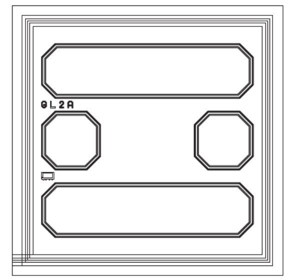
Ultra Low Noise, Medium Current

E-PHEMT Transistor Die

TAV2-14LN-D+

50Ω   0.05 to 10 GHz



The Big Deal

- Low Noise Figure, 0.6 dB typ. at 6 GHz, 2V
- High Gain, 16.4 dB typ. at 6 GHz, 4V
- High OIP3, +30.9 dBm typ. at 6 GHz, 4V
- High P1dB, 18.8 dBm typ. at 6 GHz, 4V

Product Overview

Mini-Circuits' TAV2-14LN-D+ is a MMIC E-PHEMT* transistor die with an operating frequency range from 0.05 to 10 GHz. This model combines high gain with extremely low noise figure, resulting in lower overall system noise. Low NF and IP3 performance make it an ideal choice for sensitive receivers in communications systems. This model requires external biasing and matching.

Key Features

Feature	Advantages
Wideband, 0.05 to 10 GHz Usable to 12 GHz	A single device covers many wireless communications bands including cellular, ISM, GSM, WCDMA, WiMax, WLAN, 5G and more.
High IP3 vs. DC power consumption • +30.9 dBm at 6 GHz, 4V • +33.2 dBm at 12 GHz, 4V	The TAV2-14LN-D+ matches industry leading IP3 performance relative to device size and power consumption. Enhanced linearity over a broad frequency range makes the device ideal for use in: • Driver amplifiers for complex waveform up converter paths • Drivers in linearized transmit systems
Combines high gain (16.4 dB) with very low Noise Figure (0.7 dB)	The unique combination of high gain and low Noise Figure results in lower overall system noise.
Unpackaged Die	Enables the user to integrate the amplifier directly into hybrids

* Enhancement mode Pseudomorphic High Electron Mobility Transistor.

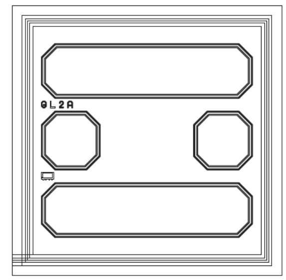
Ultra Low Noise, Medium Current

E-PHEMT Transistor Die

TAV2-14LN-D+

Product Features
- Low Noise Figure, 0.6 dB typ. at 6 GHz, 2V,
- Gain, 16.4 dB typ. at 6 GHz, 4V
- High Output IP3, +30.9 dBm at 6 GHz, 4V
- Output Power at 1dB comp., +18.8 dBm at 6 GHz, 4V
- External biasing and matching required
- Usable to 12 GHz

Typical Applications
- 5G
- Cellular
- ISM
- GSM
- WCDMA
- WiMax
- WLAN
- UNII and HIPERLAN

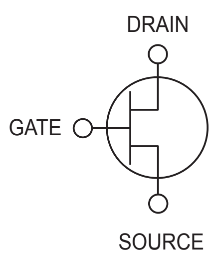


+RoHS Compliant
The +Suffix identifies RoHS Compliance. See our web site for RoHS Compliance methodologies and qualifications

Ordering Information: Refer to Last Page

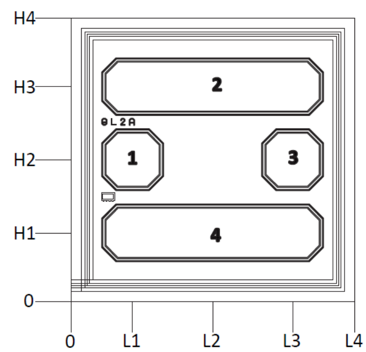
General Description
Mini-Circuits' TAV2-14LN-D+ is a MMIC E-PHEMT* transistor die with an operating frequency range from 0.05 to 10 GHz. This model combines high gain with extremely low noise figure, resulting in lower overall system noise. Low NF and IP3 performance make it an ideal choice for sensitive receivers in communications systems. This model requires external biasing and matching.

