

FGAF40N60SMD-VB Datasheet

650V Trench and Fieldstop IGBT

PRODUCT SUMMARY		
V_{CE} (V)	650	
I_C (A)	120 (TC=25 °C)	60 (TC=100 °C)
$V_{CE(sat)}$ (V)	1.7	
I_{CM} (A)	180	

FEATURES

- Very Low V_{CEsat}
- Low turn-off losses
- High speed switching
- Maximum junction temperature 175°C
- Ultra low gate charge (Q_g)
- Avalanche energy rated (UIS)



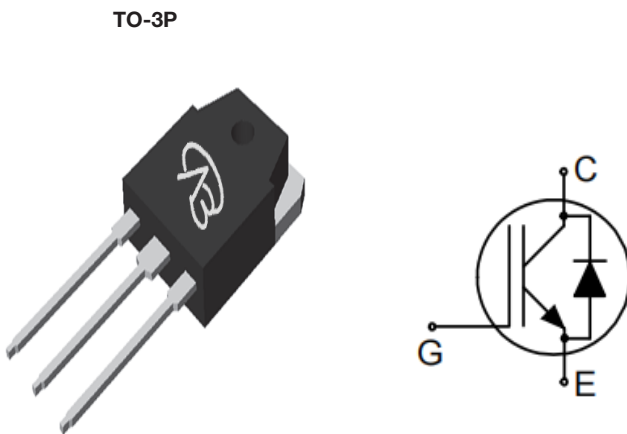
RoHS
COMPLIANT
HALOGEN
FREE

APPLICATIONS

- Telecommunications
 - Server and telecom power supplies
- Lighting
 - High-intensity discharge (HID)
 - Fluorescent ballast lighting
- Consumer and computing
 - ATX power supplies
- Industrial
 - Welding
 - Battery chargers
- Renewable energy
 - Solar (PV inverters)
- Switch mode power supplies (SMPS)

Package pin definition

- Pin1 G - Gate
- Pin2 C & backside - Collector
- Pin3 E - Emitter



ABSOLUTE MAXIMUM RATINGS ($T_C = 25\text{ °C}$, unless otherwise noted)				
PARAMETER		SYMBOL	LIMIT	UNIT
Collector-Emitter Voltage		V_{CE}	650	V
Gate-Emitter Voltage		V_{GE}	± 30	
Continuous Collector Current ($T_J = 150\text{ °C}$)	V_{GE} at 15 V	I_C	$T_C = 25\text{ °C}$	120
			$T_C = 100\text{ °C}$	60
Pulsed Collector Current ^a		I_{CM}	180	A
Diode Forward Current ^b		I_F	60	A
Maximum Power Dissipation		P_D	$T_C = 25\text{ °C}$	450
			$T_C = 100\text{ °C}$	200
Operating Junction and Storage Temperature Range		T_J, T_{stg}	-55 to +175	°C
Short Circuit Withstand Time $T_C=150$	$V_{GE}= 15V, V_{CE} = 400V$	tsc	3	μs
Short Circuit Withstand Time $T_C=100$	$V_{GE}= 15V, V_{CE} = 330V$		5	
Soldering Recommendations (Peak Temperature) ^c			for 10 s	260
				°C

Notes

- Repetitive rating; pulse width limited by maximum junction temperature.
- Current limited by maximum junction temperature.
- 1.6 mm from case.

THERMAL RESISTANCE RATINGS				
PARAMETER	SYMBOL	TYP.	MAX.	UNIT
Maximum Junction-to-Ambient	R_{thJA}	-	40	°C/W
Maximum Junction-to-Case	R_{thJC}	-	0.5	

