



0.5-1.0 GHz SUPER LOW NOISE PACKAGED AMPLIFIER WHM0510AE¹

WHM0510AE LNA is a super low noise figure, wideband, and high linear amplifier. The amplifier offers **0.40 dB** exceptional low noise figure, 38.0 dB gain, 19.0 dBm P_{1dB} and 30.0 dBm output IP₃ at the frequency range from 500 MHz to 1000 MHz.

WHM0510AE 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 UHF, Cellular, and GSM bands.

WHM0510AE is designed to meet the rugged standards of MIL-STD-202, and MIL-STD-883.

Preliminary

Key Features:

Impedance:	50 Ohm
MTBF ² :	>600,000 hrs (68 Years)
Exceptional Low Noise:	0.40 dB
Output IP ₃ :	30.0 dBm
Gain:	38.0
Gain Flatness:	+/-1.25 dB
Input VSWR:	1.25:1
Output VSWR:	1.25:1
P _{1dB} :	19.0 dBm
Single Power Supply:	100 mA, @ +5.0 V
Frequency Range:	500 ~ 1000 MHz
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 Ratings³:

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

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

³ Operation of this device above any one of these parameters may cause permanent damage.

**Specifications:**

a) **Table 1** Summary of the electrical specifications of WHM0510AE at room temperature

Index	Testing Item	Symbol	Test Constraints	Nom (RT)	Min	Max	Unit
1	Gain	S_{21}	500 - 1000 MHz	38	36	40	dB
2	Gain Variation	ΔG	500 - 1000 MHz	+/- 1.25		+/- 1.5	dB
3	Input Return Loss	S_{11}	500 - 1000 MHz	20	18		dB
4	Output Return Loss	S_{22}	500 - 1000 MHz	20	18		dB
5	Reverse Isolation	S_{12}	500 - 1000 MHz	45	40		dB
6	Noise figure	NF	500 - 1000 MHz	0.40		0.55	dB
7	Output P_{1dB} compression	P_{1dB}	500 - 1000 MHz	19.0			dBm
8	Output-Third-Order Interception point	IP_3	Two-Tone, Pout 0 dBm each, 1 MHz separation	30.0			dBm
9	Current Consumption	I_{dd}	$V_{dd} = +5 V$	100			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	$P_{IN, MAX}$	500 - 1000 MHz			10	dBm

b) Passband Frequency Response

As shown in **Figure 1**, the typical gain of the WHM0510AE is 38.0 dB across 500 MHz to 1000MHz. The typical input and output return losses are 20.0 dB and better than 18.0 dB, respectively.

The noise figure, as shown in **Figure 2**, of WHM0510AE is 0.43 dB⁴ at room temperature. The noise figure of 0.43 dB includes 0.03 dB loss of the SMA connector. The actual noise figure of the LNA module is in 0.40 dB neighborhoods. The LNA noise figure is less than 0.60 dB at 85 C and way below 0.30 dB at -40 C, which is already difficult to measure by the existing state-of-the-art noise figure measurement system.

The output 1-dB compression point and IP_3 are shown in **Figure 3**. WHM0510AE offers typical 19.0 dBm of P_{1dB} and minimum 30.0 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 WHM0510AE in the extended frequency range.

Figure 6 is the block diagram of internal circuit of WHM0510AE. 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 WHM0510AE. 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.

