

Field Stop Trench IGBT

650 V, 40 A

FGHL40T65MQD

Field stop 4th generation mid speed IGBT technology and full current rated copak Diode technology.

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 & Optimized Switching
- Tight Parameter Distribution
- RoHS Compliant

Typical Applications

- Solar Inverter
- UPS, ESS
- PFC, Converters

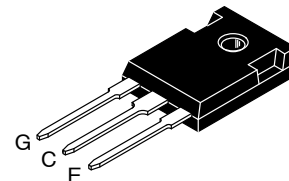
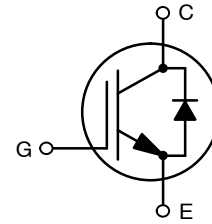
MAXIMUM RATINGS

Parameter	Symbol	Value	Unit
Collector-to-Emitter Voltage	V_{CES}	650	V
Gate-to-Emitter Voltage	V_{GES}	± 20	V
Transient Gate-to-Emitter Voltage	V_{GES}	± 30	V
Collector Current (Note 1)	I_C	$T_C = 25^{\circ}\text{C}$	A
		$T_C = 100^{\circ}\text{C}$	
Pulsed Collector Current (Note 2)	I_{LM}	160	A
Pulsed Collector Current (Note 3)	I_{CM}	160	A
Diode Forward Current (Note 1)	I_F	$T_C = 25^{\circ}\text{C}$	A
		$T_C = 65^{\circ}\text{C}$	
Pulsed Diode Maximum Forward Current	I_{FM}	160	A
Non-Repetitive Forward Surge Current (Half-Sine Pulse, $t_p = 8.3\text{ ms}$, $T_C = 25^{\circ}\text{C}$) (Half-Sine Pulse, $t_p = 8.3\text{ ms}$, $T_C = 150^{\circ}\text{C}$)	$I_{F,SM}$	85 80	A
Maximum Power Dissipation	P_D	$T_C = 25^{\circ}\text{C}$	W
		$T_C = 100^{\circ}\text{C}$	
Operating Junction and Storage Temperature Range	T_J, T_{stg}	-55 to $+175$	$^{\circ}\text{C}$
Maximum Lead Temperature for Soldering Purposes (1/8" from case for 5 s)	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.

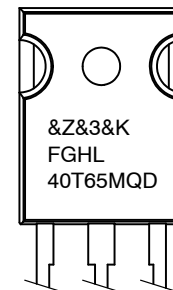
1. Value limit by bond wire
2. $V_{CC} = 400\text{ V}$, $V_{GE} = 15\text{ V}$, $I_C = 160\text{ A}$, $R_G = 14\text{ }\Omega$, Inductive Load, 100% Tested
3. Repetitive rating: Pulse width limited by max. junction temperature

BV_{CES}	$V_{CE(sat)}$ TYP	I_C MAX
650 V	1.45 V	40 A



TO-247 LONG LEADS
CASE 340CX

MARKING DIAGRAM



&Z = Assembly Plant Code
 &3 = 3-Digit Date Code
 &K = 2-Digit Lot Traceability Code
 FGHL40T65MQD = Specific Device Code

ORDERING INFORMATION

Device	Package	Shipping
FGHL40T65MQD	TO-247-3L	30 Units / Rail

FGHL40T65MQD

Table 1. THERMAL CHARACTERISTICS

Parameter	Symbol	Value	Unit
Thermal Resistance Junction-to-Case, for IGBT	$R_{\theta JC}$	0.63	°C/W
Thermal Resistance Junction-to-Case, for Diode	$R_{\theta JC}$	1.6	
Thermal Resistance Junction-to-Ambient	$R_{\theta JA}$	40	

Table 2. ELECTRICAL CHARACTERISTICS ($T_J = 25^\circ\text{C}$ unless otherwise specified)

Parameter	Test Conditions	Symbol	Min	Typ	Max	Unit
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OFF CHARACTERISTIC

Collector-emitter breakdown voltage, gate-emitter short-circuited	$V_{GE} = 0\text{ V}, I_C = 1\text{ mA}$	BV_{CES}	650	–	–	V
Temperature Coefficient of Breakdown Voltage	$V_{GE} = 0\text{ V}, I_C = 1\text{ mA}$	$\Delta BV_{CES} / \Delta T_J$	–	0.6	–	V/°C
Collector-emitter cut-off current, gate-emitter short-circuited	$V_{GE} = 0\text{ V}, V_{CE} = 650\text{ V}$	I_{CES}	–	–	250	μA
Gate leakage current, collector-emitter short-circuited	$V_{GE} = 20\text{ V}, V_{CE} = 0\text{ V}$	I_{GES}	–	–	±400	nA

