

Low Noise Amplifier with Bypass Switch for LTE Middle Band

FEATURES

- Operating frequency 1805MHz to 2200MHz
- Noise figure(NF) =0.55dB
- High power gain =18dB
- Insertion Loss in bypass mode =6.2dB
- Gain mode IIP3inb =2dBm
- Gain mode input 1dB compression point =-8dBm
- Bypass mode input 1dB compression point = +12dBm
- Supply voltage: 1.5V to 3.1V
- Gain mode current 12.0mA
- Bypass mode current <1uA
- Input and output DC decoupled
- Requires only one input matching inductor
- Integrated matching for the output
- FCDFN 1.1mmX0.7mmX0.37mm -6L package
- 2kV HBM ESD protection (including RFIN and RFOUT pin)

GENERAL DESCRIPTION

The AW5008M3 is a Low Noise Amplifier with bypass designed for LTE receiver applications. The AW5008M3 requires only one external input matching inductor, reduces assembly complexity and the PCB area, enabling a cost-effective solution.

The AW5008M3 achieves low noise figure, high linearity, high gain, over a wide range of supply voltages from 1.5V up to 3.1V. All these features make AW5008M3 an excellent choice for LTE LNA as it improves sensitivity with low noise figure and high gain, provides better immunity against jammer signals with high linearity, reduces filtering requirement of preceding stage and hence reduces the overall cost.

APPLICATIONS

- Cell phones
- Tablets
- Other RF front-end modules

The AW5008M3 is available in a small lead-free, RoHS-Compliant, FCDFN 1.1mmX0.7mmX0.37 mm -6L package.

TYPICAL APPLICATION CIRCUIT

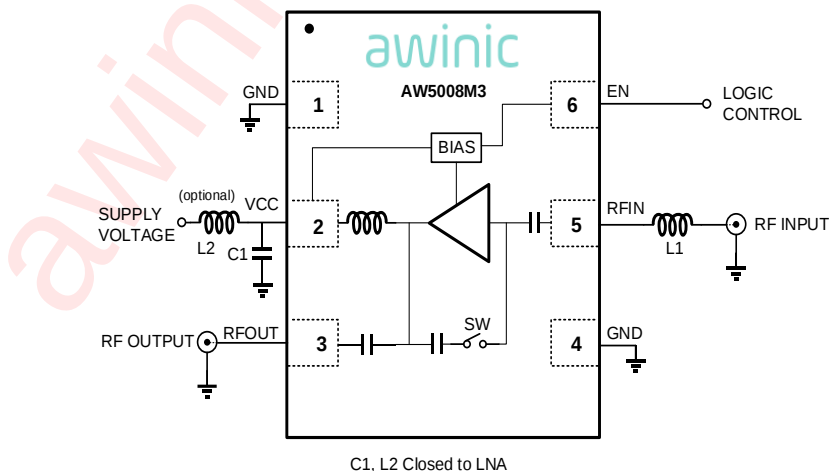


Figure 1 Typical Application Circuit of AW5008M3

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PIN CONFIGURATION AND TOP MARK

