FAIRCHILD™

March 2015

FGH60N60UFD
600V, 60A Field Stop IGBT

Features

- High Current Capability
- Low Saturation Voltage: $V_{CE(sat)}$ = 1.9 V @ I_C = 60 A
- High Input Impedance
- Fast Switching
- RoHS Compliant

Applications

- Solar Inverter, UPS, Welder and PFC

General Description

Using novel field stop IGBT technology, Fairchild's field stop IGBTs offer the optimum performance for solar inverter, UPS, welder and PFC applications where low conduction and switching losses are essential.

E C G

COLLECTOR (FLANGE)

C G E
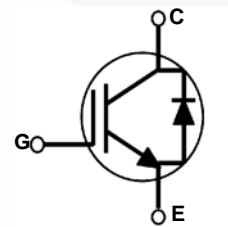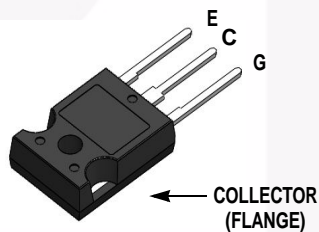
Absolute Maximum Ratings

Symbol	Description		Ratings	Unit
V_{CES}	Collector to Emitter Voltage		600	V
V_{GES}	Gate to Emitter Voltage		±20	V
	Transient Gate-to-Emitter Voltage		±30	
I_C	Collector Current	@ T_C = 25°C	120	A
	Collector Current	@ T_C = 100°C	60	A
$I_{CM\,(1)}$	Pulsed Collector Current	@ T_C = 25°C	180	A
P_D	Maximum Power Dissipation	@ T_C = 25°C	298	W
	Maximum Power Dissipation	@ T_C = 100°C	119	W
T_J	Operating Junction Temperature		-55 to +150	°C
T_{stg}	Storage Temperature Range		-55 to +150	°C
T_L	Maximum Lead Temp. for soldering Purposes, 1/8" from case for 5 seconds		300	°C

Notes:
1: Repetitive test , Pulse width limited by max. junction temperature

Thermal Characteristics

Symbol	Parameter	Typ.	Max.	Unit
$R_{\theta JC}$(IGBT)	Thermal Resistance, Junction to Case	-	0.33	°C/W
$R_{\theta JC}$(Diode)	Thermal Resistance, Junction to Case	-	1.1	°C/W
$R_{\theta JA}$	Thermal Resistance, Junction to Ambient	-	40	°C/W

Package Marking and Ordering Information

Part Number	Top Mark	Package	Packing Method	Reel Size	Tape Width	Quantity
FGH60N60UFDTU	FGH60N60UFD	TO-247	Tube	N/A	N/A	30

