



RF360
Europe GmbH

Data sheet

SAW Rx filter
Automotive Telematics
LTE band 2

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1 Application

- Low-loss RF filter for PCB systems, receive path (RX)
- Impedance transform from 50 Ω to 150 Ω
- Unbalanced to balanced operation
- Very low insertion attenuation
- Low amplitude ripple
- Usable pass band 60 MHz
- Suitable for GPRS class1 to 12

2 Features

- Package size 1.4 $\pm$ 0.1 mm $\times$ 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 3: -40 $^{\circ}$ C to +85 $^{\circ}$ C)

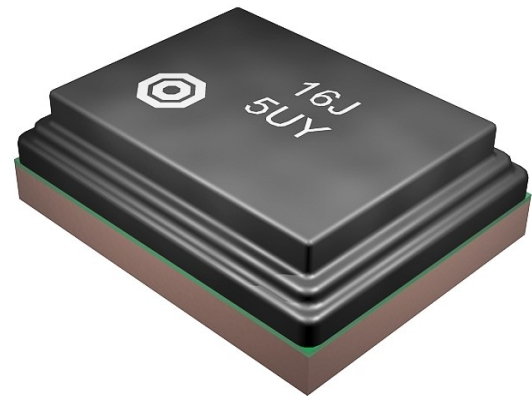
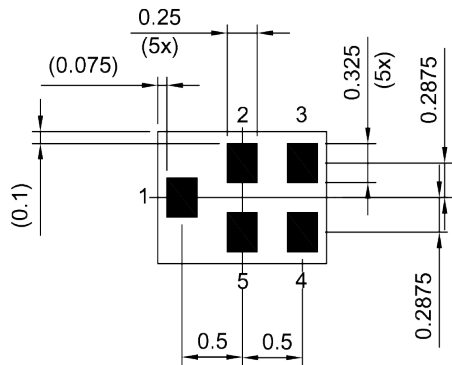


Figure 1: Picture of component with example of product marking.

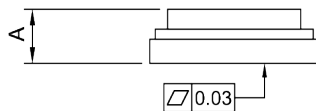
3 Package

BOTTOM VIEW

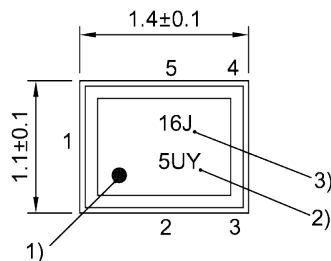


Pad and pitch tolerance ± 0.05

SIDE VIEW

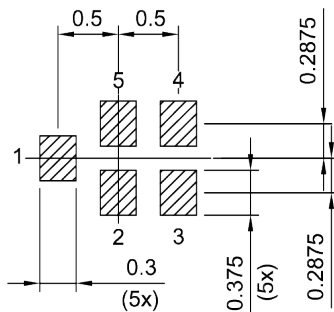


TOP VIEW



- 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. 19).

