

General Purpose 0.5 μ m N-Type GaAs MESFET Transistors

MA4TF50 Series

V3.00

Features

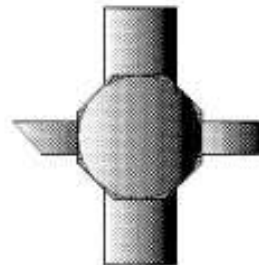
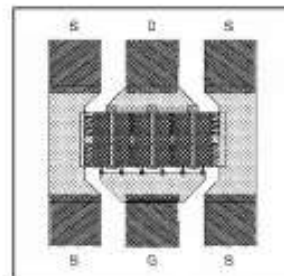
- Low Noise Figure
- High Associated Gain
- High Maximum Available Gain
- Designed for Battery Operation
- Useful to Ku-Band

Description

The MA4TF50 is an n-type GaAs depletion mode Metal Semiconductor Field Effect Transistor (MESFET) series with a 0.5 micron gate length and a periphery of 300 microns. The device is available in the ceramic surface mount package, MA4TF5005, and in other hermetically sealed packages. It is also available as a chip, MA4TF5000, with the active region protected by a scratch resistant silicon nitride passivation layer.

Applications

The MA4TF50 series is intended for low cost commercial applications including low noise microwave amplifiers up to X-band and oscillators up to Ku-band. The low voltage and low current biasing requirement is attractive for battery operation.

Case Styles**1105****Chip**

Specifications Subject to Change Without Notice.

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MA4TF50 Series
Maximum Ratings

(Case Temperature 25°C Unless Otherwise Noted)

Parameter	Symbol	Maximum
Total Power Dissipation of Chip	P_d	300 mW
Total Power Dissipation Ceramic Surface Mount Package	P_d	250 mW
Drain to Source Voltage	V_{DS}	10 V
Gate to Drain Voltage	V_{GDO}	-16 V
Gate to Source Voltage	V_{GSO}	-16 V
Drain Current	I_{DS}	125 mA
Gate Current	I_{GS}	1 mA
Storage Temperature Range	T_S	-65°C to +175°C
Channel Temperature	T_{CH}	+175°C
Lead Temperature	T_L	230°C for 10 seconds

MA4TF5005 (Ceramic Surface Mount Package)
Electrical Specifications @ 25°C

Parameter	Condition	Symbol	Min	Typical	Max	Units
Saturated Drain to Source Current	$V_{DS} = 3$ V $V_{GS} = 0$ V	I_{DSS}	30	50	—	mA
Pinch-off Voltage	$I_{DS} = 1\% I_{DSS}$	V_p	-0.5	-1.6	-2.5	V
Transconductance	$V_{DS} = 3$ V $V_{GS} = 0$ V	G_m	—	45	—	mS
Gate-Drain Breakdown Voltage	$I_G = 10$ μ A	BV_{GDO}	-7	-14	—	V
Gate-Source Breakdown Voltage	$I_G = 10$ μ A	BV_{GSO}	-7	-14	—	V
Gate-Source Leakage Current	$V_{GS} = -5$ V	I_{GSO}	—	—	10	μ A
Thermal Resistance (Channel to Ambient)	—	R_{TH}	—	200	—	°C/W
Maximum Frequency of Oscillation	$V_{DS} = 3$ V $I_{DS} = 10$ mA	f_{MAX}	—	>60	—	GHz
Maximum Available Gain	$V_{DS} = 3$ V $I_{DS} = 30$ mA $f = 4$ GHz	MAG	—	16	—	dB
Optimum Noise Figure	$V_{DS} = 3$ V $I_{DS} = 10$ mA $f = 4$ GHz	NF_O	—	1.0	1.5	dB
Associated Gain	$V_{DS} = 3$ V $I_{DS} = 10$ mA $f = 4$ GHz	G_A	—	11.5	—	dB
Transducer Gain	$V_{DS} = 3$ V $I_{DS} = 30$ mA $f = 4$ GHz	$ S_{21} ^2$	4	8	—	dB
Power Output at 1 dB Compression	$V_{DS} = 3$ V $I_{DS} = 30$ mA $f = 4$ GHz	P_{1dB}	—	+16.0	—	dBm

Specifications Subject to Change Without Notice.

