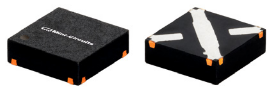
ULTRA LOW NOISE, MEDIUM CURRENT

E-PHEMT Transistor

TAV-581+

THE BIG DEAL

- Low Noise Figure, 0.5 dB
- Gain, 17 dB at 2 GHz
- High Output IP3, +31 dBm
- Output Power at 1dB comp., +19 dBm
- Low Current, 30mA
- Wide bandwidth
- External biasing and matching required



Generic photo used for illustration purposes only

CASE STYLE: FG873

+RoHS Compliant
The +Suffix identifies RoHS Compliance. See our web site for RoHS Compliance methodologies and qualifications

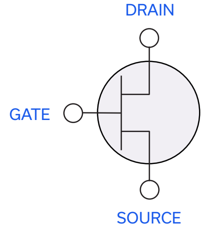
APPLICATIONS

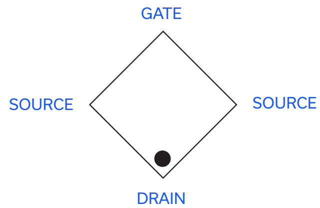
- Cellular
- ISM
- GSM
- WCDMA
- WiMax
- WLAN
- UNII and HIPERLAN

PRODUCT OVERVIEW

TAV-581+ is an ultra-low noise, high IP3 transistor device, manufactured using E-PHEMT* technology enabling it to work with a single positive supply voltage. It has outstanding Noise Figure, particularly below 2.5 GHz, and when combining this noise figure with high IP3 performance in a single device it makes it an ideal amplifier for demanding base station applications. We offer these units assembled into a complete module, 50Ω in/out, noise matched and fully specified. For more information please see our TAMP family of models on our web site.

SIMPLIFIED SCHEMATIC AND PAD DESCRIPTION





Function	Pad Number	Description
Source	2 & 4	Source terminal, normally connected to ground
Gate	3	Gate used for RF input
Drain	1	Drain used for RF output

* Enhancement mode Pseudomorphic High Electron Mobility Transistor.

REV. D
ECO-011337
TAV-581+
220112

ELECTRICAL SPECIFICATIONS AT T_{AMB}=25°C, FREQUENCY 0.45 TO 6 GHZ

Symbol	Parameter	Condition		Min.	Typ.	Max.	Units
		DC Specifications					
V_{GS}	Operational Gate Voltage	VDS=3V, IDS=30 mA		0.28	0.39	0.5	V
V_{TH}	Threshold Voltage	VDS=3V, IDS=4 mA		0.18	0.26	0.38	V
I_{DSS}	Saturated Drain Current	VDS=3V, VGS=0 V			1.0	5.0	μA
G_M	Transconductance	V_{DS}=3V, Gm=Δ I_{DS}/ΔV_{GS} ΔV_{GS}=VG_{S1}-VG_{S2} VG_{S1}=V_{GS} at I_{DS}=30 mA VG_{S2}=VG_{S1}+0.05V		— — 230 — —	— — 327 — —	— — 560 — —	mS
I_{GSS}	Gate leakage Current	VGD=VGS=-3V				200	μA
		RF Specifications, Z_0=50 Ohms (Figure 1)					
NF(1)	Noise Figure	V_{DS}=3V, I_{DS}=30 mA	f=0.9 GHz		0.4	—	dB
			f=2.0 GHz		0.5	0.9	
			f=3.9 GHz		0.9	—	
			f=5.8 GHz		1.5	—	
		V_{DS}=4V, I_{DS}=30 mA	f=0.9 GHz	—	0.4	—	
			f=2.0 GHz	—	0.5	—	
Gain	Gain	V_{DS}=3V, I_{DS}=30 mA	f=0.9 GHz	—	22.9	—	dB
			f=2.0 GHz	15.0	17.3	18.5	
			f=3.9 GHz	—	12.1	—	
			f=5.8 GHz	—	8.8	—	
		V_{DS}=4V, I_{DS}=30 mA	f=0.9 GHz		22.7		
			f=2.0 GHz		17.2		
OIP3	Output IP3	V_{DS}=3V, I_{DS}=30 mA	f=0.9 GHz		28.3		dBm
			f=2.0 GHz		30.3		
			f=3.9 GHz		33.0		
			f=5.8 GHz		34.7		
		V_{DS}=4V, I_{DS}=30 mA	f=0.9 GHz		28.1		
			f=2.0 GHz		30.0		
P1dB(2)	Power output at 1 dB Compression	V_{DS}=3V, I_{DS}=30 mA	f=0.9 GHz		17.8		dBm
			f=2.0 GHz		18.3		
			f=3.9 GHz		18.8		
			f=5.8 GHz		19.1		
		V_{DS}=4V, I_{DS}=30 mA	f=0.9 GHz		19.4		
			f=2.0 GHz		20.2		

MAXIMUM RATINGS(3)

Symbol	Parameter	Max.	Units
V_{DS}(4)	Drain-Source Voltage	5	V
V_{GS}(4)	Gate-Source Voltage	-5 to 0.7	V
V_{GD}(4)	Gate-Drain Voltage	-5 to 0.7	V
I_{DS}(4)	Drain Current	100	mA
I_{GS}	Gate Current	2	mA
P_{DISS}	Total Dissipated Power	550	mW
P_{IN}(5)	RF Input Power	17	dBm
T_{CH}	Channel Temperature	150	°C
T_{OP}	Operating Temperature	-40 to 85	°C
T_{STD}	Storage Temperature	-65 to 150	°C
Θ_{JC}	Thermal Resistance	112	°C/W

(1) Includes testboard loss (measured in Mini-Circuits test board TB-154)
(2) During Compression, IDS increases to 48mA typ.
(3) Operation of this device above any one of these parameters may cause permanent damage.
(4) Assumes DC quiescent conditions.
(5) IGS is limited to 2 mA during test.

