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DATA SHEET
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IGBT – Power, Co-PAK N-Channel, Field Stop VII (FS7), SCR, TO247-4L

1200 V, 1.67 V, 40 A

AFGH4L40T120RWD-STD

Description

Using the novel field stop 7th generation IGBT technology and the Gen7 Diode in TO247 4–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

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

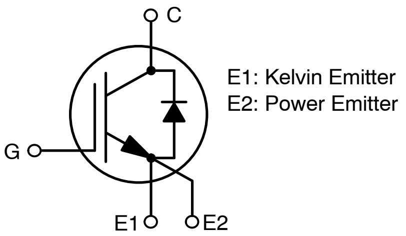
Parameter		Symbol	Value	Unit
Collector–to–Emitter Voltage		V_{CE}	1200	V
Gate–to–Emitter Voltage		V_{GE}	±20	
Transient Gate–to–Emitter Voltage			±30	
Collector Current	T_C = 25°C	I_C	80	A
	T_C = 100°C		40	
Power Dissipation	T_C = 25°C	P_D	416	W
	T_C = 100°C		208	
Pulsed Collector Current	T_C = 25°C, 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	

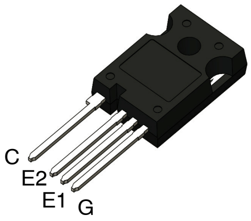
Stresses exceeding those listed in the Maximum Ratings table may damage the device. If any of these limits are exceeded, device functionality should not be assumed, damage may occur and reliability may be affected.

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

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

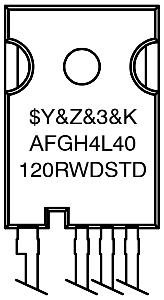
PIN CONNECTIONS





TO–247–4LD
CASE 340CJ

MARKING DIAGRAM



$Y = **onsemi** Logo
&Z = Assembly Plant Code
&3 = 3–Digit Date Code
&K = 2–Digit Lot Traceability Code
AFGH4L40120RWDSTD = Specific Device code

ORDERING INFORMATION

Device	Package	Shipping
AFGH4L40T120RWD–STD	TO–247–4L (Pb–Free)	30 Units / Tube

April, 2024 – Rev. 0

THERMAL CHARACTERISTICS

Parameter	Symbol	Value	Unit
Thermal Resistance, Junction–to–Case for IGBT	$R_{\theta JC}$	0.36	°C/W
Thermal Resistance, Junction–to–Case for Diode	$R_{\theta JCD}$	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	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	5.10	6	6.90	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}		–	51.1	–	
SWITCHING CHARACTERISTICS						
Turn–On Delay Time	$t_{d(on)}$	V_{CE} = 600 V, V_{GE} = 15 V, I_C = 20 A, R_G = 6 Ω, T_J = 25°C	–	37.2	–	ns
Turn–Off Delay Time	$t_{d(off)}$		–	200	–	
Rise Time	t_r		–	15	–	
Fall Time	t_f		–	146	–	
Turn–On Switching Loss	E_{on}		–	0.54	–	mJ
Turn–Off Switching Loss	E_{off}		–	0.99	–	
Total Switching Loss	E_{ts}		–	1.54	–	
Turn–On Delay Time	$t_{d(on)}$	V_{CE} = 600 V, V_{GE} = 15 V, I_C = 40 A, R_G = 6 Ω, T_J = 25°C	–	40.2	–	ns
Turn–Off Delay Time	$t_{d(off)}$		–	164	–	
Rise Time	t_r		–	21.9	–	
Fall Time	t_f		–	90.1	–	
Turn–On Switching Loss	E_{on}		–	1.56	–	mJ
Turn–Off Switching Loss	E_{off}		–	1.22	–	
Total Switching Loss	E_{ts}		–	2.79	–	

