

RFM4N35/4N40 RFP4N35/4N40

N-Channel Enhancement Mode Power Field Effect Transistors

August 1991

Features

- 4A, 350V and 400V
- $r_{DS(on)} = 2\Omega$
- SOA is Power-Dissipation Limited
- Nanosecond Switching Speeds
- Linear Transfer Characteristics
- High Input Impedance
- Majority Carrier Device

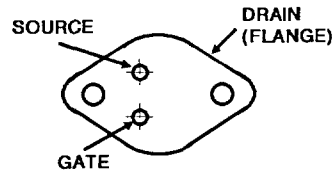
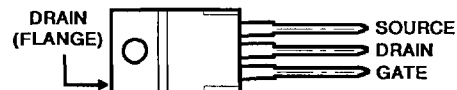
Description

The RFM4N35 and RFM4N40 and the RFP4N35 and RFP4N40 are n-channel enhancement-mode silicon-gate power field-effect transistors designed for applications such as switching regulators, switching converters, motor drivers, relay drivers, and drivers for high-power bipolar switching transistors requiring high speed and low gate-drive power. These types can be operated directly from integrated circuits.

The RFM-series types are supplied in the JEDEC TO-204AA steel package and the RFP-series types in the JEDEC TO-220AB plastic package.

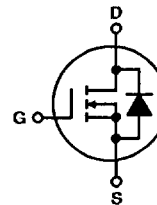
Packages

TO-204AA


 TO-220AB
TOP VIEW


Terminal Diagram

N-CHANNEL ENHANCEMENT MODE


4
**N-CHANNEL
POWER MOSFETS**

Absolute Maximum Ratings ($T_C = 25^\circ\text{C}$), Unless Otherwise Specified

| | RFM4N35 | RFM4N40 | RFP4N35 | RFP4N40 | UNITS | |
|---|----------------|-------------|-------------|-------------|-------------|---------------------|
| Drain-Source Voltage | V_{DSS} | 350 | 400 | 350 | 400 | V |
| Drain-Gate Voltage ($R_{GS} = 1\text{m}\Omega$) | V_{DGR} | 350 | 400 | 350 | 400 | V |
| Continuous Drain Current | | | | | | |
| RMS Continuous | I_D | 4 | 4 | 4 | 4 | A |
| Pulsed Drain Current | I_{DM} | 8 | 8 | 8 | 8 | A |
| Gate-Source Voltage | V_{GS} | ± 20 | ± 20 | ± 20 | ± 20 | V |
| Maximum Power Dissipation | | | | | | |
| $T_C = +25^\circ\text{C}$ | P_D | 75 | 75 | 60 | 60 | W |
| Above $T_C = +25^\circ\text{C}$, Derate Linearly | | 0.6 | 0.6 | 0.48 | 0.48 | W/ $^\circ\text{C}$ |
| Operating and Storage Junction | T_J, T_{STG} | -55 to +150 | -55 to +150 | -55 to +150 | -55 to +150 | $^\circ\text{C}$ |
| Temperature Range | | | | | | |

Specifications RFM4N35, RFM4N40, RFP4N35, RFP4N40

ELECTRICAL CHARACTERISTICS, At Case Temperature (T_C): 25°C unless otherwise specified.

