HARRIS

RFM15N05/15N06
RFP15N05/15N06

N-Channel Enhancement Mode Power Field Effect Transistors

May 1992

Features

- 15A, 50V and 60V
- $r_{DS(on)} = 0.14\Omega$
- SOA is Power-Dissipation Limited
- Nanosecond Switching Speeds
- Linear Transfer Characteristics
- High Input Impedance
- Majority Carrier Device
- Temperature Compensated SPICE Model Provided

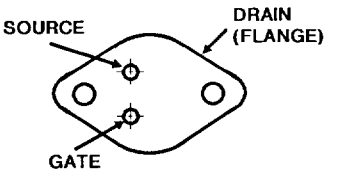
Description

The RFM15N05 and RFM15N06 and the RFP15N05 and RFP15N06 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.

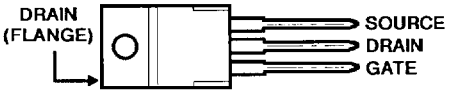
The RFM series types are supplied in the JEDEC TO-204AA steel package and the RFP series types in the TO-220AB plastic package.

Packages

TO-204AA
BOTTOM VIEW

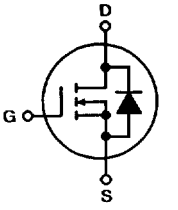


TO-220AB
TOP VIEW



Terminal Diagram

N-CHANNEL ENHANCEMENT MODE



Absolute Maximum Ratings ($T_C = 25^oC$), Unless Otherwise Specified

	RFM15N05	RFM15N06	RFP15N05	RFP15N06	UNITS
Drain-Source Voltage ..... V_{DSS}	50	60	50	60	V
Drain-Gate Voltage ($R_{GS} = 1m\Omega$) ..... V_{DGR}	50	60	50	60	V
Continuous Drain Current					
RMS Continuous ..... I_D	15	15	15	15	A
Pulsed Drain Current ..... I_{DM}	40	40	40	40	A
Gate-Source Voltage ..... V_{GS}	±20	±20	±20	±20	V
Maximum Power Dissipation					
$T_C = +25^oC$ ..... P_D	90	90	90	90	W
Above $T_C = +25^oC$, Derate Linearly	0.48	0.48	0.48	0.48	$W/^oC$
Operating and Storage Junction Temperature Range ..... T_J, T_{STG}	-55 to +150	-55 to +150	-55 to +150	-55 to +150	^oC

CAUTION: These devices are sensitive to electrostatic discharge. Proper I.C. handling procedures should be followed.

File Number **1478.1**

ELECTRICAL CHARACTERISTICS, *At Case Temperature (T_c)=25°C unless otherwise specified*

CHARACTERISTIC	SYMBOL	TEST CONDITIONS	LIMITS				UNITS
			RFM15N05 RFP15N05		RFM15N06 RFP15N06		
			Min.	Max.	Min.	Max.	
Drain-Source Breakdown Voltage	BV_{DSS}	I_D=1 mA V_{GS}=0	50	—	60	—	V
Gate-Threshold Voltage	$V_{GS}(th)$	V_{GS}=V_{DS} I_D=1 mA	2	4	2	4	V
Zero-Gate Voltage Drain Current	I_{DSS}	V_{DS}=40 V	—	1	—	—	μA
		V_{DS}=50 V	—	—	—	1	
		T_C=125°C V_{DS}=40 V	—	50	—	—	
		V_{DS}=50 V	—	—	—	50	
Gate-Source Leakage Current	I_{GSS}	V_{GS}=±20 V V_{DS}=0	—	100	—	100	nA
Drain-Source On Voltage	$V_{DS}(on)$[a]	I_D=7.5 A V_{GS}=10 V	—	1.05	—	1.05	V
		I_D=15 A V_{GS}=10 V	—	2.5	—	2.5	
Static Drain-Source On Resistance	$r_{DS}(on)$[a]	I_D=7.5 A V_{GS}=10 V	—	0.14	—	0.14	Ω
Forward Transconductance	g_{fs}[a]	V_{DS}=10 V I_D=7.5 A	2	—	2	—	mho
Input Capacitance	C_{iss}	V_{DS}=25 V	—	850	—	850	pF
Output Capacitance	C_{oss}	V_{GS}=0 V	—	450	—	450	
Reverse-Transfer Capacitance	C_{rss}	f = 1MHz	—	180	—	180	
Turn-On Delay Time	$t_d(on)$	V_{DD}=30 V	16(typ)	40	16(typ)	40	ns
Rise Time	t_r	I_D=7.5 A	100(typ)	175	100(typ)	175	
Turn-Off Delay Time	$t_d(off)$	R_{gen}=R_{gs}=50 Ω	72(typ)	175	72(typ)	175	
Fall Time	t_f	V_{GS}=10 V	66(typ)	140	66(typ)	140	
Thermal Resistance Junction-to-Case	$R_{\theta JC}$	RFM15N05, RFM15N06	—	1.67	—	1.67	°C/W
		RFP15N05, RFP15N06	—	1.67	—	1.67	

