol	Min	Typ	Max	Unit
SWITCHING CHARACTERISTIC, INDUCTIVE LOAD						
Turn-on Delay Time	$T_J = 175^\circ\text{C}$ $V_{CC} = 600\text{ V}, I_C = 20\text{ A}$ $R_g = 10\ \Omega$ $V_{GE} = 15\text{ V}$ Inductive Load	$t_{d(on)}$	-	32	-	ns
Rise Time		t_r	-	12	-	
Turn-off Delay Time		$t_{d(off)}$	-	264	-	
Fall Time		t_f	-	156	-	
Turn-on Switching Loss		E_{on}	-	1.05	-	mJ
Turn-off Switching Loss		E_{off}	-	1.62	-	
Total Switching Loss		E_{ts}	-	2.67	-	
Turn-on Delay Time	$T_J = 175^\circ\text{C}$ $V_{CC} = 600\text{ V}, I_C = 40\text{ A}$ $R_g = 10\ \Omega$ $V_{GE} = 15\text{ V}$ Inductive Load	$t_{d(on)}$	-	36	-	ns
Rise Time		t_r	-	20	-	
Turn-off Delay Time		$t_{d(off)}$	-	236	-	
Fall Time		t_f	-	204	-	
Turn-on Switching Loss		E_{on}	-	1.62	-	mJ
Turn-off Switching Loss		E_{off}	-	2.51	-	
Total Switching Loss		E_{ts}	-	4.13	-	

DIODE CHARACTERISTIC

Forward Voltage	$V_{GE} = 0\text{ V}, I_F = 40\text{ A}, T_J = 25^\circ\text{C}$	V_F	-	3.31	3.80	V
	$V_{GE} = 0\text{ V}, I_F = 40\text{ A}, T_J = 175^\circ\text{C}$		-	2.97	-	
Reverse Recovery Energy	$T_J = 25^\circ\text{C}$ $I_F = 40\text{ A}, V_R = 600\text{ V}$ $di_F/dt = 1000\text{ A}/\mu\text{s}$	E_{REC}	-	126	-	μJ
Diode Reverse Recovery Time		T_{rr}	-	59	-	ns
Diode Reverse Recovery Charge		Q_{rr}	-	804	-	nC
Reverse Recovery Energy	$T_J = 175^\circ\text{C}$ $I_F = 20\text{ A}, V_R = 600\text{ V}$ $di_F/dt = 1000\text{ A}/\mu\text{s}$	E_{REC}	-	540	-	μJ
Diode Reverse Recovery Time		T_{rr}	-	115	-	ns
Diode Reverse Recovery Charge		Q_{rr}	-	2090	-	nC
Reverse Recovery Energy	$T_J = 175^\circ\text{C}$ $I_F = 40\text{ A}, V_R = 600\text{ V}$ $di_F/dt = 1000\text{ A}/\mu\text{s}$	E_{REC}	-	667	-	μJ
Diode Reverse Recovery Time		T_{rr}	-	127	-	ns
Diode Reverse Recovery Charge		Q_{rr}	-	2613	-	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.

FGH4L40T120LQD

TYPICAL CHARACTERISTICS

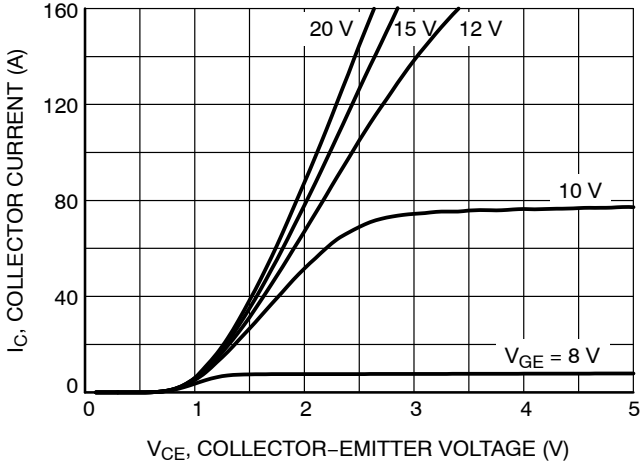


Figure 1. Typical Output Characteristics
($T_J = 25^\circ\text{C}$)

