



RF360
Europe GmbH

Data sheet

BAW filter
TD-LTE band 41

Part number:	B9650
Ordering code:	B39262B9650P810
Date:	October 08, 2021
Version:	2.0

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RF360 Europe GmbH
Anzinger Straße 13
81671 Munich, Germany

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1 Application

- Low-loss BAW RF single filter for TD-LTE Band 41
- TD-LTE band 41: 2593 MHz (pass band 194 MHz)

2 Features

- Industrial grade qualified family
- Package size $1.4_{\pm 0.1} \text{ mm} \times 1.1_{\pm 0.1} \text{ mm}$
- 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)

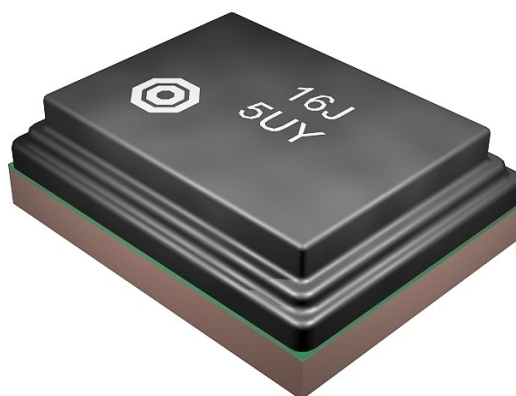
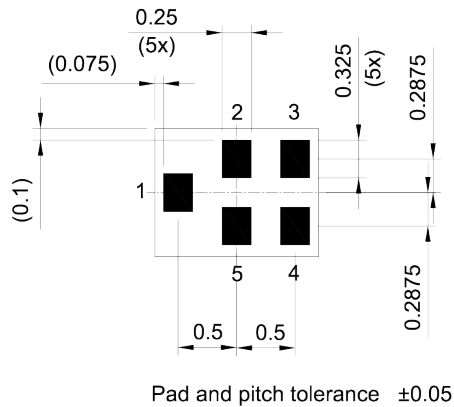


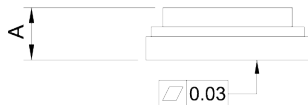
Figure 1: Picture of component with example of product marking.

3 Package

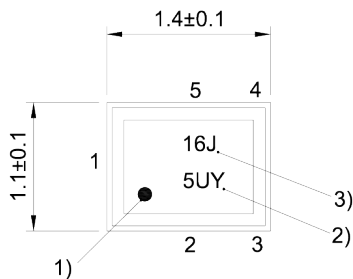
BOTTOM VIEW



SIDE VIEW

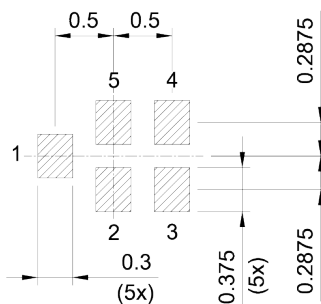


TOP VIEW



- 1) Marking for pad number 1
- 2) Example of encoded lot number
- 3) Example of encoded filter type number

Land pattern
THRU VIEW



Landing pad tolerance -0.02

Figure 2: Drawing of package with package height A = 0.45 mm (max.). See Sec. Package information (p. 20).

4 Pin configuration

- 1 Input
- 4 Output
- 2, 3, 5 Ground

5 Matching circuit

■ $L_{p1} = 5.0 \text{ nH}$

■ $L_{p4} = 5.0 \text{ nH}$

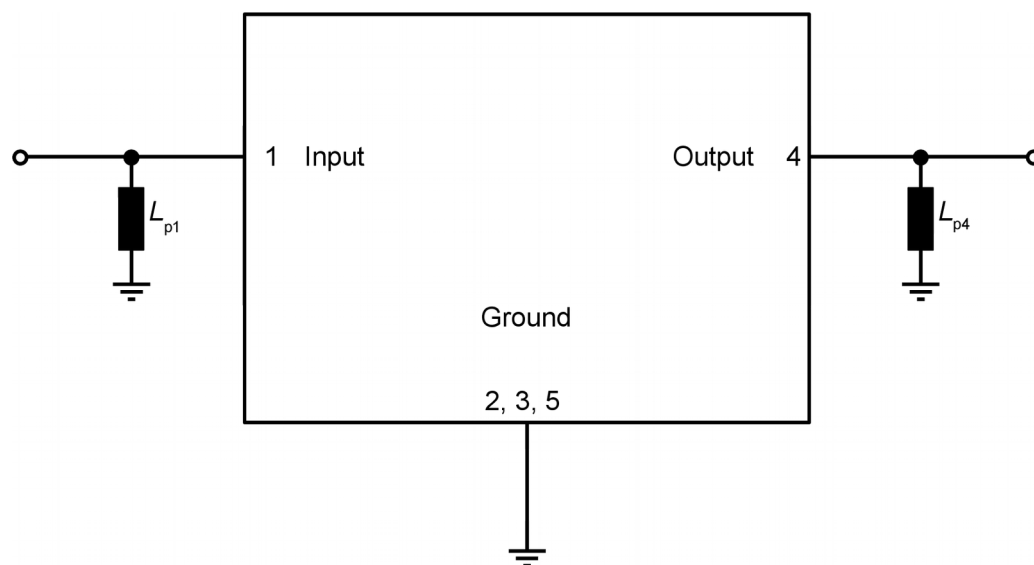


Figure 3: Schematic of matching circuit.

