

**FAIRCHILD**

A Schlumberger Company

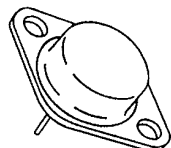
**IRF420-423/IRF820-823 T-39-11**  
**MTP2N45/2N50**  
**N-Channel Power MOSFETs,**  
**3.0 A, 450 V/500 V**

Power And Discrete Division

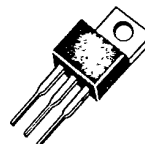
**Description**

These devices are n-channel, enhancement mode, power MOSFETs designed especially for high speed applications, such as switching power supplies, converters, AC and DC motor controls, relay and solenoid drivers and other pulse circuits.

- Low  $R_{DS(on)}$
- $V_{GS}$  Rated at  $\pm 20$  V
- Silicon Gate for Fast Switching Speeds
- $I_{DSS}$ ,  $V_{DS(on)}$  Specified at Elevated Temperature
- Rugged
- Low Drive Requirements
- Ease of Paralleling

**TO-204AA**

IS00020F

 IRF420  
 IRF421  
 IRF422  
 IRF423
**TO-220AB**

IS00010F

 IRF820  
 IRF821  
 IRF822  
 IRF823  
 MTP2N45  
 MTP2N50
**Product Summary**

| Part Number | $V_{DSS}$ | $R_{DS(on)}$ | $I_D$ at<br>$T_C = 25^\circ C$ | $I_D$ at<br>$T_C = 100^\circ C$ | Case Style |
|-------------|-----------|--------------|--------------------------------|---------------------------------|------------|
| IRF420      | 500 V     | 3.0 $\Omega$ | 2.5 A                          | 1.5 A                           | TO-204AA   |
| IRF421      | 450 V     | 3.0 $\Omega$ | 2.5 A                          | 1.5 A                           |            |
| IRF422      | 500 V     | 4.0 $\Omega$ | 2.0 A                          | 1.0 A                           |            |
| IRF423      | 450 V     | 4.0 $\Omega$ | 2.0 A                          | 1.0 A                           |            |
| IRF820      | 500 V     | 3.0 $\Omega$ | 2.5 A                          | 1.5 A                           | TO-220AB   |
| IRF821      | 450 V     | 3.0 $\Omega$ | 2.5 A                          | 1.5 A                           |            |
| IRF822      | 500 V     | 4.0 $\Omega$ | 2.0 A                          | 1.0 A                           |            |
| IRF823      | 450 V     | 4.0 $\Omega$ | 2.0 A                          | 1.0 A                           |            |
| MTP2N45     | 450 V     | 4.0 $\Omega$ | 3.0 A                          | 2.0 A                           |            |
| MTP2N50     | 500 V     | 4.0 $\Omega$ | 3.0 A                          | 2.0 A                           |            |

**Notes**

For information concerning connection diagram and package outline, refer to Section 7.

## IRF420-423/IRF820-823

## MTP2N45/2N50

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## Maximum Ratings

| Symbol                            | Characteristic                                                                | Rating<br>IRF420/422<br>IRF820/822<br>MTP2N50 | Rating<br>IRF421/423<br>IRF821/823<br>MTP2N45 | Unit |
|-----------------------------------|-------------------------------------------------------------------------------|-----------------------------------------------|-----------------------------------------------|------|
| V <sub>DSS</sub>                  | Drain to Source Voltage <sup>1</sup>                                          | 500                                           | 450                                           | V    |
| V <sub>DGR</sub>                  | Drain to Gate Voltage <sup>1</sup><br>R <sub>GS</sub> = 20 k $\Omega$         | 500                                           | 450                                           | V    |
| V <sub>GS</sub>                   | Gate to Source Voltage                                                        | $\pm 20$                                      | $\pm 20$                                      | V    |
| T <sub>J</sub> , T <sub>slg</sub> | Operating Junction and<br>Storage Temperatures                                | -55 to +150                                   | -55 to +150                                   | °C   |
| T <sub>L</sub>                    | Maximum Lead Temperature<br>for Soldering Purposes,<br>1/8" From Case for 5 s | 275                                           | 275                                           | °C   |

