

FAIRCHILD
SEMICONDUCTOR®

August 2007

SuperFET™

FCH20N60 / FCA20N60 / FCA20N60_F109

600V N-Channel MOSFET

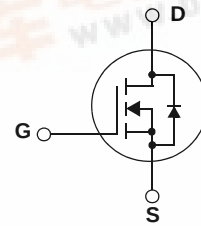
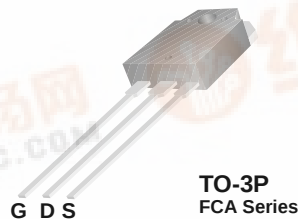
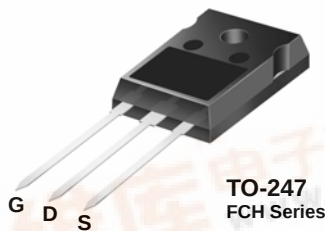
Features

- 650V @ $T_J = 150^\circ\text{C}$
- Typ. $R_{DS(on)} = 0.15\Omega$
- Ultra low gate charge (typ. $Q_g = 55\text{nC}$)
- Low effective output capacitance (typ. $C_{oss,eff} = 110\text{pF}$)
- 100% avalanche tested

Description

SuperFET™ is, Fairchild'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.



Absolute Maximum Ratings

Symbol	Parameter	FCH20N60	FCA20N60	Unit
V_{DSS}	Drain-Source Voltage	600		V
I_D	Drain Current - Continuous ($T_C = 25^\circ\text{C}$)	20		A
	- Continuous ($T_C = 100^\circ\text{C}$)	12.5		A
I_{DM}	Drain Current - Pulsed (Note 1)	60		A
V_{GSS}	Gate-Source voltage	± 30		V
E_{AS}	Single Pulsed Avalanche Energy (Note 2)	690		mJ
I_{AR}	Avalanche Current (Note 1)	20		A
E_{AR}	Repetitive Avalanche Energy (Note 1)	20.8		mJ
dv/dt	Peak Diode Recovery dv/dt (Note 3)	4.5		V/ns
P_D	Power Dissipation ($T_C = 25^\circ\text{C}$)	208		W
	- Derate above 25°C	1.67		W/ $^\circ\text{C}$
T_J, T_{STG}	Operating and Storage Temperature Range	-55 to +150		$^\circ\text{C}$
T_L	Maximum Lead Temperature for Soldering Purpose, 1/8" from Case for 5 Seconds	300		$^\circ\text{C}$

Thermal Characteristics

Symbol	Parameter	Typ.	Max.	Unit
$R_{\theta JC}$	Thermal Resistance, Junction-to-Case	--	0.6	$^\circ\text{C/W}$
$R_{\theta CS}$	Thermal Resistance, Case-to-Sink	0.24	--	
$R_{\theta JA}$	Thermal Resistance, Junction-to-Ambient	--	41.7	$^\circ\text{C/W}$



Package Marking and Ordering Information

Device Marking	Device	Package	Reel Size	Tape Width	Quantity
FCH20N60	FCH20N60	TO-247	-	-	30
FCA20N60	FCA20N60	TO-3P	-	-	30
FCA20N60	FCA20N60_F109	TO-3PN	-	-	30

