Qualcomm

RF360
Europe GmbH

Data sheet

SAW duplexer

Automotive telematics
WCDMA band 8

Series/type:	B4401
Ordering code:	B39941B4401P810
Date:	November 01, 2019
Version:	2.4

DCN: 80-PA243-419 Rev. A

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1 Application

- Low-loss SAW duplexer for W-CDMA Band 8 systems
- Low insertion attenuation
- Low amplitude ripple
- Usable pass band 35 MHz
- Single-ended to balanced transformation in Antenna-Rx path
- Impedance transformation 50 Ω to 100 Ω in Antenna-Rx path
- High isolation between Tx and Rx

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

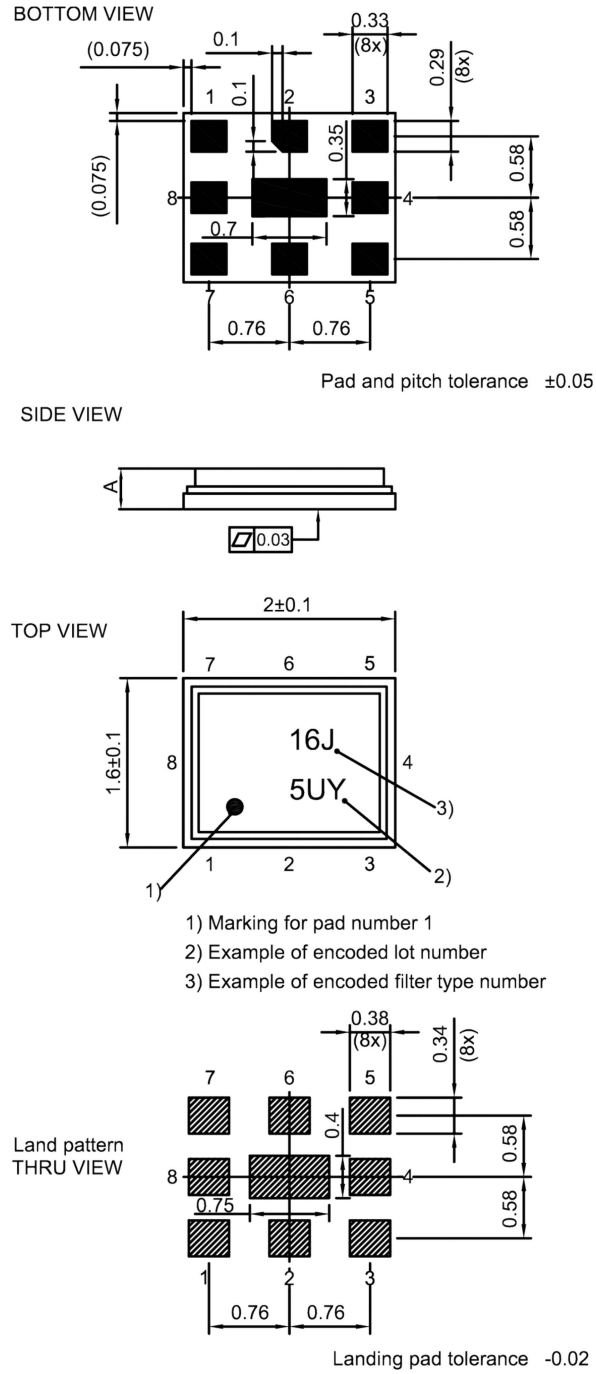

Figure 2: Drawing of package with package height A = 0.45 mm (max.). See Sec. Package information (p. 26).

4 Pin configuration

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

5 Matching circuit

- $L_{p1,8}$ = 39 nH
- L_{p6} = 7.8 nH
- L_{p3} = 25 nH

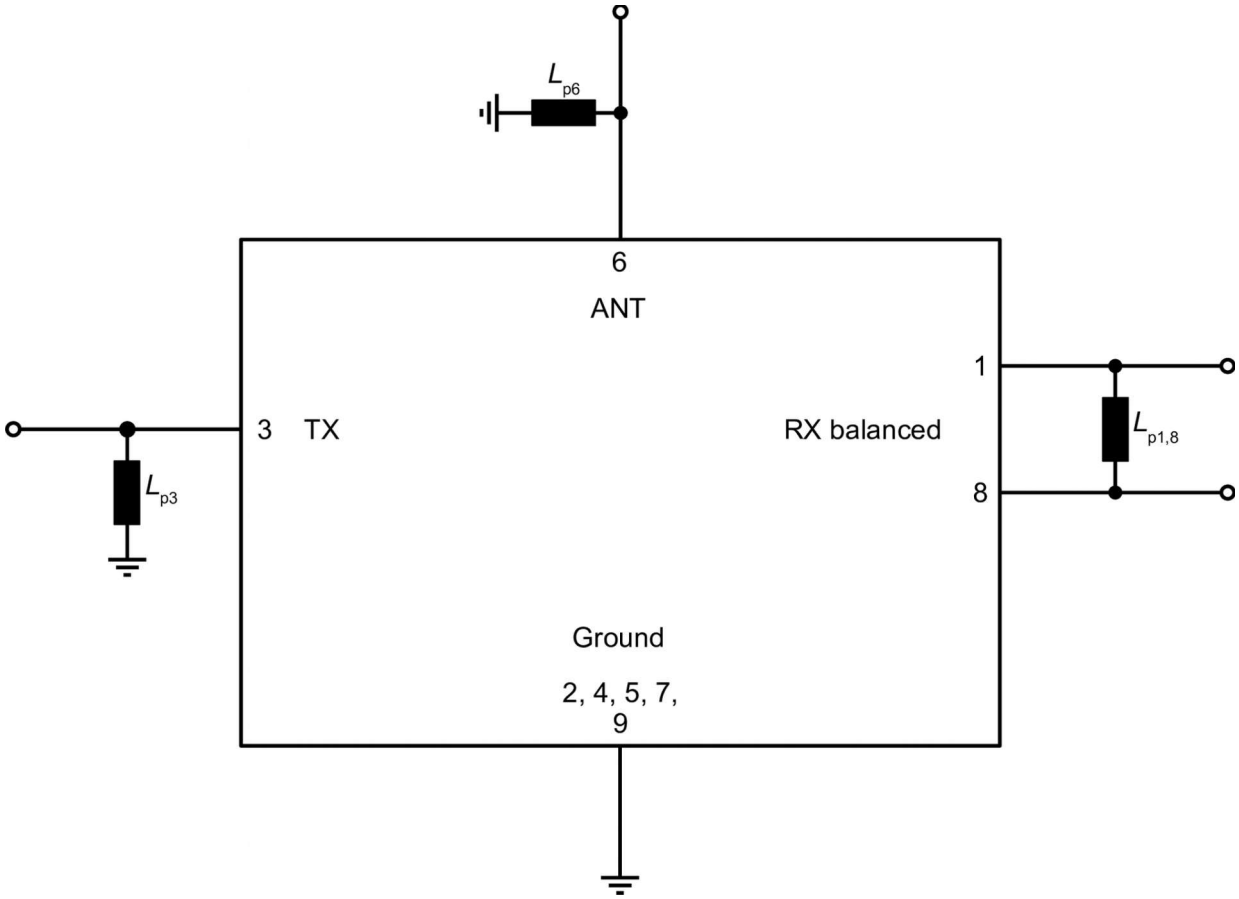

Figure 3: Schematic of matching circuit.

