FAIRCHILD
A Schlumberger Company

# IRF140-143/IRF540-543 T-39-13
# N-Channel Power MOSFETs, 27 A, 60-100 V

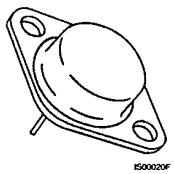
Power And Discrete Division

## Description

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

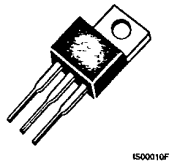
- **Low $R_{DS(on)}$**
- **$V_{GS}$ Rated at ±20 V**
- **Silicon Gate for Fast Switching Speeds**
- **$I_{DSS}$, $V_{DS(on)}$, Specified at Elevated Temperature**
- **Rugged**
- **Low Drive Requirements**
- **Ease of Paralleling**

**TO-204AE**




**IRF140**
**IRF141**
**IRF142**
**IRF143**

**TO-220AB**




**IRF540**
**IRF541**
**IRF542**
**IRF543**

## Product Summary

| Part Number | $V_{DSS}$ | $R_{DS\ (on)}$ | $I_D$ at $T_C$ = 25°C | $I_D$ at $T_C$ = 100°C | Case Style |
|---|---|---|---|---|---|
| IRF140 | 100 V | 0.085 Ω | 27 A | 17 A | TO-204AE |
| IRF141 | 60 V | 0.085 Ω | 27 A | 17 A | |
| IRF142 | 100 V | 0.11 Ω | 24 A | 15 A | |
| IRF143 | 60 V | 0.11 Ω | 24 A | 15 A | |
| IRF540 | 100 V | 0.085 Ω | 27 A | 17 A | TO-220AB |
| IRF541 | 60 V | 0.085 Ω | 27 A | 17 A | |
| IRF542 | 100 V | 0.11 Ω | 24 A | 15 A | |
| IRF543 | 60 V | 0.11 Ω | 24 A | 15 A | |

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

# IRF140-143/IRF540-543

T-39-13

## Maximum Ratings

| Symbol | Characteristic | Rating IRF140/142 IRF540/542 | Rating IRF141/143 IRF541/543 | Unit |
|---|---|---|---|---|
| $V_{DSS}$ | Drain to Source Voltage[1] | 100 | 60 | V |
| $V_{DGR}$ | Drain to Gate Voltage[1] $R_{GS}$ = 20 kΩ | 100 | 60 | V |
| $V_{GS}$ | Gate to Source Voltage | ±20 | ±20 | V |
| $T_J$, $T_{stg}$ | Operating Junction and Storage Temperatures | −55 to +150 | −55 to +150 | °C |
| $T_L$ | Maximum Lead Temperature for Soldering Purposes, 1/8" From Case for 5 s | 275 | 275 | °C |

## Maximum Thermal Characteristics

| | | IRF140-143 | IRF540-543 | |
|---|---|---|---|---|
| $R_{\theta JC}$ | Thermal Resistance, Junction to Case | 1.0 | 1.0 | °C/W |
| $P_D$ | Total Power Dissipation at $T_C$ = 25°C | 125 | 125 | W |
| $I_{DM}$ | Pulsed Drain Current[2] | 108 | 108 | A |

