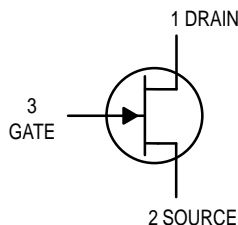


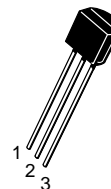
# JFETs Switching

## N-Channel — Depletion



**MPF4392**  
**MPF4393**

Motorola Preferred Devices



CASE 29-04, STYLE 5  
TO-92 (TO-226AA)

### MAXIMUM RATINGS

Rating	Symbol	Value	Unit
Drain-Source Voltage	$V_{DS}$	30	Vdc
Drain-Gate Voltage	$V_{DG}$	30	Vdc
Gate-Source Voltage	$V_{GS}$	30	Vdc
Forward Gate Current	$I_{G(f)}$	50	mAdc
Total Device Dissipation @ $T_A = 25^\circ\text{C}$ Derate above $25^\circ\text{C}$	$P_D$	350 2.8	mW mW/ $^\circ\text{C}$
Operating and Storage Channel Temperature Range	$T_{\text{channel}}$ $T_{\text{stg}}$	-65 to +150	$^\circ\text{C}$

### ELECTRICAL CHARACTERISTICS ( $T_A = 25^\circ\text{C}$ unless otherwise noted)

Characteristic	Symbol	Min	Typ	Max	Unit
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#### OFF CHARACTERISTICS

Gate-Source Breakdown Voltage ( $I_G = 1.0 \mu\text{Adc}$ , $V_{DS} = 0$ )	$V_{(BR)GSS}$	30	—	—	Vdc
Gate Reverse Current ( $V_{GS} = 15 \text{ Vdc}$ , $V_{DS} = 0$ ) ( $V_{GS} = 15 \text{ Vdc}$ , $V_{DS} = 0$ , $T_A = 100^\circ\text{C}$ )	$I_{GSS}$	— —	— —	1.0 0.2	nAdc $\mu\text{Adc}$
Drain-Cutoff Current ( $V_{DS} = 15 \text{ Vdc}$ , $V_{GS} = 12 \text{ Vdc}$ ) ( $V_{DS} = 15 \text{ Vdc}$ , $V_{GS} = 12 \text{ Vdc}$ , $T_A = 100^\circ\text{C}$ )	$I_{D(off)}$	— —	— —	1.0 0.1	nAdc $\mu\text{Adc}$
Gate-Source Voltage ( $V_{DS} = 15 \text{ Vdc}$ , $I_D = 10 \text{ nAdc}$ )	$V_{GS}$	-2.0 -0.5	— —	-5.0 -3.0	Vdc

#### ON CHARACTERISTICS

Zero-Gate-Voltage Drain Current <sup>(1)</sup> ( $V_{DS} = 15 \text{ Vdc}$ , $V_{GS} = 0$ )	$I_{DSS}$	25 5.0	— —	75 30	mAdc
Drain-Source On-Voltage ( $I_D = 6.0 \text{ mAdc}$ , $V_{GS} = 0$ ) ( $I_D = 3.0 \text{ mAdc}$ , $V_{GS} = 0$ )	$V_{DS(on)}$	— —	— —	0.4 0.4	Vdc
Static Drain-Source On Resistance ( $I_D = 1.0 \text{ mAdc}$ , $V_{GS} = 0$ )	$r_{DS(on)}$	— —	— —	60 100	$\Omega$

#### SMALL-SIGNAL CHARACTERISTICS

Forward Transfer Admittance ( $V_{DS} = 15 \text{ Vdc}$ , $I_D = 25 \text{ mAdc}$ , $f = 1.0 \text{ kHz}$ ) ( $V_{DS} = 15 \text{ Vdc}$ , $I_D = 5.0 \text{ mAdc}$ , $f = 1.0 \text{ kHz}$ )	$ y_{fs} $	— —	17 12	— —	mmhos
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1. Pulse Test: Pulse Width  $\leq 300 \mu\text{s}$ , Duty Cycle  $\leq 3.0\%$ .

Preferred devices are Motorola recommended choices for future use and best overall value.

