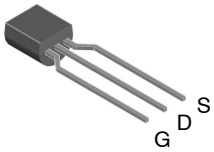
MOSFET – N-Channel QFET®

600 V, 0.3 A, 11.5 Ω

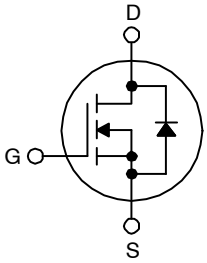
FQN1N60C

ON Semiconductor®

www.onsemi.com



TO−92 4.75x4.80
CASE 135AV



Description

This N−Channel enhancement mode power MOSFET is produced using ON Semiconductor's proprietary planar stripe and DMOS technology. This advanced MOSFET technology has been especially tailored to reduce on−state resistance, and to provide superior switching performance and high avalanche energy strength. These devices are suitable for switched mode power supplies, active power factor correction (PFC), and electronic lamp ballasts.

Features

- 0.3 A, 600 V, $R_{DS(on)}$ = 11.5 Ω (Max.) @ V_{GS} = 10 V, I_D = 0.15 A
- Low Gate Charge (Typ. 4.8 nC)
- Low Crss (Typ. 3.5 pF)
- 100% Avalanche Tested

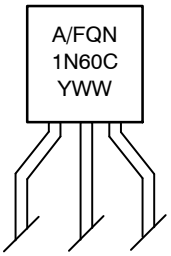
ABSOLUTE MAXIMUM RATINGS (T_C = 25°C unless otherwise noted)

Symbol	Parameter		Value	Unit
V_{DSS}	Drain to Source Voltage		600	V
V_{GSS}	Gate to Source Voltage		±30	V
I_D	Drain Current Continuous (T_C = 25°C) Continuous (T_C = 100°C)		 0.3 0.18	A
I_{DM}	Drain Current − Pulsed	(Note 1)	1.2	A
E_{AS}	Single Pulsed Avalanche Energy	(Note 2)	33	mJ
I_{AR}	Avalanche Current	(Note 1)	0.3	A
E_{AR}	Repetitive Avalanche Energy	(Note 1)	0.3	mJ
dv/dt	Peak Diode Recovery dv/dt	(Note 3)	4.5	V/ns
P_D	Power Dissipation (T_A = 25°C) (T_L = 25°C) Derate above 25°C		 1 3 0.02	 W W 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. L = 59 mH, I_{AS} = 1.1 A, V_{DD} = 50 V, R_G = 25 Ω, Starting T_J = 25°C.
3. I_{SD} ≤ 0.3 A, di/dt ≤ 200 A/μs, V_{DD} ≤ BV_{DSS}, Starting T_J = 25°C.

MARKING DIAGRAM



A	= Assembly Site
FQN1N60C	= Specific Device Code
Y	= Year of Production
WW	= Work Week Number

ORDERING INFORMATION

Device	Package	Shipping
FQN1N60CTA	TO−92 3LD	2000 / Fan−Fold

THERMAL CHARACTERISTICS

Symbol	Parameter		Value	Unit
$R_{\theta JL}$	Thermal Resistance, Junction−to−Lead, Max.	(Note 5)	50	°C/W
$R_{\theta JA}$	Thermal Resistance, Junction−to−Ambient, Max.	(Note 6)	140	

