Qualcomm

RF360
Europe GmbH

Data sheet

SAW duplexer

Automotive telematics
LTE band 13

Series/type:	B4402
Ordering code:	B39781B4402P810
Date:	October 15, 2019
Version:	2.3

DCN: 80-PA243-399 Rev. A

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

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1 Application

- Low-loss SAW duplexer for W-CDMA Band 13 systems
- Low insertion attenuation
- High isolation
- Usable pass band 10 MHz
- Single-ended to balanced transformation in Antenna-Rx path
- Impedance transformation 50 Ω to 100 Ω in Antenna-Rx path

2 Features

- Package size $2.0_{\pm 0.1}$ mm × $1.6_{\pm 0.1}$ mm
- Package height 0.45 mm (max.)
- Approximate weight 5 mg
- RoHS compatible
- Package for Surface Mount Technology (SMT)
- Ni/Au-plated terminals
- Filter surface passivated
- Electrostatic Sensitive Device (ESD)
- Moisture Sensitivity Level 2a (MSL2a)
- AEC-Q200 qualified component family (Grade 3: −40 °C to +85 °C)

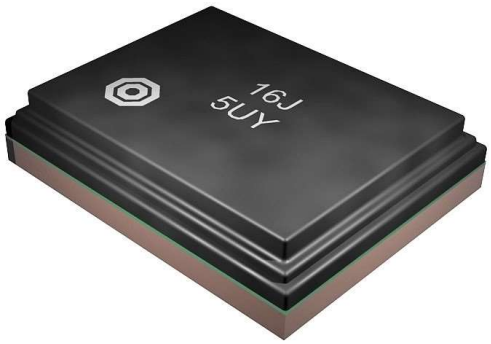

Figure 1: Picture of component with example of product marking.

3 Package

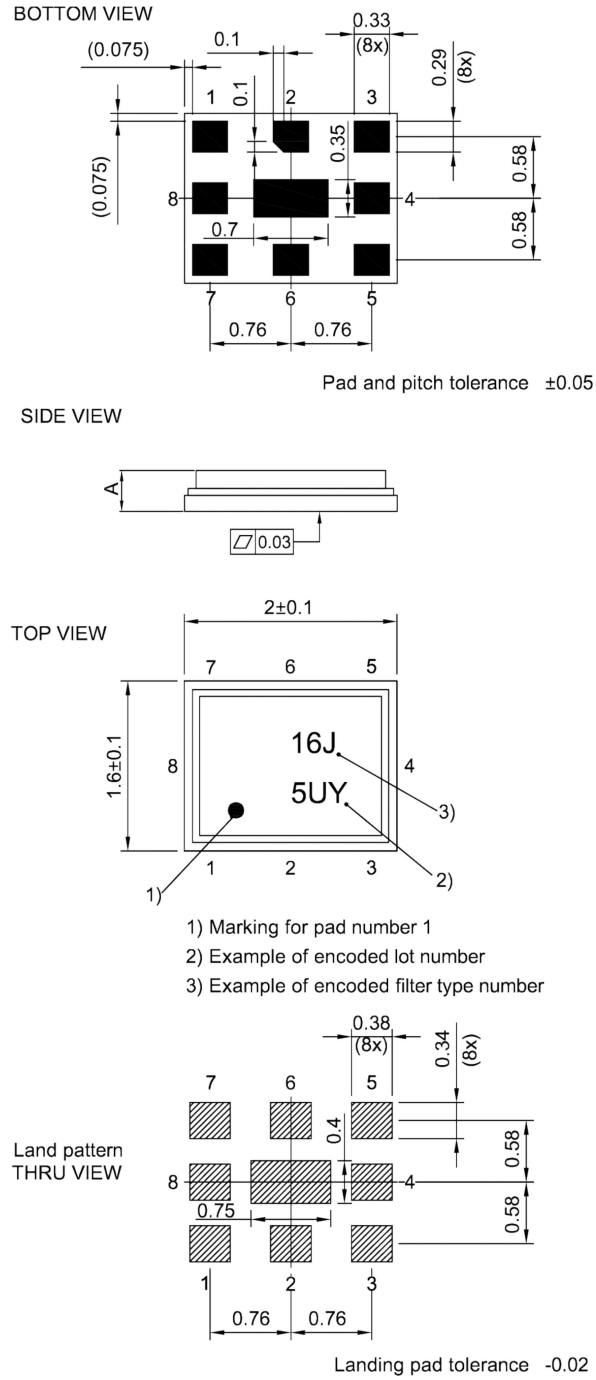

Figure 2: Drawing of package with package height A = 0.45 mm (max.). See Sec. Package information (p. 23).

