August 2015

FGH60T65SHD

650 V, 60 A Field Stop Trench IGBT

Features

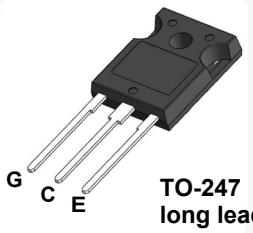
- Maximum Junction Temperature : T_J =175°C
- Positive Temperature Co-efficient for Easy Parallel Operating
- High Current Capability
- Low Saturation Voltage: $V_{CE(sat)}$ =1.6 V(Typ.) @ I_C = 60 A
- 100% of the Parts Tested for I_{LM}(1)
- High Input Impedance
- Fast Switching
- Tighten Parameter Distribution
- RoHS Compliant

General Description

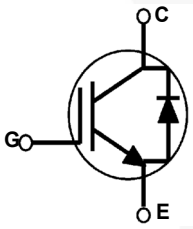
Using novel field stop IGBT technology, Fairchild's new series of field stop 3rd generation IGBTs offer the optimum performance for solar inverter, UPS, welder, telecom, ESS and PFC applications where low conduction and switching losses are essential.

Applications

- Solar Inverter, UPS, Welder, Telecom, ESS, PFC



TO-247
long leads



Absolute Maximum Ratings T_C = 25°C unless otherwise noted

Symbol	Description		FGH60T65SHD_F155	Unit
V_{CES}	Collector to Emitter Voltage		650	V
V_{GES}	Gate to Emitter Voltage		± 20	V
	Transient Gate to Emitter Voltage		± 30	V
I_C	Collector Current	@ T_C = 25°C	120	A
	Collector Current	@ T_C = 100°C	60	A
$I_{LM\ (1)}$	Pulsed Collector Current	@ T_C = 25°C	180	A
$I_{CM\ (2)}$	Pulsed Collector Current		180	A
I_F	Diode Forward Current	@ T_C = 25°C	60	A
	Diode Forward Current	@ T_C = 100°C	30	A
$I_{FM\ (2)}$	Pulsed Diode Maximum Forward Current		180	A
P_D	Maximum Power Dissipation	@ T_C = 25°C	349	W
	Maximum Power Dissipation	@ T_C = 100°C	174	W
T_J	Operating Junction Temperature		-55 to +175	°C
T_{stg}	Storage Temperature Range		-55 to +175	°C
T_L	Maximum Lead Temp. for soldering Purposes, 1/8" from case for 5 seconds		300	°C

Notes:
1. V_{CC} = 400 V, V_{GE} = 15 V, I_C =180 A, R_G = 27 Ω, Inductive Load
2. Repetitive rating: Pulse width limited by max. junction temperature

Thermal Characteristics

Symbol	Parameter	FGH60T65SHD_F155	Unit
$R_{\theta JC}$(IGBT)	Thermal Resistance, Junction to Case, Max.	0.43	°C/W
$R_{\theta JC}$(Diode)	Thermal Resistance, Junction to Case, Max.	1.25	°C/W
$R_{\theta JA}$	Thermal Resistance, Junction to Ambient, Max.	40	°C/W

Package Marking and Ordering Information

Part Number	Top Mark	Package	Packing Method	Reel Size	Tape Width	Quantit
FGH60T65SHD_F155	FGH60T65SHD	TO-247 G03	Tube	-	-	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} = 0V, I_C = 1 mA	650	-	-	V
ΔBV_{CES} / ΔT_J	Temperature Coefficient of Breakdown Voltage	I_C = 1 mA, Reference to 25°C	-	0.6	-	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 = 60 mA, V_{CE} = V_{GE}	4.0	5.5	7.5	V
$V_{CE(sat)}$	Collector to Emitter Saturation Voltage	I_C = 60 A, V_{GE} = 15 V	-	1.6	2.1	V
		I_C = 60 A, V_{GE} = 15 V, T_C = 175°C	-	2.14	-	V
Dynamic Characteristics						
C_{ies}	Input Capacitance	V_{CE} = 30 V, V_{GE} = 0 V, f = 1MHz	-	2980	-	pF
C_{oes}	Output Capacitance		-	110	-	pF
C_{res}	Reverse Transfer Capacitance		-	36	-	pF
Switching Characteristics						
$t_{d(on)}$	Turn-On Delay Time	V_{CC} = 400 V, I_C = 60 A, R_G = 6 Ω, V_{GE} = 15 V, Inductive Load, T_C = 25°C	-	26	-	ns
t_r	Rise Time		-	48	-	ns
$t_{d(off)}$	Turn-Off Delay Time		-	87	-	ns
t_f	Fall Time		-	47	-	ns
E_{on}	Turn-On Switching Loss		-	1.69	-	mJ
E_{off}	Turn-Off Switching Loss		-	0.63	-	mJ
E_{ts}	Total Switching Loss		-	2.32	-	mJ
$t_{d(on)}$	Turn-On Delay Time	V_{CC} = 400 V, I_C = 60 A, R_G = 6 Ω, V_{GE} = 15 V, Inductive Load, T_C = 175°C	-	25	-	ns
t_r	Rise Time		-	60	-	ns
$t_{d(off)}$	Turn-Off Delay Time		-	93	-	ns
t_f	Fall Time		-	72	-	ns
E_{on}	Turn-On Switching Loss		-	2.54	-	mJ
E_{off}	Turn-Off Switching Loss		-	1.04	-	mJ
E_{ts}	Total Switching Loss		-	3.58	-	mJ

