Wan7com, Inc.

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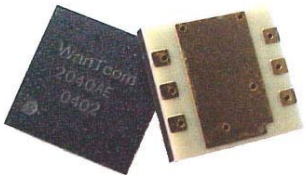
2.5 – 3.5 GHz LOW NOISE AMPLIFIER WHM2535-12AE[1]

WHM2535-12AE LNA is a low noise figure, wideband, and high linearity SMT packaged amplifier. The amplifier offers typical noise figure of 0.90 dB and output IP_3 of 31.0 dBm at the frequency range from 2.50 GHz to 3.50 GHz of L, S, and C bands. WHM2535-12AE provides excellent performance consistency between each part due to the high volume precision production with advance quality control. WHM2535-12AE 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]:	>1,500,000 hrs (171 Years)
LGA (land grid array) package:	6-pin
Low Noise:	0.90 dB
Output IP_3:	31 dBm
Gain:	14.0 dB
P_{1dB}:	14.0 dBm
Single power supply:	30 mA @ +5V
Frequency Range:	2.5 ~ 3.5 GHz
Operating Temperature:	-40 ~ +85 ºC
Input Return Losses:	16 dB or better
Output Return Losses:	20 dB or better
Small size:	0.25" x 0.25" x 0.060" (5.0 mm x 5.0 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 WHM2535-12AE at room temperature

Index	Testing Item	Symbol	Test Constraints	Nom (RT)	Min	Max	Unit
1	Gain	S_{21}	2.5 – 3.5 GHz	14	13.0	15	dB
2	Gain Variation	ΔG	2.5 – 3.5 GHz	+/- 0.25		+/- 0.5	dB
3	Input Return Loss	S_{11}	2.5 – 3.5 GHz	17	16		dB
4	Output Return Loss	S_{22}	2.5 – 3.5 GHz	22	20		dB
5	Reverse Isolation	S_{12}	2.5 – 3.5 GHz	18	16		dB
6	Noise figure	NF	2.5 – 3.5 GHz	0.90		1.2	dB
7	Output Power 1dB compression Point	P_{1dB}	2.5 – 3.5 GHz	14	13		dBm
8	Output-Third-Order Interception point	IP_3	Two-Tone, P_{out} +0 dBm each, 1 MHz separation	31	29		dBm
10	Current Consumption	I_{dd}	V_{dd}= +5 V	30	25	35	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	T_o			-40	+85	°C
14	Maximum Average RF Input Power	$P_{IN, MAX}$	2.5 – 3.5 GHz			10	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 WHM2535-12AE is 14.0 dB across 2.5 to 3.5 GHz. The typical input and output return losses are 17 dB and 22 dB across the frequency of 2.5 to 3.5 GHz, respectively.

Figure 2 shows the measured P_{1dB} and IP_3 of the WHM2535-12AE. The typical P_{1dB} and IP_3 are 14 dBm and 31 dBm in the frequency range of 2.5 to 3.5 GHz, respectively.

Figure 3 illustrates the measured noise figure performance at full temperature. The measured results include the test fixture loss of approximately 0.10 dB. The noise figure is 1.0 dB (including 0.10 dB test fixture loss) across the frequency range of 2.5 to 3.5 GHz at room temperature. At 85 ^{0}C, WHM2535-12AE only has 0.30 dB noise increases. At –40 ^{0}C, WHM2535-12AE offers approximately 0.25 dB less noise figure than that at room temperature.

Figure 4 demonstrates the stability factor ***k*** of the amplifier.

Figure 5 is the block diagram of internal circuit of WHM2535-12AE. It is a one-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 integrated in.

Figure 6 demonstrates the application schematic diagram of WHM2535-12AE. It requires the external decoupling capacitors C1 of 0.01 uF to build a LNA with WHM2535-12AE. C1 is to be as close to Pin 2 as possible. This capacitor eliminates the parasitic. The +5V DC is applied at Pin 2. No DC block capacitor is required for both input and output RF ports. The NC pins connected to ground are recommended. For +5V line trace length being longer than 6 inch without a decoupling capacitor, an additional 0.01 ~ 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 ^{0}C to 85 ^{0}C to ensure the entire circuit working in the specified temperature range.

Figure 7 shows the mechanical outline and recommended motherboard layout of WHM2535-12AE. 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.