[a]Pulsed: Pulse duration=300 μs max., duty cycle 2%

SOURCE-DRAIN DIODE RATINGS AND CHARACTERISTICS

CHARACTERISTIC	SYMBOL	TEST CONDITIONS	LIMITS				UNITS
			RFM15N05 RFP15N05		RFM15N06 RFP15N06		
			MIN.	MAX.	MIN.	MAX.	
Diode Forward Voltage	V_{SD}	I_{SD} = 15A	—	1.4	—	1.4	V
Reverse Recovery Time	t_{rr}	I_F=4 A d_{IF}/d_t=100 A/μs	100 (typ)		100(typ)		ns

*Pulse Test: Width ≤ 300 μs, duty cycle ≤ 2%.

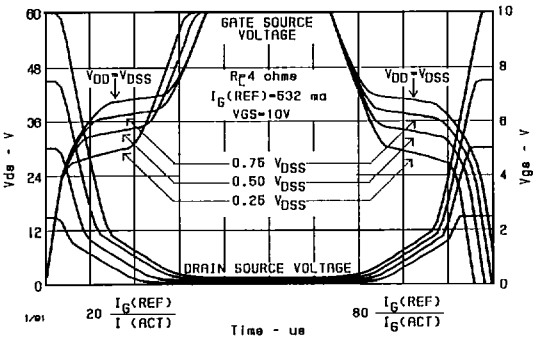


FIGURE 1. NORMALIZED SWITCHING WAVEFORMS

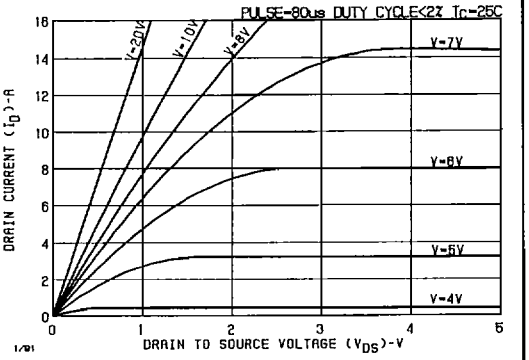


FIGURE 2. TYPICAL SATURATION CHARACTERISTICS

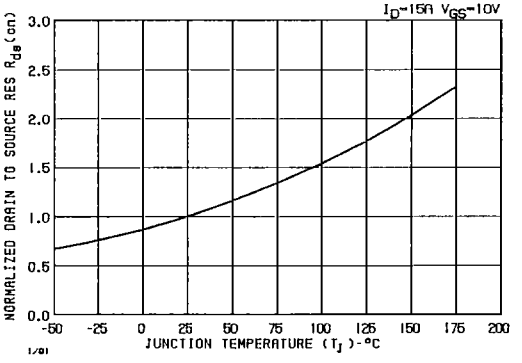


FIGURE 3. NORMALIZED $r_{DS(ON)}$ vs TEMPERATURE

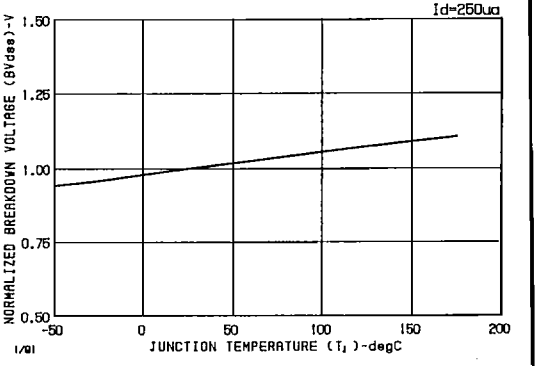


FIGURE 4. BREAKDOWN VOLTAGE vs TEMPERATURE

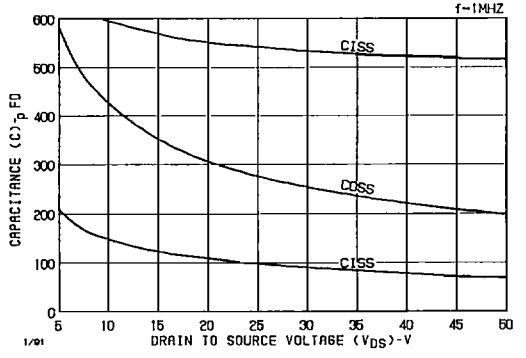


FIGURE 5. CAPACITANCE vs DRAIN TO SOURCE VOLTAGE

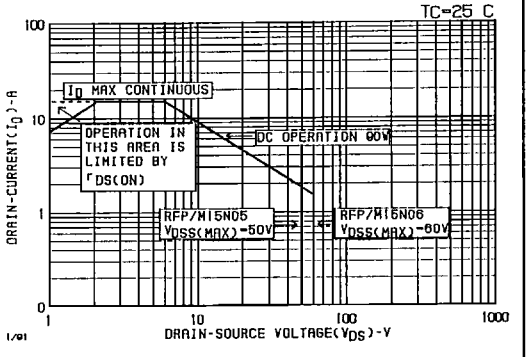


FIGURE 6. MAXIMUM SAFE OPERATING AREA

