

Field Stop Trench IGBT

650 V, 50 A

FGHL50T65MQD

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: $V_{CE(\text{sat})} = 1.45 \text{ V (Typ.)} @ I_C = 50 \text{ A}$
- 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)	$T_C = 25^\circ\text{C}$	I_C	80	A
	$T_C = 100^\circ\text{C}$		50	
Pulsed Collector Current (Note 2)		I_{LM}	200	A
Pulsed Collector Current (Note 3)		I_{CM}	200	A
Diode Forward Current (Note 1)	$T_C = 25^\circ\text{C}$	I_F	55	A
	$T_C = 65^\circ\text{C}$		40	
Pulsed Diode Maximum Forward Current		I_{FM}	200	A
Maximum Power Dissipation	$T_C = 25^\circ\text{C}$	P_D	268	W
	$T_C = 100^\circ\text{C}$		134	
Operating Junction and Storage Temperature Range		T_J, T_{stg}	-55 to +175	°C
Maximum Lead Temperature for Soldering Purposes (1/8" from case for 5 s)		T_L	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.

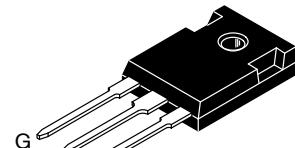
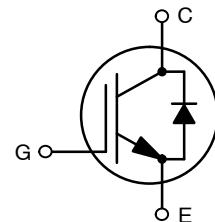
1. Value limit by bond wire
2. $V_{CC} = 400 \text{ V}$, $V_{GE} = 15 \text{ V}$, $I_C = 200 \text{ A}$, $R_G = 14 \Omega$, Inductive Load, 100% Tested
3. Repetitive rating: Pulse width limited by max. junction temperature



ON Semiconductor®

www.onsemi.com

BV_{CES}	$V_{CE(\text{sat})}$ TYP	I_C MAX
650 V	1.45 V	50 A



TO-247 LONG LEADS
CASE 340CX

MARKING DIAGRAM



&Z&3&K
FGHL
50T65MQD

&Z = Assembly Plant Code
&3 = 3-Digit Date Code
&K = 2-Digit Lot Traceability Code
FGHL50T65MQD = Specific Device Code

ORDERING INFORMATION

Device	Package	Shipping
FGHL50T65MQD	TO-247-3L	30 Units / Rail

FGHL50T65MQD

Table 1. THERMAL CHARACTERISTICS

Parameter	Symbol	Value	Unit
Thermal Resistance Junction-to-Case, for IGBT	$R_{\theta JC}$	0.56	$^{\circ}\text{C}/\text{W}$
Thermal Resistance Junction-to-Case, for Diode	$R_{\theta JC}$	1.07	
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
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	–	$^{\circ}\text{C}/\text{V}$
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	$V_{GE} = V_{CE}$, $I_C = 50 \text{ mA}$	$V_{GE(\text{th})}$	3.0	4.5	6.0	V
Collector-emitter saturation voltage	$V_{GE} = 15 \text{ V}$, $I_C = 50 \text{ A}$ $V_{GE} = 15 \text{ V}$, $I_C = 50 \text{ A}$, $T_J = 175^{\circ}\text{C}$	$V_{CE(\text{sat})}$	–	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}	–	3226	–	pF
Output capacitance		C_{oes}	–	85	–	
Reverse transfer capacitance		C_{res}	–	10	–	
Gate charge total	$V_{CE} = 400 \text{ V}$, $I_C = 50 \text{ A}$, $V_{GE} = 15 \text{ V}$	Q_g	–	94	–	nC
Gate-to-Emitter charge		Q_{ge}	–	17	–	
Gate-to-Collector charge		Q_{gc}	–	22	–	
SWITCHING CHARACTERISTIC, INDUCTIVE LOAD						
Turn-on delay time	$T_C = 25^{\circ}\text{C}$ $V_{CC} = 400 \text{ V}$, $I_C = 25 \text{ A}$ $R_G = 10 \Omega$ $V_{GE} = 15 \text{ V}$ Inductive Load	$t_{d(\text{on})}$	–	21	–	ns
Rise time		t_r	–	15	–	
Turn-off delay time		$t_{d(\text{off})}$	–	128	–	
Fall time		t_f	–	50	–	
Turn-on switching loss		E_{on}	–	0.41	–	mJ
Turn-off switching loss		E_{off}	–	0.31	–	
Total switching loss		E_{ts}	–	0.72	–	
Turn-on delay time	$T_C = 25^{\circ}\text{C}$ $V_{CC} = 400 \text{ V}$, $I_C = 50 \text{ A}$ $R_G = 10 \Omega$ $V_{GE} = 15 \text{ V}$ Inductive Load	$t_{d(\text{on})}$	–	23	–	ns
Rise time		t_r	–	34	–	
Turn-off delay time		$t_{d(\text{off})}$	–	120	–	
Fall time		t_f	–	46	–	
Turn-on switching loss		E_{on}	–	1.05	–	mJ
Turn-off switching loss		E_{off}	–	0.70	–	
Total switching loss		E_{ts}	–	1.75	–	