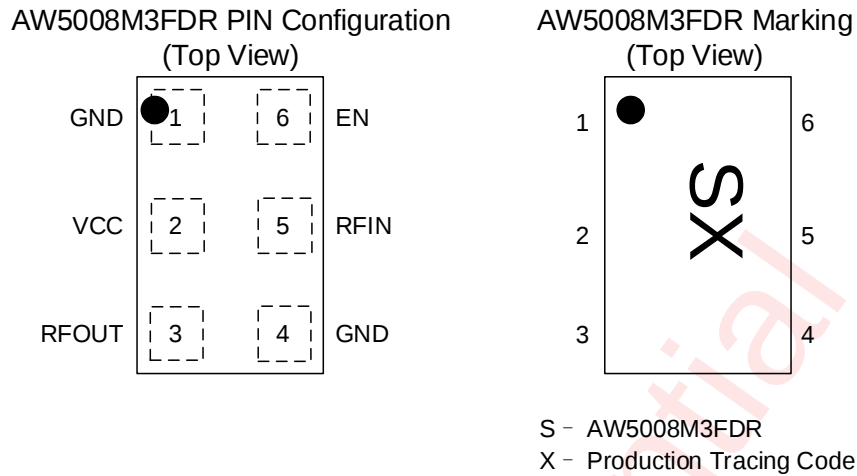


Figure 2 Pin Configuration and Top Mark

PIN DEFINITION

No.	NAME	DESCRIPTION
1	GND	Ground.
2	VCC	Supply connection.
3	RFOUT	RF output
4	GND	Ground
5	RFIN	RF input
6	EN	EN (high level) supports 1.8V/2.8V IO with internal 150Kohm pull-down resistor.

FUNCTIONAL BLOCK DIAGRAM

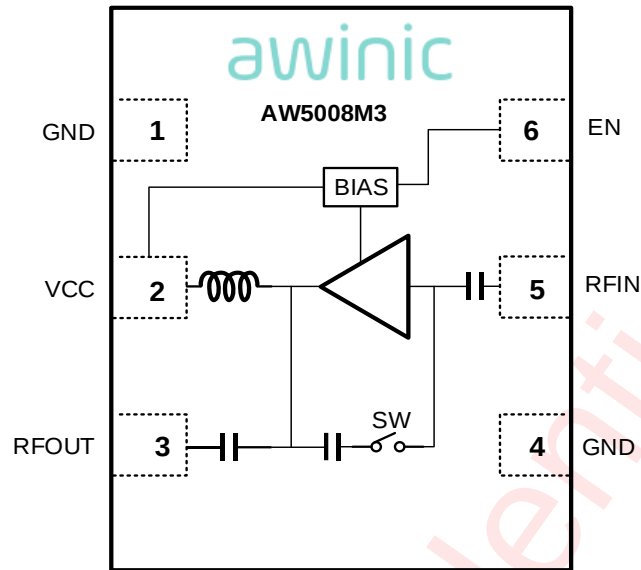


Figure 3 Functional Block Diagram

ORDERING INFORMATION

Part Number	Temperature	Package	Marking	Moisture Sensitivity Level	Environmental Information	Delivery Form
AW5008M3FDR	-40℃~85℃	FCDFN 1.1mmX 0.7mm -6L	S	MSL1	ROHS+HF	3000 units/Tape & Reel

ABSOLUTE MAXIMUM RATINGS^[1]

PARAMETERS	RANGE
Supply voltage VCC	-0.3V to 3.6V
EN pin voltage	-0.3V to 3.6V
Supply maximum current ICC	30mA
RF input power Pin	10dBm
Maximum Junction temperature T _{JMAX}	150°C
Storage temperature T _{STG}	-65°C to 150°C
Operating free-air temperature range	-40°C to 85°C
Lead temperature (Soldering 10 Seconds)	260°C
ESD ^[2]	
HBM	±2kV
CDM	±1kV
Latch-up	
Standard: JEDEC STANDARD NO.78D NOVEMBER 2011	+IT: +200mA -IT: -200mA

[1] Conditions out of those ranges listed in "absolute maximum ratings" may cause permanent damages to the device. In spite of the limits above, functional operation conditions of the device should within the ranges listed in "recommended operating conditions". Exposure to absolute-maximum-rated conditions for prolonged periods may affect device reliability.

[2] The human body model is a 100pF capacitor discharged through a 1.5kΩ resistor into each pin. Test method: MIL-STD-883J Method 3015.9. The CDM test method: JEDEC EIA/JESD22-C101F.

ELECTRICAL CHARACTERISTICS

TA=+25°C, V_{CC}=2.8V, EN=2.8V, frequency=1805MHz to 2200MHz. Input matched to 50Ω using a 7.5nH^[3] inductor in series. (unless otherwise noted).

