

**FAIRCHILD**

A Schlumberger Company

**IRF320-323/IRF720-723**  
**MTP3N35/3N40** 7-39-11  
**N-Channel Power MOSFETs,**  
**3.0 A, 350-400 V**

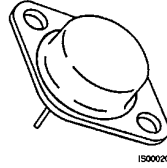
Power And Discrete Division

**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.

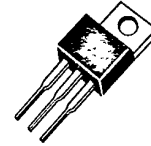
- Low  $R_{DS(on)}$
- $V_{GS}$  Rated at  $\pm 20$  V
- Silicon Gate for Fast Switching Speeds
- $I_{DSS}$ ,  $V_{DS(on)}$ , Specified at Elevated Temperature
- Rugged
- Low Drive Requirements
- Ease of Paralleling

TO-204AA



IRF320  
 IRF321  
 IRF322  
 IRF323

TO-220AB



IRF720  
 IRF721  
 IRF722  
 IRF723  
 MTP3N35  
 MTP3N40

**Product Summary**

Part Number	$V_{DSS}$	$R_{DS(on)}$	$I_D$ at $T_C = 25^\circ C$	$I_D$ at $T_C = 100^\circ C$	Case Style
IRF320	400 V	1.8 $\Omega$	3.0 A	2.0 A	TO-204AA
IRF321	350 V	1.8 $\Omega$	3.0 A	2.0 A	
IRF322	400 V	2.5 $\Omega$	2.5 A	1.5 A	
IRF323	350 V	2.5 $\Omega$	2.5 A	1.5 A	
IRF720	400 V	1.8 $\Omega$	3.0 A	2.0 A	TO-220AB
IRF721	350 V	1.8 $\Omega$	3.0 A	2.0 A	
IRF722	400 V	2.5 $\Omega$	2.5 A	1.5 A	
IRF723	350 V	2.5 $\Omega$	2.5 A	1.5 A	
MTP3N35	350 V	3.3 $\Omega$	3.0 A	2.0 A	
MTP3N40	400 V	3.3 $\Omega$	3.0 A	2.0 A	

**Notes**

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

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**Maximum Ratings**

Symbol	Characteristic	Rating IRF320/322 IRF720/722 MTP3N40	Rating IRF321/323 IRF721/723 MTP3N35	Unit
V <sub>DSS</sub>	Drain to Source Voltage <sup>2</sup>	400	350	V
V <sub>DGR</sub>	Drain to Gate Voltage <sup>2</sup> R <sub>GS</sub> = 20 kΩ	400	350	V
V <sub>GS</sub>	Gate to Source Voltage	± 20	± 20	V
T <sub>J</sub> , T <sub>stg</sub>	Operating Junction and Storage Temperatures	-55 to +150	-55 to +150	°C
T <sub>L</sub>	Maximum Lead Temperature for Soldering Purposes, 1/8" From Case for 5 s	275	275	°C

**Maximum Thermal Characteristics**

		IRF320-323/ IRF720-723	MTP3N35/3N40	
R <sub>θJC</sub>	Thermal Resistance, Junction to Case	3.12	1.67	°C/W
R <sub>θJA</sub>	Thermal Resistance, Junction to Ambient	30/80	80	°C/W
P <sub>D</sub>	Total Power Dissipation at T <sub>C</sub> = 25°C	40	75	W
I <sub>DM</sub>	Pulsed Drain Current <sup>2</sup>	12	12	A

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

Symbol	Characteristic	Min	Max	Unit	Test Conditions
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**Off Characteristics**

V <sub>(BR)DSS</sub>	Drain Source Breakdown Voltage <sup>1</sup> IRF320/322/720/722/ MTP3N40 IRF321/323/721/723/ MTP3N35			V	V <sub>GS</sub> = 0 V, I <sub>D</sub> = 250 μA
		400			
		350			
I <sub>DSS</sub>	Zero Gate Voltage Drain Current		250	μA	V <sub>DS</sub> = Rated V <sub>DSS</sub> , V <sub>GS</sub> = 0 V
			1000	μA	V <sub>DS</sub> = 0.8 x Rated V <sub>DSS</sub> , V <sub>GS</sub> = 0 V, T <sub>C</sub> = 125°C
I <sub>gss</sub>	Gate-Body Leakage Current IRF320-323 IRF720-723/MTP3N35/3N40		± 100 ± 500	nA	V <sub>GS</sub> = ± 20 V, V <sub>DS</sub> = 0 V

