MRF177

The RF MOSFET Line
100W, 400MHz, 28V

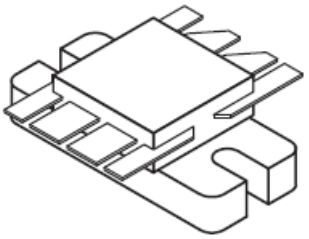
Rev. V1

Designed for broadband commercial and military applications up to 400 MHz frequency range. Primarily used as a driver or output amplifier in push–pull configurations. Can be used in manual gain control, ALC and modulation circuits.

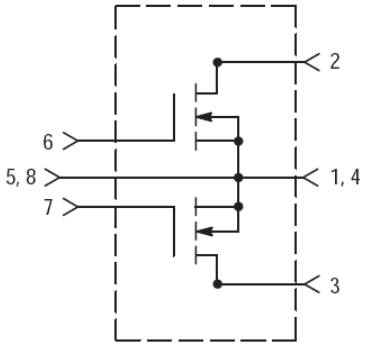
N–Channel enhancement mode MOSFET

- Typical performance at 400 MHz, 28 V:
  - Output power — 100 W
  - Gain — 12 dB
  - Efficiency — 60%
- Low thermal resistance
- Low Crss — 10 pF typ. @ VDS = 28 V
- Ruggedness tested at rated output power
- Nitride passivated die for enhanced reliability
- Excellent thermal stability; suited for Class A operation

Product Image



CASE 744A–01, STYLE 2



MAXIMUM RATINGS

Rating	Symbol	Value	Unit
Drain–Source Voltage	V_{DSS}	65	Vdc
Drain–Gate Voltage (R_{GS} = 1.0 MΩ)	V_{DGR}	65	Vdc
Gate–Source Voltage	V_{GS}	±40	Vdc
Drain Current — Continuous	I_D	16	Adc
Total Device Dissipation @ T_C = 25°C (1) Derate above 25°C	P_D	270 1.54	Watts W/°C
Storage Temperature Range	T_{stg}	–65 to +150	°C
Operating Temperature Range	T_J	200	°C

THERMAL CHARACTERISTICS

Characteristic	Symbol	Max	Unit
Thermal Resistance, Junction–to–Case	$R_{\theta JC}$	0.65	°C/W

(1) Total device dissipation rating applies only when the device is operated as an RF push–pull amplifier.

NOTE — CAUTION — MOS devices are susceptible to damage from electrostatic charge. Reasonable precautions in handling and packaging MOS devices should be observed.

ELECTRICAL CHARACTERISTICS (T_C = 25°C unless otherwise noted)

Characteristic (1)	Symbol	Min	Typ	Max	Unit
OFF CHARACTERISTICS					
Drain–Source Breakdown Voltage (V_{GS} = 0, I_D = 50 mA)	$V_{(BR)DSS}$	65	—	—	Vdc
Zero Gate Voltage Drain Current (V_{DS} = 28 V, V_{GS} = 0)	I_{DSS}	—	—	2.0	mAdc
Gate–Source Leakage Current (V_{GS} = 20 V, V_{DS} = 0)	I_{GSS}	—	—	1.0	μAdc
ON CHARACTERISTICS (1)					
Gate Threshold Voltage (V_{DS} = 10 V, I_D = 50 mA)	$V_{GS(th)}$	1.0	3.0	6.0	Vdc
Drain–Source On–Voltage (V_{GS} = 10 V, I_D = 3.0 A)	$V_{DS(on)}$	—	—	1.4	Vdc
Forward Transconductance (V_{DS} = 10 V, I_D = 2.0 A)	g_{fs}	1.8	2.2	—	mhos
DYNAMIC CHARACTERISTICS (1)					
Input Capacitance (V_{DS} = 28 V, V_{GS} = 0, f = 1.0 MHz)	C_{iss}	—	100	—	pF
Output Capacitance (V_{DS} = 28 V, V_{GS} = 0, f = 1.0 MHz)	C_{oss}	—	105	—	pF
Reverse Transfer Capacitance (V_{DS} = 28 V, V_{GS} = 0, f = 1.0 MHz)	C_{rss}	—	10	—	pF
FUNCTIONAL CHARACTERISTICS (Figure 8) (2)					
Common Source Power Gain (V_{DD} = 28 Vdc, P_{out} = 100 W, f = 400 MHz, I_{DQ} = 200 mA)	G_{PS}	10	12	—	dB
Drain Efficiency (V_{DD} = 28 Vdc, P_{out} = 100 W, f = 400 MHz, I_{DQ} = 200 mA)	η	55	60	—	%
Electrical Ruggedness (V_{DD} = 28 Vdc, P_{out} = 100 W, f = 400 MHz, I_{DQ} = 200 mA, Load VSWR = 30:1, All Phase Angles At Frequency of Test)	ψ	No Degradation in Output Power Before & After Test			