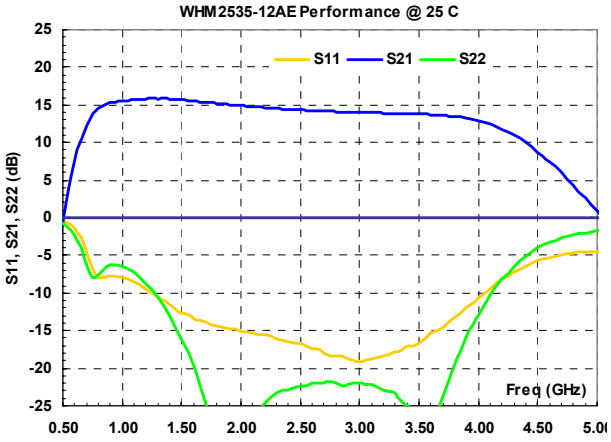


FIG. 1 Typical small signal performance.

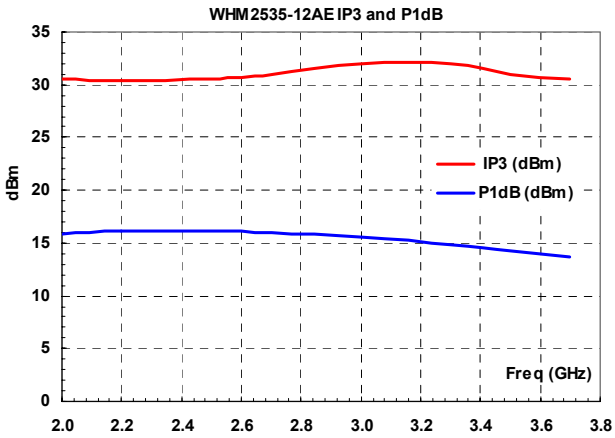


FIG. 2 Typical P_{1dB} and IP_3 at room temperature.

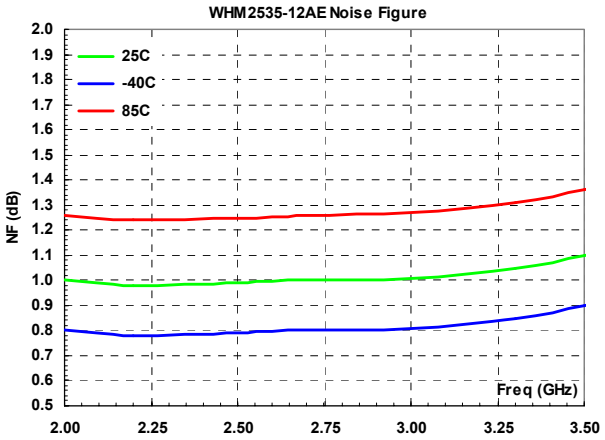


FIG. 3 Noise figure performance at full temperature

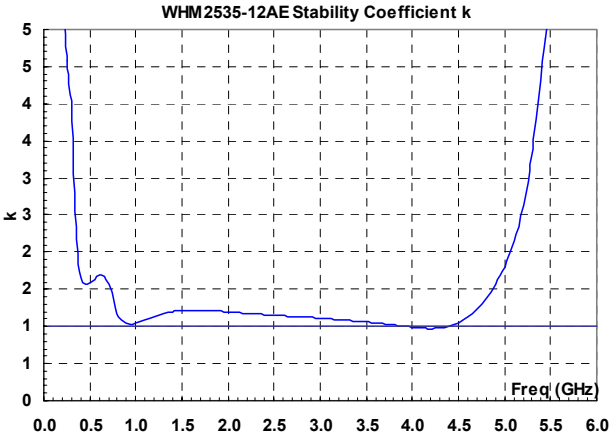


FIG. 4 Measured stability factor ***k***

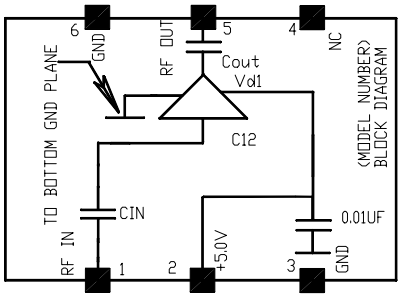


FIG. 5 Block diagram of internal circuit.