ON CHARACTERISTIC

Gate-emitter threshold voltage	$V_{GE} = V_{CE}, I_C = 40\text{ mA}$	$V_{GE(th)}$	3.0	4.5	6.0	V
Collector-emitter saturation voltage	$V_{GE} = 15\text{ V}, I_C = 40\text{ A}$ $V_{GE} = 15\text{ V}, I_C = 40\text{ A}, T_J = 175^\circ\text{C}$	$V_{CE(sat)}$	– –	1.45 1.77	1.8 –	V

DYNAMIC CHARACTERISTIC

Input capacitance	$V_{CE} = 30\text{ V}, V_{GE} = 0\text{ V}, f = 1\text{ MHz}$	C_{ies}	–	2756	–	pF
Output capacitance		C_{oes}	–	64	–	
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	–	86	–	nC
Gate-to-Emitter charge		Q_{ge}	–	16	–	
Gate-to-Collector charge		Q_{gc}	–	21	–	

SWITCHING CHARACTERISTIC, INDUCTIVE LOAD

Turn-on delay time	$T_C = 25^\circ\text{C}$ $V_{CC} = 400\text{ V}, I_C = 20\text{ A}$ $R_G = 10\ \Omega$ $V_{GE} = 15\text{ V}$ Inductive Load	$t_{d(on)}$	–	20	–	ns
Rise time		t_r	–	13	–	
Turn-off delay time		$t_{d(off)}$	–	116	–	
Fall time		t_f	–	51	–	
Turn-on switching loss		E_{on}	–	0.33	–	mJ
Turn-off switching loss		E_{off}	–	0.26	–	
Total switching loss		E_{ts}	–	0.59	–	
Turn-on delay time	$T_C = 25^\circ\text{C}$ $V_{CC} = 400\text{ V}, I_C = 40\text{ A}$ $R_G = 10\ \Omega$ $V_{GE} = 15\text{ V}$ Inductive Load	$t_{d(on)}$	–	22	–	ns
Rise time		t_r	–	30	–	
Turn-off delay time		$t_{d(off)}$	–	109	–	
Fall time		t_f	–	46	–	
Turn-on switching loss		E_{on}	–	0.86	–	mJ
Turn-off switching loss		E_{off}	–	0.52	–	
Total switching loss		E_{ts}	–	1.38	–	

FGHL40T65MQD

Table 2. ELECTRICAL CHARACTERISTICS ($T_J = 25^\circ\text{C}$ unless otherwise specified) (continued)

Parameter	Test Conditions	Symbol	Min	Typ	Max	Unit
SWITCHING CHARACTERISTIC, INDUCTIVE LOAD						
Turn-on delay time	$T_C = 175^{\circ}\text{C}$ $V_{CC} = 400\text{ V}, I_C = 20\text{ A}$ $R_G = 10\ \Omega$ $V_{GE} = 15\text{ V}$ Inductive Load	$t_{d(\text{on})}$	–	20	–	ns
Rise time		t_r	–	14	–	
Turn-off delay time		$t_{d(\text{off})}$	–	127	–	
Fall time		t_f	–	76	–	
Turn-on switching loss		E_{on}	–	0.60	–	mJ
Turn-off switching loss		E_{off}	–	0.42	–	
Total switching loss		E_{ts}	–	1.02	–	
Turn-on delay time		$T_C = 175^{\circ}\text{C}$ $V_{CC} = 400\text{ V}, I_C = 40\text{ A}$ $R_G = 10\ \Omega$ $V_{GE} = 15\text{ V}$ Inductive Load	$t_{d(\text{on})}$	–	20	
Rise time	t_r		–	32	–	
Turn-off delay time	$t_{d(\text{off})}$		–	119	–	
Fall time	t_f		–	63	–	
Turn-on switching loss		E_{on}	–	1.28	–	mJ
Turn-off switching loss		E_{off}	–	0.77	–	
Total switching loss		E_{ts}	–	2.05	–	
DIODE CHARACTERISTIC2.5						
Diode Forward Voltage	$I_F = 40\text{ A}, T_C = 25^{\circ}\text{C}$ $I_F = 40\text{ A}, T_C = 175^{\circ}\text{C}$	V_{FM}	– –	2.55 2.3	2.85 –	V
Reverse Recovery Energy	$I_F = 40\text{ A}, dl_F/dt = 200\text{ A}/\mu\text{s}, T_C = 175^{\circ}\text{C}$	E_{rec}	–	56	–	μJ
Diode Reverse Recovery Time	$I_F = 40\text{ A}, dl_F/dt = 200\text{ A}/\mu\text{s}, T_C = 25^{\circ}\text{C}$ $I_F = 40\text{ A}, dl_F/dt = 200\text{ A}/\mu\text{s}, T_C = 175^{\circ}\text{C}$	T_{rr}	–	33 222	–	ns
Diode Reverse Recovery Charge	$I_F = 40\text{ A}, dl_F/dt = 200\text{ A}/\mu\text{s}, T_C = 25^{\circ}\text{C}$ $I_F = 40\text{ A}, dl_F/dt = 200\text{ A}/\mu\text{s}, T_C = 175^{\circ}\text{C}$	Q_{rr}	–	47 759	–	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 CHARACTERISTICS