FGHL50T65MQD

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	$T_C = 175^\circ\text{C}$ $V_{CC} = 400 \text{ V}, I_C = 25 \text{ A}$ $R_G = 10 \Omega$ $V_{GE} = 15 \text{ V}$ Inductive Load	$t_{d(on)}$	–	20	–	ns
Rise time		t_r	–	17	–	
Turn-off delay time		$t_{d(off)}$	–	146	–	
Fall time		t_f	–	75	–	
Turn-on switching loss		E_{on}	–	0.75	–	mJ
Turn-off switching loss		E_{off}	–	0.53	–	
Total switching loss		E_{ts}	–	1.28	–	
Turn-on delay time	$T_C = 175^\circ\text{C}$ $V_{CC} = 400 \text{ V}, I_C = 50 \text{ A}$ $R_G = 10 \Omega$ $V_{GE} = 15 \text{ V}$ Inductive Load	$t_{d(on)}$	–	22	–	ns
Rise time		t_r	–	36	–	
Turn-off delay time		$t_{d(off)}$	–	130	–	
Fall time		t_f	–	58	–	
Turn-on switching loss		E_{on}	–	1.63	–	mJ
Turn-off switching loss		E_{off}	–	0.94	–	
Total switching loss		E_{ts}	–	2.57	–	
DIODE CHARACTERISTIC						
Diode Forward Voltage	$I_F = 50 \text{ A}, T_C = 25^\circ\text{C}$ $I_F = 50 \text{ A}, T_C = 175^\circ\text{C}$	V_{FM}	–	2.45 2.2	2.75	V
Reverse Recovery Energy	$I_F = 50 \text{ A}, dI_F/dt = 200 \text{ A}/\mu\text{s}, T_C = 175^\circ\text{C}$	E_{rec}	–	57	–	μJ
Diode Reverse Recovery Time	$I_F = 50 \text{ A}, dI_F/dt = 200 \text{ A}/\mu\text{s}, T_C = 25^\circ\text{C}$ $I_F = 50 \text{ A}, dI_F/dt = 200 \text{ A}/\mu\text{s}, T_C = 175^\circ\text{C}$	T_{rr}	–	32 202	–	ns
Diode Reverse Recovery Charge	$I_F = 50 \text{ A}, dI_F/dt = 200 \text{ A}/\mu\text{s}, T_C = 25^\circ\text{C}$ $I_F = 50 \text{ A}, dI_F/dt = 200 \text{ A}/\mu\text{s}, T_C = 175^\circ\text{C}$	Q_{rr}	–	46 814	–	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

