

# IGBT - Field Stop, Trench

1000 V, 40 A

## FGH40T100SMD, FGH40T100SMD-F155

### Description

Using innovative field stop trench IGBT technology, ON Semiconductor's new series of field stop trench IGBTs offer the optimum performance for hard switching application such as solar inverter, UPS, welder and PFC applications.

### Features

- High Current Capability
- Low Saturation Voltage:  $V_{CE(sat)} = 1.9 \text{ V(Typ.) @ } I_C = 40 \text{ A}$
- High Input Impedance
- Fast Switching
- These Devices are Pb-Free and are RoHS Compliant

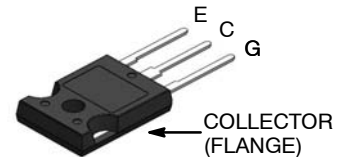
### Applications

- UPS, Welder, PFC



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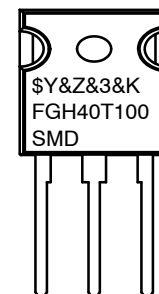
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TO-247-3LD  
CASE 340CK  
FGH40T100SMD

TO-247-3LD  
CASE 340CH  
FGH40T100SMD-F155

### MARKING DIAGRAM



\$Y	= ON Semiconductor Logo
&Z	= Assembly Plant Code
&3	= Numeric Date Code
&K	= Lot Code
FGH40T100SMD	= Specific Device Code

### ORDERING INFORMATION

See detailed ordering and shipping information in the package dimensions section on page 2 of this data sheet.

# FGH40T100SMD, FGH40T100SMD-F155

## ABSOLUTE MAXIMUM RATINGS (T<sub>C</sub> = 25°C unless otherwise noted)

Description		Symbol	Ratings	Unit
Collector to Emitter Voltage		V <sub>CES</sub>	1000	V
Gate to Emitter Voltage		V <sub>GES</sub>	±25	V
Transient Gate to Emitter Voltage			±30	V
Collector Current	T <sub>C</sub> = 25°C	I <sub>C</sub>	80	A
Collector Current	T <sub>C</sub> = 100°C		40	A
Pulsed Collector Current (Note 1)	T <sub>C</sub> = 25°C	I <sub>CM</sub>	120	A
Diode Forward Current	T <sub>C</sub> = 25°C	I <sub>F</sub>	80	A
Diode Forward Current	T <sub>C</sub> = 100°C		40	A
Pulsed Diode Forward Current (Note 1)	T <sub>C</sub> = 25°C	I <sub>FM</sub>	120	A
Maximum Power Dissipation	T <sub>C</sub> = 25°C	P <sub>D</sub>	333	W
Maximum Power Dissipation	T <sub>C</sub> = 100°C		166	W
Operating Junction Temperature		T <sub>J</sub>	−55 to +175	°C
Storage Temperature Range		T <sub>stg</sub>	−55 to +175	°C
Maximum Lead Temp. for Soldering Purposes, 1/8" from Case for 5 Seconds		T <sub>L</sub>	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. Repetitive Rating: Pulse width limited by max. junction temperature.

## THERMAL CHARACTERISTICS

Parameter	Symbol	Typ	Max	Unit
Thermal Resistance, Junction to Case (IGBT)	R <sub>θJC</sub>	–	0.45	°C/W
Thermal Resistance, Junction to Case (Diode)	R <sub>θJC</sub>	–	0.8	°C/W
Thermal Resistance, Junction to Ambient	R <sub>θJA</sub>	–	40	°C/W

## PACKAGE MARKING AND ORDERING INFORMATION

Device Marking	Device	Package	Reel Size	Tape Width	Quantity
FGH40T100SMD	FGH40T100SMD	TO-247-3	–	–	30
FGH40T100SMD	FGH40T100SMD-F155	TO-247-3	–	–	30

## ELECTRICAL CHARACTERISTICS OF THE IGBT (T<sub>C</sub> = 25°C unless otherwise noted)

Parameter	Symbol	Test Conditions	Min	Typ	Max	Unit
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### OFF CHARACTERISTICS

Collector to Emitter Breakdown Voltage	BV <sub>CES</sub>	V <sub>GE</sub> = 0 V, I <sub>C</sub> = 1 mA	1000	–	–	V
Temperature Coefficient of Breakdown Voltage	ΔBV <sub>CES</sub> /ΔT <sub>J</sub>	V <sub>GE</sub> = 0 V, I <sub>C</sub> = 250 μA		0.6		V/°C
Collector Cut-Off Current	I <sub>CES</sub>	V <sub>CE</sub> = V <sub>CES</sub> , V <sub>GE</sub> = 0 V	–	–	1000	μA
G–E Leakage Current	I <sub>GES</sub>	V <sub>GE</sub> = V <sub>GES</sub> , V <sub>CE</sub> = 0 V	–	–	±500	nA

