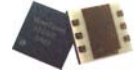




2.2 – 2.7 GHz LOW NOISE AMPLIFIER WHM25-3020AE¹

WHM25-3020AE LNA is a low noise figure, wideband, and low power SMT packaged amplifiers with unconditional stable design. The amplifier offers typical 1.0 dB noise figure and 16 dBm output IP₃ at the frequency range from 2.2 GHz to 2.7 GHz of 3G and ISM bands. WHM25-3020AE LNA is most suitable for cellular base stations, wireless data communications, tower top receiver amplifiers, last-mile wireless communication systems, and wireless measurement applications.



WHM25-3020AE is designed to meet the rugged standards of MIL-STD-202 and MIL-STD-883.

Key Features:

Preliminary

Impedance:	50 Ohm
MTBF ² :	>600,000 hrs (68 Years)
LGA (land grid array) Package:	6-pin
Unconditional Stable:	$k > 1$
Low Noise:	1.0 dB
Output IP ₃ :	16.0 dBm
Gain:	27.0 dB
P _{1dB} :	6.0 dBm
Single Power Supply:	25 mA @ +5V
Frequency Range:	2.2 ~ 2.7 GHz, usable from 1.8 ~ 3.0 GHz
Operating Temperature:	-40 ~ +85 °C
Return Losses:	20 dB Typical
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 Ratings³:

Symbol	Parameters	Units	Absolute Maximum
V _{dd}	DC Power Supply Voltage	V	7.0
I _{dd}	Drain Current	mA	50
P _{diss}	Total Power Dissipation	mW	350
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	-55 ~ 100
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 WHM25-3020AE at room temperature

Index	Testing Item	Symbol	Test Constraints	Nom (RT)	Min	Max	Unit
1	Gain	S_{21}	2.2 – 2.7 GHz	27	25	29	dB
2	Gain Variation	ΔG	2.2 – 2.7 GHz	+/- 0.5		+/- 0.75	dB
3	Input Return Loss	S_{11}	2.2 – 2.7 GHz	20	16		dB
4	Output Return Loss	S_{22}	2.2 – 2.7 GHz	20	16		dB
5	Reverse Isolation	S_{12}	2.2 – 2.7 GHz	43	40		dB
6	Noise figure	NF	2.2 – 2.7 GHz	1.0		1.2	dB
7	Output Power 1dB compression Point	P_{1dB}	2.2 – 2.7 GHz	7	6		dBm
8	Output-Third-Order Interception point	IP_3	Two-Tone, P_{out} +0 dBm each, 1 MHz separation	16	14		dBm
9	Current Consumption	I_{dd}	$V_{dd} = +5$ V	25	22	30	mA
10	Power Supply Voltage	V_{dd}		+5	+4.7	+5.3	V
11	Thermal Resistance	$R_{th,c}$	Junction to case			220	°C/W
12	Operating Temperature	T_o			-40	+85	°C
13	Maximum Average RF Input Power	$P_{IN, MAX}$	2.2 – 2.7 GHz			10	dBm

b) Passband Frequency Response

As shown in **Figure 1**, the typical gain of the WHM25-3020AE is 27.0 dB across 2.2 to 2.7 GHz. The typical input and output return losses are 20 dB across the frequency of 2.2 to 2.7 GHz. The LNA works from 1.8 GHz to 3.0 GHz.

Figure 2 shows the measured P_{1dB} and IP_3 of the WHM25-3020AE. The typical P_{1dB} and IP_3 are 7.0 dBm and 16.0 dBm in the frequency range of 2.2 to 2.7 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 dB. The noise figure is 1.0 dB across the frequency range of 2.2 to 2.7 GHz at room temperature. At 85 °C, WHM25-3020AE only has 0.25 dB noise increases. At -40 °C, WHM25-3020AE offers approximately 0.20 dB less noise figure than that at room temperature.

Figure 4 demonstrates the stability factor k of the amplifier. It is greater than 1.0 in any frequency band and the amplifier is unconditional stable.

Figure 5 is the block diagram of internal circuit of WHM25-3020AE. 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 6 demonstrates the application schematic diagram of WHM25-3020AE. It may require one external decoupling capacitor of 0.01 uF to build a LNA with WHM25-3020AE. 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 °C to 85 °C to ensure the entire circuit working in the specified temperature range.

