Qualcomm

RF360
Europe GmbH

Data sheet

SAW RF 2in1 filter input diplex
5G band 25_70 + band 66

Part number:	B9977
Ordering code:	B39222B9977L210
Date:	June 14, 2021
Version:	2.1

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Table of contents

1 Application

- Low-loss 2in1 RF filter for mobile phone 5G band 25_70 and band 66 systems, receive path (Rx)
- 5G band 25_70: 1975 MHz (pass band 90 MHz)
- 5G band 66: 2155 MHz (pass band 90 MHz)
- Usable pass band
- Filter 1 (Band 66): 90MHz
- Filter 2 (Band 25_70): 90MHz
- Impedance transformation from 50Ω to 50Ω for both filters
- Unbalanced to unbalanced operation for both filters

2 Features

- Package size $1.5_{\pm 0.05}$ mm × $1.1_{\pm 0.05}$ mm
- Package height 0.6 mm (max.)
- Approximate weight 3 mg
- RoHS compatible
- Package for Surface Mount Technology (SMT)
- Ni/Au-plated terminals
- Electrostatic Sensitive Device (ESD)
- Moisture Sensitivity Level 3 (MSL3)

3 Package

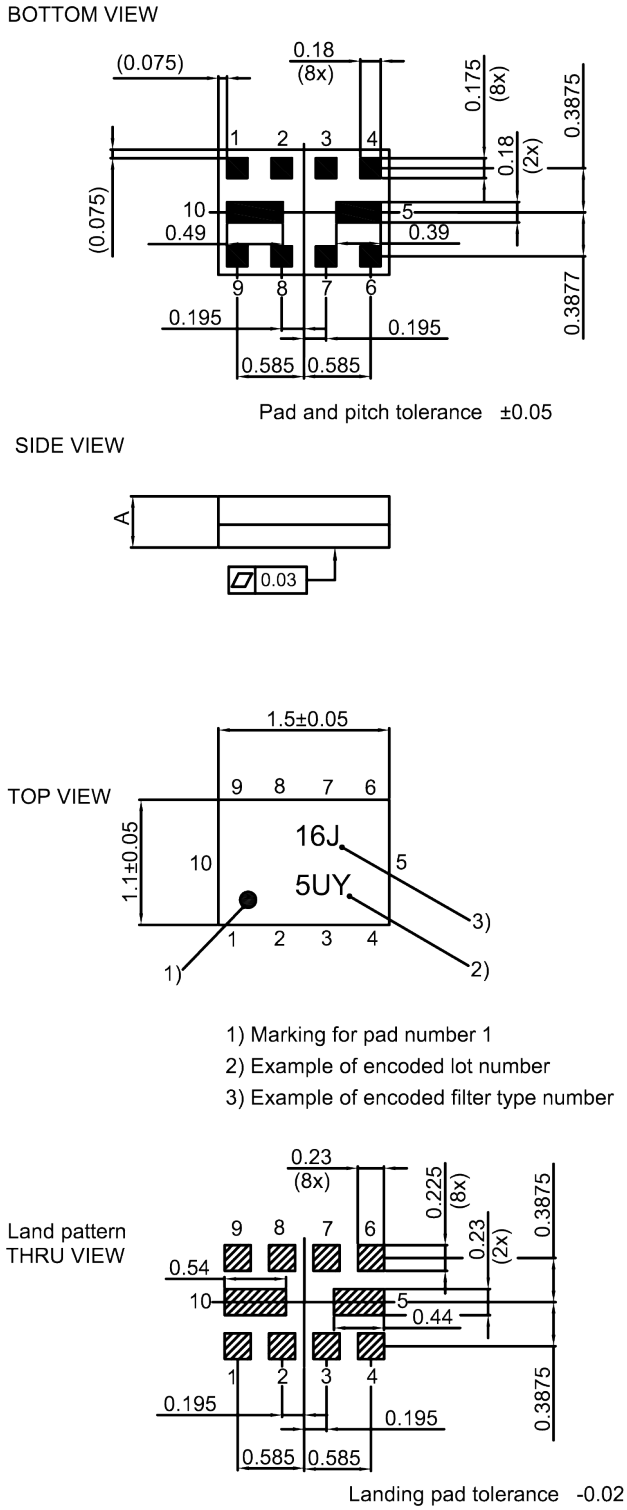

Figure 1: Drawing of package with package height A = 0.6 mm (max.). See Sec. Package information (p. 23).

4 Pin configuration

- 1 — Input (5G band 25_70; 5G band 66)
- 6 — Output (5G band 66)
- 9 — Output (5G band 25_70)
- 2, 3, 4, 5, 7, 8, 10 — Ground

5 Matching circuit

- L_{p1} = 3.0 nH
- L_{s6} = 3.5 nH
- L_{s9} = 1.9 nH

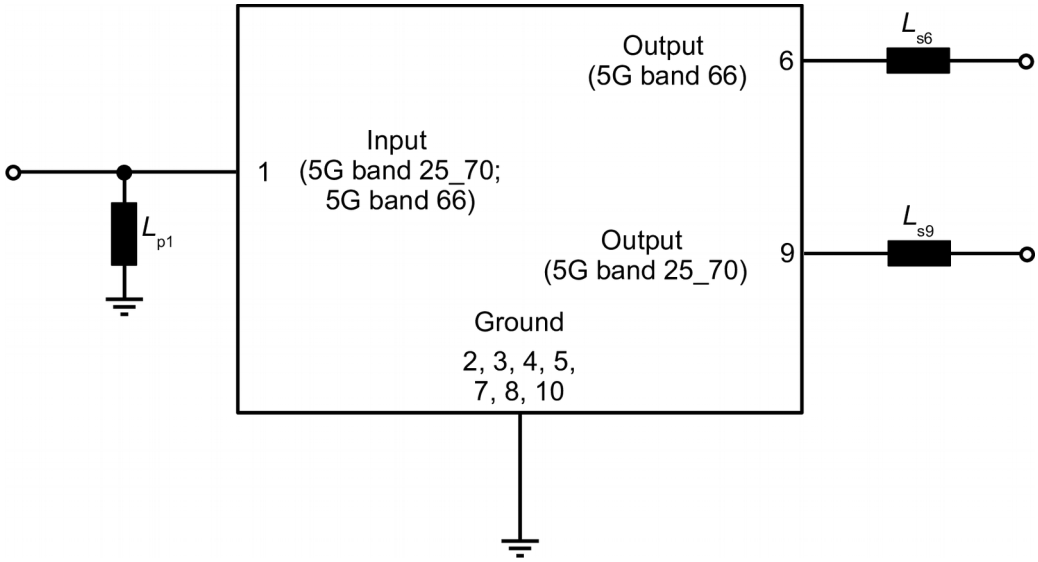

Figure 2: Schematic of matching circuit.

External shunt inductor for ESD protection is recommended at any ports towards antenna.

