RF360
Europe GmbH

Data sheet

SAW duplexer

Small cell & femtocell
LTE band 26

Part number:	B8209
Ordering code:	B39881B8209P810
Date:	April 26, 2021
Version:	2.1

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Anzinger Straße 13
81671 Munich, Germany

Table of contents

1 Application

- Low-loss SAW duplexer for 3G/LTE small cell and femtocell systems (Band 26)
- LTE band 26 downlink (TX): pass band 859 – 894 MHz
- LTE band 26 uplink (RX): pass band 814 – 849 MHz
- Low insertion attenuation
- Usable pass band 35 MHz
- High isolation between TX and RX

2 Features

- Industrial grade qualified family
- Package size $2.5_{\pm0.1}$ mm × $2.0_{\pm0.1}$ mm
- Package height 0.5 mm (max.)
- Approximate weight 0.01 g
- RoHS compatible
- Package for Surface Mount Technology (SMT)
- Ni/Au-plated terminals
- Electrostatic Sensitive Device (ESD)
- Moisture Sensitivity Level 2a (MSL2a)

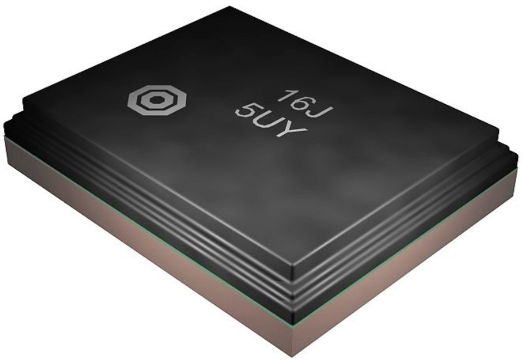

Figure 1: Picture of component
with example of product marking.

3 Package

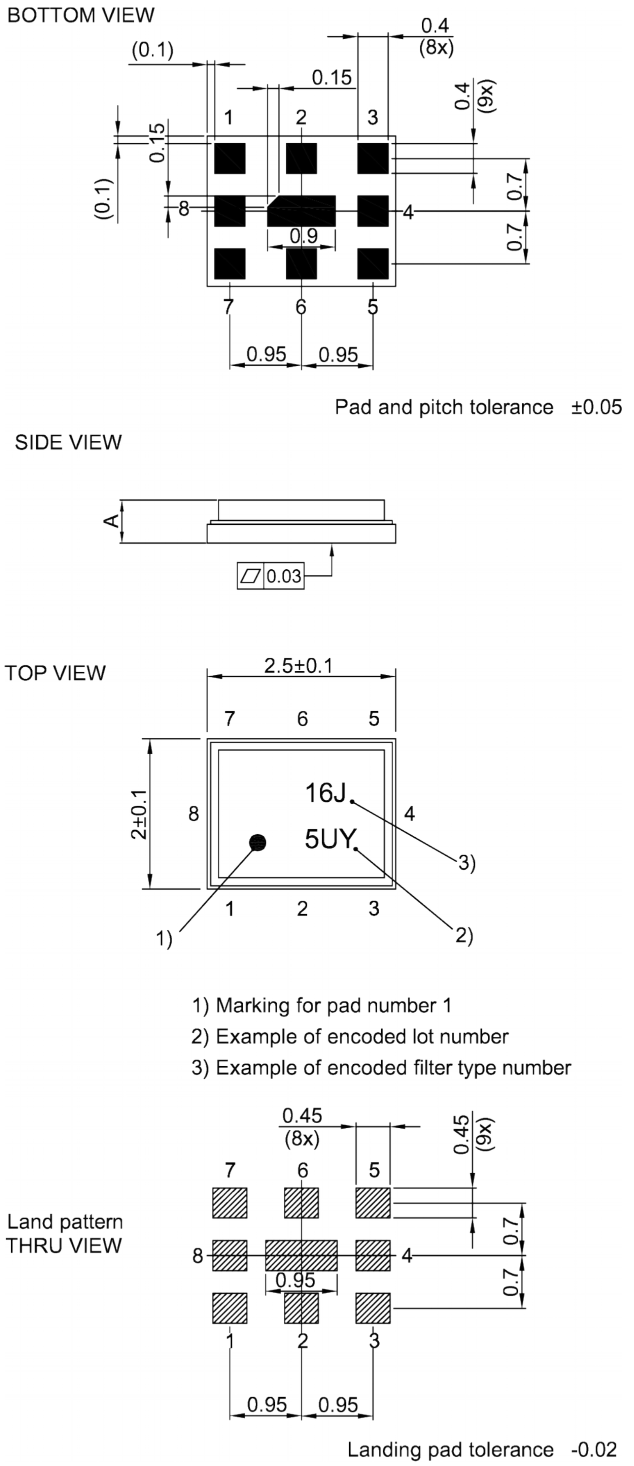

Figure 2: Drawing of package with package height A = 0.5 mm (max.). See Sec. Package information (p. 25).

4 Pin configuration

- 1 TX
- 3 RX
- 6 ANT
- 2, 4, 5, 7, 8, 9 Ground

5 Matching circuit

- L_{p6} = 9.1 nH

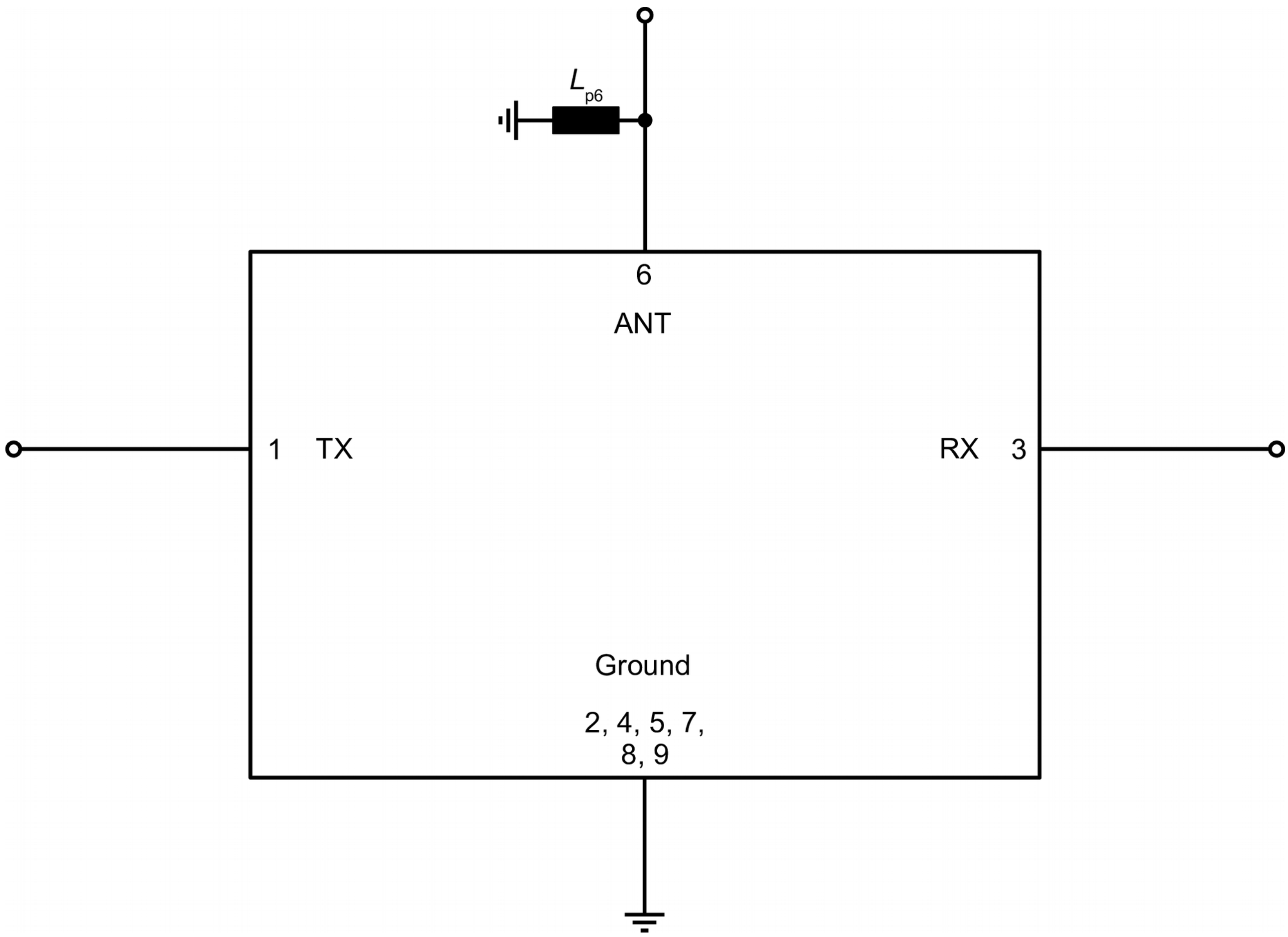

Figure 3: Schematic of matching circuit.