Figure 7 shows the mechanical outline and recommended motherboard layout of WHM25-3020AE. 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.

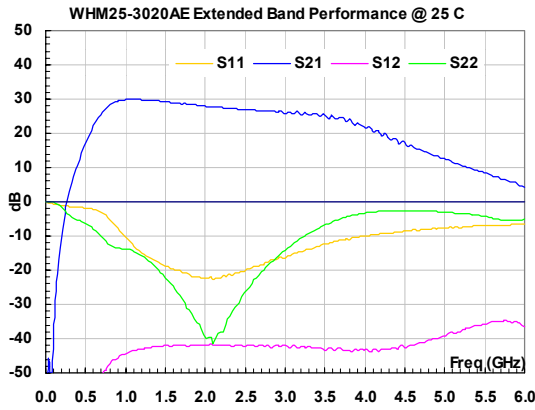


FIG. 1 Typical small signal performance.

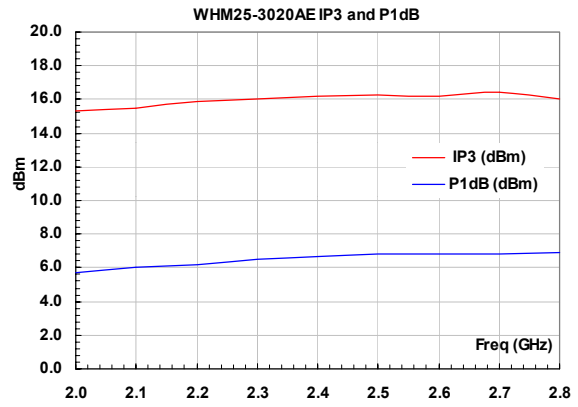


FIG. 2 Typical P_{1dB} and IP_3 at room temperature.

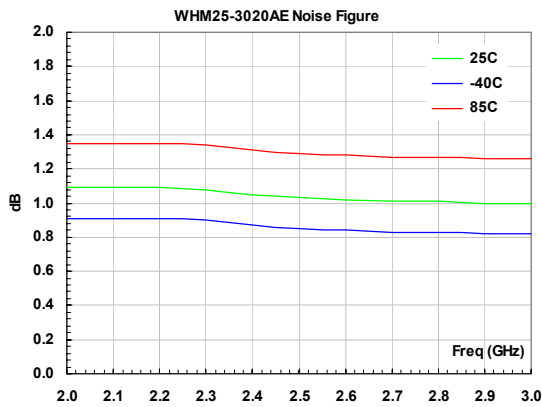


FIG. 3 Noise figure performance at full temperature

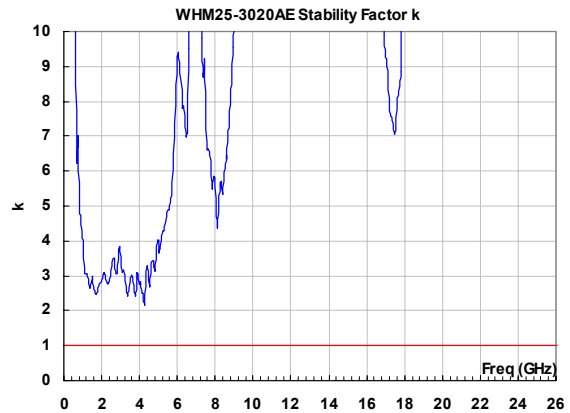


FIG. 4 Measured stability factor k

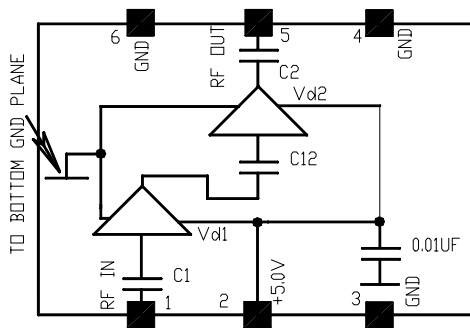


FIG. 5 Block diagram of internal circuit.

