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# FQN1N60C

## N-Channel QFET® MOSFET

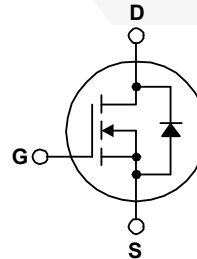
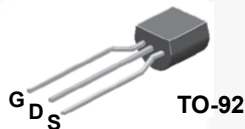
600 V, 0.30 A, 11.5 Ω

### Description

This N-Channel enhancement mode power MOSFET is produced using Fairchild 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

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



### Absolute Maximum Ratings $T_C = 25^\circ\text{C}$ unless otherwise noted.

Symbol	Parameter	FQN1N60CTA	Unit
$V_{DSS}$	Drain-Source Voltage	600	V
$I_D$	Drain Current	- Continuous ( $T_C = 25^\circ\text{C}$ )	0.3
		- Continuous ( $T_C = 100^\circ\text{C}$ )	0.18
$I_{DM}$	Drain Current - Pulsed (Note 1)	1.2	A
$V_{GSS}$	Gate-Source Voltage	$\pm 30$	V
$E_{AS}$	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 ( $T_A = 25^\circ\text{C}$ )	1	W
	Power Dissipation ( $T_L = 25^\circ\text{C}$ )	3	W
	- Derate above $25^\circ\text{C}$	0.02	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, 1/8" from Case for 5 Seconds.	300	$^\circ\text{C}$

### Thermal Characteristics

Symbol	Parameter	FQN1N60CTA	Unit
$R_{\theta JL}$	Thermal Resistance, Junction-to-Lead, Max. (Note 5a)	50	$^\circ\text{C/W}$
$R_{\theta JA}$	Thermal Resistance, Junction-to-Ambient, Max. (Note 5b)	140	

## Package Marking and Ordering Information

Part Number	Top Mark	Package	Packing Method	Reel Size	Tape Width	Quantity
FQN1N60CTA	1N60C	TO-92	AMMO	N/A	N/A	2000 units

## Electrical Characteristics T<sub>C</sub> = 25°C unless otherwise noted.

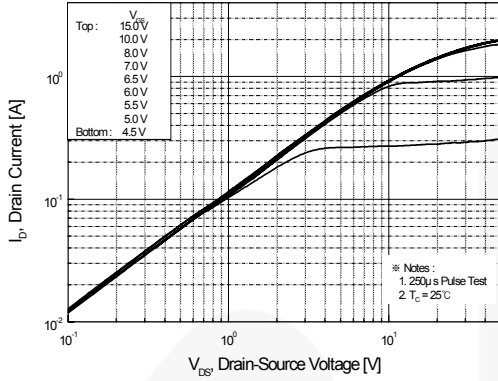
Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
<b>Off Characteristics</b>						
$BV_{DSS}$	Drain-Source Breakdown Voltage	$V_{GS} = 0\text{ V}, I_D = 250\ \mu\text{A}$	600	--	--	V
$\Delta BV_{DSS} / \Delta T_J$	Breakdown Voltage Temperature Coefficient	$I_D = 250\ \mu\text{A}$ , Referenced to 25°C	--	0.6	--	V/°C
$I_{DSS}$	Zero Gate Voltage Drain Current	$V_{DS} = 600\text{ V}, V_{GS} = 0\text{ V}$	--	--	50	$\mu\text{A}$
		$V_{DS} = 480\text{ V}, T_C = 125^\circ\text{C}$	--	--	250	$\mu\text{A}$
$I_{GSSF}$	Gate-Body Leakage Current, Forward	$V_{GS} = 30\text{ V}, V_{DS} = 0\text{ V}$	--	--	100	nA
$I_{GSSR}$	Gate-Body Leakage Current, Reverse	$V_{GS} = -30\text{ V}, V_{DS} = 0\text{ V}$	--	--	-100	nA
<b>On Characteristics</b>						
$V_{GS(th)}$	Gate Threshold Voltage	$V_{DS} = V_{GS}, I_D = 250\ \mu\text{A}$	2.0	--	4.0	V
$R_{DS(on)}$	Static Drain-Source On-Resistance	$V_{GS} = 10\text{ V}, I_D = 0.15\text{ A}$	--	9.3	11.5	$\Omega$
$g_{FS}$	Forward Transconductance	$V_{DS} = 40\text{ V}, I_D = 0.3\text{ A}$	--	0.75	--	S
<b>Dynamic Characteristics</b>						
$C_{iss}$	Input Capacitance	$V_{DS} = 25\text{ V}, V_{GS} = 0\text{ V},$ $f = 1.0\text{ MHz}$	--	130	170	pF
$C_{oss}$	Output Capacitance		--	19	25	pF
$C_{rss}$	Reverse Transfer Capacitance		--	3.5	6	pF
<b>Switching Characteristics</b>						
$t_{d(on)}$	Turn-On Delay Time	$V_{DD} = 300\text{ V}, I_D = 1.1\text{ A},$ $R_G = 25\ \Omega$	--	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		(Note 4)	--	27	64
$Q_g$	Total Gate Charge	$V_{DS} = 480\text{ V}, I_D = 1.1\text{ A},$ $V_{GS} = 10\text{ V}$	--	4.8	6.2	nC
$Q_{gs}$	Gate-Source Charge		--	0.7	--	nC
$Q_{gd}$	Gate-Drain Charge		(Note 4)	--	2.7	--
<b>Drain-Source Diode Characteristics and Maximum Ratings</b>						
$I_S$	Maximum Continuous Drain-Source Diode Forward Current		--	--	0.3	A
$I_{SM}$	Maximum Pulsed Drain-Source Diode Forward Current		--	--	1.2	A
$V_{SD}$	Drain-Source Diode Forward Voltage	$V_{GS} = 0\text{ V}, I_S = 0.3\text{ A}$	--	--	1.4	V
$t_{rr}$	Reverse Recovery Time	$V_{GS} = 0\text{ V}, I_S = 1.1\text{ A},$ $di_F / dt = 100\text{ A}/\mu\text{s}$	--	190	--	ns
$Q_{rr}$	Reverse Recovery Charge		--	0.53	--	$\mu\text{C}$