### ON CHARACTERISTICS

G–E Threshold Voltage	V <sub>GE(th)</sub>	I <sub>C</sub> = 250 μA, V <sub>CE</sub> = V <sub>GE</sub>	4.2	5.3	6.5	V
Collector to Emitter Saturation Voltage	V <sub>CE(sat)</sub>	I <sub>C</sub> = 40 A, V <sub>GE</sub> = 15 V	–	1.9	2.3	V
		I <sub>C</sub> = 40 A, V <sub>GE</sub> = 15 V, T <sub>C</sub> = 175°C	–	2.4	–	V

# FGH40T100SMD, FGH40T100SMD-F155

## ELECTRICAL CHARACTERISTICS OF THE IGBT ( $T_C = 25^\circ\text{C}$ unless otherwise noted) (continued)

Parameter	Symbol	Test Conditions	Min	Typ	Max	Unit
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### DYNAMIC CHARACTERISTICS

Input Capacitance	$C_{ies}$	$V_{CE} = 30\text{ V}, V_{GE} = 0\text{ V}, f = 1\text{ MHz}$	–	3980	5295	pF
Output Capacitance	$C_{oes}$		–	124	165	pF
Reverse Transfer Capacitance	$C_{res}$		–	76	115	pF

### SWITCHING CHARACTERISTICS

Turn-On Delay Time	$t_{d(on)}$	$V_{CC} = 600\text{ V}, I_C = 40\text{ A},$ $R_G = 10\ \Omega, V_{GE} = 15\text{ V},$ Inductive Load, $T_C = 25^\circ\text{C}$	–	29	38	ns
Rise Time	$t_r$		–	42	55	ns
Turn-Off Delay Time	$t_{d(off)}$		–	285	371	ns
Fall Time	$t_f$		–	23	30	ns
Turn-On Switching Loss	$E_{on}$		–	2.35	3.1	mJ
Turn-Off Switching Loss	$E_{off}$		–	1.15	1.5	mJ
Total Switching Loss	$E_{ts}$		–	3.5	4.6	mJ
Turn-On Delay Time	$t_{d(on)}$	$V_{CC} = 600\text{ V}, I_C = 40\text{ A},$ $R_G = 10\ \Omega, V_{GE} = 15\text{ V},$ Inductive Load, $T_C = 175^\circ\text{C}$	–	27	36	ns
Rise Time	$t_r$		–	49	64	ns
Turn-Off Delay Time	$t_{d(off)}$		–	285	371	ns
Fall Time	$t_f$		–	20	26	ns
Turn-On Switching Loss	$E_{on}$		–	4.4	5.7	mJ
Turn-Off Switching Loss	$E_{off}$		–	1.9	2.5	mJ
Total Switching Loss	$E_{ts}$		–	6.3	8.2	mJ
Total Gate Charge	$Q_g$	$V_{CE} = 600\text{ V}, I_C = 40\text{ A}, V_{GE} = 15\text{ V}$	–	265	398	nC
Gate to Emitter Charge	$Q_{ge}$		–	32	48	nC
Gate to Collector Charge	$Q_{gc}$		–	135	203	nC

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

Parametr	Symbol	Test Conditions		Min	Typ	Max	Unit
Diode Forward Voltage	V <sub>FM</sub>	I <sub>F</sub> = 40 A	T <sub>C</sub> = 25°C	–	3.4	4.4	V
			T <sub>C</sub> = 175°C	–	2.6	–	
Diode Reverse Recovery Time	t <sub>rr</sub>	I <sub>F</sub> = 40 A, dI <sub>F</sub> /dt = 200 A/μs	T <sub>C</sub> = 25°C	–	60	78	ns
			T <sub>C</sub> = 175°C	–	256	–	
Diode Reverse Recovery Charge	Q <sub>rr</sub>		T <sub>C</sub> = 25°C	–	185	260	nC
			T <sub>C</sub> = 175°C	–	1512	–	

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 PERFORMANCE CHARACTERISTICS

