

### Description

Using Trench design and advance FS technology, the 650V FS IGBT offers superior and switching performances, high avalanche ruggedness easy parallel operation



### Features

- FS Trench Technology, Positive temperature coefficient
- Low saturation voltage:  $V_{CE(sat)}(typ.) = 1.8V @ I_C = 40A, T_j = 25^\circ C$
- Extremely enhanced avalanche capability
- Maximum Junction Temperature  $175^\circ C$

Product Summary		
$V_{CES}(V)$	$V_{CESAT}(V)Typ$	$I_C(A)$
650	1.8 @ 15V,40A	40

### Mechanical Data

- Case: TO-247 Package

### Application

- Uninterrupted Power Supply
- Welding Converters
- Solar Converters
- PFC

TO-247  
GP40N65FTD



### Block Diagram

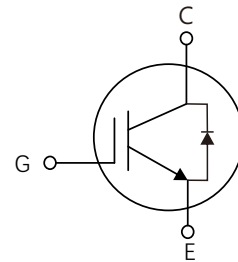


Table1 Absolute Maximum Ratings ( $T_c = 25^\circ C$ , unless otherwise specified)

Parameters	Symbol	Value	Unit
Collector-Emmitter Voltage	$V_{CES}$	650	V
Gate-Emmitter Voltage	$V_{GES}$	$\pm 20$	V
Collector Current-continuous	$I_C$	$T_c = 25^\circ C$	80
		$T_c = 100^\circ C$	40
Collector Current – pulse (Note 1)	$I_{CM}$	160	A
Power Dissipation	$P_D$	$T_c = 25^\circ C$	280
		$T_c = 100^\circ C$	140
Operating Junction Temperature	$T_j$	-55 ~ +175	$^\circ C$
Storage Temperature Range	$T_{STG}$	-55 ~ +150	

Table 2. Thermal Characteristics

Parameters	Symbol	Value	Unit
IGBT Thermal resistance Junction to Ambient	$R_{\theta JA}$	40	$^{\circ}\text{C}/\text{W}$
IGBT Thermal resistance Junction to Case	$R_{\theta JC}$	0.52	$^{\circ}\text{C}/\text{W}$
Diode Thermal resistance Junction to Case	$R_{\theta JC}$	0.79	$^{\circ}\text{C}/\text{W}$

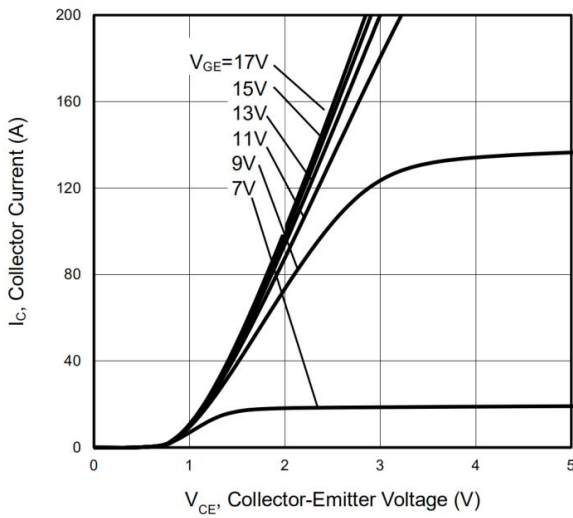
Table 3. Electrical Characteristics ( $T_J=25^{\circ}\text{C}$ , unless otherwise specified)