| CHARACTERISTICS | SYMBOL | TEST CONDITIONS | LIMITS | | | | UNITS |
|--|----------------|---|--------------------|-------|--------------------|-------|--------------------|
| | | | RFM4N35 RFP4N35 | | RFM4N40 RFP4N40 | | |
| | | | MIN. | MAX. | MIN. | MAX. | |
| Drain-Source Breakdown Voltage | BV_{DSS} | $I_D=1\text{ mA}$ $V_{GS}=0$ | 350 | — | 400 | — | V |
| Gate Threshold Voltage | $V_{GS(th)}$ | $V_{GS}=V_{DS}$ $I_D=1\text{ mA}$ | 2 | 4 | 2 | 4 | V |
| Zero Gate Voltage Drain Current | I_{DSS} | $V_{DS}=280\text{ V}$ $V_{GS}=320\text{ V}$ | — | 10 | — | — | μA |
| | | $T_C=125^\circ\text{C}$ $V_{DS}=280\text{ V}$ $V_{GS}=320\text{ V}$ | — | 100 | — | 100 | |
| Gate-Source Leakage Current | I_{GSS} | $V_{GS}=\pm 20\text{ V}$ $V_{DS}=0$ | — | 100 | — | 100 | nA |
| Drain-Source On Voltage | $V_{DS(on)}^a$ | $I_D=2\text{ A}$ $V_{GS}=10\text{ V}$ | — | 4 | — | 4 | V |
| | | $I_D=4\text{ A}$ $V_{GS}=10\text{ V}$ | — | 12 | — | 12 | |
| Static Drain-Source On Resistance | $r_{DS(on)}^a$ | $I_D=2\text{ A}$ $V_{GS}=10\text{ V}$ | — | 2 | — | 2 | Ω |
| Forward Transconductance | g_{fs}^a | $V_{DS}=10\text{ V}$ $I_D=2\text{ A}$ | 1 | — | 1 | — | mho |
| Input Capacitance | C_{iss} | $V_{DS}=25\text{ V}$ | — | 750 | — | 750 | pF |
| Output Capacitance | C_{oss} | $V_{GS}=0\text{ V}$ | — | 150 | — | 150 | |
| Reverse Transfer Capacitance | C_{rss} | $f=1\text{ MHz}$ | — | 100 | — | 100 | |
| Turn-On Delay Time | $t_d(on)$ | $V_{DD}=200\text{ V}$ $I_D=2\text{ A}$ $R_{gen}=R_{gs}=50\ \Omega$ | 12(typ) | 45 | 12(typ) | 45 | ns |
| Rise Time | t_r | | 42(typ) | 60 | 42(typ) | 60 | |
| Turn-Off Delay Time | $t_d(off)$ | | 130(typ) | 200 | 130(typ) | 200 | |
| Fall Time | t_f | | 62(typ) | 100 | 62(typ) | 100 | |
| Thermal Resistance Junction-to-Case | $R\theta_{JC}$ | RFM4N35, RFM4N40 | — | 1.67 | — | 1.67 | $^\circ\text{C/W}$ |
| | | RFP4N35, RFP4N40 | — | 2.083 | — | 2.083 | |

SOURCE-DRAIN DIODE RATINGS AND CHARACTERISTICS

| CHARACTERISTIC | SYMBOL | TEST CONDITIONS | LIMITS | | | | UNITS |
|-----------------------|------------|--|--------------------|------|--------------------|------|-------|
| | | | RFM4N35 RFP4N35 | | RFM4N40 RFP4N40 | | |
| | | | MIN. | MAX. | MIN. | MAX. | |
| Diode Forward Voltage | V_{SD}^a | $I_{SD}=2\text{ A}$ | — | 1.4 | — | 1.4 | V |
| Reverse Recovery Time | t_{rr} | $I_F=4\text{ A}$ $dI_F/dt=100\text{ A}/\mu\text{s}$ | 800(typ) | | 800(typ) | | ns |

^aPulsed: Pulse duration = 300 μs max., duty cycle = 2%.

RFM4N35, RFM4N40, RFP4N35, RFP4N40

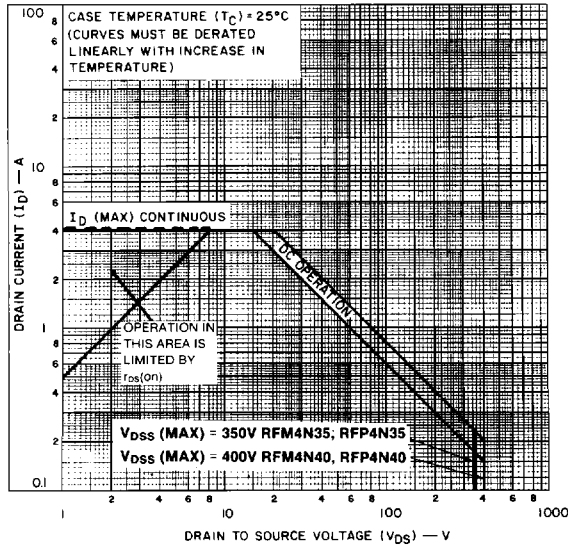


Fig. 1 — Maximum operating areas for all types.

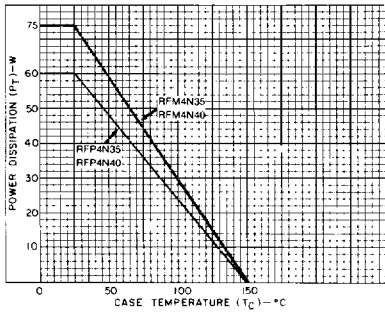


Fig. 2 — Power dissipation vs. temperature derating curve for all types.

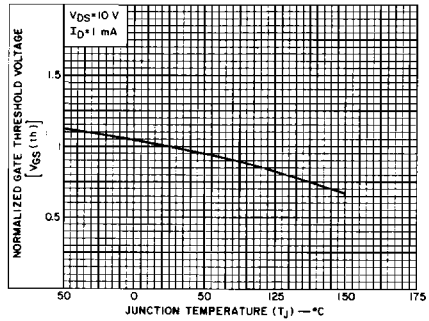


Fig. 3 — Typical normalized gate threshold voltage as a function of junction temperature for all types.