SPECIFICATIONS ($T_J = 25\text{ }^\circ\text{C}$, unless otherwise noted)							
PARAMETER	SYMBOL	TEST CONDITIONS		MIN.	TYP.	MAX.	UNIT
Static							
Collector-Emitter Breakdown Voltage	BV_{CE}	$V_{GE} = 0\text{ V}, I_C = 250\text{ }\mu\text{A}$ $V_{GE} = 0\text{ V}, I_C = 1\text{ mA}$		650 650	- -	- -	V
Gate-Source Threshold Voltage (N)	$V_{GE(th)}$	$V_{CE} = V_{GE}, I_D = 250\text{ }\mu\text{A}$		4	5	6	V
Zero Gate Voltage Collector Current	I_{CES}	$V_{CE} = 650\text{ V}, V_{GE} = 0\text{ V}, T_J = 25\text{ }^\circ\text{C}$		-	1	20	μA
		$V_{CE} = 650\text{ V}, V_{GE} = 0\text{ V}, T_J = 150\text{ }^\circ\text{C}$		-	1000	-	μA
Gate-Emitter Leakage Current	I_{GES}	$V_{CE} = 0\text{ V}, V_{GS} = \pm 2\text{ V}$		-	-	100	nA
Collector-Emitter Saturation Voltage	$V_{CE(sat)}$	$V_{GE} = 15\text{ V}$	$I_C = 60\text{ A}$	-	1.8	2.1	V
Forward Transconductance	g_{fs}	$V_{CE} = 20\text{ V}, I_C = 60\text{ A}$		-	40	-	S
Dynamic							
Input Capacitance	C_{ies}	$V_{GE} = 0\text{ V}, V_{CE} = 25\text{ V},$ $f = 500\text{ KHz}$		-	6210	-	pF
Output Capacitance	C_{oes}			-	228	-	
Reverse Transfer Capacitance	C_{res}			-	60	-	
Turn-on Energy	E_{on}	$V_{CE} = 400\text{ V}, V_{GE} = 0/15\text{V},$ $I_C = 60\text{ A}, R_g = 10\text{ }\Omega$		-	0.76	-	nJ
Turn-off Energy	E_{off}			-	0.26	-	
Total Gate Charge	Q_g	$V_{GE} = 15\text{ V}$	$I_C = 60\text{ A}, V_{CE} = 400\text{ V}$	-	165	-	nC
Gate-Emitter Charge	Q_{ge}			-	18	-	
Gate to Collector Charge	Q_{gc}			-	2 3	-	
Turn-On Delay Time	$t_{d(on)}$	$V_{CE} = 400\text{ V}, V_{GE} = 0/15\text{V},$ $I_C = 60\text{ A}, R_g = 10\text{ }\Omega$		-	72	-	ns
Rise Time	t_r			-	42	-	
Turn-Off Delay Time	$t_{d(off)}$			-	170	-	
Fall Time	t_f			-	26	-	
Internal emitter inductance measured 5 mm	L_E			-	13	-	
Diode Characteristics							
Diode Forward Current	I_F	IGBT symbol showing the integral reverse junction diode		-	-	60	A
Pulsed Diode Forward Current	I_{FM}			-	-	180	
Diode Forward Voltage	V_F	$I_F = 60\text{ A}$		-	1.50	2.0	V
Reverse Recovery Time	t_{rr}	$T_J = 25\text{ }^\circ\text{C}, I_F = 60\text{ A},$ $dI_F/dt = 200\text{ A}/\mu\text{s}, V_R = 400\text{ V}$		-	60	-	ns
Reverse Recovery Charge	Q_{rr}			-	0.3	-	μC
Reverse Recovery Current	I_{RRM}			-	11	-	A

