

# IGBT - Power, Single, N-Channel, Field Stop VII (FS7), SCR, Power TO247-4L 1200 V, 1.4 V, 40 A

## AFGH4L40T120RW

### Description

Using the novel field stop 7th generation IGBT technology 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 –  $T_J = 175^\circ\text{C}$
- Short Circuit Rated and Low Saturation Voltage
- Fast Switching and Tightened Parameter Distribution
- AEC-Q101 Qualified, PPAP Available Upon Request
- These 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)

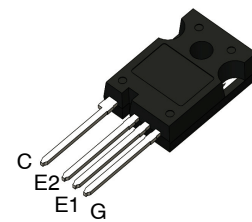
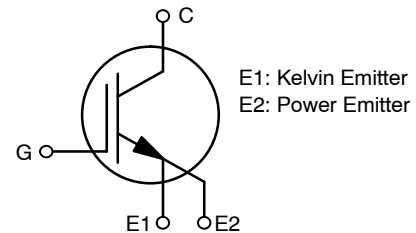
Parameter	Symbol	Value	Unit
Collector to Emitter Voltage	$V_{CE}$	1200	V
Gate to Emitter Voltage	$V_{GE}$	$\pm 20$	V
Transient Gate to Emitter Voltage		$\pm 30$	
Collector Current	$I_C$	$T_C = 25^\circ\text{C}$	A
		$T_C = 100^\circ\text{C}$	
Power Dissipation	$P_D$	$T_C = 25^\circ\text{C}$	W
		$T_C = 100^\circ\text{C}$	
Pulsed Collector Current	$I_{CM}$	120	A
Short Circuit Withstand Time $V_{GE} = 15\text{ V}, V_{CC} = 800\text{ V}, T_C = 150^\circ\text{C}$	$T_{SC}$	6	$\mu\text{s}$
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

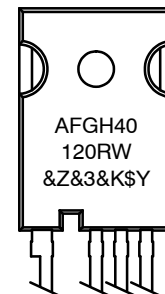
$BV_{CES}$	$V_{CE(sat)}$ TYP	$I_C$ MAX
1200 V	1.4 V	40 A

### PIN CONNECTIONS



TO-247-4LD  
CASE 340CJ

### MARKING DIAGRAM



AFGH40120RW = 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
AFGH4L40T120RW	TO-247-4L (Pb-Free)	30 Units / Rail

# AFGH4L40T120RW

## THERMAL CHARACTERISTICS

Parameter	Symbol	Value	Unit
Thermal Resistance, Junction-to-Case for IGBT	$R_{\theta JC}$	0.26	°C/W
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
Zero Gate Voltage Collector Current	$I_{CES}$	$V_{GE} = 0\text{ V}, V_{CE} = V_{CES}$	–	–	40	$\mu\text{A}$
Gate-to-Emitter leakage Current	$I_{GES}$	$V_{GE} = \pm 20\text{ V}, V_{CE} = 0\text{ V}$	–	–	$\pm 400$	nA

### ON CHARACTERISTICS

Gate to Emitter Threshold Voltage	$V_{GE(th)}$	$V_{GE} = V_{CE}, I_C = 40\text{ mA}, T_J = 25^\circ\text{C}$	5.03	5.93	6.83	V
Collector to Emitter Saturation Voltage	$V_{CE(sat)}$	$V_{GE} = 15\text{ V}, I_C = 40\text{ A}, T_J = 25^\circ\text{C}$	–	1.4	1.73	V
		$V_{GE} = 15\text{ V}, I_C = 40\text{ A}, T_J = 175^\circ\text{C}$	–	1.66	–	

### DYNAMIC CHARACTERISTICS

Input Capacitance	$C_{IES}$	$V_{CE} = 30\text{ V}, V_{GE} = 0\text{ V}, f = 1\text{ MHz}$	–	4721	–	pF
Output Capacitance	$C_{OES}$		–	144	–	pF
Reverse Transfer Capacitance	$C_{RES}$		–	24.2	–	pF
Total Gate Charge	$Q_G$	$V_{CE} = 600\text{ V}, V_{GE} = 15\text{ V}, I_C = 40\text{ A}$	–	171	–	nC
Gate to Emitter Charge	$Q_{GE}$		–	42.2	–	nC
Gate to Collector Charge	$Q_{GC}$		–	73.4	–	nC

