

IGBT – Power, Co-PAK

N-Channel, Field Stop VII (FS7), TO247-4L

1200 V, 1.7 V, 160 A

FGY4L160T120SWD

Description

Using the novel field stop 7th generation IGBT technology and the Gen7 Diode in TO247 4-lead package, FGY4L160T120SWD offers the optimum performance with low switching and conduction losses for high-efficiency operations in various applications like Solar Inverter, UPS and ESS.

Features

- Maximum Junction Temperature $T_J = 175^\circ\text{C}$
- Positive Temperature Coefficient for Easy Parallel Operation
- High Current Capability
- Smooth and Optimized Switching
- Low Switching Loss
- RoHS Compliant

Applications

- Solar Inverter
- UPS
- Energy Storage System

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

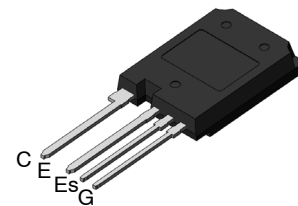
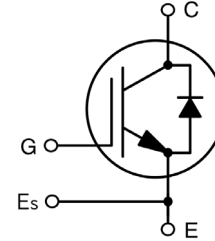
Parameter	Symbol	Value	Unit
Collector-to-Emitter Voltage	V_{CE}	1200	V
Gate-to-Emitter Voltage	V_{GE}	± 20	
Transient Gate-to-Emitter Voltage		± 30	
Collector Current	I_C	$T_C = 25^\circ\text{C}$ (Note 1)	200
		$T_C = 100^\circ\text{C}$	160
Power Dissipation	P_D	$T_C = 25^\circ\text{C}$	1500
		$T_C = 100^\circ\text{C}$	750
Pulsed Collector Current	I_{CM}	640	A
Diode Forward Current	I_F	$T_C = 25^\circ\text{C}$ (Note 1)	200
		$T_C = 100^\circ\text{C}$	160
Pulsed Diode Forward Current	I_{FM}	640	
Operating Junction and Storage Temperature Range	T_J, T_{stg}	-55 to +175	$^\circ\text{C}$
Lead Temperature for Soldering Purposes	T_L	265	

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. Value limited by bond wire
2. Repetitive rating: Pulse width limited by max. junction temperature.

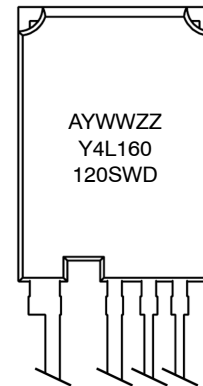
BV_{CES}	$V_{CE(SAT_TYP)}$	I_C
1200 V	1.7 V	160 A

PIN CONNECTIONS



TO-247-4LD
CASE 340BW

MARKING DIAGRAM



A = Assembly Location
 YWW = Date code (Year & week)
 ZZ = Assembly Lot
 Y4L160120SWD = Specific Device Code

ORDERING INFORMATION

Device	Package	Shipping
FGY4L160T120SWD	TO-247-4LD (Pb-Free)	30 Units / Tube

FGY4L160T120SWD

THERMAL CHARACTERISTICS

Parameter	Symbol	Value			Unit
		Min	Typ	Max	
Thermal Resistance, Junction-to-Case for IGBT	$R_{\theta JC}$	-	0.08	0.10	°C/W
Thermal Resistance, Junction-to-Case for Diode	$R_{\theta JCD}$	-	0.12	0.16	
Thermal Resistance, Junction-to-Ambient	$R_{\theta JA}$	-	-	40	

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

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
Breakdown Voltage Temperature Coefficient	$\frac{\Delta BV_{CES}}{\Delta T_J}$	$V_{GE} = 0\text{ V}, I_C = 9.99\text{ mA}$	-	1180	-	mV/°C
Collector-to-Emitter Cut-Off 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-to-Emitter Threshold Voltage	$V_{GE(th)}$	$V_{GE} = V_{CE}, I_C = 160\text{ mA}$	5.6	6.5	7.4	V
Collector-to-Emitter Saturation Voltage	$V_{CE(sat)}$	$V_{GE} = 15\text{ V}, I_C = 160\text{ A}, T_J = 25^\circ\text{C}$	-	1.7	2.0	
		$V_{GE} = 15\text{ V}, I_C = 160\text{ A}, T_J = 175^\circ\text{C}$	-	2.4	-	

DYNAMIC CHARACTERISTICS

Input Capacitance	C_{ies}	$V_{CE} = 30\text{ V}, V_{GE} = 0\text{ V}, f = 1\text{ MHz}$	-	15203	-	pF
Output Capacitance	C_{oes}		-	432	-	
Reverse Transfer Capacitance	C_{res}		-	57	-	
Total Gate Charge	Q_g	$V_{CE} = 600\text{ V}, V_{GE} = 15\text{ V}, I_C = 160\text{ A}$	-	474	-	nC
Gate-to-Emitter Charge	Q_{ge}		-	126	-	
Gate-to-Collector Charge	Q_{gc}		-	172	-	

