

# MPF4392, MPF4393

Preferred Devices

## JFET Switching Transistors

### N-Channel – Depletion

#### Features

- Pb-Free Packages are Available\*

#### MAXIMUM RATINGS

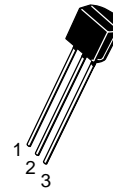
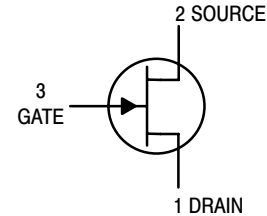
| Rating  | Symbol                                     | Value       | Unit                       |
|---|--|-------------|----------------------------|
| Drain-Source Voltage  | $V_{DS}$                                   | 30          | Vdc                        |
| Drain-Gate Voltage  | $V_{DG}$  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

Maximum ratings are those values beyond which device damage can occur. Maximum ratings applied to the device are individual stress limit values (not normal operating conditions) and are not valid simultaneously. If these limits are exceeded, device functional operation is not implied, damage may occur and reliability may be affected.



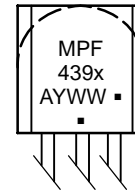
**ON Semiconductor®**

<http://onsemi.com>



TO-92 (TO-226AA)  
CASE 29-11  
STYLE 5

#### MARKING DIAGRAM



MPF439x = Device Code  
x = 2 or 3

A = Assembly Location

Y = Year

WW = Work Week

■ = Pb-Free Package

(Note: Microdot may be in either location)

#### ORDERING INFORMATION

| Device       | Package            | Shipping†         |
|--------------|--------------------|-------------------|
| MPF4392      | TO-92              | 1000 Units / Bulk |
| MPF4392G     | TO-92<br>(Pb-Free) | 1000 Units / Bulk |
| MPF4393      | TO-92              | 1000 Units / Bulk |
| MPF4393G     | TO-92<br>(Pb-Free) | 1000 Units / Bulk |
| MPF4393RLRP  | TO-92              | 1000 / Ammo Box   |
| MPF4393RLRPG | TO-92<br>(Pb-Free) | 1000 / Ammo Box   |

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

\*For additional information on our Pb-Free strategy and soldering details, please download the ON Semiconductor Soldering and Mounting Techniques Reference Manual, SOLDERRM/D.

# MPF4392, MPF4393

## ELECTRICAL CHARACTERISTICS (T<sub>A</sub> = 25°C unless otherwise noted)

| Characteristic   | Symbol               | Min          | Typ    | Max          | Unit         |
|--|----------------------|--------------|--------|--------------|--------------|
| <b>OFF CHARACTERISTICS</b>   |                      |              |        |              |              |
| Gate–Source Breakdown Voltage<br>(I <sub>G</sub> = 1.0 μAdc, V <sub>DS</sub> = 0)  | V <sub>(BR)GSS</sub> | 30           | –      | –            | Vdc          |
| Gate Reverse Current<br>(V <sub>GS</sub> = 15 Vdc, V <sub>DS</sub> = 0)<br>(V <sub>GS</sub> = 15 Vdc, V <sub>DS</sub> = 0, T <sub>A</sub> = 100°C)           | I <sub>GSS</sub>     | –<br>–       | –<br>– | 1.0<br>0.2   | nAdc<br>μAdc |
| Drain–Cutoff Current<br>(V <sub>DS</sub> = 15 Vdc, V <sub>GS</sub> = 12 Vdc)<br>(V <sub>DS</sub> = 15 Vdc, V <sub>GS</sub> = 12 Vdc, T <sub>A</sub> = 100°C) | I <sub>D(off)</sub>  | –<br>–       | –<br>– | 1.0<br>0.1   | nAdc<br>μAdc |
| Gate–Source Voltage<br>(V <sub>DS</sub> = 15 Vdc, I <sub>D</sub> = 10 nAdc)  | V <sub>GS</sub>      | –2.0<br>–0.5 | –<br>– | –5.0<br>–3.0 | Vdc          |