4 Pin configuration

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

5 Matching circuit

■ L_{p6} = 15 nH

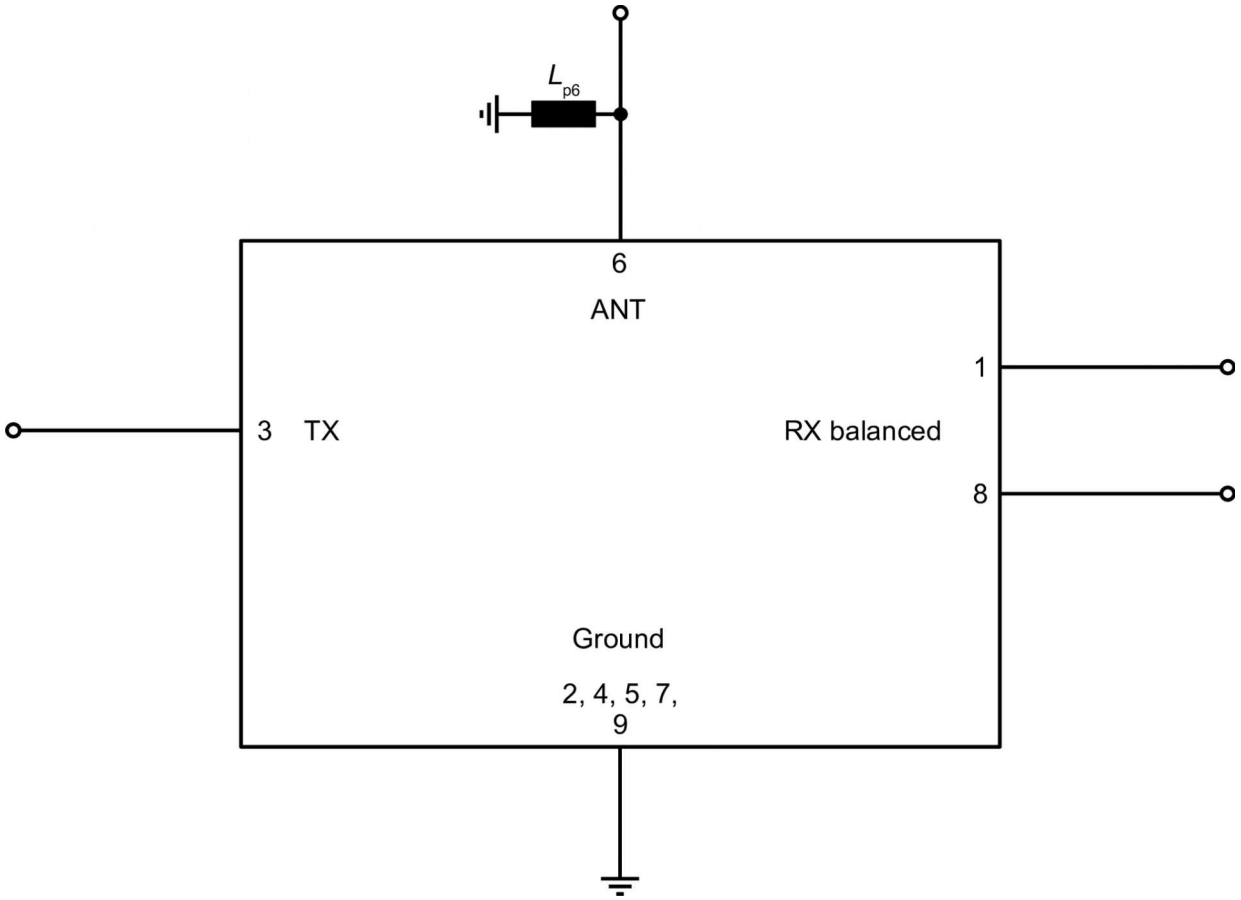

Figure 3: Schematic of matching circuit.

6 Characteristics

6.1 TX – ANT

Temperature range for specification	T_{SPEC}	= −30 °C ... +85 °C
TX terminating impedance	Z_{TX}	= 50 Ω
ANT terminating impedance	Z_{ANT}	= 50 Ω // 15 nH[1)]
RX terminating impedance	Z_{RX}	= 100 Ω

Characteristics TX – ANT				**min.** for T_{SPEC}	**typ.** @ +25 °C	**max.** for T_{SPEC}	
Center frequency			f_C	—	782	—	MHz
Maximum insertion attenuation			α_{max}				
	777 ... 787	MHz		—	2.0	2.5	dB
Amplitude ripple (p-p)			$\Delta\alpha$				
	777 ... 787	MHz		—	1.0	1.5	dB
Maximum VSWR			$VSWR_{max}$				
@ TX port	777 ... 787	MHz		—	1.4	2.1	
@ ANT port	777 ... 787	MHz		—	1.5	2.1	
Maximum error vector magnitude			EVM_{max} [2)]				
@ 25°C	779.4 ... 784.6	MHz		—	2.3	3.0	%
	779.4 ... 784.6	MHz		—	3.0	4.0	%
Minimum attenuation			α_{min}				
	50 ... 716	MHz		30	40	—	dB
	716 ... 728	MHz		40	45	—	dB
	728 ... 746	MHz		35	45	—	dB
	746 ... 756	MHz		45	53	—	dB
	758 ... 767.5	MHz		35	43	—	dB
	767.5 ... 768	MHz		30	42	—	dB
	768 ... 769	MHz		14	30	—	dB
	769 ... 770	MHz		6	15	—	dB
	770 ... 771	MHz		3	10	—	dB
	771 ... 772	MHz		2	5	—	dB
	808 ... 815	MHz		28	31	—	dB
	815 ... 869	MHz		30	45	—	dB
	869 ... 894	MHz		35	42	—	dB
	1554 ... 1565	MHz		30	55	—	dB
	1565 ... 1585	MHz		45	54	—	dB
	1597 ... 1607	MHz		45	55	—	dB
	1805 ... 1880	MHz		35	52	—	dB
	1930 ... 1990	MHz		35	55	—	dB
	2110 ... 2170	MHz		35	54	—	dB
	2331 ... 2361	MHz		35	45	—	dB
	2400 ... 2484	MHz		40	51	—	dB
	3108 ... 3148	MHz		30	52	—	dB

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

[2] Error Vector Magnitude (EVM) based on definition in 3GPP TS 25.141.

