

IGBT - Field Stop 600 V, 40 A

FGH40N60SMD-F085

Description

Using Novel Field Stop IGBT Technology, **onsemi**'s new series of Field Stop IGBTs offer the optimum performance for Automotive Chargers, Inverter, and other applications where low conduction and switching losses are essential.

Features

- Maximum Junction Temperature: $T_J = 175$ °C
- Positive Temperature Co-efficient for Easy Parallel Operating
- High Current Capability
- Low Saturation Voltage: $V_{CE(sat)} = 1.9 \text{ V(Typ.)}$ @ $I_C = 40 \text{ A}$
- High Input Impedance
- Tightened Parameter Distribution
- AEC Qualified and PPAP Capable IGBT: AEC-Q101
- This Device is Pb-Free and is RoHS Compliant

Applications

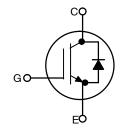
- Automotive Chargers, Converters, High Voltage Auxiliaries
- Inverters, SMPS, PFC, UPS

ABSOLUTE MAXIMUM RATINGS

Rating	Symbol	Ratings	Unit
Collector to Emitter Voltage	V _{CES}	600	V
Gate to Emitter Voltage	V _{GES}	±20	V
Collector Current @ T _C = 25°C @ T _C = 100°C	I _C	80 40	Α
Pulsed Collector Current	I _{CM} (Note 1)	120	Α
Diode Forward Current @ T _C = 25°C @ T _C = 100°C	I _F	40 20	Α
Pulsed Diode Maximum Forward Current	I _{FM} (Note 1)	120	Α
Maximum Power Dissipation @ T _C = 25°C @ T _C = 100°C	P _D	349 174	W
Operating Junction Temperature	TJ	-55 to +175	°C
Storage Temperature Range	T _{stg}	-55 to +175	°C
Maximum Lead Temperature for Soldering, 1/8" from Case for 5 Seconds	TL	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.

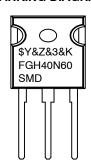
1. Repetitive rating: Pulse width limited by max. junction temperature.





TO-247-3LD CASE 340CK

MARKING DIAGRAM



\$Y	= onsemi Logo
&Z	= Assembly Plant Code
&3	= Numeric Date Code
&K	= Lot Code
FGH40N60SMD	 Specific Device Code

ORDERING INFORMATION

See detailed ordering and shipping information on page 2 of this data sheet.

THERMAL CHARACTERISTICS

Parameter	Symbol	Ratings	Unit
Thermal Resistance Junction-to-Case, for IGBT	R _{θJC} (Note 2)	0.43	°C/W
Thermal Resistance Junction-to-Case, for Diode	$R_{ hetaJC}$	1.8	°C/W
Parameter	Symbol	Тур.	
Thermal Resistance Junction-to-Ambient (PCB Mount) (Note 2)	$R_{ hetaJA}$	45	°C/W

R_{θJC} for TO-247: according to Mil standard 883-1012 test method. R_{θJA} for TO-247: according to JESD51-2, test method environmental condition and JESD51-10, test boards for through hole perimeter leaded package thermal measurements. JESD51-3: Low Effective Thermal Conductivity Test Board for Leaded Surface Mount Package.

PACKAGE MARKING AND ORDERING INFORMATION

Device Marking	Device	Package	Package Type	Quantity
FGH40N60SMD	FGH40N60SMD-F085	TO-247-3	Tube	30 Units

ELECTRICAL CHARACTERISTICS OF THE IGBT (T_C = 25°C unless otherwise noted)

