Low Noise Amplifier with Bypass Switch for LTE Middle Band

FEATURES

- Operating frequency 1805MHz to 2200MHz
- Noise figure(NF) =0.9dB
- High power gain =13.5dB
- Insertion Loss in bypass mode =3dB
- Gain mode IIP3ib=+7dBm
- Gain mode input 1dB-compression point= -1.2dBm
- Bypass mode input 1dB-compression point= +4dBm
- Supply voltage: 1.5V to 3.3V
- Gain mode current 8.0mA
- 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 AW15208MFDR is a Low Noise Amplifier with bypass designed for LTE receiver applications. The AW15208MFDR requires only one external input matching inductor, reduces assembly complexity and the PCB area, enabling a cost-effective solution.
- The AW15208MFDR achieves low noise figure, high linearity, high gain, over a wide range of supply voltages from 1.5V up to 3.3V. All these features make AW15208MFDR 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.
- The AW15208MFDR is available in a small lead-free, RoHS-Compliant, FCDFN 1.1mmX0.7mmX0.37 mm -6L package.

APPLICATIONS

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

TYPICAL APPLICATION CIRCUIT

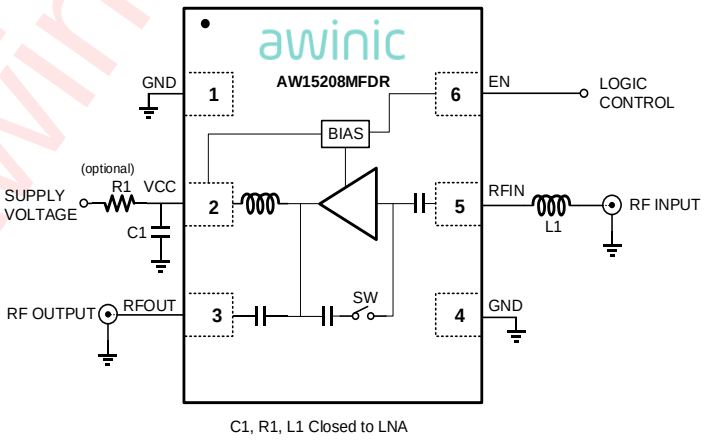
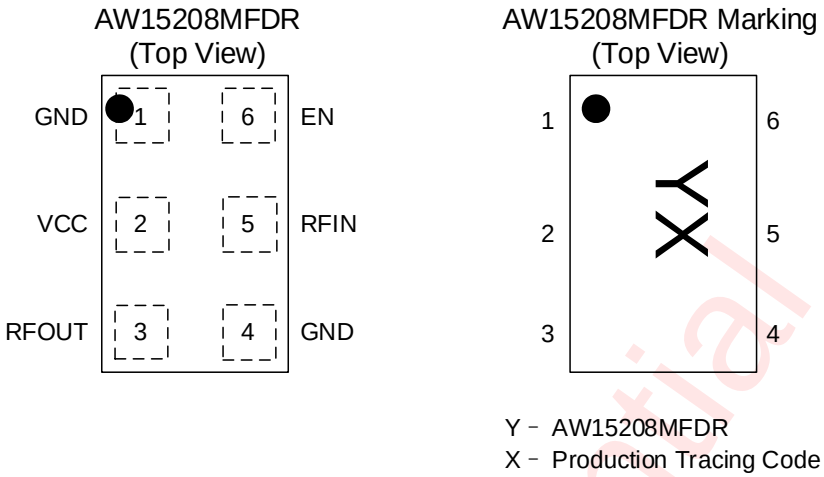