Symbol	Parameter	Test Condition	Min	Typ	Max	Units
DC Electrical Characteristic						
VCC	Supply Voltage		1.5	-	3.1	V
VEN	Digital Input-Logic High		0.8	-	VCC	V
	Digital Input-Logic Low				0.45	V
Gain Mode						
ICC	Supply Current		10	13	16	mA
Gp	Power Gain	f=1843MHz [4]	15.4	17.3	19	dB
		f=1960MHz [5]	16.1	18.2	19.1	
		f=2140MHz [6]	14.6	16.5	18	
RLin	Input Return Loss	f=1843MHz [4]	5.3	6.3		dB
		f=1960MHz [5]	6.3	7.5		
		f=2140MHz [6]	6.5	8		
RLout	Output Return Loss	f=1843MHz [4]	6.3	8.0		dB
		f=1960MHz [5]	8	15.0		
		f=2140MHz [6]	5	6.5		
ISL	Reverse Isolation	f=1843MHz [4]	30	34.0		dB
		f=1960MHz [5]	30	34.0		
		f=2140MHz [6]	30	34.0		
NF	Noise Figure	f=1843MHz [4][7]		0.55	0.8	dB
		f=1960MHz [5][7]		0.55	0.8	
		f=2140MHz [6][7]		0.6	0.9	
IP1dB	In-band input 1dB-compression point	f=1843MHz [4]	-10	-8		dBm
		f=1960MHz [5]	-11	-9		
		f=2140MHz [6]	-10	-8		
IIP3ib	In-band input 3 rd -order intercept point	f=1843MHz [4]	0	2		dBm
		f=1960MHz [5]	-1	1		
		f=2140MHz [6]	0	2		
ton	turn-on time	time from V _{EN} ON to 90% of the gain		3.0	4	μs
toff	turn-off time	time from V _{EN} OFF to 10% of the gain		1	2	μs
Bypass Mode						
ICC	Supply Current	VEN<0.45V			1	uA
Gp	Power Gain	f=1843MHz [4]	-7	-6.2		dB
		f=1960MHz [5]	-7.5	-6.6		
		f=2140MHz [6]	-9	-8.2		

Symbol	Parameter	Test Condition	Min	Typ	Max	Units
RLin	Input Return Loss	f=1843MHz [4]	10	15		dB
		f=1960MHz [5]	6	8.5		
		f=2140MHz [6]	3.3	5.5		
RLout	Output Return Loss	f=1843MHz [4]	5	8.2		dB
		f=1960MHz [5]	5	8.3		
		f=2140MHz [6]	3.2	4.6		
IP1dB	In-band input 1dB-compression point	f=1843MHz [4]	10	12		dBm
		f=1960MHz [5]	10	12		
		f=2140MHz [6]	10	12		

[3] High quality-factor 7.5nH inductor.

[4] E-UTRA operating band 3(1805MHz to 1880MHz) , input power is -25dBm.

[5] E-UTRA operating band 2(1930MHz to 1990MHz) , input power is -25dBm.

[6] E-UTRA operating band 1(2110MHz to 2170MHz) , input power is -25dBm.

[7] PCB losses are subtracted.

TA=+25°C , V_{CC}=1.8V, EN=1.8V, frequency=1805MHz to 2200MHz. Input matched to 50Ω using a 7.5nH^[3] inductor in series. (unless otherwise noted).

Symbol	Parameter	Test Condition	Min	Typ	Max	Units
DC Electrical Characteristic						
VCC	Supply Voltage		1.5	-	3.1	V
VEN	Digital Input-Logic High		0.8	-	VCC	V
	Digital Input-Logic Low				0.45	V
Gain Mode						
ICC	Supply Current		10	12.0	16	mA
Gp	Power Gain	f=1843MHz [4]	15.4	17.0	19	dB
		f=1960MHz [5]	16.1	18.0	19.1	
		f=2140MHz [6]	15.0	16.3	18	
RLin	Input Return Loss	f=1843MHz [4]	5.3	6.3		dB
		f=1960MHz [5]	6.3	7.3		
		f=2140MHz [6]	6.5	8.0		
RLout	Output Return Loss	f=1843MHz [4]	6.3	8.0		dB
		f=1960MHz [5]	8.0	15.0		
		f=2140MHz [6]	5.0	6.5		
ISL	Reverse Isolation	f=1843MHz [4]	30.0	34.0		dB
		f=1960MHz [5]	30.0	34.0		
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NF	Noise Figure	f=1843MHz [4][7]		0.55	0.8	dB
		f=1960MHz [5][7]		0.55	0.8	
		f=2140MHz [6][7]		0.6	0.9	
IP1dB	In-band input 1dB-compression point	f=1843MHz [4]	-13	-11		dBm
		f=1960MHz [5]	-15	-12		

