Qualcomm

RF360
Europe GmbH

Data sheet

SAW RF 2in1 filter
Small cell & femtocell
5G-NR n78

Part number:	B9729
Ordering code:	B39382B9729P810
Date:	August 12, 2020
Version:	2.0

DCN: 80-PA243-517 Rev. A

RF360 Europe GmbH, Anzinger Str. 13, München, Germany

Table of contents

1 Application

- 2 in 1 band edge SAW filter for 5G-NR n78
- Usable pass bands:
- Filter 1(3300MHz) : 100 MHz
- Filter 2(3700MHz) : 100 MHz

2 Features

- Package size $1.8_{\pm 0.1}$ mm × $1.4_{\pm 0.1}$ mm
- Package height 0.45 mm (max.)
- Approximate weight 5 mg
- RoHS compatible
- Package for Surface Mount Technology (SMT)
- Ni/Au-plated terminals
- Electrostatic Sensitive Device (ESD)
- Moisture Sensitivity Level 2a (MSL2a)

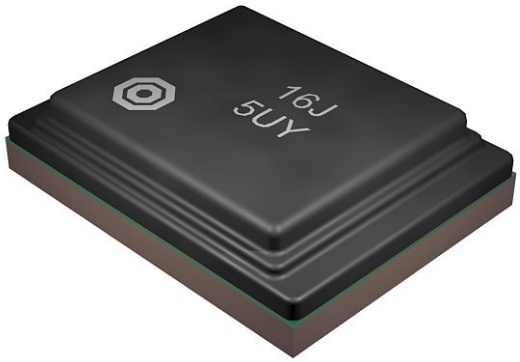

Figure 1: Picture of component with example of product marking.

3 Package

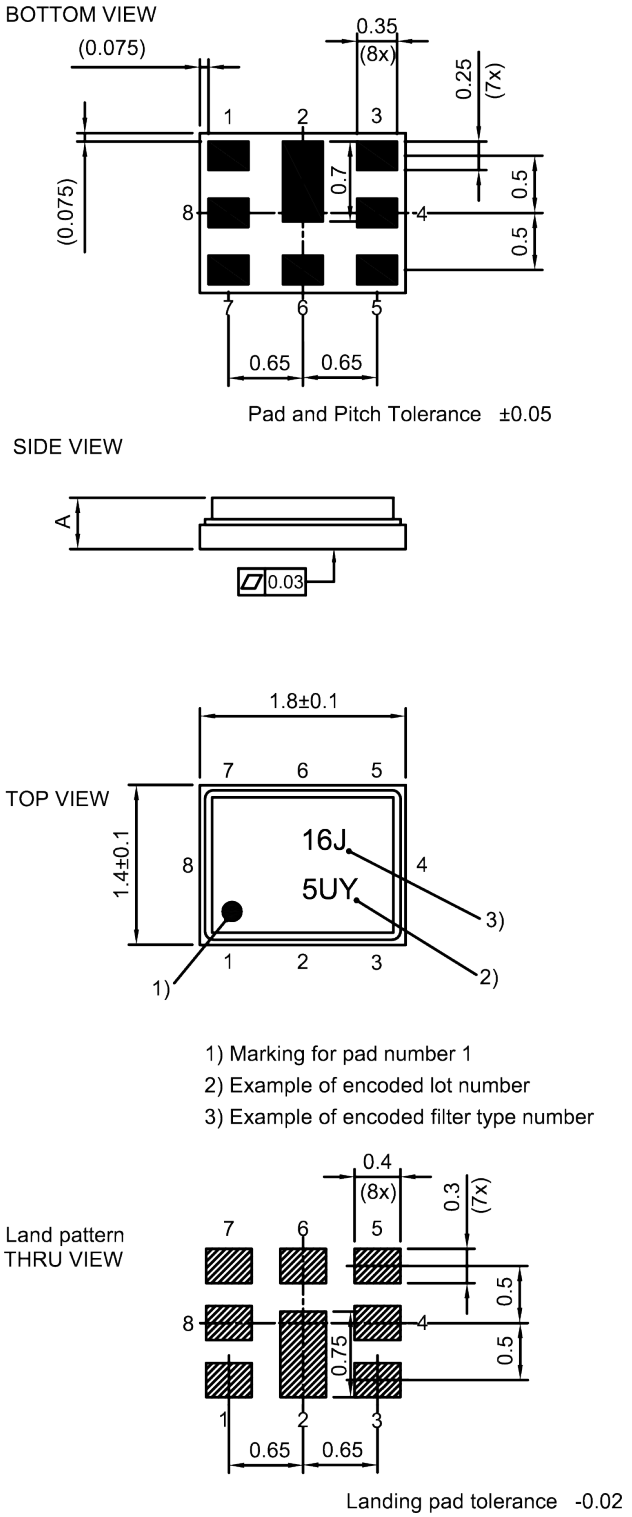

Figure 2: Drawing of package with package height A = 0.45 mm (max.). See Sec. Package information (p. 24).

4 Pin configuration

- 1 Input (3300MHz)
- 3 Input (3700MHz)
- 5 Output (3700MHz)
- 7 Output (3300MHz)
- 2, 4, 6, 8 Ground

5 Matching circuit

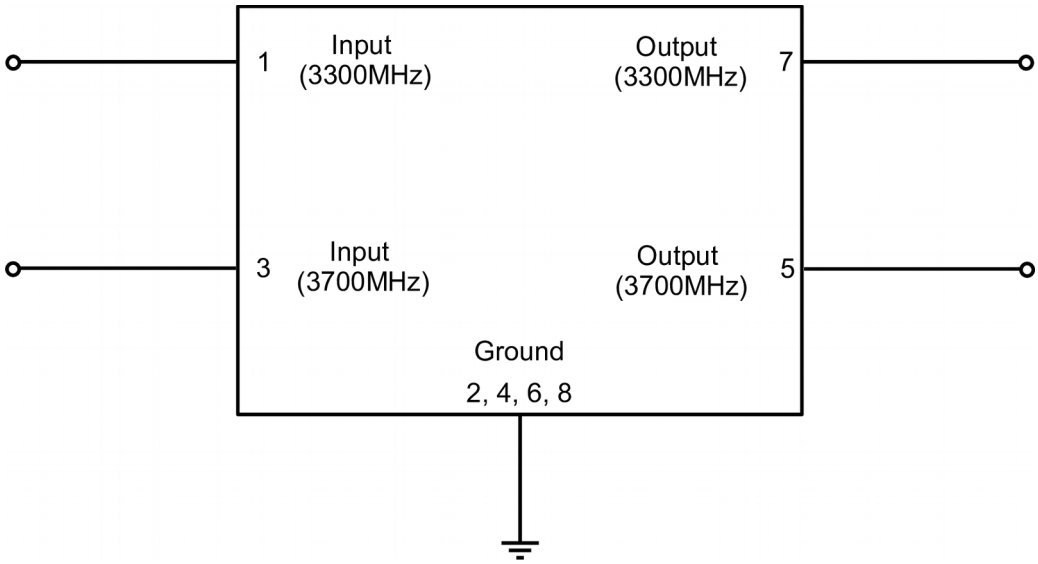

Figure 3: Schematic of matching circuit. No external matching components required.