Electrical Characteristics T_C = 25°C unless otherwise noted

Symbol	Parameter	Conditions	Min	Typ	Max	Units
Off Characteristics						
BV _{DSS}	Drain-Source Breakdown Voltage	V _{GS} = 0V, I _D = 250μA, T _J = 25°C	600	--	--	V
		V _{GS} = 0V, I _D = 250μA, 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 = 20A	--	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	μA
I _{GSSF}	Gate-Body Leakage Current, Forward	V _{GS} = 30V, V _{DS} = 0V	--	--	100	nA
I _{GSSR}	Gate-Body Leakage Current, Reverse	V _{GS} = -30V, V _{DS} = 0V	--	--	-100	nA
On Characteristics						
V _{GS(th)}	Gate Threshold Voltage	V _{DS} = V _{GS} , I _D = 250μA	3.0	--	5.0	V
R _{DS(on)}	Static Drain-Source On-Resistance	V _{GS} = 10V, I _D = 10A	--	0.15	0.19	Ω
g _{FS}	Forward Transconductance	V _{DS} = 40V, I _D = 10A (Note 4)	--	17	--	S
Dynamic Characteristics						
C _{iss}	Input Capacitance	V _{DS} = 25V, V _{GS} = 0V, f = 1.0MHz	--	2370	3080	pF
C _{oss}	Output Capacitance		--	1280	1665	pF
C _{rss}	Reverse Transfer Capacitance		--	95	--	pF
C _{oss}	Output Capacitance	V _{DS} = 480V, V _{GS} = 0V, f = 1.0MHz	--	65	85	pF
C _{oss eff.}	Effective Output Capacitance	V _{DS} = 0V to 400V, V _{GS} = 0V	--	165	--	pF
Switching Characteristics						
t _{d(on)}	Turn-On Delay Time	V _{DD} = 300V, I _D = 20A R _G = 25Ω (Note 4, 5)	--	62	135	ns
t _r	Turn-On Rise Time		--	140	290	ns
t _{d(off)}	Turn-Off Delay Time		--	230	470	ns
t _f	Turn-Off Fall Time		--	65	140	ns
Q _g	Total Gate Charge	V _{DS} = 480V, I _D = 20A V _{GS} = 10V (Note 4, 5)	--	75	98	nC
Q _{gs}	Gate-Source Charge		--	13.5	18	nC
Q _{gd}	Gate-Drain Charge		--	36	--	nC
Drain-Source Diode Characteristics and Maximum Ratings						
I _S	Maximum Continuous Drain-Source Diode Forward Current		--	--	20	A
I _{SM}	Maximum Pulsed Drain-Source Diode Forward Current		--	--	60	A
V _{SD}	Drain-Source Diode Forward Voltage	V _{GS} = 0V, I _S = 20A	--	--	1.4	V
t _{rr}	Reverse Recovery Time	V _{GS} = 0V, I _S = 20A	--	530	--	ns
Q _{rr}	Reverse Recovery Charge	dI _F /dt = 100A/μs (Note 4)	--	10.5	--	μC

NOTES:

1. Repetitive Rating: Pulse width limited by maximum junction temperature
2. I_{AS} = 10A, V_{DD} = 50V, R_G = 25Ω, Starting T_J = 25°C
3. I_{SD} ≤ 20A, di/dt ≤ 200A/μs, V_{DD} ≤ BV_{DSS}, Starting T_J = 25°C
4. Pulse Test: Pulse width ≤ 300μs, Duty Cycle ≤ 2%
5. Essentially Independent of Operating Temperature Typical Characteristics