6 Characteristics

6.1 TX – ANT

Temperature range for specification	T_{SPEC}	= −20 °C ... +85 °C
TX terminating impedance	Z_{TX}	= 50 Ω // 25 nH[1)]
ANT terminating impedance	Z_{ANT}	= 50 Ω // 7.8 nH[1)]
RX terminating impedance	Z_{RX}	= 100 Ω // 39 nH[1)]

Characteristics TX – ANT					min. for T_{SPEC}	typ. @ +25 °C	max. for T_{SPEC}	
Center frequency				f_C	—	897.5	—	MHz
Maximum insertion attenuation								
		880... 915	MHz	α_{max}	—	2.4	2.8[2)]	dB
		880... 915	MHz	α_{max}	—	2.4	3.9	dB
	@$f_{carrier}$	882.4... 912.6	MHz	$\alpha_{WCDMA,max}$[3)]	—	1.8	2.8	dB
Amplitude ripple (p-p)								
		880... 915	MHz	$\Delta\alpha$	—	1.6	3.1	dB
	@$f_{carrier}$	882.4... 912.6	MHz	$\Delta\alpha_{WCDMA}$[3)]	—	1.0	2.0	dB
Maximum VSWR				$VSWR_{max}$				
@ TX port		880... 915	MHz		—	1.8	2.1	
@ ANT port		880... 915	MHz		—	1.7	2.0	
Maximum error vector magnitude				EVM_{max}[4)]				
		882.4... 912.6	MHz		—	2.3	4.0[2)]	%
		882.4... 912.6	MHz		—	2.3	6.0	%
Minimum attenuation								
		50... 716	MHz	α_{min}	30	34	—	dB
		716... 728	MHz	α_{min}	30	34	—	dB
		728... 865	MHz	α_{min}	30	34	—	dB
		865... 870	MHz	α_{min}	10	41	—	dB
	@$f_{carrier}$	927.4... 957.6	MHz	$\alpha_{WCDMA,min}$[3)]	45[5)]	53	—	dB
	@$f_{carrier}$	927.4... 957.6	MHz	$\alpha_{WCDMA,min}$[3)]	38	53	—	dB
		1452... 1477	MHz	α_{min}	20	42	—	dB
		1565.42... 1573.374	MHz	α_{min}	40	48	—	dB
		1573.374... 1577.466	MHz	α_{min}	40	49	—	dB
		1577.466... 1585.42	MHz	α_{min}	40	49	—	dB
		1597.55... 1605.89	MHz	α_{min}	40	49	—	dB
		1670... 1675	MHz	α_{min}	25	51	—	dB
		1760... 1830	MHz	α_{min}	38	46	—	dB
		1830... 1880	MHz	α_{min}	27	45	—	dB
		2110... 2170	MHz	α_{min}	27	40	—	dB
		2400... 2500	MHz	α_{min}	30	36	—	dB
		2620... 2650	MHz	α_{min}	27	31	—	dB

Characteristics TX – ANT				min. for T_{SPEC}	typ. @ +25 °C	max. for T_{SPEC}	
	2650... 2745	MHz	α_{min}	30	35	—	dB
	3520... 3660	MHz	α_{min}	20	32	—	dB
	4400... 4575	MHz	α_{min}	20	32	—	dB
	5100... 5490	MHz	α_{min}	15	24	—	dB
	5490... 5850	MHz	α_{min}	10	17	—	dB

1) See Sec. Matching circuit (p. 6).
2) Valid for typical temperature T = +25 °C.
3) Attenuation of WCDMA signal ("power transfer function"). Please refer to definition of Power Transfer Function (PTF) of WCDMA signal (p. 25).
4) Error Vector Magnitude (EVM) based on definition in 3GPP TS 25.141.
5) Valid for temperature T = +5 °C...+85 °C.

6.2 ANT – RX

Temperature range for specification	T_{SPEC}	= −20 °C ... +85 °C
TX terminating impedance	Z_{TX}	= 50 Ω // 25 nH[1]
ANT terminating impedance	Z_{ANT}	= 50 Ω // 7.8 nH[1]
RX terminating impedance	Z_{RX}	= 100 Ω // 39 nH[1]

Characteristics ANT – RX					min. for T_{SPEC}	typ. @ +25 °C	max. for T_{SPEC}	
Center frequency				f_C	—	942.5	—	MHz
Maximum insertion attenuation								
	925... 960	MHz		α_{max}	—	2.4	3.2[2]	dB
	925... 960	MHz		α_{max}	—	2.4	3.7[3]	dB
	925... 960	MHz		α_{max}	—	2.4	4.7	dB
@$f_{carrier}$	927.4... 957.6	MHz		$\alpha_{WCDMA,max}$[4]	—	1.8	2.5	dB
Amplitude ripple (p-p)								
	925... 960	MHz		$\Delta\alpha$	—	1.0	3.5	dB
@$f_{carrier}$	927.4... 957.6	MHz		$\Delta\alpha_{WCDMA}$[4]	—	0.6	1.3	dB
Maximum VSWR				$VSWR_{max}$				
@ ANT port	925... 960	MHz			—	1.7	2.0	
@ RX port	925... 960	MHz			—	1.8	2.1	
Maximum error vector magnitude				EVM_{max}[5]				
	927.4... 957.6	MHz			—	3.3	4.5[2]	%
	927.4... 957.6	MHz			—	3.3	8.5	%
Minimum common-mode rejection ratio				$CMRR_{min}$				
	925... 960	MHz			23	30	—	dB
Minimum attenuation								
	50... 462	MHz		α_{min}	35	90	—	dB
	462... 480	MHz		α_{min}	45	86	—	dB
	480... 835	MHz		α_{min}	38	68	—	dB
	835... 870	MHz		α_{min}	49	65	—	dB
	870... 880	MHz		α_{min}	38	67	—	dB
@$f_{carrier}$	882.4... 912.6	MHz		$\alpha_{WCDMA,min}$[4]	50	57	—	dB
	980... 1045	MHz		α_{min}	16	20	—	dB
	1045... 2400	MHz		α_{min}	35	57	—	dB
	2400... 2500	MHz		α_{min}	45	60	—	dB
	2500... 4810	MHz		α_{min}	35	55	—	dB
	5100... 5825	MHz		α_{min}	35	52	—	dB

[1] See Sec. Matching circuit (p. 6).
[2] Valid for typical temperature T = +25 °C.
[3] Valid for temperature T = +5 °C...+85 °C.
[4] Attenuation of WCDMA signal ("power transfer function"). Please refer to definition of Power Transfer Function (PTF) of WCDMA signal (p. 25).
[5] Error Vector Magnitude (EVM) based on definition in 3GPP TS 25.141.

