FAIRCHILD SEMICONDUCTOR®

February 2010

SuperFET™

FCH35N60

600V N-Channel MOSFET

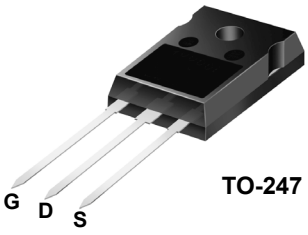
Features

- 650V @ T_J = 150°C
- Typ.$R_{DS(on)}$ = 0.079Ω
- Ultra low gate charge (Typ. Q_g = 139nC)
- Low effective output capacitance (Typ. C_{oss}.eff = 340pF)
- 100% avalanche tested

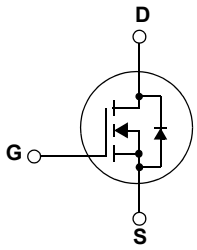
Description

SuperFET™ is Farichild's proprietary, new generation of high voltage MOSFET family that is utilizing an advanced charge balance mechanism for outstanding low on-resistance and lower gate charge performance.

This advanced technology has been tailored to minimize conduction loss, provide superior switching performance, and withstand extreme dv/dt rate and higher avalanche energy. Consequently, SuperFET is very suitable for various AC/DC power conversion in switching mode operation for system miniaturization and higher efficiency.



TO-247



MOSFET Maximum Ratings T_C = 25°C unless otherwise noted*

Symbol	Parameter		Ratings	Units
V_{DSS}	Drain to Source Voltage		600	V
V_{GSS}	Gate-Soure voltage		±30	V
I_D	Drain Current	-Continuous (T_C = 25°C)	35	A
		-Continuous (T_C = 100°C)	22.2	
I_{DM}	Drain Current	- Pulsed (Note 1)	105	A
E_{AS}	Single Pulsed Avalanche Energy	(Note 2)	1455	mJ
I_{AR}	Avalanche Current	(Note 1)	35	A
E_{AR}	Repetitive Avalanche Energy	(Note 1)	31.25	mJ
dv/dt	Peak Diode Recovery dv/dt	(Note 3)	20	V/ns
P_D	Power Dissipation	(T_C = 25°C)	312.5	W
		- Derate above 25°C	2.5	W/°C
T_J, T_{STG}	Operating and Storage Temperature Range		-55 to +150	°C
T_L	Maximum Lead Temperature for Soldering Purpose, 1/8" from Case for 5 Seconds		300	°C

*Drain current limited by maximum junction temperature

Thermal Characteristics

Symbol	Parameter	Typ.	Max.	Units
$R_{\theta JC}$	Thermal Resistance, Junction to Case	-	0.4	°C/W
$R_{\theta CS}$	Thermal Resistance, Case-to-Heat Sink	0.24	-	
$R_{\theta JA}$	Thermal Resistance, Junction to Ambient	-	42	

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Package Marking and Ordering Information $T_C = 25^oC$ unless otherwise noted

Device Marking	Device	Package	Reel Size	Tape Width	Quantity
FCH35N60	FCH35N60	TO-247	-	-	30

