Qualcomm

RF360
Europe GmbH

Data sheet

SAW Rx diplexer

Automotive telematics
LTE bands 2 & 4

Series/type:	B4385
Ordering code:	B39212B4385P810
Date:	November 08, 2019
Version:	2.2

DCN: 80-PA243-422 Rev. A

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Table of contents

1 Application

- Low-loss 2in1 RF filter
- Usable pass band:
- Band 2: 60 MHz
- Band 4: 45 MHz

2 Features

- Package size $1.5_{\pm 0.1}$ mm × $1.1_{\pm 0.1}$ mm
- Package height 0.45 mm (max.)
- Approximate weight 3 mg
- RoHS compatible
- Package for Surface Mount Technology (SMT)
- Ni/Au-plated terminals
- Filter surface passivated
- Electrostatic Sensitive Device (ESD)
- Moisture Sensitivity Level 2a (MSL2a)
- AEC-Q200 qualified component family (Grade 1: −40 °C to +125 °C)

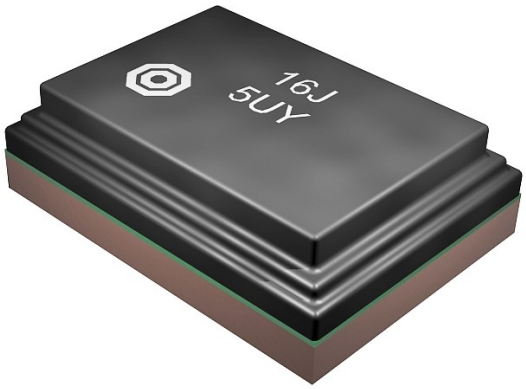

Figure 1: Picture of component with example of product marking.

3 Package

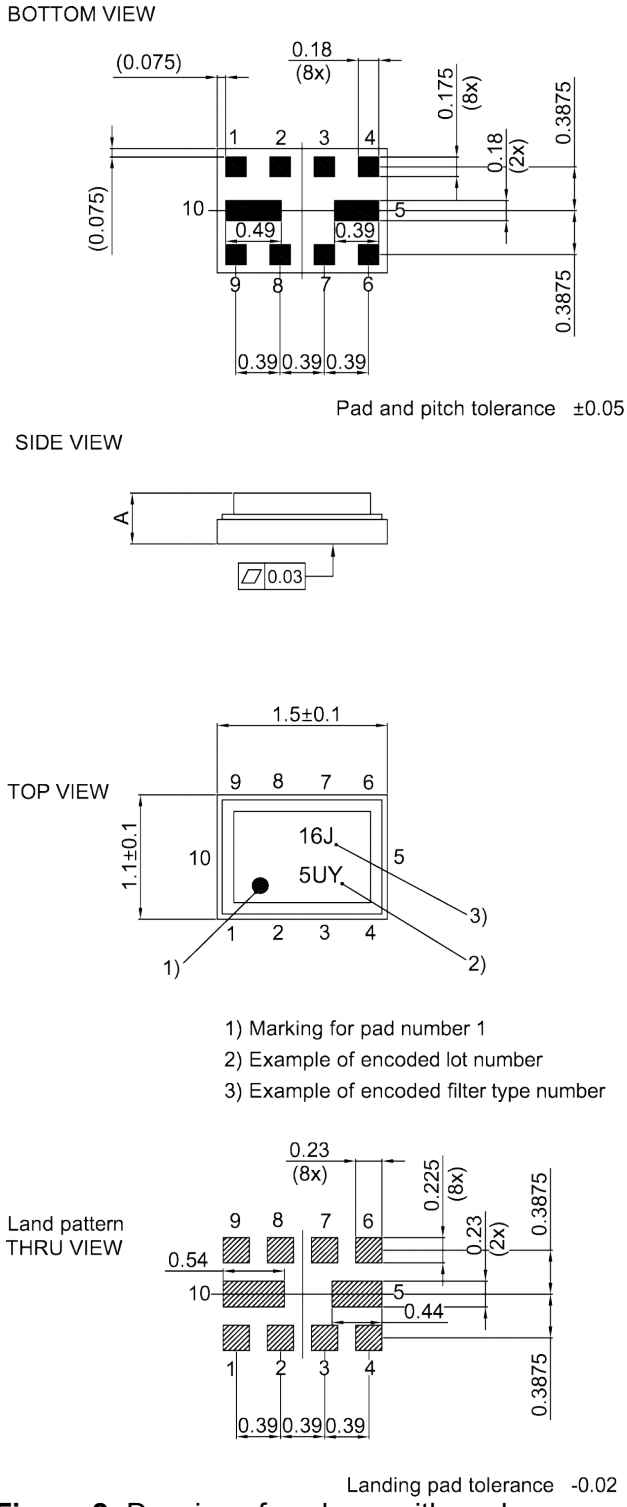

Figure 2: Drawing of package with package height A = 0.45 mm (max.). See Sec. Package information (p. 21).