6 Characteristics 3300MHz

Temperature range for specification T_{SPEC} = −10 °C ... +85 °C
3300MHz input terminating impedance $Z_{3300MHz\ IN}$ = 50 Ω
3300MHz output terminating impedance $Z_{3300MHz\ OUT}$ = 50 Ω

Characteristics 3300MHz				min. for T_{SPEC}	typ. @ +25 °C	max. for T_{SPEC}	
Center frequency			f_C	—	3350	—	MHz
Maximum insertion attenuation			α_{max}				
	3300... 3310	MHz		—	0.8	4.0	dB
	3310... 3390	MHz		—	1.2	2.5	dB
	3390... 3400	MHz		—	1.5	4.0	dB
Amplitude ripple (p-p)			$\Delta\alpha$				
	3300... 3400	MHz		—	0.8	3.3	dB
	3310... 3390	MHz		—	0.5	1.7	dB
Maximum group delay			t_{max}				
	3300... 3400	MHz		—	8.0	20	ns
Group delay ripple			Dt_{var}				
	3300... 3400	MHz		—	4.0	15	ns
Maximum VSWR			$VSWR_{max}$				
@ 3300MHz input port	3300... 3400	MHz		—	1.8	2.2	
@ 3300MHz output port	3300... 3400	MHz		—	1.7	2.2	
Minimum attenuation			α_{min}				
	10... 960	MHz		22	27	—	dB
	960... 1574	MHz		20	26	—	dB
	1574... 1710	MHz		20	26	—	dB
	1710... 2400	MHz		20	26	—	dB
	2400... 2690	MHz		20	26	—	dB
	2690... 3070	MHz		22	27	—	dB
	3070... 3200	MHz		22	33	—	dB
	3200... 3240	MHz		12	35	—	dB
	3500... 3900	MHz		26	31	—	dB
	3900... 4030	MHz		26	31	—	dB
	4030... 5000	MHz		26	31	—	dB
	5000... 5150	MHz		30	35	—	dB
	5150... 5850	MHz		30	36	—	dB
	5850... 6000	MHz		30	43	—	dB

Temperature range for specification	T_{SPEC} = −40 °C ... +95 °C
3300MHz input terminating impedance	$Z_{3300MHz\ IN}$ = 50 Ω
3300MHz output terminating impedance	$Z_{3300MHz\ OUT}$ = 50 Ω

Characteristics 3300MHz				**min.** for T_{SPEC}	**typ.** @ +25 °C	**max.** for T_{SPEC}	
Center frequency			f_C	—	3350	—	MHz
Maximum insertion attenuation			α_{max}				
	3300 ... 3310	MHz		—	0.8	5.0	dB
	3310 ... 3390	MHz		—	1.2	2.5	dB
	3390 ... 3400	MHz		—	1.5	5.0	dB
Amplitude ripple (p-p)			$\Delta\alpha$				
	3300 ... 3400	MHz		—	0.8	4.3	dB
	3310 ... 3390	MHz		—	0.5	1.7	dB
Maximum group delay			t_{max}				
	3300 ... 3400	MHz		—	8.0	20	ns
Group delay ripple			Dt_{var}				
	3300 ... 3400	MHz		—	4.0	15	ns
Maximum VSWR			$VSWR_{max}$				
@ 3300MHz input port	3300 ... 3400	MHz		—	1.8	2.5	
@ 3300MHz output port	3300 ... 3400	MHz		—	1.7	2.5	
Minimum attenuation			α_{min}				
	10 ... 960	MHz		22	27	—	dB
	960 ... 1574	MHz		20	26	—	dB
	1574 ... 1710	MHz		20	26	—	dB
	1710 ... 2400	MHz		20	26	—	dB
	2400 ... 2690	MHz		20	26	—	dB
	2690 ... 3070	MHz		22	27	—	dB
	3070 ... 3200	MHz		22	33	—	dB
	3200 ... 3240	MHz		10	35	—	dB
	3500 ... 3900	MHz		26	31	—	dB
	3900 ... 4030	MHz		26	31	—	dB
	4030 ... 5000	MHz		26	31	—	dB
	5000 ... 5150	MHz		30	35	—	dB
	5150 ... 5850	MHz		30	36	—	dB
	5850 ... 6000	MHz		30	43	—	dB

7 Characteristics 3700MHz

Temperature range for specification T_{SPEC} = −10 °C ... +85 °C
3700MHz input terminating impedance $Z_{3700MHz\ IN}$ = 50 Ω
3700MHz output terminating impedance $Z_{3700MHz\ OUT}$ = 50 Ω

Characteristics 3700MHz				min. for T_{SPEC}	typ. @ +25 °C	max. for T_{SPEC}	
Center frequency			f_C	—	3750	—	MHz
Maximum insertion attenuation			α_{max}				
	3700... 3710	MHz		—	1.3	4.0	dB
	3710... 3790	MHz		—	1.6	2.5	dB
	3790... 3800	MHz		—	1.9	4.0	dB
Amplitude ripple (p-p)			$\Delta\alpha$				
	3700... 3800	MHz		—	1.0	3.1	dB
	3710... 3790	MHz		—	0.7	1.7	dB
Maximum group delay			t_{max}				
	3700... 3800	MHz		—	8.0	20	ns
Group delay ripple			Dt_{var}				
	3700... 3800	MHz		—	4.0	15	ns
Maximum VSWR			$VSWR_{max}$				
@ 3700MHz input port	3700... 3800	MHz		—	1.6	2.2	
@ 3700MHz output port	3700... 3800	MHz		—	1.5	2.2	
Minimum attenuation			α_{min}				
	10... 960	MHz		22	28	—	dB
	960... 1574	MHz		20	26	—	dB
	1574... 1710	MHz		20	26	—	dB
	1710... 2400	MHz		20	26	—	dB
	2400... 2690	MHz		20	27	—	dB
	2690... 3070	MHz		22	27	—	dB
	3070... 3200	MHz		22	29	—	dB
	3200... 3550	MHz		25	30	—	dB
	3860... 3900	MHz		12	26	—	dB
	3900... 4030	MHz		20	37	—	dB
	4030... 5000	MHz		28	34	—	dB
	5000... 5150	MHz		30	38	—	dB
	5150... 5850	MHz		30	37	—	dB
	5850... 6000	MHz		30	50	—	dB