6 Characteristics

Temperature range for specification

$$T_{\text{SPEC}} = -10\text{ °C} \dots +85\text{ °C}$$

Input terminating impedance

$$Z_{\text{IN}} = 50\ \Omega // 5.0\ \text{nH}^{(1)}$$

Output terminating impedance

$$Z_{\text{OUT}} = 50\ \Omega // 5.0\ \text{nH}^{(1)}$$

Characteristics			min. for T_{SPEC}	typ. @ +25 °C	max. for T_{SPEC}	
Insertion attenuation						
		$\alpha_{\text{INT}}^{(2)}$				
	2496... 2501	MHz	—	2.7	3.4 ^(3),4)	dB
	2501... 2685	MHz	—	2.2	3.4	dB
	2685... 2690	MHz	—	2.3	3.6	dB
Maximum insertion attenuation						
		α_{max}				
	2496... 2502	MHz	—	3.0	4.5 ^(3),5)	dB
	2502... 2687	MHz	—	2.3	3.5	dB
	2687... 2690	MHz	—	2.5	4.2	dB
Amplitude ripple (p-p)						
		$\Delta\alpha$				
	2496... 2502	MHz	—	2.5	3.5 ^(3),6)	dB
	2502... 2687	MHz	—	1.2	2.7	dB
	2687... 2690	MHz	—	1.6	3.2	dB
Maximum VSWR						
		VSWR _{max}				
@ input port	2496... 2690	MHz	—	1.5	2.2	
@ output port	2496... 2690	MHz	—	1.5	2.2	
Attenuation						
		$\alpha_{\text{WLAN}}^{(7)}$				
WLAN ch1	2403.1... 2420.9	MHz	40	44	—	dB
WLAN ch2	2408.1... 2425.9	MHz	40	43	—	dB
WLAN ch3	2413.1... 2430.9	MHz	40	43	—	dB
WLAN ch4	2418.1... 2435.9	MHz	40	43	—	dB
WLAN ch5	2423.1... 2440.9	MHz	40	43	—	dB
WLAN ch6	2428.1... 2445.9	MHz	40	44	—	dB
WLAN ch7	2433.1... 2450.9	MHz	40	45	—	dB
WLAN ch8	2438.1... 2455.9	MHz	40	47	—	dB
WLAN ch9	2443.1... 2460.9	MHz	40	49	—	dB
WLAN ch10	2448.1... 2465.9	MHz	40	49	—	dB
WLAN ch11	2453.1... 2470.9	MHz	36	47	—	dB
WLAN ch12	2458.1... 2475.9	MHz	18	47	—	dB
Minimum attenuation						
		α_{min}				
	50... 960	MHz	38	41	—	dB
	960... 1710	MHz	25	27	—	dB
	1710... 1785	MHz	25	27	—	dB
	1785... 1805	MHz	25	27	—	dB
	1805... 1880	MHz	25	27	—	dB
	1880... 1915	MHz	25	27	—	dB
	1915... 1930	MHz	25	27	—	dB

Characteristics			min. for T_{SPEC}	typ. @ +25 °C	max. for T_{SPEC}	
	1930... 1995	MHz	25	27	—	dB
	2110... 2200	MHz	25	28	—	dB
	2200... 2300	MHz	26	30	—	dB
	2300... 2400	MHz	30	34	—	dB
	2456... 2476	MHz	12	45	—	dB
	2710... 2730	MHz	14 ^{3),8)}	22	—	dB
	2730... 2770	MHz	40	56	—	dB
	2770... 2840	MHz	35	38	—	dB
	2840... 3550	MHz	28	32	—	dB
	3550... 3980	MHz	22	33	—	dB
	3980... 4992	MHz	30	36	—	dB
	4992... 5380	MHz	36	47	—	dB
	5380... 5850	MHz	30	44	—	dB
	5850... 7000	MHz	25	37	—	dB
	7000... 7990	MHz	14	34	—	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.

³⁾ Valid for temperature $T = +25\text{ °C}...+85\text{ °C}$.

⁴⁾ Max=4.3 dB for temperature $T = -10\text{ °C}...+85\text{ °C}$.

⁵⁾ Max=5.4 dB for temperature $T = -10\text{ °C}...+85\text{ °C}$.

⁶⁾ Max=4.9 dB for temperature $T = -10\text{ °C}...+85\text{ °C}$.

⁷⁾ Average over each WLAN channel with band width of 17.8 MHz.

⁸⁾ Min=10 dB for temperature $T = -10\text{ °C}...+85\text{ °C}$.

7 Maximum ratings

Operable temperature	$T_{OP} = -40\text{ °C} \dots +95\text{ °C}$	
Storage temperature	$T_{STG}^{1)} = -40\text{ °C} \dots +95\text{ °C}$	
DC voltage	$ V_{DC} ^{2)} = 0\text{ V (max.)}$	
ESD voltage		
	$V_{ESD}^{3)} = 150\text{ V (max.)}$	Machine model.
	$V_{ESD}^{4)} = 250\text{ V (max.)}$	Human body model.
Input power	P_{IN}	
@ input port: 2496 ... 2690 MHz	24 dBm	Continuous wave for 24 h @ 85 °C. Source and load impedance 50Ω. ⁵⁾
@ input port: 2496 ... 2690 MHz	15 dBm	Continuous wave for 100000 h @ 55 °C. Source and load impedance 50Ω.
@ input port: other frequency ranges	10 dBm	Continuous wave for 100000 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 tests, and wear out models.

