Qualcomm

RF360
Europe GmbH

# Data sheet

## SAW duplexer
LTE band 13 & LTE / 5G band 14

| | |
|---|---|
| Part number: | B1294 |
| Ordering code: | B39781B1294L210 |
| Date: | April 05, 2021 |
| Version: | 2.0 |

DCN: 80-PA243-559 Rev. A



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## Table of contents

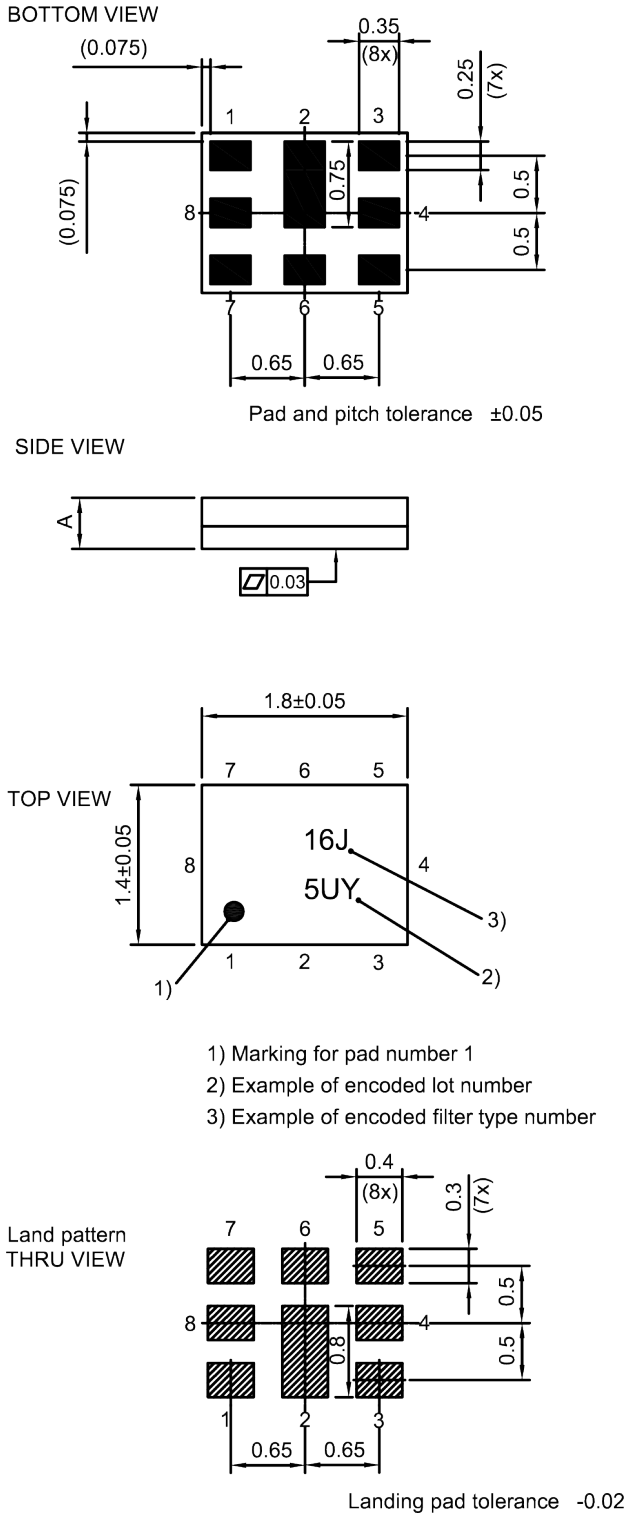
## 1 Application

- Duplexer for 4G Band13 and 4G/ 5G Band14
- Bands 13 & 14 uplink: 787.5 MHz (pass band 21 MHz)
- Bands 13 & 14 downlink: 757 MHz (pass band 22 MHz)
- High attenuation
- Low amplitude ripple
- NS07 rejection, public safety frequency band
- Near zero temperature drift
- Single-ended duplexer

## 2 Features

- Package size $1.8_{\pm 0.05}$ mm × $1.4_{\pm 0.05}$ mm
- Package height 0.64 mm (max.)
- Approximate weight 4 mg
- RoHS compatible
- Package for Surface Mount Technology (SMT)
- Ni/Au-plated terminals
- Electrostatic Sensitive Device (ESD)
- Moisture Sensitivity Level 3 (MSL3)

## 3 Package




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

**Figure 1:** Drawing of package with package height A = 0.64 mm (max.). See Sec. Package information (p. 24).

## 4 Pin configuration

| | |
|---|---|
| ■ 1 | RX |
| ■ 3 | TX |
| ■ 6 | ANT |
| ■ 2, 4, 5, 7, 8 | Ground |