Temperature range for specification	T_{SPEC} = −40 °C ... +95 °C
3700MHz input terminating impedance	$Z_{3700MHz\ IN}$ = 50 Ω
3700MHz output terminating impedance	$Z_{3700MHz\ OUT}$ = 50 Ω

Characteristics 3700MHz				**min.** for T_{SPEC}	**typ.** @ +25 °C	**max.** for T_{SPEC}	
Center frequency			f_C	—	3750	—	MHz
Maximum insertion attenuation			α_{max}				
	3700 ... 3710	MHz		—	1.3	5.5	dB
	3710 ... 3790	MHz		—	1.6	2.5	dB
	3790 ... 3800	MHz		—	1.9	5.5	dB
Amplitude ripple (p-p)			$\Delta\alpha$				
	3700 ... 3800	MHz		—	1.0	4.6	dB
	3710 ... 3790	MHz		—	0.7	1.7	dB
Maximum group delay			t_{max}				
	3700 ... 3800	MHz		—	8.0	20	ns
Group delay ripple			Dt_{var}				
	3700 ... 3800	MHz		—	4.0	15	ns
Maximum VSWR			$VSWR_{max}$				
@ 3700MHz input port	3700 ... 3800	MHz		—	1.6	3.2	
@ 3700MHz output port	3700 ... 3800	MHz		—	1.5	3.2	
Minimum attenuation			α_{min}				
	10 ... 960	MHz		22	28	—	dB
	960 ... 1574	MHz		20	26	—	dB
	1574 ... 1710	MHz		20	26	—	dB
	1710 ... 2400	MHz		20	26	—	dB
	2400 ... 2690	MHz		20	27	—	dB
	2690 ... 3070	MHz		22	27	—	dB
	3070 ... 3200	MHz		22	29	—	dB
	3200 ... 3550	MHz		25	30	—	dB
	3860 ... 3900	MHz		7	26	—	dB
	3900 ... 4030	MHz		20	37	—	dB
	4030 ... 5000	MHz		28	34	—	dB
	5000 ... 5150	MHz		30	38	—	dB
	5150 ... 5850	MHz		30	37	—	dB
	5850 ... 6000	MHz		30	50	—	dB

8 Maximum ratings

Operable temperature	T_{OP} = −40 °C ... +95 °C	
Storage temperature	T_{STG} [1] = −40 °C ... +95 °C	
DC voltage	$\|V_{DC}\|$ [2] = 0 V	
ESD voltage		
	V_{ESD} [3] = 75 V	Machine model.
	V_{ESD} [4] = 150 V	Human body model.
Input power	P_{IN}	
@ 3300MHz input port: 3300 ... 3400 MHz	21 dBm [5], [6]	Continuous wave for 100000 h @ 55 °C. Source and load impedance 50Ω.
@ 3300MHz input port: 3300 ... 3400 MHz	26 dBm [5]	Continuous wave for 24 h @ 85 °C. Source and load impedance 50Ω.
@ 3700MHz input port: 3700 ... 3800 MHz	20 dBm [5], [7]	Continuous wave for 100000 h @ 55 °C. Source and load impedance 50Ω.
@ 3700MHz input port: 3700 ... 3800 MHz	25 dBm [5]	Continuous wave for 24 h @ 55 °C. Source and load impedance 50Ω.

1) Not valid for packaging material. Storage temperature for packaging material is −25 °C to +40 °C.
2) In case of applied DC voltage blocking capacitors are mandatory.
3) According to JESD22-A115B (MM – Machine Model), 10 negative & 10 positive pulses.
4) According to JESD22-A114F (HBM – Human Body Model), 1 negative & 1 positive pulse.
5) Expected lifetime according to accelerated power durability simulation, and wear out models.
6) T_{SPEC} is the ambient temperature of the PCB at component position. Specified min./max values from section 6 "characteristics" for maximum input power 21dBm are valid for temperature up to 78ºC.
7) T_{SPEC} is the ambient temperature of the PCB at component position. Specified min./max values from section 7 "characteristics" for maximum input power 20dBm are valid for temperature up to 78ºC.