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**MTP3N35/3N40**

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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	$I_D = 250 \mu\text{A}$ , $V_{DS} = V_{GS}$ $I_D = 1 \text{ mA}$ , $V_{DS} = V_{GS}$
	IRF320-323/IRF720-723	2.0	4.0		
	MTP3N35/40	2.0	4.5		
$R_{DS(on)}$	Static Drain-Source On-Resistance <sup>2</sup>			$\Omega$	$V_{GS} = 10 \text{ V}$ , $I_D = 1.5 \text{ A}$
	IRF320/321/720/721		1.8		
	IRF322/323/722/723		2.5		
	MTP3N35/40		3.3		
$V_{DS(on)}$	Drain-Source On-Voltage <sup>2</sup>		12	V	$V_{GS} = 10 \text{ V}$ ; $I_D = 3.0 \text{ A}$ ;
	MTP3N35/40		10	V	$V_{GS} = 10 \text{ V}$ ; $I_D = 1.5 \text{ A}$ ; $T_C = 100^\circ\text{C}$
$g_{fs}$	Forward Transconductance	1.0		S ( $\Omega$ )	$V_{DS} = 10 \text{ V}$ , $I_D = 1.5 \text{ A}$

**Dynamic Characteristics**

$C_{iss}$	Input Capacitance		500	pF	$V_{DS} = 25 \text{ V}$ , $V_{GS} = 0 \text{ V}$ $f = 1.0 \text{ MHz}$
$C_{oss}$	Output Capacitance		100	pF	
$C_{rss}$	Reverse Transfer Capacitance		40	pF	

**Switching Characteristics** ( $T_C = 200^\circ\text{C}$ , Figures 1, 2)<sup>3</sup>

$t_{d(on)}$	Turn-On Delay Time		40	ns	$V_{DD} = 200 \text{ V}$ , $I_D = 1.5 \text{ A}$ $V_{GS} = 10 \text{ V}$ , $R_{GEN} = 50 \Omega$ $R_{GS} = 50 \Omega$
$t_r$	Rise Time		50	ns	
$t_{d(off)}$	Turn-Off Delay Time		100	ns	
$t_f$	Fall Time		50	ns	
$Q_g$	Total Gate Charge		15	nC	$V_{GS} = 10 \text{ V}$ , $I_D = 4.0 \text{ A}$ $V_{DD} = 200 \text{ V}$

Symbol	Characteristic	Typ	Max	Unit	Test Conditions
<b>Source-Drain Diode Characteristics</b>					
$V_{SD}$	Diode Forward Voltage		1.6	V	$I_S = 3.0 \text{ A}$ ; $V_{GS} = 0 \text{ V}$
	IRF320/321/720/721		1.5	V	$I_S = 2.5 \text{ A}$ ; $V_{GS} = 0 \text{ V}$
$t_{rr}$	Reverse Recovery Time	450		ns	$I_F = 3.0 \text{ A}$ ; $di_S/dt = 100 \text{ A}/\mu\text{S}$

**Notes**

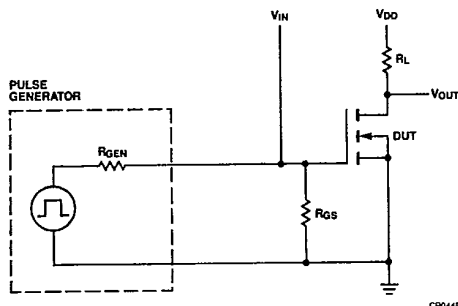
- $T_J = +25^\circ\text{C}$  to  $+150^\circ\text{C}$
- Pulse test: Pulse width  $\leq 80 \mu\text{s}$ , Duty cycle  $\leq 1\%$
- Switching time measurements performed on LEM TR-58 test equipment.

**IRF320-323/IRF720-723  
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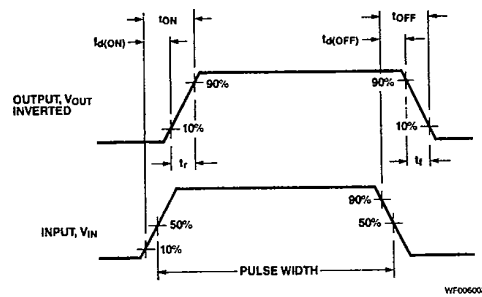
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**Typical Electrical Characteristics**