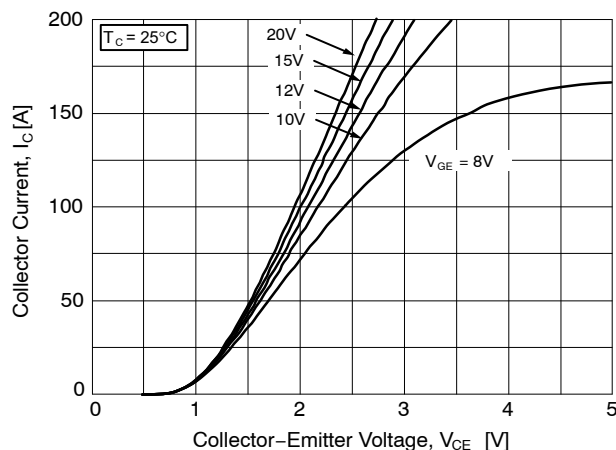


Figure 1. Typical Output Characteristics
($T_J = 25^\circ\text{C}$)

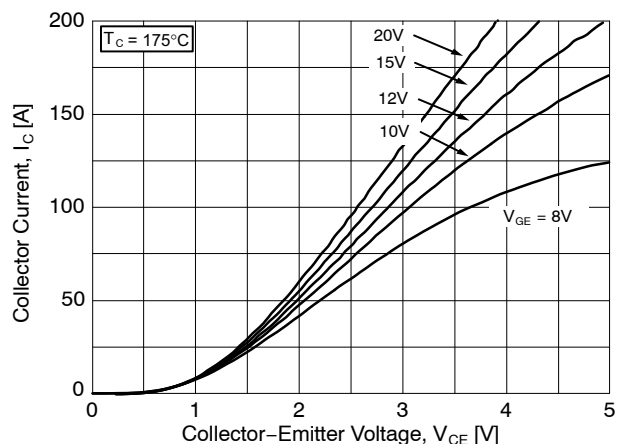


Figure 2. Typical Output Characteristics
($T_J = 175^\circ\text{C}$)

