Qualcomm

RF360
Europe GmbH

Data sheet

SAW Rx diplexer

Automotive telematics
LTE bands 1 & 3

Series/type:	B4386
Ordering code:	B39212B4386P810
Date:	November 08, 2019
Version:	2.2

DCN: 80-PA243-423 Rev. A

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Table of contents

1 Application

- Low-loss 2in1 RF diplexer filter, LTE / WCDMA band 1 and band 3 for carrier aggregation, receive path (Rx).
- Usable pass band filter 1: 60 Mhz (LTE / WCDMA Band 1)
- Usable pass band filter 3: 75 Mhz (LTE / WCDMA Band 3)

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)

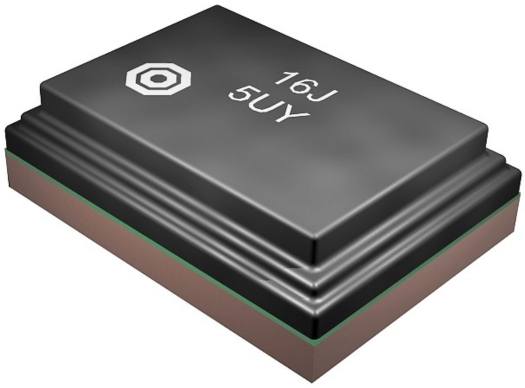

Figure 1: Picture of component with example of product marking.

3 Package

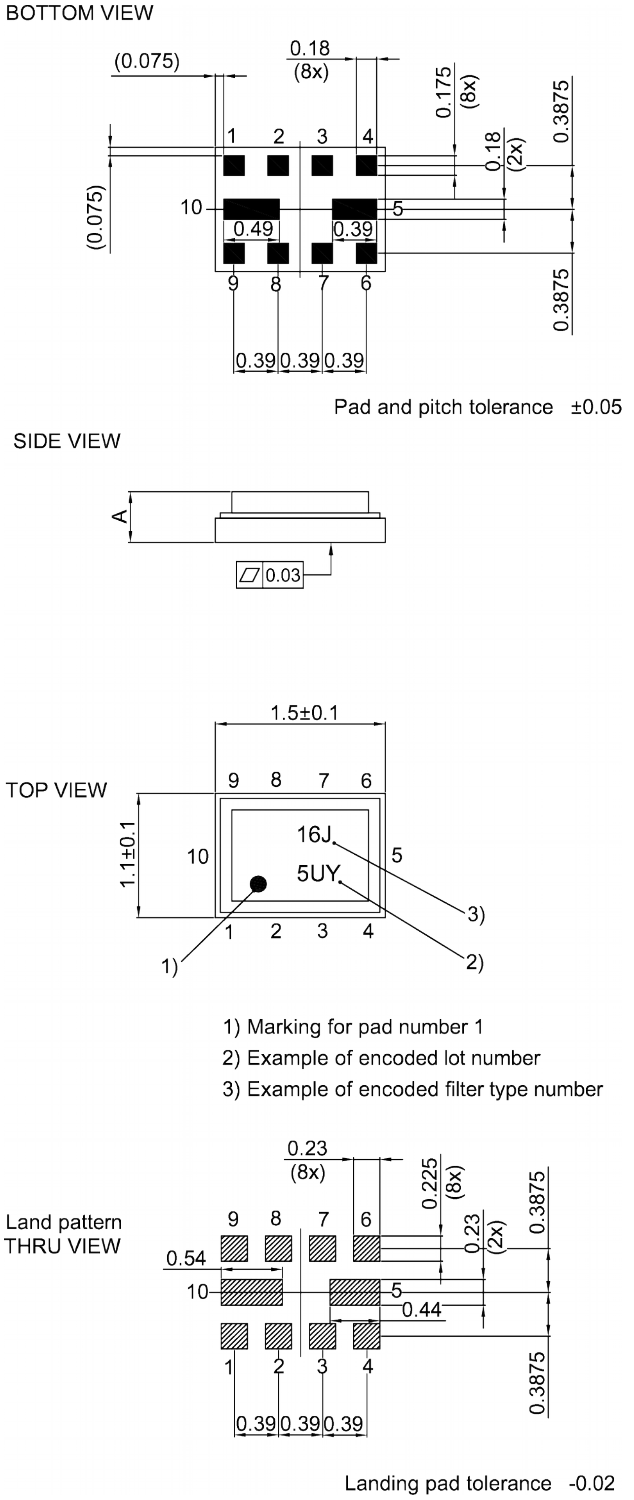

Figure 2: Drawing of package with package height A = 0.45 mm (max.). See Sec. Package information (p. 22).

4 Pin configuration

- 1 Input (B1 & B3)
- 6 Output (B1)
- 9 Output (B3)
- 2, 3, 4, 5, 7, 8, 10 Ground

