

Field Stop Trench IGBT

650 V, 40 A

FGHL40T65MQDT

Field stop 4th generation mid speed IGBT technology copacked with full rated current diode.

Features

- Maximum Junction Temperature: $T_J = 175^{\circ}\text{C}$
- Positive Temperature Co-efficient for Easy Parallel Operating
- High Current Capability
- Low Saturation Voltage: $V_{CE(Sat)} = 1.45\text{ V (Typ.) @ } I_C = 40\text{ A}$
- 100% of the Parts are Tested for I_{LM} (Note 2)
- Smooth and Optimized Switching
- Tight Parameter Distribution
- RoHS Compliant

Typical Applications

- Solar Inverter
- UPS, ESS
- PFC, Converters

MAXIMUM RATINGS

Parameter	Symbol	Value	Unit
Collector to Emitter Voltage	V_{CES}	650	V
Gate to Emitter Voltage Transient Gate to Emitter Voltage	V_{GES}	± 20 ± 30	V
Collector Current (Note 1) @ $T_C = 25^{\circ}\text{C}$ @ $T_C = 100^{\circ}\text{C}$	I_C	60 40	A
Pulsed Collector Current (Note 2)	I_{LM}	160	A
Pulsed Collector Current (Note 3)	I_{CM}	160	A
Diode Forward Current (Note 1) @ $T_C = 25^{\circ}\text{C}$ @ $T_C = 100^{\circ}\text{C}$	I_F	60 40	A
Pulsed Diode Maximum Forward Current	I_{FM}	160	A
Maximum Power Dissipation @ $T_C = 25^{\circ}\text{C}$ @ $T_C = 100^{\circ}\text{C}$	P_D	238 119	W
Operating Junction and Storage Temperature Range	T_J , T_{STG}	-55 to +175	$^{\circ}\text{C}$
Maximum Lead Temp. for Soldering Purposes (1/8" from case for 5 s)	T_L	260	$^{\circ}\text{C}$

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.

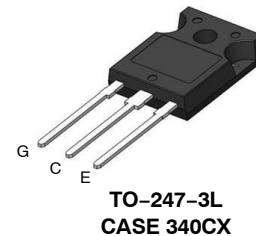
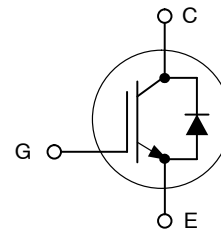
1. Value limit by bond wire
2. $V_{CC} = 400\text{ V}$, $V_{GE} = 15\text{ V}$, $I_C = 160\text{ A}$, Inductive Load, 100% tested
3. Repetitive rating: pulse width limited by max. junction temperature



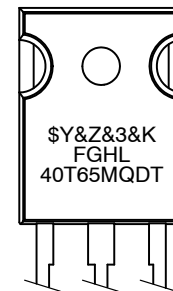
ON Semiconductor®

www.onsemi.com

40 A, 650 V
 $V_{CESat} = 1.45\text{ V}$



MARKING DIAGRAM



\$Y = ON Semiconductor Logo
&Z = Assembly Plant Code
&3 = 3-Digit Date Code
&K = 2-Digit Lot Traceability Code
FGHL40T65MQDT = Specific Device Code

ORDERING INFORMATION

Device	Package	Shipping
FGHL40T65MQDT	TO-247-3L	30 Units / Tube

FGHL40T65MQDT

THERMAL CHARACTERISTICS

Rating	Symbol	Value	Unit
Thermal Resistance Junction-to-case, for IGBT	$R_{\theta JC}$	0.63	°C/W
Thermal Resistance Junction-to-case, for Diode	$R_{\theta JC}$	0.91	°C/W
Thermal Resistance Junction-to-ambient	$R_{\theta JA}$	40	°C/W

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

Parameter	Test Conditions	Symbol	Min	Typ	Max	Unit
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OFF CHARACTERISTICS

Collector to Emitter Breakdown Voltage	$V_{GE} = 0\text{ V},$ $I_C = 1\text{ mA}$	BV_{CES}	650	–	–	V
Temperature Coefficient of Breakdown Voltage	$V_{GE} = 0\text{ V},$ $I_C = 1\text{ mA}$	$\frac{\Delta BV_{CES}}{\Delta T_J}$	–	0.6	–	V/°C
Collector to Emitter Cut-off Current	$V_{GE} = 0\text{ V},$ $V_{CE} = 650\text{ V}$	I_{CES}	–	–	250	μA
Gate Leakage Current	$V_{GE} = 20\text{ V},$ $V_{CE} = 0\text{ V}$	I_{GES}	–	–	±400	nA