6 Characteristics

6.1 TX – ANT

Temperature range for specification	T_{SPEC} [1]	= −10 °C ... +85 °C
TX terminating impedance	Z_{TX}	= 50 Ω
ANT terminating impedance	Z_{ANT}	= 50 Ω // 9.1 nH[2]
RX terminating impedance	Z_{RX}	= 50 Ω

Characteristics TX – ANT				min. for T_{SPEC}	typ. @ +25 °C	max. for T_{SPEC}	
Center frequency			f_C	—	876.5	—	MHz
Insertion attenuation			α_{INT} [3]				
	859... 864	MHz		—	1.6	2.4	dB
	864... 889	MHz		—	1.1	2.0	dB
	889... 894	MHz		—	1.1	2.0	dB
Maximum insertion attenuation			α_{max}				
	859.25... 893.75	MHz		—	1.9	3.0[4]	dB
	859.25... 893.75	MHz		—	1.9	3.2	dB
Amplitude ripple (p-p)			$\Delta\alpha$				
	859.25... 893.75	MHz		—	1.3	2.3[4]	dB
	859.25... 893.75	MHz		—	1.3	2.5	dB
Maximum group delay			t_{max}				
	859.25... 893.75	MHz		—	75	130	ns
Group delay ripple			$\Delta\tau_{var}$				
	859.25... 893.75	MHz		—	55	120	ns
Maximum VSWR			$VSWR_{max}$				
@ TX port	859.25... 893.75	MHz		—	1.7	2.1	
@ ANT port	859.25... 893.75	MHz		—	1.7	2.1	
Minimum attenuation			α_{min}				
	10... 814	MHz		30	39	—	dB
	814.25... 848.75	MHz		45	52	—	dB
	1559... 1606	MHz		40	50	—	dB
	1628... 1788	MHz		40	54	—	dB
	1850... 1915	MHz		40	55	—	dB
	1920... 1980	MHz		40	53	—	dB
	2400... 2500	MHz		35	46	—	dB
	2442... 2682	MHz		35	46	—	dB
	3400... 3800	MHz		30	39	—	dB
	3800... 5850	MHz		20	31	—	dB

1) T is the ambient temperature of the PCB at component position.
2) See Sec. Matching circuit (p. 6).
3) Integrated attenuation α_{INT}: Averaged power $|S_{ij}|^2$ over the center 4.5 MHz of LTE 5 MHz (25 RB) channels.
4) Valid for temperatureT= +10 °C...+85 °C.

Temperature range for specification	T_{SPEC}	= −40 °C ... +95 °C
TX terminating impedance	Z_{TX}	= 50 Ω
ANT terminating impedance	Z_{ANT}	= 50 Ω // 9.1 nH[1)]
RX terminating impedance	Z_{RX}	= 50 Ω

Characteristics TX – ANT				min. for T_{SPEC}	typ. @ +25 °C	max. for T_{SPEC}	
Insertion attenuation			α_{INT} [2)]				
	859... 864	MHz		—	1.6	3.0	dB
	864... 889	MHz		—	1.1	2.1	dB
	889... 894	MHz		—	1.1	3.0	dB
Maximum insertion attenuation			α_{max}				
	859.25... 893.75	MHz		—	1.9	4.5	dB
Amplitude ripple (p-p)			$\Delta\alpha$				
	859.25... 893.75	MHz		—	1.3	3.8	dB
Maximum group delay			t_{max}				
	859.25... 893.75	MHz		—	75	150	ns
Group delay ripple			$\Delta\tau_{var}$				
	859.25... 893.75	MHz		—	55	140	ns
Maximum VSWR			$VSWR_{max}$				
@ TX port	859.25... 893.75	MHz		—	1.7	2.5	
@ ANT port	859.25... 893.75	MHz		—	1.7	2.5	
Minimum attenuation			α_{min}				
	10... 814	MHz		30	39	—	dB
	814.25... 848.75	MHz		41	52	—	dB
	1559... 1606	MHz		40	50	—	dB
	1628... 1788	MHz		40	54	—	dB
	1850... 1915	MHz		40	55	—	dB
	1920... 1980	MHz		40	53	—	dB
	2400... 2500	MHz		35	46	—	dB
	2442... 2682	MHz		35	46	—	dB
	3400... 3800	MHz		30	39	—	dB
	3800... 5850	MHz		20	31	—	dB

1) See Sec. Matching circuit (p. 6).
2) Integrated attenuation α_{INT}: Averaged power $|S_{ij}|^2$ over the center 4.5 MHz of LTE 5 MHz (25 RB) channels.

6.2 ANT – RX

Temperature range for specification	T_{SPEC} [1]	= −10 °C ... +85 °C
TX terminating impedance	Z_{TX}	= 50 Ω
ANT terminating impedance	Z_{ANT}	= 50 Ω // 9.1 nH[2]
RX terminating impedance	Z_{RX}	= 50 Ω

Characteristics ANT – RX				**min.** for T_{SPEC}	**typ.** @ +25 °C	**max.** for T_{SPEC}	
Center frequency			f_C	—	831.5	—	MHz
Insertion attenuation			α_{INT} [3]				
	814 ... 819	MHz		—	1.1	2.0	dB
	819 ... 844	MHz		—	1.0	2.0	dB
	844 ... 849	MHz		—	1.2	2.4	dB
Maximum insertion attenuation			α_{max}				
	814.25 ... 848.75	MHz		—	1.4	3.0	dB
Amplitude ripple (p-p)			$\Delta\alpha$				
	814.25 ... 848.75	MHz		—	0.7	2.2	dB
Maximum group delay			t_{max}				
	814.25 ... 848.75	MHz		—	70	140	ns
Group delay ripple			$\Delta\tau_{var}$				
	814.25 ... 848.75	MHz		—	50	130	ns
Maximum VSWR			$VSWR_{max}$				
@ ANT port	814.25 ... 848.75	MHz		—	1.5	2.1	
@ RX port	814.25 ... 848.75	MHz		—	1.7	2.1	
Minimum attenuation			α_{min}				
	10 ... 791	MHz		30	39	—	dB
	859.25 ... 893.75	MHz		45	52	—	dB
	1628 ... 1788	MHz		40	54	—	dB
	1805 ... 1880	MHz		40	54	—	dB
	1850 ... 1995	MHz		40	48	—	dB
	2110 ... 2200	MHz		35	44	—	dB
	2400 ... 2500	MHz		35	42	—	dB
	2442 ... 2547	MHz		35	43	—	dB
	2577 ... 2682	MHz		35	43	—	dB
	2690 ... 3800	MHz		25	37	—	dB
	3800 ... 5850	MHz		15	26	—	dB

[1] T is the ambient temperature of the PCB at component position.
[2] See Sec. Matching circuit (p. 6).
[3] Integrated attenuation α_{INT}: Averaged power $|S_{ij}|^2$ over the center 4.5 MHz of LTE 5 MHz (25 RB) channels.