Figure 1 Typical Application Circuit of AW15208MFDR

PIN CONFIGURATION AND TOP MARK



Y – AW15208MFDR
X – Production Tracing Code

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

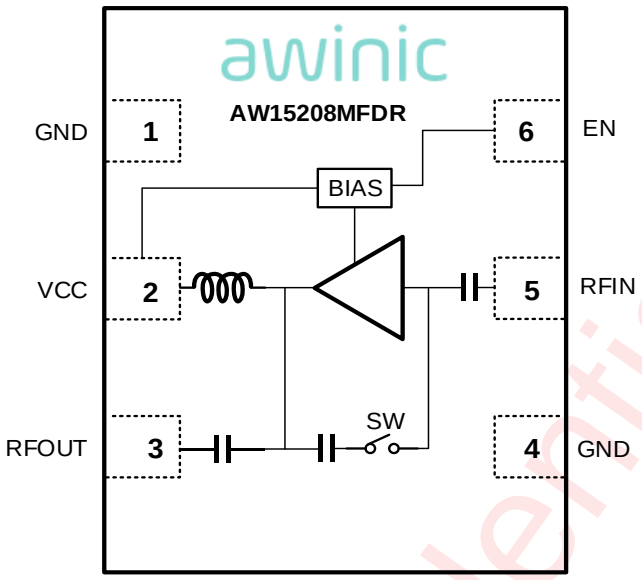


Figure 3 Functional Block Diagram

ORDERING INFORMATION

Part Number	Temperature	Package	Marking	Moisture Sensitivity Level	Environmental Information	Delivery Form
AW15208MFDR	-40℃～85℃	FCDFN 1.1mmX 0.7mm -6L	Y	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	25dBm
Maximum Junction temperature T_{JMAX}	150℃
Storage temperature T_{STG}	-65℃ to 150℃
Operating free-air temperature range	-40℃ to 85℃
Lead temperature (Soldering 10 Seconds)	260℃
ESD[2]	
HBM	±2kV
CDM	±1kV
Latch-up	
Standard: JEDEC EIA/JESD78E	+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: ANSI/ESDA/JEDEC JS-001-2017. The CDM test method: ANSI/ESDA/JEDEC JS-002-2018.

ELECTRICAL CHARACTERISTICS

TA=+25°C , V_{CC}=2.8V, EN=2.8V, frequency=1805MHz to 2200MHz. Input matched to 50Ω using a 3.3nH[3] inductor in series. (unless otherwise noted).

Symbol	Parameter	Test Condition	Min	Typ	Max	Units
DC Electrical Characteristic						
VCC	Supply Voltage		1.5	-	3.3	V
VEN	Digital Input-Logic High		0.8		3.3	V
	Digital Input-Logic Low				0.45	V
IEN	Control current				10	uA
ISD	Leakage current	VDD=3.4V			3	uA
Gain Mode						
ICC	Supply Current	VEN>0.8V		8	11	mA
Gp	Power Gain	1805MHz-2200MHz [4] [5]	12	13.5	15	dB
RLin	Input Return Loss	1805MHz-2200MHz [4] [5]	6	11.0		dB
RLout	Output Return Loss	1805MHz-2200MHz [4] [5]	6	12.0		dB
ISL	Reverse Isolation	1805MHz-2200MHz [4] [5]	17	25.0		dB
NF	Noise Figure	1805MHz-2200MHz [4] [5]		0.9	1.4	dB
IP1dB	In-band input 1dB-compression point	1805MHz-2200MHz [4] [5]	-6	-4.5		dBm
IIP3ib	In-band input 3rd-order intercept point	1805MHz-2200MHz [4] [5]	0	6.7		dBm
ton	turn-on time	time from V_{EN} ON to 90% of the gain		2	4	μs
toff	turn-off time	time from V_{EN} OFF to 10% of the gain		1	2	μs
K	Stability Factor	0.2MHz-10GHz	1			
Bypass Mode						
ICC	Supply Current	VEN<0.45V			1	uA
Gp	Power Gain	1805MHz-2200MHz [4] [5]	-4	-2.5		dB
RLin	Input Return Loss	1805MHz-2200MHz [4] [5]	6	12.0		dB
RLout	Output Return Loss	1805MHz-2200MHz [4] [5]	6	13.0		dB
NF	Noise Figure	1805MHz-2200MHz [4] [5]		2.5	4	dB
IP1dB	In-band input 1dB-compression point	1805MHz-2200MHz [4] [5]	1	4		dBm
IIP3	In-band input 3rd-order intercept point	1805MHz-2200MHz [4] [5]	**6**	11		dBm

[3] High quality-factor 3.3nH inductor.
[4] Input power is -25dBm.
[5] PCB losses are subtracted.