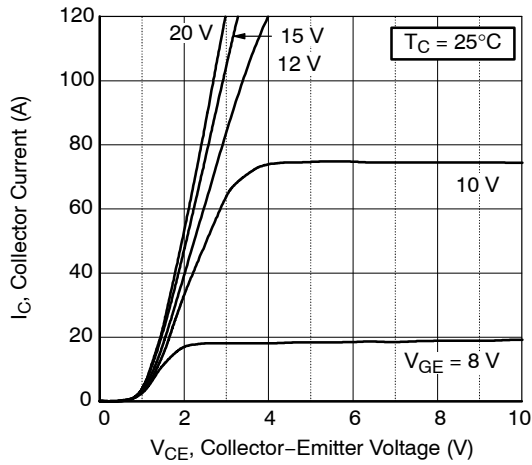


Figure 1. Typical Output Characteristics

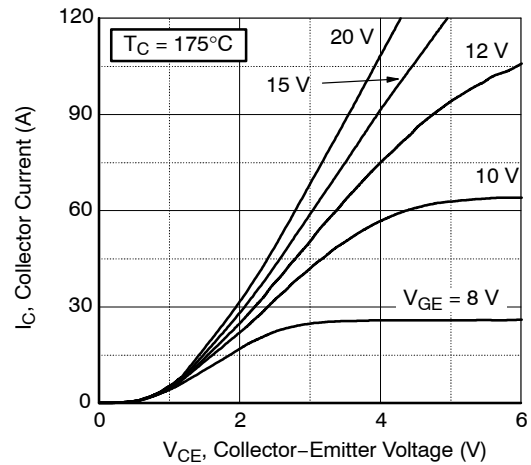


Figure 2. Typical Output Characteristics

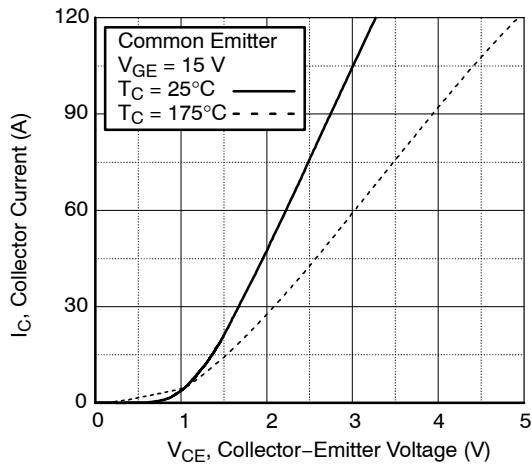


Figure 3. Typical Saturation Voltage Characteristics

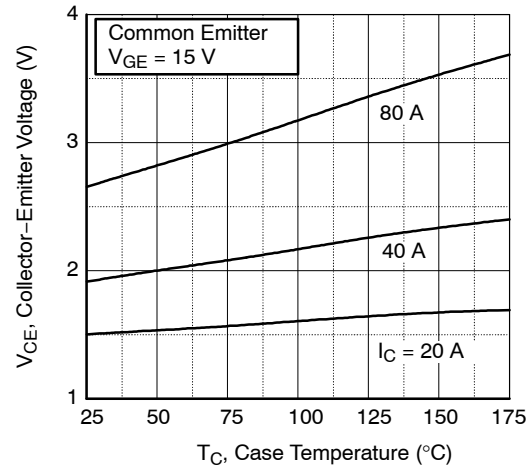


Figure 4. Saturation Voltage vs. Case Temperature at Variant Current Level

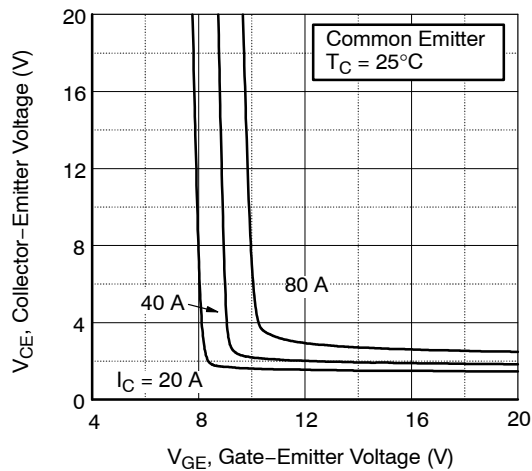


Figure 5. Saturation Voltage vs  $V_{GE}$

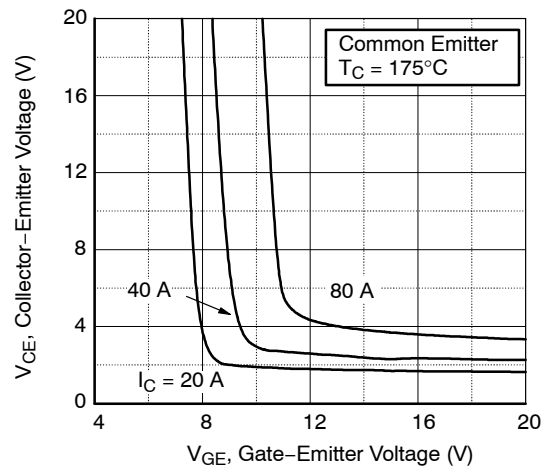


Figure 6. Saturation Voltage vs  $V_{GE}$

TYPICAL PERFORMANCE CHARACTERISTICS (continued)