Electrical Characteristics of the IGBT (Continued)

Symbol	Parameter	Test Conditions	Min.	Typ.	Max	Unit
Q_g	Total Gate Charge	V_{CE} = 400 V, I_C = 60 A, V_{GE} = 15 V	-	102	-	nC
Q_{ge}	Gate to Emitter Charge		-	18.4	-	nC
Q_{gc}	Gate to Collector Charge		-	37.5	-	nC

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

Symbol	Parameter	Test Conditions		Min.	Typ.	Max	Unit
V_{FM}	Diode Forward Voltage	I_F = 30 A	T_C = 25°C	-	2.3	2.7	V
			T_C = 175°C	-	1.9	-	
E_{rec}	Reverse Recovery Energy	I_F =30 A, dI_F/dt = 200 A/μs	T_C = 175°C	-	50	-	uJ
t_{rr}	Diode Reverse Recovery Time		T_C = 25°C	-	34.6	-	ns
			T_C = 175°C	-	197	-	
Q_{rr}	Diode Reverse Recovery Charge		T_C = 25°C	-	58.6	-	nC
			T_C = 175°C	-	810	-	

Typical Performance Characteristics

Figure 1. Typical Output Characteristics

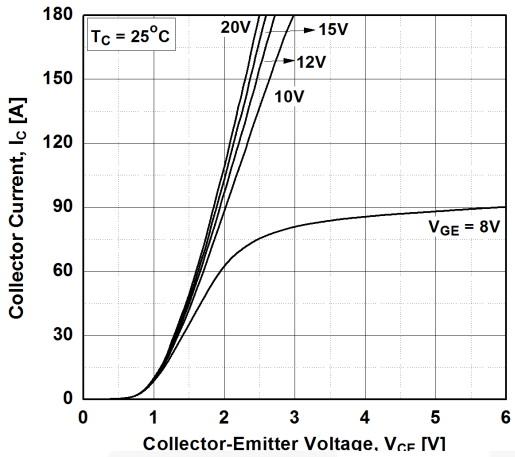


Figure 2. Typical Output Characteristics

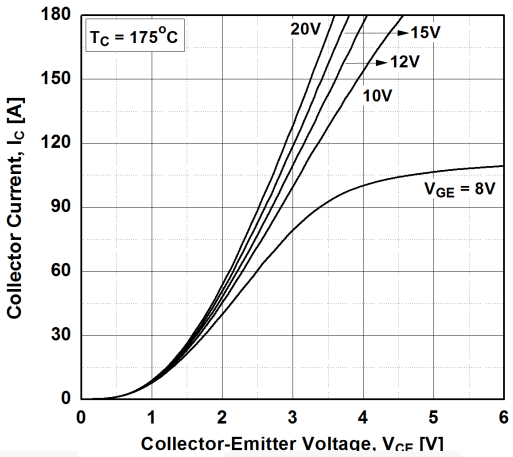


Figure 3. Typical Saturation Voltage Characteristics

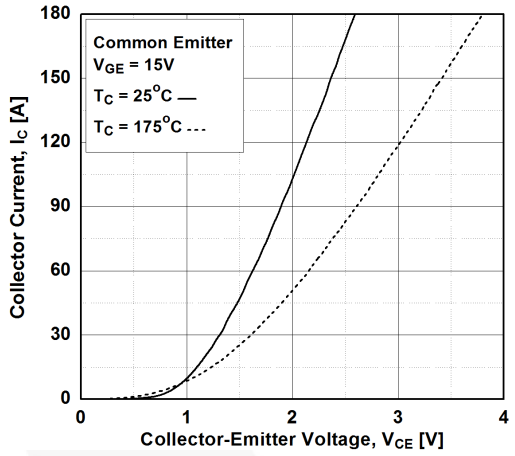


Figure 4. Saturation Voltage vs. Case Temperature at Variant Current Level

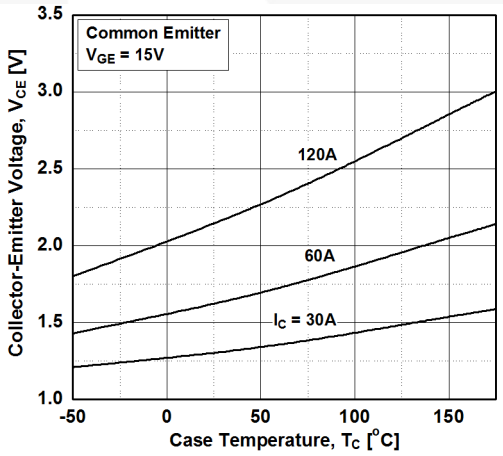


Figure 5. Saturation Voltage vs. V_{GE}

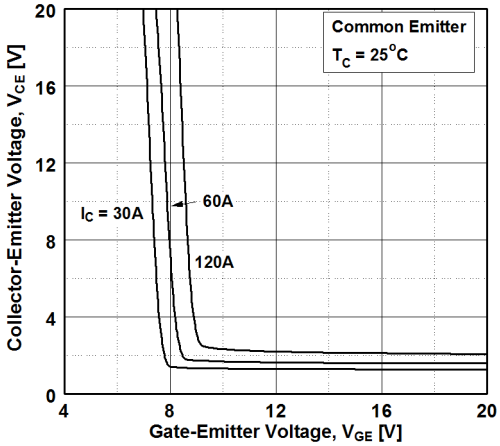
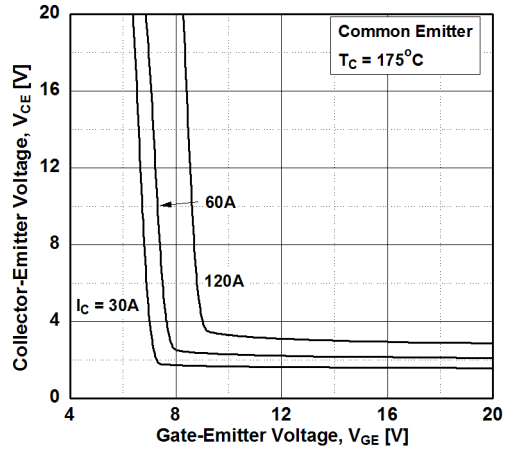