MA4TF5005
Typical Common Source Scattering Parameters
in the Ceramic Surface Mount Package
 $V_{DS} = 3\text{ V}$, $I_{DS} = 10\text{ mA}$

Frequency (GHz)	S_{11E}		S_{21E}		S_{12E}		S_{22E}	
	Mag	Angle	Mag	Angle	Mag	Angle	Mag	Angle
0.50	1.02	-9.4	2.20	171.2	0.01	83.5	0.73	-6.2
1.00	1.02	-19.0	2.21	162.3	0.02	77.4	0.73	-12.5
1.50	1.01	-28.6	2.26	153.2	0.03	70.4	0.74	-19.5
2.00	0.97	-37.3	2.19	142.8	0.05	62.6	0.74	-25.5
2.50	0.95	-47.6	2.20	133.0	0.06	55.1	0.72	-32.3
3.00	0.93	-57.9	2.19	123.4	0.07	47.8	0.71	-39.1
3.50	0.91	-67.9	2.16	113.7	0.08	40.5	0.69	-45.9
4.00	0.88	-77.7	2.12	104.6	0.08	33.2	0.68	-52.0
4.50	0.86	-87.5	2.08	95.9	0.09	26.0	0.66	-57.8
5.00	0.83	-96.8	2.06	87.4	0.10	19.3	0.64	-63.3
5.50	0.81	-106.2	2.05	79.0	0.10	12.7	0.63	-69.0
6.00	0.78	-115.7	2.04	70.6	0.10	6.3	0.60	-74.7
6.50	0.75	-126.3	2.02	61.8	0.11	-0.3	0.58	-81.2
7.00	0.72	-136.8	2.00	52.7	0.11	-8.0	0.55	-87.6
7.50	0.70	-146.9	1.96	44.5	0.11	-13.6	0.53	-93.2
8.00	0.68	-157.1	1.94	36.4	0.11	-17.6	0.51	-99.1
8.50	0.68	-167.4	1.93	28.0	0.11	-20.9	0.50	-105.8
9.00	0.68	-177.8	1.90	19.5	0.11	-25.3	0.49	-113.4
9.50	0.67	172.1	1.86	11.2	0.11	-30.2	0.48	-120.8
10.00	0.67	163.2	1.82	3.3	0.11	-34.5	0.47	-128.1
10.50	0.67	153.6	1.78	-4.5	0.11	-38.9	0.46	-136.0
11.00	0.68	144.1	1.75	-12.6	0.11	-43.4	0.46	-143.8
11.50	0.68	134.5	1.70	-20.8	0.11	-47.9	0.45	-152.1
12.00	0.69	125.4	1.66	-29.1	0.11	-52.0	0.44	-160.6
12.50	0.70	116.2	1.61	-37.4	0.10	-55.8	0.44	-169.9
13.00	0.70	107.7	1.55	-45.7	0.10	-59.1	0.43	-179.7
13.50	0.71	99.5	1.49	-53.7	0.10	-61.9	0.43	170.2
14.00	0.72	91.6	1.43	-61.5	0.09	-64.7	0.44	160.6
14.50	0.74	84.5	1.38	-69.0	0.09	-66.1	0.45	151.8
15.00	0.75	77.8	1.33	-76.3	0.09	-67.6	0.47	142.9
15.50	0.76	71.9	1.29	-83.5	0.09	-69.3	0.48	135.0
16.00	0.76	66.4	1.25	-90.6	0.09	-70.4	0.51	126.8
16.50	0.77	60.9	1.22	-97.9	0.09	-72.3	0.54	119.2
17.00	0.78	55.5	1.18	-105.2	0.09	-75.0	0.56	111.7
17.50	0.78	49.5	1.13	-112.6	0.09	-77.6	0.58	104.2
18.00	0.78	44.0	1.07	-119.8	0.09	-80.1	0.60	96.7
18.50	0.78	38.9	1.00	-126.3	0.09	-82.3	0.62	89.7
19.00	0.79	34.6	0.94	-132.5	0.09	-83.8	0.65	83.0
19.50	0.79	30.4	0.88	-138.1	0.09	-85.6	0.67	77.2
20.00	0.80	25.9	0.84	-143.7	0.09	-88.6	0.70	72.4