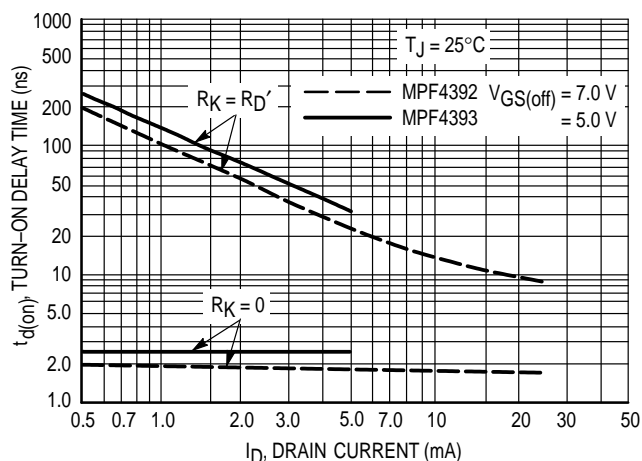
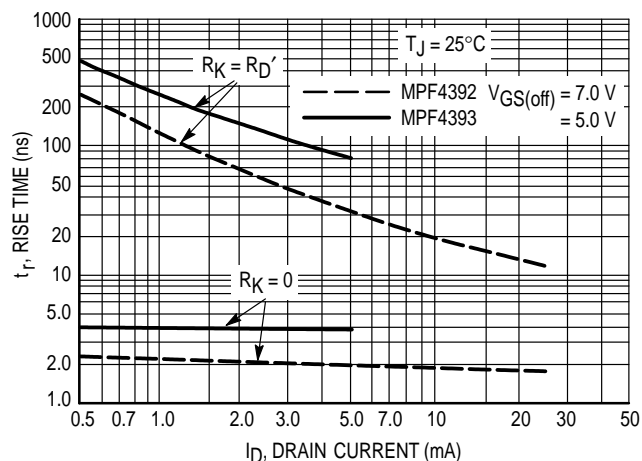
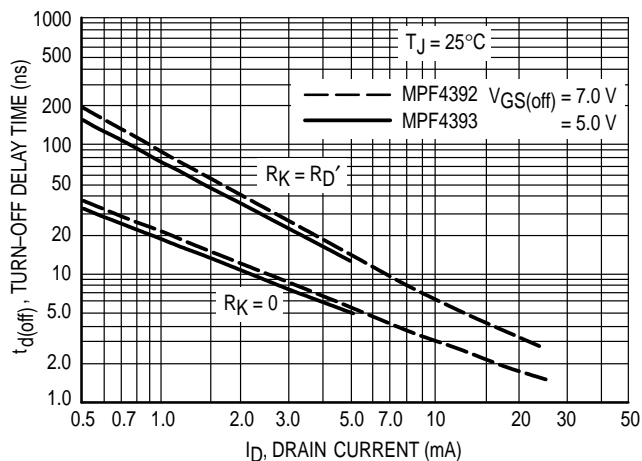
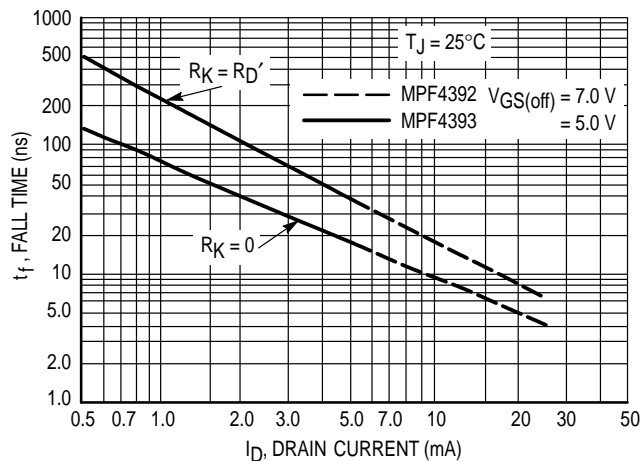
REV 1

**ELECTRICAL CHARACTERISTICS** ( $T_A = 25^\circ\text{C}$  unless otherwise noted) (Continued)

Characteristic	Symbol	Min	Typ	Max	Unit
<b>SMALL-SIGNAL CHARACTERISTICS (continued)</b>					
Drain-Source "ON" Resistance ( $V_{GS} = 0$ , $I_D = 0$ , $f = 1.0$ kHz)	$r_{ds(on)}$	—	—	60 100	$\Omega$
Input Capacitance ( $V_{GS} = 15$ Vdc, $V_{DS} = 0$ , $f = 1.0$ MHz)	$C_{iss}$	—	6.0	10	pF
Reverse Transfer Capacitance ( $V_{GS} = 12$ Vdc, $V_{DS} = 0$ , $f = 1.0$ MHz) ( $V_{DS} = 15$ Vdc, $I_D = 10$ mAdc, $f = 1.0$ MHz)	$C_{rss}$	—	2.5 3.2	3.5 —	pF

