Low Noise Amplifier for GNSS Application

Features

- AEC-Q100 in Progress
- Operation frequencies:
  L1 Band: 1550MHz to 1615MHz
  L2&L5 Band: 1164MHz to 1300MHz
- High power gain:
  18.8dB@ L1 Band
  19.5dB@ L2 Band
  19.7dB@ L5 Band
- Low noise figure:
  0.69dB@ L1 Band
  0.68dB@ L2 Band
  0.7dB@ L5 Band
- Requires only one input matching inductor for L1 band while additional output matching capacitor and inductor are needed for L2/L5 band
- Supply voltage: 1.5V to 3.6V
- DFN 1.5X1.0-6L package
- Broadband design ensures the functionality of all GNSS signals within 1164 to 1615 MHz with the same matching

Applications

- GNSS receive application for automotive
- Active antenna, dashboard camera, and navigation
- Recreational, Marine Navigation
- Personal Navigation Devices
- RF Front End modules
- Complete GPS chipset modules

General Description

The AWR5005DNR-Q1 is a Low Noise Amplifier designed for Global Navigation Satellite Systems (GNSS) as GPS, GLONASS, Galileo and Compass. With on-chip DC blocking capacitors at RFIN and RFOUT, The AWR5005DNR-Q1 can be close to the antenna, requires only one input matching inductor for L1 band while additional output matching capacitor and inductor are needed for L2/L5 band, and reduces assembly complexity and the PCB area, enabling a cost-effective solution.

The AWR5005DNR-Q1 with patented Smart Linearity Technology (SLT) achieves ultra-low noise figure, high linearity, high gain, over a wide range of supply voltages from 1.5V up to 3.6V. All these features make AWR5005DNR-Q1 an excellent choice for GNSS LNA as it improves sensitivity with low noise figure and high gain, provides better immunity against out-of-band jammer signals with high linearity, reduces filtering requirement of preceding stage and hence reduces the overall cost of the GNSS receiver.

The AWR5005DNR-Q1 is available in a small lead-free, RoHS-Compliant, DFN 1.5X1.0-6L package