4 Pin configuration

- 1 Input (B2 & B4)
- 6 Output (B4)
- 9 Output (B2)
- 2, 3, 4, 5, 7, 8, 10 Ground

5 Matching circuit

■ L_{p1} = 3.6 nH

■ L_{s9} = 2.0 nH

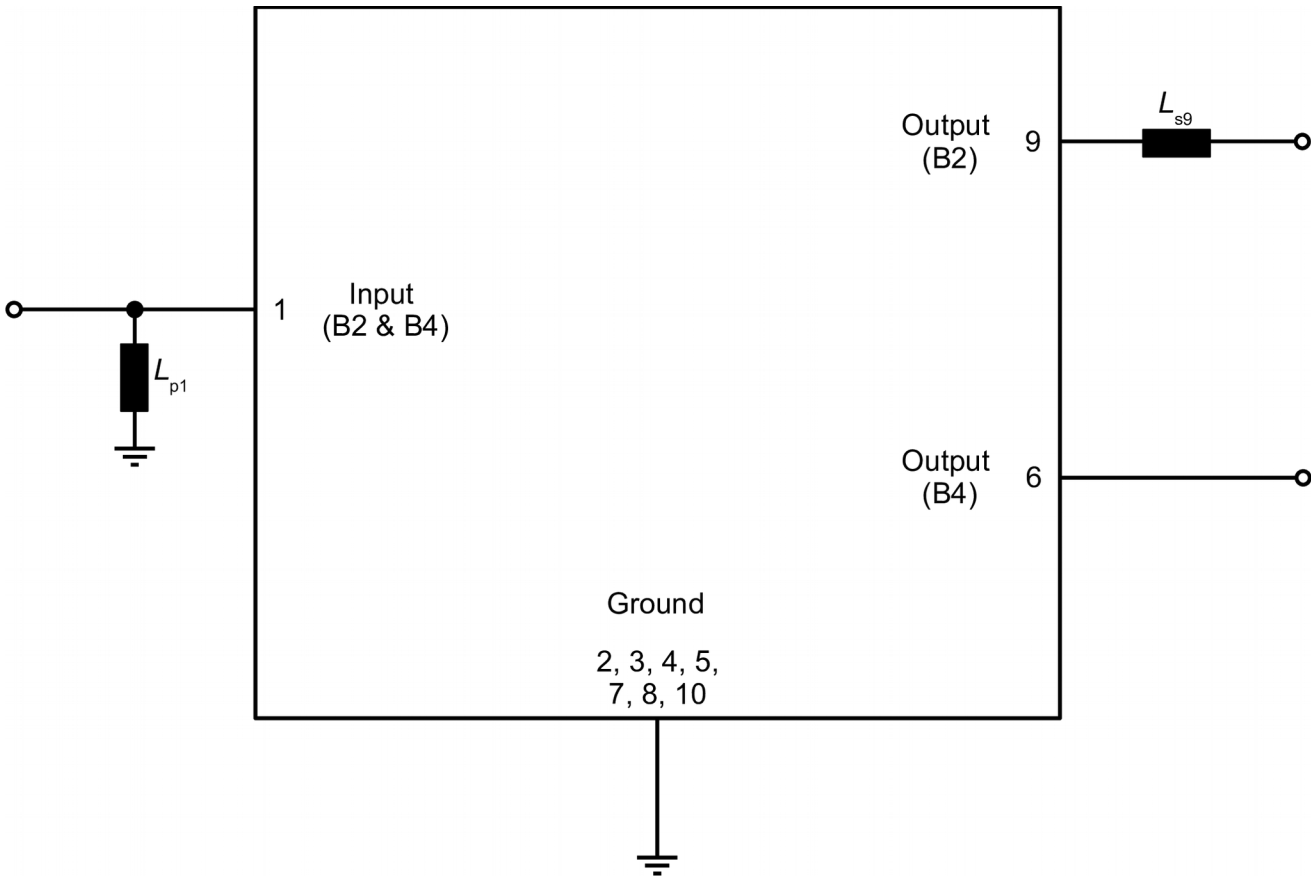

Figure 3: Schematic of matching circuit.

6 Characteristics LTE B2

Temperature range for specification T_{SPEC} = −30 °C ... +85 °C
Input terminating impedance Z_{IN} = 50 Ω // 3.6 nH[1)]
B2 output terminating impedance $Z_{B2\ OUT}$ = 50 Ω + 2.0 nH[1)]
B4 output terminating impedance $Z_{B4\ OUT}$ = 50 Ω

Characteristics LTE B2				min. for T_{SPEC}	typ. @ +25 °C	max. for T_{SPEC}	
Center frequency			f_C	—	1960	—	MHz
Maximum insertion attenuation			α_{max}				
	1930... 1990	MHz		—	2.1	3.0	dB
Amplitude ripple (p-p)			$\Delta\alpha$				
	1930... 1990	MHz		—	0.7	1.8	dB
Maximum VSWR			$VSWR_{max}$				
@ input port	1930... 1990	MHz		—	1.6	2.1	
@ B2 output port	1930... 1990	MHz		—	1.6	2.1	
Minimum attenuation			α_{min}				
	699... 849	MHz		45	50	—	dB
	849... 1710	MHz		38	43	—	dB
	1710... 1755	MHz		45	49	—	dB
	1755... 1785	MHz		32	36	—	dB
	1785... 1850	MHz		32	36	—	dB
	1850... 1910	MHz		30	33	—	dB
	2055... 2080	MHz		33	37	—	dB
	2080... 2500	MHz		34	38	—	dB
	2500... 4900	MHz		32	35	—	dB