⁴ 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.wantcominc.com

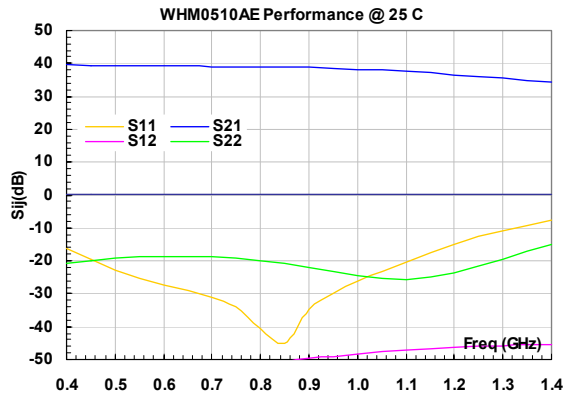


FIG. 1 Small signal performance of WHM0510AE

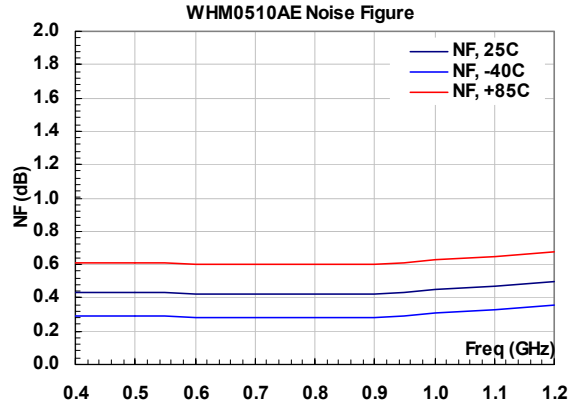


FIG. 2 Noise figure performance at full temperature

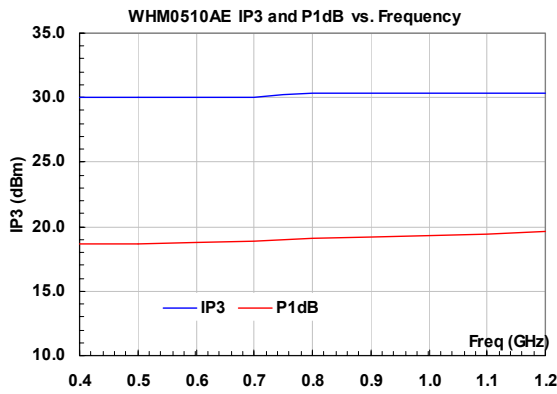


Fig. 3 Output 1-dB compression point and IP₃

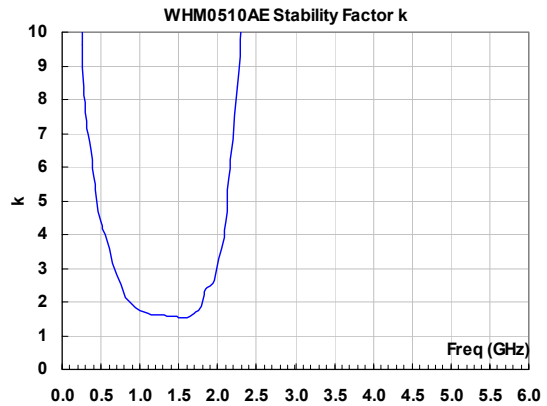


Fig. 4 Stability factor *k*

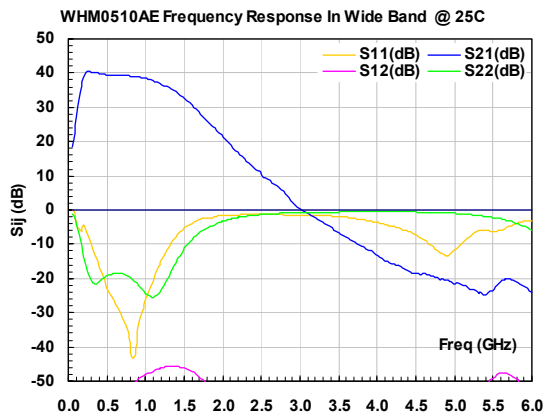


FIG. 5 Frequency response in the extended band.

