JFETs Switching
N–Channel — Depletion

1 DRAIN

3
GATE
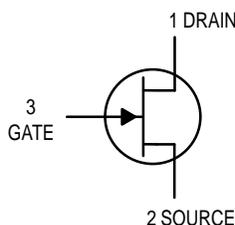
2 SOURCE

MPF4392
MPF4393

Motorola Preferred Devices

1
2
3

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°C Derate above 25°C	P_D	350 2.8	mW mW/°C
Operating and Storage Channel Temperature Range	$T_{channel}$, T_{stg}	−65 to +150	°C

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

Characteristic		Symbol	Min	Typ	Max	Unit
OFF CHARACTERISTICS						
Gate–Source Breakdown Voltage (I_G = 1.0 μAdc, V_{DS} = 0)		$V_{(BR)GSS}$	30	—	—	Vdc
Gate Reverse Current (V_{GS} = 15 Vdc, V_{DS} = 0) (V_{GS} = 15 Vdc, V_{DS} = 0, T_A = 100°C)		I_{GSS}	— —	— —	1.0 0.2	nAdc μAdc
Drain–Cutoff Current (V_{DS} = 15 Vdc, V_{GS} = 12 Vdc) (V_{DS} = 15 Vdc, V_{GS} = 12 Vdc, T_A = 100°C)		$I_{D(off)}$	— —	— —	1.0 0.1	nAdc μAdc
Gate Source Voltage (V_{DS} = 15 Vdc, I_D = 10 nAdc)	MPF4392 MPF4393	V_{GS}	−2.0 −0.5	— —	−5.0 −3.0	Vdc
ON CHARACTERISTICS						
Zero–Gate–Voltage Drain Current[1] (V_{DS} = 15 Vdc, V_{GS} = 0)	MPF4392 MPF4393	I_{DSS}	25 5.0	— —	75 30	mAdc
Drain–Source On–Voltage (I_D = 6.0 mAdc, V_{GS} = 0) (I_D = 3.0 mAdc, V_{GS} = 0)	MPF4392 MPF4393	$V_{DS(on)}$	— —	— —	0.4 0.4	Vdc
Static Drain–Source On Resistance (I_D = 1.0 mAdc, V_{GS} = 0)	MPF4392 MPF4393	$r_{DS(on)}$	— —	— —	60 100	Ω
SMALL–SIGNAL CHARACTERISTICS						
Forward Transfer Admittance (V_{DS} = 15 Vdc, I_D = 25 mAdc, f = 1.0 kHz) (V_{DS} = 15 Vdc, I_D = 5.0 mAdc, f = 1.0 kHz)	MPF4392 MPF4393	$|y_{fs}|$	— —	17 12	— —	mmhos

1. Pulse Test: Pulse Width ≤ 300 μs, Duty Cycle ≤ 3.0%.

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

REV 1

MOTOROLA

ELECTRICAL CHARACTERISTICS (T_A = 25°C unless otherwise noted) (Continued)