Symbol	Parameter	Test Condition	Min	Typ	Max	Units
		f=2140MHz [6]	-14	-11		
IIP3ib	In-band input 3 rd -order intercept point	f=1843MHz [4]	-3	-1		dBm
		f=1960MHz [5]	-4	-2		
		f=2140MHz [6]	-3	-1		
ton	turn-on time	time from V _{EN} ON to 90% of the gain		3	4	μs
toff	turn-off time	time from V _{EN} OFF to 10% of the gain		1	2	μs
Bypass Mode						
ICC	Supply Current	VEN<0.45V			1	uA
Gp	Power Gain	f=1843MHz [4]	-9	-6.4		dB
		f=1960MHz [5]	-9	-6.8		
		f=2140MHz [6]	-9	-8.4		
RLin	Input Return Loss	f=1843MHz [4]	10	15		dB
		f=1960MHz [5]	6	8		
		f=2140MHz [6]	4	5		
RLout	Output Return Loss	f=1843MHz [4]	5	8		dB
		f=1960MHz [5]	5	8.3		
		f=2140MHz [6]	3.2	4.6		
IP1dB	In-band input 1dB-compression point	f=1843MHz [4]	10	12		dBm
		f=1960MHz [5]	10	12		
		f=2140MHz [6]	10	12		

[3] High quality-factor 7.5nH inductor.

[4] E-UTRA operating band 3(1805MHz to 1880MHz) , input power is -25dBm.

[5] E-UTRA operating band 2(1930MHz to 1990MHz) , input power is -25dBm.

[6] E-UTRA operating band 1(2110MHz to 2170MHz) , input power is -25dBm.

[7] PCB losses are subtracted.

APPLICATION INFORMATION

Choice of components

1. The AW5008M3 requires only one external inductor for input matching. If the device/phone manufacturers implement very good power supply filtering on their boards, the bypass capacitor mentioned in this application circuit may be optional. With the power supply decoupling capacitor, better performance would be received, like a little higher gain, etc. The value is optimized for the key performance, such as higher power gain, lower noise figure, and better return loss. Typical value of inductor is 7.5nH with high quality factor, and capacitor is 1nF. The typical application circuit can refer to Figure1.

2. The output of AW5008M3 is internally matched to 50 ohm and a DC blocking capacitor is integrated on-chip, thus no external component is required at the output.

3. The AW5008M3 should be placed close to the diversity antenna with the input-matching inductor. Use 50 ohm micro-strip lines to connect RF INPUT and RF OUTPUT. Bypass capacitor need be located close to the device. For long V_{CC} lines, it may be necessary to add more decoupling capacitors. Proper grounding of the GND pins is very important.

Following tables show recommended inductor and capacitor values.