8 Transmission coefficient

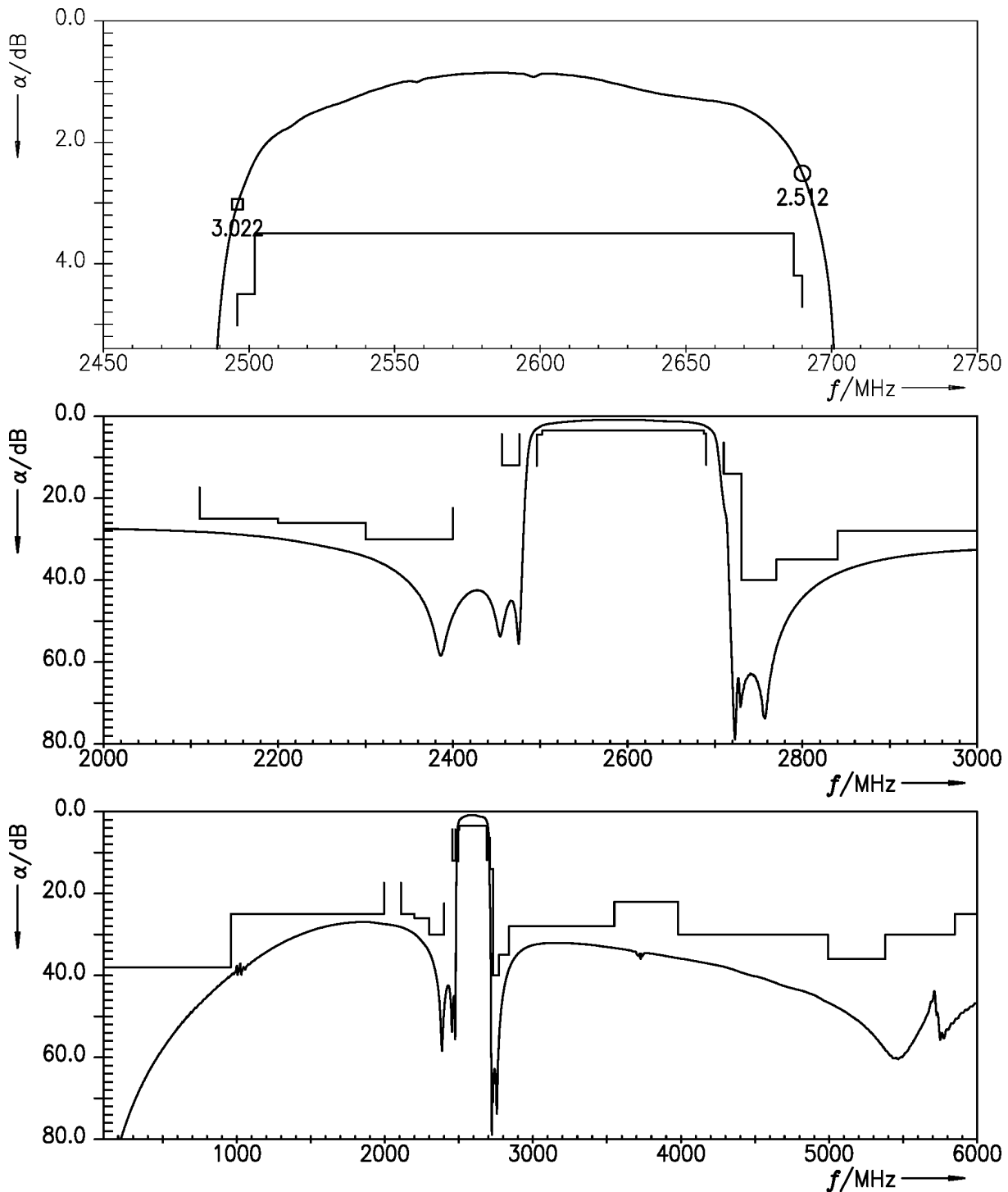


Figure 4: Attenuation.

