

# IGBT – Power, Co-PAK N-Channel, Field Stop VII (FS7), Non SCR, TO247-3L 1200 V, 1.7 V, 40 A

## FGHL40T120SWD

### Description

Using the novel field stop 7th generation IGBT technology and the Gen7 Diode in TO247 3-lead package, FGHL40T120SWD offers the optimum performance with low switching and conduction losses for high efficiency operations in various applications like Solar, 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

- Boost and Inverter in Solar Applications
- UPS
- Energy Storage System

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

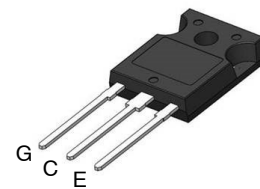
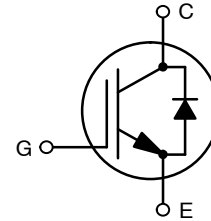
Parameter	Symbol	Value	Unit	
Collector-to-Emitter Voltage	$V_{CES}$	1200	V	
Gate-to-Emitter Voltage	$V_{GES}$	$\pm 20$	V	
Transient Gate-to-Emitter Voltage		$\pm 30$		
Collector Current	$I_C$	$T_C = 25^\circ\text{C}$ (Note 1)	70	A
		$T_C = 100^\circ\text{C}$	40	
Power Dissipation	$P_D$	$T_C = 25^\circ\text{C}$	469	W
		$T_C = 100^\circ\text{C}$	234	
Pulsed Collector Current	$I_{CM}$	$T_C = 25^\circ\text{C}$ (Note 2) $t_p = 10 \mu\text{s}$	160	A
Diode Forward Current	$I_F$	$T_C = 25^\circ\text{C}$ (Note 1)	80	A
		$T_C = 100^\circ\text{C}$	40	
Pulsed Diode Maximum Forward Current	$I_{FM}$	$T_C = 25^\circ\text{C}$ , $t_p = 10 \mu\text{s}$	160	A
Operating Junction and Storage Temperature Range	$T_J, T_{stg}$	-55 to +175		$^\circ\text{C}$
Lead Temperature for Soldering Purposes	$T_L$	260		$^\circ\text{C}$

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

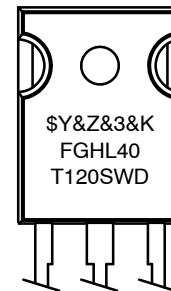
$BV_{CES}$	$V_{CE(SAT)}$	$I_C$
1200 V	1.7 V	40 A

### PIN CONNECTIONS



TO-247-3LD  
CASE 340CX

### MARKING DIAGRAM



\$Y = onsemi Logo  
&Z = Assembly Plant Code  
&3 = 3-Digit Date Code  
&K = 2-Digit Lot Traceability Code  
FGHL40T120SWD = Specific Device Code

### ORDERING INFORMATION

Device	Package	Shipping
FGHL40T120SWD	TO-247 (Pb-Free)	30 Units / Tube

# FGHL40T120SWD

## 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	$R_{\theta JCD}$	0.57	
Thermal Resistance, Junction-to-Ambient	$R_{\theta JA}$	40	

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

Parameter	Symbol	Test Conditions	Min	Typ	Max	Unit
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### OFF CHARACTERISTICS

Collector-to-Emitter Breakdown Voltage	$BV_{CES}$	$V_{GE} = 0\text{ V}, I_C = 5\text{ mA}$	1200			V
Collector-to-Emitter Breakdown Voltage Temperature Coefficient	$\frac{\Delta BV_{CES}}{\Delta T_J}$	$V_{GE} = 0\text{ V}, I_C = 5\text{ mA}$		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	$I_{GES}$	$V_{GE} = 20\text{ V}, V_{CE} = 0\text{ V}$			±400	nA

### ON CHARACTERISTICS

Gate Threshold Voltage	$V_{GE(th)}$	$V_{GE} = V_{CE}, I_C = 40\text{ mA}$	5.6	6.55	7.4	V
Collector-to-Emitter Saturation Voltage	$V_{CE(sat)}$	$V_{GE} = 15\text{ V}, I_C = 40\text{ A}, T_J = 25^\circ\text{C}$	1.35	1.68	2.0	V
		$V_{GE} = 15\text{ V}, I_C = 40\text{ A}, T_J = 175^\circ\text{C}$		2.26		

