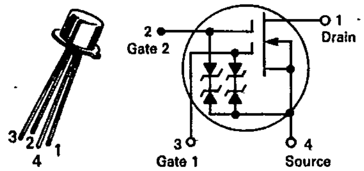
N-CHANNEL DUAL-GATE SILICON-NITRIDE PASSIVATED MOS FIELD-EFFECT TRANSISTORS

... high Y_{fs} depletion mode dual gate transistors designed for VHF amplifier and mixer applications.

- MFE211 — VHF Amplifier/IF Amplifier
  MFE212 — VHF Mixer
- High Forward Transfer Admittance — $|Y_{fs}|$ = 17–40 mmhos
- Low Reverse Transfer Capacitance — C_{rss} = 0.03 pF (Max)
- Diode Protected Gates

MFE211
MFE212

CASE 20-03, STYLE 9
TO-72 (TO-206AF)



DUAL-GATE MOSFETs

N-CHANNEL — DEPLETION

MAXIMUM RATINGS

Rating	Symbol	Value	Unit
Drain-Source Voltage	V_{DSX}	20	Vdc
Drain-Gate Voltage	V_{DG1} V_{DG2}	35 35	Vdc
Gate Current	I_{G1} I_{G2}	±10 ±10	mAdc
Drain Current — Continuous	I_D	50	mAdc
Total Power Dissipation @ T_A = 25°C Derate above 25°C	P_D	360 2.4	mW mW/°C
Total Power Dissipation @ T_C = 25°C Derate above 25°C	P_D	1.2 8.0	Watt mW/°C
Storage Channel Temperature Range	T_{stg}	−65 to +200	°C
Junction Temperature Range	T_J	−65 to +175	°C
Lead Temperature, 1/16" From Seated Surface for 10 Seconds	T_L	300	°C

ELECTRICAL CHARACTERISTICS (T_A = 25°C unless otherwise noted.)

Characteristic		Symbol	Min	Max	Unit
OFF CHARACTERISTICS					
Drain-Source Breakdown Voltage (I_D = 10 μAdc, V_{G1S} = V_{G2S} = −4.0 Vdc)		$V_{(BR)DSX}$	20	—	Vdc
Gate 1 — Source Breakdown Voltage(1) (I_{G1} = ±10 mAdc, V_{G2S} = V_{DS} = 0)		$V_{(BR)G1SO}$	±6.0	—	Vdc
Gate 2 — Source Breakdown Voltage(1) (I_{G2} = ±10 mAdc, V_{G1S} = V_{DS} = 0)		$V_{(BR)G2SO}$	±6.0	—	Vdc
Gate 1 to Source Cutoff Voltage (V_{DS} = 15 Vdc, V_{G2S} = 4.0 Vdc, I_D = 20 μAdc)	MFE211 MFE212	$V_{G1S(off)}$	−0.5 −0.5	−5.5 −4.0	Vdc
Gate 2 to Source Cutoff Voltage (V_{DS} = 15 Vdc, V_{G1S} = 0, I_D = 20 μAdc)	MFE211 MFE212	$V_{G2S(off)}$	−0.2 −0.2	−2.5 −4.0	Vdc
Gate 1 Leakage Current (V_{G1S} = ±5.0 Vdc, V_{G2S} = V_{DS} = 0) (V_{G1S} = −5.0 Vdc, V_{G2S} = V_{DS} = 0, T_A = 150°C)		I_{G1SS}	— —	±10 −10	mAdc μAdc
Gate 2 Leakage Current (V_{G2S} = ±5.0 Vdc, V_{G1S} = V_{DS} = 0) (V_{G2S} = −5.0 Vdc, V_{G1S} = V_{DS} = 0, T_A = 150°C)		I_{G2SS}	— —	±10 −10	nAdc μAdc
ON CHARACTERISTICS					
Zero-Gate Voltage Drain Current(2) (V_{DS} = 15 Vdc, V_{G1S} = 0, V_{G2S} = 4.0 Vdc)		I_{DSS}	6.0	40	mAdc
SMALL-SIGNAL CHARACTERISTICS					
Forward Transfer Admittance(3) (V_{DS} = 15 Vdc, V_{G2S} = 4.0 Vdc, V_{G1S} = 0, f = 1.0 kHz)		$\|Y_{fs}\|$	17	40	mmhos
Reverse Transfer Capacitance (V_{DS} = 15 Vdc, V_{G2S} = 4.0 Vdc, I_D = 10 mAdc; f = 1.0 MHz)		C_{rss}	0.005	0.05	pF