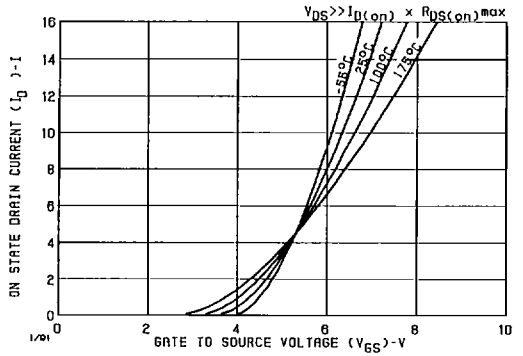


FIGURE 7. TYPICAL TRANSFER CHARACTERISTICS

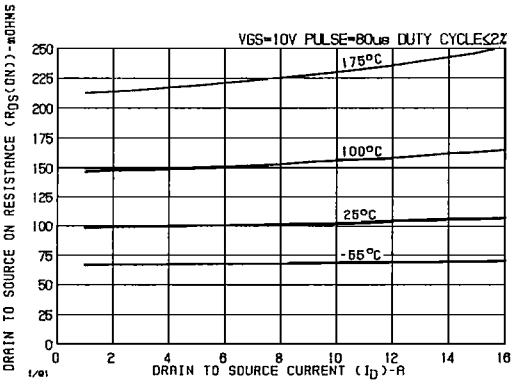


FIGURE 8. $r_{DS(ON)}$ vs DRAIN CURRENT

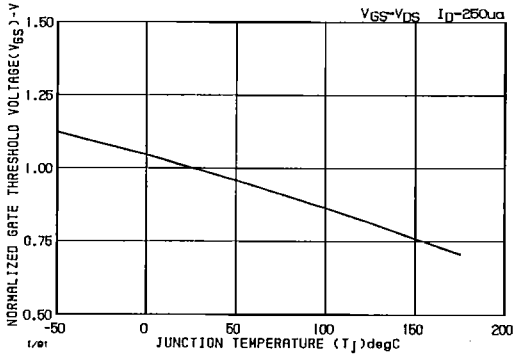


FIGURE 9. THRESHOLD VOLTAGE vs TEMPERATURE (T_J)

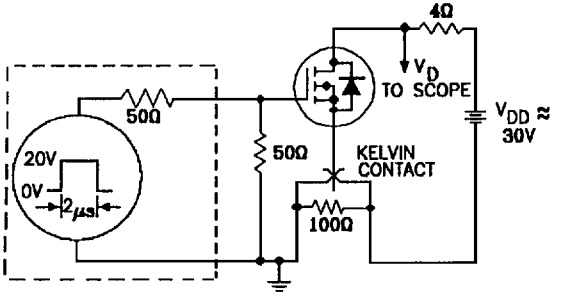
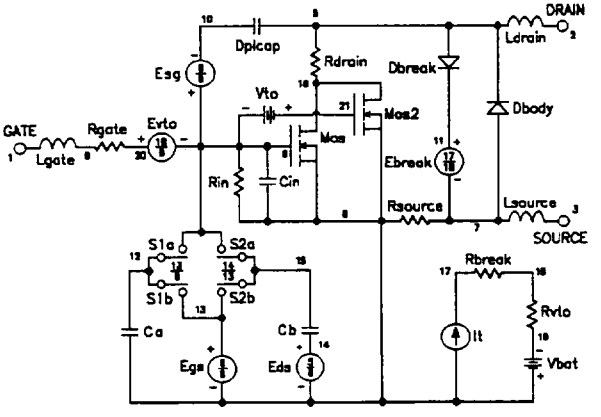


FIGURE 10. SWITCHING TIME TEST CIRCUIT

Spice Model (RFM15N06)

```
.SUBCKT RFM15N06  2  1  3;  rev 01/07/91
*Nominal Temperature = 25°C
.MODEL MOSMOD NMOS (VTO=3.46  KP=3.09  IS=1e-30  N=10  TOS=1  L=1u  W=1u)
Vto  21  6  .74
Rsource  8  7  RDSMOD  34.82e-3
Rdrain  5  16  RDSMOD  13.3e-3
.MODEL RDSMOD RES (TCI=6.5e-3  TC2=3.28e-5)
.MODEL RVTOMOD RES (TCI=-4.30e-3  TC2=-3.77e-6)
.MODEL RVTOMOD2 RES (TCI=0  TC2=0)
Ebreak  11  7  17  18  102.35
.MODEL RBKMOD RES (TCI=8.33e-1  TRS1=7.81e-4  TRS2=-9.28e-6)
.MODEL DBKMOD D (RS=3.83e-1  TRS1=7.81e-4  TRS2=-9.28e-6)
.MODEL DBDMOD D (IS=8.16e-13  RS=1.54e-2  TRS1=1.77e-3  TRS2=1.85e-5)