### SWITCHING CHARACTERISTICS, INDUCTIVE LOAD (Note: Si Diode Applied)

Turn-On Delay Time	$t_{d(on)}$	$V_{CE} = 600\text{ V}$ $V_{GE} = 0/15\text{ V}$ $I_C = 20\text{ A}$ $R_G = 6\ \Omega$ $T_J = 25^\circ\text{C}$	–	53.5	–	ns
Turn-Off Delay Time	$t_{d(off)}$		–	311	–	
Rise Time	$t_r$		–	27.8	–	
Fall Time	$t_f$		–	189	–	mJ
Turn-On Switching Loss	$E_{on}$		–	1.26	–	
Turn-Off Switching Loss	$E_{off}$		–	1.36	–	
Total Switching Loss	$E_{ts}$		–	2.61	–	
Turn-On Delay Time	$t_{d(on)}$	$V_{CE} = 600\text{ V}$ $V_{GE} = 0/15\text{ V}$ $I_C = 40\text{ A}$ $R_G = 6\ \Omega$ $T_J = 25^\circ\text{C}$	–	58.2	–	ns
Turn-Off Delay Time	$t_{d(off)}$		–	258	–	
Rise time	$t_r$		–	47.4	–	
Fall Time	$t_f$		–	122	–	mJ
Turn-On Switching Loss	$E_{on}$		–	3.38	–	
Turn-Off Switching Loss	$E_{off}$		–	1.7	–	
Total Switching Loss	$E_{ts}$		–	5.08	–	

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

Parameter	Symbol	Test Conditions	Min	Typ	Max	Unit
<b>SWITCHING CHARACTERISTICS, INDUCTIVE LOAD</b> (Note: Si Diode Applied)						
Turn-On Delay Time	$t_{d(on)}$	$V_{CE} = 600\text{ V}$ $V_{GE} = 0/15\text{ V}$ $I_C = 20\text{ A}$ $R_G = 6\ \Omega$ $T_J = 175^\circ\text{C}$	–	58.7	–	ns
Turn-Off Delay Time	$t_{d(off)}$		–	433	–	
Rise Time	$t_r$		–	39.4	–	
Fall Time	$t_f$		–	376	–	
Turn-On Switching Loss	$E_{on}$		–	2.01	–	mJ
Turn-Off Switching Loss	$E_{off}$		–	2.52	–	
Total Switching Loss	$E_{ts}$		–	4.53	–	
Turn-On Delay Time	$t_{d(on)}$	$V_{CE} = 600\text{ V}$ $V_{GE} = 0/15\text{ V}$ $I_C = 40\text{ A}$ $R_G = 6\ \Omega$ $T_J = 175^\circ\text{C}$	–	65.7	–	ns
Turn-Off Delay Time	$t_{d(off)}$		–	343	–	
Rise Time	$t_r$		–	64.7	–	
Fall Time	$t_f$		–	233	–	
Turn-On Switching Loss	$E_{on}$		–	5.45	–	mJ
Turn-Off Switching Loss	$E_{off}$		–	3.04	–	
Total Switching Loss	$E_{ts}$		–	8.49	–	

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.