### DYNAMIC CHARACTERISTICS

Input Capacitance	$C_{ies}$	$V_{CE} = 30\text{ V}, V_{GE} = 0\text{ V}, f = 1\text{ MHz}$		3384		pF
Output Capacitance	$C_{oes}$			139		
Reverse Transfer Capacitance	$C_{res}$			16.2		
Gate Charge Total	$Q_g$	$V_{CE} = 600\text{ V}, V_{GE} = 15\text{ V}, I_C = 40\text{ A}$		118		nC
Gate-to-Emitter Charge	$Q_{ge}$			28.8		
Gate-to-Collector Charge	$Q_{gc}$			45.4		

### SWITCHING CHARACTERISTICS

Turn-on Delay Time	$t_{d(on)}$	$V_{CE} = 600\text{ V}, V_{GE} = 0/15\text{ V}, I_C = 20\text{ A}, R_G = 4.7\ \Omega, T_J = 25^\circ\text{C}$		22.4		ns
Turn-off Delay Time	$t_{d(off)}$			160		
Rise Time	$t_r$			14.4		
Fall Time	$t_f$			78.4		mJ
Turn-on Switching Loss	$E_{on}$			1.1		
Turn-off Switching Loss	$E_{off}$			0.7		
Total Switching Loss	$E_{ts}$			1.8		
Turn-on Delay Time	$t_{d(on)}$	$V_{CE} = 600\text{ V}, V_{GE} = 0/15\text{ V}, I_C = 40\text{ A}, R_G = 4.7\ \Omega, T_J = 25^\circ\text{C}$		24.0		ns
Turn-off Delay Time	$t_{d(off)}$			118		
Rise Time	$t_r$			35.2		
Fall Time	$t_f$			67.4		mJ
Turn-on Switching Loss	$E_{on}$			2.4		
Turn-off Switching Loss	$E_{off}$			1.1		
Total Switching Loss	$E_{ts}$			3.5		

# FGHL40T120SWD

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

Parameter	Symbol	Test Conditions	Min	Typ	Max	Unit
<b>SWITCHING CHARACTERISTICS</b>						
Turn-on Delay Time	$t_{d(on)}$	$V_{CE} = 600\text{ V}, V_{GE} = 0/15\text{ V}$ $I_C = 20\text{ A}, R_G = 4.7\ \Omega, T_J = 175^\circ\text{C}$		19.2		ns
Turn-off Delay Time	$t_{d(off)}$			197		
Rise Time	$t_r$			16.0		
Fall Time	$t_f$			126		
Turn-on Switching Loss	$E_{on}$			1.8		mJ
Turn-off Switching Loss	$E_{off}$			1.1		
Total Switching Loss	$E_{ts}$			3.0		
Turn-on Delay Time	$t_{d(on)}$	$V_{CE} = 600\text{ V}, V_{GE} = 0/15\text{ V}$ $I_C = 40\text{ A}, R_G = 4.7\ \Omega, T_J = 175^\circ\text{C}$		20.8		ns
Turn-off Delay Time	$t_{d(off)}$			138		
Rise Time	$t_r$			35.2		
Fall Time	$t_f$			99.6		
Turn-on Switching Loss	$E_{on}$			3.6		mJ
Turn-off Switching Loss	$E_{off}$			1.5		
Total Switching Loss	$E_{ts}$			5.2		

### DIODE CHARACTERISTICS

Forward Voltage	$V_F$	$I_F = 40\text{ A}, T_J = 25^\circ\text{C}$	1.62	1.87	2.22	V
		$I_F = 40\text{ A}, T_J = 175^\circ\text{C}$		1.84		