Temperature range for specification	T_{SPEC}	= −40 °C ... +95 °C
TX terminating impedance	Z_{TX}	= 50 Ω
ANT terminating impedance	Z_{ANT}	= 50 Ω // 9.1 nH[1)]
RX terminating impedance	Z_{RX}	= 50 Ω

Characteristics ANT – RX				**min.** for T_{SPEC}	**typ.** @ +25 °C	**max.** for T_{SPEC}	
Insertion attenuation			α_{INT} [2)]				
	814 ... 819	MHz		—	1.1	3.0	dB
	819 ... 844	MHz		—	1.0	2.1	dB
	844 ... 849	MHz		—	1.2	3.0	dB
Maximum insertion attenuation			α_{max}				
	814.25 ... 848.75	MHz		—	1.4	4.6	dB
Amplitude ripple (p-p)			$\Delta\alpha$				
	814.25 ... 848.75	MHz		—	0.7	3.8	dB
Maximum group delay			t_{max}				
	814.25 ... 848.75	MHz		—	70	160	ns
Group delay ripple			$\Delta\tau_{var}$				
	814.25 ... 848.75	MHz		—	50	150	ns
Maximum VSWR			$VSWR_{max}$				
@ ANT port	814.25 ... 848.75	MHz		—	1.5	2.5	
@ RX port	814.25 ... 848.75	MHz		—	1.7	2.8	
Minimum attenuation			α_{min}				
	10 ... 791	MHz		30	39	—	dB
	859.25 ... 893.75	MHz		37	52	—	dB
	1628 ... 1788	MHz		40	54	—	dB
	1805 ... 1880	MHz		40	54	—	dB
	1850 ... 1995	MHz		40	48	—	dB
	2110 ... 2200	MHz		35	44	—	dB
	2400 ... 2500	MHz		35	42	—	dB
	2442 ... 2547	MHz		35	43	—	dB
	2577 ... 2682	MHz		35	43	—	dB
	2690 ... 3800	MHz		25	37	—	dB
	3800 ... 5850	MHz		15	26	—	dB

1) See Sec. Matching circuit (p. 6).
2) Integrated attenuation α_{INT}: Averaged power $|S_{ij}|^2$ over the center 4.5 MHz of LTE 5 MHz (25 RB) channels.

6.3 TX – RX

Temperature range for specification	T_{SPEC}[1)]	= −10 °C ... +85 °C
TX terminating impedance	Z_{TX}	= 50 Ω
ANT terminating impedance	Z_{ANT}	= 50 Ω // 9.1 nH[2)]
RX terminating impedance	Z_{RX}	= 50 Ω

Characteristics TX – RX				**min.** for T_{SPEC}	**typ.** @ +25 °C	**max.** for T_{SPEC}	
Isolation			α_{INT}[3)]				
	814 ... 849	MHz		50	54	—	dB
	859 ... 894	MHz		50	55	—	dB
Minimum isolation			α_{min}				
	814.25 ... 848.75	MHz		50	54	—	dB
	849 ... 859	MHz		18	27	—	dB
	859.25 ... 893.75	MHz		50	54	—	dB

1) T is the ambient temperature of the PCB at component position.
2) See Sec. Matching circuit (p. 6).
3) Integrated attenuation α_{INT}: Averaged power $|S_{ij}|^2$ over the center 4.5 MHz of LTE 5 MHz (25 RB) channels.

Temperature range for specification	T_{SPEC}	= −40 °C ... +95 °C
TX terminating impedance	Z_{TX}	= 50 Ω
ANT terminating impedance	Z_{ANT}	= 50 Ω // 9.1 nH[1)]
RX terminating impedance	Z_{RX}	= 50 Ω

Characteristics TX – RX				**min.** for T_{SPEC}	**typ.** @ +25 °C	**max.** for T_{SPEC}	
Isolation			α_{INT} [2)]				
	814 ... 848	MHz		50	54	—	dB
	844 ... 849	MHz		46	61	—	dB
	859 ... 864	MHz		46	64	—	dB
	860 ... 894	MHz		50	55	—	dB
Minimum isolation			α_{min}				
	814.25 ... 848	MHz		50	54	—	dB
	848 ... 848.75	MHz		46	65	—	dB
	849 ... 859	MHz		17	27	—	dB
	859.25 ... 860	MHz		42	60	—	dB
	860 ... 893	MHz		50	55	—	dB
	893 ... 893.75	MHz		49	55	—	dB

1) See Sec. Matching circuit (p. 6).
2) Integrated attenuation α_{INT}: Averaged power $|S_{ij}|^2$ over the center 4.5 MHz of LTE 5 MHz (25 RB) channels.

7 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)] = 150 V	Machine model.
	V_{ESD}[4)] = 250 V	Human body model.
Input power	P_{IN}	
@ TX port: 859.25 ... 893.75 MHz	28 dBm[6)]	5 MHz LTE downlink signal (25 RB) for 100000 h @ 55 °C. P_{IN}28 dBm average - 39 dBm peak. Source and load impedance 50 Ω.
@ RX port: 814.25 ... 848.75 MHz	28 dBm[5)]	5 MHz LTE uplink signal (25 RB) for 5000 h @ 55 °C. Source and load impedance 50 Ω.

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 test and wear out models.Specified min./max. values from section 6 “Characteristics” for maximum input power 28 dBm are valid for temperature up to 55 °C.
6) Expected lifetime according to accelerated power durability test and wear out models.Specified min./max. values from section 6 “Characteristics” for maximum input power 28 dBm are valid for temperature up to 60 °C.