6.2 ANT – RX

Temperature range for specification	T_{SPEC}	= −30 °C ... +85 °C
TX terminating impedance	Z_{TX}	= 50 Ω
ANT terminating impedance	Z_{ANT}	= 50 Ω // 15 nH[1)]
RX terminating impedance	Z_{RX}	= 100 Ω

Characteristics ANT – RX				min. for T_{SPEC}	typ. @ +25 °C	max. for T_{SPEC}	
Center frequency			f_C	—	751	—	MHz
Maximum insertion attenuation			α_{max}				
	746... 756	MHz		—	1.9	2.5	dB
Amplitude ripple (p-p)			Δα				
	746... 756	MHz		—	0.7	1.3	dB
Maximum VSWR			$VSWR_{max}$				
@ ANT port	746... 756	MHz		—	1.6	2.1	
@ RX port	746... 756	MHz		—	1.7	2.1	
Minimum common-mode rejection ratio			$CMRR_{min}$				
	746... 756	MHz		25	30	—	dB
Minimum attenuation			α_{min}				
	50... 600	MHz		50	65	—	dB
	600... 730	MHz		35	40	—	dB
	730... 736	MHz		25	38	—	dB
	777... 787	MHz		50	56	—	dB
	793... 805	MHz		40	46	—	dB
	805... 4000	MHz		40	44	—	dB

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

6.3 TX – RX

Temperature range for specification	T_{SPEC}	= −30 °C ... +85 °C
TX terminating impedance	Z_{TX}	= 50 Ω
ANT terminating impedance	Z_{ANT}	= 50 Ω // 15 nH[1)]
RX terminating impedance	Z_{RX}	= 100 Ω

Characteristics TX – RX				min. for T_{SPEC}	typ. @ +25 °C	max. for T_{SPEC}	
Minimum isolation			α_{min}				
	746.5... 749	MHz		50	56	—	dB
	749... 752	MHz		55	59	—	dB
	752... 755.5	MHz		60	63	—	dB
	777... 787	MHz		54	58	—	dB
	1552... 1574	MHz		40	60	—	dB
	2328... 2361	MHz		35	57	—	dB
	3104... 3148	MHz		30	55	—	dB
Minimum common-mode isolation			α_{min}				
	777... 787	MHz		58	63	—	dB

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

7 Maximum ratings

Operable temperature	T_{OP} = −40 °C ... +85 °C	
Storage temperature	T_{STG} [1] = −40 °C ... +85 °C	
DC voltage	$\lvert V_{DC} \rvert$ [2] = 0 V (max.)	
Input power	P_{IN}	
@ TX port: 777 ... 787 MHz	29 dBm	Continuous wave for 5000 h @ 50 °C.
Elsewhere @ TX port	10 dBm	Continuous wave for 5000 h @ 50 °C.

[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.

8 Transmission coefficients

8.1 TX – ANT

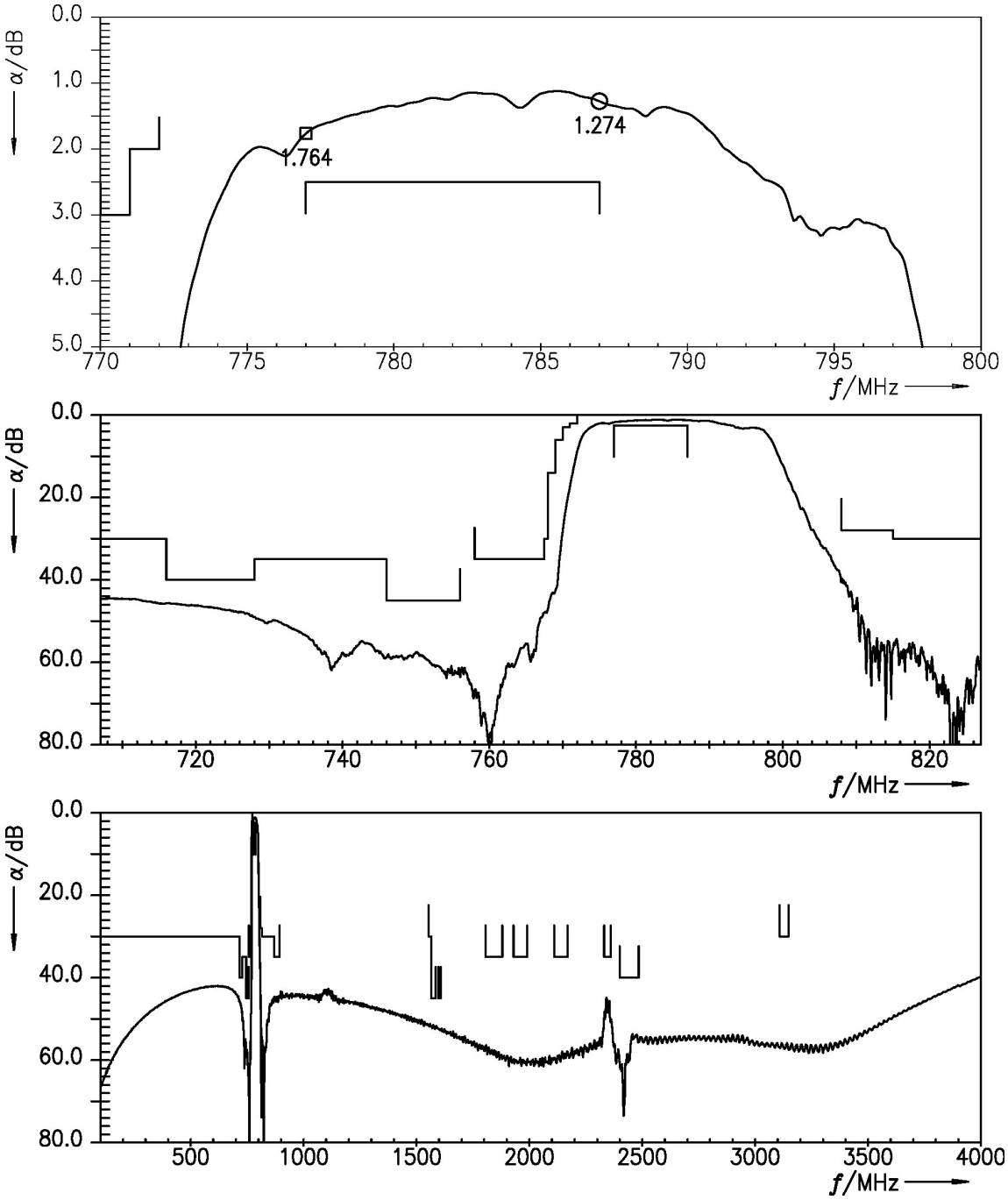

Figure 4: Attenuation TX – ANT.

