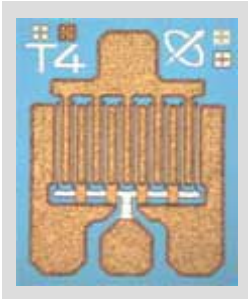
0.5 W High Linearity and High Efficiency GaAs Power FETs

FEATURES

- 0.5W Typical Power at 12 GHz
- Linear Power Gain: G_L = 9 dB Typical at 12 GHz
- High Linearity: IP3 = 37 dBm Typical at 12 GHz
- High Power Added Efficiency (PAE): 40% typical
- Via holes in the source pads
- Breakdown Voltage: BV_{DGO} ≥ 15 V
- Lg = 0.35 μm, Wg = 1.2 mm
- Tight Vp ranges control
- High RF input power handling capability
- 100 % DC Tested

PHOTO ENLARGEMENT



DESCRIPTION

The TC1401 is a GaAs Pseudomorphic High Electron Mobility Transistor (PHEMT) which has high linearity and high Power Added Efficiency. The device is with via-hole processes to reduce the thermal resistance and grounding inductance. The short gate length enables the device to be used in a circuit up to 20GHz. All devices are 100% DC tested to assure consistent quality. Backside gold plating is compatible with standard AuSn die-attach.

ELECTRICAL SPECIFICATIONS (T_A=25 °C)

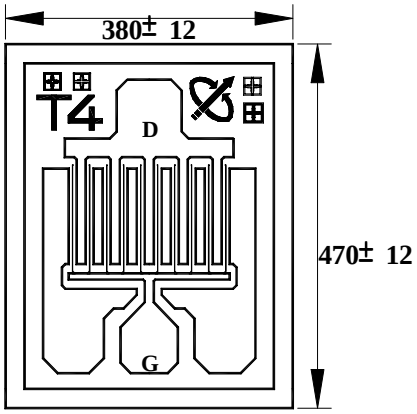
Symbol	Conditions	MIN	TYP	MAX	UNIT
P_{1dB}	Output Power at 1dB Gain Compression Point, f = 12GHz,V_{DS} = 8 V, I_{DS} = 120 mA	26.5	27		dBm
G_L	Linear Power Gain, f = 12GHz,V_{DS} = 8 V, I_{DS} = 120 mA	8	9		dB
IP3	Intercept Point of the 3rd-order Intermodulation, f = 12GHz,V_{DS} = 8 V, I_{DS} = 120 mA, P_{SCL} = 14 dBm		37		dBm
PAE	Power Added Efficiency at 1dB Compression Power, f = 12GHz		40		%
I_{DSS}	Saturated Drain-Source Current at V_{DS} = 2 V, V_{GS} = 0 V		300		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 = 2.4 mA		-1.7*		Volts
BV_{DGO}	Drain-Gate Breakdown Voltage at I_{DGO} =0.6 mA	15	18		Volts
R_{th}	Thermal Resistance		24		°C/W

Note: * For the tight control of the pinch-off voltage . TC1401's are divided into 3 groups:
(1) **TC1401P0710** : Vp = -1.5V to -1.9V (2) **TC1401P0811** : Vp = -1.6V to -2.0V (3) **TC1401P0912** : Vp = -1.7V to -2.1V
In addition, the customers may specify their requirements.

ABSOLUTE MAXIMUM RATINGS (T_A=25 °C)

Symbol	Parameter	Rating
V_{DS}	Drain-Source Voltage	12 V
V_{GS}	Gate-Source Voltage	-5 V
I_{DS}	Drain Current	I_{DSS}
P_{in}	RF Input Power, CW	26 dBm
P_T	Continuous Dissipation	1.9 W
T_{CH}	Channel Temperature	175 °C
T_{STG}	Storage Temperature	- 65 °C to +175 °C