Parameters	Symbol	Test Conditions	Min	Typ	Max	Unit	
Off Characteristics							
Collector-Emmitter Voltage	$BV_{CES}$	$V_{GE}=0\text{V}, I_C=250\mu\text{A}$	650			V	
Zero Gate Voltage Collector Current	$I_{CES}$	$V_{CE}=650\text{V}, V_{GE}=0\text{V}$			10	$\mu\text{A}$	
Gate-body Leakage Current	Forward	$I_{GES}$ $V_{GS}=20\text{V}, V_{DS}=0\text{V}$ $V_{GS}=-20\text{V}, V_{DS}=0\text{V}$			200	nA	
	Reverse				-200	nA	
On Characteristics							
Gate Threshold Voltage	$V_{GE(TH)}$	$V_{CE}=V_{GE}, I_C=0.5\text{mA}$	3.5	5.0	6.5	V	
Collector-Emmitter saturation Voltage	$V_{CESAT}$	$V_{GE}=15\text{V}, I_C=40\text{A}$	$T_J=25^{\circ}\text{C}$	1.8	2.3	V	
			$T_J=175^{\circ}\text{C}$	2.3			
Dynamic Characteristics							
Input Capacitance	$C_{IES}$	$V_{CE}=25\text{V}, V_{GE}=0\text{V}, f=1\text{MHz}$		1565		pF	
Output Capacitance	$C_{OES}$			37		pF	
Reverse Transfer Capacitance	$C_{RES}$			120		pF	
Switching Characteristics							
Turn-On Delay Time	$t_d(\text{on})$	$V_{CE}=400\text{V}, I_C=40\text{A},$ $V_{GE}=15\text{V}, R_G=10\Omega,$ $V_{CE}=480\text{V}, I_C=40\text{A},$ $V_{GE}=15\text{V}$		30		ns	
Turn-On Rise Time	$t_r$			24		ns	
Turn-Off Delay Time	$t_d(\text{off})$			170		ns	
Turn-Off Fall Time	$t_f$			22		ns	
Total Gate Charge	$Q_G$				186		nC
Gate to emitter charge	$Q_{GE}$				42		nC
Gate to collector charge	$Q_{GC}$			76		nC	
Diode Characteristics							
Diode Continuous Forward Current	$I_F$	$T_C=100^{\circ}\text{C}$	40				
Diode Continuous Forward Current	$I_{FM}$	$T_C=100^{\circ}\text{C}$	200				
Diode Forward Voltage	$V_F$	$I_F=40\text{A}$		1.85	2.25	V	
Reverse Recovery Time	$T_{rr}$	$I_F=40\text{A}, T_J=25^{\circ}\text{C}$		80		ns	
Reverse Recovery Charge	$Q_{rr}$	$di/dt=200\text{A}/\mu\text{S}$		4.9		nC	

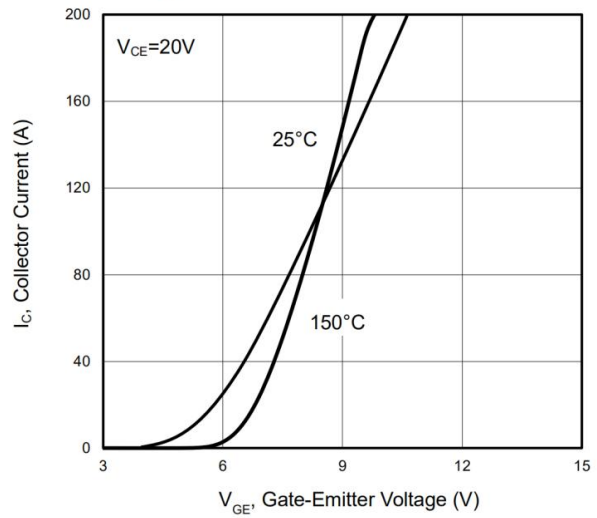
Notes: 1 Repetitive Rating:Pulse width limited by maximum junction temperature