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

Symbol	Parameter	Test Conditions	Min	Typ	Max	Unit
OFF CHARACTERISTIC						
BV_{DSS}	Drain to Source Breakdown Voltage	I_D = 250 μA, V_{GS} = 0 V	600	–	–	V
$\Delta BV_{DSS}/\Delta T_J$	Breakdown Voltage Temperature Coefficient	I_D = 250 μA, Referenced to 25°C	–	0.6	–	V/°C
I_{DSS}	Zero Gate Voltage Drain Current	V_{DS} = 600 V, V_{GS} = 0 V	–	–	50	μA
		V_{DS} = 480 V, T_C = 125°C	–	–	250	
I_{GSSF}	Gate to Body Leakage Current, Forward	V_{GS} = 30 V, V_{DS} = 0 V	–	–	100	nA
I_{GSSR}	Gate to Body Leakage Current, Reverse	V_{GS} = −30 V, V_{DS} = 0 V	–	–	−100	nA
ON CHARACTERISTICS						
$V_{GS(th)}$	Gate Threshold Voltage	V_{GS} = V_{DS}, I_D = 250 μA	2.0	–	4.0	V
$R_{DS(on)}$	Static Drain to Source On−Resistance	V_{GS} = 10 V, I_D = 0.15 A	–	9.3	11.5	Ω
g_{FS}	Forward Transconductance	V_{DS} = 40 V, I_D = 0.3 A	–	0.75	–	S
DYNAMIC CHARACTERISTICS						
C_{iss}	Input Capacitance	V_{DS} = 25 V, V_{GS} = 0 V, f = 1.0 MHz	–	130	170	pF
C_{oss}	Output Capacitance		–	19	25	pF
C_{rss}	Reverse Transfer Capacitance		–	3.5	6	pF
SWITCHING CHARACTERISTICS						
$t_{d(on)}$	Turn−On Delay Time	V_{DD} = 300 V, I_D = 1.1 A, R_G = 25 Ω (Note 4)	–	7	24	ns
t_r	Turn−On Rise Time		–	21	52	ns
$t_{d(off)}$	Turn−Off Delay Time		–	13	36	ns
t_f	Turn−Off Fall Time		–	27	64	ns
Q_g	Total Gate Charge	V_{DS} = 480 V, I_D = 1.1 A, V_{GS} = 10 V (Note 4)	–	4.8	6.2	nC
Q_{gs}	Gate to Source Charge		–	0.7	–	nC
Q_{gd}	Gate to Drain Charge		–	2.7	–	nC
DRAIN−SOURCE DIODE CHARACTERISTICS AND MAXIMUM RATINGS						
I_S	Maximum Continuous Drain to Source Diode Forward Current		–	–	0.3	A
I_{SM}	Maximum Pulsed Drain to Source Diode Forward Current		–	–	1.2	A
V_{SD}	Drain to Source Diode Forward Voltage	V_{GS} = 0 V, I_S = 0.3 A	–	–	1.4	V
t_{rr}	Reverse Recovery Time	V_{GS} = 0 V, I_S = 1.1 A, dI_F/dt = 100 A/μs	–	190	–	ns
Q_{rr}	Reverse Recovery Charge		–	0.53	–	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.
5. Reference point of the $R_{\theta JL}$ is the drain lead.
6. When mounted on 3”x4.5” FR−4 PCB without any pad copper in a still air environment ($R_{\theta JA}$ is the sum of the junction−to−case and case−to−ambient thermal resistance. $R_{\theta CA}$ is determined by the user’s board design)