Simplified Schematic and Pad description



Pad#	Description
1	GATE used for RF-IN
2,4 & bottom of die	SOURCE Terminal, connected to ground
3	DRAIN used for RF-OUT

Bonding Pad Position



Dimensions in µm, Typical

L1	L2	L3	L4	H1	H2	H3	H4
87	200	313	400	97	200	303	400

Thickness	Die size	Pad Size 1 & 3	Pad size 2 & 4
100	400 x 400	75 x 75	301 x 69

Electrical Specifications at T_{AMB}=25°C

Symbol	Parameter	Condition	Min.	Typ.	Max.	Units
DC Specifications						
V_{TH}	Threshold Voltage	V_{DS}=4V, I_{DS}=4 mA		0.37		V
I_{DSS}	Saturated Drain Current	V_{DS}=4V, V_{GS}=0 V	—	2.0	—	µA
G_M	Transconductance	V_{DS}=4V, Gm =$\Delta I_{DS}/\Delta V_{GS}$, $\Delta V_{GS} = V_{GS2}-V_{GS1}$, V_{GS2}=0.7V, V_{GS1}=0.6V, ΔI_{DS}=(I_{DS} at V_{GS2})-(I_{DS} at V_{GS1})	—	192	—	mS
I_{GSS}	Gate leakage Current	V_{GD}=V_{GS}=-3V	—	1.0		µA

RF & DC Specifications, Z0=50 Ohms						
Parameter	Condition (GHz)	V_{DS} = 4V[1], I_{DS} = 40mA			V_{DS} = 2V[1] I_{DS} = 20mA	Units
		Min.	Typ.	Max.	Typ.	
Gain	0.05		23.4		22	dB
	6		16.4		15.9	
	8		13.9		13.3	
	10		11.8		11.3	
	12		10.2		10	
Input Return Loss	0.05		—		—	dB
	6		7		6	
	8		7		6	
	10		7		7	
	12		8		7	
Output Return Loss	0.05		5		5	dB
	6		13		13	
	8		20		17	
	10		20		17	
	12		19		16	
P1dB[2]	0.05		17.7		13.3	dBm
	6		18.8		13.1	
	8		19.1		13.4	
	10		19.4		13.5	
	12		19.1		13	
OIP3 Pout=5dBm/Tone	0.05		27.1		22.8	dBm
	6		30.9		24.9	
	8		31.6		25.9	
	10		33.0		28.5	
	12		33.2		29.0	
Noise Figure	0.05		2.5		0.7	dB
	6		0.7		0.6	
	8		0.7		0.6	
	10		0.8		0.7	
	12		1.0		0.8	
I_{DS}	DC		40		20	mA
V_{GS}	DC	0.44	0.65	0.72	0.58	V

1. Die is packaged in 2x2 mm, 6-lead MCLP package and soldered on TB-TAV2-14LN+. See Fig. 1
2. Drain current bias allowed to increase during compression measurement.

Absolute Maximum Ratings[3]

Symbol	Parameter	Max.	Units
V_{DS}[4]	Drain-Source Voltage	5	V
V_{GS}[4]	Gate-Source Voltage at V_{DS}=4V	-5 &1	V
I_{DS}[4]	Drain Current at V_{DS}=4V	65	mA
I_{GS}	Gate Current	15	μA
P_{DISS}	Total Dissipated Power	325	mW
P_{IN}[5]	RF Input Power	18 (5-minute max.) 15 (continuous)	dBm
T_{CH}	Channel Temperature	150	°C
T_{OP}	Operating Temperature	-40 to 85	°C
T_{STD}	Storage Temperature	-65 to 150	°C
θjc	Thermal Resistance	170	°C/W

3. Operation of this device above any one of these parameters may cause permanent damage.
4. Assumes DC quiescent conditions.
5. I_{GS} is limited to 15μA during test.