(continued)

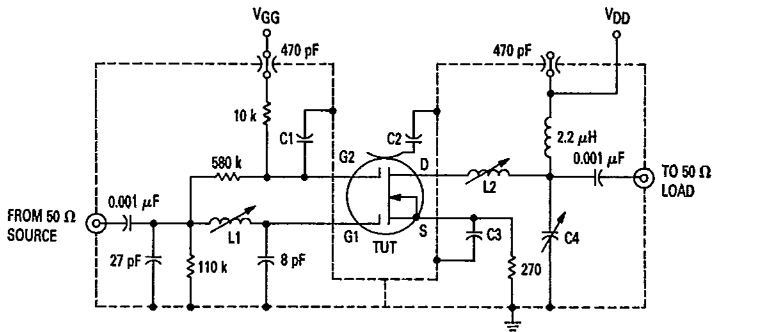
4

T-31-25

ELECTRICAL CHARACTERISTICS (continued) (T_A = 25°C unless otherwise noted.)

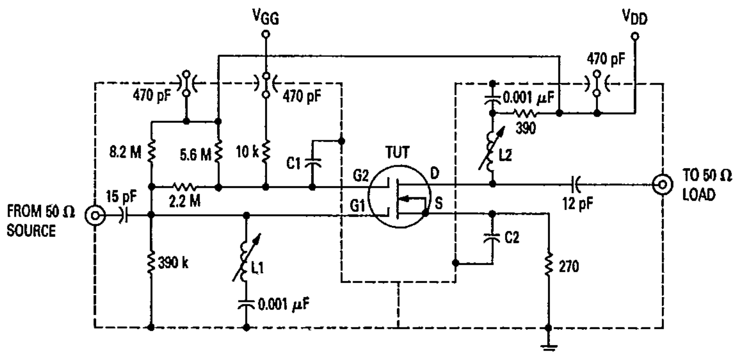
Characteristic			Symbol	Min	Max	Unit
FUNCTIONAL CHARACTERISTICS						
Noise Figure			NF			dB
(V_{DD} = 18 Vdc, V_{GG} = 7.0 Vdc, f = 200 MHz)	(Figure 1)	MFE211		—	3.5	
(V_{DD} = 24 Vdc, V_{GG} = 6.0 Vdc, f = 45 MHz)	(Figure 2)	MFE212		—	4.0	
Common Source Power Gain			G_{ps}			dB
(V_{DD} = 18 Vdc, V_{GG} = 7.0 Vdc, f = 200 MHz)	(Figure 1)	MFE211		24	35	
(V_{DD} = 18 Vdc, V_{GG} = 6.0 Vdc, f = 45 MHz)	(Figure 3)	MFE211		29	37	
(V_{DD} = 18 Vdc, f_{LO} = 245 MHz, f_{RF} = 200 MHz)	(Figure 3)	MFE212	G_c(5)	21	28	
Bandwidth			BW			MHz
(V_{DD} = 18 Vdc, V_{GG} = 7.0 Vdc, f = 200 MHz)	(Figure 1)	MFE211		5.0	12	
(V_{DD} = 18 Vdc, f_{LO} = 245 MHz, f_{RF} = 200 MHz)	(Figure 3)	MFE212		4.0	7.0	
(V_{DD} = 18 Vdc, V_{GG} = 6.0 Vdc, f = 45 MHz)	(Figure 2)	MFE211		3.5	6.0	
Gain Control Gate-Supply Voltage(4)			$V_{GG(GC)}$			Vdc
(V_{DD} = 18 Vdc, ΔG_{ps} = −30 dB, f = 200 MHz)	(Figure 1)	MFE211		—	−2.0	
(V_{DD} = 18 Vdc, ΔG_{ps} = −30 dB, f = 45 MHz)	(Figure 2)	MFE211		—	±1.0	