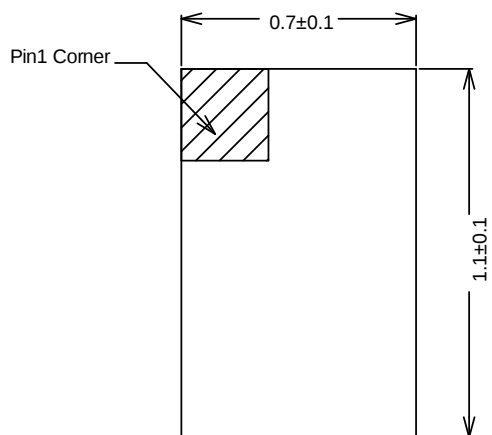
Inductor Selection Table

Part	Typical(nH)	Q(min)	Frequency(MHz)	MFR	Size
LQW15A	7.5	25	250	Murata	0402

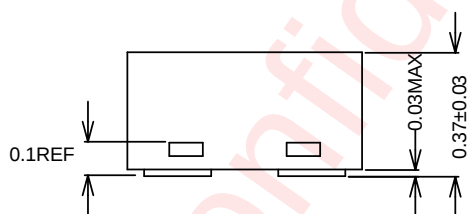
Capacitor Selection Table

Part	Typical(pF)	Voltage(V)	MFR	Size
GRM155	1000	50	Murata	0402

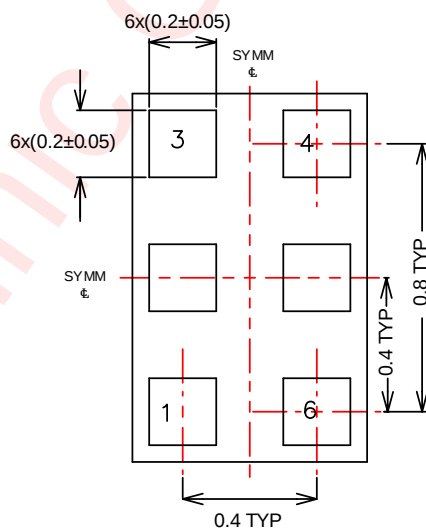
PACKAGE DESCRIPTION



TOP VIEW



SIDE VIEW

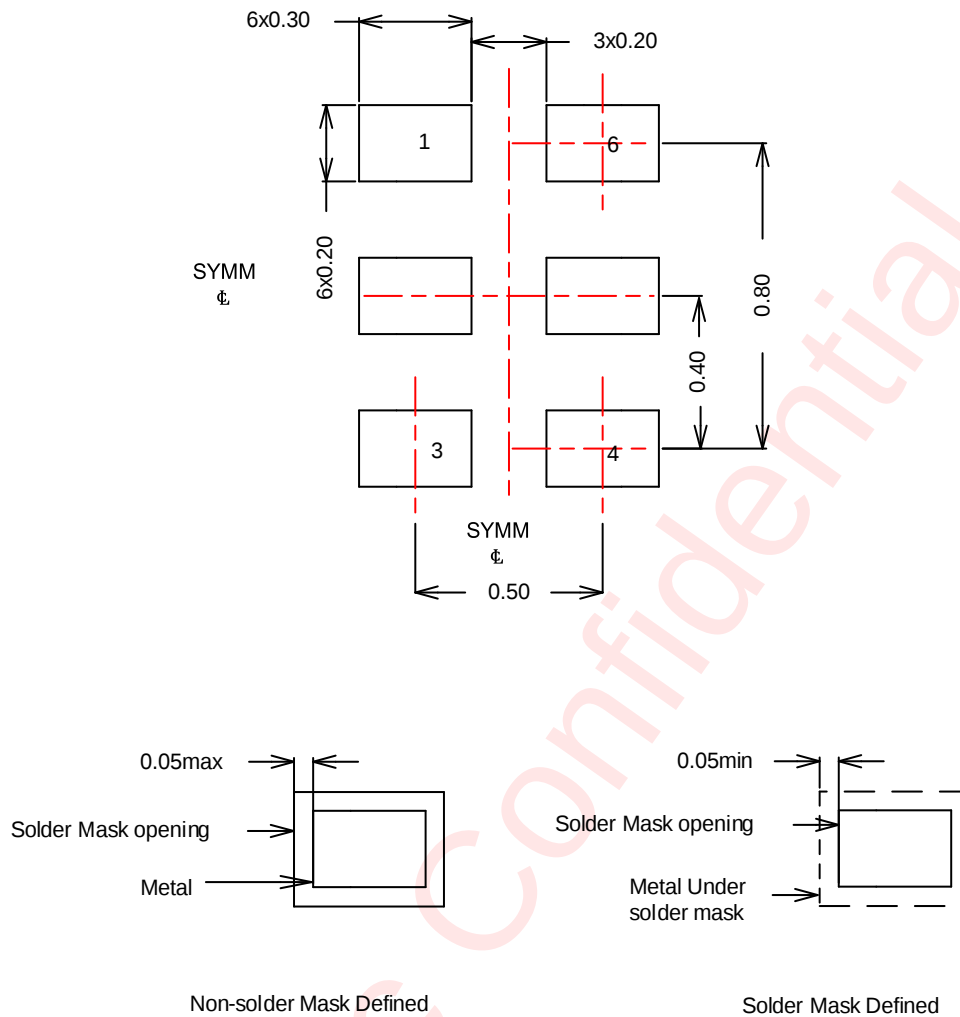


BOTTOM VIEW

Unit: mm

Figure 4 Package Outline

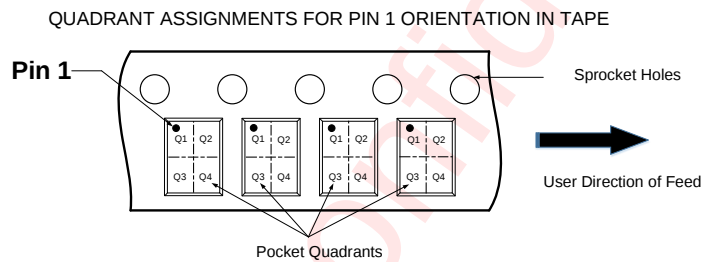
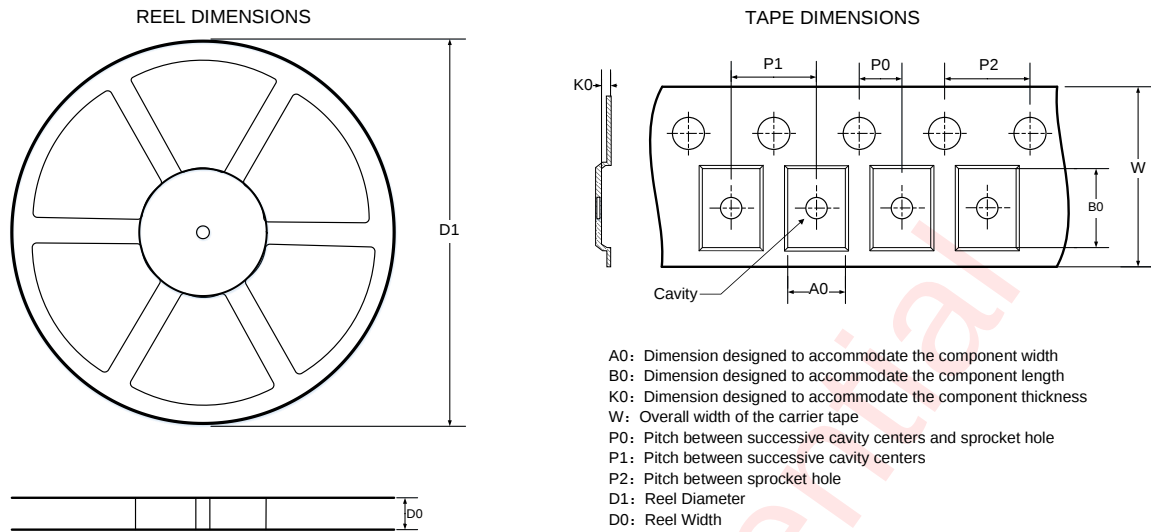
LAND PATTERN



Unit: mm

Figure 5 Land Pattern

TAPE & REEL DESCRIPTION



Note: The above picture is for reference only. Please refer to the value in the table below for the actual size

DIMENSIONS AND PIN1 ORIENTATION

D1 (mm)	D0 (mm)	A0 (mm)	B0 (mm)	K0 (mm)	P0 (mm)	P1 (mm)	P2 (mm)	W (mm)	Pin1 Quadrant
178	8.4	0.8	1.2	0.55	2	2	4	8	Q1

All dimensions are nominal

Figure 6 Tape & Reel Description

REVISION HISTORY

Version	Date	Change Record
V1.0	Jun 2019	Officially Released
V1.1	Jul 2020	Update electrical characteristics
V1.2	Nov 2022	Add VEN Max
V1.3	Mar 2023	Modify features of NF and Insertion Loss in bypass mode

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