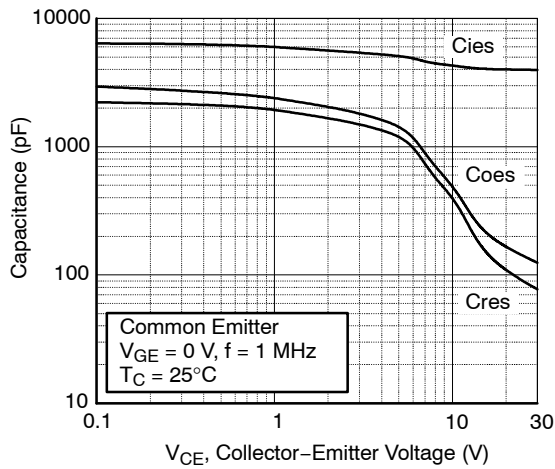


Figure 7. Capacitance Characteristics

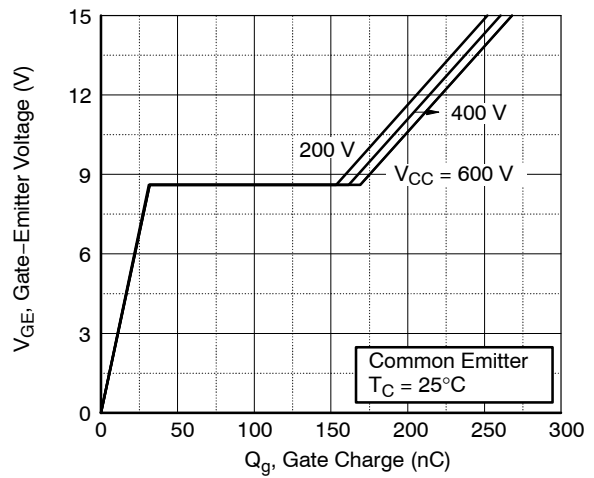


Figure 8. Gate Charge Characteristics

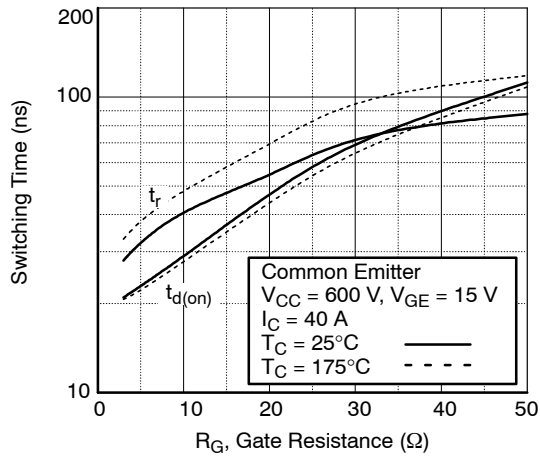


Figure 9. Turn-On Characteristics vs. Gate Resistance

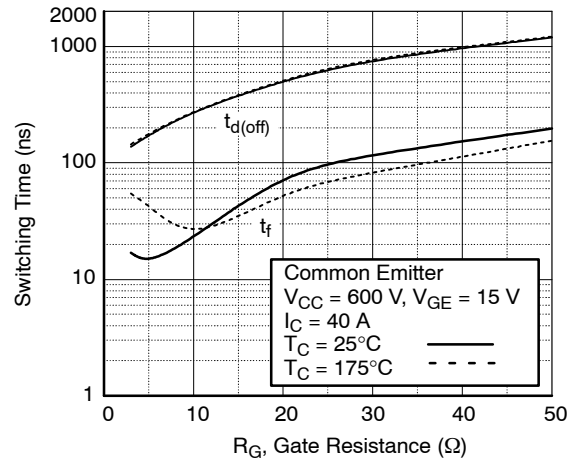


Figure 10. Turn-Off Characteristics vs. Gate Resistance

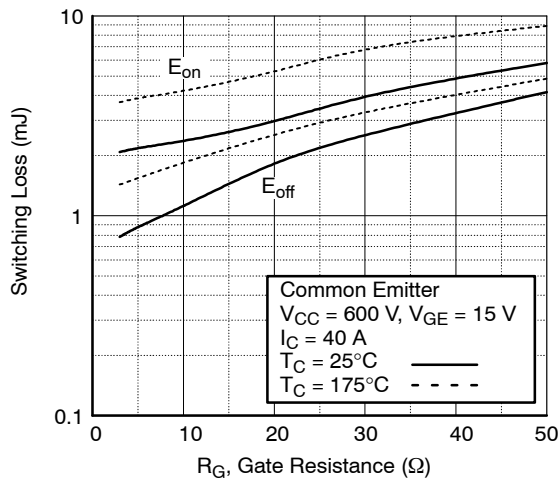


Figure 11. Switching Loss vs. Gate Resistance

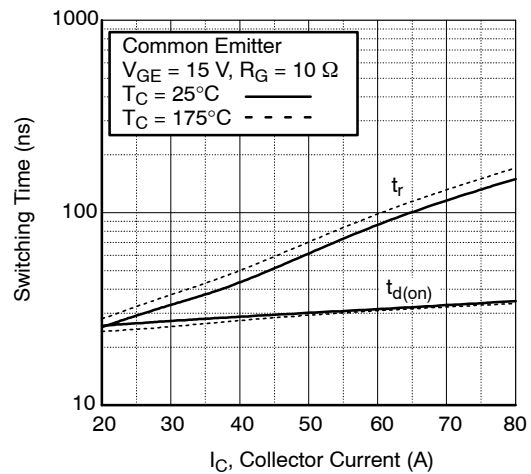


Figure 12. Turn-On Characteristics vs. Collector Current

TYPICAL PERFORMANCE CHARACTERISTICS (continued)

