

IGBT - Power, Co-PAK, N-Channel, Field Stop VII (FS7), SCR, TO247-4L 1200 V, 1.4 V, 25 A AFGH4L25T120RWD

Description

Using the novel field stop 7th generation IGBT technology and the Gen7 Diode in TO247 4–lead package, this device offers the optimum performance with low on state voltage and minimal switching losses for both hard and soft switching topologies in automotive applications.

Features

- Extremely Efficient Trench with Field Stop Technology
- Maximum Junction Temperature $T_J = 175$ °C
- Short Circuit Rated and Low Saturation Voltage
- Fast Switching and Tightened Parameter Distribution
- AEC-Q101 Qualified, PPAP Available Upon Request
- This Device is Pb–Free, Halogen Free/BFR Free and RoHS Compliant

Applications

- Automotive E-compressor
- Automotive EV PTC Heater
- OBC

MAXIMUM RATINGS (T_J = 25°C unless otherwise noted)

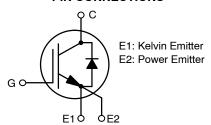
Paran	Symbol	Value	Unit	
Collector-to-Emitter Vo	V _{CE}	1200	V	
Gate-to-Emitter Voltage	Э	V _{GE}	±20	
Transient Gate-to-Emit	ter Voltage	1	±30	
Collector Current	T _C = 25°C	I _C	50	Α
	T _C = 100°C		25	
Power Dissipation	$T_C = 25^{\circ}C$	P _D	416	W
	T _C = 100°C		208	
Pulsed Collector Current	$T_C = 25^{\circ}C$, tp = 10 μ s (Note 1)	I _{CM}	75	Α
Diode Forward T _C = 25°C		ΙF	50	Α
Current	T _C = 100°C		25	
Pulsed Diode Maximum Forward Current	Maximum Forward $tp = 10 \mu s$ (Note 1)		75	A
Short Circuit Withstand V _{GE} = 15 V, V _{CC} = 800	T _{SC}	6	μs	
Operating Junction and Range	T _J , T _{stg}	-55 to +175	°C	
Lead Temperature for S	TL	260		

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

BV _{CES}	V _{CE(sat)} TYP	I _C MAX
1200 V	1.4 V	25 A

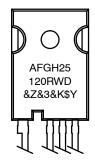
PIN CONNECTIONS





TO-247-4LD CASE 340CJ

MARKING DIAGRAM



AFGH25120RWD = Specific Device Code &Z = Assembly Plant Code &3 = 3-Digit Date Code &K = 2-Digit Lot Traceability Code \$Y = **onsemi** Logo

ORDERING INFORMATION

Device	Package	Shipping
AFGH4L25T120RWD	TO-247-4L (Pb-Free)	30 Units / Rail

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

THERMAL CHARACTERISTICS

Parameter	Symbol	Value	Unit
Thermal Resistance, Junction-to-Case for IGBT		0.36	°C/W
Thermal Resistance, Junction-to-Case for Diode		0.66	
Thermal Resistance, Junction-to-Ambient	$R_{\theta JA}$	40	

ELECTRICAL CHARACTERISTICS (T_J = 25°C unless otherwise specified)