Typical Performance Characteristics

Figure 1. On-Region Characteristics

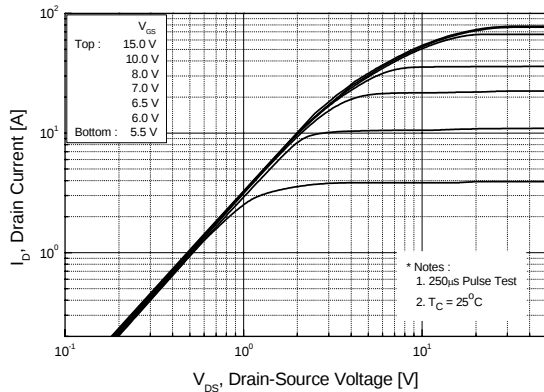


Figure 2. Transfer Characteristics

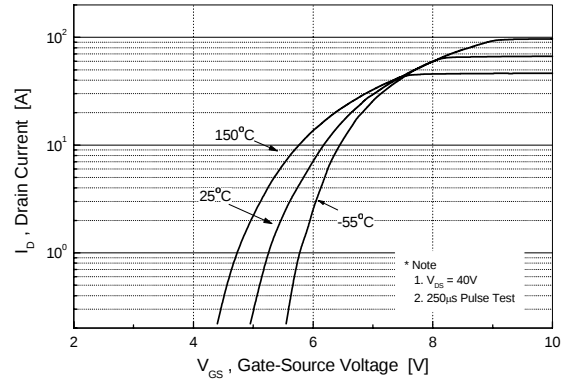


Figure 3. On-Resistance Variation vs. Drain Current and Gate Voltage

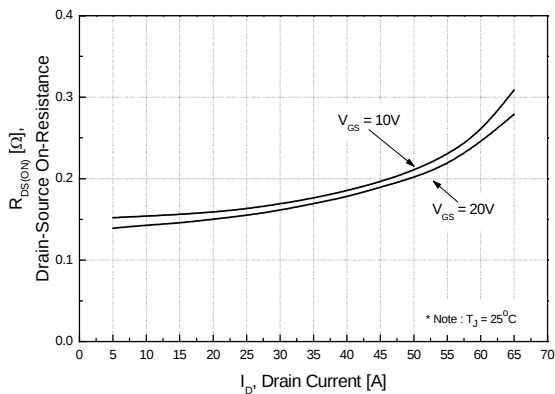


Figure 4. Body Diode Forward Voltage Variation vs. Source Current and Temperature

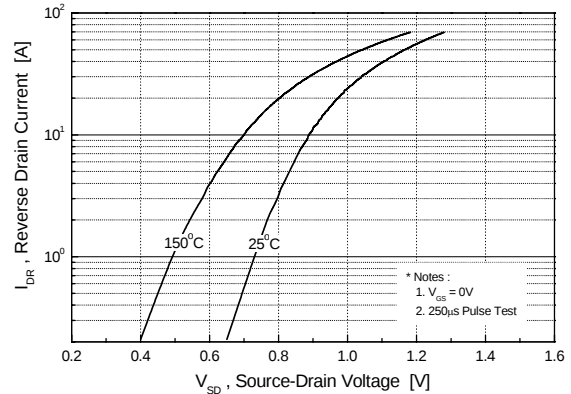


Figure 5. Capacitance Characteristics

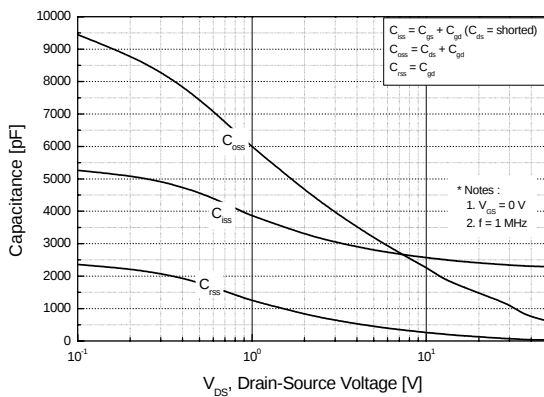
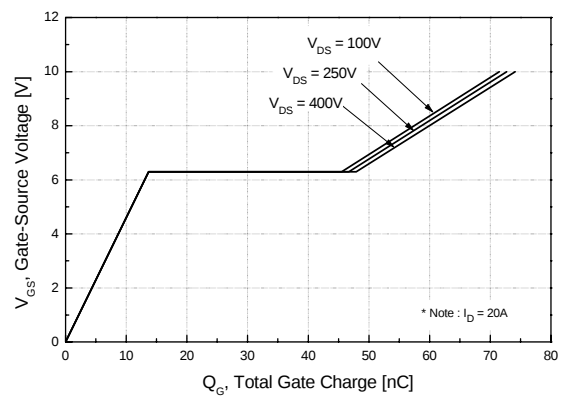


Figure 6. Gate Charge Characteristics



Typical Performance Characteristics (Continued)