## 5 Matching circuit

- $L_{p6}$ = 12 nH
- $L_{s3}$ = 1.2 nH
- $L_{s1}$ = 6.0 nH

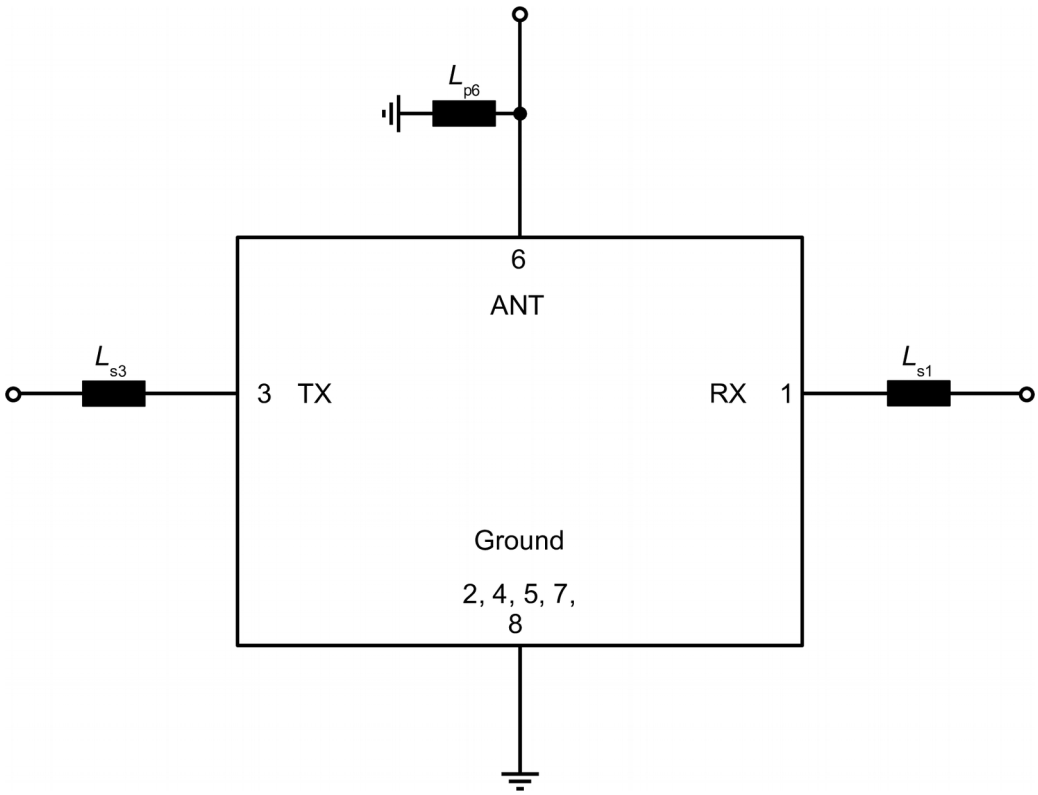



**Figure 2:** Schematic of matching circuit.

External shunt inductor for ESD protection is recommended at any ports towards antenna.

# 6 Characteristics

## 6.1 TX – ANT

Temperature range for specification $T_{SPEC}$ = −30 °C ... +85 °C
TX terminating impedance $Z_{TX}$ = 50 Ω + 1.2 nH[1)]
ANT terminating impedance $Z_{ANT}$ = 50 Ω // 12 nH[1)]
RX terminating impedance $Z_{RX}$ = 50 Ω + 6.0 nH[1)]