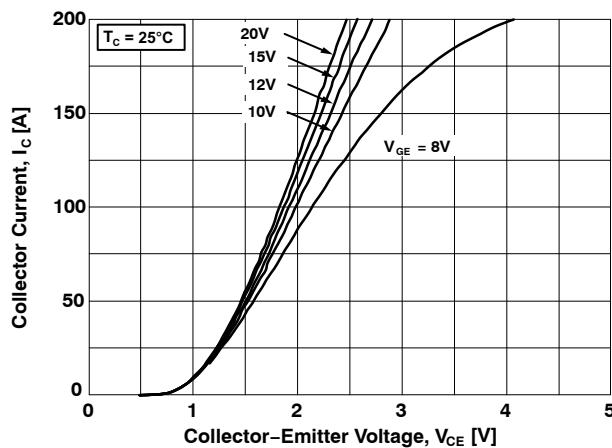


Figure 1. Typical Output Characteristics
($T_J = 25^\circ\text{C}$)

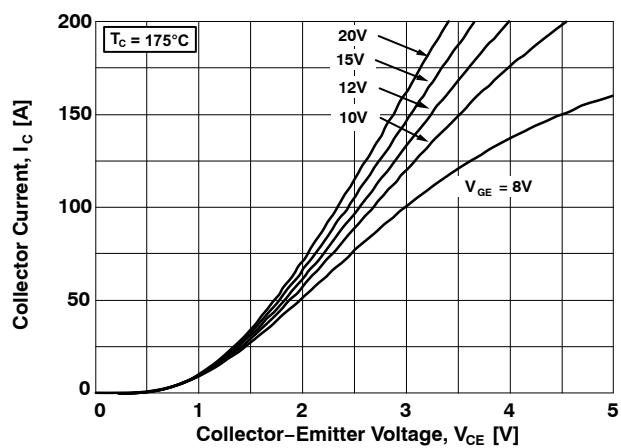


Figure 2. Typical Output Characteristics
($T_J = 175^\circ\text{C}$)