TYPICAL CHARACTERISTICS

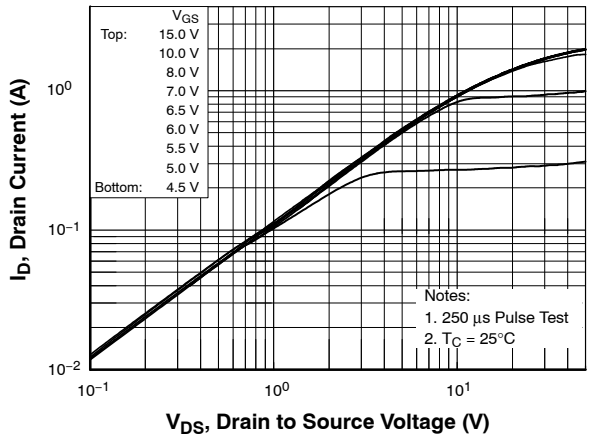


Figure 1. On−Region Characteristics

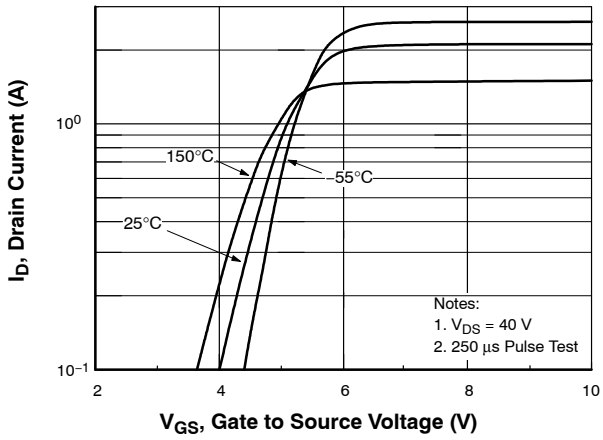


Figure 2. Transfer Characteristics

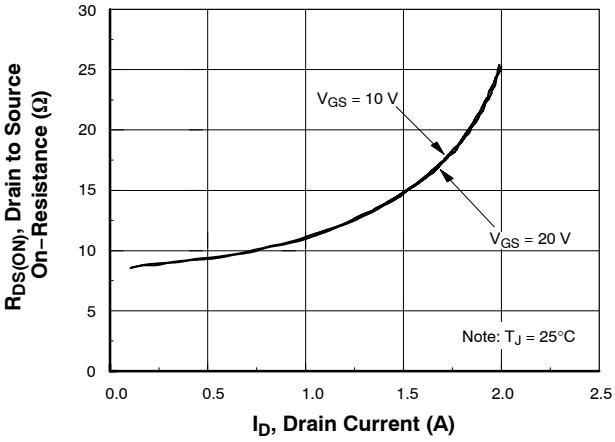


Figure 3. On−Resistance Variation vs. Drain Current and Gate Voltage

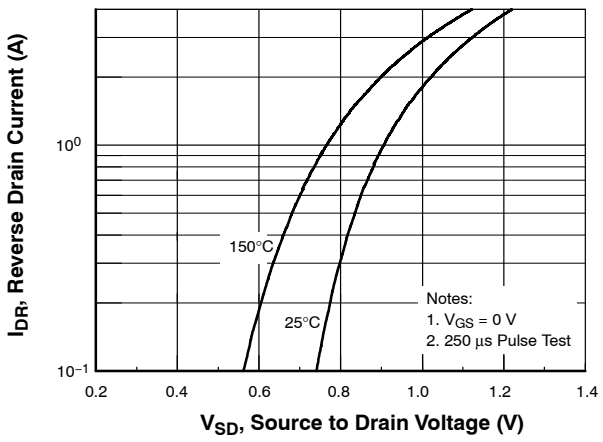


Figure 4. Body Diode Forward Voltage Variation vs. Source Current and Temperature

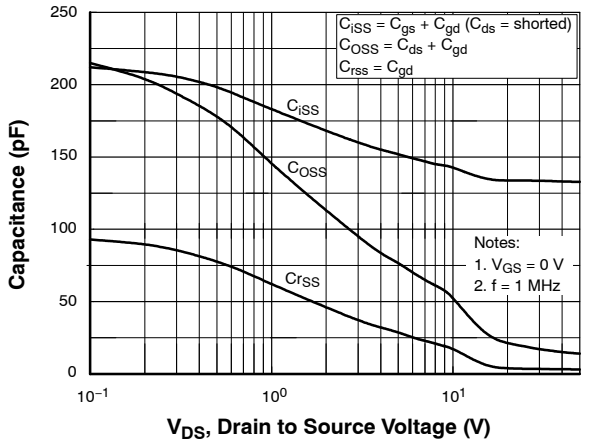


Figure 5. Capacitance Characteristics

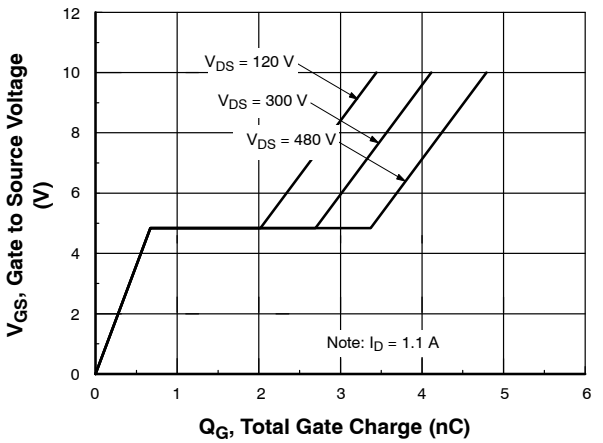


Figure 6. Gate Charge Characteristics

TYPICAL CHARACTERISTICS (Continued)