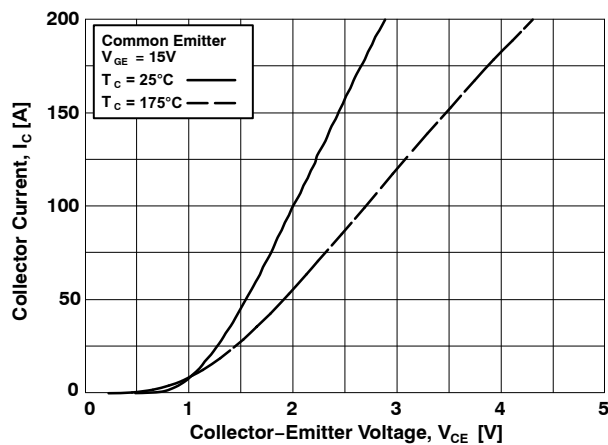


Figure 3. Typical Saturation Voltage Characteristics

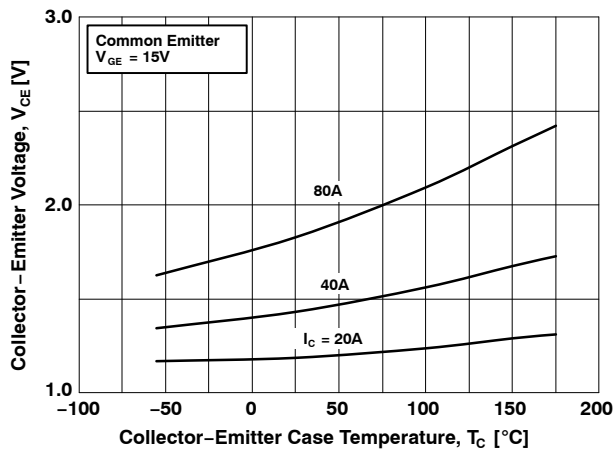


Figure 4. Saturation Voltage vs. Case Temperature
at Variant Current Level

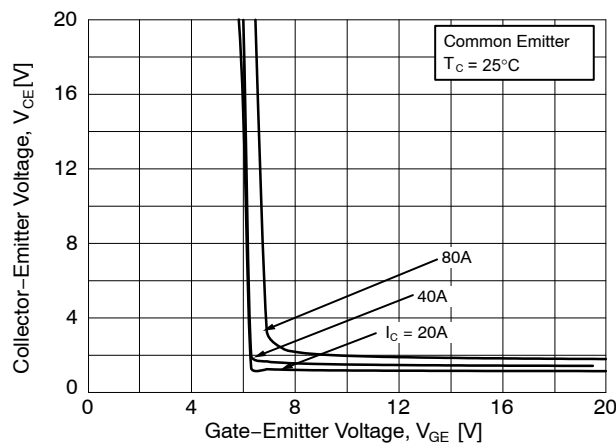


Figure 5. Saturation Voltage vs. V_{GE} ($T_J = 25^\circ\text{C}$)

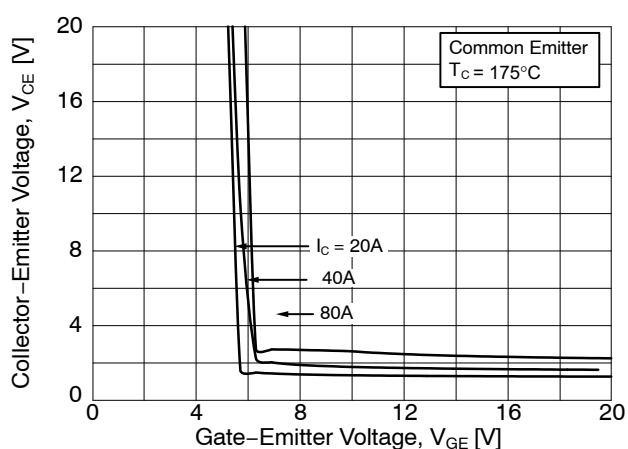


Figure 6. Saturation Voltage vs. V_{GE} ($T_J = 175^\circ\text{C}$)

TYPICAL CHARACTERISTICS (CONTINUED)