9 Transmission coefficient (WLAN)

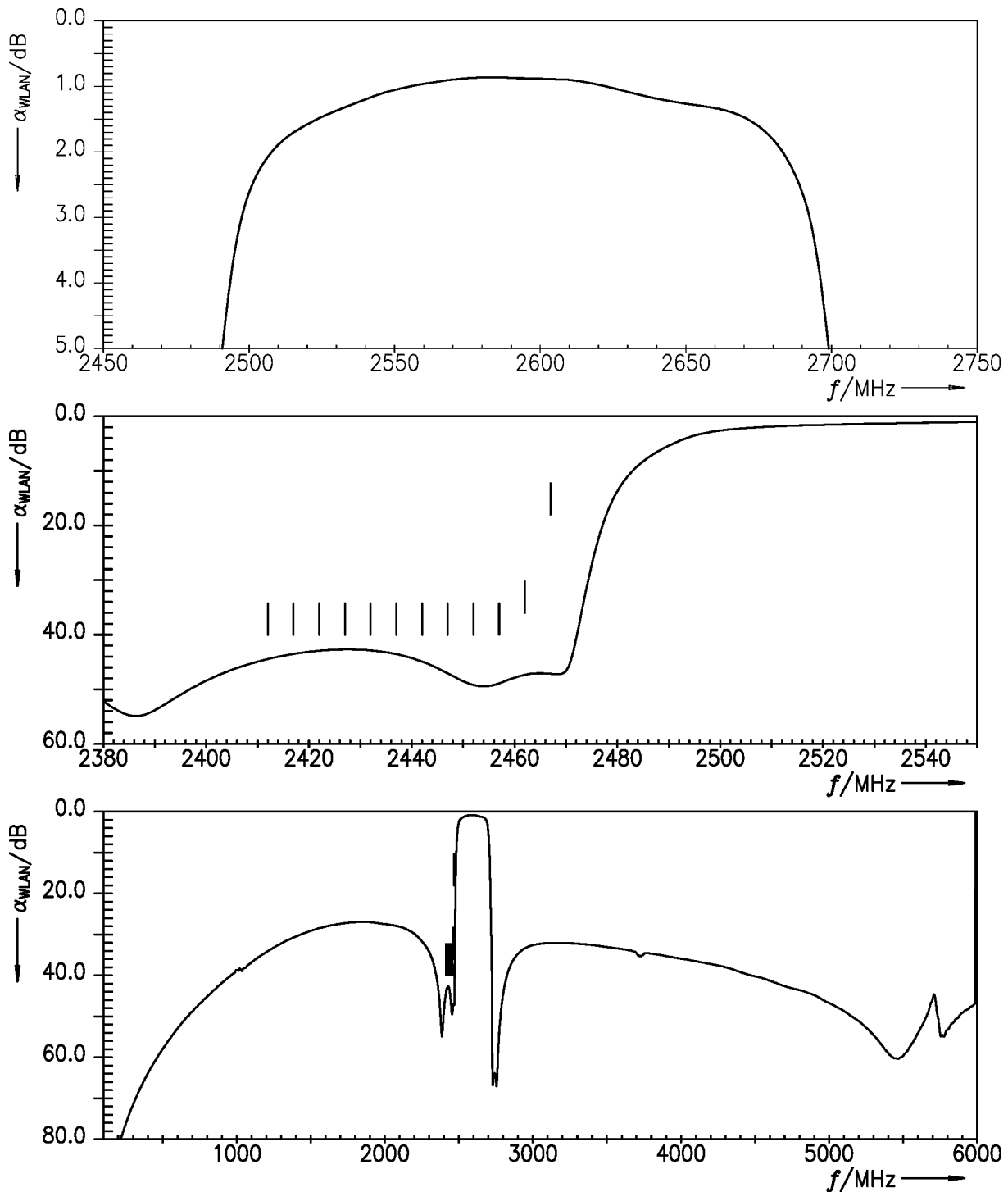


Figure 5: Attenuation (WLAN) (integration window = 17.8 MHz).

10 Reflection coefficients

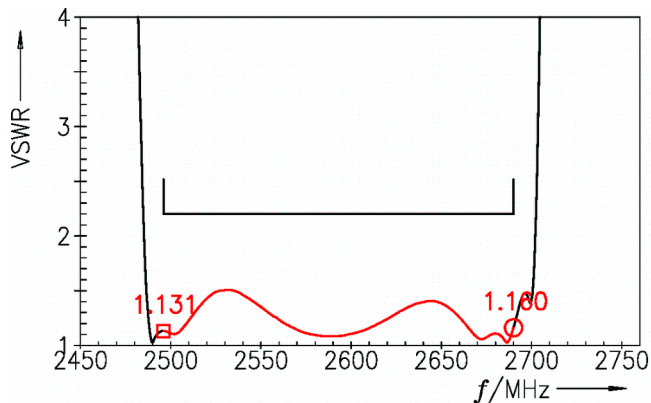


Figure 6: Reflection coefficient at input port.

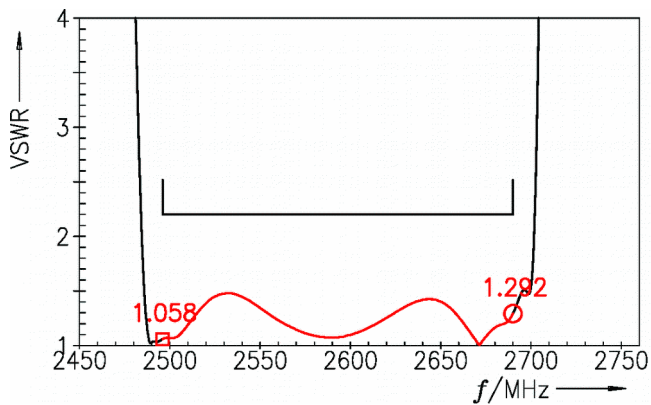
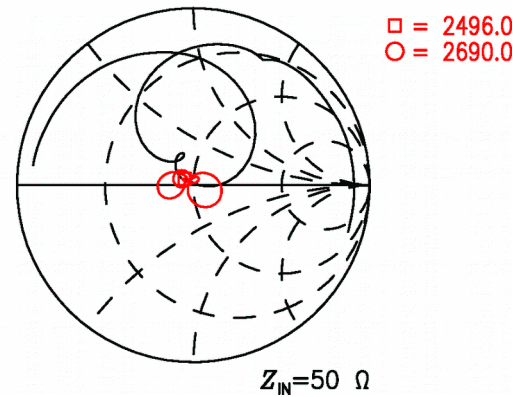
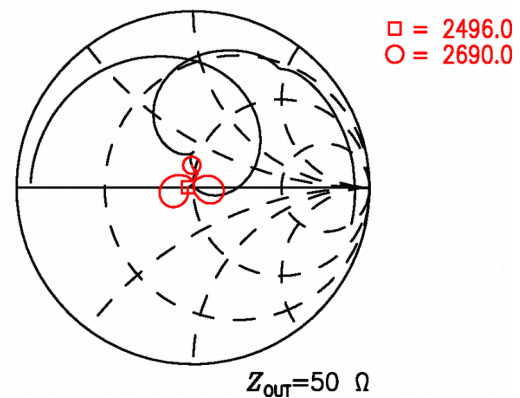