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 = 6 Ω, T_J = 175°C	–	41.4	–	ns
Turn−Off Delay Time	$t_{d(off)}$		–	270	–	
Rise Time	t_r		–	25.5	–	
Fall Time	t_f		–	284	–	
Turn−On Switching Loss	E_{on}		–	1	–	mJ
Turn−Off Switching Loss	E_{off}		–	1.81	–	
Total Switching Loss	E_{ts}		–	2.81	–	
Turn−On Delay Time	$t_{d(on)}$	V_{CE} = 600 V, V_{GE} = 15 V, I_C = 40 A, R_G = 6 Ω, T_J = 175°C	–	46.4	–	ns
Turn−Off Delay Time	$t_{d(off)}$		–	211	–	
Rise Time	t_r		–	38	–	
Fall Time	t_f		–	168	–	
Turn−On Switching Loss	E_{on}		–	3.05	–	mJ
Turn−Off Switching Loss	E_{off}		–	2.15	–	
Total Switching Loss	E_{ts}		–	5.19	–	
DIODE CHARACTERISTICS						
Forward Voltage	V_F	I_F = 40 A, T_J = 25°C	–	1.99	2.36	V
		I_F = 40 A, T_J = 175°C	–	2.06	–	
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}		–	1732	–	nC
Reverse Recovery Energy	E_{rec}		–	0.52	–	mJ
Peak Reverse Recovery Current	I_{RRM}		–	25.3	–	A
Reverse Recovery Time	t_{rr}	V_R = 600 V, I_F = 40 A, dI_F/dt = 500 A/μs, T_J = 25°C	–	192	–	ns
Reverse Recovery Charge	Q_{rr}		–	3051	–	nC
Reverse Recovery Energy	E_{rec}		–	0.69	–	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}		–	2724	–	nC
Reverse Recovery Energy	E_{rec}		–	0.97	–	mJ
Peak Reverse Recovery Current	I_{RRM}		–	30	–	A
Reverse Recovery Time	t_{rr}	V_R = 600 V, I_F = 40 A, dI_F/dt = 500 A/μs, T_J = 175°C	–	256	–	ns
Reverse Recovery Charge	Q_{rr}		–	4974	–	nC
Reverse Recovery Energy	E_{rec}		–	1.35	–	mJ
Peak Reverse Recovery Current	I_{RRM}		–	43.2	–	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

