Low Noise and Medium Power GaAs FETs

FEATURES

- Low Noise Figure: NF = 0.8 dB Typical at 12 GHz
- High Associated Gain: Ga = 10 dB Typical at 12 GHz
- High Dynamic Range: 1 dB Compression Power P_{-1} = 24.5 dBm at 12 GHz
- Breakdown Voltage: $BV_{DGO} \geq 9$ V
- Lg = 0.25 µm, Wg = 600 µm
- All-Gold Metallization for High Reliability
- Tight Vp ranges control
- High RF input power handling capability
- 100 % DC Tested

PHOTO ENLARGEMENT

DESCRIPTION

The TC1301 is a GaAs Pseudomorphic High Electron Mobility Transistor (PHEMT) chip, which has very low noise figure, high associated gain and high dynamic range. The device can be used in circuits up to 30 GHz and suitable for low noise and medium power amplifier applications including a wide range of commercial and military applications. All devices are 100% DC tested to assure consistent quality. All bond pads are gold plated for either thermo-compression or thermo-sonic wire bonding.

ELECTRICAL SPECIFICATIONS (T_A=25 °C)

Symbol	Conditions	MIN	TYP	MAX	UNIT
NF	Noise Figure at V_{DS} = 4 V, I_{DS} = 50 mA, f = 12GHz		0.8	1.0	dB
G_a	Associated Gain at V_{DS} = 4 V, I_{DS} = 50 mA, f = 12GHz	9	10		dB
P_{1dB}	Output Power at 1dB Gain Compression Point , f = 12GHz V_{DS} = 6 V, I_{DS} = 80 mA	23.5	24.5		dBm
G_L	Linear Power Gain, f = 12GHz ,V_{DS} = 6 V, I_{DS} = 80 mA	9	10		dB
I_{DSS}	Saturated Drain-Source Current at V_{DS} = 2 V, V_{GS} = 0 V		180		mA
g_m	Transconductance at V_{DS} = 2 V, V_{GS} = 0 V		200		mS
V_P	Pinch-off Voltage at V_{DS} = 2 V, I_D = 1.2 mA		-1.0*		Volts
BV_{DGO}	Drain-Gate Breakdown Voltage at I_{DGO} =0.3 mA	9	12		Volts
R_{th}	Thermal Resistance		60		°C/W

Note: * For the tight control of the pinch-off voltage . TC1301's are divided into 3 groups:
(1) **TC1301P0710** : Vp = -0.7V to -1.0V (2) **TC1301P0811** : Vp = -0.8V to -1.1V (3) **TC1301P0912** : Vp = -0.9V to -1.2V
In addition, the customers may specify their requirements.

ABSOLUTE MAXIMUM RATINGS (T_A=25 °C)

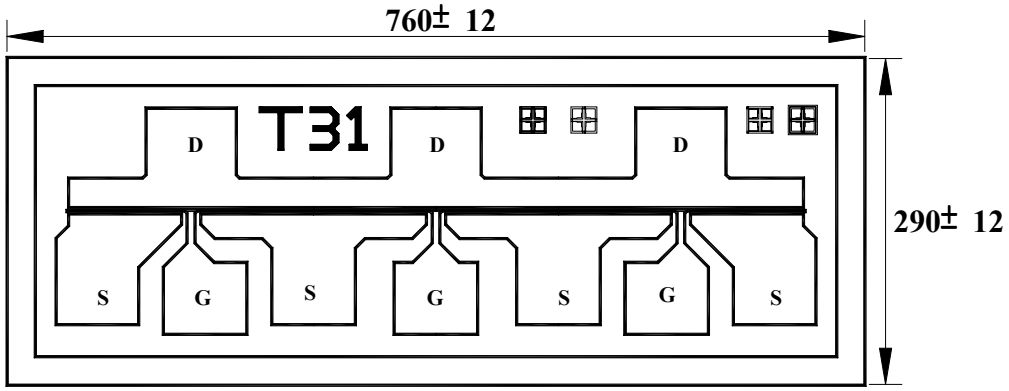
Symbol	Parameter	Rating
V_{DS}	Drain-Source Voltage	7.0 V
V_{GS}	Gate-Source Voltage	-3.0 V
I_{DS}	Drain Current	I_{DSS}
I_{GS}	Gate Current	600 μA
P_{in}	RF Input Power, CW	24 dBm
P_T	Continuous Dissipation	800 mW
T_{CH}	Channel Temperature	175 °C
T_{STG}	Storage Temperature	- 65 °C to +175 °C

TYPICAL NOISE PARAMETERS (T_A=25 °C)