4 Pin configuration

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

5 Matching circuit

■ $L_{p3,4} = 15 \text{ nH}$

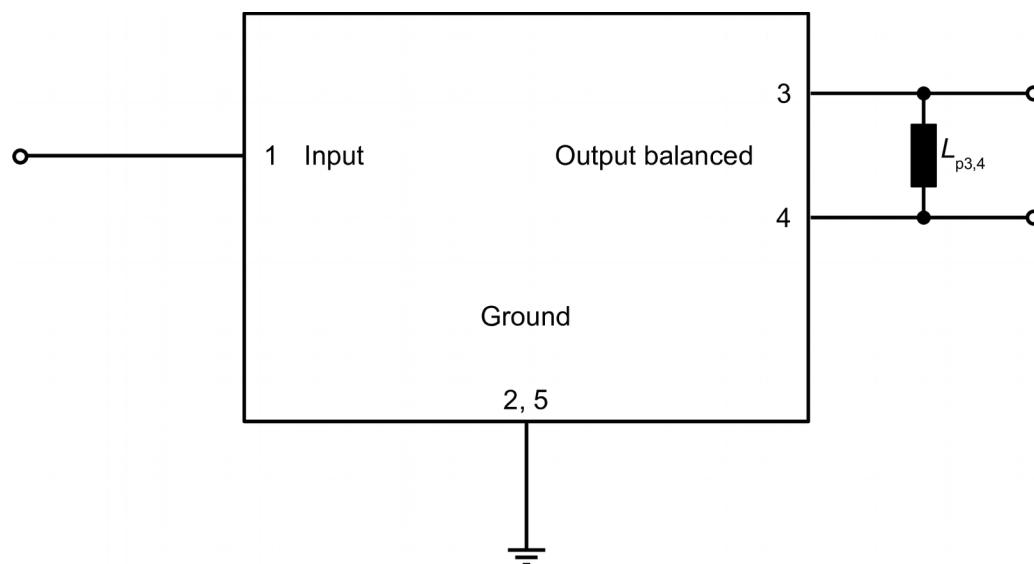


Figure 3: Schematic of matching circuit.

6 Characteristics

Temperature range for specification	T_{SPEC}	= -20 °C ... +75 °C
Input terminating impedance	Z_{IN}	= 50 Ω
Output terminating impedance	Z_{OUT}	= 150 Ω // 15 nH ¹⁾

Characteristics			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	—	1.7	2.6	dB
Amplitude ripple (p-p)		$\Delta\alpha$				
	1930... 1990	MHz	—	0.7	1.7	dB
Maximum VSWR		$VSWR_{max}$				
@ input port	1930... 1990	MHz	—	1.7	2.4	
@ output port	1930... 1990	MHz	—	1.7	2.4	
Minimum common-mode rejection ratio		$CMRR_{min}$				
$(S_{21}-S_{31} / S_{21}+S_{31})$	1930... 1990	MHz	19 ²⁾	26	—	dB
Minimum attenuation		α_{min}				
	10... 1500	MHz	40	44	—	dB
	1500... 1830	MHz	30	37	—	dB
	1830... 1850	MHz	26	32	—	dB
	1850... 1890	MHz	23	28	—	dB
	1890... 1910	MHz	11	18	—	dB
	2010... 2070	MHz	4 ³⁾	14	—	dB
	2070... 2400	MHz	26	30	—	dB
	2400... 2500	MHz	34	40	—	dB
	2500... 3860	MHz	28	33	—	dB
	3860... 3980	MHz	40	49	—	dB
	3980... 5790	MHz	28	41	—	dB
	5790... 6000	MHz	34	42	—	dB

¹⁾ See Sec. Matching circuit (p. 6).

²⁾ A CMRR of 19.6 d B corresponds to a phase imbalance of +/-10° together with an amplitude imbalance of +/-1.0 d B .

³⁾ 11.5dB at 25°C.

7 Maximum ratings

Operable temperature	$T_{OP} = -40\text{ °C} \dots +85\text{ °C}$	
Storage temperature	$T_{STG}^{1)} = -40\text{ °C} \dots +85\text{ °C}$	
DC voltage	$ V_{DC} ^{2)} = 0\text{ V (max.)}$	
ESD voltage	$V_{ESD}^{3)} = 50\text{ V}$	Machine model.
Input power	P_{IN}	
GSM850,GSM900 Tx bands @ input port	15 dBm	Peak power of GSM signal.
GSM1800,GSM1900 Tx bands @ input port	15 dBm	Duty cycle 4:8.

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.