SWITCHING CHARACTERISTIC, INDUCTIVE LOAD

Turn-on Delay Time	$t_{d(on)}$	$V_{CE} = 600\text{ V}, V_{GE} = 15\text{ V}, I_C = 80\text{ A}, R_G = 4.0\ \Omega, T_J = 25^\circ\text{C}$	-	56.8	-	ns
Rise Time	t_r		-	16.8	-	
Turn-off Delay Time	$t_{d(off)}$		-	259.2	-	
Fall Time	t_f		-	72	-	
Turn-on Switching Loss	E_{on}		-	2.3	-	mJ
Turn-off Switching Loss	E_{off}		-	2.8	-	
Total Switching Loss	E_{ts}		-	5.1	-	
Turn-on Delay Time	$t_{d(on)}$	$V_{CE} = 600\text{ V}, V_{GE} = 15\text{ V}, I_C = 160\text{ A}, R_G = 4.0\ \Omega, T_J = 25^\circ\text{C}$	-	60.8	-	ns
Rise Time	t_r		-	28.8	-	
Turn-off Delay Time	$t_{d(off)}$		-	236.8	-	
Fall Time	t_f		-	67.2	-	
Turn-on Switching Loss	E_{on}		-	4.2	-	mJ
Turn-off Switching Loss	E_{off}		-	5.9	-	
Total Switching Loss	E_{ts}		-	10.1	-	

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

Parameter	Symbol	Test Conditions	Min	Typ	Max	Unit
SWITCHING CHARACTERISTIC, INDUCTIVE LOAD						
Turn-on Delay Time	$t_{d(on)}$	$V_{CE} = 600\text{ V}, V_{GE} = 15\text{ V}$ $I_C = 80\text{ A}, R_G = 4.0\ \Omega, T_J = 175^\circ\text{C}$	-	50.4	-	ns
Rise Time	t_r		-	20.8	-	
Turn-off Delay Time	$t_{d(off)}$		-	299.2	-	
Fall Time	t_f		-	107.2	-	
Turn-on Switching Loss	E_{on}		-	5.2	-	mJ
Turn-off Switching Loss	E_{off}		-	3.8	-	
Total Switching Loss	E_{ts}		-	9	-	
Turn-on Delay Time	$t_{d(on)}$	$V_{CE} = 600\text{ V}, V_{GE} = 15\text{ V}$ $I_C = 160\text{ A}, R_G = 4.0\ \Omega, T_J = 175^\circ\text{C}$	-	54.4	-	ns
Rise Time	t_r		-	36.8	-	
Turn-off Delay Time	$t_{d(off)}$		-	281.6	-	
Fall Time	t_f		-	120	-	
Turn-on Switching Loss	E_{on}		-	8.4	-	mJ
Turn-off Switching Loss	E_{off}		-	8.7	-	
Total Switching Loss	E_{ts}		-	17.1	-	

DIODE CHARACTERISTICS

Forward Voltage	V_F	$I_F = 160\text{ A}, T_J = 25^\circ\text{C}$	1.74	2.04	2.34	V
		$I_F = 160\text{ A}, T_J = 175^\circ\text{C}$	-	2.2	-	

DIODE SWITCHING CHARACTERISTICS, INDUCTIVE LOAD

Reverse Recovery Time	t_{rr}	$V_R = 600\text{ V}, I_F = 80\text{ A},$ $di_F/dt = 1000\text{ A}/\mu\text{s}, T_J = 25^\circ\text{C}$	-	193.7	-	ns
Reverse Recovery Charge	Q_{rr}		-	4.8	-	μC
Reverse Recovery Energy	E_{REC}		-	1.7	-	mJ
Peak Reverse Recovery Current	I_{RRM}		-	49.5	-	A
Reverse Recovery Time	t_{rr}	$V_R = 600\text{ V}, I_F = 160\text{ A},$ $di_F/dt = 1000\text{ A}/\mu\text{s}, T_J = 25^\circ\text{C}$	-	264.1	-	ns
Reverse Recovery Charge	Q_{rr}		-	7.6	-	μC
Reverse Recovery Energy	E_{REC}		-	2.7	-	mJ
Peak Reverse Recovery Current	I_{RRM}		-	56.6	-	A
Reverse Recovery Time	t_{rr}	$V_R = 600\text{ V}, I_F = 80\text{ A},$ $di_F/dt = 1000\text{ A}/\mu\text{s}, T_J = 175^\circ\text{C}$	-	320.5	-	ns
Reverse Recovery Charge	Q_{rr}		-	12.1	-	μC
Reverse Recovery Energy	E_{REC}		-	4.6	-	mJ
Peak Reverse Recovery Current	I_{RRM}		-	75.5	-	A
Reverse Recovery Time	t_{rr}	$V_R = 600\text{ V}, I_F = 160\text{ A},$ $di_F/dt = 1000\text{ A}/\mu\text{s}, T_J = 175^\circ\text{C}$	-	499.1	-	ns
Reverse Recovery Charge	Q_{rr}		-	18.4	-	μC
Reverse Recovery Energy	E_{REC}		-	7.2	-	mJ
Peak Reverse Recovery Current	I_{RRM}		-	82.2	-	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.