Parameter	Symbol	Test Conditions	Min	Тур	Max	Unit
OFF CHARACTERISTICS						
Collector to Emitter Breakdown Voltage	BV _{CES}	V _{GE} = 0 V, I _C = 250 μA	600	-	-	V
Temperature Coefficient of Breakdown Voltage	$\Delta BV_{CES}/\Delta T_{J}$	V_{GE} = 0 V, I_C = 250 μA	-	0.6	-	V/°C
Collector Cut-Off Current	I _{CES}	V _{CE} = V _{CES} , V _{GE} = 0 V	-	-	250	μΑ
		I _{CES} at 80% * B _{VCES} , 175°C	-	-	800	
G-E Leakage Current	I _{GES}	V _{GE} = V _{GES} , V _{CE} = 0 V	-	-	±400	nA
ON CHARACTERISTICs						
G-E Threshold Voltage	V _{GE(th)}	$I_C = 250 \mu A, V_{CE} = V_{GE}$	3.5	4.5	6.0	V
Collector to Emitter Saturation Voltage	V _{CE(sat)}	I _C = 40 A, V _{GE} = 15 V	-	1.9	2.5	٧
		I _C = 40 A, V _{GE} = 15 V, T _C = 175°C	-	2.1	-	٧
DYNAMIC CHARACTERISTICS						
Input Capacitance	C _{ies}	V _{CE} = 30 V, V _{GE} = 0 V, f = 1 MHz	-	1880	2500	pF
Output Capacitance	C _{oes}		-	180	240	pF
Reverse Transfer Capacitance	C _{res}		-	50	65	pF
SWITCHING CHARACTERISTICS						
Turn-On Delay Time	t _{d(on)}	V _{CC} = 400 V, I _C = 40 A,	-	18	24	ns
Rise Time	t _r	$R_G = 6 \Omega$, $V_{GE} = 15 V$, Inductive Load, $T_C = 25^{\circ}C$	-	28	36.4	ns
Turn-Off Delay Time	t _{d(off)}		-	110	143	ns
Fall Time	t _f		_	13.2	18.5	ns
Turn-On Switching Loss	E _{on}		_	0.92	1.2	mJ
Turn-Off Switching Loss	E _{off}		_	0.3	0.39	mJ
Total Switching Loss	E _{ts}]	-	1.22	1.59	mJ

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

Parameter	Symbol	Test Conditions	Min	Тур	Max	Unit
Turn-On Delay Time	t _{d(on)}	V _{CC} = 400 V, I _C = 40 A,	_	16.7	23.8	ns
Rise Time	t _r	$R_G = 6 \Omega$, $V_{GE} = 15 V$, Inductive Load, $T_C = 175^{\circ}C$	-	27	35.1	ns
Turn-Off Delay Time	t _{d(off)}		-	116	151	ns
Fall Time	t _f		-	56.5	81	ns
Turn-On Switching Loss	E _{on}		-	1.47	1.91	mJ
Turn-Off Switching Loss	E _{off}	1	_	0.73	0.95	mJ
Total Switching Loss	E _{ts}	1	_	2.20	2.86	mJ
Total Gate Charge	Q_g	$V_{CE} = 400 \text{ V}, I_{C} = 40 \text{ A}, V_{GE} = 15 \text{ V}$	_	119	180	nC
Gate to Emitter Charge	Q _{ge}		-	13	20	nC
Gate to Collector Charge	Q _{gc}		=	58	90	nC

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

Parameter	Symbol	Test Conditions		Min	Тур	Max	Unit
Diode Forward Voltage	V_{FM}	I _F = 20 A	T _C = 25°C	-	2.3	2.8	V
			T _C = 175°C	-	1.67	_	
Reverse Recovery Energy	E _{rec}	$I_F = 20 \text{ A}, \text{ di}_F/\text{dt} = 200 \text{ A}/\mu\text{s}$	T _C = 175°C	_	48.9	_	μJ
Diode Reverse Recovery Time	t _{rr}		T _C = 25°C	_	36	47	ns
			T _C = 175°C	_	110	_	
Diode Reverse Recovery Charge	Q _{rr}		T _C = 25°C	_	46.8	61	nC
			T _C = 175°C	_	470	_	