## Maximum Thermal Characteristics

|                                    |                                                     | IRF420-423/<br>IRF820-823 | MTP2N45/2N50 |      |
|------------------------------------|-----------------------------------------------------|---------------------------|--------------|------|
| R <sub><math>\theta</math>JC</sub> | Thermal Resistance,<br>Junction to Case             | 3.12                      | 1.67         | °C/W |
| R <sub><math>\theta</math>JA</sub> | Thermal Resistance,<br>Junction to Ambient          | 30/80                     | 80           | °C/W |
| P <sub>D</sub>                     | Total Power Dissipation<br>at T <sub>C</sub> = 25°C | 40                        | 75           | W    |
| I <sub>DM</sub>                    | Pulsed Drain Current <sup>2</sup>                   | 10                        | 10           | A    |

Electrical Characteristics (T<sub>C</sub> = 25°C unless otherwise noted)

| Symbol               | Characteristic                                                                                                  | Min | Max       | Unit    | Test Conditions                                                                                          |
|----------------------|-----------------------------------------------------------------------------------------------------------------|-----|-----------|---------|----------------------------------------------------------------------------------------------------------|
| Off Characteristics  |                                                                                                                 |     |           |         |                                                                                                          |
| V <sub>(BR)DSS</sub> | Drain Source Breakdown Voltage <sup>1</sup><br>IRF420/422/820/822/<br>MTP2N50<br>IRF421/423/821/823/<br>MTP2N45 |     |           | V       | V <sub>GS</sub> = 0 V, I <sub>D</sub> = 250 $\mu$ A                                                      |
|                      |                                                                                                                 | 500 |           |         |                                                                                                          |
|                      |                                                                                                                 | 450 |           |         |                                                                                                          |
| I <sub>DSS</sub>     | Zero Gate Voltage Drain Current                                                                                 |     | 250       | $\mu$ A | V <sub>DS</sub> = Rated V <sub>DSS</sub> , V <sub>GS</sub> = 0 V                                         |
|                      |                                                                                                                 |     | 1000      | $\mu$ A | V <sub>DS</sub> = 0.8 $\times$ Rated V <sub>DSS</sub> ,<br>V <sub>GS</sub> = 0 V, T <sub>C</sub> = 125°C |
| I <sub>GSS</sub>     | Gate-Body Leakage Current<br>IRF420-423<br>IRF820-823/MTP2N45/50                                                |     |           | nA      | V <sub>GS</sub> = $\pm 20$ V, V <sub>DS</sub> = 0 V                                                      |
|                      |                                                                                                                 |     | $\pm 100$ |         |                                                                                                          |
|                      |                                                                                                                 |     | $\pm 500$ |         |                                                                                                          |

**IRF420-423/IRF820-823**  
**MTP2N45/2N50**

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**Electrical Characteristics (Cont.)** ( $T_C = 25^\circ\text{C}$  unless otherwise noted)

| Symbol                    | Characteristic                                 | Min | Max | Unit           | Test Conditions                                 |
|---------------------------|------------------------------------------------|-----|-----|----------------|-------------------------------------------------|
| <b>On Characteristics</b> |                                                |     |     |                |                                                 |
| $V_{GS(th)}$              | Gate Threshold Voltage                         |     |     | V              |                                                 |
|                           | IRF420-423/IRF820-823                          | 2.0 | 4.0 |                | $I_D = 250 \mu\text{A}$ , $V_{DS} = V_{GS}$     |
|                           | MTP2N45/MTP2N50                                | 2.0 | 4.5 |                | $I_D = 1.0 \text{ mA}$ , $V_{DS} = V_{GS}$      |
| $R_{DS(on)}$              | Static Drain-Source On-Resistance <sup>2</sup> |     |     | $\Omega$       | $V_{GS} = 10 \text{ V}$ , $I_D = 1.0 \text{ A}$ |
|                           | IRF420/421/820/821                             |     | 3.0 |                |                                                 |
|                           | IRF422/423/822/823                             |     | 4.0 |                |                                                 |
|                           | MTP2N45/50                                     |     | 4.0 |                |                                                 |
| $V_{DS(on)}$              | Drain-Source On-Voltage <sup>2</sup>           |     |     | V              | $V_{GS} = 10 \text{ V}$ ; $I_D = 2.0 \text{ A}$ |
|                           |                                                |     | 10  |                | $V_{GS} = 10 \text{ V}$ ; $I_D = 1.0 \text{ A}$ |
|                           | MTP2N45/50                                     |     | 8   | V              | $T_C = 100^\circ\text{C}$                       |
| $g_{fs}$                  | Forward Transconductance                       | 1.0 |     | S ( $\Omega$ ) | $V_{DS} = 10 \text{ V}$ , $I_D = 1.0 \text{ A}$ |

