DATA SHEET
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MOSFET – N-Channel, SUPERFET®, FRFET®

600 V, 20 A, 190 mΩ

FCA20N60F

Description

SUPERFET MOSFET is **onsemi**'s first generation of high voltage super−junction (SJ) MOSFET family that is utilizing charge balance technology for outstanding low on−resistance and lower gate charge performance. This technology is tailored to minimize conduction loss, provide superior switching performance, dv/dt rate and higher avalanche energy. Consequently, SUPERFET MOSFET is very suitable for the switching power applications such as PFC, server/telecom power, FPD TV power, ATX power and industrial power applications. SUPERFET FRFET MOSFET's optimized body diode reverse recovery performance can remove additional component and improve system reliability.

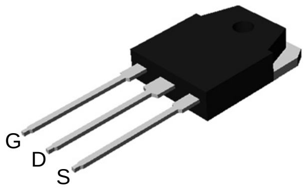
Features

- 650 V @ T_J = 150°C
- Typ. $R_{DS(on)}$ = 150 mΩ
- Fast Recovery Time (Typ. T_{rr} = 160 ns)
- Ultra Low Gate Charge (Typ. Q_g = 75 nC)
- Low Effective Output Capacitance (Typ. $C_{oss(eff.)}$ = 165 pF)
- 100% Avalanche Tested
- RoHS Compliant

Applications

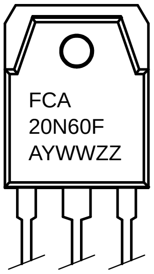
- LCD / LED / PDP TV
- Solar Inverter
- AC−DC Power Supply

V_{DSS}	$R_{DS(on)}$ MAX	I_D MAX
600 V	190 mΩ @ 10 V	20 A



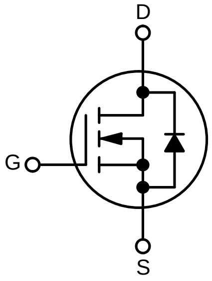
TO−3P−3LD / EIAJ SC−65, ISOLATED
CASE 340BZ

MARKING DIAGRAM



FCA20N60F	= Specific Device Code
A	= Assembly Location
YWW	= Date Code (Year & Week)
ZZ	= Assembly Lot

N−CHANNEL MOSFET



ORDERING INFORMATION

Part Number	Package	Shipping
FCA20N60F	TO−3P−3LD (Pb−Free)	450 Units / Tube

February, 2024 − Rev. 3

Publication Order Number:
FCA20N60F/D

ABSOLUTE MAXIMUM RATINGS (T_C = 25°C, unless otherwise noted)

Symbol	Parameter		FCA20N60F	Unit
V_{DSS}	Drain−Source Voltage		600	V
I_D	Drain Current	− Continuous (T_C = 25°C)	20	A
		− Continuous (T_C = 100°C)	12.5	
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)		50	V/ns
P_D	Power Dissipation	(T_C = 25°C)	208	W
		− Derate above 25°C	1.67	W/°C
T_J, T_{STG}	Operating and Storage Temperature Range		−55 to +150	°C
T_L	Maximum Lead Temperature for Soldering, 1/8” from Case for 5 Seconds		300	°C

Stresses exceeding those listed in the Maximum Ratings table may damage the device. If any of these limits are exceeded, device functionality should not be assumed, damage may occur and reliability may be affected.

1. Repetitive rating: pulse−width limited by maximum junction temperature.
2. I_{AS} = 10 A, V_{DD} = 50 V, R_G = 25 Ω, starting T_J = 25°C.
3. $I_{SD} \leq$ 20 A, di/dt ≤ 1200 A/μs, $V_{DD} \leq BV_{DSS}$, starting T_J = 25°C.

