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

AFGHL40T120RWD-STD

BV$_{CES}$	V$_{CE(sat)}$ TYP	I$_C$ MAX
1200 V	1.67 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 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°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

$Y&Z&3&K
AFGHL40
120RWDSTD

$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

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$_D$	468	W
	T$_C$ = 100°C		234	
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.
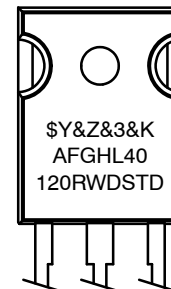
1. Repetitive rating: Pulse width limited by max. junction temperature

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°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	5.1	6	6.9	V
Collector−to−Emitter Saturation Voltage	$V_{CE(sat)}$	V_{GE} = 15 V, I_C = 40 A, T_J = 25°C	–	1.67	2.00	V
		V_{GE} = 15 V, I_C = 40 A, T_J = 175°C	–	2.12	–	
DYNAMIC CHARACTERISTICS						
Input Capacitance	C_{IES}	V_{CE} = 30 V, V_{GE} = 0 V, f = 1 MHz	–	3054	–	pF
Output Capacitance	C_{OES}		–	126	–	
Reverse Transfer Capacitance	C_{RES}		–	15.4	–	
Total Gate Charge	Q_G	V_{CE} = 600 V, V_{GE} = 15 V, I_C = 40 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 V, V_{GE} = 15 V, I_C = 20 A, R_G = 4.7 Ω, T_J = 25°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 V, V_{GE} = 15 V, I_C = 40 A, R_G = 4.7 Ω, T_J = 25°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	–	

AFGHL40T120RWD−STD

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} = 15 V, I_C = 20 A, R_G = 4.7 Ω, T_J = 175°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}		–	1.58	–	mJ
Turn−Off Switching Loss	E_{off}		–	1.8	–	
Total Switching Loss	E_{ts}		–	3.38	–	
Turn−On Delay Time	$t_{d(on)}$	V_{CE} = 600 V, V_{GE} = 15 V, I_C = 40 A, R_G = 4.7 Ω, T_J = 175°C	–	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}		–	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 A, T_J = 25°C	–	1.98	2.36	V
		I_F = 40 A, T_J = 175°C	–	2.04	–	
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	–	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 V, I_F = 40 A, dI_F/dt = 500 A/µs, T_J = 25°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 V, I_F = 20 A, dI_F/dt = 500 A/µs, T_J = 175°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 V, I_F = 40 A, dI_F/dt = 500 A/µs, T_J = 175°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.