| Characteristics TX – ANT | | | | min. for $T_{SPEC}$ | typ. @ +25 °C | max. for $T_{SPEC}$ | |
|---|---|---|---|---|---|---|---|
| **Center frequency** | | | $f_C$ | — | 787.5 | — | MHz |
| **Maximum insertion attenuation** | | | $\alpha_{max}$ | | | | |
| | 777.5 ... 786.5 | MHz | | — | 2.1 | 3.3[2)] | dB |
| | 777.5 ... 786.5 | MHz | | — | 2.1 | 3.5 | dB |
| | 788.34 ... 797.66 | MHz | | — | 1.4 | 2.4[2)] | dB |
| | 788.34 ... 797.66 | MHz | | — | 1.4 | 2.6 | dB |
| **Amplitude ripple (p-p)** | | | $\Delta\alpha$ | | | | |
| | 777.5 ... 786.5 | MHz | | — | 1.5 | 2.9 | dB |
| | 788.34 ... 797.66 | MHz | | — | 0.7 | 1.5 | dB |
| **Maximum VSWR** | | | $VSWR_{max}$ | | | | |
| @ TX port | 777.5 ... 786.5 | MHz | | — | 1.7 | 2.0 | |
| | 788.34 ... 797.66 | MHz | | — | 1.6 | 2.0 | |
| @ ANT port | 777.5 ... 786.5 | MHz | | — | 1.5 | 2.0 | |
| | 788.34 ... 797.66 | MHz | | — | 1.6 | 2.0 | |
| **Minimum attenuation (relative to $\alpha_{max}$)** | | | $\alpha_{rel,min}$ | | | | |
| NS07 | 768 ... 775 | MHz | | 21[3)] | 23[3)] | — | dB |
| **Minimum attenuation** | | | $\alpha_{min}$ | | | | |
| | 10 ... 662 | MHz | | 30 | 40 | — | dB |
| | 663 ... 698 | MHz | | 30 | 40 | — | dB |
| | 699 ... 716 | MHz | | 30 | 42 | — | dB |
| | 716 ... 728 | MHz | | 40 | 43 | — | dB |
| | 729 ... 746 | MHz | | 40 | 46 | — | dB |
| | 746 ... 768 | MHz | | 50 | 54 | — | dB |
| | 869 ... 894 | MHz | | 40 | 42 | — | dB |
| | 1166 ... 1187 | MHz | | 42 | 49 | — | dB |
| | 1226 ... 1250 | MHz | | 42 | 52 | — | dB |
| | 1554 ... 1565 | MHz | | 45 | 54 | — | dB |
| | 1559 ... 1563 | MHz | | 45 | 54 | — | dB |
| | 1565.42 ... 1573.37 | MHz | | 45 | 54 | — | dB |
| | 1573.37 ... 1577.47 | MHz | | 45 | 54 | — | dB |
| | 1577.47 ... 1585.42 | MHz | | 45 | 54 | — | dB |
| | 1597.55 ... 1605.89 | MHz | | 45 | 53 | — | dB |
| | 1710 ... 1785 | MHz | | 30 | 44 | — | dB |
| | 1805 ... 1880 | MHz | | 35 | 42 | — | dB |

| Characteristics TX – ANT | | | min. for $T_{SPEC}$ | typ. @ +25 °C | max. for $T_{SPEC}$ | |
|---|---|---|---|---|---|---|
| 1850... 1915 | MHz | | 30 | 42 | — | dB |
| 1930... 1990 | MHz | | 30 | 44 | — | dB |
| 2110... 2200 | MHz | | 30 | 40 | — | dB |
| 2331... 2361 | MHz | | 30 | 35 | — | dB |
| 2364... 2394 | MHz | | 30 | 35 | — | dB |
| 2400... 2484 | MHz | | 30 | 34 | — | dB |
| 2496... 2690 | MHz | | 30 | 33 | — | dB |
| 3108... 3148 | MHz | | 25 | 33 | — | dB |
| 3152... 3192 | MHz | | 25 | 32 | — | dB |
| 3300... 4200 | MHz | | 25 | 30 | — | dB |
| 4900... 5950 | MHz | | 18 | 22 | — | dB |

1) See Sec. Matching circuit (p. 6).
2) Valid for typical temperature $T$ = +25 °C.
3) Relative to insertion loss in 777.50 – 786.50MHz.

## 6.2 ANT – RX

| | | |
|---|---|---|
| Temperature range for specification | $T_{SPEC}$ | = −30 °C ... +85 °C |
| TX terminating impedance | $Z_{TX}$ | = 50 Ω + 1.2 nH[1] |
| ANT terminating impedance | $Z_{ANT}$ | = 50 Ω // 12 nH[1] |
| RX terminating impedance | $Z_{RX}$ | = 50 Ω + 6.0 nH[1] |