**SWITCHING CHARACTERISTICS**

Rise Time (See Figure 2) ( $I_{D(on)} = 6.0$ mAdc) ( $I_{D(on)} = 3.0$ mAdc)	MPF4392 MPF4393	$t_r$	— —	2.0 2.5	5.0 5.0	ns
Fall Time (See Figure 4) ( $V_{GS(off)} = 7.0$ Vdc) ( $V_{GS(off)} = 5.0$ Vdc)	MPF4392 MPF4393	$t_f$	— —	15 29	20 35	ns
Turn-On Time (See Figures 1 and 2) ( $I_{D(on)} = 6.0$ mAdc) ( $I_{D(on)} = 3.0$ mAdc)	MPF4392 MPF4393	$t_{on}$	— —	4.0 6.5	15 15	ns
Turn-Off Time (See Figures 3 and 4) ( $V_{GS(off)} = 7.0$ Vdc) ( $V_{GS(off)} = 5.0$ Vdc)	MPF4392 MPF4393	$t_{off}$	— —	20 37	35 55	ns

**TYPICAL SWITCHING CHARACTERISTICS**

**Figure 1. Turn-On Delay Time**

**Figure 2. Rise Time**

**Figure 3. Turn-Off Delay Time**

**Figure 4. Fall Time**

## NOTE 1

The switching characteristics shown above were measured using a test circuit similar to Figure 5. At the beginning of the switching interval, the gate voltage is at Gate Supply Voltage ( $-V_{GG}$ ). The Drain-Source Voltage ( $V_{DS}$ ) is slightly lower than Drain Supply Voltage ( $V_{DD}$ ) due to the voltage divider. Thus Reverse Transfer Capacitance ( $C_{rss}$ ) or Gate-Drain Capacitance ( $C_{gd}$ ) is charged to  $V_{GG} + V_{DS}$ .

During the turn-on interval, Gate-Source Capacitance ( $C_{gs}$ ) discharges through the series combination of  $R_{GEN}$  and  $R_K$ .  $C_{gd}$  must discharge to  $V_{DS(on)}$  through  $R_G$  and  $R_K$  in series with the parallel combination of effective load impedance ( $R_D'$ ) and Drain-Source Resistance ( $r_{ds}$ ). During the turn-off, this charge flow is reversed.

Predicting turn-on time is somewhat difficult as the channel resistance  $r_{ds}$  is a function of the gate-source voltage. While  $C_{gs}$  discharges,  $V_{GS}$  approaches zero and  $r_{ds}$  decreases. Since  $C_{gd}$  discharges through  $r_{ds}$ , turn-on time is non-linear. During turn-off, the situation is reversed with  $r_{ds}$  increasing as  $C_{gd}$  charges.

The above switching curves show two impedance conditions: 1)  $R_K$  is equal to  $R_D'$  which simulates the switching behavior of cascaded stages where the driving source impedance is normally the load impedance of the previous stage, and 2)  $R_K = 0$  (low impedance) the driving source impedance is that of the generator.