(1) Note each transistor chip measured separately
(2) Both transistor chips operating in push–pull amplifier

TYPICAL CHARACTERISTICS

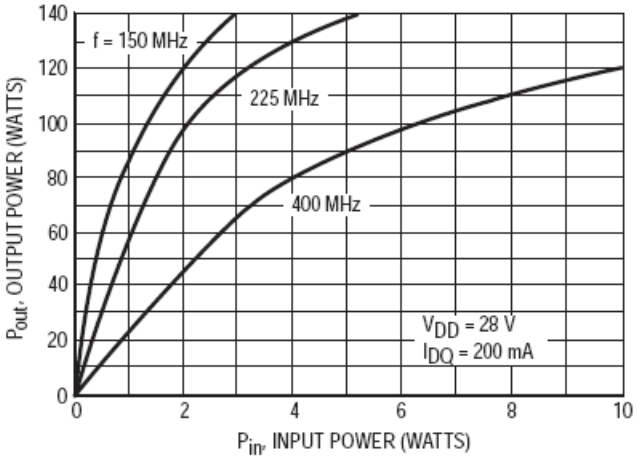


Figure 1. Output Power versus Input Power

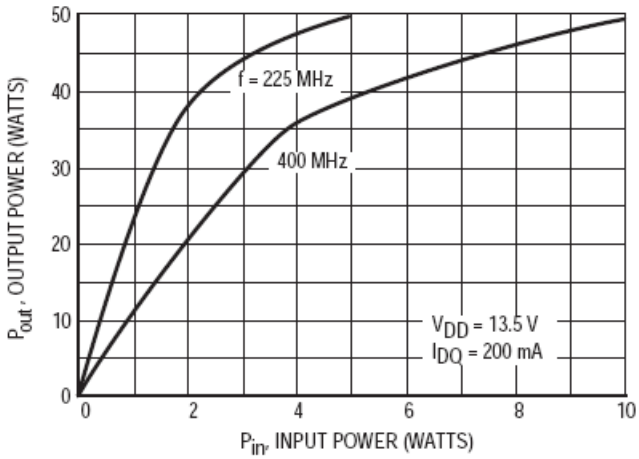


Figure 2. Output Power versus Input Power

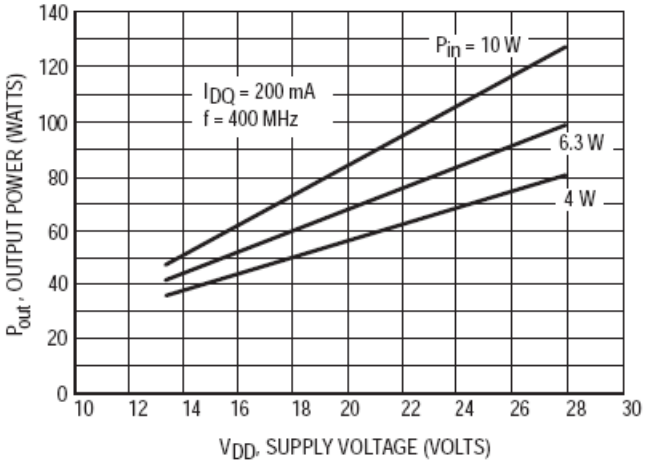


Figure 3. Output Power versus Supply Voltage

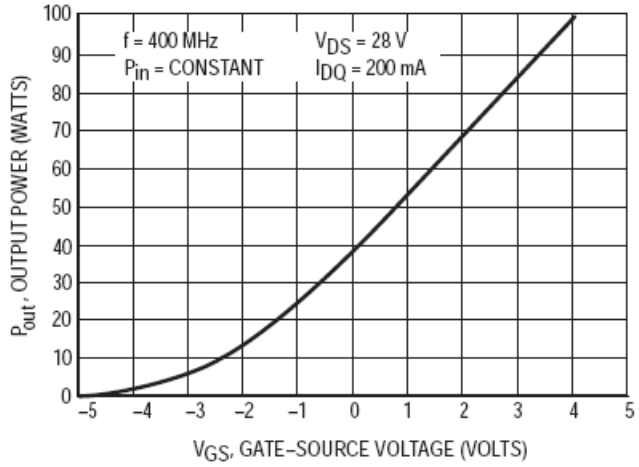