5 Matching circuit

- L_{p1} = 3.0 nH
- L_{s6} = 2.2 nH
- L_{s9} = 2.9 nH

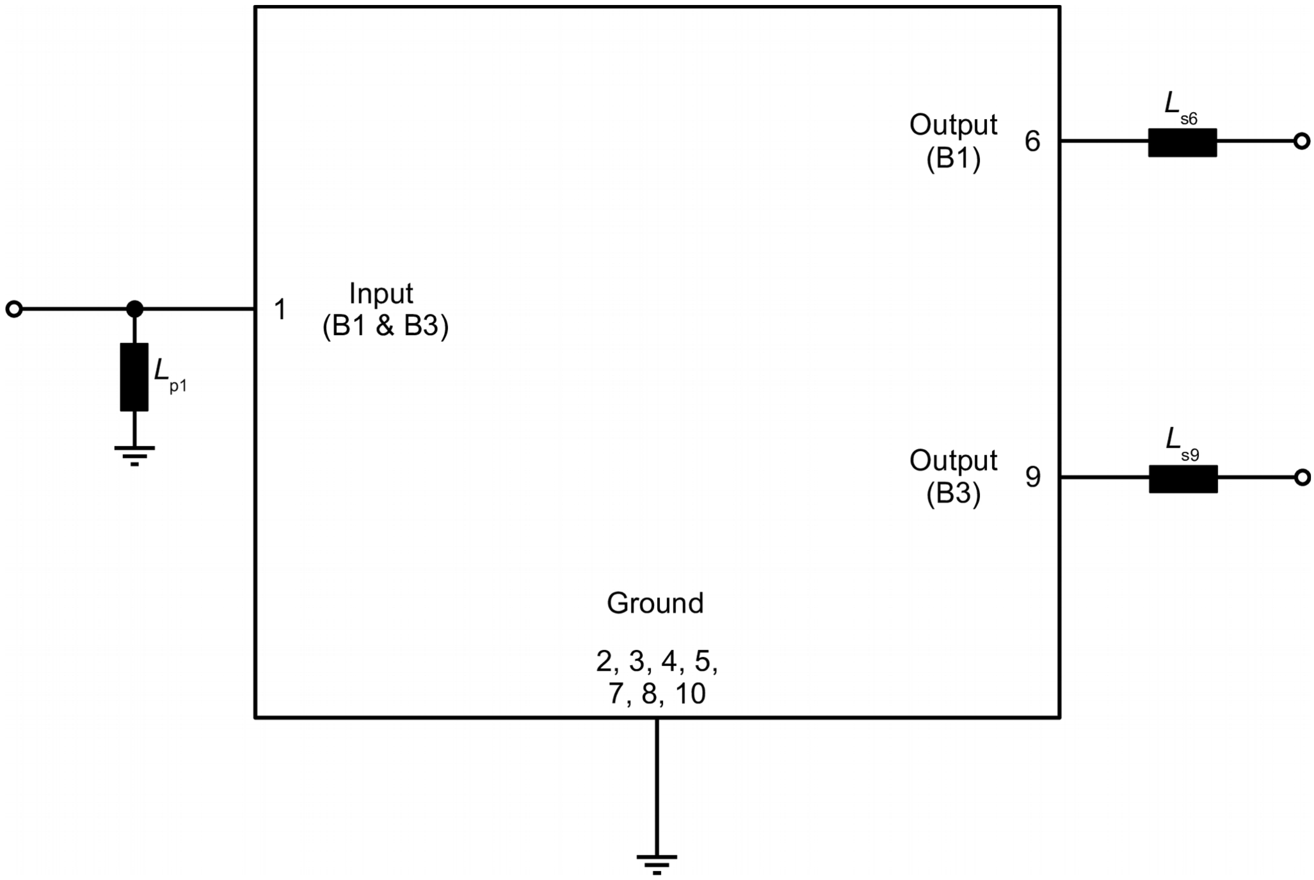

Figure 3: Schematic of matching circuit.

6 Characteristics LTE B1

Temperature range for specification	T_{SPEC}	= −40 °C ... +85 °C
Input terminating impedance	Z_{IN}	= 50 Ω // 3.0 nH[1]
B1 output terminating impedance	$Z_{B1\ OUT}$	= 50 Ω + 2.2 nH[1]
B3 output terminating impedance	$Z_{B3\ OUT}$	= 50 Ω + 2.9 nH[1]

Characteristics LTE B1					**min.** for T_{SPEC}	**typ.** @ +25 °C	**max.** for T_{SPEC}	
Center frequency				f_C	—	2140	—	MHz
Maximum insertion attenuation				α_{max}				
		2110 ... 2170	MHz		—	1.9	2.4	dB
Amplitude ripple (p-p)				$\Delta\alpha$				
		2110 ... 2170	MHz		—	0.5	1.0	dB
Maximum VSWR				$VSWR_{max}$				
@ input port		2110 ... 2170	MHz		—	1.4	2.0	
@ B1 output port		2110 ... 2170	MHz		—	1.4	2.0	
Maximum error vector magnitude				EVM_{max}[2]				
		2110 ... 2170	MHz		—	1.2	3.0	%
Minimum attenuation								
		50 ... 1710	MHz	α_{min}	40	49	—	dB
		188 ... 192	MHz	α_{min}	50	85	—	dB
		398 ... 402	MHz	α_{min}	50	73	—	dB
		699 ... 716	MHz	α_{min}	40	63	—	dB
		777 ... 787	MHz	α_{min}	40	60	—	dB
		814 ... 849	MHz	α_{min}	40	60	—	dB
		880 ... 915	MHz	α_{min}	40	58	—	dB
		1710 ... 1785	MHz	α_{min}	43	50	—	dB
	@$f_{carrier}$	1712.64 ... 1782.36	MHz	$\alpha_{WCDMA,min}$[3]	43	47	—	dB
		1785 ... 1920	MHz	α_{min}	40	45	—	dB
		1920 ... 1980	MHz	α_{min}	42	48	—	dB
	@$f_{carrier}$	1922.74 ... 1977.26	MHz	$\alpha_{WCDMA,min}$[3]	42	48	—	dB
		2015 ... 2075	MHz	α_{min}	8	20	—	dB
		2255 ... 2400	MHz	α_{min}	37	41	—	dB
		2400 ... 2500	MHz	α_{min}	38	42	—	dB
		2500 ... 4900	MHz	α_{min}	40	47	—	dB
		4900 ... 5950	MHz	α_{min}	40	55	—	dB

1) See Sec. Matching circuit (p. 6).
2) Error Vector Magnitude (EVM) based on definition in 3GPP TS 25.141.
3) Attenuation of WCDMA signal ("power transfer function"). Please refer to definition of Power Transfer Function (PTF) of WCDMA signal (p. 21).