| **Characteristics ANT – RX** | | | | **min.** for $T_{SPEC}$ | **typ.** @ +25 °C | **max.** for $T_{SPEC}$ | |
|---|---|---|---|---|---|---|---|
| **Center frequency** | | | $f_C$ | — | 757 | — | MHz |
| **Maximum insertion attenuation** | | | $\alpha_{INT,max}$ [2] | | | | |
| | 746 ... 756 | MHz | | — | 1.0 | 1.6[3] | dB |
| | 746 ... 756 | MHz | | — | 1.0 | 1.8 | dB |
| | 758 ... 768 | MHz | | — | 1.1 | 2.3[3] | dB |
| | 758 ... 768 | MHz | | — | 1.1 | 2.5 | dB |
| **Amplitude ripple (p-p)** | | | Δα | | | | |
| | 746.34 ... 755.66 | MHz | | — | 0.6 | 1.5 | dB |
| | 758.34 ... 767.66 | MHz | | — | 0.7 | 2.0 | dB |
| **Maximum VSWR** | | | $VSWR_{max}$ | | | | |
| @ ANT port | 746.34 ... 755.66 | MHz | | — | 1.4 | 2.0 | |
| | 758.34 ... 767.66 | MHz | | — | 1.4 | 2.0 | |
| @ RX port | 746.34 ... 755.66 | MHz | | — | 1.4 | 2.0 | |
| | 758.34 ... 767.66 | MHz | | — | 1.3 | 2.0 | |
| **Minimum attenuation** | | | $\alpha_{min}$ | | | | |
| | 10 ... 686 | MHz | | 40 | 46 | — | dB |
| | 31 | MHz | | 40 | >65 | — | dB |
| | 663 ... 698 | MHz | | 30 | 47 | — | dB |
| | 699 ... 716 | MHz | | 30 | 49 | — | dB |
| | 777.5 ... 798 | MHz | | 47 | 54 | — | dB |
| | 798 ... 809 | MHz | | 40 | 52 | — | dB |
| | 809 ... 825 | MHz | | 35 | 46 | — | dB |
| | 825 ... 840 | MHz | | 40 | 51 | — | dB |
| | 1523 ... 1543 | MHz | | 37 | 43 | — | dB |
| | 1710 ... 1780 | MHz | | 28 | 33 | — | dB |
| | 1850 ... 1915 | MHz | | 28 | 33 | — | dB |
| | 2238 ... 2268 | MHz | | 30 | 44 | — | dB |
| | 2274 ... 2304 | MHz | | 30 | 44 | — | dB |
| | 2305 ... 2315 | MHz | | 30 | 43 | — | dB |
| | 2400 ... 2500 | MHz | | 30 | 41 | — | dB |
| | 2496 ... 2690 | MHz | | 30 | 39 | — | dB |
| | 3300 ... 4200 | MHz | | 35 | 42 | — | dB |
| | 4900 ... 5950 | MHz | | 30 | 43 | — | dB |

[1] See Sec. Matching circuit (p. 6).
[2] Integrated attenuation $\alpha_{INT}$: Averaged power $|S_{ij}|^2$ over the center 4.5 MHz of LTE 5 MHz (25 RB) channels.
[3] Valid for typical temperature $T$ = +25 °C.

## 6.3 TX – RX

| | | |
|---|---|---|
| Temperature range for specification | $T_{SPEC}$ | = −30 °C ... +85 °C |
| TX terminating impedance | $Z_{TX}$ | = 50 Ω + 1.2 nH[1)] |
| ANT terminating impedance | $Z_{ANT}$ | = 50 Ω // 12 nH[1)] |
| RX terminating impedance | $Z_{RX}$ | = 50 Ω + 6.0 nH[1)] |

| **Characteristics TX – RX** | | | **min.** for $T_{SPEC}$ | **typ.** @ +25 °C | **max.** for $T_{SPEC}$ | |
|---|---|---|---|---|---|---|
| **Minimum isolation** | $\alpha_{min}$ | | | | | |
| | 746.34 ... 755.66 | MHz | 55 | 60 | — | dB |
| | 758.34 ... 767.66 | MHz | 53 | 55 | — | dB |
| | 777.5 ... 786.5 | MHz | 55 | 58 | — | dB |
| | 788.34 ... 797.66 | MHz | 55 | 58 | — | dB |

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

## 7 Maximum ratings

| | | |
|---|---|---|
| Storage temperature | $T_{STG}$ [1] = −40 °C ... +85 °C | |
| DC voltage | $\lvert V_{DC} \rvert$ [2] = 0 V (max.) | |
| ESD voltage | | |
| | $V_{ESD}$ [3] = 600 V (max.) | Charged device model. |
| | $V_{ESD}$ [4] = 500 V (max.) | Human body model. |
| | $V_{ESD}$ [5] = 125 V (max.) | Machine model. |
| Input power | $P_{IN}$ | |
| @ TX port: 777.5 ... 786.5 MHz | 29.5 dBm | 5 MHz LTE uplink signal (1 RB) for 5000 h @ 50 °C. |
| @ TX port: 788 ... 798 MHz | 31 dBm | 5 MHz LTE uplink signal (1 RB) for 5000 h @ 50 °C. |
| @ TX port: 788 ... 798 MHz | 29.5 dBm | 5 MHz 5G-NR (CP-OFDM) (1 RB) 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.
3) According to JESD22-C101C (CDM – Field Induced Charged Device Model), 3 negative & 3 positive pulses.
4) According to JESD22-A114F (HBM – Human Body Model), 1 negative & 1 positive pulse.
5) According to JESD22-A115B (MM – Machine Model), 10 negative & 10 positive pulses.