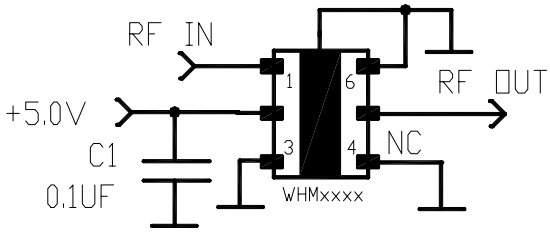


FIG. 6 Typical application schematic for WHM2535-12AE

WHM2535-12AE Mechanical Outline, WHM-1S:

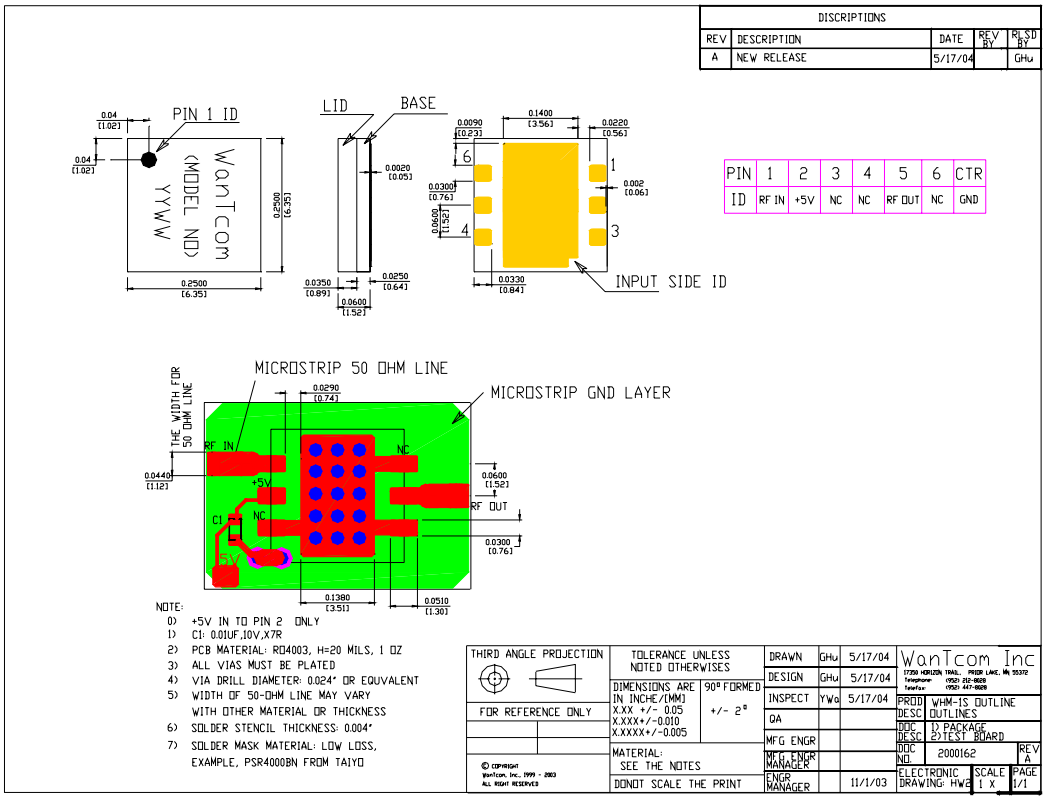


FIG. 7 WHM2535-12AE outline

Ordering Information

Model Number	WHM2535-12AE

Waffle pack with the capacity of 100 pieces (10 x 10) is used for the packing. Contact factory for tape and reel packing option for higher volume requirements.

Small Signal S-Parameters:

!WHM2535-12AE
!s-parameters at Vds=5V, Id=30 mA, including the test board.
!Last updated 3/07/04.