7 Characteristics LTE B3

Temperature range for specification	T_{SPEC}	= −40 °C ... +85 °C
Input terminating impedance	Z_{IN}	= 50 Ω // 3.0 nH[1)]
B1 output terminating impedance	$Z_{B1\ OUT}$	= 50 Ω + 2.2 nH[1)]
B3 output terminating impedance	$Z_{B3\ OUT}$	= 50 Ω + 2.9 nH[1)]

Characteristics LTE B3					**min.** for T_{SPEC}	**typ.** @ +25 °C	**max.** for T_{SPEC}	
Center frequency				f_C	—	1842.5	—	MHz
Maximum insertion attenuation				α_{max}				
		1805 ... 1880	MHz		—	2.3	3.5[2)]	dB
		1805 ... 1880	MHz		—	2.3	3.7	dB
Amplitude ripple (p-p)				$\Delta\alpha$				
		1805 ... 1880	MHz		—	1.2	2.4[2)]	dB
		1805 ... 1880	MHz		—	1.2	2.6	dB
Maximum VSWR				$VSWR_{max}$				
@ input port		1805 ... 1880	MHz		—	1.6	2.0	
@ B3 output port		1805 ... 1880	MHz		—	1.8	2.1	
Maximum error vector magnitude				EVM_{max} [3)]				
		1805 ... 1880	MHz		—	1.2	6.0	%
Minimum attenuation								
		50 ... 1710	MHz	α_{min}	35	40	—	dB
		824 ... 862	MHz	α_{min}	40	49	—	dB
		880 ... 915	MHz	α_{min}	40	48	—	dB
		1710 ... 1785	MHz	α_{min}	30	35	—	dB
	@$f_{carrier}$	1712.64 ... 1782.36	MHz	$\alpha_{WCDMA,min}$ [4)]	30	35	—	dB
		1785 ... 1790	MHz	α_{min}	6	42	—	dB
		1920 ... 1980	MHz	α_{min}	40	43	—	dB
	@$f_{carrier}$	1922.74 ... 1977.26	MHz	$\alpha_{WCDMA,min}$ [4)]	40	43	—	dB
		1980 ... 3000	MHz	α_{min}	30	38	—	dB
		2400 ... 2500	MHz	α_{min}	38	44	—	dB
		2500 ... 2570	MHz	α_{min}	38	42	—	dB
		4900 ... 5950	MHz	α_{min}	30	35	—	dB

1) See Sec. Matching circuit (p. 6).
2) Valid for temperature T = −20 °C...+85 °C.
3) Error Vector Magnitude (EVM) based on definition in 3GPP TS 25.141.
4) Attenuation of WCDMA signal ("power transfer function"). Please refer to definition of Power Transfer Function (PTF) of WCDMA signal (p. 21).

8 Maximum ratings

Operable temperature	T_{OP} = −40 °C ... +125 °C	
Storage temperature	T_{STG}[1)] = −40 °C ... +125 °C	
DC voltage	$\|V_{DC}\|$[2)] = 0 V (max.)	
Input power	P_{IN}	
@ input port: 1710 ... 1785 MHz	15 dBm	Continuous wave for 5000 h @ 50 °C.
@ input port: 1920 ... 1980 MHz	15 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.

9 Transmission coefficient LTE B1

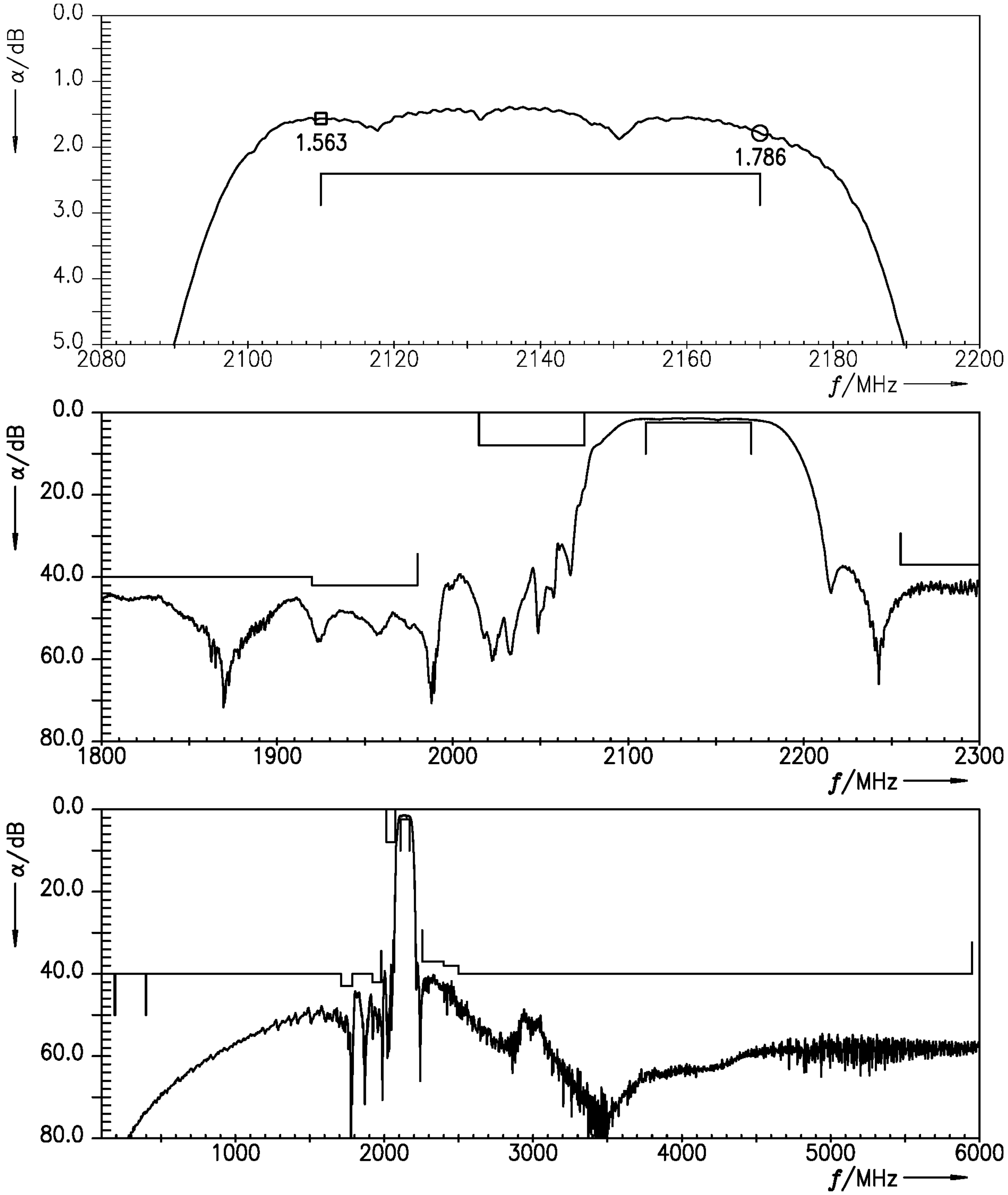

Figure 4: Attenuation LTE B1.