CHARACTERIZATION TEST CIRCUIT

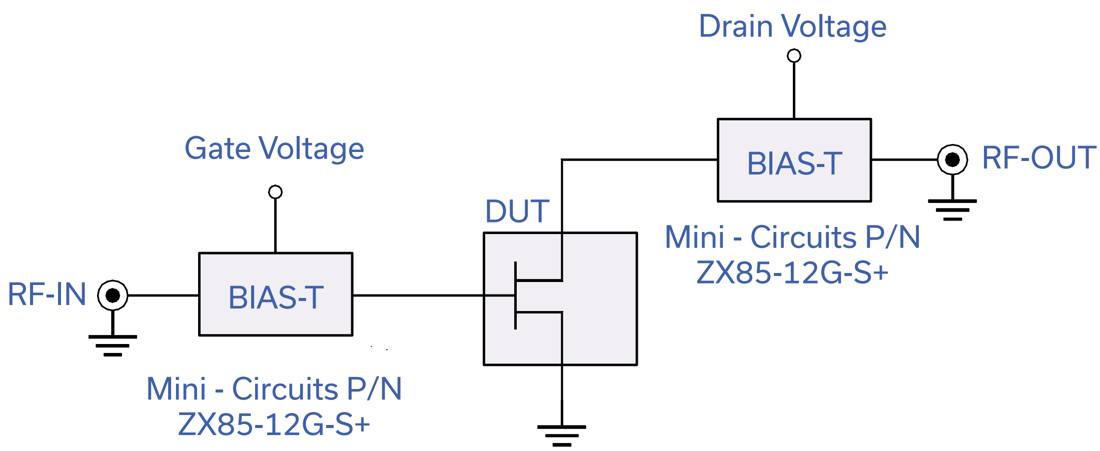


Fig 1. Block Diagram of Test Circuit used for characterization. (DUT soldered on Mini-Circuits Test Board TB-154)

Gain, Output power at 1dB compression (P1 dB) and output IP3 (OIP3) are measured using R&S Network Analyzer ZVA-24.
Noise Figure measured using Agilent's Noise Figure meter N8975A and noise source N4000A.

Conditions:
1. Drain voltage (with reference to source, VDS)= 3 or 4V as shown.
2. Gate Voltage (with reference to source, VGS) is set to obtain desired Drain-Source current (IDS) as shown in graphs or specification table.
3. Gain: Pin= -25dBm
4. Output IP3 (OIP3): Two tones, spaced 1 MHz apart, 0 dBm/tone at output.
5. No external matching components used.

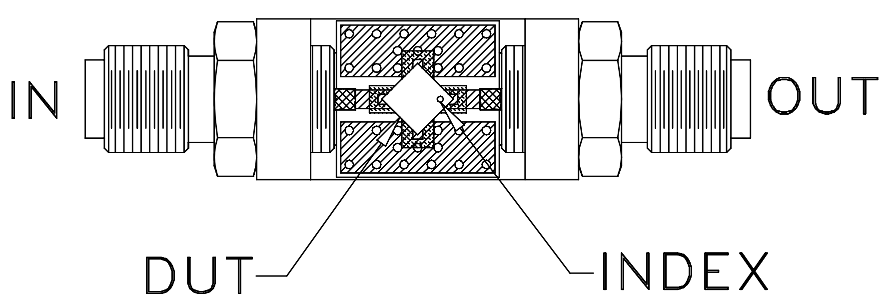
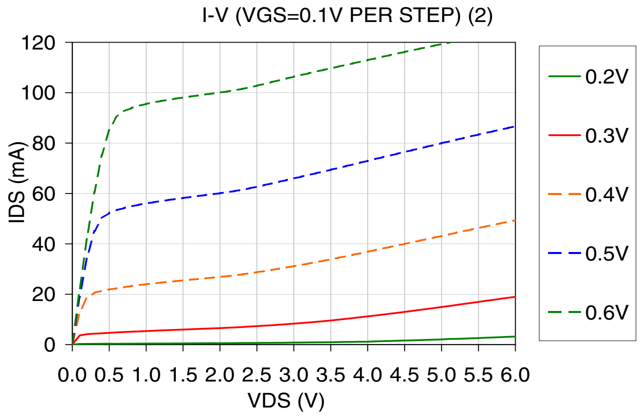
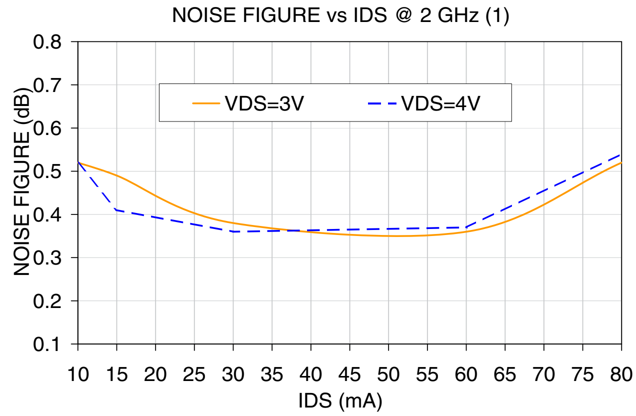
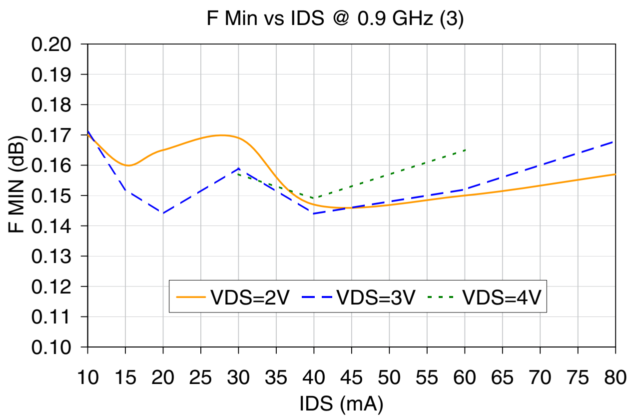