Electrical Characteristics

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Units
Off Characteristics						
BV_{DSS}	Drain to Source Breakdown Voltage	I_D = 250μA, V_{GS} = 0V, T_J = 25°C	600	-	-	V
		I_D = 250μA, V_{GS} = 0V, T_J = 150°C	-	650	-	V
ΔBV_{DSS} / ΔT_J	Breakdown Voltage Temperature Coefficient	I_D = 250μA, Referenced to 25°C	-	0.6	-	V/°C
BV_{DS}	Drain-Source Avalanche Breakdown Voltage	V_{GS} = 0V, I_D = 16A	-	700	-	V
I_{DSS}	Zero Gate Voltage Drain Current	V_{DS} = 600V, V_{GS} = 0V	-	-	1	μA
		V_{DS} = 480V, T_C = 125°C	-	-	10	
I_{GSS}	Gate to Body Leakage Current	V_{GS} = ±30V, V_{DS} = 0V	-	-	±100	nA
On Characteristics						
$V_{GS(th)}$	Gate Threshold Voltage	V_{GS} = V_{DS}, I_D = 250μA	3.0	-	5.0	V
$R_{DS(on)}$	Static Drain to Source On Resistance	V_{GS} = 10V, I_D = 17.5A	-	0.079	0.098	Ω
g_{FS}	Forward Transconductance	V_{DS} = 40V, I_D = 17.5A	-	28.8	-	S
Dynamic Characteristics						
C_{iss}	Input Capacitance	V_{DS} = 25V, V_{GS} = 0V f = 1MHz	-	4990	6640	pF
C_{oss}	Output Capacitance		-	2380	3170	pF
C_{rss}	Reverse Transfer Capacitance		-	140	-	pF
C_{oss}	Output Capacitance	V_{DS} = 480V, V_{GS} = 0V, f = 1.0MHz	-	113	-	pF
C_{oss} eff.	Effective Output Capacitance	V_{DS} = 0V to 480V, V_{GS} = 0V	-	340	-	pF
Q_g	Total Gate Charge at 10V	V_{DS} = 480V, I_D = 35A V_{GS} = 10V (Note 4)	-	139	181	nC
Q_{gs}	Gate to Source Gate Charge		-	31	-	nC
Q_{gd}	Gate to Drain “Miller” Charge		-	69	-	nC
ESR	Equivalent Series Resistance (G-S)	Drain Open, F= 1MHZ	-	1.4	-	Ω
Switching Characteristics						
$t_{d(on)}$	Turn-On Delay Time	V_{DD} = 300V, I_D = 35A R_G = 4.7Ω (Note 4)	-	34	78	ns
t_r	Turn-On Rise Time		-	120	250	ns
$t_{d(off)}$	Turn-Off Delay Time		-	105	220	ns
t_f	Turn-Off Fall Time		-	73	155	ns
Drain-Source Diode Characteristics						
I_S	Maximum Continuous Drain to Source Diode Forward Current		-	-	35	A
I_{SM}	Maximum Pulsed Drain to Source Diode Forward Current		-	-	105	A
V_{SD}	Drain to Source Diode Forward Voltage	V_{GS} = 0V, I_{SD} = 35A	-	-	1.4	V
t_{rr}	Reverse Recovery Time	V_{GS} = 0V, I_{SD} = 35A dI_F/dt = 100A/μs	-	614	-	ns
Q_{rr}	Reverse Recovery Charge		-	16.3	-	μC

Notes:
1: Repetitive Rating: Pulse width limited by maximum junction temperature
2: I_{AS} = 17.5A, V_{DD} = 50V, R_G = 25Ω, Starting T_J = 25°C
3: I_{SD} ≤ 35A, di/dt ≤ 200A/μs, V_{DD} ≤ BV_{DSS}, Starting T_J = 25°C
4: Essentially Independent of Operating Temperature Typical Characteristics

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Typical Performance Characteristics