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

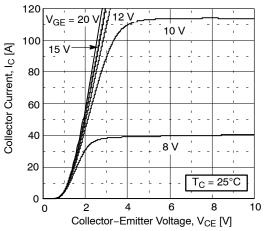


Figure 1. Typical Output Characteristics

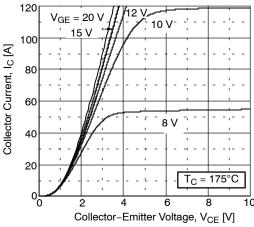


Figure 2. Typical Output Characteristics

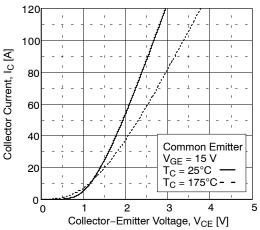


Figure 3. Typical Saturation Voltage Characteristics

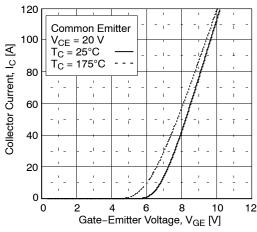


Figure 4. Transfer Characteristics

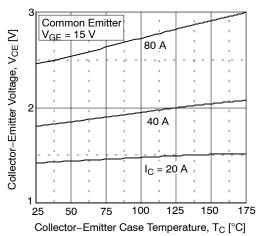


Figure 5. Saturation Voltage vs. Case Temperature at Variant Current Level

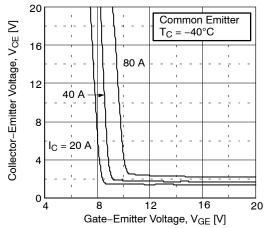


Figure 6. Saturation Voltage vs. V_{GE}

TYPICAL CHARACTERISTICS

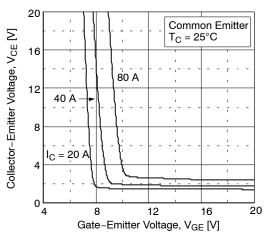


Figure 7. Saturation Voltage vs. V_{GE}

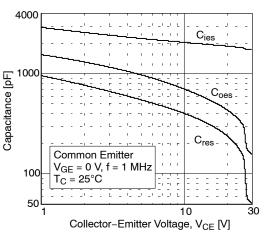


Figure 9. Capacitance Characteristics

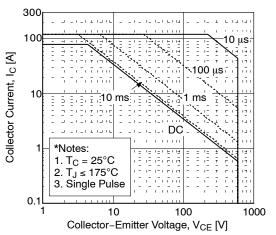


Figure 11. SOA Characteristics

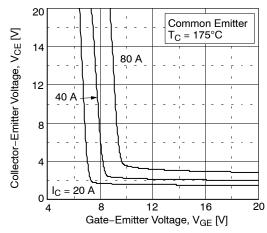


Figure 8. Saturation Voltage vs. V_{GE}

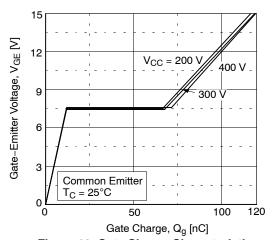


Figure 10. Gate Charge Characteristics

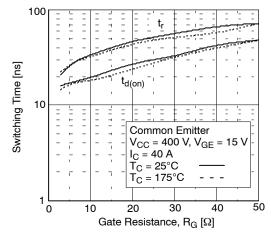


Figure 12. Turn-on Characteristics vs. Gate Resistance

TYPICAL CHARACTERISTICS

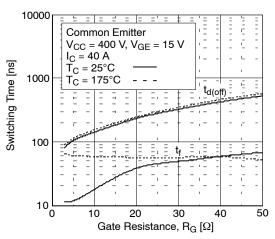


Figure 13. Turn-off Characteristics vs. Gate Resistance

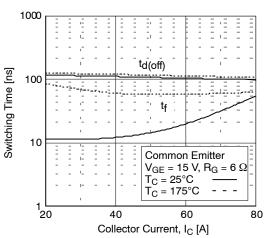


Figure 15. Turn-off Characteristics vs. Collector Current

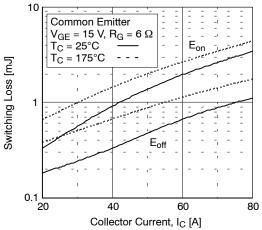


Figure 17. Switching Loss vs. Collector Current

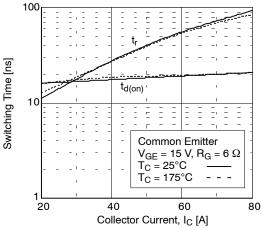


Figure 14. Turn-on Characteristics vs.
Collector Current

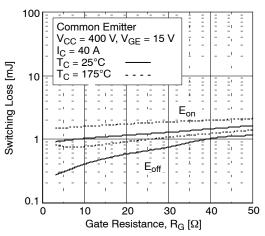


Figure 16. Switching Loss vs. Gate Resistance