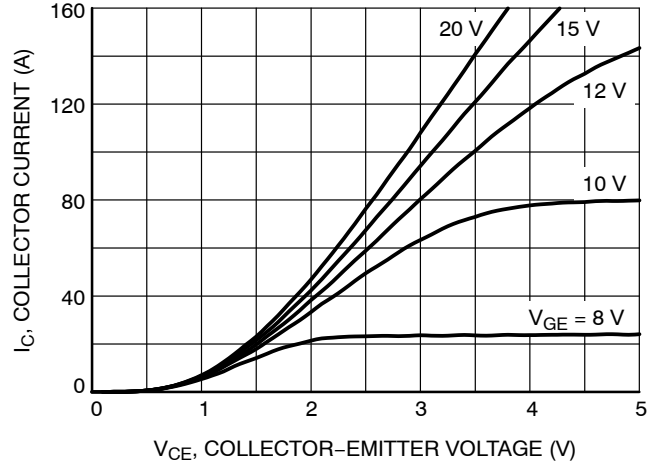


Figure 2. Typical Output Characteristics
($T_J = 175^\circ\text{C}$)

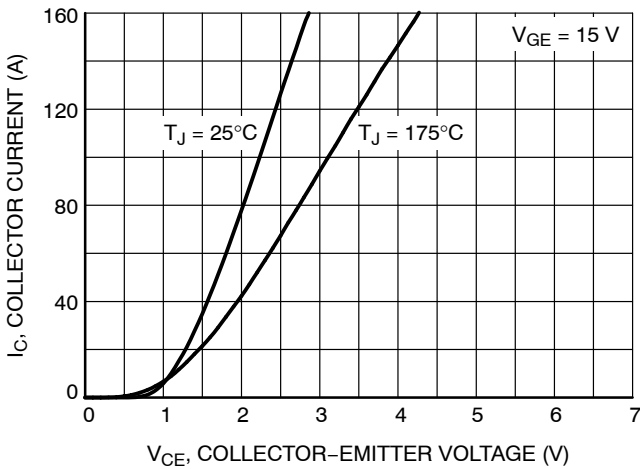


Figure 3. Typical Saturation Voltage Characteristics

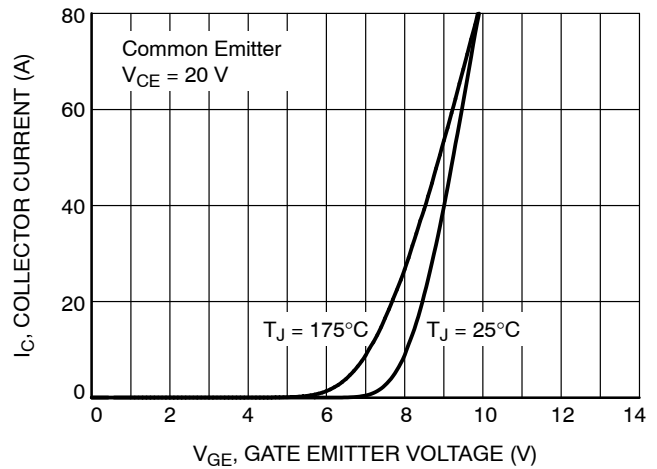


Figure 4. Typical Transfer Characteristics

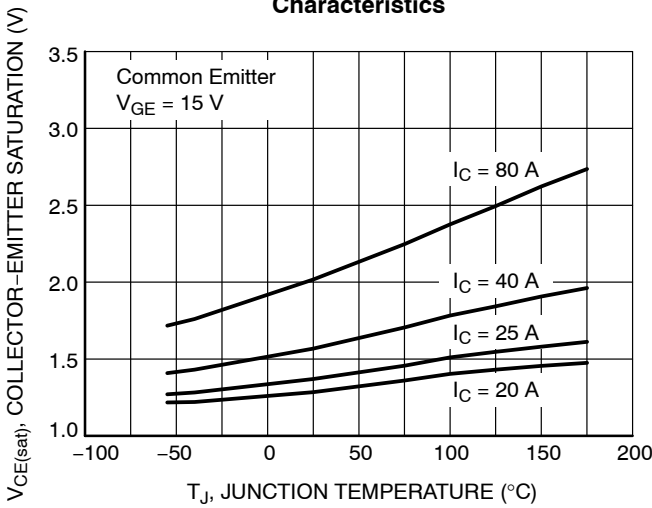


Figure 5. Saturation Voltage vs. Junction Temperature

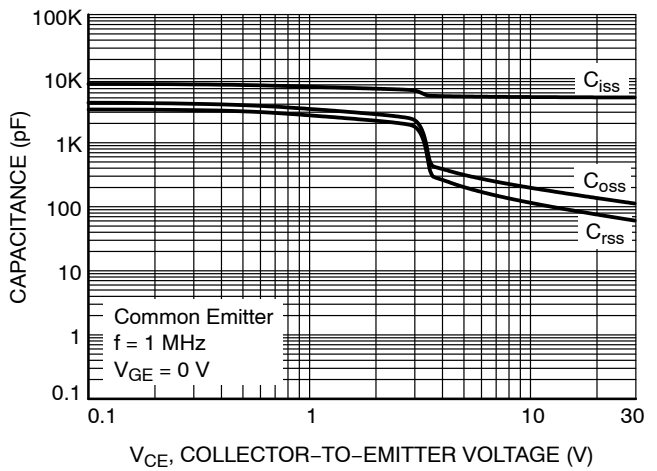


Figure 6. Capacitance Characteristics

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TYPICAL CHARACTERISTICS

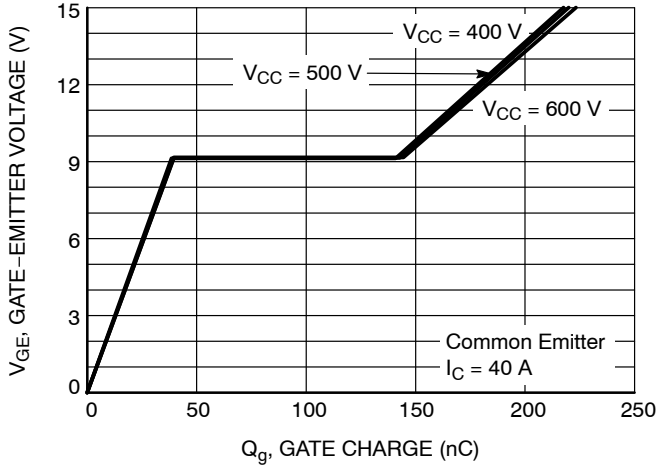


Figure 7. Gate Charge Characteristics

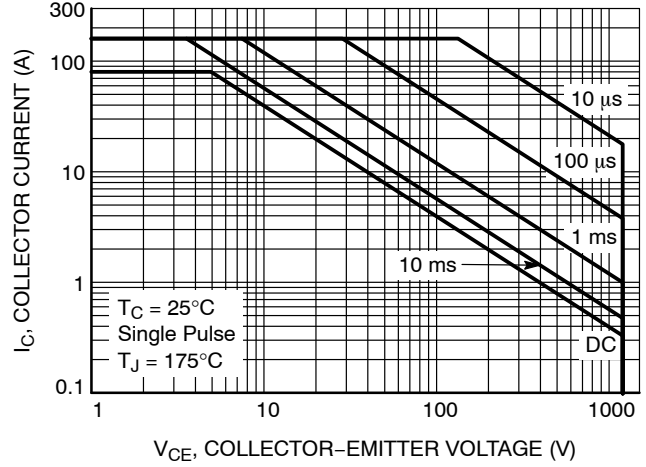


Figure 8. SOA Characteristics (FBSOA)