Electrical Characteristics of the IGBT T_C = 25°C unless otherwise noted

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
Off Characteristics						
BV_{CES}	Collector to Emitter Breakdown Voltage	V_{GE} = 0 V, I_C = 250 µA	600	-	-	V
ΔBV_{CES} / ΔT_J	Temperature Coefficient of Breakdown Voltage	V_{GE} = 0 V, I_C = 250 µA	-	0.67	-	V/°C
I_{CES}	Collector Cut-Off Current	V_{CE} = V_{CES}, V_{GE} = 0 V	-	-	250	µA
I_{GES}	G-E Leakage Current	V_{GE} = V_{GES}, V_{CE} = 0 V	-	-	±400	nA
On Characteristics						
$V_{GE(th)}$	G-E Threshold Voltage	I_C = 250 µA, V_{CE} = V_{GE}	4.0	5.0	6.5	V
$V_{CE(sat)}$	Collector to Emitter Saturation Voltage	I_C = 60 A, V_{GE} = 15 V	-	1.9	2.4	V
		I_C = 60 A, V_{GE} = 15 V, T_C = 125°C	-	2.1	-	V
Dynamic Characteristics						
C_{ies}	Input Capacitance	V_{CE} = 30 V, V_{GE} = 0 V, f = 1 MHz	-	2855	-	pF
C_{oes}	Output Capacitance		-	325	-	pF
C_{res}	Reverse Transfer Capacitance		-	110	-	pF
Switching Characteristics						
$t_{d(on)}$	Turn-On Delay Time	V_{CC} = 400 V, I_C = 60 A, R_G = 5 Ω, V_{GE} = 15 V, Inductive Load, T_C = 25°C	-	23	-	ns
t_r	Rise Time		-	58	-	ns
$t_{d(off)}$	Turn-Off Delay Time		-	130	-	ns
t_f	Fall Time		-	40	80	ns
E_{on}	Turn-On Switching Loss		-	1.81	-	mJ
E_{off}	Turn-Off Switching Loss		-	0.81	-	mJ
E_{ts}	Total Switching Loss		-	2.62	-	mJ
$t_{d(on)}$	Turn-On Delay Time	V_{CC} = 400 V, I_C = 60 A, R_G = 5 Ω, V_{GE} = 15 V, Inductive Load, T_C = 125°C	-	22	-	ns
t_r	Rise Time		-	61	-	ns
$t_{d(off)}$	Turn-Off Delay Time		-	141	-	ns
t_f	Fall Time		-	63	-	ns
E_{on}	Turn-On Switching Loss		-	1.92	-	mJ
E_{off}	Turn-Off Switching Loss		-	1.23	-	mJ
E_{ts}	Total Switching Loss		-	3.15	-	mJ
Q_g	Total Gate Charge	V_{CE} = 400 V, I_C = 60 A, V_{GE} = 15 V	-	188	-	nC
Q_{ge}	Gate to Emitter Charge		-	21	-	nC
Q_{gc}	Gate to Collector Charge		-	97	-	nC

Electrical Characteristics of the Diode $T_C = 25°C$ unless otherwise noted

Symbol	Parameter	Test Conditions		Min.	Typ.	Max	Units
V_{FM}	Diode Forward Voltage	$I_F = 30$ A	$T_C = 25^oC$	-	2.0	2.6	V
			$T_C = 125^oC$	-	1.8	-	
t_{rr}	Diode Reverse Recovery Time	$I_F = 30$ A, $di_F/dt = 200$ A/μs	$T_C = 25^oC$	-	47	-	ns
			$T_C = 125^oC$	-	179	-	
Q_{rr}	Diode Reverse Recovery Charge		$T_C = 25^oC$	-	83	-	nC
			$T_C = 125^oC$	-	567	-	

