



## 1.7 – 2.2 GHz LOW NOISE AMPLIFIER WHM19-3030AE<sup>1</sup>

WHM19-3030AE LNA is a low noise figure, wideband, and high linearity SMT packaged amplifier with unconditional stable design. The amplifier offers typical 0.90 dB noise figure, 30 dB gain, and output IP<sub>3</sub> of 27.0 dBm at the frequency range from 1.7 GHz to 2.2 GHz of DCS, PCS, 3G, and L bands. WHM19-3030AE 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 <sup>2</sup> :	>600,000 hrs (68 Years)
LGA (land grid array) Package:	6-pin
Low Noise:	0.90 dB
Output IP <sub>3</sub> :	27 dBm
Gain:	30.0 dB
P <sub>1dB</sub> :	14.0 dBm
Single Power Supply:	50 mA @ +5V
Frequency Range:	1.7 ~ 2.2 GHz
Operating Temperature:	-40 ~ +85 °C
VSWR:	1.3:1
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.

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

Symbol	Parameters	Units	Absolute Maximum
V <sub>dd</sub>	DC Power Supply Voltage	V	6.0
I <sub>dd</sub>	Drain Current	mA	100
P <sub>diss</sub>	Total Power Dissipation	mW	350
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	-165 ~ 150
T <sub>O,MAX</sub>	Maximum Operating Temperature	°C	-155 ~ 100
T <sub>Re,MAX</sub>	Maximum Reflow Temperature	°C	230 <sup>4</sup>
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.

<sup>4</sup> Refer to Wan7com's AN-109 for correct solder reflow temperature profile.



## Specifications:

a) **Table 1** Summary of the electrical specifications WHM19-3030AE at room temperature

Index	Testing Item	Symbol	Test Constraints	Nom (RT)	Min	Max	Unit
1	Gain	$S_{21}$	1.7 – 2.2 GHz	30	28	32	dB
2	Gain Variation	$\Delta G$	1.7 – 2.2 GHz	+/- 0.50		+/- 0.75	dB
3	Input VSWR	$VSWR_1$	1.7 – 2.2 GHz	1.25		1.30	
4	Output VSWR	$VSWR_2$	1.7 – 2.2 GHz	1.30		1.35	
5	Reverse Isolation	$S_{12}$	1.7 – 2.2 GHz	47	45		dB
6	Noise figure	NF	1.7 – 2.2 GHz	0.85		1.1	dB
7	Output Power 1dB compression Point	$P_{1dB}$	1.7 – 2.2 GHz	14	12		dBm
8	Output-Third-Order Interception point	$IP_3$	Two-Tone, $P_{out} = +0$ dBm each, 1 MHz separation	27	26		dBm
10	Current Consumption	$I_{dd}$	$V_{dd} = +5$ 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	$^{\circ}C/W$
13	Operating Temperature	$T_o$			-40	+85	$^{\circ}C$
14	Maximum Average RF Input Power	$P_{IN, MAX}$	1.7 – 2.2 GHz			10	dBm

## b) Passband Frequency Response

As shown in **Figure 1**, the typical gain of the WHM19-3030AE is 30.0 dB across 1.7 to 2.2 GHz. The typical input and output return losses are 18 dB across the frequency of 1.7 to 2.2 GHz.

**Figure 2** shows the measured  $P_{1dB}$  and  $IP_3$  of the WHM19-3030AE. The typical  $P_{1dB}$  and  $IP_3$  are 14.0 dBm and 27.0 dBm in the frequency range of 1.7 to 2.2 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 ~ 0.10 dB. The noise figure is 0.90 dB across the frequency range of 1.7 to 2.2 GHz at room temperature. At 85  $^{\circ}C$ , WHM19-3030AE only has 0.30 dB noise increases. At -40  $^{\circ}C$ , WHM19-3030AE offers approximately 0.25 dB less noise figure than that at room temperature.

**Figure 4** demonstrates the stability factor  $k$  of the amplifier. It is greater than 3.0 in full frequency band and the amplifier is unconditional stable.

**Figure 5** is the frequency response of WHM19-3030AE in the extended frequencies. The amplifier works from 1.2 GHz to 3.0 GHz.

**Figure 6** is the block diagram of internal circuit of WHM19-3030AE. 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 7** demonstrates the application schematic diagram of WHM19-3030AE. It may require one external decoupling capacitor of 0.01  $\mu F$  to build a LNA with WHM19-3030AE. The +5V DC can be applied at Pin 2. No DC block capacitor is required for both input and output RF ports. The NC pins connecting to ground are recommended. For +5V line trace length being longer than 6 inch without a decoupling capacitor, an additional 0.01 ~ 0.1  $\mu F$  decoupling 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 8** shows the mechanical outline and recommended motherboard layout of WHM19-3030AE. 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.