THERMAL CHARACTERISTICS

Symbol	Parameter	FCA20N60F	Unit
$R_{\theta JC}$	Thermal Resistance, Junction−to−Case, Max.	0.6	°C/W
$R_{\theta JA}$	Thermal Resistance, Junction−to−Ambient, Max.	40	°C/W

ELECTRICAL CHARACTERISTICS (T_C = 25°C unless otherwise noted)

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
OFF CHARACTERISTICS						
BV_{DSS}	Drain−Source Breakdown Voltage	V_{GS} = 0 V, I_D = 250 μA, T_J = 25°C	600	−	−	V
		V_{GS} = 0 V, I_D = 250 μA, T_J = 150°C	−	650	−	
ΔBV_{DSS} / ΔT_J	Breakdown Voltage Temperature Coefficient	I_D = 250 μA, Referenced to 25°C	−	0.6	−	V/°C
BV_{DSS}	Drain−Source Avalanche Breakdown Voltage	V_{GS} = 0 V, I_D = 20 A	−	700	−	V
I_{DSS}	Zero Gate Voltage Drain Current	V_{DS} = 600 V, V_{GS} = 0 V	−	−	10	μA
		V_{DS} = 480 V, T_C = 125°C	−	−	100	
I_{GSSF}	Gate−Body Leakage Current, Forward	V_{GS} = 30 V, V_{DS} = 0 V	−	−	100	nA
I_{GSSR}	Gate−Body Leakage Current, Reverse	V_{GS} = −30 V, V_{DS} = 0 V	−	−	−100	nA
ON CHARACTERISTICS						
$V_{GS(th)}$	Gate Threshold Voltage	V_{DS} = V_{GS}, I_D = 250 μA	3.0	−	5.0	V
$R_{DS(on)}$	Static Drain−Source On−Resistance	V_{GS} = 10 V, I_D = 10 A	−	0.15	0.19	Ω
g_{FS}	Forward Transconductance	V_{DS} = 40 V, I_D = 10 A	−	17	−	S
DYNAMIC CHARACTERISTICS						
C_{iss}	Input Capacitance	V_{DS} = 25 V, V_{GS} = 0 V, f = 1.0 MHz	−	2370	3080	pF
C_{oss}	Output Capacitance		−	1280	1665	pF
C_{rss}	Reverse Transfer Capacitance		−	95	−	pF
C_{oss}	Output Capacitance	V_{DS} = 480 V, V_{GS} = 0 V, f = 1.0 MHz	−	65	85	pF
C_{oss} eff.	Effective Output Capacitance	V_{DS} = 0 to 400 V, V_{GS} = 0 V	−	165	−	pF
SWITCHING CHARACTERISTICS						
$t_{d(on)}$	Turn−On Delay Time	V_{DD} = 300 V, I_D = 20 A, R_G = 25 Ω (Note 4)	−	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} = 480 V, I_D = 20 A, V_{GS} = 10 V (Note 4)	−	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} = 0 V, I_S = 20 A	−	−	1.4	V
t_{rr}	Reverse Recovery Time	V_{GS} = 0 V, I_S = 20 A, dI_F/dt = 100 A/μs	−	160	−	ns
Q_{rr}	Reverse Recovery Charge		−	1.1	−	μC

Product parametric performance is indicated in the Electrical Characteristics for the listed test conditions, unless otherwise noted. Product performance may not be indicated by the Electrical Characteristics if operated under different conditions.