6.3 TX – RX

Temperature range for specification	T_{SPEC}	= −20 °C ... +85 °C
TX terminating impedance	Z_{TX}	= 50 Ω // 25 nH[1)]
ANT terminating impedance	Z_{ANT}	= 50 Ω // 7.8 nH[1)]
RX terminating impedance	Z_{RX}	= 100 Ω // 39 nH[1)]

Characteristics TX – RX					min. for T_{SPEC}	typ. @ +25 °C	max. for T_{SPEC}	
Minimum isolation				$\alpha_{WCDMA,min}$ [2)]				
	@$f_{carrier}$	882.4... 912.6	MHz		56	60	—	dB
	@$f_{carrier}$	927.4... 957.6	MHz		50[3)]	57	—	dB
	@$f_{carrier}$	927.4... 957.6	MHz		43	57	—	dB
Minimum common-mode isolation				$\alpha_{WCDMA,min}$ [2)]				
	@$f_{carrier}$	882.4... 912.6	MHz		55	65	—	dB

1) See Sec. Matching circuit (p. 6).
2) Attenuation of WCDMA signal ("power transfer function"). Please refer to definition of Power Transfer Function (PTF) of WCDMA signal (p. 25).
3) Valid for temperature T = +5 °C...+85 °C.

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: 880 ... 915 MHz	30 dBm	WCDMA signal for 10000 h @ 55 °C.
Elsewhere @ TX port	10 dBm	WCDMA signal for 10000 h @ 55 °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

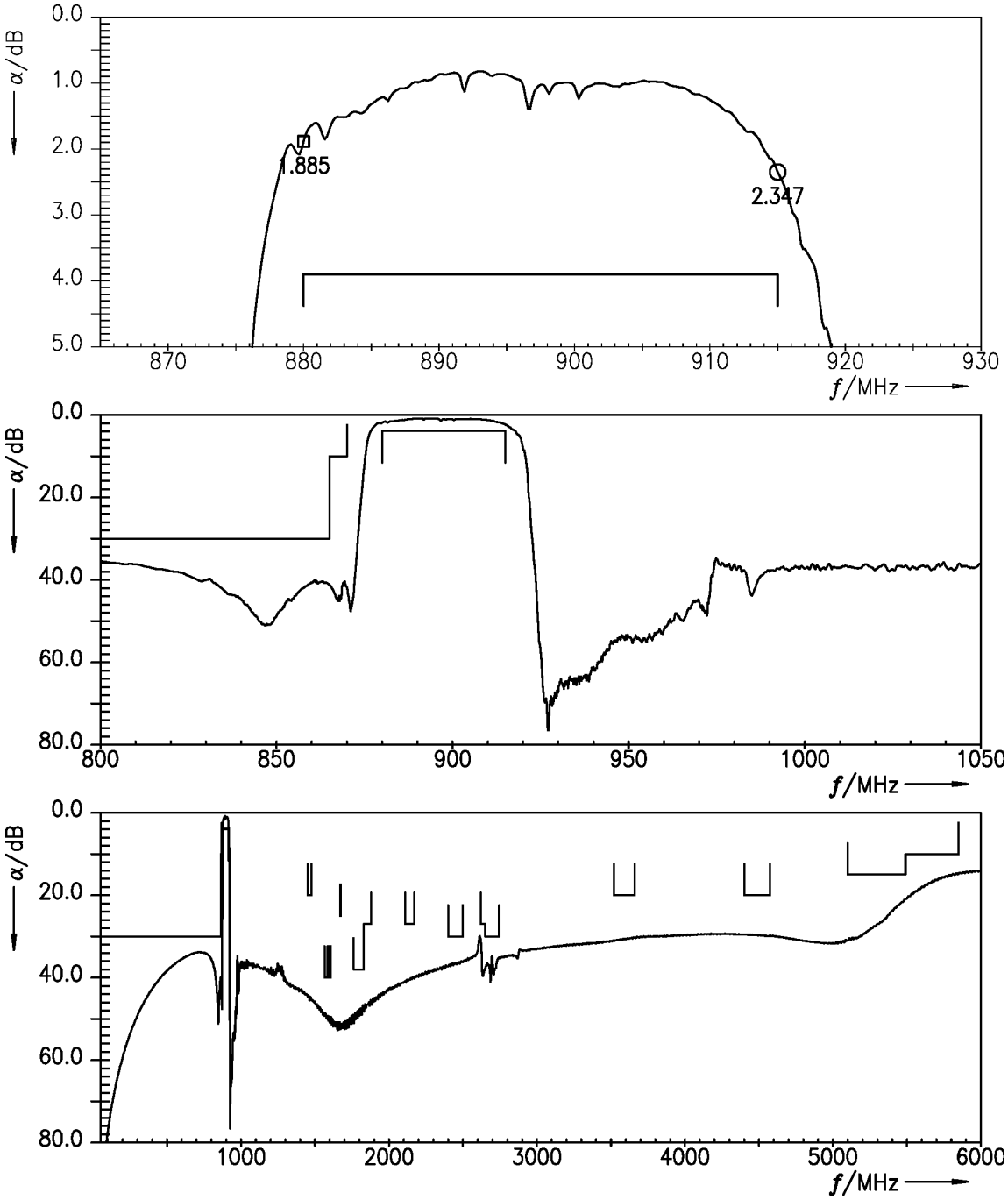

Figure 4: Attenuation TX – ANT.