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TYPICAL CHARACTERISTICS

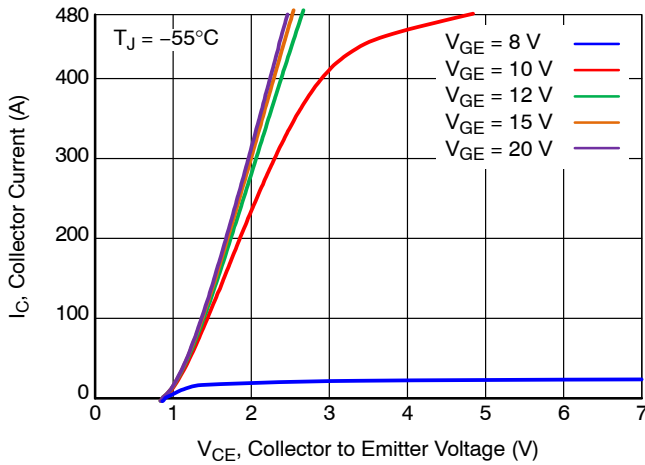


Figure 1. Output Characteristics

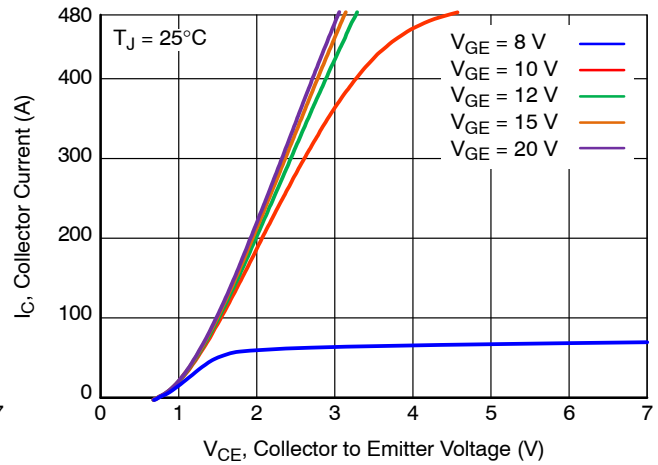


Figure 2. Output Characteristics

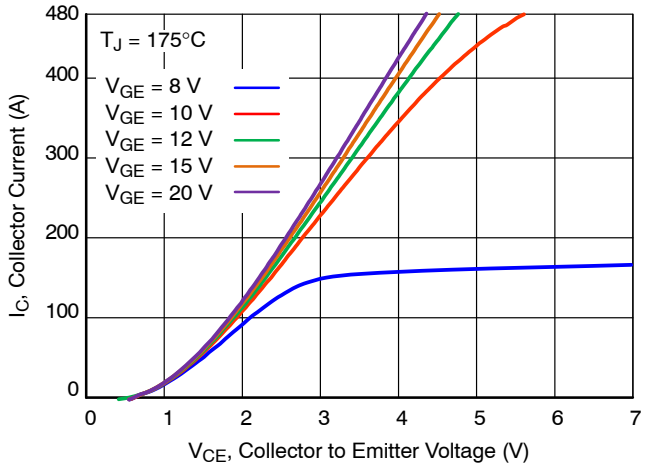


Figure 3. Output Characteristics

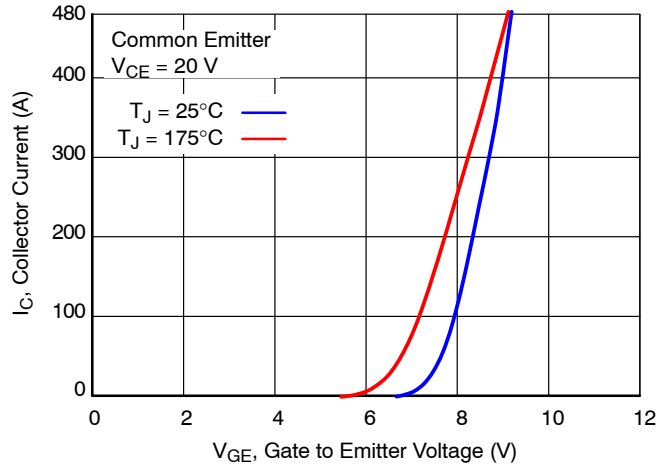


Figure 4. Transfer Characteristics

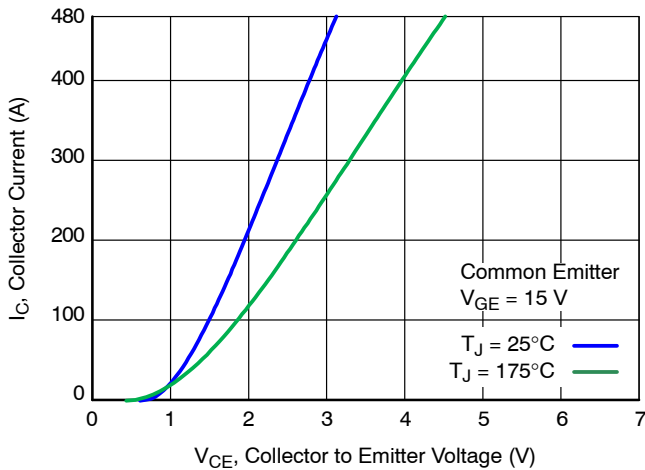


Figure 5. Saturation Characteristics