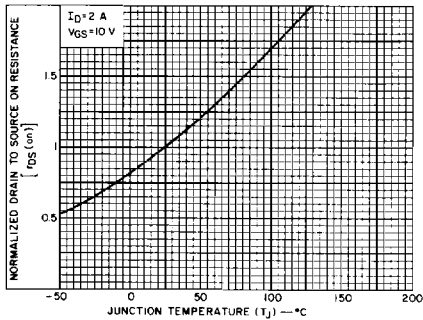


Fig. 4 — Normalized drain-to-source resistance to junction temperature for all types.

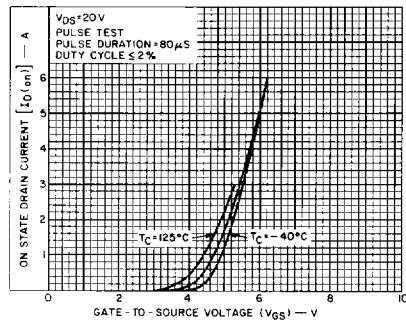


Fig. 5 — Typical transfer characteristics for all types.

RFM4N35, RFM4N40, RFP4N35, RFP4N40

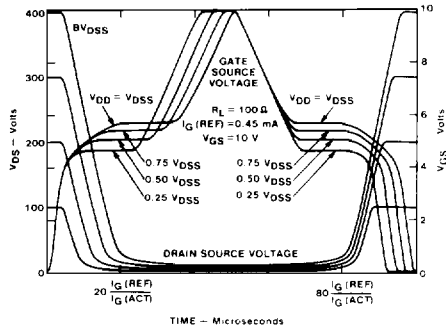


Fig. 6 - Normalized switching waveforms for constant gate-current. Refer to Harris application notes AN-7254 and AN-7260

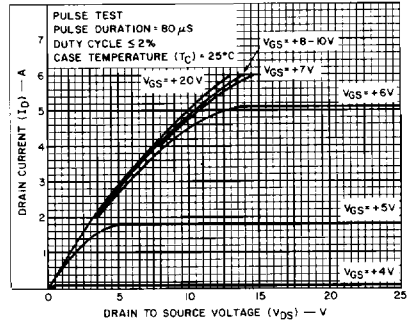


Fig. 7 - Typical saturation characteristics for all types.

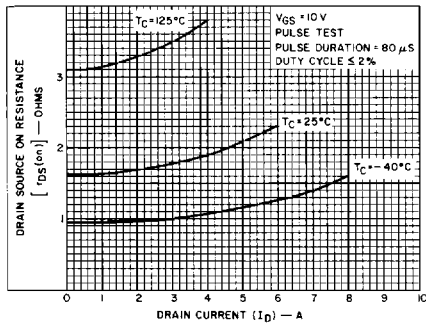


Fig. 8 - Typical drain-to-source on resistance as a function of drain current for all types.

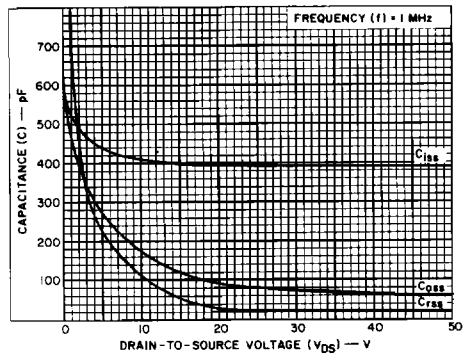


Fig. 9 - Capacitance as a function of drain-to-source voltage for all types.

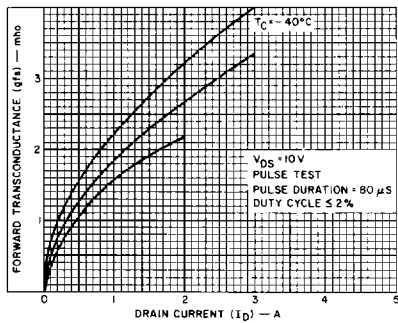


Fig. 10 - Typical forward transconductance as a function of drain current for all types.

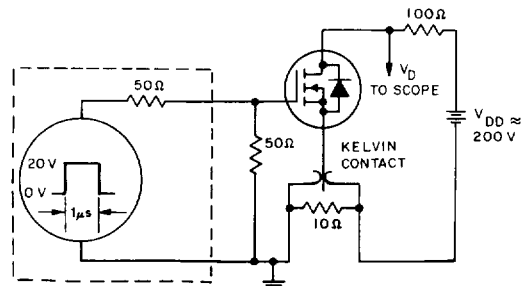


Fig. 11 - Switching Time Test Circuit