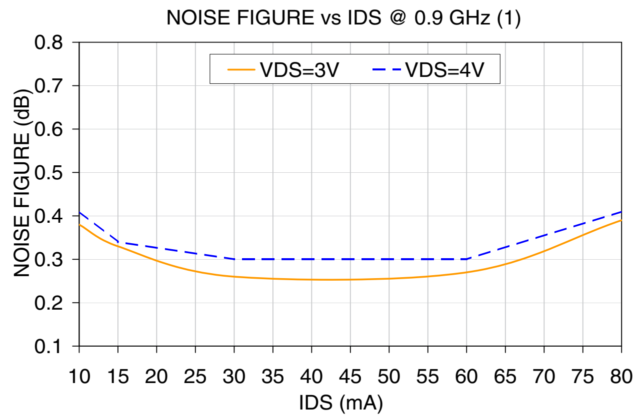
Fig 2. Test Board used for characterization, Mini-Circuits P/N TB-154 (Material: Rogers 4350, Thickness: 0.02")

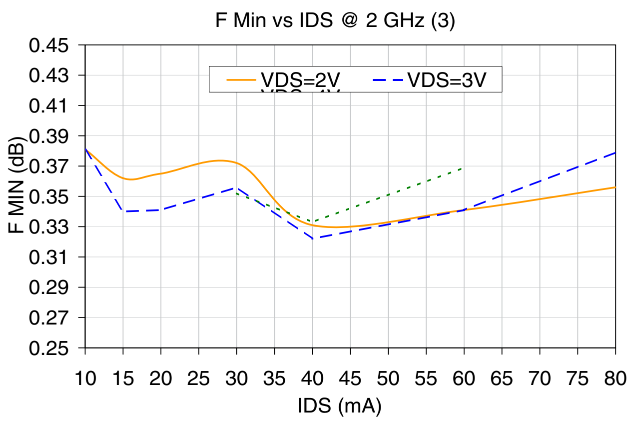
TYPICAL PERFORMANCE CURVES

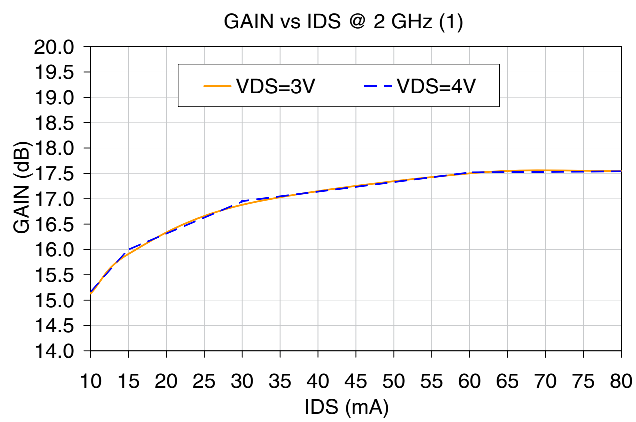








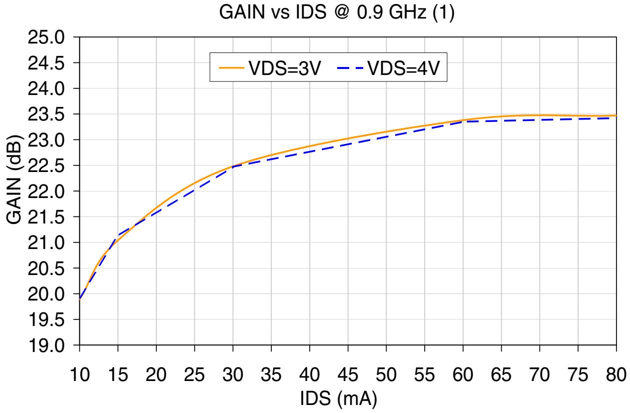




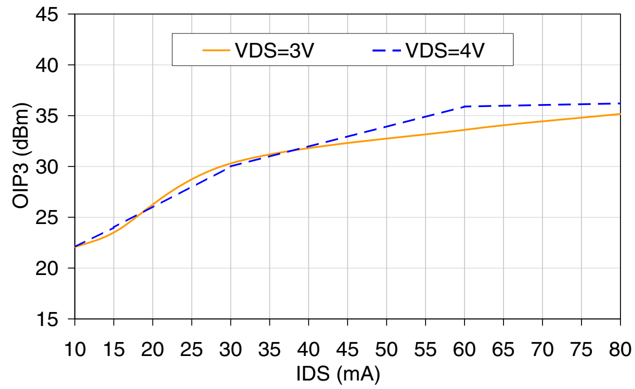
(1) Includes test board loss, set-up and conditions per Figure 1.
(2) Measured using HP4155B semiconductor parameter analyzer.
(3) F Min is minimum Noise Figure.
(4) Drain current was allowed to increase during compression measurement.