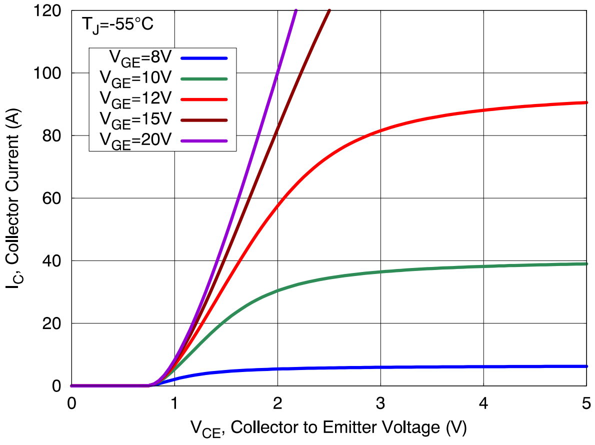


Figure 1. Output Characteristics

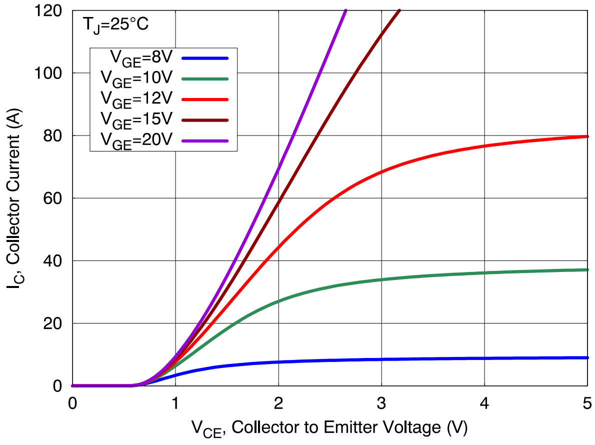


Figure 2. Output Characteristics

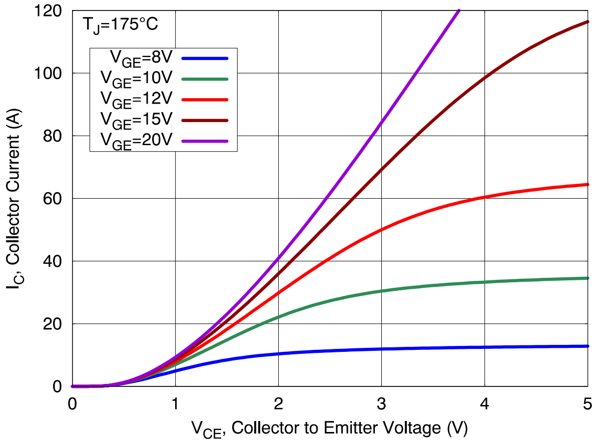


Figure 3. Output Characteristics

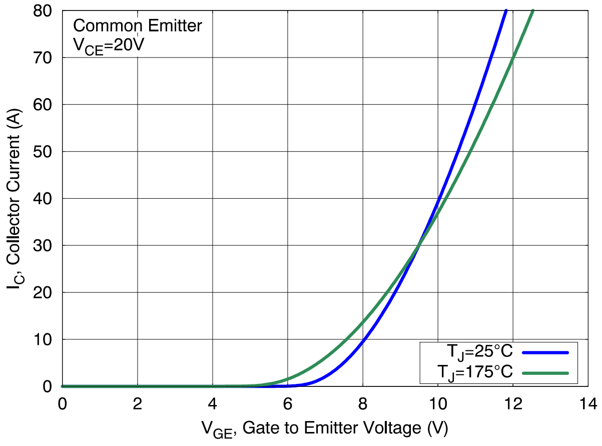


Figure 4. Transfer Characteristics

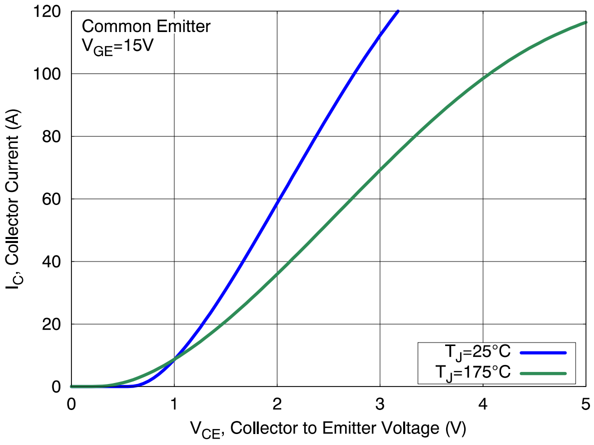