9 Transmission coefficient 3300MHz

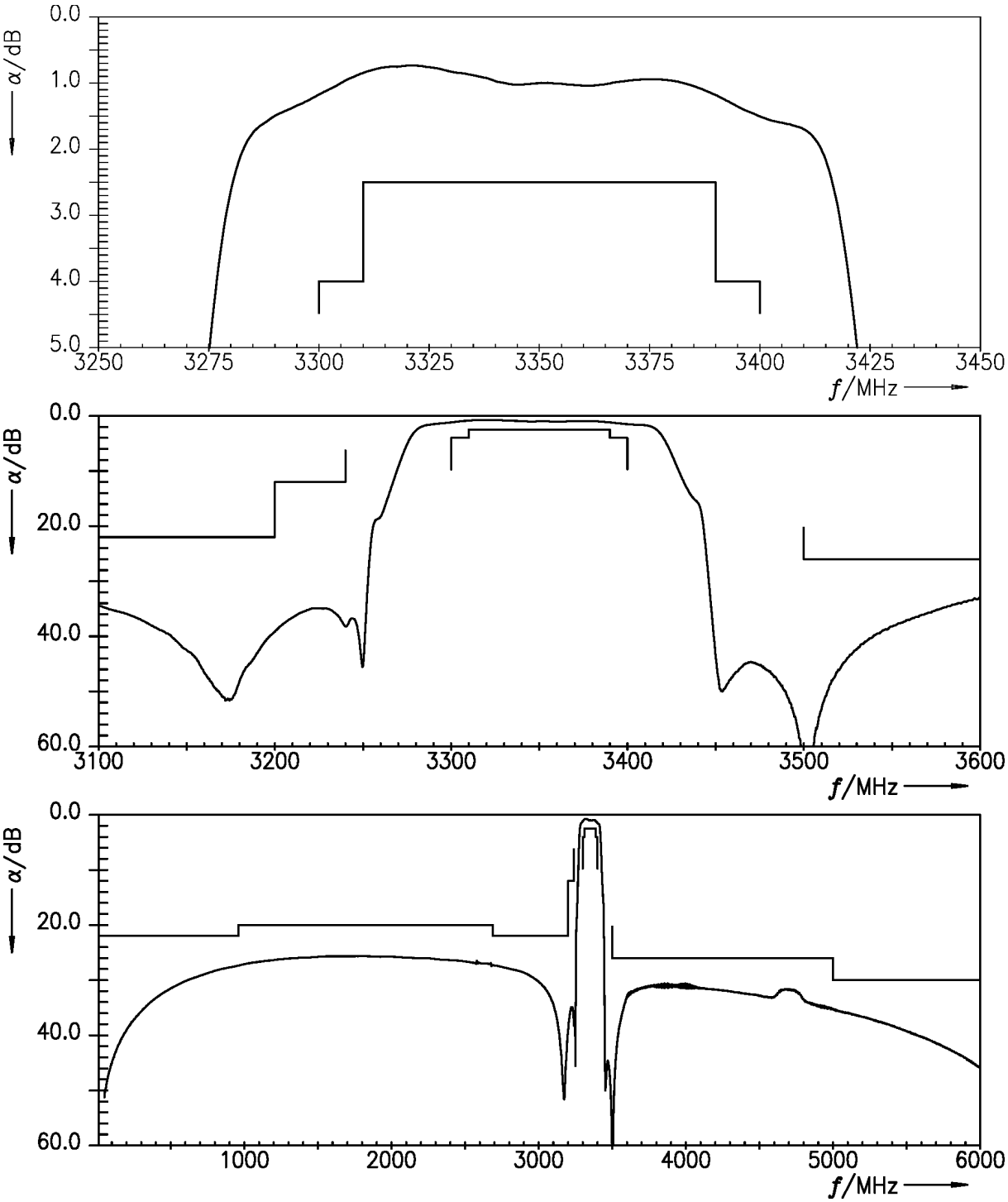

Figure 4: Attenuation 3300MHz.

10 Reflection coefficients 3300MHz

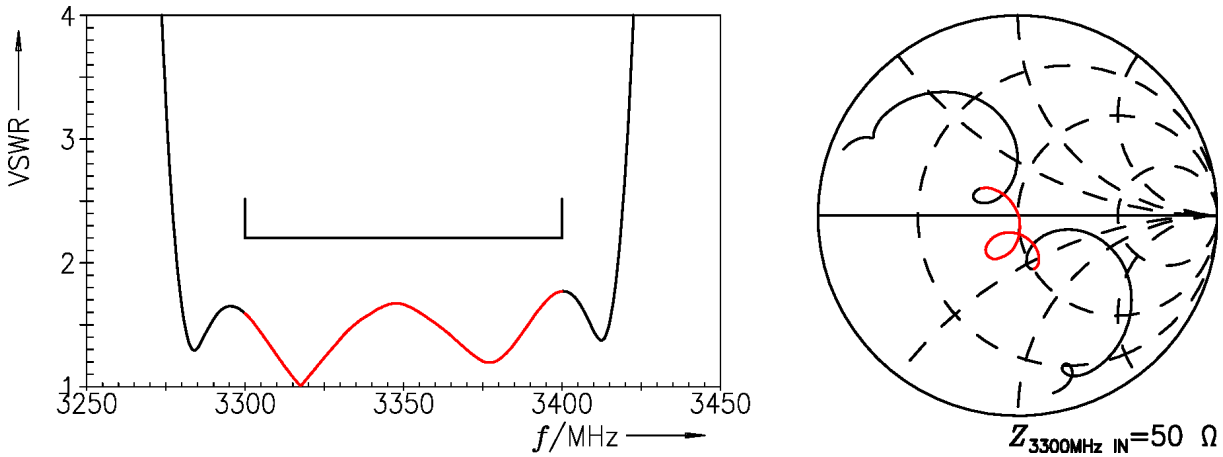

Figure 5: Reflection coefficient at 3300MHz IN port.

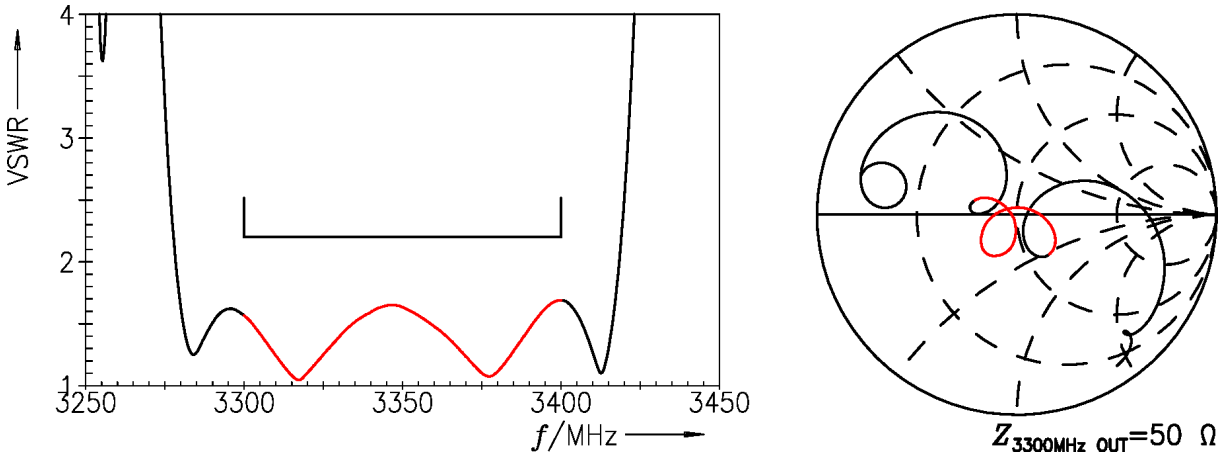

Figure 6: Reflection coefficient at 3300MHz OUT port.

11 Group delay 3300MHz

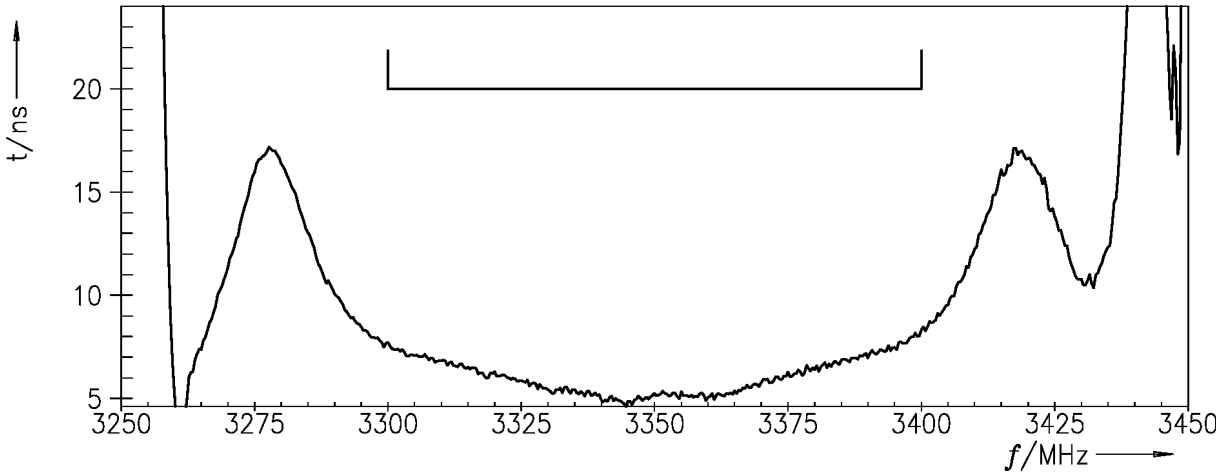

Figure 7: Group delay 3300MHz.