6 Characteristics 5G band 25_70

Temperature range for specification T_{SPEC} = −30 °C ... +85 °C
Input terminating impedance Z_{IN} = 50 Ω // 3.0 nH[1)]
5G band 25 70 output terminating impedance $Z_{5G\ band\ 25\ 70\ OUT}$ = 50 Ω + 1.9 nH[1)]
5G band 66 output terminating impedance $Z_{5G\ band\ 66\ OUT}$ = 50 Ω + 3.5 nH[1)]

Characteristics 5G band 25_70				min. for T_{SPEC}	typ. @ +25 °C	max. for T_{SPEC}	
Center frequency			f_C	—	1975	—	MHz
Maximum insertion attenuation			α_{max}				
	1930.24 ... 1994.76	MHz		—	2.4	3.4[2)]	dB
	1930.24 ... 1994.76	MHz		—	2.4	4.0	dB
	1995.24 ... 2019.76	MHz		—	2.1	3.6[2)]	dB
	1995.24 ... 2019.76	MHz		—	2.1	3.6	dB
Amplitude ripple (p-p)			$\Delta\alpha$				
	1930.24 ... 2019.76	MHz		—	1.4	3.0	dB
Maximum VSWR			$VSWR_{max}$				
@ input port	1930.24 ... 2019.76	MHz		—	1.7	2.1	
@ 5G band 25 70 output port	1930.24 ... 2019.76	MHz		—	1.7	2.1	
Minimum attenuation							
	10 ... 1910	MHz	α_{min}	25	38	—	dB
	80	MHz	α_{min}	50	97	—	dB
	300 ... 310	MHz	α_{min}	40	73	—	dB
	643.3 ... 673.3	MHz	α_{min}	40	60	—	dB
	663 ... 698	MHz	α_{min}	40	60	—	dB
	699 ... 716	MHz	α_{min}	40	59	—	dB
	814 ... 849	MHz	α_{min}	40	56	—	dB
	965 ... 1010	MHz	α_{min}	40	54	—	dB
	1395 ... 1400	MHz	α_{min}	40	50	—	dB
	1695 ... 1710	MHz	α_{min}	40	58	—	dB
	1710 ... 1780	MHz	α_{min}	40	51	—	dB
	1770 ... 1835	MHz	α_{min}	37	43	—	dB
	1845 ... 1865	MHz	α_{min}	35	40	—	dB
	1845 ... 1870	MHz	α_{min}	25	40	—	dB
	1850.24 ... 1914.76	MHz	α_{min}	32[2)]	39	—	dB
	1850.24 ... 1914.76	MHz	$\alpha_{INT,min}$[3)]	35[2)]	40	—	dB
	1850.24 ... 1914.76	MHz	α_{min}	15	39	—	dB
	1850.24 ... 1914.76	MHz	$\alpha_{INT,min}$[3)]	18	40	—	dB
	2080 ... 2105	MHz	α_{min}	25	44	—	dB
	2105 ... 7990	MHz	α_{min}	25	39	—	dB
	2400 ... 2500	MHz	α_{min}	37	48	—	dB
	2496 ... 2690	MHz	α_{min}	40	46	—	dB

Characteristics 5G band 25_70				min. for T_{SPEC}	typ. @ +25 °C	max. for T_{SPEC}	
3300... 4200	MHz	α_{min}		33	38	—	dB
3550... 3730	MHz	α_{min}		34	39	—	dB
3700... 4200	MHz	α_{min}		33	38	—	dB
3860... 4040	MHz	α_{min}		33	38	—	dB
4900... 5950	MHz	α_{min}		32	37	—	dB
5790... 6600	MHz	α_{min}		32	36	—	dB
5925... 7125	MHz	α_{min}		32	36	—	dB

1) See Sec. Matching circuit (p. 6).
2) Valid for typical temperature T = +25 °C.
3) Integrated attenuation α_{INT}: Averaged power $|S_{ij}|^2$ over the center 4.5 MHz of LTE 5 MHz (25 RB) channels.

7 Characteristics 5G band 66

Temperature range for specification T_{SPEC} = −30 °C ... +85 °C
Input terminating impedance Z_{IN} = 50 Ω // 3.0 nH[1)]
5G band 25 70 output terminating impedance $Z_{5G\ band\ 25\ 70\ OUT}$ = 50 Ω + 1.9 nH[1)]
5G band 66 output terminating impedance $Z_{5G\ band\ 66\ OUT}$ = 50 Ω + 3.5 nH[1)]

Characteristics 5G band 66				min. for T_{SPEC}	typ. @ +25 °C	max. for T_{SPEC}	
Center frequency			f_C	—	2155	—	MHz
Maximum insertion attenuation			α_{max}				
	2110... 2200	MHz		—	1.5	2.0[2)]	dB
	2110... 2200	MHz		—	1.5	2.4	dB
Amplitude ripple (p-p)			Δα				
	2110... 2200	MHz		—	0.6	1.5	dB
Maximum VSWR			$VSWR_{max}$				
@ input port	2110... 2200	MHz		—	1.6	2.0	
@ 5G band 66 output port	2110... 2200	MHz		—	1.7	2.0	
Minimum attenuation			α_{min}				
	10... 2025	MHz		25	38	—	dB
	400	MHz		40	69	—	dB
	663... 698	MHz		40	59	—	dB
	693... 716	MHz		40	59	—	dB
	814... 849	MHz		40	56	—	dB
	1055... 1100	MHz		40	51	—	dB
	1310... 1360	MHz		40	47	—	dB
	1695... 1710	MHz		40	46	—	dB
	1710... 1780	MHz		40	43	—	dB
	1850... 1915	MHz		40	47	—	dB
	1910... 1990	MHz		30	45	—	dB
	2025... 2050	MHz		15	29	—	dB
	2230... 2285	MHz		6	14	—	dB
	2285... 7990	MHz		25	36	—	dB
	2400... 2500	MHz		35	38	—	dB
	2496... 2690	MHz		35	39	—	dB
	3300... 3800	MHz		36	41	—	dB
	3550... 3700	MHz		36	41	—	dB
	3700... 4200	MHz		35	40	—	dB
	3820... 3980	MHz		35	40	—	dB
	4220... 4400	MHz		35	39	—	dB
	4900... 5950	MHz		34	38	—	dB
	5530... 5760	MHz		34	38	—	dB
	5925... 7125	MHz		32	37	—	dB
	6330... 6600	MHz		32	37	—	dB

[1)] See Sec. Matching circuit (p. 6).

[2] Valid for typical temperature T = +25 °C.

8 Maximum ratings

Storage temperature	T_{STG} [2] = −40 °C ... +85 °C [1]	
DC voltage	$\|V_{DC}\|$ = 5.0 V (max.) [3]	
ESD voltage		
	V_{ESD} [4] = 125 V (max.)	Machine model.
	V_{ESD} [5] = 225 V (max.)	Human body model.
	V_{ESD} [6] = 700 V (max.)	Charged device model.
Input power	P_{IN}	
@ input port: 1695 ... 1710 MHz	15 dBm	Continuous wave for 5000 h @ 50 °C.
@ input port: 1710 ... 1780 MHz	15 dBm	Continuous wave for 5000 h @ 50 °C.
@ input port: 1850 ... 1915 MHz	15 dBm	Continuous wave for 5000 h @ 50 °C.

1) Extended upperlimit: 96h@125°C acc. to IEC 60068-2-2 Bb.
2) Not valid for packaging material. Storage temperature for packaging material is −25 °C to +40 °C.
3) 168h Damp Heat Steady State acc. to IEC 60068-2-67 Cy.
4) According to JESD22-A115B (MM – Machine Model), 10 negative & 10 positive pulses.
5) According to JESD22-A114F (HBM – Human Body Model), 1 negative & 1 positive pulse.
6) According to JESD22-C101C (CDM – Field Induced Charged Device Model), 3 negative & 3 positive pulses.