Parameter	Symbol	Test Conditions	Min	Тур	Max	Unit
OFF CHARACTERISTICS	•					
Collector-to-Emitter Breakdown Voltage	BV _{CES}	$V_{GE} = 0 \text{ V}, I_{C} = 1 \text{ mA}$	1200	-	-	V
Collector-to-Emitter Breakdown Voltage Temperature Coefficient	ΔBV _{CES} / ΔΤ _J	V_{GE} = 0 V, I_{C} = 9.99 mA	-	1226	-	mV/°C
Zero Gate Voltage Collector Current	I _{CES}	V _{GE} = 0 V, V _{CE} = V _{CES}	_	-	40	μΑ
Gate-to-Emitter Leakage Current	I _{GES}	V _{GE} = ±20 V, V _{CE} = 0 V	-	-	±400	nA
ON CHARACTERISTICS						
Gate-to-Emitter Threshold Voltage	$V_{GE(th)}$	$V_{GE} = V_{CE}$, $I_C = 25 \text{ mA}$	5.1	6.0	6.9	V
Collector-to-Emitter Saturation Voltage	V _{CE(sat)}	V _{GE} = 15 V, I _C = 25 A, T _J = 25°C	-	1.4	1.73	
		V _{GE} = 15 V, I _C = 25 A, T _J = 175°C	-	1.62	-	
DYNAMIC CHARACTERISTICS						
Input Capacitance	C _{IES}	V _{CE} = 30 V, V _{GE} = 0 V, f = 1 MHz	-	3054	-	pF
Output Capacitance	C _{OES}		1	126	-	1
Reverse Transfer Capacitance	C _{RES}		1	15.4	-]
Total Gate Charge	Q_{G}	V _{CE} = 600 V, V _{GE} = 15 V, I _C = 25 A	-	113	-	nC
Gate-to-Emitter Charge	Q _{GE}	I _C = 25 A	-	27.2	-	1
Gate-to-Collector Charge	Q _{GC}		-	49.5	_	
SWITCHING CHARACTERISTICS	•				-	
Turn-On Delay Time	t _{d(on)}	$V_{CE} = 600 \text{ V}, V_{GE} = 0/15 \text{ V},$	-	39.7	_	ns
Turn-Off Delay Time	t _{d(off)}	$V_{CE} = 600 \text{ V}, V_{GE} = 0/15 \text{ V}, \ I_{C} = 12.5 \text{ A}, R_{G} = 8 \Omega, \ T_{J} = 25^{\circ}\text{C}$	-	254	_	
Rise Time	t _r	-	-	19.3	-	1
Fall Time	t _f		1	192	-]
Turn-On Switching Loss	E _{on}		1	0.52	-	mJ
Turn-Off Switching Loss	E _{off}		1	0.86	-]
Total Switching Loss	E _{ts}		-	1.38	-]
Turn-On Delay Time	t _{d(on)}	$V_{CE} = 600 \text{ V}, V_{GE} = 0/15 \text{ V},$	-	43	_	ns
Turn-Off Delay Time	t _{d(off)}	I_C = 25 A, R_G = 8 Ω, T_J = 25°C	-	203	-]
Rise Time	t _r		_	32.7	-	1
Fall Time	t _f		_	126	-	1
Turn-On Switching Loss	E _{on}		-	1.46	-	mJ
Turn-Off Switching Loss	E _{off}		-	1.07	_	1
Total Switching Loss	E _{ts}	1	-	2.53	_	1

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

Parameter	Symbol	Test Conditions	Min	Тур	Max	Unit
SWITCHING CHARACTERISTICS						
Turn-On Delay Time	t _{d(on)}	$V_{CE} = 600 \text{ V}, V_{GE} = 0/15 \text{ V},$	-	42.5	_	ns
Turn-Off Delay Time	t _{d(off)}	I_C = 12.5 A, R_G = 8 Ω, T_J = 175°C	-	348	-	1
Rise Time	t _r		-	27.4	-	1
Fall Time	t _f		_	384	_	1
Turn-On Switching Loss	E _{on}		-	0.75	-	mJ
Turn-Off Switching Loss	E _{off}		-	1.61	-	1
Total Switching Loss	E _{ts}		-	2.36	_	1
Turn-On Delay Time	t _{d(on)}	$V_{CE} = 600 \text{ V}, V_{GE} = 0/15 \text{ V},$	_	47.3	_	ns
Turn-Off Delay Time	t _{d(off)}	I_C = 25 A, R_G = 8 Ω, T_J = 175°C	-	265	_	1
Rise Time	t _r		-	45	_	1
Fall Time	t _f		-	241	_	1
Turn-On Switching Loss	E _{on}		-	2.15	_	mJ
Turn-Off Switching Loss	E _{off}		-	1.92	_	
Total Switching Loss	E _{ts}		-	4.07	_	
DIODE CHARACTERISTICS						
Diode Forward Voltage	V _F	I _F = 25 A, T _J = 25°C	-	1.7	2.0	V
		I _F = 25 A, T _J = 175°C	-	1.67	-	
DIODE SWITCHING CHARACTERISTIC	S, INDUCTIVE LOA	AD.				
Reverse Recovery Time	t _{rr}	$I_F = 12.5 \text{ A}, dI_{F}/dt = 500 \text{ A}/\mu\text{s}$ $V_R = 600 \text{ V}, T_J = 25^{\circ}\text{C}$	-	130	_	ns
Reverse Recovery Charge	Q _{rr}		-	1149	-	nC
Reverse Recovery Energy	E _{rec}		-	0.37	_	mJ
Peak Reverse Recovery Current	I _{RRM}		-	22.4	_	Α
Reverse Recovery Time	t _{rr}	I _F = 25 A, dI _{F/} dt = 500 A/μs	-	174	_	ns
Reverse Recovery Charge	Q _{rr}	$V_R = 600 \text{ V}, T_J = 25 ^{\circ}\text{C}$	-	2088	_	nC
Reverse Recovery Energy	E _{rec}		-	0.59	_	mJ
Peak Reverse Recovery Current	I _{RRM}		-	27.6	_	Α
Reverse Recovery Time	t _{rr}	I _F = 12.5 A, dI _F /dt = 500 A/μs	-	176	_	ns
Reverse Recovery Charge	Q _{rr}	V _R = 600 V, T _J = 175°C	-	1738	-	nC
Reverse Recovery Energy	E _{rec}		-	0.65	-	mJ
Peak Reverse Recovery Current	I _{RRM}		-	25.1	_	Α
Reverse Recovery Time	t _{rr}	I _F = 25 A, dI _F /dt = 500 A/μs	-	228	-	ns
Reverse Recovery Charge	Q _{rr}	$V_R = 600 \text{ V}, T_J = 175^{\circ}\text{C}$	_	3324	-	nC
Reverse Recovery Energy	E _{rec}		_	1.1	_	mJ
Peak Reverse Recovery Current	I _{RRM}		-	33.8	-	Α