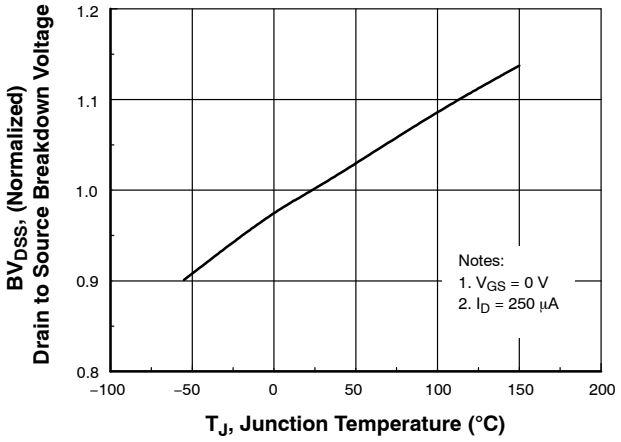


Figure 7. Breakdown Voltage Variation vs. Temperature

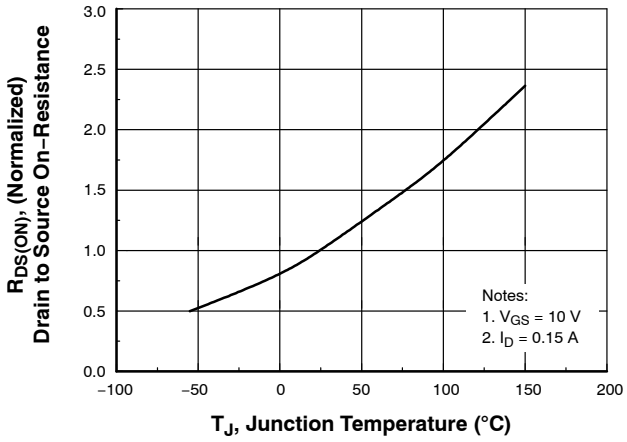


Figure 8. On−Resistance Variation vs. Temperature

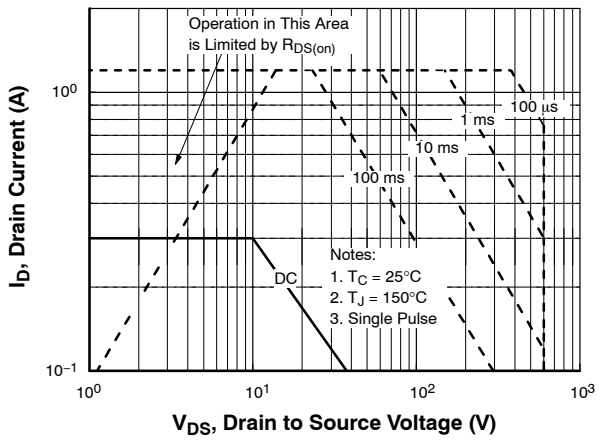


Figure 9. Maximum Safe Operating Area

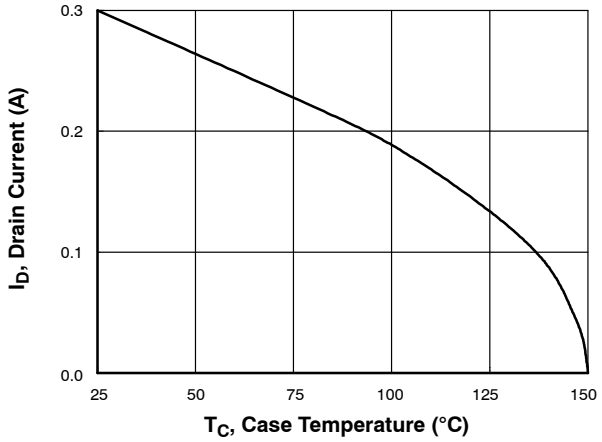


Figure 10. Maximum Drain Current vs. Case Temperature

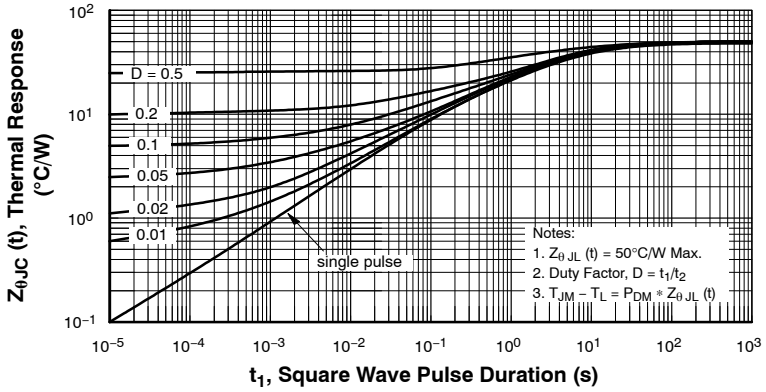


Figure 11. Transient Thermal Response Curve