Characterization Test Circuit

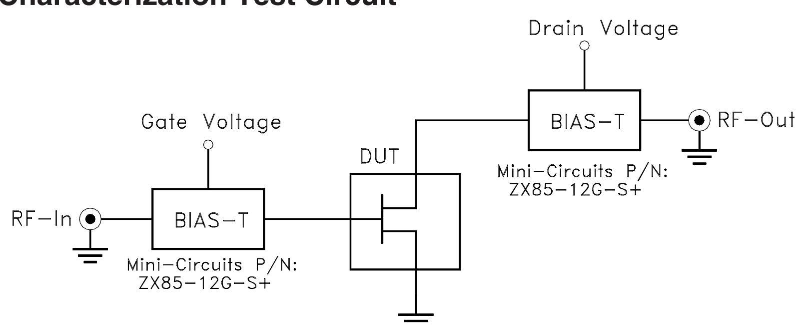
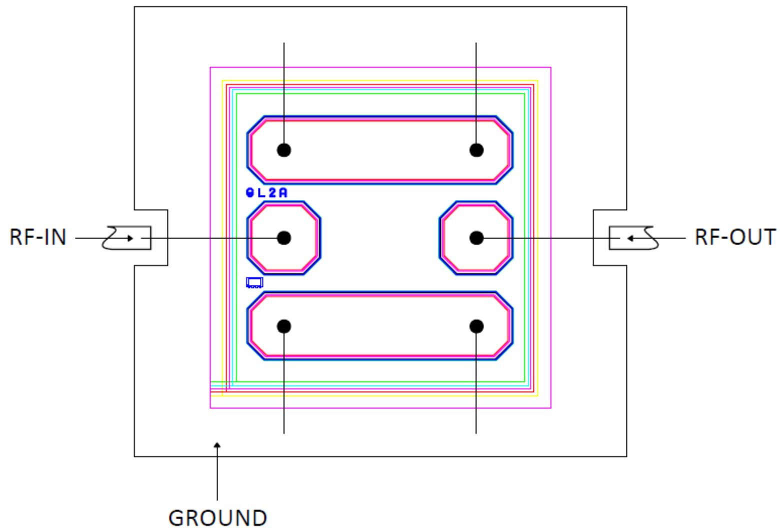


Fig 1. Block Diagram of Test Circuit used for characterization. (DUT is soldered on Mini-Circuits Test Board TB-TAV2-14LN+)
Gain, Output power at 1dB compression (P1dB), Noise Figure and output IP3 (OIP3) are measured using Agilent's Microwave Network Analyzer N5242A PNA-X.

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

Assembly Diagram



Assembly and Handling Procedure

1. Storage
   Dice should be stored in a dry nitrogen purged desiccators or equivalent.
2. ESD
   MMIC E-PHEMT transistor dice are susceptible to electrostatic and mechanical damage. Die are supplied in antistatic protected material, which should be opened in clean room conditions at an appropriately grounded anti-static worksta tion. Devices need careful handling using correctly designed collets, vacuum pickup tips or sharp antistatic tweezers to deter ESD damage to dice.
3. Die Attach
   The die mounting surface must be clean and flat. Using conductive silver filled epoxy, recommended epoxies are DieMat DM6030HK-PT/H579 or Ablestik 84-1LMISR4. Apply sufficient epoxy to meet required epoxy bond line thickness, epoxy fillet height and epoxy coverage around total die periphery. Parts shall be cured in a nitrogen filled atmosphere per manufacturer's cure condition. It is recommended to use antistatic die pick up tools only.
4. Wire Bonding
   Bond pad openings in the surface passivation above the bond pads are provided to allow wire bonding to the dice gold bond pads. Thermosonic bonding is used with minimized ultrasonic content. Bond force, time, ultrasonic power and temperature are all critical parameters. Suggested wire is pure gold, 1 mil diameter. Bonds must be made from the bond pads on the die to the package or substrate. All bond wires should be kept as short as low as reasonable to minimize performance degradation due to undesirable series inductance.

Additional Detailed Technical Information

additional information is available on our dash board.

Performance Data	Data Table	
	Swept Graphs	
	S-Parameter (S2P Files) Data Set	
Case Style	Die	
Die Ordering and packaging information	Quantity, Package	Model No.
	Small, Gel - Pak: 5,10,50,100 KGD*	TAV2-14LN-DG+
	Medium†, Partial wafer: KGD*<3721	TAV2-14LN-DP+
	Large†, Full Wafer	TAV2-14LN-DF+
	†*Available upon request contact sales representative* Refer to AN-60-067	
Environmental Ratings	ENV80	

*Known Good Dice ("KGD") means that the dice in question have been subjected to Mini-Circuits DC test performance criteria and measurement instructions and that the parametric data of such dice fall within a predefined range. While DC testing is not definitive, it does help to provide a higher degree of confidence that dice are capable of meeting typical RF electrical parameters specified by Mini-Circuits.