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.

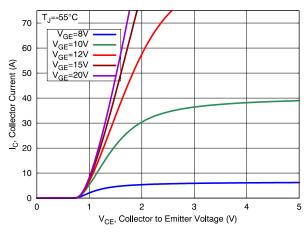


Figure 1. Output Characteristics

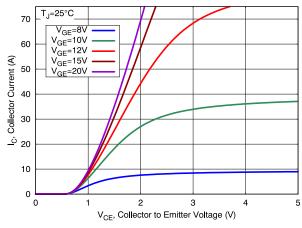


Figure 2. Output Characteristics

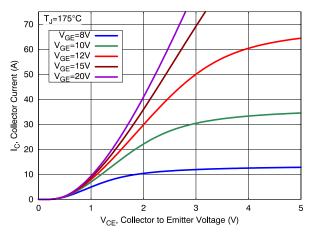


Figure 3. Output Characteristics

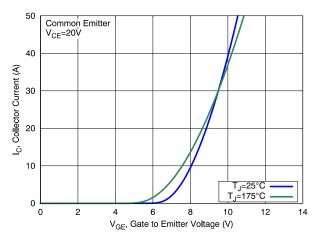


Figure 4. Transfer Characteristics

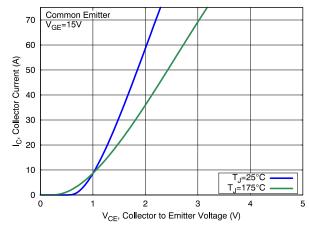


Figure 5. Saturation Characteristics

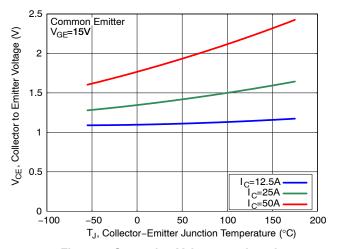


Figure 6. Saturation Voltage vs. Junction Temperature

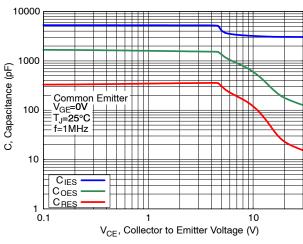


Figure 7. Capacitance Characteristics

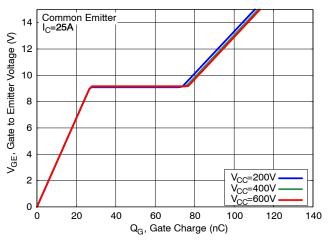


Figure 8. Gate Charge Characteristics

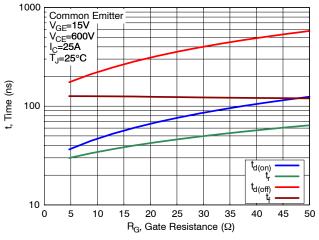


Figure 9. Switching Time vs. Gate Resistance

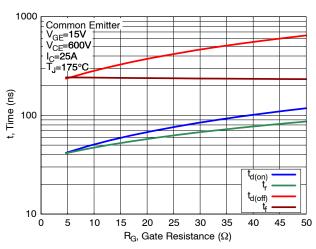


Figure 10. Switching Time vs. Gate Resistance

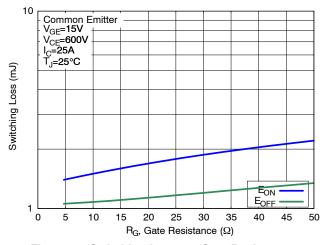


Figure 11. Switching Loss vs. Gate Resistance

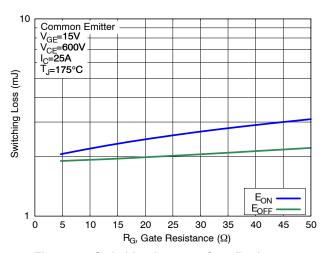


Figure 12. Switching Loss vs. Gate Resistance

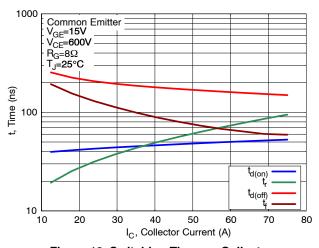


Figure 13. Switching Time vs. Collector Current

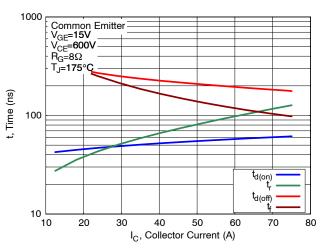