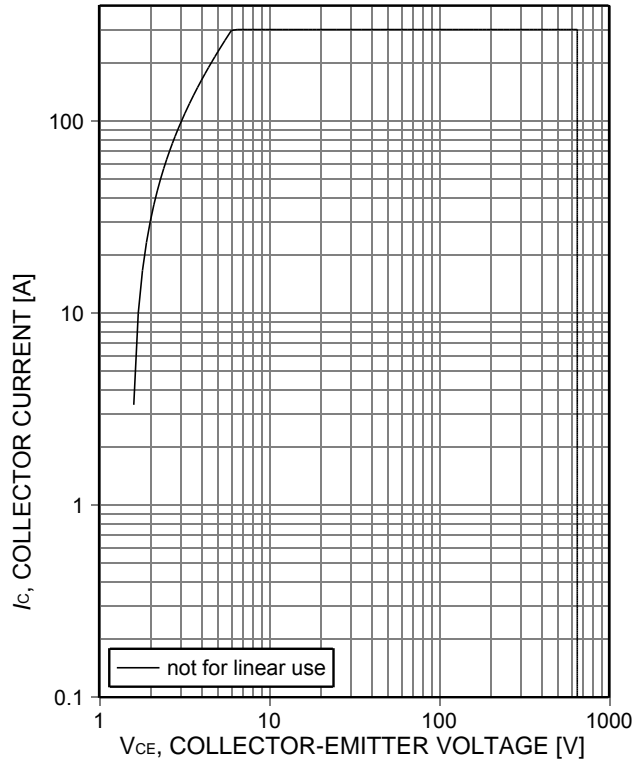


Figure 1. Forward bias safe operating area



Figure 2. Power dissipation as a function of case

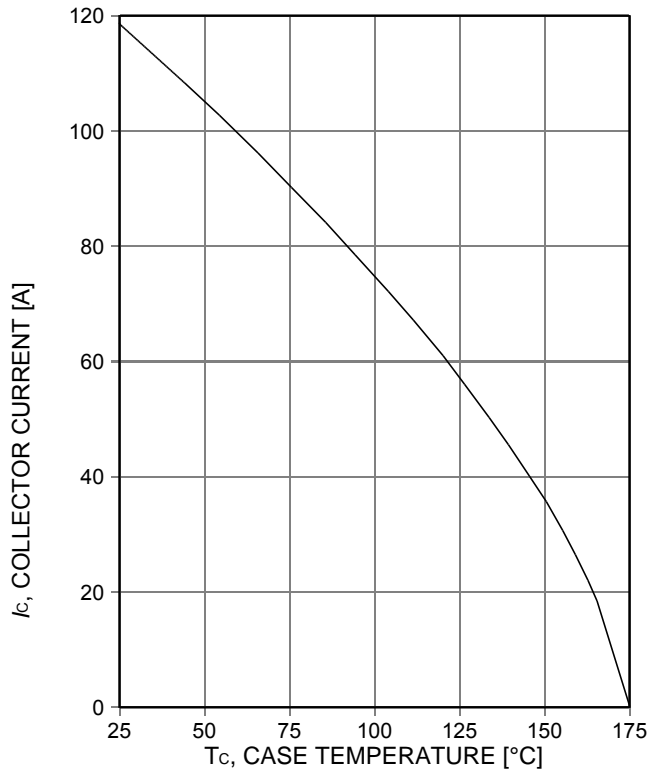


Figure 3. Collector current as a function of case temperature



Figure 4. Typical output characteristic

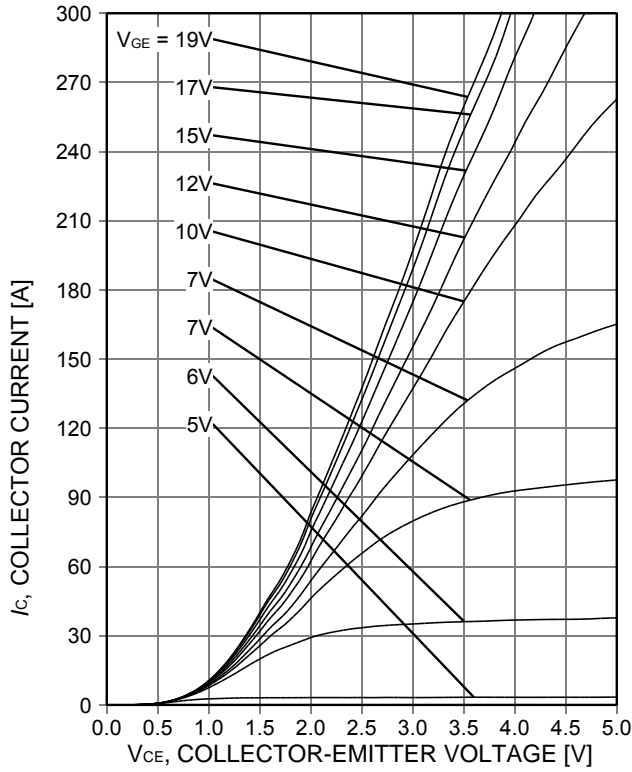


Figure 5. Typical output characteristic



Figure 6. Typical transfer characteristic

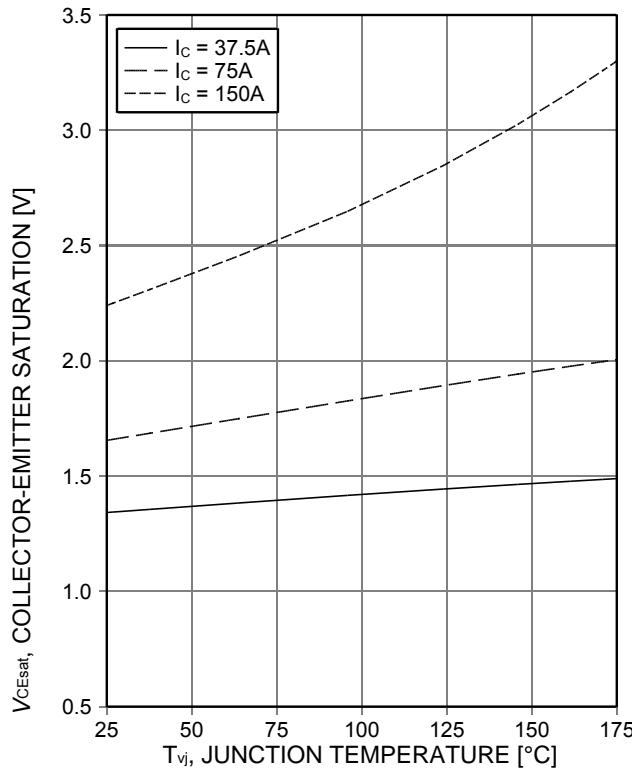


Figure 7. Typical collector-emitter saturation voltage as a function of junction temperature

