

# RFD16N05L RFD16N05LSM

## N-Channel Logic Level Enhancement-Mode Power Field-Effect Transistors (MegaFETs)

June 1992

### Features

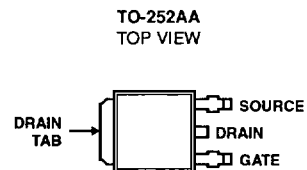
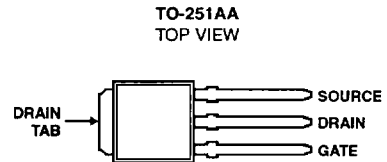
- 16A, 50V
- $r_{DS(ON)} = 0.047\Omega$
- UIS SOA Rating Curves (Single Pulse)
- Design Optimized for 5V Gate Drives
- Can be Driven Directly from QMOS, NMOS, TTL Circuits
- Compatible with Automotive Drive Requirements
- SOA is Power-Dissipation Limited
- Nanosecond Switching Speeds
- Linear Transfer Characteristics
- High Input Impedance
- Majority Carrier Device
- Operating Temperature +150°C

### Description

The RFD16N05L and RFD16N05LSM N-channel logic level power MOSFETs are manufactured using the MegaFET process. This process, which uses feature sizes approaching those of LSI integrated circuits gives optimum utilization of silicon, resulting in outstanding performance. The RFD16N05L and RFD16N05LSM were designed for use with logic level (5V) driving sources in applications such as programmable controllers, automotive switching, switching regulators, switching converters, motor relay drivers and emitter switches for bipolar transistors. This performance is accomplished through a special gate oxide design which provides full rated conductance at gate biases in the 3V - 5V range, thereby facilitating true on-off power control directly from logic circuit supply voltages.

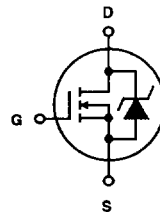
The RFD16N05L is supplied in the JEDEC TO-251 plastic package and the RFD16N05LSM in the JEDEC TO-252 plastic package.

### Package



### Terminal Diagram

#### N-CHANNEL ENHANCEMENT MODE



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

		UNITS
Drain-Source Voltage	$V_{DS}$	50 V
Drain-Gate Voltage ( $R_{GS} = 1M\Omega$ )	$V_{DGR}$	50 V
Continuous Drain Current		
RMS Continuous	$I_D$	16 A
Pulsed Drain Current	$I_{DM}$	45 A
Single Pulse Avalanche Rating		Refer to UIS SOA Curve
Gate-Source Voltage	$V_{GS}$	$\pm 10$ V
Maximum Power Dissipation		
$T_C = +25^\circ\text{C}$	$P_D$	60 W
Above $T_C = +25^\circ\text{C}$ , Derate Linearly		0.48 W/°C
Operating and Storage Junction Temperature Range	$T_J, T_{STG}$	-55 to +150 °C

# Specifications RFD16N05L, RFD16N05LSM

**Electrical Characteristics** At Case Temperature ( $T_c$ ) = +25°C, Unless Otherwise Specified

CHARACTERISTICS	SYMBOL	TEST CONDITIONS	LIMITS		UNITS	
			MIN	MAX		
Drain-Source Breakdown Voltage	$BV_{DSS}$	$I_D = 2.05mA, V_{GS} = 0V$	50	-	V	
Gate Threshold Voltage	$V_{GS(th)}$	$V_{GS} = V_{DS}, I_D = 2.05mA$	1	2	V	
Zero Gate Voltage Drain Current	$I_{DSS}$	$V_{DS} = 40V, V_{GS} = 0V$ $T_C = 150^\circ C$	-	1 50	$\mu A$	
Gate-Source Leakage Current	$I_{GSS}$	$V_{GS} = \pm 10V, V_{DS} = 0V$	-	100	nA	
Static Drain-Source On Resistance	$r_{DS(on)}$	$I_D = 16A, V_{GS} = 5V$ $I_D = 16A, V_{GS} = 4V$	-	0.047 0.056	W	
Turn-On Time	$t_{(on)}$	$V_{DD} = 25V, I_D = 8A, I_{G1} = I_{G2} = 0.4A, V_{GS}(clamp) + 5V, -0.6V, R_L = 3.125\Omega$	-	60	ns	
Turn-On Delay Time	$t_{d(on)}$		-	14(typ)	ns	
Rise Time	$t_r$		-	30 (typ)	ns	
Turn-Off Delay Time	$t_{d(off)}$		-	42 (typ)	ns	
Fall Time	$t_f$		-	14 (typ)	ns	
Turn-Off Time	$t_{(off)}$		-	100	ns	
Total Gate Charge	$Q_g(total)$	$V_{GS} = 0-10V$	$V_{DD} = 40V$ $I_D = 16A$ $R_L = 2.5\Omega$	-	80	nC
Gate Charge at 5V	$Q_g(5)$	$V_{GS} = 0-5V$		-	45	nC
Threshold Gate Charge	$Q_g(th)$	$V_{GS} = 0-1V$		-	3	nC
Plateau Voltage	$V(plateau)$	$I_D = 16A, V_{DS} = 15V$	-	4	V	
Turn-Off Energy Loss per Cycle	$E_{off}$	$V_{DD} = 25V, I_D = 8A, R_L = 3.125\Omega, L = 0.2\mu H, I_{G1} = I_{G2} = 0.8A, V_{GS}(clamp) + 5V, -0.6V$	-	19	$\mu J$	
Thermal Resistance, Junction-to-Case	$R_{\theta JC}$		-	2.083	$^\circ C/W$	
Thermal Resistance, Junction-to-Ambient	$R_{\theta JA}$		-	100	$^\circ C/W$	