8 Transmission coefficient

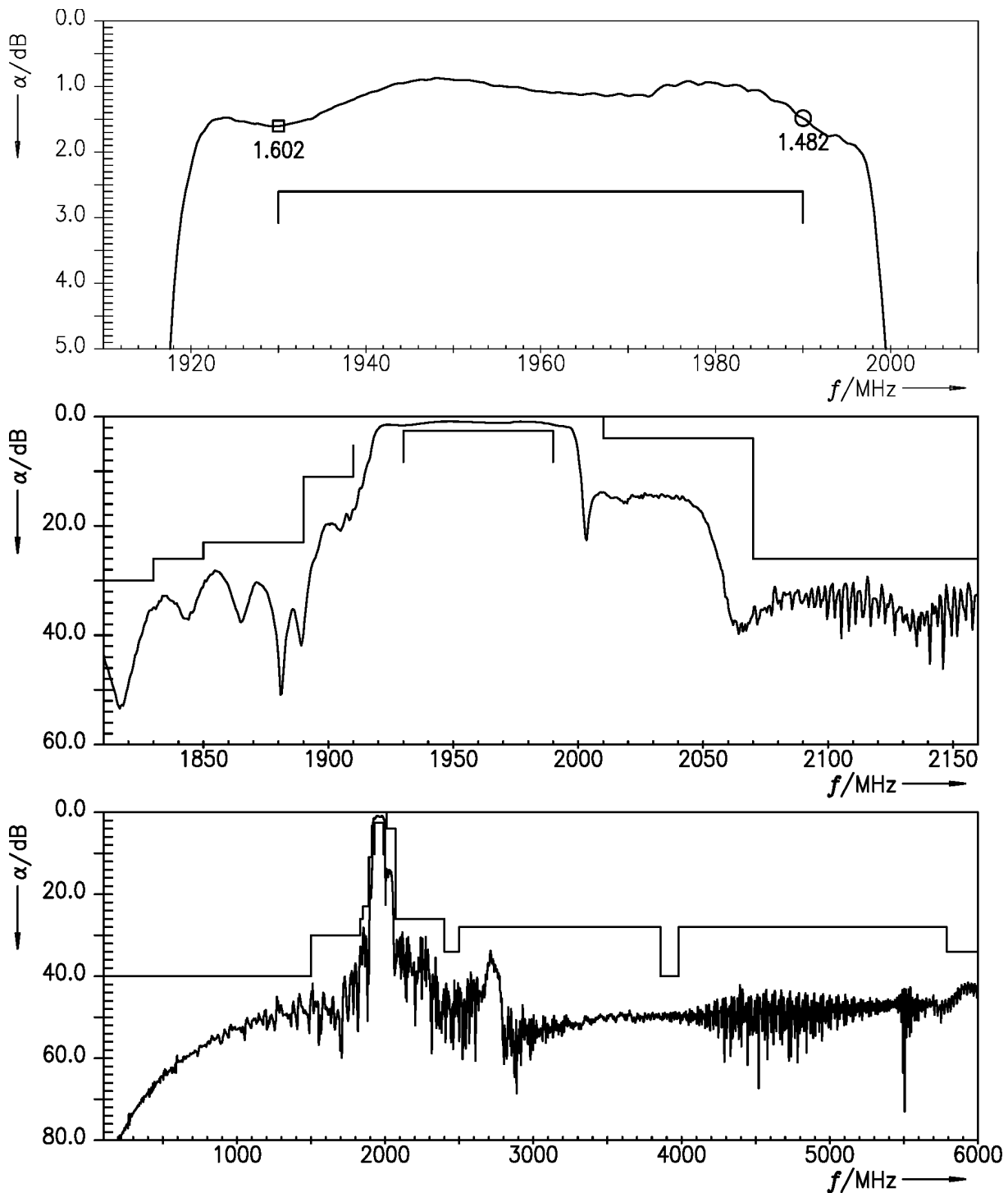


Figure 4: Attenuation.