Notes:
1. All gate breakdown voltages are measured while the device is conducting rated gate current. This ensures that the gate-voltage limiting network is functioning properly.
2. Pulse Test: Pulse Width = 300 μs, Duty Cycle ≤ 2.0%.
3. This parameter must be measured with bias voltages applied for less than 5 seconds to avoid overheating. The signal is applied to gate 1 with gate 2 at ac ground.
4. ΔG_{ps} is defined as the change in G_{ps} from the value at V_{GG} = 7.0 volts (MFE211).
5. Power Gain Conversion. Amplitude at input from local oscillator is adjusted for maximum G_c.



C1, C2 & C3: Leadless disc ceramic, 0.001 μF
C4: ARCO 462, 5–80 pF, or equivalent
L1: 3 Turns #18, 3/16″ diameter aluminum slug
L2: 8 Turns #20, 3/16″ diameter aluminum slug

Figure 1. 200 MHz Power Gain, Gain Control Voltage, and Noise Figure Test Circuit for MFE211



C1: Leadless disc ceramic, 0.001 μF
C2: Leadless disc ceramic, 0.01 μF
L1: 8 Turns #28, 5/32″ diameter form, type "J" slug
L2: 9 Turns #28, 5/32″ diameter form, type "J" slug

Figure 2. 45 MHz Power Gain and Noise Figure Test Circuit for MFE211

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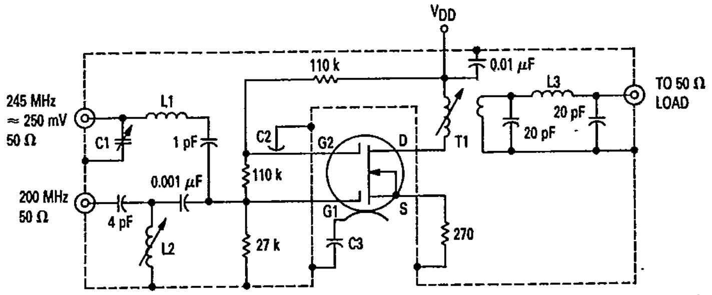

L1: 7 Turns #34, 1/4" diameter aluminum slug
L2: 5-1/2 Turns #20, 1/4" diameter aluminum slug
L3: 7 Turns #24, 1/4" diameter air core

C1: Arco type 462, 5–80 pF
C2: 0.001 µF leadless disc
C3: 0.01 µF leadless disc

T1: Pri: 25 Turns #30, close wound on 1/4" diameter form, type "J" slug
Sec: 4 Turns #30, centered over primary