### DIODE SWITCHING CHARACTERISTICS, INDUCTIVE LOAD

Reverse Recovery Time	$t_{rr}$	$V_R = 600\text{ V}, I_F = 20\text{ A},$ $di_F/dt = 1000\text{ A}/\mu\text{s}, T_J = 25^\circ\text{C}$		113		ns
Reverse Recovery Charge	$Q_{rr}$			1433		nC
Reverse Recovery Energy	$E_{REC}$			0.4		mJ
Peak Reverse Recovery Current	$I_{RRM}$			25.3		A
Reverse Recovery Time	$t_{rr}$	$V_R = 600\text{ V}, I_F = 40\text{ A},$ $di_F/dt = 1000\text{ A}/\mu\text{s}, T_J = 25^\circ\text{C}$		185		ns
Reverse Recovery Charge	$Q_{rr}$			2512		nC
Reverse Recovery Energy	$E_{REC}$			0.7		mJ
Peak Reverse Recovery Current	$I_{RRM}$			26.9		A
Reverse Recovery Time	$t_{rr}$	$V_R = 600\text{ V}, I_F = 20\text{ A},$ $di_F/dt = 1000\text{ A}/\mu\text{s}, T_J = 175^\circ\text{C}$		193		ns
Reverse Recovery Charge	$Q_{rr}$			3258		nC
Reverse Recovery Energy	$E_{REC}$			1.0		mJ
Peak Reverse Recovery Current	$I_{RRM}$			33.6		A
Reverse Recovery Time	$t_{rr}$	$V_R = 600\text{ V}, I_F = 40\text{ A},$ $di_F/dt = 1000\text{ A}/\mu\text{s}, T_J = 175^\circ\text{C}$		275		ns
Reverse Recovery Charge	$Q_{rr}$			5211		nC
Reverse Recovery Energy	$E_{REC}$			1.7		mJ
Peak Reverse Recovery Current	$I_{RRM}$			37.9		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.