Typical Characteristics Diagrams

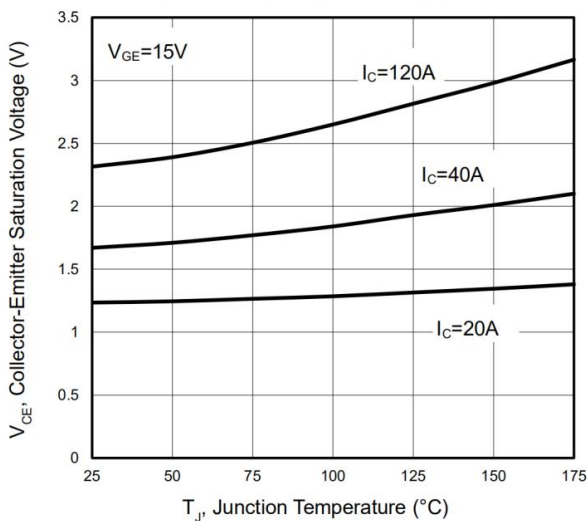
**Figure 1 Output Characteristics**



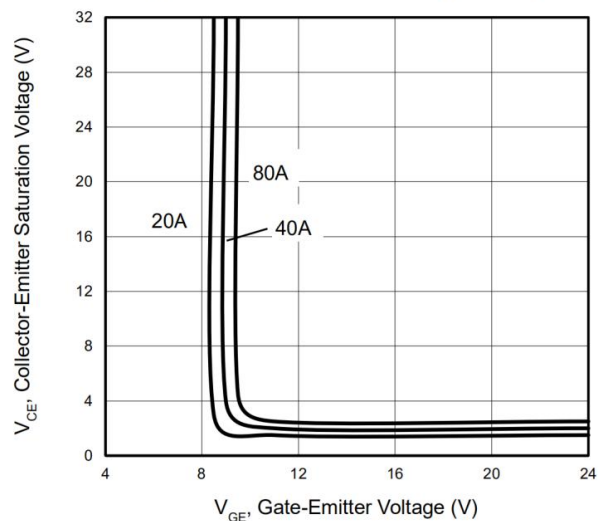
**Figure 2 Transfer Characteristics**



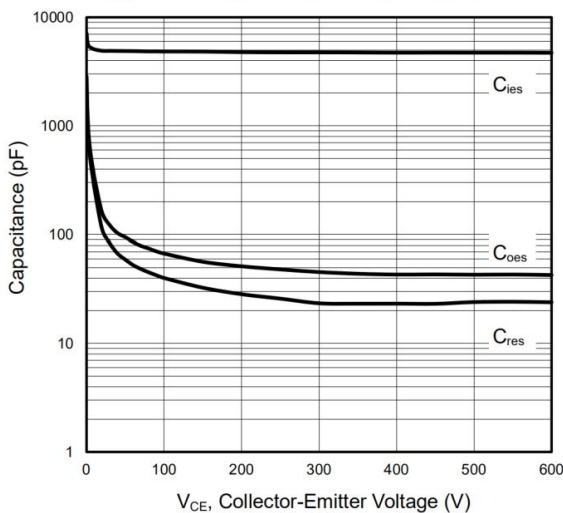
**Figure 3  $V_{CE(sat)}$  vs. Temperature**



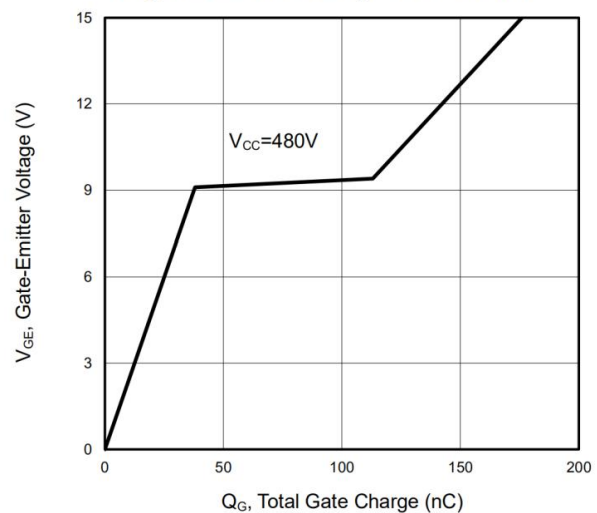
**Figure 4 Saturation Voltage vs.  $V_{GE}$**