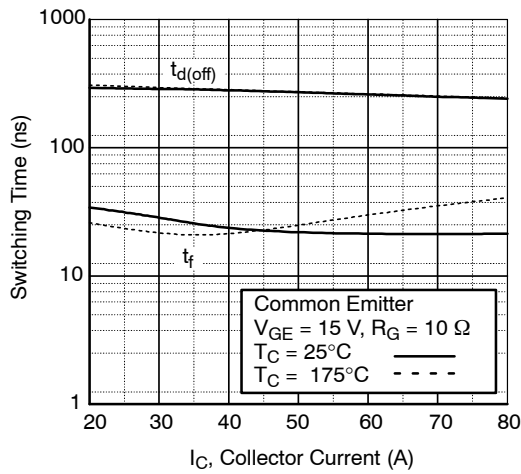


Figure 13. Turn-Off Characteristics vs. Collector Current

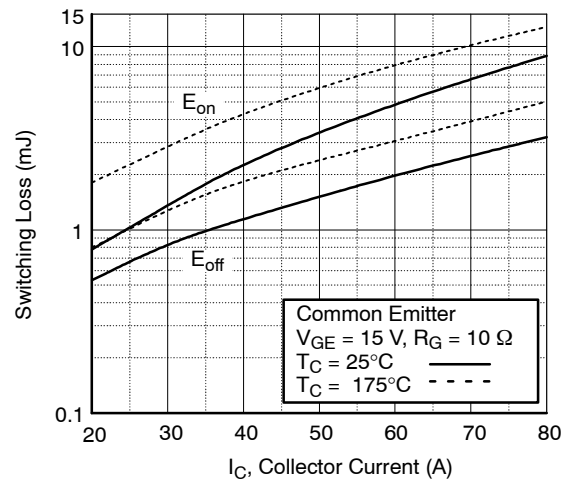


Figure 14. Switching Loss vs. Collector Current

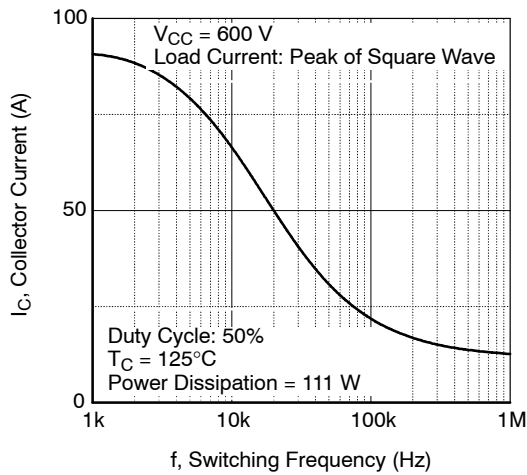


Figure 15. Load Current vs. Frequency

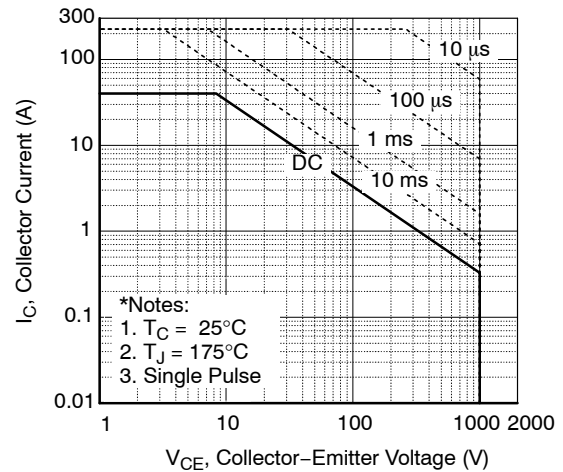