Figure 5. Saturation Characteristics

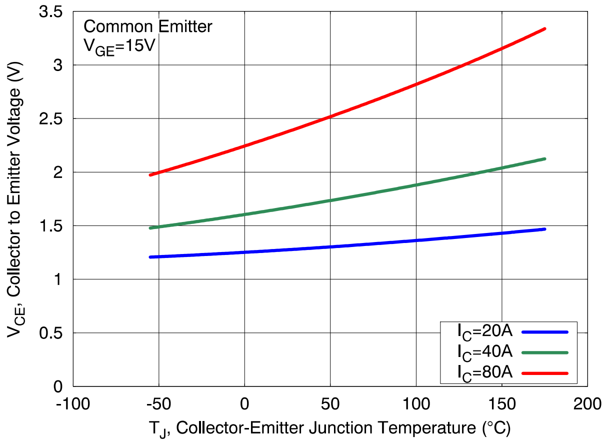


Figure 6. Saturation Voltage vs. Junction Temperature

TYPICAL CHARACTERISTICS

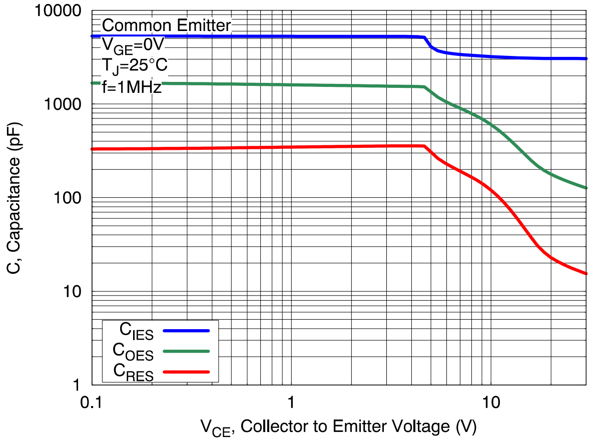


Figure 7. Capacitance Characteristics

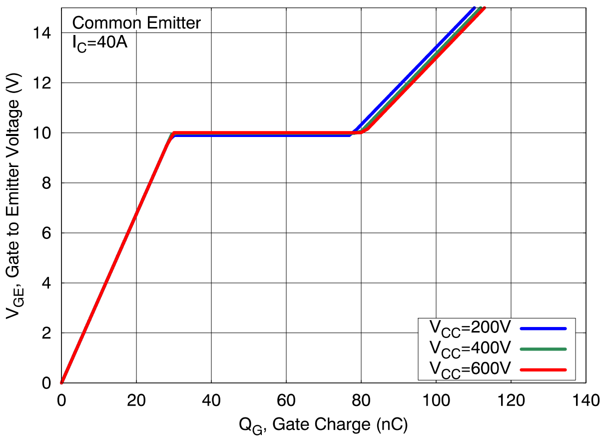


Figure 8. Gate Charge Characteristics

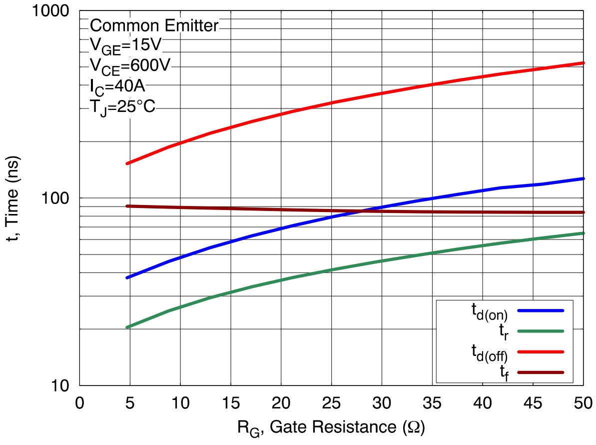


