



## 0.20-0.55 GHz SUPER LOW NOISE AMPLIFIER WHM0105AE<sup>1</sup>

WHM0105AE LNA is a super low noise figure, ultra wideband, and high linearity amplifier. The amplifier offers **0.50 dB** exceptional low noise figure, 43.0 dB gain, 18.0 dB P<sub>1dB</sub> and output IP<sub>3</sub> of 35.0 dBm at the frequency range from 0.20 GHz to 0.55 GHz.

WHM0105AE is most suitable for cellular base stations, wireless data communications, tower top receiver amplifiers, cellular micro-cells, last-mile wireless communication systems, and wireless measurement applications of VHF and UHF bands.

WHM0105AE is designed to meet the rugged standards of MIL-STD-202, and MIL-STD-883.

# Preliminary

### Key Features:

Impedance:	50 Ohm
MTBF <sup>2</sup> :	>600,000 hrs (68 Years)
LGA (land grid array) package:	6-pin
Unconditional Stable:	k <sub>e</sub> > 1
<b>Exceptional Low Noise:</b>	<b>0.50 dB</b>
Output IP <sub>3</sub> :	35.0 dBm
Gain:	43.0
Gain Flatness:	+/-0.75 dB
Input VSWR:	1.25:1
Output VSWR:	1.25:1
P <sub>1dB</sub> :	18.0 dBm
Single Power Supply:	90 mA, @ +5.0 V
Frequency Range:	0.20 ~ 0.55 GHz and usable up to 1 GHz
Operating Temperature:	-40 ~ +85 °C
Small Size:	0.50" x 0.35" x 0.10" surface mount (SMT) format
Built-In Functions:	DC blocks at input and output, DC-DC converter temperature Compensation circuits, and auto DC biases.

### Absolute Maximum Ratings<sup>3</sup>:

Symbol	Parameters	Units	Absolute Maximum
V <sub>dd</sub>	DC Power Supply Voltage	V	7.0
I <sub>dd</sub>	Drain Current	mA	150
P <sub>diss</sub>	Total Power Dissipation	mW	1000
P <sub>In,Max</sub>	RF Input Power	dBm	10
T <sub>ch</sub>	Channel Temperature	°C	150
T <sub>STG</sub>	Storage Temperature	°C	-65 ~ 150
T <sub>O,MAX</sub>	Maximum Operating Temperature	°C	-40 ~ 85
R <sub>th,c</sub>	Thermal Resistance	°C/W	220

<sup>1</sup> Specifications are subject to change without notice.

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

<sup>3</sup> Operation of this device above any one of these parameters may cause permanent damage.



### Specifications:

a) **Table 1** Summary of the electrical specifications of WHM0105AE at room temperature

Index	Testing Item	Symbol	Test Constraints	Nom (RT)	Min	Max	Unit
1	Gain	$S_{21}$	0.20 – 0.55 GHz	43.0			dB
2	Gain Variation	$\Delta G$	0.20 – 0.55 GHz	+/- 0.75		+/- 1.0	dB
3	Input Return Loss	$S_{11}$	0.20 – 0.55 GHz	22	20		dB
4	Output Return Loss	$S_{22}$	0.20 – 0.55 GHz	22	20		dB
5	Reverse Isolation	$S_{12}$	0.20 – 0.55 GHz	45	42		dB
6	<b>Noise figure</b>	<b>NF</b>	0.20 – 0.55 GHz	<b>0.50</b>		<b>0.65</b>	<b>dB</b>
7	Output $P_{1dB}$ compression	$P_{1dB}$	0.20 – 0.55 GHz	18.0			dBm
8	Output-Third-Order Interception point	$IP_3$	Two-Tone, Pout 0 dBm each, 1 MHz separation	35.0			dBm
9	Current Consumption	$I_{dd}$	$V_{dd} = +5 V$	90			mA
10	Power Supply Voltage	$V_{dd}$		5.0	4.80	5.20	V
11	Operating Temperature	$T_o$			-40	+85	°C
12	Maximum Average RF Input Power	$P_{IN, MAX}$	0.20 – 0.55 GHz			10	dBm

### b) Passband Frequency Response

As shown in **Figure 1**, the typical gain of the WHM0105AE is 43.0 dB across 200 MHz to 550 MHz frequency range. The typical input and output return losses are 22 dB and better than 20 dB, respectively.

The noise figure, as shown in **Figure 2**, of WHM0105AE is 0.50 dB<sup>4</sup> at room temperature. The noise figure of 0.50 dB includes certain insertion loss of the test fixture. The actual noise figure of the LNA module is below 0.50 dB. The LNA noise figure only adds 0.15 dB at 85 C and decreases 0.15 dB at -40 C.