8.2 ANT – RX

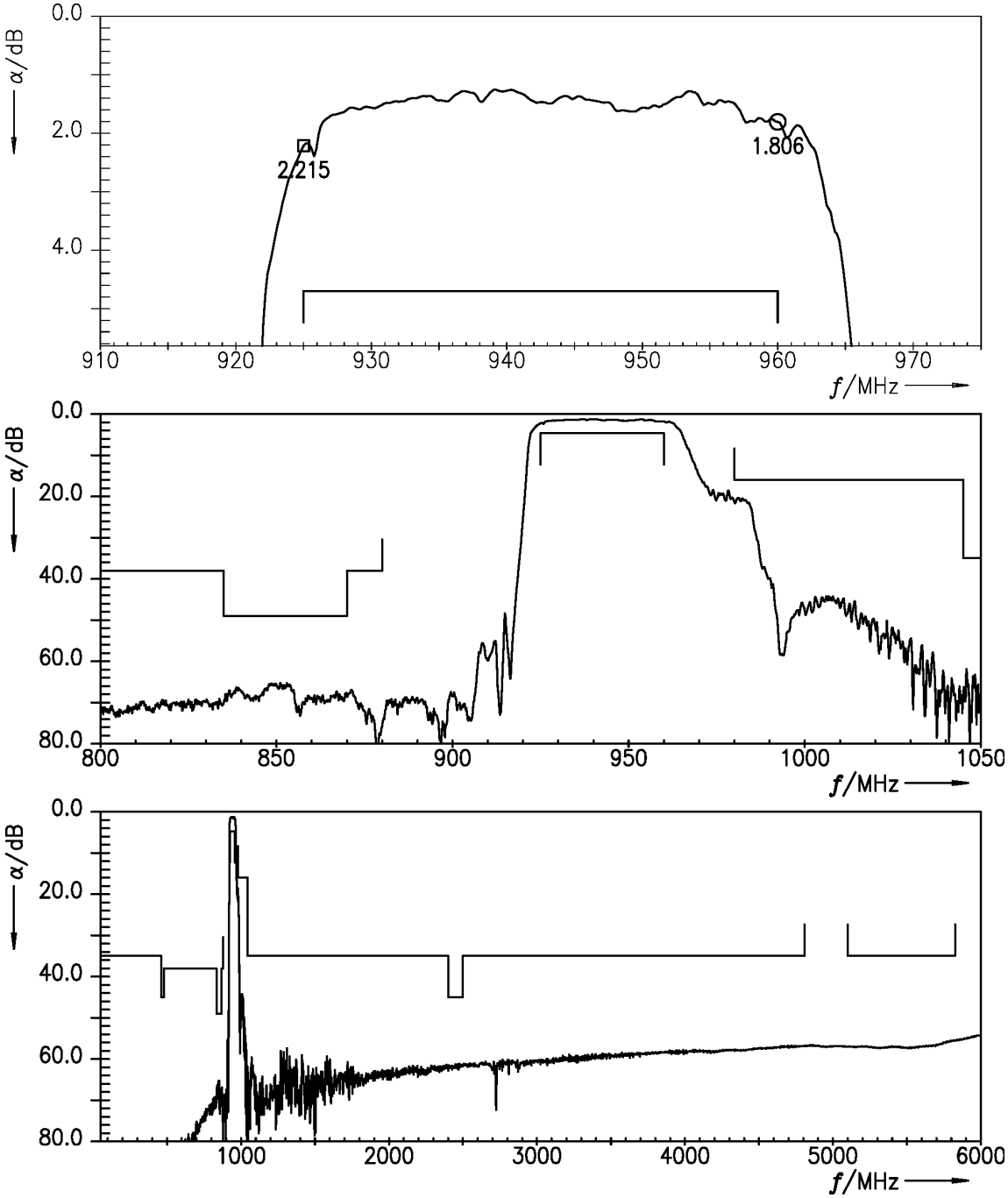

Figure 5: Attenuation ANT – RX.

9 Power transfer functions (WCDMA)

9.1 TX – ANT

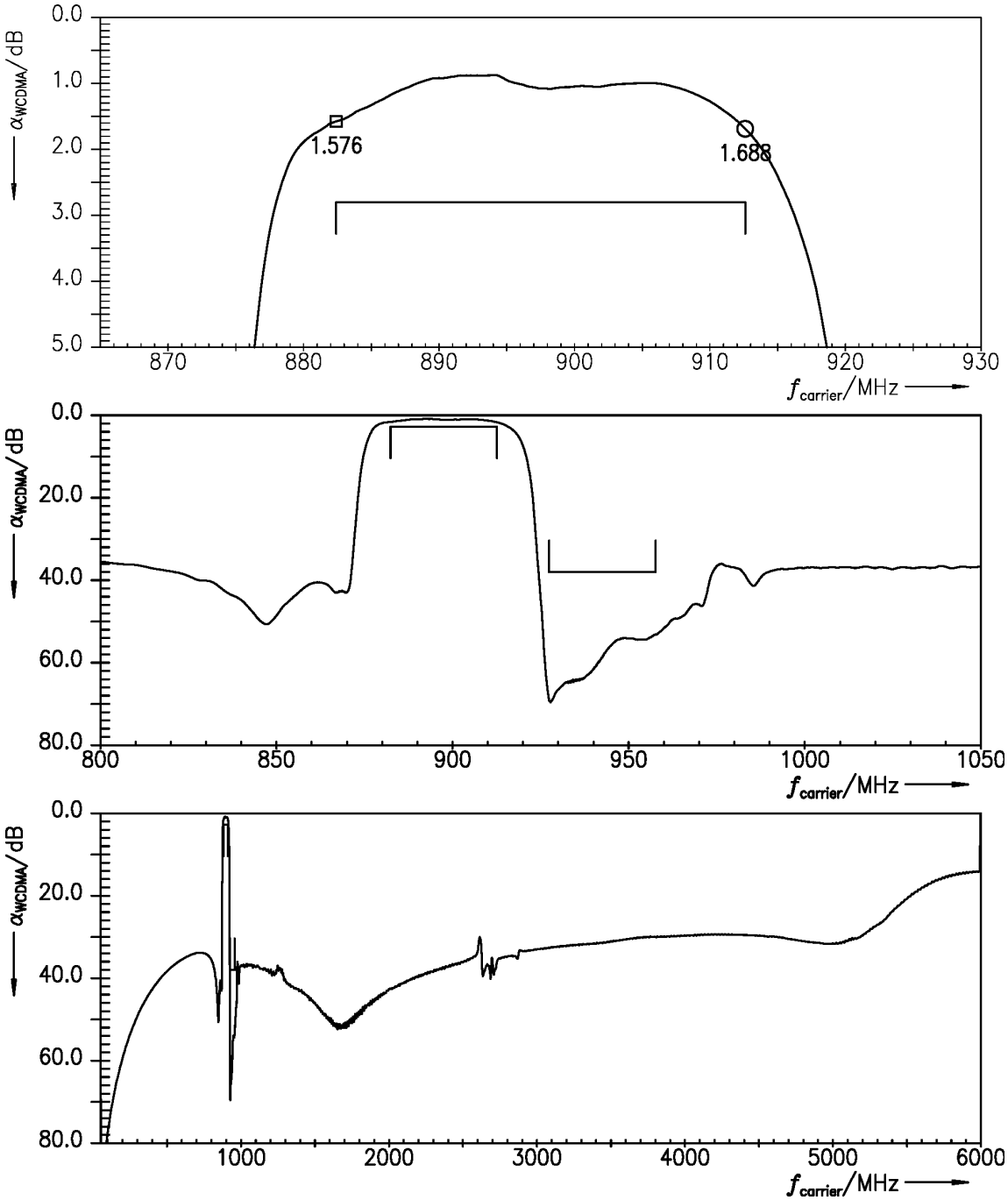

Figure 6: Attenuation (WCDMA) TX – ANT.