# FGHL40T120SWD

## TYPICAL CHARACTERISTICS

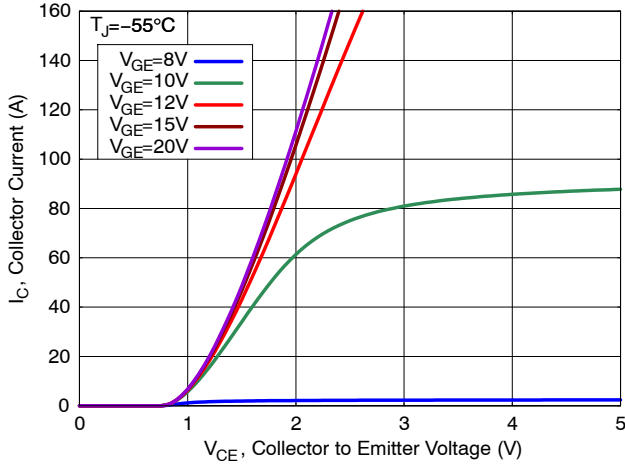


Figure 1. Output Characteristics

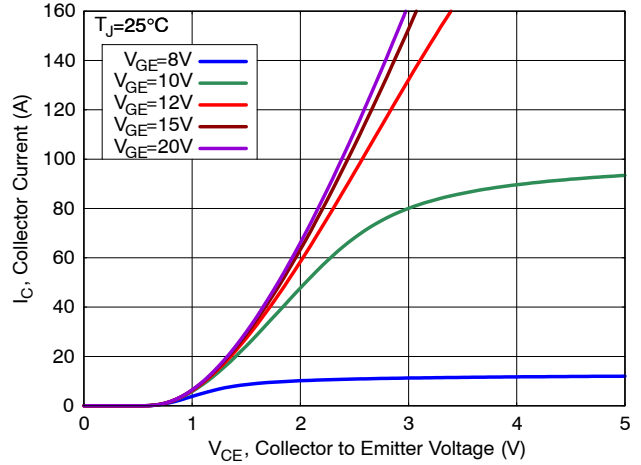


Figure 2. Output Characteristics

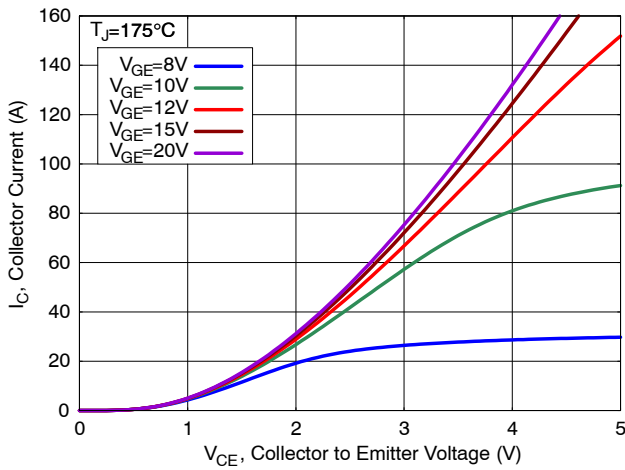


Figure 3. Output Characteristics

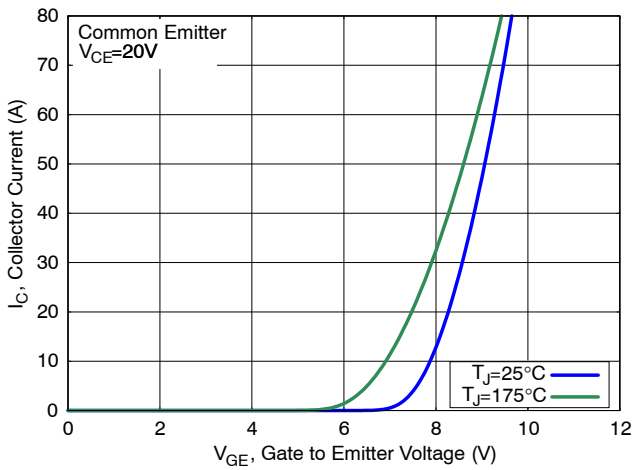


Figure 4. Transfer Characteristics

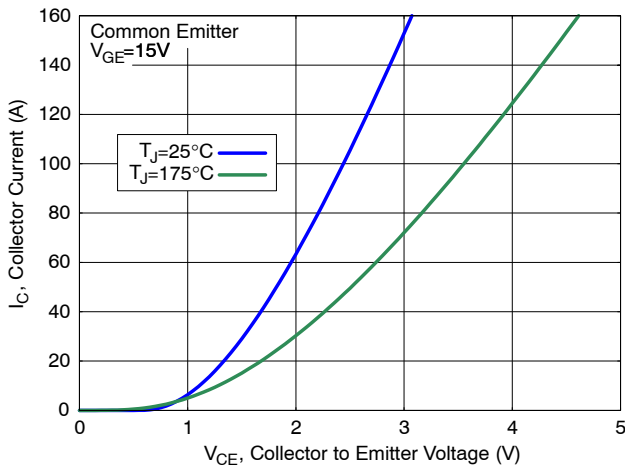