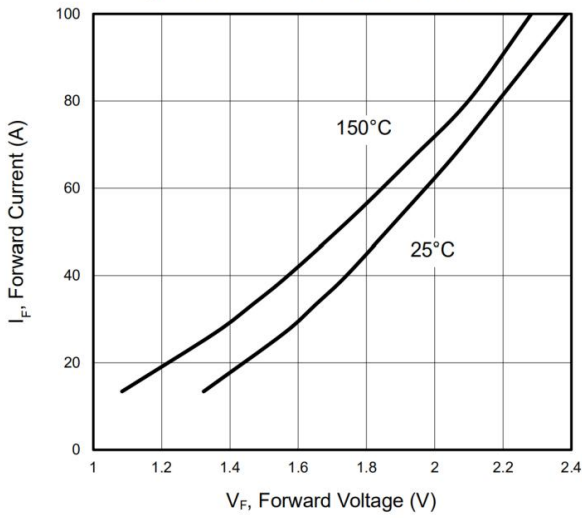
**Figure 5 Capacitance Characteristics**



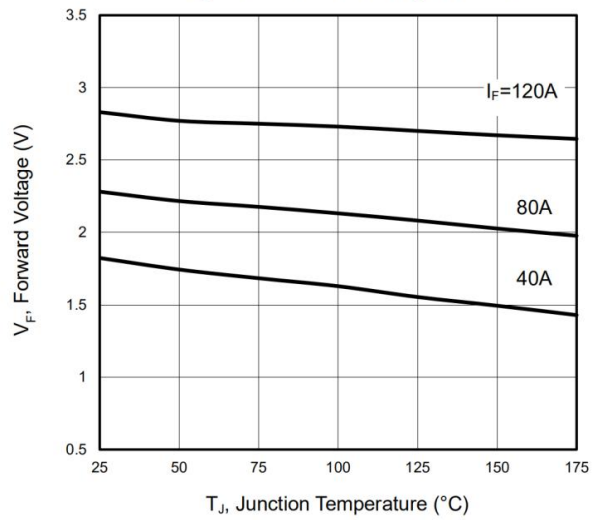
**Figure 6 Gate Charge Wave Form**



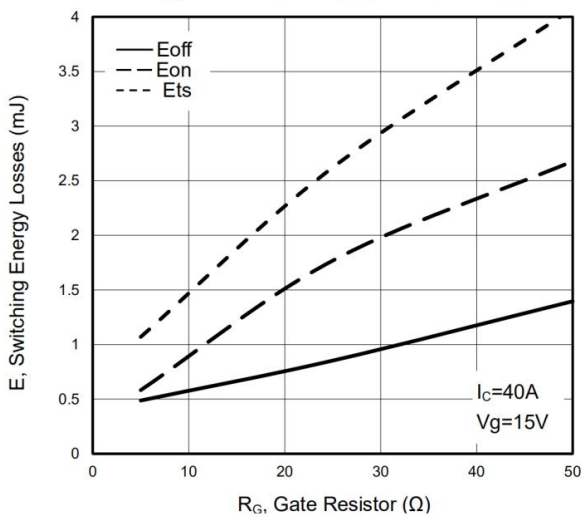
**Figure 7 Forward Characteristics**



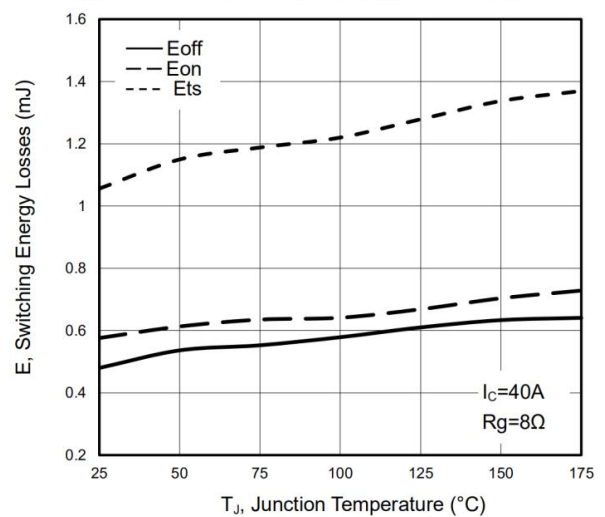