Typical Performance Characteristics

Figure 1. Typical Output Characteristics
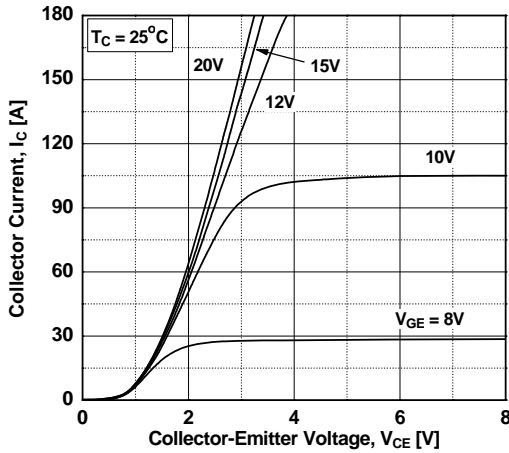
Figure 2. Typical Output Characteristics
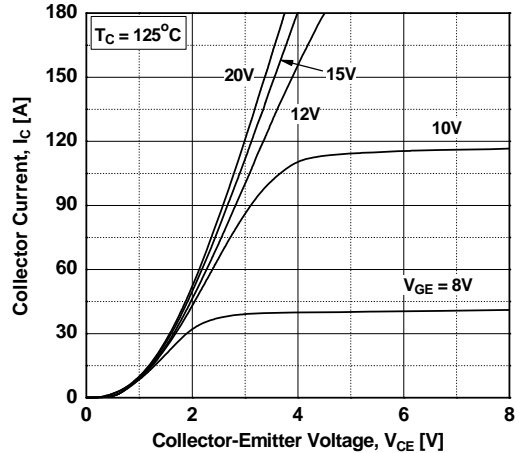
Figure 3. Typical Saturation Voltage Characteristics
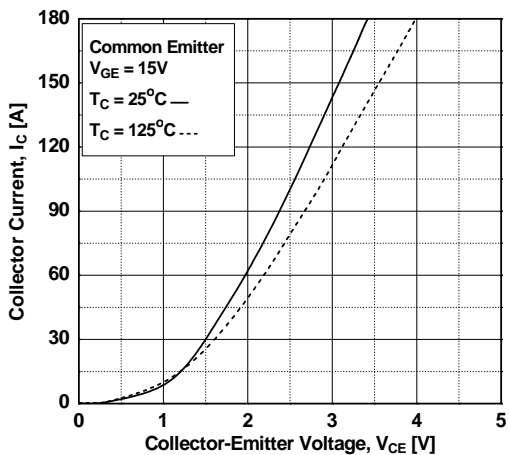
Figure 4. Transfer Characteristics
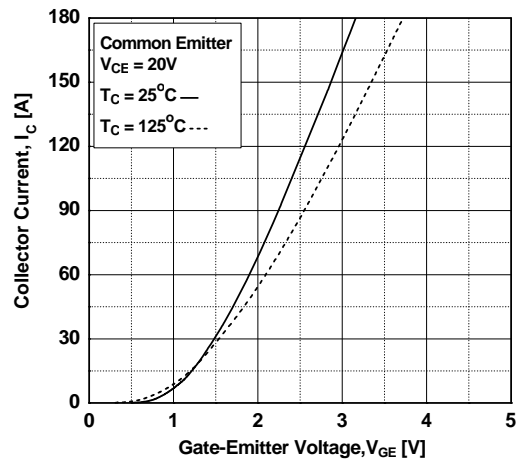
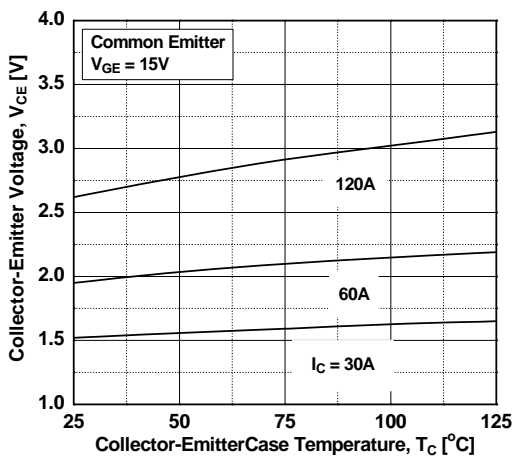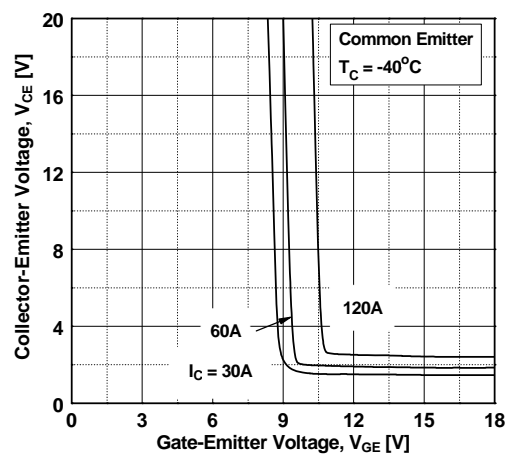### Figure 5. Saturation Voltage vs. Case Temperature at Variant Current Level