Figure 9. Switching Time vs Gate Resistance

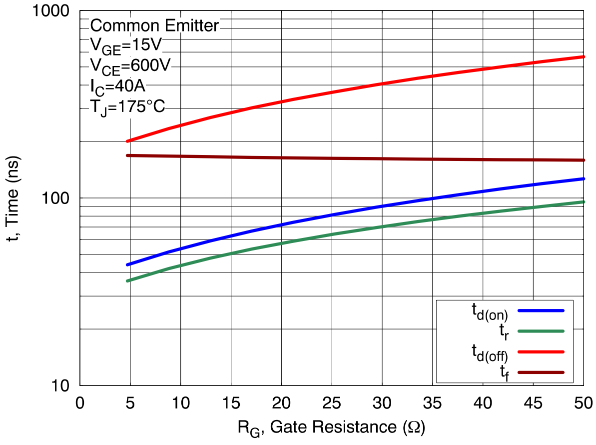


Figure 10. Switching Time vs Gate Resistance

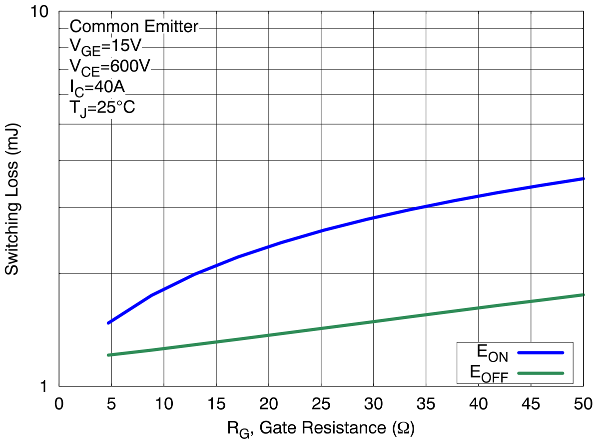


Figure 11. Switching Loss vs Gate Resistance

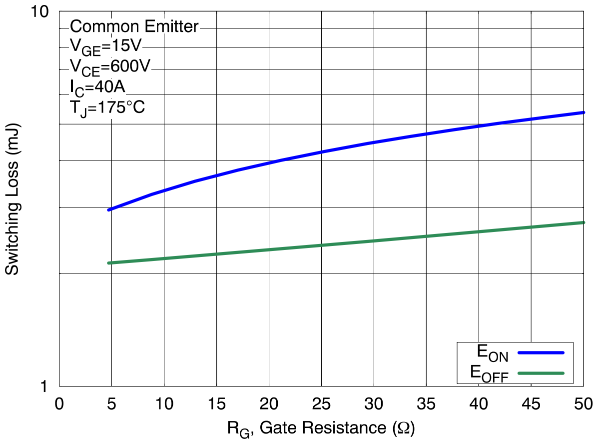


Figure 12. Switching Loss vs Gate Resistance

TYPICAL CHARACTERISTICS

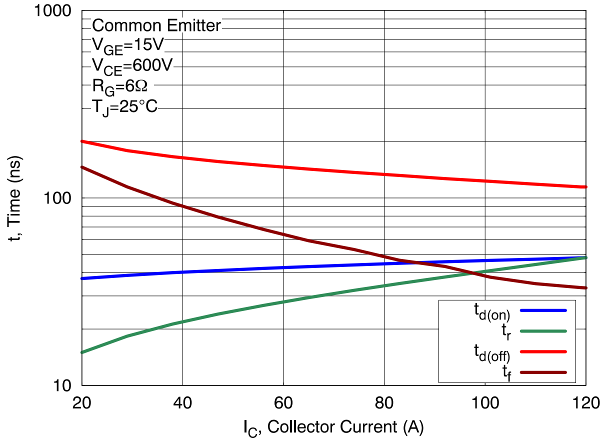