**Figure 8  $V_F$  vs. Temperature**



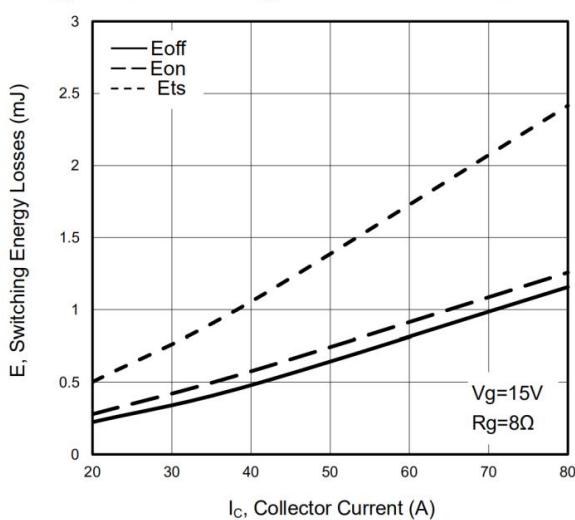
**Figure 9 Switching Loss vs.  $R_G$**



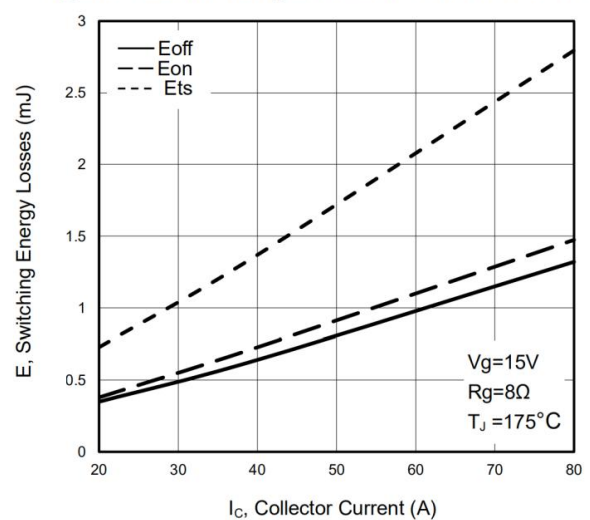
**Figure 10 Switching Energy vs. Temperature**



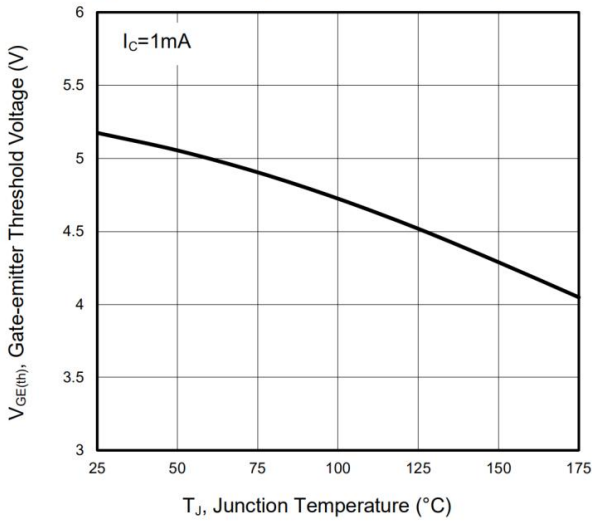
**Figure 11 Switching Loss vs. Collector Current**