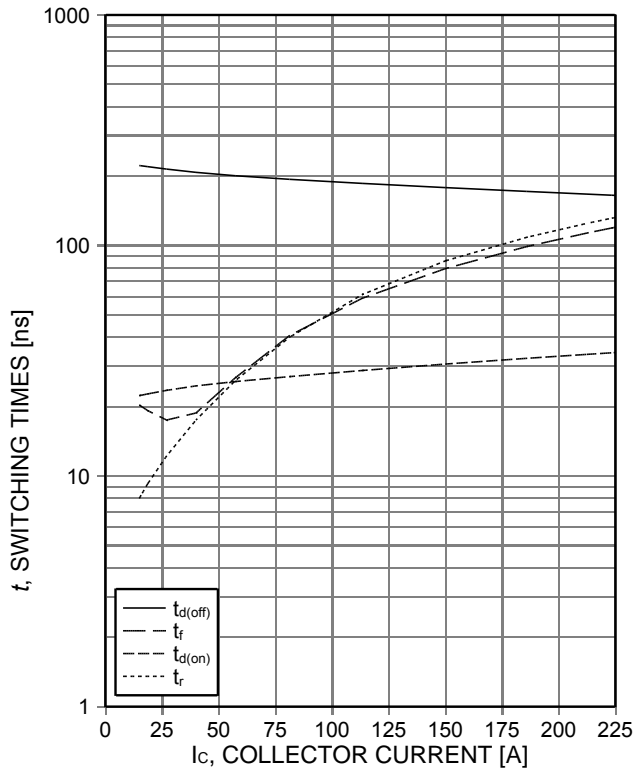


Figure 8. Typical switching times as a function of collector current

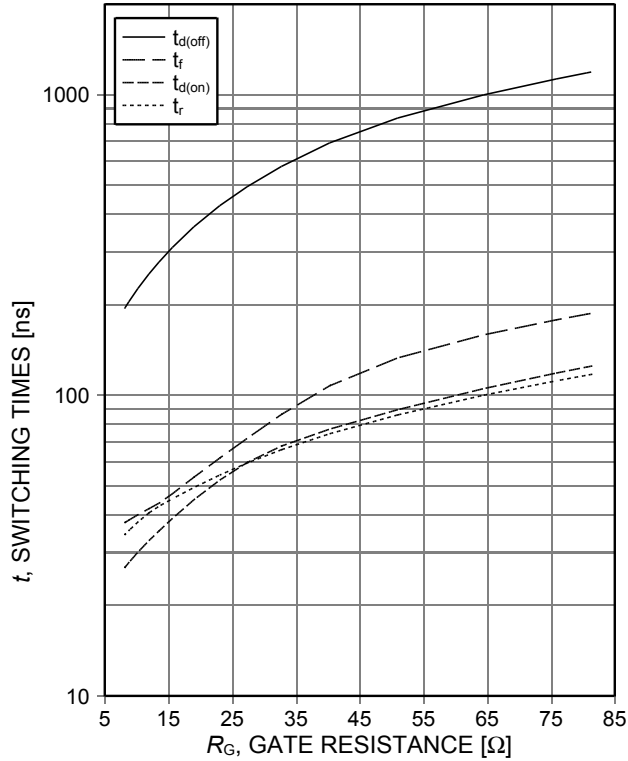


Figure 9. Typical switching times as a function of gate resistance

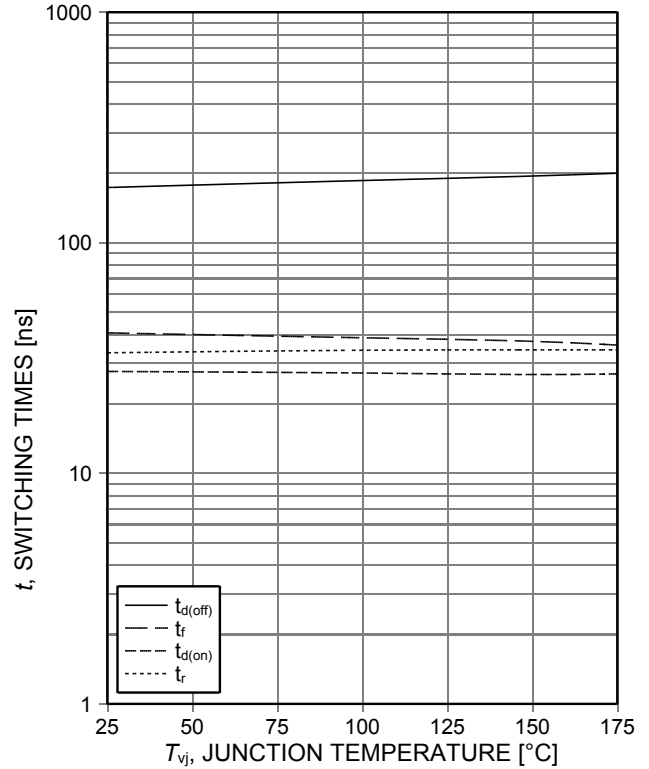


Figure 10. Typical switching times as a function of junction temperature