CHIP DIMENSIONS



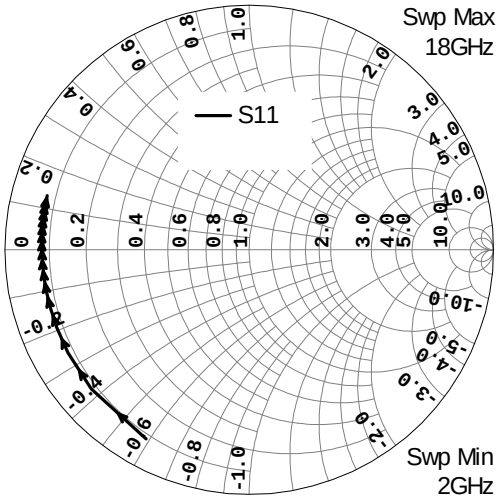
Units: Micrometers

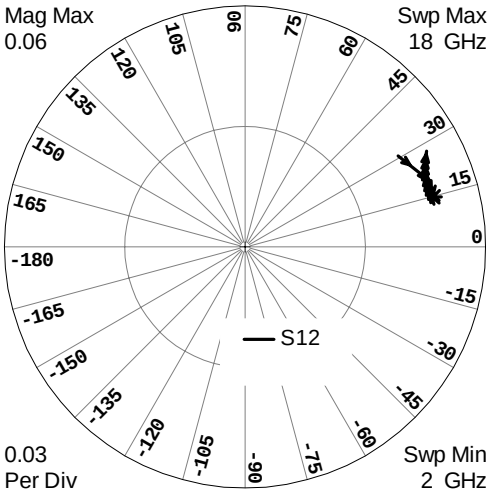
Chip Thickness: 50

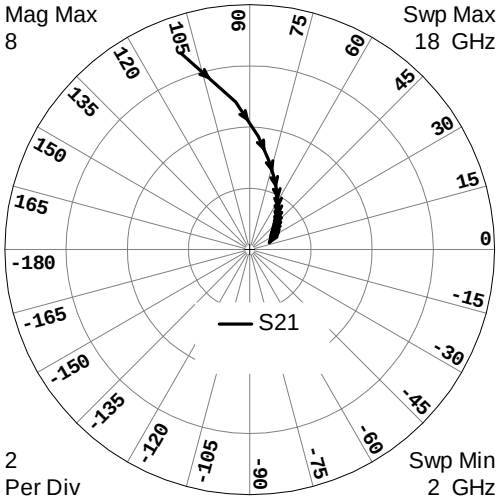
Gate Pad: 59.5 x 76.0

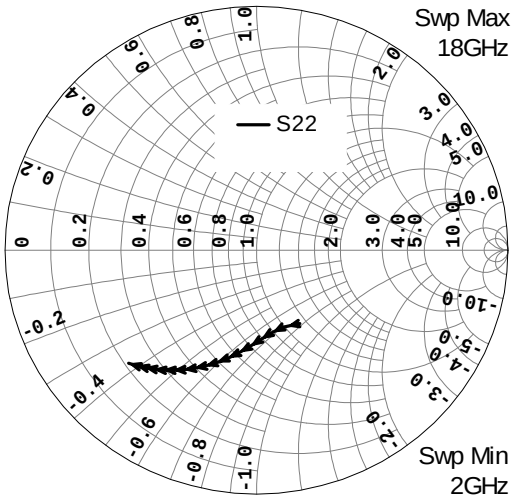
Drain Pad: 86.0 x 76.0

TYPICAL SCATTERING PARAMETERS (T_A=25 °C) V_{DS} = 8 V, I_{DS} = 120 mA







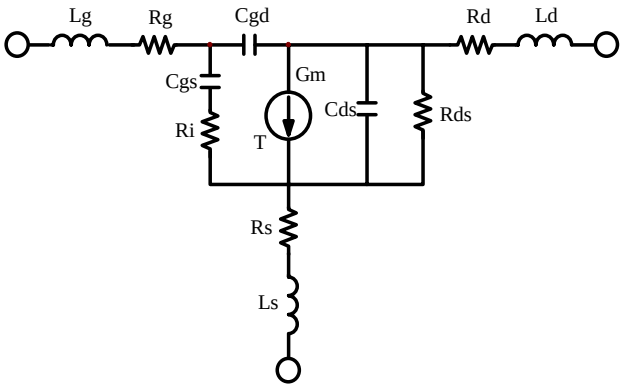


FREQUENCY	S11		S21		S12		S22	
(GHz)	MAG	ANG	MAG	ANG	MAG	ANG	MAG	ANG
2	0.8812	-118.69	6.8027	109.38	0.0444	30.70	0.3464	-60.23
3	0.8615	-138.63	4.8458	95.45	0.0475	22.46	0.3334	-72.09
4	0.8533	-150.38	3.7044	85.59	0.0486	18.30	0.3462	-80.95
5	0.8495	-158.25	2.9703	77.67	0.0488	16.10	0.3704	-88.26
6	0.8478	-164.04	2.4611	70.87	0.0487	15.04	0.3997	-94.57
7	0.8472	-168.60	2.0880	64.79	0.0485	14.71	0.4307	-100.14
8	0.8472	-172.36	1.8031	59.23	0.0483	14.91	0.4619	-105.13
9	0.8476	-175.58	1.5788	54.09	0.0481	15.50	0.4922	-109.66
10	0.8482	-178.43	1.3979	49.30	0.0479	16.40	0.5210	-113.80
11	0.8489	179.00	1.2492	44.81	0.0478	17.53	0.5481	-117.60
12	0.8497	176.64	1.1250	40.58	0.0479	18.84	0.5733	-121.11
13	0.8506	174.44	1.0200	36.58	0.0481	20.27	0.5967	-124.37