## ON CHARACTERISTICS

|   |                     |           |        |            |      |
|---|---------------------|-----------|--------|------------|------|
| Zero–Gate–Voltage Drain Current (Note 1)<br>(V <sub>DS</sub> = 15 Vdc, V <sub>GS</sub> = 0)                                     | I <sub>DSS</sub>    | 25<br>5.0 | –<br>– | 75<br>30   | mAdc |
| Drain–Source On–Voltage<br>(I <sub>D</sub> = 6.0 mAdc, V <sub>GS</sub> = 0)<br>(I <sub>D</sub> = 3.0 mAdc, V <sub>GS</sub> = 0) | V <sub>DS(on)</sub> | –<br>–    | –<br>– | 0.4<br>0.4 | Vdc  |
| Static Drain–Source On Resistance<br>(I <sub>D</sub> = 1.0 mAdc, V <sub>GS</sub> = 0)   | r <sub>DS(on)</sub> | –<br>–    | –<br>– | 60<br>100  | Ω    |

## SMALL–SIGNAL CHARACTERISTICS

|  |                     |        |            |           |       |
|--|---------------------|--------|------------|-----------|-------|
| Forward Transfer Admittance<br>(V <sub>DS</sub> = 15 Vdc, I <sub>D</sub> = 25 mAdc, f = 1.0 kHz)<br>(V <sub>DS</sub> = 15 Vdc, I <sub>D</sub> = 5.0 mAdc, f = 1.0 kHz) | y <sub>fs</sub>     | –<br>– | 17<br>12   | –<br>–    | mmhos |
| Drain–Source “ON” Resistance<br>(V <sub>GS</sub> = 0, I <sub>D</sub> = 0, f = 1.0 kHz)   | r <sub>ds(on)</sub> | –<br>– | –<br>–     | 60<br>100 | Ω     |
| Input Capacitance (V <sub>GS</sub> = 15 Vdc, V <sub>DS</sub> = 0, f = 1.0 MHz)   | C <sub>iss</sub>    | –      | 6.0        | 10        | pF    |
| Reverse Transfer Capacitance<br>(V <sub>GS</sub> = 12 Vdc, V <sub>DS</sub> = 0, f = 1.0 MHz)<br>(V <sub>DS</sub> = 15 Vdc, I <sub>D</sub> = 10 mAdc, f = 1.0 MHz)      | C <sub>rss</sub>    | –<br>– | 2.5<br>3.2 | 3.5<br>–  | pF    |

## SWITCHING CHARACTERISTICS

|   |                  |        |            |            |    |
|---|------------------|--------|------------|------------|----|
| Rise Time (See Figure 2)<br>(I <sub>D(on)</sub> = 6.0 mAdc)<br>(I <sub>D(on)</sub> = 3.0 mAdc)              | t <sub>r</sub>   | –<br>– | 2.0<br>2.5 | 5.0<br>5.0 | ns |
| Fall Time (See Figure 4)<br>(V <sub>GS(off)</sub> = 7.0 Vdc)<br>(V <sub>GS(off)</sub> = 5.0 Vdc)            | t <sub>f</sub>   | –<br>– | 15<br>29   | 20<br>35   | ns |
| Turn–On Time (See Figures 1 and 2)<br>(I <sub>D(on)</sub> = 6.0 mAdc)<br>(I <sub>D(on)</sub> = 3.0 mAdc)    | t <sub>on</sub>  | –<br>– | 4.0<br>6.5 | 15<br>15   | ns |
| Turn–Off Time (See Figures 3 and 4)<br>(V <sub>GS(off)</sub> = 7.0 Vdc)<br>(V <sub>GS(off)</sub> = 5.0 Vdc) | t <sub>off</sub> | –<br>– | 20<br>37   | 35<br>55   | ns |