8.2 ANT – RX

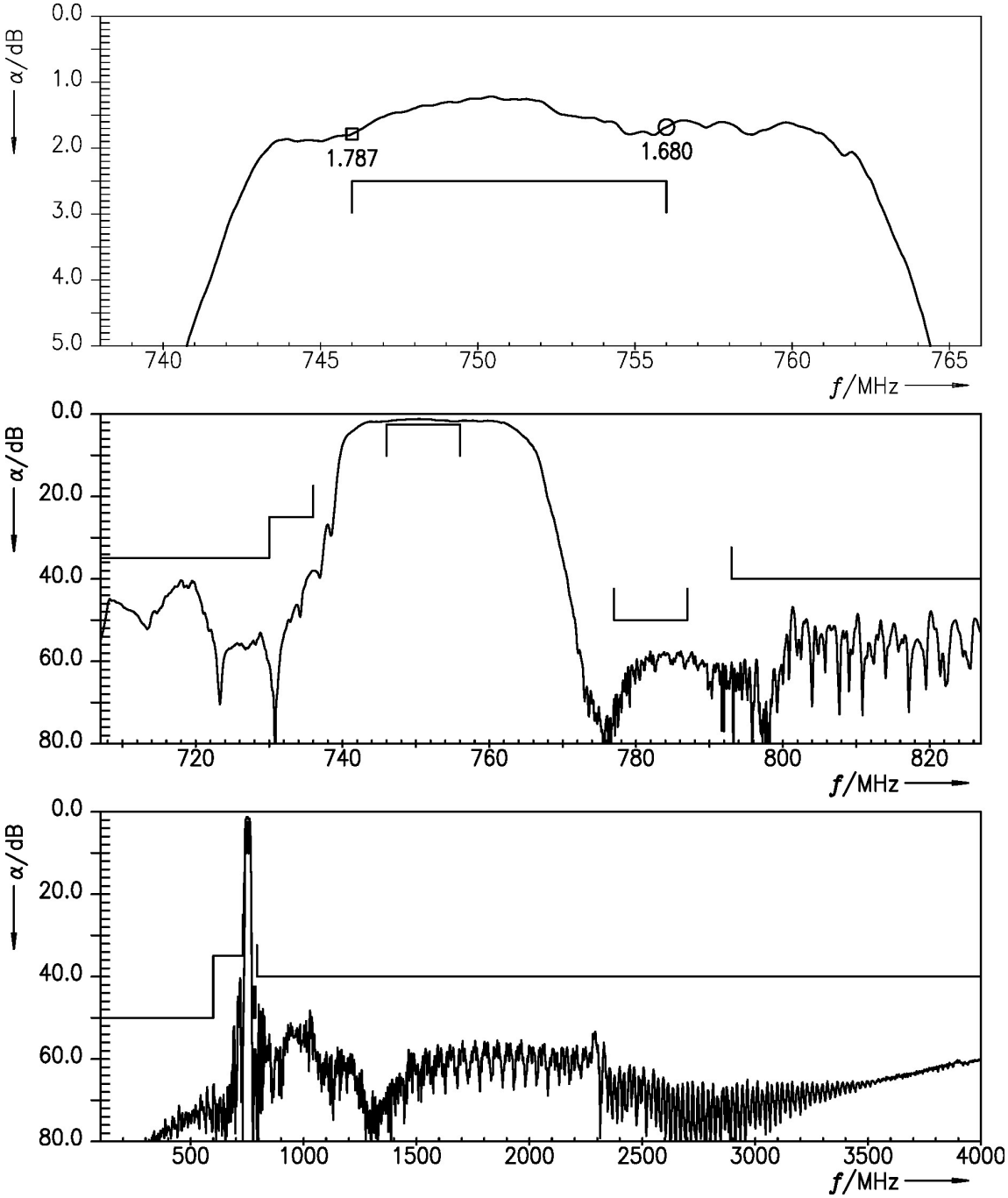

Figure 5: Attenuation ANT – RX.