Figure 6. Saturation Voltage vs. V_GE

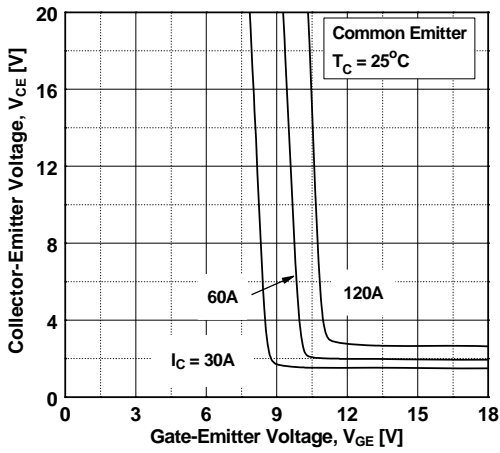# Typical Performance Characteristics

Figure 7. Saturation Voltage vs. V_GE
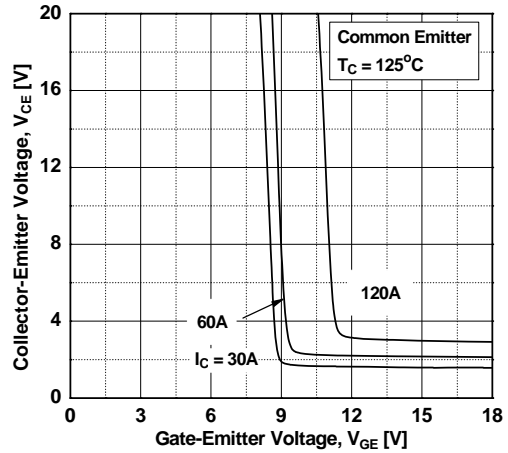

Figure 7. Saturation Voltage vs. V_{GE}

Common Emitter
$T_C = 25^oC$

Collector-Emitter Voltage, V_{CE} [V]
Gate-Emitter Voltage, V_{GE} [V]
60A, 120A, $I_C = 30A$

Figure 8. Saturation Voltage vs. V_GE

Figure 8. Saturation Voltage vs. V_{GE}

Common Emitter
$T_C = 125^oC$

Collector-Emitter Voltage, V_{CE} [V]
Gate-Emitter Voltage, V_{GE} [V]
60A, 120A, $I_C = 30A$

Figure 9. Capacitance Characteristics

Figure 9. Capacitance Characteristics

Common Emitter
$V_{GE} = 0V$, $f = 1MHz$
$T_C = 25^oC$

Capacitance [pF]
Collector-Emitter Voltage, V_{CE} [V]
C_{ies}, C_{oes}, C_{res}

Figure 10. Gate charge Characteristics

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Common Emitter
$T_C = 25^oC$

Gate-Emitter Voltage, V_{GE} [V]
Gate Charge, Q_g [nC]
$V_{CC} = 100V$, 200V, 300V
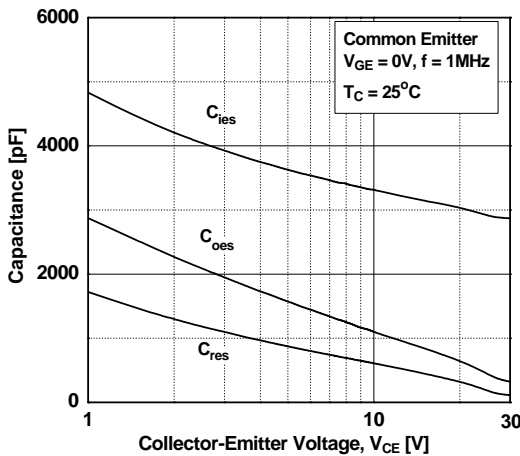
Figure 11. SOA Characteristics