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

# MPF4392, MPF4393

## TYPICAL SWITCHING CHARACTERISTICS

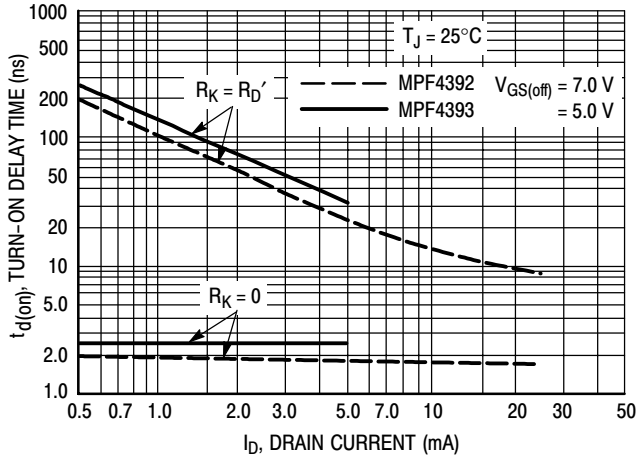


Figure 1. Turn-On Delay Time

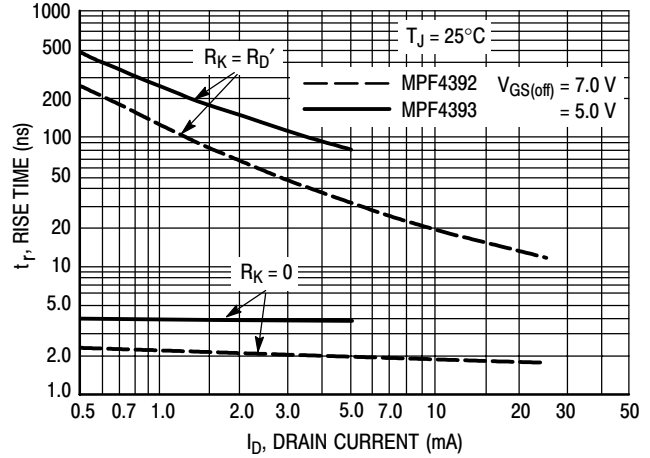


Figure 2. Rise Time

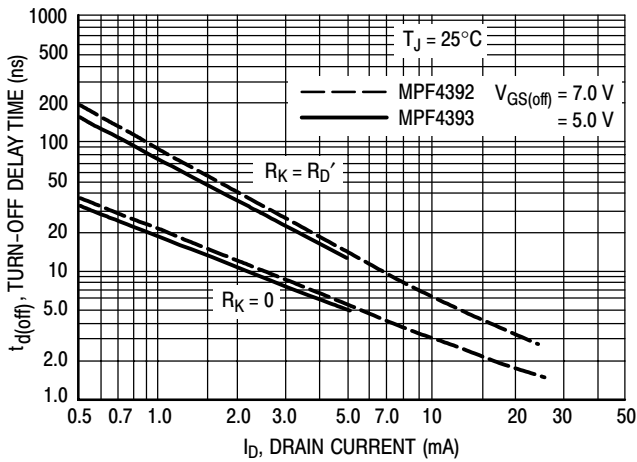


Figure 3. Turn-Off Delay Time

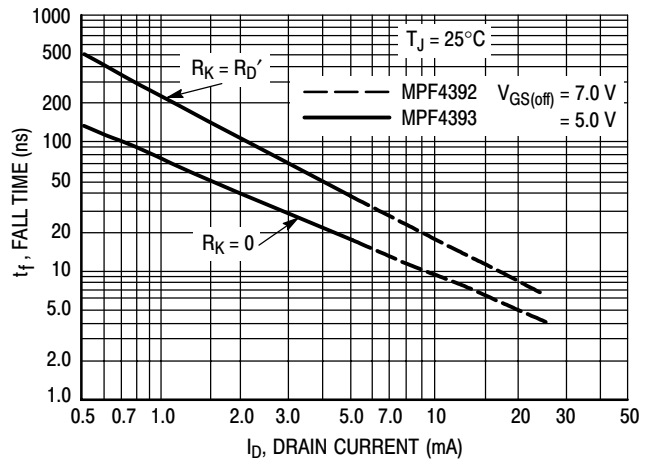


Figure 4. Fall Time

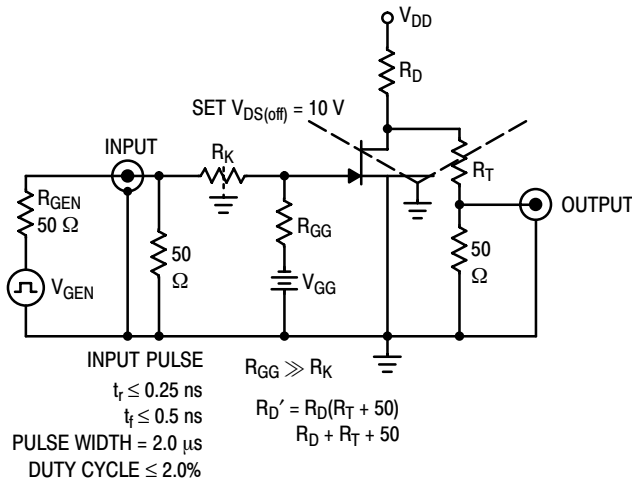


Figure 5. Switching Time Test Circuit

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.