ON CHARACTERISTICS

Gate to Emitter Threshold Voltage	$V_{GE} = V_{CE}, I_C = 40\text{ mA}$	$V_{GE(th)}$	3.0	4.5	6.0	V
Collector to Emitter Saturation Voltage	$V_{GE} = 15\text{ V}, I_C = 40\text{ A}, T_J = 25^\circ\text{C}$ $V_{GE} = 15\text{ V}, I_C = 40\text{ A}, T_J = 175^\circ\text{C}$	$V_{CE(sat)}$	– –	1.45 1.65	1.8 –	V

DYNAMIC CHARACTERISTICS

Input Capacitance	$V_{CE} = 30\text{ V},$ $V_{GE} = 0\text{ V},$ $f = 1\text{ MHz}$	C_{ies}	–	2680	–	pF
Output Capacitance		C_{oes}	–	80	–	
Reverse Transfer Capacitance		C_{res}	–	9	–	
Gate Charge Total	$V_{CE} = 400\text{ V},$ $I_C = 40\text{ A},$ $V_{GE} = 15\text{ V}$	Q_g	–	80	–	nC
Gate to Emitter Charge		Q_{ge}	–	16	–	
Gate to Collector Charge		Q_{gc}	–	19	–	

SWITCHING CHARACTERISTICS, INDUCTIVE LOAD

Turn-on Delay Time	$T_J = 25^\circ\text{C},$ $V_{CC} = 400\text{ V},$ $I_C = 20\text{ A},$ $R_G = 6\ \Omega,$ $V_{GE} = 15\text{ V}$	$t_{d(on)}$	–	16	–	ns
Rise Time		t_r	–	10	–	
Turn-off Delay Time		$t_{d(off)}$	–	82	–	
Fall Time		t_f	–	51	–	
Turn-on Switching Loss	$T_J = 25^\circ\text{C},$ $V_{CC} = 400\text{ V},$ $I_C = 40\text{ A},$ $R_G = 6\ \Omega,$ $V_{GE} = 15\text{ V}$	E_{on}	–	0.35	–	mJ
Turn-off Switching Loss		E_{off}	–	0.25	–	
Total Switching Loss		E_{ts}	–	0.60	–	
Turn-on Delay Time		$t_{d(on)}$	–	18	–	ns
Rise Time	$T_J = 25^\circ\text{C},$ $V_{CC} = 400\text{ V},$ $I_C = 40\text{ A},$ $R_G = 6\ \Omega,$ $V_{GE} = 15\text{ V}$	t_r	–	22	–	
Turn-off Delay Time		$t_{d(off)}$	–	75	–	
Fall Time		t_f	–	38	–	
Turn-on Switching Loss	$T_J = 25^\circ\text{C},$ $V_{CC} = 400\text{ V},$ $I_C = 40\text{ A},$ $R_G = 6\ \Omega,$ $V_{GE} = 15\text{ V}$	E_{on}	–	0.88	–	mJ
Turn-off Switching Loss		E_{off}	–	0.49	–	
Total Switching Loss		E_{ts}	–	1.36	–	

FGHL40T65MQDT

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

Parameter	Test Conditions	Symbol	Min	Typ	Max	Unit
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SWITCHING CHARACTERISTICS, INDUCTIVE LOAD

Turn-on delay time	$T_J = 175^\circ\text{C}$, $V_{CC} = 400\text{ V}$, $I_C = 20\text{ A}$, $R_G = 6\ \Omega$, $V_{GE} = 15\text{ V}$	$t_{d(on)}$	–	16	–	ns
Rise time		t_r	–	11	–	
Turn-off delay time		$t_{d(off)}$	–	93	–	
Fall time		t_f	–	88	–	
Turn-on switching loss		E_{on}	–	0.64	–	mJ
Turn-off switching loss		E_{off}	–	0.49	–	
Total switching loss		E_{ts}	–	1.13	–	
Turn-on delay time	$T_J = 175^\circ\text{C}$, $V_{CC} = 400\text{ V}$, $I_C = 40\text{ A}$, $R_G = 6\ \Omega$, $V_{GE} = 15\text{ V}$	$t_{d(on)}$	–	16	–	ns
Rise time		t_r	–	26	–	
Turn-off delay time		$t_{d(off)}$	–	85	–	
Fall time		t_f	–	75	–	
Turn-on switching loss		E_{on}	–	1.31	–	mJ
Turn-off switching loss		E_{off}	–	0.90	–	
Total switching loss		E_{ts}	–	2.21	–	

DIODE CHARACTERISTICS

Diode Forward Voltage	$I_F = 40\text{ A}$, $T_J = 25^\circ\text{C}$	V_F	–	1.7	2.15	V
	$I_F = 40\text{ A}$, $T_J = 175^\circ\text{C}$		–	1.65	–	

