

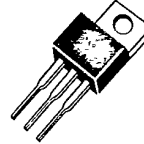


**IRF710-713**  
**MTP2N35/2N40** T-39.09  
**N-Channel Power MOSFETs,**  
**2.25 A, 350-400 V**  
 Power And Discrete Division

**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 driver and high energy pulse circuits.

TO-220AB



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- 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

IRF710  
 IRF711  
 IRF712  
 IRF713  
 MTP2N35  
 MTP2N40

**Maximum Ratings**

Symbol	Characteristic	Rating IRF710/712 MTP2N40	Rating IRF711/713 MTP2N35	Unit
$V_{DSS}$	Drain to Source Voltage <sup>1</sup>	400	350	V
$V_{DGR}$	Drain to Gate Voltage <sup>1</sup> $R_{GS} = 20$ k $\Omega$	400	350	V
$V_{GS}$	Gate to Source Voltage	$\pm 20$	$\pm 20$	V
$T_J$ , $T_{stg}$	Operating Junction and Storage Temperatures	-55 to +150	-55 to +150	$^{\circ}C$
$T_L$	Maximum Lead Temperature for Soldering Purposes, 1/8" From Case for 5 s	275	275	$^{\circ}C$

**Maximum On-State Characteristics**

		IRF710-711	IRF712-713	MTP2N35/40	Unit
$R_{DS(on)}$	Static Drain-to-Source On Resistance	3.6	5.0	5.0	$\Omega$
$I_D$	Drain Current				A
	Continuous at $T_C = 25^{\circ}C$	1.5	1.4	1.3	
	Continuous at $T_C = 100^{\circ}C$	1.0	0.9	0.8	
	Pulsed	6.0	5.0	5.0	

**Maximum Thermal Characteristics**

					Unit
$R_{\theta JC}$	Thermal Resistance, Junction to Case	6.4	6.4	2.5	$^{\circ}C/W$
$R_{\theta JA}$	Thermal Resistance, Junction to Ambient	80	80	80	$^{\circ}C/W$
$P_D$	Total Power Dissipation at $T_C = 25^{\circ}C$	20	20	50	W

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

IRF710-713  
MTP2N35/2N40

T-39-09

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

Symbol	Characteristic	Min	Max	Unit	Test Conditions
<b>Off Characteristics</b>					
$V_{(BR)DSS}$	Drain Source Breakdown Voltage <sup>1</sup>			V	$V_{GS} = 0\text{ V}, I_D = 250\ \mu\text{A}$
	IRF710/712/MTP2N40	400			
	IRF711/713/MTP2N35	350			
$I_{DSS}$	Zero Gate Voltage Drain Current		250	$\mu\text{A}$	$V_{DS} = \text{Rated } V_{DSS}, V_{GS} = 0\text{ V}$
			1000	$\mu\text{A}$	$V_{DS} = 0.8 \times \text{Rated } V_{DSS}, V_{GS} = 0\text{ V}, T_C = 125^\circ\text{C}$
$I_{GSS}$	Gate-Body Leakage Current		$\pm 500$	nA	$V_{GS} = \pm 20\text{ V}, V_{DS} = 0\text{ V}$
<b>On Characteristics</b>					
$V_{GS(th)}$	Gate Threshold Voltage			V	$I_D = 250\ \mu\text{A}, V_{DS} = V_{GS}$ $I_D = 1\text{ mA}, V_{DS} = V_{GS}$
	IRF710-713	2.0	4.0		
	MTP2N35/2N40	2.0	4.5		
$R_{DS(on)}$	Static Drain-Source On-Resistance <sup>2</sup>			$\Omega$	$V_{GS} = 10\text{ V}, I_D = 0.8\text{ A}$
	IRF710/711		3.6		
	IRF712/713/MTP2N35/40		5.0		
$V_{DS(on)}$	Drain-Source On-Voltage <sup>2</sup>		13	V	$V_{GS} = 10\text{ V}, I_D = 2.0\text{ A}$
	MTP2N35/2N40		10	V	$V_{GS} = 10\text{ V}, I_D = 1.0\text{ A}, T_C = 100^\circ\text{C}$
$g_{fs}$	Forward Transconductance	0.5		S ( $\Omega$ )	$V_{DS} = 10\text{ V}, I_D = 0.8\text{ A}$
<b>Dynamic Characteristics</b>					
$C_{iss}$	Input Capacitance		200	pF	$V_{DS} = 25\text{ V}, V_{GS} = 0\text{ V}$ $f = 1.0\text{ MHz}$
$C_{oss}$	Output Capacitance		50	pF	
$C_{rss}$	Reverse Transfer Capacitance		15	pF	
<b>Switching Characteristics</b> ( $T_C = 25^\circ\text{C}$ , Figures 11, 12) <sup>3</sup>					
$t_{d(on)}$	Turn-On Delay Time		10	ns	$V_{DD} = 200\text{ V}, I_D = 0.8\text{ A}$ $V_{GS} = 10\text{ V}, R_{GEN} = 50\ \Omega$ $R_{GS} = 50\ \Omega$
$t_r$	Rise Time		20	ns	
$t_{d(off)}$	Turn-Off Delay Time		10	ns	
$t_f$	Fall Time		15	ns	
$Q_g$	Total Gate Charge		7.5	nC	$V_{GS} = 10\text{ V}, I_D = 2.0\text{ A}$ $V_{DD} = 200\text{ V}$