Figure 7. Breakdown Voltage Variation vs. Temperature

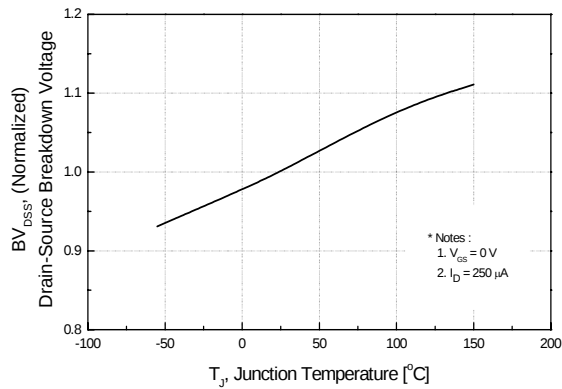


Figure 8. On-Resistance Variation vs. Temperature

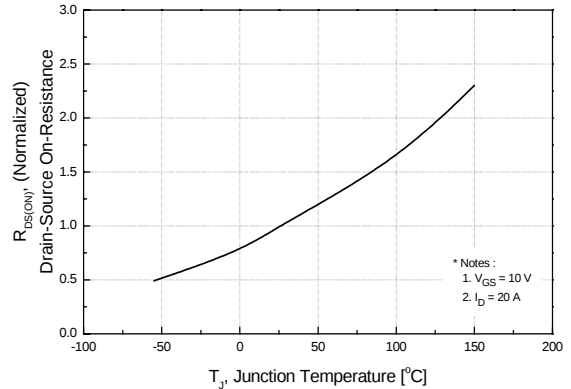


Figure 9. Maximum Safe Operating Area

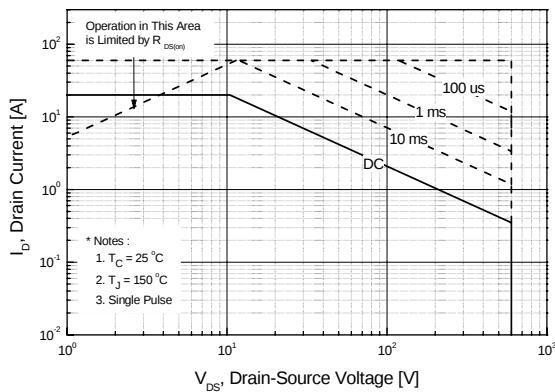


Figure 10. Maximum Drain Current vs. Case Temperature

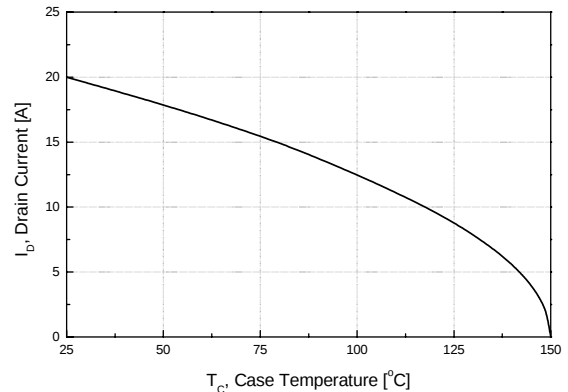
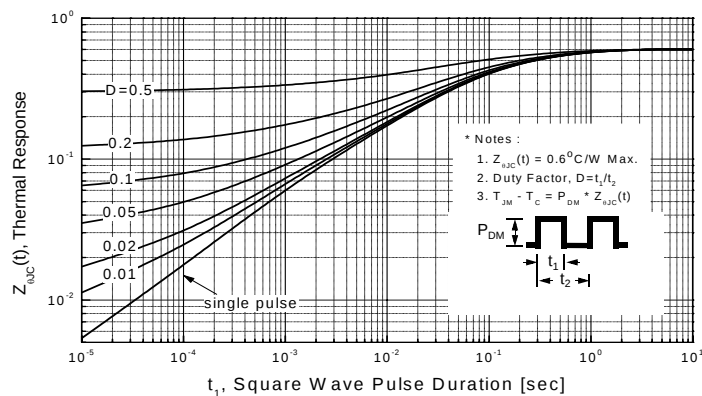
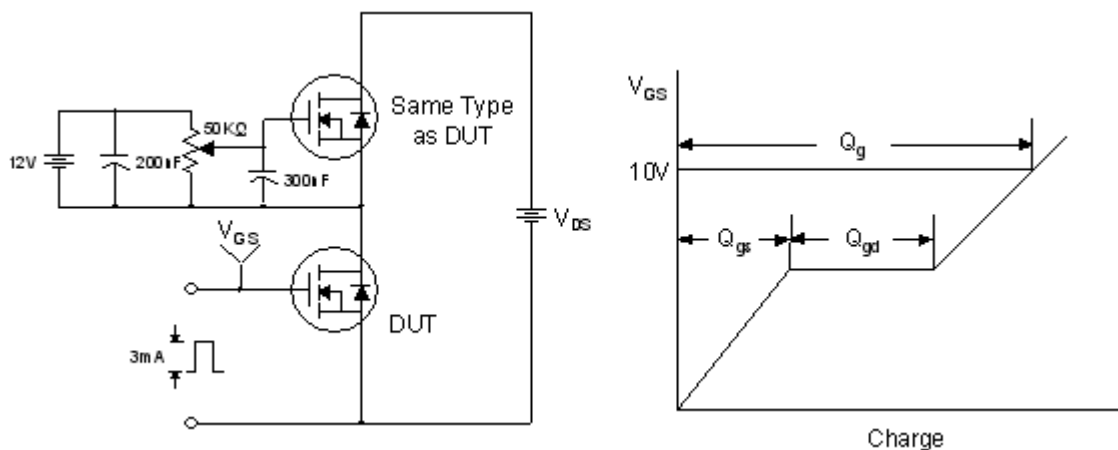