## Source-Drain Diode Ratings and Characteristics

CHARACTERISTICS	SYMBOL	TEST CONDITIONS	LIMITS		UNITS
			MIN	MAX	
Diode Forward Voltage	$V_{SD}$	$I_{SD} = 16A$	-	1.5	V
Reverse Recovery Time	$t_{rr}$	$I_F = 16A, di/dt = 100A/\mu s$	-	125	ns

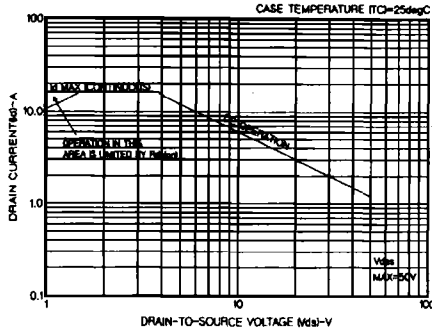


FIGURE 1. SAFE OPERATING AREA CURVE. (CURVES MUST BE DERATED LINEARLY WITH INCREASE IN TEMP.)

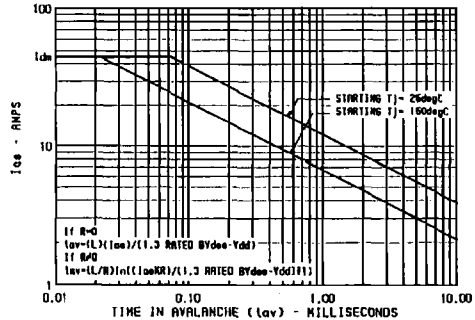


FIGURE 2. UNCLAMPED INDUCTIVE SWITCHING SOA. (SINGLE PULSE UIS SOA)

