

IGBT – Power, Co-PAK N-Channel, Field Stop VII (FS7), SCR, TO247-3L 1200 V, 1.67 V, 40 A

AFGHL40T120RWD-STD

Description

Using the novel field stop 7th generation IGBT technology and the Gen7 Diode in TO247 3-lead package, this device offers good performance with low on state voltage and low switching losses for both hard and soft switching topologies in automotive applications.

Features

- Extremely Efficient Trench with Field Stop Technology
- Maximum Junction Temperature – $T_J = 175^\circ\text{C}$
- 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

MAXIMUM RATINGS ($T_J = 25^\circ\text{C}$ unless otherwise noted)

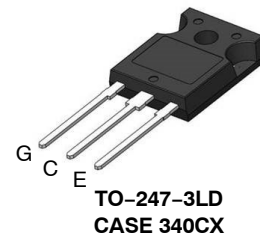
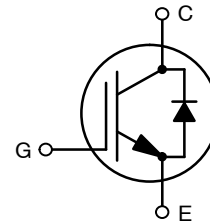
Parameter	Symbol	Value	Unit
Collector-to-Emitter Voltage	V_{CE}	1200	V
Gate-to-Emitter Voltage	V_{GE}	± 20	
Transient Gate-to-Emitter Voltage		± 30	
Collector Current	$T_C = 25^\circ\text{C}$	I_C	80
	$T_C = 100^\circ\text{C}$		40
Power Dissipation	$T_C = 25^\circ\text{C}$	P_D	468
	$T_C = 100^\circ\text{C}$		234
Pulsed Collector Current	$T_C = 25^\circ\text{C}$, $t_p = 10 \mu\text{s}$ (Note 1)	I_{CM}	120
Diode Forward Current	$T_C = 25^\circ\text{C}$	I_F	80
	$T_C = 100^\circ\text{C}$		40
Pulsed Diode Maximum Forward Current	$T_C = 25^\circ\text{C}$, $t_p = 10 \mu\text{s}$ (Note 1)	I_{FM}	120
Short Circuit Withstand Time $V_{GE} = 15 \text{ V}$, $V_{CC} = 800 \text{ V}$, $T_C = 150^\circ\text{C}$	T_{SC}	6	μs
Operating Junction and Storage Temperature Range	T_J, T_{stg}	-55 to +175	$^\circ\text{C}$
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.

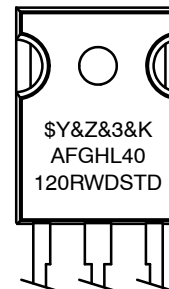
1. Repetitive rating; Pulse width limited by max. junction temperature

BV_{CES}	$V_{CE(sat)}$ TYP	I_C MAX
1200 V	1.67 V	40 A

PIN CONNECTIONS



MARKING DIAGRAM



$\$Y$ = onsemi Logo
 $\&Z$ = Assembly Plant Code
 $\&3$ = 3-Digit Date Code
 $\&K$ = 2-Digit Lot Traceability Code
 AFGHL40120RWDSTD = Specific Device code

ORDERING INFORMATION

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

AFGHL40T120RWD-STD

THERMAL CHARACTERISTICS

Parameter	Symbol	Value	Unit
Thermal Resistance, Junction-to-Case for IGBT	$R_{\theta JC}$	0.32	°C/W
Thermal Resistance, Junction-to-Case for Diode	$R_{\theta JCD}$	0.59	
Thermal Resistance, Junction-to-Ambient	$R_{\theta JA}$	40	

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

Parameter	Symbol	Test Conditions	Min	Typ	Max	Unit
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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	$\Delta BV_{CES}/\Delta T_J$	$V_{GE} = 0\text{ V}, I_C = 9.99\text{ mA}$	–	1226	–	mV/°C
Zero Gate Voltage Collector Current	I_{CES}	$V_{GE} = 0\text{ V}, V_{CE} = V_{CES}$	–	–	40	μA
Gate-to-Emitter Leakage Current	I_{GES}	$V_{GE} = \pm 20\text{ V}, V_{CE} = 0\text{ V}$	–	–	±400	nA

ON CHARACTERISTICS

Gate Threshold Voltage	$V_{GE(th)}$	$V_{GE} = V_{CE}, I_C = 40\text{ mA}$	5.1	6	6.9	V
Collector-to-Emitter Saturation Voltage	$V_{CE(sat)}$	$V_{GE} = 15\text{ V}, I_C = 40\text{ A}, T_J = 25^\circ\text{C}$	–	1.67	2.00	V
		$V_{GE} = 15\text{ V}, I_C = 40\text{ A}, T_J = 175^\circ\text{C}$	–	2.12	–	