9 Transmission coefficient 5G band 25_70

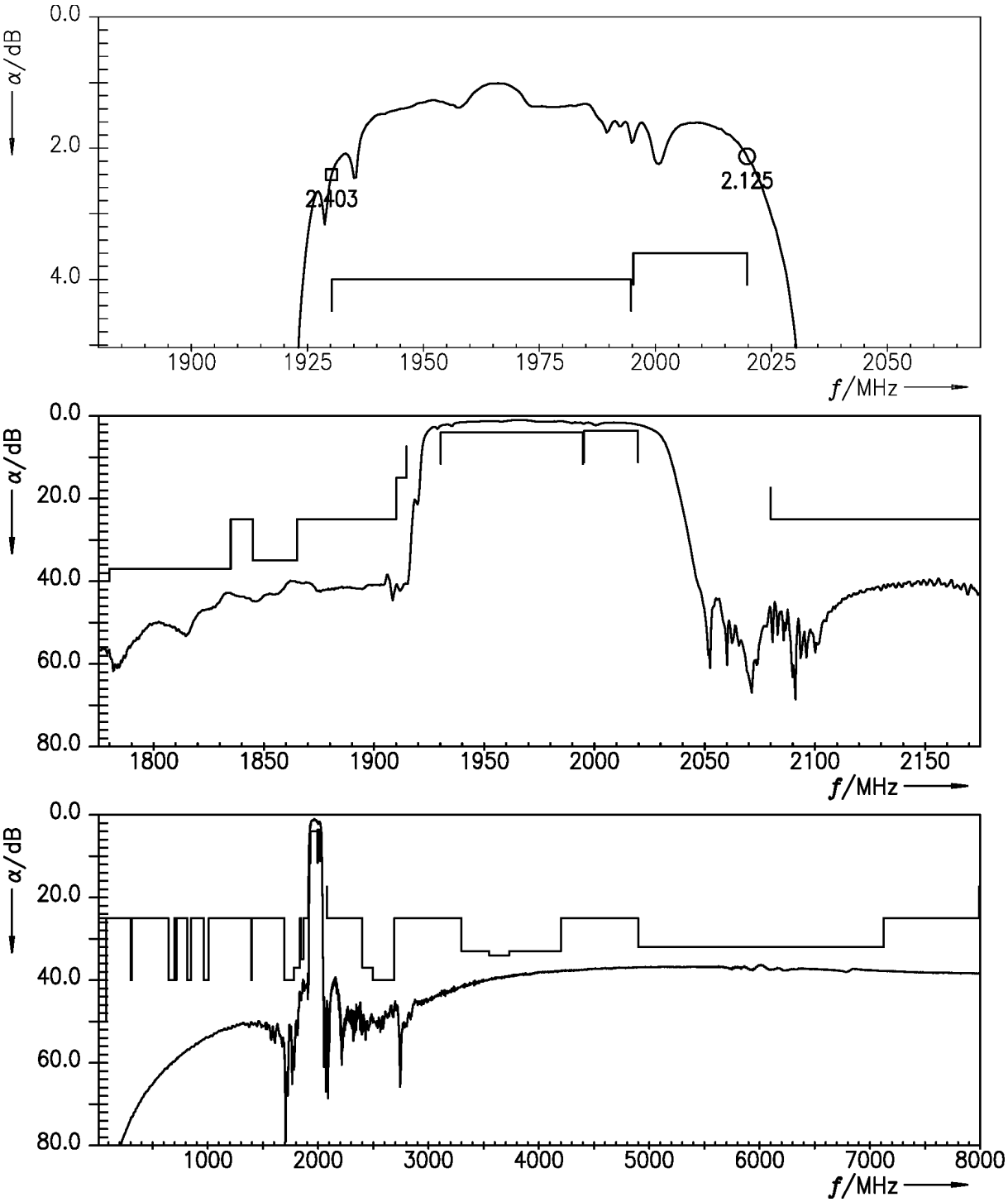

Figure 3: Attenuation 5G band 25_70.

10 Reflection coefficients 5G band 25_70

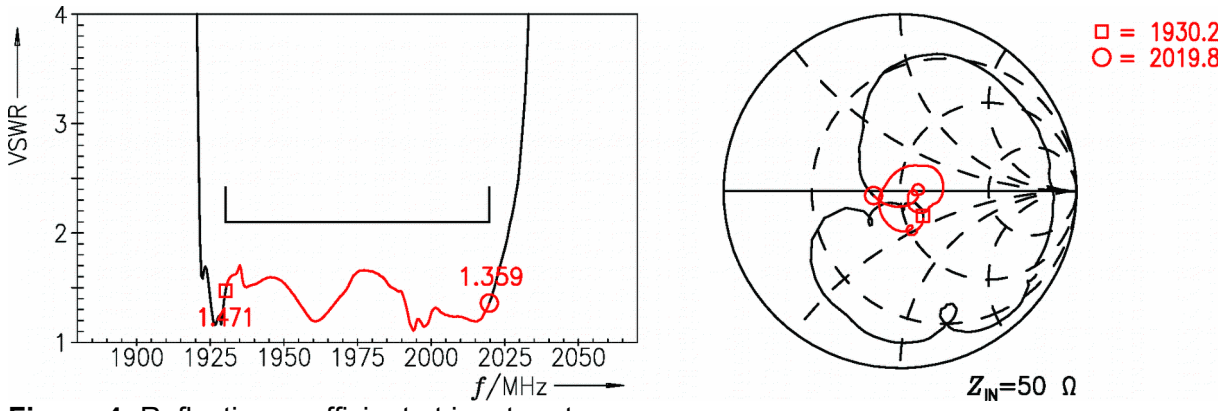

Figure 4: Reflection coefficient at input port.

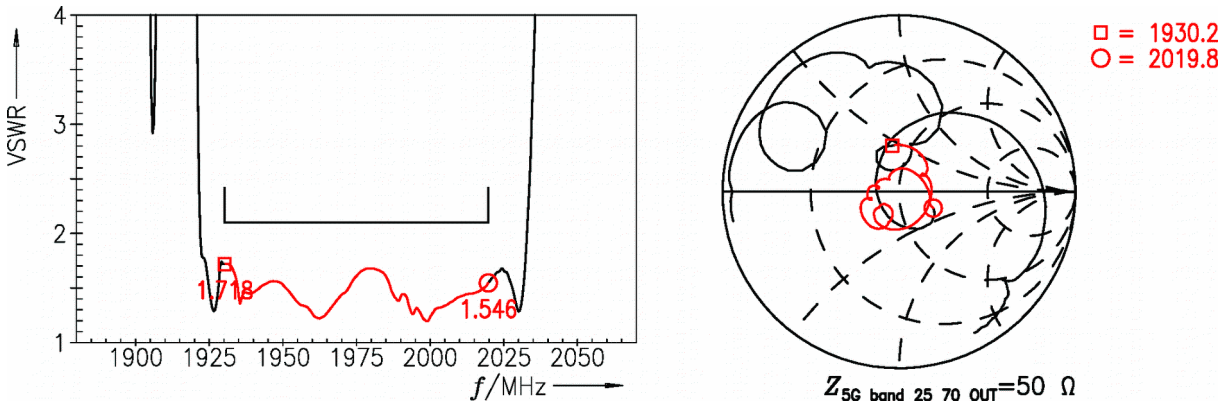

Figure 5: Reflection coefficient at 5G band 25 70 OUT port.