### Notes:

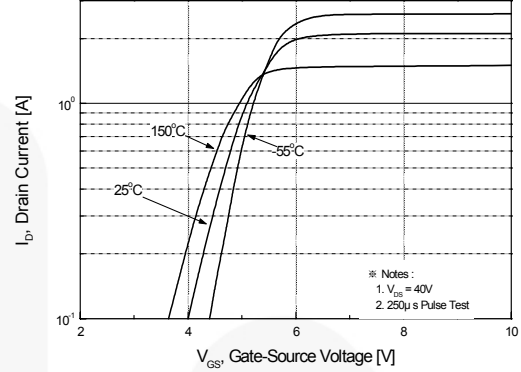
- Repetitive rating : pulse-width limited by maximum junction temperature.
- $L = 59\text{ mH}, I_{AS} = 1.1\text{ A}, V_{DD} = 50\text{ V}, R_G = 25\ \Omega$ , starting  $T_J = 25^\circ\text{C}$ .
- $I_{SD} \leq 0.3\text{ A}, di/dt \leq 200\text{ A}/\mu\text{s}, V_{DD} \leq BV_{DSS}$ , starting  $T_J = 25^\circ\text{C}$ .
- Essentially independent of operating temperature.
- a) Reference point of the  $R_{\theta JL}$  is the drain lead.  
b) 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 Performance Characteristics