DYNAMIC CHARACTERISTICS

Input Capacitance	C_{iES}	$V_{CE} = 30\text{ V}, V_{GE} = 0\text{ V}, f = 1\text{ MHz}$	–	3054	–	pF
Output Capacitance	C_{oES}		–	126	–	
Reverse Transfer Capacitance	C_{RES}		–	15.4	–	
Total Gate Charge	Q_G	$V_{CE} = 600\text{ V}, V_{GE} = 15\text{ V}, I_C = 40\text{ A}$	–	112	–	nC
Gate-to-Emitter Charge	Q_{GE}		–	29.6	–	
Gate-to-Collector Charge	Q_{GC}		–	51.2	–	

SWITCHING CHARACTERISTICS

Turn-On Delay Time	$t_{d(on)}$	$V_{CE} = 600\text{ V}, V_{GE} = 15\text{ V},$ $I_C = 20\text{ A}, R_G = 4.7\ \Omega,$ $T_J = 25^\circ\text{C}$	–	35.6	–	ns
Turn-Off Delay Time	$t_{d(off)}$		–	188	–	
Rise Time	t_r		–	29.2	–	
Fall Time	t_f		–	145	–	
Turn-On Switching Loss	E_{on}		–	1.11	–	mJ
Turn-Off Switching Loss	E_{off}		–	0.99	–	
Total Switching Loss	E_{ts}		–	2.1	–	
Turn-On Delay Time	$t_{d(on)}$	$V_{CE} = 600\text{ V}, V_{GE} = 15\text{ V},$ $I_C = 40\text{ A}, R_G = 4.7\ \Omega,$ $T_J = 25^\circ\text{C}$	–	40.1	–	ns
Turn-Off Delay Time	$t_{d(off)}$		–	152	–	
Rise Time	t_r		–	55.4	–	
Fall Time	t_f		–	90.6	–	
Turn-On Switching Loss	E_{on}		–	3.27	–	mJ
Turn-Off Switching Loss	E_{off}		–	1.27	–	
Total Switching Loss	E_{ts}		–	4.54	–	

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

Parameter	Symbol	Test Conditions	Min	Typ	Max	Unit
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SWITCHING CHARACTERISTICS

Turn-On Delay Time	$t_{d(on)}$	$V_{CE} = 600\text{ V}, V_{GE} = 15\text{ V},$ $I_C = 20\text{ A}, R_G = 4.7\ \Omega,$ $T_J = 175^\circ\text{C}$	–	40.5	–	ns
Turn-Off Delay Time	$t_{d(off)}$		–	256	–	
Rise Time	t_r		–	38.8	–	
Fall Time	t_f		–	282	–	
Turn-On Switching Loss	E_{on}	$V_{CE} = 600\text{ V}, V_{GE} = 15\text{ V},$ $I_C = 40\text{ A}, R_G = 4.7\ \Omega,$ $T_J = 175^\circ\text{C}$	–	1.58	–	mJ
Turn-Off Switching Loss	E_{off}		–	1.8	–	
Total Switching Loss	E_{ts}		–	3.38	–	
Turn-On Delay Time	$t_{d(on)}$		–	46.8	–	ns
Turn-Off Delay Time	$t_{d(off)}$		–	199	–	
Rise Time	t_r		–	70.7	–	
Fall Time	t_f		–	167	–	
Turn-On Switching Loss	E_{on}	$V_{CE} = 600\text{ V}, V_{GE} = 15\text{ V},$ $I_C = 40\text{ A}, R_G = 4.7\ \Omega,$ $T_J = 175^\circ\text{C}$	–	4.74	–	mJ
Turn-Off Switching Loss	E_{off}		–	2.19	–	
Total Switching Loss	E_{ts}		–	6.93	–	

DIODE CHARACTERISTICS

Forward Voltage	V_F	$I_F = 40\text{ A}, T_J = 25^\circ\text{C}$	–	1.98	2.36	V
		$I_F = 40\text{ A}, T_J = 175^\circ\text{C}$	–	2.04	–	