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

7 Characteristics LTE B4

Temperature range for specification T_{SPEC} = −30 °C ... +85 °C
Input terminating impedance Z_{IN} = 50 Ω // 3.6 nH[1)]
B2 output terminating impedance $Z_{B2\ OUT}$ = 50 Ω + 2.0 nH[1)]
B4 output terminating impedance $Z_{B4\ OUT}$ = 50 Ω

Characteristics LTE B4				**min.** for T_{SPEC}	**typ.** @ +25 °C	**max.** for T_{SPEC}	
Center frequency			f_C	—	2132.5	—	MHz
Maximum insertion attenuation			α_{max}				
	2110... 2155	MHz		—	2.0	2.5	dB
Amplitude ripple (p-p)			$\Delta\alpha$				
	2110... 2155	MHz		—	0.4	1.0	dB
Maximum VSWR			$VSWR_{max}$				
@ input port	2110... 2155	MHz		—	1.6	2.1	
@ B4 output port	2110... 2155	MHz		—	1.6	2.1	
Minimum attenuation			α_{min}				
	699... 915	MHz		55	60	—	dB
	915... 1710	MHz		45	53	—	dB
	1710... 1785	MHz		46	53	—	dB
	1785... 1850	MHz		46	53	—	dB
	1850... 1910	MHz		46	49	—	dB
	1910... 1920	MHz		46	51	—	dB
	1920... 1980	MHz		39	42	—	dB
	2015... 2075	MHz		32	39	—	dB
	2255... 2400	MHz		41	46	—	dB
	2400... 2500	MHz		44	49	—	dB
	2500... 4900	MHz		40	48	—	dB

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

8 Maximum ratings

Operable temperature	T_{OP} = −40 °C ... +125 °C	
Storage temperature	T_{STG} [2] = −40 °C ... +125 °C	
DC voltage	$\lvert V_{DC} \rvert$ [3] = 0 V (max.)	
ESD voltage	V_{ESD} [1] = 50 V (max.)	Machine model.
Input power	P_{IN}	
@ input port: 1710 ... 1755 MHz	15 dBm	Continuous wave for 2000 h @ 55 °C.
@ input port: 1850 ... 1910 MHz	15 dBm	Continuous wave for 2000 h @ 55 °C.

[1] According to JESD22-A115B (MM – Machine Model), 10 negative & 10 positive pulses.
[2] Not valid for packaging material. Storage temperature for packaging material is −25 °C to +40 °C.
[3] In case of applied DC voltage blocking capacitors are mandatory.

