IGBT - Power, Co-PAK N-Channel, Field Stop VII (FS7), SCR, TO247-3L

1200 V, 1.45 V, 40 A

AFGHL40T120RWD

BV_{CES}	$V_{CE(sat)}$ TYP	I_C MAX
1200 V	1.45 V	40 A

Description

Using the novel field stop 7th generation IGBT technology and the Gen7 Diode in TO247 3−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.

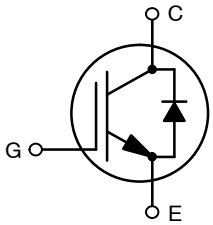
Features

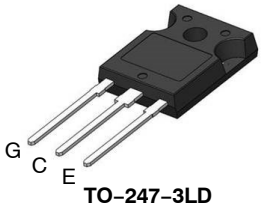
- Extremely Efficient Trench with Field Stop Technology
- Maximum Junction Temperature − T_J =175°C
- Short Circuit Rated and Low Saturation Voltage
- Fast Switching and Tightened Parameter Distribution
- AEC−Q101 Qualified, PPAP Available Upon Request
- This Device is Pb−Free, Halogen Free/BFR Free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

Applications

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

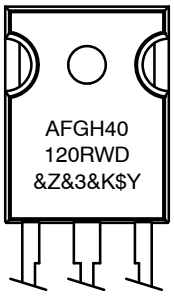
PIN CONNECTIONS





TO−247−3LD
CASE 340CX

MARKING DIAGRAM



AFGH40120RWD	= Specific Device Code
&Z	= Assembly Plant Code
&3	= 3−Digit Date Code
&K	= 2−Digit Lot Traceability Code
$Y	= **onsemi** Logo

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

Parameter		Symbol	Value	Unit
Collector−to−Emitter Voltage		V_{CE}	1200	V
Gate−to−Emitter Voltage		V_{GE}	±20	
Transient Gate−to−Emitter Voltage			±30	
Collector Current	T_C = 25°C	I_C	80	A
	T_C = 100°C		40	
Power Dissipation	T_C = 25°C	P_D	652	W
	T_C = 100°C		326	
Pulsed Collector Current	T_C = 25°C, tp = 10 μs (Note 1)	I_{CM}	120	A
Diode Forward Current	T_C = 25°C	I_F	80	
	T_C = 100°C		40	
Pulsed Diode Maximum Forward Current	T_C = 25°C, tp = 10 μs (Note 1)	I_{FM}	120	
Short Circuit Withstand Time V_{GE} = 15 V, V_{CC} = 800 V, T_C = 150°C		T_{SC}	6	μs
Operating Junction and Storage Temperature Range		T_J, T_{stg}	−55 to +175	°C
Lead Temperature for Soldering Purposes		T_L	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. Repetitive rating: Pulse width limited by max. junction temperature

ORDERING INFORMATION

Device	Package	Shipping
AFGHL40T120RWD	TO−247−3L (Pb−Free)	30 Units / Tube

© Semiconductor Components Industries, LLC, 2022

THERMAL CHARACTERISTICS

Parameter	Symbol	Value	Unit
Thermal Resistance, Junction−to−Case for IGBT	$R_{\theta JC}$	0.23	°C/W
Thermal Resistance, Junction−to−Case for Diode	$R_{\theta JCD}$	0.41	
Thermal Resistance, Junction−to−Ambient	$R_{\theta JA}$	40	