9.2 ANT – RX

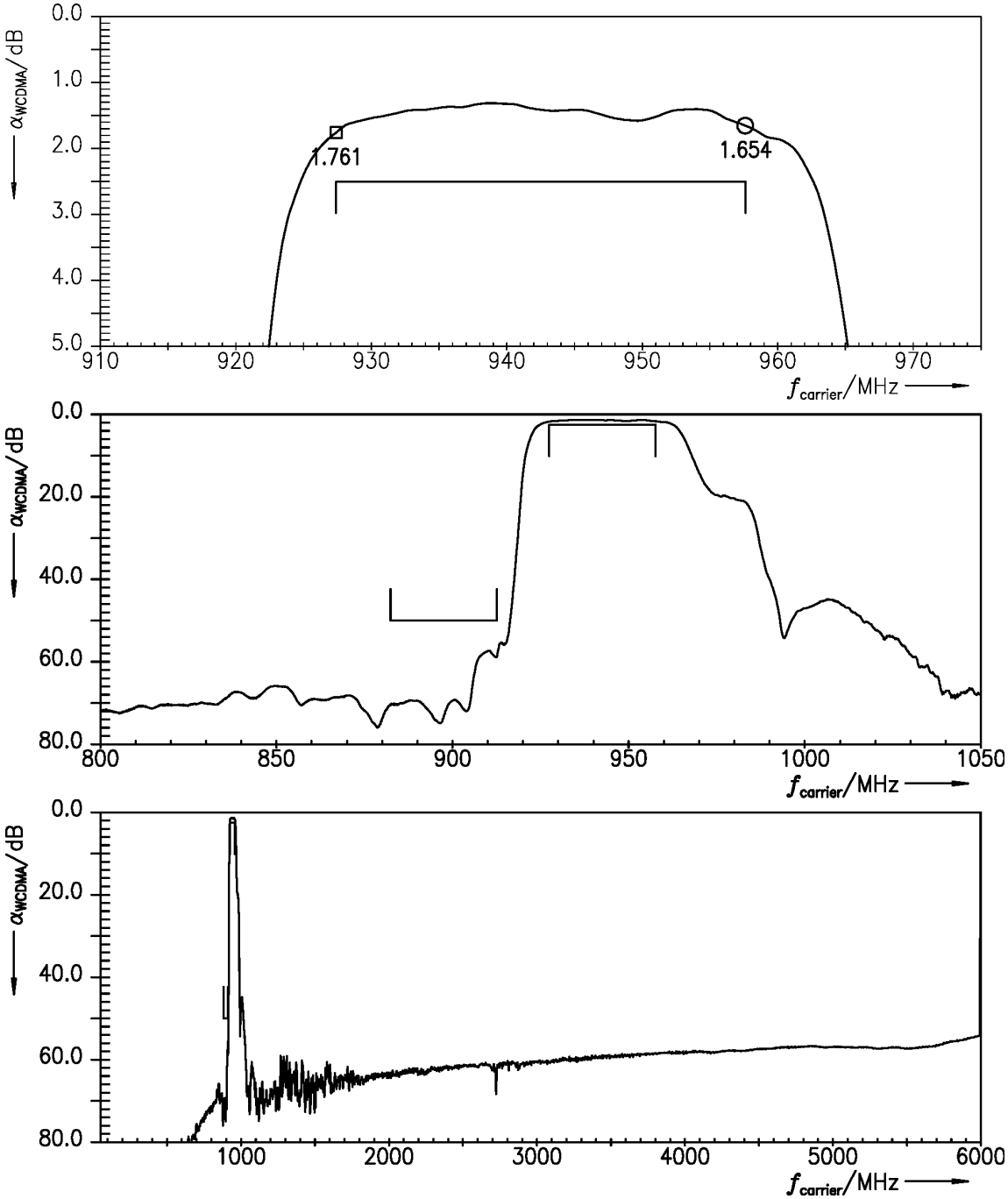

Figure 7: Attenuation (WCDMA) ANT – RX.

9.3 TX – RX

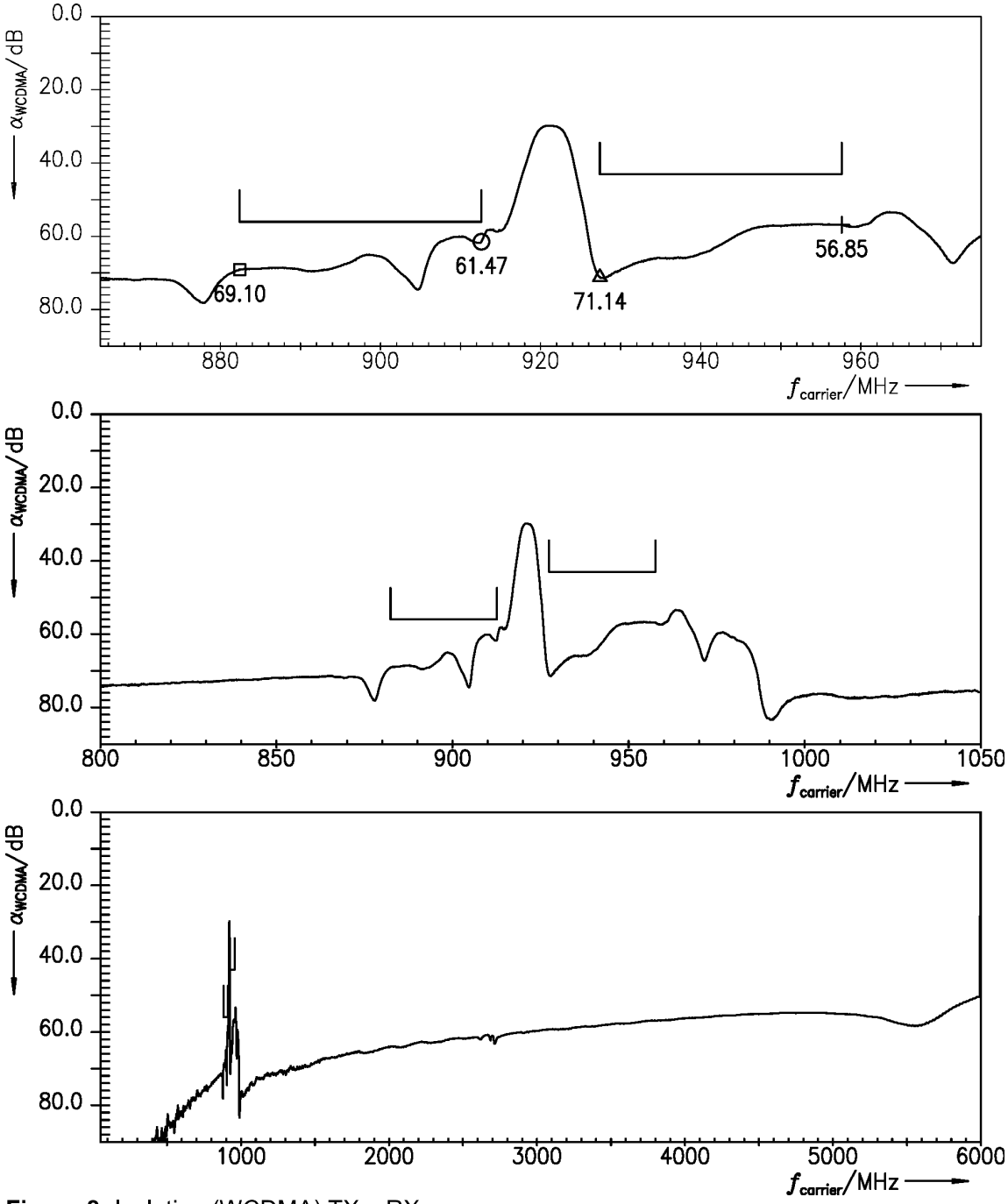

Figure 8: Isolation (WCDMA) TX – RX.