10 Reflection coefficients LTE B1

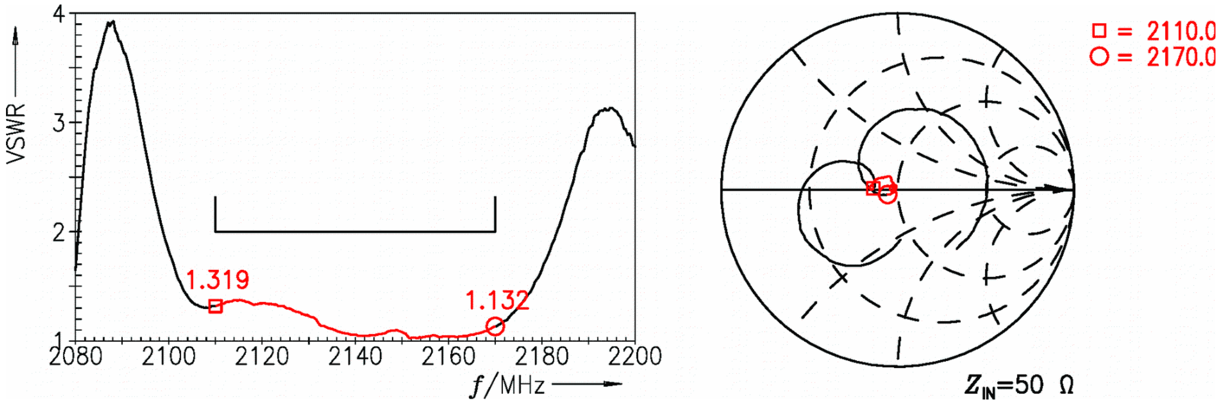

Figure 5: Reflection coefficient at input port.

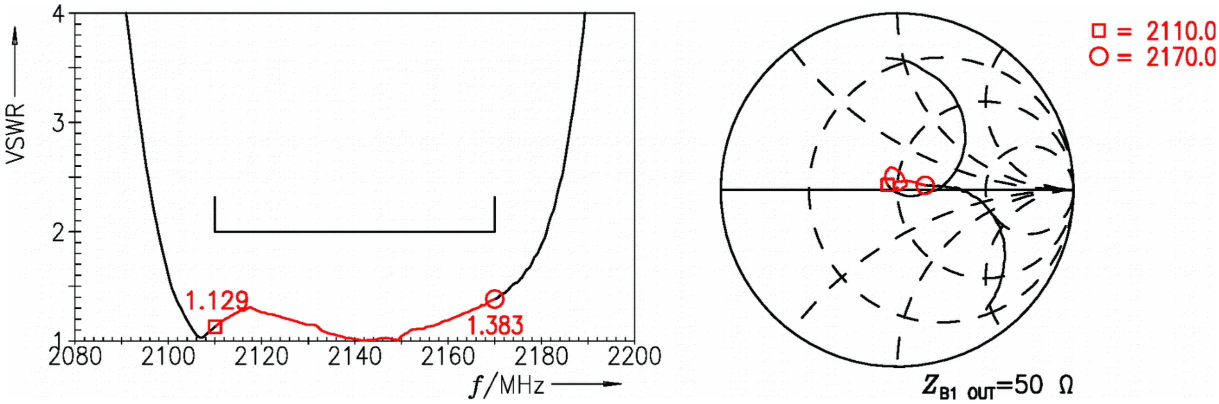

Figure 6: Reflection coefficient at B1 OUT port.

11 EVM LTE B1

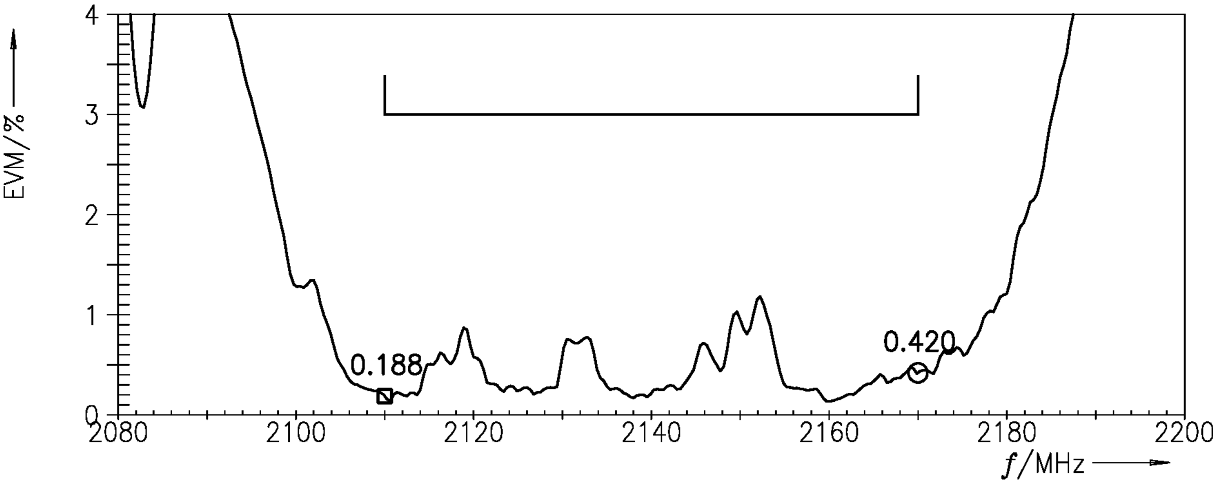

Figure 7: Error vector magnitude LTE B1.