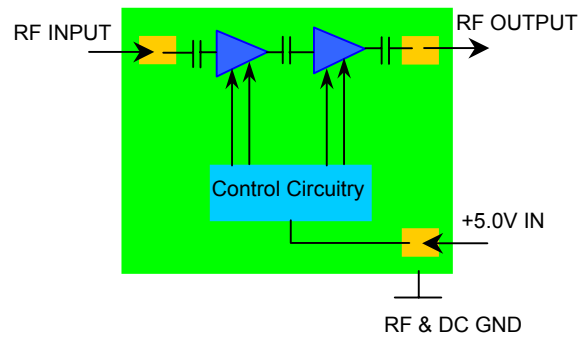


FIG. 6 Block diagram of WHM0510AE



WHM0510AE Mechanical Outline, WHM-4

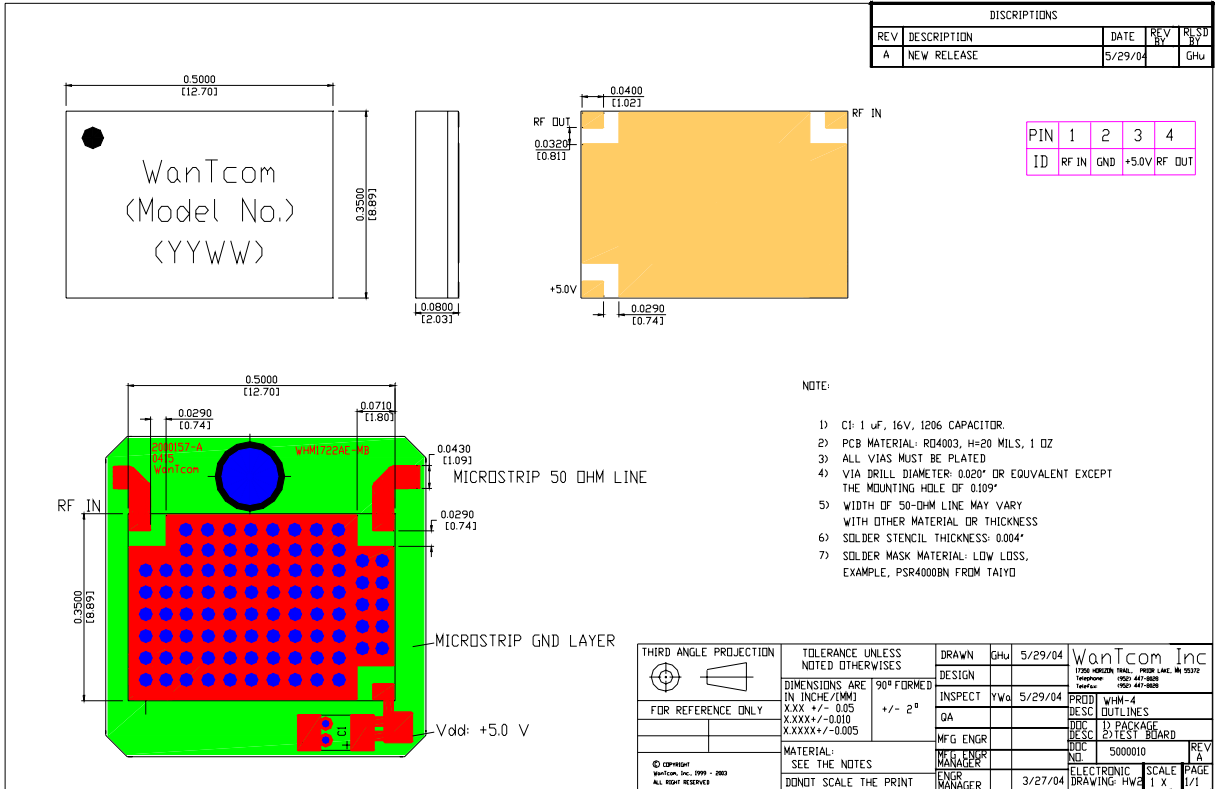


FIG. 7 WHM-4 Outline

Ordering Information

Model Number	WHM0510AE
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Small Signal S-parameters

IWHM0510AE

IS-parameters at $V_{dd} = 5V$, $I_{dd} = 100mA$, including test fixture. Last updated 07/07/04.