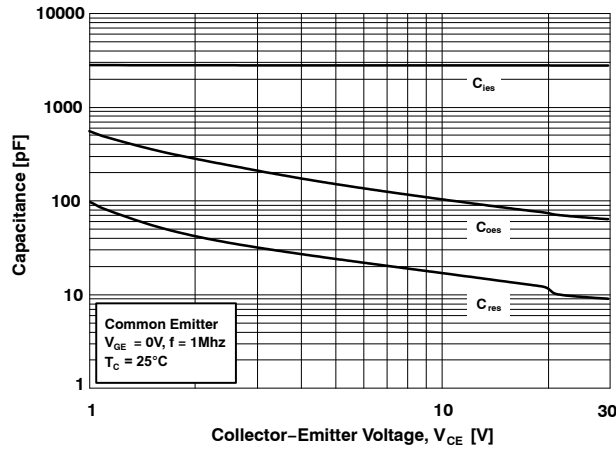


Figure 7. Capacitance Characteristics

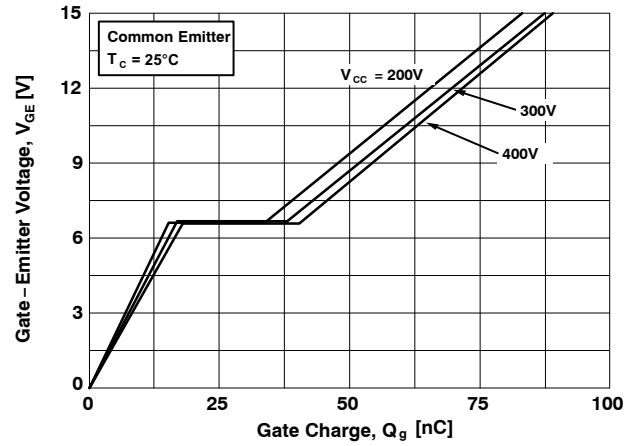


Figure 8. Gate Charge Characteristics

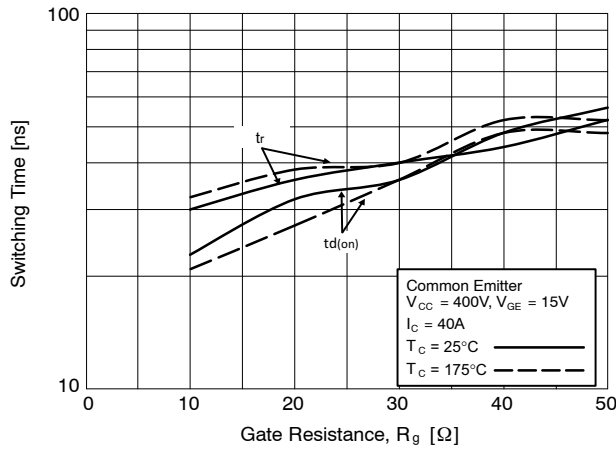


Figure 9. Turn-On Characteristics vs. Gate Resistance

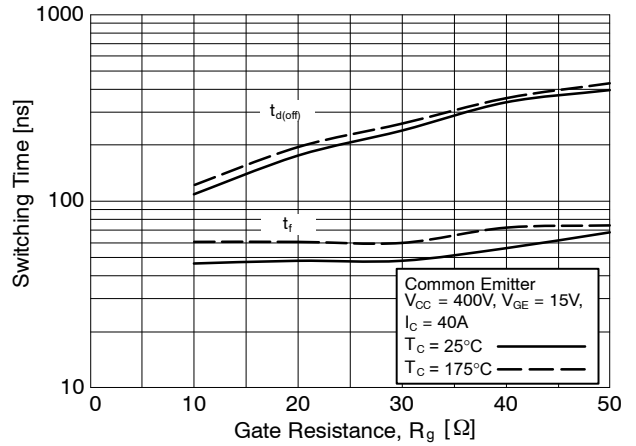


Figure 10. Turn-Off Characteristics vs. Gate Resistance

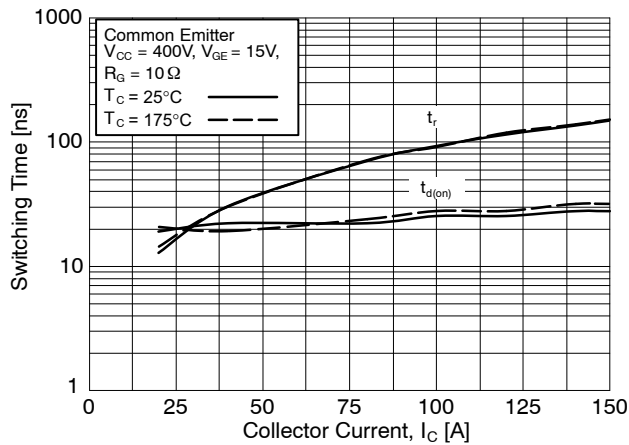


Figure 11. Turn-On Characteristics vs. Collector Current

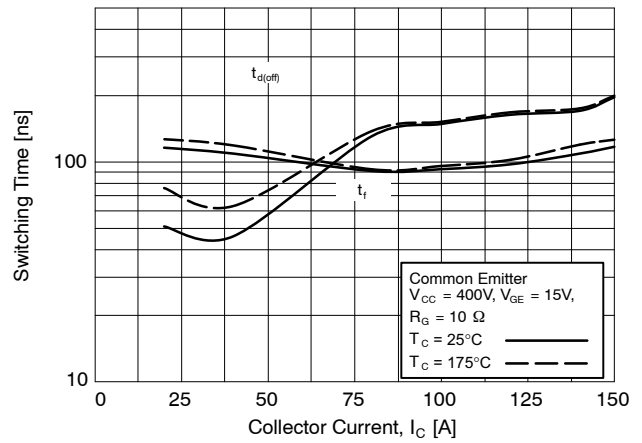


Figure 12. Turn-Off Characteristics vs. Collector Current

TYPICAL CHARACTERISTICS (CONTINUED)