DIODE SWITCHING CHARACTERISTICS, INDUCTIVE LOAD

Reverse Recovery Time	t_{rr}	$V_R = 600\text{ V}, I_F = 20\text{ A},$ $di_F/dt = 500\text{ A}/\mu\text{s}, T_J = 25^\circ\text{C}$	–	161	–	ns
Reverse Recovery Charge	Q_{rr}		–	1773	–	nC
Reverse Recovery Energy	E_{rec}		–	0.56	–	mJ
Peak Reverse Recovery Current	I_{RRM}		–	25.8	–	A
Reverse Recovery Time	t_{rr}	$V_R = 600\text{ V}, I_F = 40\text{ A},$ $di_F/dt = 500\text{ A}/\mu\text{s}, T_J = 25^\circ\text{C}$	–	194	–	ns
Reverse Recovery Charge	Q_{rr}		–	3123	–	nC
Reverse Recovery Energy	E_{rec}		–	0.81	–	mJ
Peak Reverse Recovery Current	I_{RRM}		–	35.8	–	A
Reverse Recovery Time	t_{rr}	$V_R = 600\text{ V}, I_F = 20\text{ A},$ $di_F/dt = 500\text{ A}/\mu\text{s}, T_J = 175^\circ\text{C}$	–	215	–	ns
Reverse Recovery Charge	Q_{rr}		–	2768	–	nC
Reverse Recovery Energy	E_{rec}		–	1	–	mJ
Peak Reverse Recovery Current	I_{RRM}		–	30.2	–	A
Reverse Recovery Time	t_{rr}	$V_R = 600\text{ V}, I_F = 40\text{ A},$ $di_F/dt = 500\text{ A}/\mu\text{s}, T_J = 175^\circ\text{C}$	–	261	–	ns
Reverse Recovery Charge	Q_{rr}		–	5087	–	nC
Reverse Recovery Energy	E_{rec}		–	1.5	–	mJ
Peak Reverse Recovery Current	I_{RRM}		–	42.7	–	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.