GHZ s MA R 50

IF(GHz) MAG S11 ANG S11 MAG S21 ANG S21 MAG S12 ANG S12 MAG S22 ANG S22

0.05	0.961	-40.3	10.030	137.5	0.000017	136.1	0.860	-52.6
0.1	0.578	-71.3	27.300	117.2	0.000044	139.3	0.637	-82.7
0.2	0.544	-77.4	71.124	43.9	0.000288	175.4	0.223	-134.7
0.3	0.305	-137.9	97.031	-14.4	0.000608	133.2	0.090	-128.0
0.4	0.153	-177.9	95.521	-55.1	0.000895	109.1	0.091	-114.5
0.5	0.073	136.6	92.297	-86.8	0.001227	95.6	0.108	-129.1
0.6	0.043	78.2	90.374	-115.1	0.001552	83.3	0.117	-155.0
0.7	0.028	28.6	89.593	-142.5	0.002019	70.3	0.116	174.5
0.8	0.009	-0.6	88.628	-170.2	0.002597	56.7	0.103	139.2
0.9	0.018	131.6	86.269	161.4	0.003257	39.5	0.080	99.3
1	0.050	125.9	81.568	132.6	0.003833	22.1	0.059	53.5
1.1	0.098	121.0	75.131	104.0	0.004406	5.0	0.052	6.9
1.2	0.179	107.0	67.663	75.6	0.004842	-14.6	0.066	-29.1
1.3	0.289	88.8	59.560	47.3	0.005137	-34.9	0.106	-55.2
1.4	0.418	66.8	51.096	19.0	0.005218	-55.2	0.177	-80.7
1.5	0.543	44.3	42.183	-8.4	0.004982	-75.5	0.268	-107.7
1.6	0.649	22.4	33.454	-35.1	0.004393	-94.2	0.368	-134.6
1.7	0.727	1.8	25.864	-60.1	0.003663	-115.8	0.465	-160.2
1.8	0.767	-17.6	19.566	-81.3	0.003014	-129.7	0.551	175.5
1.9	0.789	-32.7	15.555	-100.5	0.002588	-143.0	0.614	154.4
2	0.825	-48.5	12.025	-120.9	0.001959	-160.6	0.683	134.8
2.1	0.833	-62.7	9.148	-137.9	0.001554	-169.7	0.734	116.2
2.2	0.842	-75.5	7.088	-152.9	0.001087	-179.4	0.777	98.8
2.3	0.860	-88.5	5.517	-167.0	0.000742	173.9	0.808	82.6
2.4	0.867	-100.6	4.306	178.9	0.000449	160.3	0.835	67.3
2.5	0.867	-112.6	3.485	165.3	0.000189	175.3	0.854	53.2
2.6	0.864	-124.1	2.838	153.2	0.000148	-173.9	0.872	39.6
2.7	0.861	-135.6	2.294	142.0	0.000142	-157.0	0.885	26.5
2.8	0.845	-146.3	1.741	128.0	0.000051	-111.3	0.897	14.3
2.9	0.832	-155.0	1.217	116.9	0.000295	-59.1	0.904	2.3
3	0.852	-165.4	0.919	112.8	0.000433	-81.8	0.912	-9.0
3.1	0.847	-176.6	0.758	103.3	0.000442	-105.5	0.917	-20.0
3.2	0.839	173.2	0.582	90.1	0.000357	-88.3	0.923	-30.7
3.3	0.829	162.8	0.452	75.1	0.000238	-99.0	0.926	-41.4
3.4	0.814	153.2	0.335	59.9	0.000292	-110.9	0.929	-51.5
3.5	0.798	142.9	0.241	34.3	0.000343	-65.5	0.933	-61.4
3.6	0.775	132.3	0.209	3.6	0.000222	-46.7	0.935	-71.2
3.7	0.751	122.6	0.212	-27.7	0.000540	-65.8	0.937	-80.9
3.8	0.725	113.1	0.239	-54.5	0.000685	-50.5	0.940	-90.2
3.9	0.692	103.4	0.274	-76.6	0.000977	-52.3	0.940	-99.5
4	0.655	93.6	0.313	-92.6	0.001175	-59.8	0.942	-108.8
4.1	0.613	84.2	0.343	-105.6	0.001325	-75.6	0.940	-117.9
4.2	0.575	75.5	0.367	-118.2	0.001688	-93.6	0.941	-126.9
4.3	0.529	67.2	0.368	-130.5	0.001778	-106.0	0.940	-135.9
4.4	0.484	58.1	0.348	-141.0	0.001796	-123.2	0.939	-144.9
4.5	0.425	50.2	0.323	-149.7	0.001881	-133.5	0.937	-154.0
5	0.251	68.2	0.164	-151.5	0.001655	175.3	0.897	161.0
5.5	0.475	31.2	0.158	-143.5	0.003652	151.4	0.776	115.7
6	0.683	-9.0	0.206	-116.7	0.002599	85.4	0.512	72.8