8 Transmission coefficients

8.1 TX – ANT

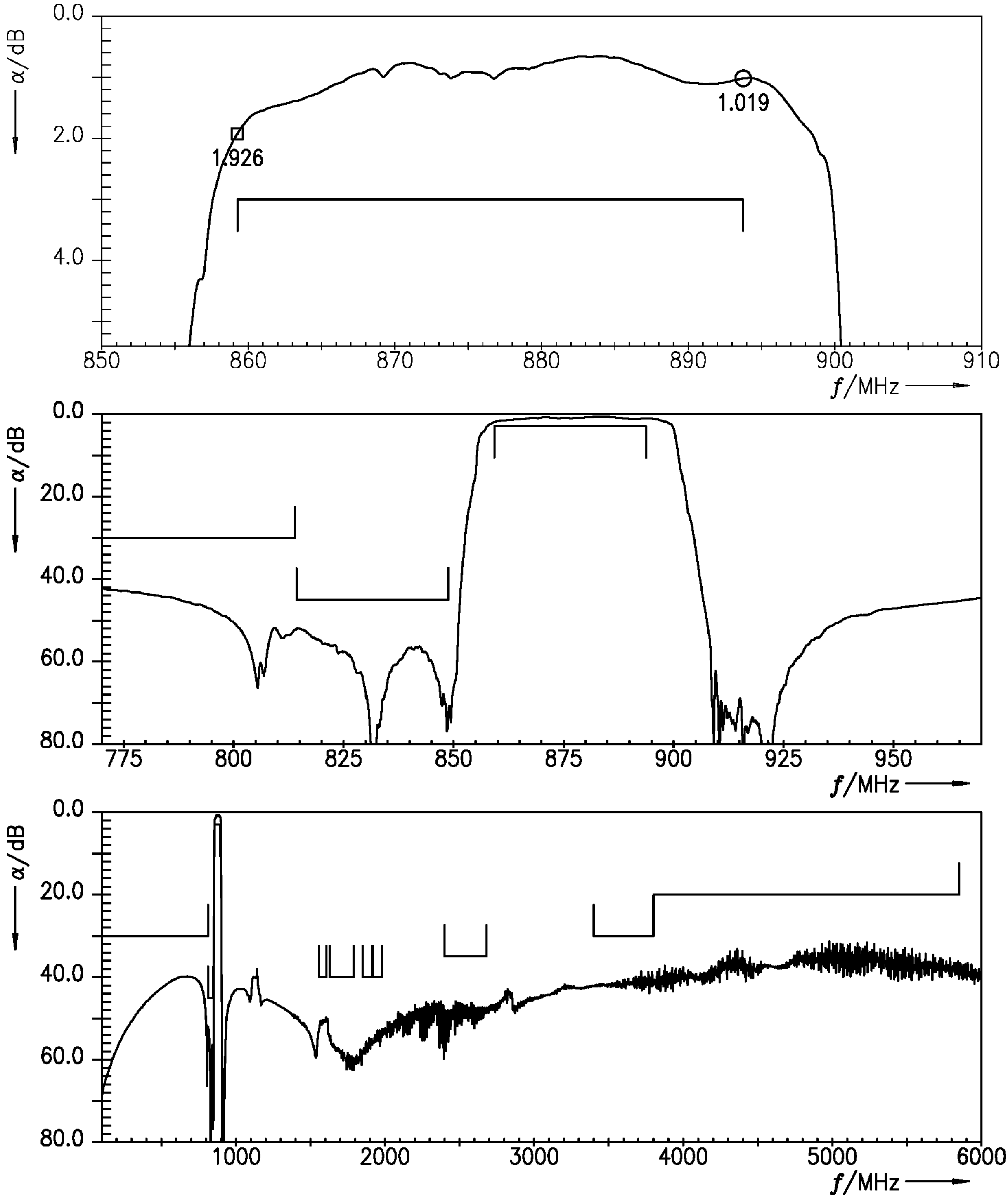

Figure 4: Attenuation TX – ANT.

8.2 ANT – RX

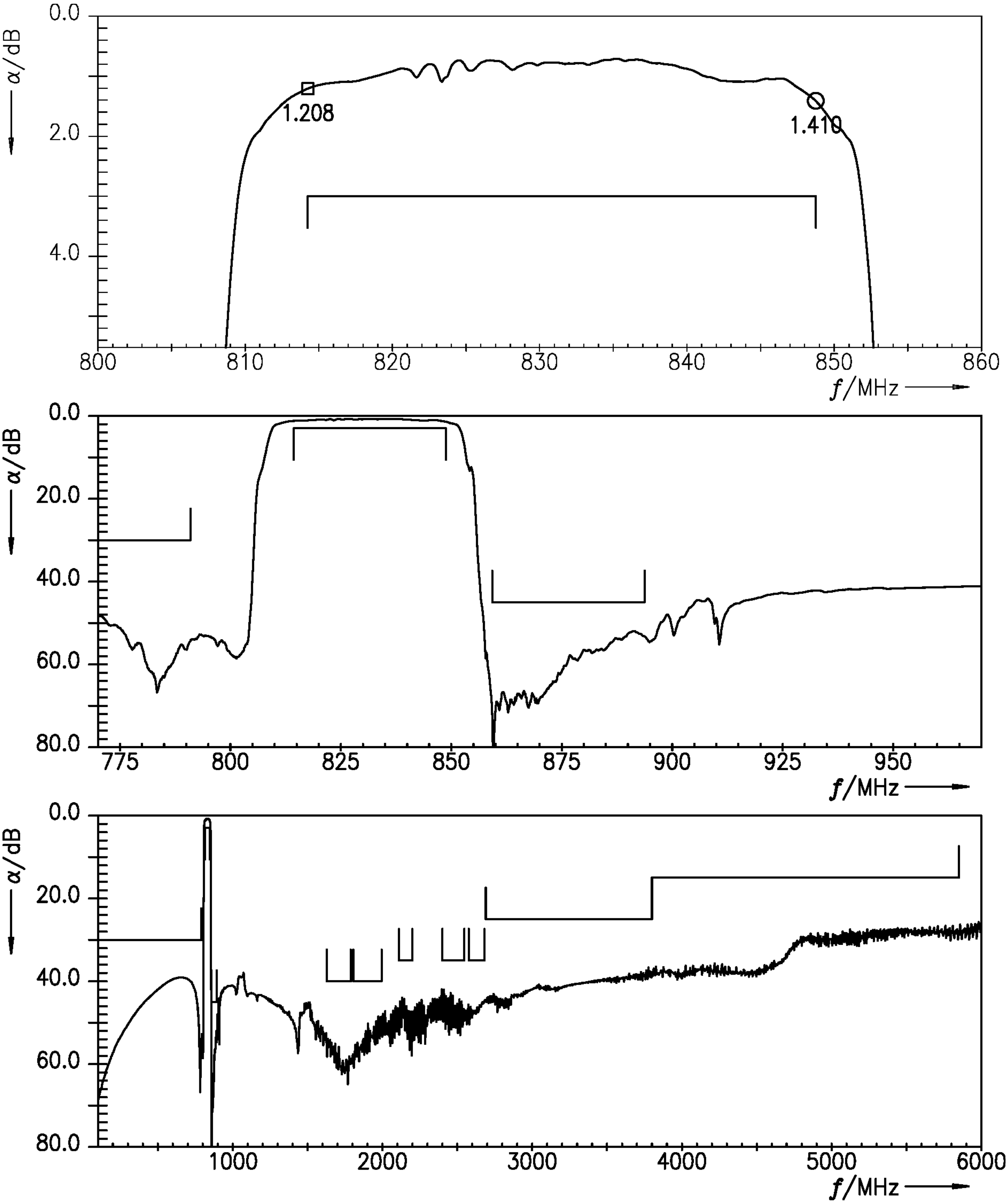

Figure 5: Attenuation ANT – RX.