TYPICAL PERFORMANCE CURVES

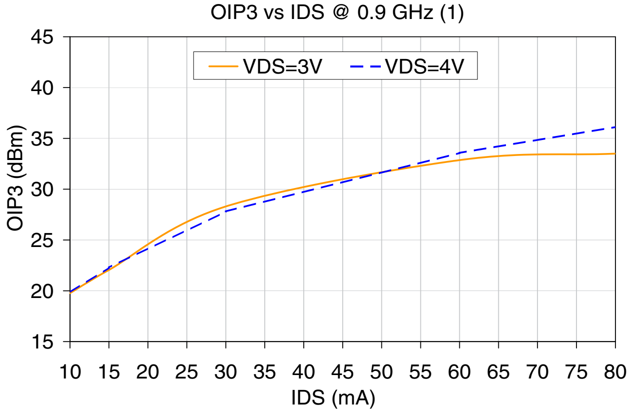
GAIN vs IDS @ 0.9 GHz (1)



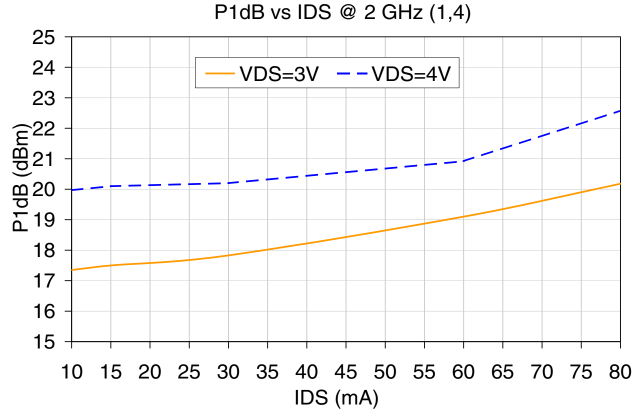
OIP3 vs IDS @ 2GHz (1)



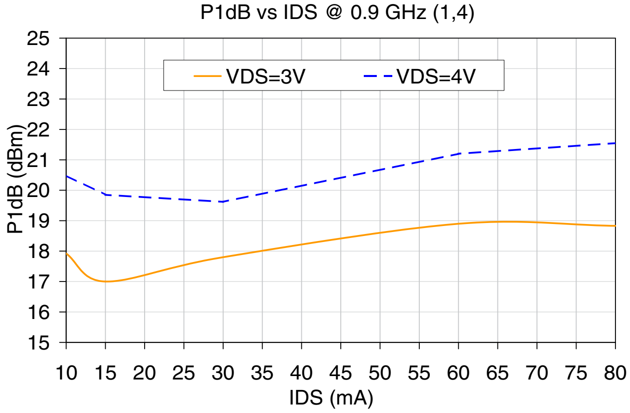
OIP3 vs IDS @ 0.9 GHz (1)



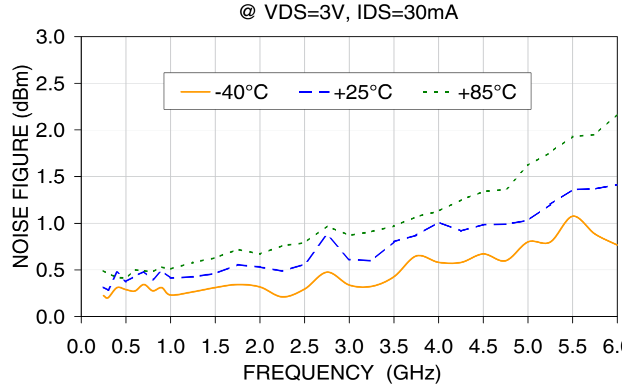
P1dB vs IDS @ 2 GHz (1,4)



P1dB vs IDS @ 0.9 GHz (1,4)



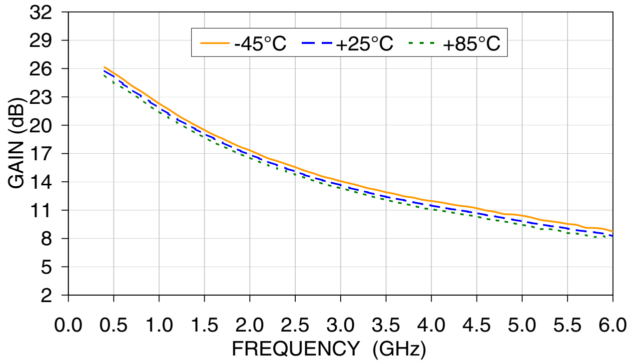
NF vs FREQUENCY & TEMPERATURE (1)
@ VDS=3V, IDS=30mA



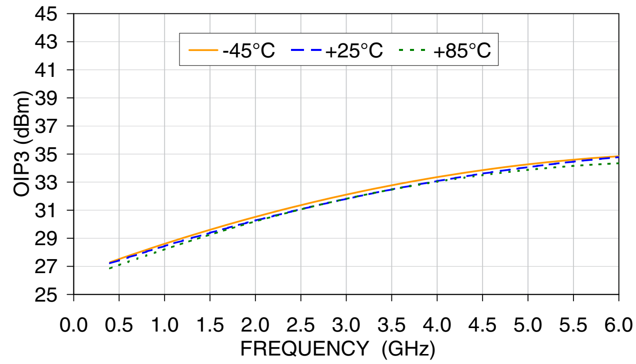
(1) Includes test board loss, set-up and conditions per Figure 1.
(2) Measured using HP4155B semiconductor parameter analyzer.
(3) F Min is minimum Noise Figure.
(4) Drain current was allowed to increase during compression measurement.