# 8 Transmission coefficients

## 8.1 TX – ANT

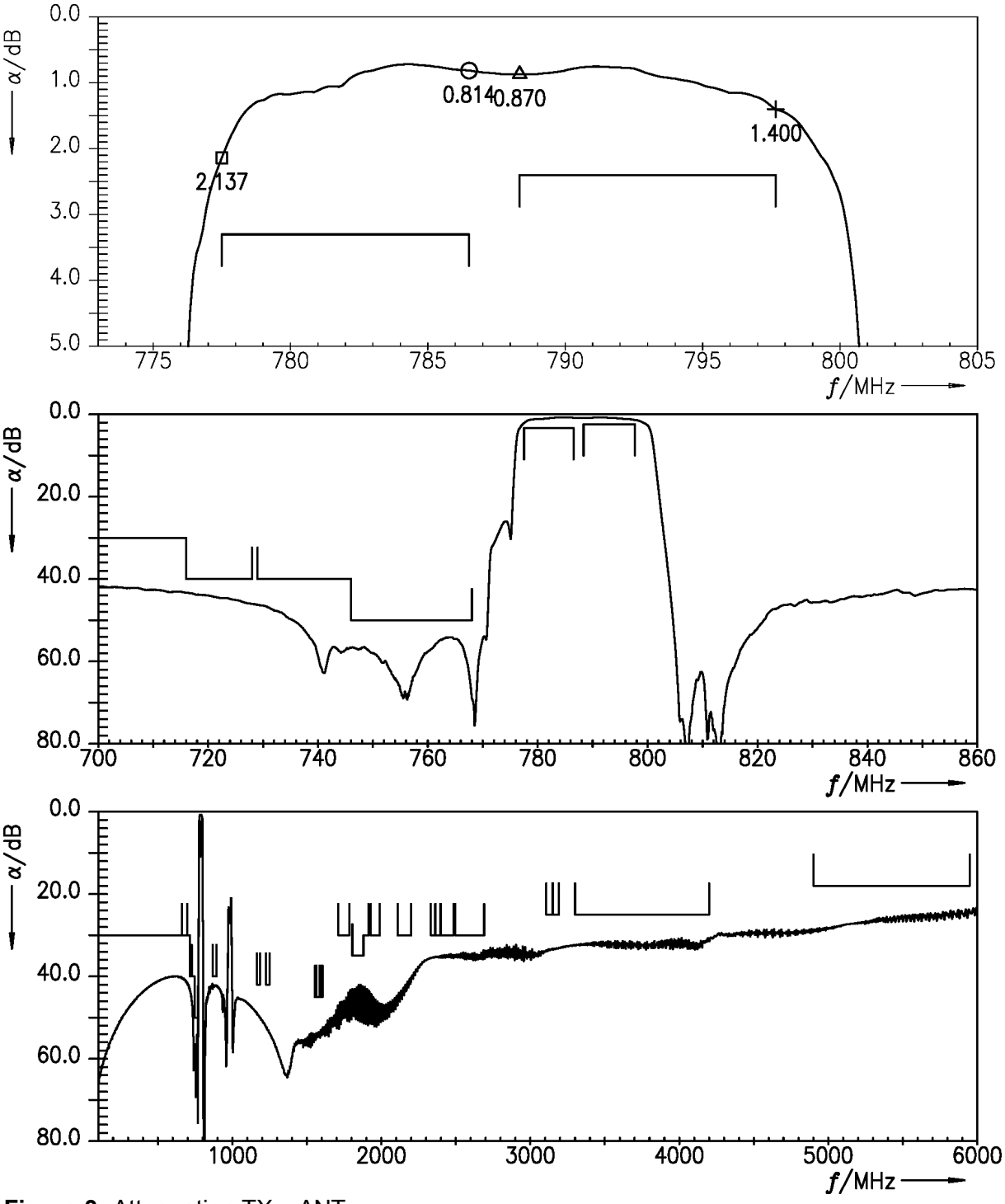



**Figure 3:** Attenuation TX – ANT.

## 8.2 ANT – RX

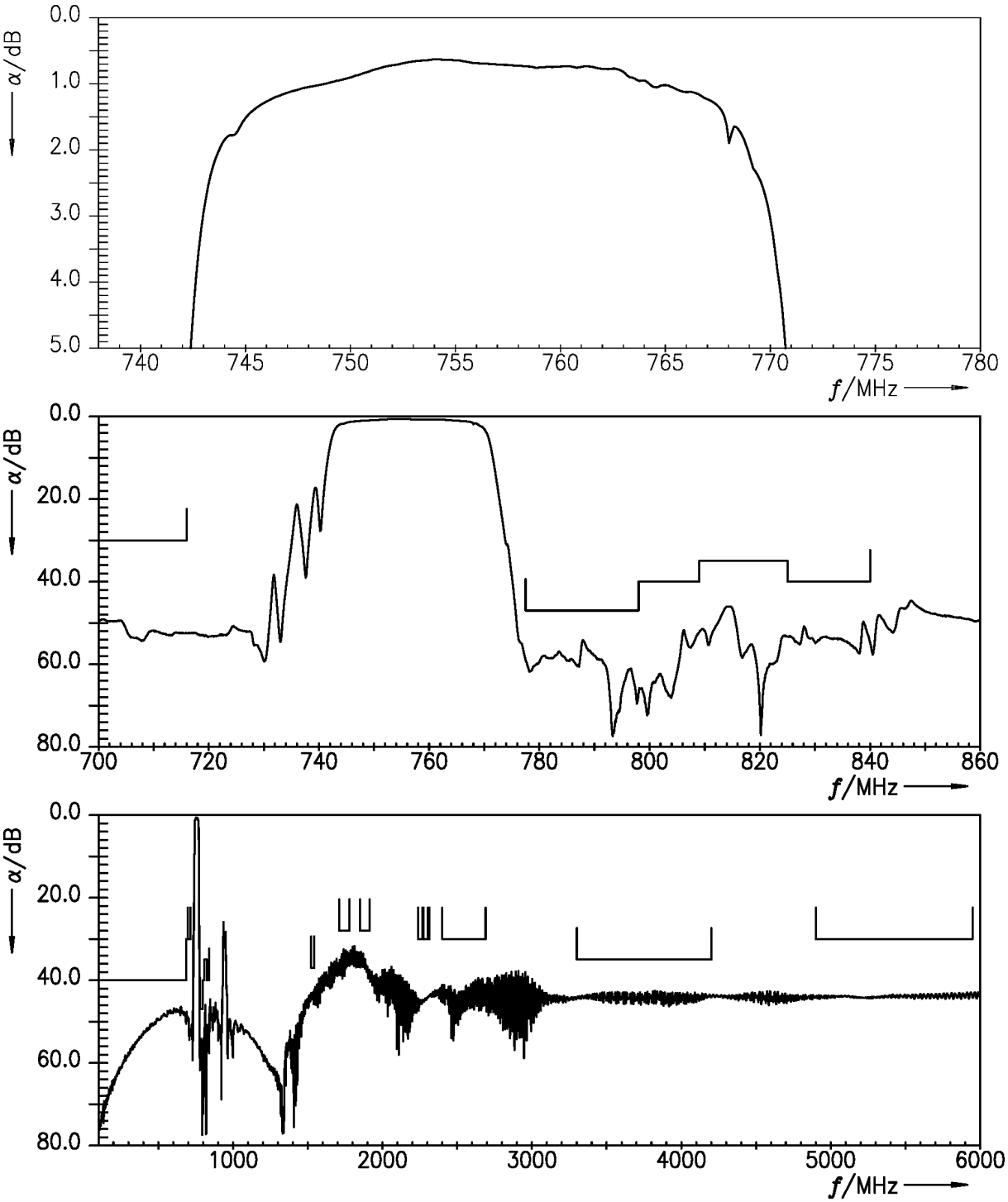