Figure 6. Saturation Voltage vs. V_{GE}



Typical Performance Characteristics

Figure 7. Capacitance Characteristics

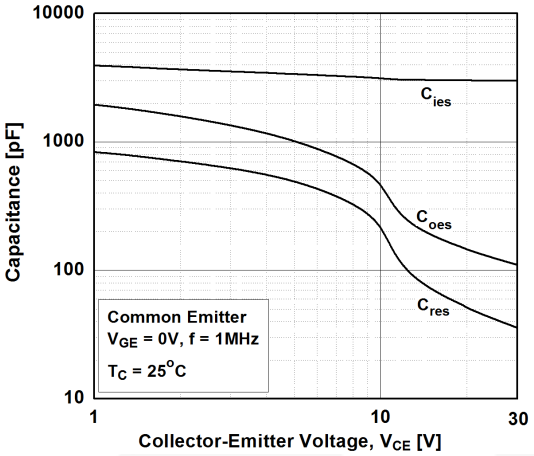


Figure 8. Gate Charge Characteristics

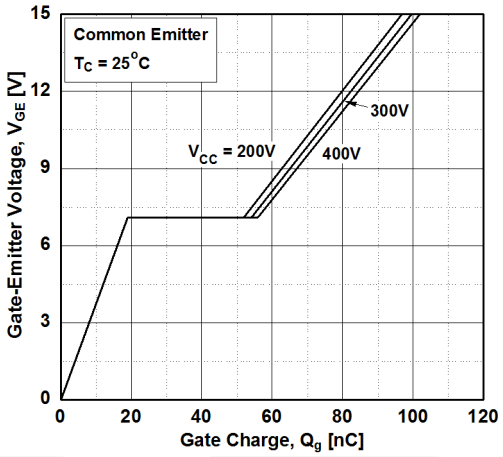


Figure 9. Turn-on Characteristics vs. Gate Resistance

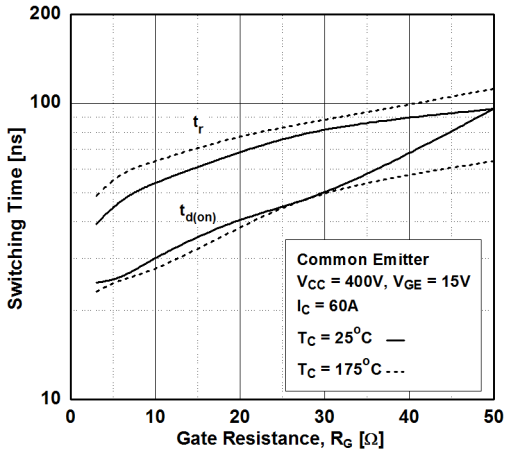


Figure 10. Turn-off Characteristics vs. Gate Resistance

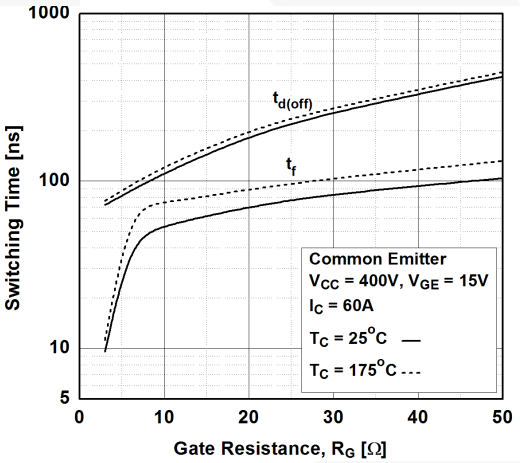


Figure 11. Switching Loss vs. Gate Resistance

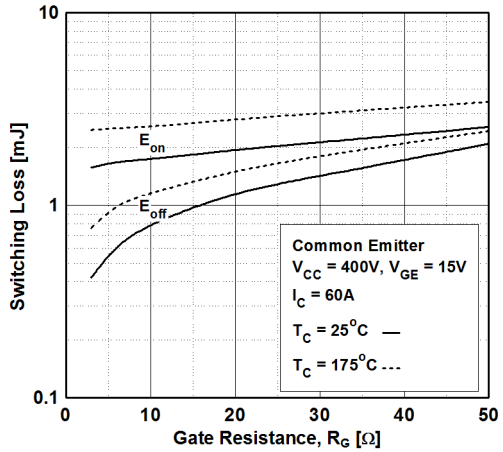
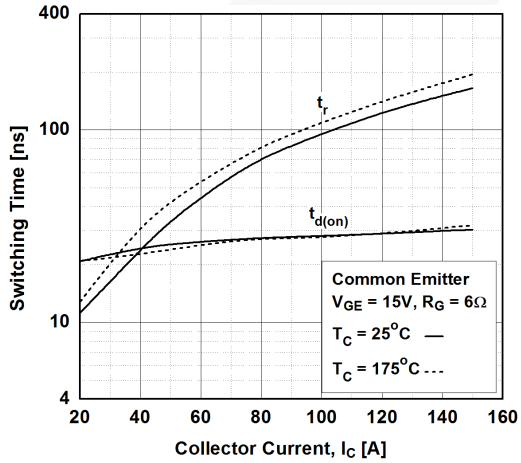