4. Essentially independent of operating temperature typical characteristics.

TYPICAL PERFORMANCE CHARACTERISTICS

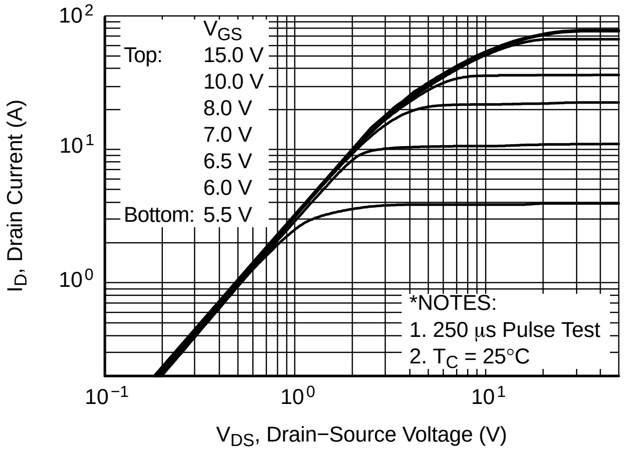


Figure 1. On−Region Characteristics

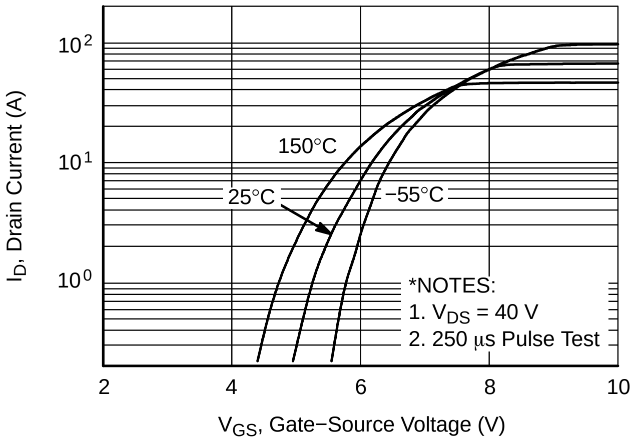


Figure 2. Transfer Characteristics

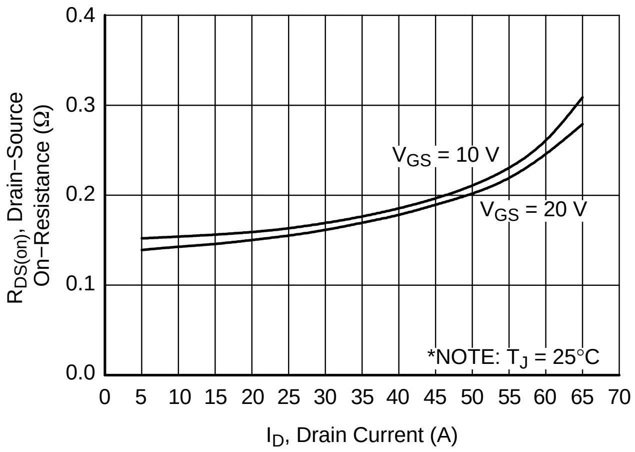


Figure 3. On−Resistance Variation vs. Drain Current and Gate Voltage

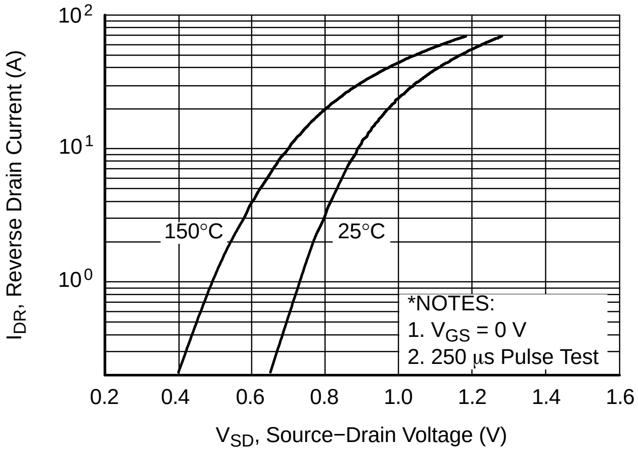


Figure 4. Body Diode Forward Voltage Variation vs. Source Current and Temperature