12 Transmission coefficient LTE B3

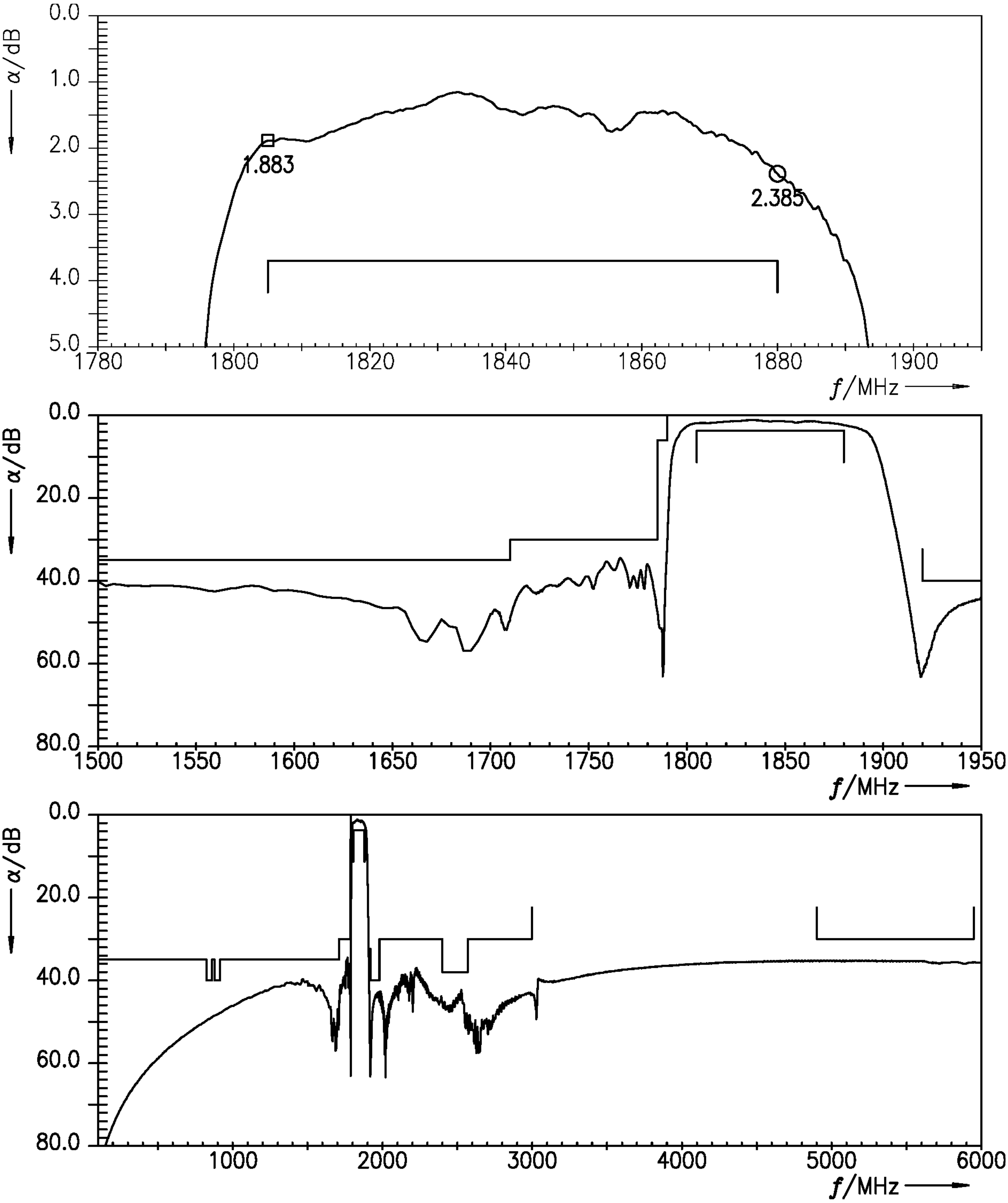

Figure 8: Attenuation LTE B3.

13 Reflection coefficients LTE B3

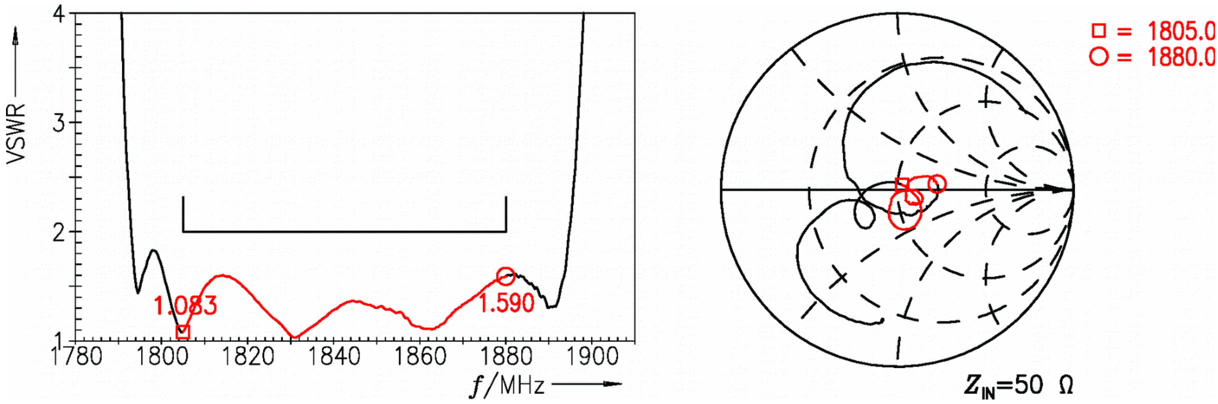

Figure 9: Reflection coefficient at input port.