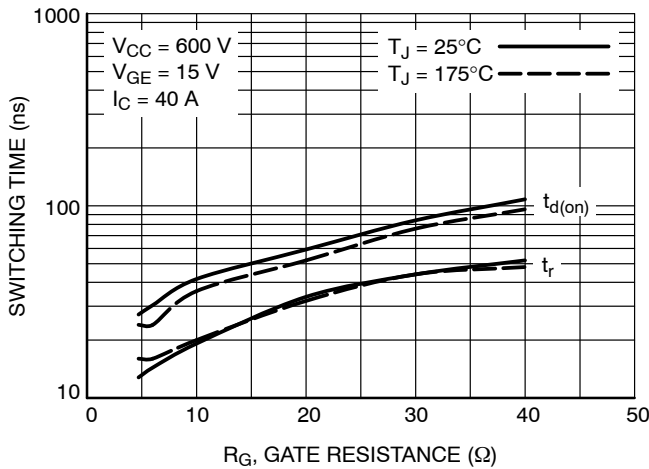


Figure 9. Turn-on Characteristics vs. Gate Resistance

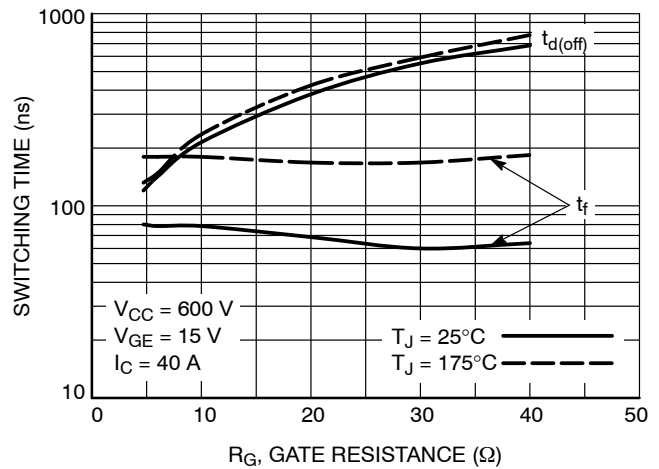


Figure 10. Turn-off Characteristics vs. Gate Resistance

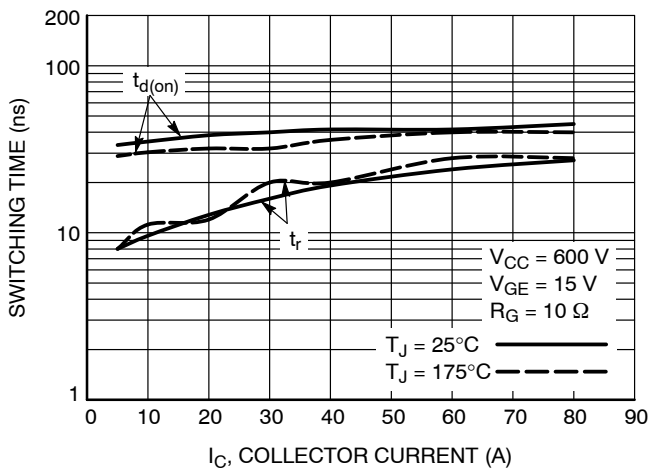


Figure 11. Turn-on Characteristics vs. Collector Current