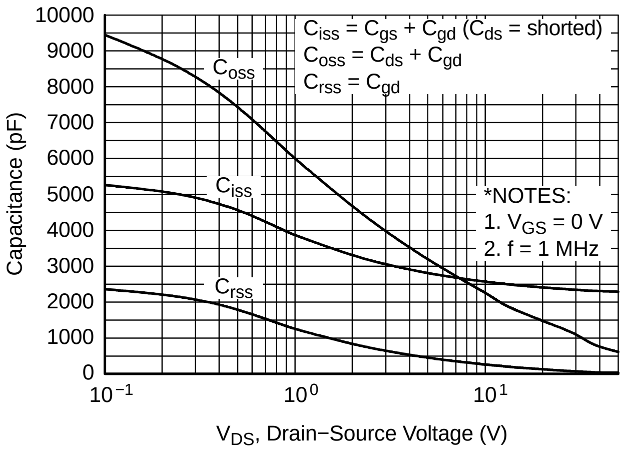


Figure 5. Capacitance Characteristics

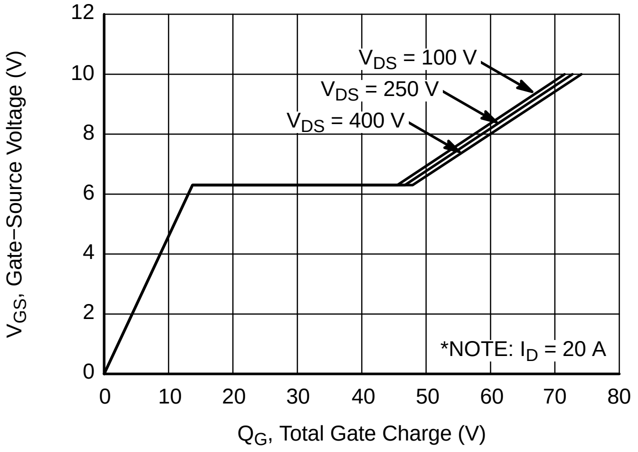


Figure 6. Gate Charge Characteristics

TYPICAL PERFORMANCE CHARACTERISTICS (CONTINUED)