# AFGH4L40T120RW

## TYPICAL CHARACTERISTICS

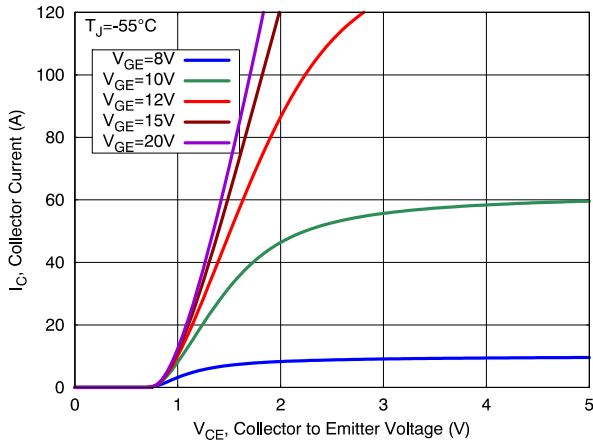


Figure 1. Output Characteristics

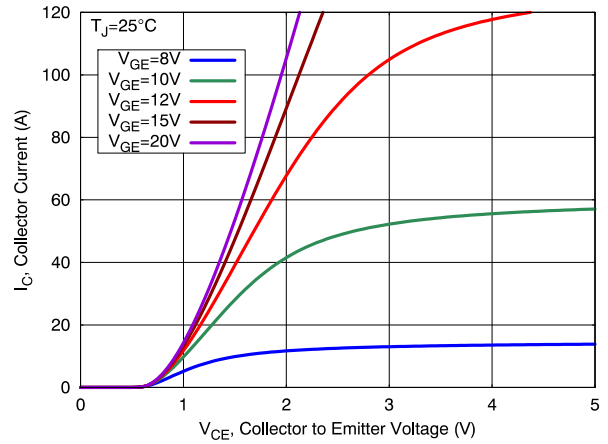


Figure 2. Output Characteristics

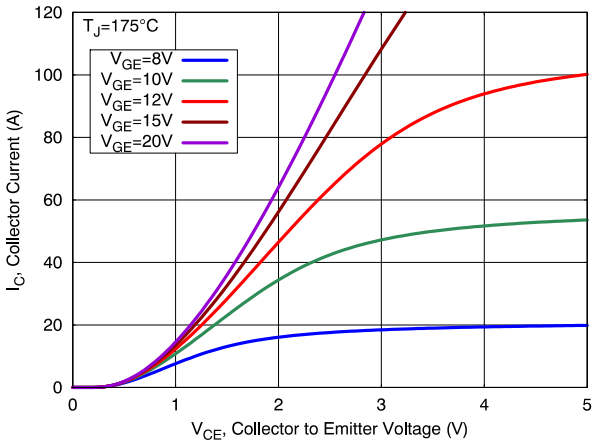


Figure 3. Output Characteristics

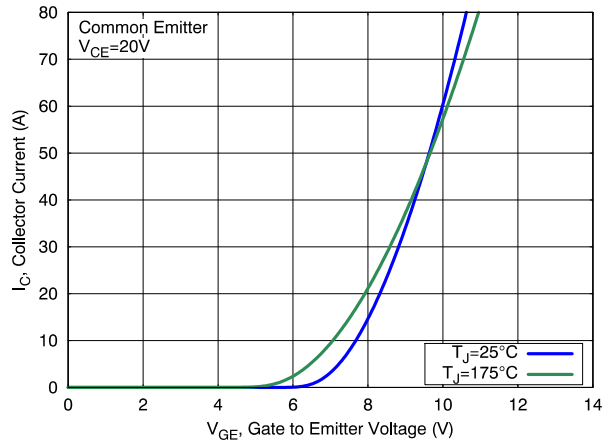


Figure 4. Transfer Characteristics

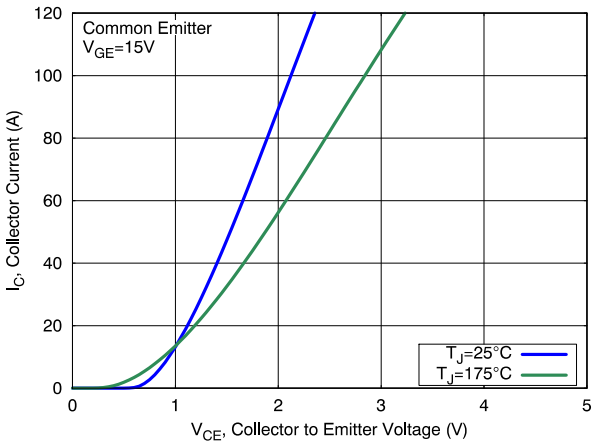


