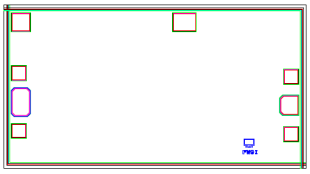
Low Noise, Wideband, Shutdown

Monolithic Amplifier Die

TSS-44-D+

50Ω 22 to 43.5 GHz

The Big Deal



- 22 to 43.5 GHz for 5G Applications
- Excellent Gain flatness, ±0.9 dB typ. over 22-40 GHz
- Shutdown feature

Product Overview

The TSS-44-D+ is a MMIC amplifier die with shutdown feature fabricated using E-PHEMT technology and is a fully integrated 3-stage gain block up to 43.5 GHz with excellent active directivity. The TSS-44-D+ integrates the entire matching network with the majority of the bias circuit into the design, reducing the need for complicated external circuits. This approach makes the TSS-44-D+ extremely flexible and enables simple, straightforward use.

Key Features

Feature	Advantages
Wideband, 22 to 43.5 GHz	The broad frequency range supports a wide array of requirements including telecommunications applications such as 5G and microwave radio backhaul, broadband commercial test and measurement systems, radar and commercial satellite applications
Excellent Gain Flatness	Typical ±0.9 dB gain flatness across the entire frequency range minimizes the need for external equalizer networks making it a great fit for instrumentation and other broadband applications
High Directivity	With active directivity of 28 dB, the TSS-44-D+ is an excellent choice for buffering broadband circuits. eliminating the need for an expensive isolator in most cases.
Shutdown feature	Allow users to turn on and off the amplifier with pulsed signals while keeping the power supply at constant voltage.
Integrated DC Blocks & Bias-Tee	Saves motherboard space and minimizes overall cost. Very user friendly.
Unpackaged die	Enables user to integrate it directly into hybrids.

Wideband, Microwave, Shutdown

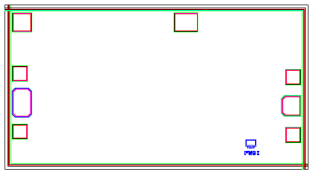
Monolithic Amplifier Die

TSS-44-D+

50Ω 22 to 43.5 GHz

Product Features

- Super high frequency and wideband, 22 to 43.5 GHz
- Gain, 17.6 dB typ. & Flatness, ±0.9 dB to 40 GHz
- Excellent active directivity, 28 dB typ.
- Positive Supply Voltage, 4V, 22mA
- Integrated DC blocks, Bias-Tee & Microwave bypass capacitor
- Unconditionally Stable



+RoHS Compliant

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

Ordering Information: Refer to Last Page

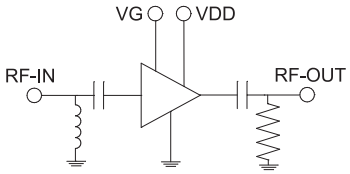
Typical Applications

- 5G
- Radio Navigation
- Mobile
- Fixed satellite
- Space research

General Description

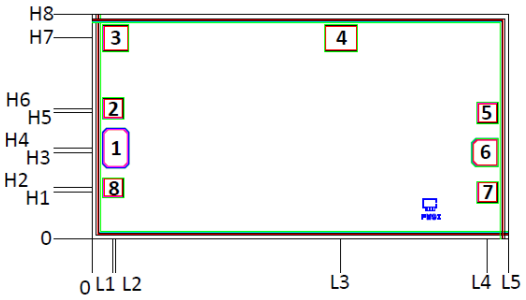
The TSS-44-D+ is a MMIC amplifier die with shutdown feature fabricated using E-PHEMT technology and is a fully integrated 3-stage gain block up to 43.5 GHz with excellent active directivity. The TSS-44-D+ integrates the entire matching network with the majority of the bias circuit into the design, reducing the need for complicated external circuits. This approach makes the TSS-44-D+ extremely flexible and enables simple, straightforward use.