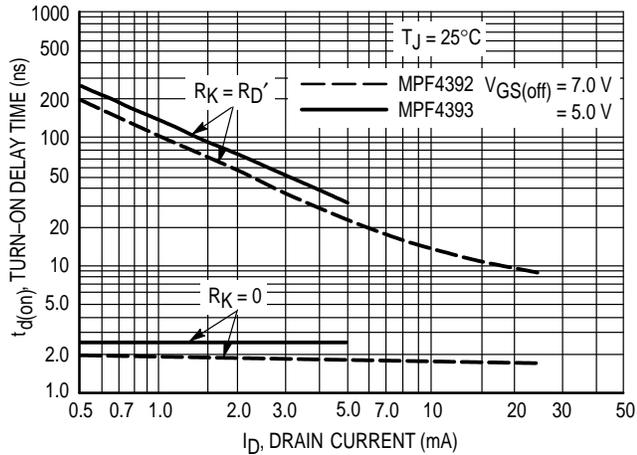| Characteristic		Symbol	Min	Typ	Max	Unit
SMALL–SIGNAL CHARACTERISTICS (continued)						
Drain–Source "ON" Resistance (V_{GS} = 0, I_D = 0, f = 1.0 kHz)		$r_{ds(on)}$				Ω
	MPF4392		—	—	60	
	MPF4393		—	—	100	
Input Capacitance (V_{GS} = 15 Vdc, V_{DS} = 0, f = 1.0 MHz)		C_{iss}	—	6.0	10	pF
Reverse Transfer Capacitance		C_{rss}				pF
(V_{GS} = 12 Vdc, V_{DS} = 0, f = 1.0 MHz)			—	2.5	3.5	
(V_{DS} = 15 Vdc, I_D = 10 mAdc, f = 1.0 MHz)			—	3.2	—	
SWITCHING CHARACTERISTICS						
Rise Time (See Figure 2)		t_r				ns
($I_{D(on)}$ = 6.0 mAdc)	MPF4392		—	2.0	5.0	
($I_{D(on)}$ = 3.0 mAdc)	MPF4393		—	2.5	5.0	
Fall Time (See Figure 4)		t_f				ns
($V_{GS(off)}$ = 7.0 Vdc)	MPF4392		—	15	20	
($V_{GS(off)}$ = 5.0 Vdc)	MPF4393		—	29	35	
Turn–On Time (See Figures 1 and 2)		t_{on}				ns
($I_{D(on)}$ = 6.0 mAdc)	MPF4392		—	4.0	15	
($I_{D(on)}$ = 3.0 mAdc)	MPF4393		—	6.5	15	
Turn–Off Time (See Figures 3 and 4)		t_{off}				ns
($V_{GS(off)}$ = 7.0 Vdc)	MPF4392		—	20	35	
($V_{GS(off)}$ = 5.0 Vdc)	MPF4393		—	37	55	

TYPICAL SWITCHING CHARACTERISTICS

Figure 1. Turn–On Delay Time
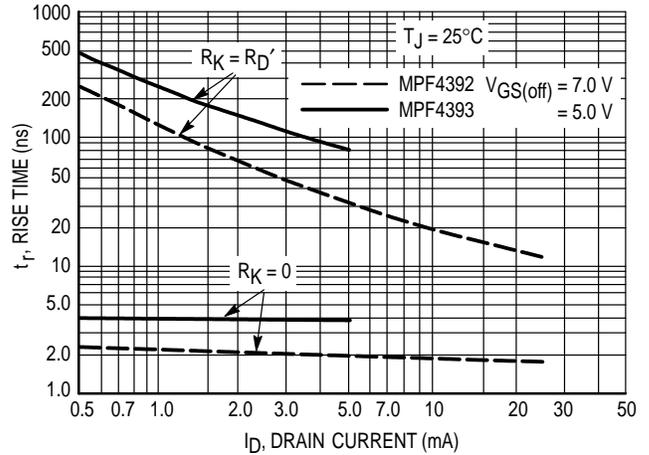
Figure 2. Rise Time
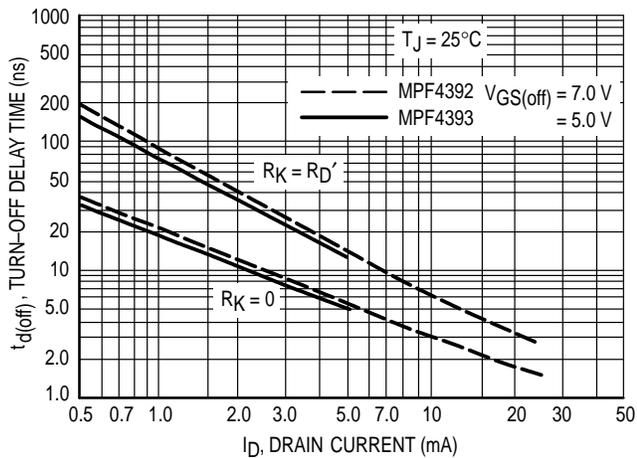
Figure 3. Turn–Off Delay Time

Figure 4. Fall Time

SET $V_{DS(off)}$ = 10 V

INPUT PULSE
$t_r \leq 0.25$ ns
$t_f \leq 0.5$ ns
PULSE WIDTH = 2.0 μs
DUTY CYCLE $\leq$ 2.0%