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

Parameter	Symbol	Test Conditions	Min	Typ	Max	Unit
OFF CHARACTERISTICS						
Collector−to−Emitter Breakdown Voltage	BV_{CES}	V_{GE} = 0 V, I_C = 1 mA	1200	–	–	V
Collector−to−Emitter Breakdown Voltage Temperature Coefficient	$\Delta BV_{CES}/\Delta T_J$	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	μA
Gate−to−Emitter Leakage Current	I_{GES}	V_{GE} = ±20 V, V_{CE} = 0 V	–	–	±400	nA
ON CHARACTERISTICS						
Gate Threshold Voltage	$V_{GE(th)}$	V_{GE} = V_{CE}, I_C = 40 mA	4.98	5.88	6.78	V
Collector−to−Emitter Saturation Voltage	$V_{CE(sat)}$	V_{GE} = 15 V, I_C = 40 A, T_J = 25°C	–	1.45	1.78	V
		V_{GE} = 15 V, I_C = 40 A, T_J = 175°C	–	1.75	–	
DYNAMIC CHARACTERISTICS						
Input Capacitance	C_{IES}	V_{CE} = 30 V, V_{GE} = 0 V, f = 1 MHz	–	4714	–	pF
Output Capacitance	C_{OES}		–	195	–	
Reverse Transfer Capacitance	C_{RES}		–	23.7	–	
Total Gate Charge	Q_G	V_{CE} = 600 V, V_{GE} = 15 V, I_C = 40 A	–	170	–	nC
Gate−to−Emitter Charge	Q_{GE}		–	42.2	–	
Gate−to−Collector Charge	Q_{GC}		–	73.1	–	
SWITCHING CHARACTERISTICS						
Turn−On Delay Time	$t_{d(on)}$	V_{CE} = 600 V, V_{GE} = 0/15 V, I_C = 20 A, R_G = 4.7 Ω, T_J = 25°C	–	50.1	–	ns
Turn−Off Delay Time	$t_{d(off)}$		–	293	–	
Rise Time	t_r		–	30.9	–	
Fall Time	t_f		–	189	–	
Turn−On Switching Loss	E_{on}		–	1.37	–	mJ
Turn−Off Switching Loss	E_{off}		–	1.35	–	
Total Switching Loss	E_{ts}		–	2.72	–	
Turn−On Delay Time	$t_{d(on)}$	V_{CE} = 600 V, V_{GE} = 0/15 V, I_C = 40 A, R_G = 4.7 Ω, T_J = 25°C	–	55.2	–	ns
Turn−Off Delay Time	$t_{d(off)}$		–	241	–	
Rise Time	t_r		–	55.2	–	
Fall Time	t_f		–	122	–	
Turn−On Switching Loss	E_{on}		–	3.68	–	mJ
Turn−Off Switching Loss	E_{off}		–	1.7	–	
Total Switching Loss	E_{ts}		–	5.38	–	

Share Feedback
Your Opinion Matters

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

Parameter	Symbol	Test Conditions	Min	Typ	Max	Unit
SWITCHING CHARACTERISTICS						
Turn−On Delay Time	$t_{d(on)}$	V_{CE} = 600 V, V_{GE} = 0/15 V, I_C = 20 A, R_G = 4.7 Ω, T_J = 175°C	–	56	–	ns
Turn−Off Delay Time	$t_{d(off)}$		–	414	–	
Rise Time	t_r		–	41.7	–	
Fall Time	t_f		–	375	–	
Turn−On Switching Loss	E_{on}		–	2.13	–	mJ
Turn−Off Switching Loss	E_{off}		–	2.51	–	
Total Switching Loss	E_{ts}		–	4.64	–	
Turn−On Delay Time	$t_{d(on)}$	V_{CE} = 600 V, V_{GE} = 0/15 V, I_C = 40 A, R_G = 4.7 Ω, T_J = 175°C	–	63.1	–	ns
Turn−Off Delay Time	$t_{d(off)}$		–	325	–	
Rise Time	t_r		–	71.2	–	
Fall Time	t_f		–	233	–	
Turn−On Switching Loss	E_{on}		–	5.75	–	mJ
Turn−Off Switching Loss	E_{off}		–	3.03	–	
Total Switching Loss	E_{ts}		–	8.79	–	
DIODE CHARACTERISTICS						
Forward Voltage	V_F	I_F = 40 A, T_J = 25°C	–	1.55	1.85	V
		I_F = 40 A, T_J = 175°C	–	1.54	–	
DIODE SWITCHING CHARACTERISTICS, INDUCTIVE LOAD						
Reverse Recovery Time	t_{rr}	V_R = 600 V, I_F = 20 A, dI_F/dt = 500 A/μs, T_J = 25°C	–	147	–	ns
Reverse Recovery Charge	Q_{rr}		–	2110	–	nC
Reverse Recovery Energy	E_{rec}		–	0.53	–	mJ
Peak Reverse Recovery Current	I_{RRM}		–	33.5	–	A
Reverse Recovery Time	t_{rr}	V_R = 600 V, I_F = 40 A, dI_F/dt = 500 A/μs, T_J = 25°C	–	185	–	ns
Reverse Recovery Charge	Q_{rr}		–	3612	–	nC
Reverse Recovery Energy	E_{rec}		–	0.78	–	mJ
Peak Reverse Recovery Current	I_{RRM}		–	43.2	–	A
Reverse Recovery Time	t_{rr}	V_R = 600 V, I_F = 20 A, dI_F/dt = 500 A/μs, T_J = 175°C	–	207	–	ns
Reverse Recovery Charge	Q_{rr}		–	3670	–	nC
Reverse Recovery Energy	E_{rec}		–	1.1	–	mJ
Peak Reverse Recovery Current	I_{RRM}		–	41.5	–	A
Reverse Recovery Time	t_{rr}	V_R = 600 V, I_F = 40 A, dI_F/dt = 500 A/μs, T_J = 175°C	–	258	–	ns
Reverse Recovery Charge	Q_{rr}		–	6684	–	nC
Reverse Recovery Energy	E_{rec}		–	1.66	–	mJ
Peak Reverse Recovery Current	I_{RRM}		–	56.5	–	A

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.