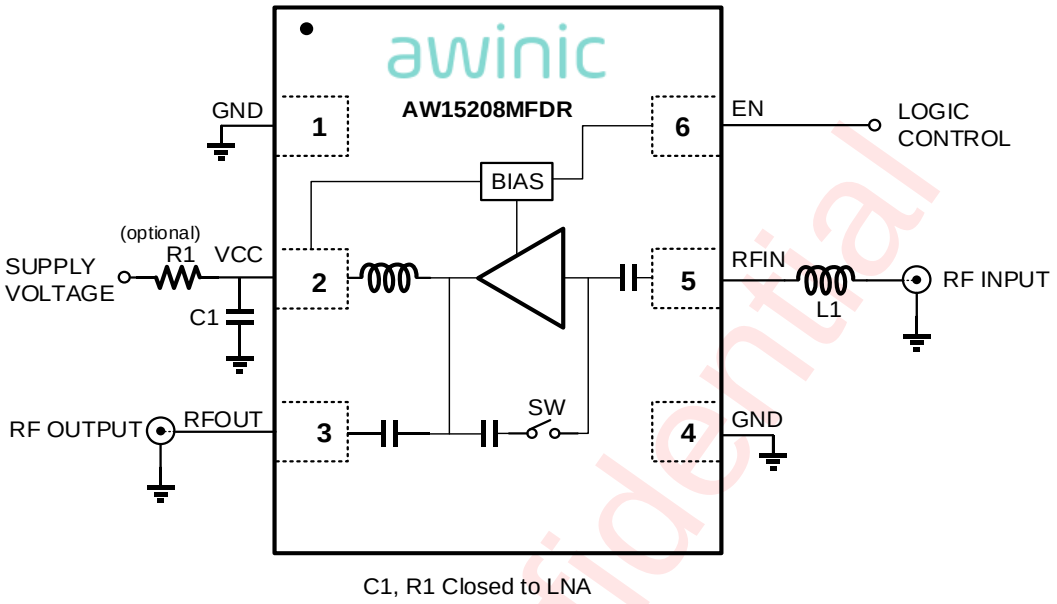
TA=+25°C , V_{CC}=1.8V, EN=1.8V, frequency=1805MHz to 2200MHz. Input matched to 50Ω using a 3.3nH[3] inductor in series. (unless otherwise noted).

Symbol	Parameter	Test Condition	Min	Typ	Max	Units
DC Electrical Characteristic						
VCC	Supply Voltage		1.5	-	3.3	V
VEN	Digital Input-Logic High		0.8		3.3	V
	Digital Input-Logic Low				0.45	V
IEN	Control current				10	uA
ISD	Leakage current	VDD=3.4V			3	uA
Gain Mode						
ICC	Supply Current	VEN>0.8V		8.0	10	mA
Gp	Power Gain	1805MHz-2200MHz [4] [5]	12	13.1	15	dB
RLin	Input Return Loss	1805MHz-2200MHz [4] [5]	6	8.0		dB
RLout	Output Return Loss	1805MHz-2200MHz [4] [5]	6	12.0		dB
ISL	Reverse Isolation	1805MHz-2200MHz [4] [5]	17	25.0		dB
NF	Noise Figure	1805MHz-2200MHz [4] [5]		0.9	1.4	dB
IP1dB	In-band input 1dB-compression point	1805MHz-2200MHz [4] [5]	-8	-6.7		dBm
IIP3ib	In-band input 3rd-order intercept point	1805MHz-2200MHz [4] [5]	0	6.7		dBm
ton	turn-on time	time from VEN ON to 90% of the gain		2	4	μs
toff	turn-off time	time from VEN OFF to 10% of the gain		1	2	μs
K	Stability Factor	0.2MHz-10GHz	1			
Bypass Mode						
ICC	Supply Current	VEN<0.45V			1	uA
Gp	Power Gain	1805MHz-2200MHz [4] [5]	-4	-3.0		dB
RLin	Input Return Loss	1805MHz-2200MHz [4] [5]	6	11.5		dB
RLout	Output Return Loss	1805MHz-2200MHz [4] [5]	6	13.0		dB
NF	Noise Figure	1805MHz-2200MHz [4] [5]		3	4	dB
IP1dB	In-band input 1dB-compression point	1805MHz-2200MHz [4] [5]	1	4		dBm
IIP3	In-band input 3rd-order intercept point	1805MHz-2200MHz [4] [5]	**6**	11		dBm

[3] High quality-factor 3.3nH inductor.
[4] Input power is -25dBm.
[5] PCB losses are subtracted.