AFGHL40T120RWD-STD

TYPICAL CHARACTERISTICS

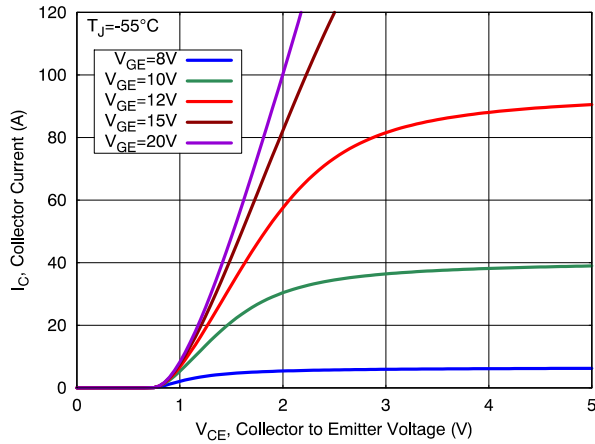


Figure 1. Output Characteristics

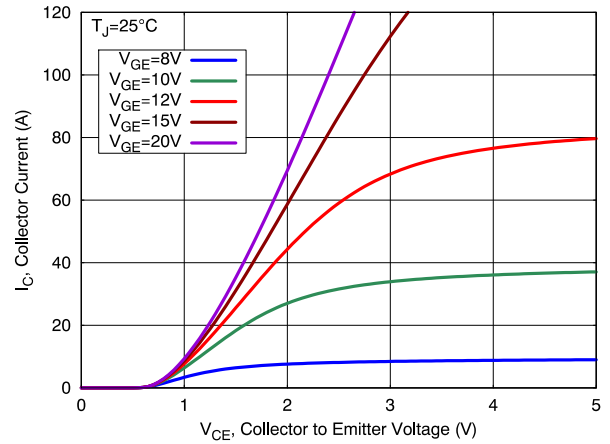


Figure 2. Output Characteristics

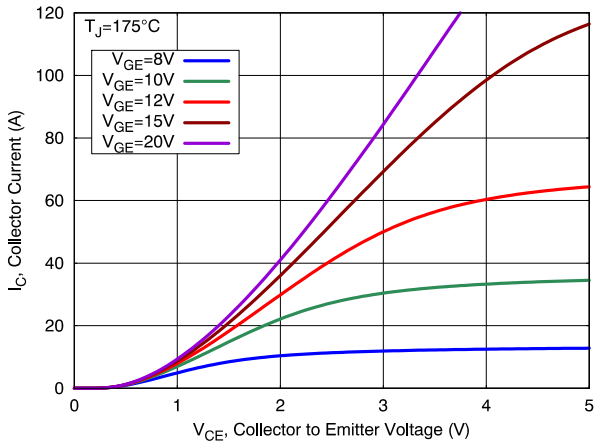


Figure 3. Output Characteristics

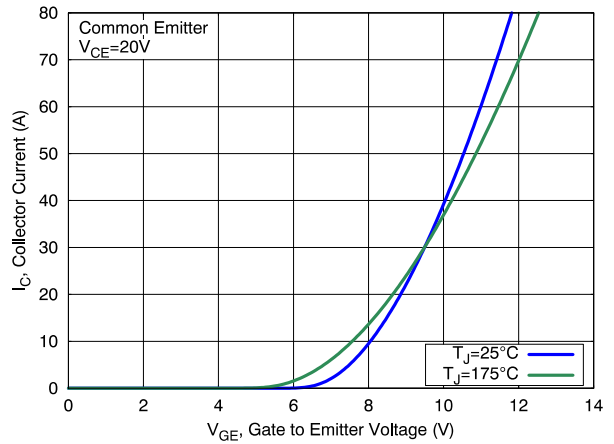


Figure 4. Transfer Characteristics

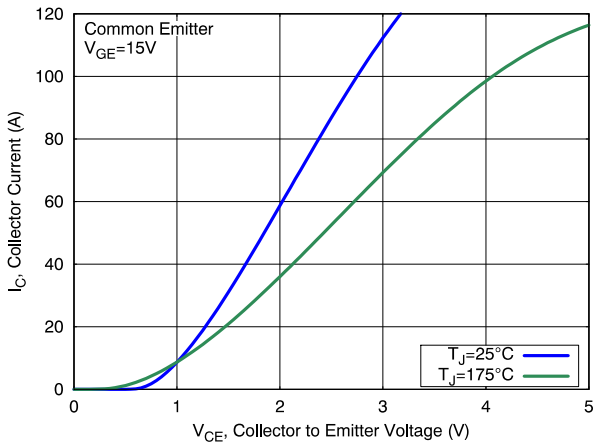


Figure 5. Saturation Characteristics

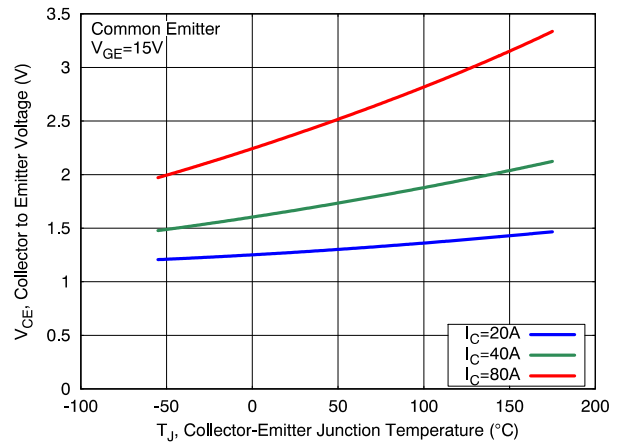


Figure 6. Saturation Voltage vs. Junction Temperature