V_{DS} = 4 V, I_{DS} = 50 mA

Frequency	NF_{opt}	G_A	Γ_{opt}		Rn/50
(GHz)	(dB)	(dB)	MAG	ANG	
2	0.36	19.7	0.88	15	0.28
4	0.48	16.6	0.74	39	0.18
6	0.59	14.3	0.62	64	0.15
8	0.70	12.7	0.55	92	0.12
10	0.78	11.7	0.50	120	0.09
12	0.85	10.9	0.49	148	0.06
14	0.98	10.4	0.50	174	0.04
16	1.12	9.8	0.51	-162	0.04
18	1.27	9.0	0.54	-141	0.07

CHIP DIMENSIONS

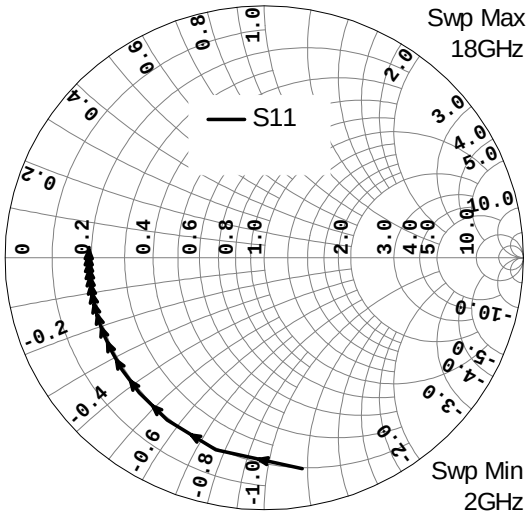


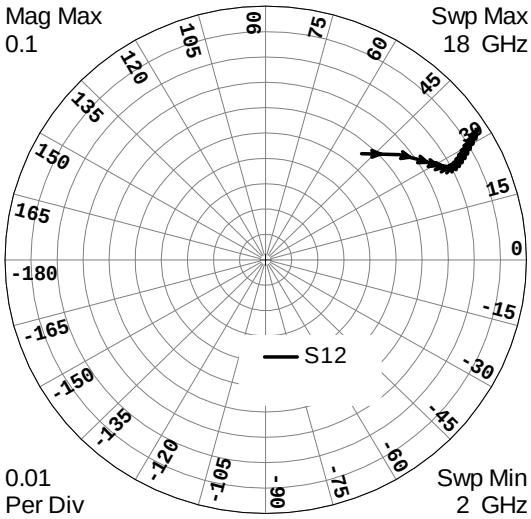
Chip Thickness: 100

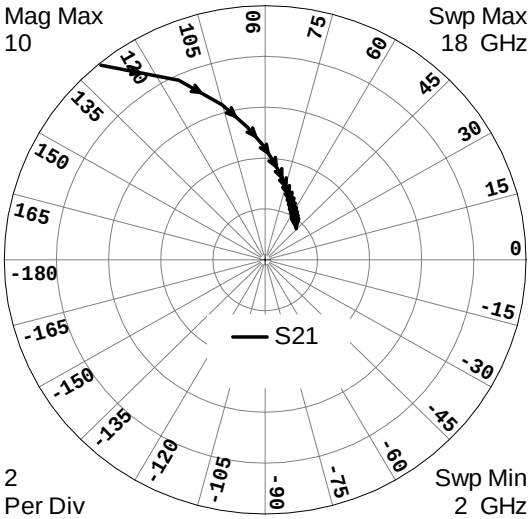
Drain Pad: 80 x 70

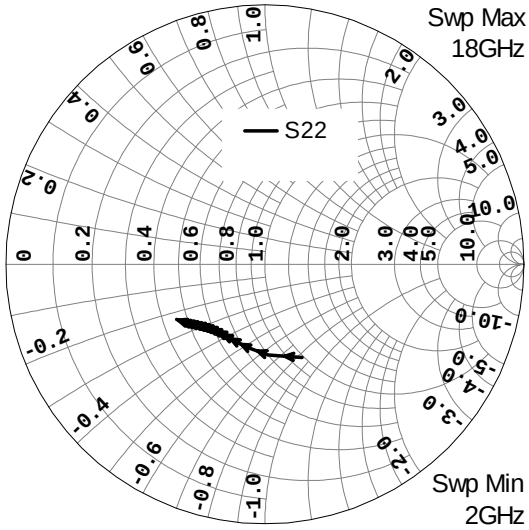
Source Pad: 75 x 80

TYPICAL SCATTERING PARAMETERS (T_A=25 °C) V_{DS} = 4 V, I_{DS} = 50 mA





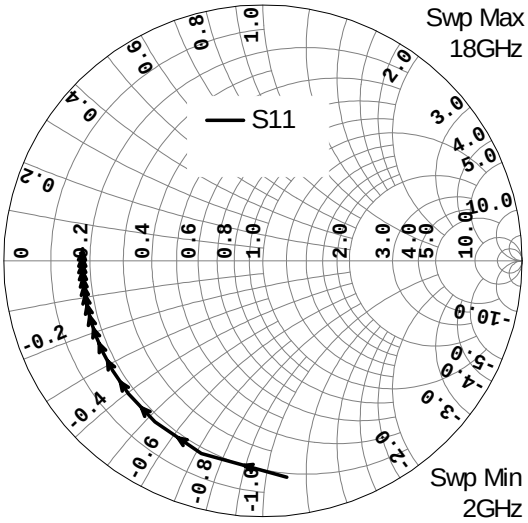


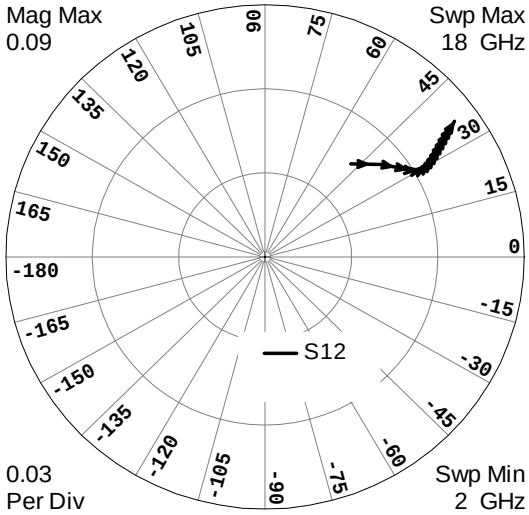


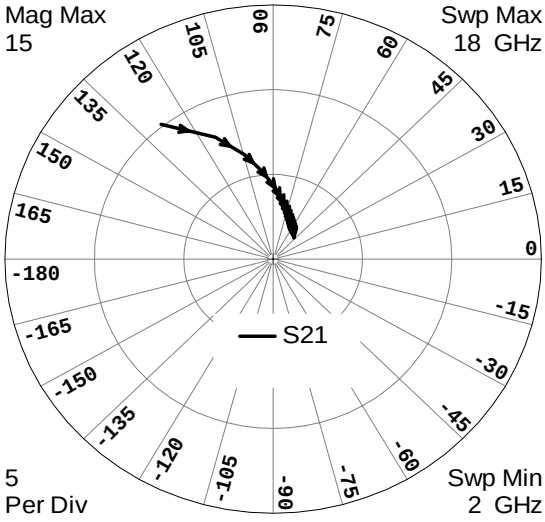
FREQUENCY	S11		S21		S12		S22	
(GHz)	MAG	ANG	MAG	ANG	MAG	ANG	MAG	ANG
2	0.8504	-80.07	9.9111	129.43	0.0557	48.67	0.3868	-68.29
