

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%
- No Via holes in the source pads
- Non-Via Hole Source for Self-Bias Application
- Breakdown Voltage: $BV_{DGO} \geq 15$ V
- $L_g = 0.35$ μ m, $W_g = 1.2$ mm
- Tight V_p ranges control
- High RF input power handling capability
- 100 % DC Tested

PHOTO ENLARGEMENT



DESCRIPTION

The TC1401N is a GaAs Pseudomorphic High Electron Mobility Transistor (PHEMT), which has high linearity and high Power Added Efficiency. The device has no via holes in the source pads. The short gate length characteristic 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, $f = 12$ GHz, $V_{DS} = 8$ V, $I_{DS} = 120$ mA	26.5	27		dBm
G_L	Linear Power Gain, $f = 12$ GHz, $V_{DS} = 8$ V, $I_{DS} = 120$ mA		9		dB
$IP3$	Intercept Point of the 3 rd -order Intermodulation, $f = 12$ GHz, $V_{DS} = 8$ V, $I_{DS} = 120$ mA, $P_{SCL} = 14$ dBm		37		dBm
PAE	Power Added Efficiency at 1dB Compression Power, $f = 12$ GHz		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		30		°C/W

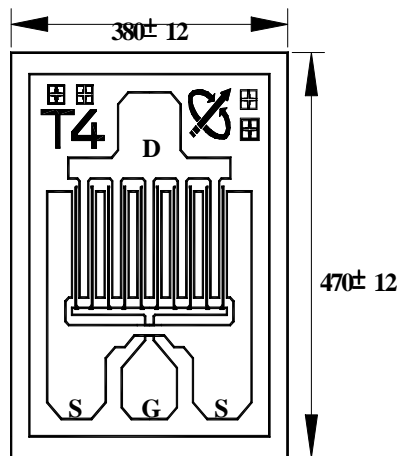
Note: * For the tight control of the pinch-off voltage. TC1401N's are divided into 3 groups:

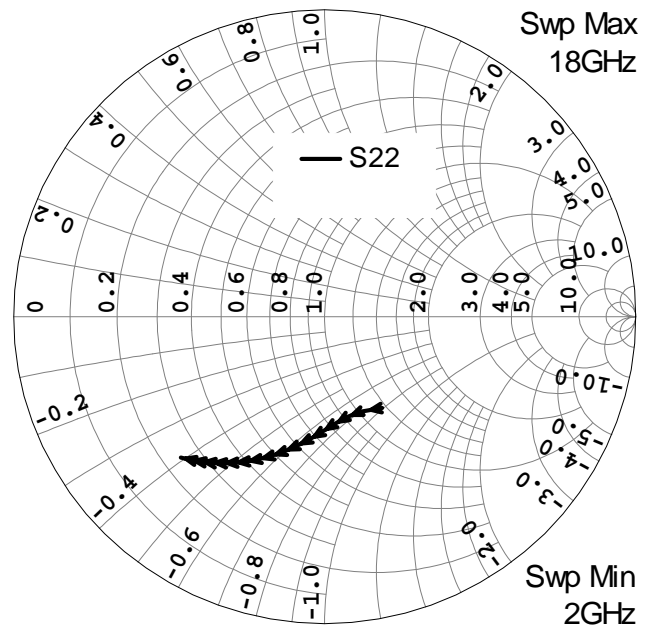
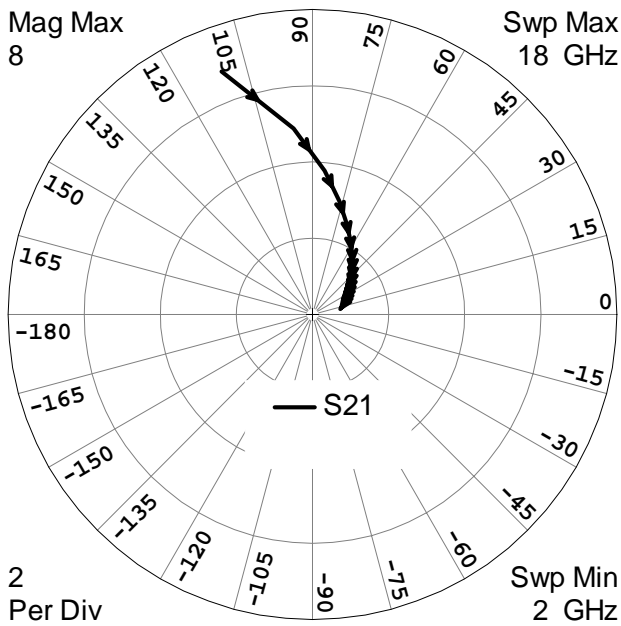
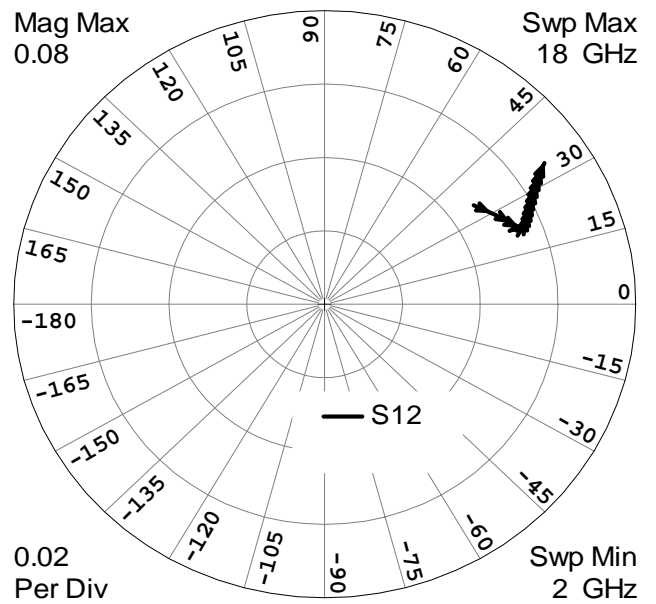
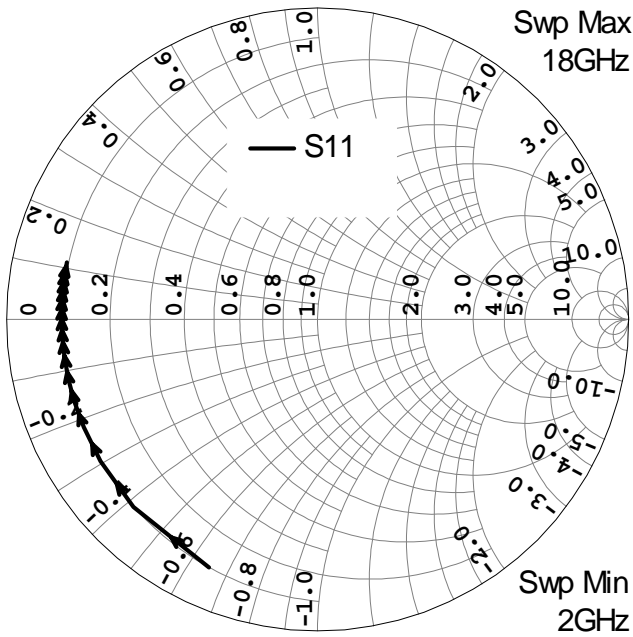
- (1) **TC1401NP0710** : $V_p = -1.5$ V to -1.9 V
- (2) **TC1401NP0811** : $V_p = -1.6$ V to -2.0 V
- (3) **TC1401NP0912** : $V_p = -1.7$ V to -2.1 V

In addition, the customers may specify their requirements.