Figure 5. Saturation Characteristics

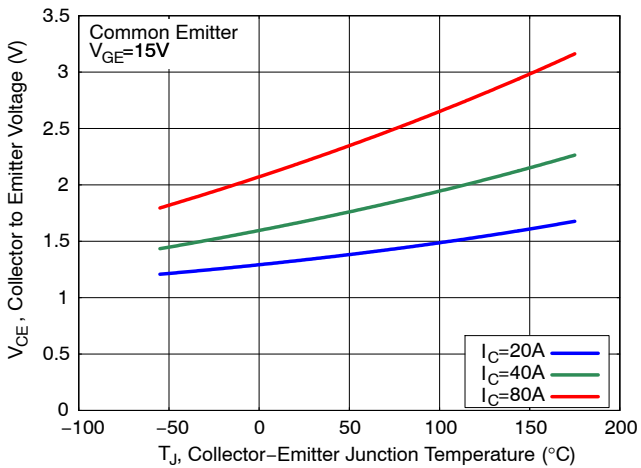


Figure 6. Saturation Voltage vs. Junction Temperature

# FGHL40T120SWD

## TYPICAL CHARACTERISTICS

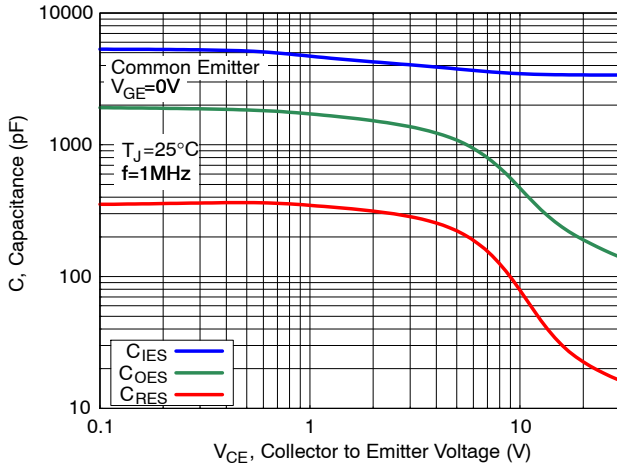


Figure 7. Capacitance Characteristics

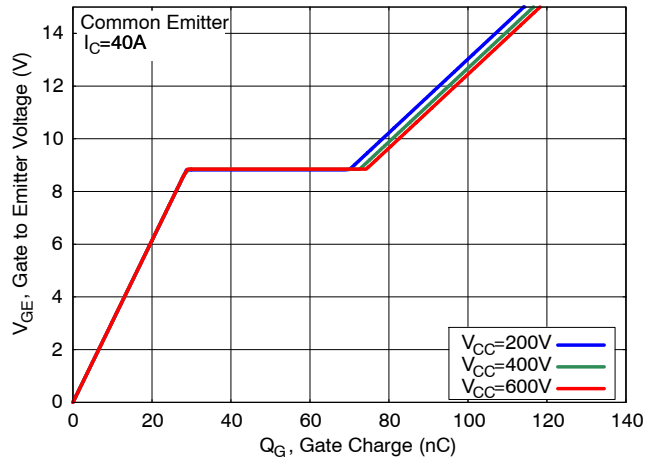


Figure 8. Gate Charge Characteristics

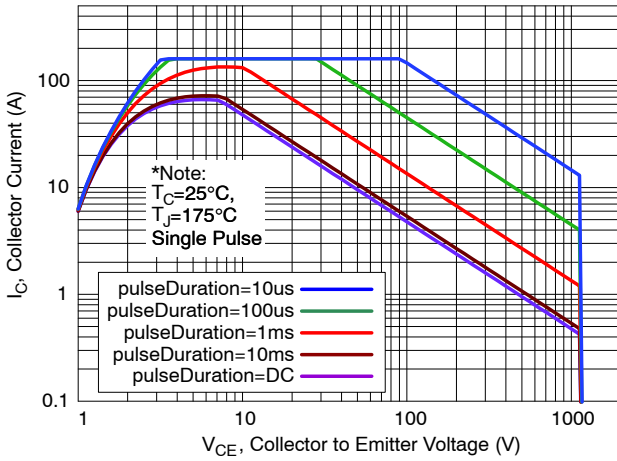


Figure 9. SOA Characteristics