## Electrical Characteristics ($T_C$ = 25°C unless otherwise noted)

| Symbol | Characteristic | Min | Max | Unit | Test Conditions |
|---|---|---|---|---|---|
| **Off Characteristics** | | | | | |
| $V_{(BR)DSS}$ | Drain Source Breakdown Voltage[1] | | | V | $V_{GS}$ = 0 V, $I_D$ = 250 μA |
| | IRF140/142/540/542 | 100 | | | |
| | IRF141/143/541/543 | 60 | | | |
| $I_{DSS}$ | Zero Gate Voltage Drain Current | | 250 | μA | $V_{DS}$ = Rated $V_{DSS}$, $V_{GS}$ = 0 V |
| | | | 1000 | μA | $V_{DS}$ = 0.8 x Rated $V_{DSS}$, $V_{GS}$ = 0 V, $T_C$ = 125°C |
| $I_{GSS}$ | Gate-Body Leakage Current IRF140-143 | | ±100 | nA | $V_{GS}$ = ±20 V, $V_{DS}$ = 0 V |
| | IRF540-543 | | ±500 | | |
| **On Characteristics** | | | | | |
| $V_{GS(th)}$ | Gate Threshold Voltage | 2.0 | 4.0 | V | $I_D$ = 250 μA, $V_{DS}$ = $V_{GS}$ |
| $R_{DS(on)}$ | Static Drain-Source On-Resistance[2] | | | Ω | $V_{GS}$ = 10 V, $I_D$ = 15 A |
| | IRF140/141/540/541 | | 0.085 | | |
| | IRF142/143/542/543 | | 0.11 | | |
| $g_{fs}$ | Forward Transconductance | 6.0 | | S (℧) | $V_{DS}$ = 10 V, $I_D$ = 15 A |

**Electrical Characteristics** (Cont.) ($T_C$ = 25°C unless otherwise noted)

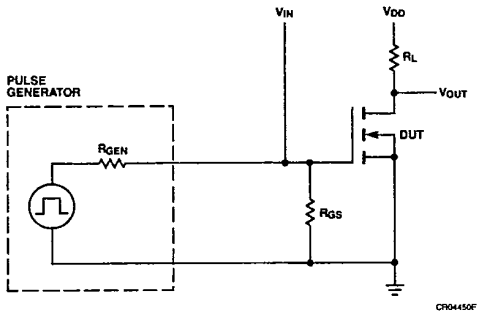
| Symbol | Characteristic | Min | Max | Unit | Test Conditions |
|---|---|---|---|---|---|
| **Dynamic Characteristics** | | | | | |
| $C_{iss}$ | Input Capacitance | | 1600 | pF | $V_{DS}$ = 25 V, $V_{GS}$ = 0 V |
| $C_{oss}$ | Output Capacitance | | 800 | pF | f = 1.0 MHz |
| $C_{rss}$ | Reverse Transfer Capacitance | | 300 | pF | |
| **Switching Characteristics** ($T_C$ = 25°C, *Figures 1, 2,*)[3] | | | | | |
| $t_{d(on)}$ | Turn-On Delay Time | | 30 | ns | $V_{DD}$ = 45 V, $I_D$ = 15 A |
| $t_r$ | Rise Time | | 60 | ns | $V_{GS}$ = 10 V, $R_{GEN}$ = 4.7 Ω |
| $t_{d(off)}$ | Turn-Off Delay Time | | 80 | ns | $R_{GS}$ = 4.7 Ω |
| $t_f$ | Fall Time | | 30 | ns | |
| $t_{d(on)}$ | Turn-On Delay Time | | 60 | ns | $V_{DD}$ = 25 V, $I_D$ = 15 A |
| $t_r$ | Rise Time | | 450 | ns | $V_{GS}$ = 10 V, $R_{GEN}$ = 50 Ω |
| $t_{d(off)}$ | Turn-Off Delay Time | | 150 | ns | $R_{GS}$ = 50 Ω |
| $t_f$ | Fall Time | | 200 | ns | |
| $Q_g$ | Total Gate Charge | | 60 | nC | $V_{GS}$ = 10 V, $I_D$ = 34 A<br>$V_{DD}$ = 35 V |

| Symbol | Characteristic | Typ | Max | Unit | Test Conditions |
|---|---|---|---|---|---|
| **Source-Drain Diode Characteristics** | | | | | |
| $V_{SD}$ | Diode Forward Voltage | | | | |
| | IRF140/141/540/541 | 2.0 | 2.5 | V | $I_S$ = 27 A; $V_{GS}$ = 0 V |
| | IRF142/143/542/543 | 2.0 | 2.3 | V | $I_S$ = 24 A; $V_{GS}$ = 0 V |
| $t_{rr}$ | Reverse Recovery Time | 300 | | ns | $I_S$ = 4.0 A; $dI_S/dt$ = 25 A/μS |

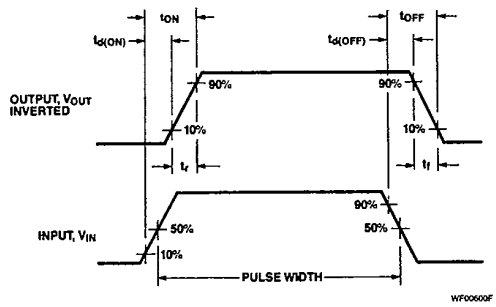
**Notes**
1. $T_J$ = +25°C to +150°C
2. Pulse width limited by $T_J$
3. Switching time measurements performed on LEM TR-58 test equipment.