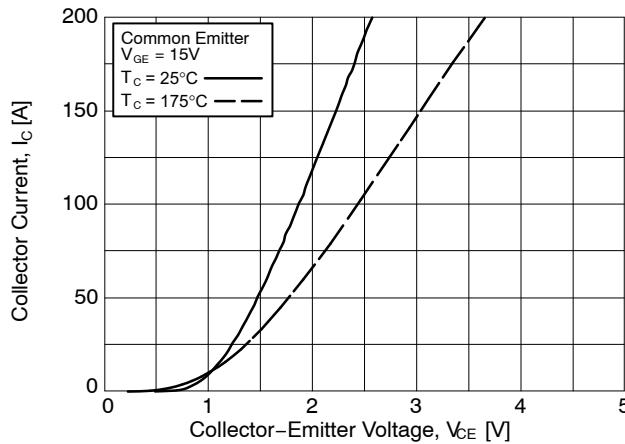


Figure 3. Typical Saturation Voltage
Characteristics

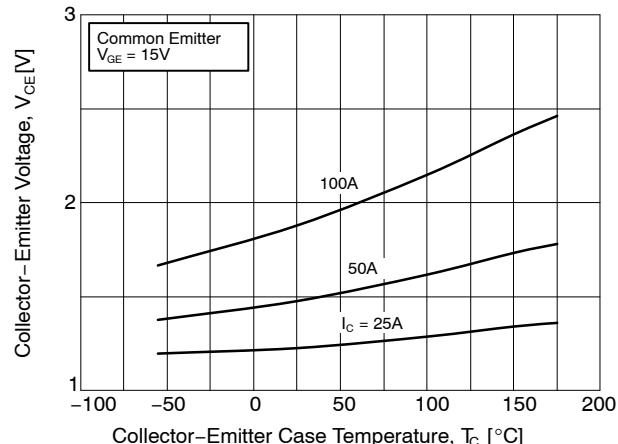


Figure 4. Saturation Voltage vs. Case Temperature
at Variant Current Level

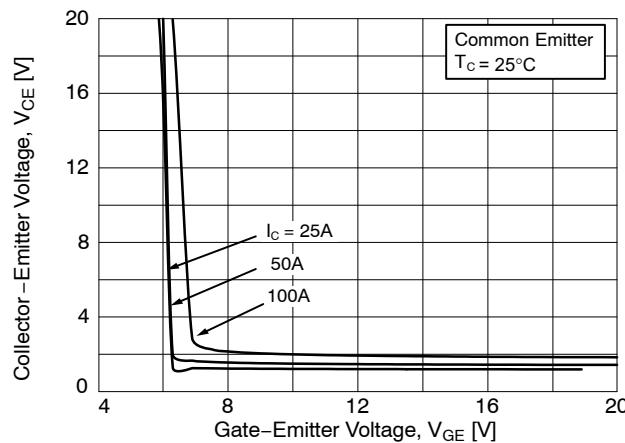


Figure 5. Saturation Voltage vs. V_{GE} ($T_J = 25^\circ\text{C}$)