12 Transmission coefficient 3700MHz

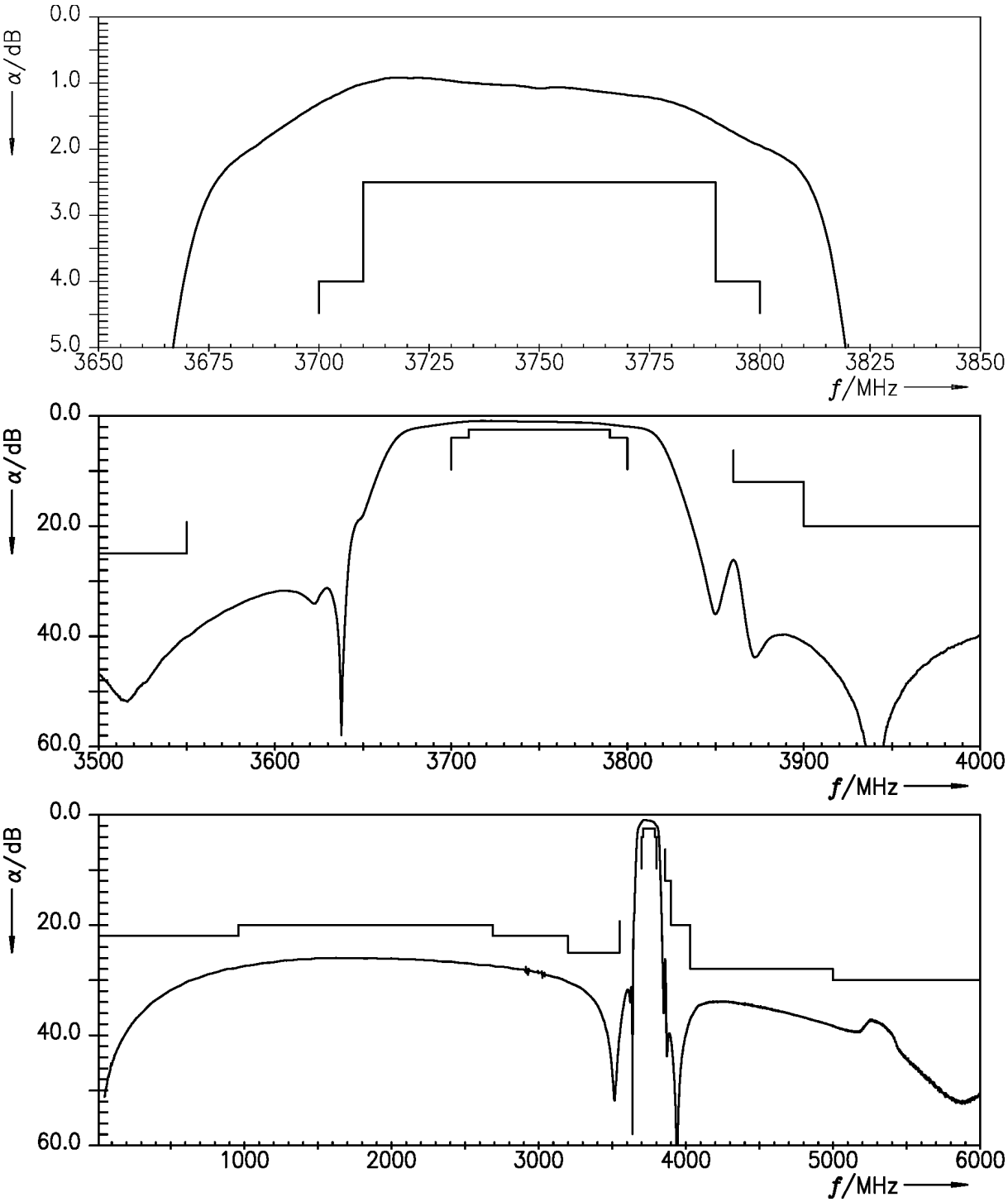

Figure 8: Attenuation 3700MHz.

13 Reflection coefficients 3700MHz

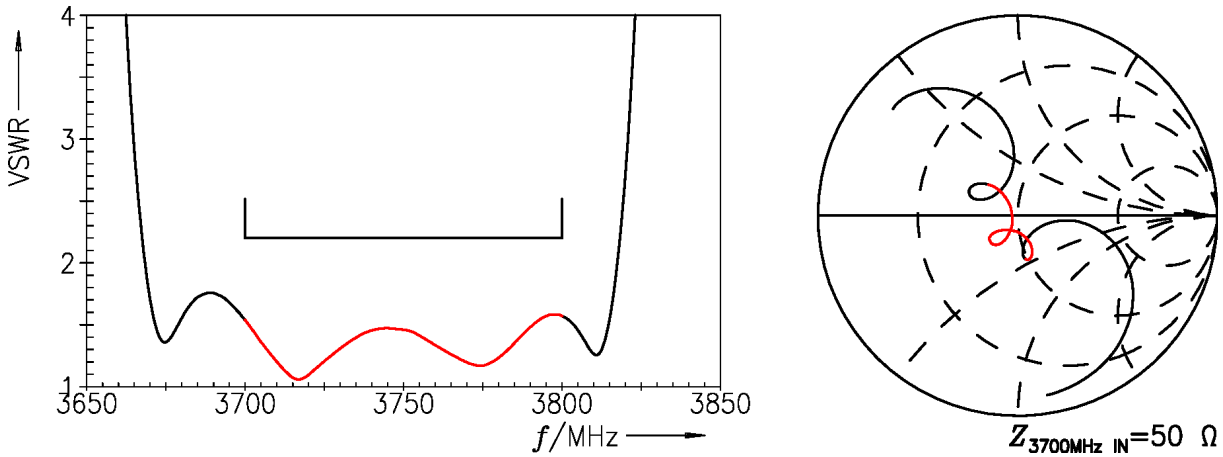

Figure 9: Reflection coefficient at 3700MHz IN port.