+CJO=9.16e-10  TT=7e-8
Cin  6  8  4.44e-10
Ca  12  8  9.14e-10
.MODEL S1AMOD VSWITCH (RON=1e-5  ROFF=0.1  VON=-3.66  VOFF=-1.66)
.MODEL S1BMOD VSWITCH (RON=1e-5  ROFF=0.1  VON=-1.66  VOFF=-3.66)
.MODEL DPLCAPMOD D (CJO=4.90e-10  IS=1e-30  N=10)
Cb  12  14  5.81e-10
.MODEL S2AMOD VSWITCH (RON=1e-5  ROFF=0.1  VON=3.07  VOFF=8.07)
.MODEL S2BMOD VSWITCH (RON=1e-5  ROFF=0.1  VON8.07  VOFF=3.07)
Rgate  9  20  20.43
Lgate  1  9  1.32e-8
Ldrain  2  5  1.0e-10
Lsource  3  7  1.68e-8
Dbody  7  5  DBDMOD
Dbreak  5  11  DBKMOD
Dplcap  10  5  DPLCAPMOD
Eds  14  8  5  8  1
Egs  13  8  6  8  1
Esg  6  10  6  8  1
Evto  20  6  18  8  1
It  8  17  1
Mos  16  6  8  8  MOSMOD  M=0.99
MOS2  16  21  8  8  MOSMOD  M=0.01
Rbreak  17  18  RBKMOD  1
Rin  6  8  1e9
Rvto  18  19  RVTOMOD  1
S1a  6  12  13  8  S1AMOD
S1b  13  12  13  8  S1BMOD
S2a  6  15  14  13  S2AMOD
S2b  13  15  14  13  S2BMOD
Vbat  8  19  DC  1
.ENDS
```