Figure 13. Switching Time vs Collector Current

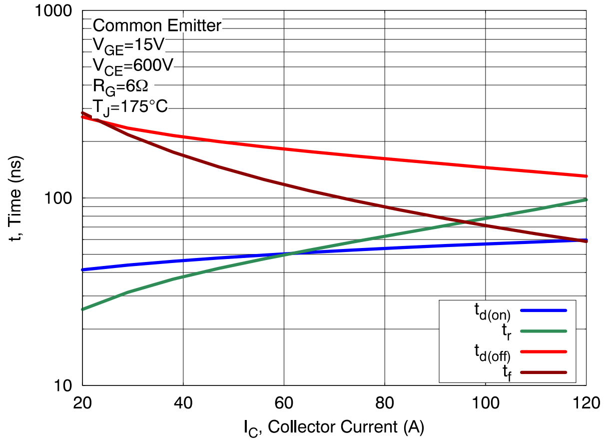


Figure 14. Switching Time vs Collector Current

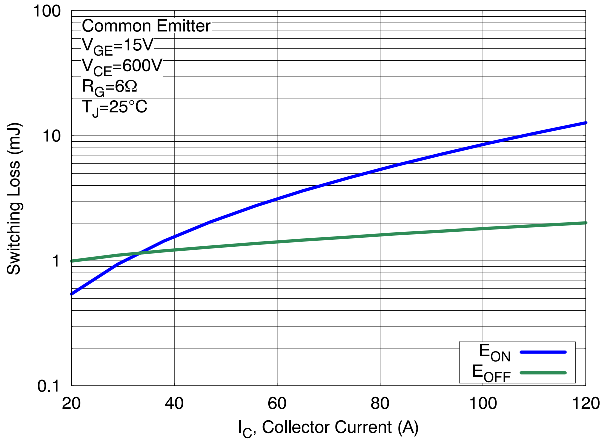


Figure 15. Switching Loss vs Collector Current

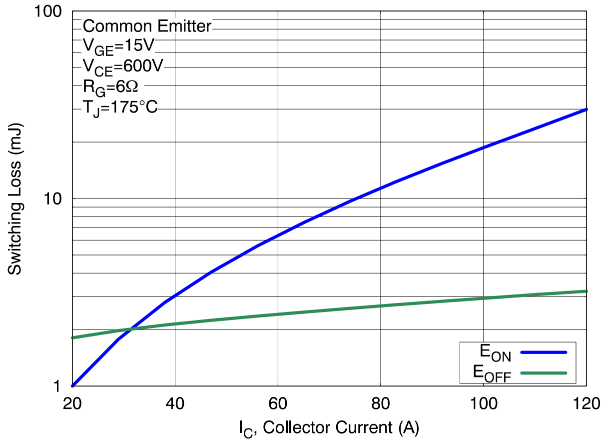


Figure 16. Switching Loss vs Collector Current

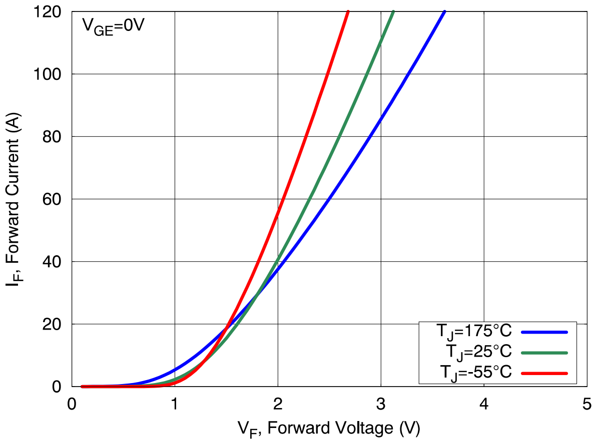