9 Reflection coefficients

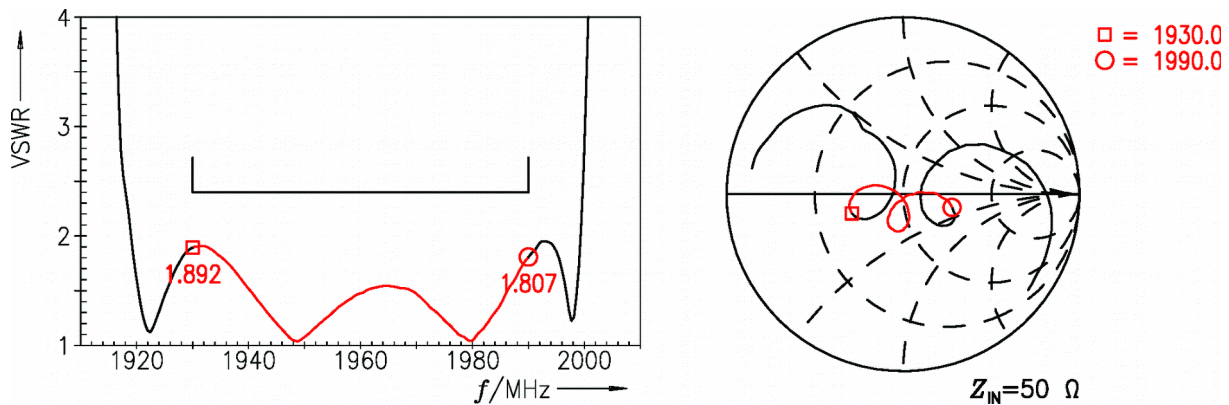


Figure 5: Reflection coefficient at input port.

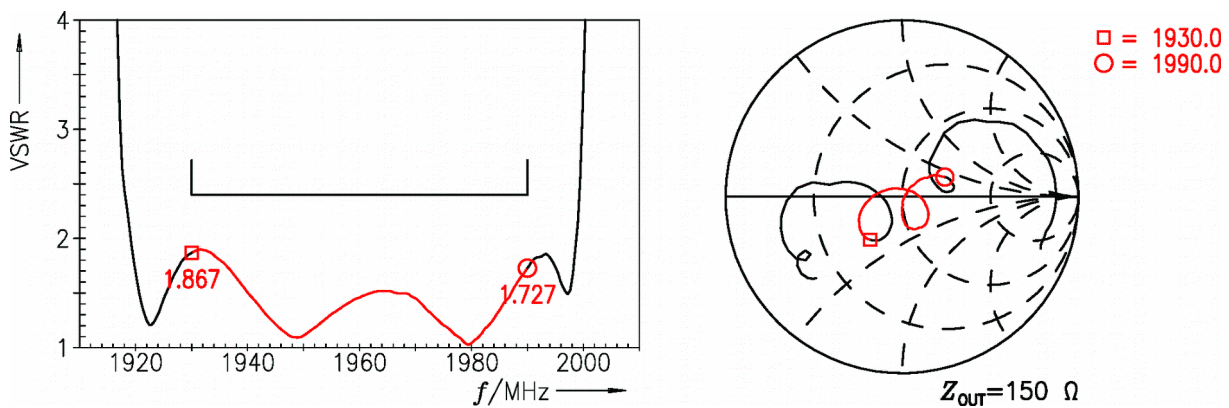
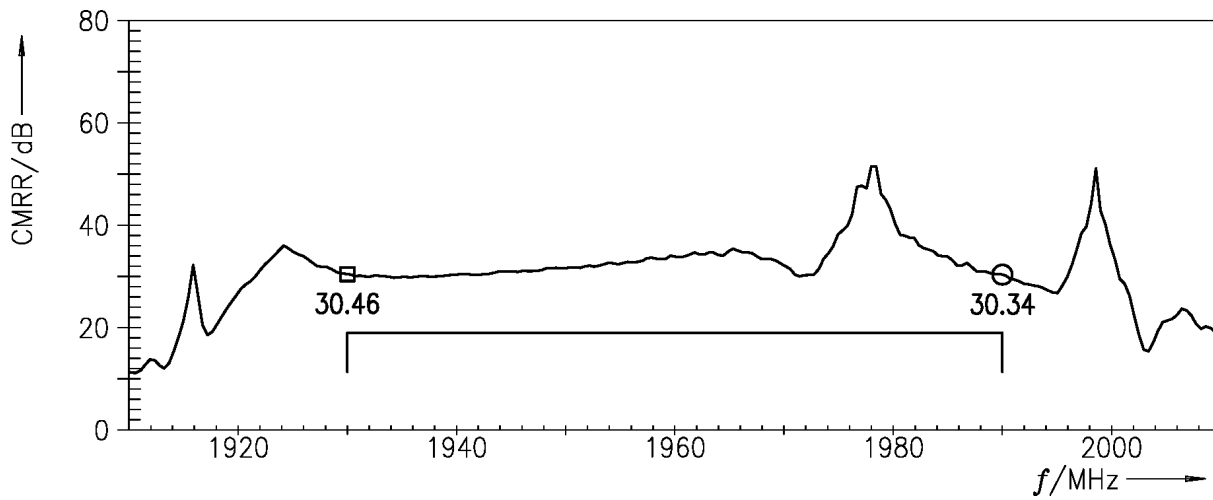