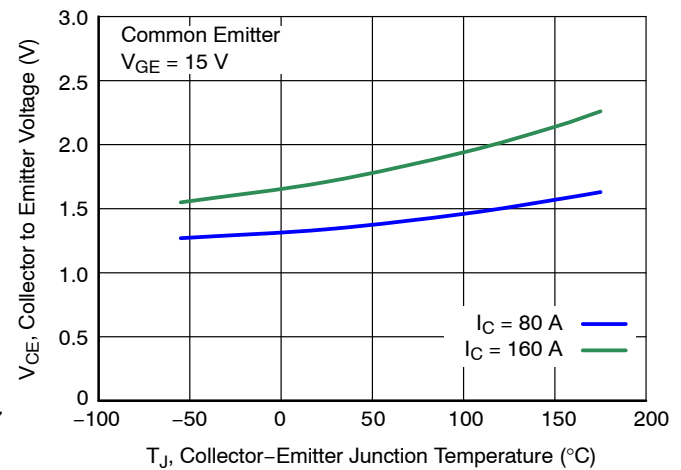


Figure 6. Saturation Voltage vs. Junction Temperature

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TYPICAL CHARACTERISTICS

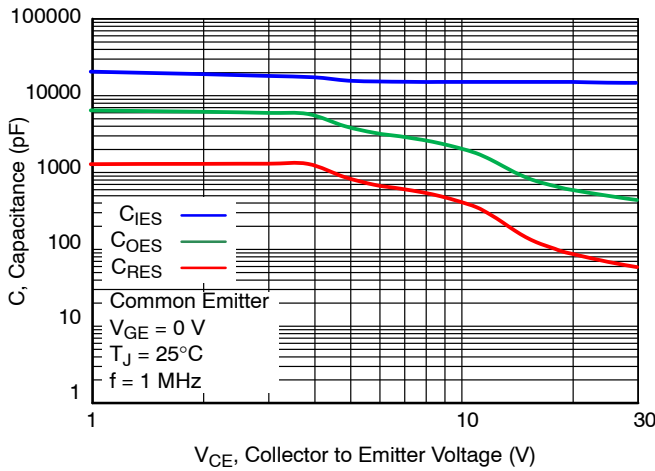


Figure 7. Capacitance Characteristics

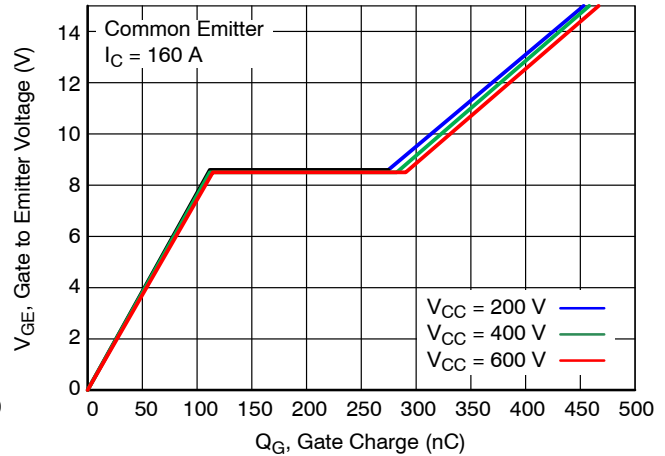


Figure 8. Gate Charge Characteristics

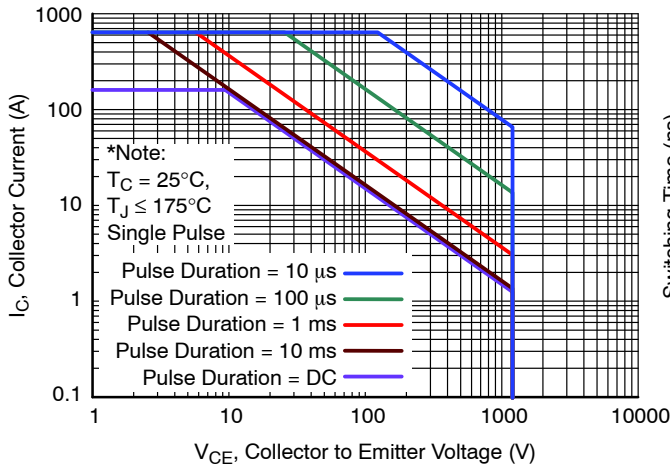


Figure 9. SOA Characteristics

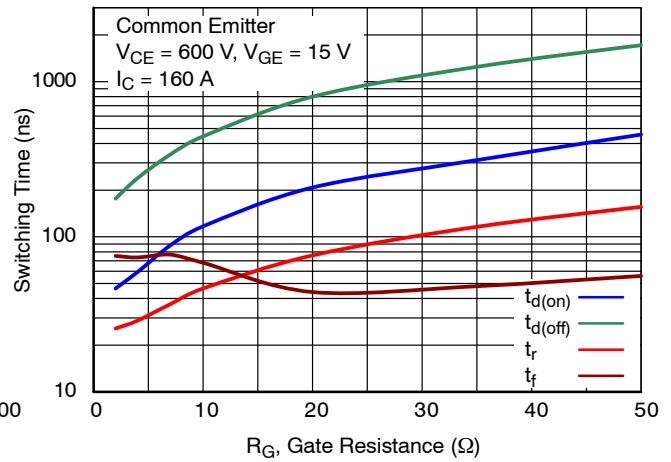