**Figure 4:** Attenuation ANT – RX.

### 8.3 TX – RX

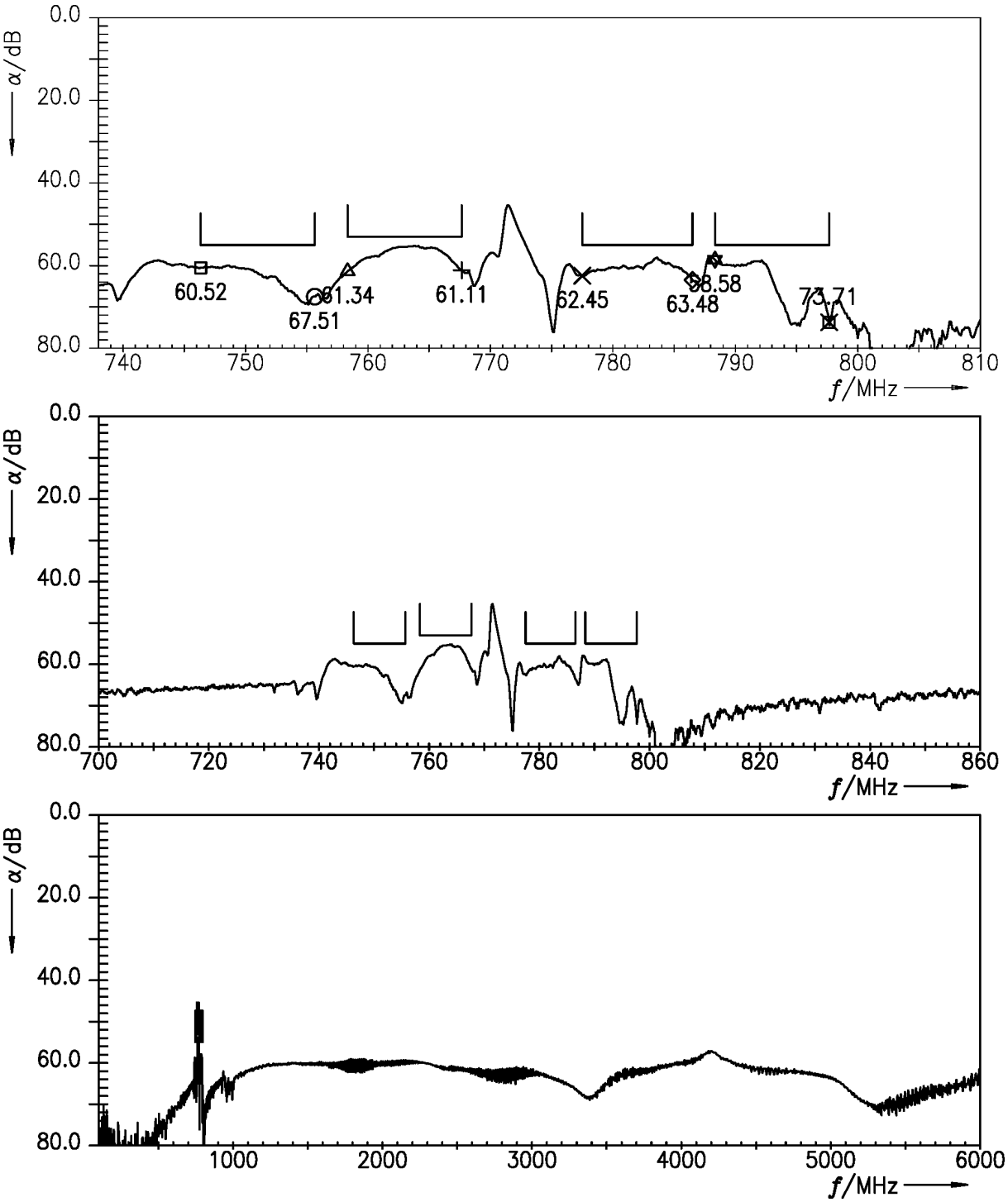



**Figure 5:** Isolation TX – RX.