8.3 TX – RX

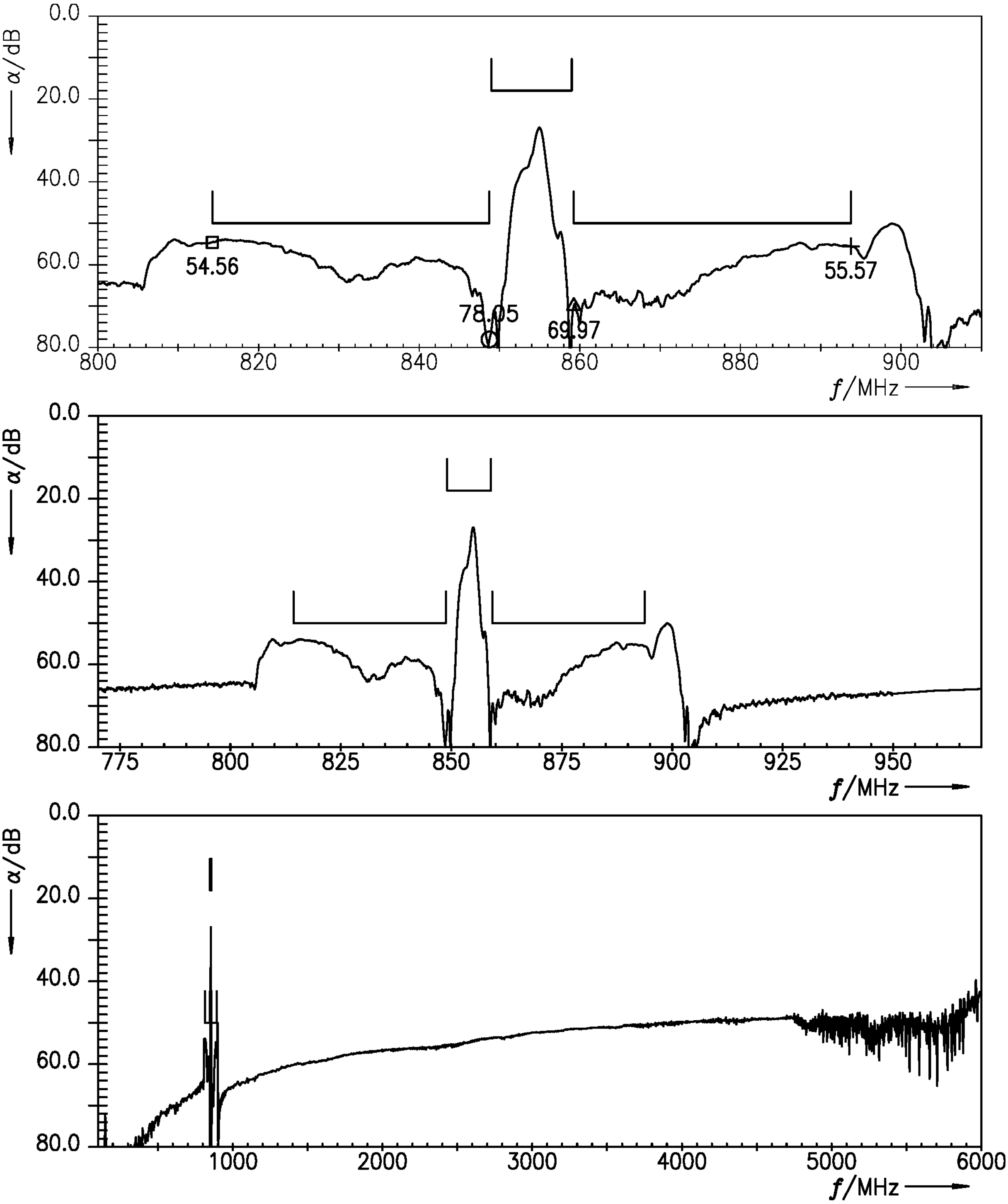

Figure 6: Isolation TX – RX.

9 Reflection coefficients

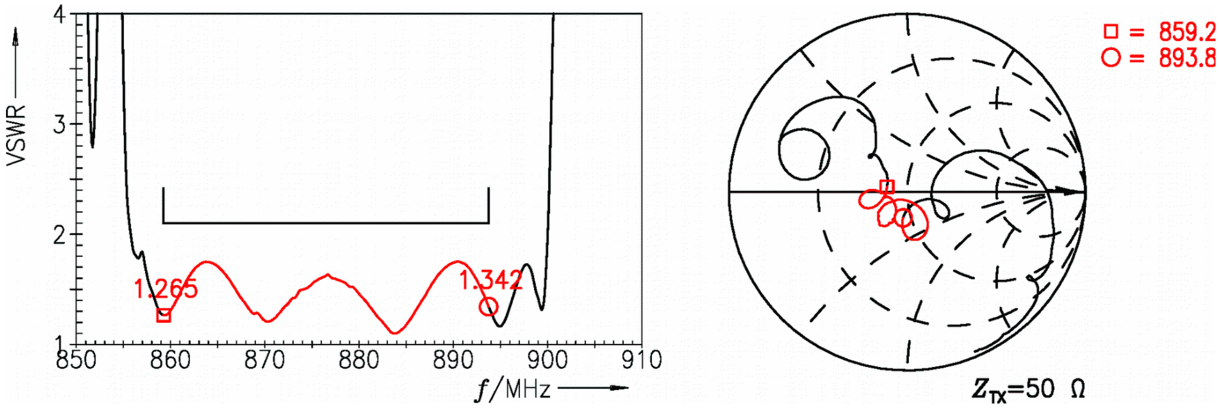

Figure 7: Reflection coefficient at TX port.

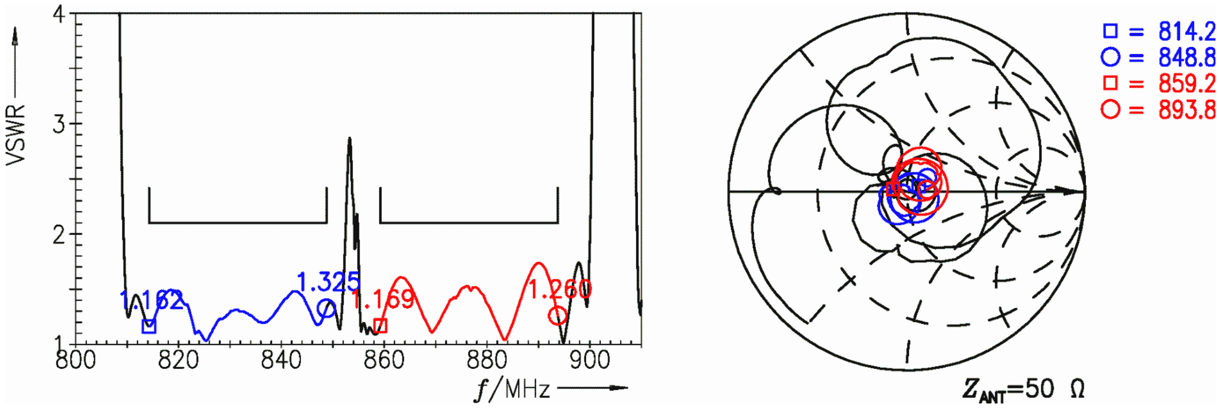

Figure 8: Reflection coefficient at ANT port.

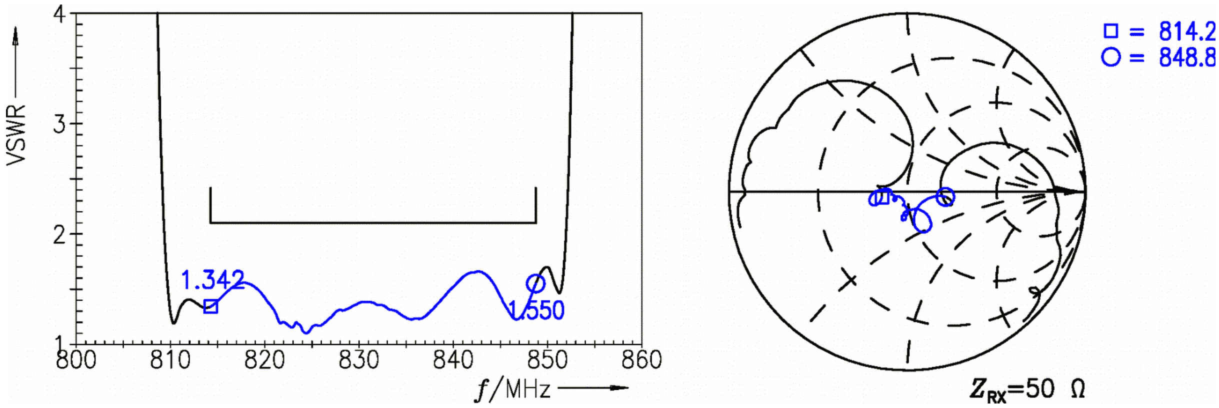

Figure 9: Reflection coefficient at RX port.