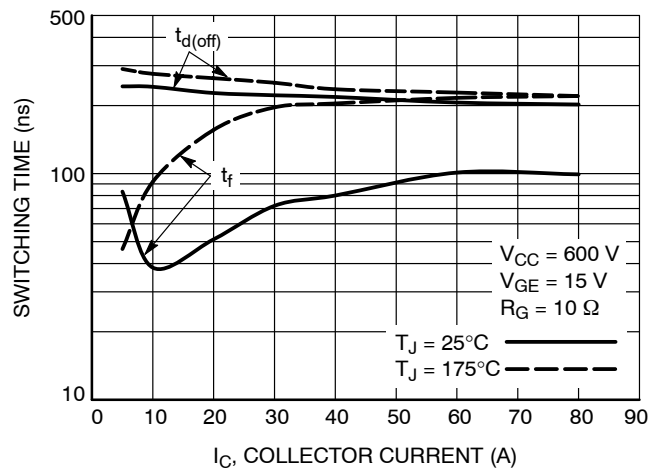


Figure 12. Turn-off Characteristics vs. Collector Current

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TYPICAL CHARACTERISTICS

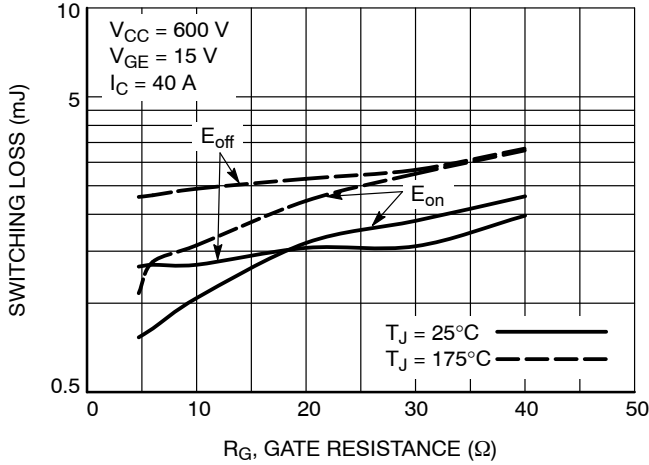


Figure 13. Switching Loss vs. Gate Resistance

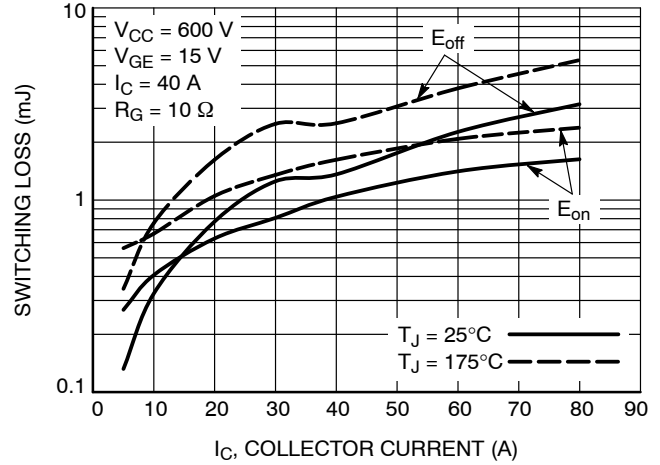