The output 1-dB compression point and  $IP_3$  are shown in **Figure 3**. WHM0105AE offers typical 18.0 dBm of  $P_{1dB}$  and minimum 35.0 dBm of  $IP_3$ .

**Figure 4** demonstrates the stability factor  $k$  of the amplifier.  $k$  is greater than 1 in all frequency range and thus the amplifier is unconditional stable.

**Figure 5** demonstrates the frequency response of WHM0105AE in the extended frequency range.

**Figure 6** is the block diagram of internal circuit of WHM0105AE. It is a two-stage amplifier with the DC block capacitors at the input and output RF ports. All the RF matching networks, DC-DC converter, DC bias circuitries, and temperature compensation circuits are built in.

**Figure 7** shows the mechanical outline and recommended motherboard layout of WHM0105AE. Plenty 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 characteristics of the substrate.

<sup>4</sup> In order to measure such low noise figure, a low ENR noise source such as HP465A is required to reduce the non-linearity of the detector due to the high ENR. Please refers to AN-106 which is available at [www.wancominc.com](http://www.wancominc.com)

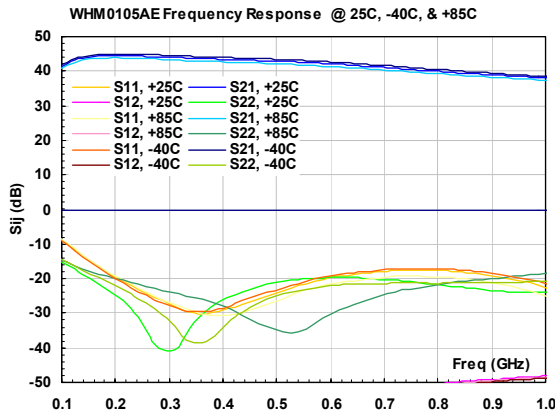


FIG. 1 Small signal performance of WHM0105AE

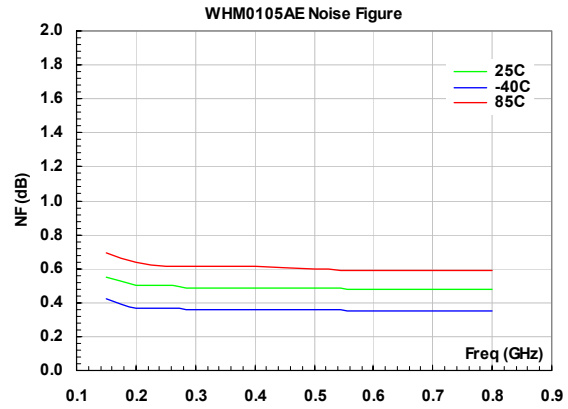


FIG. 2 Noise figure performance at full temperature

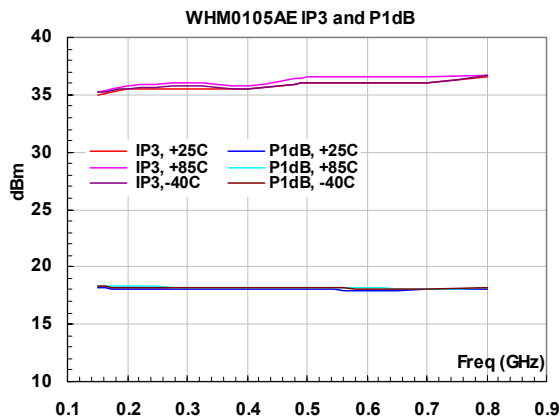


Fig. 3 Output 1-dB compression point and IP<sub>3</sub>

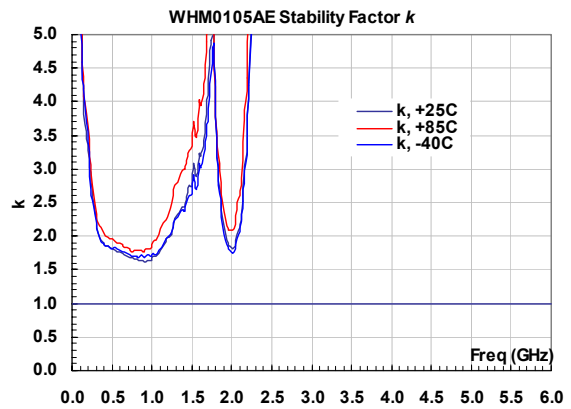


Fig. 4 Stability factor *k*

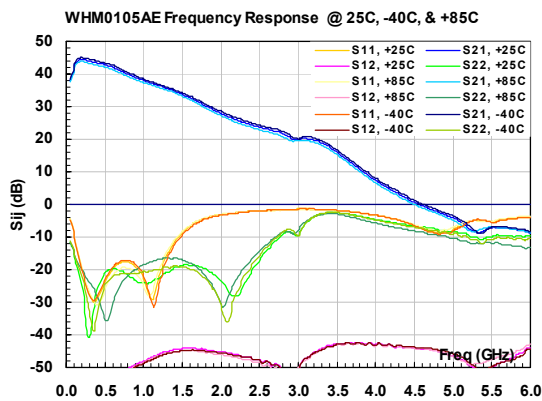


FIG. 5 Frequency response in the extended band.