TYPICAL CHARACTERISTICS

Figure 1. Output Characteristics
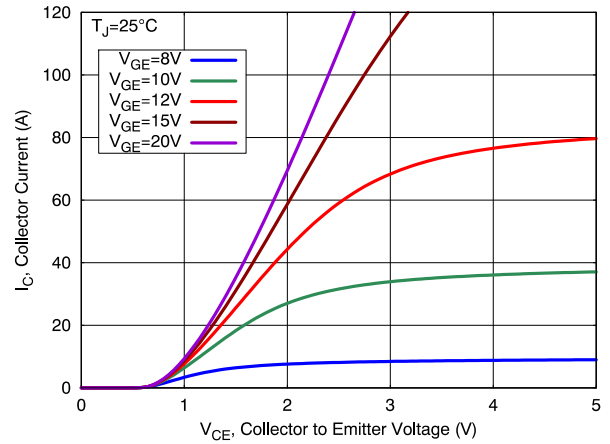
Figure 2. Output Characteristics
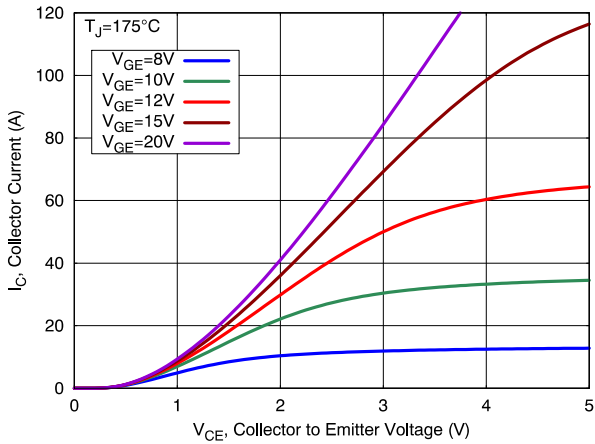
Figure 3. Output Characteristics
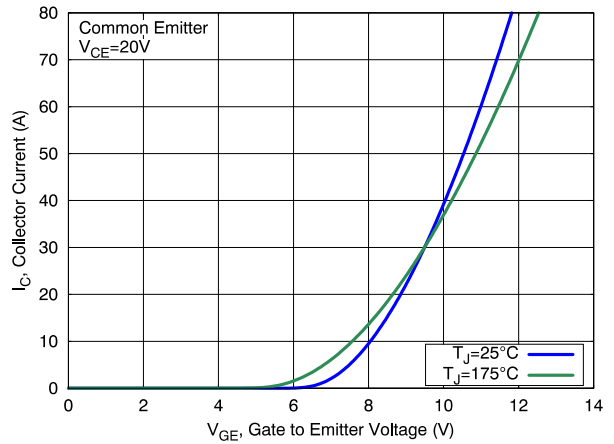
Figure 4. Transfer Characteristics
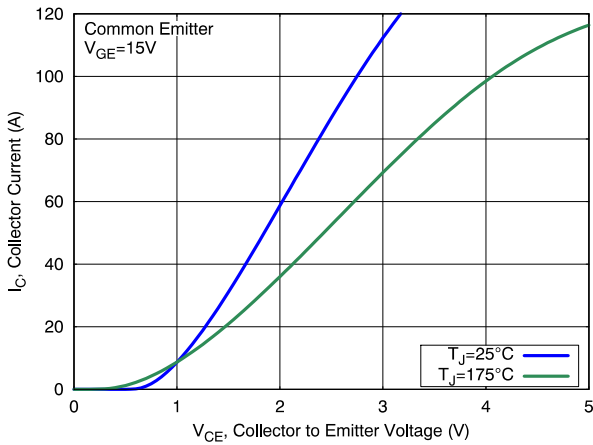
Figure 5. Saturation Characteristics
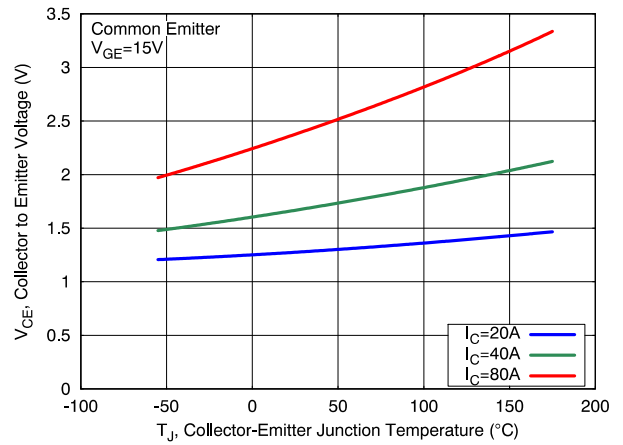
Figure 6. Saturation Voltage vs. Junction Temperature
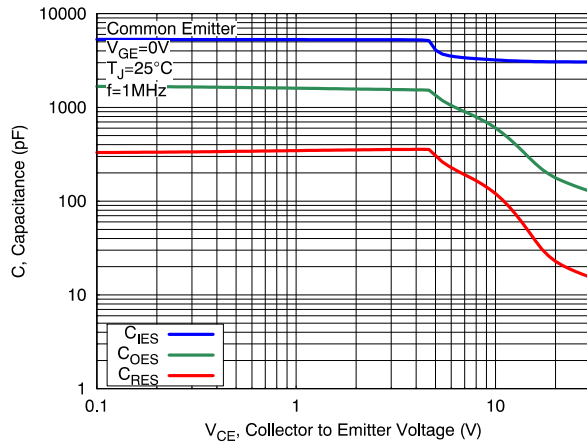
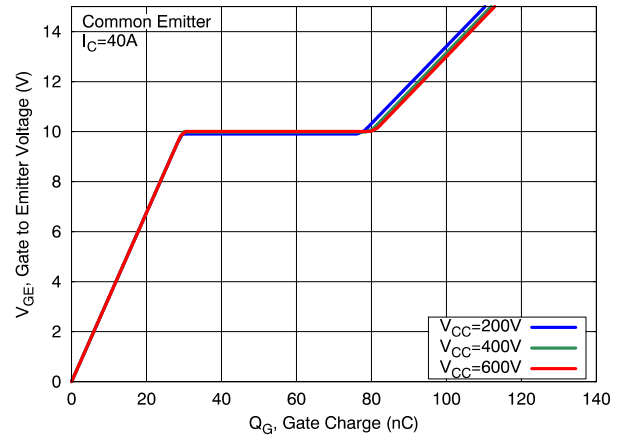## TYPICAL CHARACTERISTICS