DIODE SWITCHING CHARACTERISTICS, INDUCTIVE LOAD

Reverse Recovery Energy	$T_J = 25^\circ\text{C}$, $V_{CE} = 400\text{ V}$, $I_F = 20\text{ A}$, $di_F/dt = 1000\text{ A}/\mu\text{s}$	E_{rec}	–	54	–	μJ
Diode Reverse Recovery Time		T_{rr}	–	42	–	ns
Diode Reverse Recovery Charge		Q_{rr}	–	329	–	nC
Diode Reverse Recovery Current		I_{rr}	–	15	–	A
Reverse Recovery Energy	$T_J = 25^\circ\text{C}$, $V_{CE} = 400\text{ V}$, $I_F = 40\text{ A}$, $di_F/dt = 1000\text{ A}/\mu\text{s}$	E_{rec}	–	121	–	μJ
Diode Reverse Recovery Time		T_{rr}	–	86	–	ns
Diode Reverse Recovery Charge		Q_{rr}	–	665	–	nC
Diode Reverse Recovery Current		I_{rr}	–	15	–	A
Reverse Recovery Energy	$T_J = 175^\circ\text{C}$, $V_{CE} = 400\text{ V}$, $I_F = 20\text{ A}$, $di_F/dt = 1000\text{ A}/\mu\text{s}$	E_{rec}	–	360	–	μJ
Diode Reverse Recovery Time		T_{rr}	–	104	–	ns
Diode Reverse Recovery Charge		Q_{rr}	–	1379	–	nC
Diode Reverse Recovery Current		I_{rr}	–	27	–	A
Reverse Recovery Energy	$T_J = 175^\circ\text{C}$, $V_{CE} = 400\text{ V}$, $I_F = 40\text{ A}$, $di_F/dt = 1000\text{ A}/\mu\text{s}$	E_{rec}	–	519	–	μJ
Diode Reverse Recovery Time		T_{rr}	–	141	–	ns
Diode Reverse Recovery Charge		Q_{rr}	–	1877	–	nC
Diode Reverse Recovery Current		I_{rr}	–	26	–	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.

FGHL40T65MQDT

TYPICAL CHARACTERISTICS

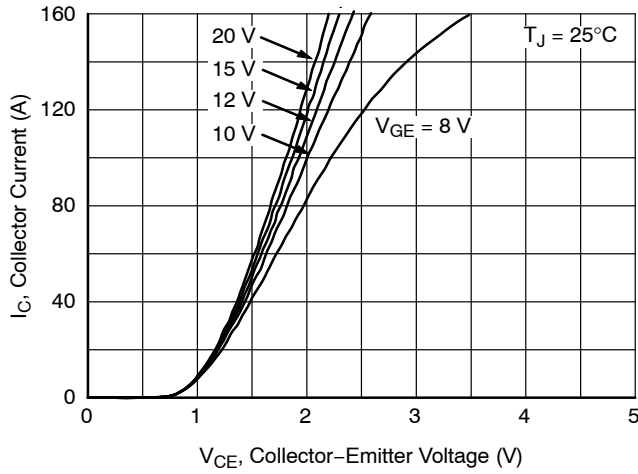


Figure 1. Typical Output Characteristics ($T_J = 25^\circ\text{C}$)

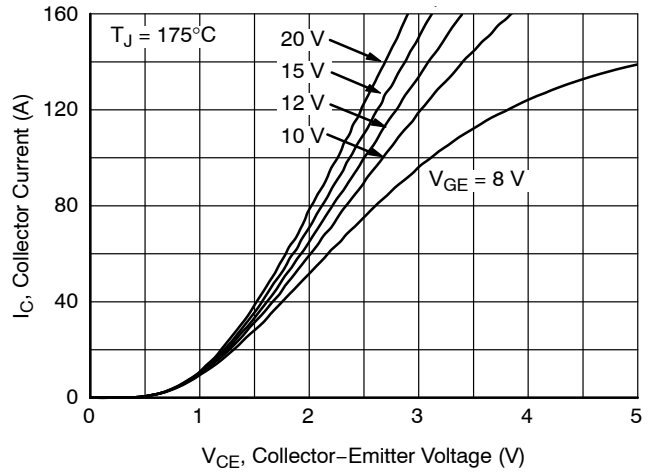


Figure 2. Typical Output Characteristics ($T_J = 175^\circ\text{C}$)