8.3 TX – RX

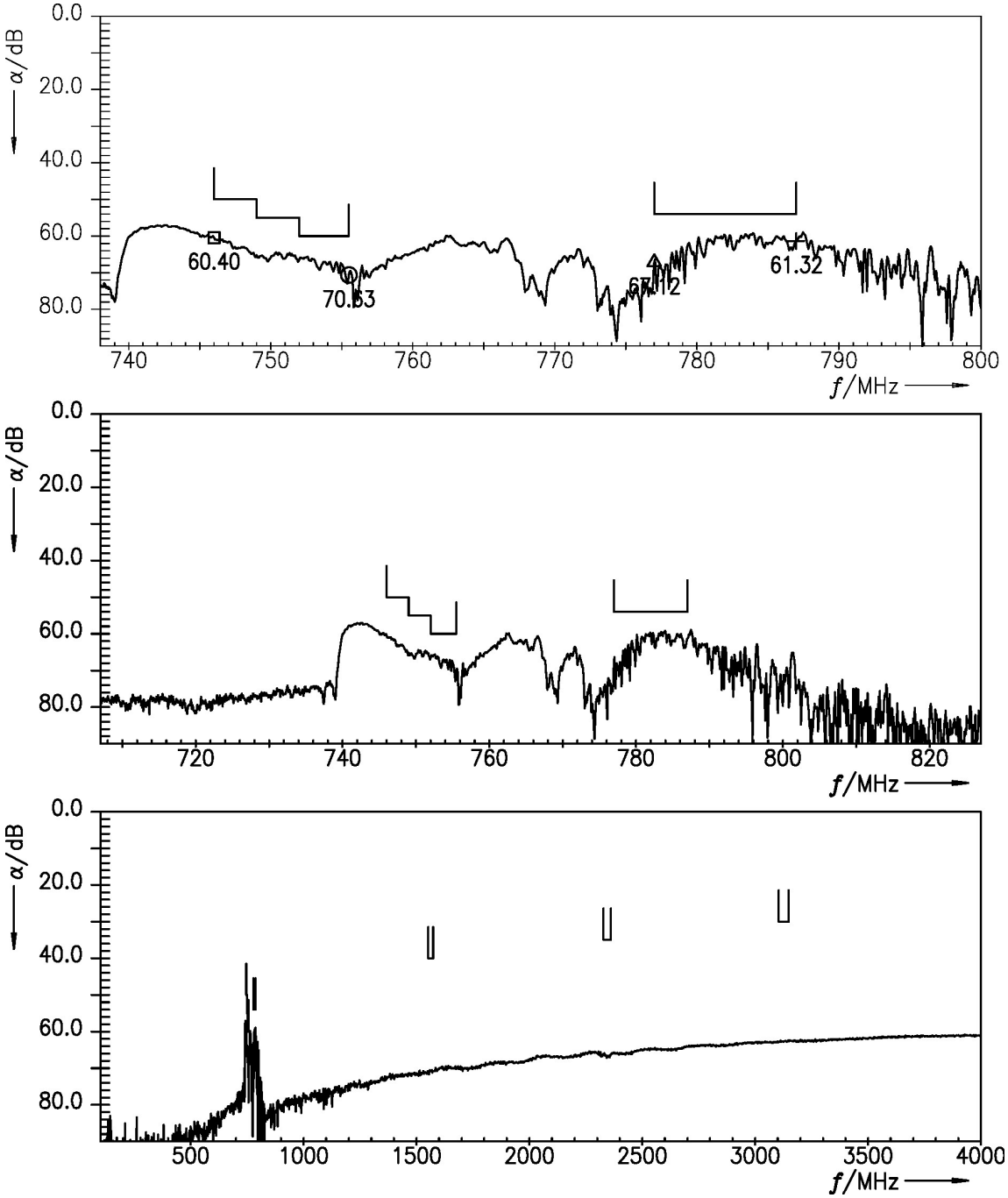

Figure 6: Isolation TX – RX.

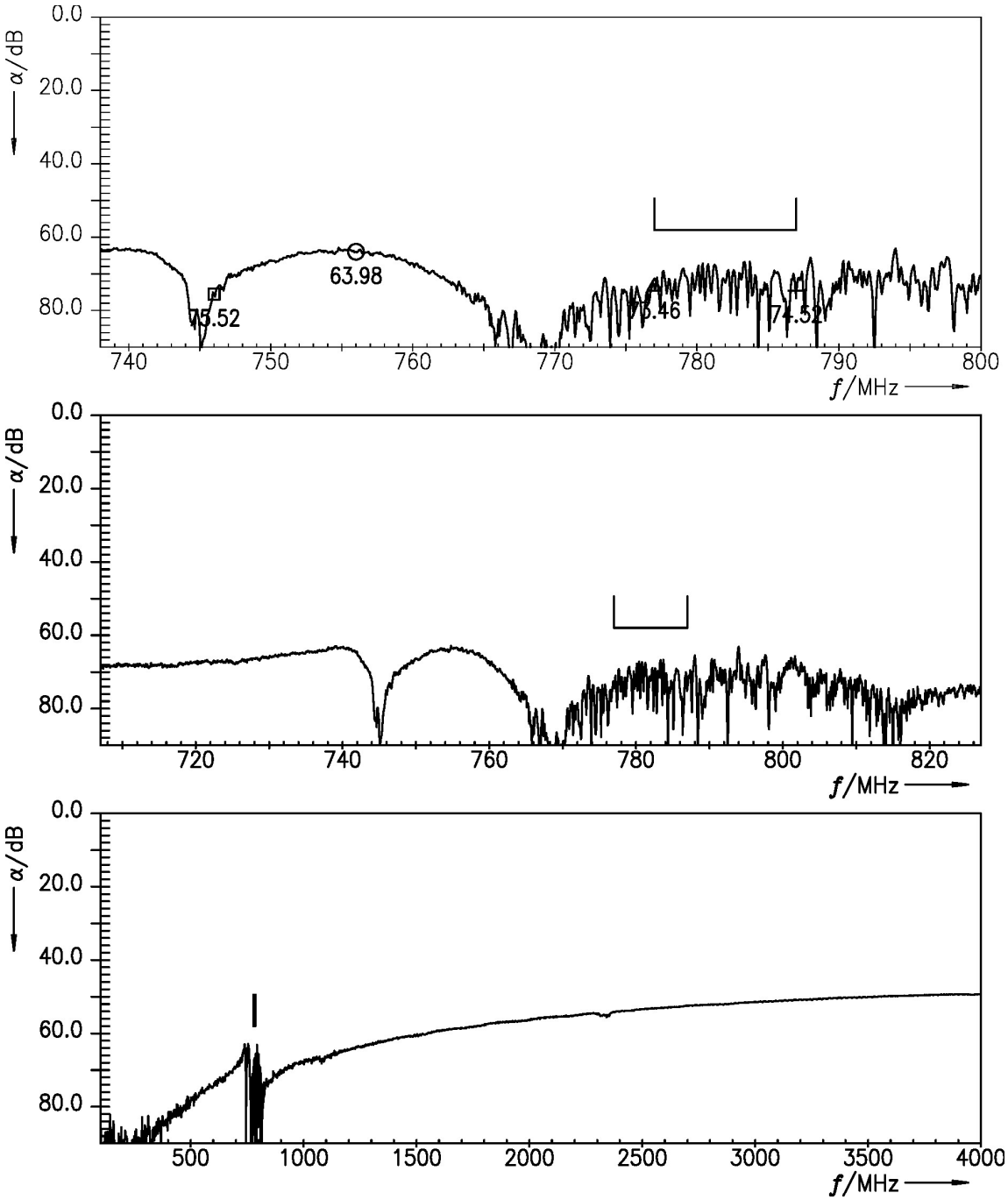

Figure 7: Common-mode isolation TX – RX.