Figure 12. Turn-on Characteristics vs. Collector Current



Typical Performance Characteristics

Figure 13. Turn-off Characteristics vs. Collector Current

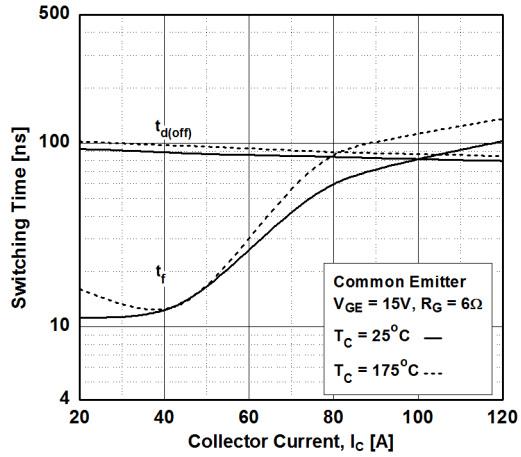


Figure 14. Switching Loss vs. Collector Current

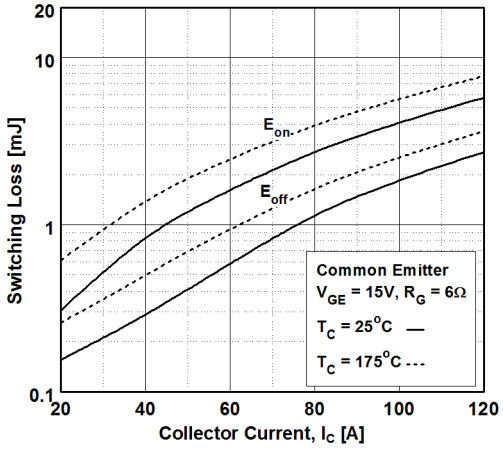


Figure 15. Load Current Vs. Frequency

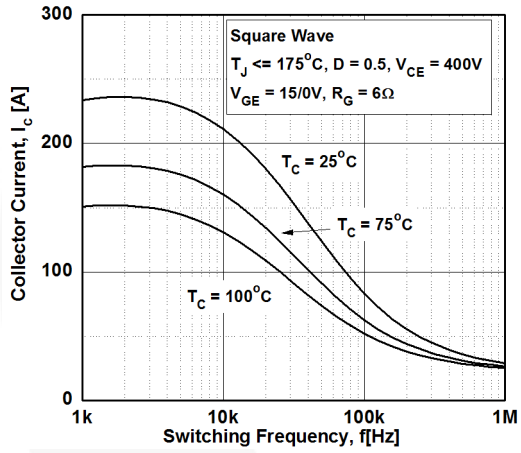


Figure 16. SOA Characteristics

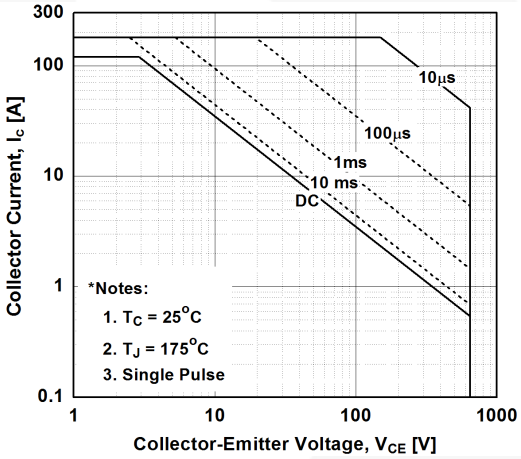


Figure 17. Forward Characteristics

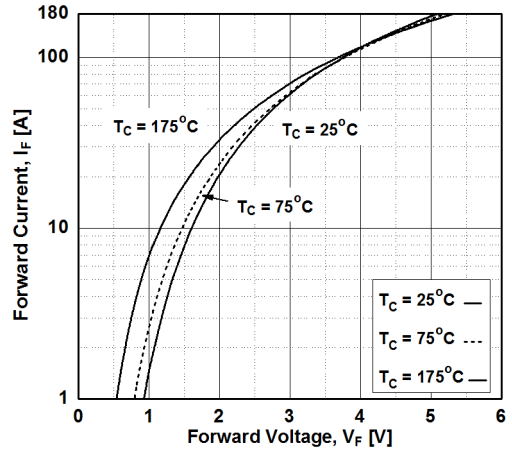
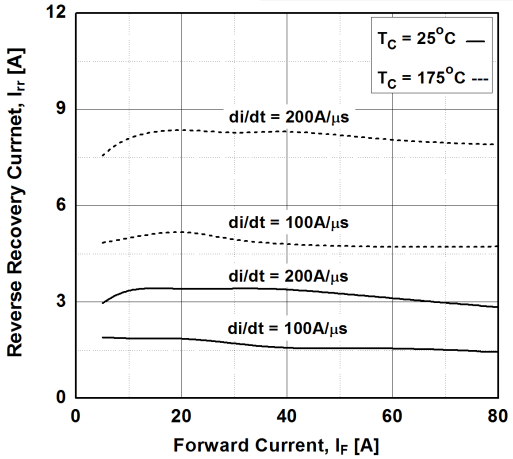