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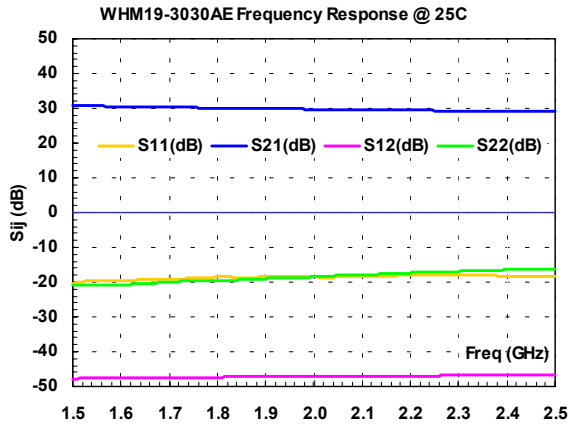


FIG. 1 Typical small signal performance.

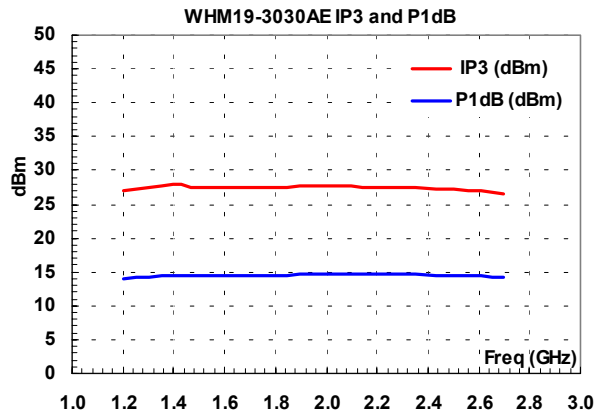


FIG. 2 Typical  $P_{1dB}$  and  $IP_3$  at room temperature.

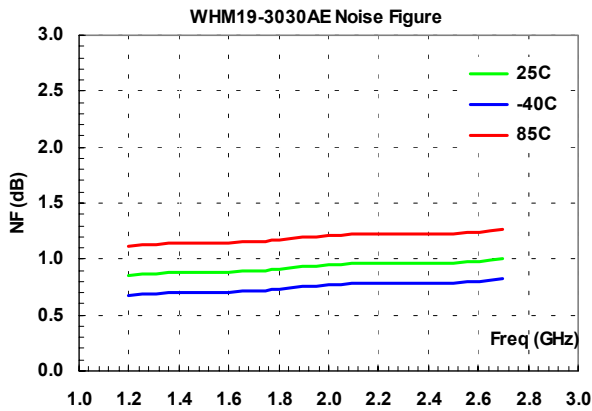


FIG. 3 Noise figure performance at full temperature

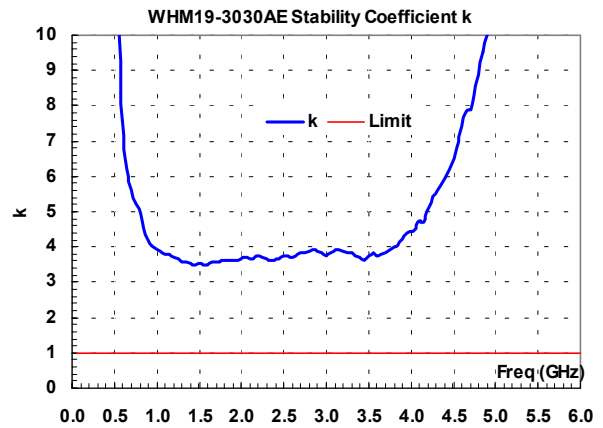


FIG. 4 Stability factor  $k$

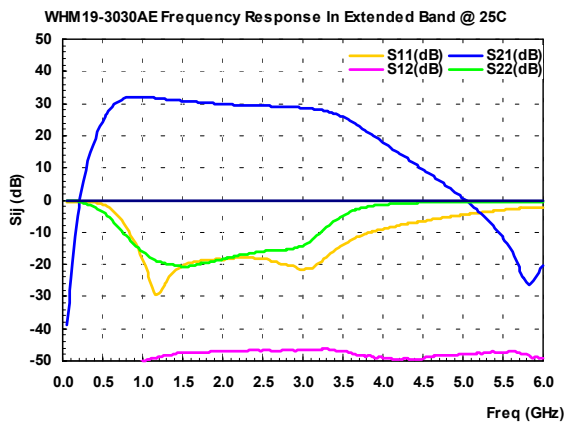


FIG. 5 Frequency response in the extended frequencies

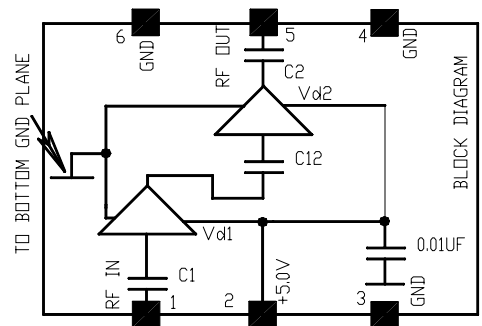


FIG. 6 Block diagram of internal circuit.