MEASUREMENT DIAGRAM

Test DC Characteristics(Current & Power Consumption)



C1, R1 Closed to LNA

Figure 4 AW15208MFDR DC Test Diagram

Test S-Parameter

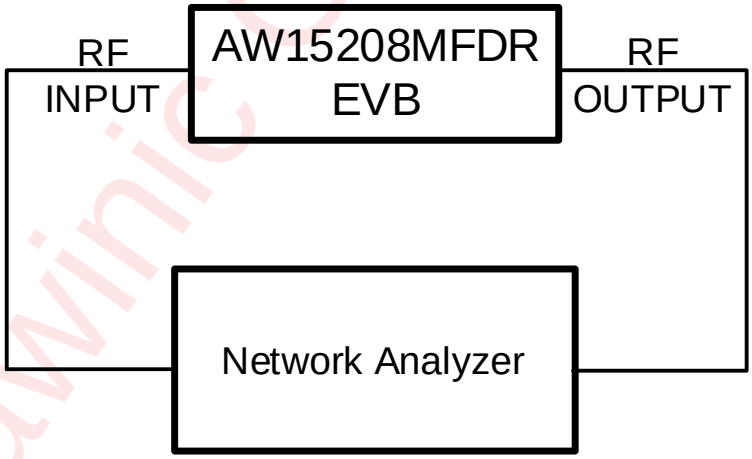


Figure 5 AW15208MFDR S-parameter Measurement Diagram

Test Noise Figure

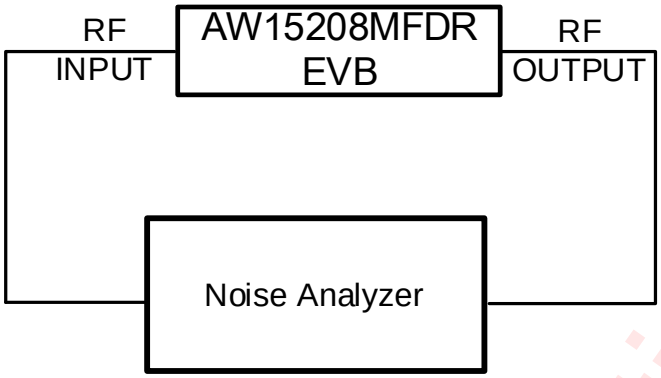


Figure 6 AW15208MFDR Noise Figure Measurement Diagram

Test IIP3

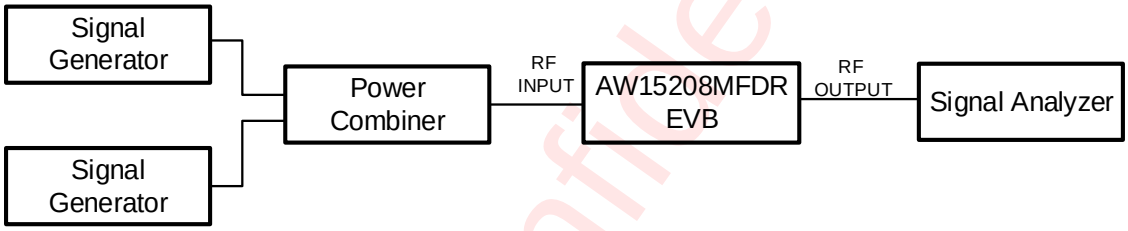


Figure 7 AW15208MFDR IIP3 Measurement Diagram

APPLICATION INFORMATION

Choice of components

- The AW15208MFDR 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 3.3nH with high quality factor, and capacitor is 1nF. The typical application circuit can refer to Figure1.
- The output of AW15208MFDR is internally matched to 50 ohm and a DC blocking capacitor is integrated on-chip, thus no external component is required at the output.
- The AW15208MFDR 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.