Figure 18. Reverse Recovery Current



Typical Performance Characteristics

Figure 19. Reverse Recovery Time

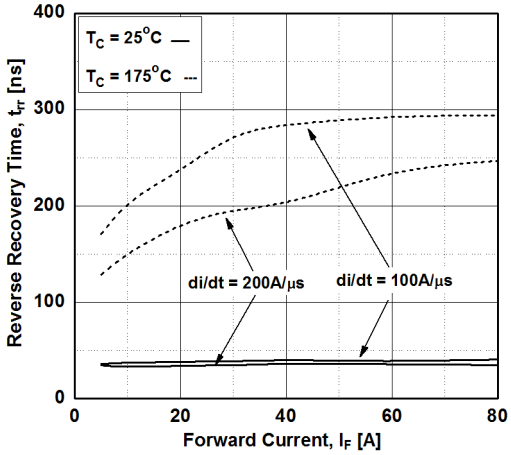


Figure 20. Stored Charge

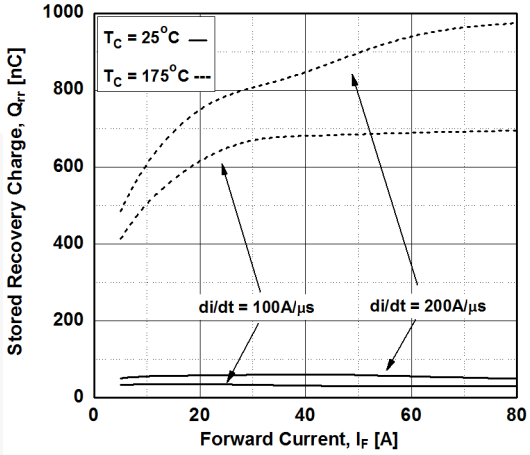


Figure 21.Transient Thermal Impedance of IGBT

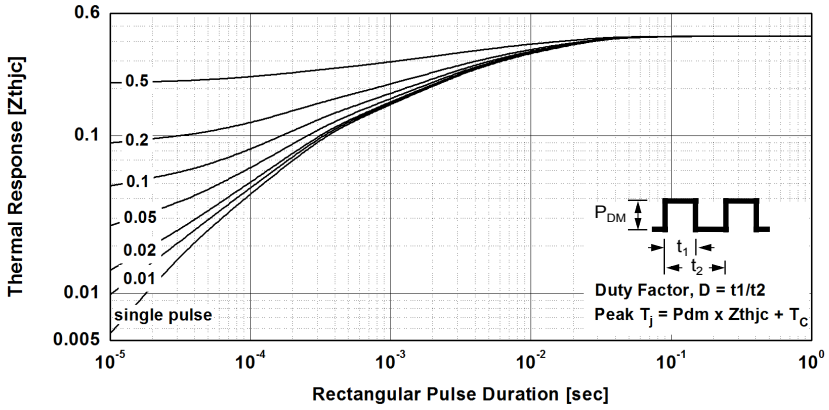
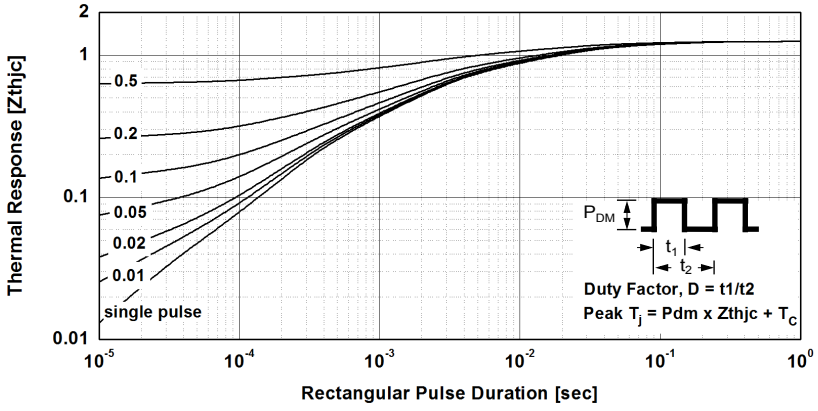
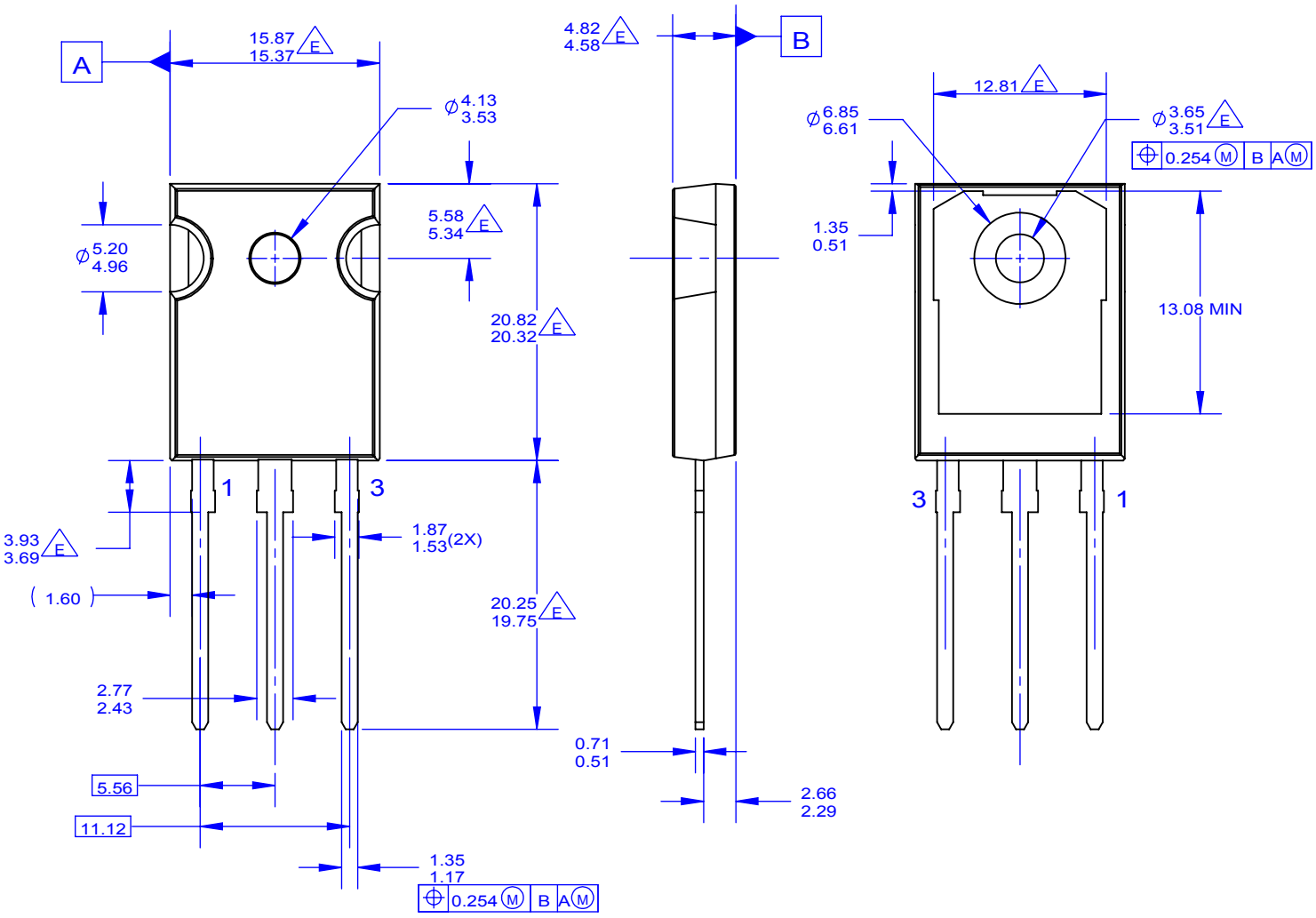