Figure 4. Output Power versus Gate Voltage

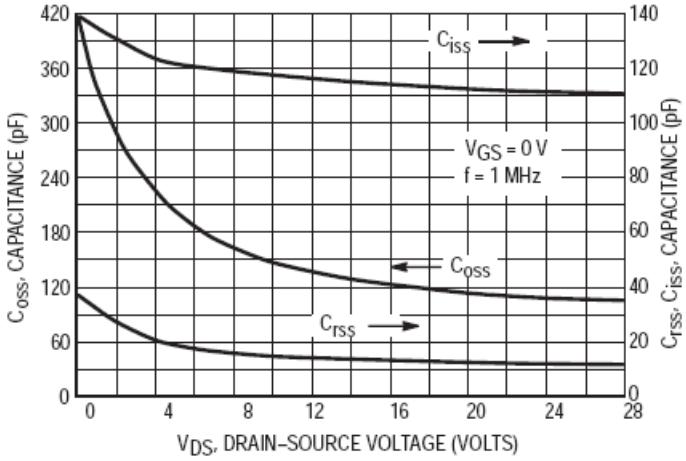


Figure 5. Capacitance versus Drain Voltage

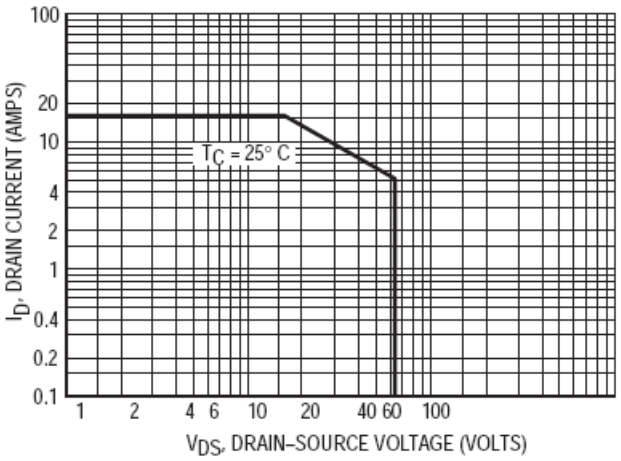
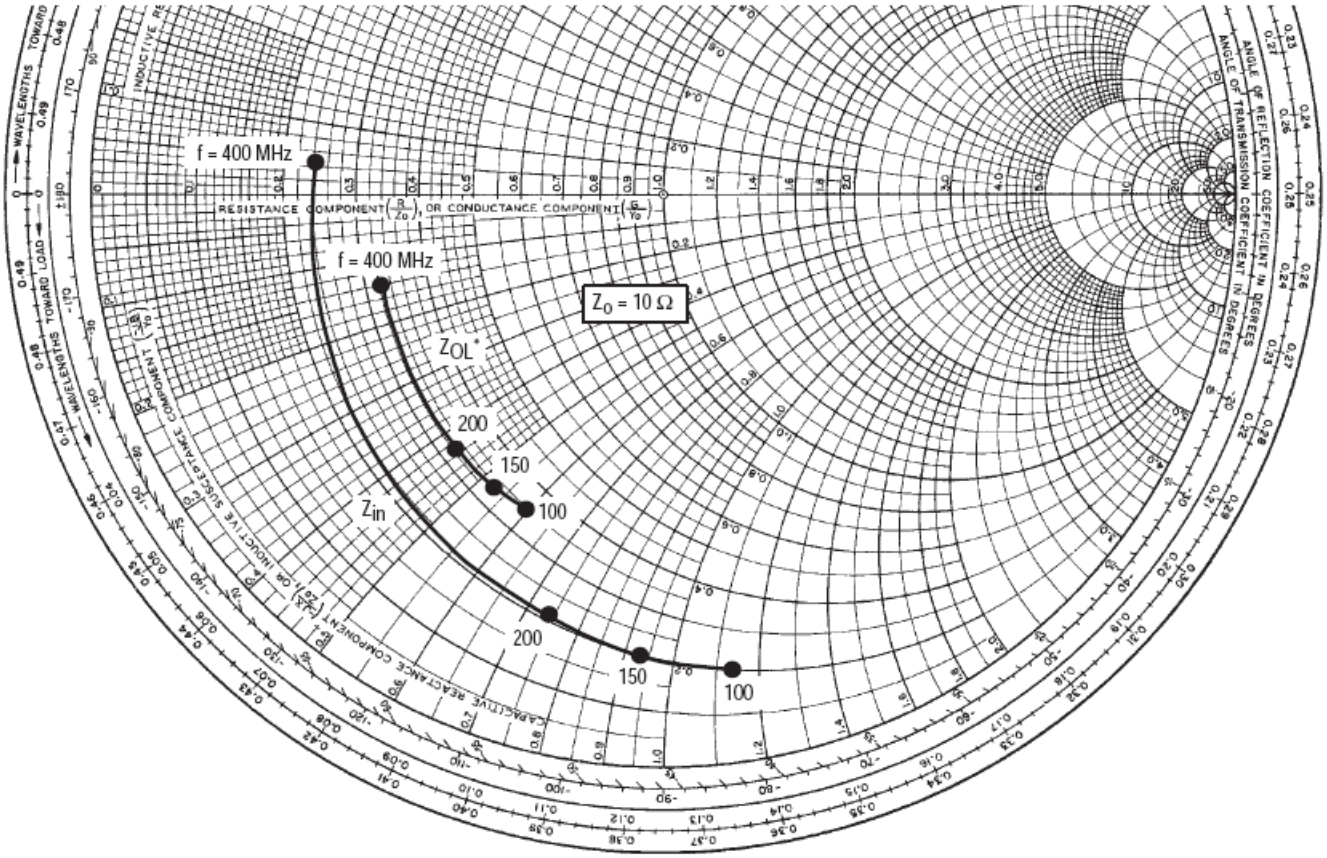


