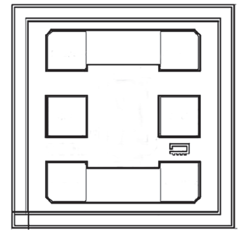
Ultra Low Noise, Medium Current

E-PHEMT Die

SAV-541-D+

50Ω 0.45 to 6 GHz



Product Features

- Low Noise Figure, 0.4 dB
- Gain, 17 dB at 2 GHz
- High Output IP3, +33 dBm
- Output Power at 1dB comp., +21 dBm
- High Current, 15 to 60mA
- Wide bandwidth
- External biasing and matching required

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

Ordering Information: Refer to Last Page

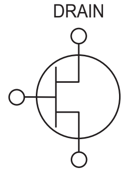
Typical Applications

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

General Description

SAV-541-D+ is an ultra-low noise, high IP3 transistor die, 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.

Simplified Schematic and Pad description



Pad	Description
Source	Ground
Gate	RF-IN
Drain	RF-OUT

* Enhancement mode Pseudomorphic High Electron Mobility Transistor.

Note: 1. Bond Pad material - Gold
2. Bottom of Die - Gold plated

DC Electrical Specifications[1] at T_{AMB}=25°C, Frequency 0.45 to 6 GHz

Symbol	Parameter	Condition	Typical			Units
I_{DSS}	Drain Current		15	30	60	mA
V_{GS}	Operational Gate Voltage	V_{DS}=3V, at respective I_{DS}	0.34	0.39	0.48	V
V_{TH}	Threshold Voltage	V_{DS}=3V, I_{DS}=4 mA	0.26	0.26	0.26	V
I_{DSS}	Saturated Drain Current	V_{DS}=3V, V_{GS}=0 V	1.0	1.0	1.0	µA
G_M	Transconductance	V_{DS}=3V, Gm=Δ I_{DS}/ΔV_{GS} ΔV_{GS}=V_{GS1}-V_{GS2} V_{GS1}=V_{GS} at respective I_{DS} V_{GS2}=V_{GS1}+0.05V	251	327	392	mS

RF Electrical Specifications[2]

			V_{DS}=3V			V_{DS}=4V,			
			I_{DS}=15mA	I_{DS}=30mA	I_{DS}=60mA	I_{DS}=15mA	I_{DS}=30mA	I_{DS}=60mA	
Symbol	Parameter	Condition (GHz)	Typ.	Typ.	Typ.	Typ.	Typ.	Typ.	Units
NF[2]	Noise Figure	0.9	0.34	0.28	0.25	0.35	0.27	0.25	dB
		2.0	0.46	0.35	0.33	0.5	0.34	0.38	
		3.9	0.66	0.62	0.53	0.63	0.52	0.53	
		5.8	1.50	1.18	1.40	1.47	1.29	1.36	
Gain	Gain	0.9	22.0	22.4	24.7	22.0	23.7	24.7	dB
		2.0	17.1	17.1	19.0	17.1	18.3	19.1	
		3.9	11.7	12.0	13.4	11.8	12.8	13.5	
		5.8	8.4	7.6	10.0	8.4	9.4	10.1	
OIP3	Output IP3	0.9	22.7	27.7	32.1	23.0	27.8	32.3	dBm
		2.0	21.7	27.4	32.9	22.1	27.7	33.1	
		3.9	23.9	30.2	32.6	24.4	30.0	35.7	
		5.8	22.0	28.3	33.8	22.5	28.3	35.8	
P1dB[3]	Power output at 1 dB Compression	0.9	16.9	17.3	18.5	20.0	18.5	20.6	dBm
		2.0	18.5	18.1	19.0	21.4	20.3	21.0	
		3.9	17.8	17.7	18.1	20.2	20.0	20.4	
		5.8	19.6	18.8	18.9	22.3	20.8	20.8	

1. Measured on industry standard SOT-343 (SC-70) package.
2. Measured on die using GSG (Ground-Signal-Ground) probe. See figure 1.
3. Drain current was allowed to increase during compression measurements.

Absolute Maximum Ratings[4]

Symbol	Parameter	Max.	Units
V_{DS}[5]	Drain-Source Voltage	5	V
V_{GS}[5]	Gate-Source Voltage	-5 to 0.7	V
V_{GD}[5]	Gate-Drain Voltage	-5 to 0.7	V
I_{DS}[5]	Drain Current	120	mA
I_{GS}	Gate Current	2	mA
P_{DISS}	Total Dissipated Power	360	mW
P_{IN}[6]	RF Input Power	17	dBm
T_{CH}	Channel Temperature	150	°C
T_{OP}	Operating Temperature	-40 to 85	°C
Θ_{JC}	Thermal Resistance	160	°C/W

4. Operation of this device above any one of these parameters may cause permanent damage.
5. Assumes DC quiescent conditions.
6. I_{GS} is limited to 2 mA during test.

Characterization Test Circuit

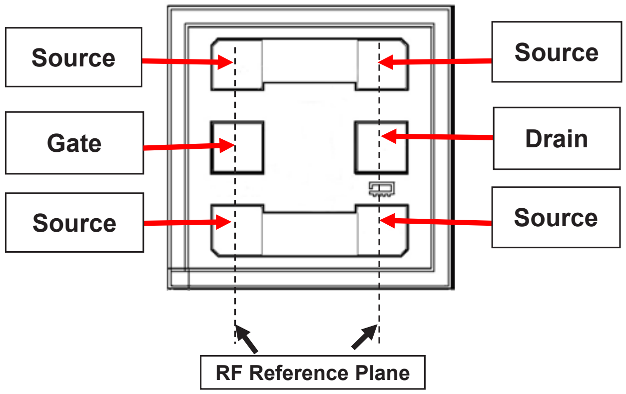


Fig 1. Block Diagram of Test Circuit used.
Gain, Return loss, Output Power at 1dB compression (P1dB), Output IP3 (OIP3) and Noise figure measured using Agilent's N5242A PNA-X Microwave network analyzer.