Simplified Schematic and Pad description



Pad#	Function
1	RF-IN
2,5,7,8	Ground
3	Vg
4	Vd
6	RF-OUT

Bonding Pad Position



Dimensions in µm, Typical

L1	L2	L3	L4	L5	H1	H2	H3	H4	H5	H6	H7	H8
79	89	944	1500	1580	178	195	328	345	478	495	761	850

Thickness	Die size	Pad size 1	Pad size 2,5,7	Pad size 3	Pad size 4	Pad size 6	Pad size 8
100	1580 x 850	101x151	81x81	101x101	126x101	101x106	81x76

Electrical Specifications[1] at 25°C, Zo=50Ω, and V_{DD}=4V unless otherwise noted.

Parameter	Condition (GHz)	Amplifier-ON			Amplifier-OFF	Units
		Min.	Typ.	Max.	Typ.	
Frequency Range		22		43.5	22-43.5	GHz
Noise Figure	22		3.7		—	dB
	25		3.3		—	
	30		3.2		—	
	35		3.3		—	
	40		3.5		—	
	43.5		4.2		—	
Gain	22		15.8		-41	dB
	25		16.8		-33	
	30		17.6		-29	
	35		17.7		-30	
	40		15.7		-27	
	43.5		10.0		-24	
Gain Flatness	22-40		0.9		—	dB
Directivity	22-43.5		28		—	dB
Input Return Loss	22		10		3	dB
	25		17		6	
	30		16		5	
	35		12		3	
	40		9		5	
	43.5		8		5	
Output Return Loss	22		13		9	dB
	25		14		8	
	30		18		9	
	35		9		7	
	40		7		4	
	43.5		9		9	
Output Power @1dB compression AMP-ON	22		1.2		—	dBm
	25		1.8		—	
	30		4.1		—	
	35		6.4		—	
	40		7.8		—	
	43.5		8.2		—	
Output IP3 (Pout=-10dBm/tone)	22		10.1		—	dBm
	25		10.1		—	
	30		12.7		—	
	35		16.7		—	
	40		15.5		—	
	43.5		15.9		—	
Device Operating Voltage (V_{DD})		3.8	4.0	4.2	4.0	V
Device Operating Current (Id)		—	22	36	3	mA
Control Voltage (V_G)		3.8	4.0	4.2	0	V
Control Voltage (I_G)			8		2	mA
DC Current (Id) Variation Vs. Temperature[2]			-15		—	µA/°C
DC Current (Id) Variation Vs. Voltage			0.006		—	mA/mV
Thermal Resistance			51.9		—	°C/W

1. Measured on Mini-Circuits Characterization test board. Die is packaged in 3X3 mm, 12-lead MCL package and soldered on TB-TSS-44+. See Characterization Test Circuit (Fig. 1)
2. (Current at 85°C - Current at -45°C)/130

Absolute Maximum Ratings[1,3]

Parameter	Ratings
Operating Temperature (ground lead)	-40°C to 85°C
Total Power Dissipation	0.94W
Input Power	19dBm (5 min. max), 8dBm (continuous)
DC Voltage V_{DD}[4] (Pad 11)	6V
DC Voltage V_G[5] (Pad 12)	5V

[3] Permanent damage may occur if these limits are exceeded.
[4] Measured by keeping V_G=4V.
[5] Measured by keeping V_{DD}=4V.

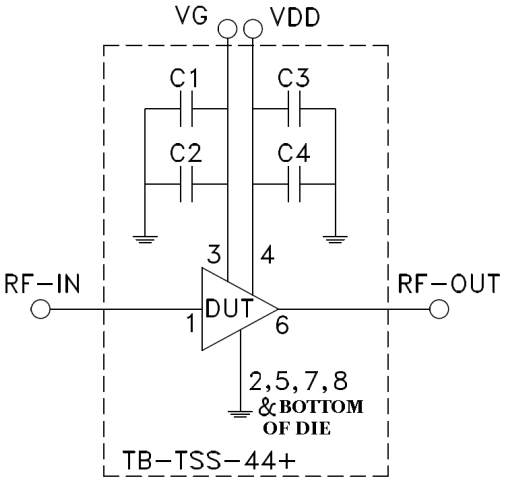
Control Voltage (V_G) Fig. 1

	Min.	Typ.	Max.	Units
Amplifier-ON	3.8	4	4.2	V
Amplifier-OFF	—	0	0.2	V

Switching Specifications (Rise/Fall Time)