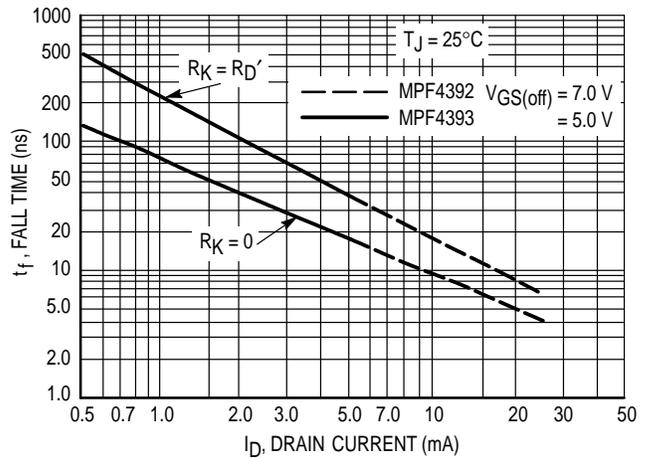$R_{GG} \gg R_K$

$$R_D' = \frac{R_D(R_T + 50)}{R_D + R_T + 50}$$

Figure 5. Switching Time Test Circuit

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.
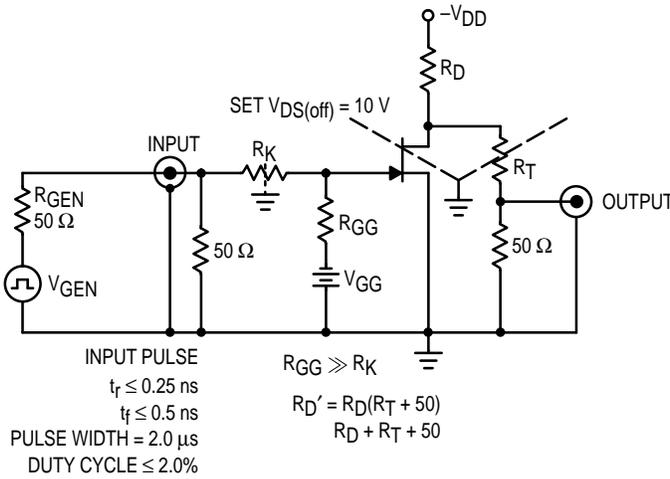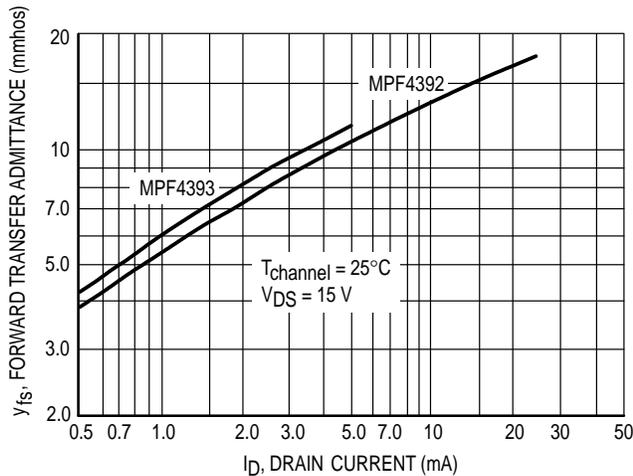

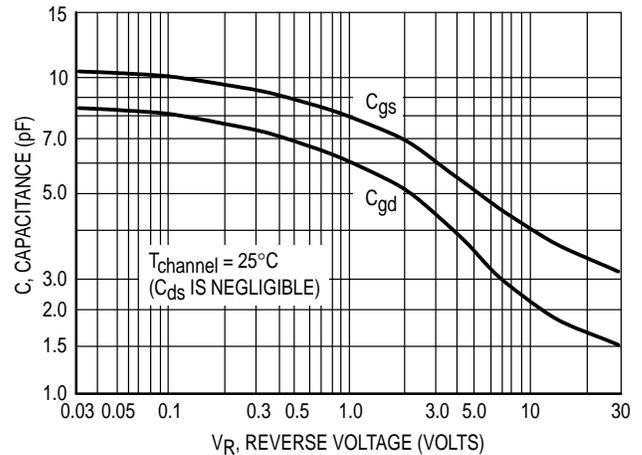**Figure 6. Typical Forward Transfer Admittance**