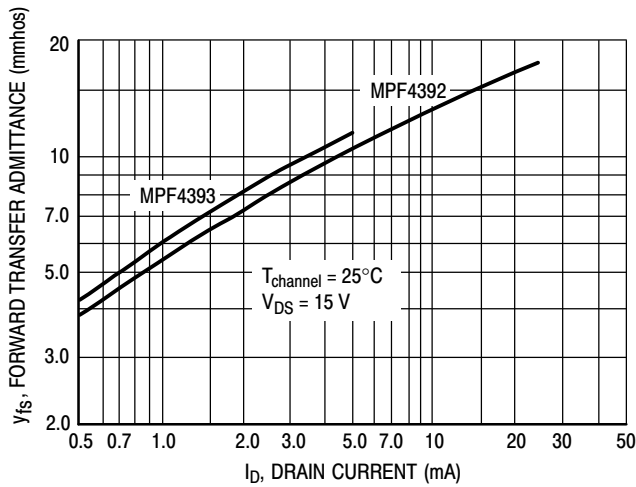


Figure 6. Typical Forward Transfer Admittance

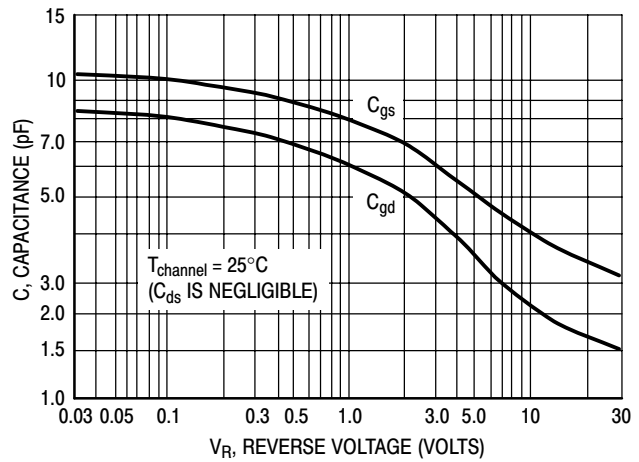


Figure 7. Typical Capacitance

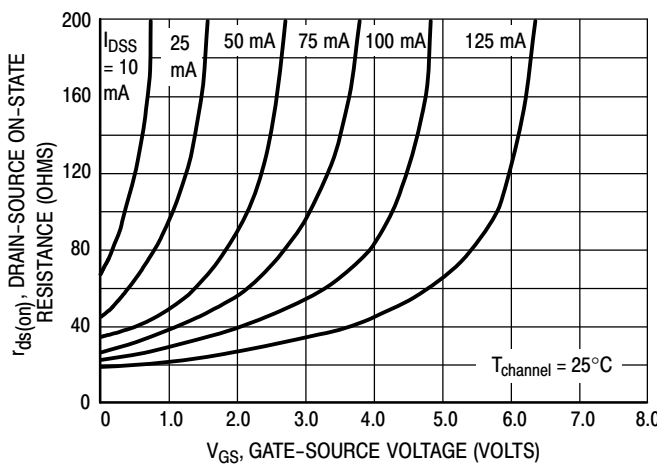


Figure 8. Effect of Gate-Source Voltage On Drain-Source Resistance

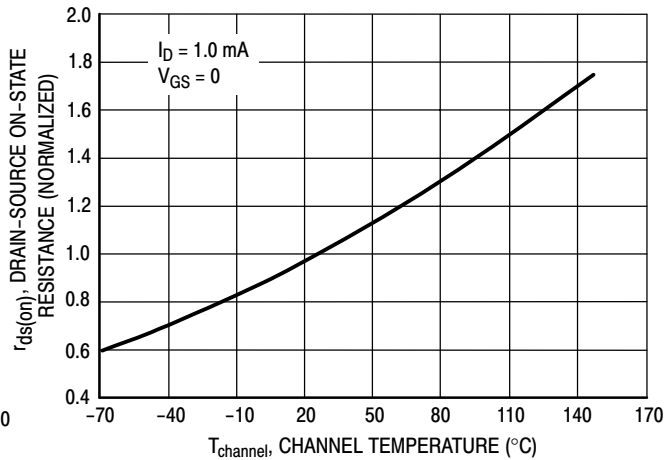
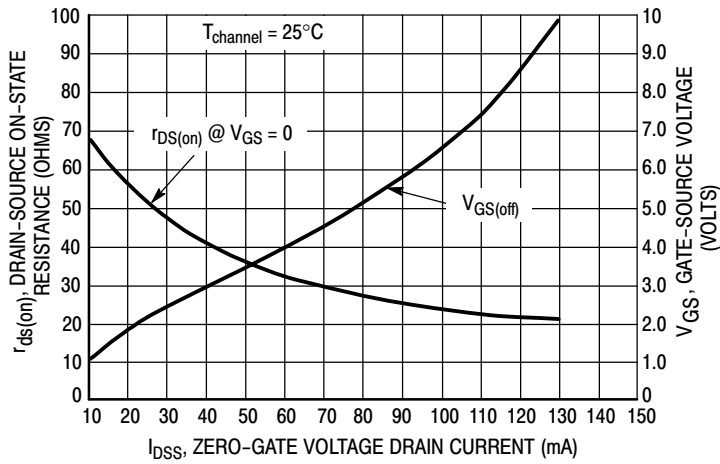


Figure 9. Effect of Temperature On Drain-Source On-State Resistance

## MPF4392, MPF4393



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

### 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

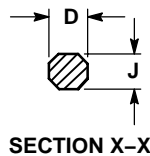
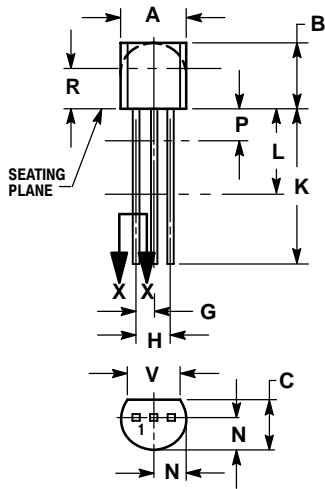
$r_{ds(on)}$  and  $V_{GS}$  range for an MPF4392

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

# MPF4392, MPF4393

## PACKAGE DIMENSIONS

TO-92 (TO-226)  
CASE 29-11  
ISSUE AL




### NOTES:

1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
2. CONTROLLING DIMENSION: INCH.
3. CONTOUR OF PACKAGE BEYOND DIMENSION R IS UNCONTROLLED.
4. 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  | 0.021 | 0.407       | 0.533 |
| 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        | ---   |

### STYLE 5:

1. DRAIN
2. SOURCE
3. GATE

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