Share Feedback
Your Opinion Matters

TYPICAL CHARACTERISTICS

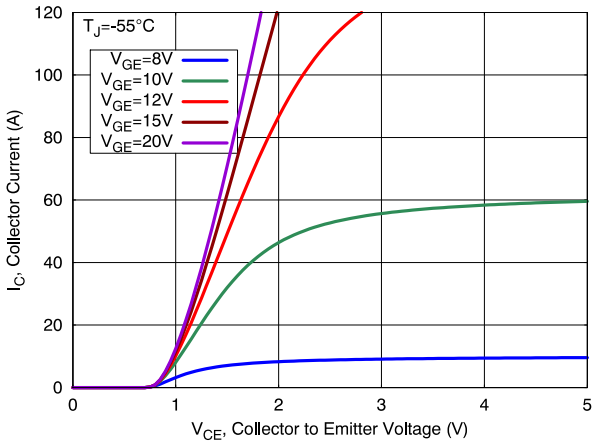


Figure 1. Output Characteristics

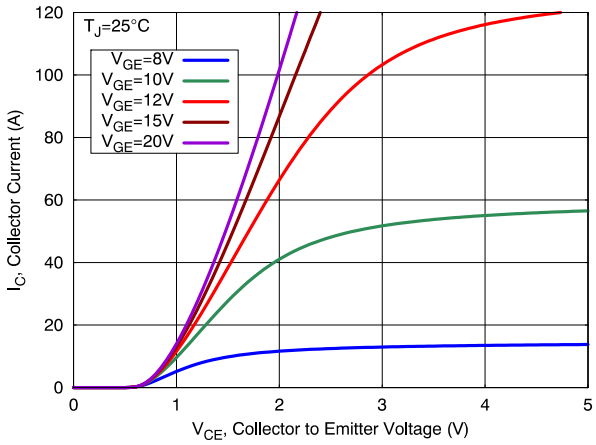


Figure 2. Output Characteristics

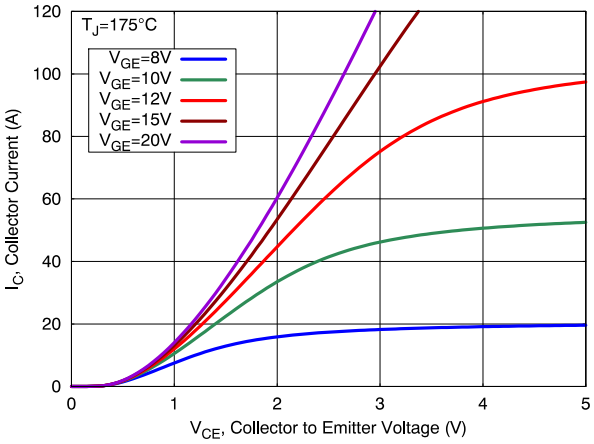


Figure 3. Output Characteristics

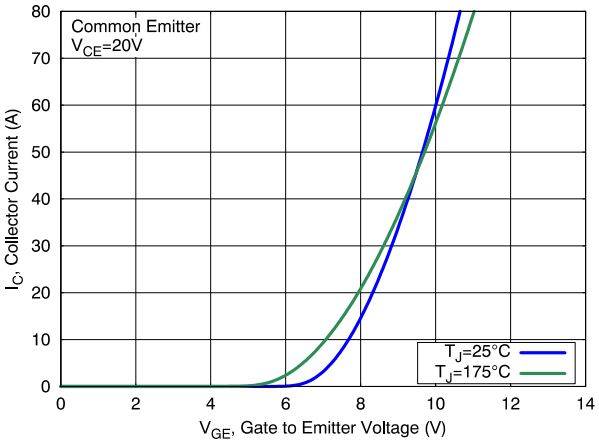


Figure 4. Transfer Characteristics

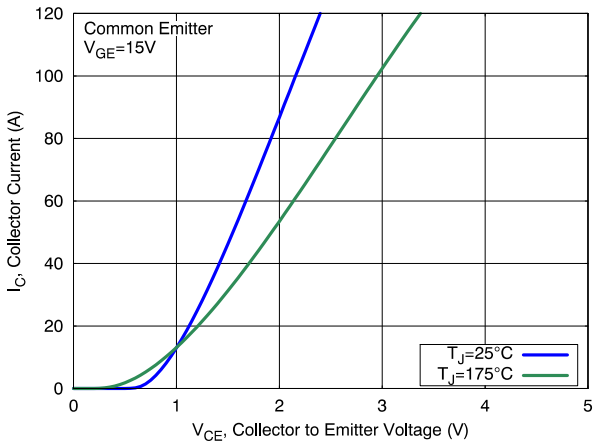


Figure 5. Saturation Characteristics