Figure 7: Reflection coefficient at output port.



11 Packing material

11.1 Tape

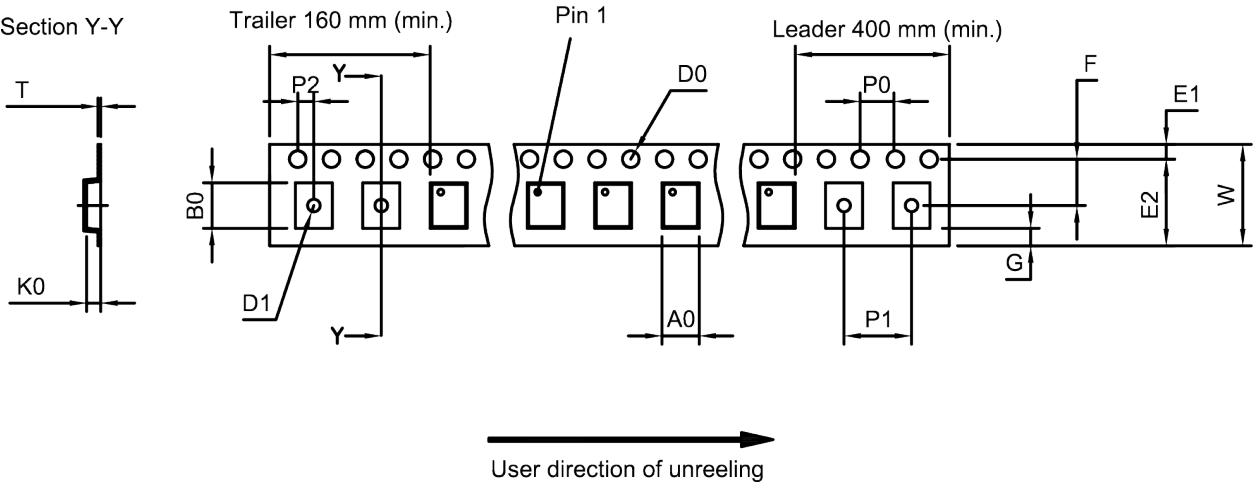


Figure 8: Drawing of tape (first-angle projection) for illustration only and not to scale. The valid tape dimensions are listed in Table 1.

A ₀	1.27±0.05 mm	E ₂	6.25 mm (min.)	P ₁	4.0±0.1 mm
B ₀	1.57±0.05 mm	F	3.5±0.05 mm	P ₂	2.0±0.05 mm
D ₀	1.5+0.1/-0 mm	G	0.75 mm (min.)	T	0.25±0.03 mm
D ₁	0.5±0.1 mm	K ₀	0.62±0.05 mm	W	8.0+0.3/-0.1 mm
E ₁	1.75±0.1 mm	P ₀	4.0±0.1 mm		

Table 1: Tape dimensions.