Spice Model (RFM15N06)

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*Nominal Temperature = 25°C
.MODEL MOSMOD NMOS (VTO=3.46  KP=3.09  IS=1e-30  N=10  TOS=1  L=1u  W=1u)
Vto  21  6  .74
Rsource  8  7  RDSMOD  34.82e-3
Rdrain  5  16  RDSMOD  13.3e-3
.MODEL RDSMOD RES (TCI=6.5e-3  TC2=3.28e-5)
.MODEL RVTOMOD RES (TCI=-4.30e-3  TC2=-3.77e-6)
.MODEL RVTOMOD2 RES (TCI=0  TC2=0)
Ebreak  11  7  17  18  102.35
.MODEL RBKMOD RES (TCI=8.33e-1  TRS1=7.81e-4  TRS2=-9.28e-6)
.MODEL DBKMOD D (RS=3.83e-1  TRS1=7.81e-4  TRS2=-9.28e-6)
.MODEL DBDMOD D (IS=8.16e-13  RS=1.54e-2  TRS1=1.77e-3  TRS2=1.85e-5 +CJO=9.16e-10  TT=7e-8)
Cin  6  8  4.44e-10
Ca  12  8  9.14e-10
.MODEL S1AMOD VSWITCH (RON=1e-5  ROFF=0.1  VON=-3.66  VOFF=-1.66)
.MODEL S1BMOD VSWITCH (RON=1e-5  ROFF=0.1  VON=-1.66  VOFF=-3.66)
.MODEL DPLCAPMOD D (CJO=4.90e-10  IS=1e-30  N=10)
Cb  12  14  5.81e-10
.MODEL S2AMOD VSWITCH (RON=1e-5  ROFF=0.1  VON=3.07  VOFF=8.07)
.MODEL S2BMOD VSWITCH (RON=1e-5  ROFF=0.1  VON=8.07  VOFF=3.07)
Rgate  9  20  20.43
Lgate  1  9  1.32e-8
Ldrain  2  5  1.0e-10
Lsource  3  7  1.68e-8
Dbody  7  5  DBDMOD
Dbreak  5  11  DBKMOD
Dplcap  10  5  DPLCAPMOD
Eds  14  8  5  8  1
Egs  13  8  6  8  1
Esg  6  10  6  8  1
Evto  20  6  18  8  1
It  8  17  1
Mos  16  6  8  8  MOSMOD  M=0.99
MOS2  16  21  8  8  MOSMOD  M=0.01
Rbreak  17  18  RBKMOD  1
Rin  6  8  1e9
Rvto  18  19  RVTOMOD  1
S1a  6  12  13  8  S1AMOD
S1b  13  12  13  8  S1BMOD
S2a  6  15  14  13  S2AMOD
S2b  13  15  14  13  S2BMOD
Vbat  8  19  DC  1
.ENDS
```