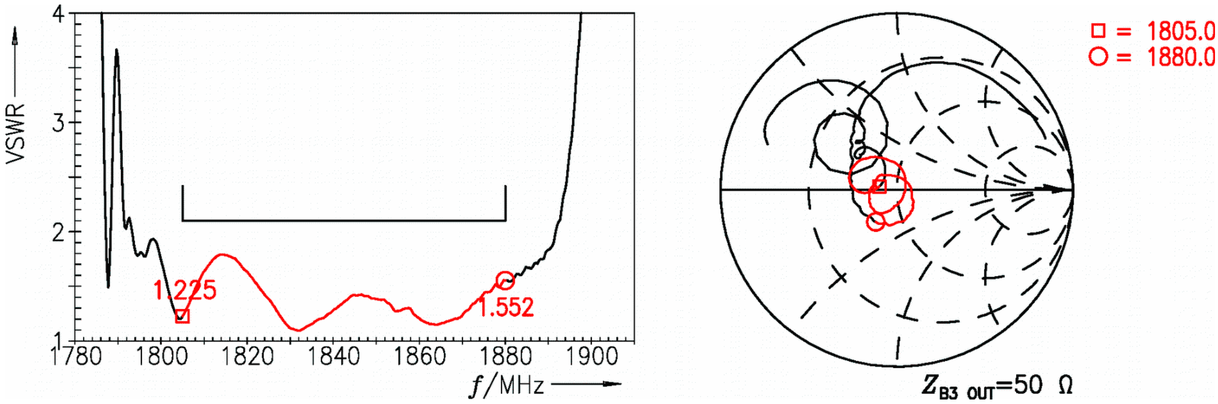

Figure 10: Reflection coefficient at B3 OUT port.

14 EVM LTE B3

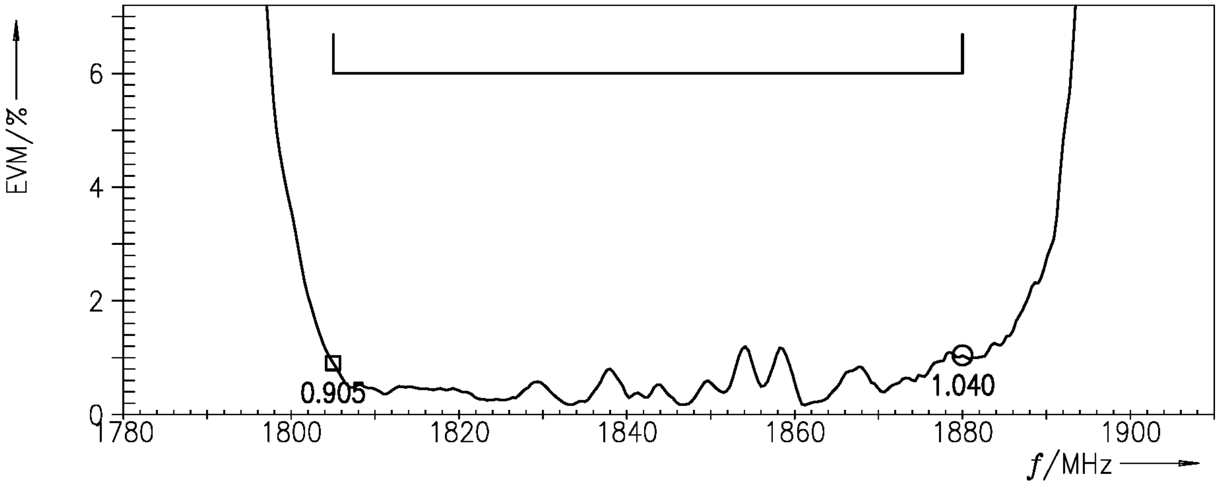

Figure 11: Error vector magnitude LTE B3.

15 Packing material

15.1 Tape

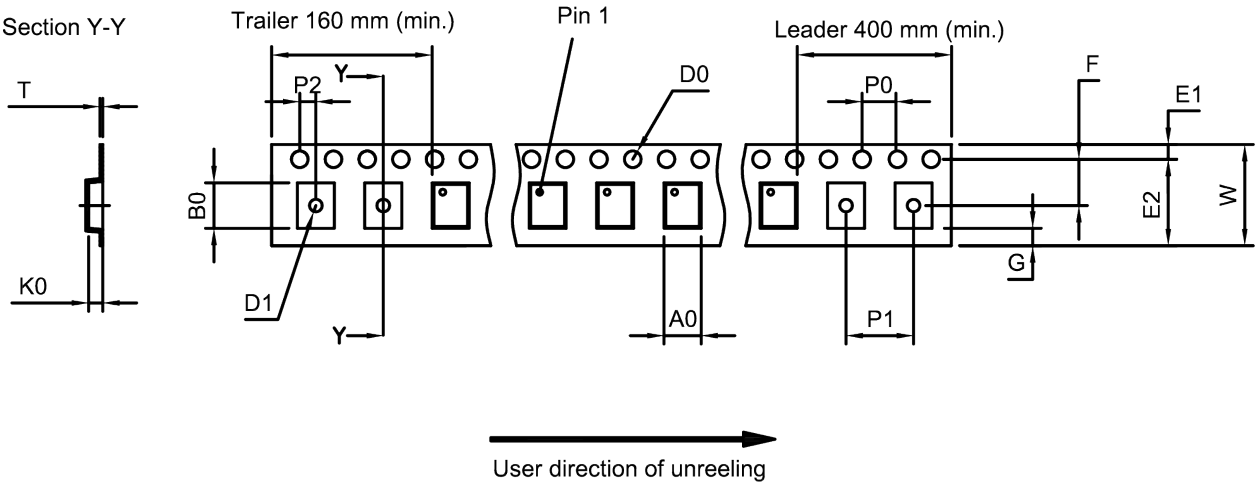

Figure 12: Drawing of tape (first-angle projection) for illustration only and not to scale. The valid tape dimensions are listed in Table 1.

A_0	1.27±0.05 mm	E_2	6.25 mm (min.)	P_1	4.0±0.1 mm
B_0	1.67±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/−0 mm	K_0	0.55±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.