Figure 10. Switching Time vs. Gate Resistance ($T_J = 25^\circ\text{C}$)

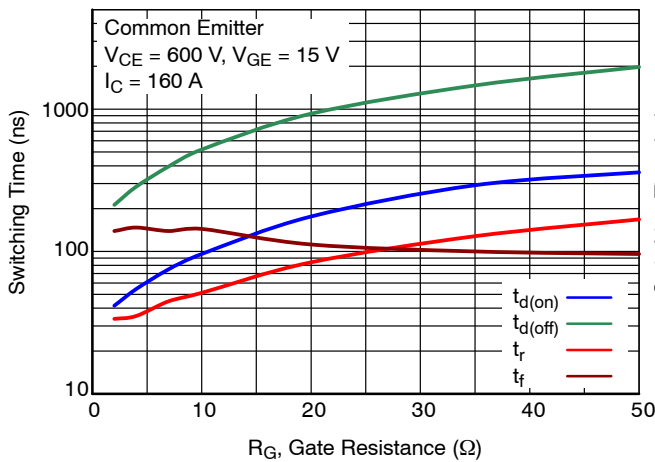


Figure 11. Switching Time vs. Gate Resistance ($T_J = 175^\circ\text{C}$)

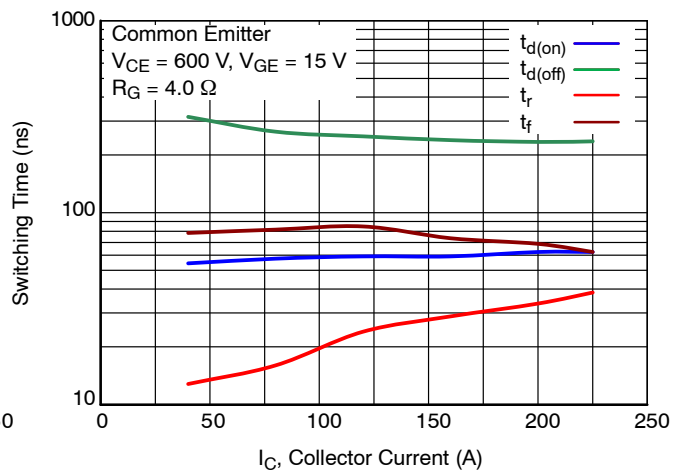


Figure 12. Switching Time vs. Collector Current ($T_J = 25^\circ\text{C}$)

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TYPICAL CHARACTERISTICS

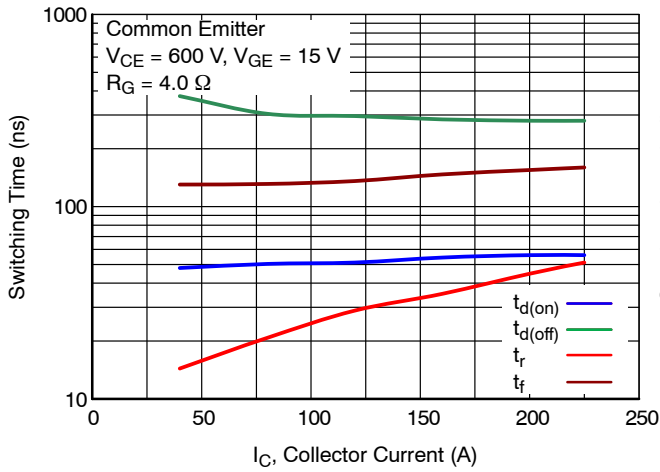


Figure 13. Switching Time vs. Collector Current ($T_J = 175^\circ\text{C}$)