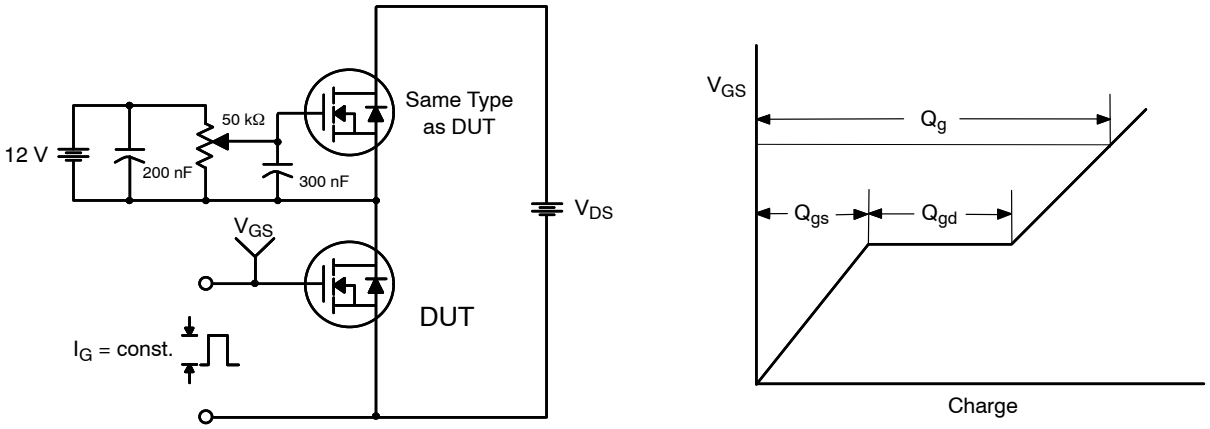


Figure 12. Gate Charge Test Circuit & Waveform

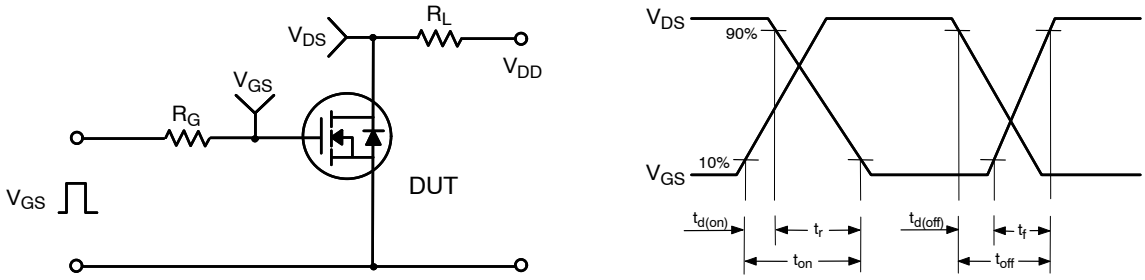


Figure 13. Resistive Switching Test Circuit & Waveforms

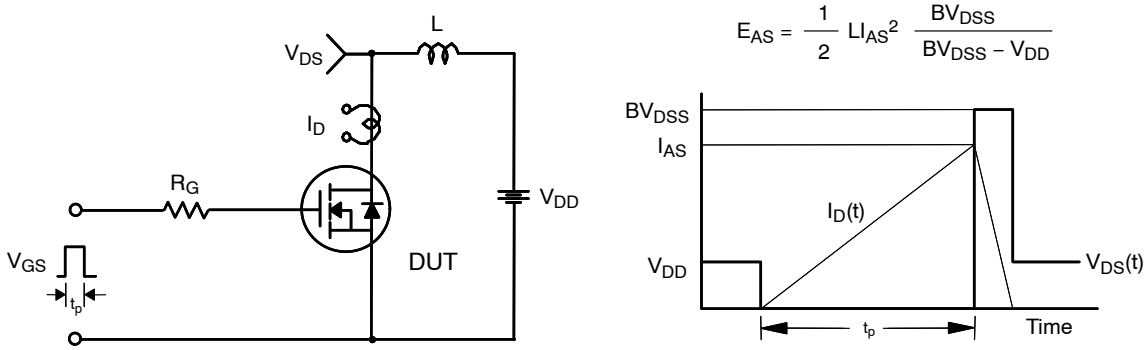


Figure 14. Unclamped Inductive Switching Test Circuit & Waveforms

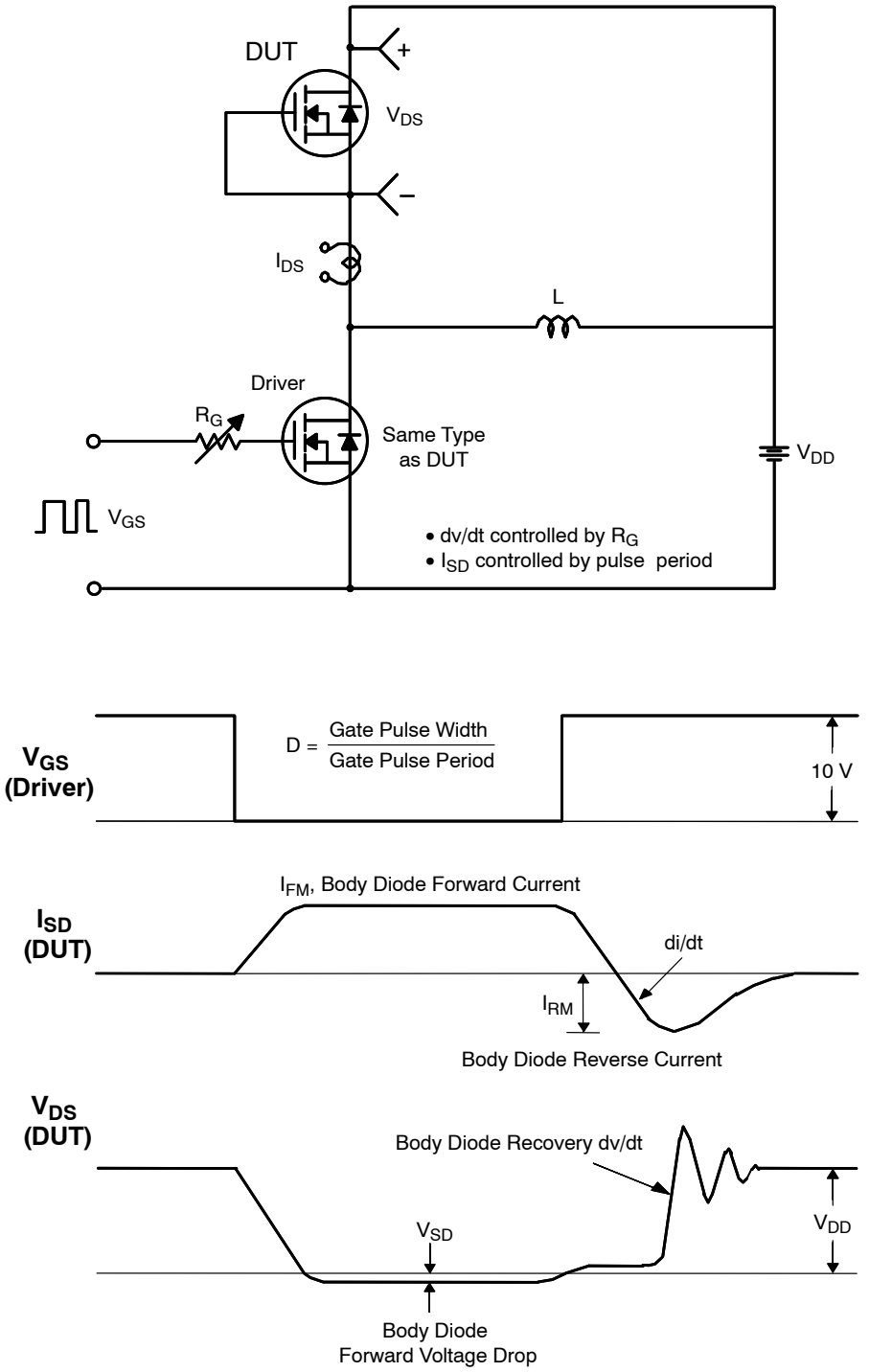


Figure 15. Peak Diode Recovery dv/dt Test Circuit & Waveforms

TO−92 3LD 4.75x4.80
CASE 135AV