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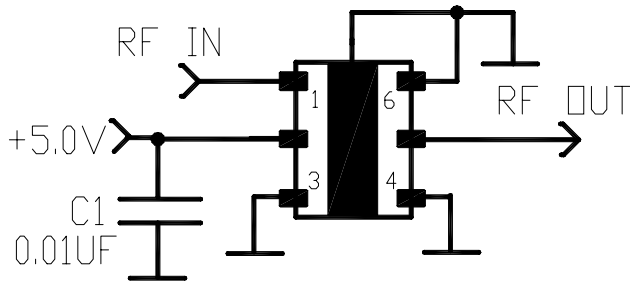


FIG. 7 Typical application schematic for WHM19-3030AE

WHM19-3030AE Mechanical Outline, WHM-2:

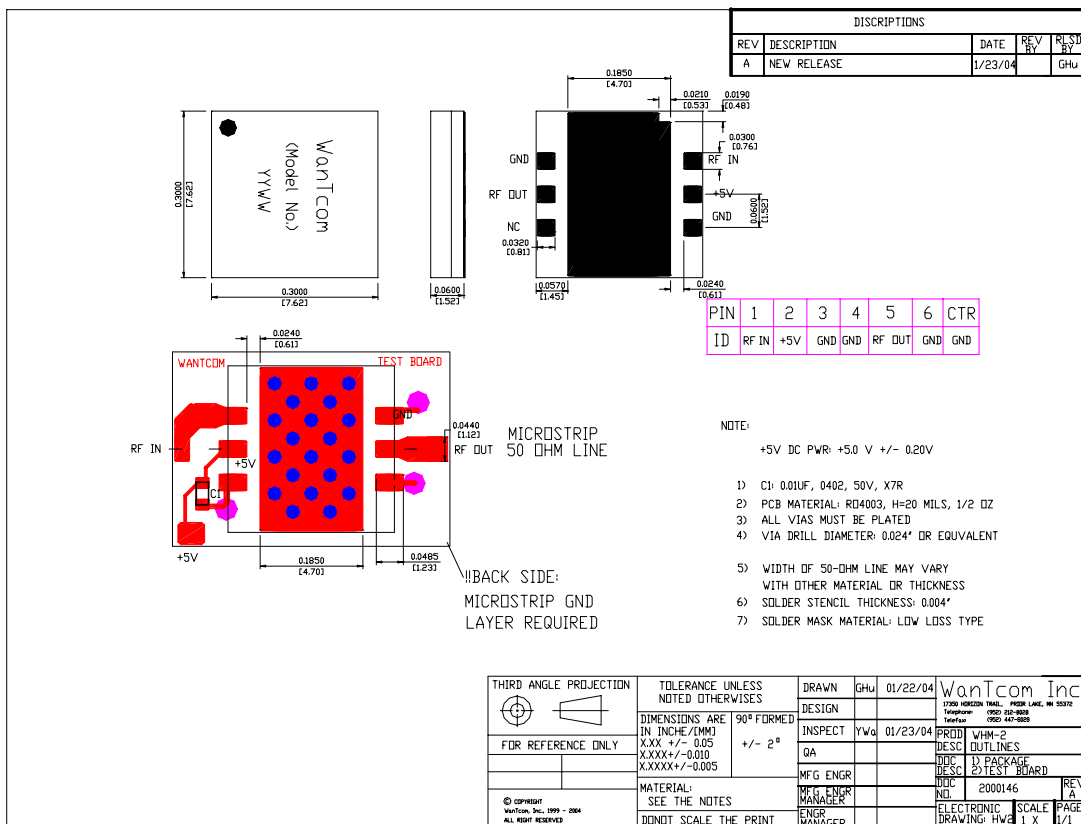


FIG. 8 WHM19-3030AE outline



### Ordering Information

<b>Model Number</b>	WHM19-3030AE
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Waffle pack with the capacity of 64 pieces (8 x 8) is used for the packing. Contact factory for tape and reel packing option for higher volume requirements.