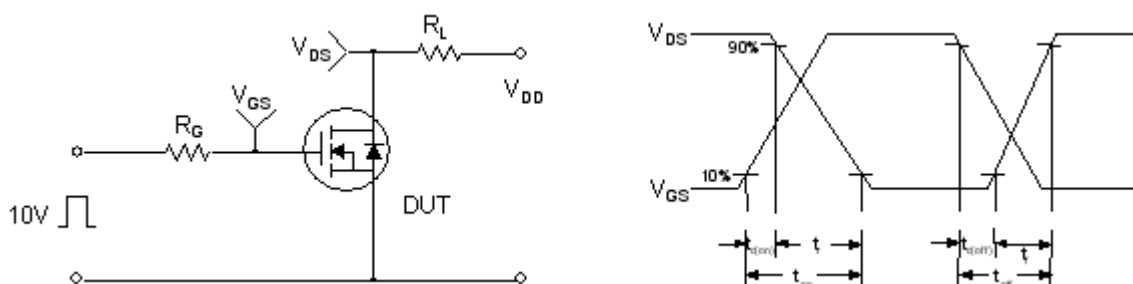
Figure 11. Transient Thermal Response Curve



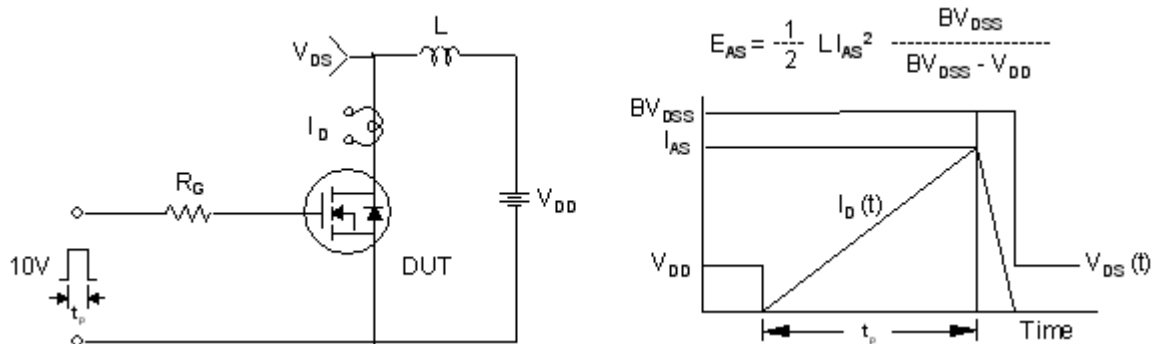