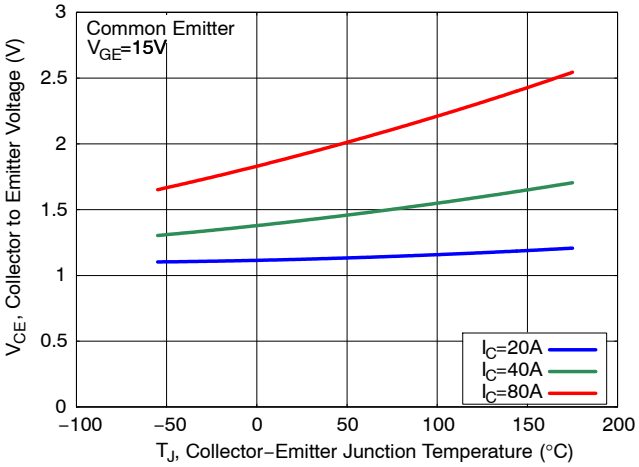


Figure 6. Saturation Voltage vs. Junction Temperature

Share Feedback
Your Opinion Matters

TYPICAL CHARACTERISTICS

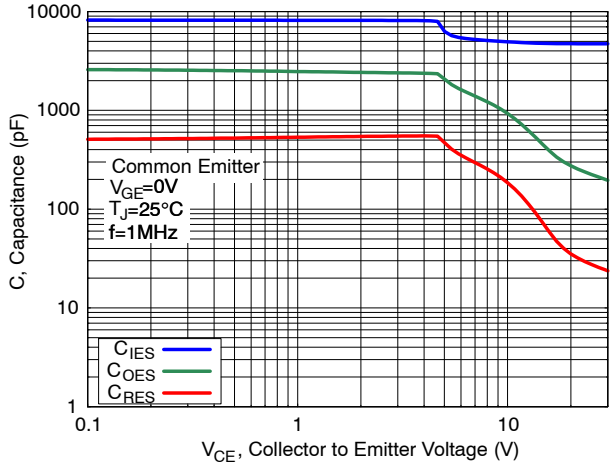


Figure 7. Capacitance Characteristics

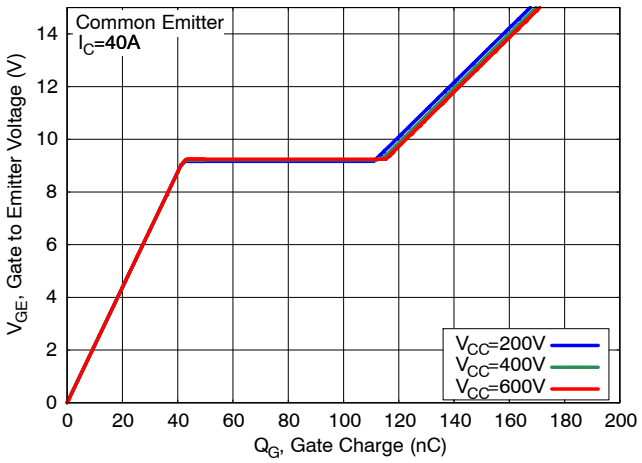


Figure 8. Gate Charge Characteristics

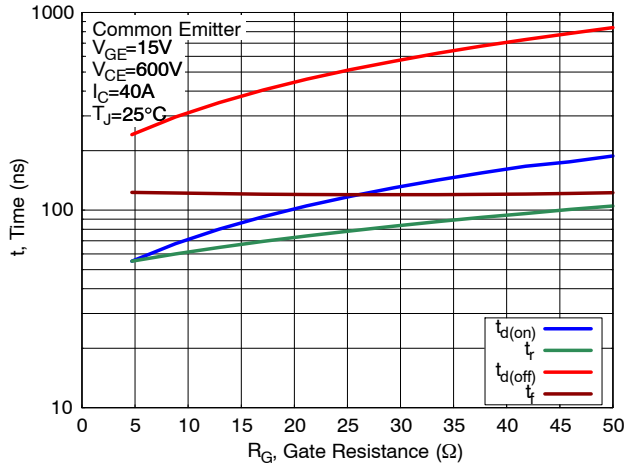


Figure 9. Switching Time vs. Gate Resistance

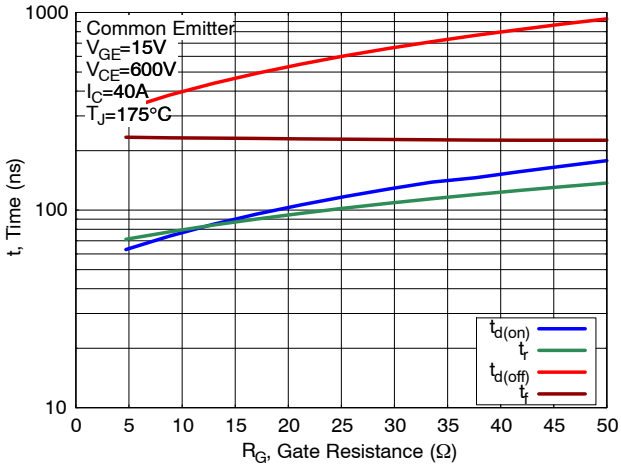


Figure 10. Switching Time vs. Gate Resistance