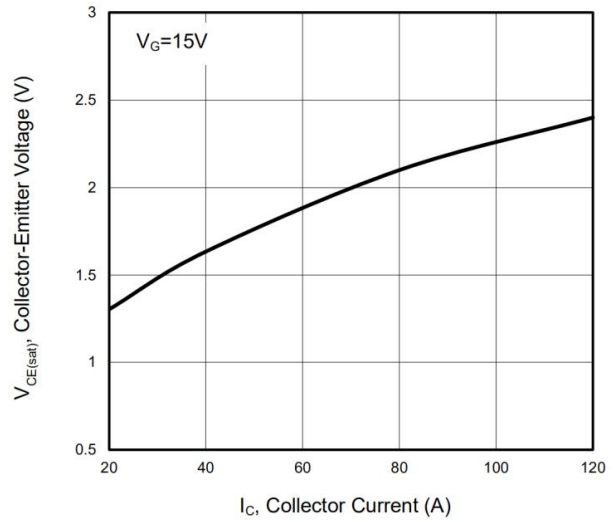
**Figure 12 Switching Loss vs. Collector Current**



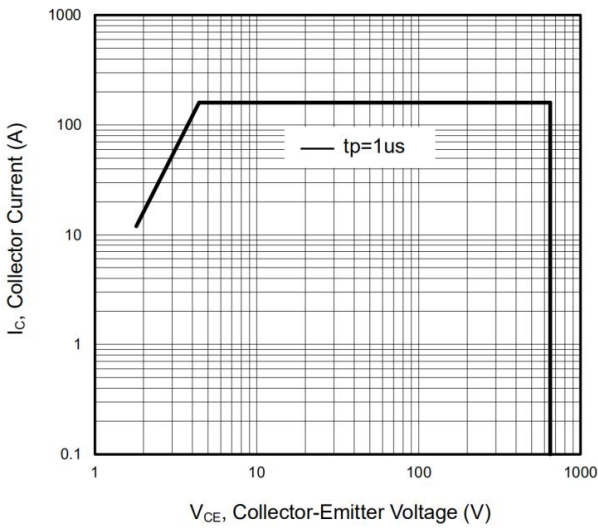
**Figure 13  $V_{GE(th)}$  vs. Junction Temperature**



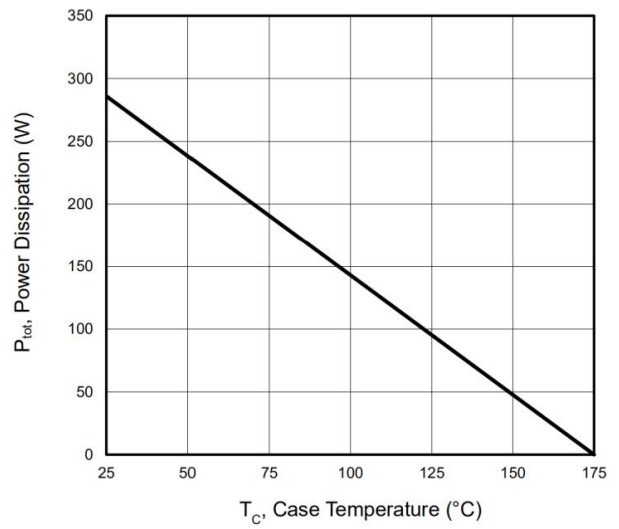
**Figure 14  $V_{CE(sat)}$  vs. Collector Current**



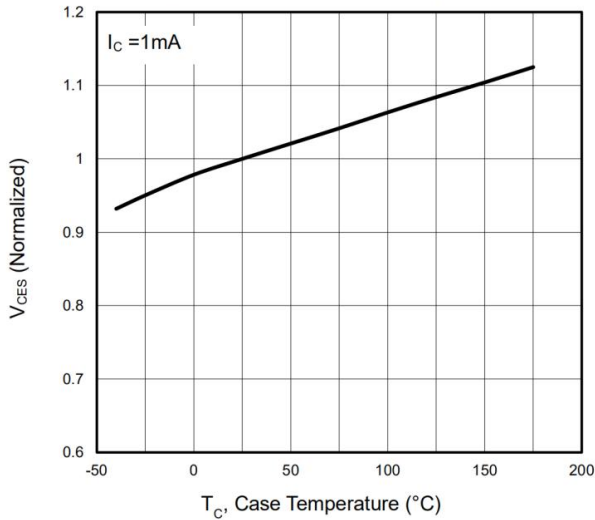
**Figure 15 Forward Bias Safe Operating Area**



