

0.6 – 2.5 GHz LOW NOISE AMPLIFIER WHM0525AE¹

WHM0525AE LNA is a low noise figure, wideband, and high linearity SMT packaged amplifiers. The amplifier offers typical noise figure of 0.90 dB and output IP₃ of 27 dBm at the frequency range from 0.6 GHz to 2.5 GHz and extendable to 3.0 GHz of VHF, UHF, Cellular, GSM, GPS, DCS, PCS, 3G, and ISM bands. WHM0525AE LNA is most suitable for cellular base stations, wireless data communications, tower top receiver amplifiers, last-mile wireless communication systems, and wireless measurement applications.



Key Features:

Impedance:	50 Ohm
MTBF ² :	>2,500,000 hrs (300 Years)
LGA (land grid array) package:	6-pin
Low Noise:	0.90 dB
Output IP ₃ :	27 dBm
Gain:	30 dB
P_{1dB} :	14.0 dBm
Single power supply:	50 mA @ +5V
Frequency Range:	0.6 ~ 2.5 GHz
Operating Temperature:	$-40 \sim +85 \text{ °C}$
Return Losses:	16 dB Typical
Small size:	0.30" x 0.30" x 0.060" (7.62 mm x 7.62 mm x 1.52 mm)
Built-in Functions:	DC blocks at input and output, temperature compensation circuits, and auto DC biases.

Specifications:

a) Table 1 Summary of the electrical specifications WHM0525AE at room temperature

Index	Testing Item	Symbol	Test Constraints	Nom (RT)	Min	Max	Unit
1	Gain	S ₂₁	0.6 – 2.5 GHz		29	35	dB
2	Gain Variation	ΔG	0.1 GHz Bandwidth	+/- 0.20		+/- 0.3	dB
3	Input Return Loss	S ₁₁	0.6 – 2.5 GHz	18	16		dB
4	Output Return Loss	S ₂₂	0.6 – 2.5 GHz	18	16		dB
5	Reverse Isolation	S ₁₂	0.6 – 2.5 GHz	47	42		dB
6	Noise figure	NF	0.6 – 2.5 GHz	0.90		1.1	dB
7	Output Power 1dB compression Point	P _{1dB}	0.6 – 2.5 GHz	14	12.5		dBm
8	Output-Third-Order Interception point	IP ₃	Two-Tone, P _{out} +0 dBm each, 1 MHz separation	27	25		dBm
10	Current Consumption	l _{dd}	V _{dd} = +5 V	50	45	55	mA
11	Power Supply Voltage	V _{dd}		+5	+4.7	+5.3	V
12	Thermal Resistance	R _{th,c}	Junction to case			215	°C/W
13	Operating Temperature	To			-40	+85	°C
14	Maximum Average RF Input Power	P _{IN, MAX}	0.6 – 2.5 GHz			0	dBm

¹ Specifications are subject to change without notice.

² MTBF: Mean Time Between Failure, Per TR-NWT-000332, ISSUE 3, SEPTEMBER, 1990, T=40 °C



b) Passband Frequency Response

As shown in **Figure 1**, the typical gain of the WHM0525AE is from 30.0 dB to 34.0 dB across 0.6 GHz to 2.5 GHz. The typical input and output return losses are 18 dB across the frequency of 0.6 to 2.5 GHz.

Figure 2 shows the measured P_{1dB} and IP_3 of the WHM0525AE. The typical P_{1dB} and IP_3 are 14 dBm and 27 dBm in the frequency range of 0.6 to 2.5 GHz, respectively.

Figure 3 illustrates the measured noise figure performance at full temperature. The measured results include the test fixture loss of approximately 0.05 dB to 0.10 dB depending on the frequency. The noise figure is 0.90 dB across the frequency range of 0.6 to 2.5 GHz at room temperature. At 85 $^{\circ}$ C, WHM0525AE has only 0.35 dB noise figure increases. At -40 $^{\circ}$ C, WHM0525AE offers approximately 0.25 dB less noise figure than that at room temperature.

Figure 4 demonstrates the stability factor k of the amplifier. The k values are above 2.4 in all frequency bands. The amplifier is unconditional stable.

Figure 5 is the block diagram of internal circuit of WHM0525AE. It is a two-stage amplifier with the DC block capacitors at the input and output RF ports. All the RF matching networks, DC bias circuitries, and temperature compensation circuits are built in.

Figure 6 demonstrates the application schematic diagram of WHM0525AE. It may require one (1) external decoupling capacitors of 0.01 uF to build a LNA with WHM0525AE. The +5V DC is applied at Pin 3. No DC block capacitor is required for both input and output RF ports. For +5V line trace length being longer than 6 inch without a decoupling capacitor, an additional $0.01 \sim 0.1$ uF de-coupling capacitor with minimum rating voltage of 10V may be needed across the +5V line to ground. The capacitor must be rated in the temperature range of -40 $^{\circ}$ C to 85 $^{\circ}$ C to ensure the entire circuit working in the specified temperature range.

Figure 7 shows the mechanical outline and recommended motherboard layout of WHM0525AE. Plenty of ground vias on the motherboard are essential for the RF grounding. The width of the 50-Ohm lines at the input and output RF ports may be different for different property of the substrate.





FIG. 2 Typical P_{1dB} and IP₃ at room temperature.



REV B

Freq (GHz)

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6 Ы GND 2 BOTTOM GND PLANE WMH0525AE BLOCK DIAGRAM Ł Vd2 C12 Vd1 0.01UF Z 5.0< C1

FIG. 5 Block diagram of internal circuit.