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TYPICAL CHARACTERISTICS

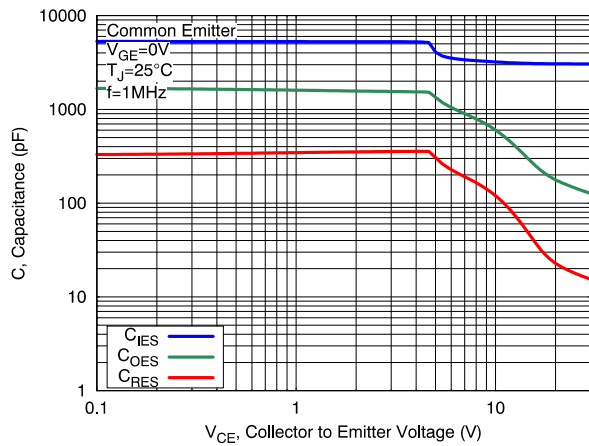


Figure 7. Capacitance Characteristics

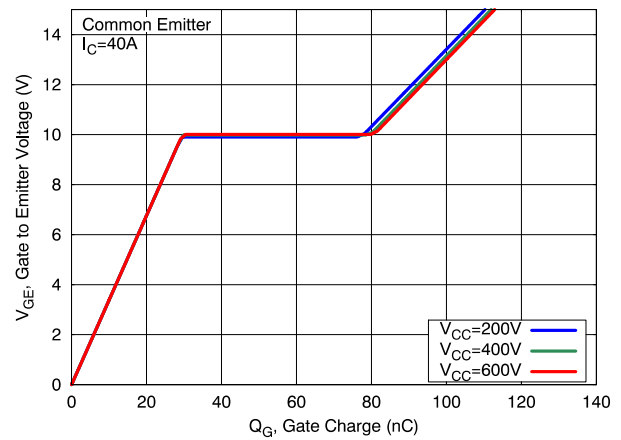


Figure 8. Gate Charge Characteristics

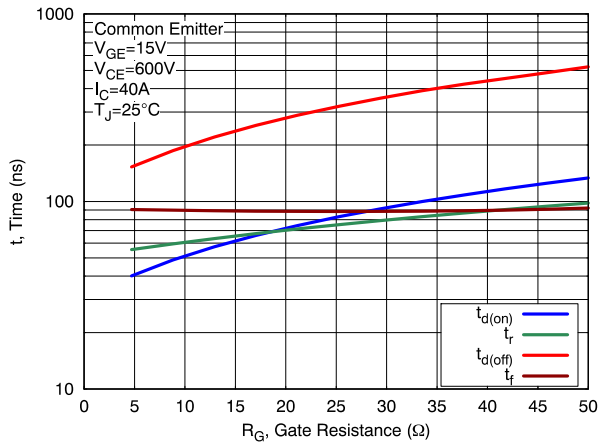


Figure 9. Switching Time vs Gate Resistance

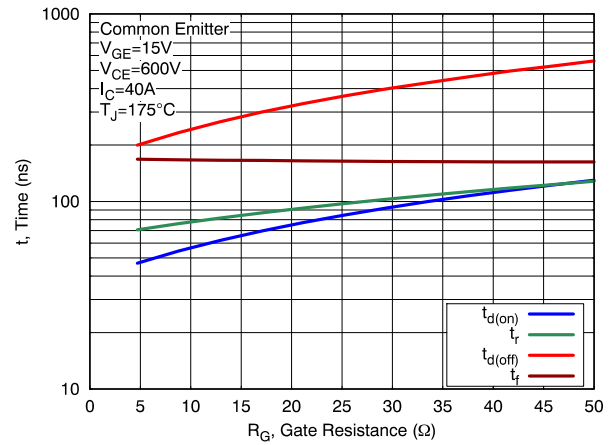


Figure 10. Switching Time vs Gate Resistance

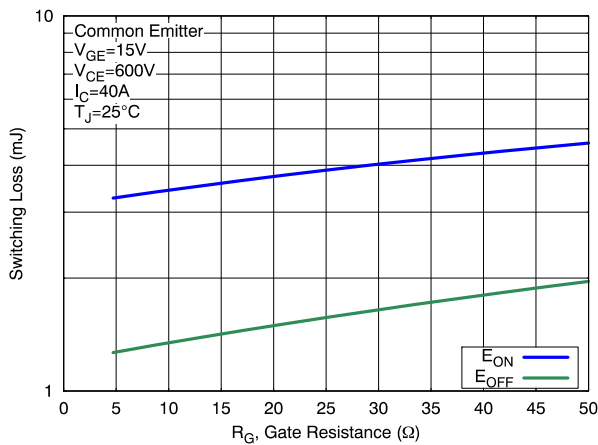


Figure 11. Switching Loss vs Gate Resistance