TYPICAL PERFORMANCE CURVES

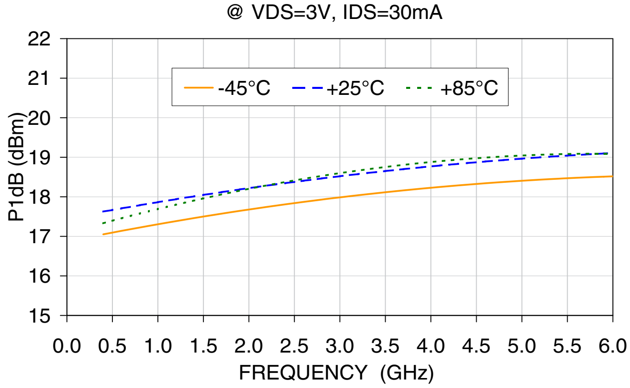
GAIN vs FREQUENCY & TEMPERATURE (1)
@ VDS=3V, IDS=30mA



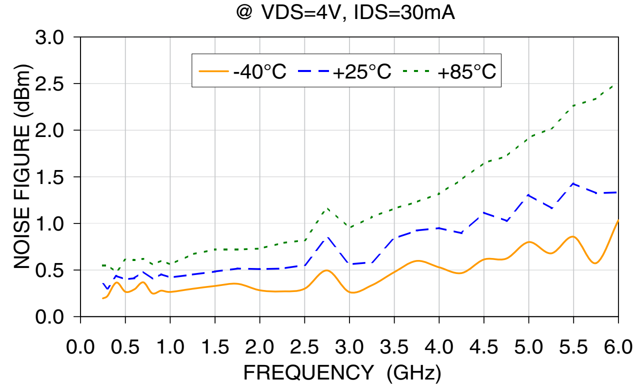
OIP3 vs FREQUENCY & TEMPERATURE (1)
@ VDS=3V, IDS=30mA



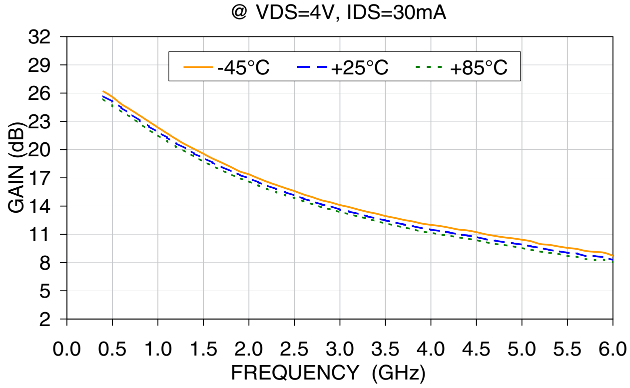
P1dB vs FREQUENCY & TEMPERATURE (1,4)
@ VDS=3V, IDS=30mA



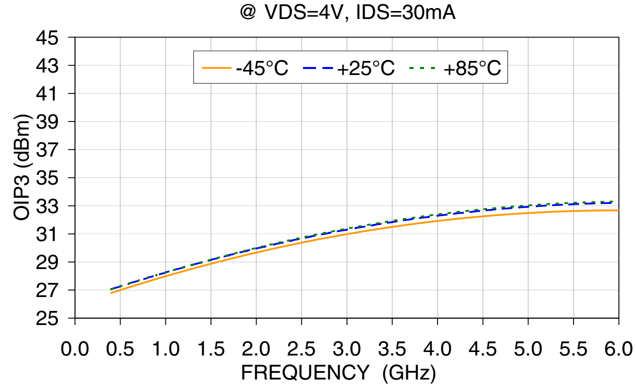
NF vs FREQUENCY & TEMPERATURE (1)
@ VDS=4V, IDS=30mA



GAIN vs FREQUENCY & TEMPERATURE (1)
@ VDS=4V, IDS=30mA

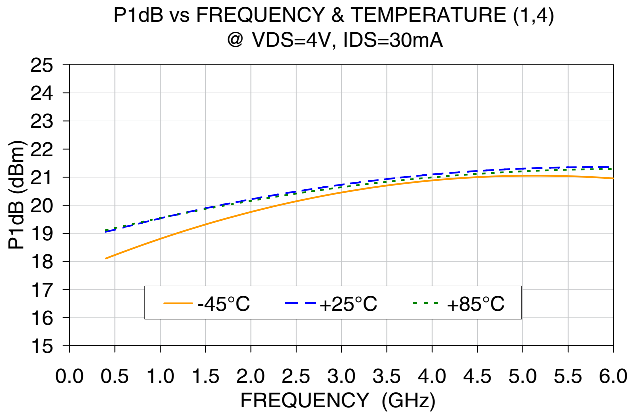


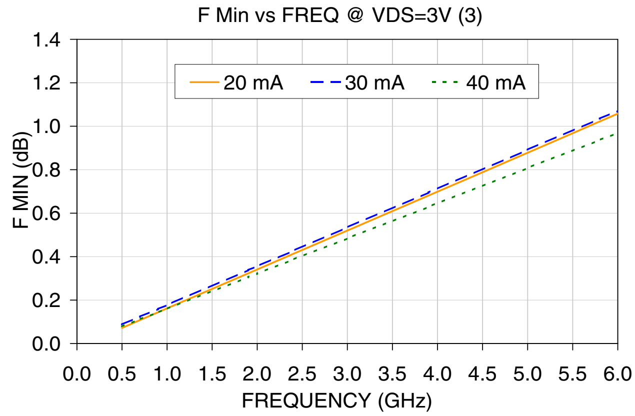
OIP3 vs FREQUENCY & TEMPERATURE
@ VDS=4V, IDS=30mA



(1) Includes test board loss, set-up and conditions per Figure 1.
(2) Measured using HP4155B semiconductor parameter analyzer.
(3) F Min is minimum Noise Figure.
(4) Drain current was allowed to increase during compression measurement.