Figure 6. DC Safe Operating Area



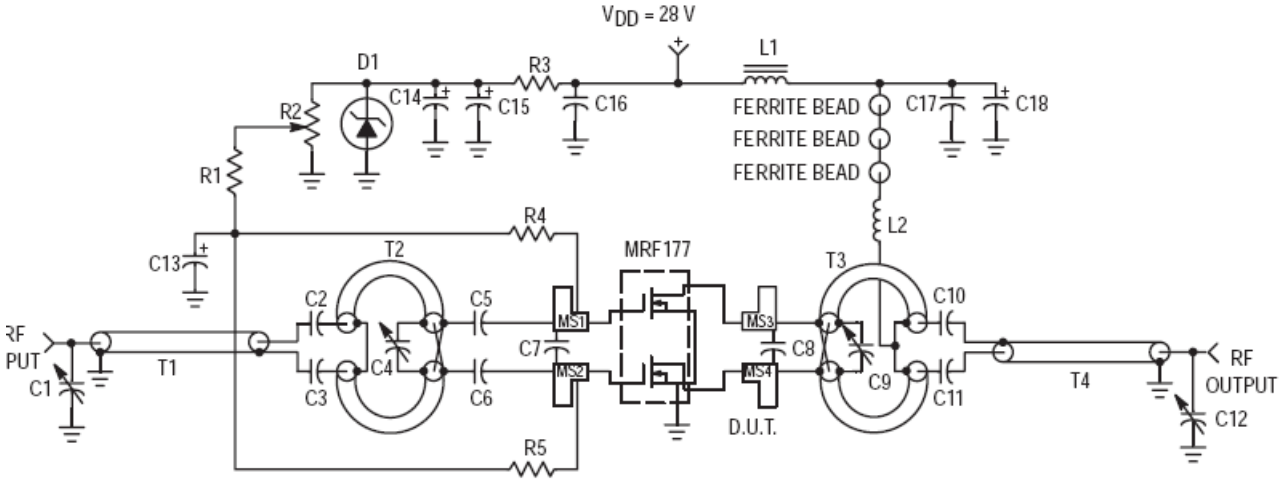
NOTE: Input and Output Impedance values given are measured gate–to–gate and drain–to–drain respectively.

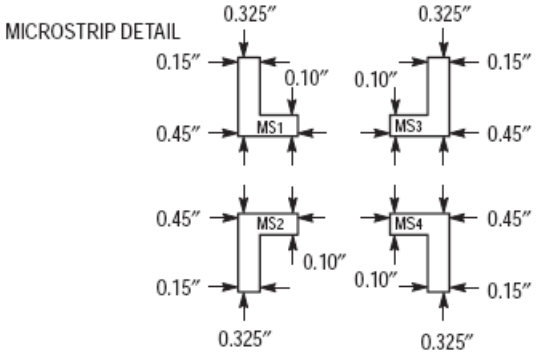
V_{DD} = 28 V I_{DQ} = 200 mA P_{out} = 100 W

f (MHz)	Z_{in} Ohms	Z_{OL}* Ohms
100	2.0 – j11.5	3.5 – j6
150	2.05 – j9.45	3.35 – j5.34
200	2.1 – j7.5	3.3 – j4.4
400	2.35 + j0.4	3.2 – j1.38

Z_{OL}*: Conjugate of optimum load impedance into which the device operates at a given output power, voltage, current and frequency.

Figure 7. Impedance or Admittance Coordinates





C1, C12	1–10 pF JOHANSON OR EQUIVALENT	D1	1N5347B, 20 Vdc
C2, C3, C5, C6, C10, C11	270 pF ATC 100 MIL CHIP CAP	L1	1–TURN NO. 18, 0.25″, 2–HOLE FERRITE BEAD
C4, C9	1–20 pF	L2	8–1/2 TURNS NO. 18, CLOSE WOUND .375″ DIA.
C7	36 pF CHIP CAP	R1, R4, R5	10 kΩ @ 1/2 W RESISTOR
C8	10 pF CHIP CAP	R2	10 kΩ, 10 TURN RESISTOR
C13, C14	0.1 µFD @ 50 Vdc	R3	2.0 kΩ @ 1/2 W RESISTOR
C15, C18	10 µFD @ 50 Vdc	T1	1–1/2 T, 50 Ω COAX, .034″ DIA. ON DUAL 0.5″ FERRITE CORE
C16	500 pF BUTTON	T2	2.0″ 25 Ω COAX, .075″ DIA.
C17	1000 pF UNCASED MICA	T3	2.1″ 10 Ω COAX, .075″ DIA.
		T4	4.0″ 50 Ω COAX, .0865″ DIA.
		BOARD	Dielectric Thickness = 0.060″ 2oz Copper, Cu–Clad, Teflon Fiberglass, ε_r = 2.55

Figure 8. Test Circuit Electrical Schematic

NOTE: S–Parameter data represents measurements taken from one chip only.