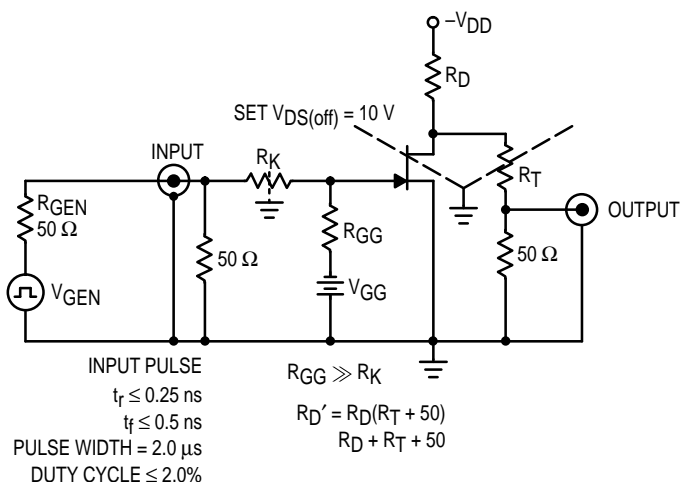


Figure 5. Switching Time Test Circuit

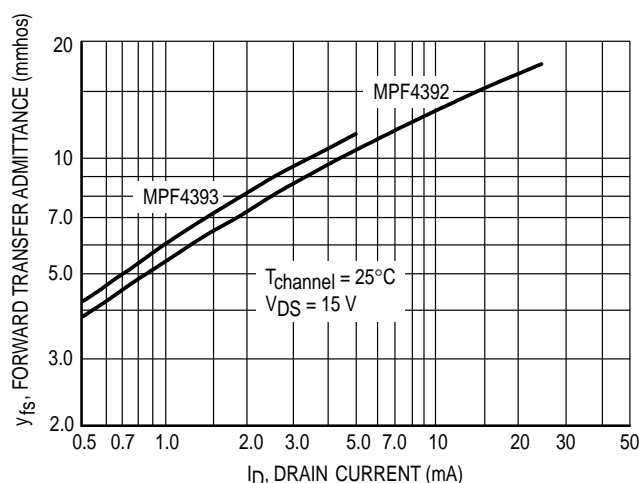


Figure 6. Typical Forward Transfer Admittance

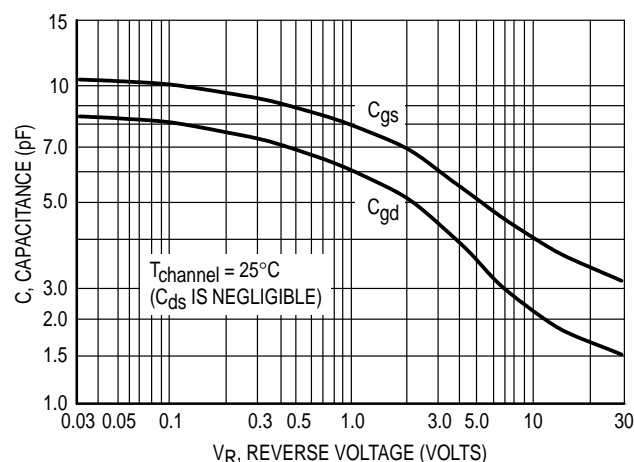


Figure 7. Typical Capacitance

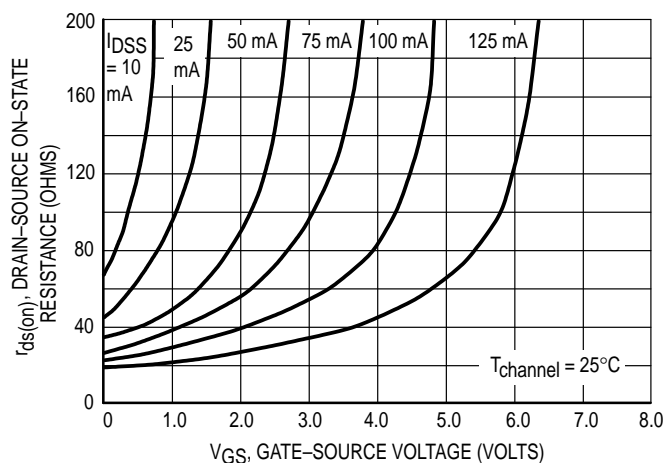


Figure 8. Effect of Gate-Source Voltage On Drain-Source Resistance

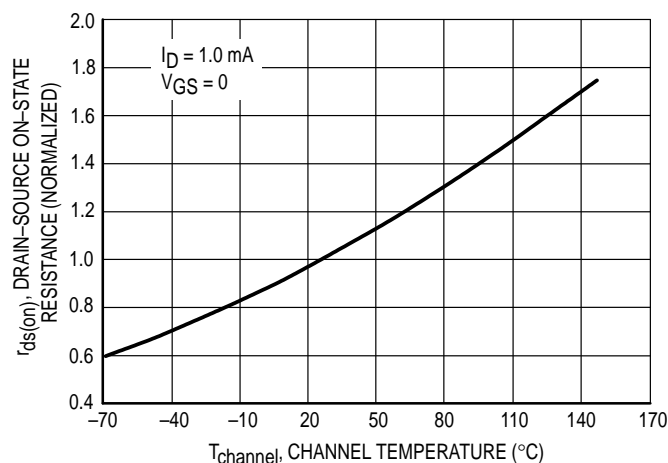
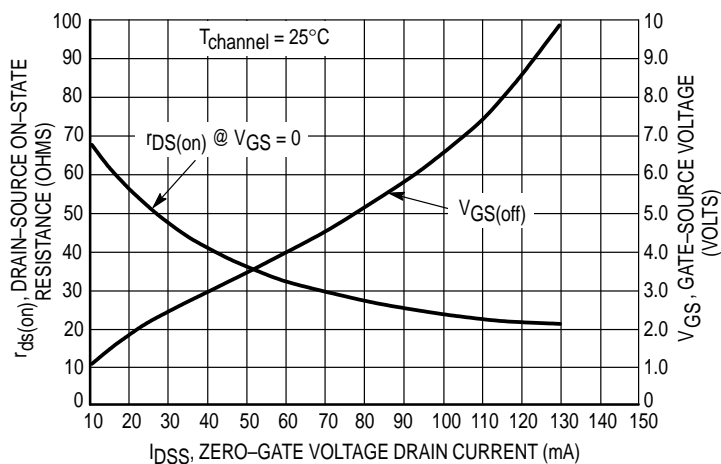


Figure 9. Effect of Temperature On Drain-Source On-State Resistance



**Figure 10. Effect of  $I_{DSS}$  On Drain-Source Resistance and Gate-Source Voltage**

#### NOTE 2

The Zero-Gate-Voltage Drain Current ( $I_{DSS}$ ), is the principle determinant of other J-FET characteristics. Figure 10 shows the relationship of Gate-Source Off Voltage ( $V_{GS(off)}$ ) and Drain-Source On Resistance ( $r_{ds(on)}$ ) to  $I_{DSS}$ . Most of the devices will be within  $\pm 10\%$  of the values shown in Figure 10. This data will be useful in predicting the characteristic variations for a given part number.

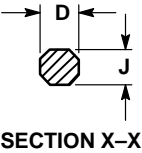
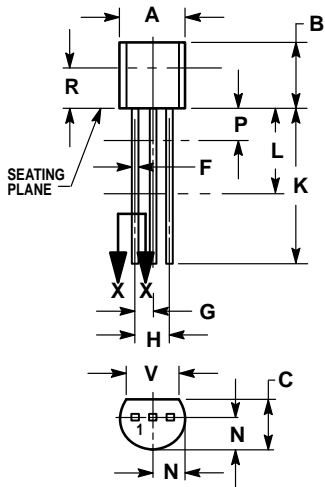
For example:

Unknown