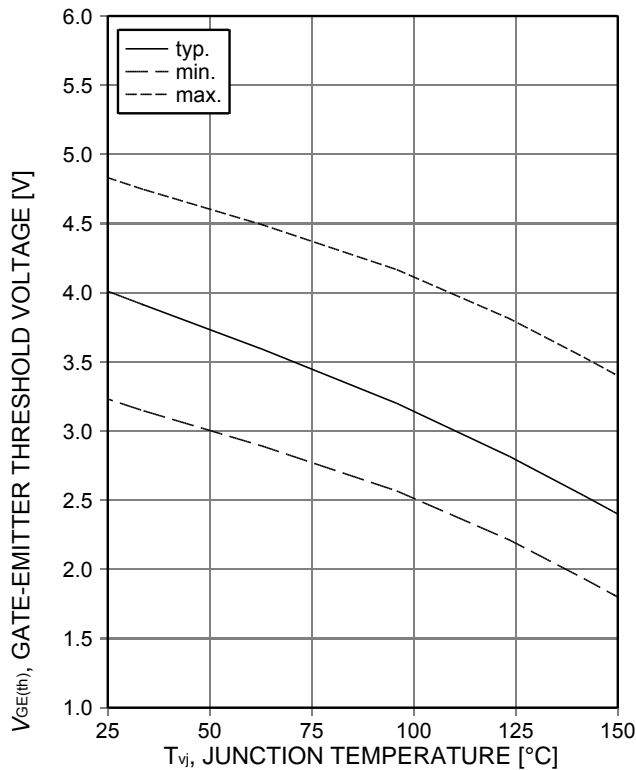


Figure 11. Gate-emitter threshold voltage as a function of junction temperature

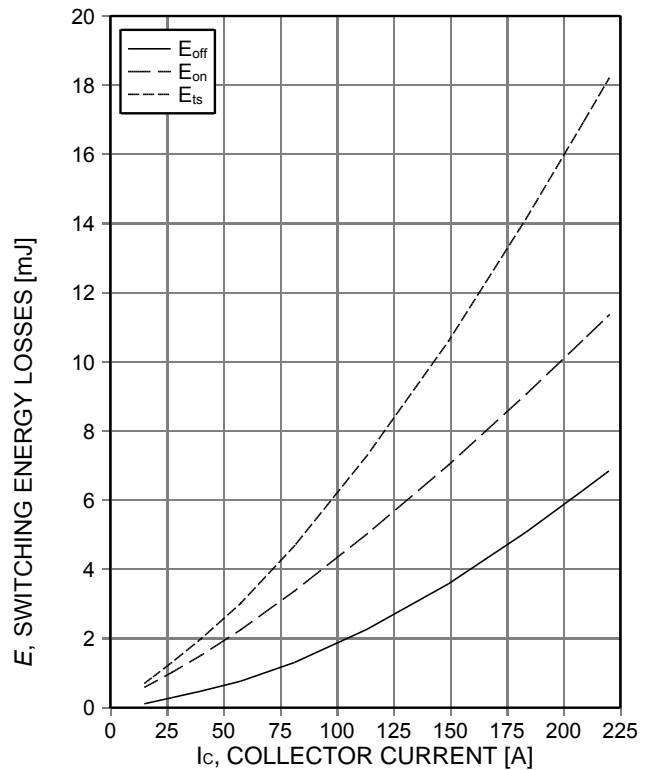


Figure 12. Typical switching energy losses as a function of collector current

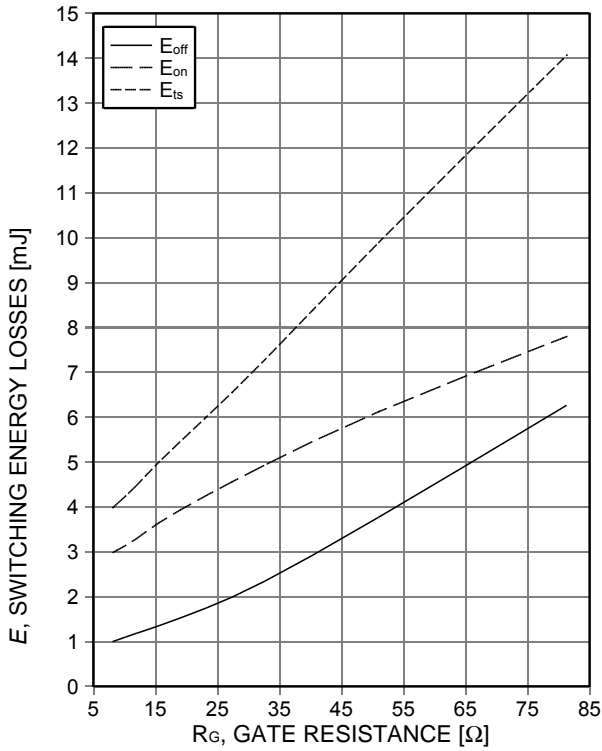