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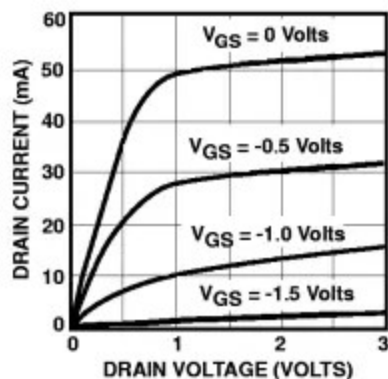
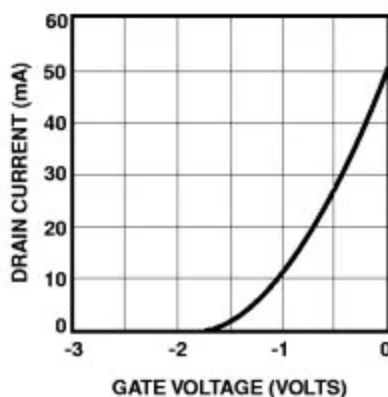
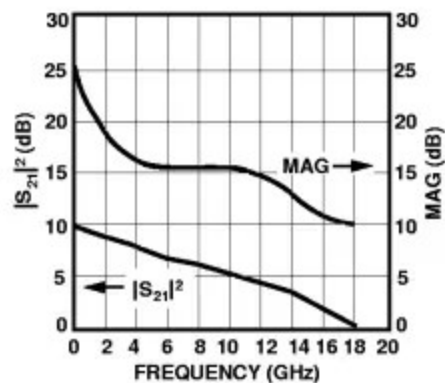
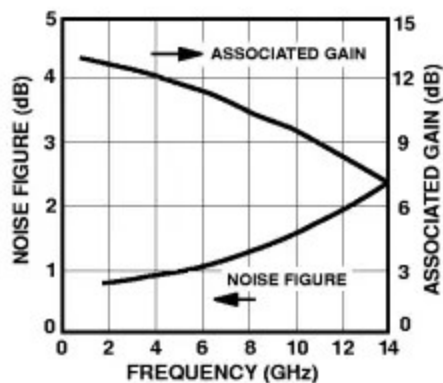
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**Typical Common Source Scattering Parameters
in the Ceramic Surface Mount Package (Cont'd)**

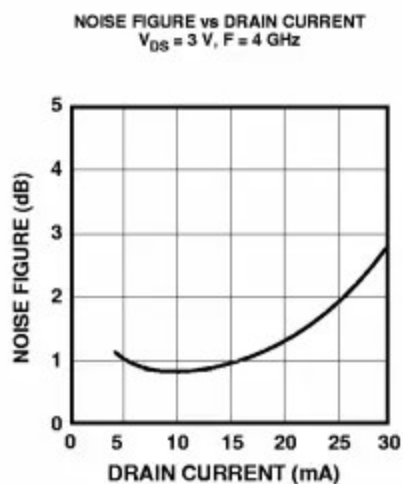
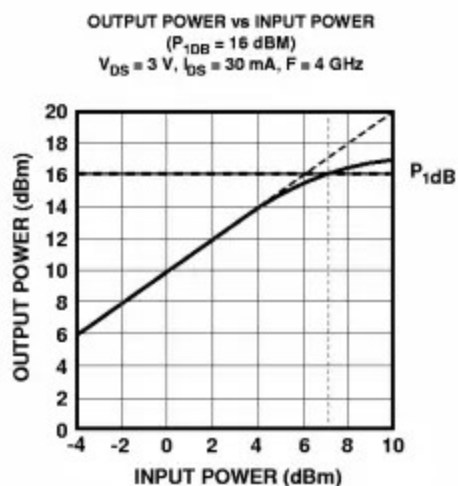
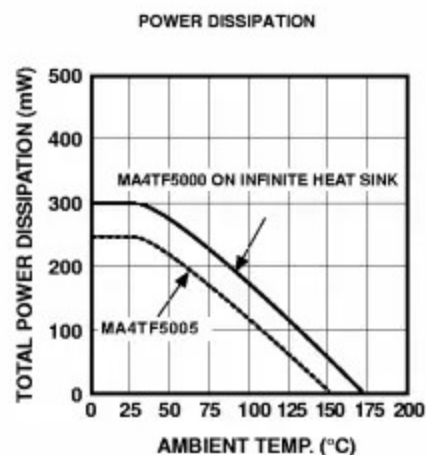
$V_{DS} = 3$ V, $I_{DS} = 30$ mA