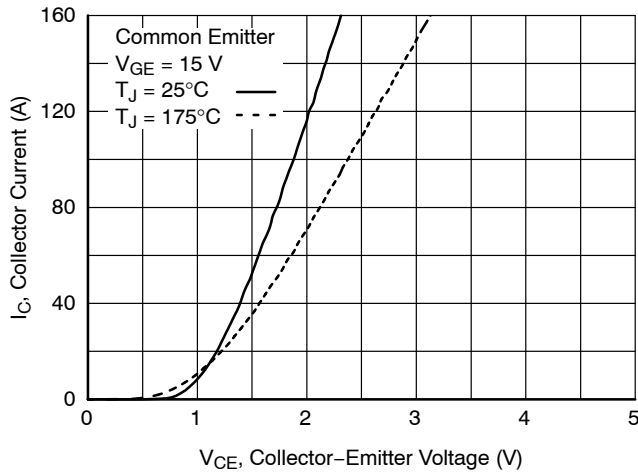


Figure 3. Typical Saturation Voltage Characteristics

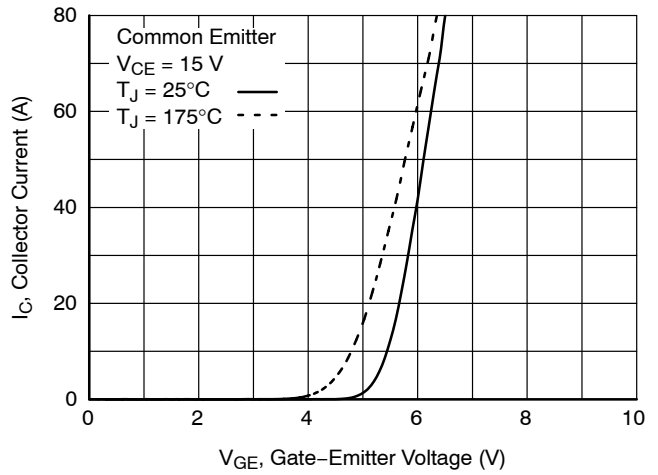


Figure 4. Typical Transfer Characteristics

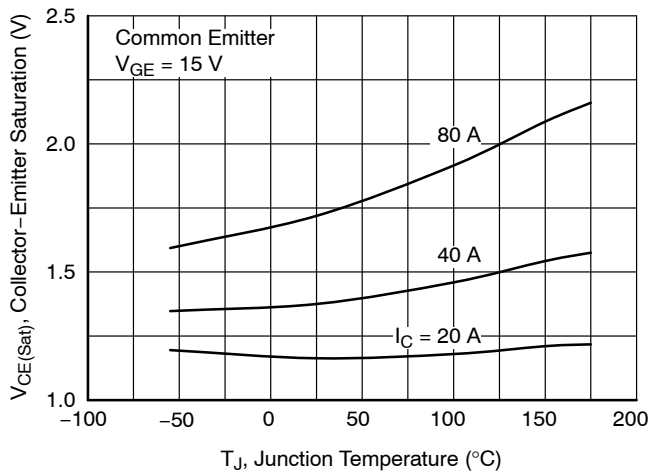


Figure 5. Saturation Voltage vs. Junction Temperature

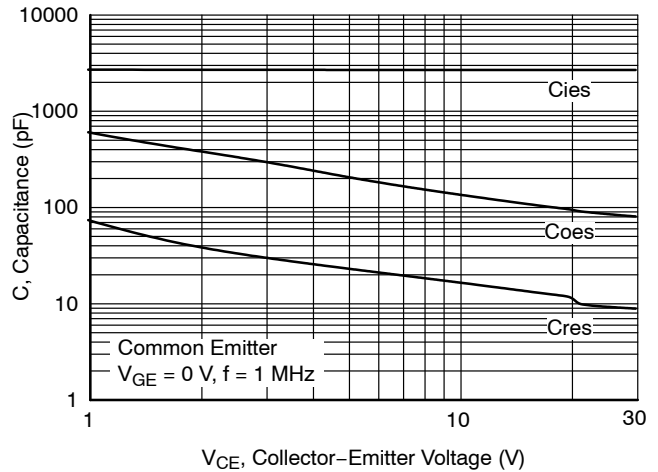


Figure 6. Capacitance Characteristics

FGHL40T65MQDT

TYPICAL CHARACTERISTICS (continued)