Figure 6: Reflection coefficient at output port.

10 Common-mode rejection ratio**Figure 7:** Common-mode rejection ratio.

11 Packing material

11.1 Tape

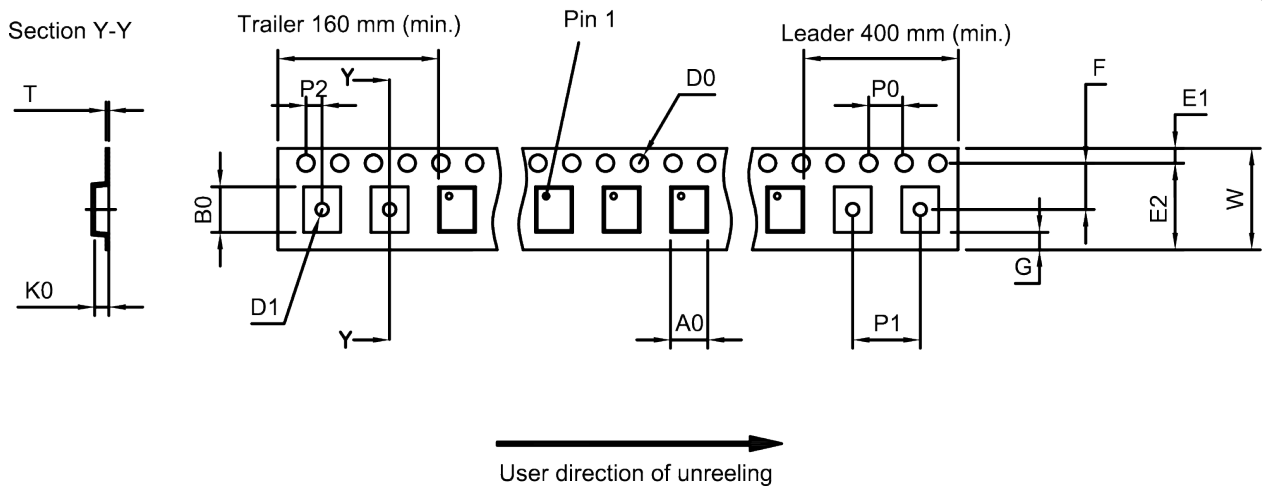


Figure 8: Drawing of tape (first-angle projection) for illustration only and not to scale. The valid tape dimensions are listed in Table 1.