15.2 Reel with diameter of 180 mm

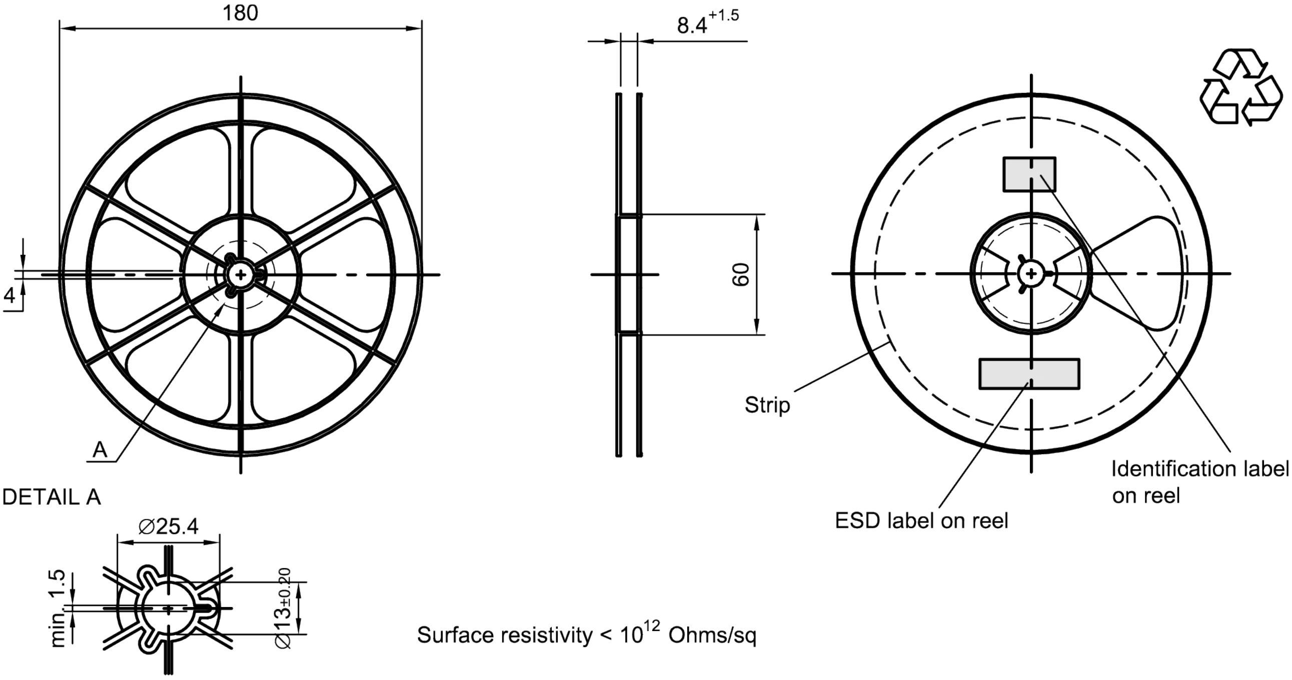

Figure 13: Drawing of reel (first-angle projection) with diameter of 180 mm.

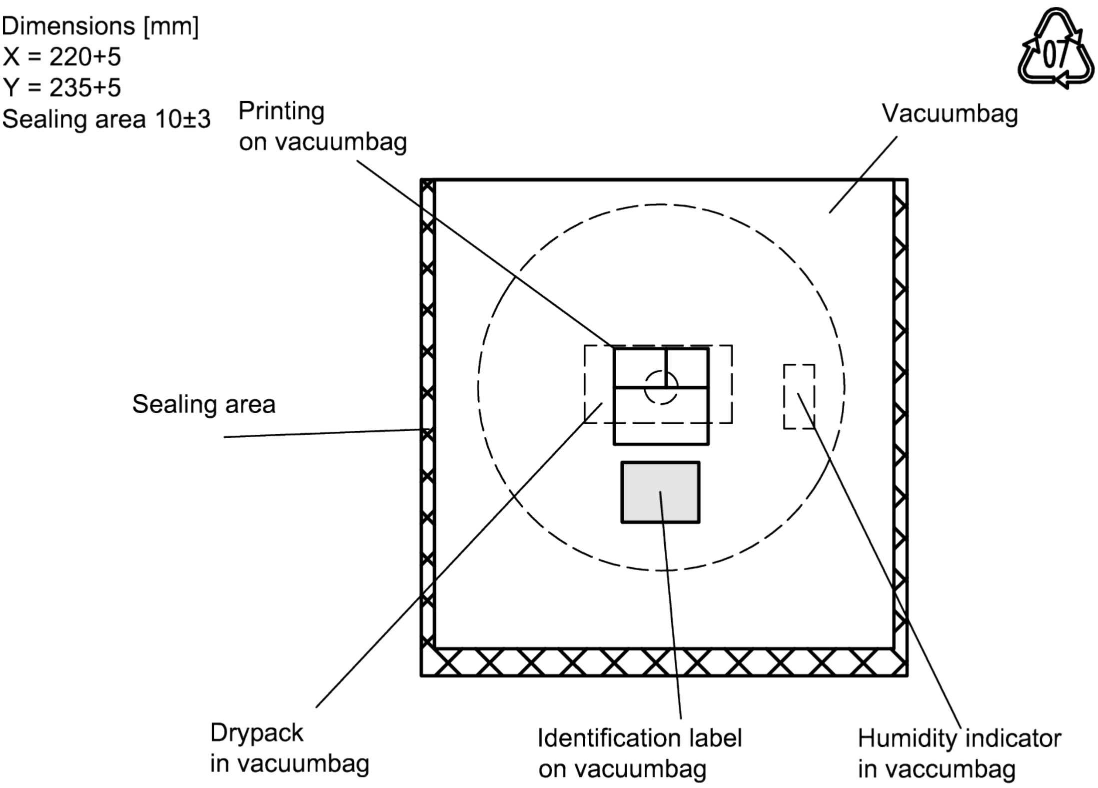

Figure 14: Drawing of moisture barrier bag (MBB) for reel with diameter of 180 mm.