Figure 11. SOA Characteristics
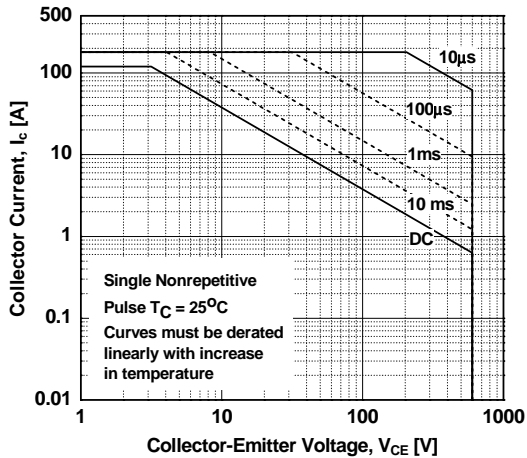
Collector Current, I_C [A]
Collector-Emitter Voltage, V_{CE} [V]
10µs, 100µs, 1ms, 10 ms, DC

Single Nonrepetitive
Pulse $T_C = 25^oC$
Curves must be derated
linearly with increase
in temperature

Figure 12. Turn off Switching SOA Characteristics

Figure 12. Turn off Switching SOA Characteristics

Collector Current, I_C [A]
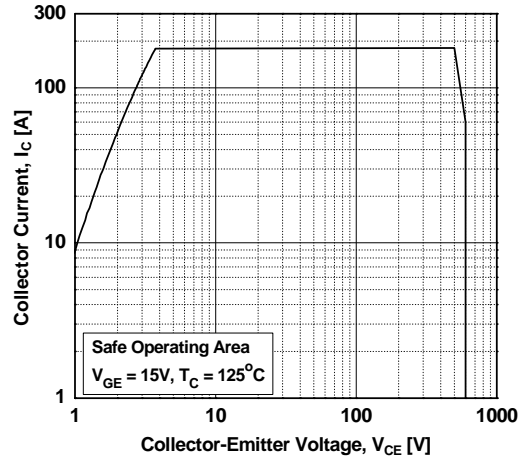Collector-Emitter Voltage, V_{CE} [V]

Safe Operating Area
$V_{GE} = 15V$, $T_C = 125^oC$

Typical Performance Characteristics

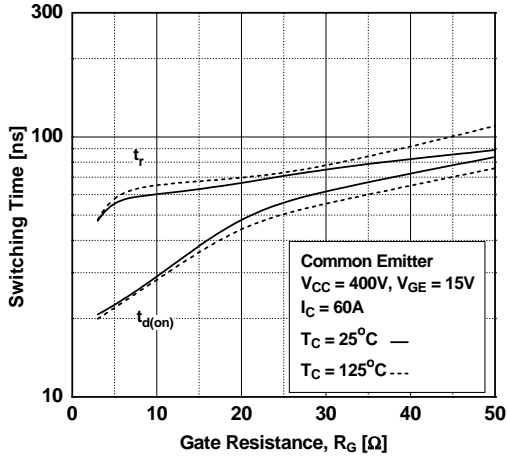**Figure 13. Turn-on Characteristics vs. Gate Resistance**

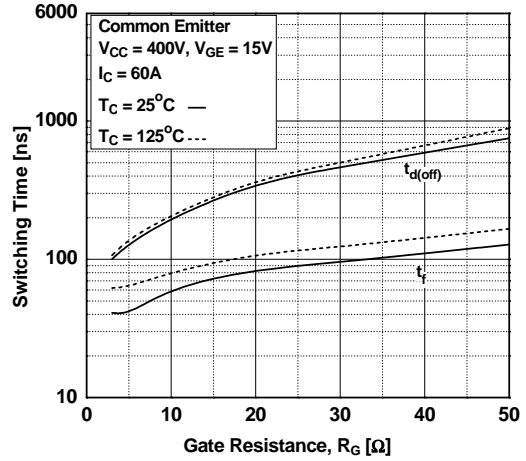**Figure 14. Turn-off Characteristics vs. Gate Resistance**