Figure 14. Switching Loss vs. Collector Current

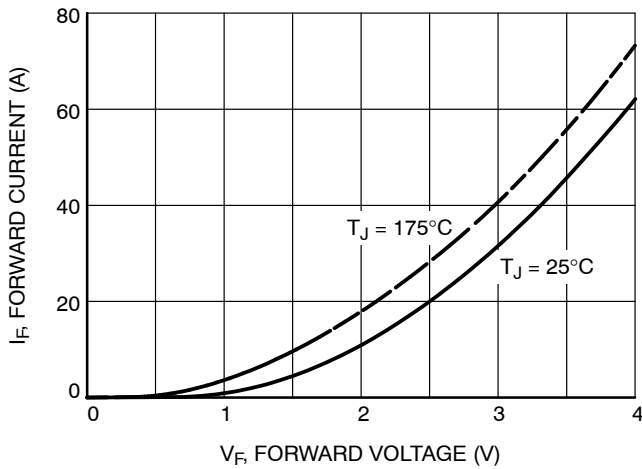


Figure 15. (Diode) Forward Characteristics

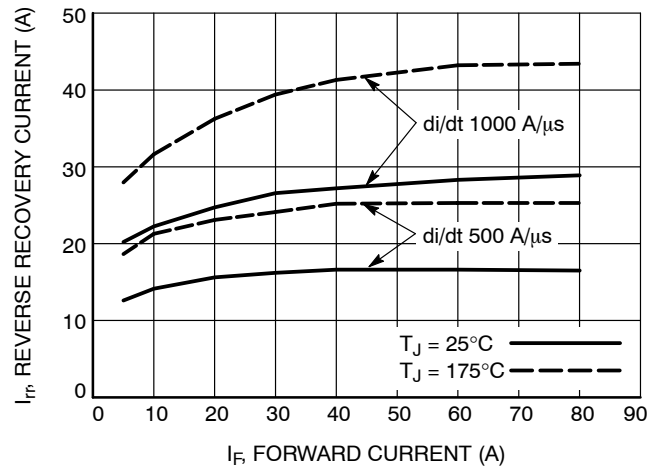


Figure 16. (Diode) Reverse Recover Current vs. Forward Current

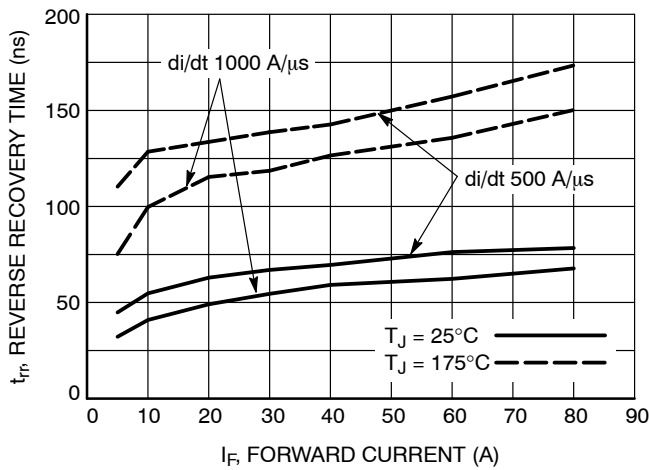


Figure 17. (Diode) Reverse Recovery Time