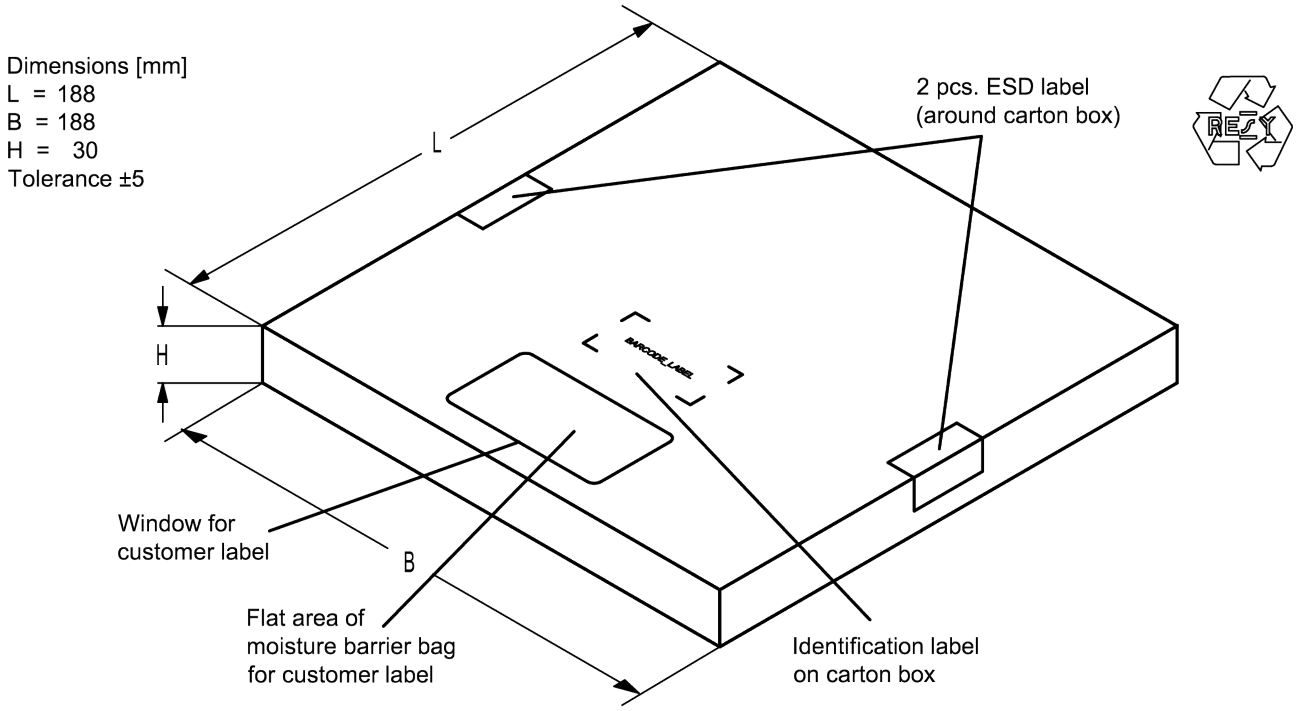

Figure 15: Drawing of folding box for reel with diameter of 180 mm.

16 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., B3xxxxB1234xxxx,
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 B4386 is 492.

- 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.

17 Soldering profile

The recommended soldering process is in accordance with IEC 60068-2-58 – 3[rd] 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).

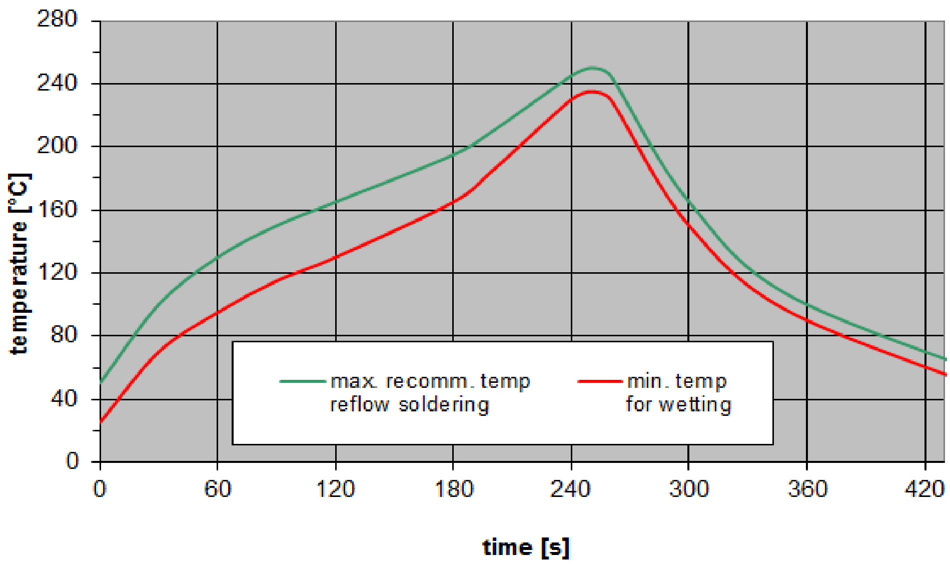

Figure 16: Recommended reflow profile for convection and infrared soldering – lead-free solder.

18 Annotations

18.1 Power Transfer Function (PTF) of WCDMA signal

Attenuation of WCDMA signal, α_{WCDMA}, is defined by

$$\alpha_{WCDMA}(f_{carrier}) = 10\log_{10}\left|\frac{1}{PTF(f_{carrier})}\right| dB$$

and

$$PTF(f_{carrier}) = \int_{-\infty}^{+\infty} \left|S_{21}(f) H_{RRC}(f - f_{carrier})\right|^2 df$$

with $f_{carrier}$ according to 3GPP TS 25.101 (e.g., for the WCDMA B8 pass band, $f_{carrier}$ ranges from 882.4 MHz to 912.6 MHz which correspond to the lowest and highest TX channels, respectively). $H_{RRC}(f)$ is the transfer function of the root-raised cosine transmit pulse shaping filter according to 3GPP TS 25.101 using the normalization

$$\int_{-\infty}^{+\infty} \left|H_{RRC}(f)\right|^2 df = 1 \quad .$$

18.2 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.

18.3 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.

19 Cautions and warnings

19.1 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/.

19.2 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.

19.3 Moldability

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

19.4 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.

20 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.