Figure 1. On-Region Characteristics

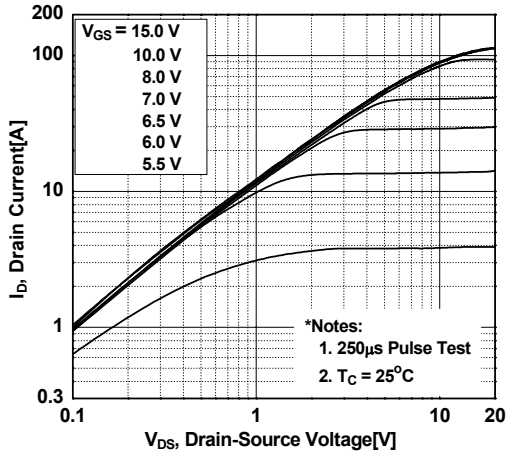


Figure 2. Transfer Characteristics

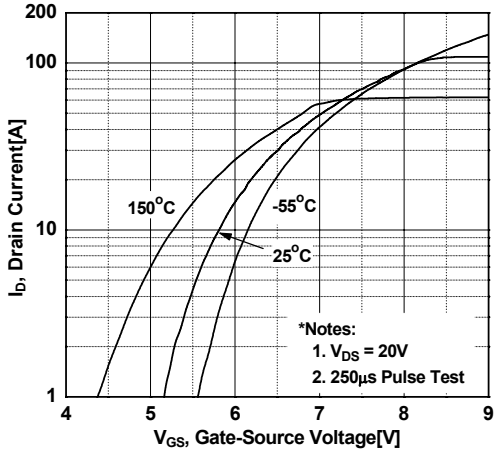


Figure 3. On-Resistance Variation vs. Drain Current and Gate Voltage

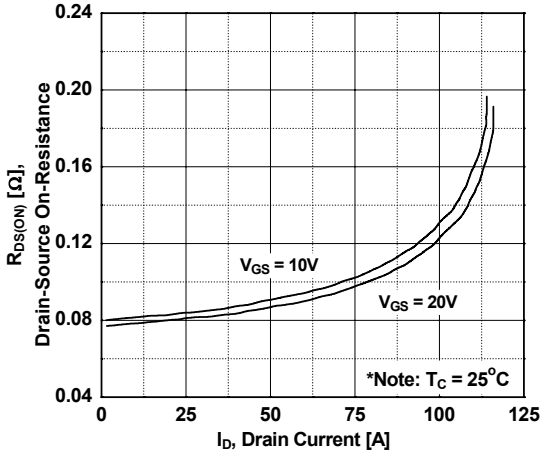


Figure 4. Body Diode Forward Voltage Variation vs. Source Current and Temperature

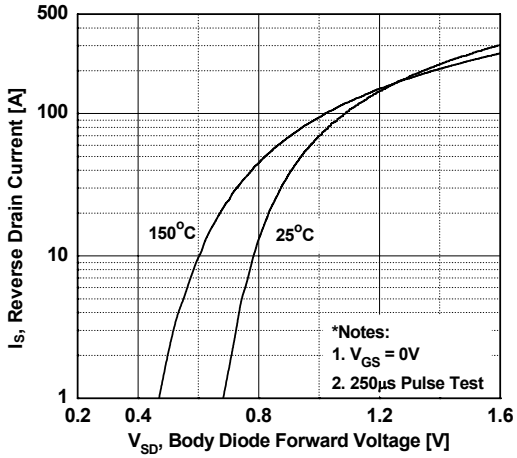


Figure 5. Capacitance Characteristics

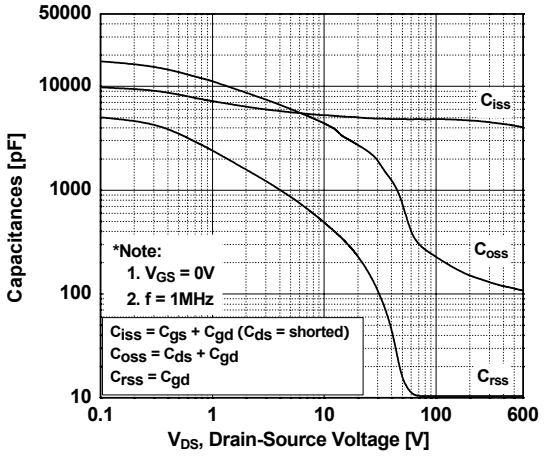
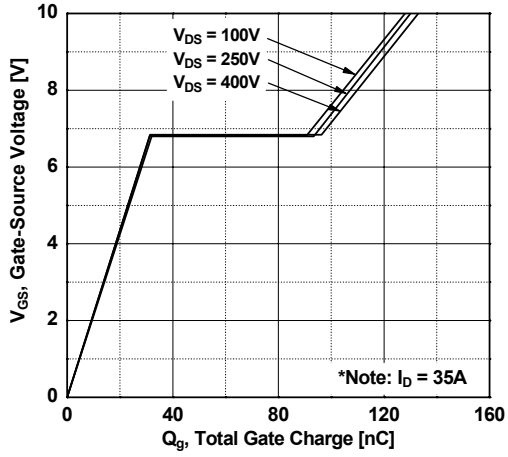