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Typical Application Circuit

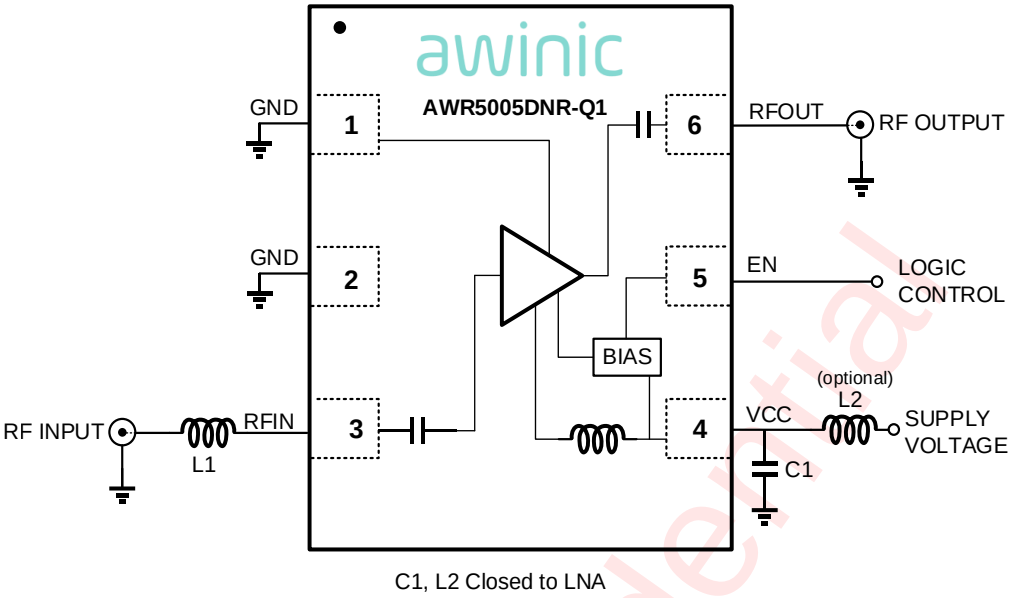

Figure 1 Typical Application Circuit of AWR5005DNR-Q1 for GNSS L1

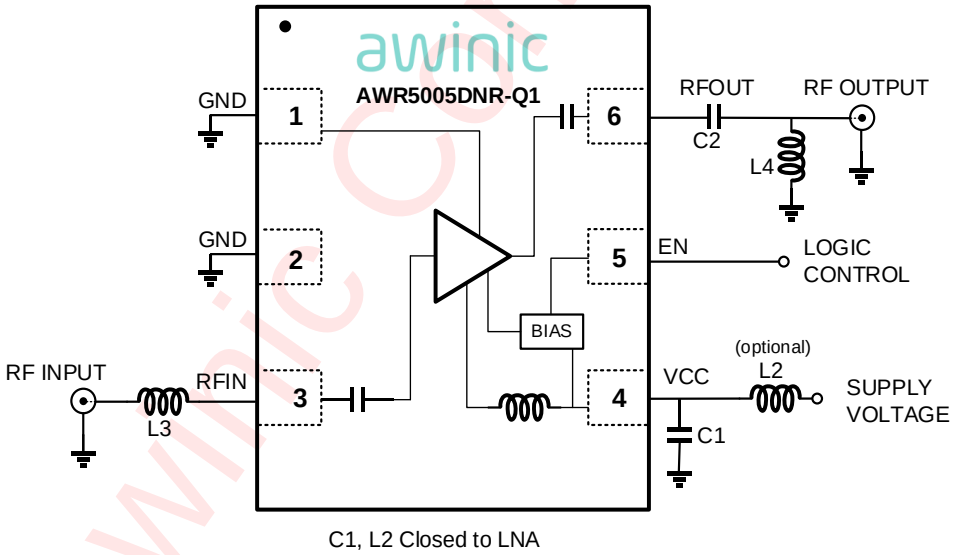

Figure 2 Typical Application Circuit of AWR5005DNR-Q1 for GNSS L2+L5

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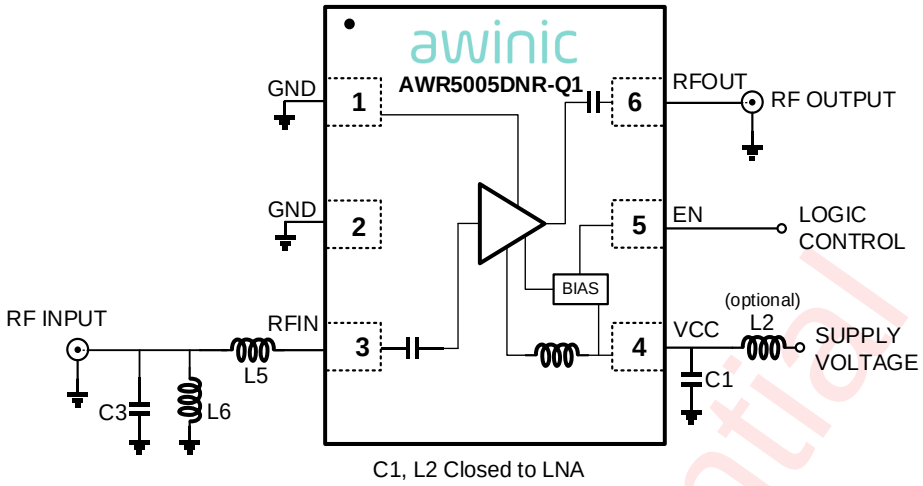

Figure 3 Typical Application Circuit of AWR5005DNR-Q1 for GNSS L1+L2+L5

Recommended Components List

Component	Frequencies Range	Part Number	Inductance	Supplier	Size
L1	1550MHz to 1615MHz	LQW15A	10nH	Murata	0402
L2	-	LQW15A	100nH	Murata	0402
C1	-	GRM155	1nF	Murata	0402
L3	1164MHz to 1300MHz	LQW15A	18nH	Murata	0402
L4		LQW15A	6.2nH	Murata	0402
C2		GRM155	15pF	Murata	0402
L5	1164MHz to 1300MHz 1550MHz to 1615MHz	LQW15A	14nH	Murata	0402
L6		LQW15A	3.1nH	Murata	0402
C3		GRM155	3.9pF	Murata	0402