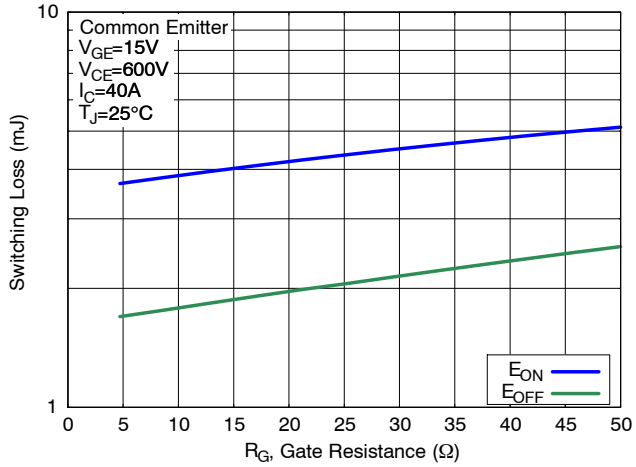


Figure 11. Switching Loss vs. Gate Resistance

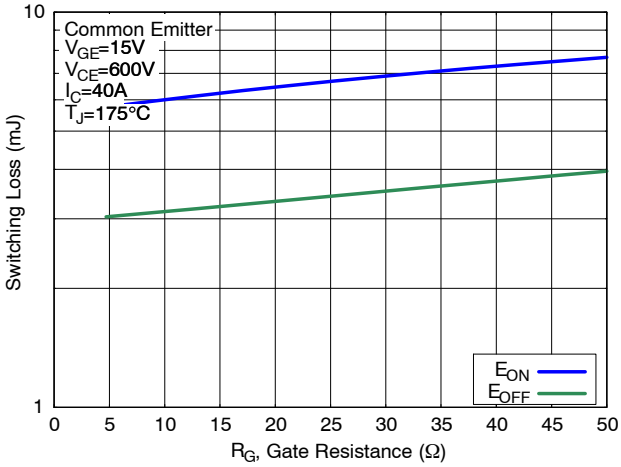


Figure 12. Switching Loss vs. Gate Resistance

Share Feedback
Your Opinion Matters

TYPICAL CHARACTERISTICS

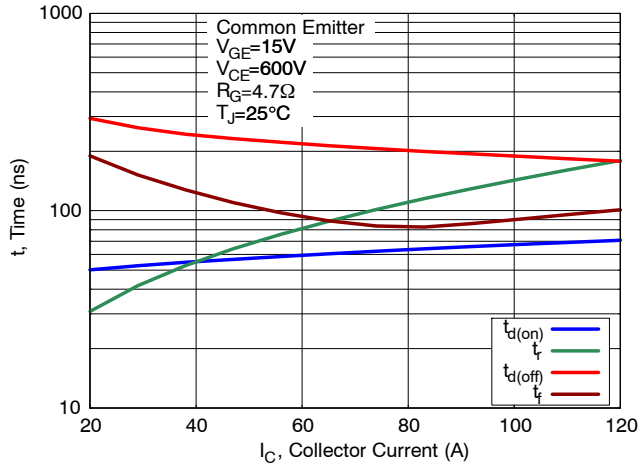


Figure 13. Switching Time vs. Collector Current

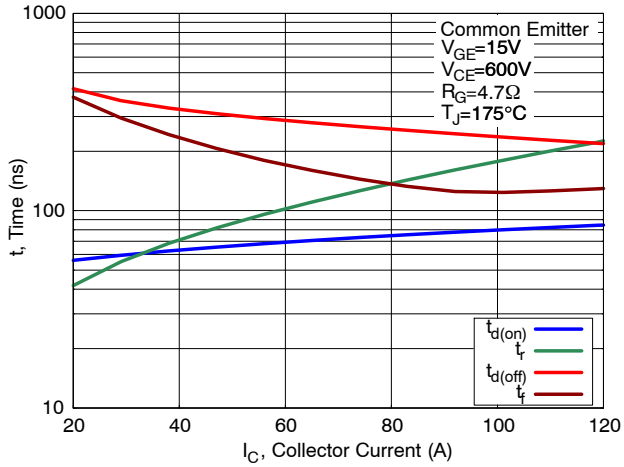


Figure 14. Switching Time vs. Collector Current