Figure 13. Typical switching energy losses as a function of gate resistance

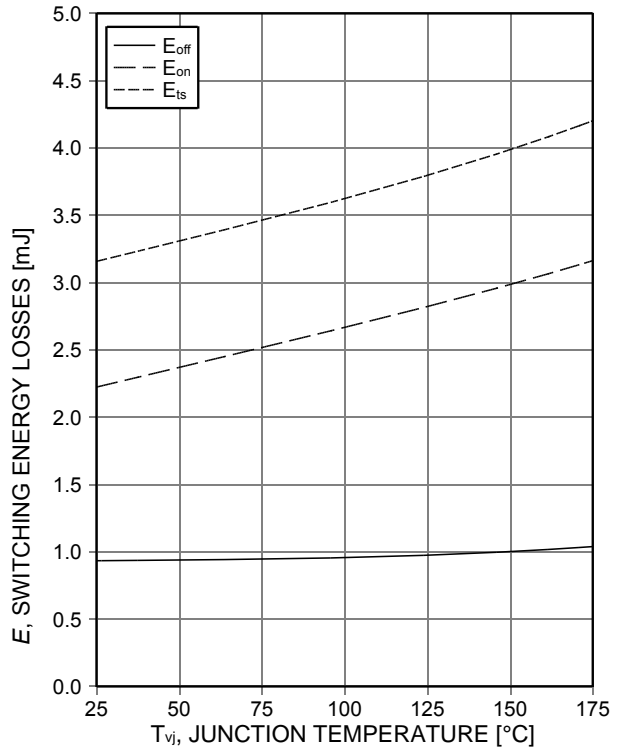


Figure 14. Typical switching energy losses as a function of junction temperature

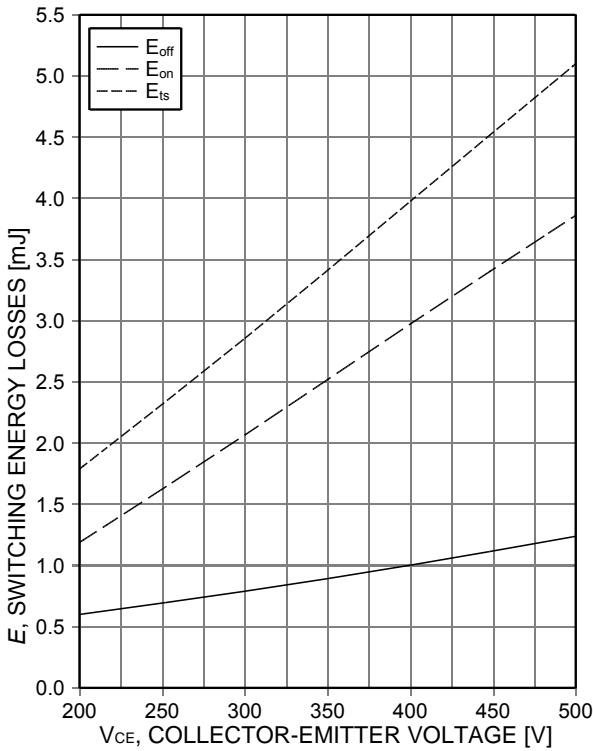


Figure 15. Typical switching energy losses as a function of collector emitter voltage