Figure 6. Gate Charge Characteristics



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Typical Performance Characteristics (Continued)

Figure 7. Breakdown Voltage Variation vs. Temperature

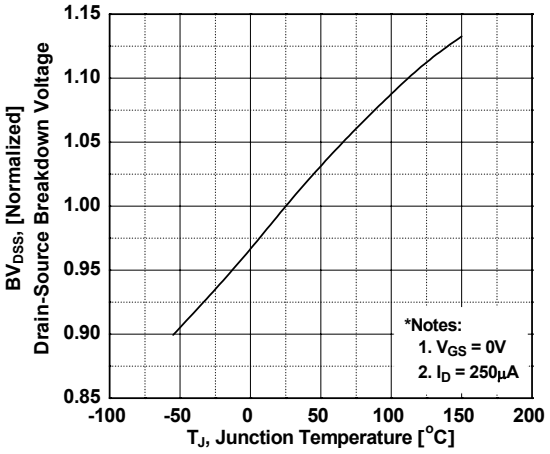


Figure 8. On-Resistance Variation vs. Temperature

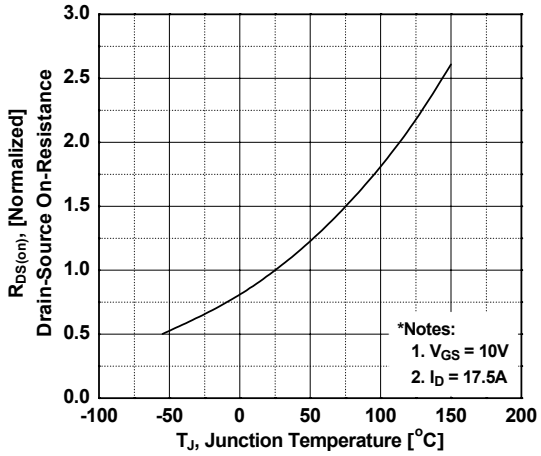


Figure 9. Maximum Safe Operating Area

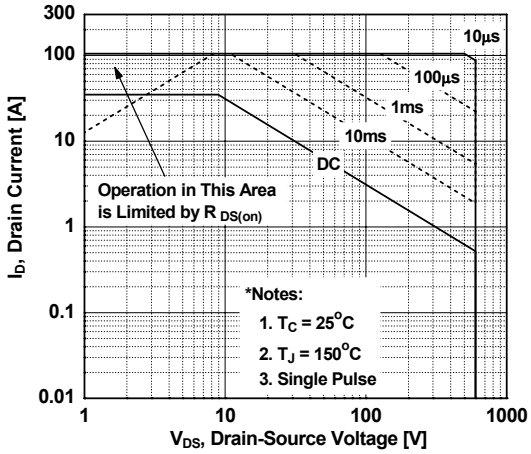


Figure 10. Maximum Drain Current vs. Case Temperature

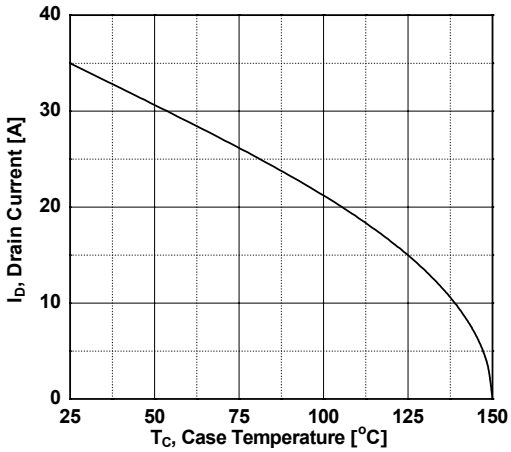
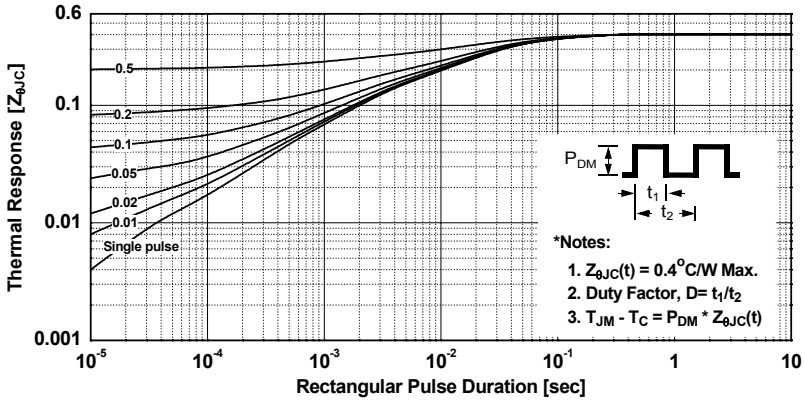