Figure 5. Saturation Characteristics

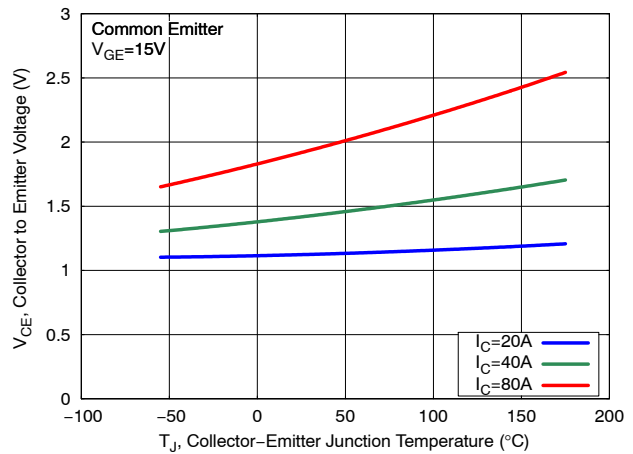


Figure 6. Saturation Voltage vs. Junction Temperature

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## TYPICAL CHARACTERISTICS

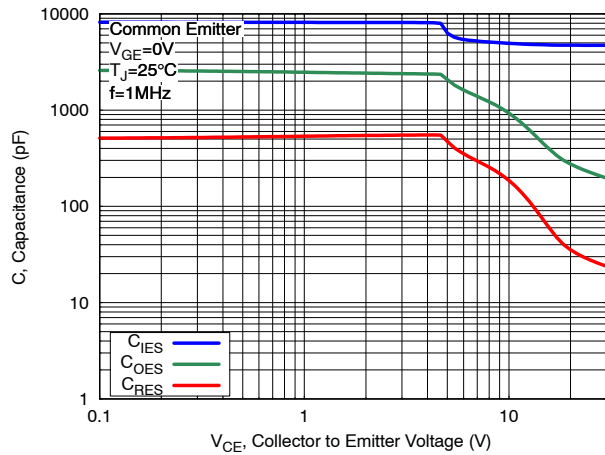


Figure 7. Capacitance Characteristics

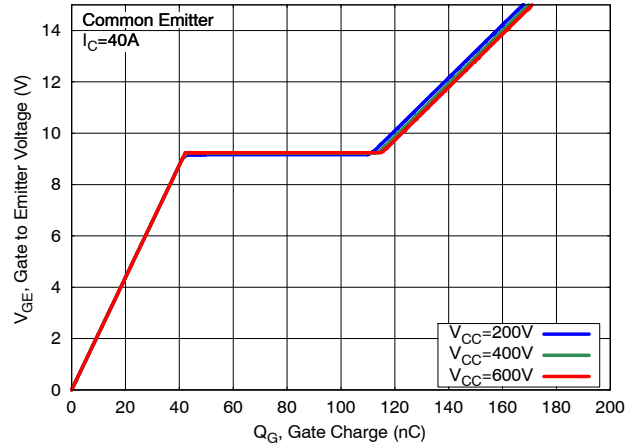


Figure 8. Gate Charge Characteristics