TYPICAL PERFORMANCE CURVES





(1) Includes test board loss, set-up and conditions per Figure 1.
(2) Measured using HP4155B semiconductor parameter analyzer.
(3) F Min is minimum Noise Figure.
(4) Drain current was allowed to increase during compression measurement.

REFERENCE PLANE LOCATION FOR S AND NOISE PARAMETERS (SEE DATA IN PAGES 8 & 9)

(Refer to Application Note AN-60-040)

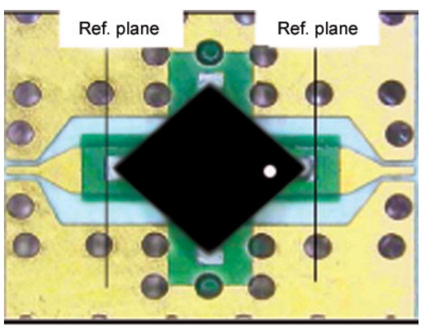


Fig 3. Reference Plane Location

Noise parameters were measured over 0.5 to 6 GHz by Modelithics® using a solid state tuner-based NP noise parameter test system available from Maury Microwave. F Min, optimimum source reflection coefficient and noise resistance values are calculated values based on a set of measurements made at approximately 16 different impedances. Some data smoothing was applied to arrive at the presented data set.

S-parameters were measured by Modelithics® on an Anritsu Lightning vector network analyzer over 0.1 to 18GHz using 350um pitch RF probes from GGB industries combined with customized thru-reflect-line (TRL) calibration standards. The reference plane is at the device package leads, as shown in the picture.

TYPICAL S-PARAMETERS, V_{DS}=3V AND I_{DS}=30 MA (FIG. 3)

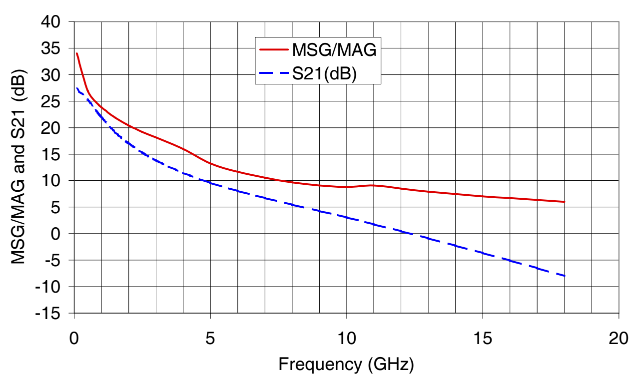
Freq. (GHz)	S11		S21			S12		S22		MSG/MAG (dB)
	Mag.	Ang.	Mag.	Mag (dB)	Ang.	Mag.	Ang.	Mag.	Ang.	
0.1	0.99	-16.36	23.19	27.31	169.5	0.009	86.4	0.60	-12.94	34.0
0.5	0.88	-73.63	18.30	25.25	132.3	0.037	52.2	0.47	-52.76	27.0
0.9	0.77	-112.16	13.45	22.57	108.1	0.05	36.6	0.35	-79.99	24.3
1.0	0.76	-120.13	12.51	21.95	103.4	0.052	34.2	0.33	-85.89	23.8
1.5	0.70	-149.97	9.11	19.19	84.2	0.059	24.0	0.25	-109.19	21.9
1.9	0.68	-167.63	7.42	17.41	72.0	0.063	19.5	0.21	-124.99	20.7
2.0	0.68	-171.42	7.09	17.02	69.3	0.065	18.2	0.20	-128.70	20.4
2.5	0.67	171.27	5.80	15.27	56.2	0.07	13.5	0.17	-146.31	19.2
3.0	0.66	156.22	4.90	13.80	44.0	0.075	8.8	0.15	-163.82	18.1
4.0	0.67	130.42	3.73	11.43	21.4	0.087	-0.3	0.13	161.15	16.0
5.0	0.68	107.77	3.02	9.59	0.0	0.099	-10.8	0.14	127.97	13.2
6.0	0.70	86.82	2.53	8.06	-20.8	0.113	-22.5	0.16	98.63	11.7
7.0	0.73	66.89	2.17	6.71	-41.4	0.125	-35.2	0.20	74.15	10.6
8.0	0.75	47.68	1.88	5.49	-61.7	0.136	-48.6	0.26	53.20	9.7
9.0	0.79	28.73	1.63	4.27	-81.9	0.145	-63.3	0.32	34.25	9.1
10.0	0.83	9.67	1.42	3.04	-102.2	0.15	-78.4	0.39	16.29	8.8
11.0	0.86	-8.89	1.23	1.77	-122.3	0.151	-94.0	0.47	-0.68	9.1
12.0	0.89	-26.76	1.06	0.47	-142.1	0.15	-109.6	0.54	-17.06	8.5
13.0	0.91	-44.42	0.91	-0.86	-162.0	0.146	-125.5	0.59	-33.39	7.9
14.0	0.93	-60.99	0.77	-2.25	178.8	0.139	-140.9	0.65	-49.07	7.5
15.0	0.94	-73.61	0.66	-3.64	163.1	0.131	-153.9	0.70	-61.42	7.0
16.0	0.96	-83.75	0.56	-5.10	149.1	0.119	-163.5	0.74	-72.07	6.7
17.0	0.96	-94.86	0.47	-6.51	134.2	0.109	-174.6	0.77	-83.99	6.4
18.0	0.95	-106.68	0.40	-7.98	118.5	0.101	174.5	0.80	-97.27	6.0