11 Transmission coefficient 5G band 66

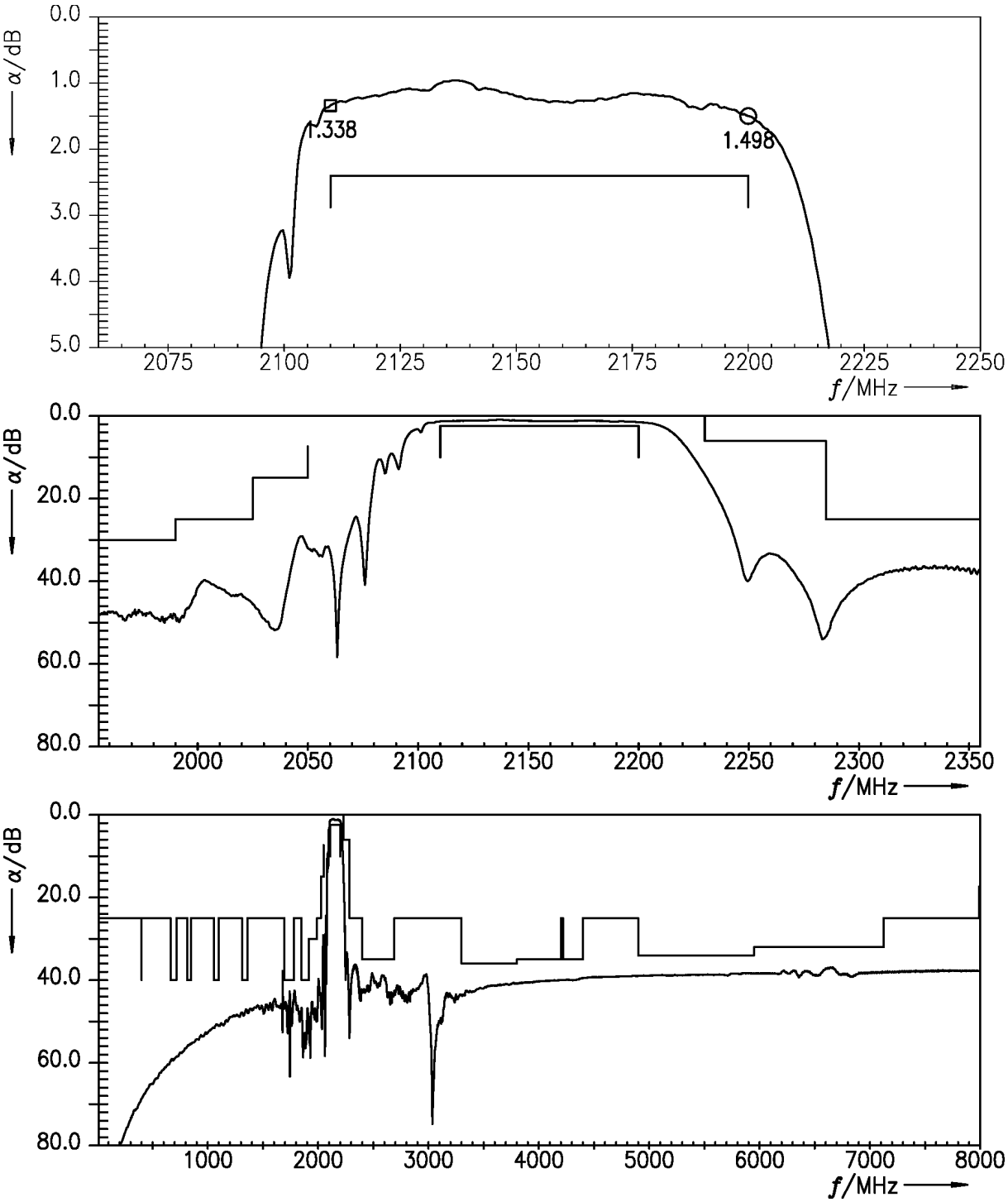

Figure 6: Attenuation 5G band 66.

12 Reflection coefficients 5G band 66

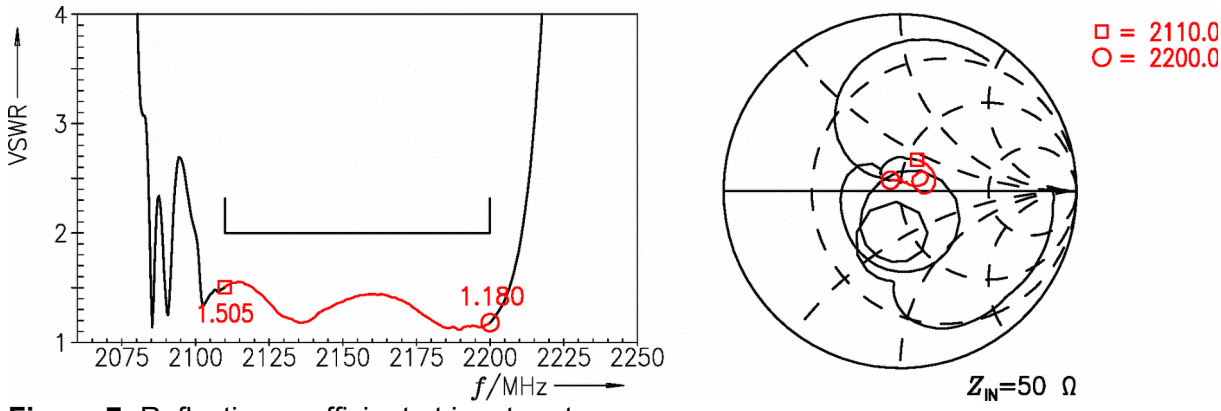

Figure 7: Reflection coefficient at input port.

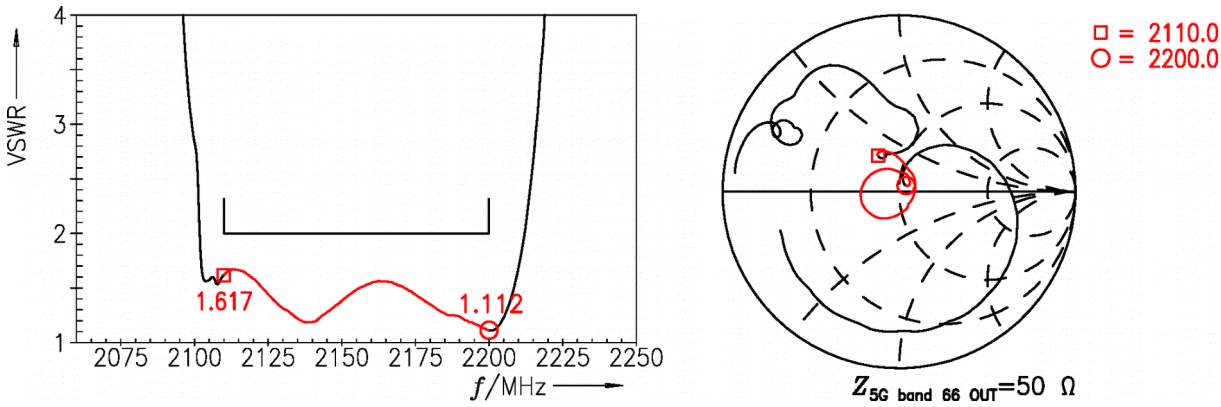

Figure 8: Reflection coefficient at 5G band 66 OUT port.