Table 1. Common Source S–Parameters (V_{DS} = 24 V, I_D = 0.4 A)

f MHz	S_{11}		S_{21}		S_{12}		S_{22}	
	$\|S_{11}\|$	ϕ	$\|S_{21}\|$	ϕ	$\|S_{12}\|$	ϕ	$\|S_{22}\|$	ϕ
30	0.797	–154	12.40	88	0.029	2	0.756	–159
40	0.739	–161	9.06	89	0.027	8	0.702	–165
50	0.749	–164	6.84	85	0.026	7	0.707	–168
60	0.770	–163	6.06	80	0.027	3	0.754	–168
70	0.790	–164	5.40	73	0.027	–1	0.776	–168
80	0.800	–166	4.60	70	0.026	–1	0.777	–168
90	0.808	–167	3.94	67	0.025	–1	0.795	–168
100	0.816	–168	3.47	64	0.024	–1	0.809	–169
110	0.816	–169	3.14	62	0.023	1	0.809	–169
120	0.815	–170	2.76	61	0.022	6	0.794	–169
130	0.821	–171	2.45	59	0.021	12	0.799	–170
140	0.828	–171	2.27	56	0.022	18	0.806	–169
150	0.836	–171	2.10	53	0.028	25	0.805	–169
160	0.861	–172	1.96	51	0.032	–6	0.823	–168
170	0.863	–173	1.77	49	0.020	–4	0.836	–166
180	0.869	–173	1.63	46	0.018	5	0.881	–169
190	0.872	–174	1.52	44	0.017	14	0.894	–169
200	0.873	–175	1.41	43	0.017	25	0.888	–171
210	0.877	–176	1.28	42	0.018	36	0.877	–171
220	0.880	–176	1.18	41	0.019	46	0.868	–171
230	0.881	–177	1.15	38	0.024	51	0.926	–173
240	0.877	–178	1.09	35	0.031	56	0.893	–174
250	0.857	–180	1.04	33	0.049	55	0.903	–173
260	0.758	–178	0.95	31	0.090	24	0.903	–172
270	0.862	–171	0.87	31	0.056	–33	0.933	–173
280	0.902	–174	0.85	32	0.027	–39	0.949	–174
290	0.913	–176	0.77	30	0.017	–28	0.891	–175
300	0.919	–177	0.72	30	0.012	–8	0.894	–175
310	0.922	–178	0.71	28	0.012	11	0.913	–175
320	0.925	–178	0.67	26	0.012	28	0.896	–175
330	0.927	–179	0.64	24	0.012	40	0.929	–176
340	0.929	–179	0.62	24	0.013	46	0.925	–179
350	0.931	–180	0.58	24	0.015	52	0.942	–174
360	0.934	180	0.55	24	0.017	55	0.944	–176
370	0.937	179	0.52	23	0.019	61	0.944	–176
380	0.940	179	0.49	21	0.020	68	0.919	–175
390	0.941	178	0.45	22	0.020	69	0.938	–177
400	0.942	178	0.46	18	0.021	73	0.920	–173
410	0.941	177	0.45	19	0.023	67	0.961	–178
420	0.943	177	0.44	18	0.026	67	0.945	–178
430	0.945	176	0.41	16	0.029	70	0.959	–179

Table 1. Common Source S–Parameters (V_{DS} = 24 V, I_D = 0.4 A) (continued)

f MHz	S_{11}		S_{21}		S_{12}		S_{22}	
	$\|S_{11}\|$	ϕ	$\|S_{21}\|$	ϕ	$\|S_{12}\|$	ϕ	$\|S_{22}\|$	ϕ
440	0.947	176	0.38	16	0.029	75	0.962	–179
450	0.949	176	0.38	19	0.030	78	0.984	–178
460	0.952	175	0.36	17	0.029	72	0.987	178
470	0.953	175	0.34	18	0.030	70	0.976	179
480	0.952	174	0.34	14	0.035	69	0.968	179
490	0.952	174	0.34	14	0.039	72	0.987	178
500	0.952	174	0.32	13	0.040	76	1.002	179
600	0.938	170	0.22	9	0.047	117	1.013	172
700	0.962	166	0.19	13	0.060	73	0.993	171
800	0.953	162	0.17	18	0.097	68	0.981	171
900	0.953	159	0.14	21	0.097	65	0.949	166
1000	0.952	156	0.14	27	0.110	68	0.982	163

