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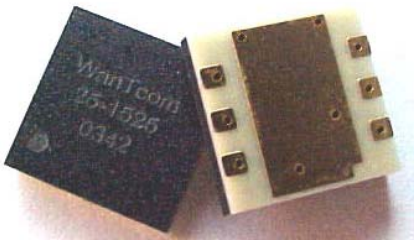
2.2 –2.6 GHz LOW NOISE AMPLIFIER WHM25-1525AE[1]

WHM25-1525AE LNA is a low noise figure and high linearity amplifier with SMT package design. The amplifier offers typical noise figure of 0.90 dB, gain of 15.2 dB, and output IP_3 of 27 dBm at the frequency range from 2.2 to 2.6 GHz. With the completely 50 Ohm drop-in design, WHM25-1525AE requires no additional external component and provides miniature size, high performance, and high reliability LNA and gain block.



Key Features:

Impedance:	50 Ohm
SMT package:	6-pin
Low Noise:	0.90 dB
Output IP_3:	27 dBm
Gain:	15.2 dB
P_{1dB}:	14 dBm
Single Power Supply:	23 mA @ +5V
Frequency Range:	2.2 – 2.6 GHz
Operating Temperature:	-55 ~ +100 ºC
Return Losses:	20 dB typical
Miniature Size:	0.200" x 0.200" x 0.060" (5.0 mm x 5.0 mm x 1.50 mm)
Built-In Functions:	DC blocks at RF input and RF output, temperature compensation circuits, ESD resistance, and auto DC biases.

Specifications:

a) Table 1 Summary of the electrical specifications of WHM25-1525AE at room temperature

Index	Testing Item	Symbol	Test Constraints	Nom (RT)	Min	Max	Unit
1	Gain	S_{21}	2.2 – 2.6 GHz	15.2	14.7	15.6	dB
2	Gain Variation	ΔG	2.2 – 2.6 GHz	0.2		0.5	dB
3	Input Return Loss	S_{11}	2.2 – 2.6 GHz	20	15		dB
4	Output Return Loss	S_{22}	2.2 – 2.6 GHz	20	15		dB
5	Reverse Isolation	S_{12}	2.2 – 2.6 GHz		18		dB
6	Noise figure	NF	2.2 – 2.6 GHz	0.90		1.1	dB
7	Output Power 1dB compression	P_{1dB}	2.2 – 2.6 GHz		14		dBm
8	Output-Third-Order Interception point	IP_3	Two-Tone, Pout +0 dBm each, 1 MHz separation	27	25		dBm
10	Current Consumption	I_{dd}	V_{dd}= +5 V	23			mA
11	Power Supply Voltage	V_{dd}		+5	+4.5	+5.5	V
12	Thermal Resistance	$R_{th,c}$	Junction to case			215	°C/W
13	Operating Temperature	T_o			-55	+100	°C
14	Maximum Average RF Input Power	$P_{IN, MAX}$	2.2 – 2.6 GHz			10	dBm

[1] Specifications are subject to change without notice.

b) Pass band Frequency Response

As shown in **Figure 1**, the typical gain of the WHM25-1525AE is 15.2 dB across 1.70 to 3.0 GHz. The standard deviation of the gain is 0.30 dB.

As shown in **Figure 2,** the typical input return loss is 20 dB across the frequency of 1.90 to 2.50 GHz and is better than 15 dB across the frequency of 1.90 to 2.60 GHz.

As shown in **Figure 3**, the typical output return loss is 20 dB across the frequency of 2.30 to 2.70 GHz and better than 15 dB across the frequency of 2.20 to 2.75 GHz.

Figure 4 shows the measured noise figure performance at room temperature. The measured results include the test fixture loss of approximately 0.10 dB. The noise figure is 0.90 dB across the frequency range of 2.2 to 2.6 GHz. **Figure 6** illustrates the noise figure performance at the full temperature. At 100 ^{0}C, WHM25-1525AE only has 0.20 dB noise increases. At –55 ^{0}C, WHM25-1525AE offers approximately 0.20 dB less noise figure than that at room temperature.