Figure 15. Turn-on Characteristics vs. Collector Current
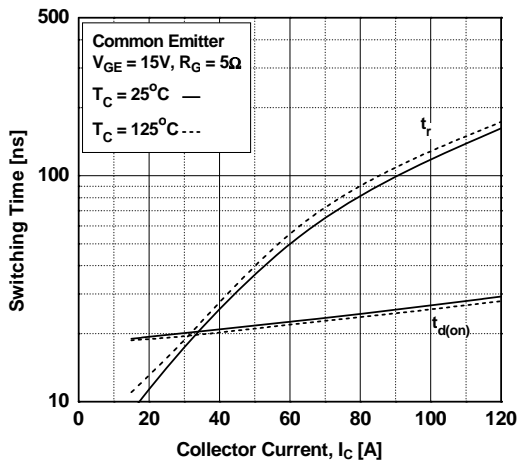

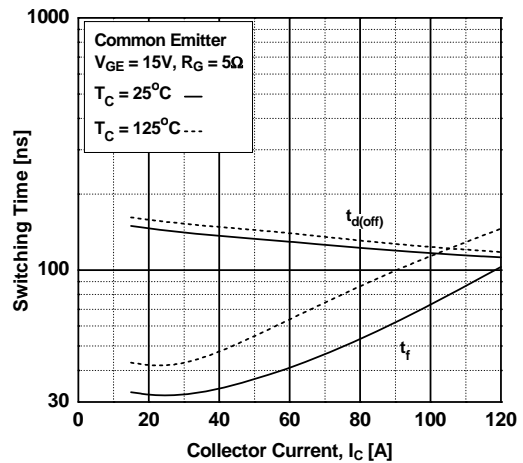**Figure 16. Turn-off Characteristics vs. Collector Current**

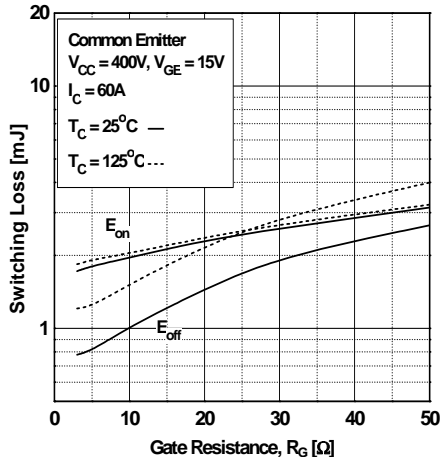

Figure 17. Switching Loss vs. Gate Resistance
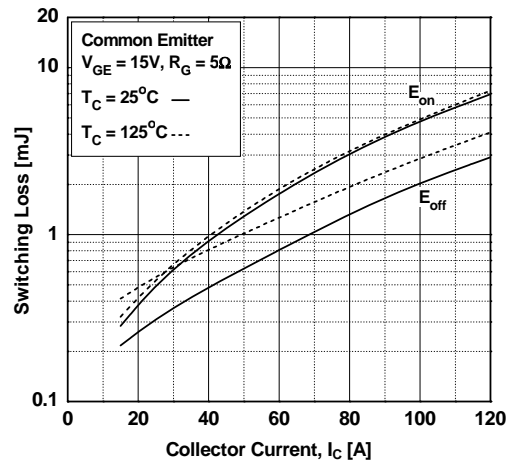