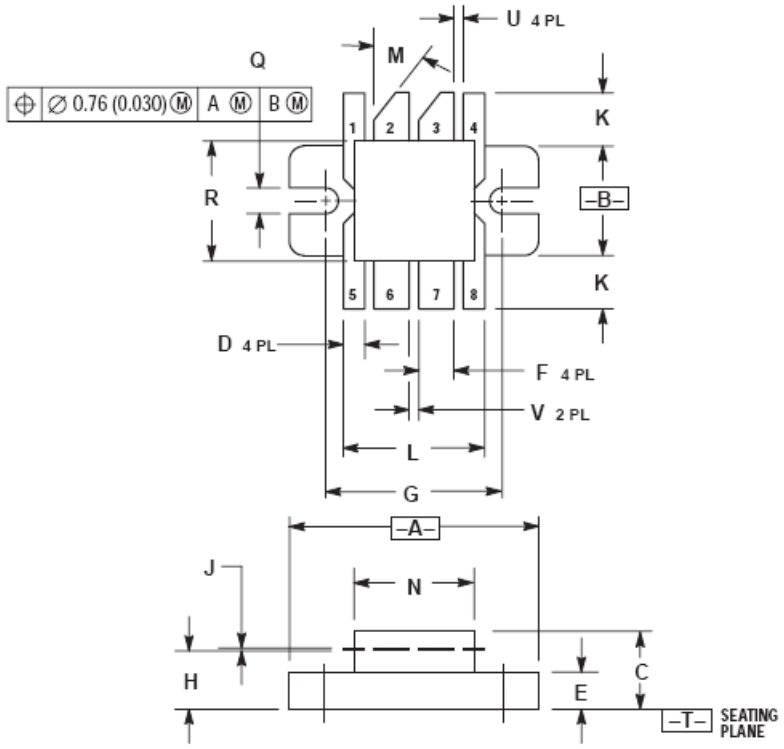
Table 2. Common Source S–Parameters (V_{DS} = 28 V, I_D = 0.435 A)

f MHz	S_{11}		S_{21}		S_{12}		S_{22}	
	$\|S_{11}\|$	ϕ	$\|S_{21}\|$	ϕ	$\|S_{12}\|$	ϕ	$\|S_{22}\|$	ϕ
30	0.803	–153	13.50	89	0.028	3	0.746	–157
40	0.742	–160	9.90	90	0.026	9	0.686	–164
50	0.752	–163	7.48	85	0.025	8	0.692	–168
60	0.773	–163	6.62	80	0.026	4	0.739	–167
70	0.794	–164	5.91	74	0.026	1	0.761	–167
80	0.803	–166	5.04	70	0.025	1	0.763	–167
90	0.812	–167	4.32	68	0.024	1	0.783	–167
100	0.819	–168	3.81	64	0.022	1	0.798	–168
110	0.818	–169	3.44	62	0.022	3	0.797	–168
120	0.817	–170	3.03	61	0.021	9	0.779	–168
130	0.823	–171	2.68	59	0.020	15	0.784	–170
140	0.830	–171	2.49	57	0.021	21	0.793	–169
150	0.838	–171	2.30	53	0.027	27	0.792	–169
160	0.864	–172	2.16	52	0.030	–5	0.816	–167
170	0.865	–173	1.95	49	0.019	–2	0.827	–166
180	0.870	–173	1.79	46	0.017	8	0.869	–168
190	0.873	–174	1.67	44	0.016	18	0.882	–168
200	0.874	–175	1.55	43	0.017	27	0.878	–171
210	0.878	–176	1.40	42	0.017	37	0.866	–171
220	0.881	–176	1.29	41	0.019	47	0.858	–171
230	0.881	–177	1.25	38	0.025	53	0.918	–172
240	0.877	–178	1.20	35	0.031	59	0.882	–173
250	0.856	–180	1.13	33	0.048	57	0.893	–173
260	0.760	–178	1.03	31	0.088	24	0.899	–172
270	0.864	–171	0.96	31	0.056	–33	0.931	–172
280	0.903	–174	0.93	32	0.027	–38	0.946	–173
290	0.914	–176	0.85	30	0.015	–25	0.885	–174