11.2 Reel with diameter of 180 mm

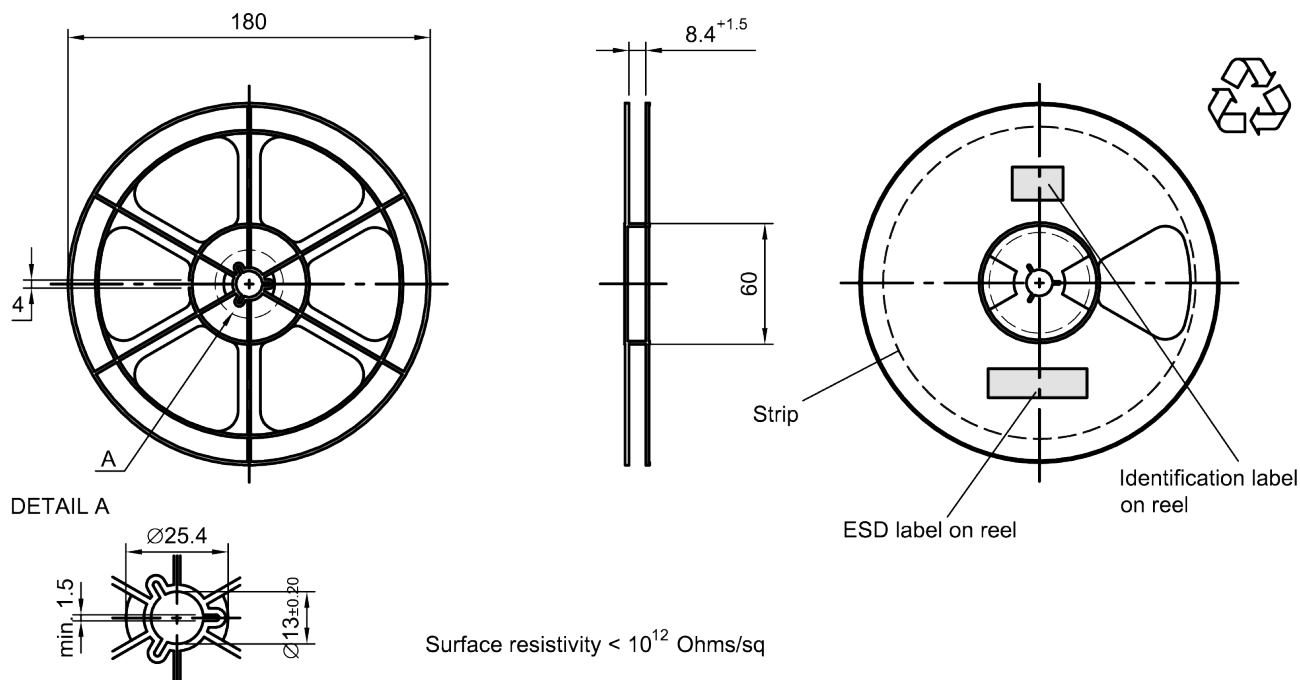


Figure 9: Drawing of reel (first-angle projection) with diameter of 180 mm.

Dimensions [mm]

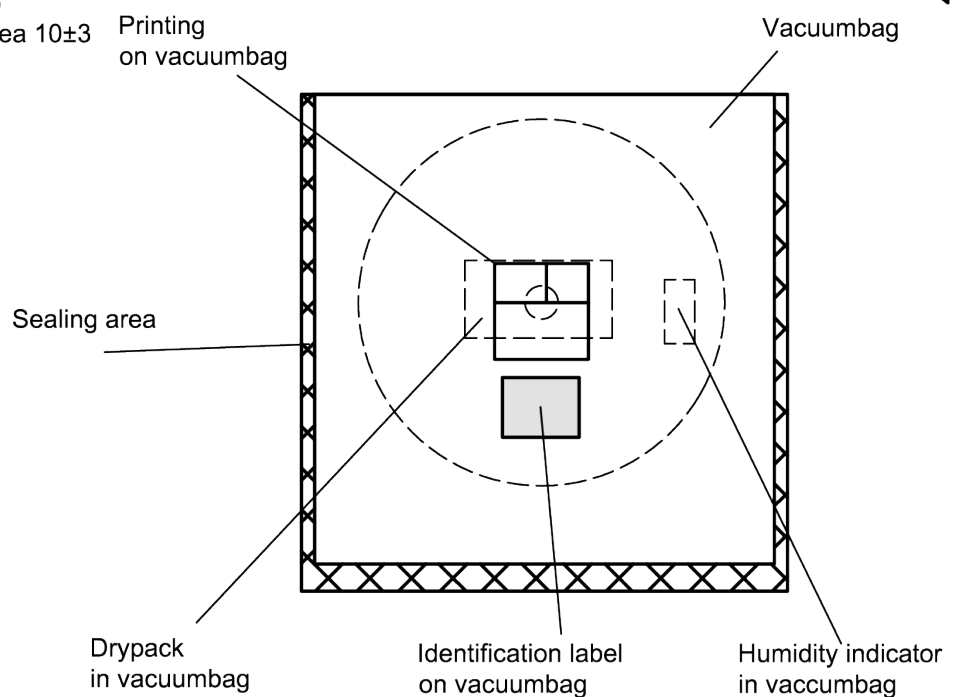
$$X = 220 + 5$$
$$Y = 235 + 5$$
Sealing area 10 ± 3 

Figure 10: Drawing of moisture barrier bag (MBB) for reel with diameter of 180 mm.