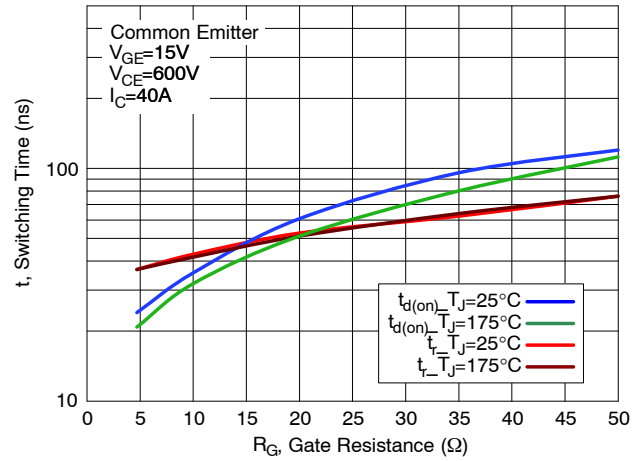


Figure 10. Turn-On Switching Time vs. Gate Resistance

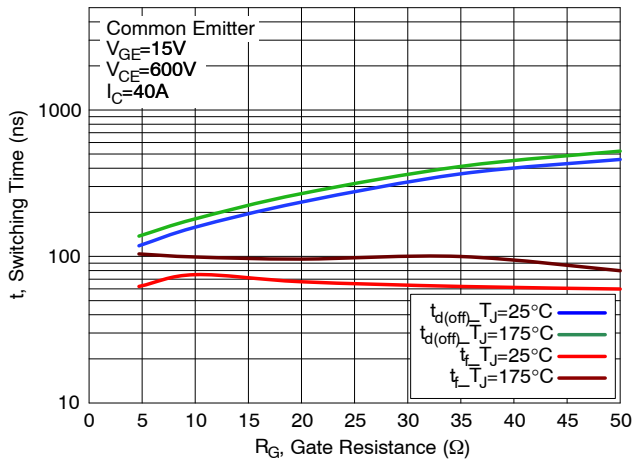


Figure 11. Turn-Off Switching Time vs. Gate Resistance

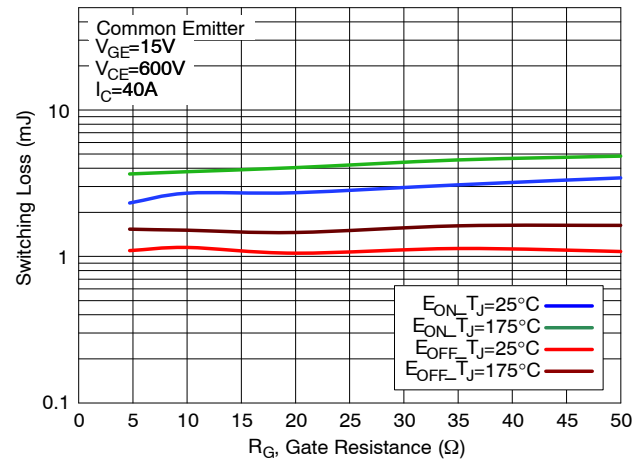


Figure 12. Switching Loss vs. Gate Resistance

# FGHL40T120SWD

## TYPICAL CHARACTERISTICS

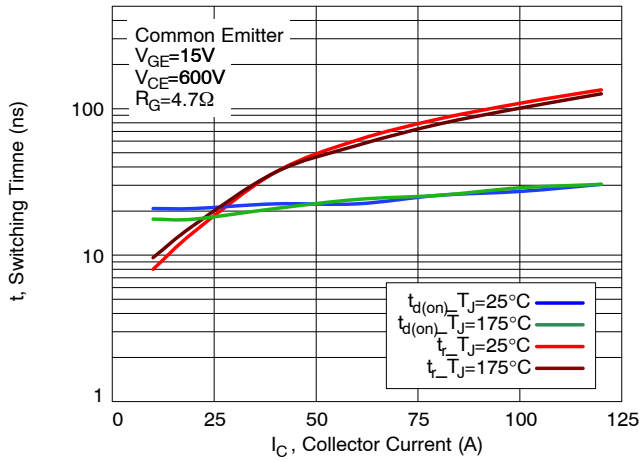


Figure 13. Turn-On Switching Time vs. Collector Current