9 Transmission coefficient LTE B2

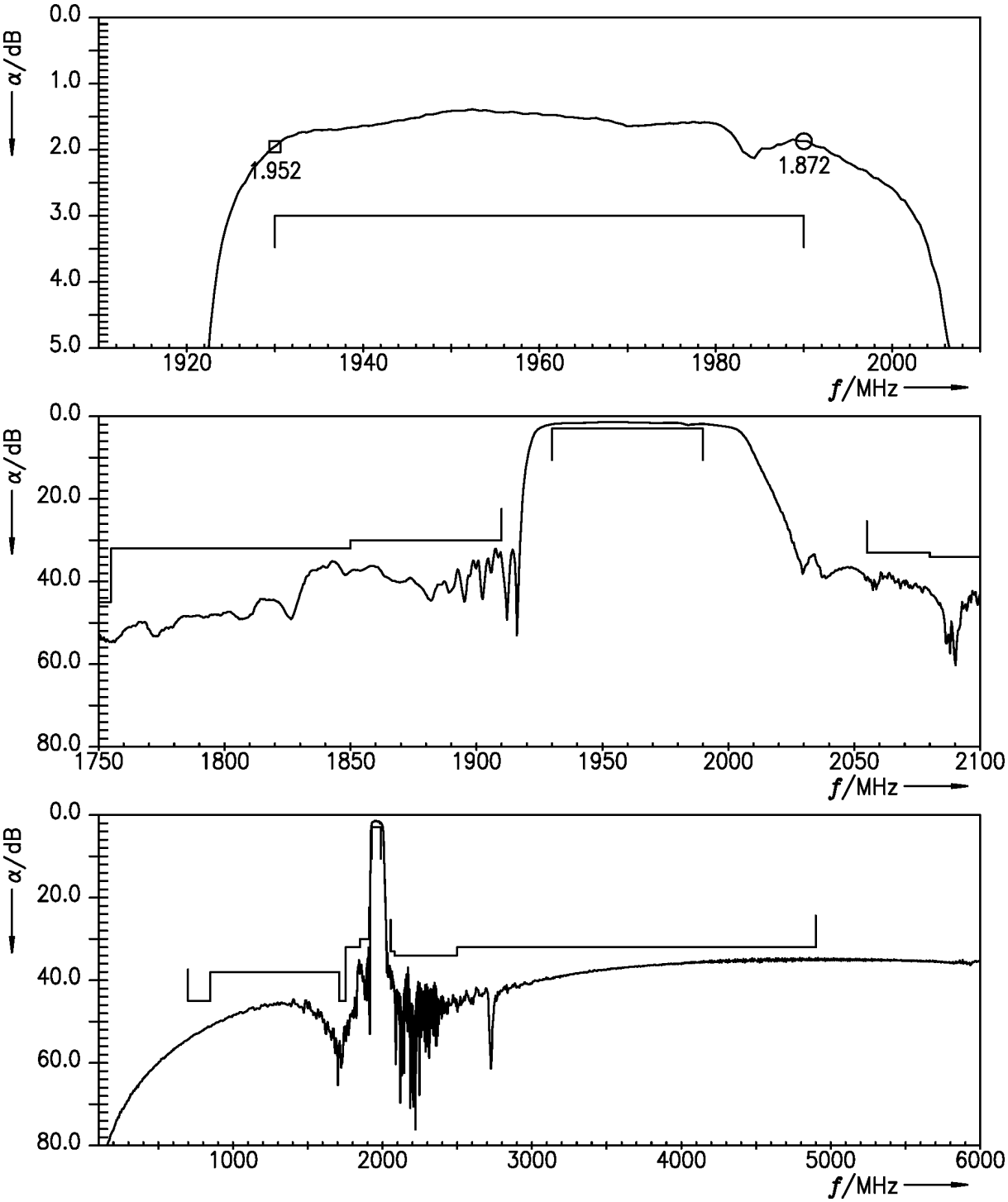

Figure 4: Attenuation LTE B2.

10 Reflection coefficients LTE B2

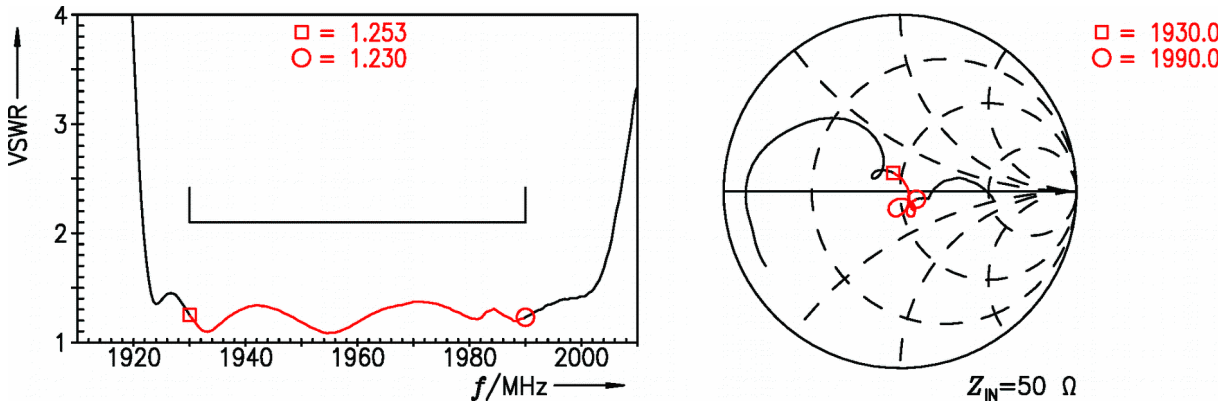

Figure 5: Reflection coefficient at input port.

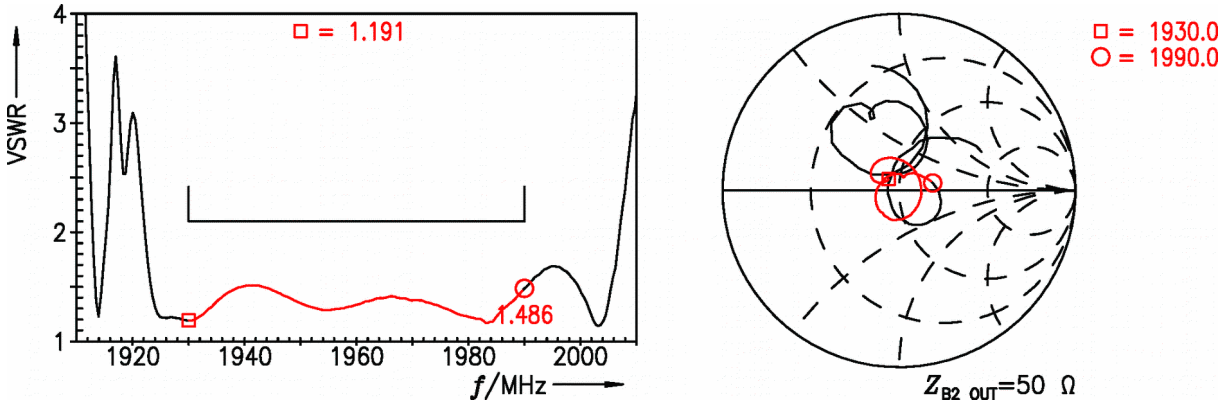

Figure 6: Reflection coefficient at B2 OUT port.