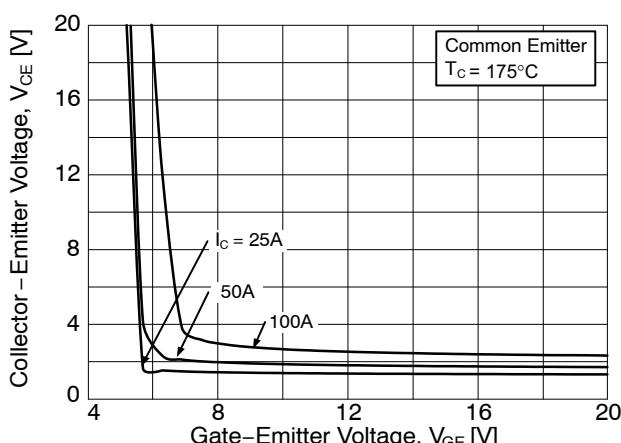
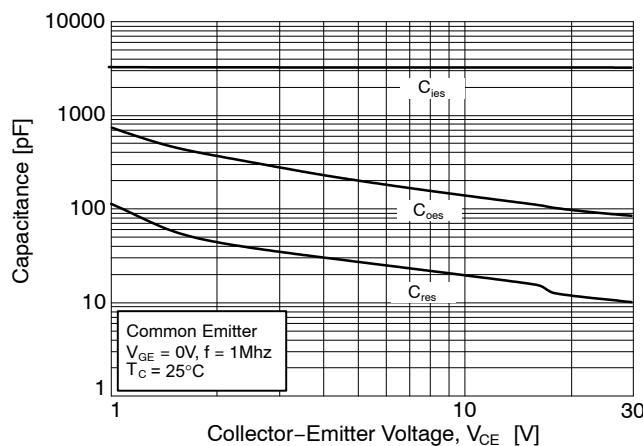
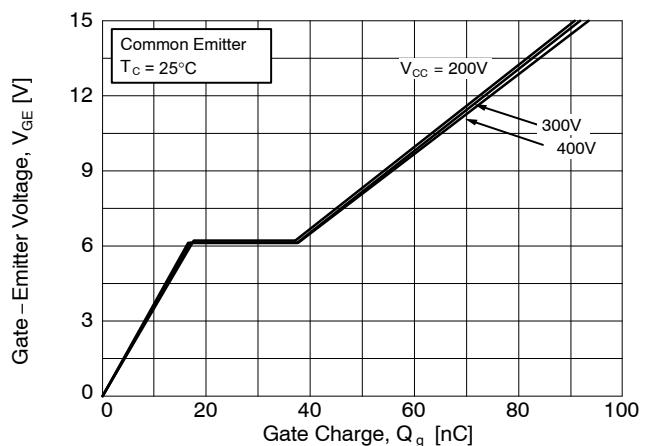
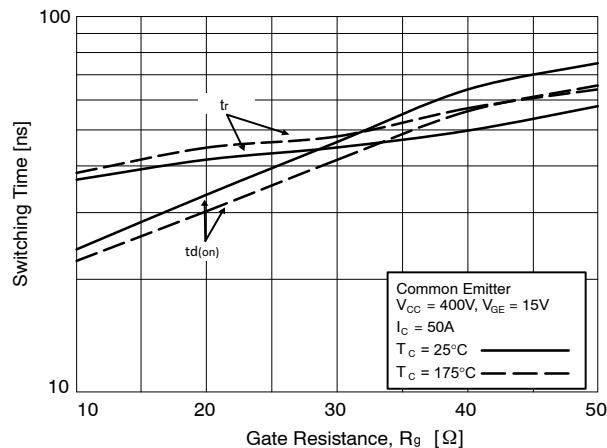