ABSOLUTE MAXIMUM RATINGS (T_A=25 °C)

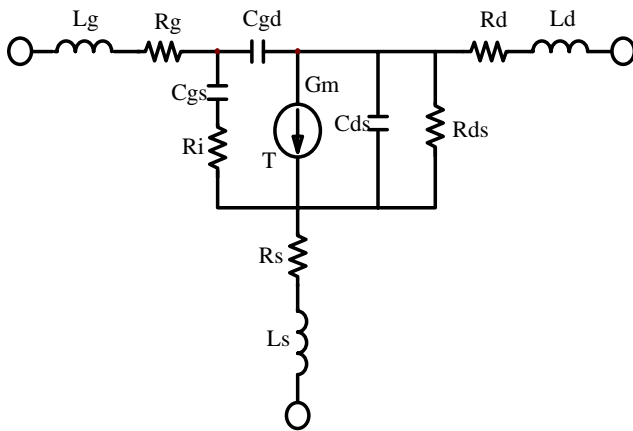
Symbol	Parameter	Rating
V _{DS}	Drain-Source Voltage	12 V
V _{GS}	Gate-Source Voltage	-5 V
I _{DS}	Drain Current	I _{DSS}
P _{in}	RF Input Power, CW	26 dBm
P _T	Continuous Dissipation	1.9 W
T _{CH}	Channel Temperature	175 °C
T _{STG}	Storage Temperature	- 65 °C to +175 °C

CHIP DIMENSIONS

Units: Micrometers
Chip Thickness: 76
Gate Pad: 59.5 x 76.0
Drain Pad: 86.0 x 76.0
Source Pad: 80 x 86

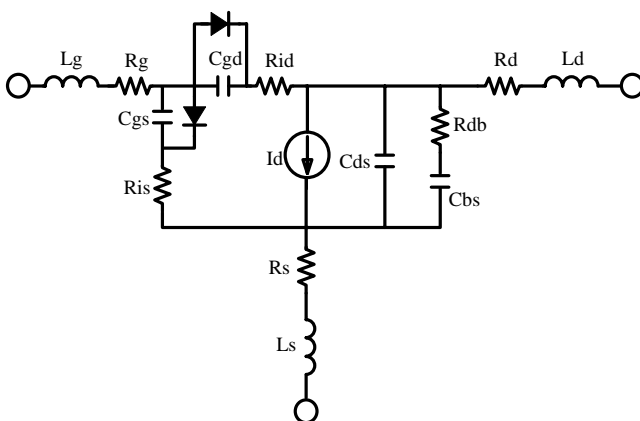
TYPICAL SCATTERING PARAMETERS (T_A=25 °C) V_{DS} = 8 V, I_{DS} = 120 mA