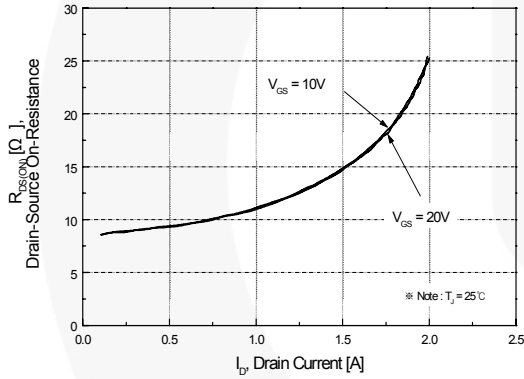
**Figure 1. On-Region Characteristics**



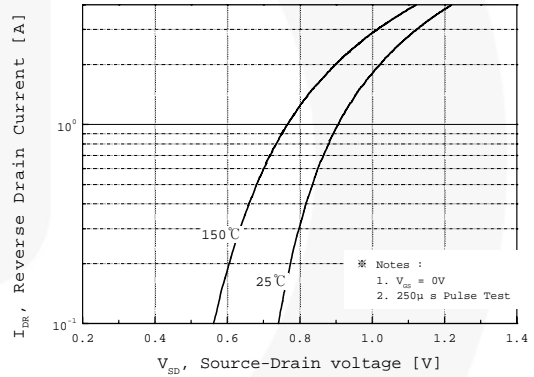
**Figure 2. Transfer Characteristics**



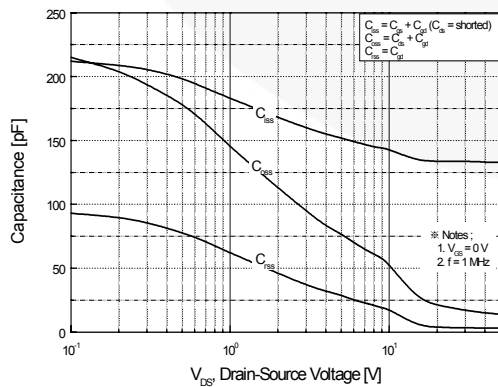
**Figure 3. On-Resistance Variation vs. Drain Current and Gate Voltage**



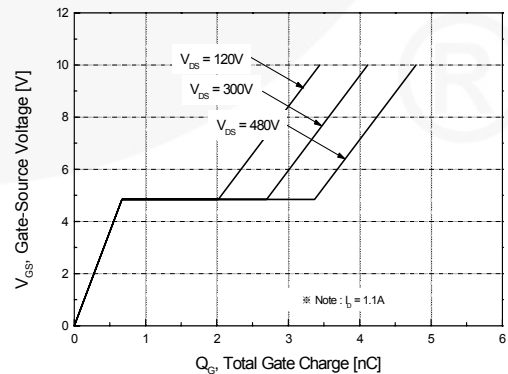
**Figure 4. Body Diode Forward Voltage Variation vs. Source Current and Temperature**



**Figure 5. Capacitance Characteristics**



**Figure 6. Gate Charge Characteristics**



Typical Performance Characteristics (Continued)