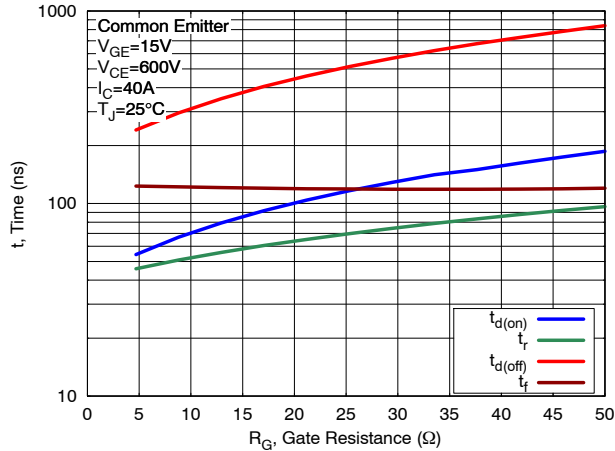


Figure 9. Switching Time vs Gate Resistance

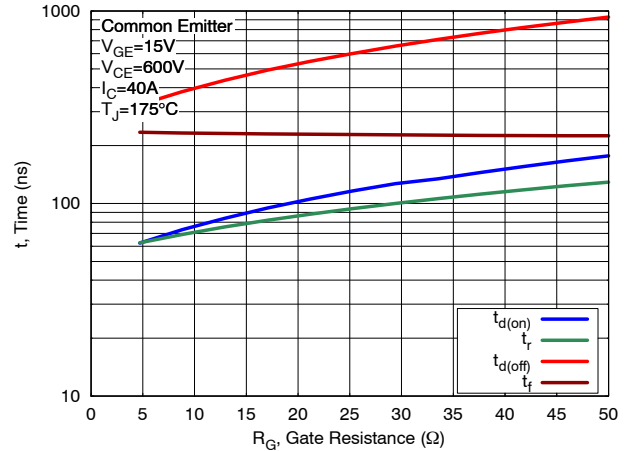


Figure 10. Switching Time vs Gate Resistance

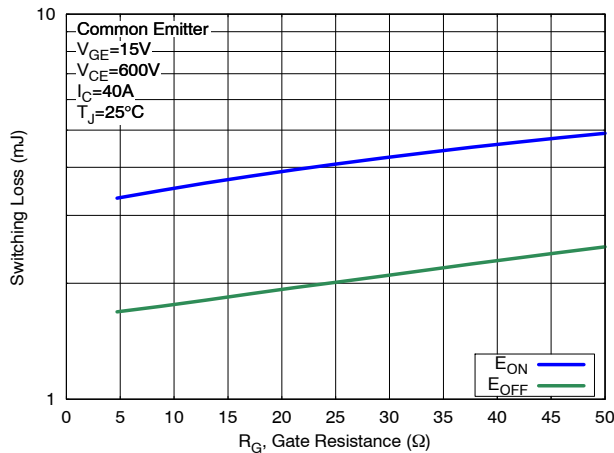


Figure 11. Switching Loss vs Gate Resistance

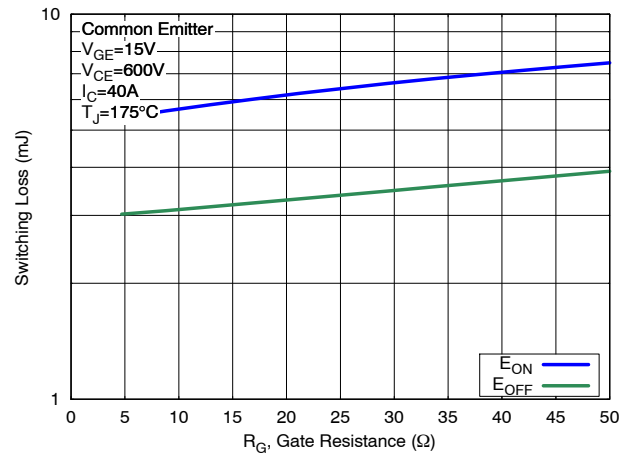


Figure 12. Switching Loss vs Gate Resistance