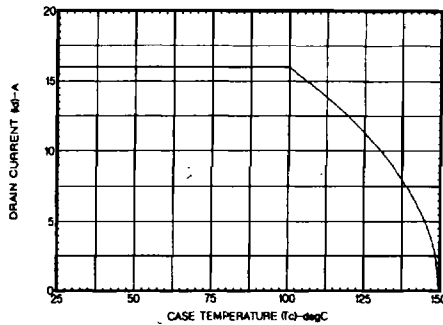


FIGURE 3. MAXIMUM CONTINUOUS DRAIN CURRENT vs TEMPERATURE

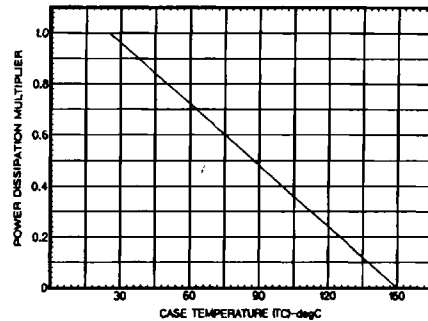


FIGURE 4. NORMALIZED POWER DISSIPATION vs TEMPERATURE DERATING CURVE

6  
LOGIC LEVEL  
POWER MOSFETS

# RFD16N05L, RFD16N05LSM

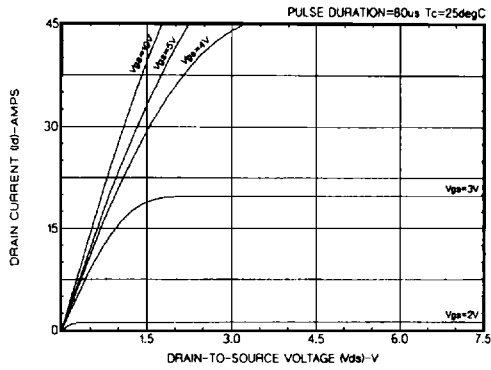


FIGURE 5. TYPICAL SATURATION CHARACTERISTICS

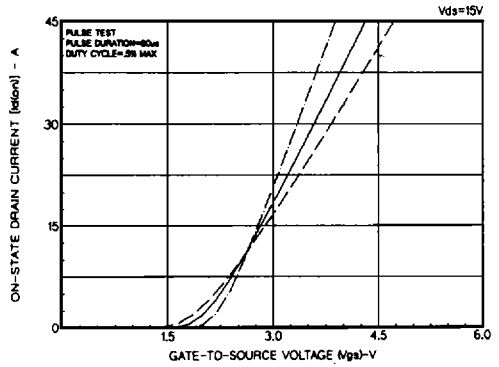


FIGURE 6. TYPICAL TRANSFER CHARACTERISTICS

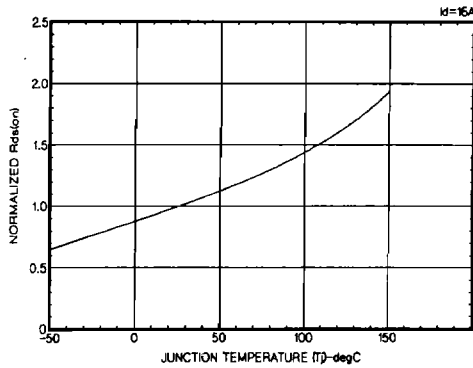


FIGURE 7. NORMALIZED  $r_{DS(on)}$  vs JUNCTION TEMPERATURE

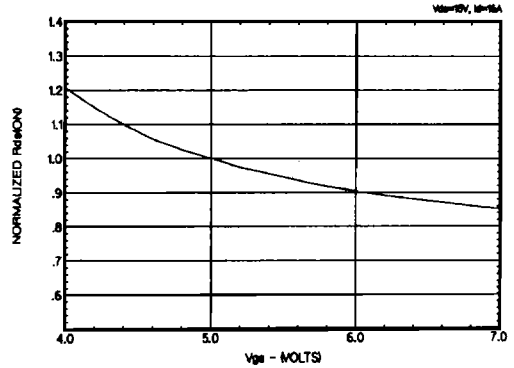


FIGURE 8. NORMALIZED  $r_{DS(on)}$  vs  $V_{GS}$

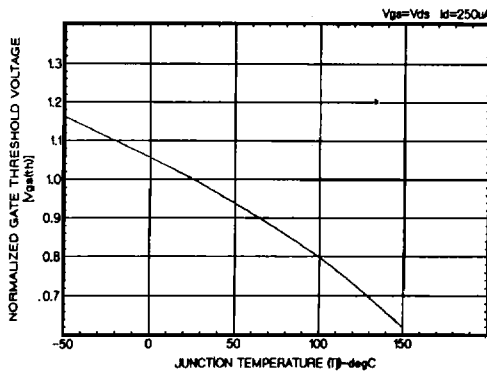


FIGURE 9. TYPICAL NORMALIZED GATE THRESHOLD VOLTAGE

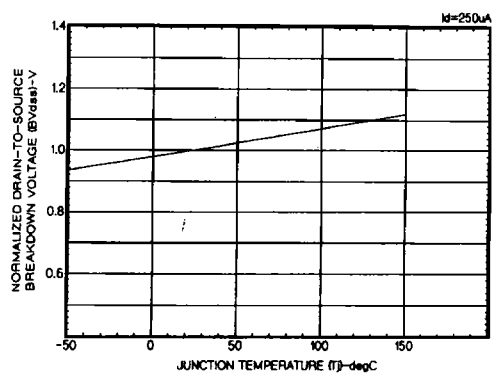


FIGURE 10. DRAIN SOURCE BREAKDOWN VOLTAGE vs TEMPERATURE

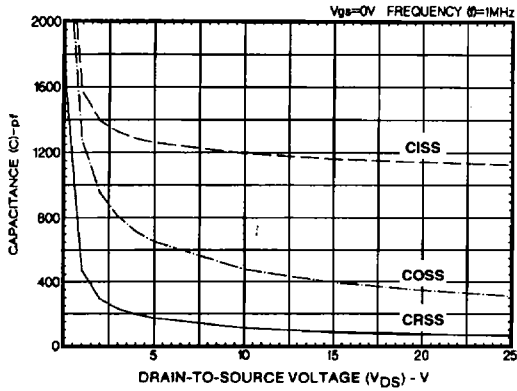


FIGURE 11. TYPICAL CAPACITANCE vs VOLTAGE

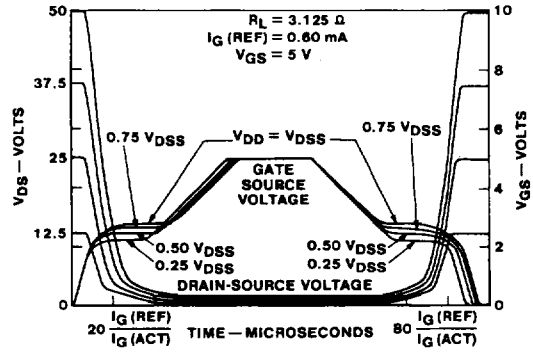
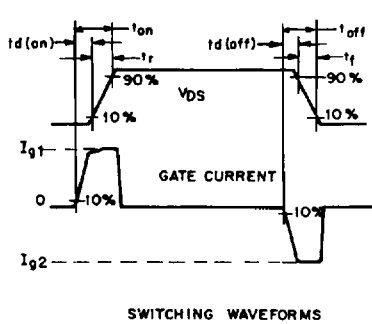
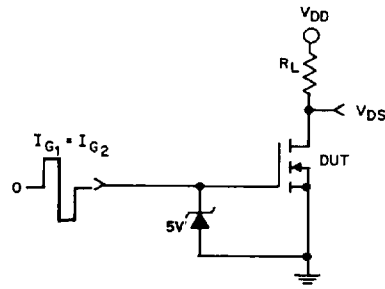


FIGURE 12. NORMALIZED SWITCHING WAVEFORMS FOR CONSTANT GATE-CURRENT. REFER TO HARRIS APPLICATION NOTES AN7254 AND AN7260.



SWITCHING WAVEFORMS



SWITCHING TEST CIRCUIT

FIGURE 13. RESISTIVE SWITCHING

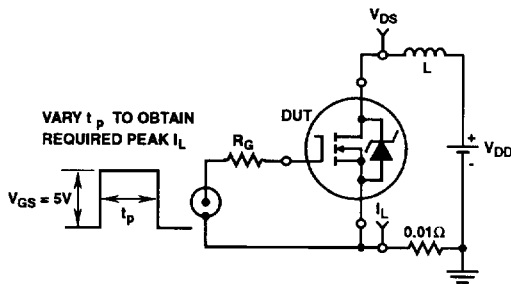