Figure 7. Breakdown Voltage Variation vs. Temperature

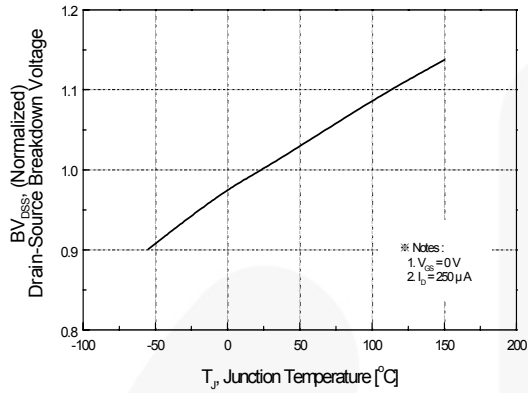


Figure 8. On-Resistance Variation vs. Temperature

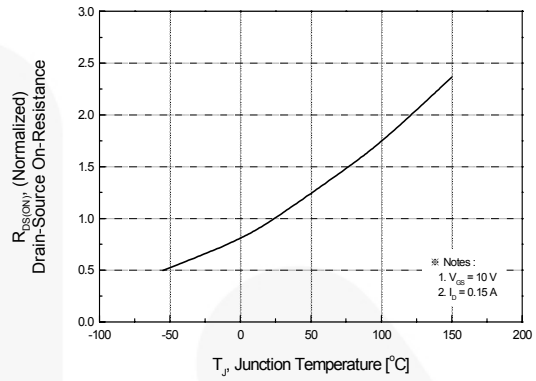


Figure 9. Maximum Safe Operating Area

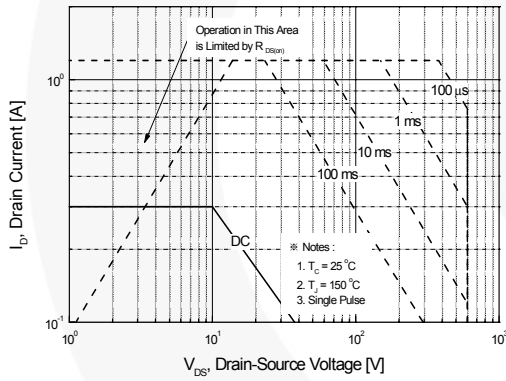


Figure 10. Maximum Drain Current vs. Case Temperature

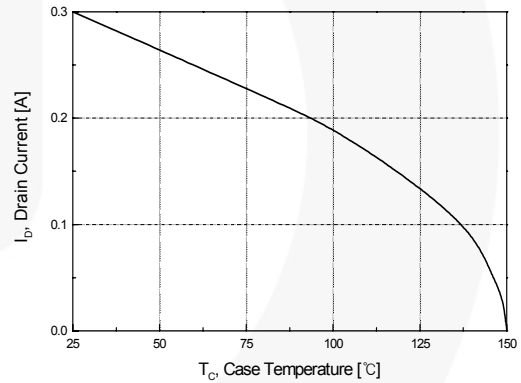
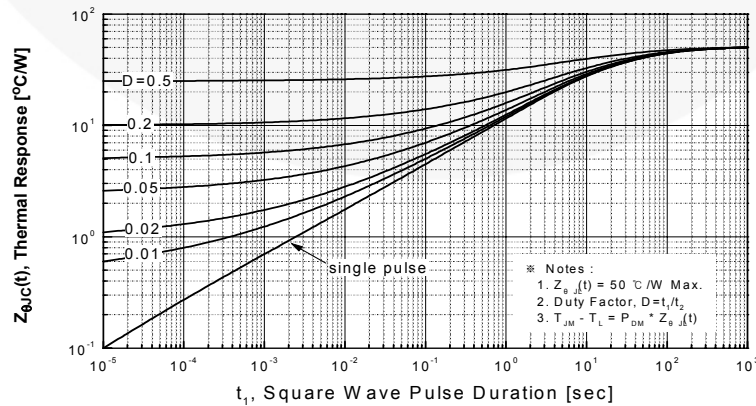