Figure 18. Switching Loss vs. Collector Current

Typical Performance Characteristics
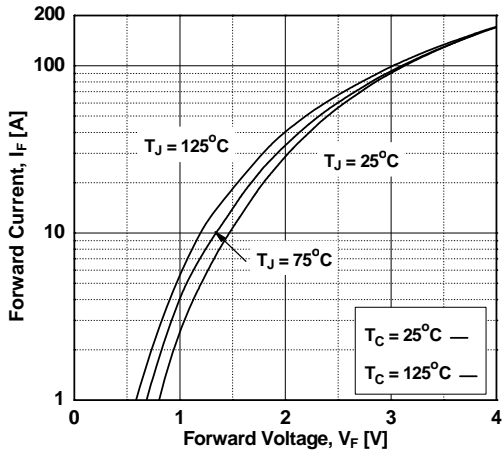
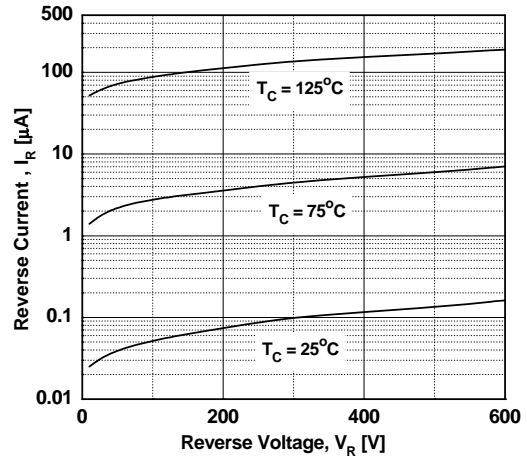### Figure 19. Forward Characteristics

Figure 20. Reverse Current
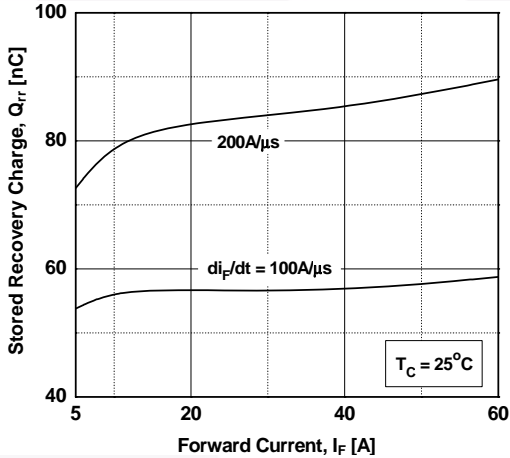

Figure 21. Stored Charge

Figure 22. Reverse Recovery Time
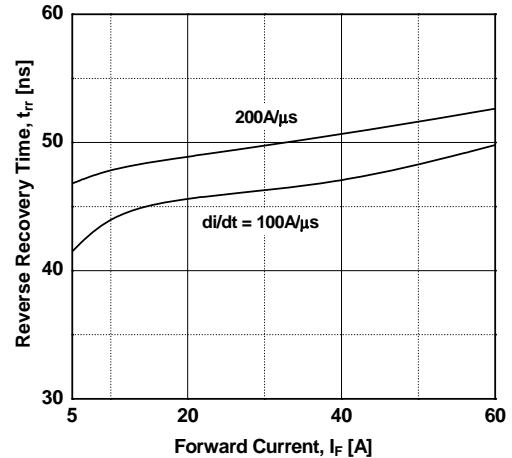
Figure 23. Transient Thermal Impedance of IGBT