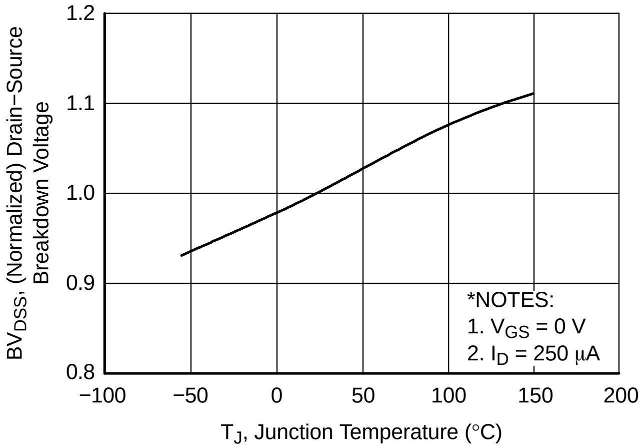


Figure 7. Breakdown Voltage Variation vs. Temperature

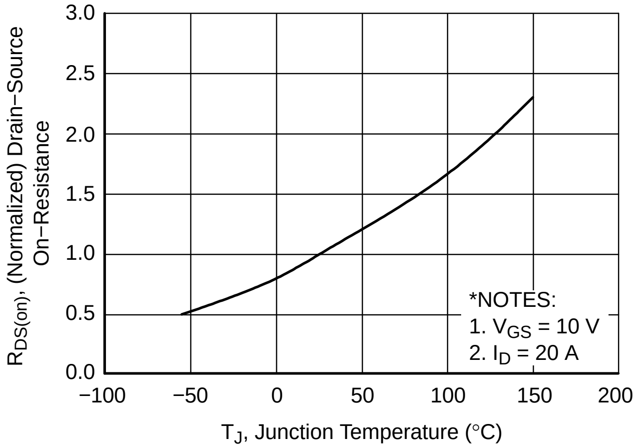


Figure 8. On−Resistance Variation vs. Temperature

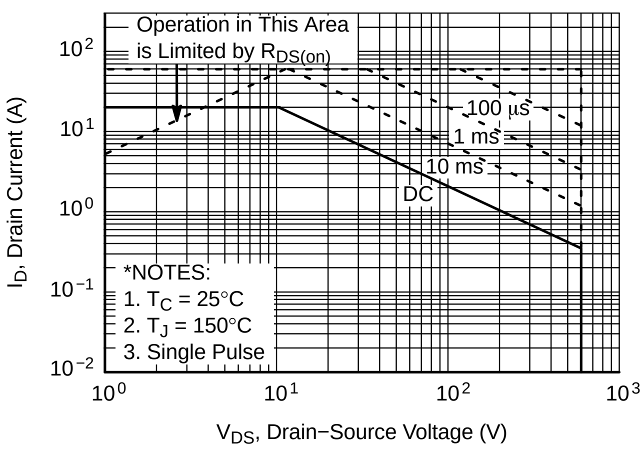


Figure 9. Maximum Safe Operating Area

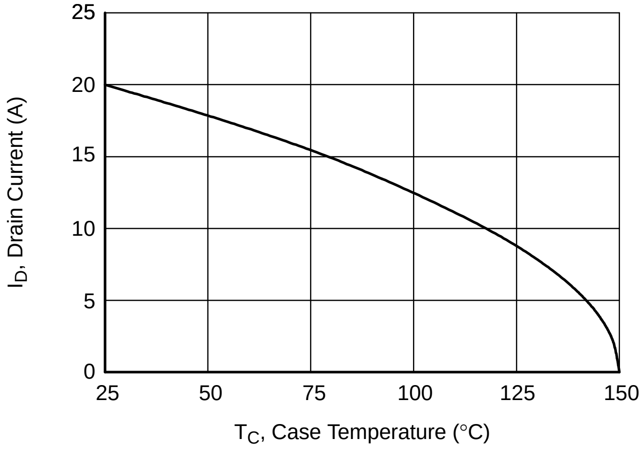