## 9 Transmission coefficient (LTE)

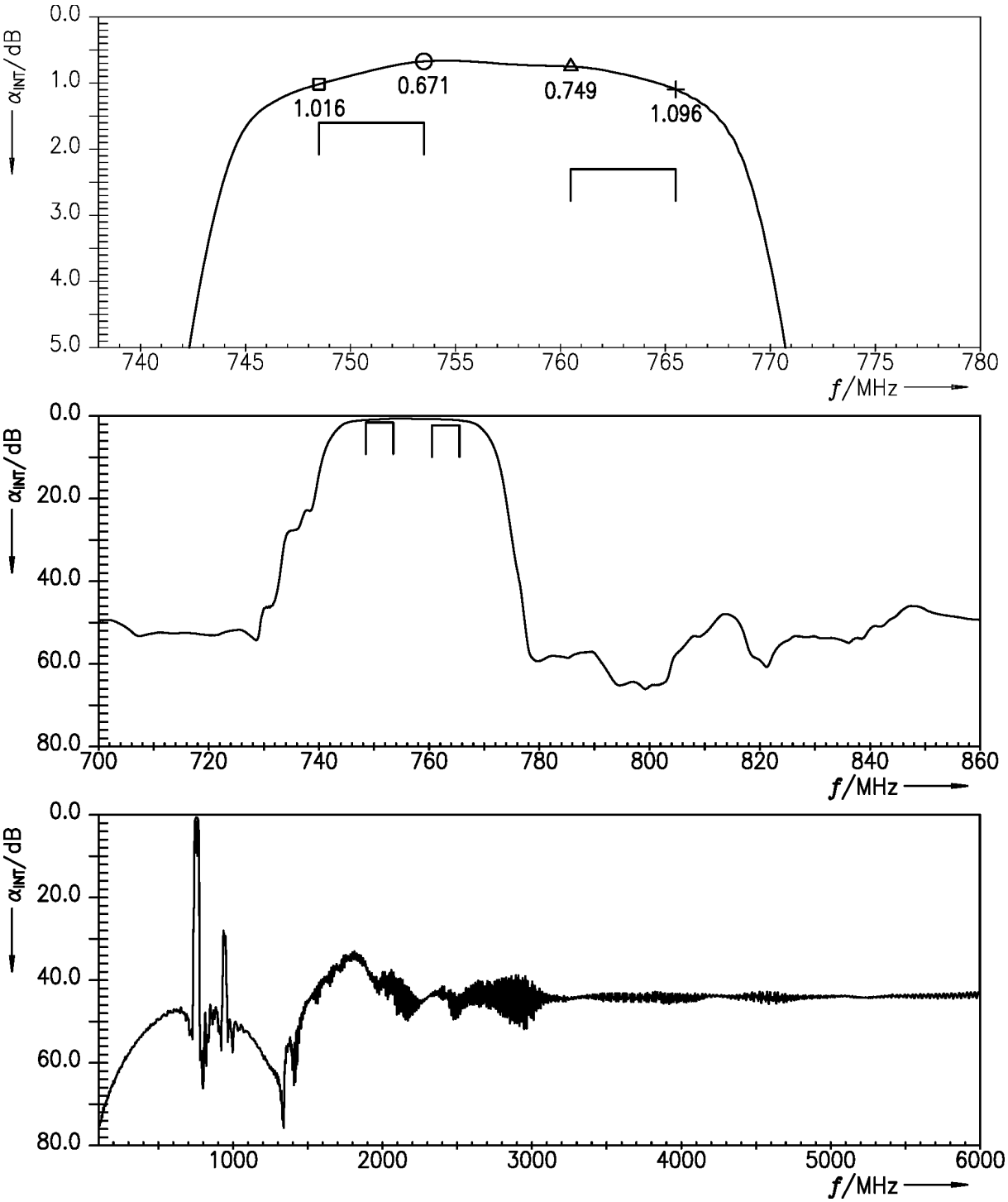



**Figure 6:** Attenuation (LTE) (integration window = 5 MHz) ANT – RX.

## 10 Reflection coefficients