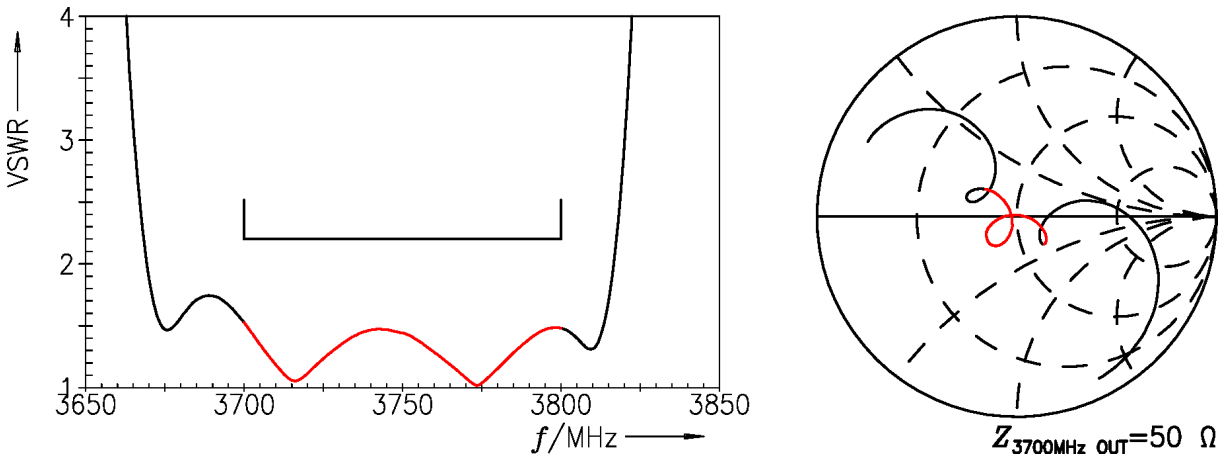

Figure 10: Reflection coefficient at 3700MHz OUT port.

14 Group delay 3700MHz

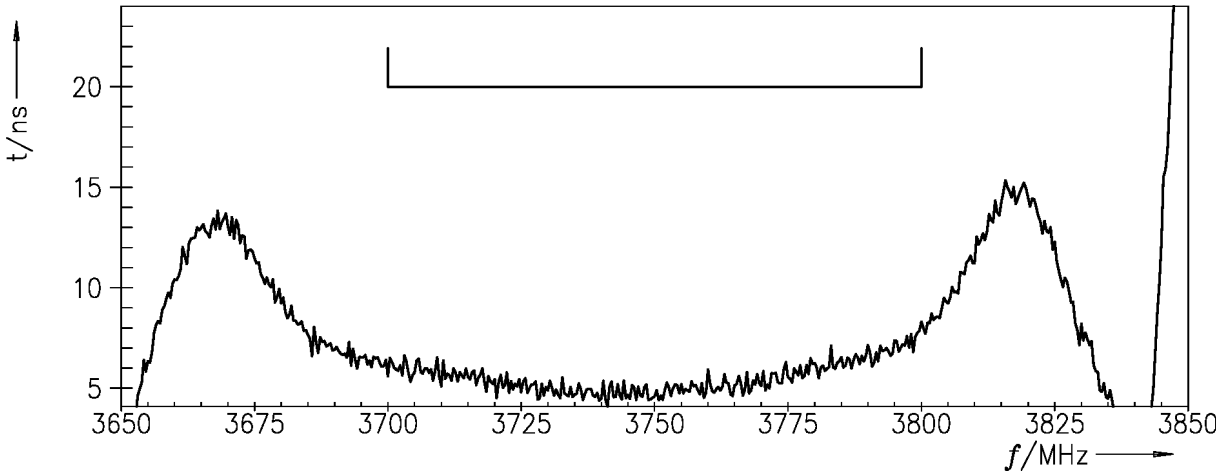

Figure 11: Group delay 3700MHz.

15 Packing material

15.1 Tape

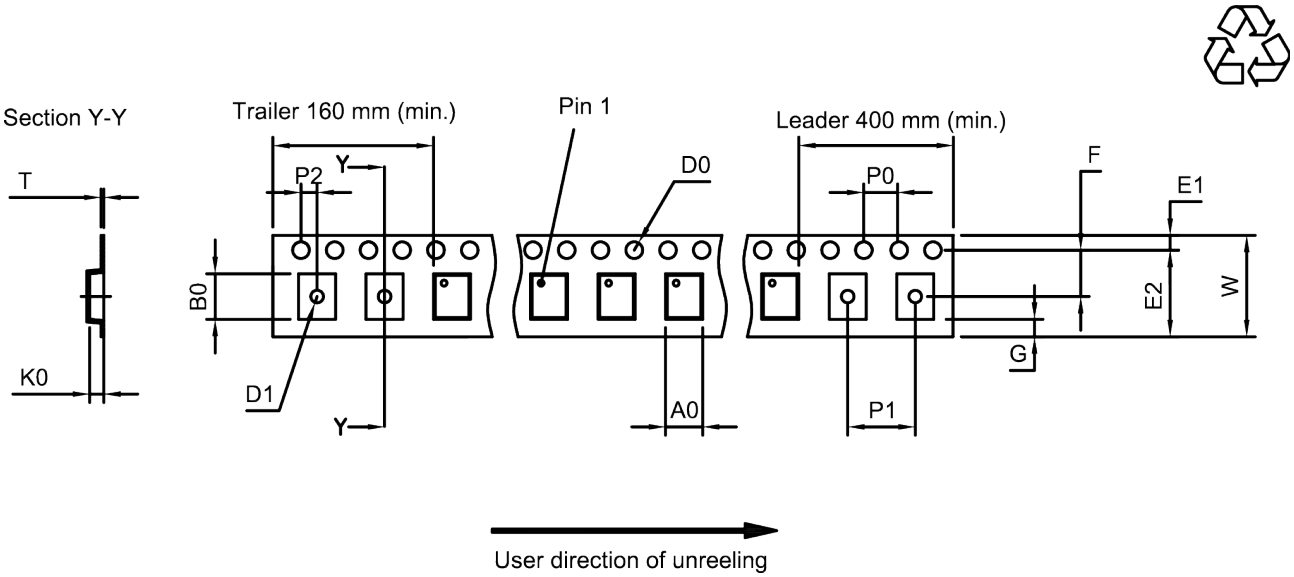

Figure 12: Drawing of tape (first-angle projection) for illustration only and not to scale. The valid tape dimensions are listed in Table 1.

A_0	1.6±0.05 mm
B_0	2.0±0.05 mm
D_0	1.5+0.1/−0 mm
D_1	0.8+0.1/−0 mm
E_1	1.75±0.1 mm

E_2	6.25 mm (min.)
F	3.5±0.05 mm
G	0.75 mm (min.)
K_0	0.64±0.05 mm
P_0	4.0±0.1 mm

P_1	4.0±0.1 mm
P_2	2.0±0.05 mm
T	0.25±0.03 mm
W	8.0+0.3/−0.1 mm

Table 1: Tape dimensions.