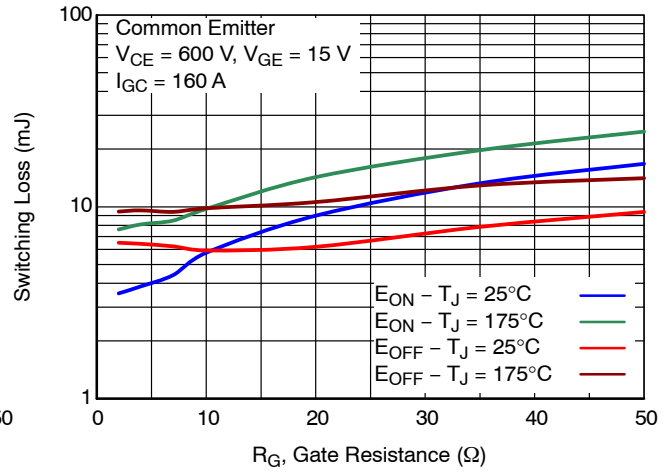


Figure 14. Switching Loss vs. Gate Resistance

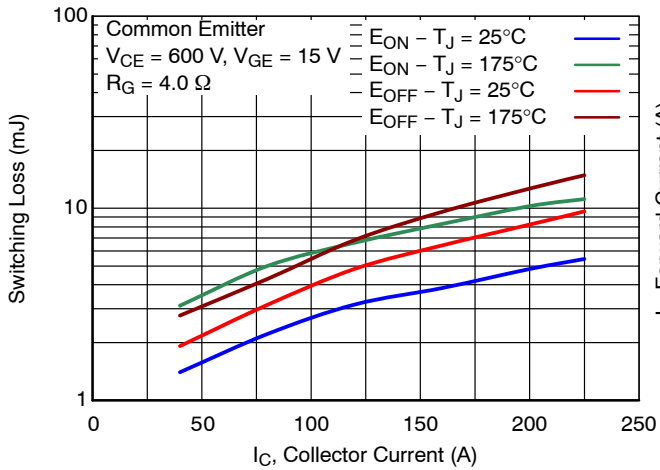


Figure 15. Switching Loss vs. Collector Current

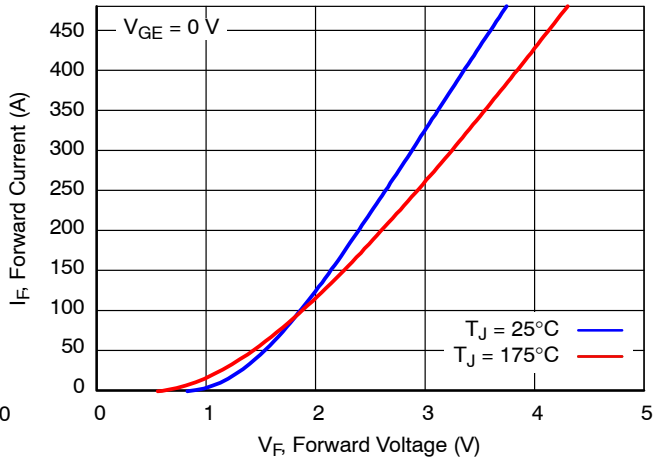


Figure 16. Diode Forward Characteristics

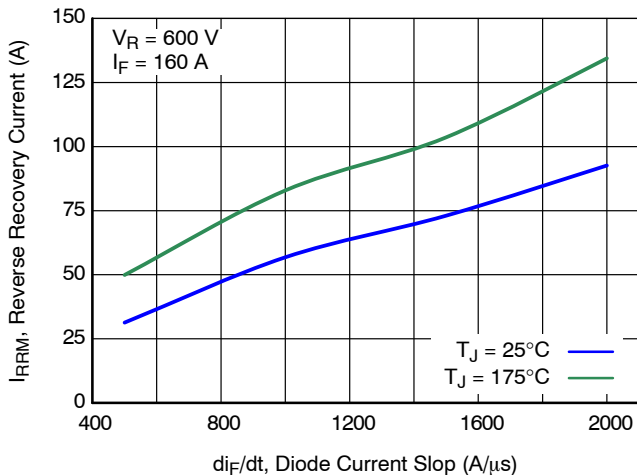


Figure 17. Diode Reverse Recovery Current

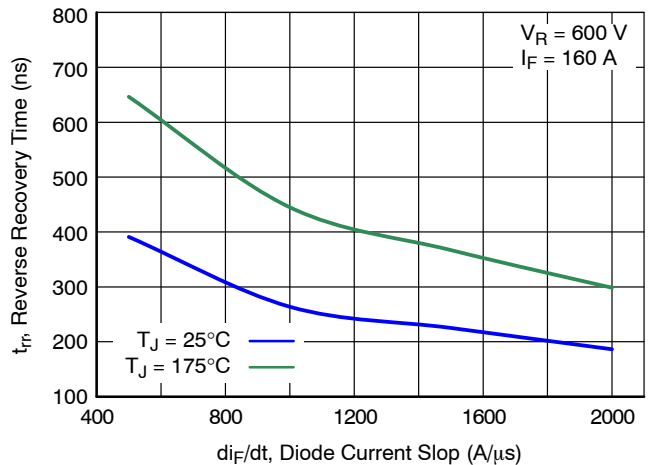


Figure 18. Diode Reverse Recovery Time

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TYPICAL CHARACTERISTICS

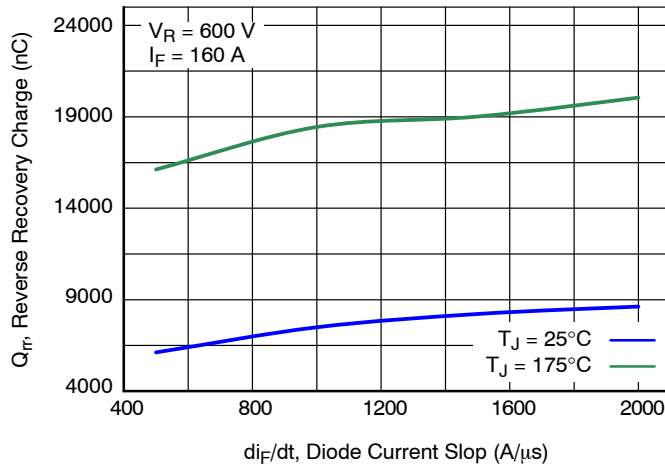