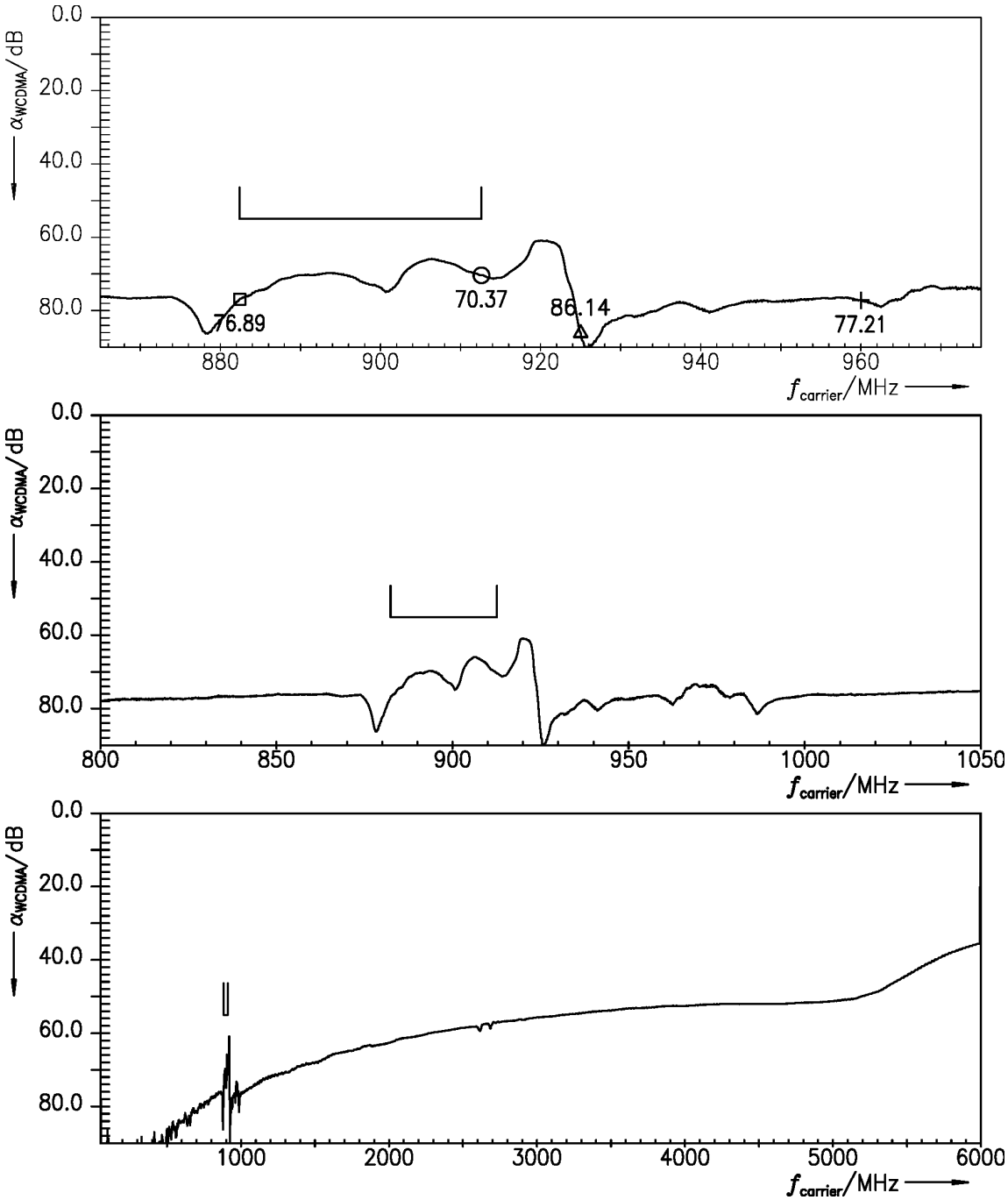

Figure 9: Common-mode isolation (WCDMA) TX – RX.

10 Reflection coefficients

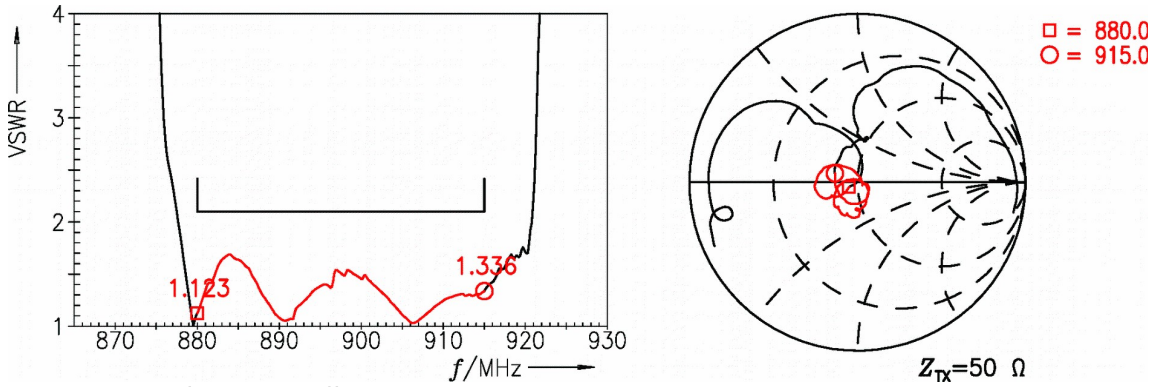

Figure 10: Reflection coefficient at TX port.

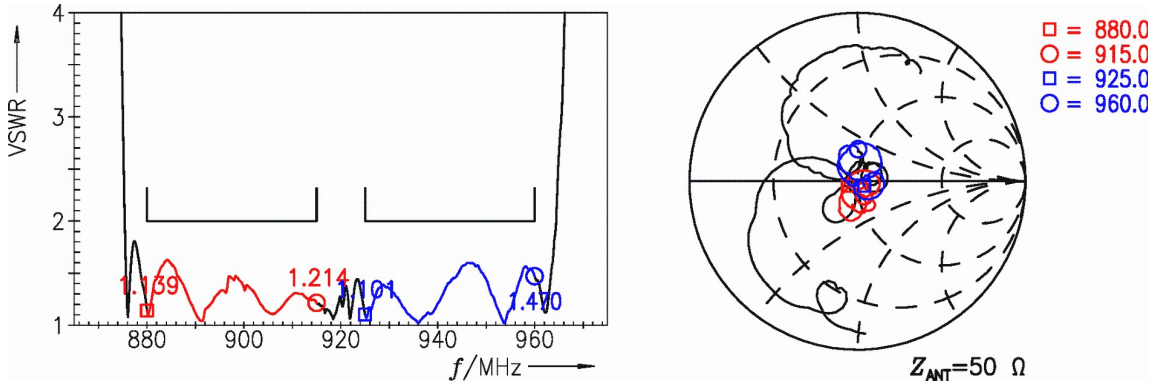

Figure 11: Reflection coefficient at ANT port.

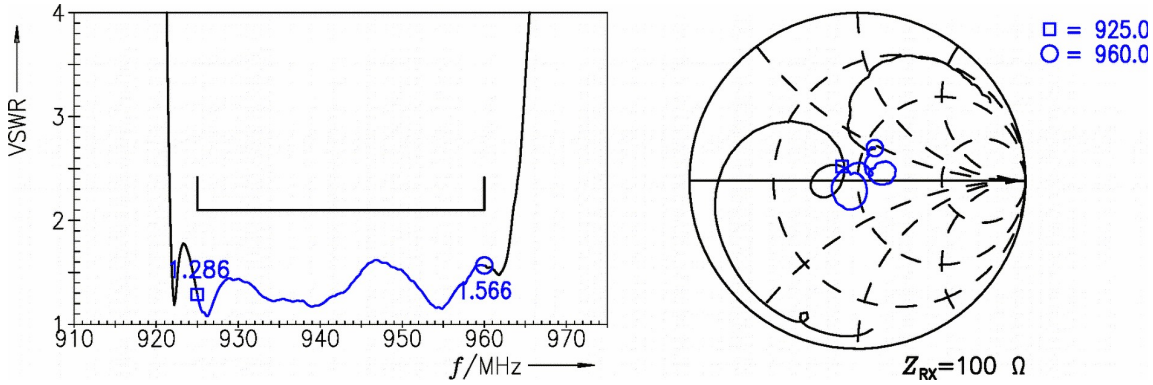

Figure 12: Reflection coefficient at RX port.