11 Transmission coefficient LTE B4

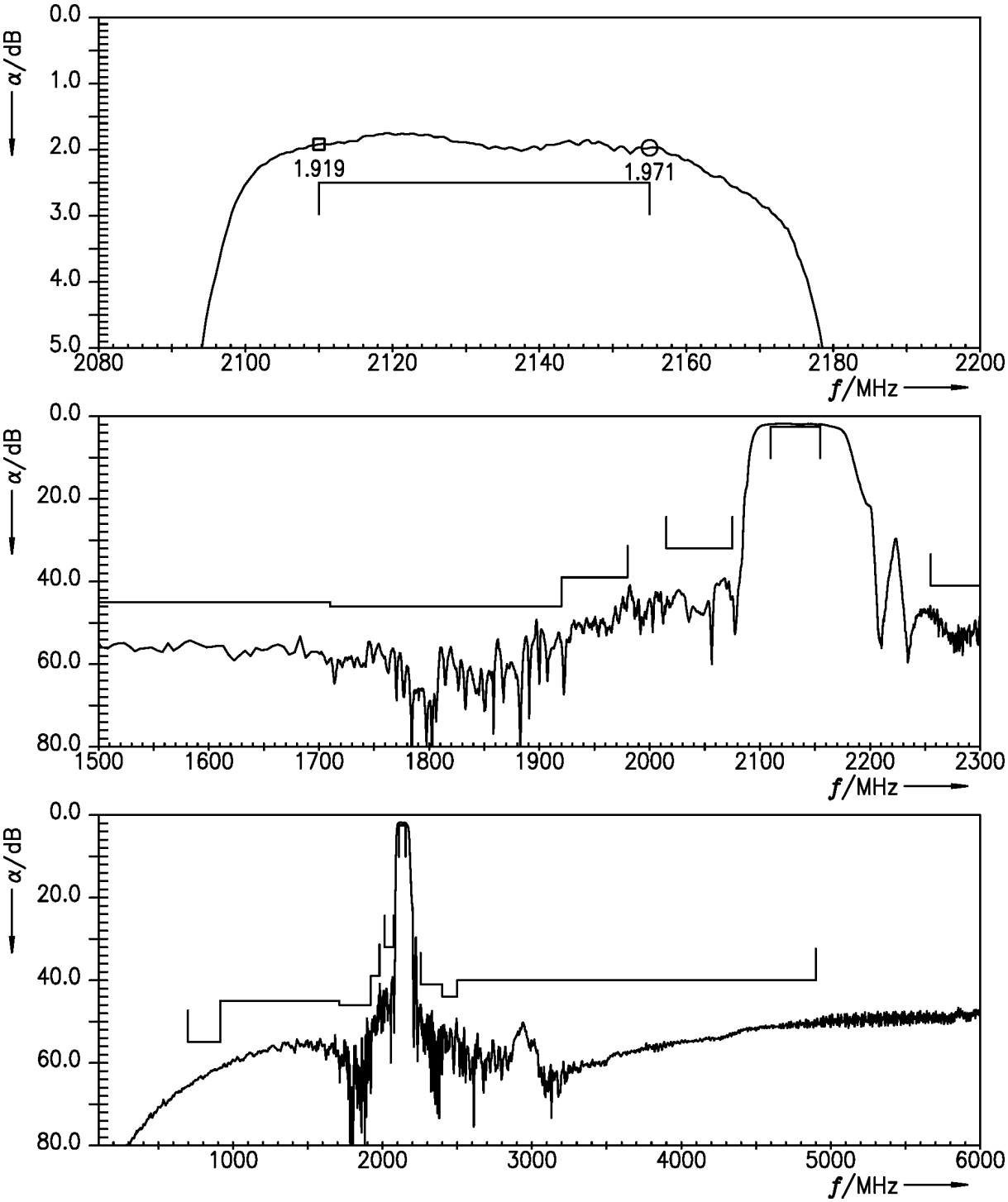

Figure 7: Attenuation LTE B4.

12 Reflection coefficients LTE B4

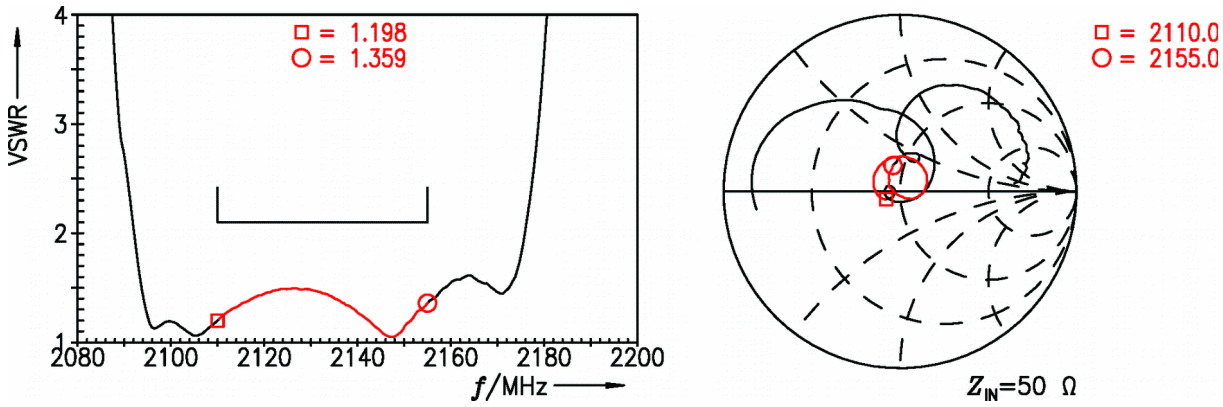

Figure 8: Reflection coefficient at input port.