Figure 14. Switching Time vs. Collector Current

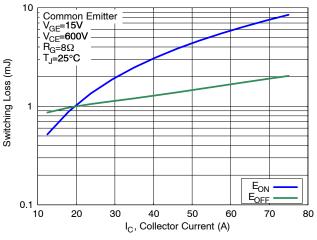


Figure 15. Switching Loss vs. Collector Current

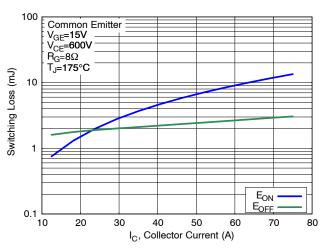


Figure 16. Switching Loss vs. Collector Current

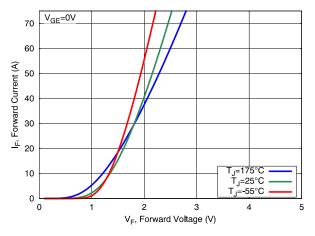


Figure 17. Diode Forward Characteristics

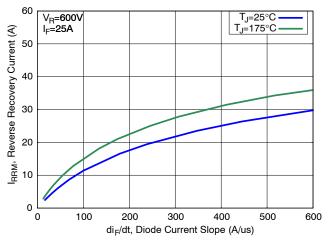
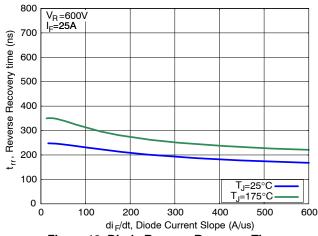


Figure 18. Diode Reverse Recovery Current



8000 V_R=600V I_F=25A Reverse Recovery Charge (nC) 7000 6000 5000 4000 3000 2000 a, 1000 T_J=25°C T_J=175°C 0 0 100 200 300 400 500 600 di_F/dt, Diode Current Slope (A/us)

Figure 19. Diode Reverse Recovery Time

Figure 20. Diode Stored Charge Characteristics

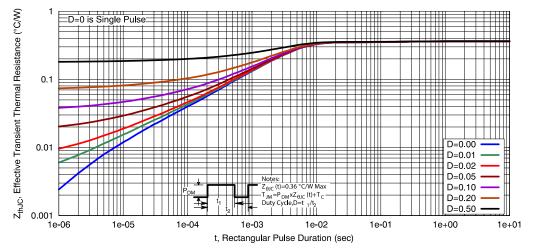


Figure 21. Transient Thermal Impedance of IGBT

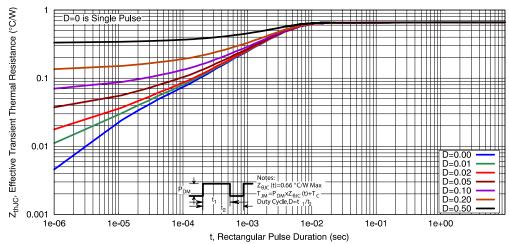


Figure 22. Transient Thermal Impedance of Diode

 \emptyset p1

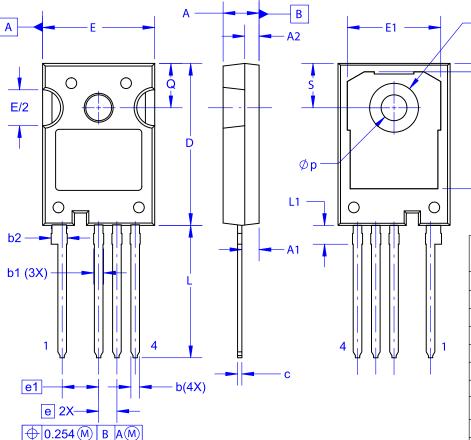
D1

D2



TO-247-4LD CASE 340CJ **ISSUE A**

DATE 16 SEP 2019



NOTES:

- A. NO INDUSTRY STANDARD APPLIES TO THIS PACKAGE.
 B. DIMENSIONS ARE EXCLUSIVE OF BURRS, MOLD
 FLASH, AND TIE BAR EXTRUSIONS.
 C. ALL DIMENSIONS ARE IN MILLIMETERS.
 D. DRAWING CONFORMS TO ASME Y14.5-2009.