14	0.8516	172.37	0.9303	32.81	0.0484	21.77	0.6182	-127.39
15	0.8526	170.40	0.8529	29.24	0.0489	23.31	0.6380	-130.22
16	0.8536	168.52	0.7855	25.86	0.0495	24.84	0.6562	-132.86
17	0.8546	166.71	0.7266	22.64	0.0503	26.34	0.6729	-135.33
18	0.8556	164.97	0.6745	19.59	0.0512	27.78	0.6881	-137.66

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

~~SMALL SIGNAL MODEL, V_{DS} = 8 V, I_{DS} = 120 mA~~

SCHEMATI

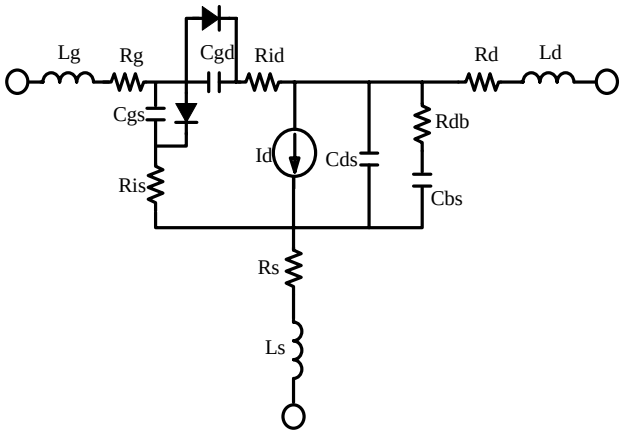


PARAMETERS

Lg	0.0813 nH	**Rs**	1.06 Ohm
Rg	0.93 Ohm	**Ls**	0.01 nH
Cgs	2.29 pF	**Cds**	0.298 pF
Ri	1.85 Ohm	**Rds**	119 Ohm
Cgd	0.08 pF	**Rd**	1.4 Ohm
Gm	233.5 mS	**Ld**	0.014 nH
T	3.9 psec		

SMALL SIGNAL MODEL, V_{DS} = 8 V, I_{DS} = 120 mA

SCHEMATI



TOM2 MODEL PARAMETERS

VTO	-1.8 V	**VMAX**	0.5 V
ALPHA	4.98	**CGD**	0.0743 pF
BETA	0.303	**CGS**	3.7075 pF
GAMMA	0.021	**CDS**	0.303 pF
DELTA	0.142	**RIS**	1.853 Ohm
Q	0.99	**RID**	0.0001 Ohm
NG	0.1	**VBR**	15 V
ND	0.01	**RDB**	121.37 Ohm
TAU	3.9 ps	**CBS**	4.569 pF
RG	0.9308 Ohm	**TNOM**	25 °C
RD	1.4 Ohm	**LS**	0.0096 nH
RS	1.092 Ohm	**LG**	0.0813 nH
IS	1E-11 mA	**LD**	0.014 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.