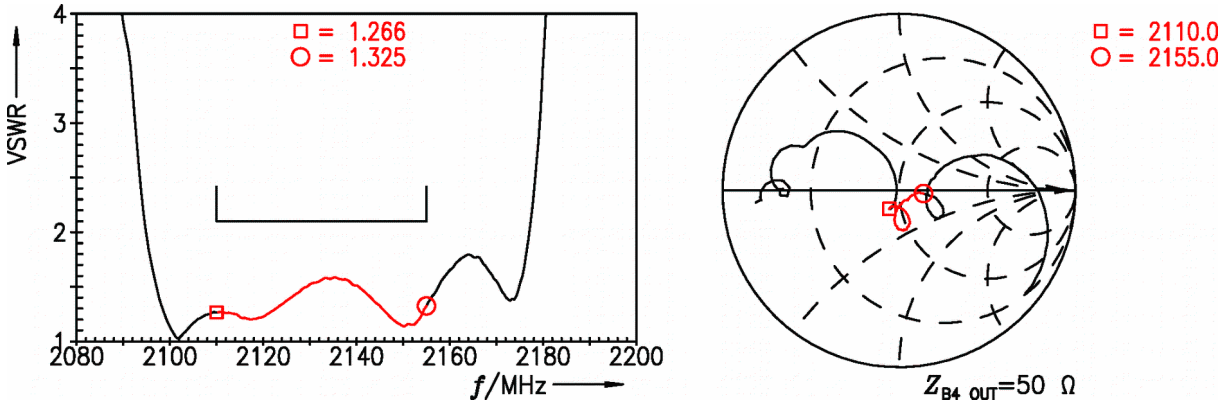

Figure 9: Reflection coefficient at B4 OUT port.

13 Packing material

13.1 Tape

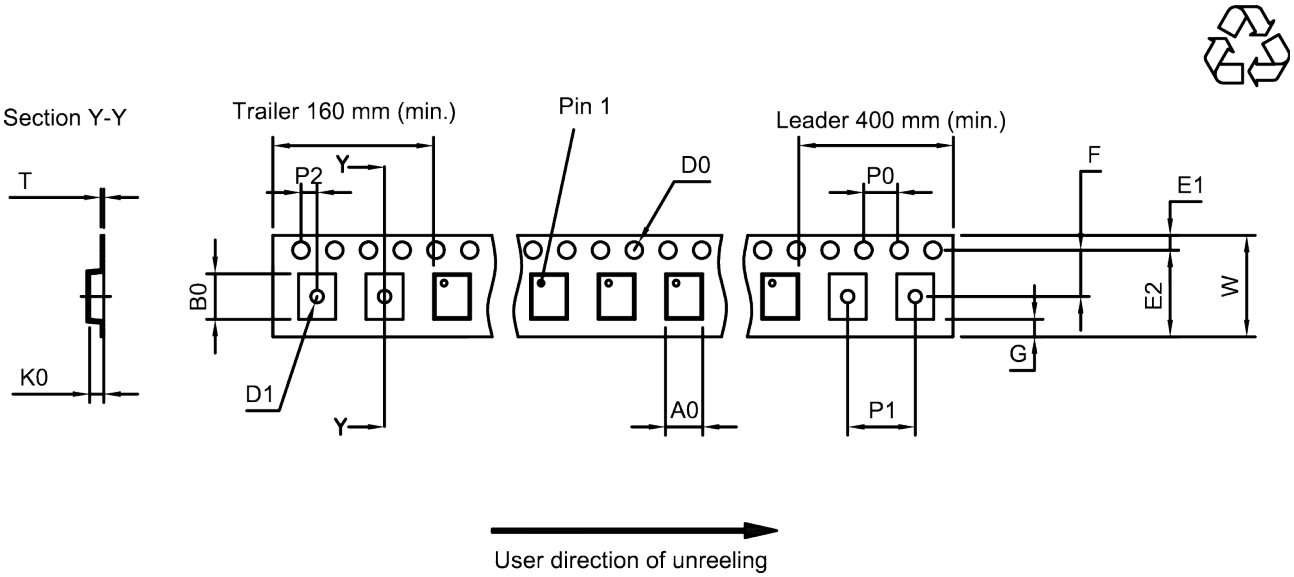

Figure 10: Drawing of tape (first-angle projection) for illustration only and not to scale. The valid tape dimensions are listed in Table 1.

A_0	1.27±0.05 mm
B_0	1.67±0.05 mm
D_0	1.5+0.1/−0 mm
D_1	0.5+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	0.55±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.