Duty Factor, D = t1/t2
Peak T_j = Pdm x Zthjc + T_C
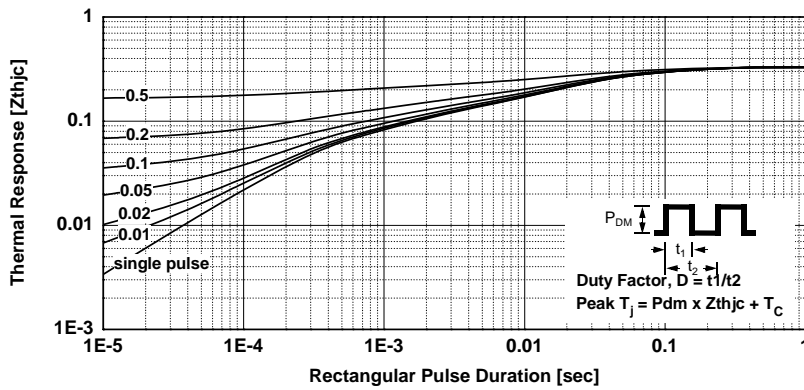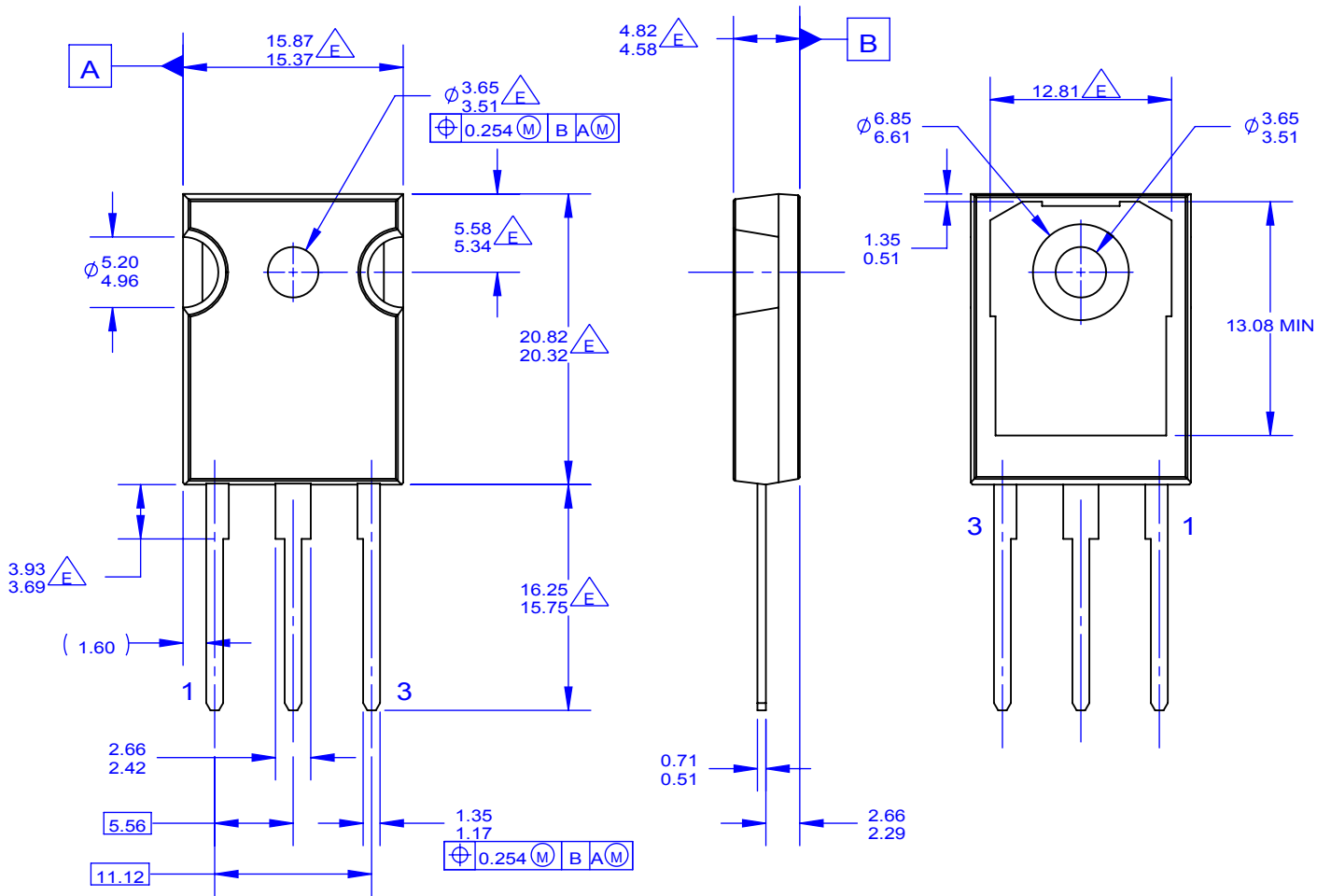
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