Figure 10. Maximum Drain Current vs. Case Temperature

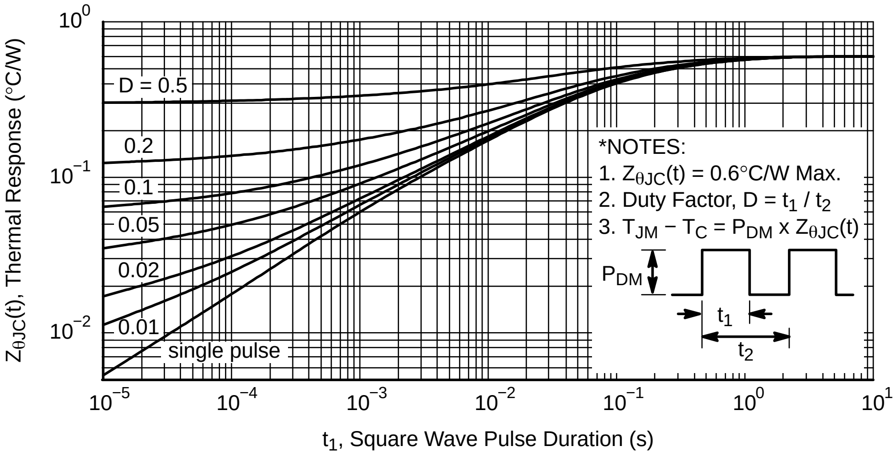


Figure 11. Transient Thermal Response Curve

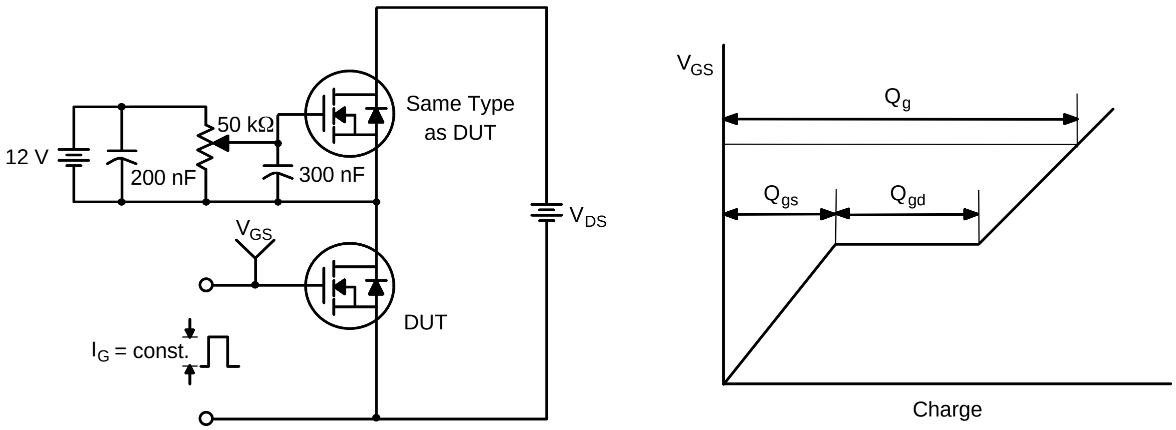


Figure 12. Gate Charge Test Circuit & Waveform

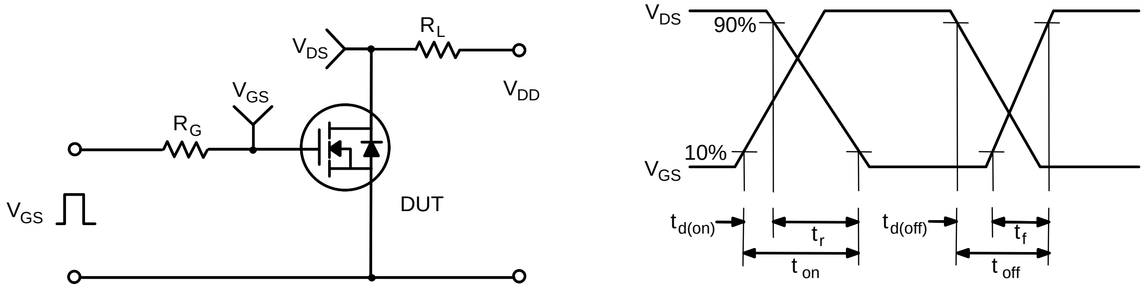
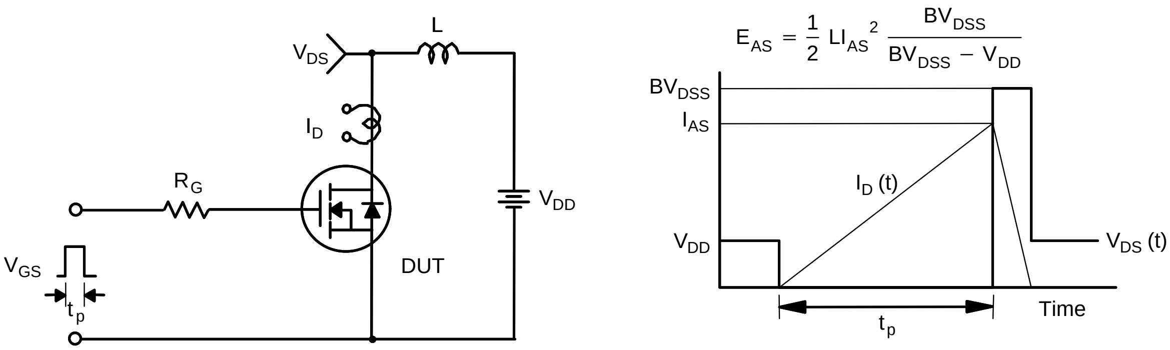