10 Packing material

10.1 Tape

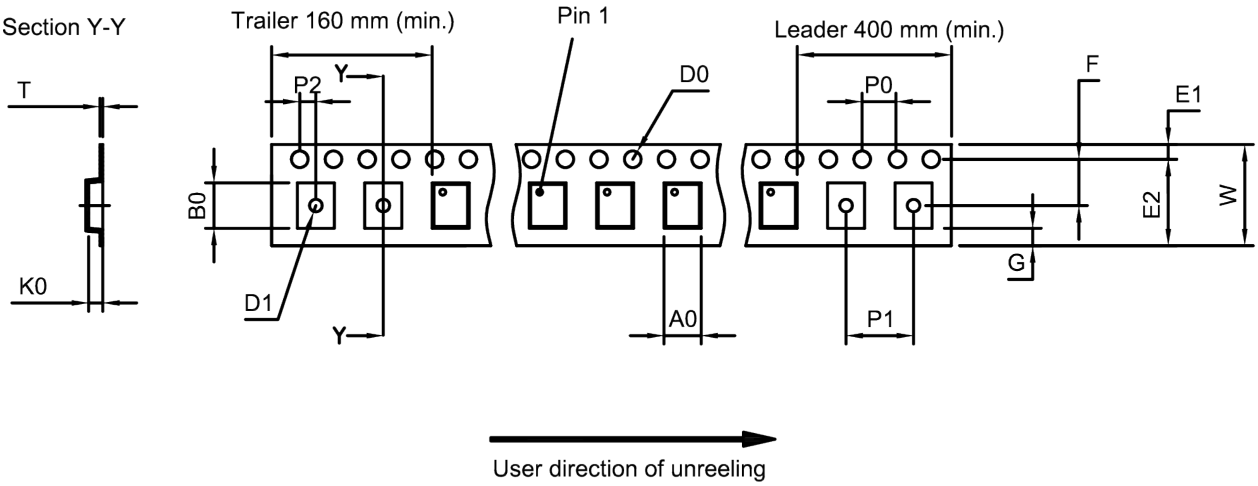

Figure 10: Drawing of tape (first-angle projection) for illustration only and not to scale. The valid tape dimensions are listed in Table 1.

A_0	2.25±0.05 mm
B_0	2.75±0.05 mm
D_0	1.5+0.1/−0 mm
D_1	1.0 mm (min.)
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	0.6±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.

10.2 Reel with diameter of 180 mm

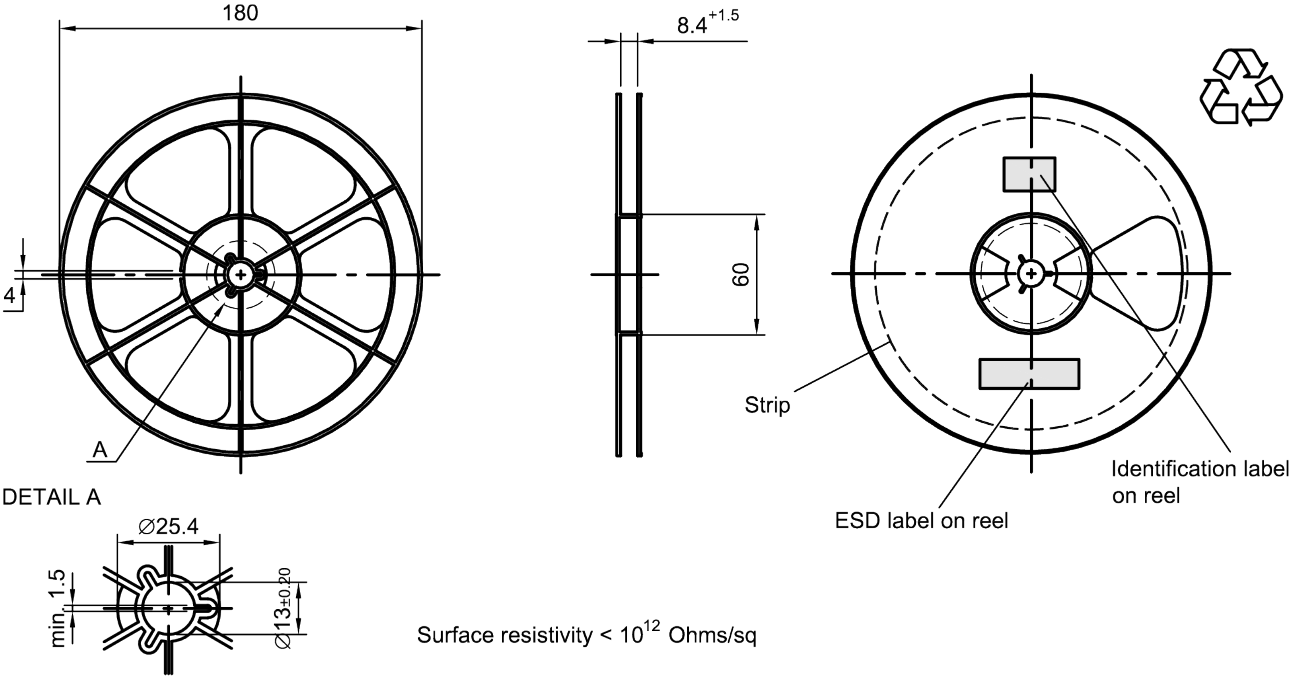

Figure 11: Drawing of reel (first-angle projection) with diameter of 180 mm.

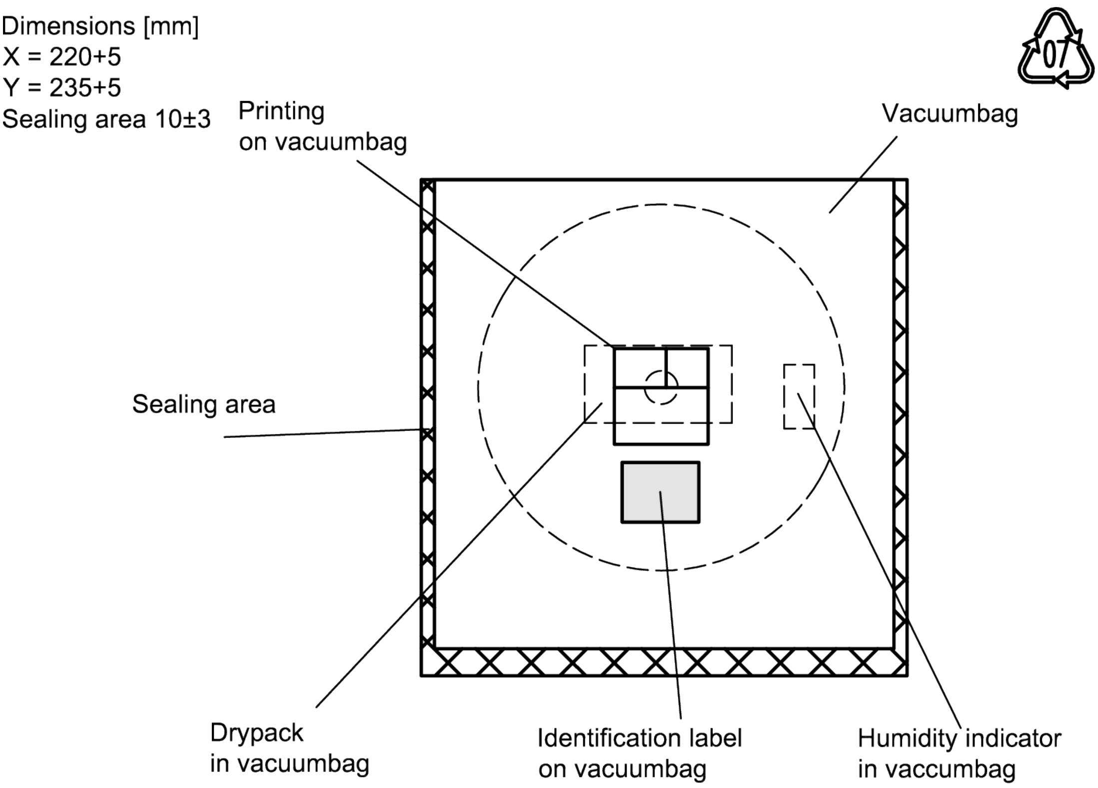

Figure 12: Drawing of moisture barrier bag (MBB) for reel with diameter of 180 mm.