13 Packing material

13.1 Tape

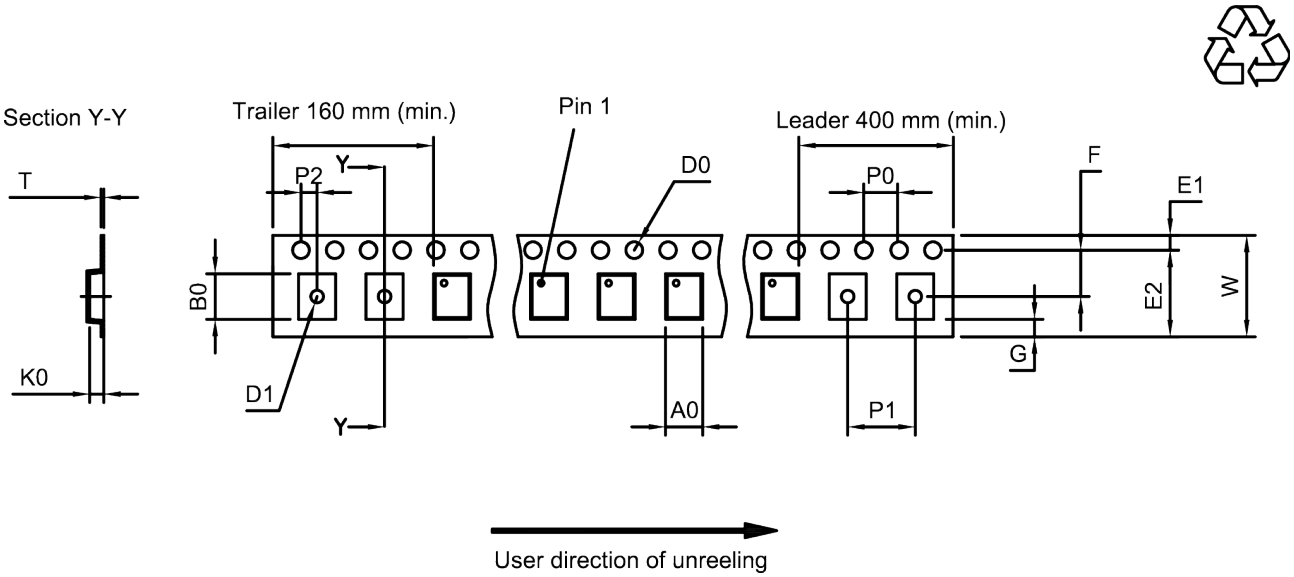

Figure 9: Drawing of tape (first-angle projection) for illustration only and not to scale. The valid tape dimensions are listed in Table 1.

A_0	$1.3_{\pm 0.05}$ mm
B_0	$1.7_{\pm 0.05}$ mm
D_0	$1.5^{+0.1/-0}$ mm
D_1	0.8 mm (min.)
E_1	$1.75_{\pm 0.1}$ mm

E_2	6.25 mm (min.)
F	$3.5_{\pm 0.05}$ mm
G	0.75 mm (min.)
K_0	$0.7_{\pm 0.05}$ mm
P_0	$4.0_{\pm 0.1}$ mm

P_1	$4.0_{\pm 0.1}$ mm
P_2	$2.0_{\pm 0.05}$ mm
T	$0.25_{\pm 0.03}$ mm
W	$8.0^{+0.3/-0.1}$ mm

Table 1: Tape dimensions.

13.2 Reel with diameter of 180 mm

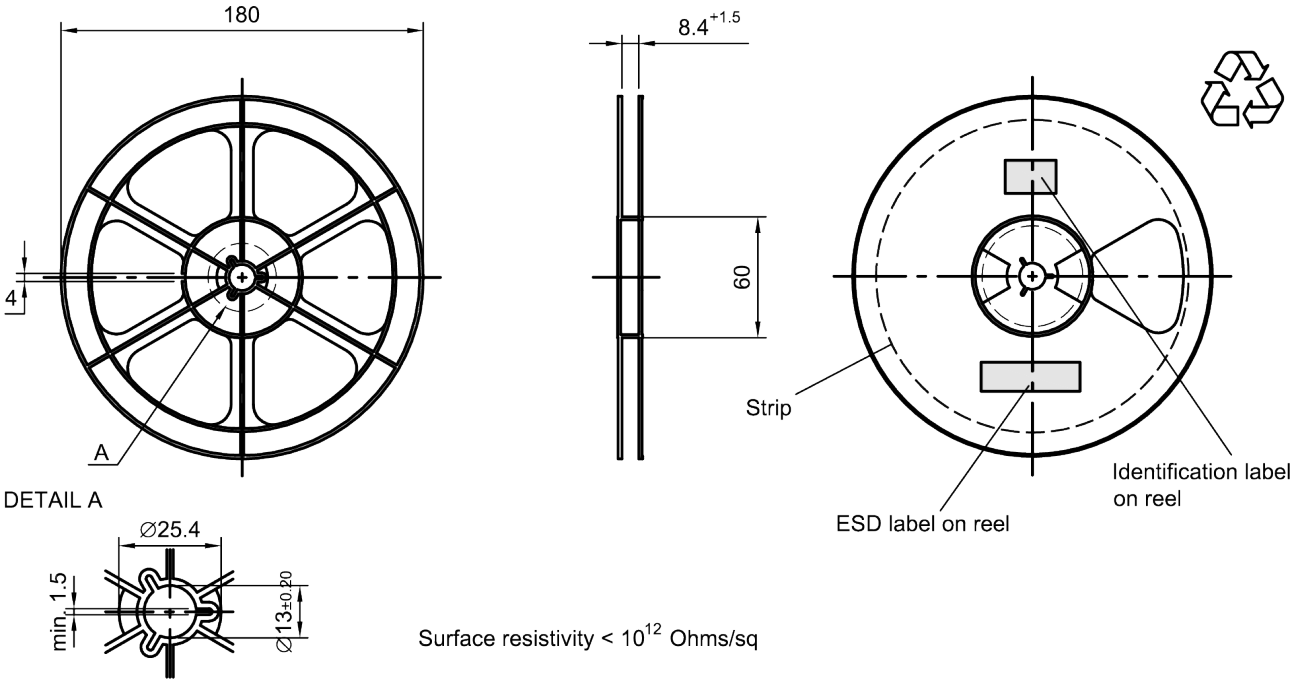

Figure 10: Drawing of reel (first-angle projection) with diameter of 180 mm.