Figure 16. SOA Characteristics

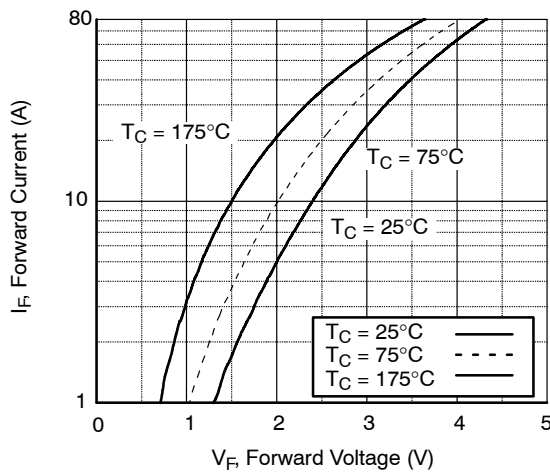


Figure 17. Forward Characteristics

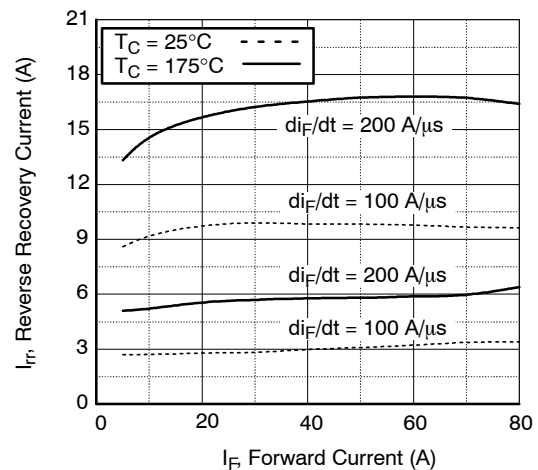


Figure 18. Reverse Recovery Current

# FGH40T100SMD, FGH40T100SMD-F155

## TYPICAL PERFORMANCE CHARACTERISTICS (continued)

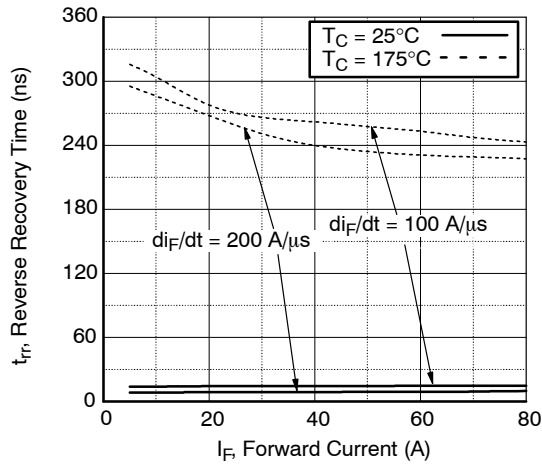