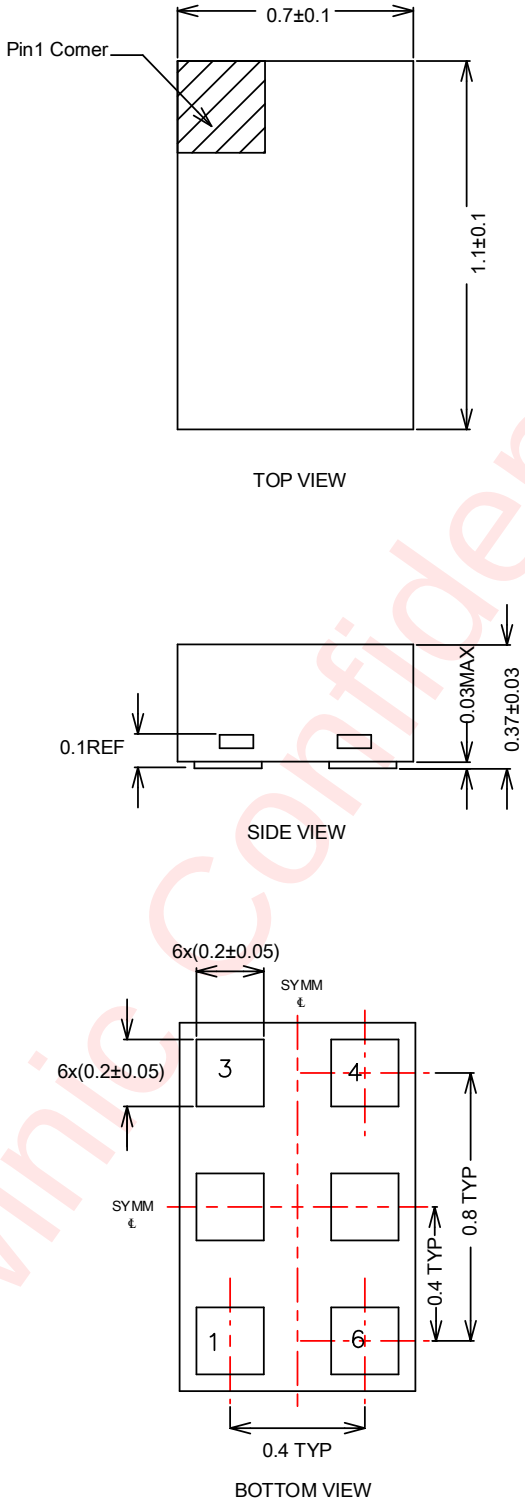
Inductor Selection Table

Component	Part	Typical(nH)	Q(min)	Frequency(MHz)	MFR	Size
L1	SDCL1005C	3.3	25	250	Sunlord	0402