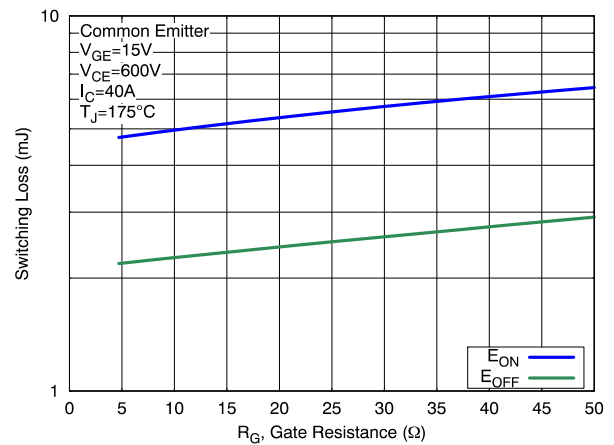


Figure 12. Switching Loss vs Gate Resistance

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TYPICAL CHARACTERISTICS

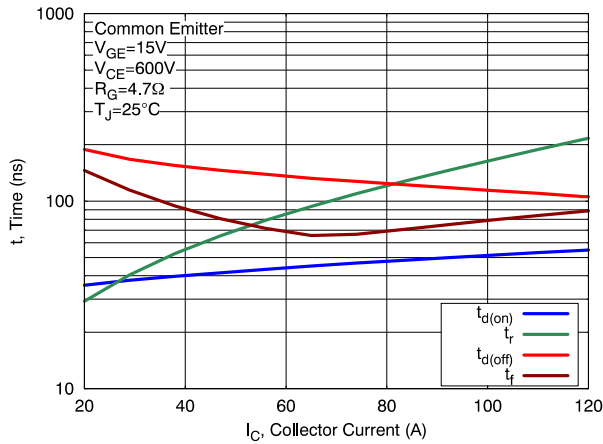


Figure 13. Switching Time vs Collector Current

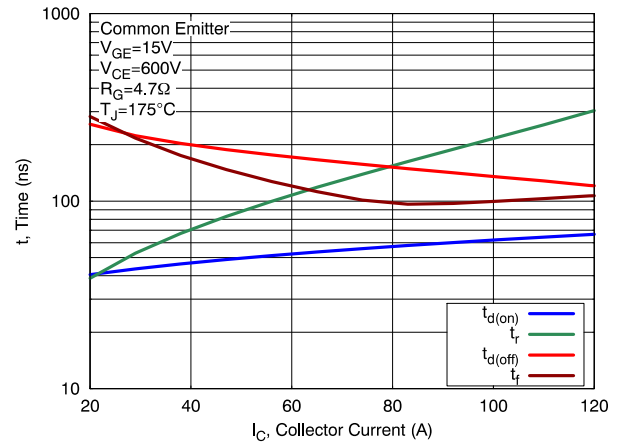


Figure 14. Switching Time vs Collector Current

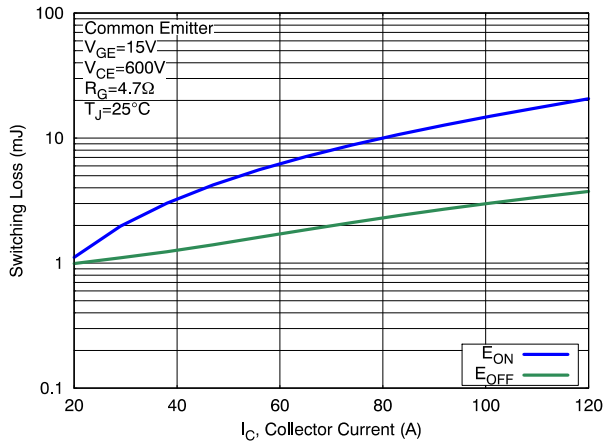


Figure 15. Switching Loss vs Collector Current

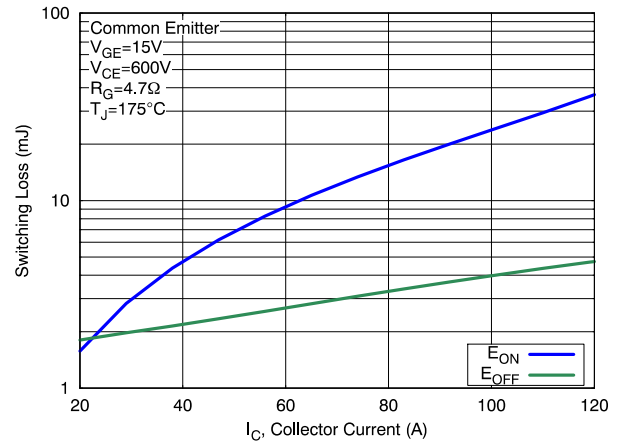