13.2 Reel with diameter of 180 mm

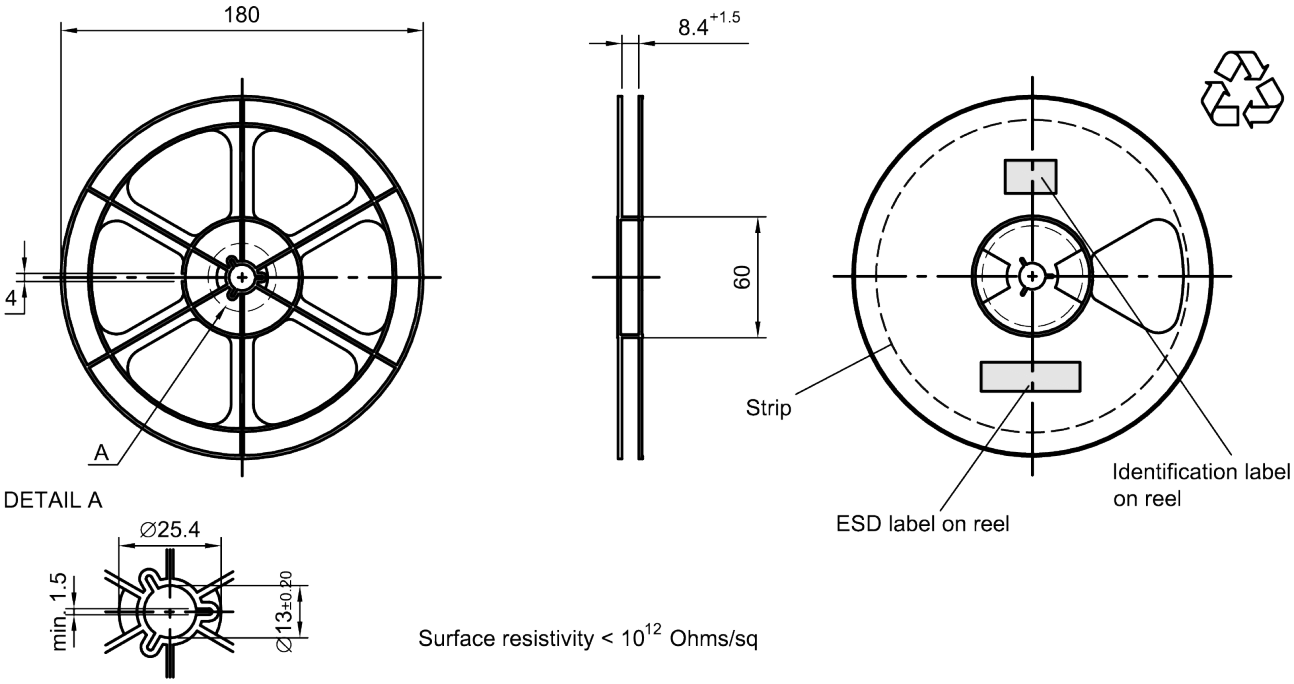

Figure 11: Drawing of reel (first-angle projection) with diameter of 180 mm.

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

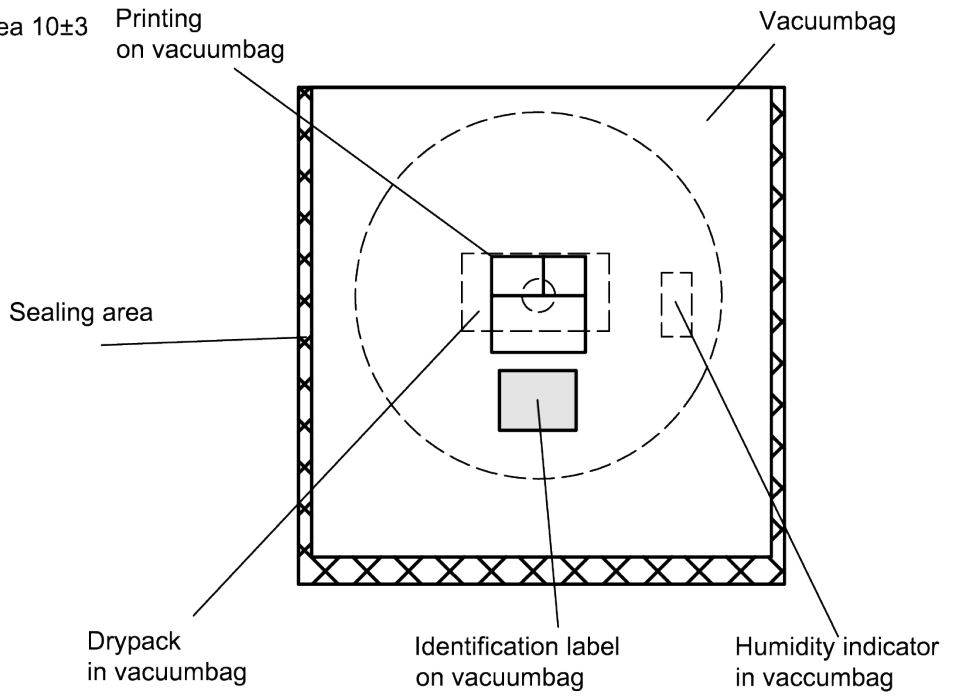

Figure 12: Drawing of moisture barrier bag (MBB) for reel with diameter of 180 mm.