Figure 13. Resistive Switching Test Circuit & Waveforms



$$E_{AS} = \frac{1}{2} L I_{AS}^{2} \frac{BV_{DSS}}{BV_{DSS} - V_{DD}}$$

Figure 14. Unclamped Inductive Switching Test Circuit & Waveforms

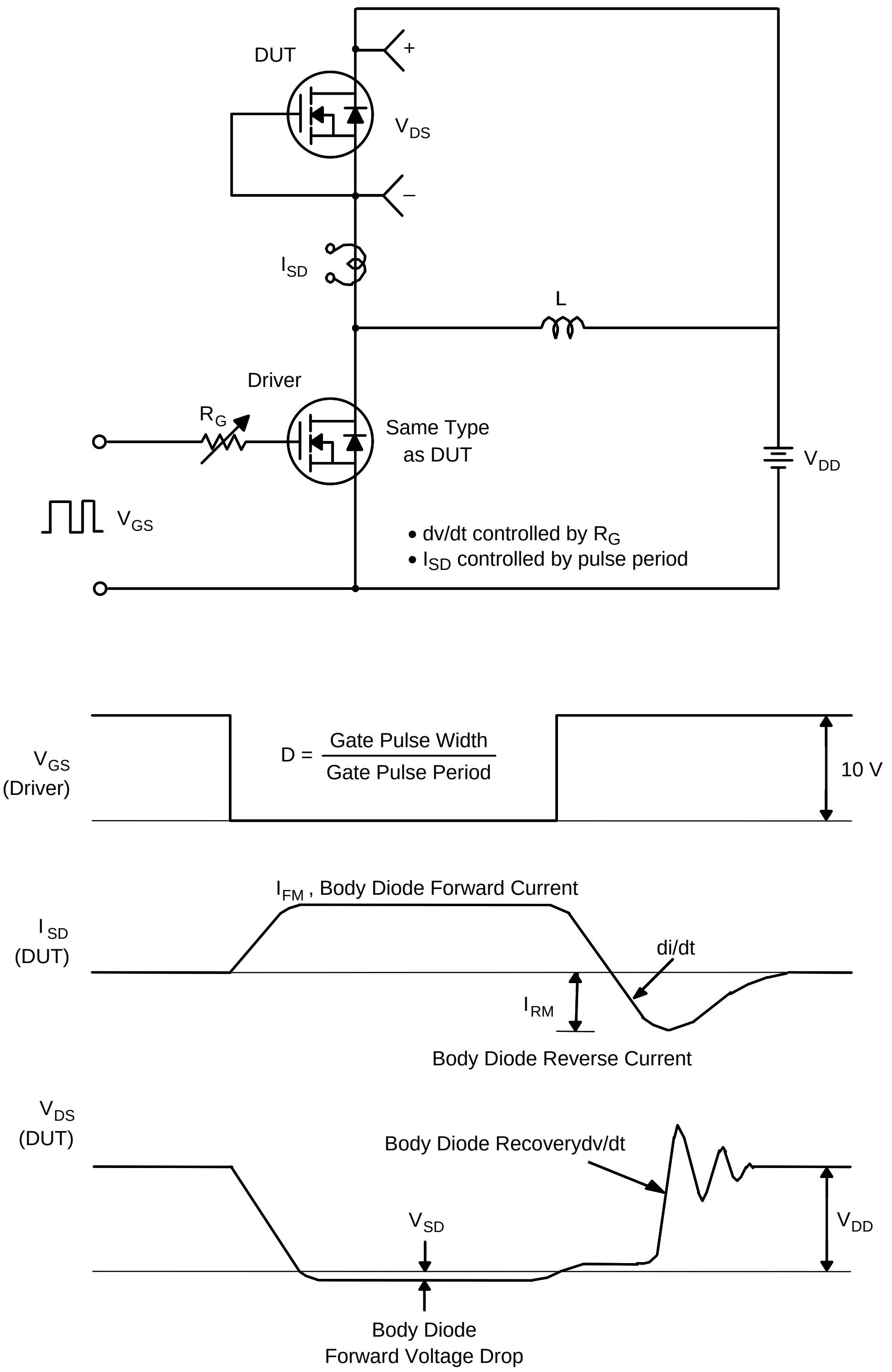


Figure 15. Peak Diode Recovery dv/dt Test Circuit & Waveforms

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TO−3P−3LD / EIAJ SC−65, ISOLATED