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

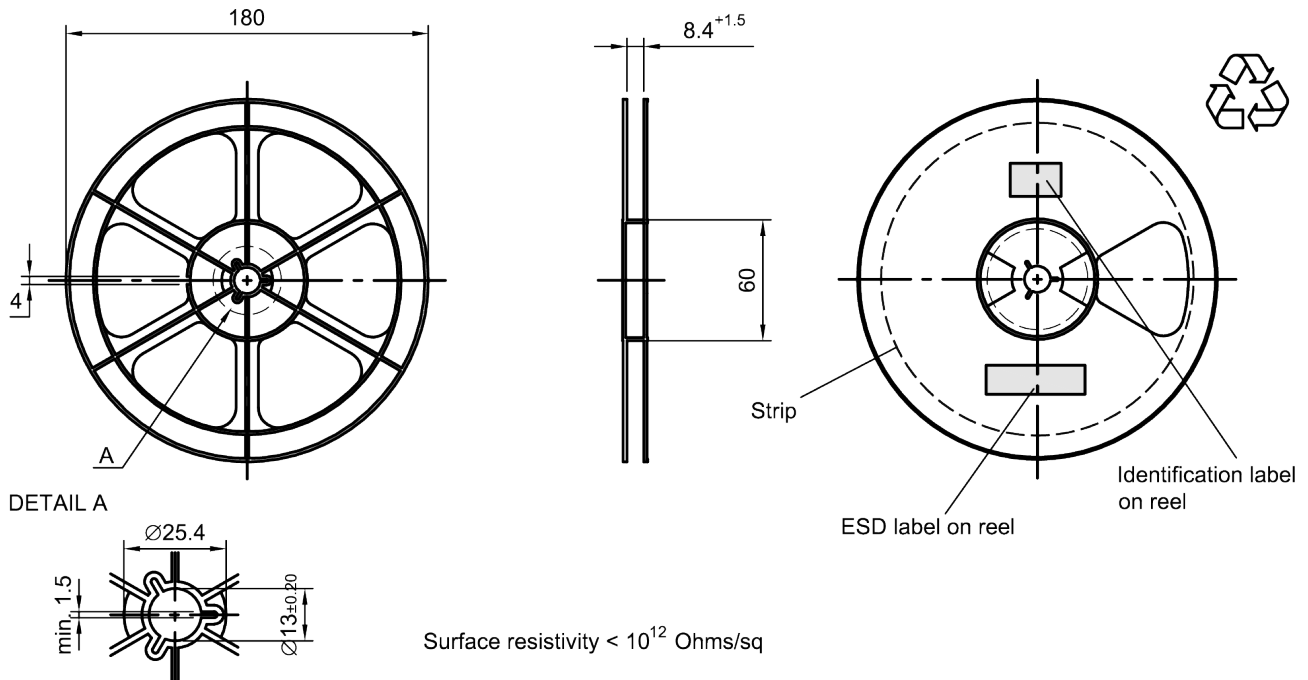


Figure 9: Drawing of reel (first-angle projection) with diameter of 180 mm.

Dimensions [mm]