ESD Rating**

Human Body Model (HBM): Class 0 (pass 50V) in accordance with ANSI/ESD STM 5.1 - 2001

** Tested in industry standard 2x2 mm, 6-Lead MCLP package.

Additional Notes

A. Performance and quality attributes and conditions not expressly stated in this specification document are intended to be excluded and do not form a part of this specification document.

B. Electrical specifications and performance data contained in this specification document are based on Mini-Circuit's applicable established test performance criteria and measurement instructions.

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Typical Performance Data

Definitions:
Input Return Loss = -S11 (dB)
Gain(Power Gain) = S21 (dB)
Reverse Isolation = -S12 (dB)
Output Return Loss = -S22 (dB)

TEST CONDITIONS: Vd = 2.00V, Id = 20mA @ Temperature = +25°C

FREQ	Gain	Isolation	Input Return Loss	Output Return Loss	Stability		IP-3 Output	1dB Comp. Output	Noise Figure
(MHz)	(dB)	(dB)	(dB)	(dB)	K	Measure	(dBm)	(dBm)	(dB)
100	22.12	51.36	0.00	4.38	0.01	1.27	24.22	13.03	0.65
200	22.10	45.16	0.02	4.41	0.03	1.27	24.10	12.96	0.58
300	22.06	41.41	0.04	4.44	0.06	1.27	24.38	13.24	0.64
400	22.01	39.22	0.07	4.47	0.06	1.27	24.50	12.81	0.69
500	21.95	37.29	0.11	4.52	0.09	1.26	24.04	12.88	0.68
1000	21.55	31.62	0.44	4.84	0.18	1.23	23.41	13.30	0.64
2000	20.28	26.75	1.44	5.77	0.34	1.14	23.19	12.84	0.67
3000	18.93	24.38	2.51	6.64	0.47	1.07	23.52	12.67	0.76
4000	17.82	22.73	3.60	7.68	0.57	1.01	23.67	12.76	0.72
5000	16.89	21.36	4.77	9.38	0.67	0.97	23.76	13.15	0.67
6000	15.88	20.35	5.89	12.39	0.78	0.95	25.45	13.20	0.75
7000	14.66	19.78	6.45	16.16	0.88	0.97	26.32	13.41	0.81
8000	13.39	19.40	6.55	17.80	0.97	1.00	26.56	13.41	0.83
9000	12.28	18.91	6.72	17.59	1.03	1.01	28.24	13.73	0.80
10000	11.37	18.29	7.12	17.44	1.07	1.00	28.98	13.52	0.78
11000	10.54	17.64	7.57	17.37	1.12	0.98	27.83	13.64	0.99
12000	9.70	17.04	7.48	16.35	1.15	0.97	29.89	13.33	1.01
13000	8.77	16.53	6.94	14.92	1.17	0.98	27.54	13.20	1.02
14000	7.89	15.98	6.59	14.26	1.19	0.99	30.01	13.42	1.13
15000	7.22	15.23	6.72	14.60	1.20	0.98	30.88	13.61	1.21
16000	6.66	14.35	7.07	15.31	1.19	0.96	30.61	13.91	1.37
17000	6.08	13.47	7.17	14.83	1.18	0.93	30.15	13.71	1.13
18000	5.36	12.71	6.87	12.99	1.17	0.90	32.36	13.46	1.27
19000	4.51	12.04	6.35	11.28	1.15	0.88	33.58	12.72	1.57
20000	3.65	11.35	5.98	10.19	1.14	0.86	34.36	12.55	2.00