9 Reflection coefficients

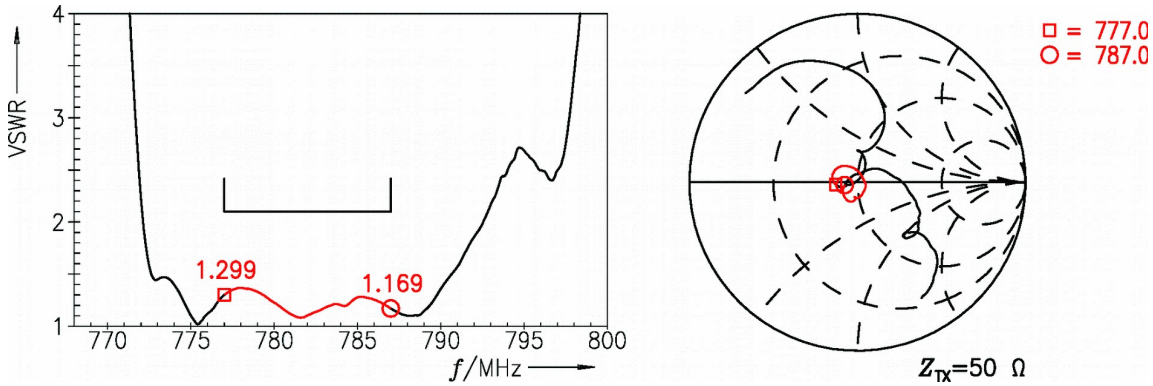

Figure 8: Reflection coefficient at TX port.

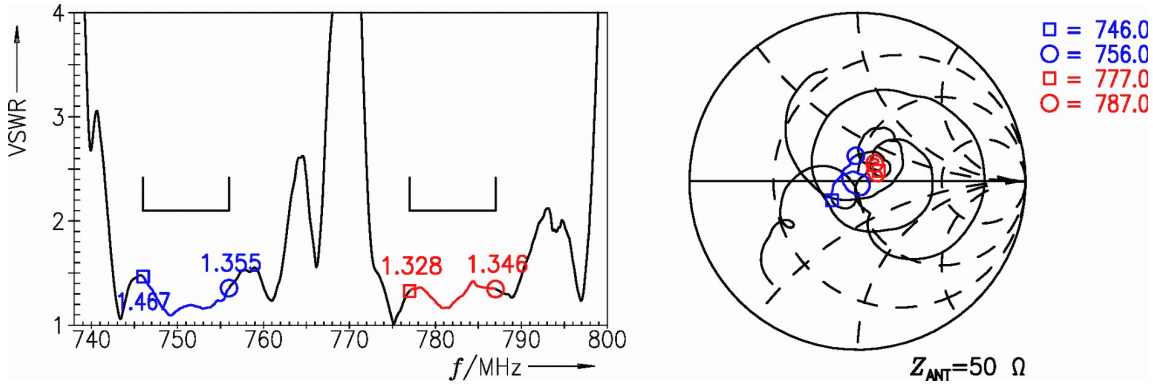

Figure 9: Reflection coefficient at ANT port.

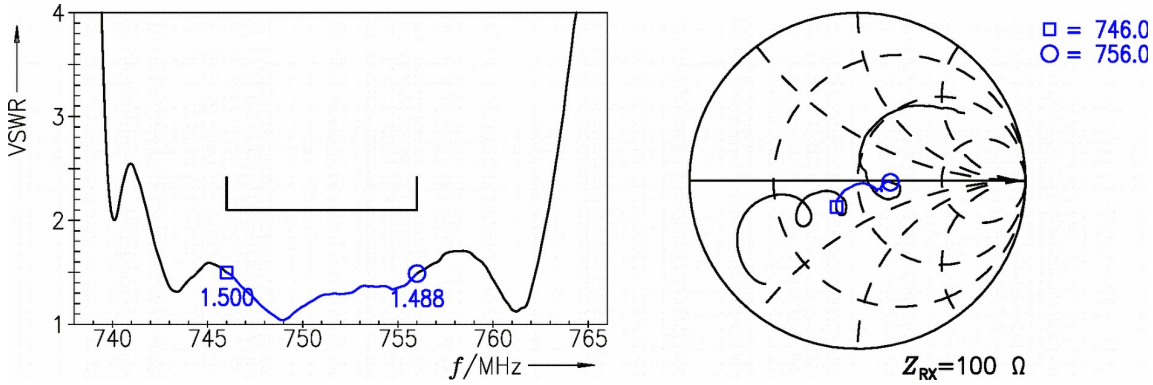

Figure 10: Reflection coefficient at RX port.