Figure 7. Typical Capacitance

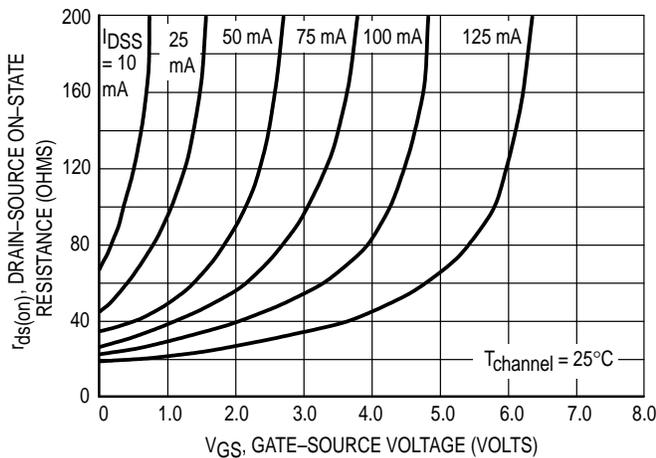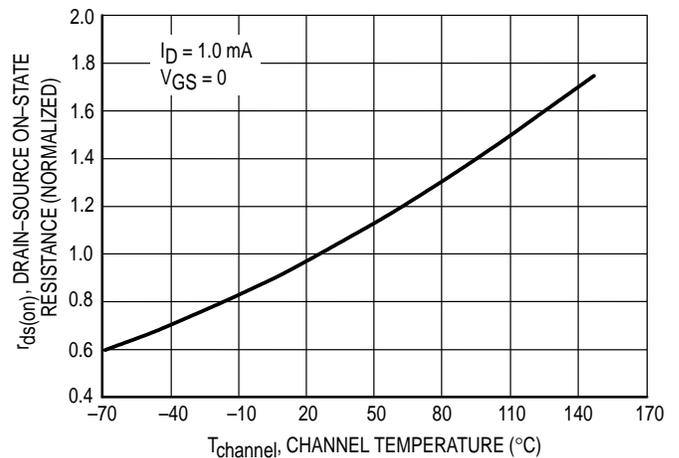**Figure 8. Effect of Gate–Source Voltage On Drain–Source Resistance**

Figure 9. Effect of Temperature On Drain–Source On–State Resistance
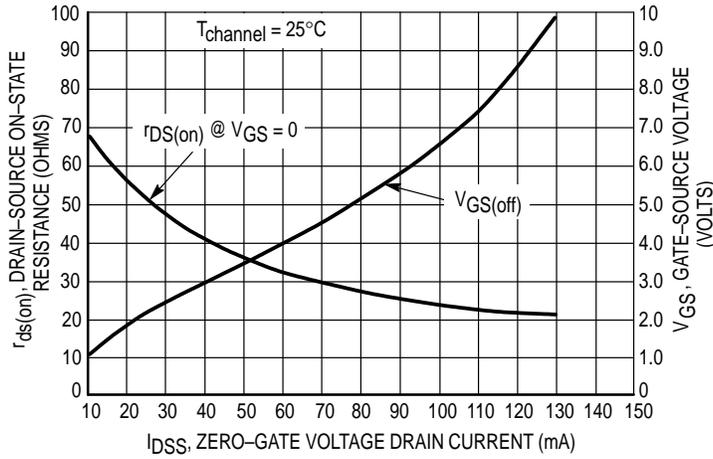
MPF4392 MPF4393

Figure 10. Effect of I$_{DSS}$ On Drain–Source Resistance and Gate–Source Voltage

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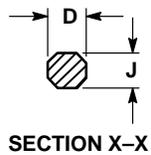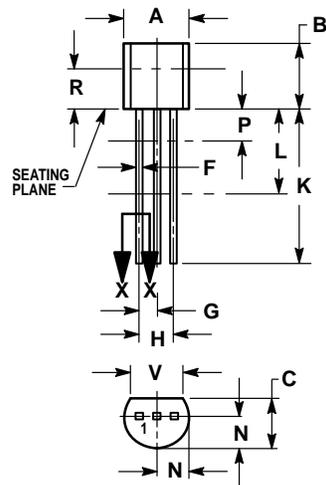
NOTES:
1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
2. CONTROLLING DIMENSION: INCH.
3. CONTOUR OF PACKAGE BEYOND DIMENSION R IS UNCONTROLLED.
4. DIMENSION F APPLIES BETWEEN P AND L. DIMENSION D AND J APPLY BETWEEN L AND K MINIMUM. LEAD DIMENSION IS UNCONTROLLED IN P AND BEYOND DIMENSION K MINIMUM.

SEATING PLANE

SECTION X–X

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

MPF4392 MPF4393

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