Figure 11. Transient Thermal Response Curve



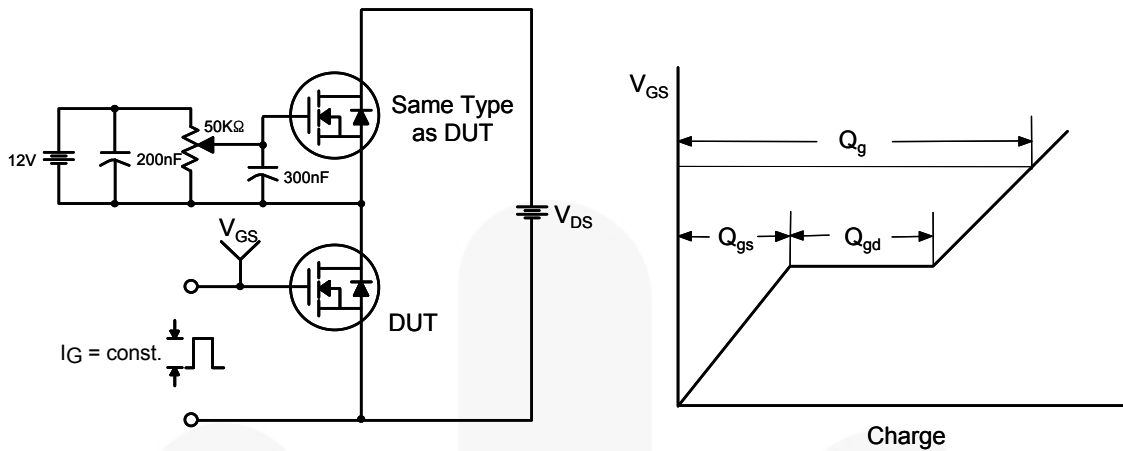


Figure 12. Gate Charge Test Circuit & Waveform

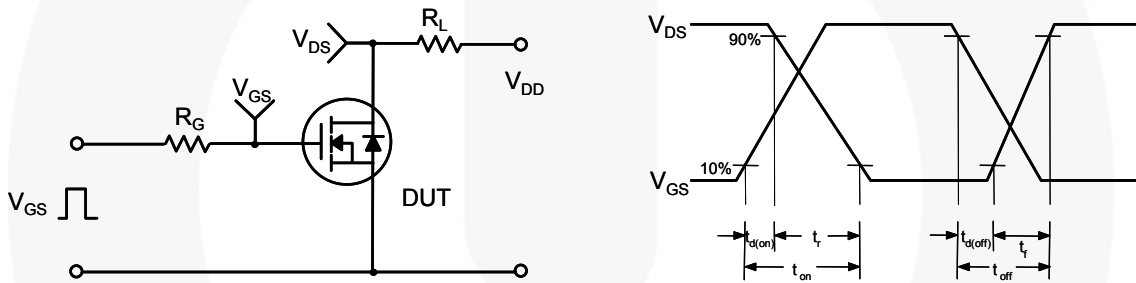


Figure 13. Resistive Switching Test Circuit & Waveforms

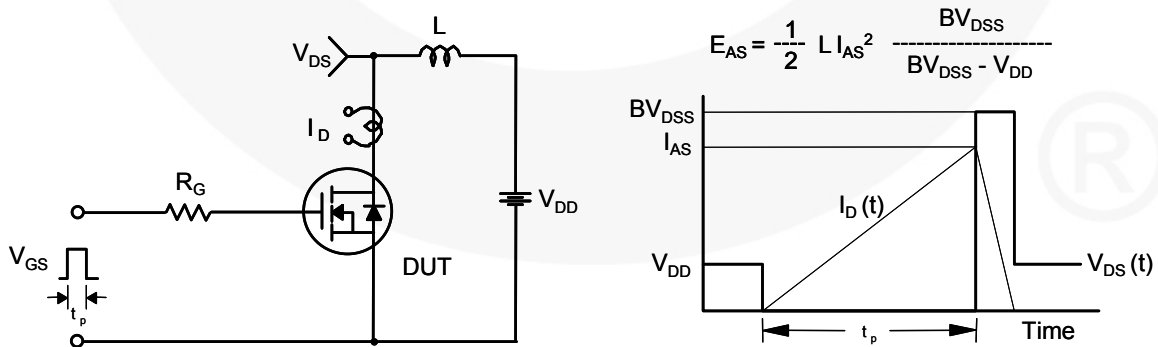


Figure 14. Unclamped Inductive Switching Test Circuit & Waveforms

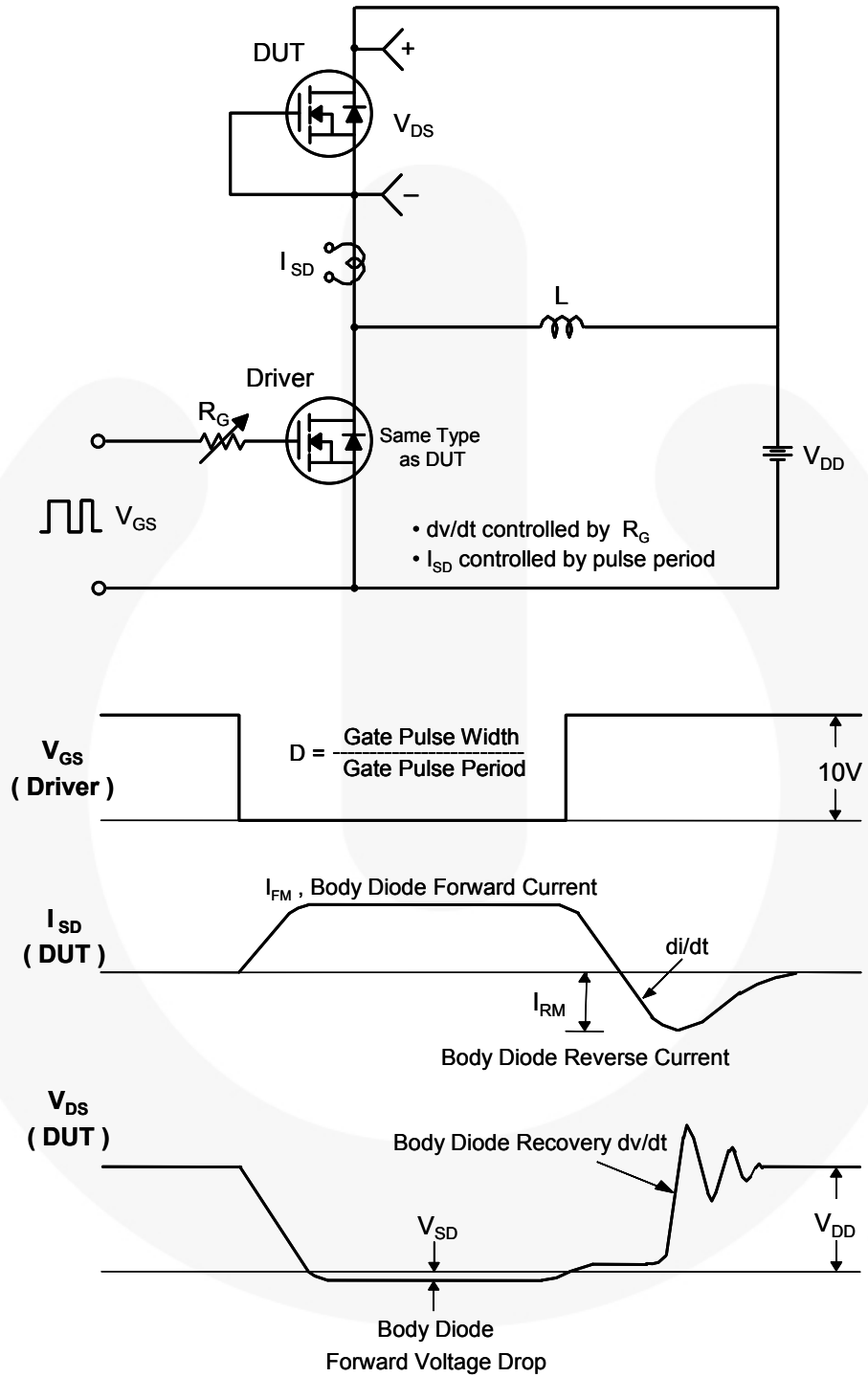
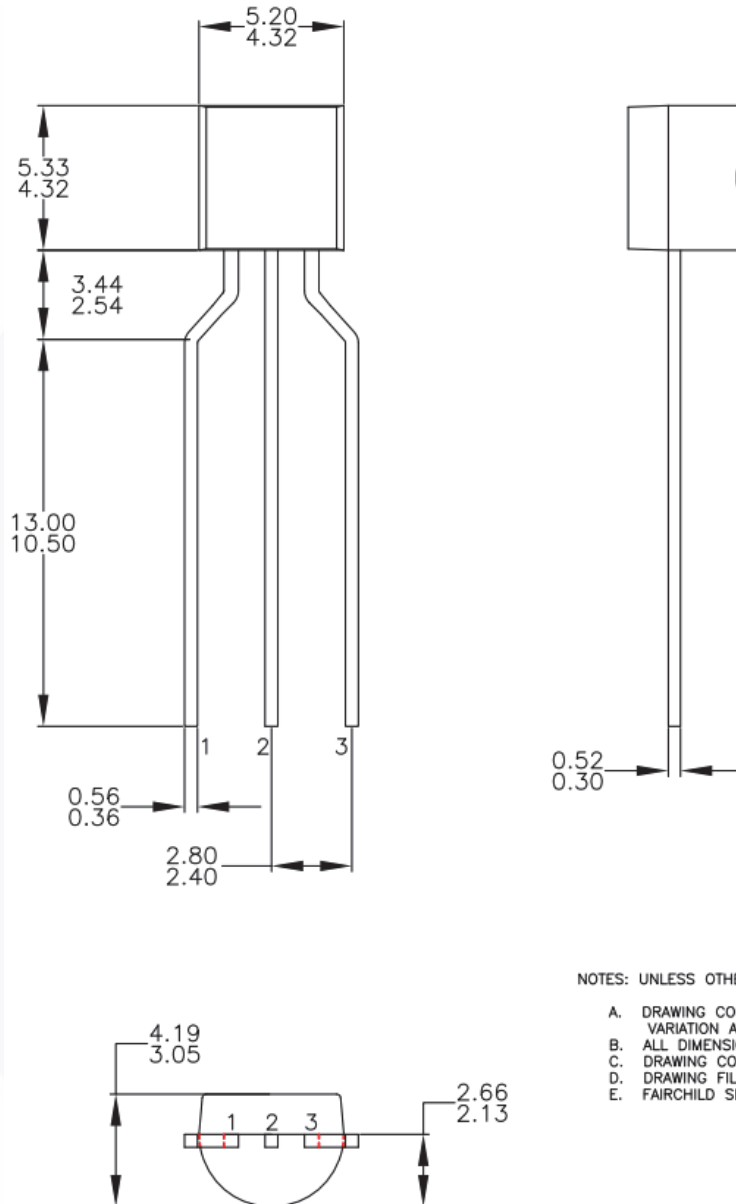


Figure 15. Peak Diode Recovery  $dv/dt$  Test Circuit & Waveforms

## Mechanical Dimensions



NOTES: UNLESS OTHERWISE SPECIFIED

- A. DRAWING CONFORMS TO JEDEC MS-013, VARIATION AC.
- B. ALL DIMENSIONS ARE IN MILLIMETERS.
- C. DRAWING CONFORMS TO ASME Y14.5M-2009.
- D. DRAWING FILENAME: MKT-ZA03FREV3.
- E. FAIRCHILD SEMICONDUCTOR.

**Figure 16. TO92, Molded, 3-Lead, 0.200 In Line Spacing LD Form (J61Z Option)**

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