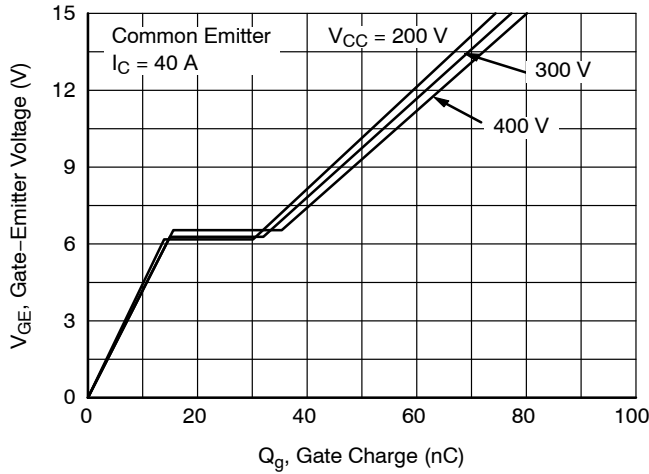


Figure 7. Gate Charge Characteristics

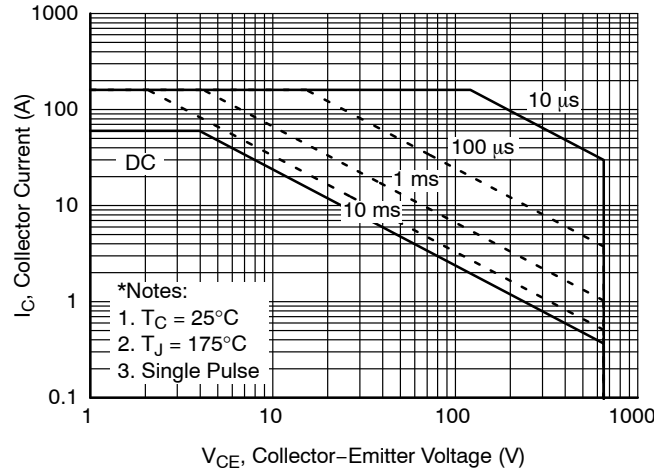


Figure 8. SOA Characteristics

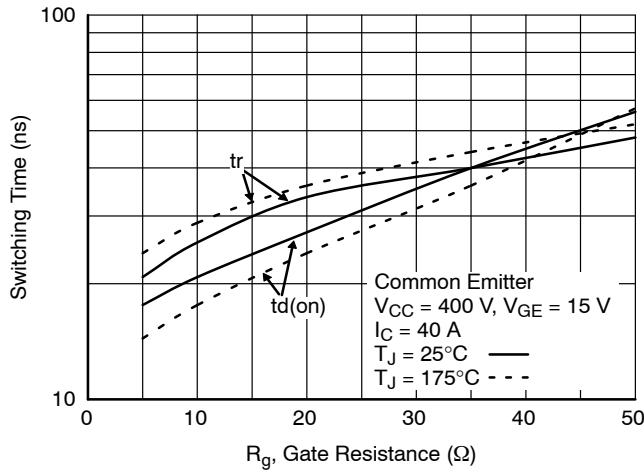


Figure 9. Turn-on Characteristics vs. Gate Resistance

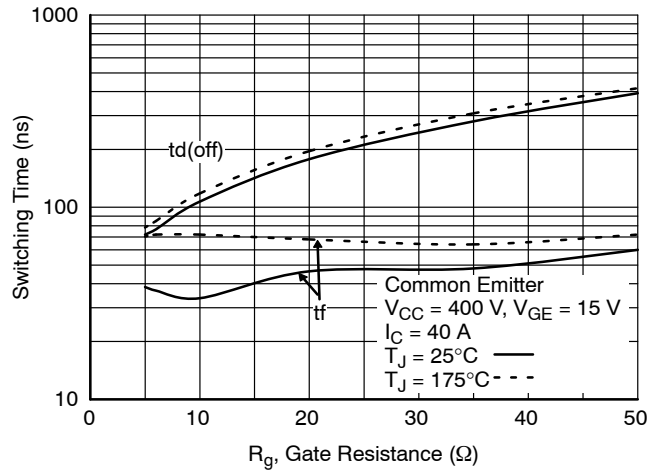


Figure 10. Turn-off Characteristics vs. Gate Resistance

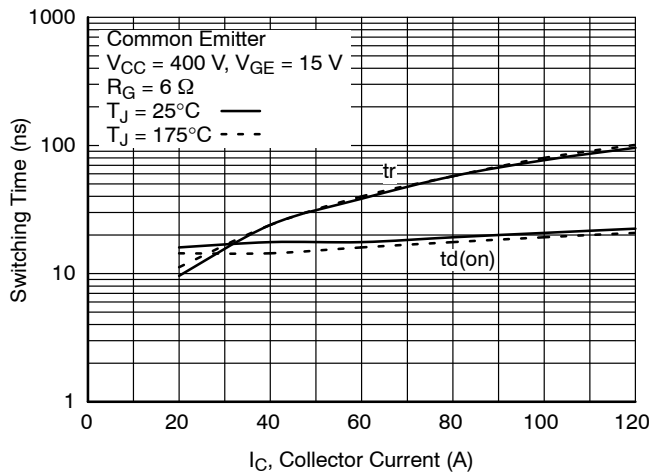


Figure 11. Turn-on Characteristics vs. Collector Current

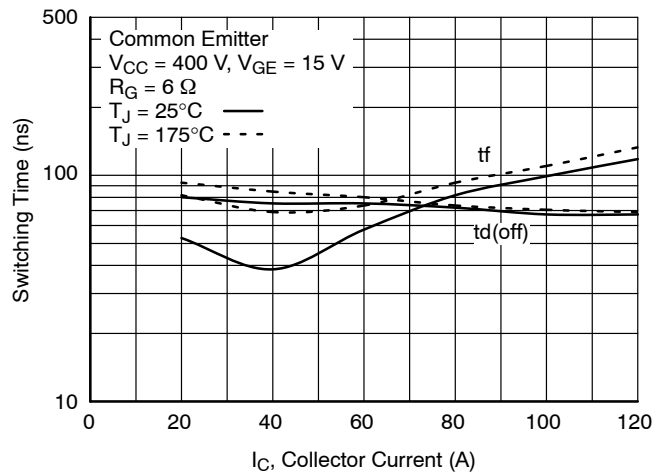


Figure 12. Turn-off Characteristics vs. Collector Current

TYPICAL CHARACTERISTICS (continued)