10 Packing material

10.1 Tape

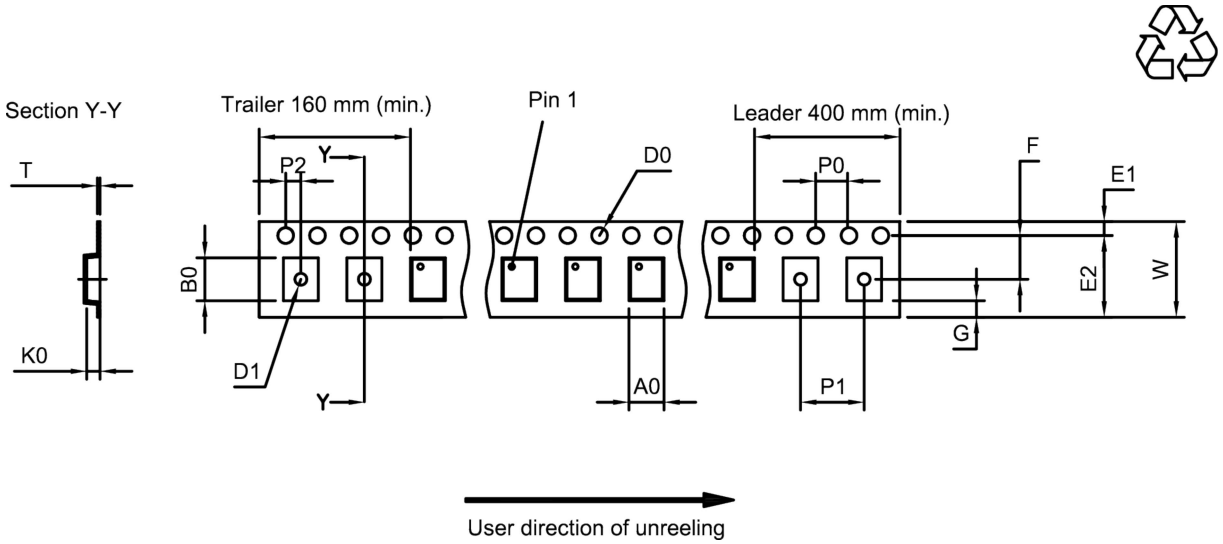

Figure 11: Drawing of tape (first-angle projection) for illustration only and not to scale. The valid tape dimensions are listed in Table 1.

A_0	$1.8_{\pm 0.05}$ mm
B_0	$2.25_{\pm 0.05}$ mm
D_0	$1.5_{+0.1/-0}$ mm
D_1	1.0 mm (min.)
E_1	$1.75_{\pm 0.1}$ mm

E_2	6.25 mm (min.)
F	$3.5_{\pm 0.05}$ mm
G	0.75 mm (min.)
K_0	$0.6_{\pm 0.05}$ mm
P_0	$4.0_{\pm 0.1}$ mm

P_1	$4.0_{\pm 0.1}$ mm
P_2	$2.0_{\pm 0.05}$ mm
T	$0.25_{\pm 0.03}$ mm
W	$8.0_{+0.3/-0.1}$ mm

Table 1: Tape dimensions.

10.2 Reel with diameter of 180 mm

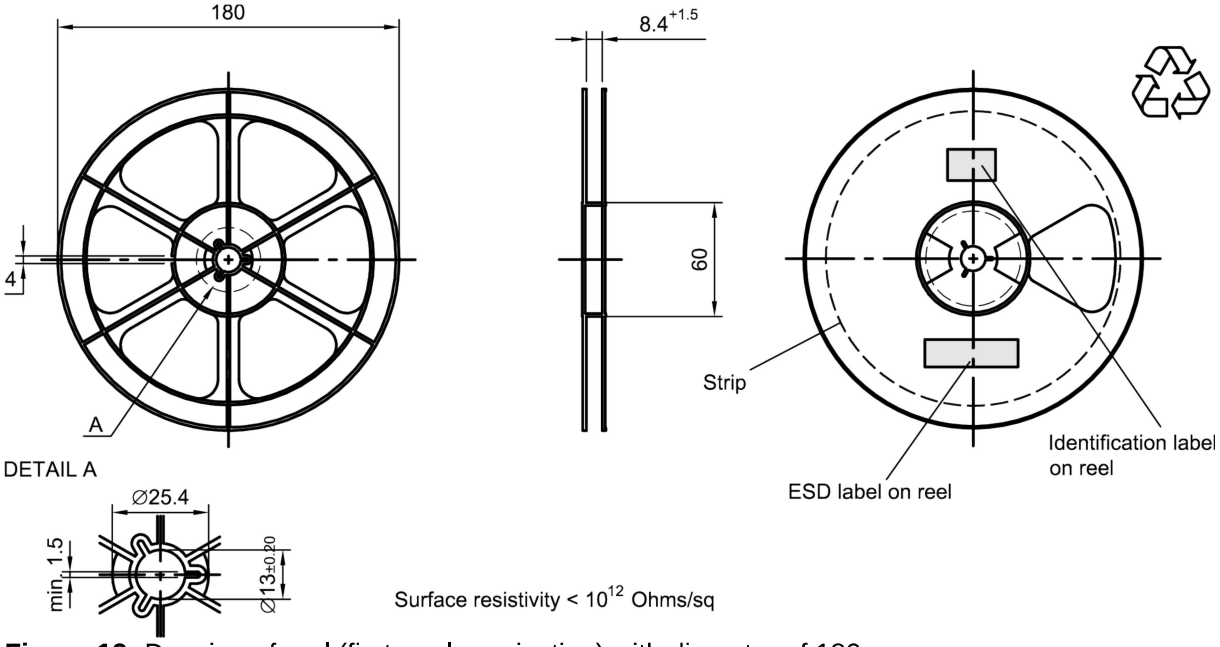

Figure 12: Drawing of reel (first-angle projection) with diameter of 180 mm.