11 Common-mode rejection ratio

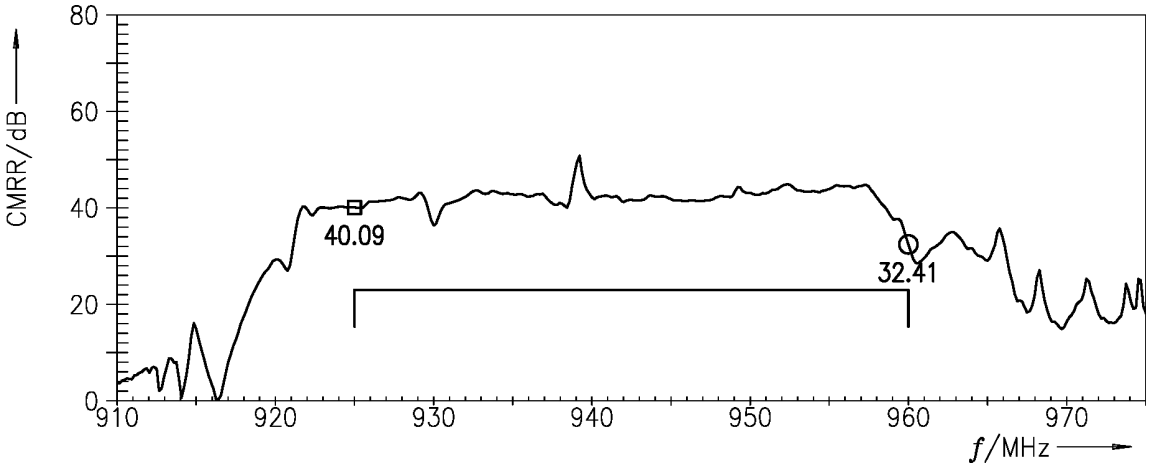

Figure 13: Common-mode rejection ratio ANT – RX.

12 Packing material

12.1 Tape

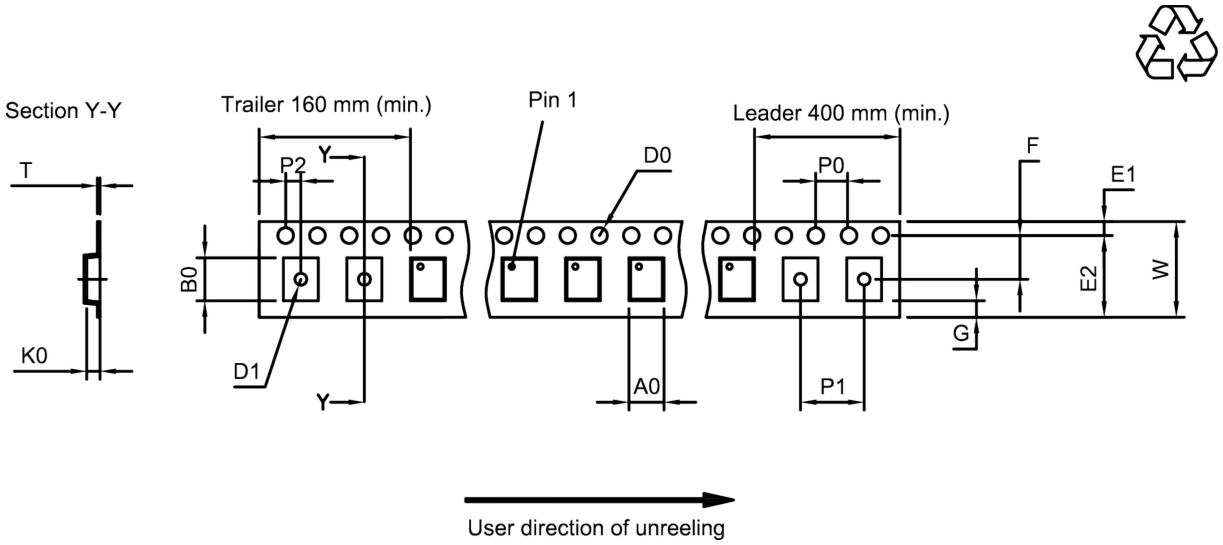

Figure 14: Drawing of tape (first-angle projection) for illustration only and not to scale. The valid tape dimensions are listed in Table 1.

A_0	1.8±0.05 mm
B_0	2.25±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.

12.2 Reel with diameter of 180 mm

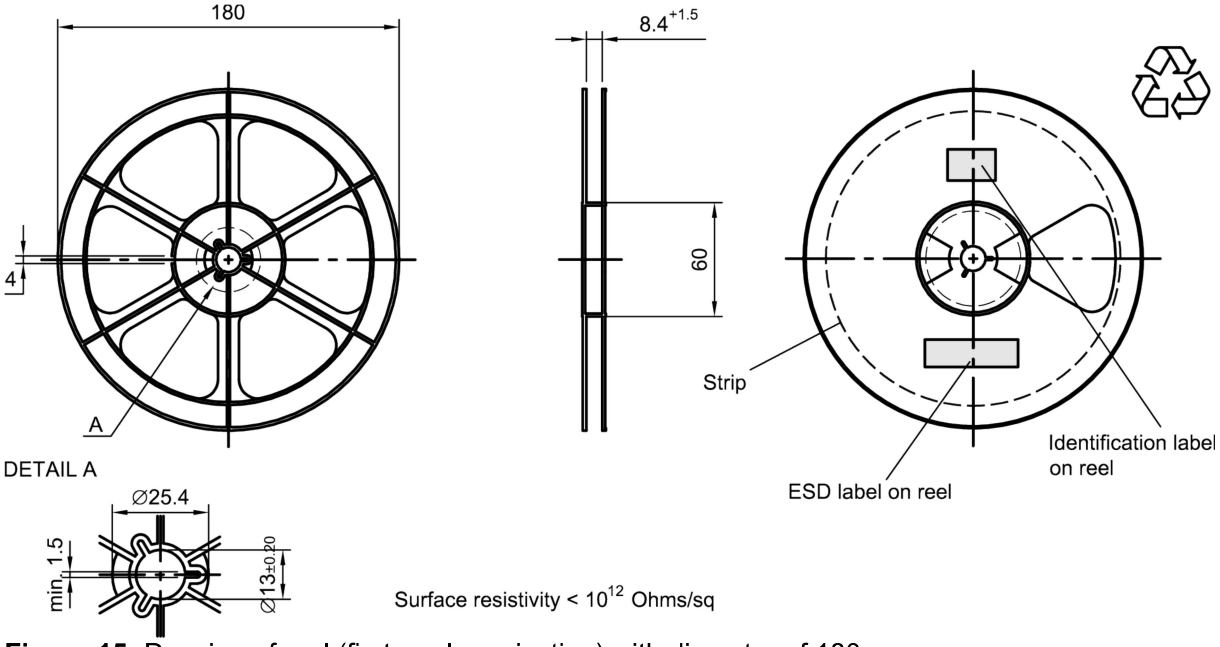

Figure 15: Drawing of reel (first-angle projection) with diameter of 180 mm.