**Dynamic Characteristics**

|           |                              |  |     |    |                                                                           |
|-----------|------------------------------|--|-----|----|---------------------------------------------------------------------------|
| $C_{iss}$ | Input Capacitance            |  | 400 | pF | $V_{DS} = 25 \text{ V}$ , $V_{GS} = 0 \text{ V}$<br>$f = 1.0 \text{ MHz}$ |
| $C_{oss}$ | Output Capacitance           |  | 100 | pF |                                                                           |
| $C_{rss}$ | Reverse Transfer Capacitance |  | 40  | pF |                                                                           |

**Switching Characteristics** ( $T_C = 25^\circ\text{C}$ , Figures 1, 2)<sup>3</sup>

|              |                     |  |    |    |                                                                                                                             |
|--------------|---------------------|--|----|----|-----------------------------------------------------------------------------------------------------------------------------|
| $t_{d(on)}$  | Turn-On Delay Time  |  | 40 | ns | $V_{DD} = 250 \text{ V}$ , $I_D = 1.0 \text{ A}$<br>$V_{GS} = 10 \text{ V}$ , $R_{GEN} = 50 \Omega$<br>$R_{GS} = 50 \Omega$ |
| $t_r$        | Rise Time           |  | 50 | ns |                                                                                                                             |
| $t_{d(off)}$ | Turn-Off Delay Time |  | 60 | ns |                                                                                                                             |
| $t_f$        | Fall Time           |  | 60 | ns |                                                                                                                             |
| $Q_g$        | Total Gate Charge   |  | 15 | nC | $V_{GS} = 10 \text{ V}$ , $I_D = 3.0 \text{ A}$<br>$V_{DD} = 200 \text{ V}$                                                 |

| Symbol                                    | Characteristic        | Typ | Max | Unit | Test Conditions                                               |
|-------------------------------------------|-----------------------|-----|-----|------|---------------------------------------------------------------|
| <b>Source-Drain Diode Characteristics</b> |                       |     |     |      |                                                               |
| $V_{SD}$                                  | Diode Forward Voltage |     | 1.4 | V    | $I_S = 2.5 \text{ A}$ ; $V_{GS} = 0 \text{ V}$                |
|                                           |                       |     | 1.3 | V    | $I_S = 2.0 \text{ A}$ ; $V_{GS} = 0 \text{ V}$                |
| $t_{rr}$                                  | Reverse Recovery Time | 600 |     | ns   | $I_S = 2.5 \text{ A}$ ; $dI_S/dt = 100 \text{ A}/\mu\text{S}$ |

**Notes**

- $T_J = +25^\circ\text{C}$  to  $+150^\circ\text{C}$
- Pulse width limited by  $T_J$
- Switching time measurements performed on LEM TR-58 test equipment.

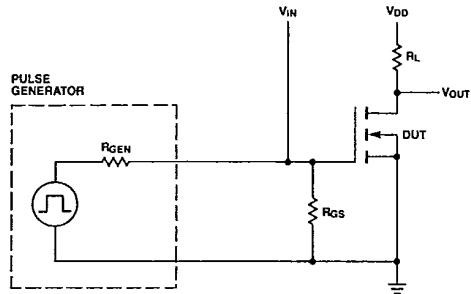
IRF420-423/IRF820-823

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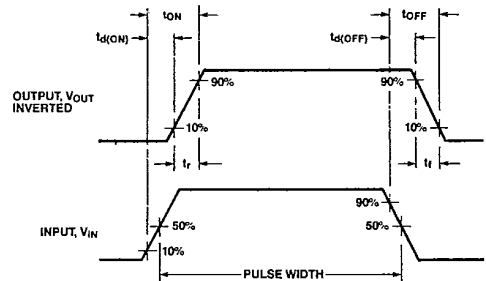
## Typical Electrical Characteristics