Figure 16. Switching Loss vs Collector Current

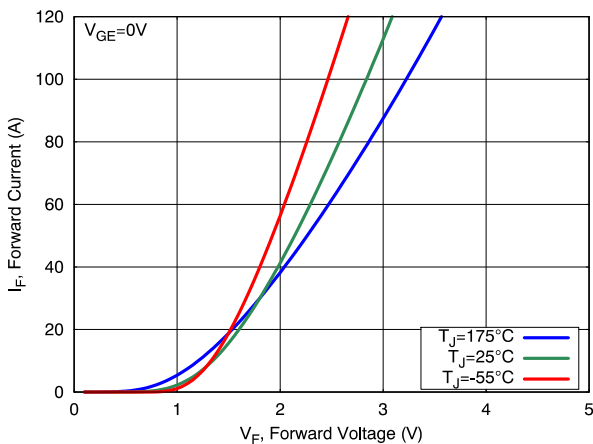


Figure 17. Diode Forward Characteristics

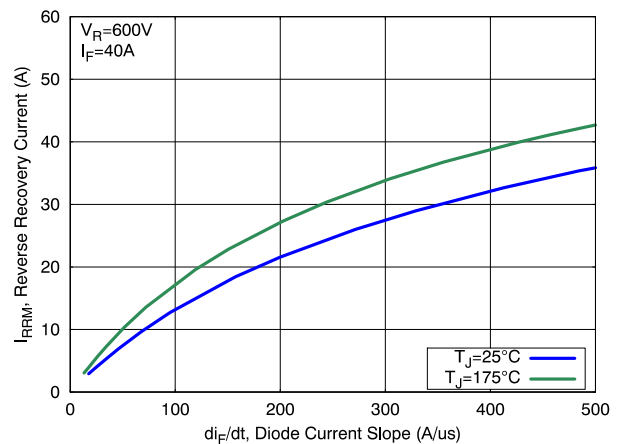


Figure 18. Diode Reverse Recovery Current

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TYPICAL CHARACTERISTICS

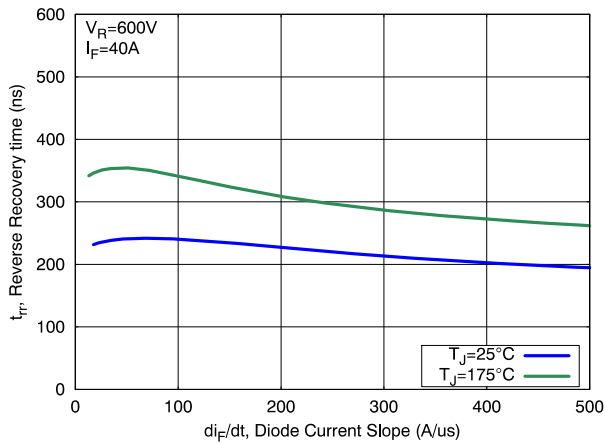


Figure 19. Diode Reverse Recovery Energy

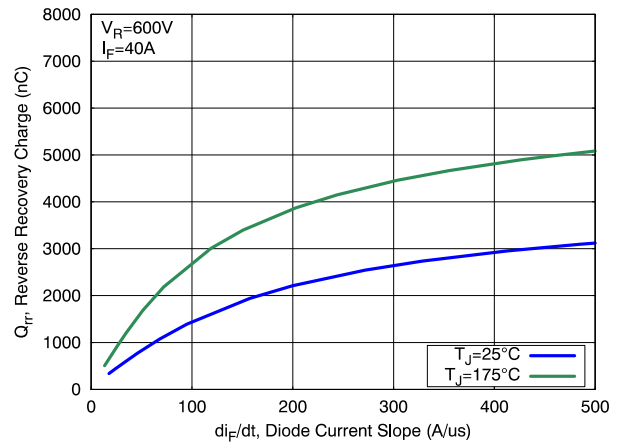


Figure 20. Diode Stored Charge Characteristics

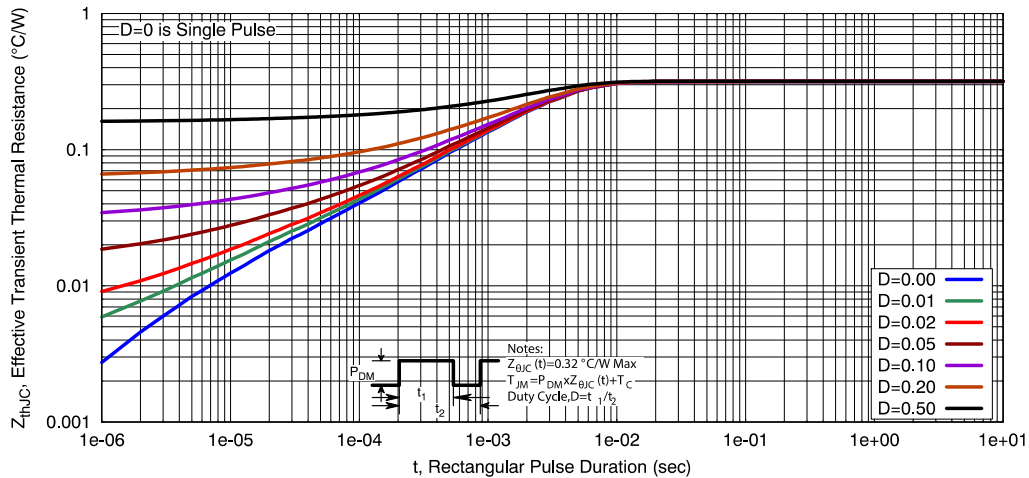