Note: Test data of Die packaged in industry standard 2x2 mm, 6-lead MCLP package

Typical Performance Data

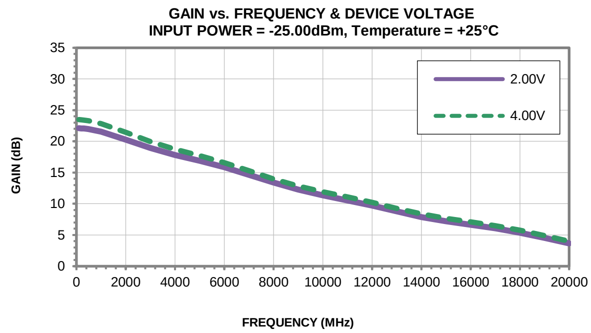
Definitions:
Input Return Loss = -S11 (dB)
Gain(Power Gain) = S21 (dB)
Reverse Isolation = -S12 (dB)
Output Return Loss = -S22 (dB)

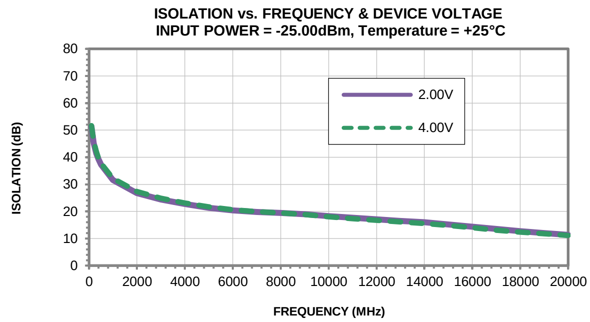
TEST CONDITIONS: Vd = 4.00V, Id = 40mA @ Temperature = +25°C

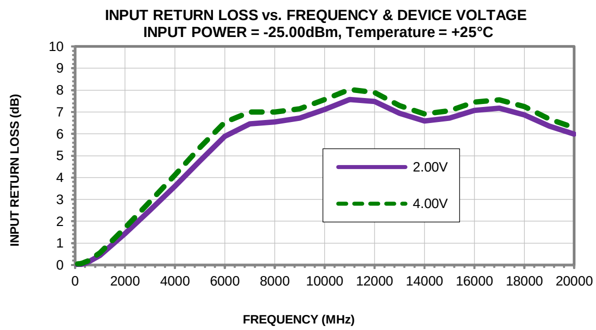
FREQ	Gain	Isolation	Input Return Loss	Output Return Loss	Stability		IP-3 Output	1dB Comp. Output	Noise Figure
(MHz)	(dB)	(dB)	(dB)	(dB)	K	Measure	(dBm)	(dBm)	(dB)
100	23.49	51.66	0.05	5.77	0.13	1.46	27.30	17.57	1.76
200	23.46	45.86	0.06	5.80	0.08	1.46	27.55	17.67	1.26
300	23.42	42.17	0.09	5.82	0.09	1.45	28.09	17.75	1.18
400	23.36	39.63	0.13	5.85	0.11	1.45	28.38	17.71	1.09
500	23.30	37.76	0.18	5.90	0.12	1.44	28.17	17.77	0.99
1000	22.84	32.16	0.55	6.28	0.22	1.38	27.94	17.68	0.85
2000	21.44	27.33	1.70	7.34	0.39	1.23	28.44	17.76	0.83
3000	19.98	24.90	2.90	8.30	0.53	1.10	28.90	17.89	0.90
4000	18.75	23.13	4.12	9.46	0.64	1.00	29.48	18.10	0.88
5000	17.70	21.68	5.38	11.40	0.73	0.93	30.06	18.60	0.86
6000	16.57	20.64	6.53	14.82	0.83	0.89	31.04	18.90	0.88
7000	15.28	19.94	6.99	17.90	0.92	0.89	31.45	19.17	1.01
8000	13.97	19.40	7.00	17.42	0.99	0.91	31.89	19.13	0.95
9000	12.85	18.81	7.15	16.75	1.03	0.92	32.75	19.52	0.92
10000	11.92	18.07	7.57	16.77	1.06	0.91	33.27	19.39	0.96
11000	11.08	17.35	8.03	16.55	1.10	0.89	33.34	19.47	1.18
12000	10.21	16.69	7.89	15.19	1.12	0.88	33.45	19.19	1.25
13000	9.27	16.16	7.29	13.57	1.14	0.88	33.58	19.07	1.22
14000	8.37	15.57	6.91	12.90	1.15	0.89	34.26	19.27	1.20
15000	7.68	14.82	7.06	13.23	1.16	0.89	35.11	19.38	1.49
16000	7.10	13.95	7.45	13.89	1.16	0.87	34.37	19.68	1.58
17000	6.50	13.11	7.56	13.53	1.15	0.84	33.98	19.37	1.58
18000	5.75	12.39	7.24	11.99	1.14	0.81	35.90	18.07	1.61
19000	4.88	11.77	6.68	10.53	1.13	0.80	35.96	16.95	2.01
20000	4.00	11.12	6.28	9.61	1.13	0.79	36.53	13.85	2.33