FIG. 6 Typical application schematic for WHM0525AE



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WHM0525AE Mechanical Outline, WHM-1:



FIG. 7 WHM0525AE outline

Ordering Information

	Model Number	WHM0525AE
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Waffle pack with the capacity of 64 pieces (8×8) is used for the packing. Contact factory for tape and reel packing option for higher volume requirements.



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Small Signal S-Parameters:

!WHM0525AE !s-parameters at Vds=5V, Id=50 mA, including the test board. !Last updated 2/04/04.

GHZ s MA R 50

!F(GHz)	MAG S11	ANG S11	MAG S21	ANG S21	MAG S12	ANG S12	MAG S22	ANG S22
								<u></u>
0.05	0.882	160.9	0.265	-47.7	0.0001	-156.8	0.977	-25.4
0.1	0.808	116.2	1.358	-89.6	0.0000	162.2	0.919	-42.4
0.2	0.731	29.4	8.601	-159.0	0.0002	-97.3	0.741	-83.0
0.3	0.561	-43.1	23.732	138.4	0.0011	-165.2	0.522	-119.7
0.4	0.350	-108.8	39.837	82.8	0.0021	150.0	0.312	-150.6
0.5	0.185	-1/1.9	49.841	36.3	0.0030	117.4	0.160	-167.5
0.6	0.106	116.1	53.334	-1.6	0.0035	91.7	0.087	-161.1
0.7	0.098	52.9	53.529	-32.8	0.0038	72.3	0.074	-140.9
0.8	0.109	10.1	52.207	-59.3	0.0041	57.5	0.083	-136.7
0.9	0.119	-17.6	50.265	-82.6	0.0043	45.7	0.092	-140.7
1	0.126	-41.1	48.091	-103.9	0.0044	34.7	0.097	-150.1
1.1	0.129	-61.5	45.878	-123.3	0.0046	25.6	0.102	-159.3
1.2	0.132	-78.9	43.852	-141.5	0.0046	16.8	0.104	-169.1
1.3	0.131	-95.4	41.818	-158.6	0.0047	8.0	0.107	179.6
1.4	0.133	-111.2	40.033	-175.0	0.0048	0.0	0.109	169.4
1.5	0.131	-125.8	38.459	169.1	0.0048	-6.7	0.111	158.6
1.6	0.131	-140.8	36.972	153.9	0.0049	-14.5	0.114	147.9
1.7	0.128	-155.9	35.553	138.7	0.0049	-21.0	0.115	134.6
1.8	0.125	-1/1.0	34.228	123.9	0.0048	-27.9	0.117	123.3
1.9	0.122	175.8	33.077	109.5	0.0048	-36.2	0.118	110.1
2	0.121	162.9	32.039	95.2	0.0049	-42.8	0.115	95.9
2.1	0.125	150.2	31.076	81.2	0.0048	-49.2	0.109	81.2
2.2	0.128	136.0	30.394	67.3	0.0047	-55.1	0.104	64.4
2.3	0.132	121.3	29.987	53.2	0.0047	-63.2	0.091	46.6
2.4	0.129	106.9	29.567	38.9	0.0048	-70.9	0.078	22.8
2.5	0.135	92.8	29.159	24.0	0.0046	-77.3	0.062	-8.0
2.6	0.135	80.1	28.800	8.7	0.0046	-86.3	0.056	-52.5
2.7	0.139	67.2	28.491	-6.7	0.0046	-93.6	0.075	-102.1
2.8	0.142	54.4	27.982	-22.6	0.0046	-103.0	0.113	-140.6
2.9	0.153	42.6	27.386	-39.2	0.0046	-113.6	0.168	-166.4
3	0.163	29.2	26.675	-56.0	0.0046	-122.6	0.235	169.9
3.1	0.179	15.8	25.607	-73.2	0.0046	-135.2	0.315	148.5
3.2	0.197	1.7	24.311	-90.7	0.0046	-147.2	0.395	128.5
3.3	0.213	-12.7	22.576	-108.1	0.0046	-161.5	0.474	108.7
3.4	0.234	-27.0	20.703	-125.7	0.0045	-1/4.6	0.553	90.1
3.5	0.249	-41.9	18.714	-143.3	0.0046	171.1	0.622	72.0
3.6	0.267	-55.5	16.592	-159.8	0.0047	156.6	0.680	54.5
3.7	0.281	-69.7	14.493	-1/5.4	0.0046	143.0	0.724	38.2
3.8	0.301	-83.8	12.429	169.4	0.0048	130.4	0.761	22.8
3.9	0.321	-97.2	10.654	154.8	0.0049	116.5	0.791	8.2
4	0.331	-110.4	9.070	140.9	0.0054	103.9	0.812	-5.5
4.1	0.359	-122.9	7.866	127.3	0.0058	92.1	0.830	-18.5
4.2	0.379	-135.4	0.784	115.1	0.0059	82.0	0.842	-30.7
4.3	0.402	-14/./	010	103.1	0.0062	12.0	0.854	-43.0
4.4	0.423	-100.1	4.930	90.4	0.0067	59.0	0.803	-54.2
4.5 F	0.449	-1/2.9	4.199	11.0	0.0070	49.0	0.870	-05.2
5	0.503	127.1	0.000	13.1	0.0081	0.4	0.890	-110.5
0.0 6	0.003	00.3	0.849	-58.1	0.0087	-31.9	0.892	-102.3
Ø	0.720	10.9	0.496	-119.7	0.0084	-58.4	0.899	154.9