Figure 19. Reverse Recovery Time

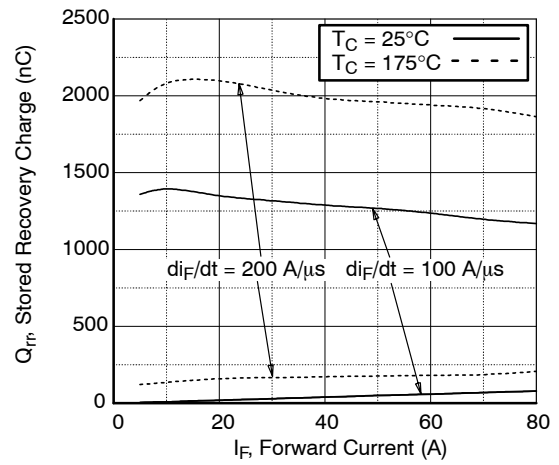


Figure 20. Stored Charge

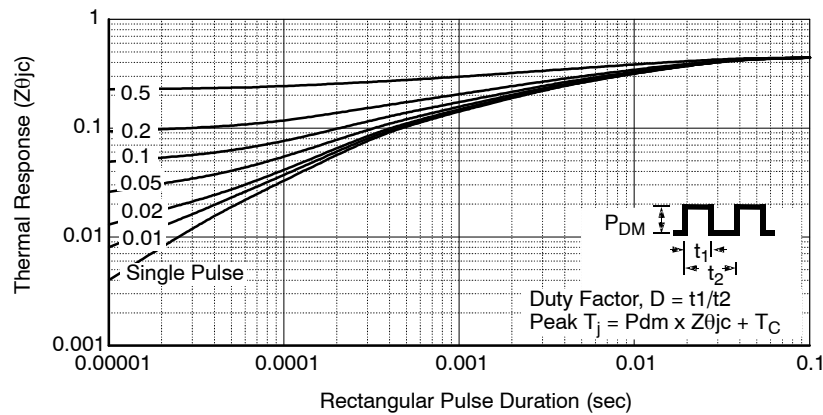


Figure 21. Transient Thermal Impedance of IGBT

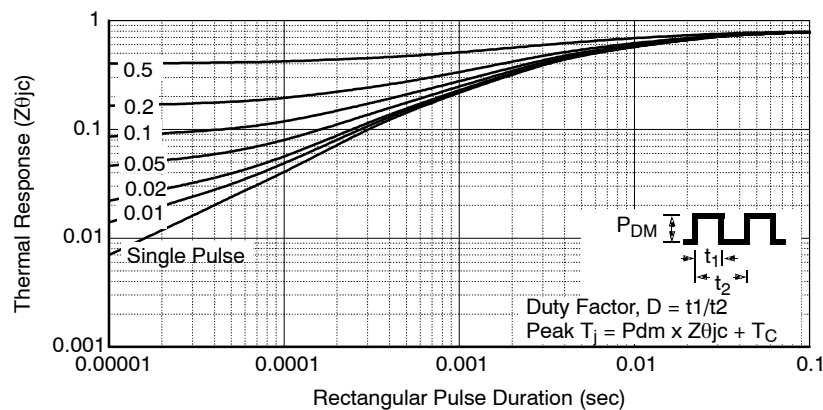
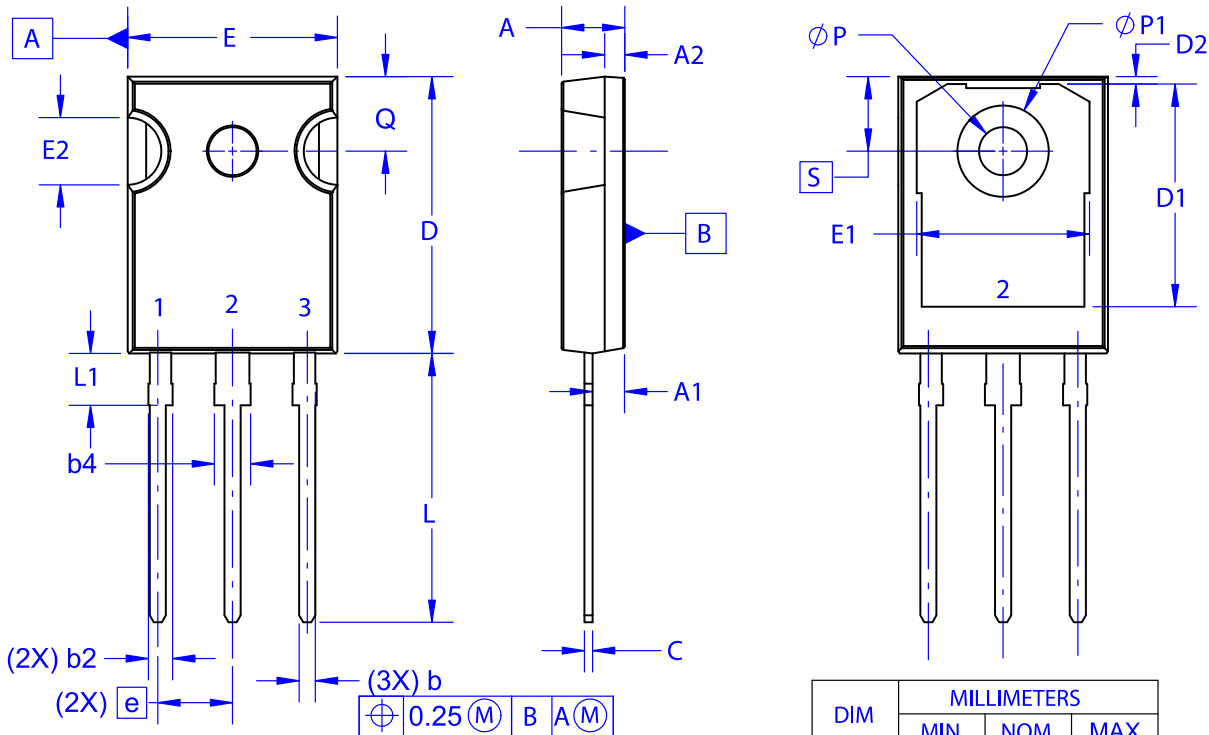