Figure 22.Transient Thermal Impedance of Diode





NOTES: UNLESS OTHERWISE SPECIFIED.

A. PACKAGE REFERENCE: JEDEC TO-247, ISSUE E, VARIATION AB, DATED JUNE, 2004.
B. DIMENSIONS ARE EXCLUSIVE OF BURRS, MOLD FLASH, AND TIE BAR EXTRUSIONS.
C. ALL DIMENSIONS ARE IN MILLIMETERS.
D. DRAWING CONFORMS TO ASME Y14.5 - 1994

E. DOES NOT COMPLY JEDEC STANDARD VALUE
F. DRAWING FILENAME: MKT-TO247G03_REV02

FAIRCHILD ™

TRADEMARKS

The following includes registered and unregistered trademarks and service marks, owned by Fairchild Semiconductor and/or its global subsidiaries, and is not intended to be an exhaustive list of all such trademarks.

AccuPower™
AttitudeEngine™
Awinda®
AX-CAP®*
BitSiC™
Build it Now™
CorePLUS™
CorePOWER™
CROSSVOLT™
CTL™
Current Transfer Logic™
DEUXPEED®
Dual Cool™
EcoSPARK®
EfficientMax™
ESBC™
®
Fairchild®
Fairchild Semiconductor®
FACT Quiet Series™
FACT®
FastvCore™
FETBench™
FPS™
F-PFS™
FRFET®
Global Power Resource℠
GreenBridge™
Green FPS™
Green FPS™ e-Series™
G*max*™
GTO™
IntelliMAX™
ISOPLANAR™
Making Small Speakers Sound Louder and Better™
MegaBuck™
MICROCOUPLER™
MicroFET™
MicroPak™
MicroPak2™
MillerDrive™
MotionMax™
MotionGrid®
MTi®
MTx®
MVN®
mWSaver®
OptoHiT™
OPTOLOGIC®
OPTOPLANAR®
®
Power Supply WebDesigner™
PowerTrench®
PowerXS™
Programmable Active Droop™
QFET®
QS™
Quiet Series™
RapidConfigure™
™
Saving our world, 1mW/W/kW at a time™
SignalWise™
SmartMax™
SMART START™
Solutions for Your Success™
SPM®
STEALTH™
SuperFET®
SuperSOT™-3
SuperSOT™-6
SuperSOT™-8
SupreMOS®
SyncFET™
Sync-Lock™
SYSTEM GENERAL®*
TinyBoost®
TinyBuck®
TinyCalc™
TinyLogic®
TINYOPTO™
TinyPower™
TinyPWM™
TinyWire™
TranSiC™
TriFault Detect™
TRUECURRENT®*
µSerDes™
SerDes™
UHC®
Ultra FRFET™
UniFET™
VCX™
VisualMax™
VoltagePlus™
XS™
Xsens™
仙童®