Gate Charge Test Circuit & Waveform



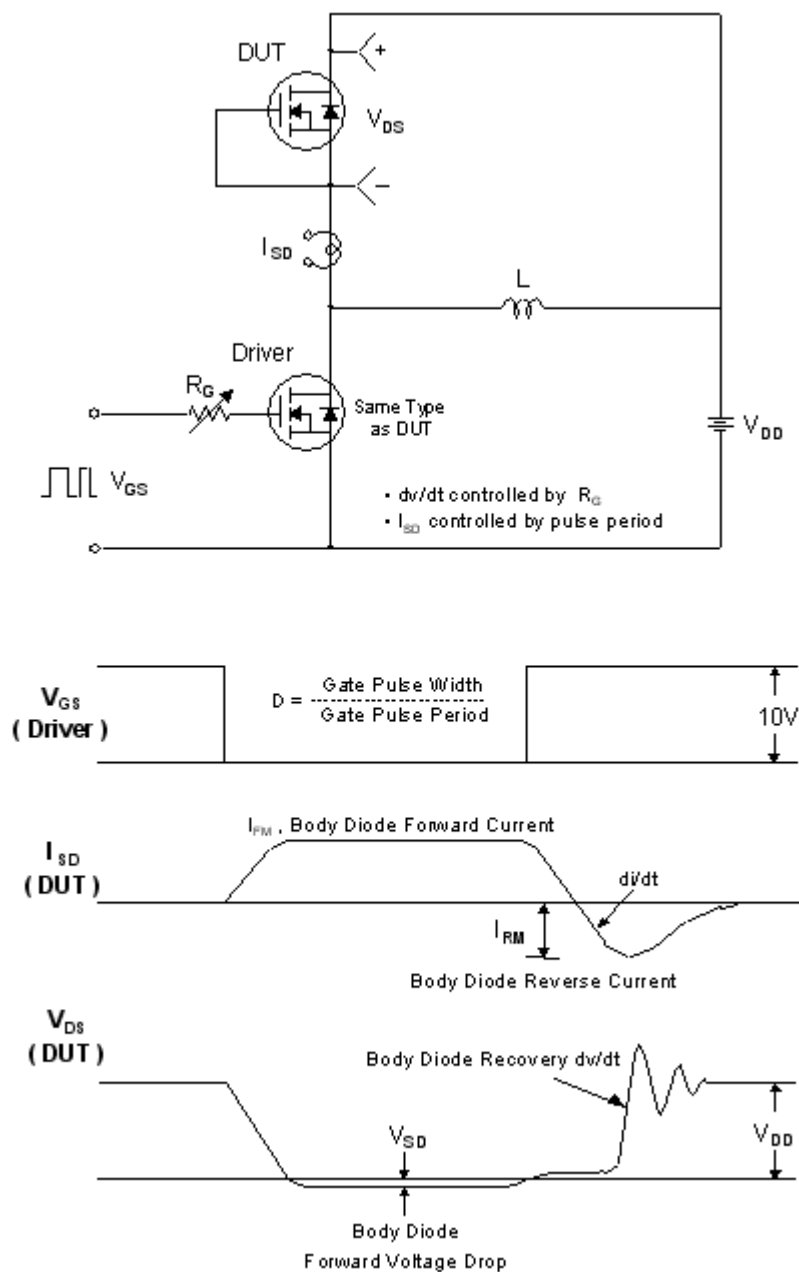
Resistive Switching Test Circuit & Waveforms