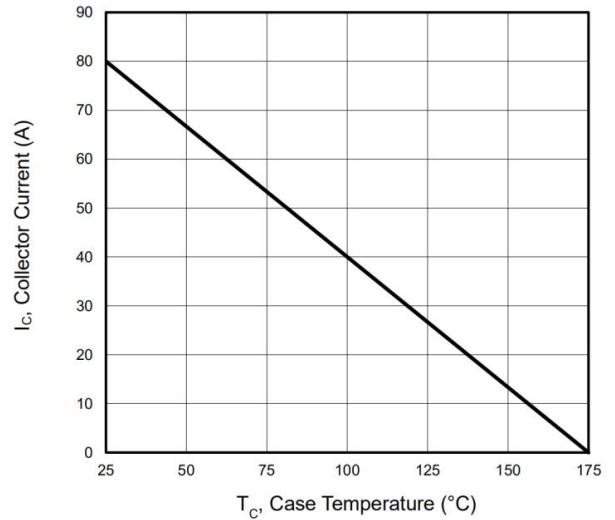
**Figure 16  $P_{tot}$  vs. Case Temperature**



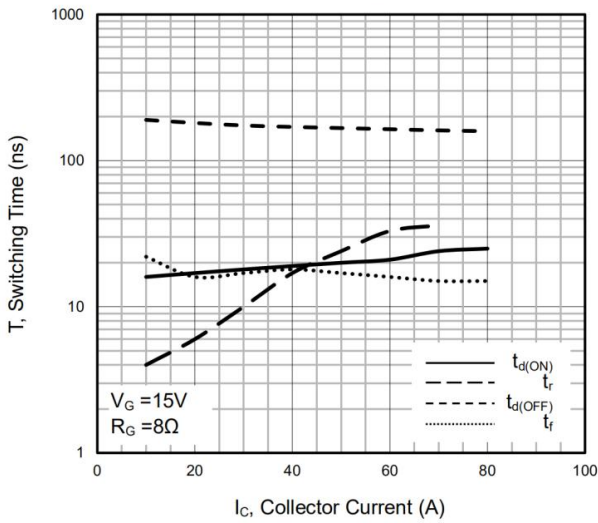
**Figure 17  $V_{CES}$  vs. Temperature**