Table 2. Common Source S–Parameters (V_{DS} = 28 V, I_D = 0.435 A) (continued)

f MHz	S_{11}		S_{21}		S_{12}		S_{22}	
	$\|S_{11}\|$	ϕ	$\|S_{21}\|$	ϕ	$\|S_{12}\|$	ϕ	$\|S_{22}\|$	ϕ
300	0.919	–177	0.79	30	0.010	–7	0.881	–175
310	0.922	–178	0.78	28	0.009	6	0.903	–175
320	0.925	–178	0.75	26	0.010	18	0.900	–175
330	0.927	–179	0.70	24	0.012	31	0.925	–176
340	0.929	–180	0.68	24	0.014	45	0.920	–178
350	0.931	180	0.63	25	0.015	63	0.932	–173
360	0.934	179	0.61	23	0.014	70	0.931	–176
370	0.936	179	0.57	23	0.013	68	0.929	–176
380	0.939	178	0.53	21	0.015	61	0.909	–176
390	0.941	178	0.50	22	0.018	61	0.940	–178
400	0.941	178	0.50	18	0.022	74	0.917	–173
410	0.940	177	0.49	19	0.024	80	0.955	–178
420	0.941	177	0.48	18	0.022	83	0.942	–178
430	0.943	176	0.46	16	0.020	77	0.957	–179
440	0.946	176	0.42	16	0.022	69	0.960	–178
450	0.948	175	0.41	18	0.029	71	0.982	–177
460	0.951	175	0.39	17	0.032	76	0.983	178
470	0.951	175	0.37	17	0.031	88	0.968	179
480	0.950	174	0.37	13	0.027	93	0.965	179
490	0.950	174	0.37	13	0.025	81	0.994	179
500	0.950	173	0.36	12	0.031	69	1.012	180
600	0.936	170	0.24	7	0.063	127	1.005	171
700	0.960	166	0.20	11	0.064	72	0.989	171
800	0.953	162	0.17	15	0.092	66	1.017	169
900	0.954	159	0.15	19	0.092	65	0.952	167
1000	0.952	156	0.15	24	0.082	56	0.988	162

PACKAGE DIMENSIONS



NOTES:
1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.

DIM	MILLIMETERS		INCHES	
	MIN	MAX	MIN	MAX
A	22.60	23.11	0.890	0.910
B	9.52	10.03	0.375	0.395
C	6.65	7.16	0.262	0.282
D	1.60	1.95	0.063	0.077
E	2.94	3.40	0.116	0.134
F	2.87	3.22	0.113	0.127
G	16.51 BSC		0.650 BSC	
H	4.01	4.36	0.158	0.172
J	0.07	0.15	0.003	0.006
K	4.34	4.90	0.171	0.193
L	12.45	12.95	0.490	0.510
M	45° NOM		45° NOM	
N	1.051	11.02	0.414	0.434
Q	3.04	3.35	0.120	0.132
R	9.90	10.41	0.390	0.410
U	1.02	1.27	0.040	0.050
V	0.64	0.89	0.025	0.035

STYLE 2:
PIN 1. SOURCE (COMMON)
2. DRAIN
3. DRAIN
4. SOURCE (COMMON)
5. SOURCE (COMMON)
6. GATE
7. GATE
8. SOURCE (COMMON)

CASE 744A–01
ISSUE C