CASE 340BZ
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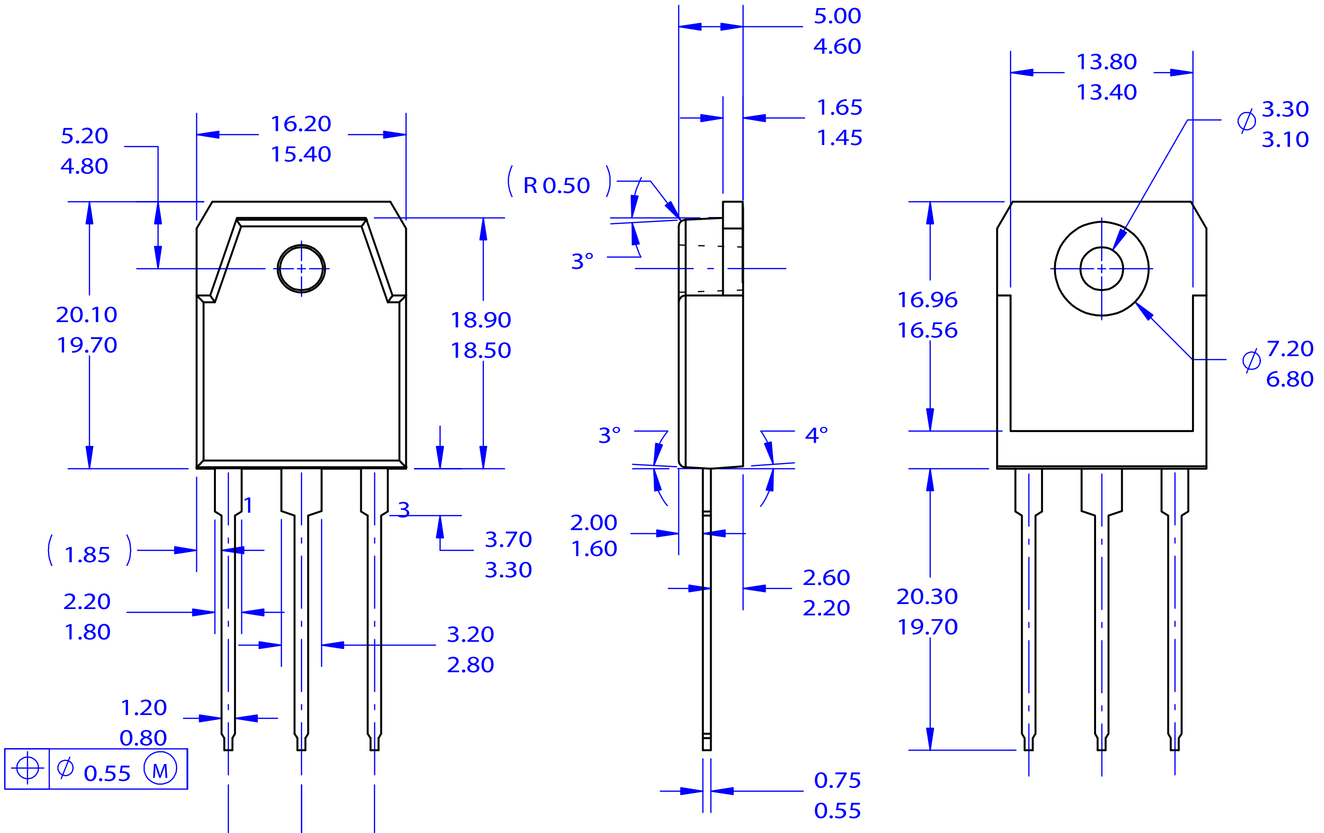
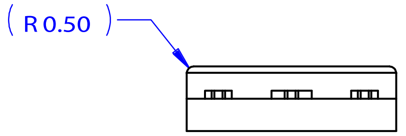
DATE 31 OCT 2016





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C) DIMENSION AND TOLERANCING PER ASME14.5-2009.
D) DIMENSIONS ARE EXCLUSSIVE OF BURRS, MOLD FLASH, AND TIE BAR EXTRUSSIONS.

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