Dimensions [mm]
X = 220+5
Y = 235+5
Sealing area 10±3

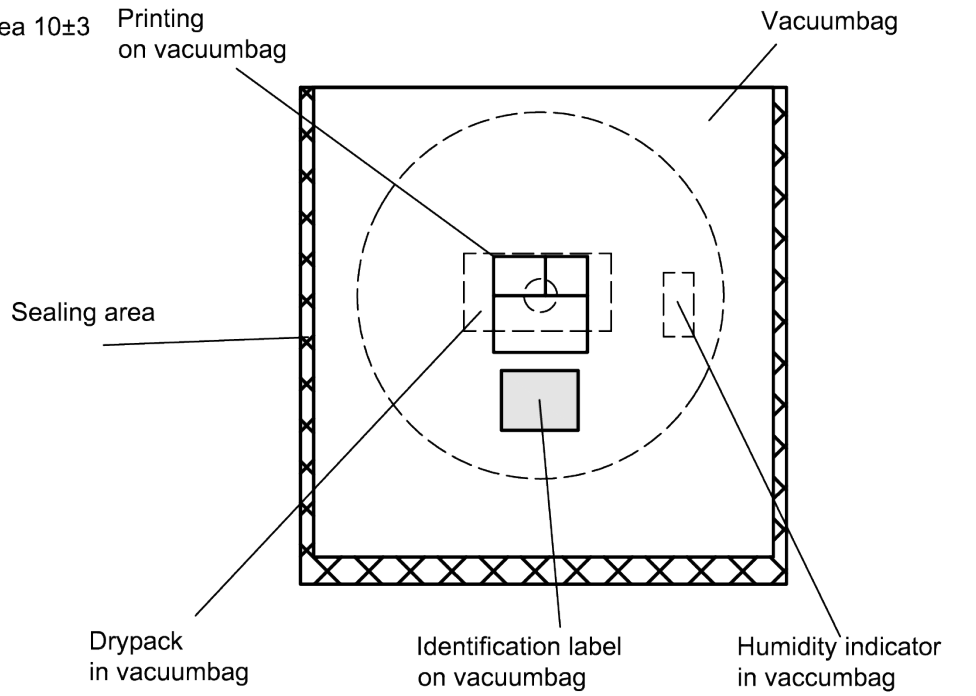

Figure 11: Drawing of moisture barrier bag (MBB) for reel with diameter of 180 mm.

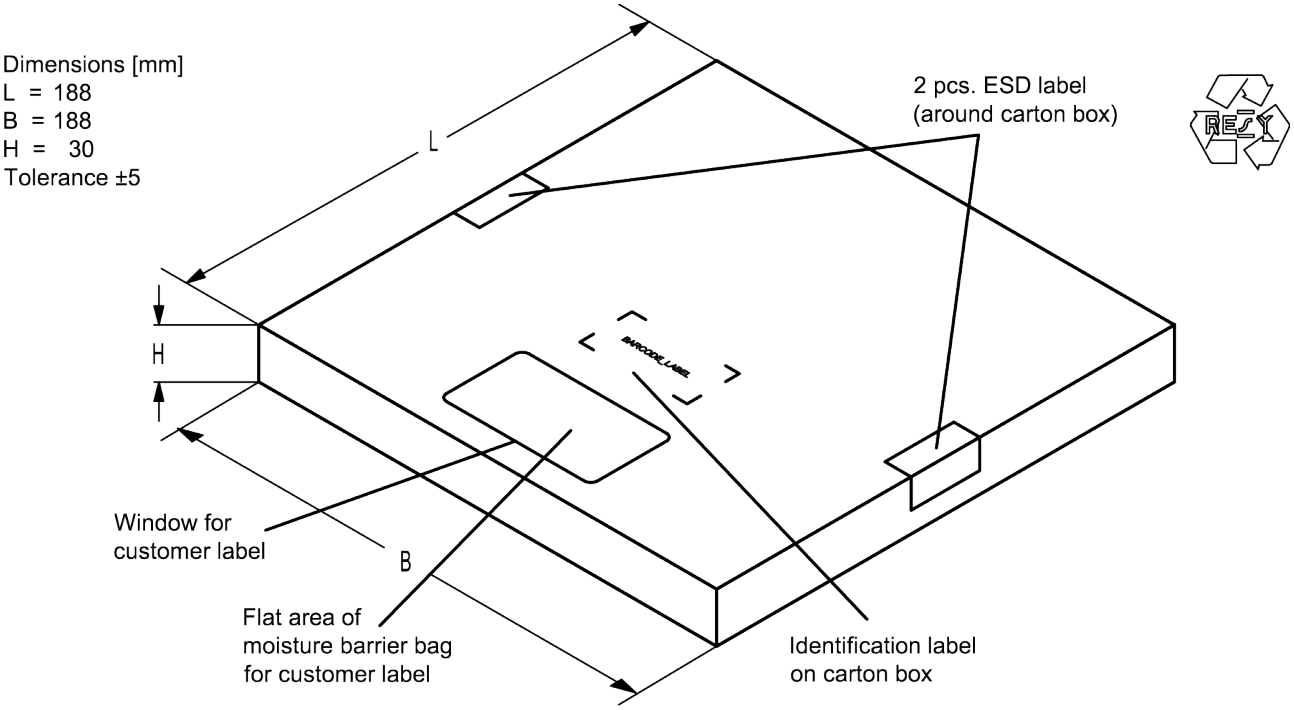

Figure 12: Drawing of folding box for reel with diameter of 180 mm.

13.3 Reel with diameter of 330 mm

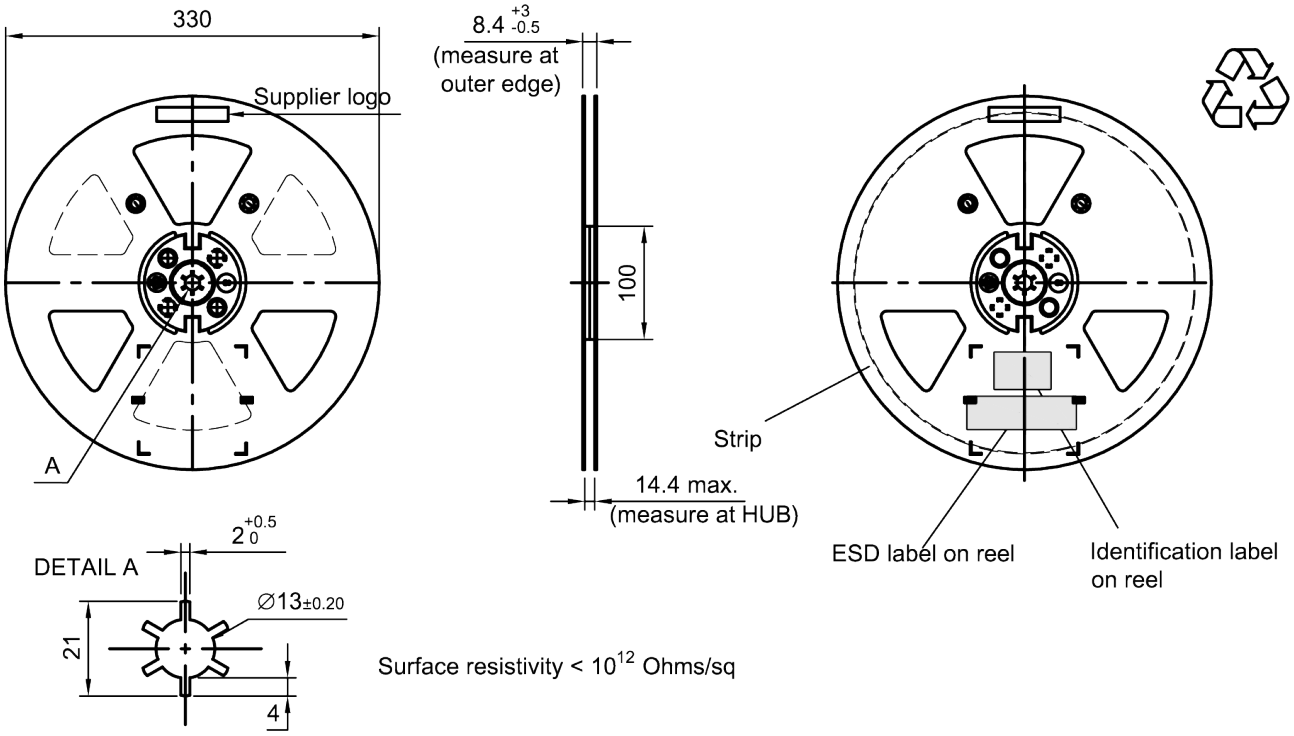

Figure 13: Drawing of reel (first-angle projection) with diameter of 330 mm.