Figure 7. Capacitance Characteristics
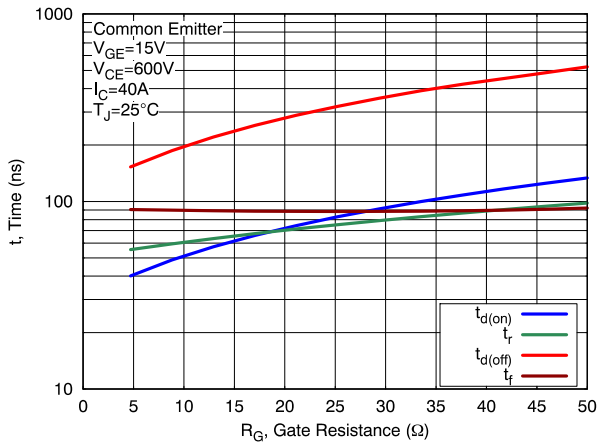

Figure 8. Gate Charge Characteristics
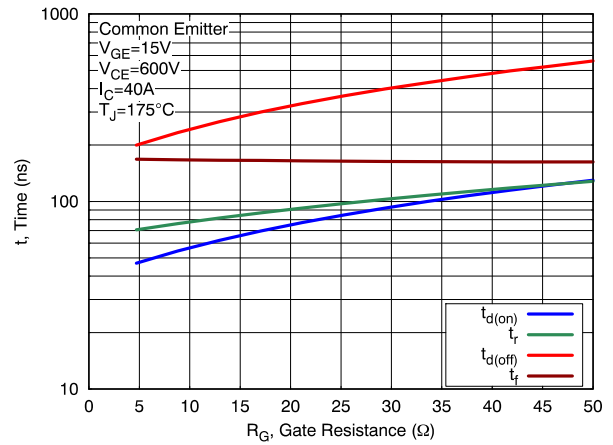

Figure 9. Switching Time vs Gate Resistance

Figure 10. Switching Time vs Gate Resistance
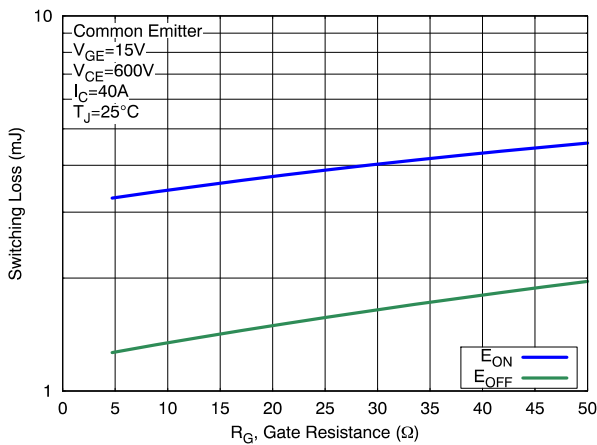
Figure 11. Switching Loss vs Gate Resistance
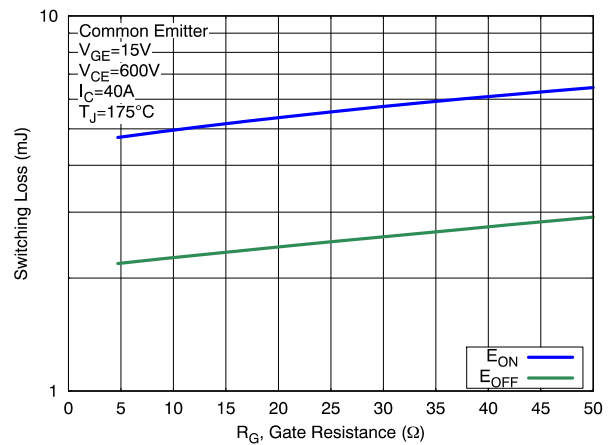
Figure 12. Switching Loss vs Gate Resistance