**Figure 1 Switching Test Circuit**

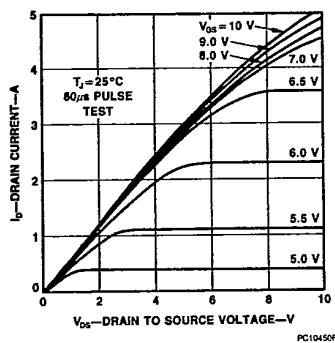


**Figure 2 Switching Waveforms**

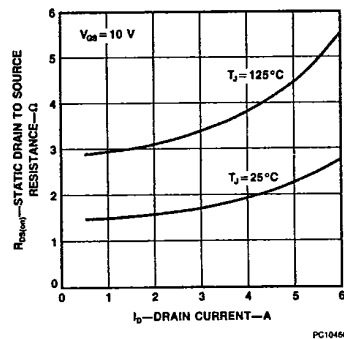


**Typical Performance Curves**

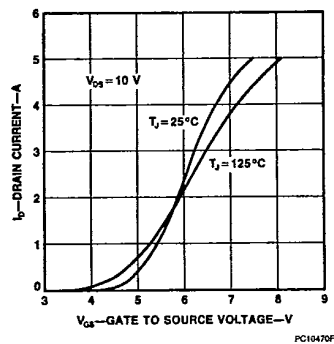
**Figure 3 Output Characteristics**



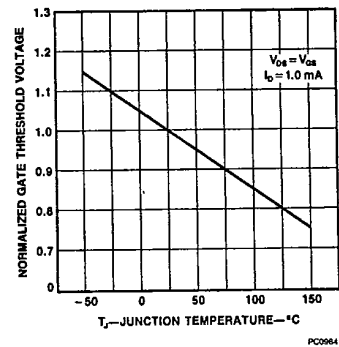
**Figure 4 Static Drain to Source Resistance vs Drain Current**



**Figure 5 Transfer Characteristics**



**Figure 6 Temperature Variation of Gate to Source Threshold Voltage**



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Typical Performance Curves (Cont.)

Figure 7 Capacitance vs Drain to Source Voltage

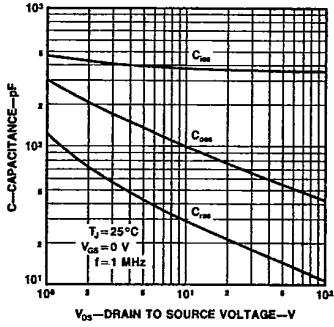


Figure 8 Gate to Source Voltage vs Total Gate Charge

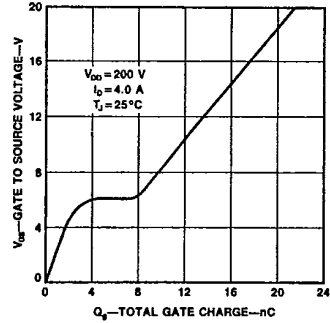


Figure 9 Forward Biased Safe Operating Area for IRF320-323 and IRF720-723

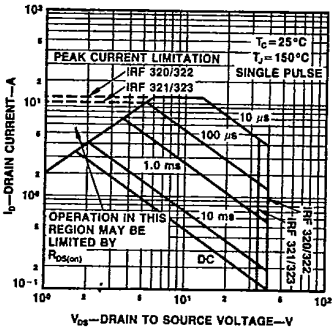


Figure 10 Transient Thermal Resistance vs Time for IRF320-323 and IRF720-723

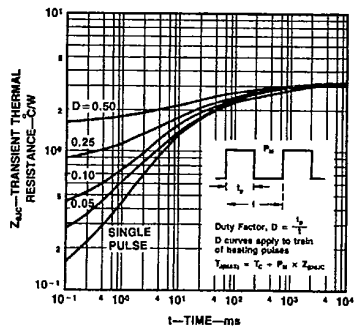


Figure 11 Forward Biased Safe Operating Area for MTP3N35/3N40

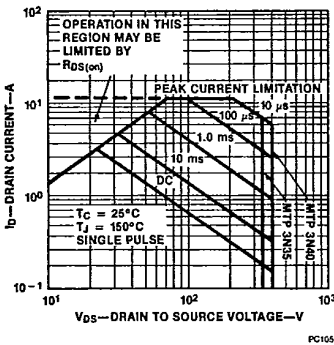
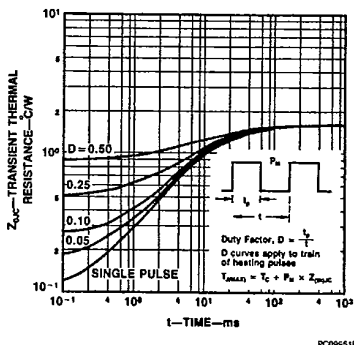


Figure 12 Transient Thermal Resistance vs Time for MTP3N35/3N40



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