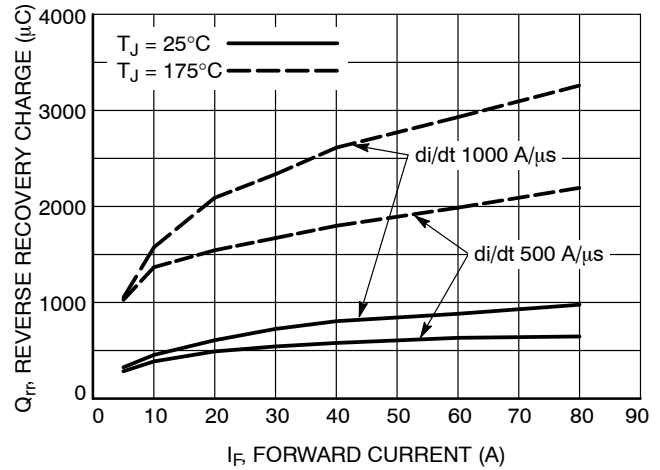


Figure 18. (Diode) Stored Charge

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TYPICAL CHARACTERISTICS

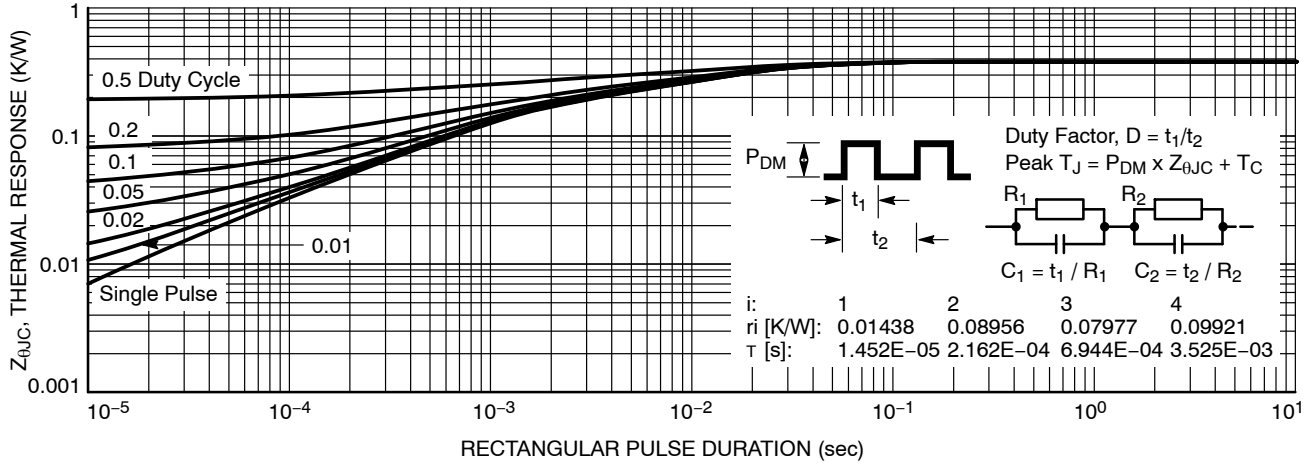


Figure 19. Transient Thermal Impedance of IGBT

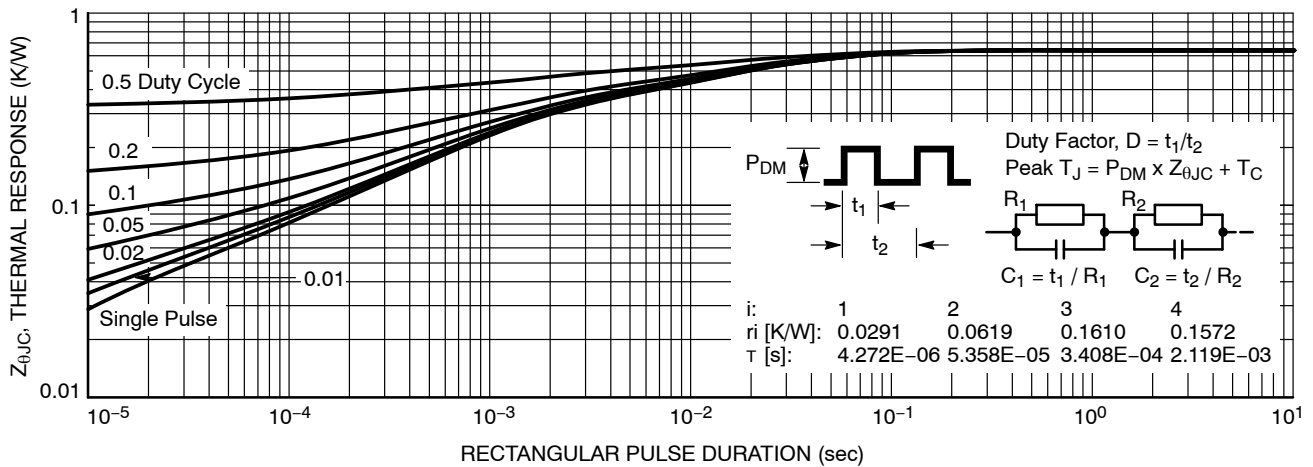


Figure 20. Transient Thermal Impedance of Diode