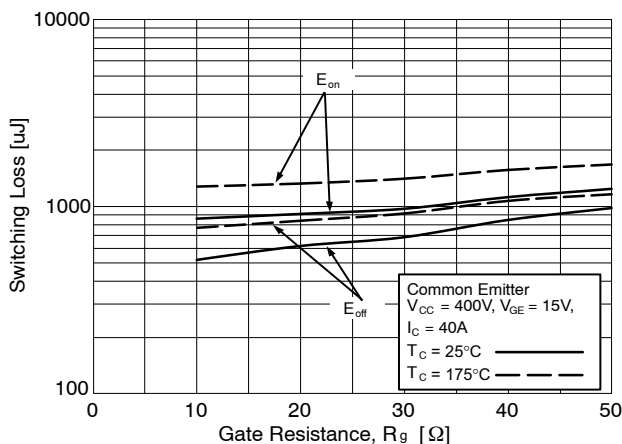


Figure 13. Switching Loss vs. Gate Resistance

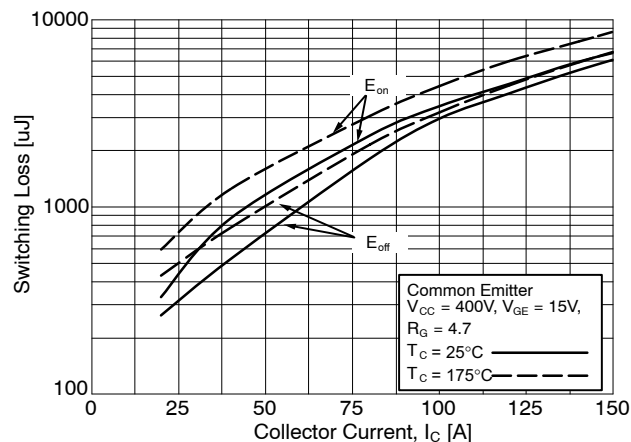


Figure 14. Switching Loss vs. Collector Current

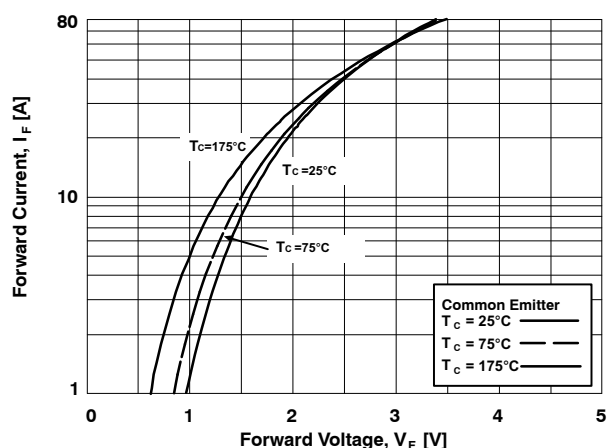


Figure 15. Forward Characteristics

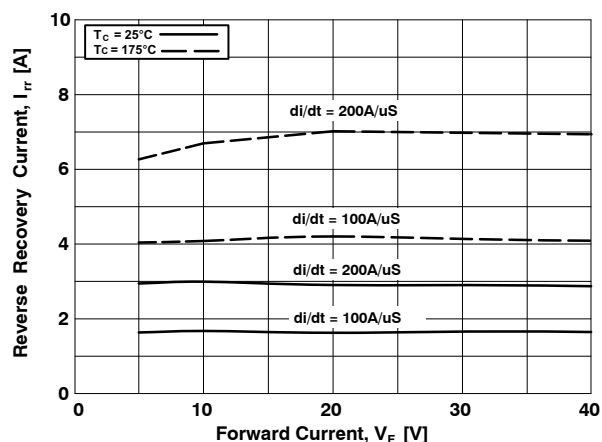


Figure 16. Reverse Recovery Current

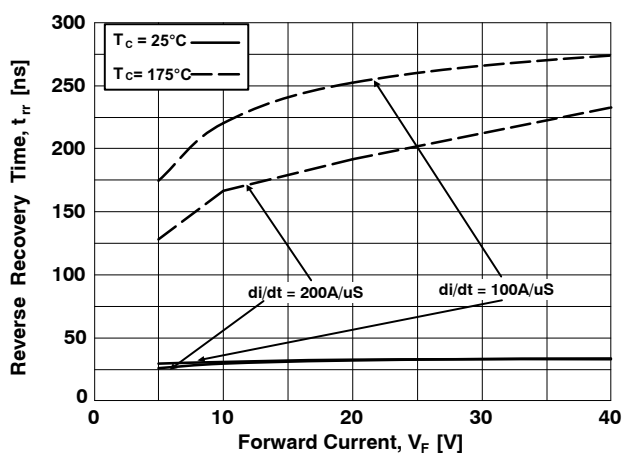


Figure 17. Reverse Recovery Time

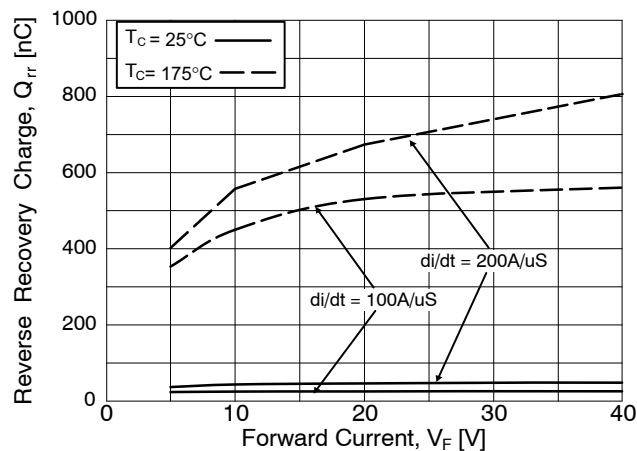


Figure 18. Stored Charge

FGHL40T65MQD

TYPICAL CHARACTERISTICS (CONTINUED)