3	0.7843	-103.76	7.8038	115.14	0.0659	38.99	0.3487	-88.15
4	0.7445	-120.17	6.3123	105.04	0.0713	33.48	0.3277	-101.61
5	0.7206	-132.00	5.2595	97.31	0.0745	30.31	0.3178	-111.02
6	0.7058	-140.93	4.4944	91.01	0.0767	28.54	0.3147	-117.84
7	0.6961	-147.93	3.9201	85.60	0.0785	27.63	0.3159	-122.98
8	0.6897	-153.62	3.4764	80.80	0.0800	27.27	0.3198	-127.02
9	0.6853	-158.39	3.1248	76.43	0.0814	27.29	0.3256	-130.30
10	0.6822	-162.46	2.8405	72.38	0.0828	27.56	0.3327	-133.08
11	0.6800	-166.03	2.6065	68.56	0.0843	28.01	0.3406	-135.50
12	0.6785	-169.21	2.4110	64.93	0.0858	28.56	0.3490	-137.67
13	0.6776	-172.07	2.2456	61.46	0.0875	29.19	0.3577	-139.65
14	0.6769	-174.69	2.1042	58.11	0.0892	29.86	0.3667	-141.49
15	0.6766	-177.11	1.9821	54.87	0.0910	30.55	0.3756	-143.23
16	0.6765	-179.36	1.8759	51.72	0.0928	31.23	0.3845	-144.89
17	0.6766	178.52	1.7827	48.65	0.0948	31.89	0.3933	-146.47
18	0.6768	176.52	1.7005	45.65	0.0969	32.53	0.4020	-148.00