* Trademarks of System General Corporation, used under license by Fairchild Semiconductor.

DISCLAIMER

FAIRCHILD SEMICONDUCTOR RESERVES THE RIGHT TO MAKE CHANGES WITHOUT FURTHER NOTICE TO ANY PRODUCTS HEREIN TO IMPROVE RELIABILITY, FUNCTION, OR DESIGN. TO OBTAIN THE LATEST, MOST UP-TO-DATE DATASHEET AND PRODUCT INFORMATION, VISIT OUR WEBSITE AT HTTP://WWW.FAIRCHILDSEMI.COM. FAIRCHILD DOES NOT ASSUME ANY LIABILITY ARISING OUT OF THE APPLICATION OR USE OF ANY PRODUCT OR CIRCUIT DESCRIBED HEREIN; NEITHER DOES IT CONVEY ANY LICENSE UNDER ITS PATENT RIGHTS, NOR THE RIGHTS OF OTHERS. THESE SPECIFICATIONS DO NOT EXPAND THE TERMS OF FAIRCHILD'S WORLDWIDE TERMS AND CONDITIONS, SPECIFICALLY THE WARRANTY THEREIN, WHICH COVERS THESE PRODUCTS.

AUTHORIZED USE

Unless otherwise specified in this data sheet, this product is a standard commercial product and is not intended for use in applications that require extraordinary levels of quality and reliability. This product may not be used in the following applications, unless specifically approved in writing by a Fairchild officer: (1) automotive or other transportation, (2) military/aerospace, (3) any safety critical application – including life critical medical equipment – where the failure of the Fairchild product reasonably would be expected to result in personal injury, death or property damage. Customer's use of this product is subject to agreement of this Authorized Use policy. In the event of an unauthorized use of Fairchild's product, Fairchild accepts no liability in the event of product failure. In other respects, this product shall be subject to Fairchild's Worldwide Terms and Conditions of Sale, unless a separate agreement has been signed by both Parties.

ANTI-COUNTERFEITING POLICY

Fairchild Semiconductor Corporation's Anti-Counterfeiting Policy. Fairchild's Anti-Counterfeiting Policy is also stated on our external website, www.fairchildsemi.com, under Terms of Use

Counterfeiting of semiconductor parts is a growing problem in the industry. All manufacturers of semiconductor products are experiencing counterfeiting of their parts. Customers who inadvertently purchase counterfeit parts experience many problems such as loss of brand reputation, substandard performance, failed applications, and increased cost of production and manufacturing delays. Fairchild is taking strong measures to protect ourselves and our customers from the proliferation of counterfeit parts. Fairchild strongly encourages customers to purchase Fairchild parts either directly from Fairchild or from Authorized Fairchild Distributors who are listed by country on our web page cited above. Products customers buy either from Fairchild directly or from Authorized Fairchild Distributors are genuine parts, have full traceability, meet Fairchild's quality standards for handling and storage and provide access to Fairchild's full range of up-to-date technical and product information. Fairchild and our Authorized Distributors will stand behind all warranties and will appropriately address any warranty issues that may arise. Fairchild will not provide any warranty coverage or other assistance for parts bought from Unauthorized Sources. Fairchild is committed to combat this global problem and encourage our customers to do their part in stopping this practice by buying direct or from authorized distributors.

PRODUCT STATUS DEFINITIONS

Definition of Terms

Datasheet Identification	Product Status	Definition
Advance Information	Formative / In Design	Datasheet contains the design specifications for product development. Specifications may change in any manner without notice.
Preliminary	First Production	Datasheet contains preliminary data; supplementary data will be published at a later date. Fairchild Semiconductor reserves the right to make changes at any time without notice to improve design.
No Identification Needed	Full Production	Datasheet contains final specifications. Fairchild Semiconductor reserves the right to make changes at any time without notice to improve the design.
Obsolete	Not In Production	Datasheet contains specifications on a product that is discontinued by Fairchild Semiconductor. The datasheet is for reference information only.

Rev. I77