FIGURE 14. UNCLAMPED ENERGY TEST CIRCUIT

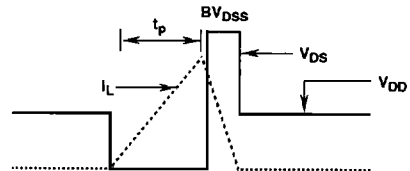


FIGURE 15. UNCLAMPED ENERGY WAVEFORMS

## RFD16N05L, RFD16N05LSM

### Spice Model (RFD16N05L)

```
.SUBCKT RFD16N05L 2 1 3; rev 04/08/92
*Nominal Temperature = 25°C
.MODEL MOSMOD NMOS (VTO=2.054 KP=24.73 IS=1e-30 N=10 TOX=1 L=1u W=1u)
Vto 21 6 0.448
Rsource 8 7 RDSMOD 0.614E-3
Rdrain 5 16 RDSMOD 27.38E-3
.MODEL RDSMOD RES (TC1=3.66E-3 TC2=1.46E-5)
.MODEL RVTOMOD RES (TC1=-1.81E3 TC2=1.41E-6)
Ebreak 11 7 17 18 70.9
.MODEL RBKMOD RES (TC1=1.01E-3 TC2=5.21E-8)
.MODEL DBKMOD D (RS=8.82E-2 TRS1=-2.01E-3 TRS2=7.32E-10)
.MODEL DBDMOD D (IS=1.34E-13 RS=1.21E-2 TRS1=1.64E-3 TRS2=2.59E-6 +CJO=1.13E-9 TT=4.14E-8)
Cin 6 8 1.21E-9
Ca 12 8 3.33E-9
.MODEL S1AMOD VSWITCH (RON=1e-5 ROFF=0.1 VON=-4.25 VOFF=-2.25)
.MODEL S1BMOD VSWITCH (RON=1e-5 ROFF=0.1 VON=-2.25 VOFF=-4.25)
.MODEL DPLCAPMOD D (CJO=5.22E-10 IS=1e-30 N=10)
Cb 15 14 3.11E-9
.MODEL S2AMOD VSWITCH (RON=1e-5 ROFF=0.1 VON=-0.65 VOFF=4.35)
.MODEL S2BMOD VSWITCH (RON=1e-5 ROFF=0.1 VON=4.35 VOFF=-0.65)
Rgate 9 20 2.98
Lgate .1 9 1.38E-9
Ldrain 2 5 1.0E-12
Lsource 3 7 1.0E-9
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
MOS1 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
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