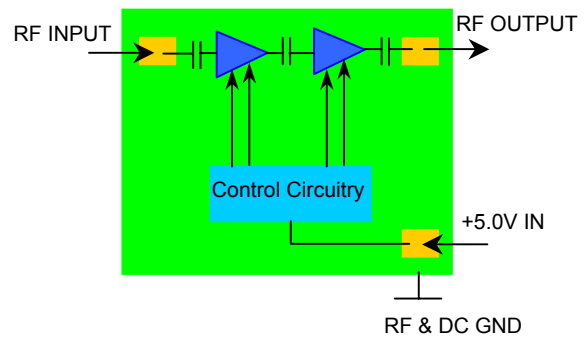


FIG. 6 Block diagram of WHM0105AE



WHM0105AE Mechanical Outline, WHM-4

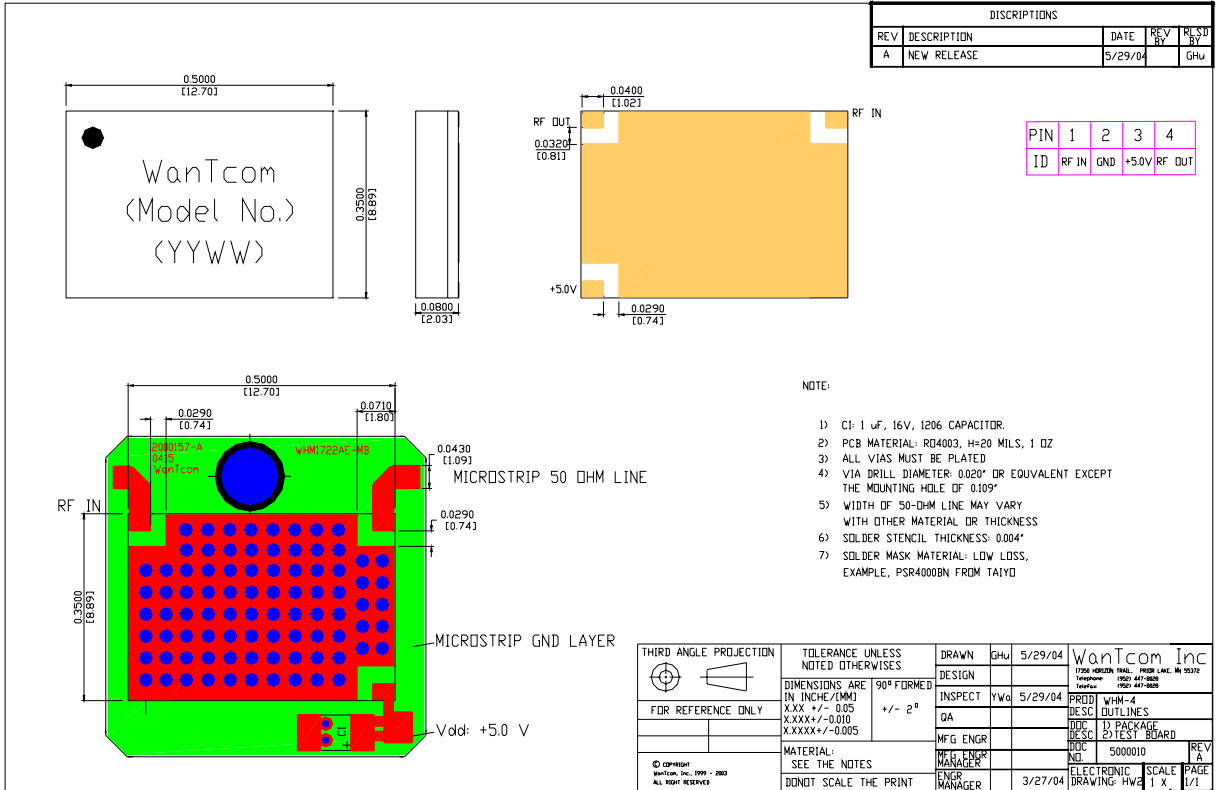


FIG. 7 WHM-4 Outline

Ordering Information

Model Number	WHM0105AE
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### Small Signal S-parameters

! WHM0105AE, @ +25C, including the test fixture  
! V<sub>dd</sub> = +5.0 V, I<sub>dd</sub> = 90 mA, Last update: 9/22/04  
# GHz s m a r 50