Unclamped Inductive Switching Test Circuit & Waveforms

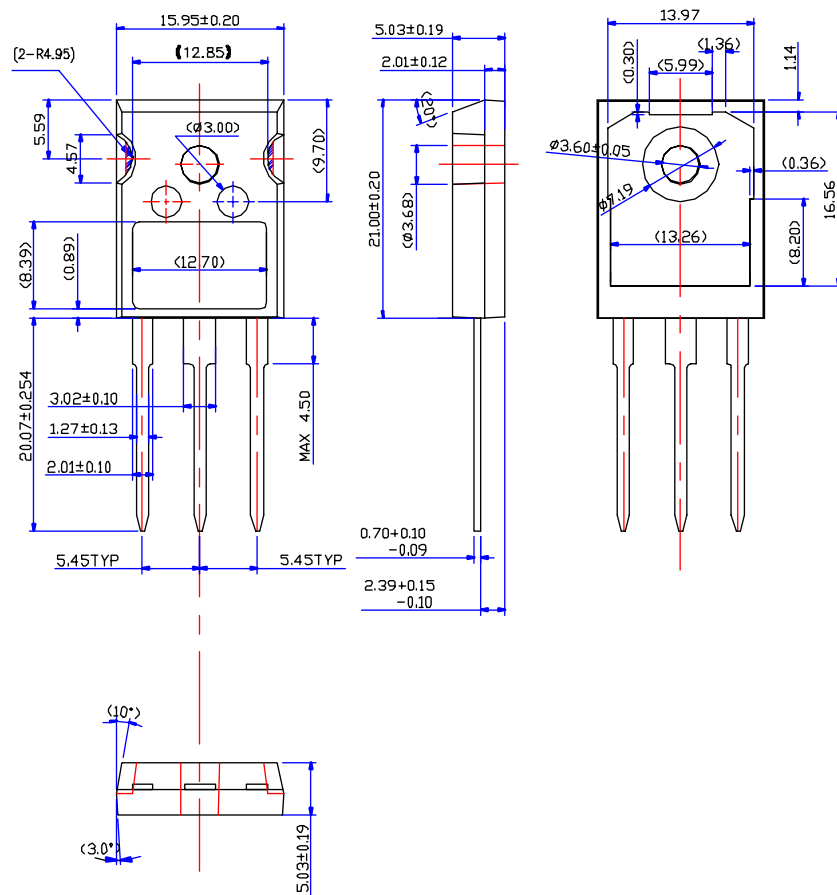


Peak Diode Recovery dv/dt Test Circuit & Waveforms



Mechanical Dimensions

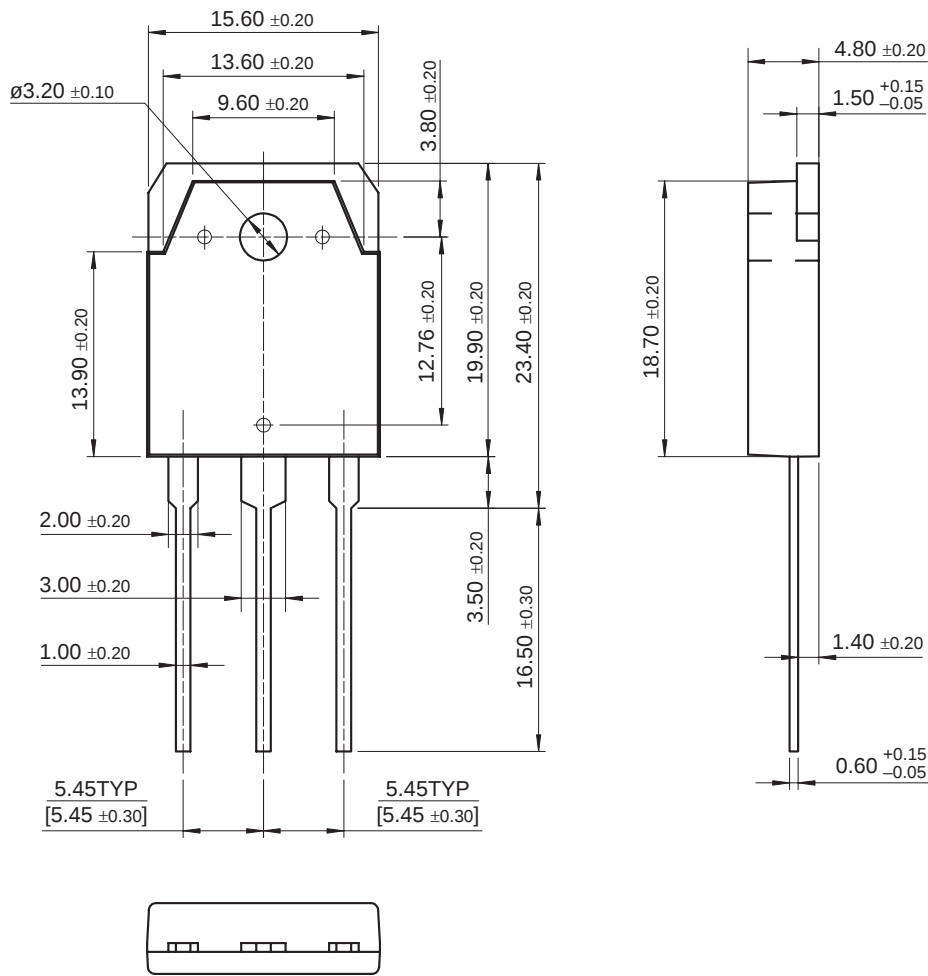
TO-247AD (FKS PKG CODE 001)