Capacitor Selection Table

Component	Part	Typical(pF)	Voltage(V)	MFR	Size
C1	GRM155	1000	50	Murata	0402

PACKAGE DESCRIPTION



Unit：mm

Figure 8 Package Outline

LAND PATTERN

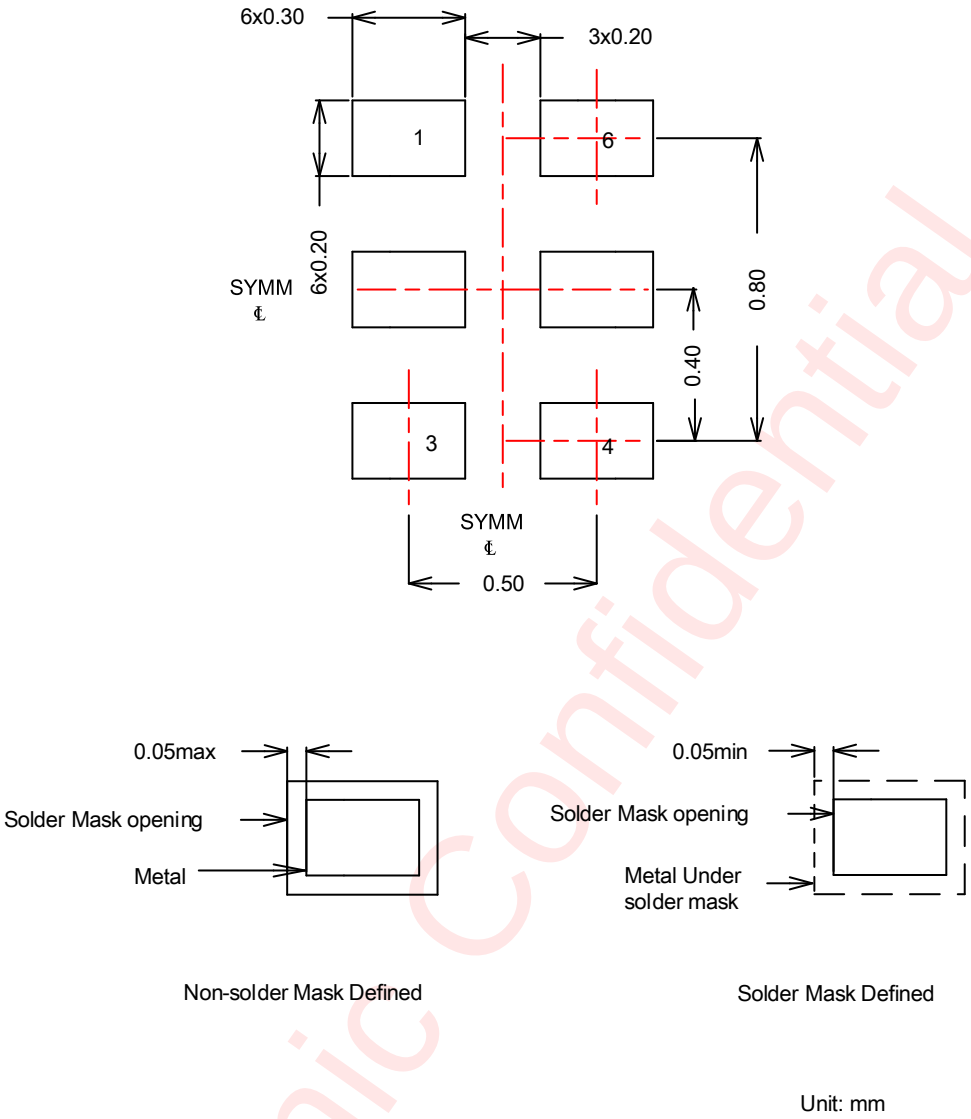
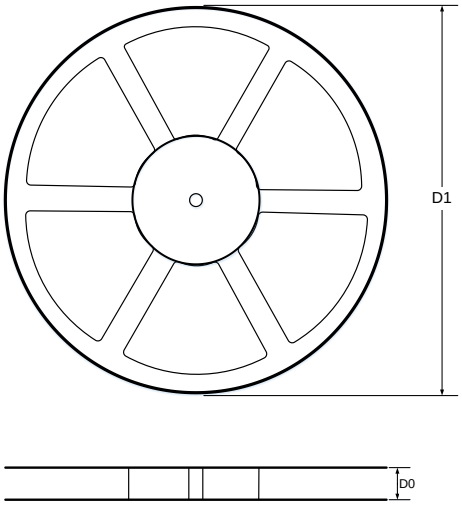


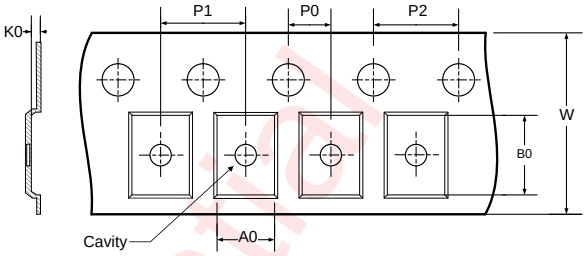
Figure 9 Land Pattern

TAPE & REEL DESCRIPTION

REEL DIMENSIONS

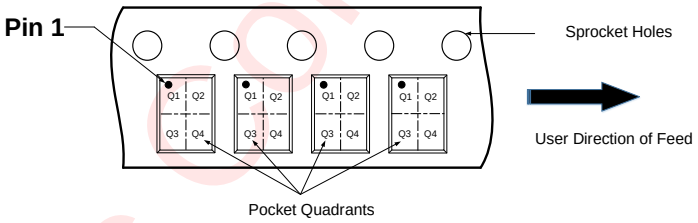


TAPE DIMENSIONS



A0：Dimension designed to accommodate the component width
B0：Dimension designed to accommodate the component length
K0：Dimension designed to accommodate the component thickness
W：Overall width of the carrier tape
P0：Pitch between successive cavity centers and sprocket hole
P1：Pitch between successive cavity centers
P2：Pitch between sprocket hole
D1：Reel Diameter
D0：Reel Width

QUADRANT ASSIGNMENTS FOR PIN 1 ORIENTATION IN TAPE



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 10 Tape & Reel Description

REVISION HISTORY

Version	Date	Change Record
V1.0	Mar. 2019	Officially Released
V1.1	Oct. 2019	Update electrical characteristics
V1.2	Oct. 2020	Update electrical characteristics
V1.3	Feb. 2021	Update stability factor Add noise figure under bypass mode
V1.4	Jul. 2021	Add IEN,ISD,IIP3 in bypass mode
V1.5	Aug. 2021	Add logic for gain mode, change test condition of ISD

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