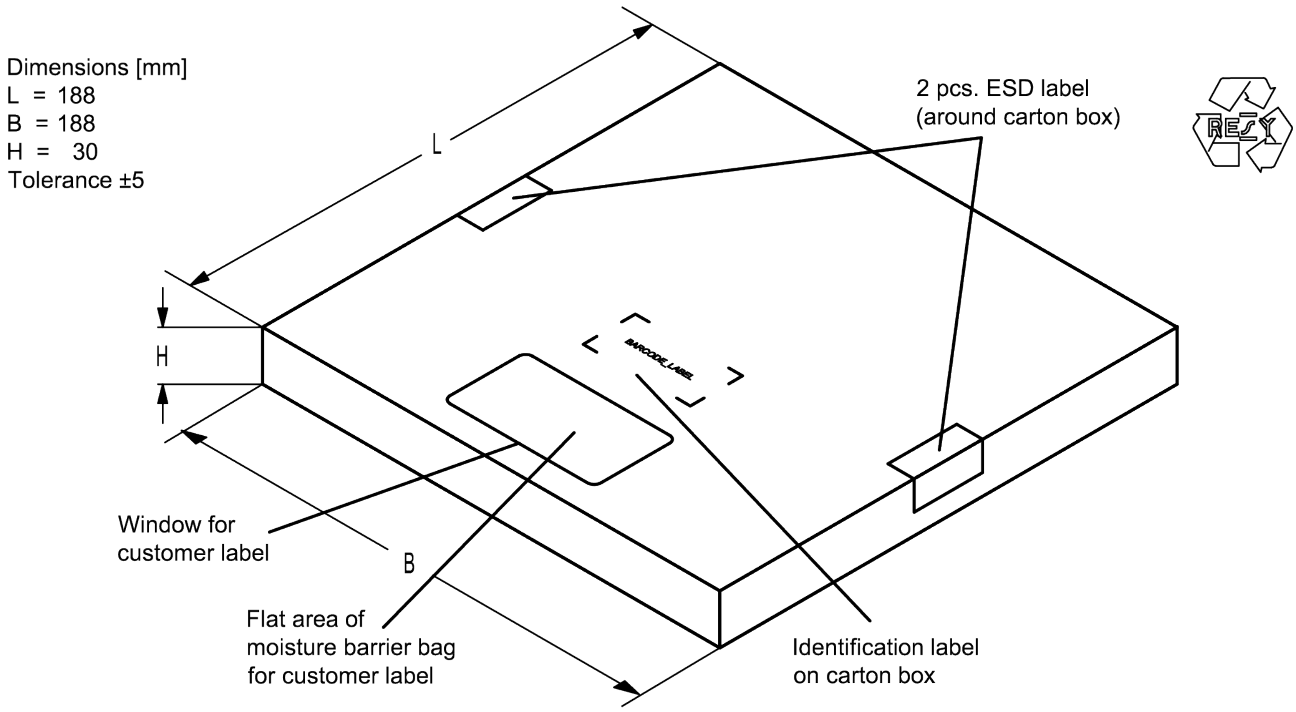

Figure 13: Drawing of folding box for reel with diameter of 180 mm.

10.3 Reel with diameter of 330 mm

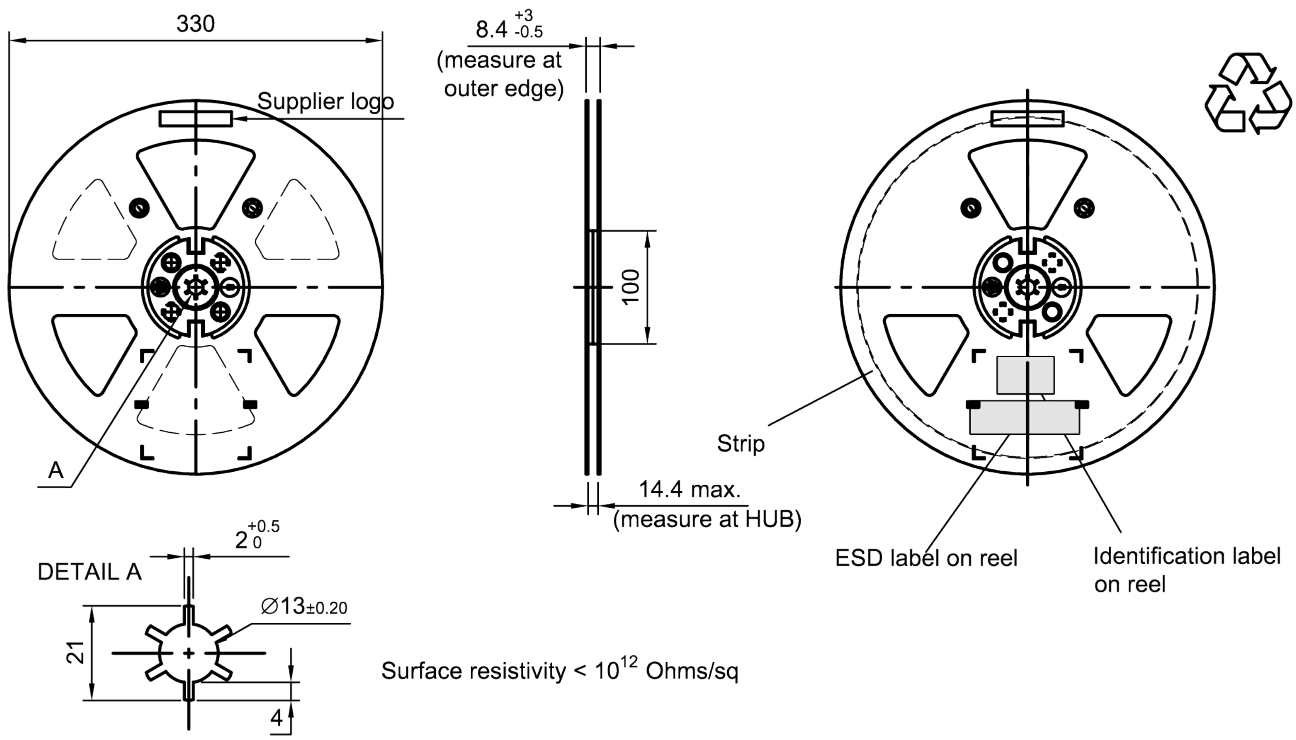

Figure 14: Drawing of reel (first-angle projection) with diameter of 330 mm.

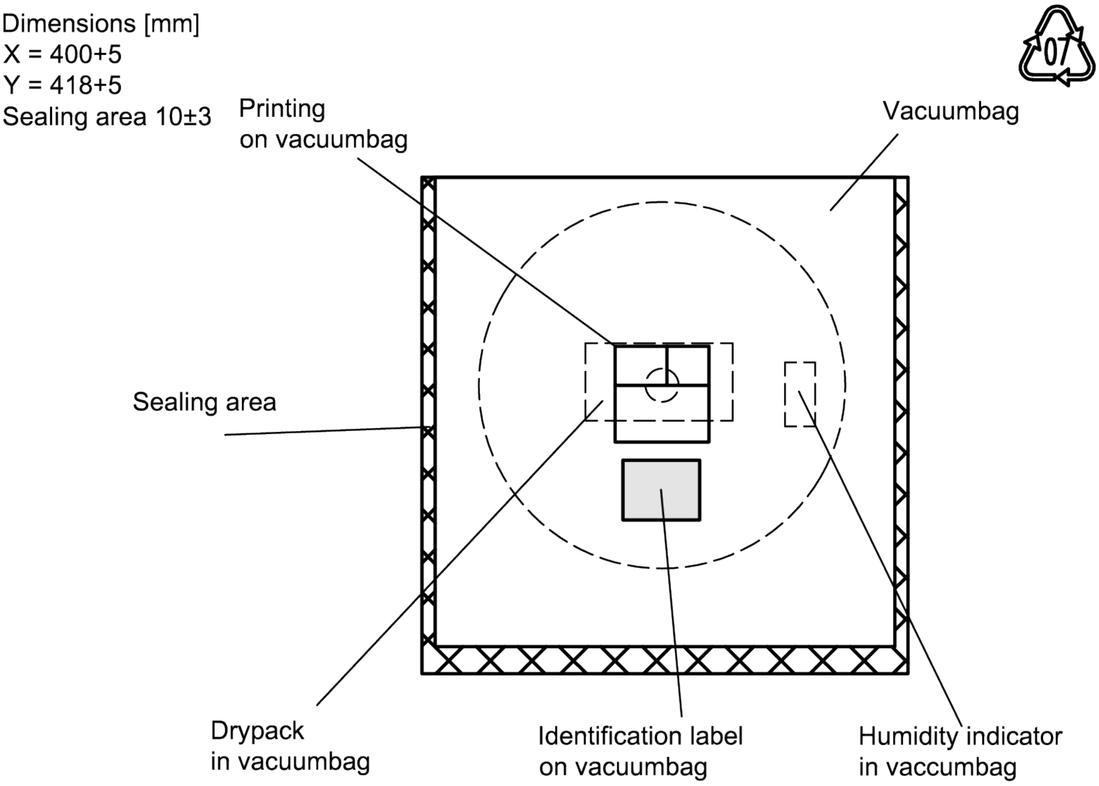

Figure 15: Drawing of moisture barrier bag (MBB) for reel with diameter of 330 mm.