Figure 11. Transient Thermal Response Curve



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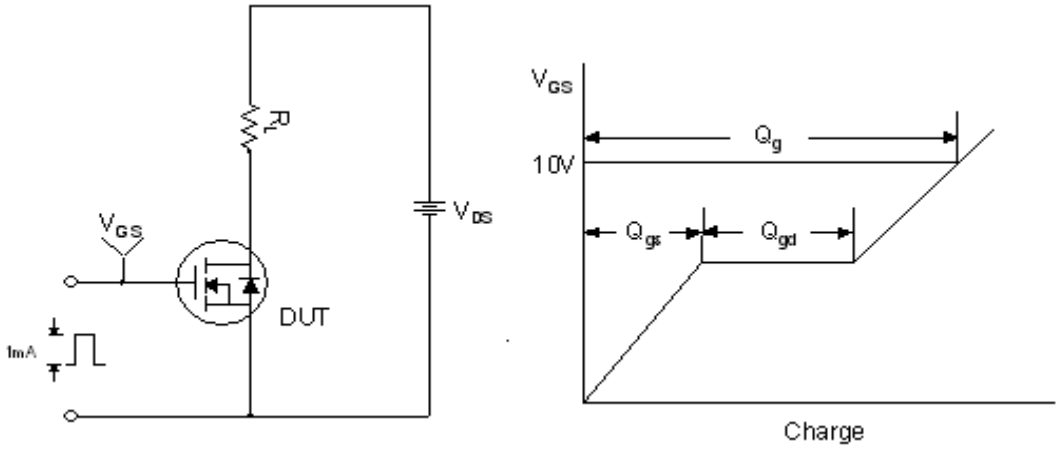
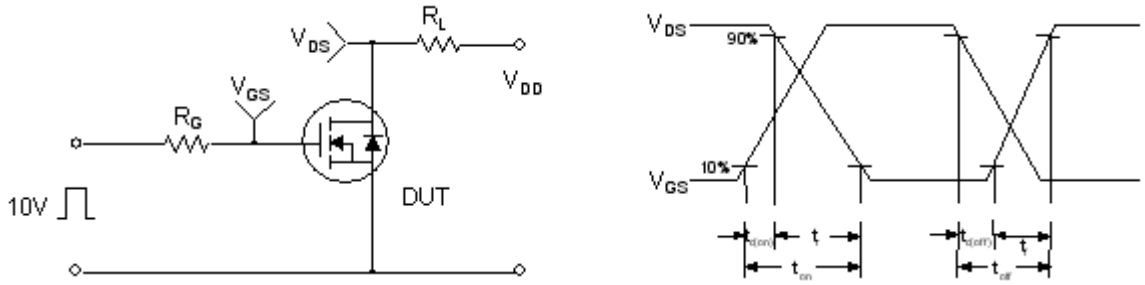
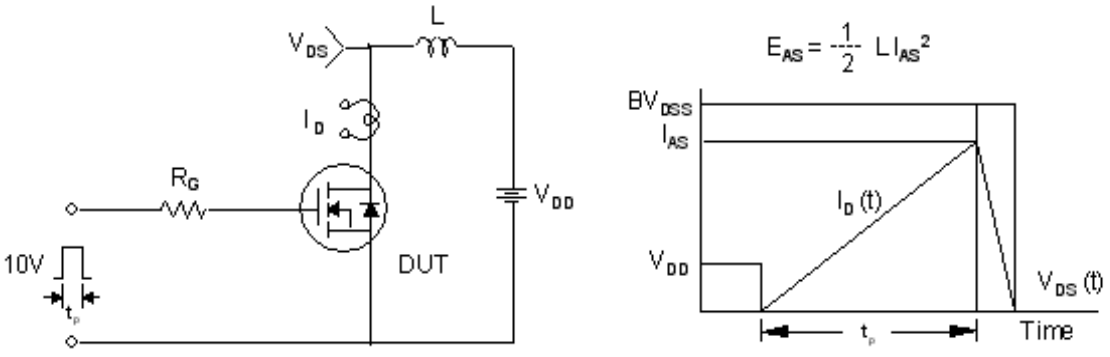
Gate Charge Test Circuit & Waveform