IRF710-713  
MTP2N35/2N40 T-39.09

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

Symbol	Characteristic	Typ	Max	Unit	Test Conditions
$V_{SD}$	Diode Forward Voltage				$I_S = 1.5 \text{ A}; V_{GS} = 0 \text{ V}$
	IRF710/711		1.6	V	
	IRF712/713		1.5	V	
$t_{rr}$	Reverse Recovery Time	380		ns	$I_S = 1.5 \text{ A}; di_S/dt = 25 \text{ A}/\mu\text{S}$

- 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.

Typical Performance Curves

Figure 1 Output Characteristics

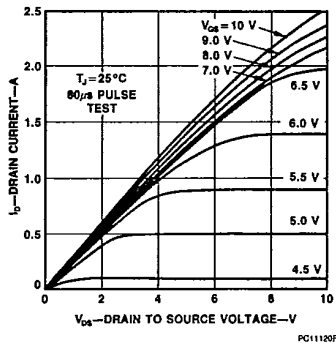


Figure 2 Static Drain to Source Resistance vs Drain Current

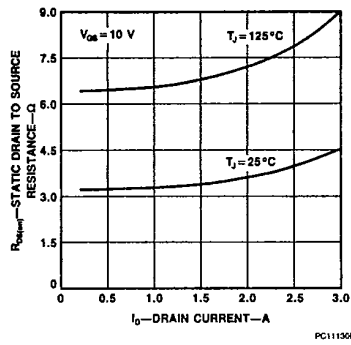


Figure 3 Transfer Characteristics

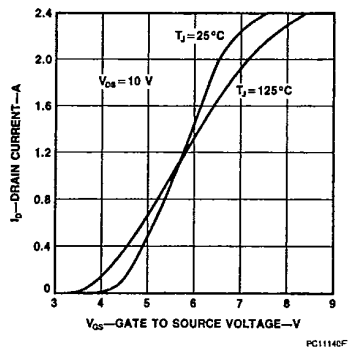
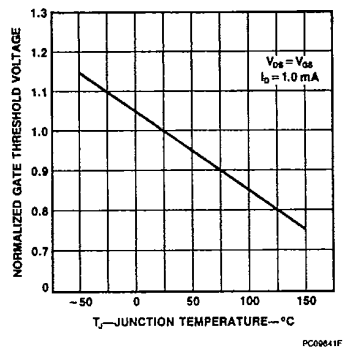