### Small Signal S-Parameters:

! WLA19-3030AE  
! Vdd = +5.0 V, Id = 50 mA, Last Updat: 3/20/04  
# Ghz s ma r 50

0.05	0.914	170.4	0.021	-52.3	0.000024	173.7	0.992	-14.1
0.1	0.880	133.4	0.125	-76.1	0.000033	142.4	0.979	-23.5
0.2	0.904	67.3	0.960	-116.3	0.000138	129.0	0.937	-47.2
0.3	0.913	18.8	3.561	-157.4	0.000152	82.4	0.867	-70.7
0.4	0.899	-22.8	8.759	161.7	0.000059	129.3	0.771	-94.8
0.5	0.841	-61.3	16.570	120.2	0.000383	-170.1	0.650	-118.9
0.6	0.714	-98.7	25.469	78.4	0.000967	172.3	0.511	-142.1
0.7	0.544	-133.7	33.018	38.1	0.001668	141.5	0.378	-161.5
0.8	0.371	-164.1	37.623	1.7	0.002167	117.8	0.273	-176.5
0.9	0.227	170.7	39.415	-30.0	0.002794	97.1	0.201	173.9
1	0.122	153.9	39.358	-57.9	0.003150	79.9	0.157	165.9
1.1	0.055	156.8	38.472	-82.3	0.003400	64.1	0.129	160.1
1.2	0.037	-156.1	37.508	-104.5	0.003598	49.9	0.111	154.3
1.3	0.055	-135.7	36.386	-124.8	0.003860	38.7	0.103	147.2
1.4	0.081	-143.0	35.339	-144.0	0.004043	28.0	0.096	138.7
1.5	0.097	-154.0	34.557	-162.3	0.004086	16.9	0.092	130.0
1.6	0.106	-167.7	33.723	-179.9	0.004233	6.0	0.093	122.5
1.7	0.112	177.1	32.824	162.7	0.004262	-2.9	0.100	110.7
1.8	0.119	161.4	31.983	146.0	0.004304	-11.5	0.106	98.4
1.9	0.120	145.4	31.322	129.7	0.004383	-20.0	0.112	87.2
2	0.118	132.2	30.675	113.5	0.004409	-28.7	0.119	75.4
2.1	0.121	118.5	30.051	97.6	0.004522	-36.6	0.126	64.2
2.2	0.127	102.4	29.577	82.0	0.004437	-44.3	0.136	53.3
2.3	0.128	84.4	29.307	66.3	0.004586	-53.2	0.143	43.9
2.4	0.122	67.8	28.966	50.2	0.004634	-61.9	0.151	34.1
2.5	0.120	51.0	28.678	33.5	0.004558	-70.7	0.157	25.1
2.6	0.112	34.3	28.383	17.0	0.004668	-79.5	0.164	17.7
2.7	0.103	22.0	28.109	0.8	0.004535	-89.1	0.167	10.1
2.8	0.096	8.8	27.701	-16.4	0.004581	-97.5	0.168	7.1
2.9	0.090	0.5	27.327	-34.1	0.004616	-108.7	0.177	4.8
3	0.081	-5.3	26.937	-52.4	0.004809	-118.4	0.194	6.2
3.1	0.086	-2.6	26.267	-71.4	0.004675	-131.8	0.233	7.1
3.2	0.100	-1.1	25.240	-91.5	0.004693	-143.1	0.296	4.1
3.3	0.130	-7.9	23.923	-111.7	0.004665	-156.2	0.383	-3.5
3.4	0.165	-17.7	21.928	-132.4	0.004665	-171.6	0.476	-14.4
3.5	0.201	-31.0	19.346	-153.0	0.004496	172.8	0.571	-27.4
3.6	0.239	-45.6	16.643	-172.9	0.004265	156.7	0.657	-41.6
3.7	0.268	-58.9	14.078	168.6	0.004016	142.4	0.725	-55.6
3.8	0.300	-73.9	11.671	151.7	0.003749	126.8	0.779	-69.2
3.9	0.331	-87.8	9.581	135.9	0.003543	110.1	0.817	-81.9
4	0.348	-101.8	7.809	121.5	0.003475	97.4	0.846	-94.2
4.1	0.378	-114.3	6.335	106.6	0.003389	85.0	0.868	-105.5
4.2	0.402	-127.4	5.216	92.7	0.003391	75.2	0.881	-116.3
4.3	0.425	-140.0	4.302	79.5	0.003329	62.5	0.894	-126.9
4.4	0.445	-152.0	3.503	66.9	0.003386	52.2	0.904	-136.9
4.5	0.469	-164.9	2.831	53.8	0.003447	40.1	0.911	-146.6
5	0.593	134.0	0.965	-11.6	0.003972	-10.2	0.929	168.6
5.5	0.696	75.5	0.332	-82.7	0.004350	-50.1	0.933	127.0
6	0.778	16.2	0.090	-135.3	0.003440	-82.2	0.939	87.9