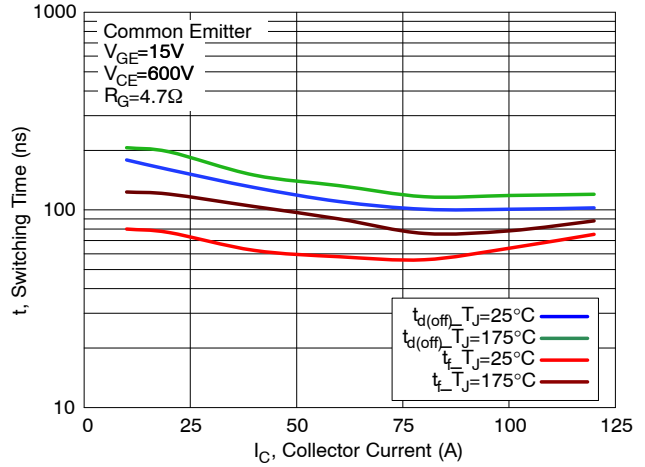


Figure 14. Turn-Off Switching Time vs. Collector Current

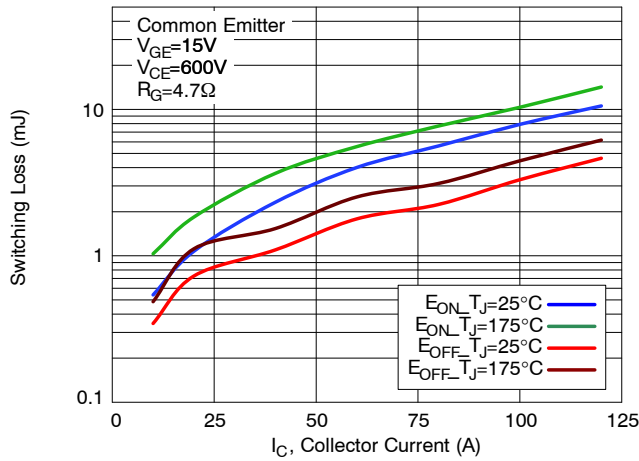


Figure 15. Switching Loss vs. Collector Current

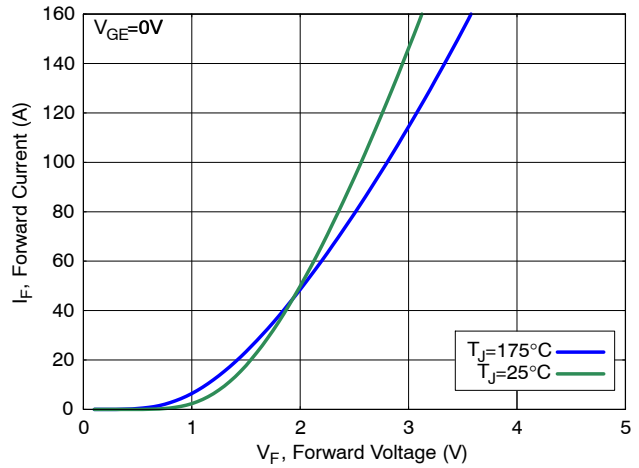


Figure 16. Diode Forward Characteristics

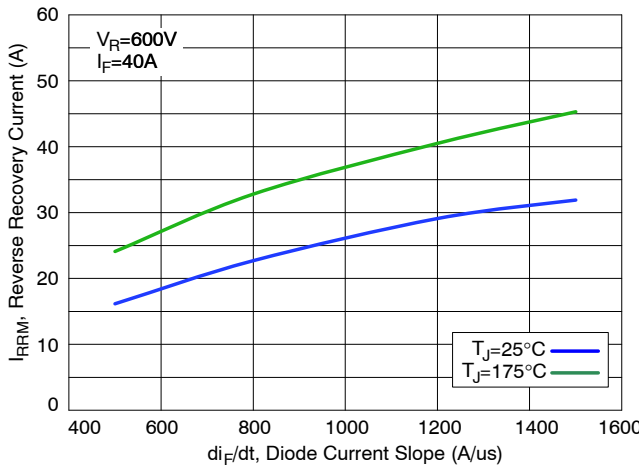


Figure 17. Diode Reverse Recovery Current

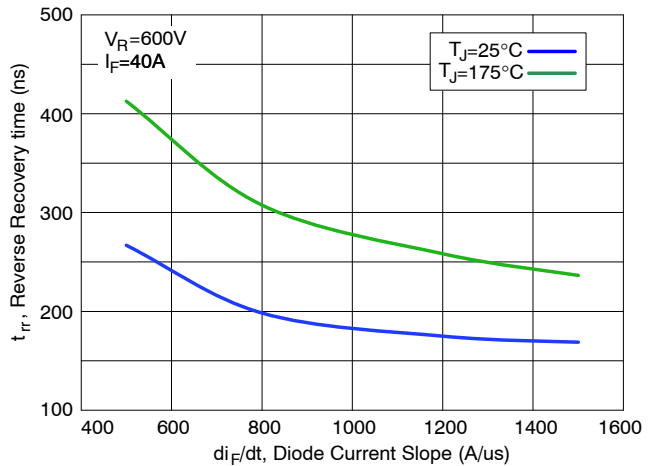