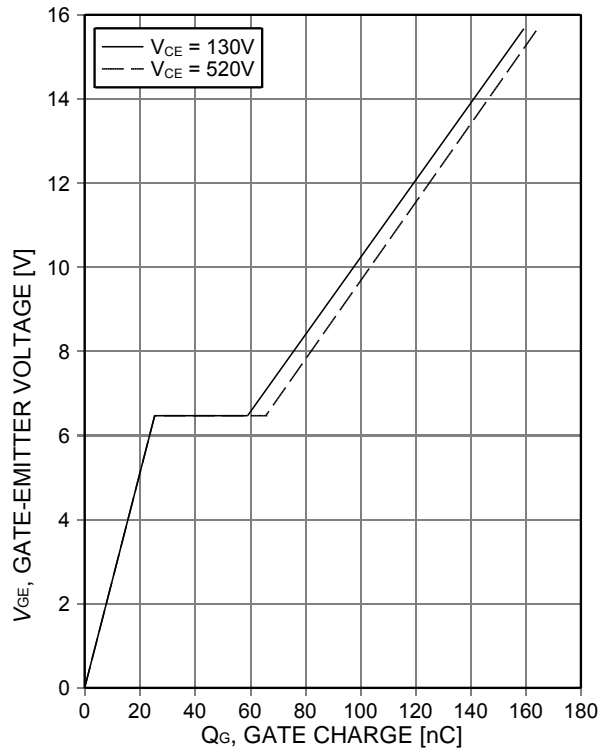


Figure 16. Typical gate charge



Figure 17. Typical capacitance as a function of collector-emitter voltage