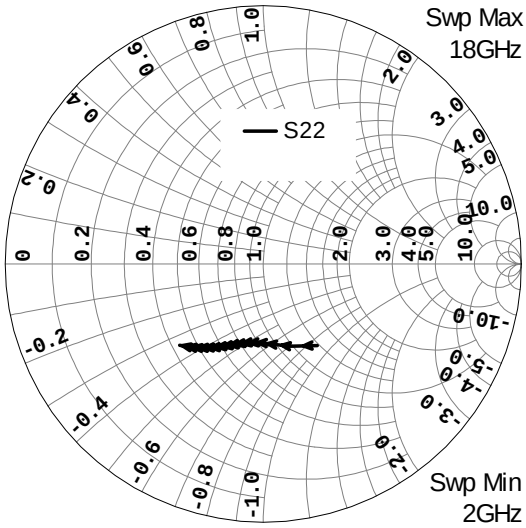
* The data does not include gate, drain and source bond wires.

TYPICAL SCATTERING PARAMETERS (T_A=25 °C) V_{DS} = 6 V, I_{DS} = 80 mA







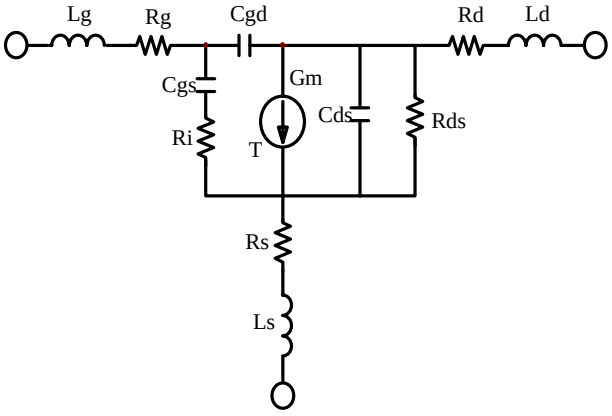


FREQUENCY	S11		S21		S12		S22	
(GHz)	MAG	ANG	MAG	ANG	MAG	ANG	MAG	ANG
2	0.8511	-83.76	10.1160	128.27	0.0446	48.15	0.3787	-56.54
3	0.7902	-107.47	7.8891	114.27	0.0523	39.06	0.3349	-72.15
4	0.7549	-123.54	6.3492	104.51	0.0564	34.17	0.3133	-82.94
5	0.7342	-134.97	5.2766	97.09	0.0590	31.58	0.3059	-90.91
6	0.7214	-143.52	4.5034	91.05	0.0609	30.31	0.3072	-97.18
7	0.7133	-150.20	3.9260	85.88	0.0626	29.84	0.3138	-102.35
8	0.7078	-155.61	3.4814	81.28	0.0641	29.86	0.3237	-106.81
9	0.7041	-160.12	3.1301	77.07	0.0655	30.19	0.3356	-110.76
10	0.7015	-163.98	2.8465	73.16	0.0671	30.73	0.3485	-114.34
11	0.6998	-167.36	2.6134	69.46	0.0686	31.38	0.3620	-117.64
12	0.6986	-170.36	2.4188	65.92	0.0703	32.10	0.3757	-120.71
13	0.6978	-173.08	2.2542	62.52	0.0720	32.85	0.3893	-123.59
14	0.6973	-175.55	2.1134	59.23	0.0738	33.60	0.4027	-126.31
15	0.6971	-177.85	1.9919	56.03	0.0756	34.33	0.4157	-128.89
16	0.6971	-179.98	1.8860	52.90	0.0775	35.03	0.4283	-131.35
17	0.6973	178.01	1.7930	49.83	0.0795	35.70	0.4404	-133.69
18	0.6976	176.11	1.7109	46.82	0.0816	36.32	0.4520	-135.92

*The data does not include gate, drain and source bond wires.