Figure 17. Diode Forward Characteristics

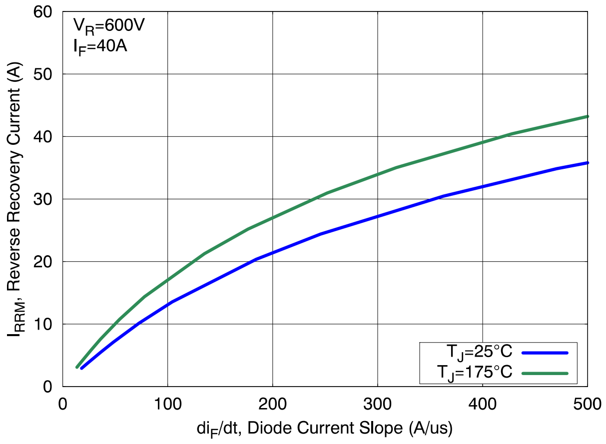


Figure 18. Diode Reverse Recovery Current

TYPICAL CHARACTERISTICS

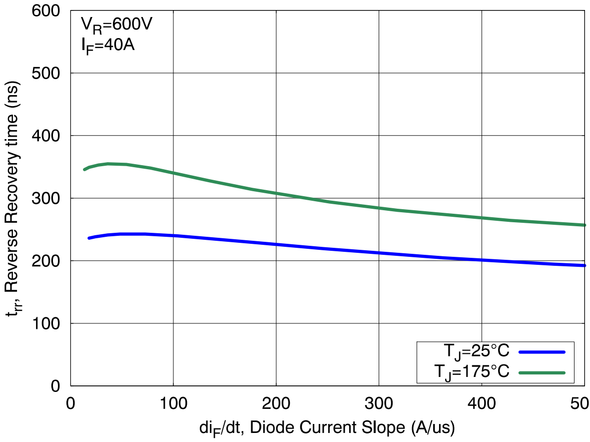


Figure 19. Diode Reverse Recovery Energy

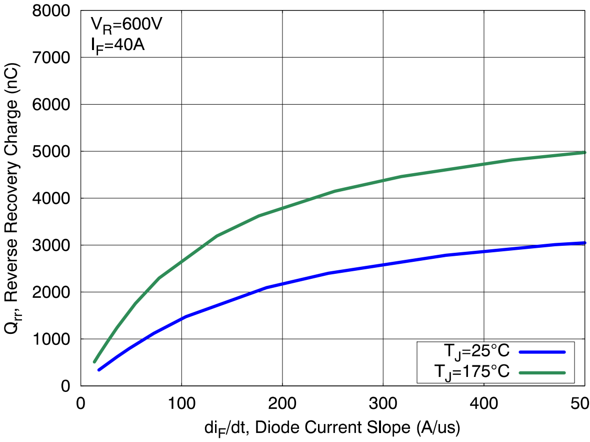
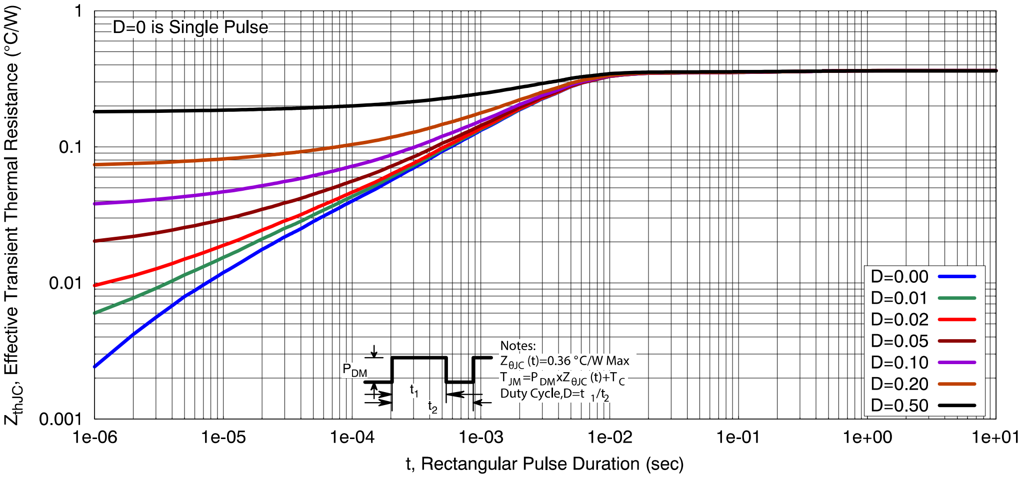
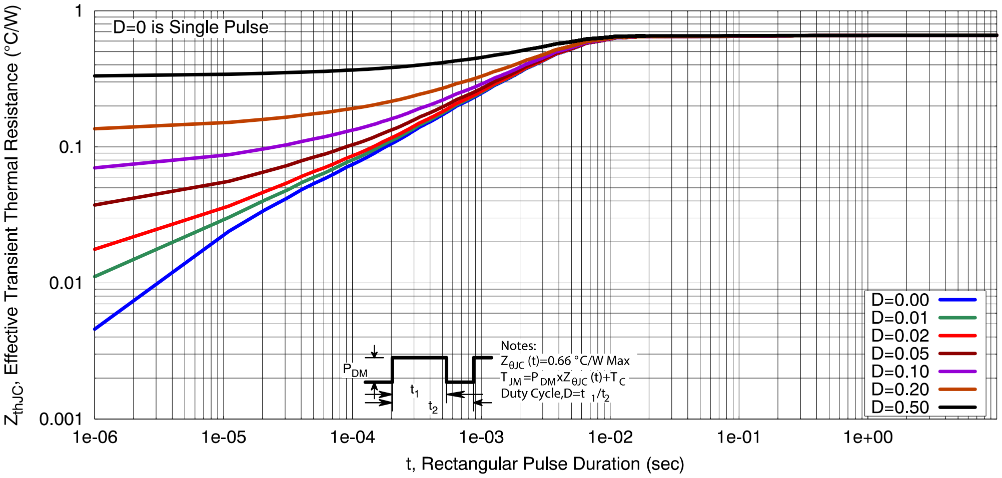