Figure 1 Switching Test Circuit



CPC4450F

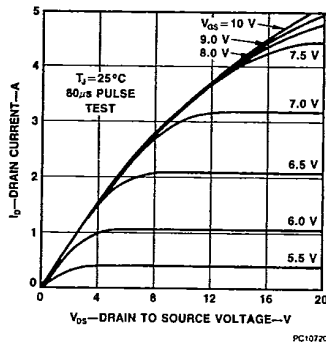
Figure 2 Switching Waveforms



WFO0600F

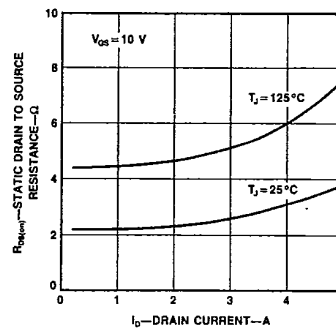
## Typical Performance Curves

Figure 3 Output Characteristics



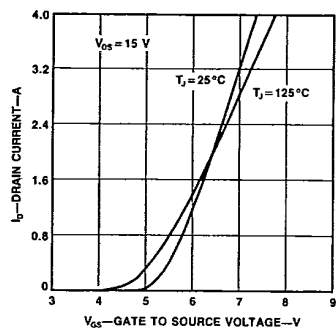
PC10720F

Figure 4 Static Drain to Source Resistance vs Drain Current



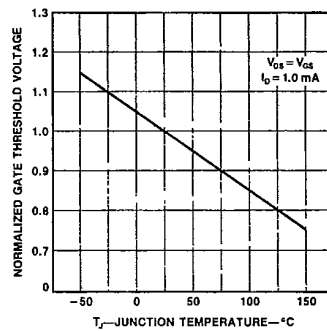
PC10730F

Figure 5 Transfer Characteristics



PC10740F

Figure 6 Temperature Variation of Gate to Source Threshold Voltage



PC03841F

Typical Performance Curves (Cont.)

Figure 7 Capacitance vs Drain to Source Voltage

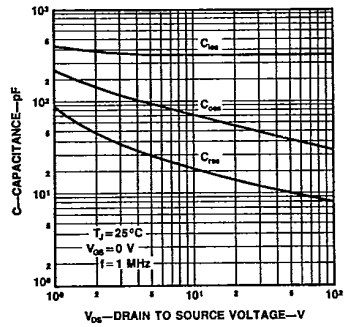


Figure 9 Forward Biased Safe Operating Area for IRF420-423 and IRF820-823

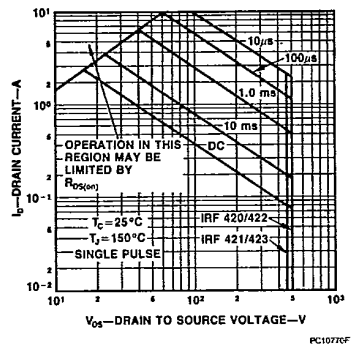


Figure 11 Forward Biased Safe Operating Area for MTP2N45/2N50

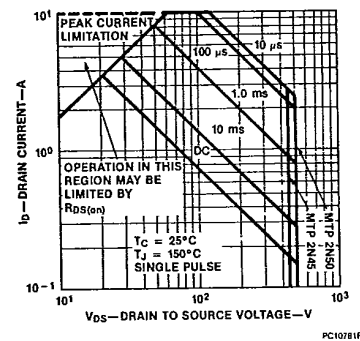


Figure 8 Gate to Source Voltage vs Total Gate Charge

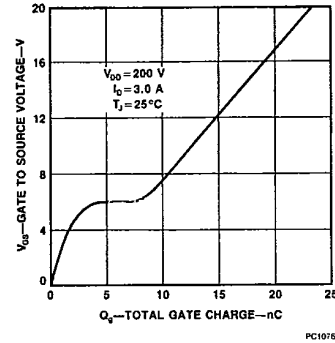


Figure 10 Transient Thermal Resistance vs Time for IRF420-423 and IRF820-823

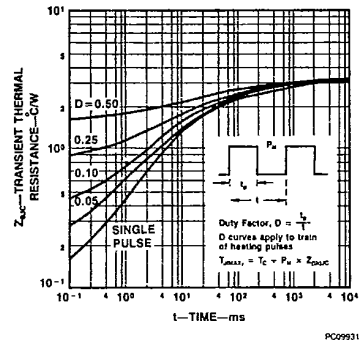


Figure 12 Transient Thermal Resistance vs Time for MTP2N45/2N50