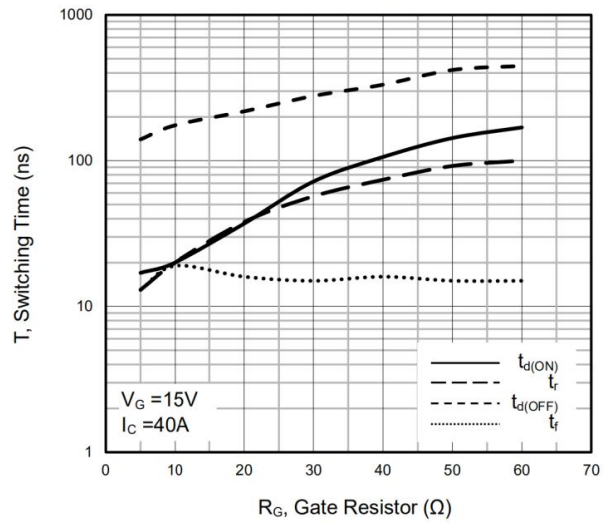
**Figure 18  $I_C$  vs. Temperature**



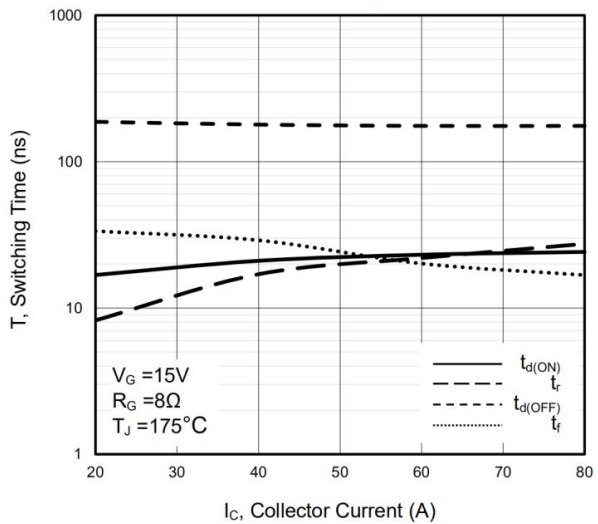
**Figure 19 Switching Time vs.  $I_C$**



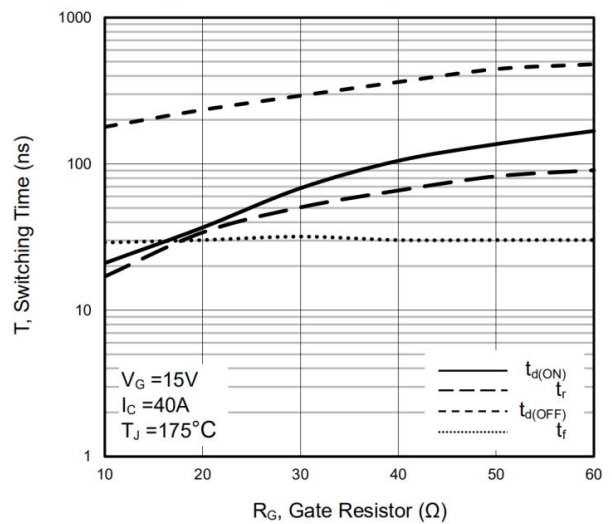
**Figure 20 Switching Time vs.  $R_G$**



**Figure 21 Switching Time vs.  $I_C$**



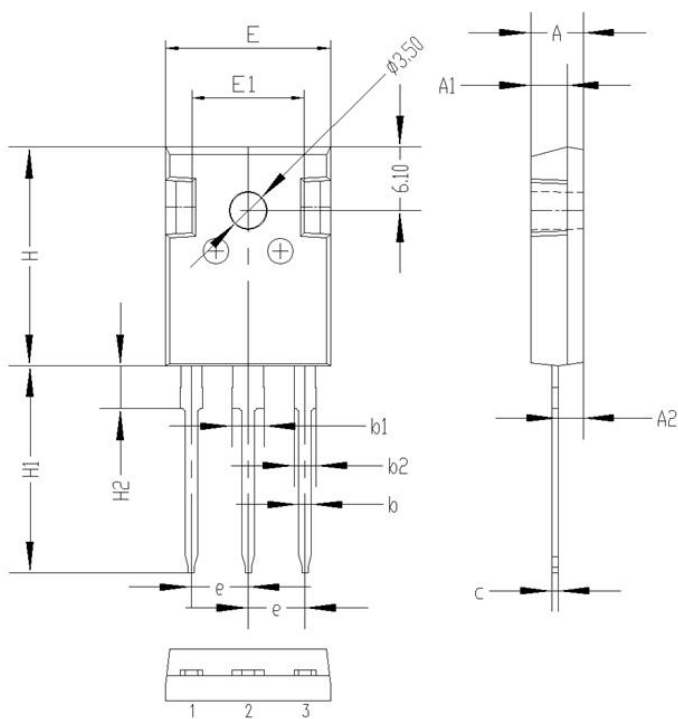
**Figure 22 Switching Time vs.  $R_G$**



Dimensions

TO-247 PACKAGE OUTLINE DIMENSIONS

TO-247 PACKAGE



Symbol	Dimensions (millimeters)	
	Min.	Max.
A	4.80	5.20
A1	3.30	3.70
A2	2.10	2.50
b	1.00	1.40
b1	2.90	3.30
b2	1.90	2.30
c	0.40	0.80
e	5.25	5.65
E	15.6	16.0
E1	10.6	11.6
H	20.8	21.2
H1	19.4	20.4
H2	3.90	4.30
G	5.90	6.30
ΦP	3.30	3.70

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