Figure 3. 200 MHz-to-45 MHz Circuit for Conversion Power Gain for MFE212

TYPICAL CHARACTERISTICS

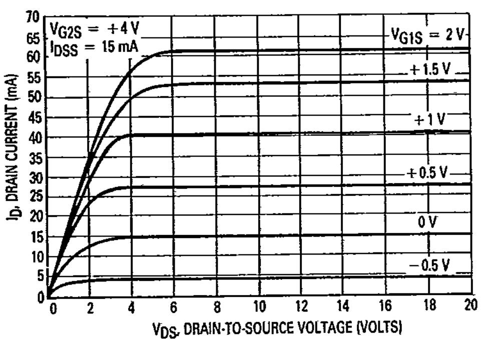

Figure 4. Drain Current versus Drain-to-Source Voltage

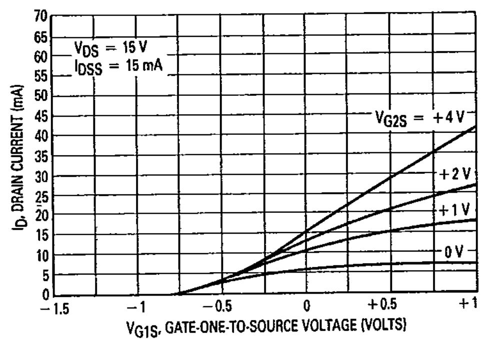

Figure 5. Drain Current versus Gate-One-to-Source Voltage

SMALL-SIGNAL COMMON-SOURCE PARAMETER

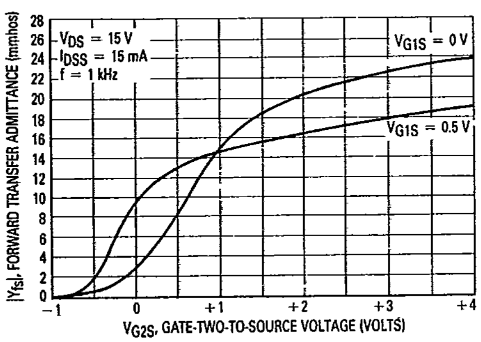

Figure 6. Forward Transfer Admittance versus Gate-Two-to-Source Voltage

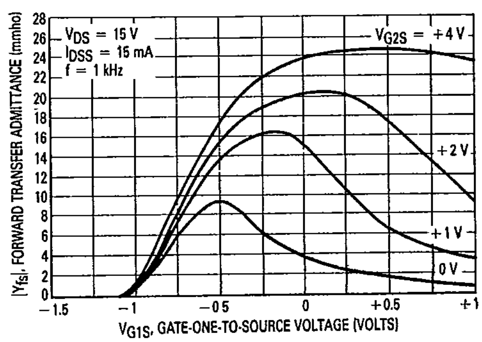

Figure 7. Forward Transfer Admittance versus Gate-One-to-Source Voltage

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T-31-25

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TYPICAL CHARACTERISTICS (continued)