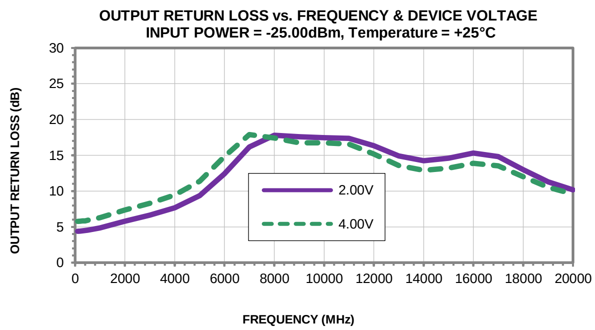
Note: Test data of Die packaged in industry standard 2x2 mm, 6-lead MCLP package

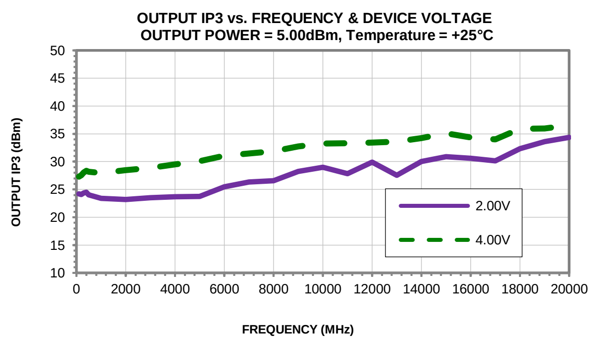
Typical Performance Curves

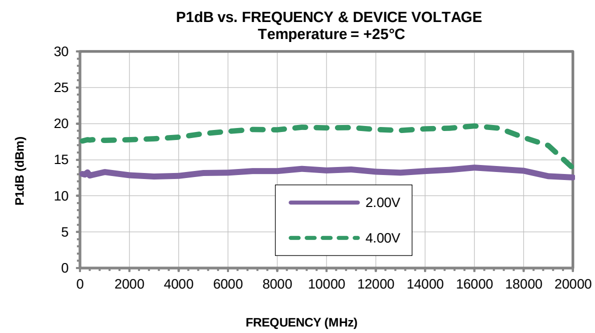


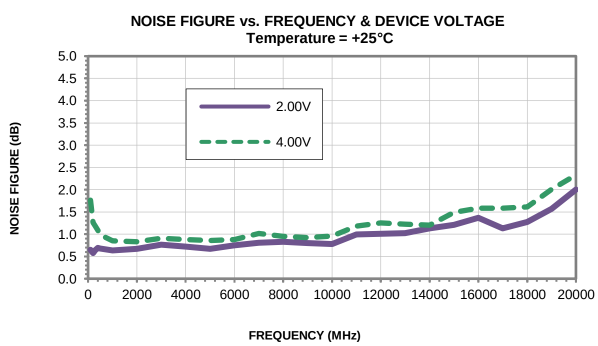












Note: Test data of Die packaged in industry standard 2x2 mm, 6-lead MCLP package

Mini-Circuits

Environmental Specifications ENV80

All Mini-Circuits products are manufactured under exacting quality assurance and control standards, and are capable of meeting published specifications after being subjected to any or all of the following physical and environmental test.

Specification	Test/Inspection Condition	Reference/Spec
Operating Temperature	-40° to 85° C or -40° to 105° C or -55° to 105° C or -45° to 105° C Ambient Environment	Refer to Individual Model Data Sheet
Storage Environment (Die)	-65° to 150°C	Individual Model Data Sheet
Storage Environment(Packaging)	-40° to 70°C and 40 to 60% humidity (In Factory Shipped Package)	