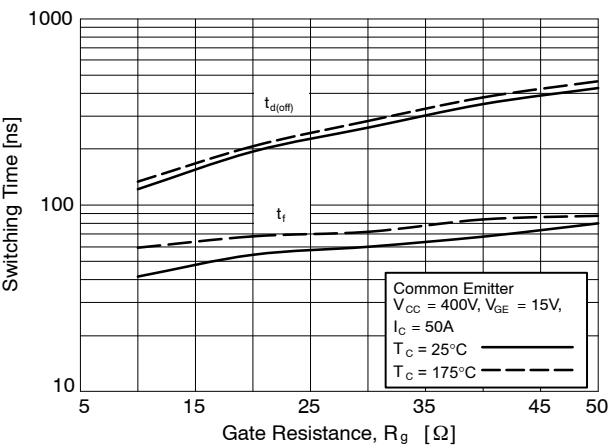
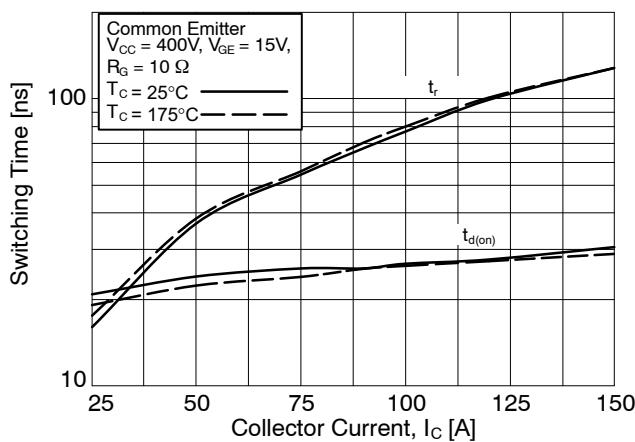
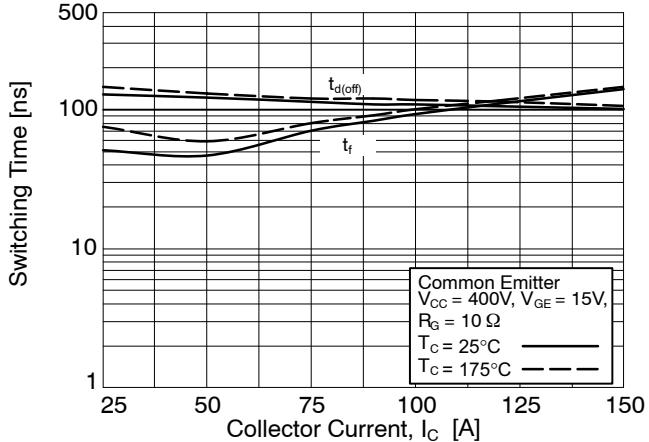
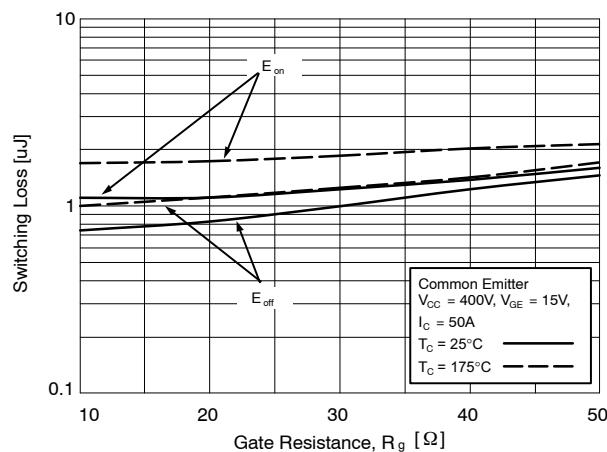
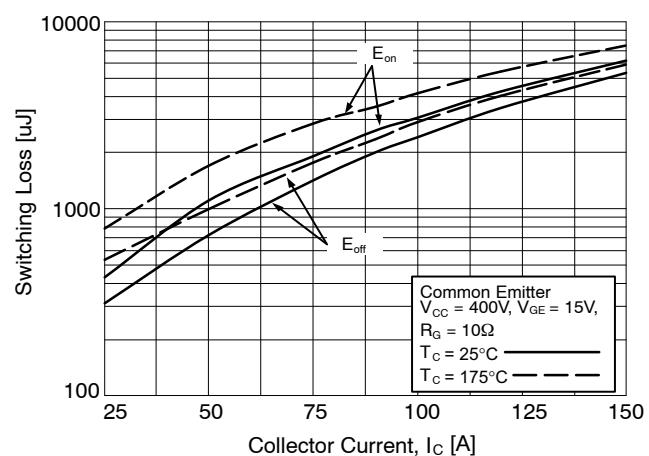