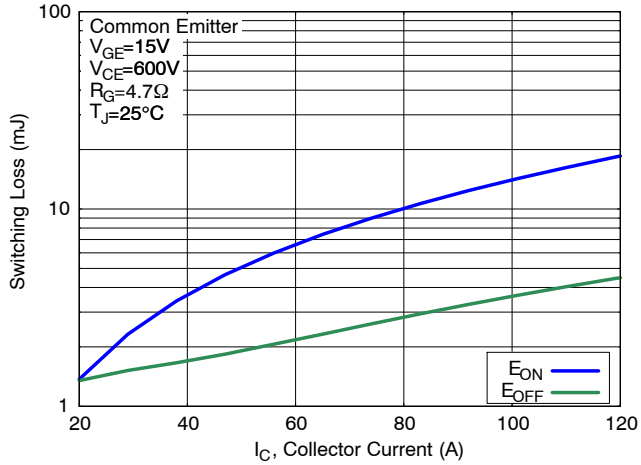


Figure 15. Switching Loss vs. Collector Current

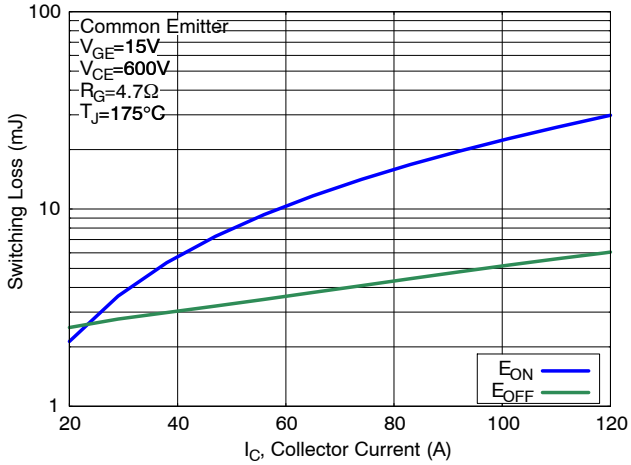


Figure 16. Switching Loss vs. Collector Current

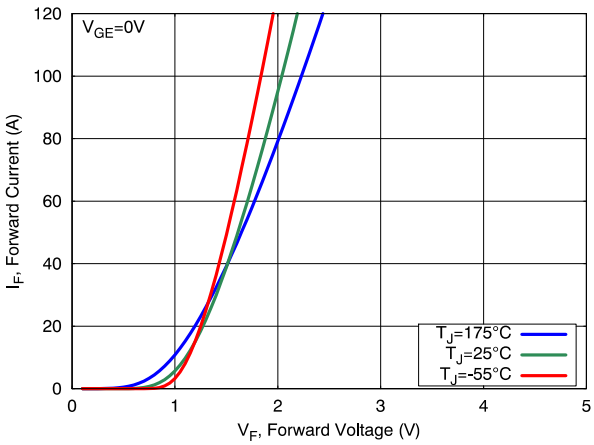


Figure 17. Diode Forward Characteristics

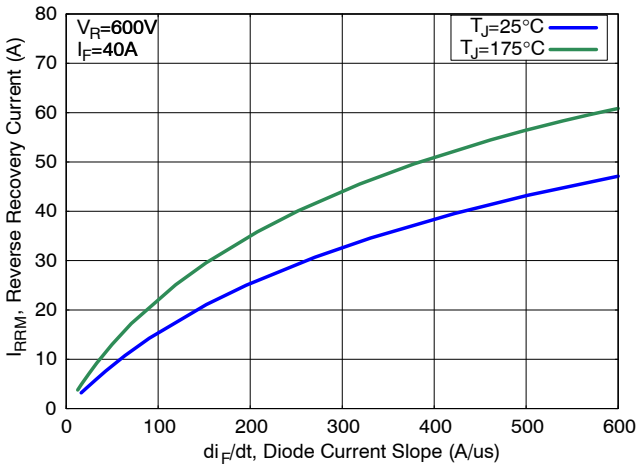


Figure 18. Diode Reverse Recovery Current

Share Feedback
Your Opinion Matters

TYPICAL CHARACTERISTICS

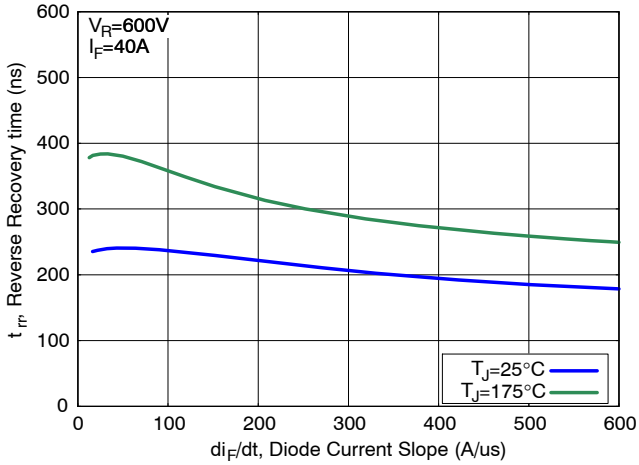


Figure 19. Diode Reverse Recovery Time