TYPICAL NOISE PARAMETERS, V_{DS}=3V AND I_{DS}=30 MA (FIG. 3)

Freq. (GHz)	F Min. (dB)	GOpt (Magni-tude)	GOpt (Angle)	Rn/50	Ga Associated Gain (dB)
0.5	0.09	0.33	16.30	0.07	26.6
0.7	0.12	0.33	28.96	0.07	24.7
0.9	0.16	0.34	41.34	0.06	23.1
1.0	0.18	0.35	47.42	0.06	22.4
1.9	0.34	0.38	99.05	0.03	17.8
2.0	0.36	0.39	104.44	0.03	17.5
2.4	0.43	0.40	125.31	0.03	16.3
3.0	0.54	0.42	154.52	0.03	14.9
3.9	0.70	0.44	-166.36	0.06	13.3
5.0	0.89	0.46	-126.19	0.11	11.8
5.8	1.04	0.47	-102.25	0.16	10.7
6.0	1.07	0.47	-96.96	0.18	10.5

F Min.: Minimum Noise Figure
GOpt: Optimum Source Reflection Coefficient
Rn: Equivalent noise resistance

MAXIMUM STABLE GAIN (MSG)/MAXIMUM AVAILABLE GAIN (MAG) vs. FREQUENCY



TYPICAL S-PARAMETERS, V_{DS}=4V AND I_{DS}=30 MA (FIG. 3)

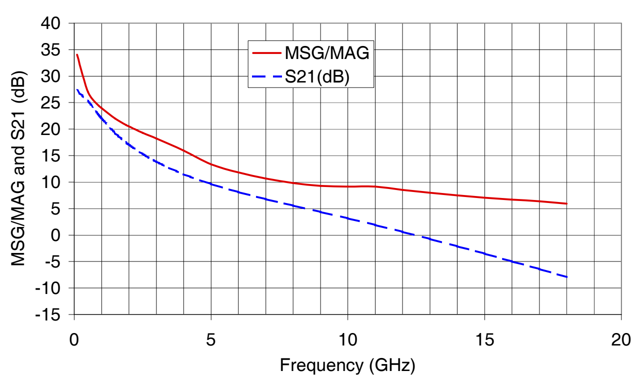
Freq. (GHz)	S11		S21			S12		S22		MSG/MAG (dB)
	Mag.	Ang.	Mag.	Mag (dB)	Ang.	Mag.	Ang.	Mag.	Ang.	
0.1	0.99	-16.62	23.16	27.30	169.5	0.009	79.4	0.61	-12.06	34.0
0.5	0.88	-73.31	18.36	25.28	132.5	0.036	52.2	0.49	-50.89	27.0
0.9	0.77	-111.77	13.51	22.61	108.3	0.049	37.1	0.36	-76.91	24.4
1.0	0.76	-119.67	12.58	21.99	103.5	0.051	33.7	0.34	-82.55	23.9
1.5	0.70	-149.65	9.17	19.25	84.3	0.058	24.1	0.25	-104.45	22.0
1.9	0.68	-167.34	7.47	17.47	72.1	0.062	19.2	0.21	-119.17	20.8
2.0	0.67	-171.13	7.14	17.07	69.3	0.063	18.4	0.20	-122.66	20.5
2.5	0.67	171.46	5.84	15.33	56.2	0.069	13.6	0.17	-139.21	19.3
3.0	0.66	156.41	4.93	13.86	44.0	0.074	9.0	0.14	-155.97	18.2
4.0	0.67	130.52	3.75	11.49	21.4	0.085	0.0	0.12	169.62	15.9
5.0	0.68	107.77	3.04	9.66	-0.1	0.098	-10.3	0.12	134.56	13.3
6.0	0.70	86.77	2.55	8.14	-20.9	0.111	-21.6	0.14	103.32	11.8
7.0	0.72	66.87	2.19	6.79	-41.6	0.123	-34.4	0.18	77.45	10.7
8.0	0.75	47.72	1.90	5.58	-61.9	0.135	-47.6	0.24	55.67	9.8
9.0	0.79	28.73	1.65	4.37	-82.2	0.144	-62.3	0.30	36.33	9.3
10.0	0.83	9.64	1.44	3.15	-102.6	0.15	-77.4	0.38	18.12	9.1
11.0	0.86	-8.92	1.24	1.89	-122.9	0.152	-93.0	0.45	0.90	9.1
12.0	0.89	-26.90	1.07	0.60	-142.8	0.151	-108.5	0.52	-15.63	8.5
13.0	0.91	-44.62	0.92	-0.73	-162.9	0.147	-124.8	0.58	-32.08	8.0
14.0	0.93	-61.40	0.78	-2.11	177.7	0.14	-140.4	0.64	-47.96	7.5
15.0	0.94	-74.24	0.67	-3.52	161.7	0.132	-153.4	0.69	-60.57	7.0
16.0	0.96	-84.49	0.56	-4.99	147.6	0.121	-163.2	0.74	-71.29	6.7
17.0	0.96	-95.82	0.48	-6.42	132.4	0.111	-174.6	0.77	-83.45	6.4
18.0	0.96	-107.81	0.40	-7.93	116.4	0.102	174.8	0.80	-96.97	5.9