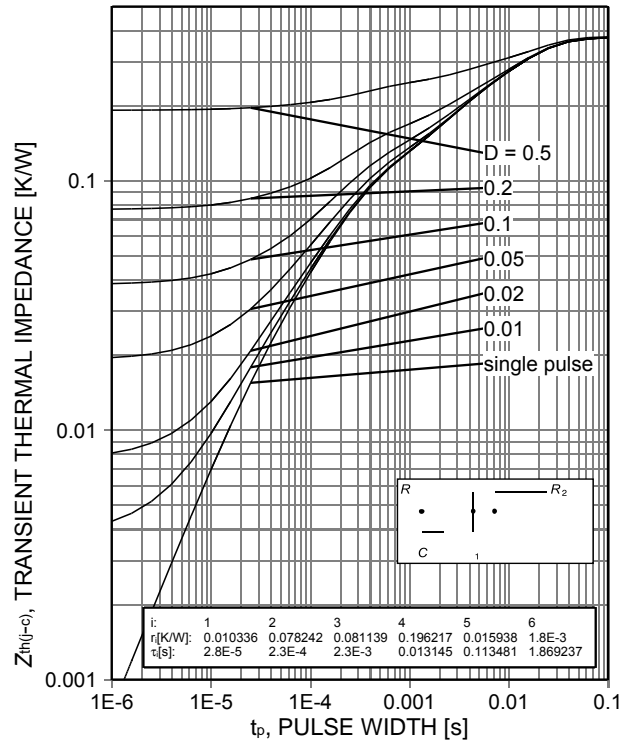
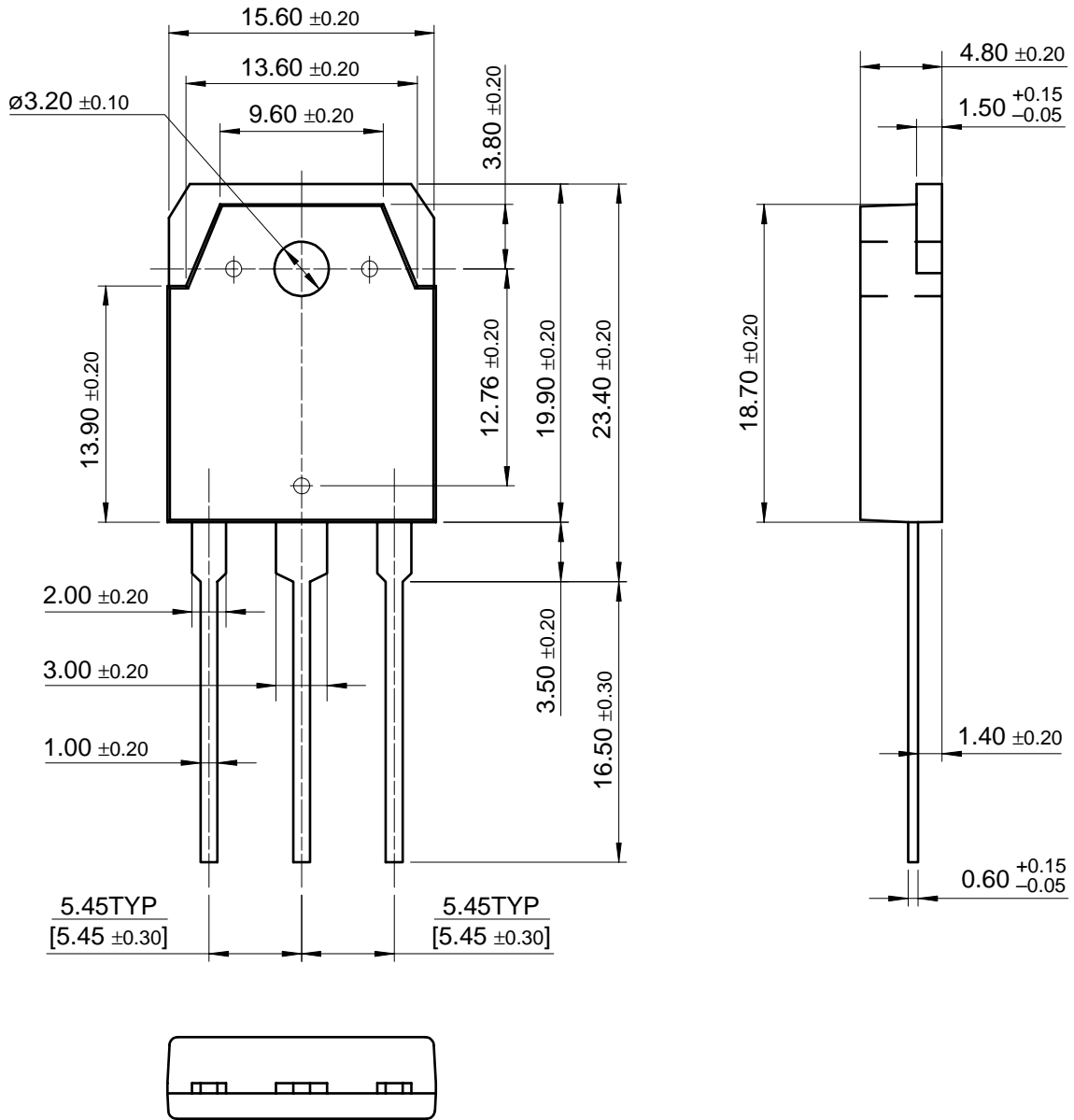


Figure 18. IGBT transient thermal impedance

TO-3P



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