Figure 5 shows the measured S-parameters in Log scale varying with the temperature. The gain changes less than 0.30 dB and return losses are better than 15 dB across the frequency range of 2.2 to 2.6 GHz in full temperature.

Figure 7 presents the P_{1dB} and IP_3 performance at room temperature. The P_{1dB} and IP_3 are better than 14 dBm and 27 dBm, respectively.

Figure 8 demonstrates the application schematic diagram of WHM25-1525AE. It requires no additional external component to build a LNA with WHM25-1525AE. The +5V DC can be applied either to Pin 3 or Pin 4 depending on the actual +5V available location. 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 longer than 6 inch without a decoupling capacitor, a 0.1 uF de-coupling capacitor with minimum rating voltage of 10V may be needed across the +5V pin to ground. The capacitor must be rated in the temperature range of -55 ^{0}C to 100 ^{0}C to ensure the whole circuit work in the specified temperature range.

Figure 9 shows the mechanical outline and recommended motherboard layout of WHM25-1525AE. Sufficient number of ground vias on the motherboard is 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.

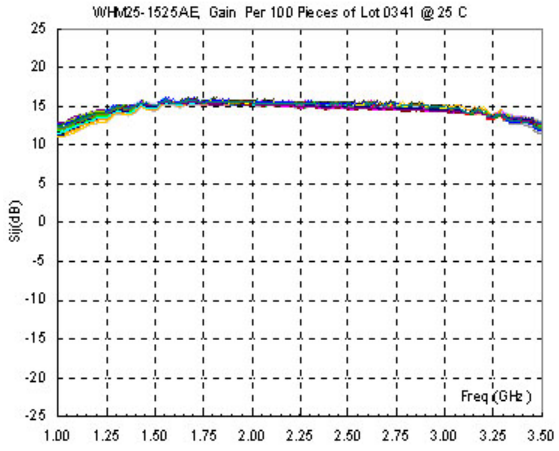


FIG. 1 Small signal gain of WHM25-1525AE, 100 pcs.

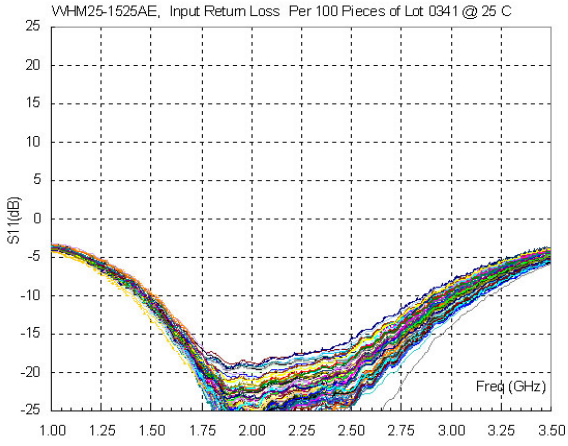


FIG. 2 Input return loss of WHM25-1525AE, 100 pcs.

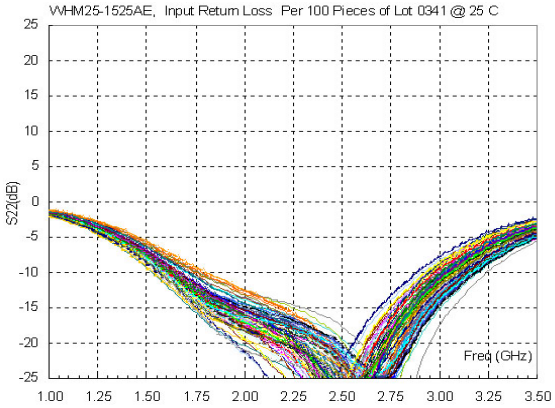


FIG. 3 Output return loss of WHM25-1525AE, 100 pcs.