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

Die Layout

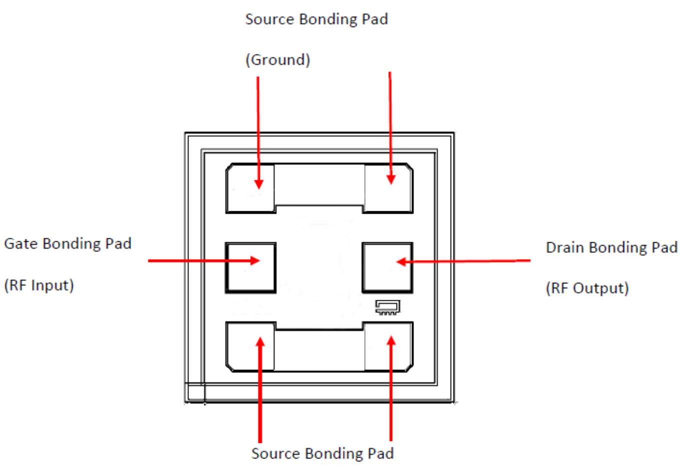


Fig 2. Die Layout

Bonding Pad Position

(Dimensions in µm, Typical)

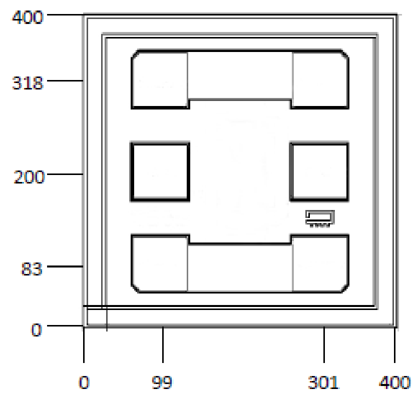


Fig 3. Bonding Pad Positions

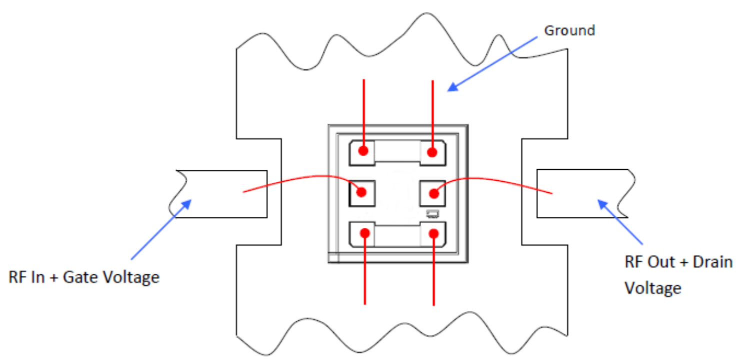
Critical Dimensions

Parameter	Values
Die Thickness, µm	100
Die Width, µm	400
Die Length, µm	400
Bond Pad Size, µm	75 x 75

Assembly and Handling Procedure

1. Storage
   Dice should be stored in a dry nitrogen purged desiccators or equivalent.
2. ESD
   MMIC EPHEMPT amplifier 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.

Assembly Diagram



Recommended Wire Length, Typical

Wire	Wire Length (mm)	Wire Loop Height (mm)
GATE, DRAIN	0.70	0.15
SOURCE (TO GROUND)	0.30	0.15

Additional Detailed Technical Information

additional information is available on our dash board.

Performance Data	Data Table	
	Swept Graphs	
	S-Parameter (S2P Files) Data Set with and without port extension(.zip file)	
Case Style	Die	
Die Ordering and packaging information	Quantity, Package	Model No.
	Small, Gel - Pak: 10,50,100 KGD*	SAV-541-DG+
	Medium†, Partial wafer: KGD*<3720	SAV-541-DP+
	†*Available upon request contact sales representative*	
	Refer to AN-60-067	
Environmental Ratings	ENV-80	

ESD Rating

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

** Tested in industry standard 6-lead 400μmx400μm 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.

C. The parts covered by this specification document are subject to Mini-Circuits standard limited warranty and terms and conditions (collectively, "Standard Terms"); Purchasers of this part are entitled to the rights and benefits contained therein. For a full statement of the Standard Terms and the exclusive rights and remedies thereunder, please visit Mini-Circuits' website at www.minicircuits.com/MCLStore/terms.jsp

D. Mini-Circuits does not warrant the accuracy or completeness of the information, text, graphics and other items contained within this document and same are provided as an accommodation and on an "As is" basis, with all faults.

E. Purchasers of this part are solely responsible for proper storing, handling, assembly and processing of Known Good Dice (including, without limitation, proper ESD preventative measures, die preparation, die attach, wire bond ing and related assembly and test activities), and Mini-Circuits assumes no responsibility therefor or for environmental effects on Known Good Dice.

F. Mini-Circuits and the Mini-Circuits logo are registered trademarks of Scientific Components Corporation d/b/a Mini-Circuits. All other third-party trademarks are the property of their respective owners. A reference to any third-party trademark does not constitute or imply any endorsement, affiliation, sponsorship, or recommendation by any such third-party of Mini-Circuits or its products.