Dimensions in Millimeters

Mechanical Dimensions (Continued)

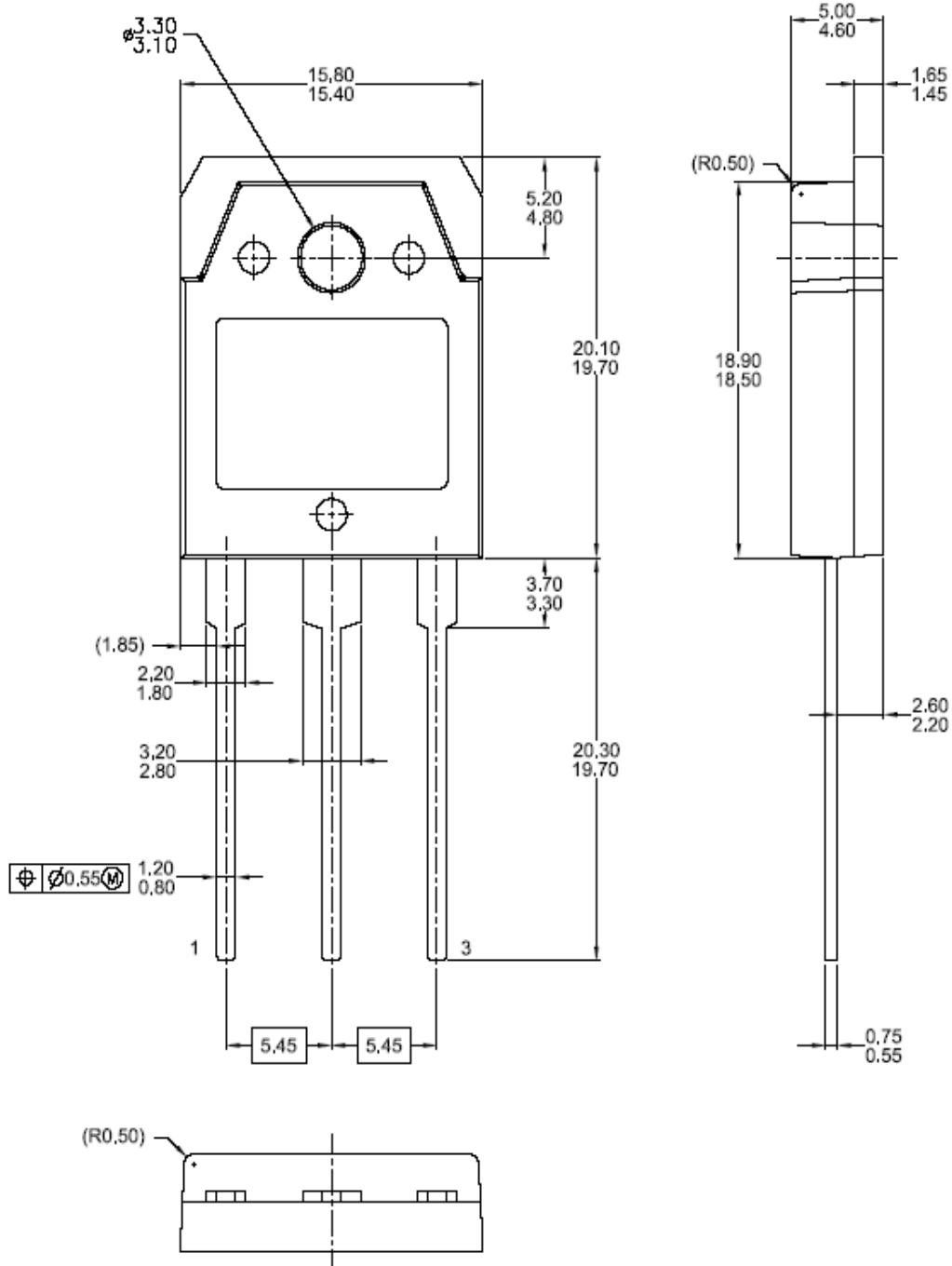
TO-3P



Dimensions in Millimeters

Mechanical Dimensions (Continued)

TO-3PN



Dimensions in Millimeters



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