Resistive Switching Test Circuit & Waveforms



Unclamped Inductive Switching Test Circuit & Waveforms



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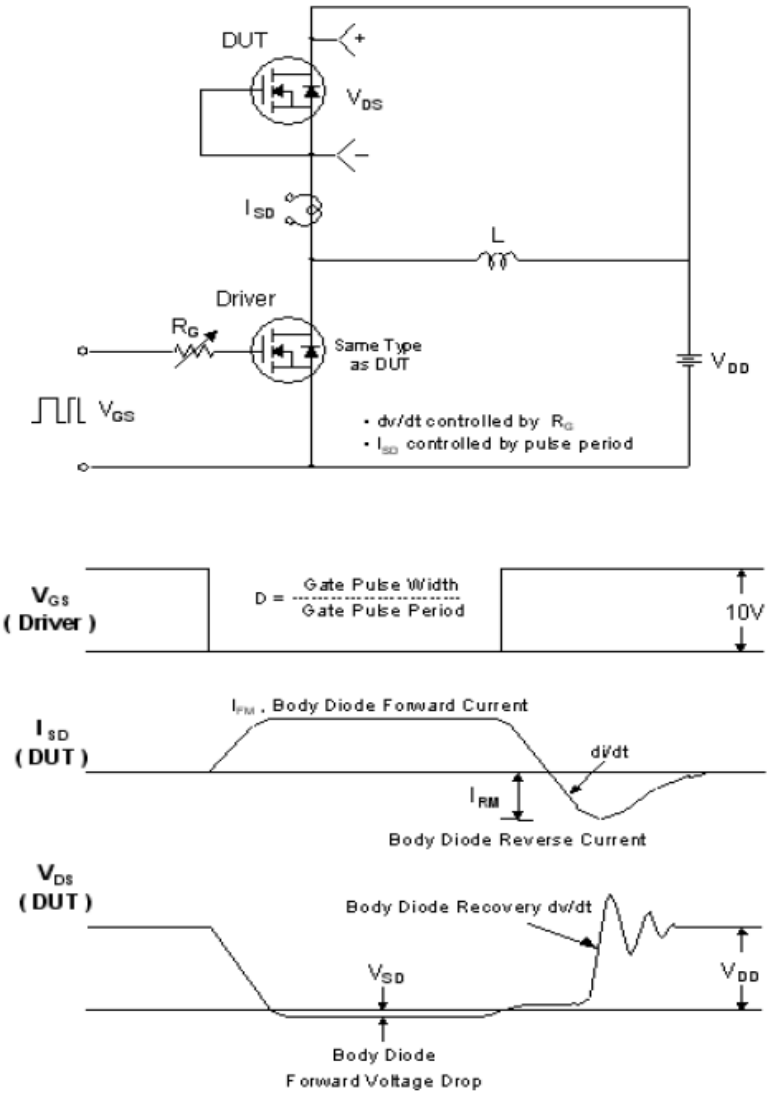
Peak Diode Recovery dv/dt Test Circuit & Waveforms