FREQUENCY (GHz)	S11		S21		S12		S22	
	MAG	ANG	MAG	ANG	MAG	ANG	MAG	ANG
0.05	0.99964	-4.2777	13.028	177.44	0.0022273	87.743	0.50265	-2.2399
0.1	0.99882	-8.5437	12.996	174.88	0.0044437	85.527	0.50175	-4.4726
0.2	0.99558	-16.995	12.869	169.82	0.0088014	81.129	0.49822	-8.888
0.3	0.99043	-25.266	12.667	164.88	0.012995	76.844	0.49259	-13.194
0.4	0.9837	-33.283	12.398	160.1	0.016962	72.722	0.48518	-17.345
0.5	0.97577	-40.984	12.077	155.53	0.020656	68.799	0.47639	-21.308
0.6	0.96704	-48.326	11.716	151.17	0.024051	65.101	0.46664	-25.059
0.7	0.095787	-55.281	11.328	147.06	0.027136	61.642	0.45632	-28.587
0.8	0.94857	-61.834	10.925	143.19	0.029916	58.429	0.44577	-31.888
0.9	0.9394	-67.983	10.516	139.57	0.032405	55.458	0.43528	-34.967
1	0.93053	-73.736	10.109	136.17	0.034622	52.721	0.42507	-37.833
1.1	0.92209	-79.105	9.7093	133.01	0.036592	50.207	0.41531	-40.499
1.2	0.91415	-84.111	9.3213	130.05	0.038338	47.901	0.40611	-42.979
1.3	0.90675	-88.773	8.9478	127.28	0.039885	45.79	0.39753	-45.289
1.4	0.89991	-93.114	8.5905	124.7	0.041256	43.857	0.38962	-47.444
1.5	0.8936	-97.158	8.2502	122.27	0.042472	42.088	0.38239	-49.46
1.6	0.88782	-100.93	7.9273	120	0.043552	40.468	0.37583	-51.35
1.7	0.88252	-104.44	7.6216	117.87	0.044514	38.984	0.36992	-53.128
1.8	0.87769	-107.72	7.3328	115.85	0.045372	37.624	0.36464	-54.805
1.9	0.87327	-110.79	7.06	113.96	0.046139	36.377	0.35995	-56.392
2	0.86924	-113.65	6.8027	112.16	0.046827	35.232	0.35582	-57.898
3	0.8443	-134.51	4.9090	95.78	0.0510	27.71	0.3300	-69.91
4	0.8331	-146.95	3.7809	85.19	0.0529	24.33	0.3361	-78.66
5	0.8275	-155.30	3.0502	76.63	0.0540	22.90	0.3547	-85.87
6	0.8246	-161.41	2.5422	69.22	0.0548	22.52	0.3792	-92.09
7	0.8230	-166.18	2.1696	62.57	0.0555	22.76	0.4062	-97.60
8	0.8223	-170.09	1.8850	56.46	0.0563	23.40	0.4341	-102.55
9	0.8219	-173.42	1.6608	50.77	0.0570	24.28	0.4616	-107.05
10	0.8219	-176.33	1.4797	45.43	0.0579	25.32	0.4883	-111.17
11	0.8221	-178.93	1.3306	40.38	0.0589	26.46	0.5138	-114.97
12	0.8225	178.69	1.2058	35.60	0.0599	27.64	0.5378	-118.49
13	0.8230	176.50	1.0998	31.06	0.0611	28.84	0.5603	-121.76
14	0.8235	174.44	1.0089	26.72	0.0624	30.02	0.5813	-124.81
15	0.8241	172.50	0.9300	22.59	0.0637	31.16	0.6009	-127.67
16	0.8248	170.66	0.8610	18.64	0.0652	32.25	0.6190	-130.34
17	0.8255	168.89	0.8000	14.85	0.0668	33.29	0.6358	-132.86
18	0.8262	167.19	0.7459	11.22	0.0684	34.26	0.6513	-135.23

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

SMALL SIGNAL MODEL, $V_{DS} = 8\text{ V}$, $I_{DS} = 120\text{ mA}$
SCHEMATI

PARAMETERS

Lg	0.071 nH	Rs	1.68 Ohm
Rg	1.27 Ohm	Ls	0.013 nH
Cgs	2.36 pF	Cds	0.297 pF
Ri	2.01 Ohm	Rds	103.7 Ohm
Cgd	0.069 pF	Rd	1.75 Ohm
Gm	253 mS	Ld	0.013 nH
T	3.9 psec		

LARGE SIGNAL MODEL, $V_{DS} = 8\text{ V}$, $I_{DS} = 120\text{ mA}$
SCHEMATI

TOM2 MODEL PARAMETERS

VTO	-1.812 V	VMAX	0.5 V
ALPHA	14.13	CGD	0.0691 pF
BETA	0.354	CGS	3.9867 pF
GAMMA	0.0228	CDS	0.278 pF
DELTA	0.1565	RIS	2.005 Ohm
Q	0.88	RID	0.0001 Ohm
NG	0.1	VBR	15 V
ND	0.01	RDB	119.667 Ohm
TAU	3.9 ps	CBS	4.7433 pF
RG	1.2733 Ohm	TNOM	25 °C
RD	1.32 Ohm	LS	0.0131 nH
RS	1.675 Ohm	LG	0.0715 nH
IS	1E-11 mA	LD	0.013 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: $290^{\circ}\text{C} \pm 5^{\circ}\text{C}$; 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.