Figure 4 Temperature Variation of Gate to Source Threshold Voltage

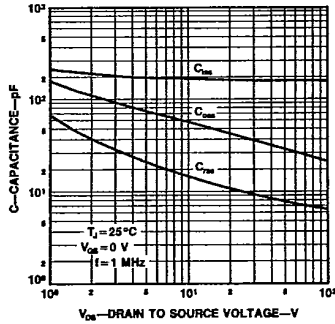


IRF710-713  
MTP2N35/2N40

T-39.09

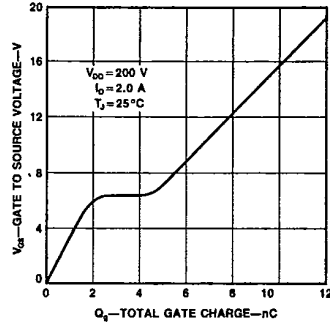
Typical Performance Curves (Cont.)

Figure 5 Capacitance vs Drain to Source Voltage



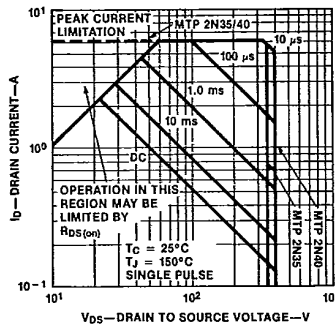
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Figure 6 Gate to Source Voltage vs Total Gate Charge



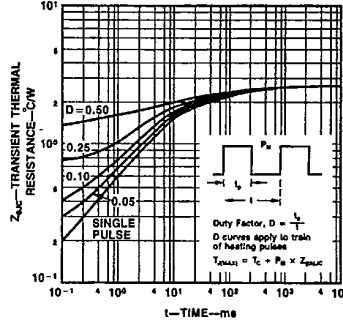
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Figure 7 Forward Biased Safe Operating Area for MTP2N35/2N40



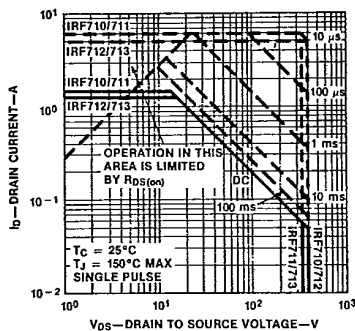
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Figure 8 Transient Thermal Resistance vs Time for MTP2N35/2N40



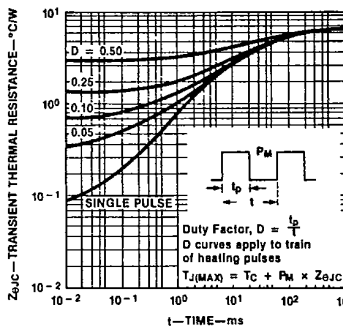
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Figure 9 Forward Biased Safe Operating Area for IRF710-713



PC1209CF

Figure 10 Transient Thermal Resistance for IRF710-713



PC12070F

Typical Electrical Characteristics

Figure 11 Switching Test Circuit

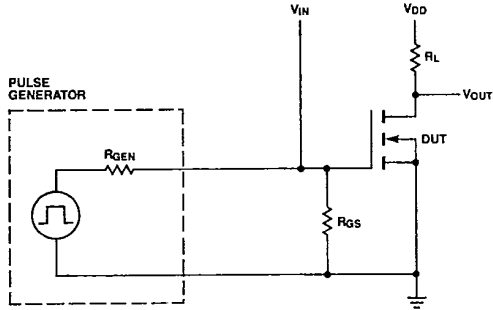
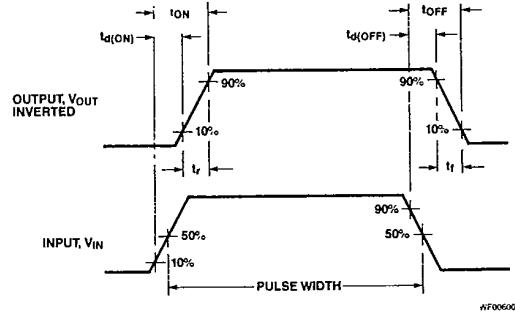


Figure 12 Switching Waveforms



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