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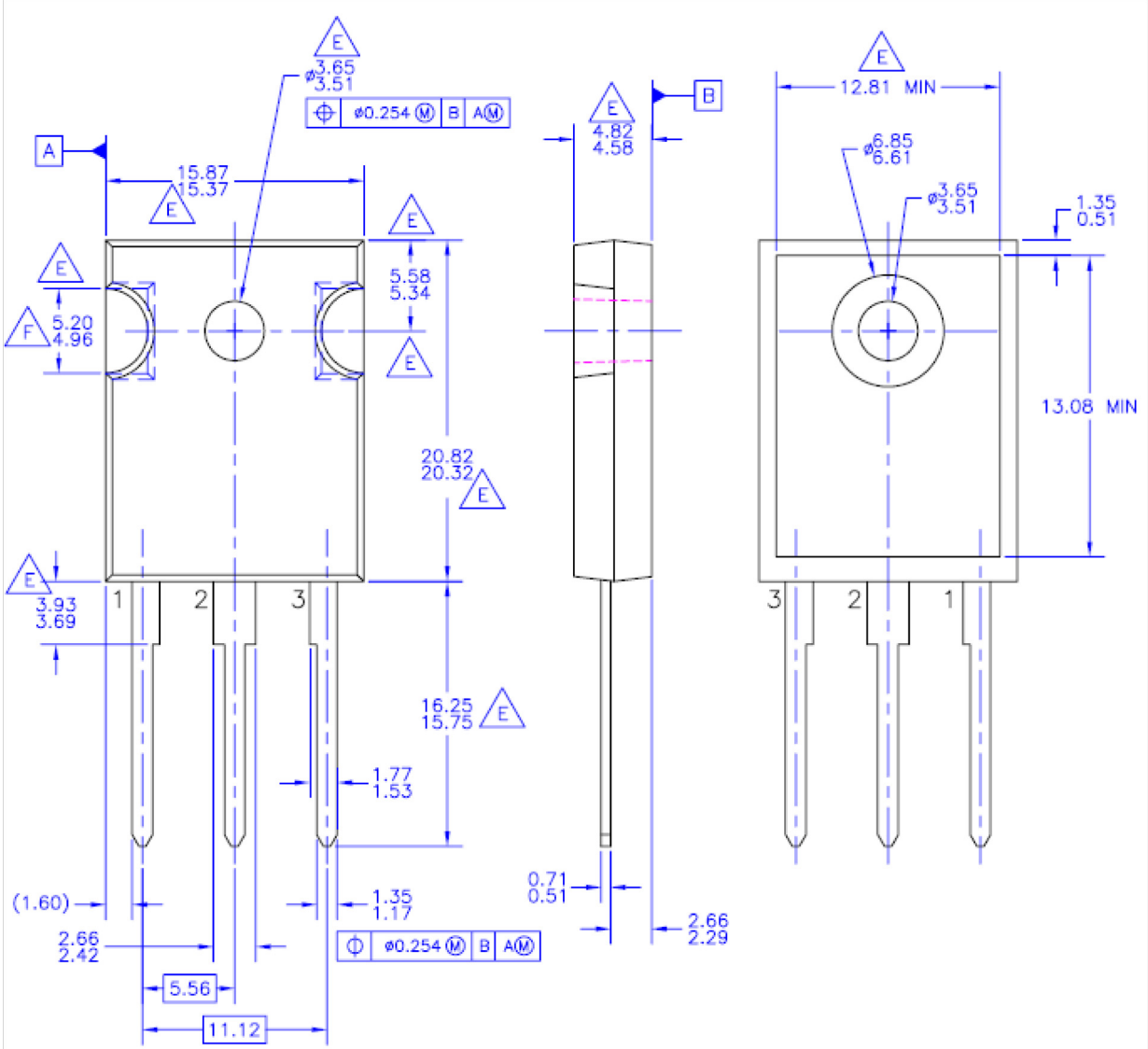
Mechanical Dimensions

TO-247-3L



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Dimensions in Millimeters

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