List of components for AWR5005DNR-Q1

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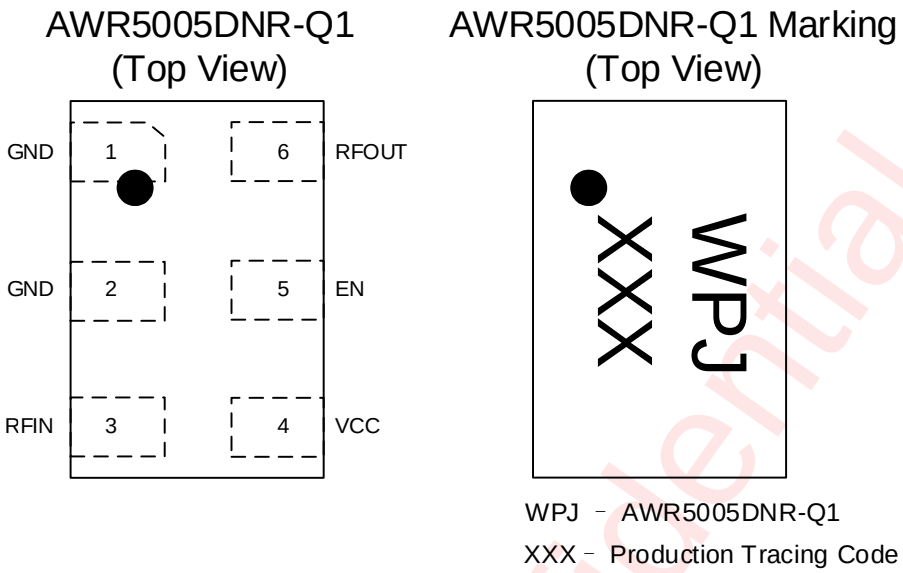
Pin Configuration And Top Mark



WPJ – AWR5005DNR-Q1

XXX – Production Tracing Code

Figure 4 Pin Configuration and Top Mark

Pin Definition

No.	NAME	DESCRIPTION
1	GND	Ground
2	GND	Ground
3	RFIN	LNA input
4	VCC	DC Supply
5	EN	Logic control
6	RFOUT	LNA output

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Functional Block Diagram

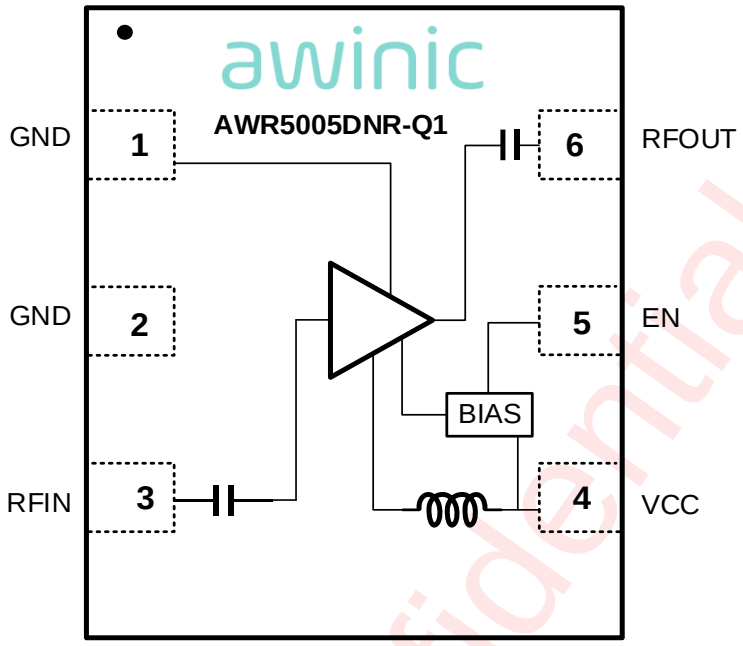

Figure 5 Functional Block Diagram

Ordering Information

Part Number	Temperature	Package	Marking	Moisture Sensitivity Level	Environmental Information	Delivery Form
AWR5005DNR-Q1	-40°C~105°C	DFN 1.5X1.0-6L	WPJ	MSL1	ROHS+HF	4500 units/ Tape & Reel

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Absolute Maximum Ratings(NOTE1)

PARAMETERS	RANGE
Supply voltage V_{CC}	-0.3V to 5.0V
Control voltage V_{EN}	-0.3V to V_{CC}
Maximum RF input power	20dBm
Maximum operating junction temperature T_{JMAX}	150°C
Operating free-air temperature range	-40°C to 105°C
Storage temperature T_{STG}	-65°C to 150°C
Lead temperature (soldering 10 seconds)	260°C
ESD (NOTE 2)	
HBM	±3000V
CDM	±1000V
Latch-Up	
AEC-Q100-004	+IT:400mA -IT:-400mA

NOTE1: Conditions out of those ranges listed in "absolute maximum ratings" may cause permanent damages to the device. Exposure to absolute-maximum-rated conditions for prolonged periods may affect device reliability.