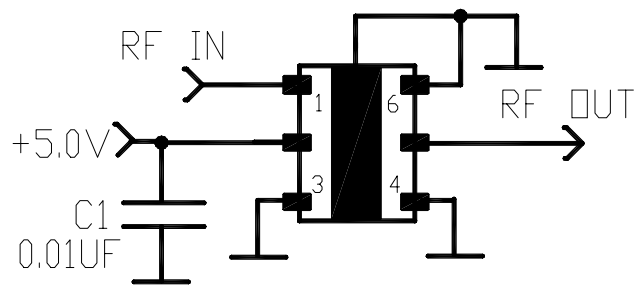


FIG. 6 Typical application schematic for WHM25-3020AE



WHM25-3020AE Mechanical Outline, WHM-2:

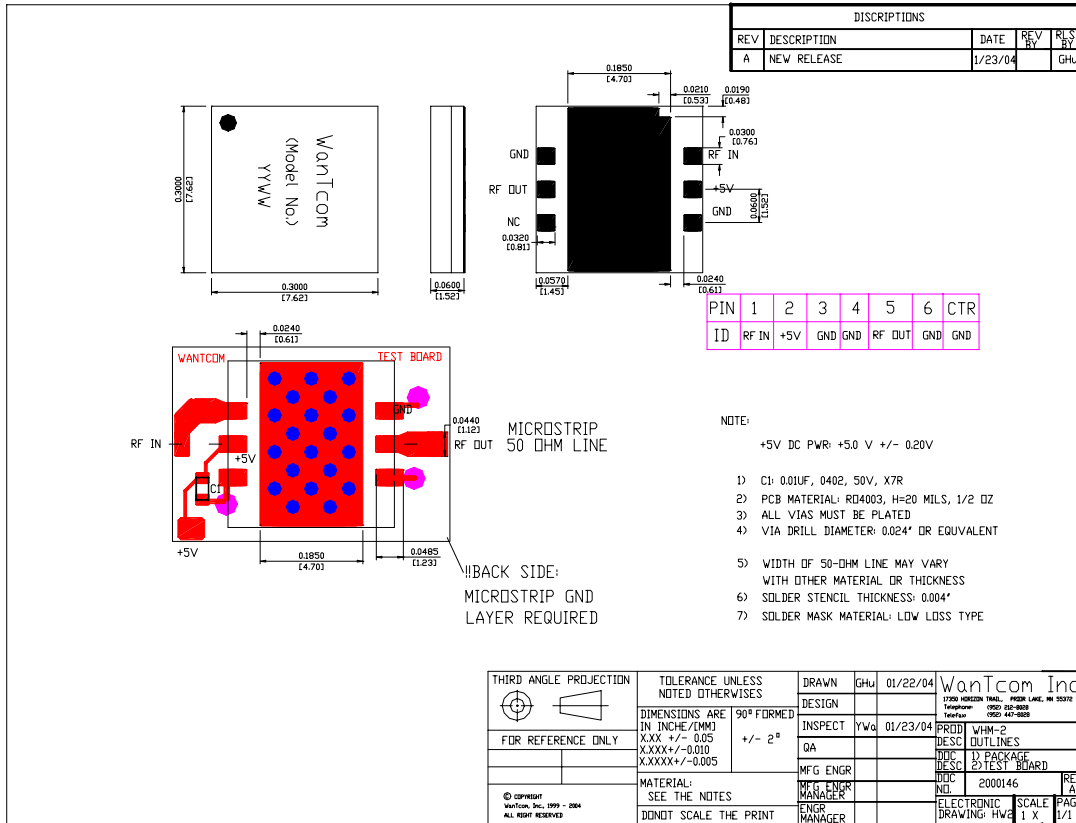


FIG. 7 WHM25-3020AE outline

Ordering Information

Model Number	WHM25-3020AE
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Waffle pack with the capacity of 81 pieces (9 x 9) is used for the packing. Contact factory for tape and reel packing option for higher volume requirements.



Small Signal S-Parameters:

IWHM25-3020AE

Is-parameters at Vdd=5V, Idd=25 mA, including the test fixture.

!Last updated 5/5/06.