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## TYPICAL CHARACTERISTICS

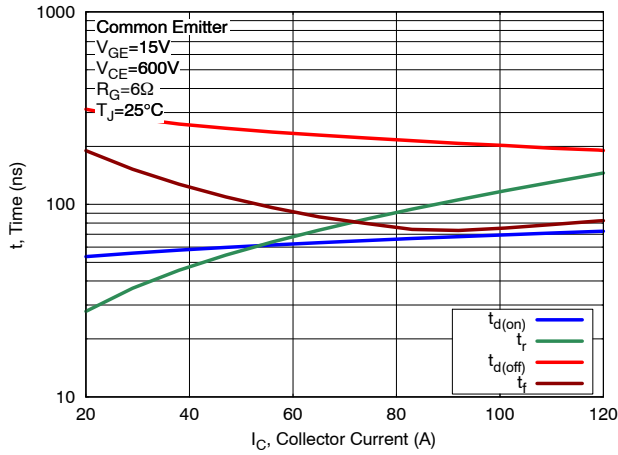


Figure 13. Switching Time vs Collector Current

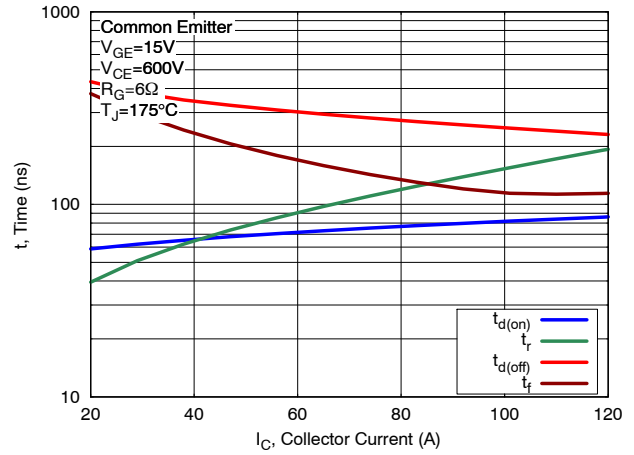


Figure 14. Switching Time vs Collector Current

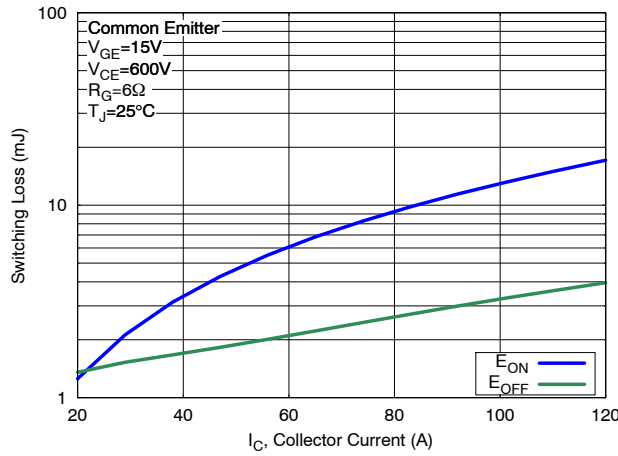


Figure 15. Switching Loss vs Collector Current

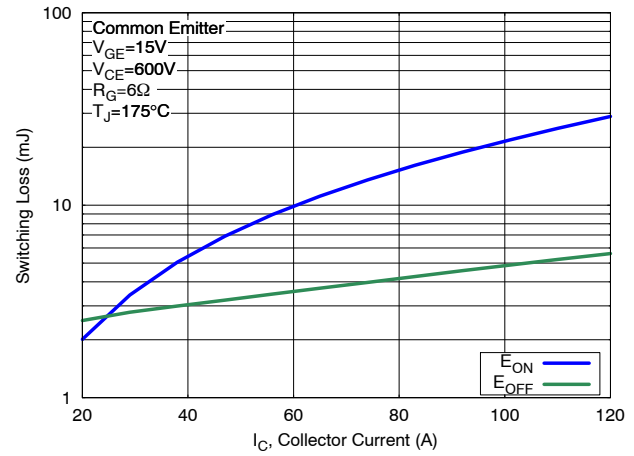