TYPICAL NOISE PARAMETERS, V_{DS}=4V AND I_{DS}=30 MA (FIG. 3)

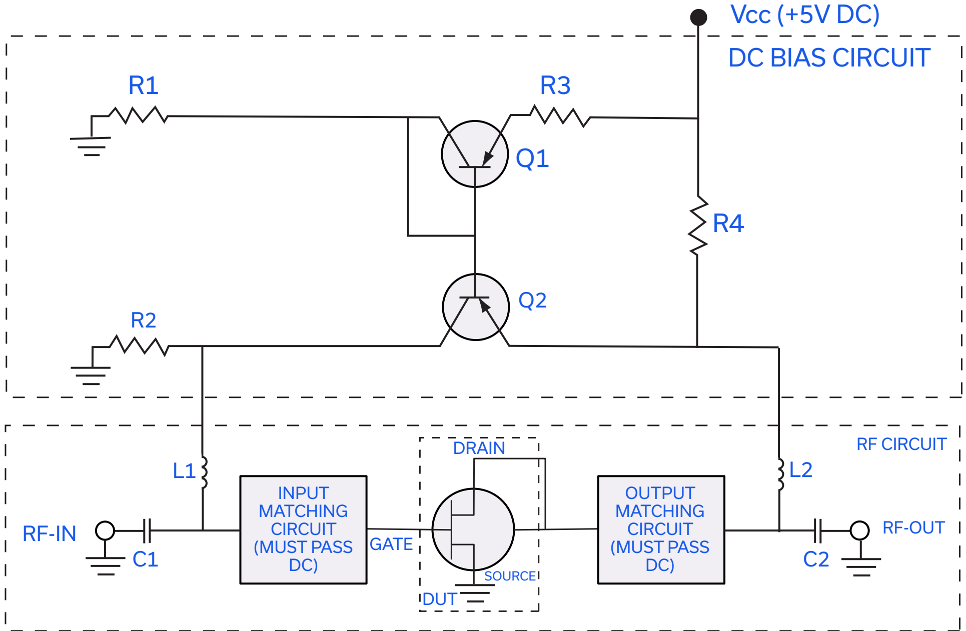
Freq. (GHz)	F Min. (dB)	GOpt (Magni-tude)	GOpt (Angle)	Rn/50	Ga Associated Gain (dB)
0.5	0.09	0.37	16.12	0.08	26.6
0.7	0.12	0.37	28.50	0.07	24.6
0.9	0.16	0.37	40.63	0.06	23.0
1.0	0.18	0.37	46.59	0.06	22.3
1.9	0.34	0.39	97.42	0.03	17.8
2.0	0.35	0.39	102.75	0.03	17.4
2.4	0.42	0.40	123.43	0.03	16.3
3.0	0.53	0.41	152.52	0.03	14.9
3.9	0.69	0.43	-168.14	0.05	13.3
5.0	0.89	0.45	-127.09	0.10	11.8
5.8	1.03	0.46	-102.09	0.16	10.8
6.0	1.06	0.47	-96.48	0.18	10.6

F Min.: Minimum Noise Figure
GOpt: Optimum Source Reflection Coefficient
Rn: Equivalent noise resistance

MAXIMUM STABLE GAIN (MSG)/MAXIMUM AVAILABLE GAIN (MAG) vs. FREQUENCY



RECOMMENDED APPLICATION CIRCUIT



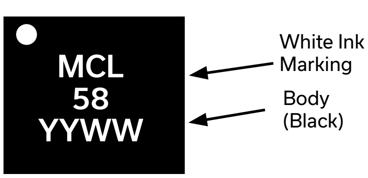
VDS, V (nom)	3	4
IDS, mA (nom)	30mA	30mA
R1	4320Ω	4320Ω
R2	4320Ω	4320Ω
R3	3570Ω	1210Ω
R4	68.1Ω	33.2Ω
Q1	MMBT3906*	MMBT3906*
Q2	MMBT3906*	MMBT3906*
C1	0.01µF	0.01µF
C2	0.01µF	0.01µF
L1**	840nH	840nH
L2**	840nH	840nH

* Fairchild Semiconductor™ part number
** Piconics™ part number CC45T47K240G5

OPTIMIZED AMPLIFIER CIRCUITS

For band specific, drop-in modules, and as an alternative to designing circuits, please refer to Mini-Circuits TAMP and RAMP series models which are based upon SAV/TAV E-PHEMT's and include all DC blocking, bias, matching and stabilization circuitry, without need for any external components.

PRODUCT MARKING



Marking may contain other features or characters for internal lot control

ADDITIONAL DETAILED TECHNICAL INFORMATION IS AVAILABLE ON OUR DASH BOARD. TO ACCESS **CLICK HERE**

Performance Data	Data Table Swept Graphs S-Parameter (S2P Files) Data Set (.zip file)
Case Style	FG873 Plastic low profile 3mm x 3mm, lead finish: tin/silver/nickel
Tape & Reel **Standard quantities available on reel**	F68 7" reels with 20, 50, 100, 200, 500,1K,2K or 3K devices
Suggested Layout for PCB Design	PL-301
Evaluation Board	TB-154+
Environmental Ratings	ENV08T2

ESD RATING

Human Body Model (HBM): Class 1A (250 V to < 500 V) in accordance with ANSI/ESD STM 5.1 - 2001

Machine Model (MM): Class M1 (40 V) in accordance with ANSI/ESD STM 5.2 - 1999

MSL RATING

Moisture Sensitivity: MSL1 in accordance with IPC/JEDECJ-STD-020D

MSL TEST FLOW CHART