NOTE2: HBM: AEC-Q100-002-RevE, CDM: AEC-Q100-011-RevD

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Electrical Characteristics

DC and Switching Characteristic

PARAMETER		TEST CONDITION	MIN	TYP	MAX	UNIT
V_{CC}	Supply Voltage	-	1.5	1.8/2.8	3.6	V
I_{SD}	Shut-Down Current	V_{CC}=2.8V&1.8V	-	-	1	μA
I_{EN}	Control current	V_{CC}=2.8V&1.8V	-	1	2	μA
I_{CC}	Supply Current	V_{CC}=1.8V	-	7	12	mA
		V_{CC}=2.8V		8	13	mA
V_{EN_H}	Digital Input-Logic High	V_{CC}=2.8V&1.8V	0.8	-	V_{CC}	V
V_{EN_L}	Digital Input-Logic Low		-	-	0.45	V
t_{on}[1]	turn-on time, V_{CC}=2.8V&1.8V	time from V_{EN} ON to 90% of the final gain	-	0.8	2	μs
t_{off}[1]	turn-off time, V_{CC}=2.8V&1.8V	time from V_{EN} OFF to 10% of the gain	-	0.2	2	μs
kf[1]	Stability factor	f=20MHz…10GHz	1	-	-	-

Typically: V_{CC}=V_{EN_H}=2.8V and TA=+25°C (measured according to Figure 1),unless otherwise noted

PARAMETER		TEST CONDITION	MIN	TYP	MAX	UNIT
Frequency Range		-	1550	1575.42	1615	MHz
Gp	Power Gain	V_{EN}=V_{EN_H}	17	18.8	20.5	dB
RL_{in}	Input Return Loss		5	7.5	-	dB
RL_{out}	Output Return Loss		8	12	-	dB
ISL	Reverse Isolation		25	29	-	dB
NF[1]	Noise Figure	Zs=50 ohm; No jammer	-	0.69[2]	1.1	dB
IP1dB[1]	Input 1dB-compression point	f=1575.42MHz	-12	-9	-	dBm
$IIP3_{ib}$[1]	In-band input 3rd-order intercept point	f1=1574.42MHz; f2=1575.42MHz; Pin=-25dBm;	-5	-1	-	dBm
$IIP3_{oob}$[1]	Out-of-band input 3rd-order intercept point	f1=1712.7MHz; f2=1850MHz; Pin=-25dBm;	-3	-0.3	-	dBm

Typically: V_{CC}=V_{EN_H}=1.8V and TA=+25°C (measured according to Figure 1), unless otherwise noted

PARAMETER		TEST CONDITION	MIN	TYP	MAX	UNIT
Frequency Range		-	1550	1575.42	1615	MHz
Gp	Power Gain	V_{EN}=V_{EN_H}	16.5	18.2	20	dB
RL_{in}	Input Return Loss		5	7.5	-	dB
RL_{out}	Output Return Loss		8	12	-	dB
ISL	Reverse Isolation		25	29	-	dB

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PARAMETER		TEST CONDITION	MIN	TYP	MAX	UNIT
NF[1]	Noise Figure	Zs=50 ohm; No jammer	-	0.7[2]	1.1	dB
IP1dB[1]	Input 1dB-compression point	f=1575.42MHz	-14	-11	-	dBm

$IIP3_{ib}$[1]	In-band input 3rd-order intercept point	f1=1574.42MHz;
		f2=1575.42MHz;
		Pin=-25dBm;
			-5	-1.7	-	dBm

$IIP3_{oob}$[1]	Out-of-band input 3rd-order intercept point	f1=1712.7MHz;
		f2=1850MHz;
		Pin=-25dBm;
			-5	-2.1	-	dBm

Typically: V_{CC}=V_{EN_H}=2.8V and TA=+25°C (measured according to Figure 2), unless otherwise noted

PARAMETER		TEST CONDITION	MIN	TYP	MAX	UNIT
Frequency Range		-	1215	1227.6	1300	MHz
Gp	Power Gain	V_{EN}=V_{EN_H}	17	19.5	22	dB
RL_{in}	Input Return Loss		4.5	7	-	dB
RL_{out}	Output Return Loss		8	13	-	dB
ISL	Reverse Isolation		25	30	-	dB
NF[1]	Noise Figure	Zs=50 ohm; No jammer	-	0.68[2]	1.1	dB
IP1dB[1]	Input 1dB-compression point	f=1227.6MHz	-15	-12	-	dBm