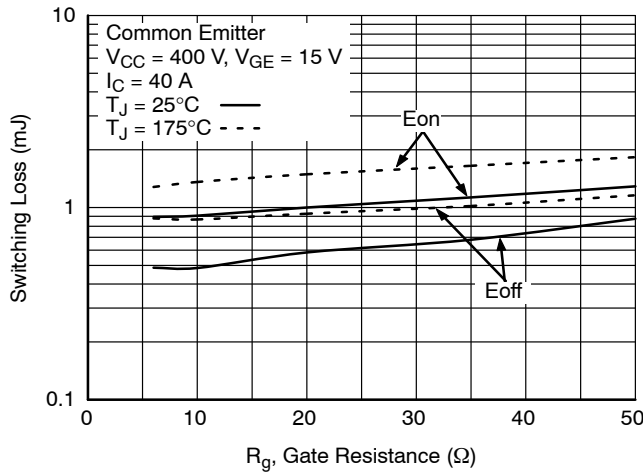


Figure 13. Switching Loss vs. Gate Resistance

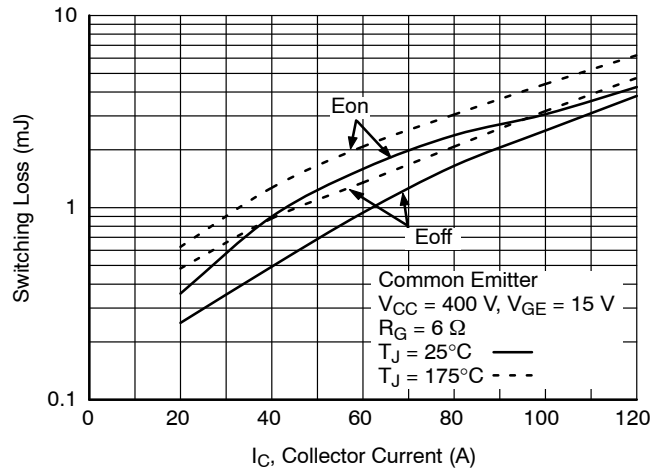


Figure 14. Switching Loss vs. Collector Current

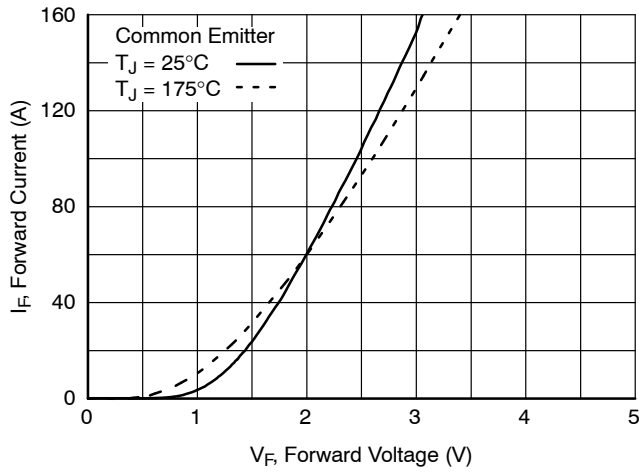


Figure 15. Forward Characteristics

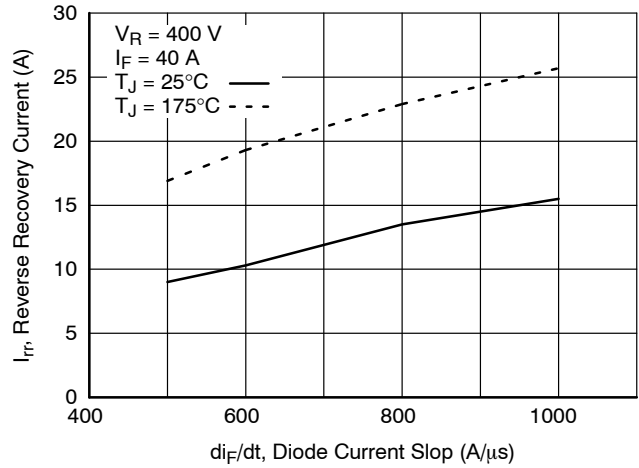


Figure 16. Reverse Recovery Current

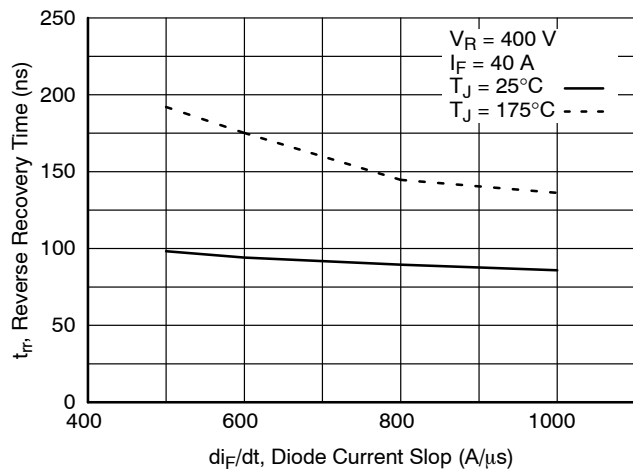


Figure 17. Reverse Recovery Time

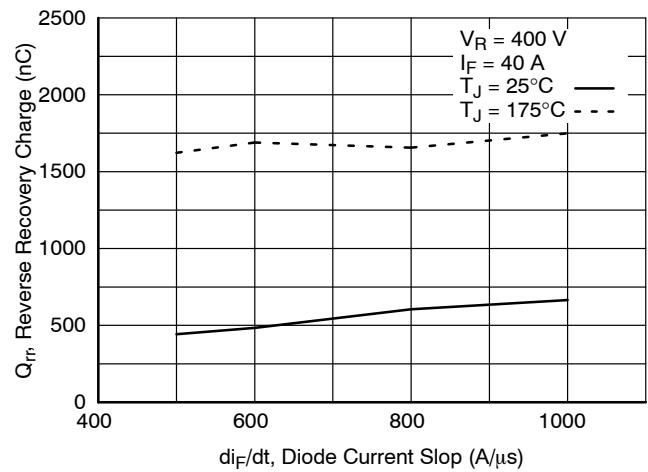


Figure 18. Stored Charge

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TYPICAL CHARACTERISTICS (continued)