Figure 18. Diode Reverse Recovery Time

# FGHL40T120SWD

## TYPICAL CHARACTERISTICS

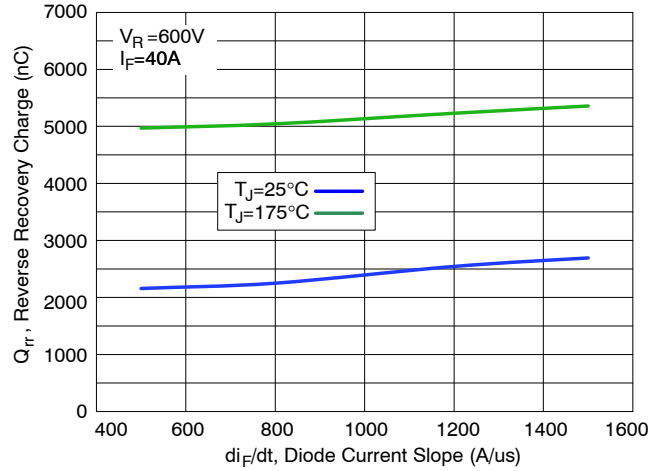


Figure 19. Diode Stored Charge Characteristics

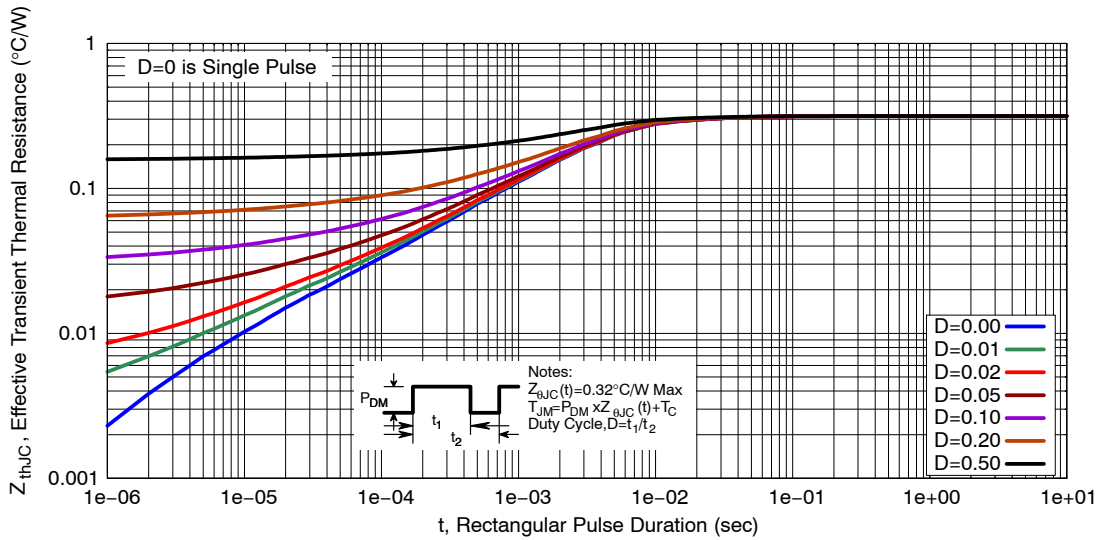


Figure 20. Transient Thermal Impedance of IGBT

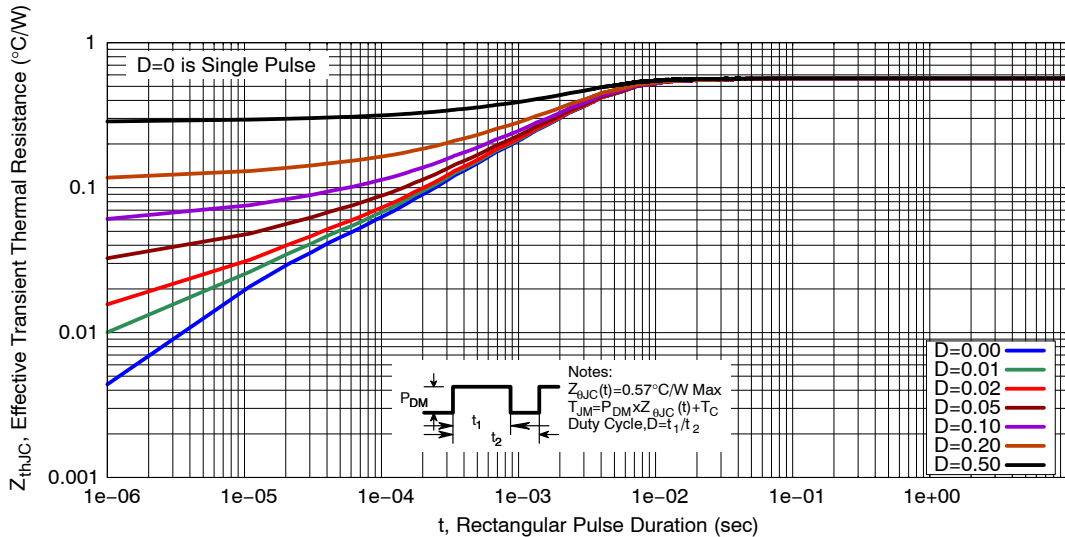


Figure 21. Transient Thermal Impedance of Diode





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