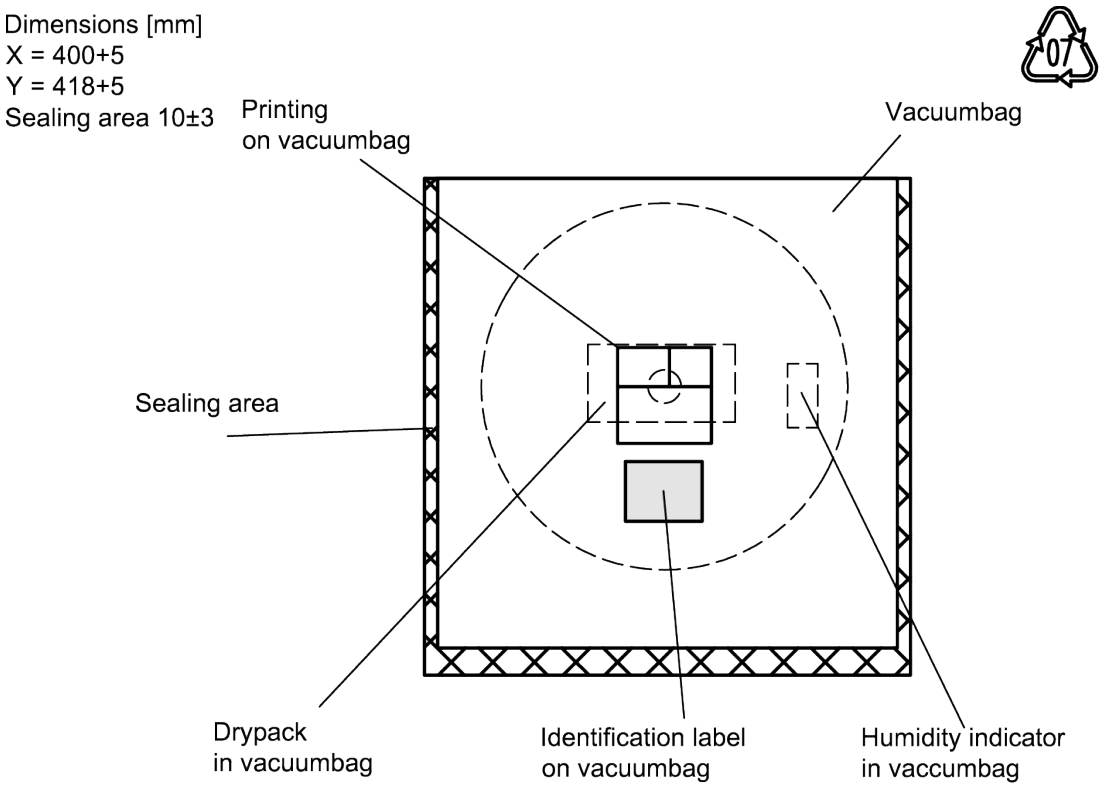

Figure 14: Drawing of moisture barrier bag (MBB) for reel with diameter of 330 mm.

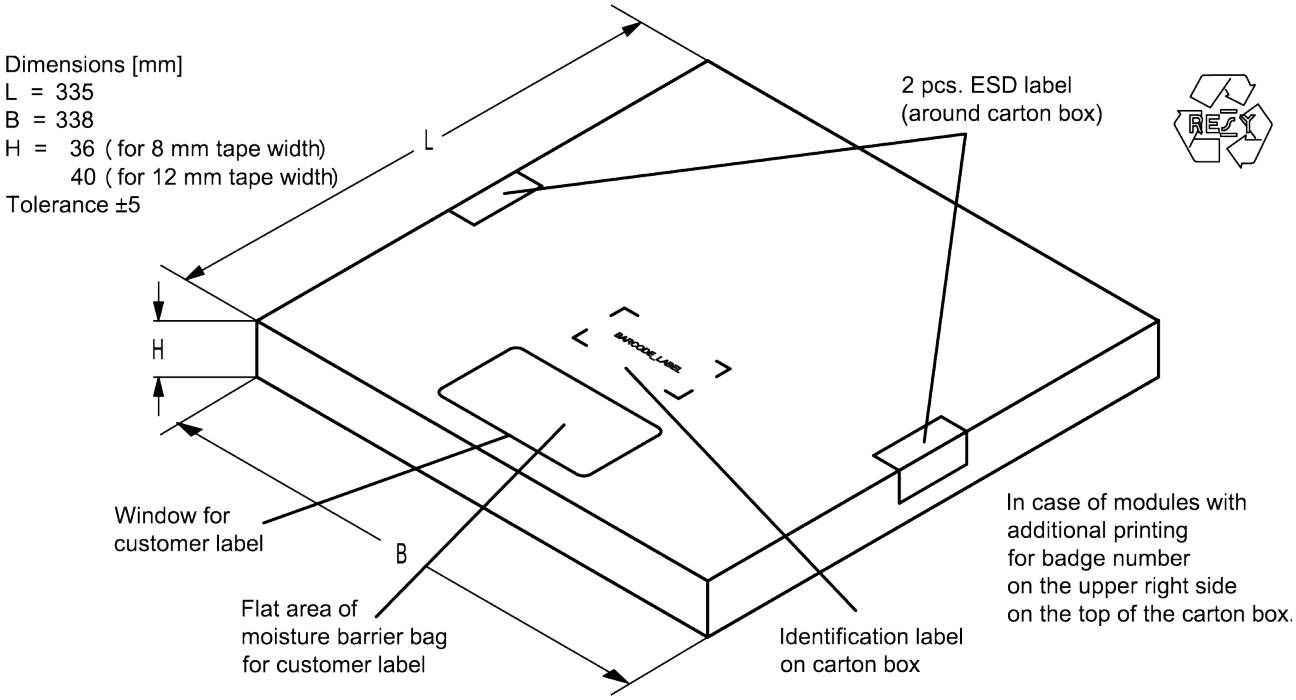

Figure 15: Drawing of folding box for reel with diameter of 330 mm.

14 Marking

Products are marked with product type number and lot number encoded according to Table 2:

- Type number:

  The 4 digit type number of the ordering code, e.g., B3xxxxB**1234**xxxx,
  is encoded by a special BASE32 code into a 3 digit marking.

  Example of decoding type number marking on device => in decimal code.
  16J => **1234**
  1 x 32^2 + **6** x 32^1 + **18 (=J)** x 32^0 = **1234**
  The BASE32 code for product type B9977 is 9QS.

- Lot number:

  The last 5 digits of the lot number, e.g., **12345**,
  are encoded based on a special BASE47 code into a 3 digit marking.

