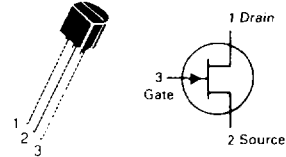


MPF4391 thru MPF4393★

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



JFETs SWITCHING

N-CHANNEL — DEPLETION

★MPF4392 and MPF4393 are Motorola
designated preferred devices.

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 \ddagger $T_A = 25^\circ\text{C}$ 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 ($T_A = 25^\circ\text{C}$ unless otherwise noted.)

Characteristic	Symbol	Min	Typ	Max	Unit
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 μAdc
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 μAdc
Gate Source Voltage ($V_{DS} = 15 \text{ Vdc}$, $I_D = 10 \text{ nAdc}$)	V_{GS}	50 25 5.0	— — —	150 75 30	Vdc
ON CHARACTERISTICS					
Zero-Gate-Voltage Drain Current(1) ($V_{DS} = 15 \text{ Vdc}$, $V_{GS} = 0$)	I_{DSS}	60 25 5.0	— — —	130 75 30	mAdc
Drain-Source On-Voltage ($I_D = 12 \text{ mAdc}$, $V_{GS} = 0$) ($I_D = 6.0 \text{ mAdc}$, $V_{GS} = 0$) ($I_D = 3.0 \text{ mAdc}$, $V_{GS} = 0$)	$V_{DS(on)}$	— — —	— — —	0.4 0.4 0.4	Vdc
Static Drain-Source On Resistance ($I_D = 1.0 \text{ mAdc}$, $V_{GS} = 0$)	$r_{DS(on)}$	— — —	— — —	30 60 100	Ohms
SMALL-SIGNAL CHARACTERISTICS					
Forward Transfer Admittance ($V_{DS} = 15 \text{ Vdc}$, $I_D = 60 \text{ mAdc}$, $f = 1.0 \text{ kHz}$) ($V_{DS} = 15 \text{ Vdc}$, $I_D = 25 \text{ mAdc}$, $f = 1.0 \text{ kHz}$) ($V_{DS} = 15 \text{ Vdc}$, $I_D = 5.0 \text{ mAdc}$, $f = 1.0 \text{ kHz}$)	$ y_{fs} $	— — —	20 17 12	— — —	mmhos
Drain-Source "ON" Resistance ($V_{GS} = 0$, $I_D = 0$, $f = 1.0 \text{ kHz}$)	$r_{ds(on)}$	— — —	— — —	30 60 100	Ohms
Input Capacitance ($V_{GS} = 15 \text{ Vdc}$, $V_{DS} = 0$, $f = 1.0 \text{ MHz}$)	C_{iss}	—	6.0	10	pF

MPF4391 thru MPF4393

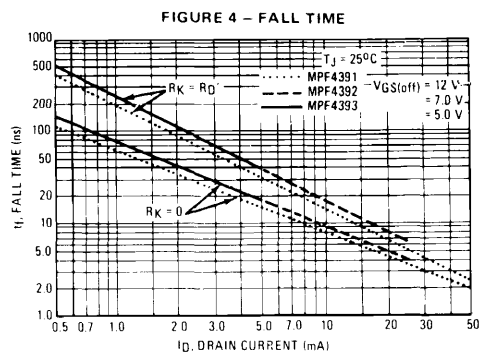
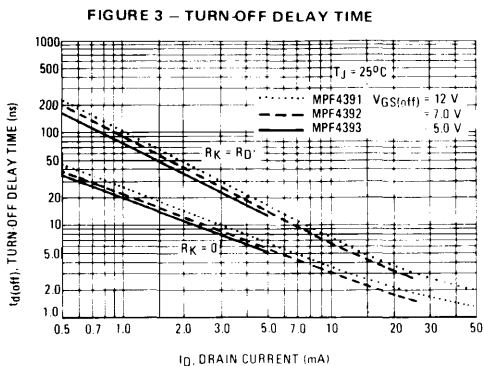
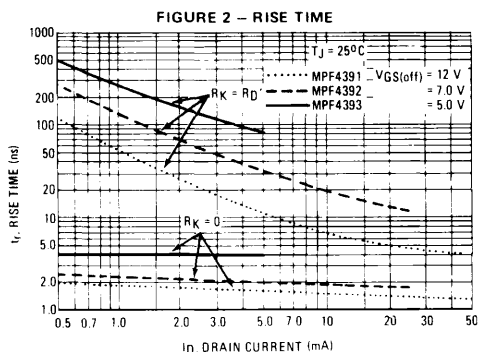
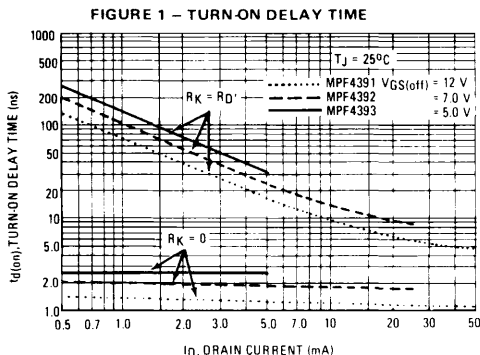
ELECTRICAL CHARACTERISTICS (continued) ($T_A = 25^\circ\text{C}$ unless otherwise noted.)