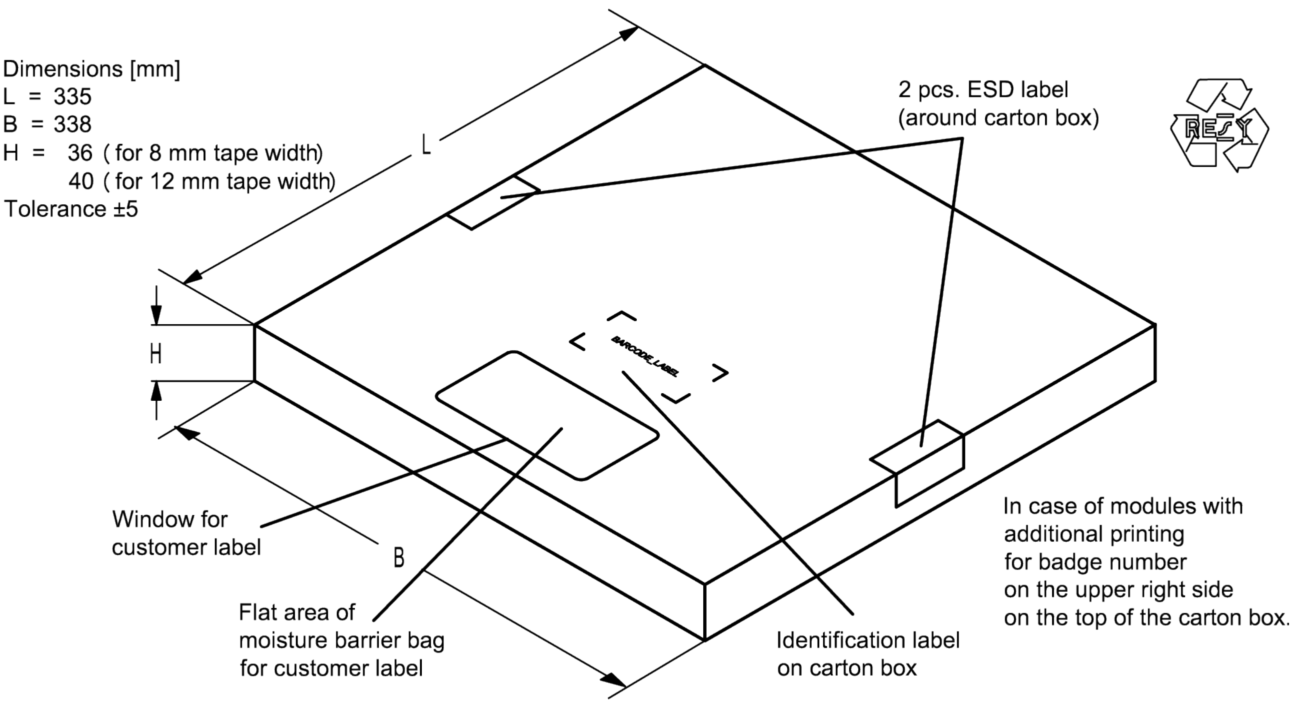

Figure 16: Drawing of folding box for reel with diameter of 330 mm.

11 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 B8209 is 80H.

- 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.

12 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).

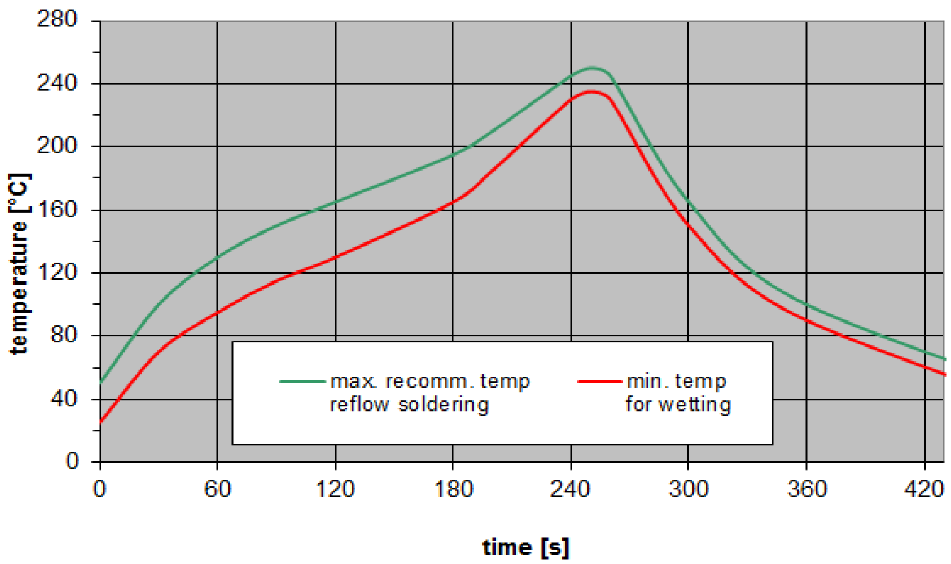

Figure 17: Recommended reflow profile for convection and infrared soldering – lead-free solder.

13 Annotations

13.1 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.

13.2 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.

13.3 Ordering codes and packing units

Ordering code	Packing unit
B39881B8209P810	5000 pcs

Table 4: Ordering codes and packing units.

14 Cautions and warnings

14.1 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/.

14.2 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.

14.3 Moldability

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

14.4 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.

15 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.

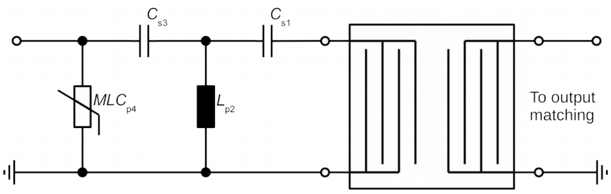

Figure 18: MLC varistor plus ESD matching.

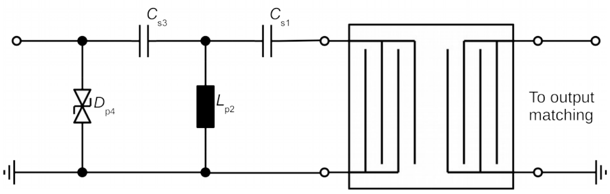

Figure 19: Suppressor diode plus ESD matching.

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

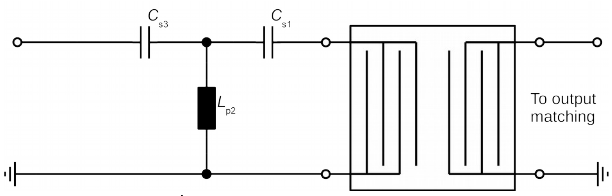

Figure 20: 3rd order high-pass structure for basic ESD protection.

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.

16 Important notes

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