15.2 Reel with diameter of 180 mm

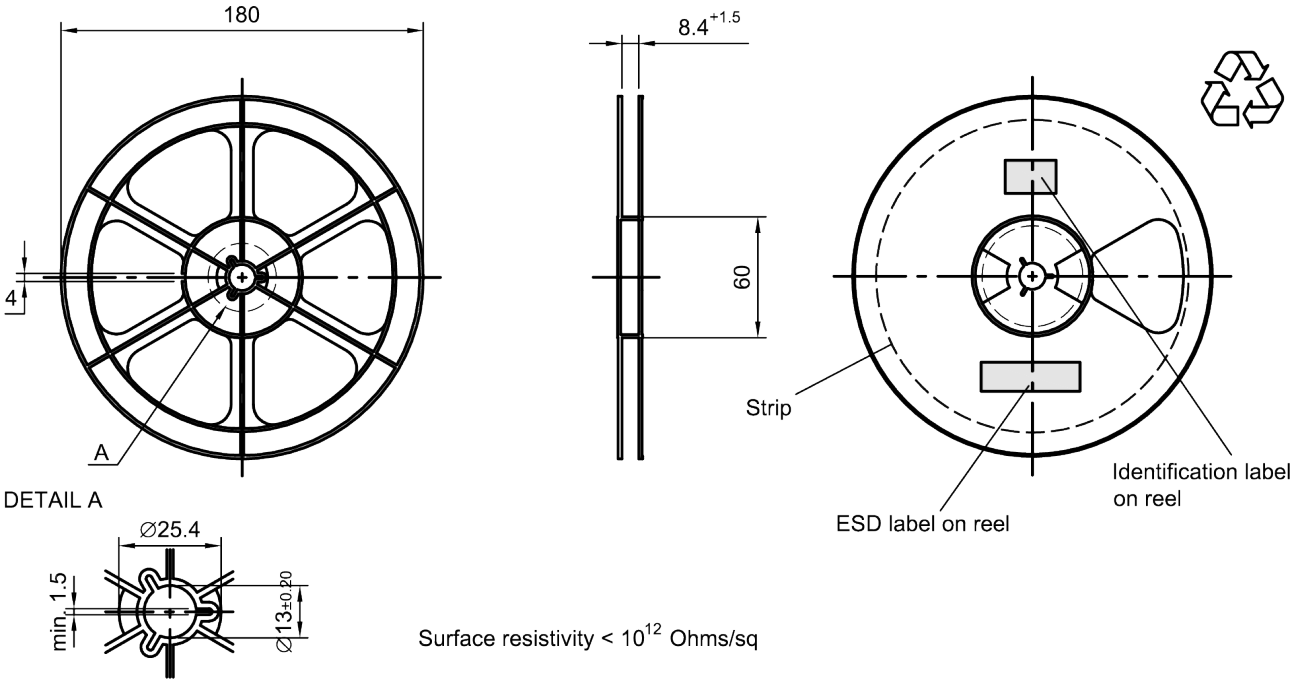

Figure 13: Drawing of reel (first-angle projection) with diameter of 180 mm.

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

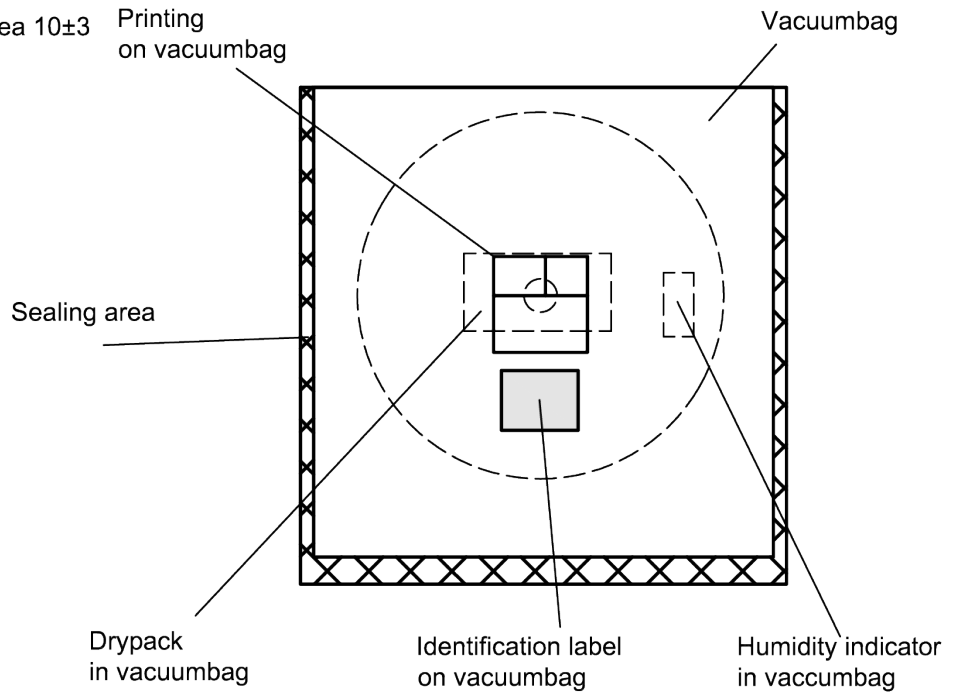

Figure 14: Drawing of moisture barrier bag (MBB) for reel with diameter of 180 mm.