AFGHL40T120RWD−STD

TYPICAL CHARACTERISTICS
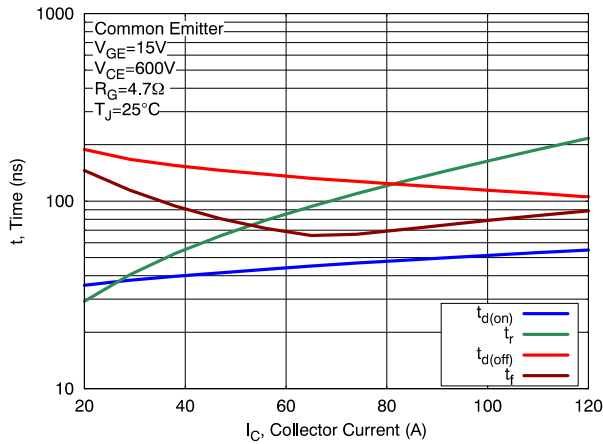
Figure 13. Switching Time vs Collector Current
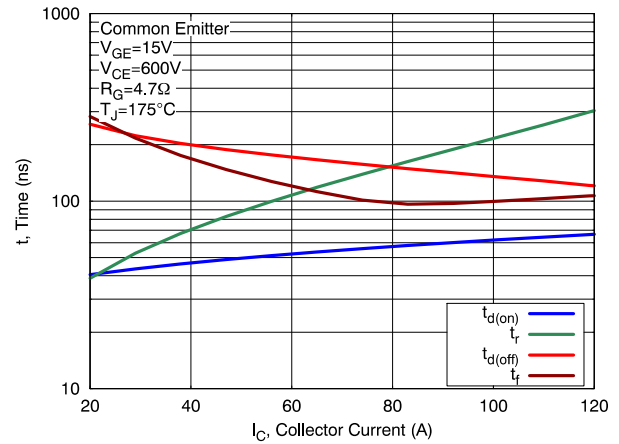
Figure 14. Switching Time vs Collector Current
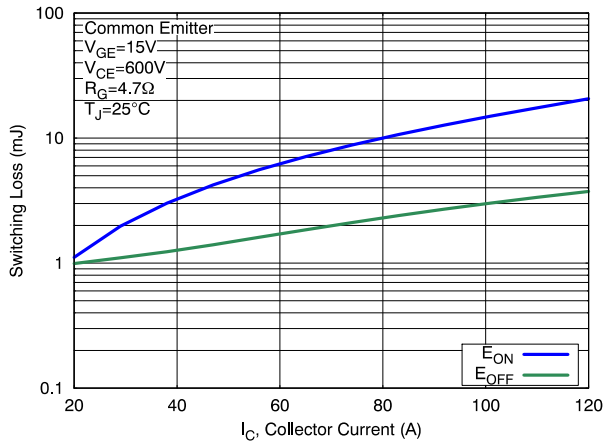
Figure 15. Switching Loss vs Collector Current
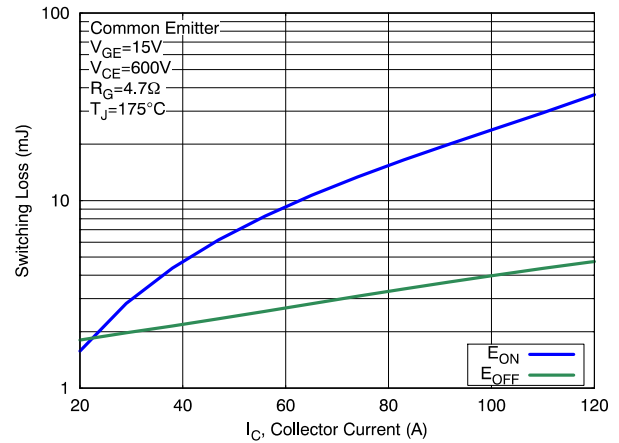
Figure 16. Switching Loss vs Collector Current
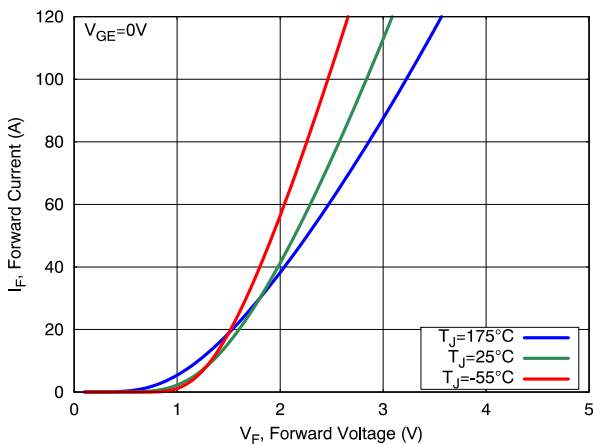
Figure 17. Diode Forward Characteristics
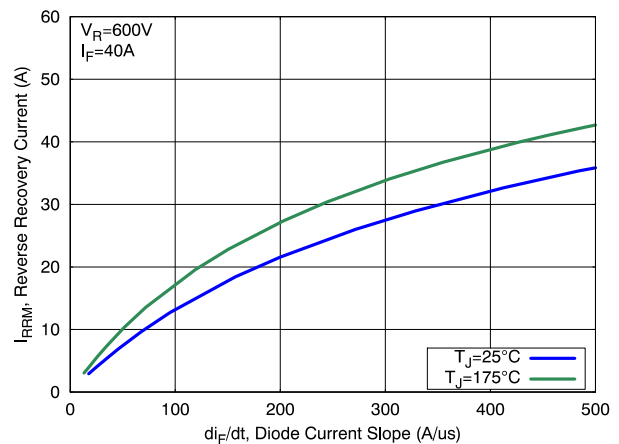
Figure 18. Diode Reverse Recovery Current