SMALL SIGNAL MODEL, V_{DS} = 4 V, I_{DS} = 50 mA

SCHEMATI

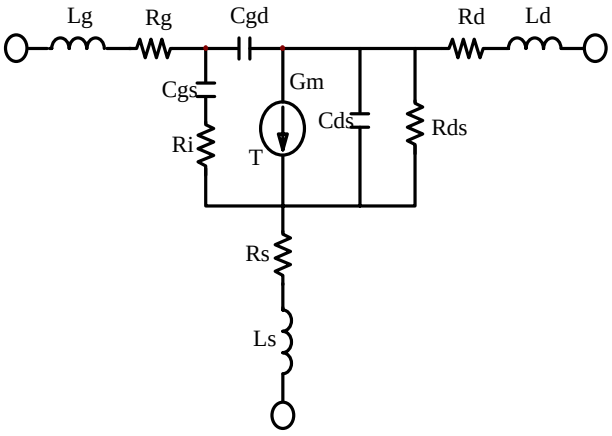


PARAMETERS

Lg	0.057 nH	**Rs**	1.66 Ohm
Rg	2.08 Ohm	**Ls**	0.019 nH
Cgs	0.959 pF	**Cds**	0.167 pF
Ri	5.78 Ohm	**Rds**	93.2 Ohm
Cgd	0.074 pF	**Rd**	1.358 Ohm
Gm	284.0 mS	**Ld**	0.038 nH
T	5.54 psec		

SMALL SIGNAL MODEL, V_{DS} = 6 V, I_{DS} = 80 mA

SCHEMATI

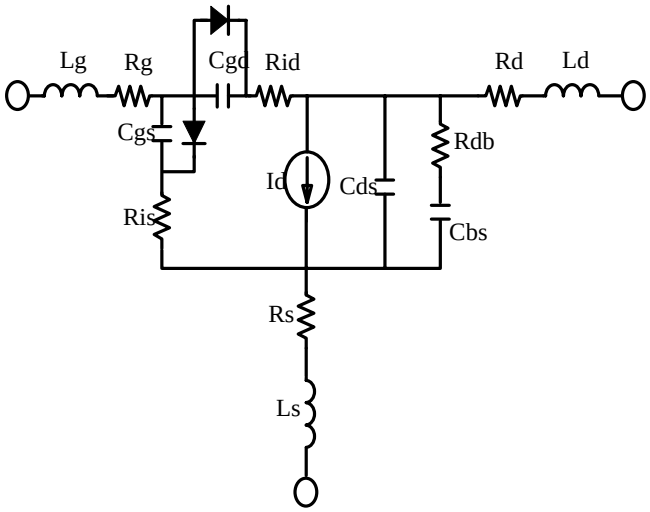


PARAMETERS

Lg	0.056 nH	**Rs**	1.808 Ohm
Rg	1.954 Ohm	**Ls**	0.016 nH
Cgs	1.33 pF	**Cds**	0.185 pF
Ri	5.58 Ohm	**Rds**	90.1 Ohm
Cgd	0.052 pF	**Rd**	1.422 Ohm
Gm	315 mS	**Ld**	0.036 nH
T	5.63 psec		

LARGE SIGNAL MODEL, V_{DS} = 6 V, I_{DS} = 80 mA

SCHEMATIC



TOM2 MODEL PARAMETERS

Parameters		Parameters	
VTO	-0.43283 V	**VMAX**	0.5 V
ALPHA	9.54	**CGD**	0.0554 pF
BETA	0.49	**CGS**	6.018 pF
GAMMA	0.0416	**CDS**	0.1599 pF
DELTA	0.3091	**RIS**	5.755 Ohm
Q	0.84	**RID**	0.001 Ohm
NG	0.1	**VBR**	9 V
ND	0.01	**RDB**	94.333 Ohm
TAU	5.558 ps	**CBS**	0.0463 pF
RG	2.0833 Ohm	**TNOM**	25 °C
RD	1.358 Ohm	**LS**	0.01893 nH
RS	1.662 Ohm	**LG**	0.0576 nH
IS	1E-11 mA	**LD**	0.038 nH
N	1	**AFAC**	1
VBI	1 V	**NFING**	1
VDELTA	0.2 V		

CHIP HANDLING

DIE ATTACHMENT: Conductive epoxy or eutectic die attach is recommended. Eutectic die attach can be accomplished with Au-Sn (80%Au-20%Sn) perform at stage temperature: 290°C ± 5°C; Handling Tool: Tweezers; Time: less than 1min.

WIRE BONDING: The recommended wire bond method is thermocompression bonding with 0.7 to 1.0 mil (0.018 to 0.025 mm) gold wire. Stage temperature: 220°C to 250°C; Bond Tip Temperature: 150°C; Bond Force: 20 to 30 gms depending on size of wire and Bond Tip Temperature.

HANDLING PRECAUTIONS: The user must operate in a clean, dry environment. Care should be exercised during handling avoid damage to the devices. Electrostatic Discharge (ESD) precautions should be observed at all stages of storage, handling, assembly, and testing. The static discharge must be less than 300V.