GHZ s MA R 50

!F(GHz)	MAG S11	ANG S11	MAG S21	ANG S21	MAG S12	ANG S12	MAG S22	ANG S22
0.05	0.999	-9.5	0.001	-50.6	0.0000	20.4	0.999	-9.0
0.1	0.998	-15.8	0.002	-168.9	0.0000	109.7	0.998	-15.2
0.2	0.998	-31.6	0.018	135.0	0.0002	14.4	0.996	-31.0
0.3	0.991	-48.4	0.093	112.2	0.0008	-17.6	0.989	-47.4
0.4	0.989	-66.7	0.324	89.9	0.0026	-36.1	0.974	-65.7
0.5	0.963	-87.4	0.946	61.2	0.0081	-60.5	0.923	-86.9
0.6	0.853	-113.1	2.338	20.1	0.0220	-96.0	0.768	-112.4
0.7	0.578	-135.8	4.162	-29.1	0.0420	-142.5	0.475	-126.8
0.8	0.399	-132.5	5.381	-74.7	0.0540	174.9	0.417	-115.3
0.9	0.406	-132.8	5.788	-110.2	0.0590	144.8	0.483	-125.7
1	0.403	-143.1	5.960	-138.3	0.0630	122.8	0.478	-144.6
1.1	0.378	-155.6	6.079	-162.1	0.0670	105.1	0.432	-164.2
1.2	0.337	-167.1	6.163	176.6	0.0700	89.3	0.364	176.3
1.3	0.296	-177.1	6.163	157.0	0.0740	75.2	0.293	157.0
1.4	0.264	175.0	6.136	138.8	0.0770	63.0	0.221	138.8
1.5	0.234	168.5	6.075	122.2	0.0790	51.5	0.158	120.2
1.6	0.213	162.4	5.975	106.7	0.0820	40.6	0.102	102.0
1.7	0.202	155.6	5.858	92.0	0.0850	30.8	0.060	79.9
1.8	0.190	148.8	5.748	78.1	0.0870	21.9	0.024	49.3
1.9	0.182	141.2	5.647	64.9	0.0900	13.1	0.011	-64.4
2	0.176	132.5	5.550	52.0	0.0920	4.6	0.031	-120.6
2.1	0.172	122.9	5.465	39.6	0.0950	-3.4	0.048	-142.9
2.2	0.166	113.0	5.384	27.5	0.0980	-11.2	0.059	-163.7
2.3	0.158	102.5	5.315	15.7	0.1010	-19.2	0.068	177.6
2.4	0.149	89.0	5.263	4.0	0.1050	-26.7	0.072	158.3
2.5	0.146	76.3	5.212	-7.4	0.1080	-34.2	0.076	139.9
2.6	0.134	63.2	5.154	-18.8	0.1100	-42.1	0.080	119.1
2.7	0.127	48.5	5.111	-30.0	0.1130	-50.1	0.079	97.9
2.8	0.122	32.4	5.070	-41.5	0.1170	-57.7	0.080	78.8
2.9	0.116	16.2	5.044	-53.0	0.1200	-65.3	0.078	54.4
3	0.111	-1.5	5.029	-64.5	0.1230	-73.2	0.079	32.6
3.1	0.115	-18.1	4.996	-76.1	0.1260	-81.1	0.077	11.1
3.2	0.120	-33.9	4.960	-87.9	0.1290	-89.0	0.071	-12.8
3.3	0.127	-51.9	4.951	-99.8	0.1320	-96.8	0.068	-38.1
3.4	0.140	-65.6	4.925	-111.7	0.1340	-105.0	0.056	-67.1
3.5	0.146	-79.5	4.890	-124.1	0.1370	-113.5	0.046	-105.9
3.6	0.169	-91.9	4.841	-136.8	0.1400	-122.0	0.046	-158.8
3.7	0.187	-105.5	4.779	-150.1	0.1430	-130.7	0.066	150.7
3.8	0.219	-115.2	4.690	-163.9	0.1450	-139.9	0.105	110.7
3.9	0.252	-126.4	4.580	-178.3	0.1460	-149.8	0.160	81.5
4	0.295	-140.2	4.411	166.8	0.1470	-160.4	0.226	57.1
4.1	0.338	-152.2	4.195	151.5	0.1480	-171.4	0.307	32.3
4.2	0.388	-166.3	3.894	135.8	0.1450	178.0	0.391	10.0
4.3	0.436	-179.6	3.552	120.1	0.1390	166.8	0.476	-12.7
4.4	0.478	166.7	3.153	104.2	0.1320	154.8	0.556	-33.8
4.5	0.515	152.6	2.754	88.5	0.1230	143.6	0.626	-54.7
5	0.594	88.9	1.107	21.6	0.0760	98.1	0.816	-143.6
5.5	0.568	36.9	0.363	-27.7	0.0450	62.6	0.866	149.5
6	0.515	-8.5	0.106	-58.9	0.0350	29.0	0.904	95.4