TYPICAL CHARACTERISTICS
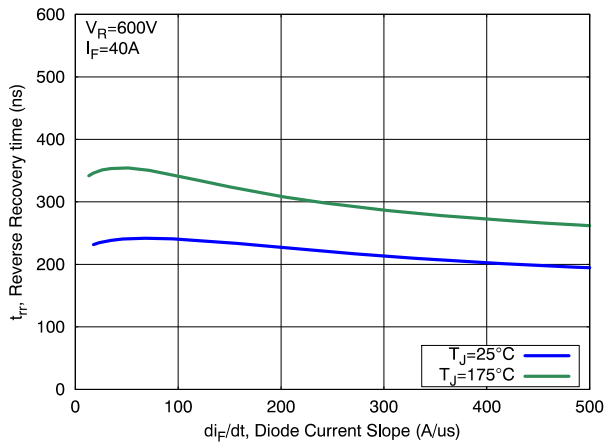
Figure 19. Diode Reverse Recovery Energy
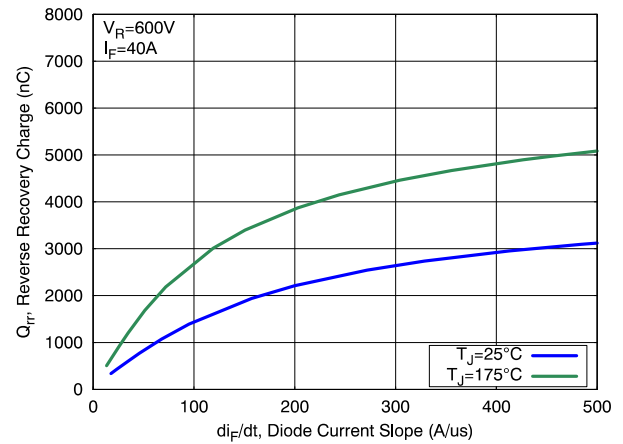
Figure 20. Diode Stored Charge Characteristics
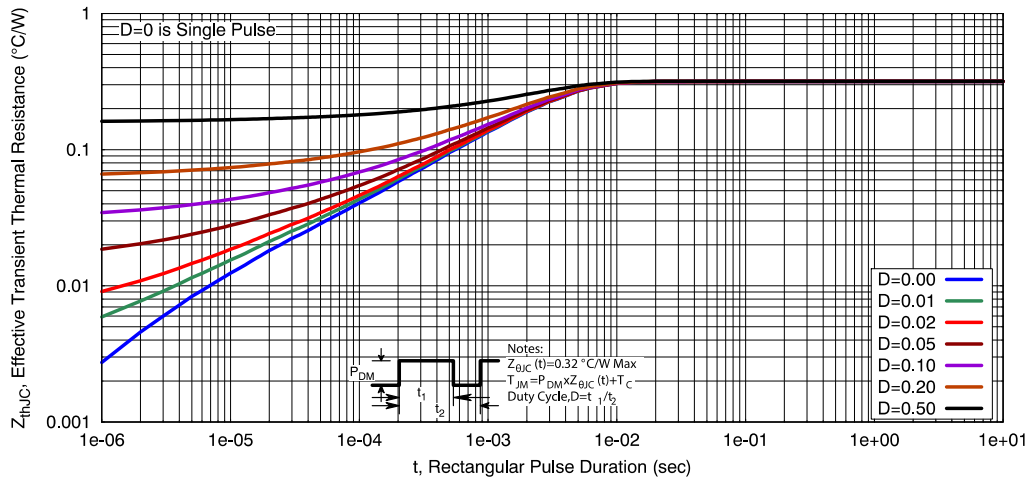
Figure 21. Transient Thermal Impedance of IGBT
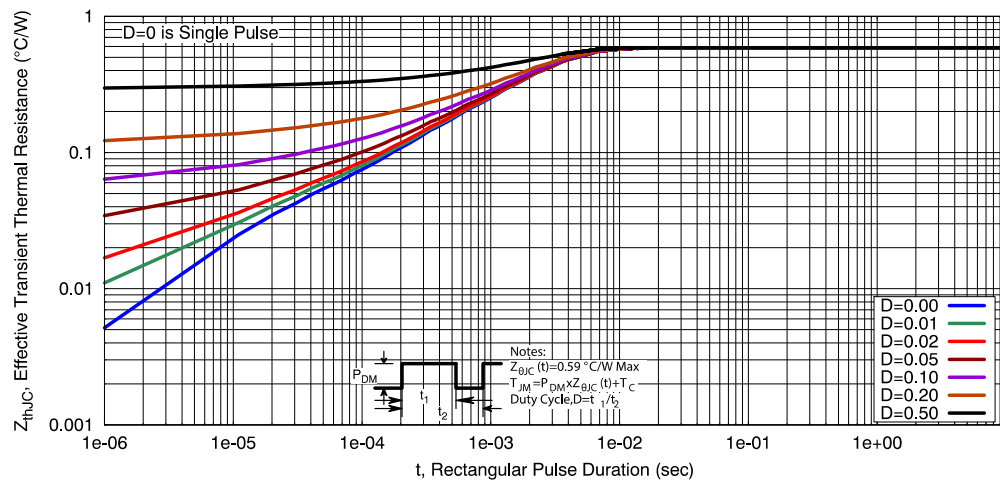
Figure 22. Transient Thermal Impedance of Diode