$IIP3_{ib}$[1]	In-band input 3rd-order intercept point	f1=1226.6MHz;
		f2=1227.6MHz;
		Pin=-25dBm;
			-5	-3	-	dBm

Typically: V_{CC}=V_{EN_H}=1.8V and TA=+25°C (measured according to Figure 2), unless otherwise noted

PARAMETER		TEST CONDITION	MIN	TYP	MAX	UNIT
Frequency Range		-	1215	1227.6	1300	MHz
Gp	Power Gain	V_{EN}=V_{EN_H}	16.5	18.8	21	dB
RL_{in}	Input Return Loss		4.5	6.5	-	dB
RL_{out}	Output Return Loss		8	13	-	dB
ISL	Reverse Isolation		25	30	-	dB
NF[1]	Noise Figure	Zs=50 ohm; No jammer	-	0.7[2]	1.1	dB
IP1dB[1]	Input 1dB-compression point	f=1227.6MHz	-16	-13	-	dBm

$IIP3_{ib}$[1]	In-band input 3rd-order intercept point	f1=1226.6MHz;
		f2=1227.6MHz;
		Pin=-25dBm;
			-5.5	-3.5	-	dBm

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Typically: V_{CC}=V_{EN_H}=2.8V and TA=+25°C (measured according to Figure 2), unless otherwise noted

PARAMETER		TEST CONDITION	MIN	TYP	MAX	UNIT
Frequency Range		-	1164	1176.45	1215	MHz
Gp	Power Gain	V_{EN}=V_{EN_H}	17.5	19.7	22	dB
RL_{in}	Input Return Loss		4.5	6	-	dB
RL_{out}	Output Return Loss		8	15	-	dB
ISL	Reverse Isolation		25	30	-	dB
NF[1]	Noise Figure	Zs=50 ohm; No jammer	-	0.7[2]	1.1	dB
IP1dB[1]	Input 1dB-compression point	f=1176.45MHz	-15	-12	-	dBm
$IIP3_{ib}$[1]	In-band input 3rd-order intercept point	f1=1175.45MHz; f2=1176.45MHz; Pin=-25dBm;	-5	-2.3	-	dBm

Typically: V_{CC}=V_{EN_H}=1.8V and TA=+25°C(measured according to Figure 2) , unless otherwise noted

PARAMETER		TEST CONDITION	MIN	TYP	MAX	UNIT
Frequency Range		-	1164	1176.45	1215	MHz
Gp	Power Gain	V_{EN}=V_{EN_H}	17	19	21	dB
RL_{in}	Input Return Loss		4.5	5.5	-	dB
RL_{out}	Output Return Loss		8	15	-	dB
ISL	Reverse Isolation		25	30	-	dB
NF[1]	Noise Figure	Zs=50 ohm; No jammer	-	0.7 [2]	1.1	dB
IP1dB[1]	Input 1dB-compression point	f=1176.45MHz	-16	-13	-	dBm
$IIP3_{ib}$[1]	In-band input 3rd-order intercept point	f1=1175.45MHz; f2=1176.45MHz; Pin=-25dBm;	-5	-2.8	-	dBm

Typically: V_{CC}=V_{EN_H}=2.8V and TA=+25°C(measured according to Figure 3), unless otherwise noted

PARAMETER		TEST CONDITION	MIN	TYP	MAX	UNIT
Frequency Ranges		-	1164	1176.45	1215	MHz
		-	1215	1227.6	1300	MHz
		-	1550	1575.42	1615	MHz
Gp[1]	Power Gain	f=1176.45MHz	17.5	19.5	22	dB
		f=1227.6MHz	18	20.2	22	
		f=1575.42MHz	16.5	18.8	21	
RL_{in}[1]	Input Return Loss	f=1176.45MHz	4	6	-	dB
		f=1227.6MHz	5	7.5	-	