Figure 22. Transient Thermal Impedance of Diode

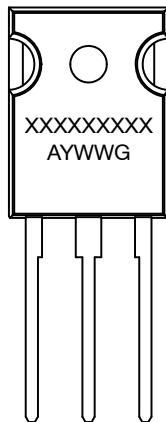
**TO-247-3LD**  
**CASE 340CH**  
**ISSUE A**

DATE 09 OCT 2019



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- 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\***


XXXX = 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	2.29	2.475	2.66
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
$\phi P$	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	~	~
$\phi P1$	6.61	6.73	6.85

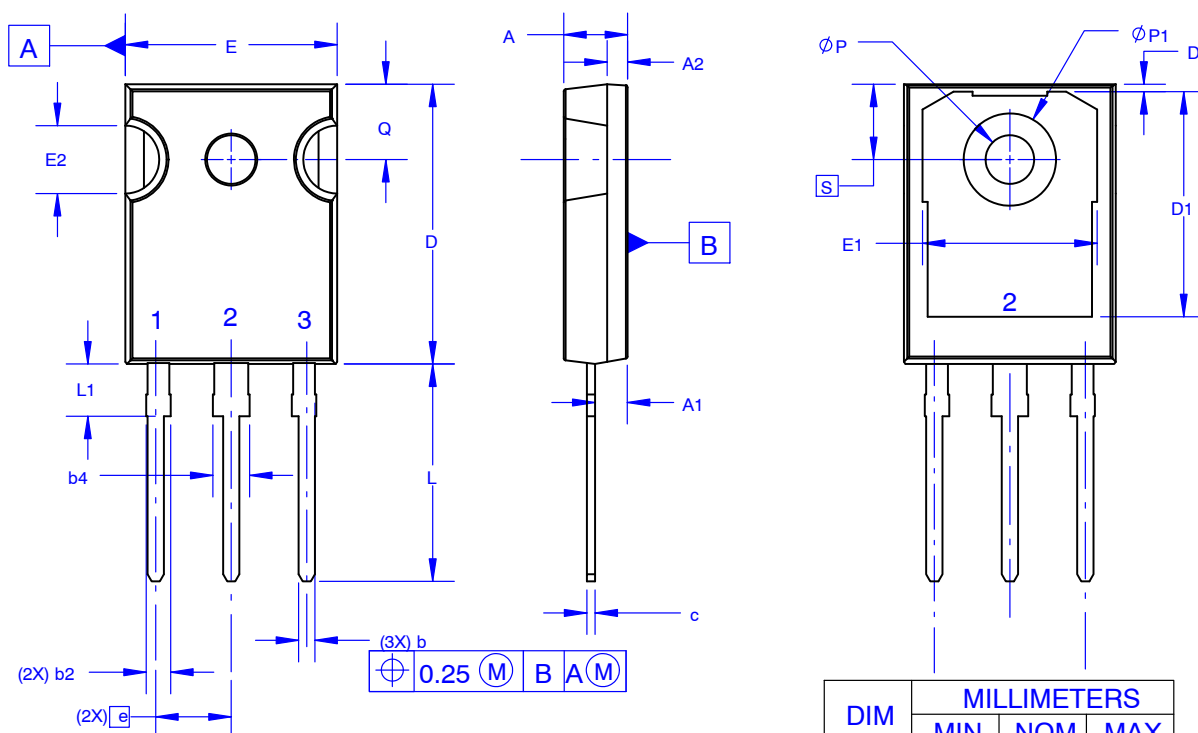
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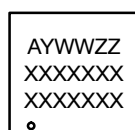
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**CASE 340CK**  
**ISSUE A**

DATE 31 JAN 2019



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D	20.32	20.57	20.82
D1	13.08	~	~
D2	0.51	0.93	1.35
E	15.37	15.62	15.87
E1	12.81	~	~
E2	4.96	5.08	5.20
e	~	5.56	~
L	15.75	16.00	16.25
L1	3.69	3.81	3.93
ØP	3.51	3.58	3.65
ØP1	6.60	6.80	7.00
Q	5.34	5.46	5.58
S	5.34	5.46	5.58

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