Characteristic	Symbol	Min	Typ	Max	Unit
Reverse Transfer Capacitance ($V_{GS} = 12\text{ Vdc}$, $V_{DS} = 0$, $f = 1.0\text{ MHz}$) ($V_{DS} = 15\text{ Vdc}$, $I_D = 10\text{ mA}$, $f = 1.0\text{ MHz}$)	C_{rss}	—	2.5 3.2	3.5 —	pF
SWITCHING CHARACTERISTICS					
Rise Time (See Figure 2) ($I_{D(on)} = 12\text{ mA}$) ($I_{D(on)} = 6.0\text{ mA}$) ($I_{D(on)} = 3.0\text{ mA}$)	t_r	—	1.2 2.0 2.5	5.0 5.0 5.0	ns
Fall Time (See Figure 4) ($V_{GS(off)} = 12\text{ Vdc}$) ($V_{GS(off)} = 7.0\text{ Vdc}$) ($V_{GS(off)} = 5.0\text{ Vdc}$)	t_f	—	7.0 15 29	15 20 35	ns
Turn-On Time (See Figures 1 and 2) ($I_{D(on)} = 12\text{ mA}$) ($I_{D(on)} = 6.0\text{ mA}$) ($I_{D(on)} = 3.0\text{ mA}$)	t_{on}	—	3.0 4.0 6.5	15 15 15	ns
Turn-Off Time (See Figures 3 and 4) ($V_{GS(off)} = 12\text{ Vdc}$) ($V_{GS(off)} = 7.0\text{ Vdc}$) ($V_{GS(off)} = 5.0\text{ Vdc}$)	t_{off}	—	10 20 37	20 35 55	ns

(1) Pulse Test: Pulse Width $\leq 100\ \mu\text{s}$, Duty Cycle $\leq 1.0\%$.

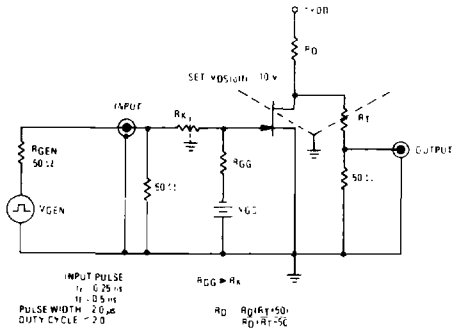
4

TYPICAL SWITCHING CHARACTERISTICS



MPF4391 thru MPF4393

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

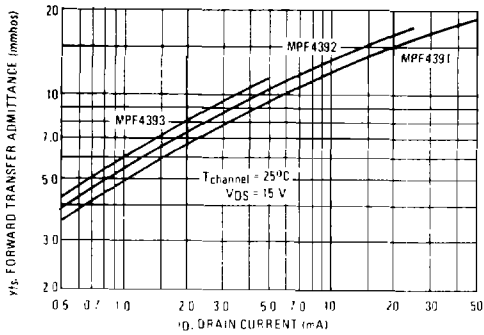


FIGURE 7 – TYPICAL CAPACITANCE

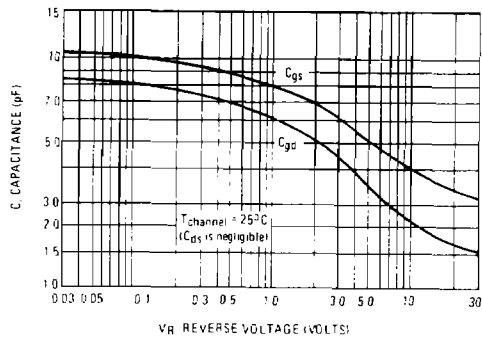


FIGURE 8 – EFFECT OF GATE SOURCE VOLTAGE ON DRAIN-SOURCE RESISTANCE

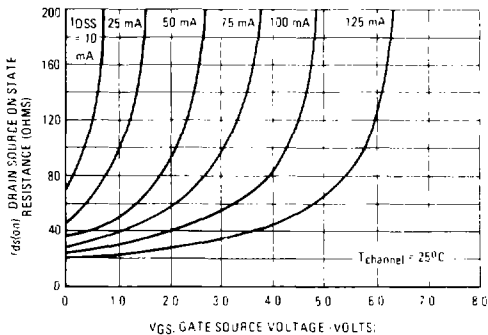
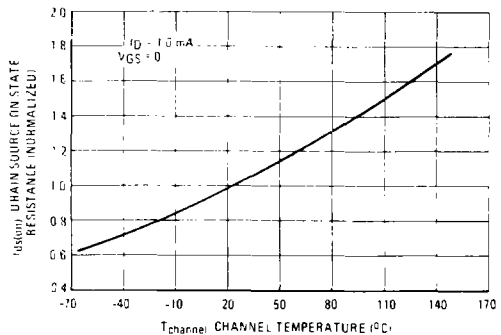
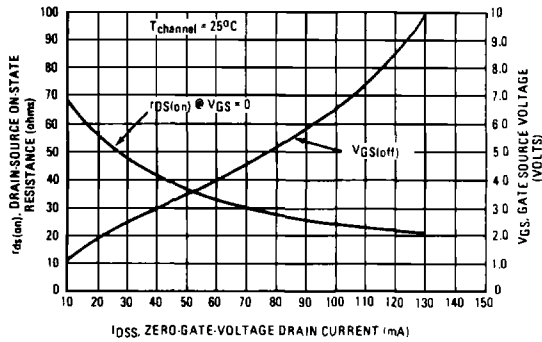


FIGURE 9 – EFFECT OF TEMPERATURE ON DRAIN-SOURCE ON-STATE RESISTANCE



MPF4391 thru MPF4393

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 characteristic. 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.