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PARAMETER		TEST CONDITION	MIN	TYP	MAX	UNIT
		f=1575.42MHz	5	8	-	
RL_{out}[1]	Output Return Loss	f=1176.45MHz	5	9	-	dB
		f=1227.6MHz	8	12	-	
		f=1575.42MHz	8	12	-	
ISL[1]	Reverse Isolation	f=1176.45MHz	25	30	-	dB
		f=1227.6MHz	25	29	-	
		f=1575.42MHz	25	29	-	
NF[1]	Noise Figure	f=1176.45MHz	-	1.1[2]	1.5	dB
		f=1227.6MHz	-	1.0[2]	1.4	
		f=1575.42MHz	-	1.0[2]	1.4	
IP1dB[1]	Input 1dB-compression point	f=1176.45MHz	-15	-12	-	dBm
		f=1227.6MHz	-16	-12.8	-	
		f=1575.42MHz	-14	-11	-	
$IIP3_{ib}$[1]	In-band input 3rd-order intercept point	f1=1574.42MHz; f2=1575.42MHz; Pin=-25dBm;	-5	-1	-	dBm
		f1=1226.6MHz; f2=1227.6MHz; Pin=-25dBm;	-7	-4	-	
		f1=1175.45MHz; f2=1176.45MHz; Pin=-25dBm;	-7	-3.5	-	
$IIP3_{oob}$[1]	Out-of-band input 3rd-order intercept point	f1=1712.7MHz; f2=1850MHz; Pin=-25dBm;	0	5	-	dBm

Typically: V_{CC}=V_{EN_H}=1.8V and TA=+25°C(measured according to Figure 3), unless otherwise noted

PARAMETER		TEST CONDITION	MIN	TYP	MAX	UNIT
Frequency Ranges		-	1164	1176.45	1215	MHz
		-	1215	1227.6	1300	MHz
		-	1550	1575.42	1615	MHz
Gp[1]	Power Gain	f=1176.45MHz	17	18.9	21	dB
		f=1227.6MHz	17.5	19.5	21.5	
		f=1575.42MHz	16	18	20	
RL_{in}[1]	Input Return Loss	f=1176.45MHz	4	6.5	-	dB
		f=1227.6MHz	5	7.5	-	
		f=1575.42MHz	5	8.5	-	
RL_{out}[1]	Output Return Loss	f=1176.45MHz	5	9	-	dB
		f=1227.6MHz	8	12	-	
		f=1575.42MHz	8	12	-	

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PARAMETER		TEST CONDITION	MIN	TYP	MAX	UNIT
ISL[1]	Reverse Isolation	f=1176.45MHz	25	30	-	dB
		f=1227.6MHz	25	29	-	
		f=1575.42MHz	25	29	-	
NF[1]	Noise Figure	f=1176.45MHz	-	1.1[2]	1.5	dB
		f=1227.6MHz	-	1.0[2]	1.4	
		f=1575.42MHz	-	1.0[2]	1.4	
IP1dB[1]	Input 1dB-compression point	f=1176.45MHz	-16.5	-13.5	-	dBm
		f=1227.6MHz	-17	-14	-	
		f=1575.42MHz	-15.5	-12.5	-	
$IIP3_{ib}$[1]	In-band input 3^{rd}-order intercept point	f1=1574.42MHz; f2=1575.42MHz; Pin=-25dBm;	-6	-2	-	dBm
		f1=1226.6MHz; f2=1227.6MHz; Pin=-25dBm;	-8	-5	-	
		f1=1175.45MHz; f2=1176.45MHz; Pin=-25dBm;	-8	-5	-	
$IIP3_{oob}$[1]	Out-of-band input 3rd-order intercept point	f1=1712.7MHz; f2=1850MHz; Pin=-25dBm;	-1	4	-	dBm

[1] Minimum and/or maximum limit is guaranteed by design and by statistical analysis of device characterization data. The specification is not guaranteed by production testing.