Figure 20. Diode Stored Charge Characteristics



Notes:
$Z_{\theta JC}(t)$=0.36 °C/W Max
$T_{JM}=P_{DM} x Z_{\theta JC}(t)+T_C$
Duty Cycle, $D=t_1/t_2$

Figure 21. Transient Thermal Impedance of IGBT

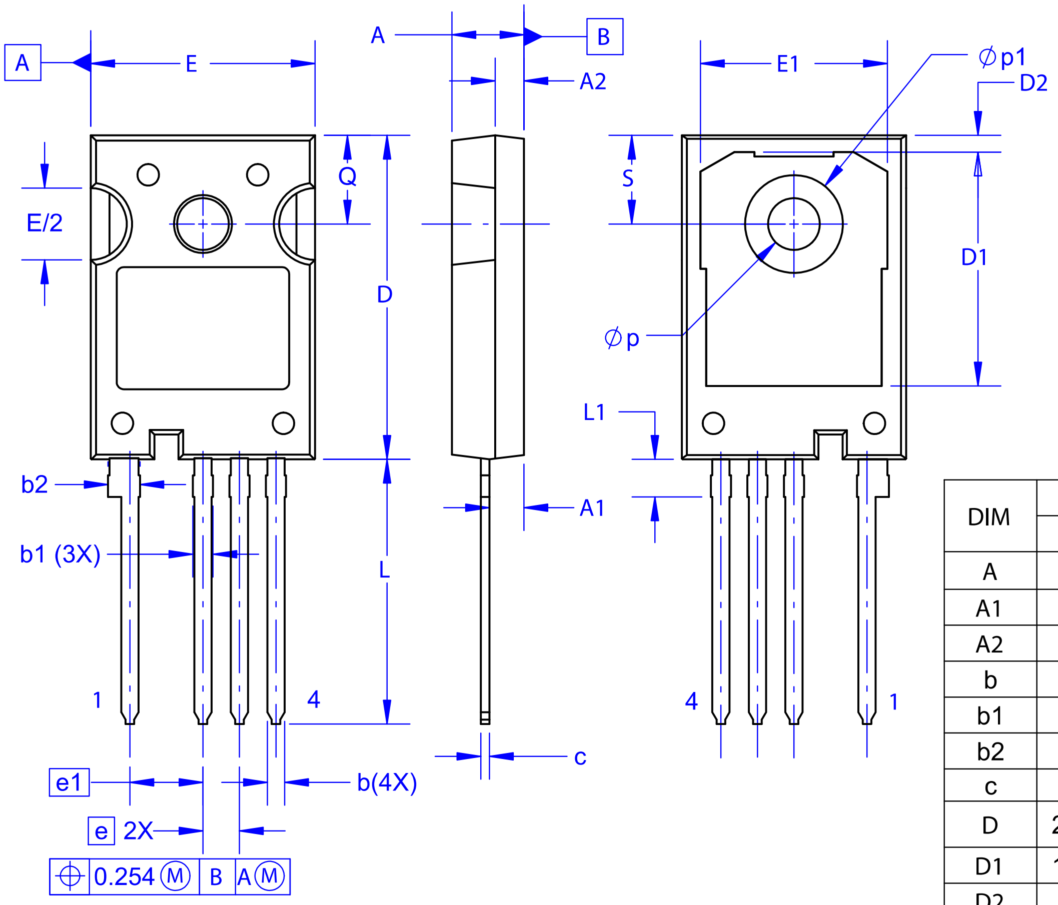


Notes:
$Z_{\theta JC}(t)$=0.66 °C/W Max
$T_{JM}=P_{DM} x Z_{\theta JC}(t)+T_C$
Duty Cycle, $D=t_1/t_2$

Figure 22. Transient Thermal Impedance of Diode

TO−247−4LD
CASE 340CJ
ISSUE A

DATE 16 SEP 2019



NOTES:

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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		
	MIN	NOM	MAX
A	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
c	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
e	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
p	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

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DESCRIPTION:	**TO−247−4LD**	**PAGE 1 OF 1**

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