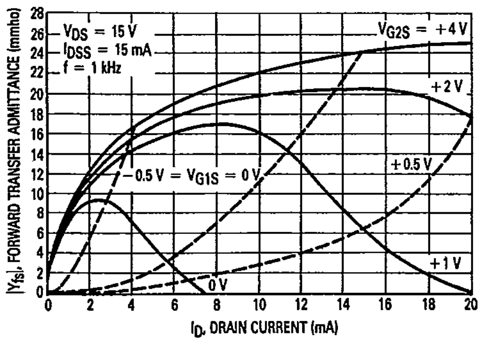

Figure 8. Forward Transfer Admittance versus Drain Current

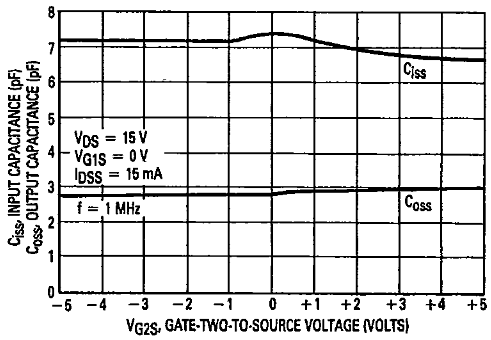

Figure 9. Input and Output Capacitance versus Gate-Two-to-Source Voltage

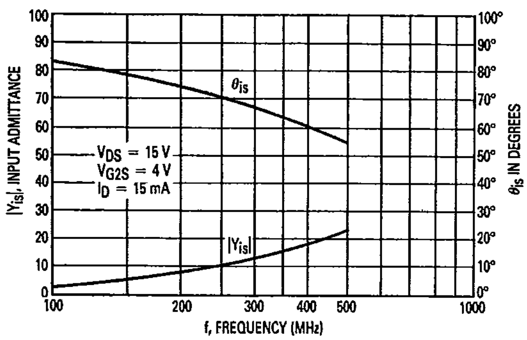

Figure 10. Small-Signal Gate-One Input Admittance versus Frequency

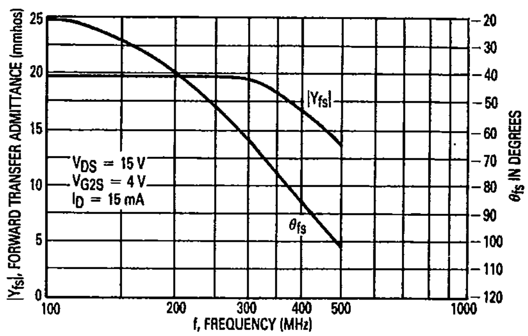

Figure 11. Small-Signal Forward Transfer Admittance versus Frequency

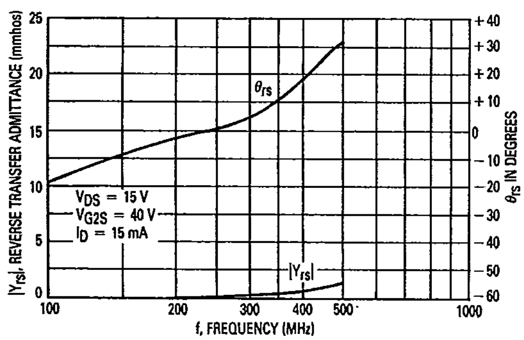

Figure 12. Small-Signal Gate-One Reverse Transfer Admittance versus Frequency

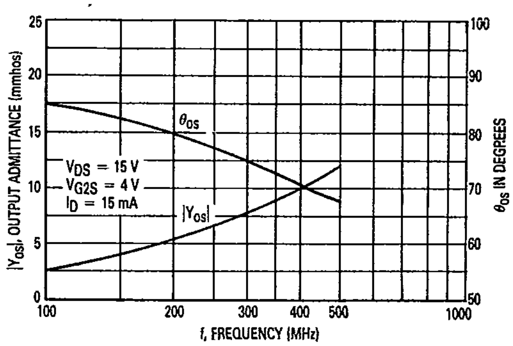

Figure 13. Small-Signal Gate-One Output Admittance versus Frequency

TYPICAL CHARACTERISTICS (continued)

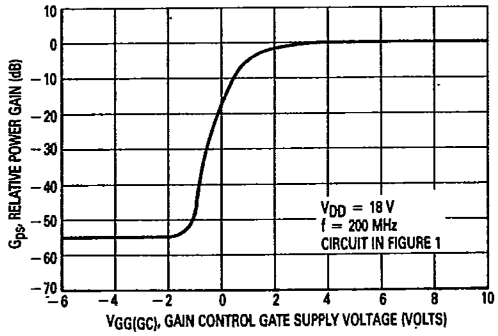

Figure 14. Relative Small-Signal Power Gain versus Gain Control Gate Supply Voltage MFE211

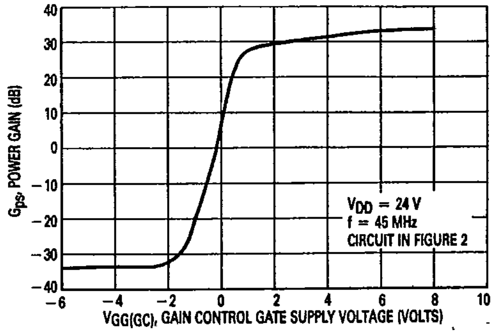

Figure 15. Small-Signal Common-Source Insertion Power Gain versus Gain Control Gate Supply Voltage

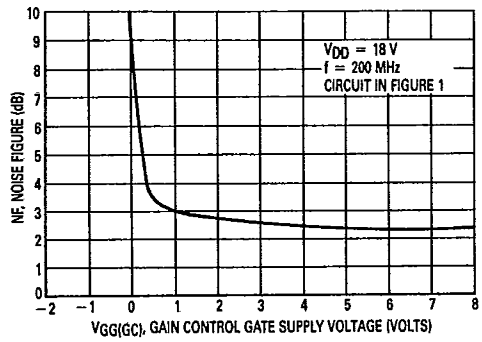

Figure 16. Common Source Spot Noise Figure versus Gain Control Gate Supply Voltage

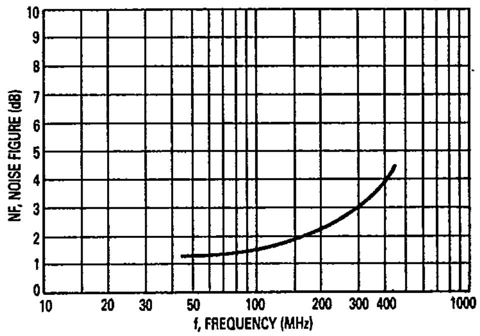

Figure 17. Optimum Spot Noise Figure versus Frequency