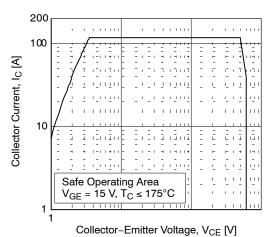


Figure 18. Turn-off Switching SOA Characteristics

TYPICAL CHARACTERISTICS

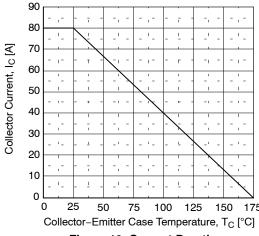


Figure 19. Current Derating

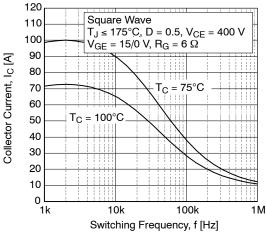


Figure 20. Load Current vs. Frequency

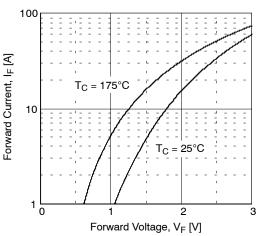


Figure 21. Forward Characteristics

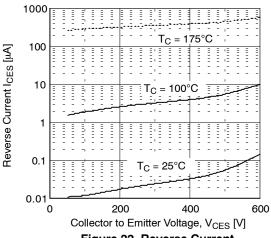
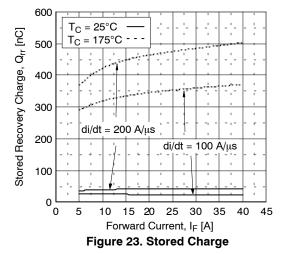


Figure 22. Reverse Current



 $T_C = 25^{\circ}C$ Reverse Recovery Time, t_{rr} [ns] di/dt = 100 A/μs $T_C = 175^{\circ}C$ 150 100 200 A/μs 50 $di/dt = 100 A/\mu s$ 200 A/μs 0 20 25 30 35 Forward Current, IF [A]

Figure 24. Reverse Recovery Time

200

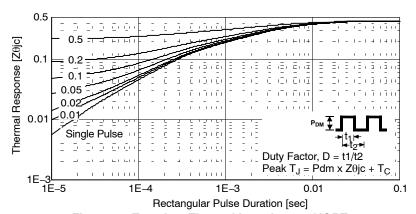


Figure 25. Transient Thermal Impedance of IGBT

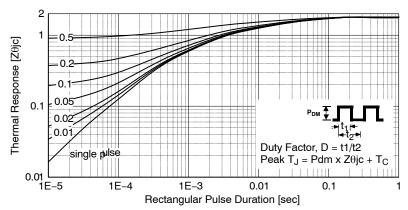
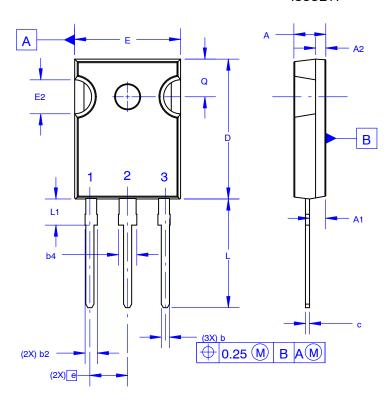


Figure 26. Transient Thermal Impedance of Diode



TO-247-3LD SHORT LEAD

CASE 340CK ISSUE A





- 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*



XXXX = Specific Device Code

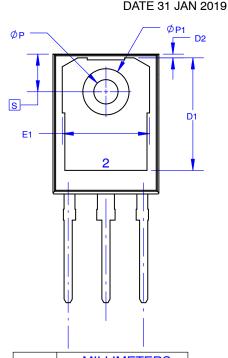
A = Assembly Location

Y = Year

WW = Work Week

ZZ = Assembly Lot Code

*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			
DIIVI	MIN	NOM	MAX	
Α	4.58	4.70	4.82	
A1	2.20	2.40	2.60	
A2	1.40	1.50	1.60	
b	1.17	1.26	1.35	
b2	1.53	1.65	1.77	
b4	2.42	2.54	2.66	
С	0.51	0.61	0.71	
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	
е	~	5.56	~	
L	15.75	16.00	16.25	
L1	3.69	3.81	3.93	
ØΡ	3.51	3.58	3.65	
Ø P1	6.60	6.80	7.00	
Q	5.34	5.46	5.58	
S	5.34	5.46	5.58	

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