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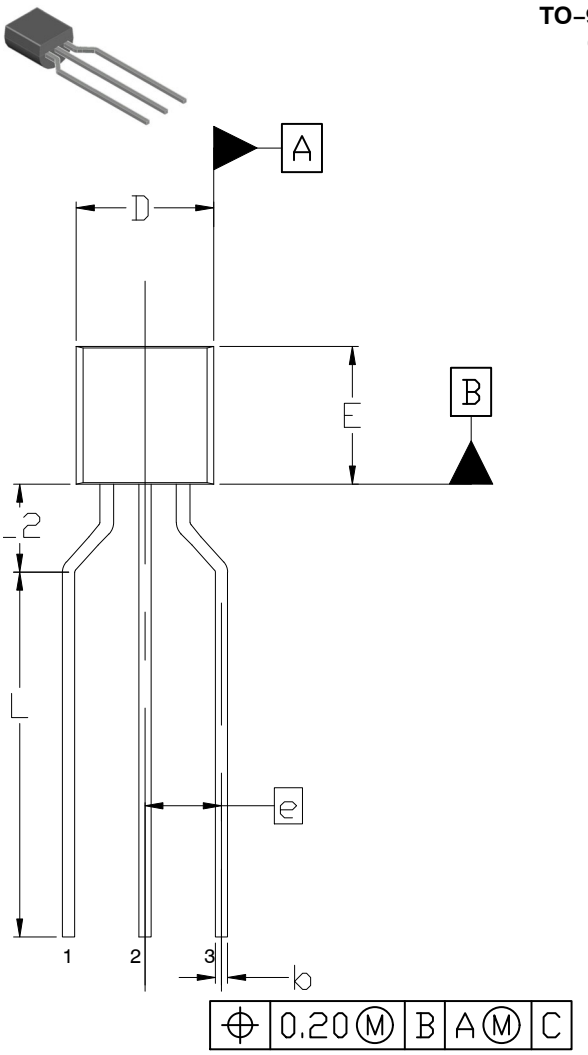
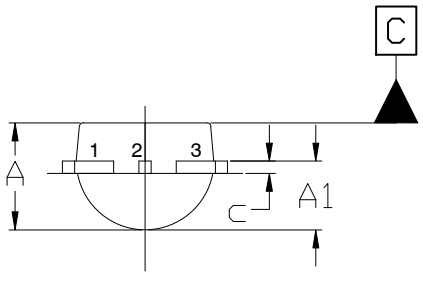
DATE 07 JAN 2021



TOP VIEW

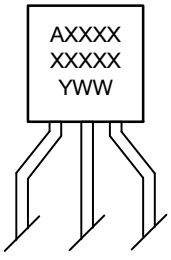


END VIEW

NOTES:
1. DIMENSIONING AND TOLERANCING PER ASME Y14.5M, 2009.
2. CONTROLLING DIMENSION: MILLIMETERS
3. DIMENSIONS ARE EXCLUSIVE OF BURRS, MOLD FLASH, GATE REMAINS AND TIE BAR PROTRUSIONS.

	MILLIMETERS		
DIM	MIN.	NOM.	MAX.
A	3.05	3.60	4.19
A1	2.13	2.50	2.88
b	0.36	0.46	0.56
c	0.30	0.40	0.52
D	4.32	4.75	5.20
E	4.32	4.80	5.33
e	2.54 BSC		
L	10.50	11.75	13.00
L2	2.54	---	3.44

GENERIC MARKING DIAGRAM*



XXXX = Specific Device Code
A = Assembly Location
Y = Year
WW = Work Week

*This information is generic. Please refer to device data sheet for actual part marking. Pb−Free indicator, “G” or microdot “▪”, may or may not be present. Some products may not follow the Generic Marking.

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