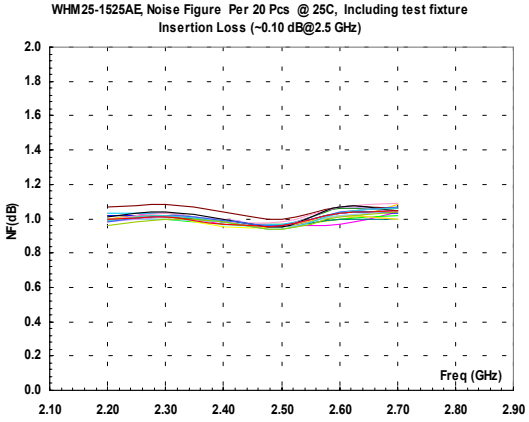


FIG. 4 Noise figure of WHM25-1525AE, 10 pcs.

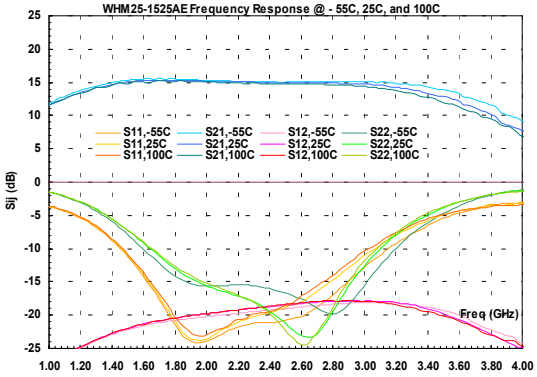


FIG. 5 Frequency response of WHM25-1525AE at full temperature

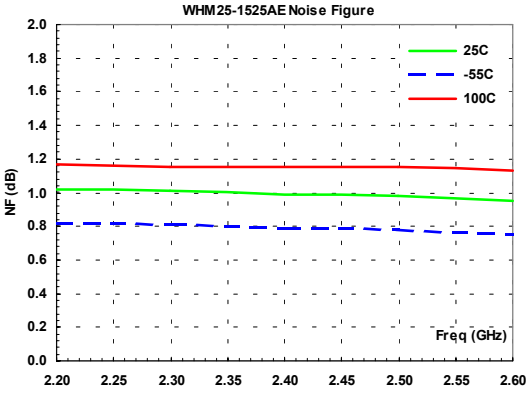


FIG. 6 Noise figure of WHM25-1525AE at full temperature

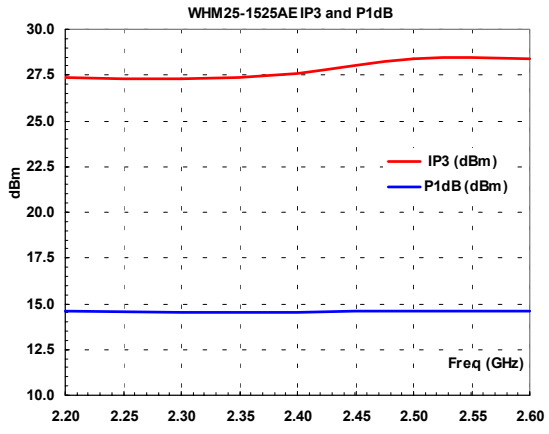
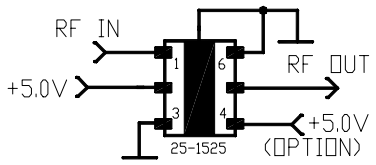


FIG. 7 Output P_{1dB} and IP3 of WHM25-1525AE



NOTE:

1. PIN 2 and 4 connected internally
2. EITHER PIN 2 OR PIN 4 FOR +5v

FIG. 8 Typical application schematic of WHM25-1525AE

WHM25-1525AE Mechanical Outline, WHM-1:

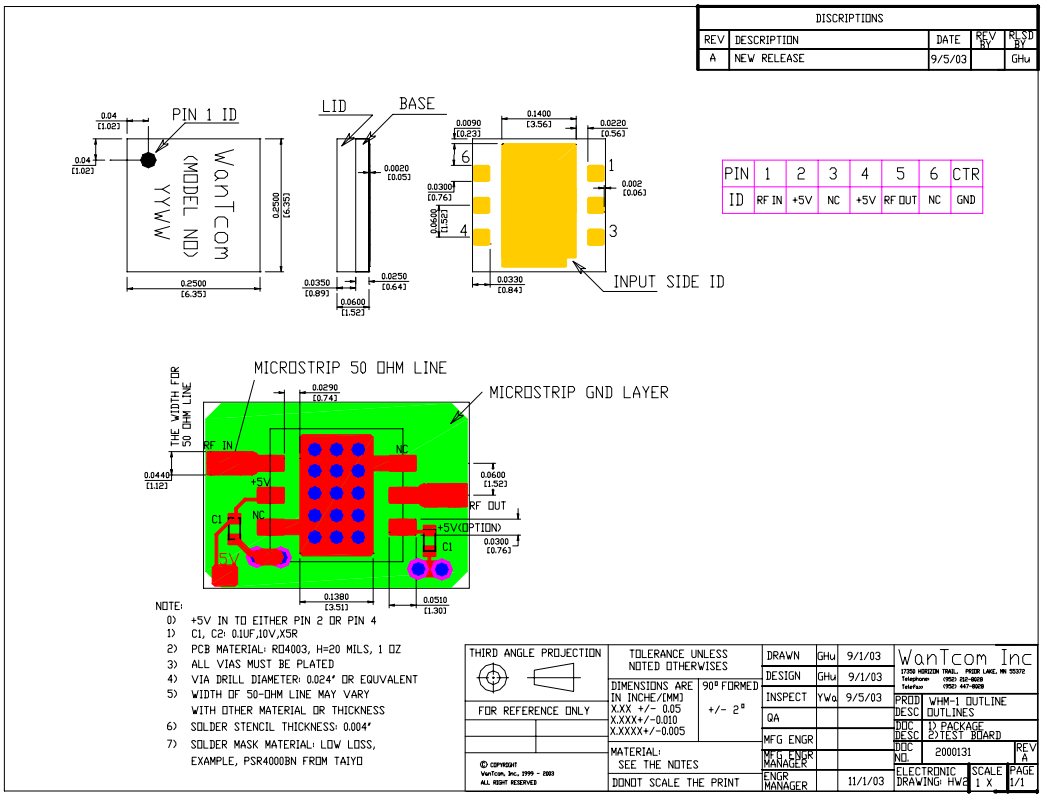


FIG. 9 WHM25-1525AE outline

Ordering Information

Model Number	WHM25-1525AE

The WHM25-1525AE is packed in a waffle pack with 100 pieces per pack. Contact factory for tape and reel packing option.

Small Signal S-Parameters:

!WHM25-1525AE
!s-parameters at V_{dd}=5V, I_{dd}=23 mA, including the test board.
!Last updated 7/12/03.