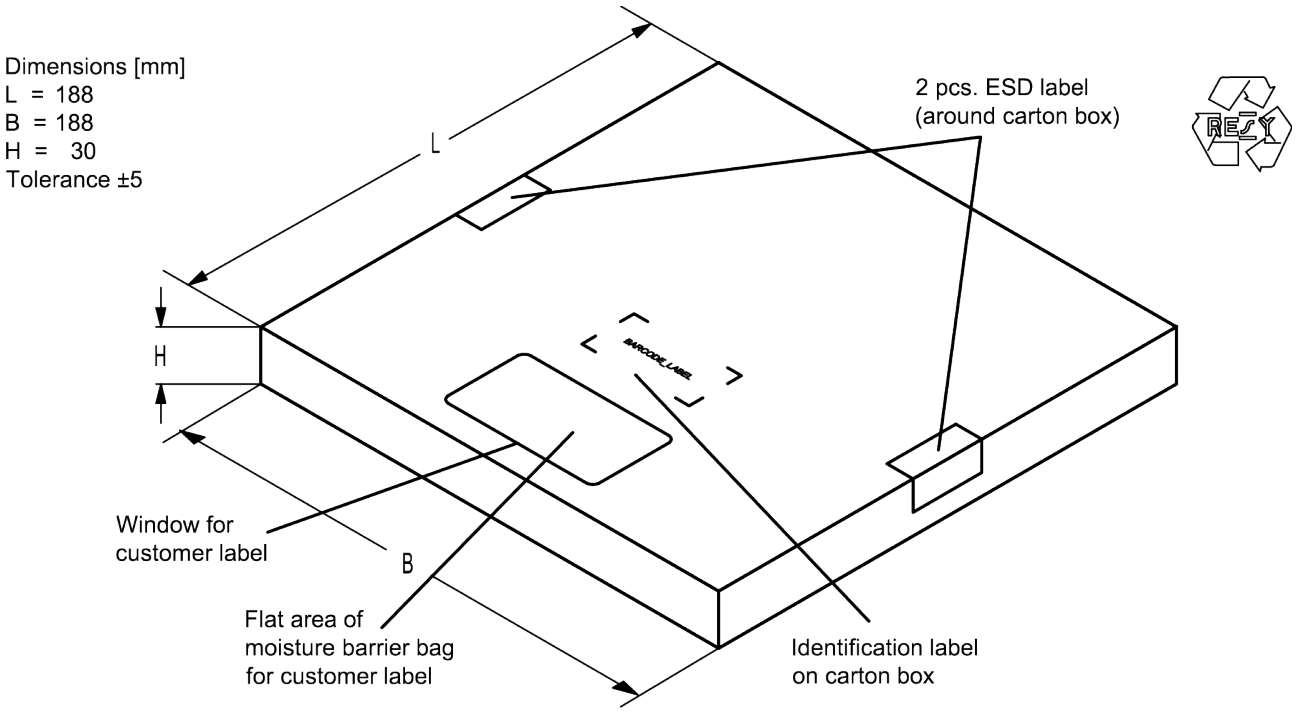

Figure 15: Drawing of folding box for reel with diameter of 180 mm.

16 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 B9729 is 9G1.

- 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.

17 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).

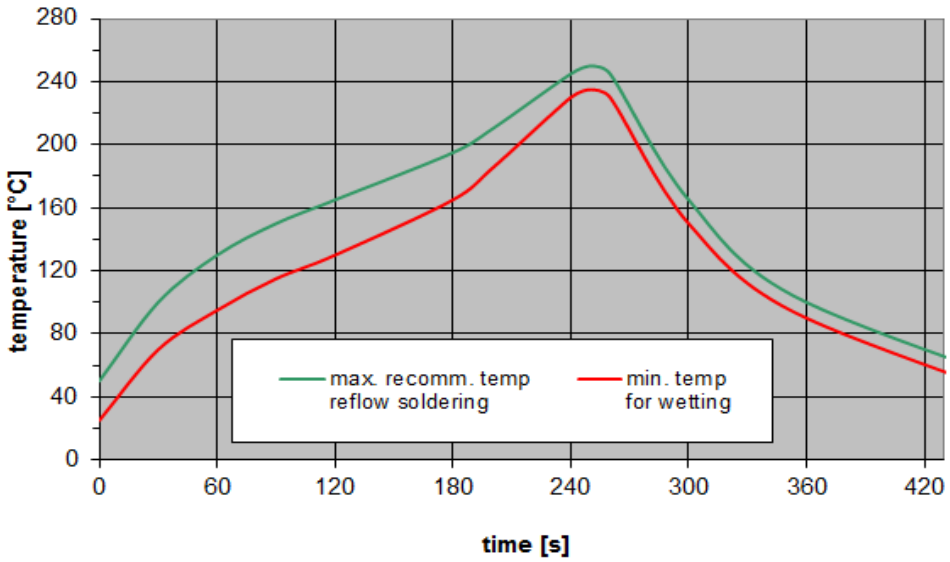

Figure 16: Recommended reflow profile for convection and infrared soldering – lead-free solder.

18 Annotations

18.1 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.

18.2 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.

18.3 Ordering codes and packing units

Ordering code	Packing unit
B39382B9729P810	5000 pcs

Table 4: Ordering codes and packing units.

19 Cautions and warnings

19.1 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/.

19.2 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.

19.3 Moldability

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

19.4 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).

Dimensions do not include burrs.

Projection method

Unless otherwise specified first-angle projection is applied.

20 ESD protection of SAW filters

SAW filters are **E**lectro **S**tatic **D**ischarge sensitive devices. To reduce the probability of damages caused by ESD, special matching topologies have to be applied.

In general, “ESD matching” has to be ensured at that filter port, where electrostatic discharge is expected.

Electrostatic discharges predominantly appear at the antenna input of RF receivers. Therefore, only the input matching of the SAW filter has to be designed to short circuit or to block the ESD pulse.

Below three figures show recommended “ESD matching” topologies.

For wide band filters the high-pass ESD matching structure needs to be at least of 3rd order to ensure a proper matching for any impedance value of antenna and SAW filter input. The required component values have to be determined from case to case.

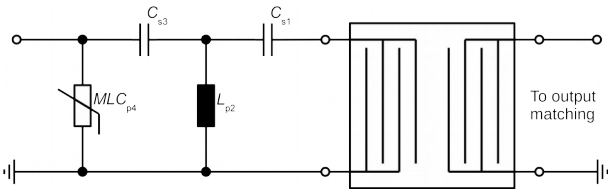

Figure 17: MLC varistor plus ESD matching.

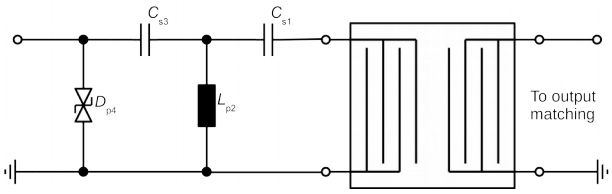

Figure 18: Suppressor diode plus ESD matching.

In cases where minor ESD occur, following simplified “ESD matching” topologies can be used alternatively.

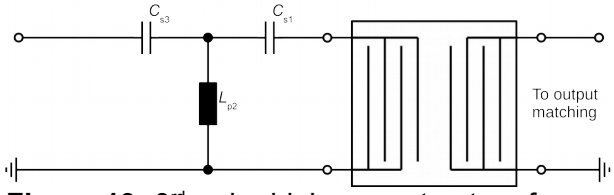

Figure 19: 3rd order high-pass structure for basic ESD protection.

In all three figures the shunt inductor L_{p2} could be replaced by a shorted microstrip with proper length and width. If this configuration is possible depends on the operating frequency and available PCB space.

Effectiveness of the applied ESD protection has to be checked according to relevant industry standards or customer specific requirements.

For further information, please refer to RF360 Application report: **“ESD protection for SAW filters”.** This report can be found under https://rffe.qualcomm.com.

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