  Example of decoding lot number marking on device => in decimal code.
  5UY => **12345**
  5 x 47^2 + **27 (=U)** x 47^1 + **31 (=Y)** x 47^0 = **12345**

Adopted BASE32 code for type number			
Decimal value	Base32 code	Decimal value	Base32 code
0	0	16	G
1	1	17	H
2	2	18	J
3	3	19	K
4	4	20	M
5	5	21	N
6	6	22	P
7	7	23	Q
8	8	24	R
9	9	25	S
10	A	26	T
11	B	27	V
12	C	28	W
13	D	29	X
14	E	30	Y
15	F	31	Z

Adopted BASE47 code for lot number			
Decimal value	Base47 code	Decimal value	Base47 code
0	0	24	R
1	1	25	S
2	2	26	T
3	3	27	U
4	4	28	V
5	5	29	W
6	6	30	X
7	7	31	Y
8	8	32	Z
9	9	33	b
10	A	34	d
11	B	35	f
12	C	36	h
13	D	37	n
14	E	38	r
15	F	39	t
16	G	40	v
17	H	41	\
18	J	42	?
19	K	43	{
20	L	44	}
21	M	45	<
22	N	46	>
23	P		

Table 2: Lists for encoding and decoding of marking.

15 Soldering profile

The recommended soldering process is in accordance with IEC 60068-2-58 – 3rd edit and IPC/JEDEC J-STD-020B.

ramp rate	≤ 3 K/s
preheat	125 °C to 220 °C, 150 s to 210 s, 0.4 K/s to 1.0 K/s
T > 220 °C	30 s to 70 s
T > 230 °C	min. 10 s
T > 245 °C	max. 20 s
T ≥ 255 °C	–
peak temperature T_{peak}	250 °C +0/-5 °C
wetting temperature T_{min}	230 °C +5/-0 °C for 10 s ± 1 s
cooling rate	≤ 3 K/s
soldering temperature T	measured at solder pads

Table 3: Characteristics of recommended soldering profile for lead-free solder (Sn95.5Ag3.8Cu0.7).

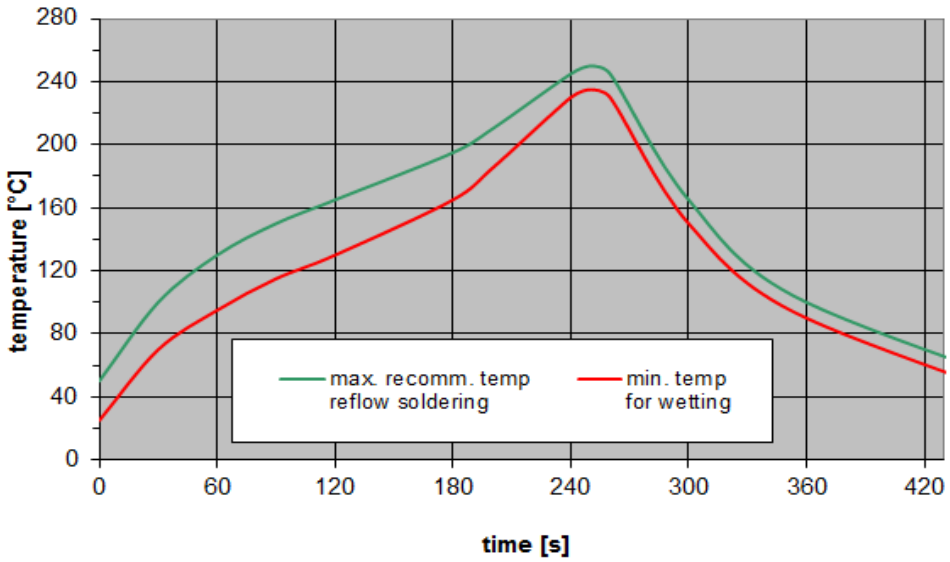

Figure 16: Recommended reflow profile for convection and infrared soldering – lead-free solder.

16 Annotations

16.1 RoHS compatibility

ROHS-compatible means that products are compatible with the requirements according to Art. 4 (substance restrictions) of Directive 2011/65/EU of the European Parliament and of the Council of June 8th, 2011, on the restriction of the use of certain hazardous substances in electrical and electronic equipment ("Directive") with due regard to the application of exemptions as per Annex III of the Directive in certain cases.

16.2 Scattering parameters (S-parameters)

The pin/port assignment is available in the headers of the S-parameter files. Please contact your local RF360 sales office.

16.3 Ordering codes and packing units

Ordering code	Packing unit
B39222B9977L210	500 pcs
B39222B9977L210S 5	5000 pcs

Table 4: Ordering codes and packing units.

17 Cautions and warnings

17.1 Display of ordering codes for RF360 products

The ordering code for one and the same product can be represented differently in data sheets, data books, other publications and the website of RF360, or in order-related documents such as shipping notes, order confirmations and product labels. The varying representations of the ordering codes are due to different processes employed and do not affect the specifications of the respective products. Detailed information can be found on the Internet under https://rffe.qualcomm.com/.

17.2 Material information

Due to technical requirements components may contain dangerous substances. For information on the type in question please also contact one of our sales offices.

For information on recycling of tapes and reels please contact one of our sales offices.

17.3 Moldability

Before using in overmolding environment, please contact your local RF360 sales office.

17.4 Package information

Landing area

The printed circuit board (PCB) land pattern (landing area) shown is based on RF360 internal development and empirical data and illustrated for example purposes, only. As customers' SMD assembly processes may have a plenty of variants and influence factors which are not under control or knowledge of RF360, additional careful process development on customer side is necessary and strongly recommended in order to achieve best soldering results tailored to the particular customer needs.

Dimensions

Unless otherwise specified all dimensions are understood using unit millimeter (mm).

Projection method

Unless otherwise specified first-angle projection is applied.

18 Important notes

The following applies to all products named in this publication:

1. Some parts of this publication contain **statements about the suitability of our products for certain areas of application**. These statements are based on our knowledge of typical requirements that are often placed on our products in the areas of application concerned. We nevertheless expressly point out **that such statements cannot be regarded as binding statements about the suitability of our products for a particular customer application.** As a rule, RF360 Europe GmbH and its affiliates are either unfamiliar with individual customer applications or less familiar with them than the customers themselves. For these reasons, it is always ultimately incumbent on the customer to check and decide whether an RF360 product with the properties described in the product specification is suitable for use in a particular customer application.
2. We also point out that **in individual cases, a malfunction of electronic components or failure before the end of their usual service life cannot be completely ruled out in the current state of the art, even if they are operated as specified.** In customer applications requiring a very high level of operational safety and especially in customer applications in which the malfunction or failure of an electronic component could endanger human life or health (e.g. in accident prevention or life-saving systems), it must therefore be ensured by means of suitable design of the customer application or other action taken by the customer (e.g. installation of protective circuitry or redundancy) that no injury or damage is sustained by third parties in the event of malfunction or failure of an electronic component.
3. **The warnings, cautions and product-specific notes must be observed.**
4. In order to satisfy certain technical requirements, **some of the products described in this publication may contain substances subject to restrictions in certain jurisdictions (e.g. because they are classed as hazardous)**. Useful information on this will be found in our Material Data Sheets on the Internet (https://rffe.qualcomm.com). Should you have any more detailed questions, please contact our sales offices.
5. We constantly strive to improve our products. Consequently, **the products described in this publication may change from time to time**. The same is true of the corresponding product specifications. Please check therefore to what extent product descriptions and specifications contained in this publication are still applicable before or when you place an order. We also **reserve the right to discontinue production and delivery of products**. Consequently, we cannot guarantee that all products named in this publication will always be available.
   The aforementioned does not apply in the case of individual agreements deviating from the foregoing for customer-specific products.

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