Figure 21. Transient Thermal Impedance of IGBT

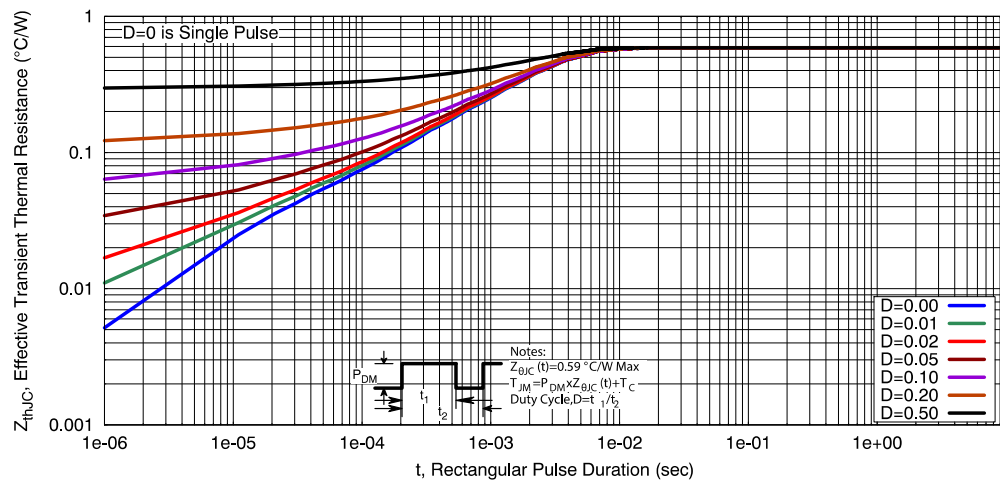
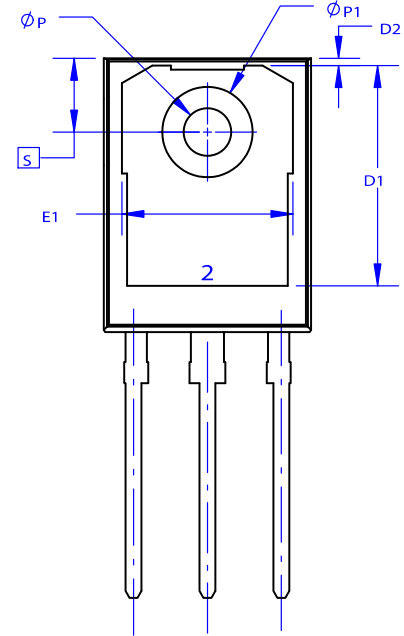
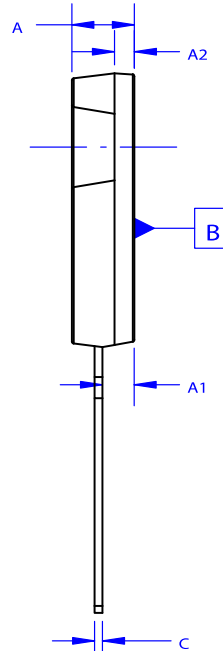
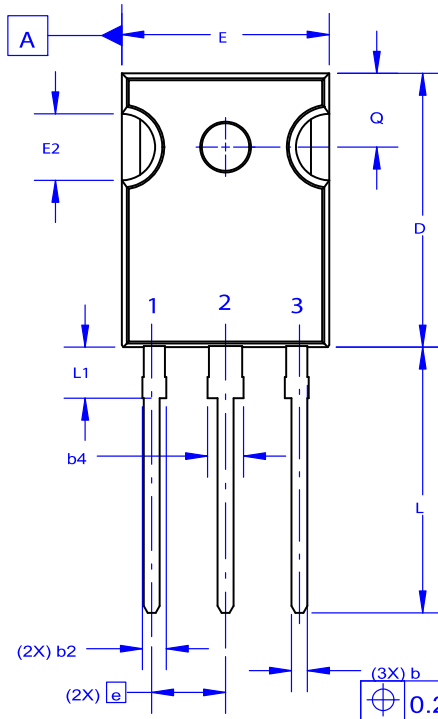
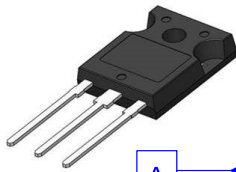


Figure 22. Transient Thermal Impedance of Diode

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.

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.

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

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