Figure 19. Diode Stored Charge

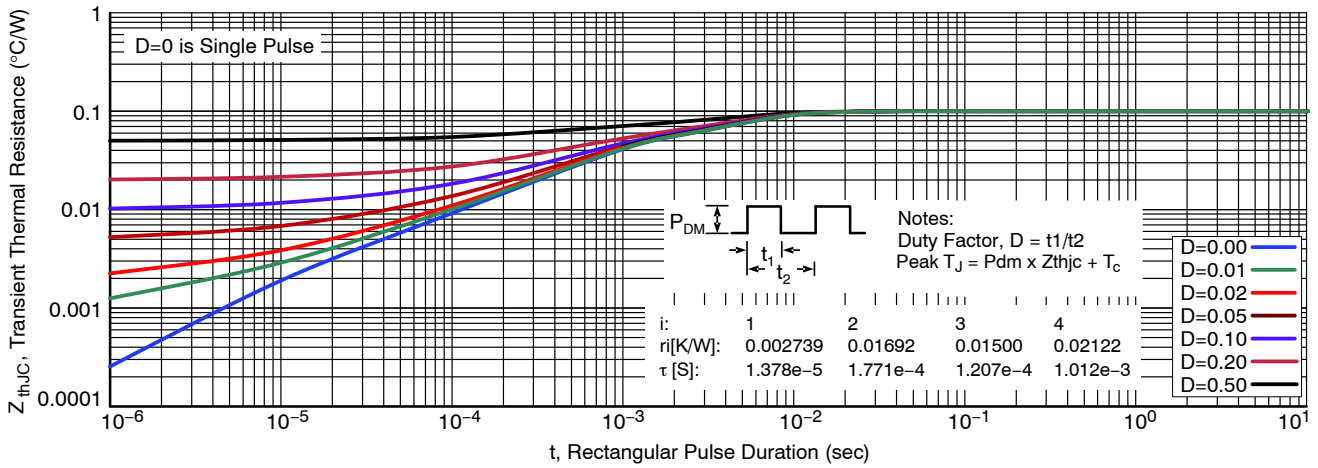


Figure 20. Max Transient Thermal Impedance of IGBT

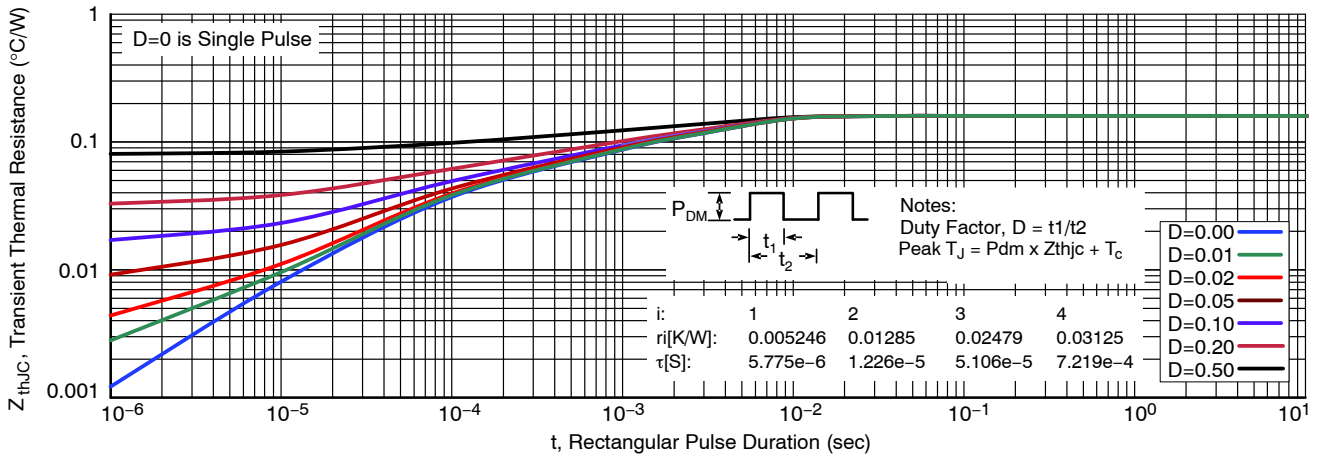
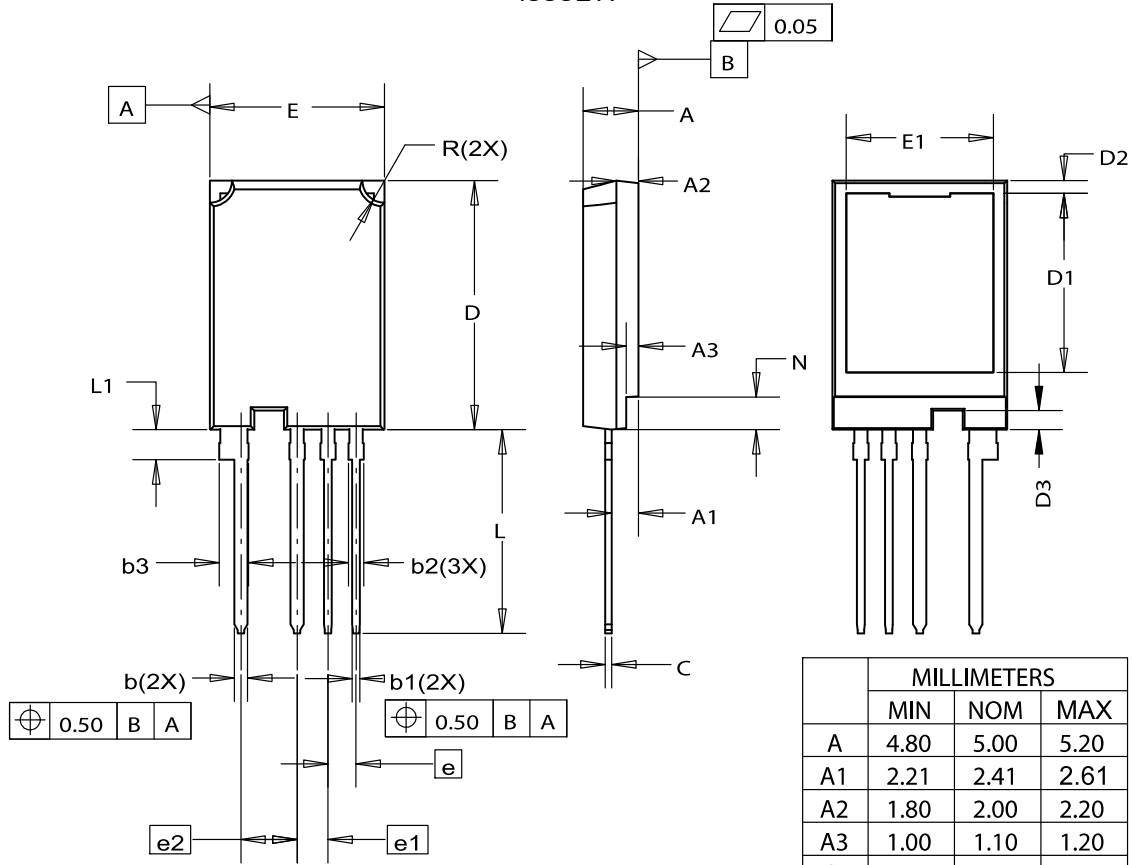


Figure 21. Max Transient Thermal Impedance of Diode

FGY4L160T120SWD

PACKAGE DIMENSIONS

TO-247-PLUS-4L 15.80x22.54x5.00, 2.54P
 CASE 340BW
 ISSUE A



NOTES:

- A. NO INDUSTRY STANDARDS APPLIES TO THIS PACKAGE.
- B. ALL DIMENSIONS ARE IN MILLIMETERS.
- C. DIMENSIONS ARE EXCLUSIVE OF BURRS, MOLD FLASH AND TIE BAR PROTRUSIONS.
- D. DRAWING CONFORMS TO ASME Y14.5-2009.

	MILLIMETERS		
	MIN	NOM	MAX
A	4.80	5.00	5.20
A1	2.21	2.41	2.61
A2	1.80	2.00	2.20
A3	1.00	1.10	1.20
b	1.07	1.20	1.33
b1	0.57	0.70	0.83
b2	1.20	1.40	1.60
b3	2.47	2.67	2.87
c	0.50	0.60	0.70
D	22.34	22.54	22.74
D1	16.00	16.20	16.40
D2	0.96	1.16	1.36
D3	1.52	1.72	1.92
e	2.54BSC		
e1	2.79BSC		
e2	5.08BSC		
E	15.60	15.80	16.00
E1	13.10	13.30	13.50
L	18.12	18.42	18.72
L1	2.52	2.72	2.92
R	1.90	2.00	2.10
N	2.75	2.95	3.15

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