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TO−247−3LD
CASE 340CX
ISSUE A

DATE 06 JUL 2020
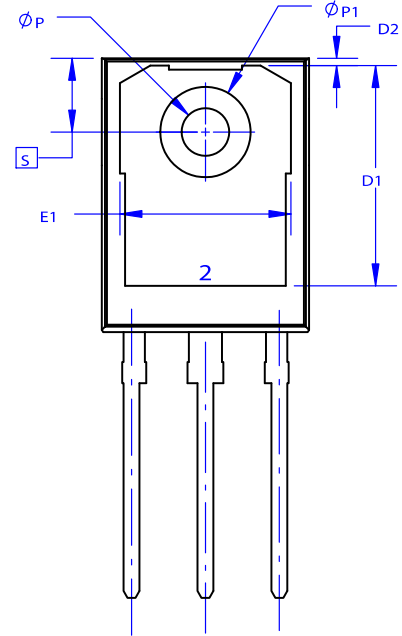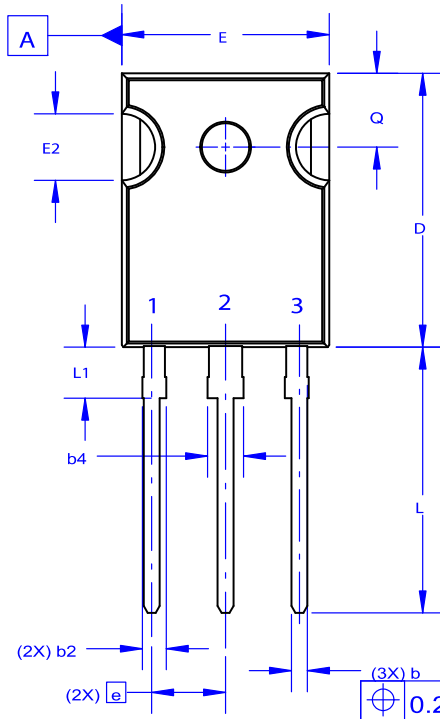
NOTES: UNLESS OTHERWISE SPECIFIED.

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
$\varnothing$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	~	~
$\varnothing$P1	6.60	6.80	7.00

**GENERIC
MARKING DIAGRAM***

XXXXXXXXXX
AYWWG

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		
DESCRIPTION:	TO−247−3LD		PAGE 1 OF 1

ADDITIONAL INFORMATION

◊