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	0.940	-166.2	0.060	-91.4	0.0100	-148.9	0.978	-12.7
0.1	0.676	164.4	0.098	-59.1	0.0052	-150.9	0.912	-24.9
0.2	0.803	98.9	0.333	-85.2	0.0024	49.6	0.843	-49.5
0.3	0.827	60.2	1.324	-108.6	0.0021	106.2	0.642	-73.5
0.4	0.745	20.3	3.345	-163.5	0.0006	162.3	0.559	-86.5
0.5	0.728	-16.6	6.608	156.7	0.0008	-139.5	0.476	-102.2
0.6	0.721	-50.6	11.146	126.4	0.0012	-172.1	0.405	-121.0
0.7	0.650	-82.7	16.933	92.9	0.0025	173.5	0.319	-135.8
0.8	0.495	-114.3	19.074	49.5	0.0031	131.8	0.250	-143.7
0.9	0.402	-141.7	21.932	15.4	0.0039	115.5	0.212	-151.3
1	0.315	-165.6	24.305	-14.6	0.0044	97.3	0.193	-160.4
1.1	0.260	173.5	25.084	-44.1	0.0062	66.2	0.182	-176.6
1.2	0.219	156.3	25.087	-68.6	0.0061	52.5	0.152	168.8
1.3	0.195	139.0	24.906	-89.9	0.0068	36.9	0.126	153.5
1.4	0.175	122.2	24.717	-110.8	0.0074	25.4	0.101	137.3
1.5	0.155	103.5	25.554	-131.6	0.0065	15.7	0.075	119.1
1.6	0.138	89.6	24.573	-149.2	0.0076	12.1	0.053	104.7
1.7	0.126	75.5	24.113	-166.9	0.0083	1.5	0.037	88.2
1.8	0.115	63.0	24.077	176.2	0.0084	-10.6	0.024	68.5
1.9	0.101	52.7	24.051	160.5	0.0077	-22.7	0.014	31.4
2	0.091	48.7	23.310	149.0	0.0078	-27.0	0.012	-5.6
2.1	0.084	44.9	22.612	134.4	0.0074	-38.5	0.013	-36.6
2.2	0.080	41.6	22.338	118.6	0.0076	-48.9	0.019	-54.7
2.3	0.078	39.2	22.237	103.2	0.0086	-51.1	0.027	-62.5
2.4	0.083	40.2	21.820	90.2	0.0083	-62.8	0.039	-72.9
2.5	0.089	36.8	21.268	75.0	0.0074	-69.1	0.054	-84.6
2.6	0.098	32.6	21.075	59.7	0.0068	-76.1	0.073	-97.0
2.7	0.112	29.0	21.064	45.1	0.0069	-85.0	0.097	-109.3
2.8	0.123	21.2	20.866	30.5	0.0079	-88.8	0.126	-123.3
2.9	0.133	14.4	20.347	16.4	0.0068	-95.9	0.160	-139.0
3	0.146	7.5	20.047	1.4	0.0064	-108.7	0.200	-153.7
3.1	0.161	0.4	20.241	-14.1	0.0074	-120.6	0.244	-167.9
3.2	0.176	-7.2	19.515	-27.5	0.0073	-133.7	0.290	174.7
3.3	0.191	-16.8	19.014	-44.0	0.0084	-139.3	0.346	158.2
3.4	0.208	-26.2	18.621	-59.3	0.0085	-145.8	0.400	141.9
3.5	0.225	-35.6	17.742	-74.3	0.0074	-158.0	0.457	124.9
3.6	0.239	-47.3	16.711	-93.7	0.0067	-171.5	0.519	108.2
3.7	0.252	-58.2	15.842	-107.7	0.0073	174.5	0.568	91.2
3.8	0.265	-69.5	14.439	-122.7	0.0072	165.4	0.611	74.6
3.9	0.277	-81.3	13.194	-140.7	0.0062	158.7	0.657	58.2
4	0.288	-92.6	12.760	-154.6	0.0060	156.7	0.716	43.5
4.1	0.295	-103.7	11.092	-167.4	0.0070	135.3	0.715	27.6
4.2	0.303	-115.4	9.867	178.1	0.0077	120.9	0.745	12.8
4.3	0.314	-127.0	9.120	163.9	0.0075	107.6	0.780	-0.2
4.4	0.322	-136.8	7.971	152.0	0.0069	85.5	0.759	-15.7
4.5	0.328	-148.4	7.349	137.4	0.0072	84.1	0.792	-27.6
5	0.365	160.2	4.330	80.0	0.0110	24.3	0.751	-88.2
5.5	0.406	112.4	2.782	24.2	0.0160	-32.0	0.676	-141.2
6	0.429	71.4	1.693	-35.5	0.0160	-93.2	0.600	-176.7