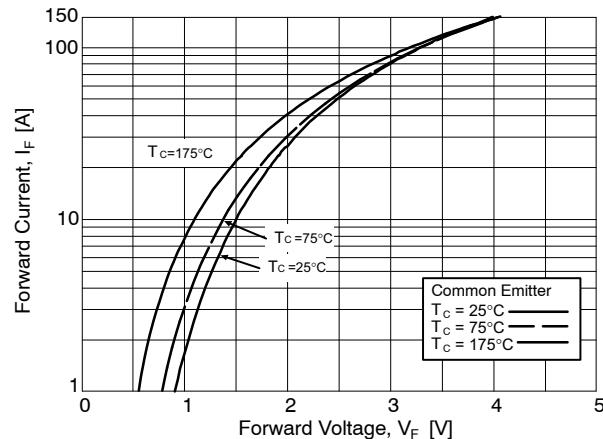
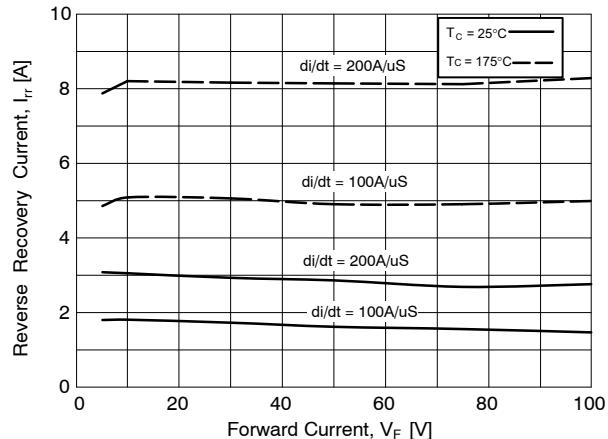
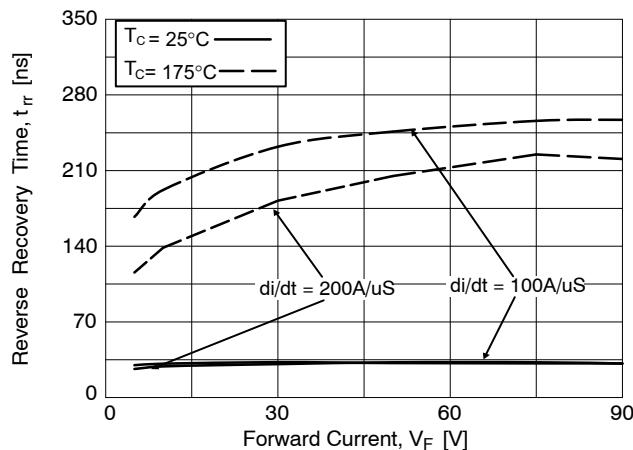
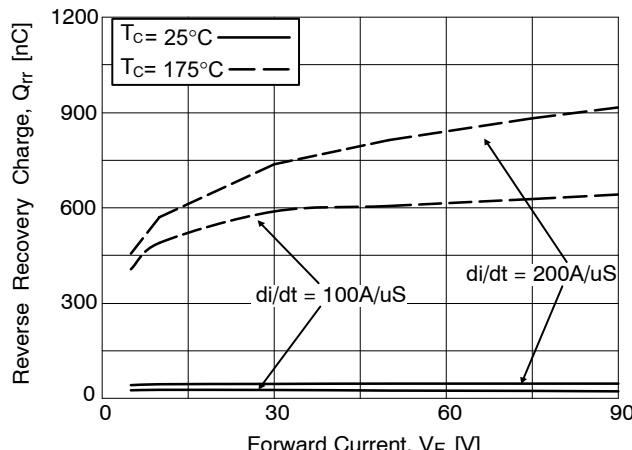