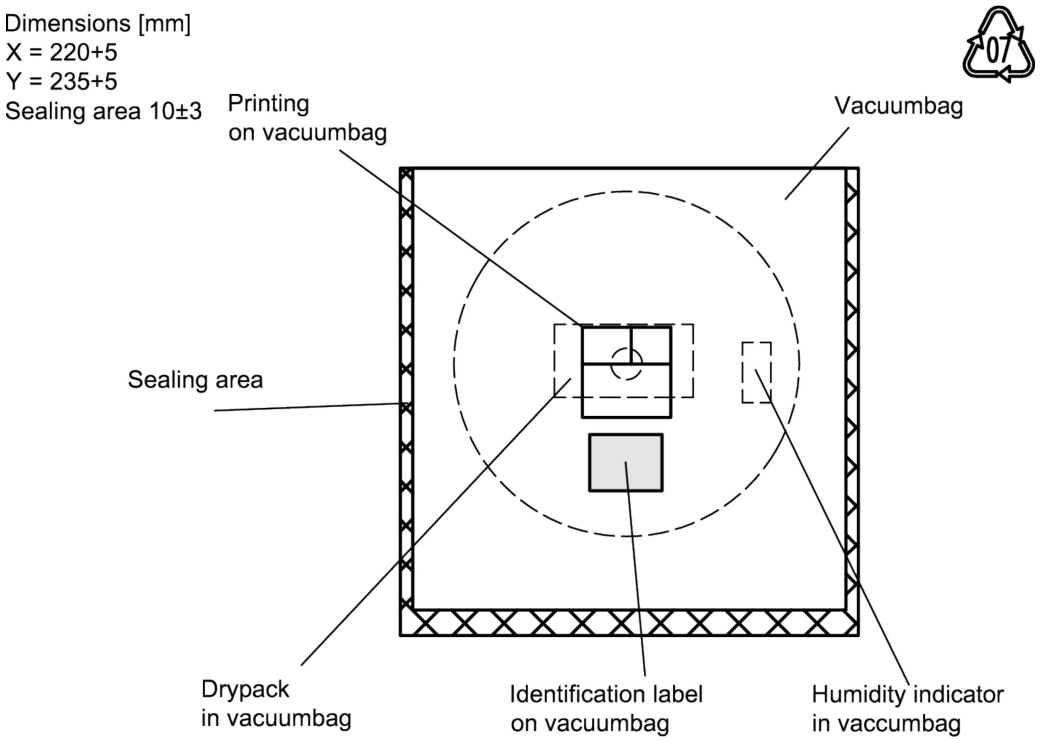

Figure 13: Drawing of moisture barrier bag (MBB) for reel with diameter of 180 mm.

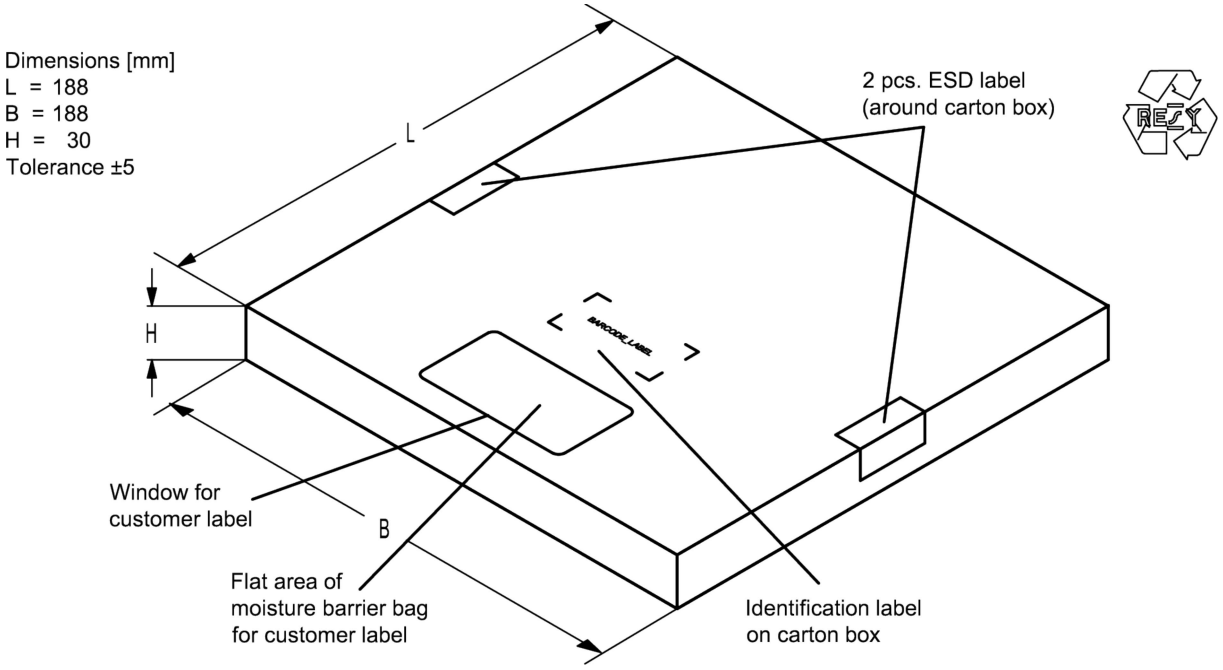

Figure 14: Drawing of folding box for reel with diameter of 180 mm.

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 B4402 is 49J.

- 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).

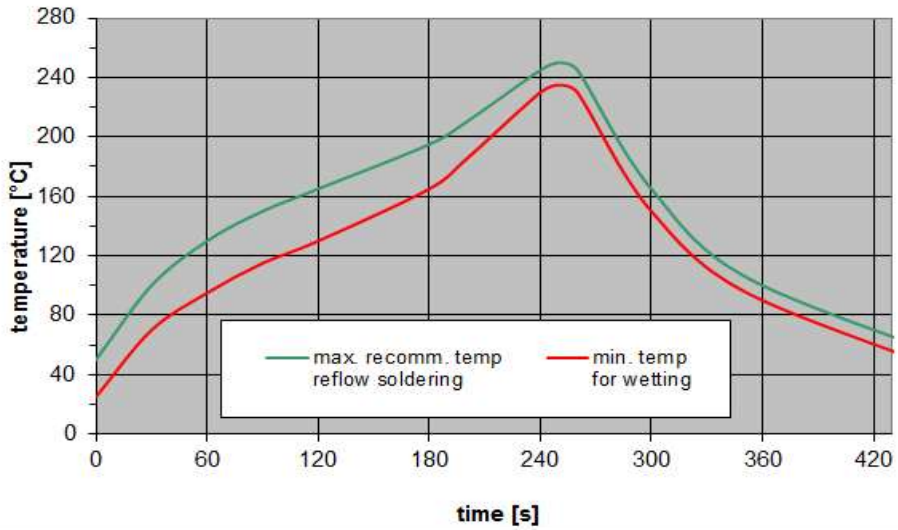

Figure 15: Recommended reflow profile for convection and infrared soldering – lead-free solder.

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.

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 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.