X = 220+5

Y = 235+5

Sealing area 10±3

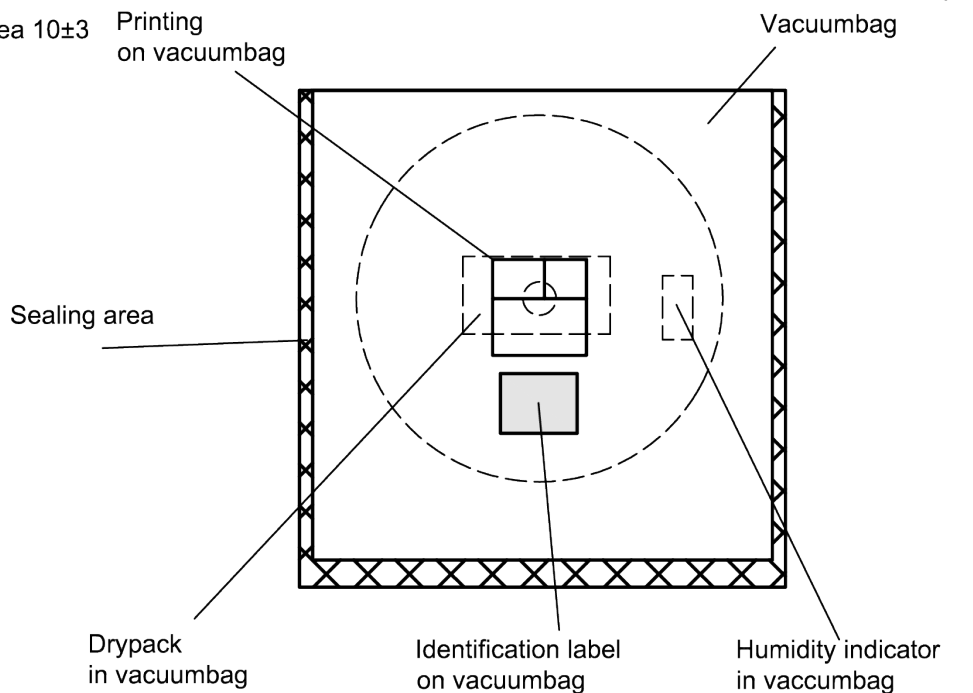


Figure 10: Drawing of moisture barrier bag (MBB) for reel with diameter of 180 mm.

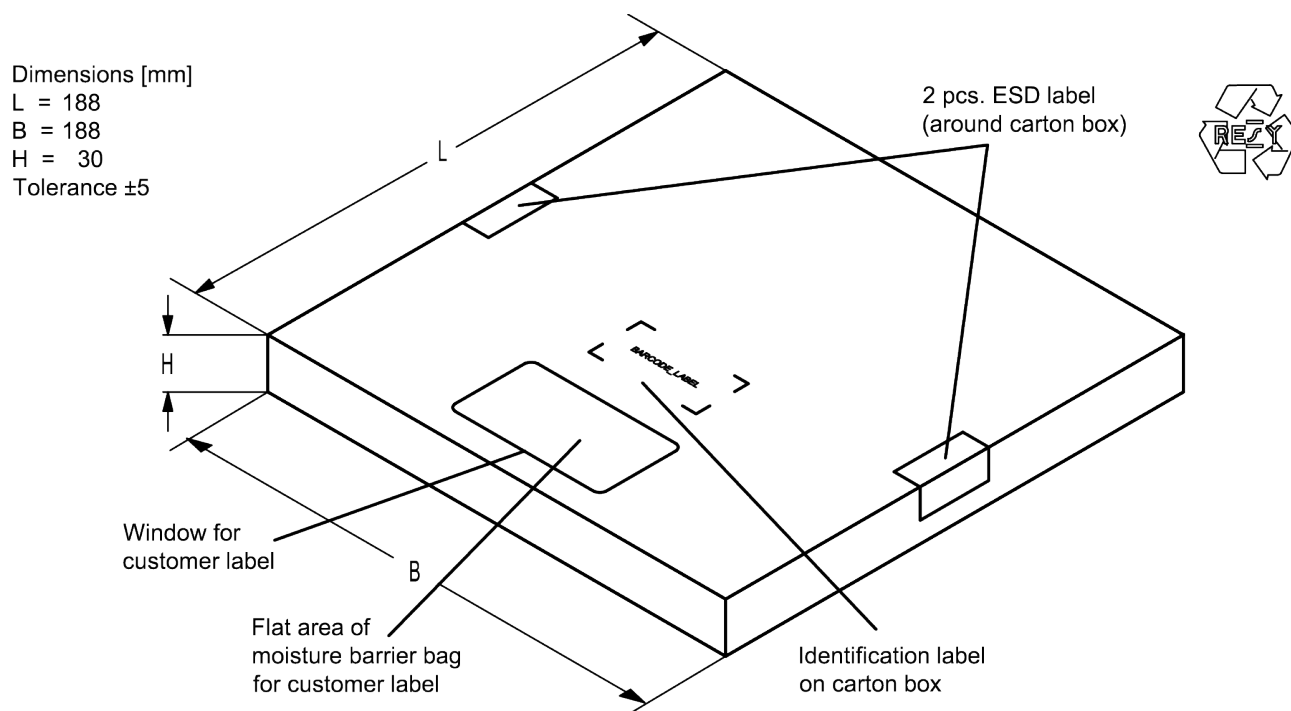


Figure 11: Drawing of folding box for reel with diameter of 180 mm.