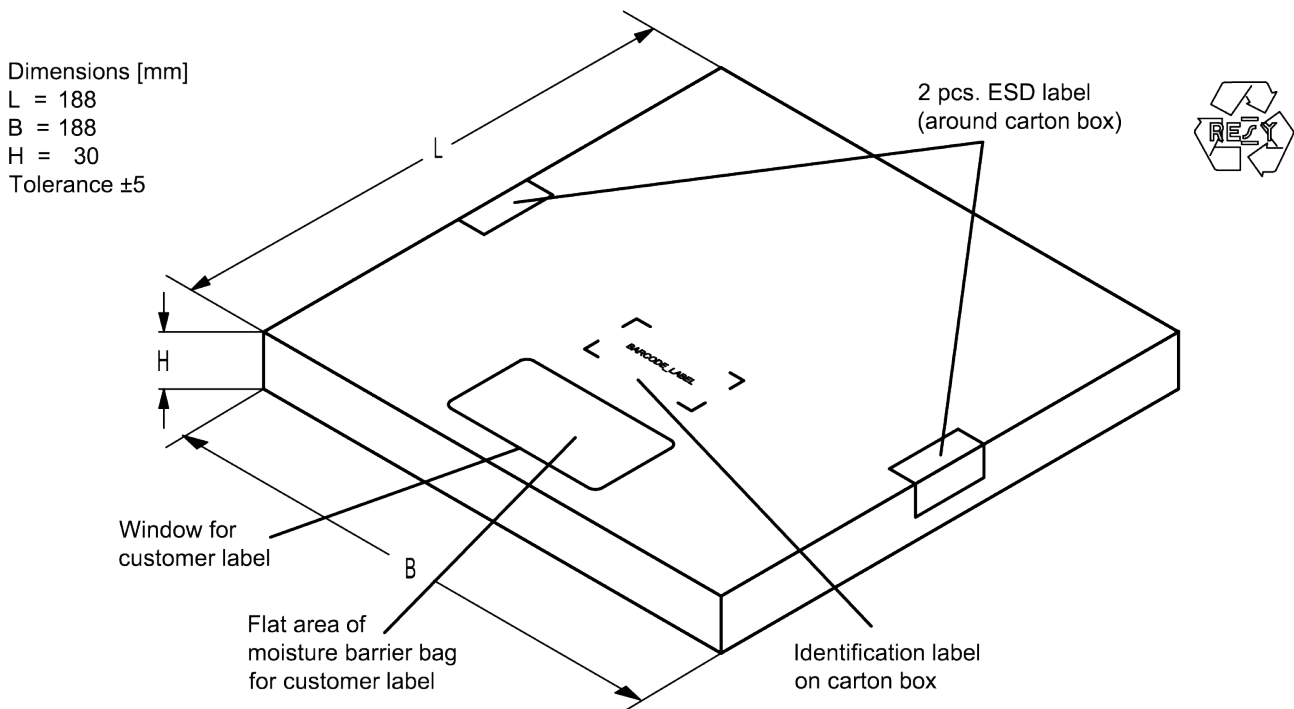


Figure 11: Drawing of folding box for reel with diameter of 180 mm.

11.3 Reel with diameter of 330 mm

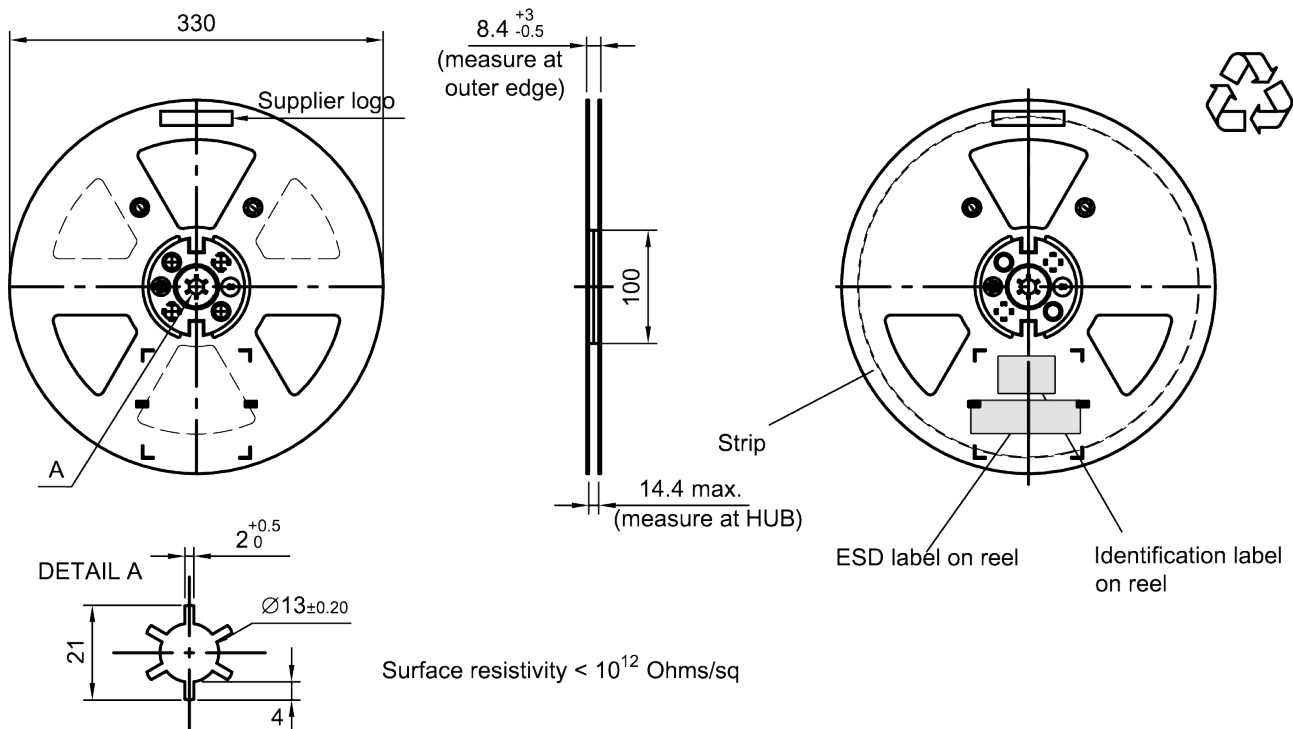


Figure 12: Drawing of reel (first-angle projection) with diameter of 330 mm.