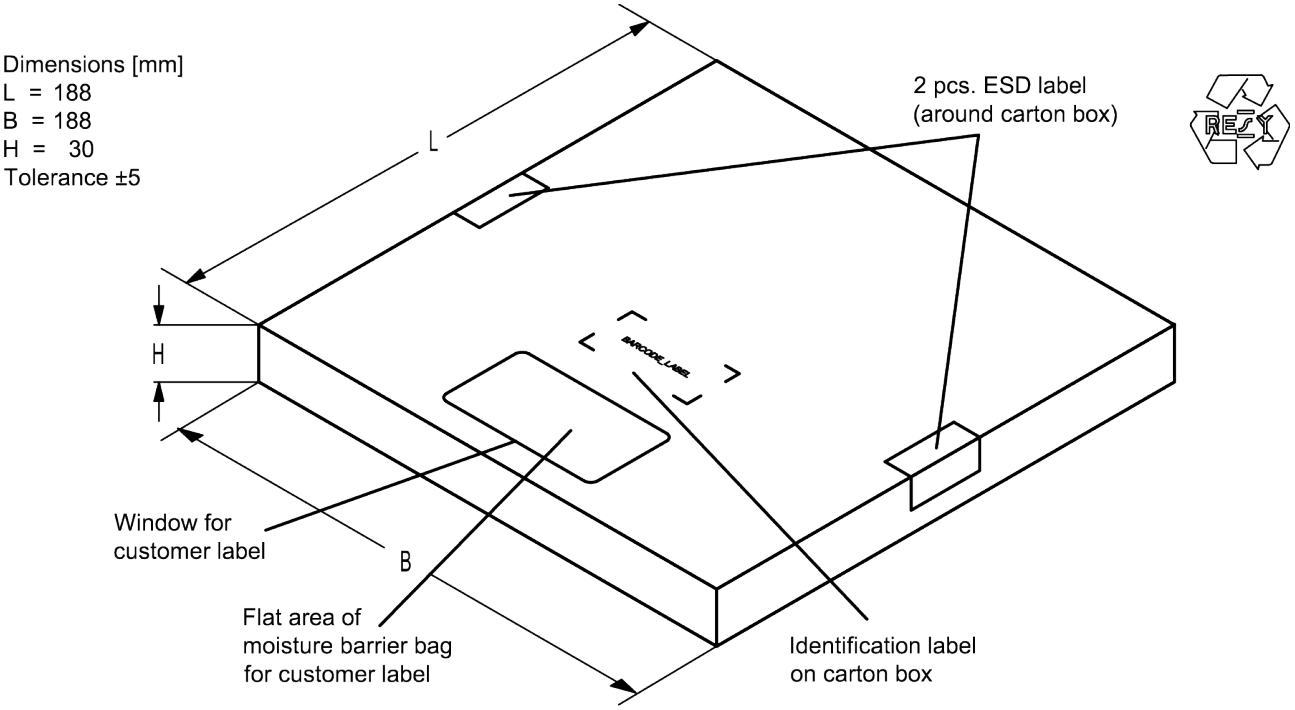

Figure 13: Drawing of folding box for reel with diameter of 180 mm.

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 B4385 is 491.

- 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).

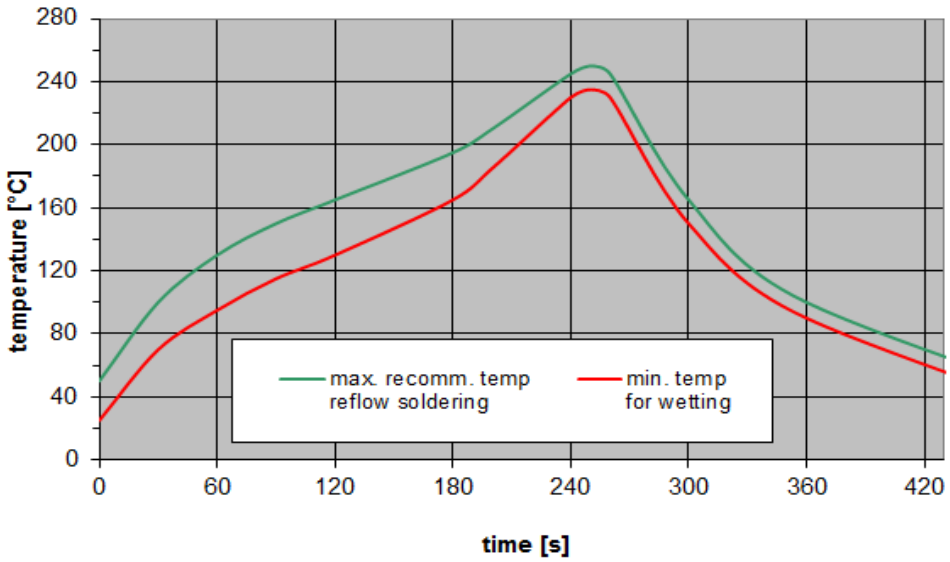

Figure 14: Recommended reflow profile for convection and infrared soldering – lead-free solder.

16 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.

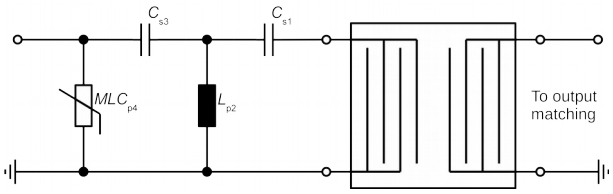

Figure 15: MLC varistor plus ESD matching.

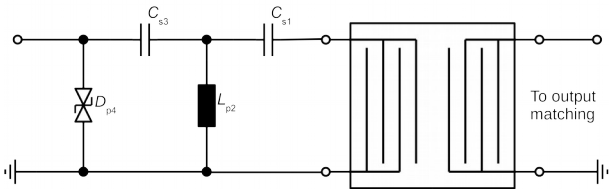

Figure 16: Suppressor diode plus ESD matching.

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

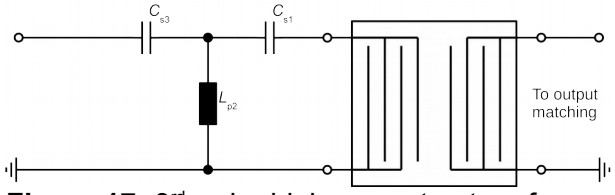

Figure 17: 3rd order high-pass structure for basic ESD protection.

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.

17 Annotations

17.1 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.

17.2 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 Cautions and warnings

18.1 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/.

18.2 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.

18.3 Moldability

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

18.4 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.

19 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.
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   The aforementioned does not apply in the case of individual agreements deviating from the foregoing for customer-specific products.