$r_{ds(on)}$  and  $V_{GS}$  range for an MPF4392

The electrical characteristics table indicates that an MPF4392 has an  $I_{DSS}$  range of 25 to 75 mA. Figure 10 shows  $r_{ds(on)} = 52$  Ohms for  $I_{DSS} = 25$  mA and 30 Ohms for  $I_{DSS} = 75$  mA. The corresponding  $V_{GS}$  values are 2.2 volts and 4.8 volts.

PACKAGE DIMENSIONS




- NOTES:
- 1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
  - 2. CONTROLLING DIMENSION: INCH.
  - 3. CONTOUR OF PACKAGE BEYOND DIMENSION R IS UNCONTROLLED.
  - 4. DIMENSION F APPLIES BETWEEN P AND L. DIMENSION D AND J APPLY BETWEEN L AND K MINIMUM. LEAD DIMENSION IS UNCONTROLLED IN P AND BEYOND DIMENSION K MINIMUM.

DIM	INCHES		MILLIMETERS	
	MIN	MAX	MIN	MAX
A	0.175	0.205	4.45	5.20
B	0.170	0.210	4.32	5.33
C	0.125	0.165	3.18	4.19
D	0.016	0.022	0.41	0.55
F	0.016	0.019	0.41	0.48
G	0.045	0.055	1.15	1.39
H	0.095	0.105	2.42	2.66
J	0.015	0.020	0.39	0.50
K	0.500	—	12.70	—
L	0.250	—	6.35	—
N	0.080	0.105	2.04	2.66
P	—	0.100	—	2.54
R	0.115	—	2.93	—
V	0.135	—	3.43	—

CASE 029-04  
(TO-226AA)  
ISSUE AD

STYLE 5:  
PIN 1. DRAIN  
2. SOURCE  
3. GATE

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