Dimensions [mm]

X = 400+5

Y = 418+5

Sealing area 10±3

Printing
on vacuumbag

Sealing area

Drypack
in vacuumbag

Identification label
on vacuumbag

Vacuumbag

Humidity indicator
in vacuumbag



Figure 13: Drawing of moisture barrier bag (MBB) for reel with diameter of 330 mm.

Dimensions [mm]

L = 335

B = 338

H = 36 (for 8 mm tape width)

40 (for 12 mm tape width)

Tolerance ±5

2 pcs. ESD label
(around carton box)



Window for
customer label

Flat area of
moisture barrier bag
for customer label

Identification label
on carton box

In case of modules with
additional printing
for badge number
on the upper right side
on the top of the carton box.

Figure 14: Drawing of folding box for reel with diameter of 330 mm.

12 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 \Rightarrow **1234**
 $1 \times 32^2 + 6 \times 32^1 + 18 (=J) \times 32^0 =$ **1234**

The BASE32 code for product type B9650 is 9DJ.

■ 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 \Rightarrow **12345**
 $5 \times 47^2 + 27 (=U) \times 47^1 + 31 (=Y) \times 47^0 =$ **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.

13 Soldering profile

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

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

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

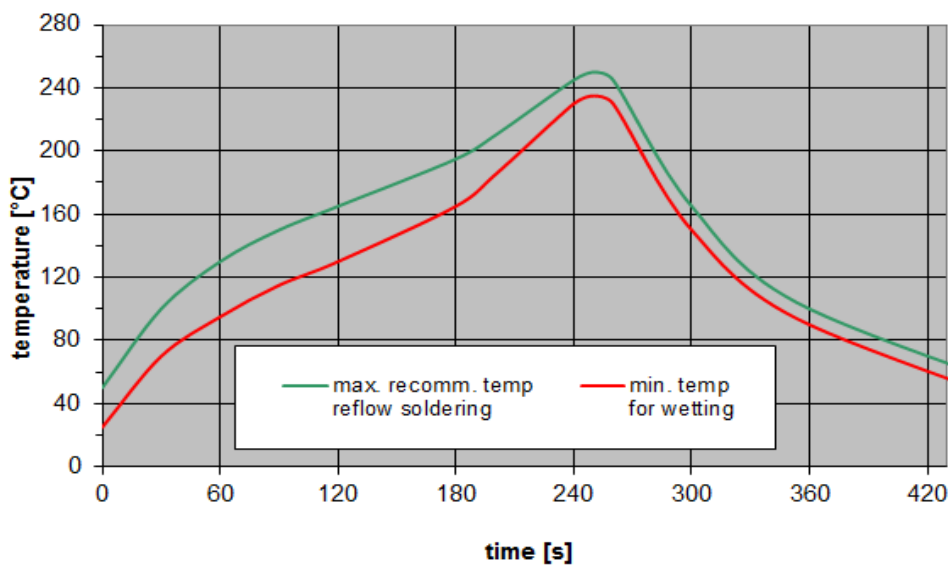


Figure 15: Recommended reflow profile for convection and infrared soldering – lead-free solder.

14 Annotations

14.1 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.

14.2 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.

14.3 Ordering codes / product IDs and packing units

Ordering code / product ID	RF360 label
B39262B9650P810	5000 pcs

Table 4: Ordering codes / product IDs and packing units.

15 Cautions and warnings

15.1 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/>.

15.2 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.

15.3 Moldability

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

15.4 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.

16 ESD protection of acoustic devices

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

In general, “ESD matching” must be ensured at that electrical port, where electrostatic discharge is expected.

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

Below three figures show recommended “ESD matching” topologies.

For wide band acoustic devices 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 input port. The required component values must be determined from case to case.

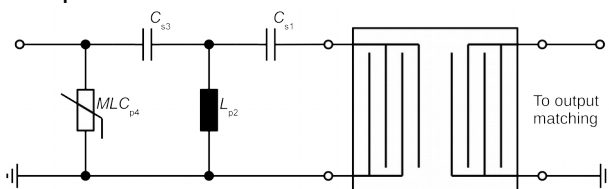


Figure 16: MLC varistor plus ESD matching.

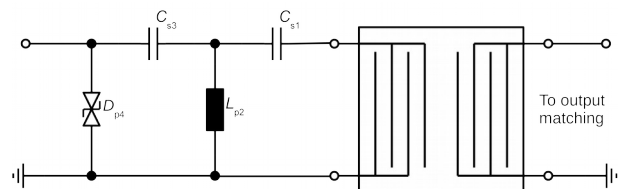


Figure 17: Suppressor diode plus ESD matching.

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

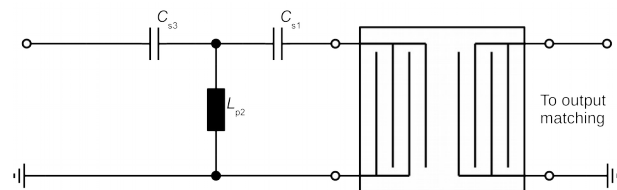


Figure 18: 3rd order high-pass structure for basic ESD protection.

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 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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