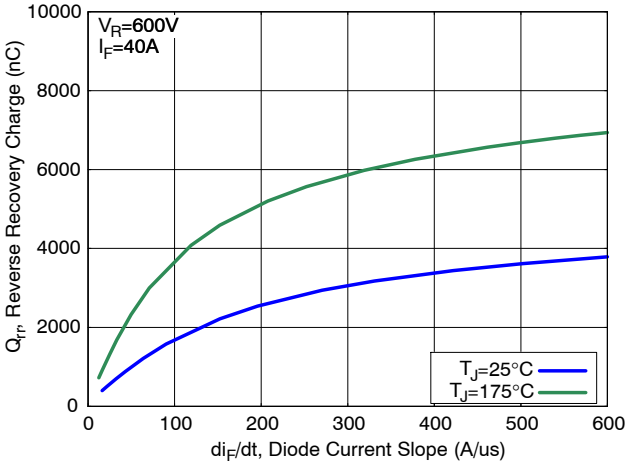


Figure 20. Diode Stored Charge Characteristics

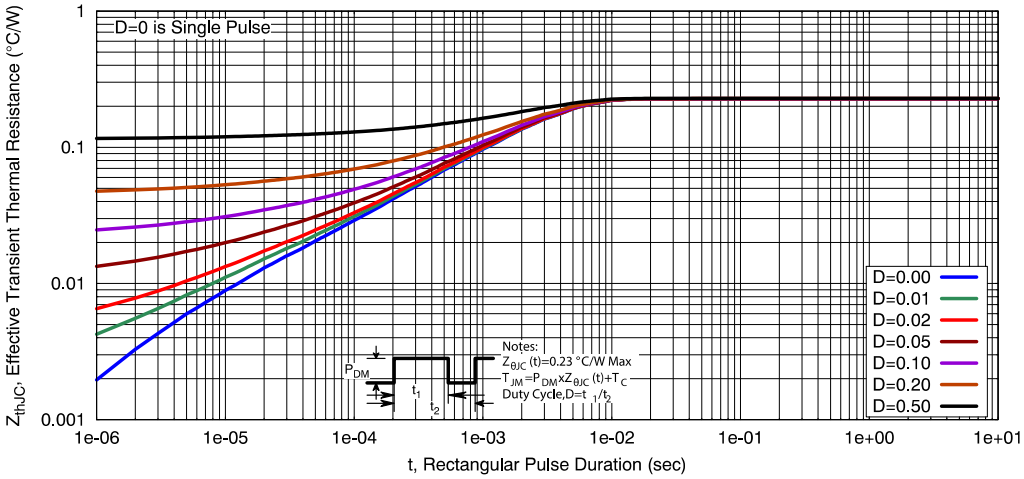


Figure 21. Transient Thermal Impedance of IGBT

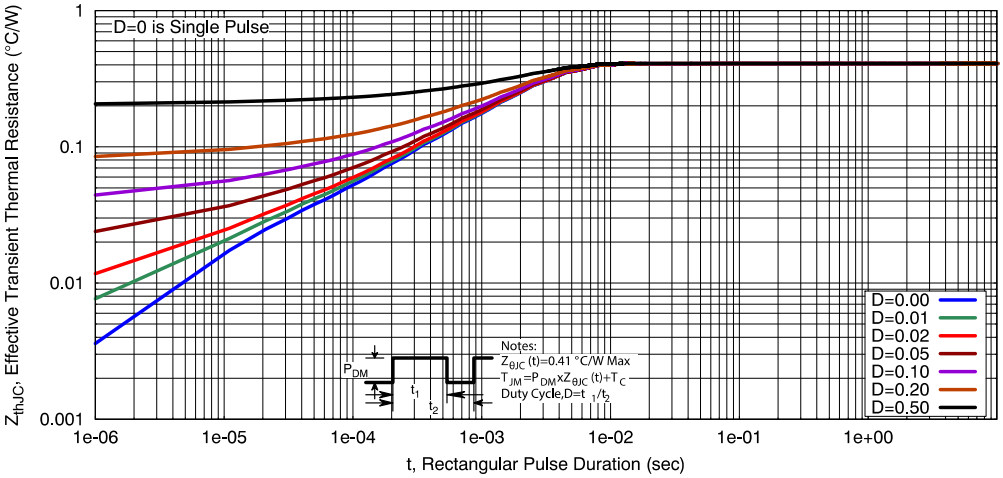
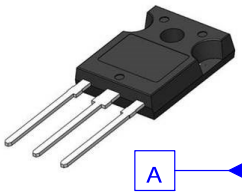


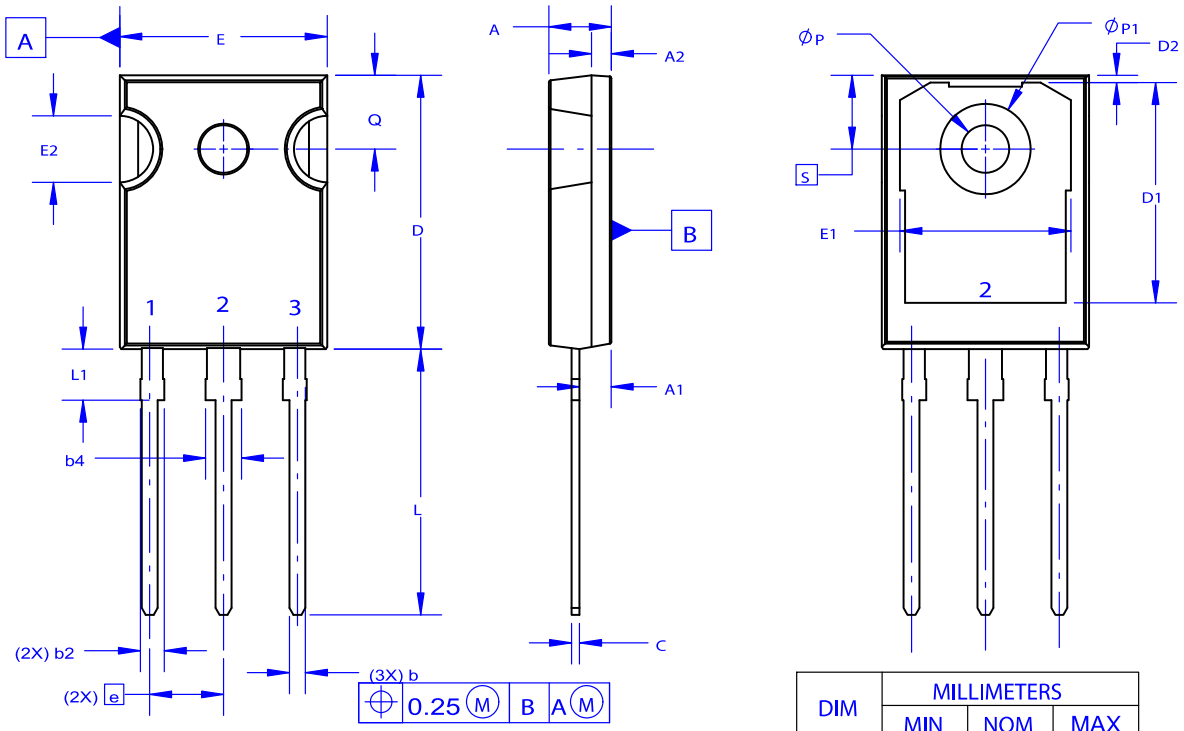
Figure 22. Transient Thermal Impedance of Diode

Share Feedback
Your Opinion Matters

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.

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

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.

DOCUMENT NUMBER:	98AON93302G	Electronic versions are uncontrolled except when accessed directly from the Document Repository. Printed versions are uncontrolled except when stamped "CONTROLLED COPY" in red.
DESCRIPTION:	TO−247−3LD	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:
Technical Library: 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