Figure 6. Saturation Voltage vs. V_{GE} ($T_J = 175^\circ\text{C}$)

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

TYPICAL CHARACTERISTICS (continued)

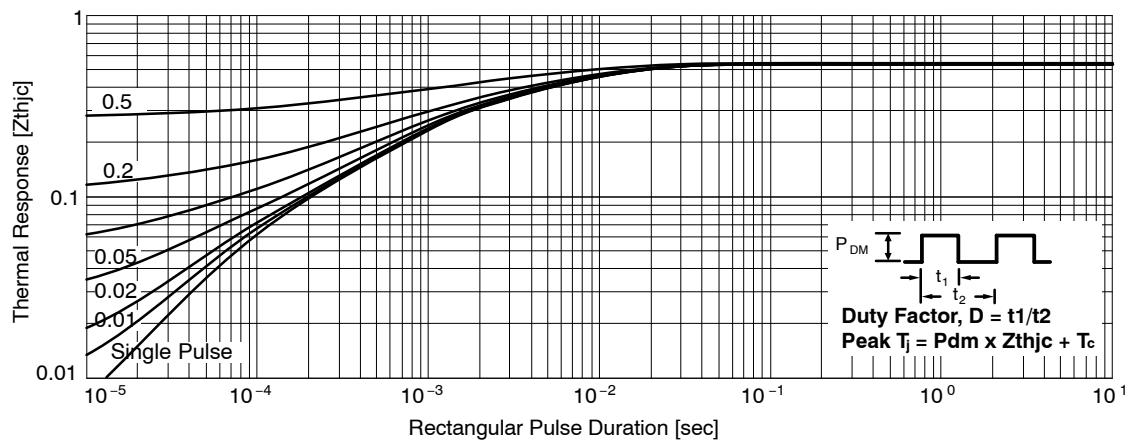


Figure 19. Transient Thermal Impedance of IGBT

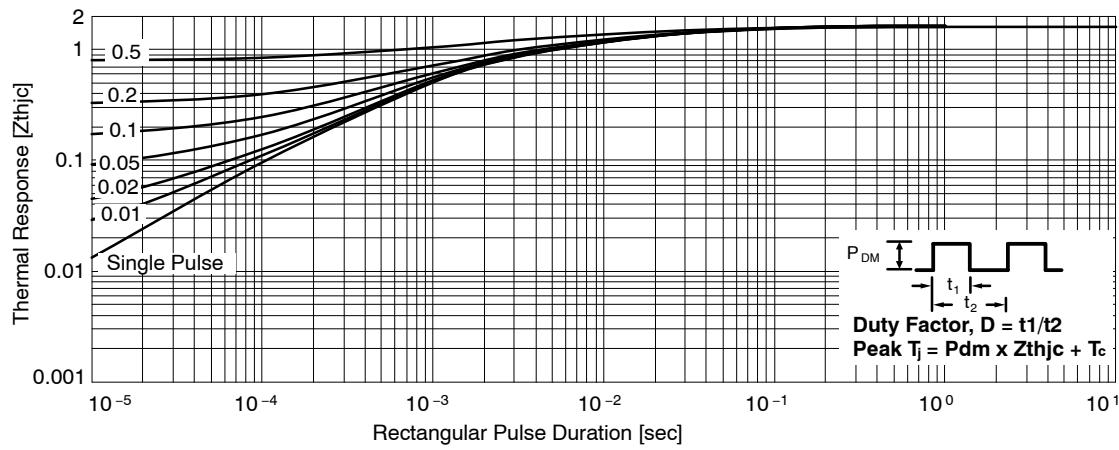
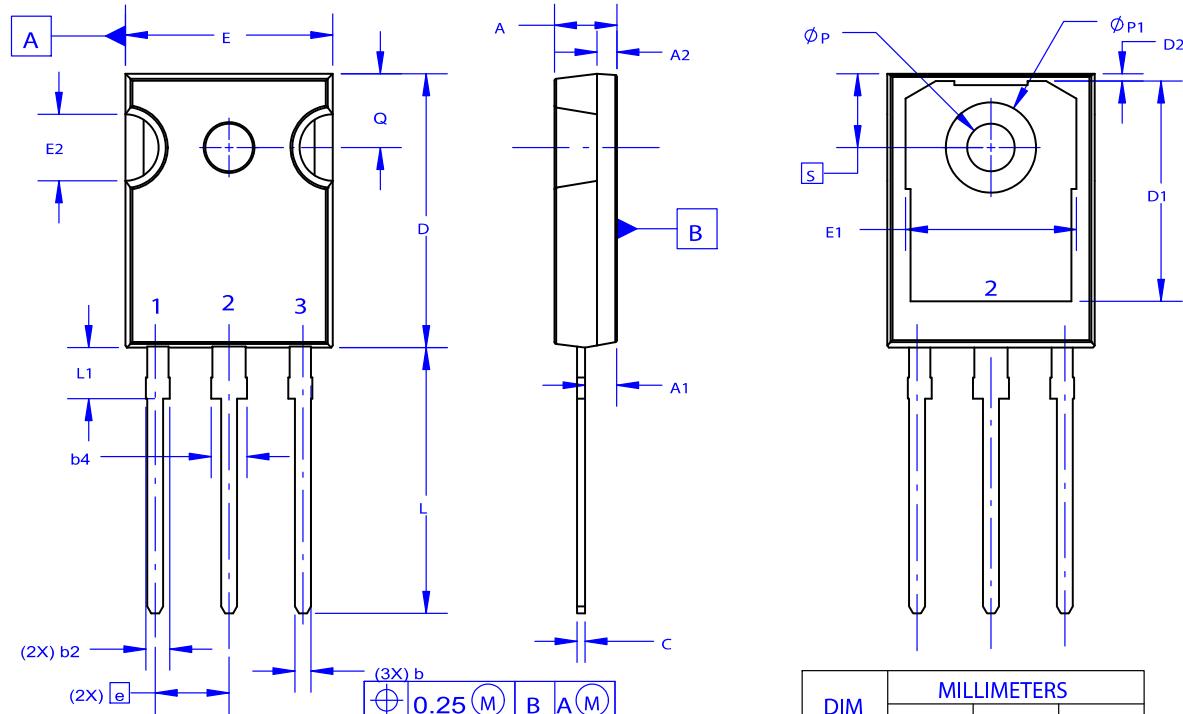


Figure 20. Transient Thermal Impedance of Diode

PACKAGE DIMENSIONS

TO-247-3LD
CASE 340CX
ISSUE O



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
ϕP	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	~	~
$\phi P1$	6.60	6.80	7.00

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