Figure 16. Switching Loss vs Collector Current

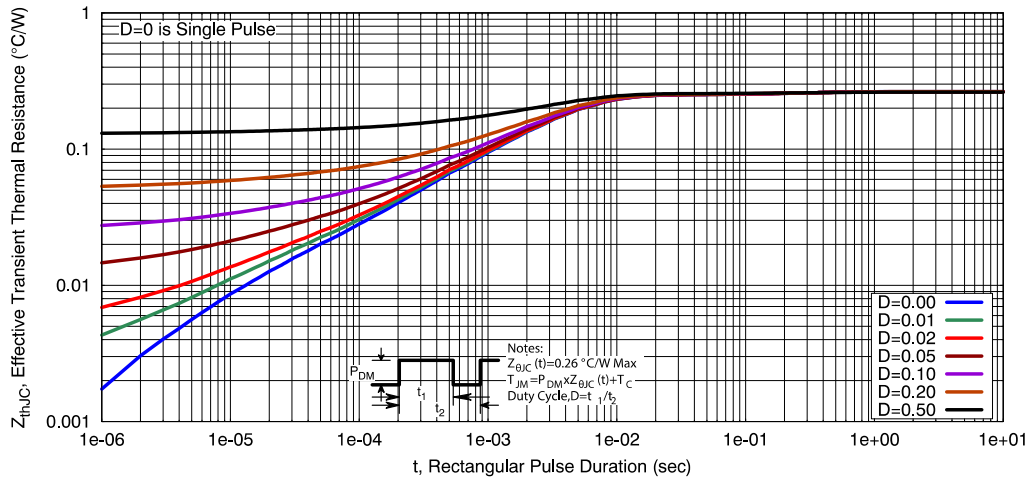


Figure 17. Transient Thermal Impedance of IGBT

# MECHANICAL CASE OUTLINE

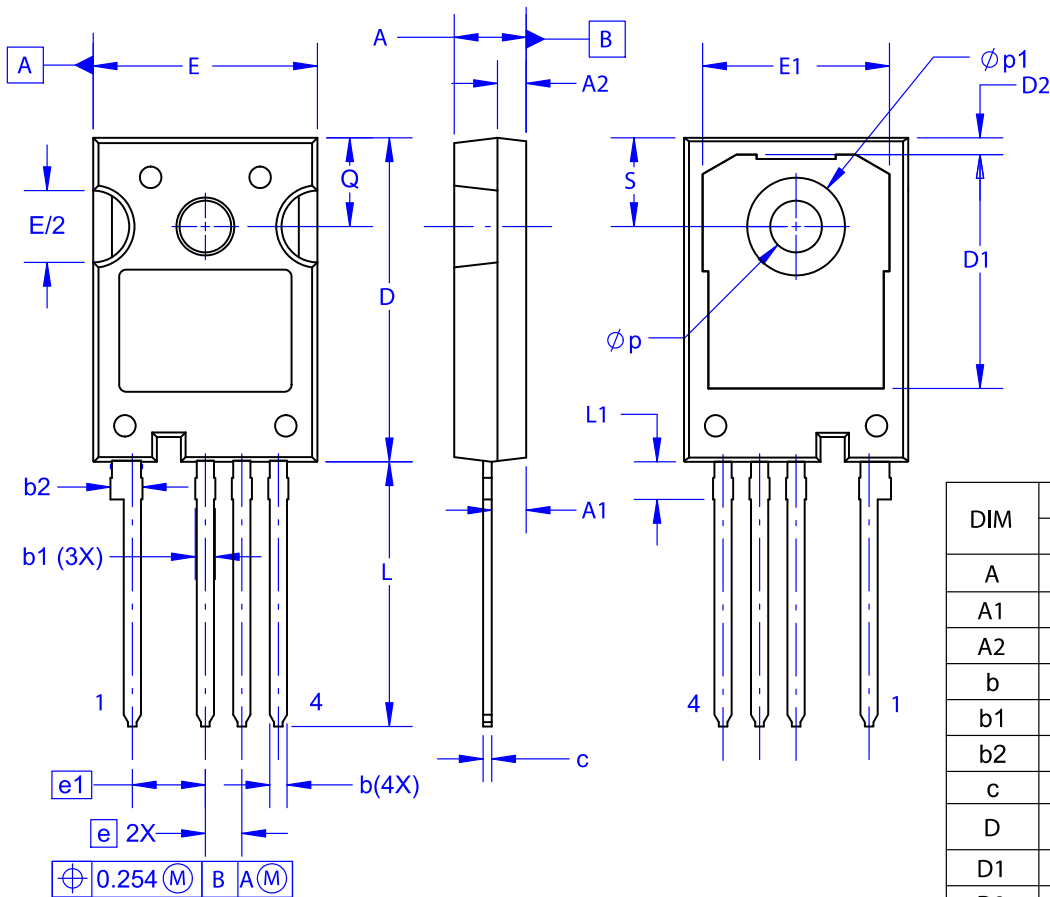
## PACKAGE DIMENSIONS

ON Semiconductor®



TO-247-4LD  
CASE 340CJ  
ISSUE A

DATE 16 SEP 2019



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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