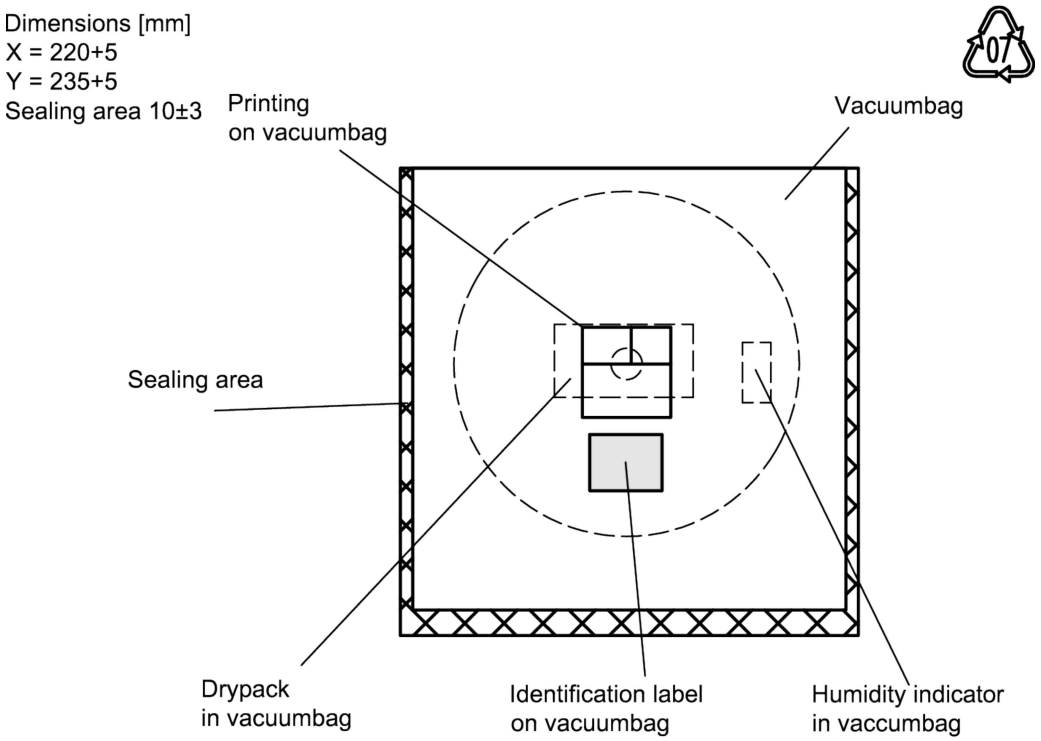

Figure 16: Drawing of moisture barrier bag (MBB) for reel with diameter of 180 mm.

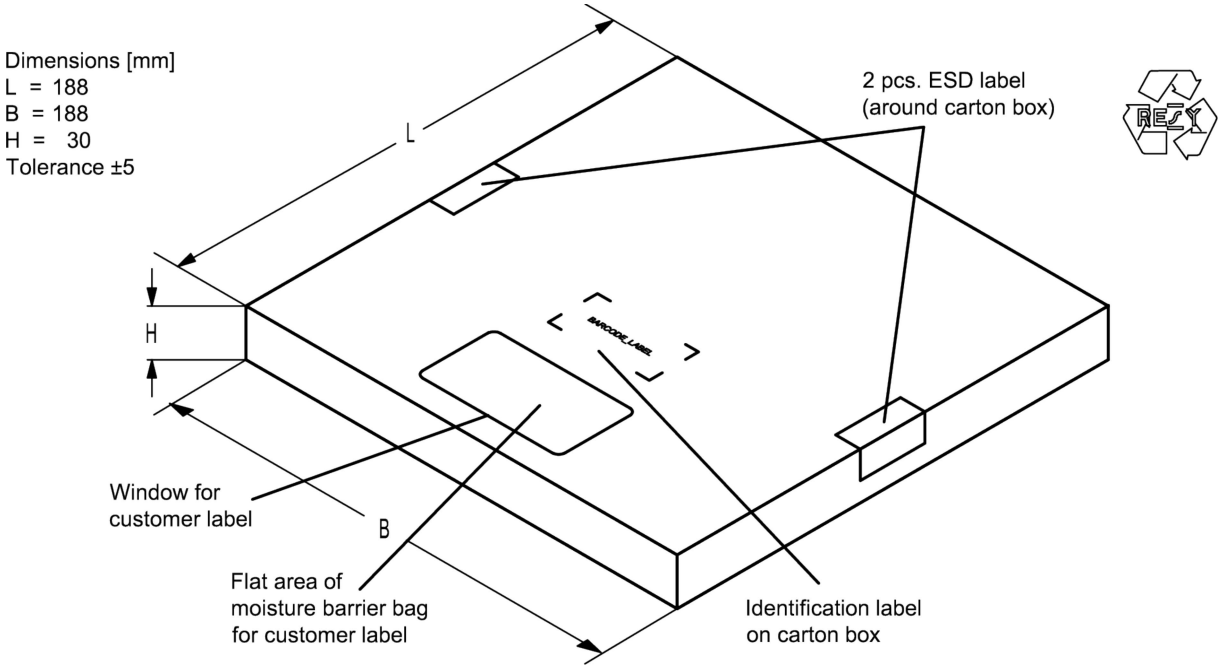

Figure 17: Drawing of folding box for reel with diameter of 180 mm.

13 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 B4401 is 49H.

- 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.

14 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).

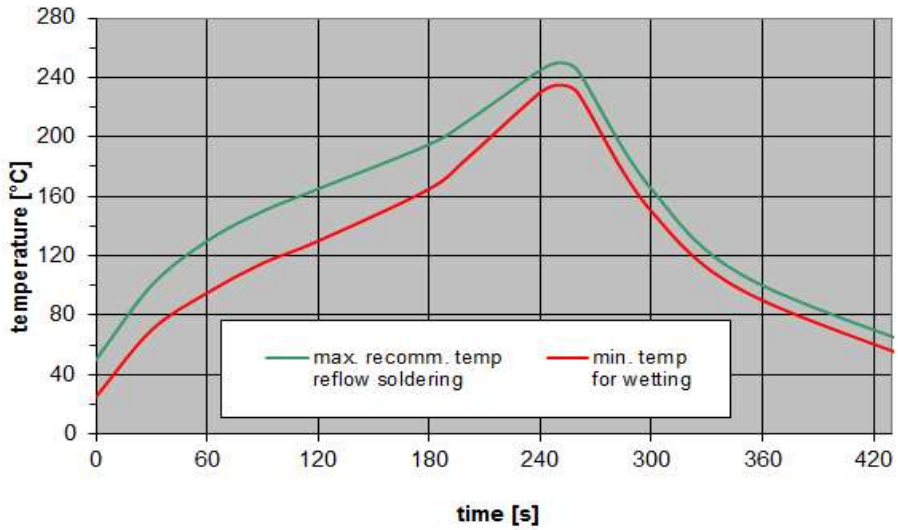

Figure 18: Recommended reflow profile for convection and infrared soldering – lead-free solder.

15 Annotations

15.1 Power Transfer Function (PTF) of WCDMA signal

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

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

and

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

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

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

15.2 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.

15.3 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.

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://rffe.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.
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.
5. We constantly strive to improve our products. Consequently, **the products described in this publication may change from time to time**. The same is true of the corresponding product specifications. Please check therefore to what extent product descriptions and specifications contained in this publication are still applicable before or when you place an order. We also **reserve the right to discontinue production and delivery of products**. Consequently, we cannot guarantee that all products named in this publication will always be available.
   The aforementioned does not apply in the case of individual agreements deviating from the foregoing for customer-specific products.