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	-8.4	0.001	179.9	0.0010	66.3	0.999	-6.2
0.1	0.997	-14.5	0.002	152.6	0.0010	-44.2	0.998	-10.5
0.2	0.997	-29.4	0.013	137.4	0.0000	156.2	0.997	-20.6
0.3	0.985	-46.1	0.083	121.1	0.0010	-119.4	0.991	-31.6
0.4	0.957	-66.4	0.349	97.7	0.0028	-39.7	0.982	-42.7
0.5	0.785	-94.7	1.262	56.8	0.0120	-82.3	0.939	-54.3
0.6	0.354	-87.5	2.648	-10.1	0.0260	-143.3	0.873	-62.8
0.7	0.578	-73.3	2.915	-59.0	0.0290	177.8	0.892	-70.9
0.8	0.677	-92.9	3.036	-87.8	0.0310	156.0	0.894	-82.2
0.9	0.683	-112.2	3.361	-110.7	0.0370	139.6	0.867	-94.4
1	0.644	-131.4	3.848	-130.4	0.0430	127.1	0.824	-106.5
1.1	0.579	-150.9	4.269	-150.2	0.0500	114.3	0.766	-118.2
1.2	0.497	-171.1	4.665	-169.8	0.0570	100.5	0.690	-129.7
1.3	0.409	169.7	5.070	171.4	0.0640	85.6	0.611	-139.9
1.4	0.319	149.2	5.328	153.8	0.0700	74.3	0.539	-148.9
1.5	0.241	130.3	5.421	136.2	0.0740	62.3	0.478	-156.7
1.6	0.173	109.6	5.487	118.9	0.0800	50.7	0.425	-163.0
1.7	0.124	90.3	5.588	104.5	0.0840	40.3	0.379	-169.0
1.8	0.085	69.6	5.599	90.7	0.0890	30.9	0.349	-175.9
1.9	0.060	47.6	5.603	76.2	0.0910	22.9	0.327	176.9
2	0.049	28.8	5.617	62.8	0.0940	13.6	0.303	168.4
2.1	0.045	18.0	5.656	50.1	0.0970	4.9	0.276	159.1
2.2	0.044	14.9	5.667	36.8	0.1000	-3.6	0.245	148.3
2.3	0.060	16.7	5.733	24.2	0.1040	-11.0	0.208	134.3
2.4	0.085	11.5	5.853	11.7	0.1070	-19.3	0.168	116.7
2.5	0.120	3.8	5.896	-1.2	0.1100	-27.5	0.126	92.7
2.6	0.161	-6.5	5.928	-15.1	0.1110	-36.8	0.092	52.0
2.7	0.208	-18.6	5.943	-28.8	0.1120	-45.0	0.098	-5.4
2.8	0.261	-30.8	5.864	-42.7	0.1130	-54.0	0.152	-48.7
2.9	0.320	-45.9	5.833	-57.2	0.1110	-63.3	0.236	-76.6
3	0.372	-60.0	5.717	-72.2	0.1080	-72.2	0.328	-98.1
3.1	0.432	-75.1	5.451	-87.0	0.1040	-82.3	0.422	-118.4
3.2	0.479	-90.0	5.143	-102.0	0.0970	-91.2	0.522	-136.6
3.3	0.517	-104.0	4.891	-116.4	0.0870	-97.6	0.616	-154.0
3.4	0.558	-118.2	4.586	-130.7	0.0730	-102.9	0.699	-171.2
3.5	0.595	-133.1	4.199	-144.5	0.0650	-103.8	0.782	171.3
3.6	0.609	-148.1	3.769	-159.9	0.0590	-98.6	0.829	154.1
3.7	0.612	-162.9	3.344	-174.7	0.0590	-95.6	0.866	137.2
3.8	0.604	-176.7	2.938	171.2	0.0650	-91.2	0.888	121.3
3.9	0.588	170.4	2.530	157.3	0.0650	-92.4	0.892	106.0
4	0.571	158.7	2.119	145.2	0.0720	-96.4	0.892	91.4
4.1	0.552	146.9	1.730	135.2	0.0780	-99.8	0.883	77.4
4.2	0.539	135.9	1.379	124.4	0.0850	-103.8	0.873	64.2
4.3	0.518	124.8	1.111	114.3	0.0880	-106.2	0.861	50.7
4.4	0.498	114.4	0.919	105.7	0.0910	-115.0	0.848	38.3
4.5	0.486	104.1	0.732	97.9	0.0980	-118.7	0.837	25.7
5	0.408	53.8	0.146	70.5	0.1000	-147.3	0.740	-31.7
5.5	0.333	5.7	0.138	-163.9	0.1050	-160.6	0.653	-75.9
6	0.276	-40.6	0.302	169.1	0.1370	178.1	0.680	-114.2