0.05	0.545	13.5	64.502	124.6	0.0001	139.2	0.264	152.9
0.15	0.191	-89.6	138.511	32.6	0.0005	110.1	0.106	94.9
0.25	0.066	-127.1	158.085	-22.9	0.0008	89.4	0.026	68.4
0.35	0.031	-175.7	149.630	-58.6	0.0011	84.9	0.027	-165.8
0.45	0.047	120.2	141.316	-87.4	0.0015	77.0	0.070	165.1
0.55	0.083	83.8	131.864	-114.6	0.0019	67.2	0.097	128.8
0.65	0.116	49.4	118.810	-140.2	0.0024	56.8	0.102	90.1
0.75	0.131	19.3	104.710	-163.0	0.0027	49.1	0.090	52.2
0.85	0.122	-6.9	92.902	176.5	0.0032	40.8	0.074	12.8
0.95	0.093	-35.5	83.158	157.2	0.0037	32.3	0.062	-29.0
1.05	0.049	-76.9	75.318	138.4	0.0042	24.5	0.061	-73.5
1.15	0.043	166.9	68.718	119.6	0.0047	14.3	0.070	-116.3
1.25	0.120	114.6	62.600	100.7	0.0052	4.0	0.083	-154.2
1.35	0.215	87.2	56.748	81.6	0.0057	-7.3	0.096	175.1
1.45	0.319	63.5	50.975	62.5	0.0060	-19.3	0.111	147.5
1.55	0.416	42.2	45.115	43.6	0.0063	-31.6	0.117	119.8
1.65	0.507	22.3	39.581	25.2	0.0063	-43.0	0.116	93.0
1.75	0.582	3.4	34.435	7.7	0.0061	-54.0	0.107	68.5
1.85	0.640	-14.1	29.815	-8.5	0.0058	-63.6	0.091	44.6
1.95	0.679	-29.9	26.112	-23.3	0.0056	-72.0	0.076	18.7
2.05	0.711	-44.6	23.335	-37.8	0.0054	-81.1	0.057	-19.7
2.15	0.727	-57.8	20.762	-51.7	0.0051	-87.8	0.038	-77.0
2.25	0.755	-69.8	18.938	-65.0	0.0048	-95.3	0.045	-135.3
2.35	0.777	-82.1	17.455	-78.4	0.0047	-101.2	0.074	-171.4
2.45	0.794	-94.1	16.166	-91.7	0.0042	-105.1	0.120	163.0
2.55	0.807	-105.8	15.166	-105.3	0.0037	-112.3	0.172	139.2
2.65	0.816	-116.8	14.307	-119.2	0.0036	-117.1	0.231	118.4
2.75	0.818	-127.5	13.482	-134.2	0.0034	-121.5	0.305	97.1
2.85	0.827	-137.4	12.029	-149.5	0.0029	-120.2	0.374	71.1
2.95	0.843	-147.6	10.500	-159.3	0.0026	-106.2	0.341	46.1
3.05	0.856	-158.3	10.654	-168.9	0.0040	-96.3	0.426	48.2
3.15	0.852	-169.5	10.458	172.5	0.0048	-104.3	0.578	25.1
3.25	0.851	-179.9	9.462	153.3	0.0058	-115.2	0.674	-0.4
3.35	0.838	169.7	8.098	134.1	0.0065	-127.9	0.727	-25.5
3.45	0.819	159.5	6.688	116.0	0.0070	-140.3	0.743	-49.0
3.55	0.802	148.9	5.324	99.3	0.0073	-156.0	0.737	-70.8
3.65	0.784	140.0	4.135	84.6	0.0077	-167.8	0.713	-91.8
3.75	0.756	129.9	3.168	70.3	0.0075	-178.4	0.676	-111.0
3.85	0.730	119.8	2.420	56.3	0.0073	167.4	0.639	-128.1
3.95	0.699	110.8	1.878	42.5	0.0073	153.7	0.607	-144.5
4.05	0.665	102.1	1.494	28.1	0.0075	145.0	0.577	-160.9
4.15	0.629	92.5	1.217	13.5	0.0070	135.4	0.541	-176.2
4.25	0.591	83.8	1.038	-2.6	0.0064	124.3	0.520	169.5
4.35	0.544	76.2	0.900	-20.3	0.0066	111.7	0.504	154.5
4.45	0.501	68.7	0.832	-36.0	0.0065	102.3	0.481	138.6
4.95	0.373	66.4	0.899	-89.3	0.0049	47.3	0.379	66.2
5.45	0.536	31.8	0.874	-108.5	0.0029	37.1	0.313	1.5
5.95	0.638	-0.3	1.045	-131.5	0.0061	13.6	0.328	-90.3
6.00	0.643	-4.6	1.040	-133.4	0.0063	4.8	0.342	-96.4

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