DIM	MILLIMETERS			
DIM	MIN	NOM	MAX	
Α	4.80	5.00	5.20	
A1	2.10	2.40	2.70	
A2	1.80	2.00	2.20	
b	1.07	1.20	1.33	
b1	1.20	1.40	1.60	
b2	2.02	2.22	2.42	
С	0.50	0.60	0.70	
D	22.34	22.54	22.74	
D1	16.00	16.25	16.50	
D2	0.97	1.17	1.37	
е	2.54 BSC			
e1	5.08 BSC			
E	15.40	15.60	15.80	
E1	12.80	13.00	13.20	
E/2	4.80	5.00	5.20	
L	18.22	18.42	18.62	
L1	2.42	2.62	2.82	
р	3.40	3.60	3.80	
p1	6.60	6.80	7.00	
Q	5.97	6.17	6.37	
S	5.97	6.17	6.37	

DOCUMENT NUMBER:	98AON13852G	Electronic versions are uncontrolled except when accessed directly from the Document Repositor Printed versions are uncontrolled except when stamped "CONTROLLED COPY" in red.		
DESCRIPTION:	TO-247-4LD		PAGE 1 OF 1	

onsemi and ONSEMi are trademarks of Semiconductor Components Industries, LLC dba onsemi or its subsidiaries in the United States and/or other countries. onsemi reserves the right to make changes without further notice to any products herein. onsemi makes no warranty, representation or guarantee regarding the suitability of its products for any particular purpose, nor does onsemi assume any liability arising out of the application or use of any product or circuit, and specifically disclaims any and all liability, including without limitation special, consequential or incidental damages. onsemi does not convey any license under its patent rights nor the rights of others.

onsemi, ONSEMI., and other names, marks, and brands are registered and/or common law trademarks of Semiconductor Components Industries, LLC dba "onsemi" or its affiliates and/or subsidiaries in the United States and/or other countries. onsemi owns the rights to a number of patents, trademarks, copyrights, trade secrets, and other intellectual property. A listing of onsemi's product/patent coverage may be accessed at www.onsemi.com/site/pdf/Patent-Marking.pdf. onsemi reserves the right to make changes at any time to any products or information herein, without notice. The information herein is provided "as-is" and onsemi makes no warranty, representation or guarantee regarding the accuracy of the information, product features, availability, functionality, or suitability of its products for any particular purpose, nor does onsemi assume any liability arising out of the application or use of any product or circuit, and specifically disclaims any and all liability, including without limitation special, consequential or incidental damages. Buyer is responsible for its products and applications using **onsemi** products, including compliance with all laws, regulations and safety requirements or standards, regardless of any support or applications information provided by **onsemi**. "Typical" parameters which may be provided in **onsemi** data sheets and/or specifications can and do vary in different applications and actual performance may vary over time. All operating parameters, including "Typicals" must be validated for each customer application by customer's technical experts. **onsemi** does not convey any license under any of its intellectual property rights nor the rights of others. **onsemi** products are not designed, intended, or authorized for use as a critical component in life support systems. or any FDA Class 3 medical devices or medical devices with a same or similar classification in a foreign jurisdiction or any devices intended for implantation in the human body. Should Buyer purchase or use **onsemi** products for any such unintended or unauthorized application, Buyer shall indemnify and hold **onsemi** and its officers, employees, subsidiaries, affiliates, and distributors harmless against all claims, costs, damages, and expenses, and reasonable attorney fees arising out of, directly or indirectly, any claim of personal injury or death associated with such unintended or unauthorized use, even if such claim alleges that **onsemi** was negligent regarding the design or manufacture of the part. **onsemi** is an Equal Opportunity/Affirmative Action Employer. This literature is subject to all applicable copyright laws and is not for resale in any manner.

ADDITIONAL INFORMATION

TECHNICAL PUBLICATIONS:

 $\textbf{Technical Library:} \ \underline{www.onsemi.com/design/resources/technical-documentation}$

onsemi Website: www.onsemi.com

ONLINE SUPPORT: www.onsemi.com/support

For additional information, please contact your local Sales Representative at

www.onsemi.com/support/sales