[2] 0.08dB PCB losses are subtracted

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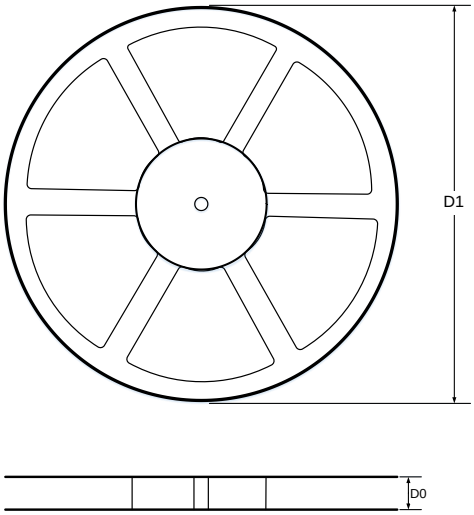
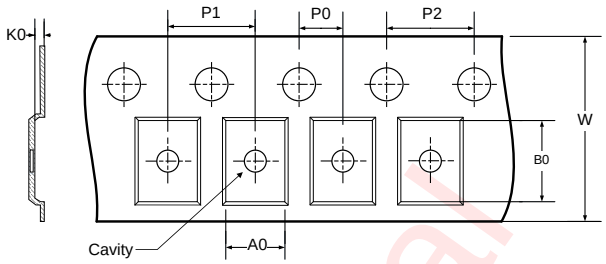
Tape And Reel Information

REEL DIMENSIONS

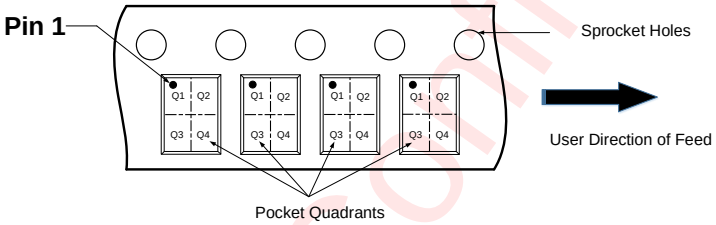


TAPE DIMENSIONS



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



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	1.12	1.72	0.7	2	4	4	8	Q1

All dimensions are nominal

Figure 6 Tape And Reel Information

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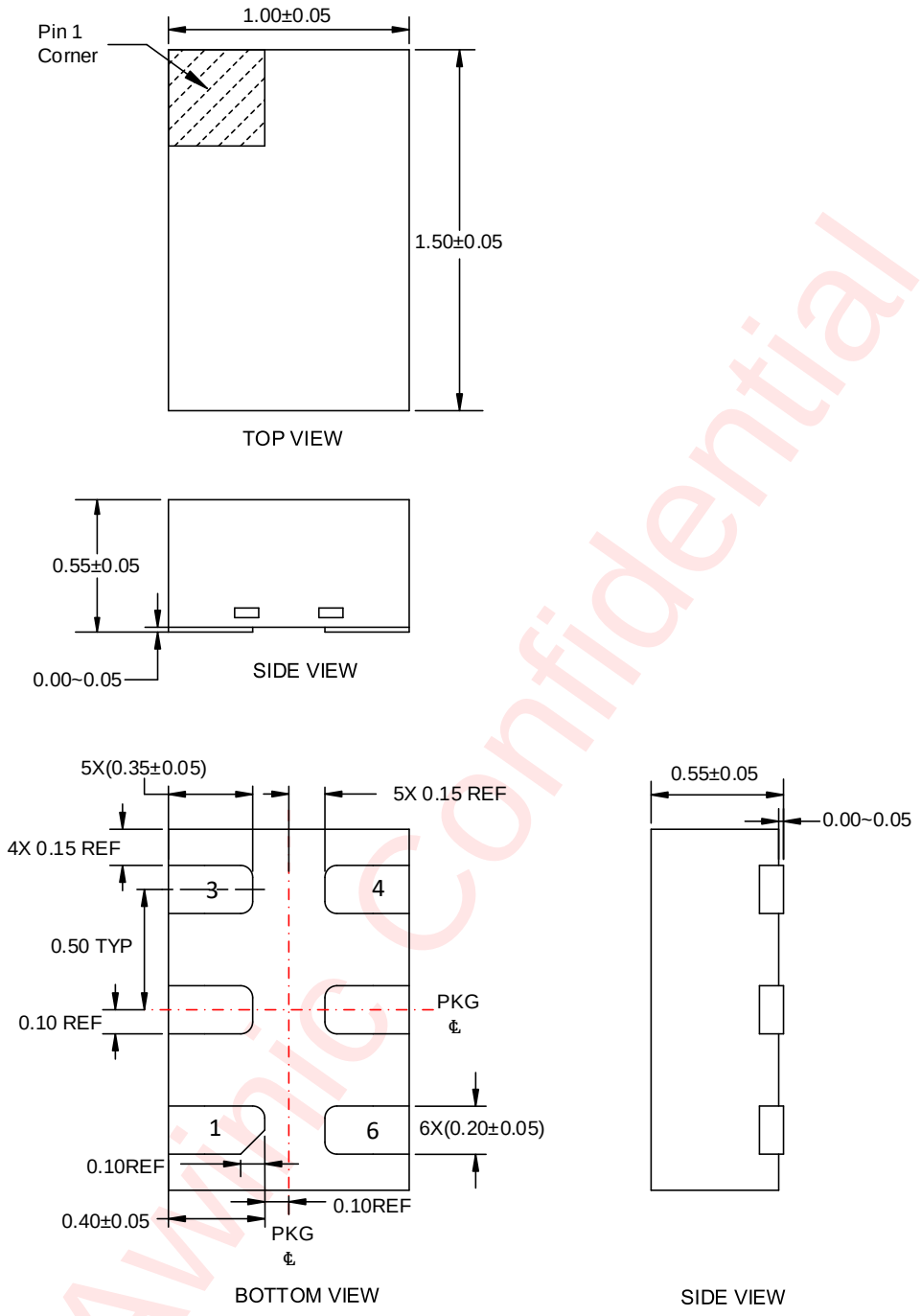
Package Description