Frequency (GHz)	S_{11E}		S_{21E}		S_{12E}		S_{22E}	
	Mag	Angle	Mag	Angle	Mag	Angle	Mag	Angle
0.50	1.02	-10.9	3.12	170.4	0.01	83.0	0.73	-6.3
1.00	1.01	-22.1	3.15	160.6	0.02	76.3	0.73	-12.7
1.50	1.01	-33.3	3.18	150.6	0.03	69.2	0.73	-19.8
2.00	0.95	-43.4	3.06	139.7	0.04	61.1	0.73	-25.7
2.50	0.93	-55.1	3.04	129.2	0.05	53.4	0.71	-32.3
3.00	0.90	-66.6	2.98	119.1	0.05	46.0	0.69	-39.0
3.50	0.88	-77.7	2.91	109.2	0.06	38.7	0.68	-45.5
4.00	0.85	-88.5	2.82	99.8	0.07	31.8	0.66	-51.3
4.50	0.82	-99.1	2.75	90.8	0.07	24.9	0.64	-56.8
5.00	0.79	-109.4	2.68	82.3	0.07	18.5	0.62	-61.8
5.50	0.76	-119.7	2.63	73.6	0.07	12.5	0.605	-67.0
6.00	0.74	-130.1	2.59	65.2	0.07	6.8	0.58	-72.0
6.50	0.71	-141.5	2.54	56.4	0.08	0.9	0.56	-78.0
7.00	0.68	-152.8	2.47	47.4	0.07	-5.7	0.53	-83.7
7.50	0.66	-163.3	2.40	39.3	0.07	-9.2	0.51	-88.6
8.00	0.65	-173.5	2.36	31.5	0.07	-10.3	0.50	-94.1
8.50	0.65	-176.2	2.32	23.3	0.07	-10.7	0.49	-100.4
9.00	0.66	-166.0	2.27	15.0	0.07	-13.5	0.48	-107.6
9.50	0.66	-156.5	2.21	7.0	0.07	-16.1	0.47	-114.7
10.00	0.66	-147.9	2.15	-0.6	0.07	-18.4	0.47	-121.8
10.50	0.67	-138.9	2.09	-8.2	0.07	-20.9	0.46	-129.5
11.00	0.68	-130.0	2.04	-16.0	0.08	-23.3	0.46	-137.2
11.50	0.69	-121.1	1.98	-23.9	0.08	-25.3	0.45	-145.2
12.00	0.70	-112.6	1.92	-31.9	0.08	-27.1	0.45	-153.6
12.50	0.71	-104.3	1.85	-39.9	0.08	-28.8	0.44	-162.9
13.00	0.72	-96.6	1.78	-47.8	0.08	-30.4	0.44	-172.6
13.50	0.74	-89.1	1.71	-55.5	0.08	-31.7	0.44	-177.3
14.00	0.75	-82.0	1.64	-63.1	0.08	-33.7	0.44	-167.4
14.50	0.76	-75.5	1.58	-70.4	0.09	-35.2	0.45	-158.4
15.00	0.77	-69.1	1.52	-77.6	0.09	-37.4	0.47	-149.2
15.50	0.79	-63.5	1.48	-84.7	0.09	-40.0	0.49	-141.0
16.00	0.79	-58.4	1.44	-91.8	0.10	-43.0	0.52	-132.5
16.50	0.80	-53.0	1.40	-99.2	0.10	-46.1	0.54	-124.6
17.00	0.81	-47.7	1.35	-106.5	0.11	-49.8	0.56	-116.7
17.50	0.81	-41.9	1.30	-113.8	0.11	-53.6	0.59	-109.0
18.00	0.81	-36.6	1.23	-120.9	0.11	-57.7	0.61	-101.0
18.50	0.81	-31.8	1.15	-127.5	0.11	-61.0	0.63	-93.6
19.00	0.81	-27.7	1.08	-133.6	0.11	-63.9	0.65	-86.6
19.50	0.82	-23.7	1.02	-139.1	0.11	-67.3	0.68	-80.4
20.00	0.82	-19.5	0.97	-144.8	0.11	-71.1	0.070	-75.2

Typical Performance Curves @ 25°C

DRAIN CURRENT vs GATE VOLTAGE AT $V_{DS} = 3\text{ V}$ MAXIMUM AVAILABLE GAIN AND TRANSDUCER GAIN
 $V_{DS} = 3\text{ V}$, $I_{DS} = 30\text{ mA}$ ASSOCIATED GAIN AND NOISE FIGURE vs FREQUENCY
 $V_{DS} = 3\text{ V}$, $I_{DS} = 30\text{ mA}$ 

Typical Performance Curves (Cont'd)