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 B4305 is 46H.

■ 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	≤ 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
$T \geq 255$ °C	–
peak temperature T_{peak}	250 °C +0/-5 °C
wetting temperature T_{min}	230 °C +5/-0 °C for $10 \text{ s} \pm 1 \text{ s}$
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).

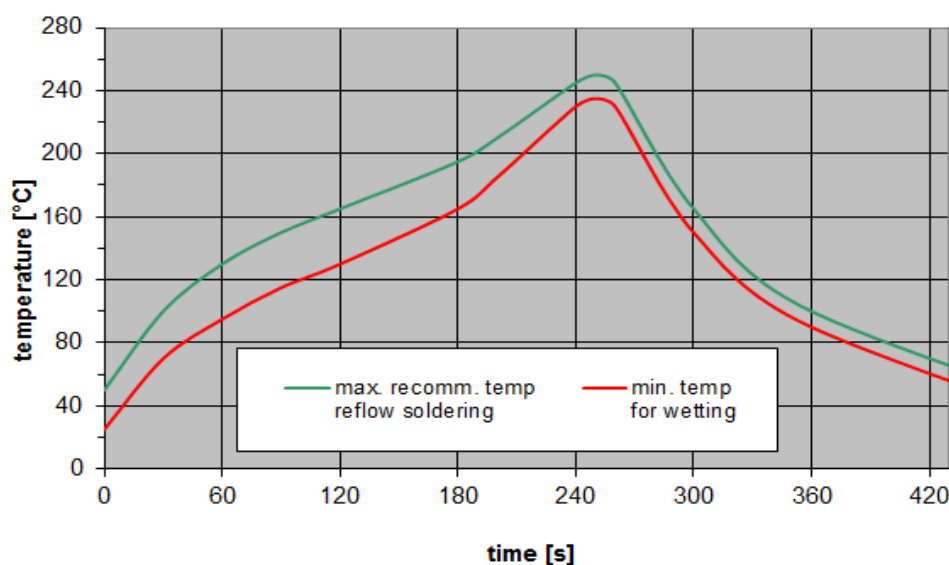


Figure 12: Recommended reflow profile for convection and infrared soldering – lead-free solder.

14 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.

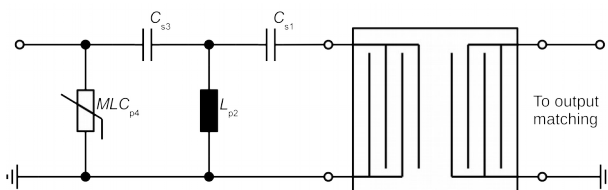


Figure 13: MLC varistor plus ESD matching.

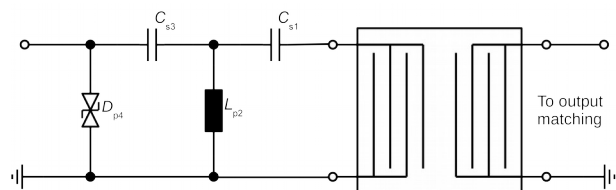


Figure 14: Suppressor diode plus ESD matching.

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

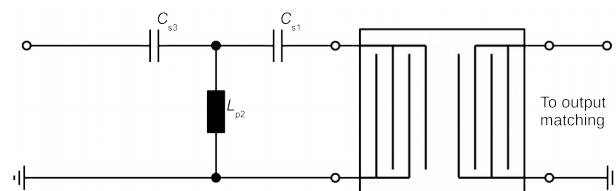


Figure 15: 3rd order high-pass structure for basic ESD protection.

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>.

15 Annotations

15.1 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.

15.2 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 Cautions and warnings

16.1 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://rfe.qualcomm.com/>.

16.2 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.

16.3 Moldability

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

16.4 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.

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.
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3. **The warnings, cautions and product-specific notes must be observed.**
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