Unit：mm

Figure 7 Package Description

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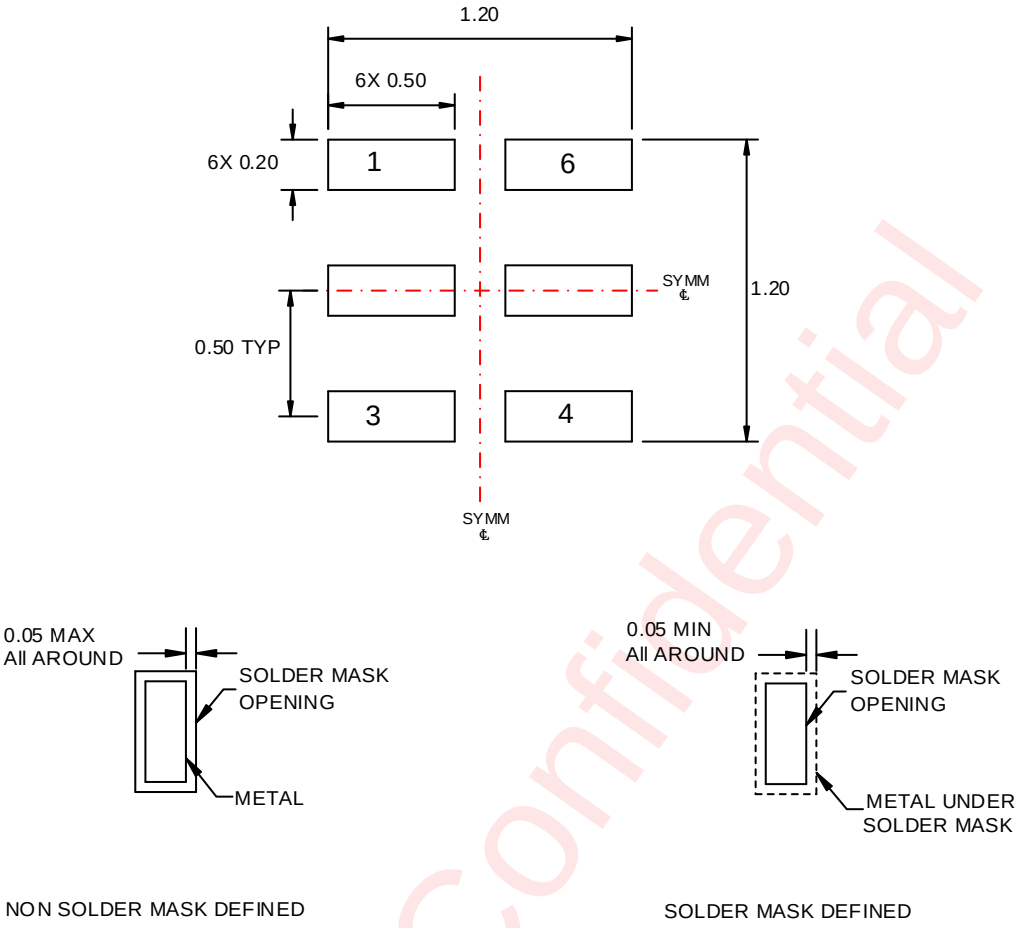
Land Pattern Data



Unit：mm

Figure 8 Land Pattern

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Revision History

Version	Date	Change Record
V1.0	Dec. 2025	Officially released

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