## Typical Electrical Characteristics

### Figure 1 Switching Test Circuit

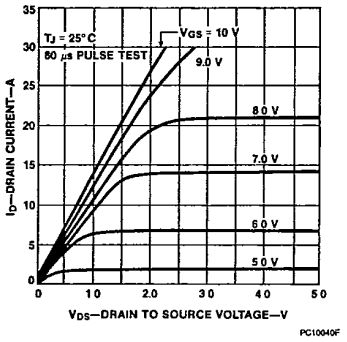



### Figure 2 Switching Waveforms

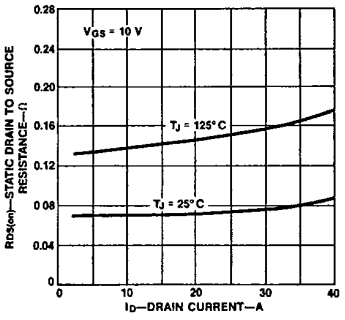



## Typical Performance Curves

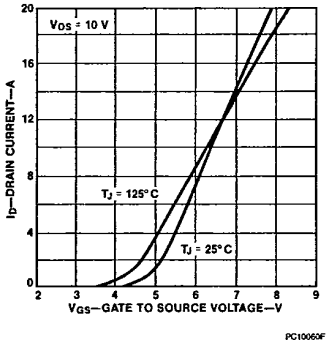
### Figure 3 Output Characteristics



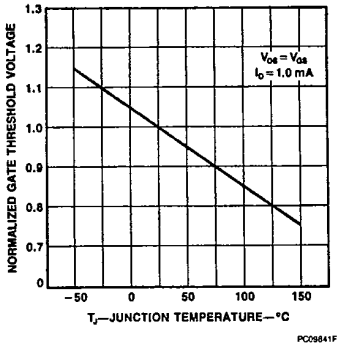

### Figure 4 Static Drain to Source Resistance vs Drain Current




### Figure 5 Transfer Characteristics




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



## Typical Performance Curves (Cont.)

**Figure 7 Capacitance vs Drain to Source Voltage**

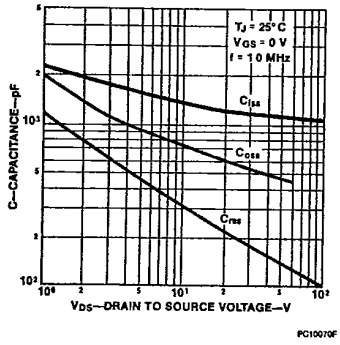



**Figure 8 Gate to Source Voltage vs Total Gate Charge**

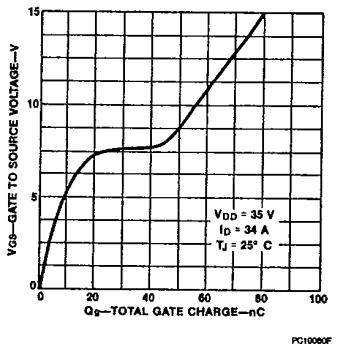



**Figure 9 Forward Biased Safe Operating Area**

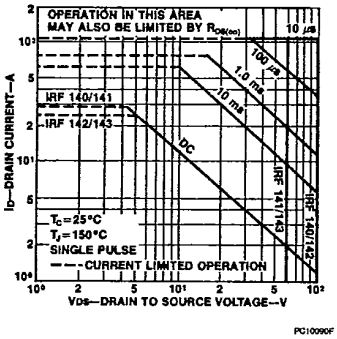



**Figure 10 Transient Thermal Resistance vs Time**