Parameter		Min.	Typ.	Max.	Units
Amplifier ON to Shutdown	OFF TIME (50% Control to 10% RF)	—	9.8	—	µs
	FALL TIME (90 to 10% RF)	—	9.2	—	
Amplifier Shutdown to ON	ON TIME (50% Control to 90% RF)	—	11.2	—	µs
	RISE TIME (10% to 90% RF)	—	10.7	—	
Control Voltage Leakage		—	2.0	—	mV

Characterization Test Circuit / Recommended Application Circuit



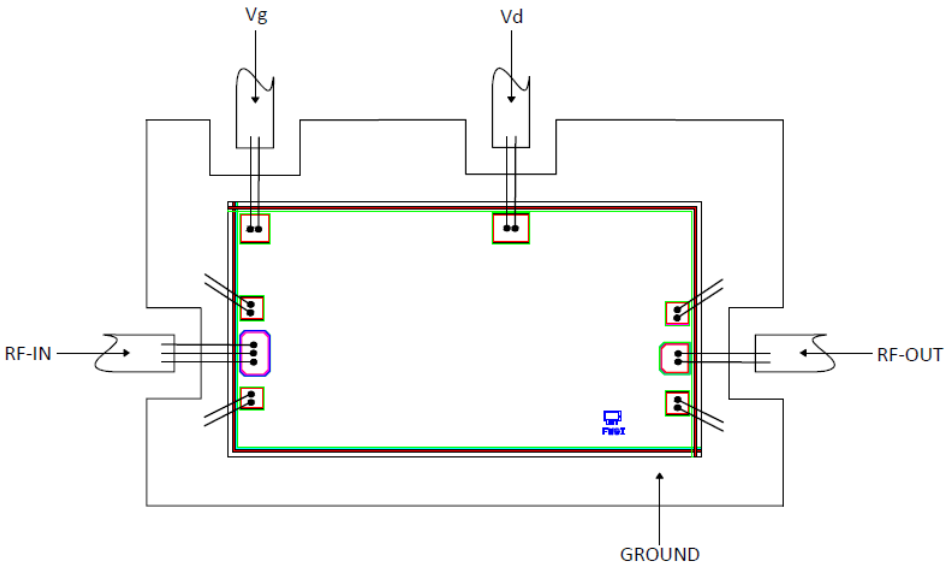
Component	Size	Value	Part Number	Manufacturer
C1, C3	0402	0.1 uF	GRM155R71C104KA88D	Murata
C2, C4	0402	100pF	GRM155C1H101JA01J	Murata

Fig 1. Block diagram of Test Circuit used for characterization. (Die is packaged in 3x3mm, 12-lead MCLP and soldered on Mini-Circuits Characterization test board TB-TSS-44+) Gain, Return loss, Output power at 1dB compression (P1dB) , output IP3 (OIP3) and noise figure measured using Agilent's N5244A PNA-X microwave network analyzer.

Conditions:

1. Gain and Return loss: Pin= -25dBm
2. Output IP3 (OIP3): Two tones, spaced 1 MHz apart, -10dBm/tone at output.
3. Switching Time:
   RF Signal:Pin=-25dBm, f_{RF}=22GHz
   V_{DD}=4VDC, VG=Pulse Signal at 1kHz with Vhigh=4V, Vlow=0V& 50% duty cycle

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 amplifier dice are susceptible to electrostatic and mechanical damage. Dice are supplied in antistatic protected material, which should be opened in clean room conditions at an appropriately grounded anti-static workstation. 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 with and without port extension(.zip file)	
Case Style	Die	
Die Ordering and packaging information	Quantity, Package	Model No.
	Small, Gel - Pak: 5,10,50,100 KGD*	TSS-44-DG+
	Medium†, Partial wafer: KGD*<1176	TSS-44-DP+
	Large†, Full Wafer	TSS-44-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 200V) in accordance with ANSI/ESD STM 5.1 - 2001

** Tested in industry standard MCLP 3x3 mm, 12-lead MCLP.

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.

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