FGH4L40T120LQD

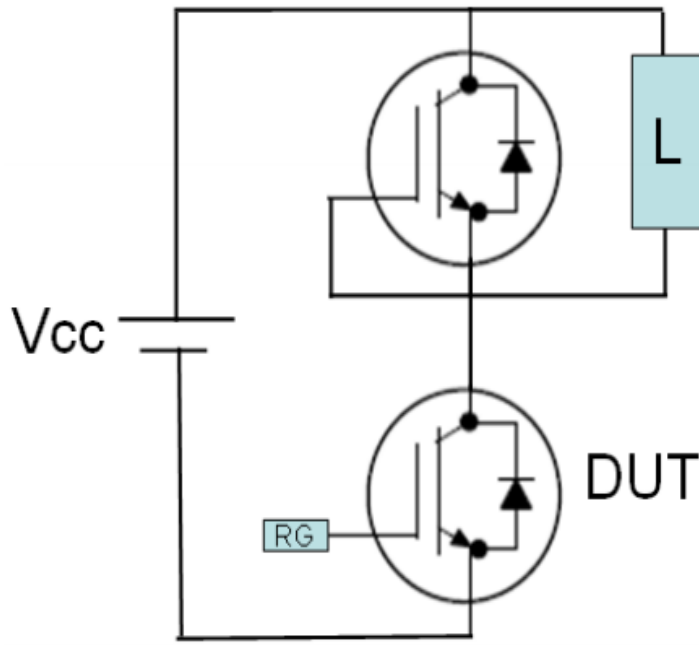


Figure 21. Test Circuits for Switching Characteristics

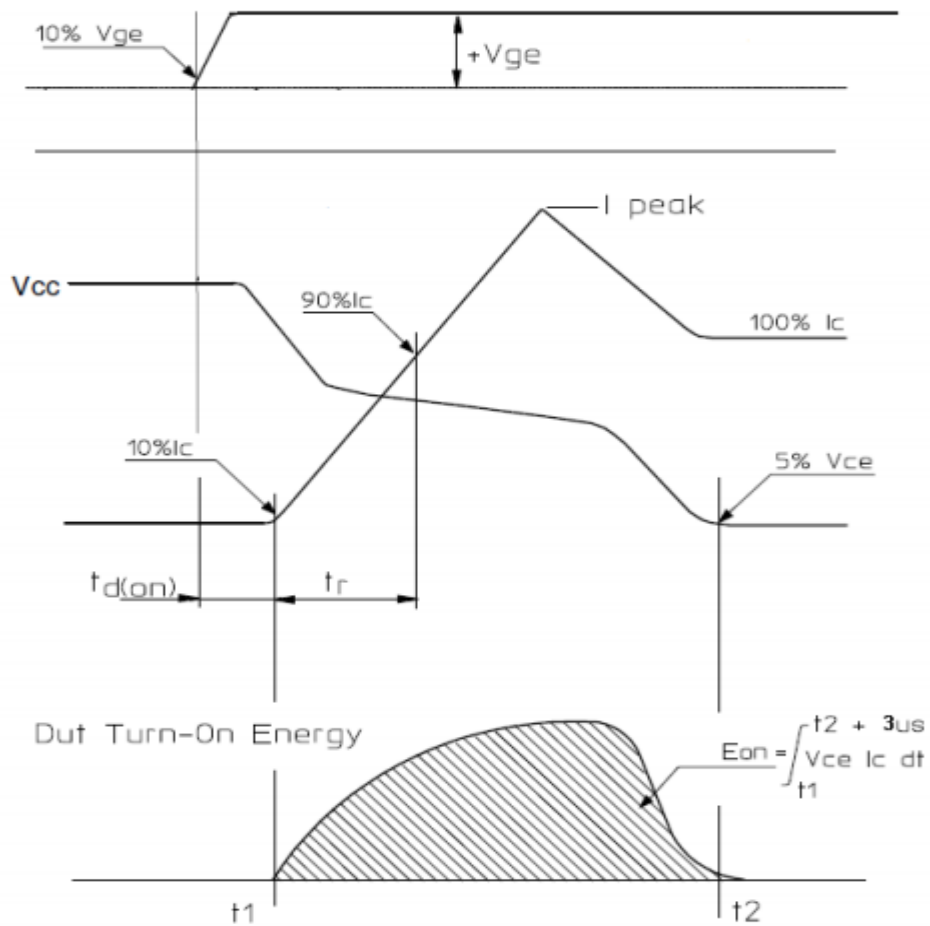


Figure 22. Definition of Turn-On Waveforms

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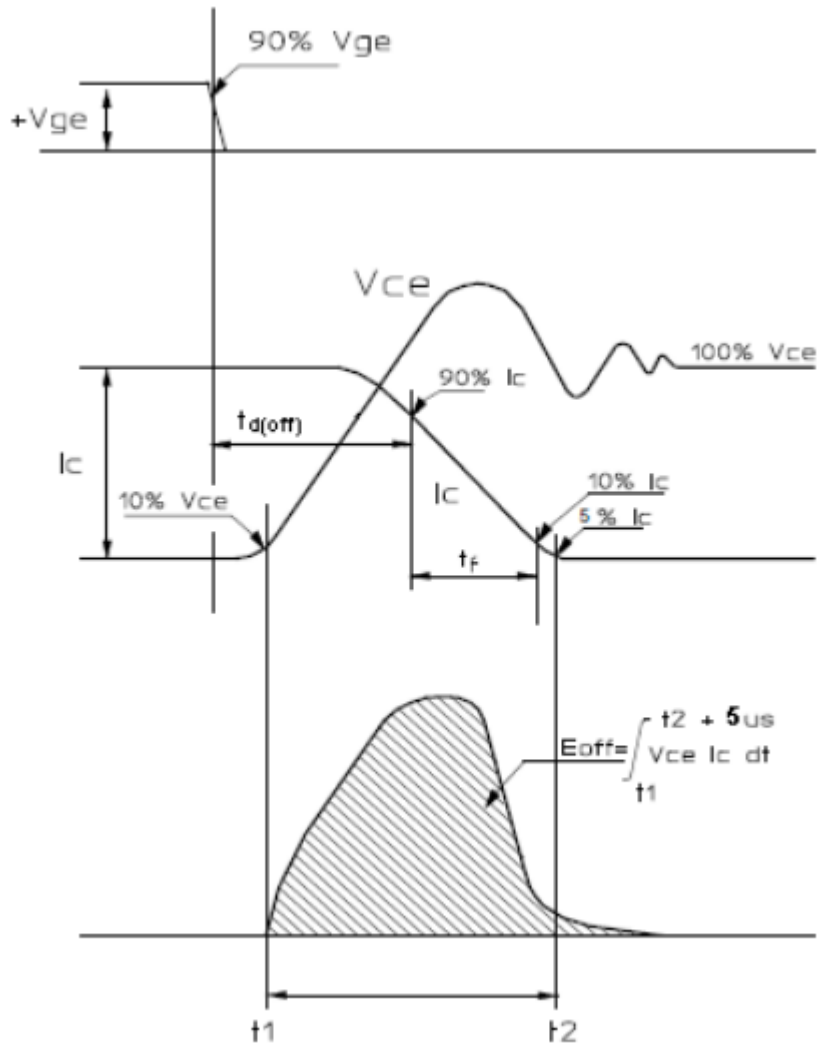