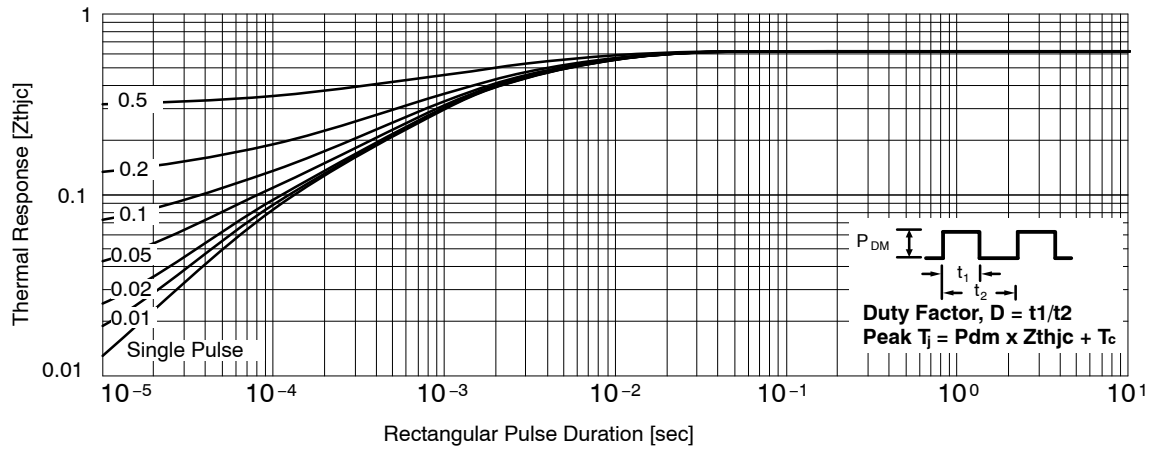


Figure 19. Transient Thermal Impedance of IGBT

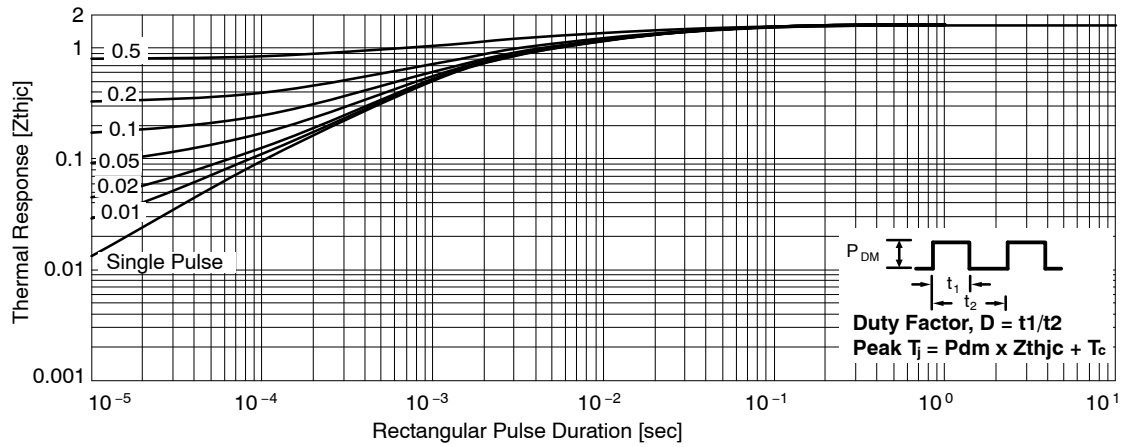
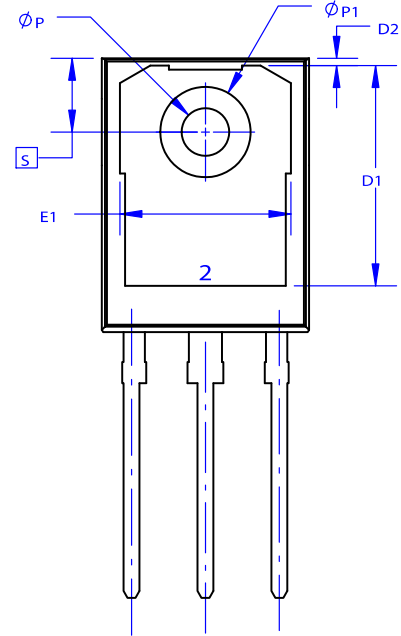
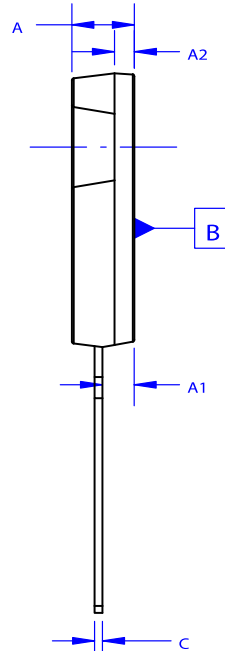
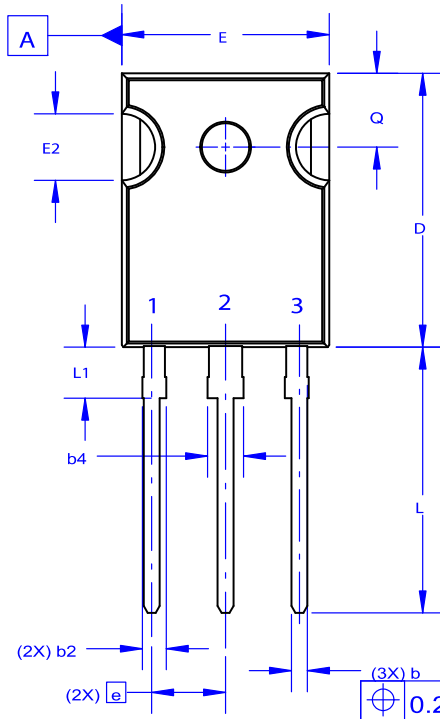


Figure 20. Transient Thermal Impedance of Diode

TO-247-3LD
CASE 340CX
ISSUE A

DATE 06 JUL 2020



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*


XXXXX = 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	2.20	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

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