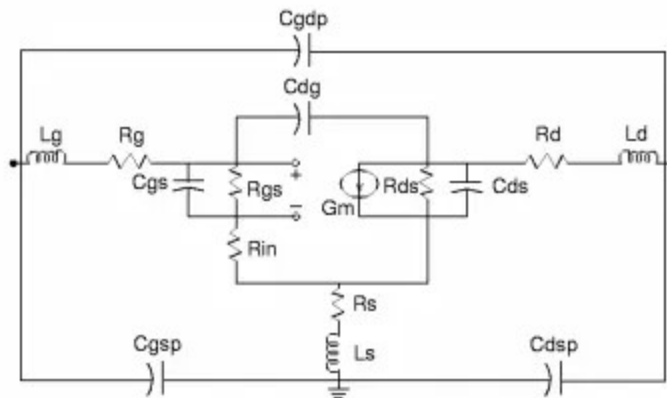


MA4TF5005 in the Ceramic Surface Mount Package Typical Noise Parameters

 $V_{DS} = 3\text{V}, I_{DS} = 10\text{mA}$

Frequency (GHz)	NF_O (dB)	G_A (dB)	Γ_{OPT}		R_n
			Mag	Angle	
2.00	0.68	14.41	0.73	28.1	22.29
3.00	0.84	12.88	0.71	43.3	25.24
4.00	1.00	11.55	0.69	60.8	25.74
5.00	1.16	10.41	0.67	80.3	23.48
6.00	1.32	9.43	0.65	101.4	18.77
7.00	1.48	8.62	0.63	123.5	12.74
8.00	1.64	7.96	0.62	146.4	7.16
9.00	1.81	7.44	0.60	169.5	3.93
10.00	1.97	7.06	0.60	-167.5	4.61
11.00	2.13	6.81	0.60	-145.1	9.94
12.00	2.29	6.67	0.60	-123.7	19.75
13.00	2.45	6.65	0.61	-103.7	33.12
14.00	2.61	6.71	0.63	-85.6	48.79

MA4TF5005 in the Ceramic Surface Mount Package Small Signal Model

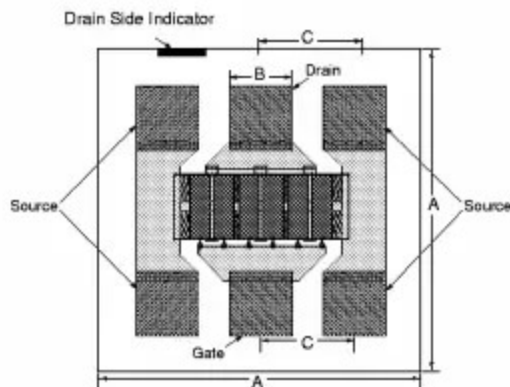
 $V_{DS} = 3\text{V}, I_{DS} = 10\text{mA}$


Element	Value
R_g	$0.18\ \Omega$
R_d	$0.0015\ \Omega$
R_s	$5.5\ \Omega$
R_{in}	$5.0\ \Omega$
R_{gs}	$1481\ \Omega$
R_{ds}	$406\ \Omega$
C_{gs}	$0.35\ \text{pF}$
C_{ds}	$0.16\ \text{pF}$
C_{gd}	$0.055\ \text{pF}$

Element	Value
G_m	$32\ \text{mS}$
τ_{au}	$8.62\ \text{ps}$
L_g	$0.60\ \text{nH}$
L_d	$0.59\ \text{nH}$
L_s	$0.045\ \text{nH}$
C_{gsp}	$0.065\ \text{pF}$
C_{gdsp}	$0.019\ \text{pF}$
C_{dsp}	$0.039\ \text{pF}$

Chip – MA4TF5000

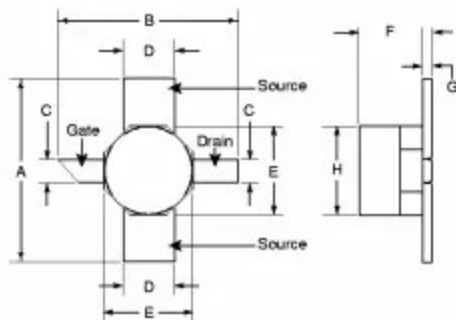
Case Style 1161

**MA4TF5000**

DIM.	INCHES (NOM.)	MILLIMETERS (NOM.)
A	0.016	0.406
B	0.002	0.050
C	0.003	0.075

Ceramic Surface Mount Package

Case Style 1105 — MA4TF5005

**MA4TF5005**

DIM.	INCHES		MILLIMETERS	
	MIN.	MAX.	MIN.	MAX.
A	0.150	0.165	3.80	4.20
B	0.150	0.165	3.80	4.20
C	0.014	0.026	0.35	0.65
D	0.032	0.047	0.80	1.20
E	0.063	0.079	1.60	2.00
F	—	0.057	—	1.45
G	0.002	0.008	0.05	0.20
H	0.063	0.079	1.60	2.00