Figure 23. Definition of Turn-Off Waveforms

MECHANICAL CASE OUTLINE

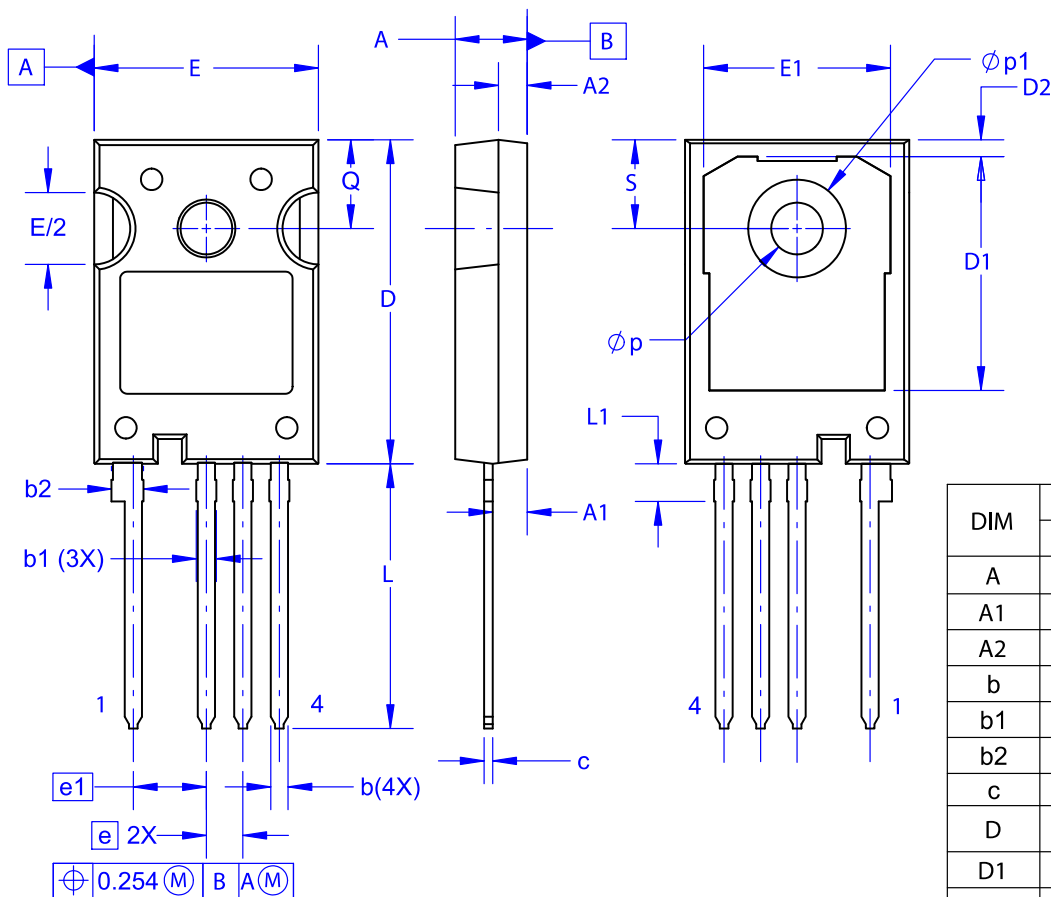
PACKAGE DIMENSIONS

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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