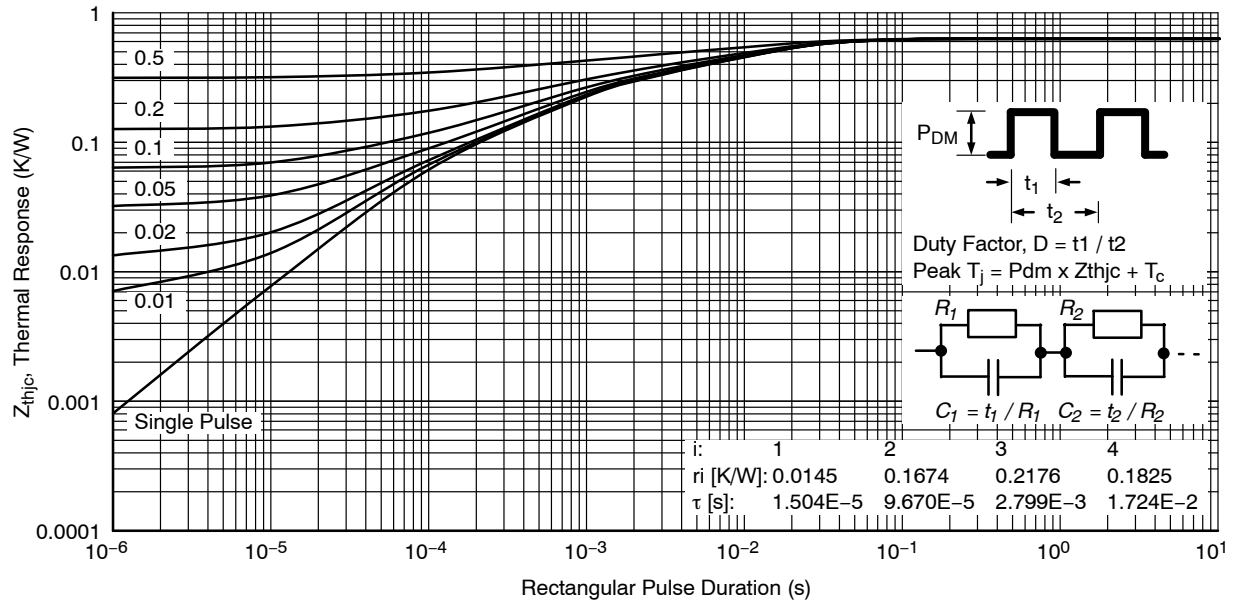


Figure 19. Transient Thermal Impedance of IGBT

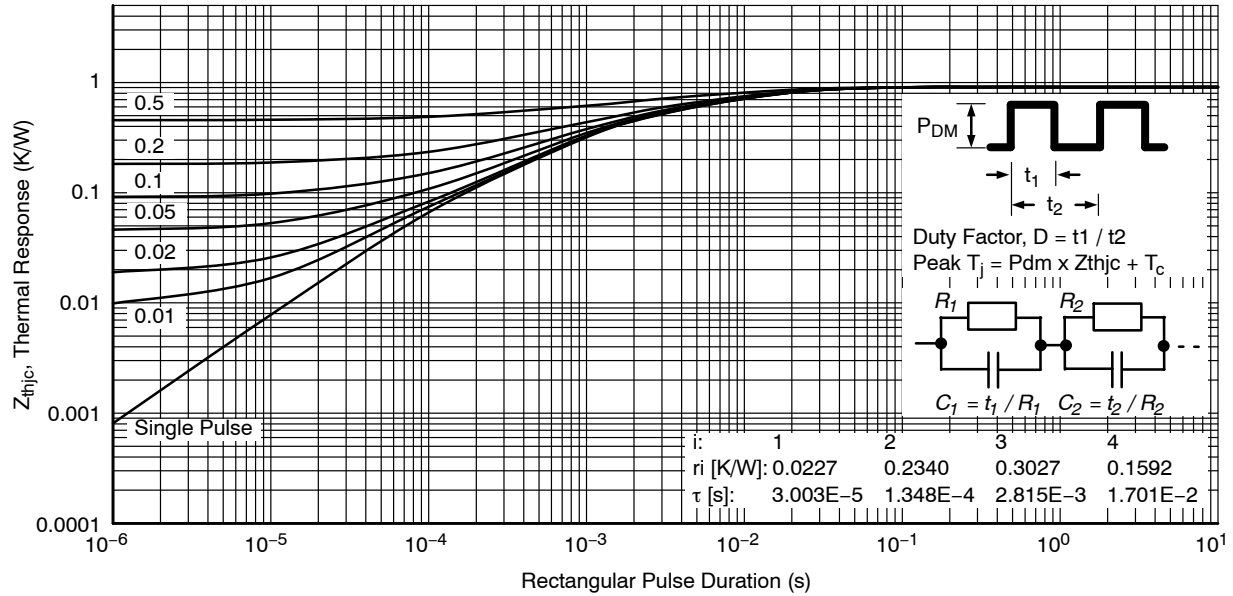
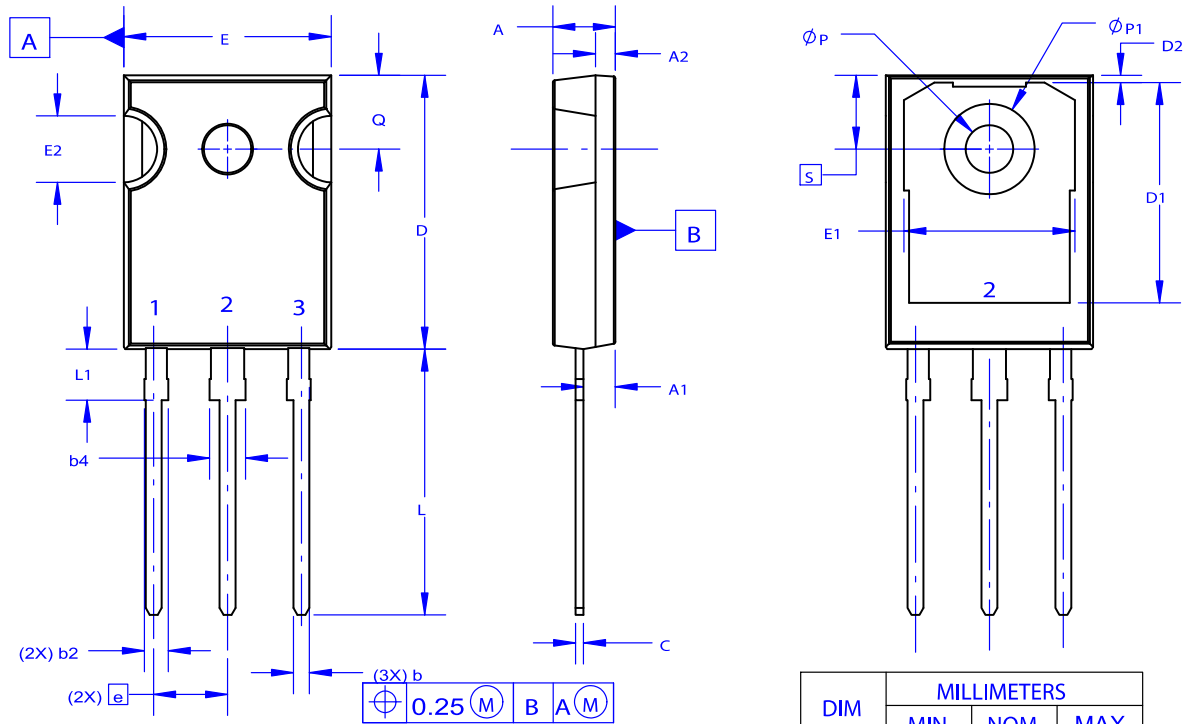


Figure 20. Transient Thermal Impedance of Diode

FGHL40T65MQDT

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.

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