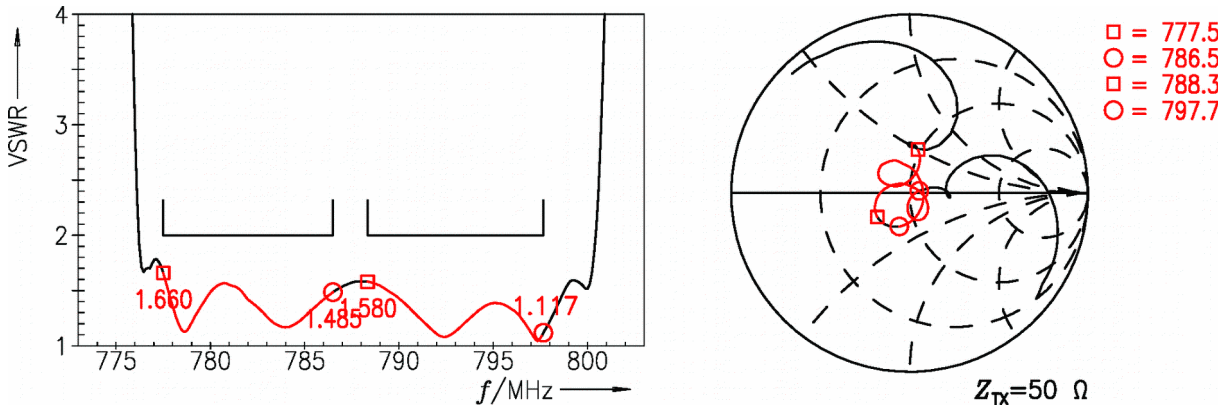



**Figure 7:** Reflection coefficient at TX port.

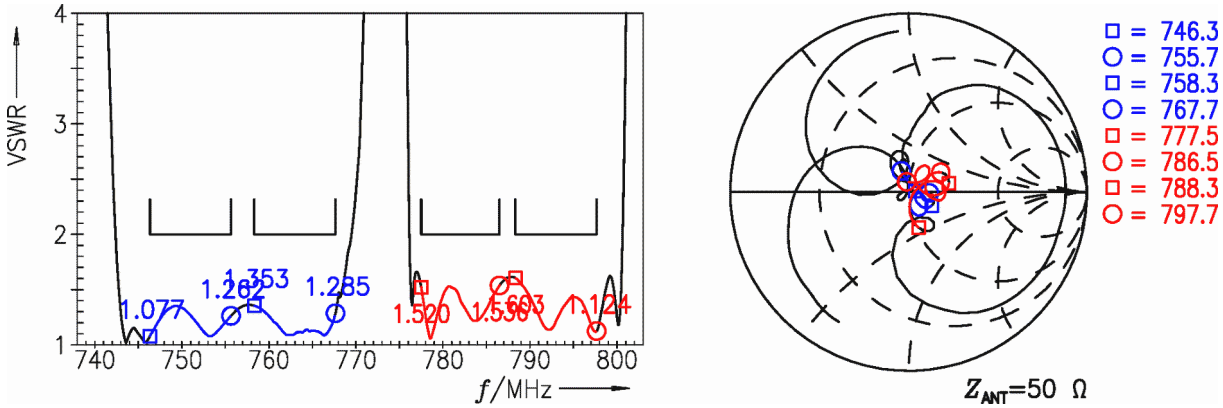



**Figure 8:** Reflection coefficient at ANT port.

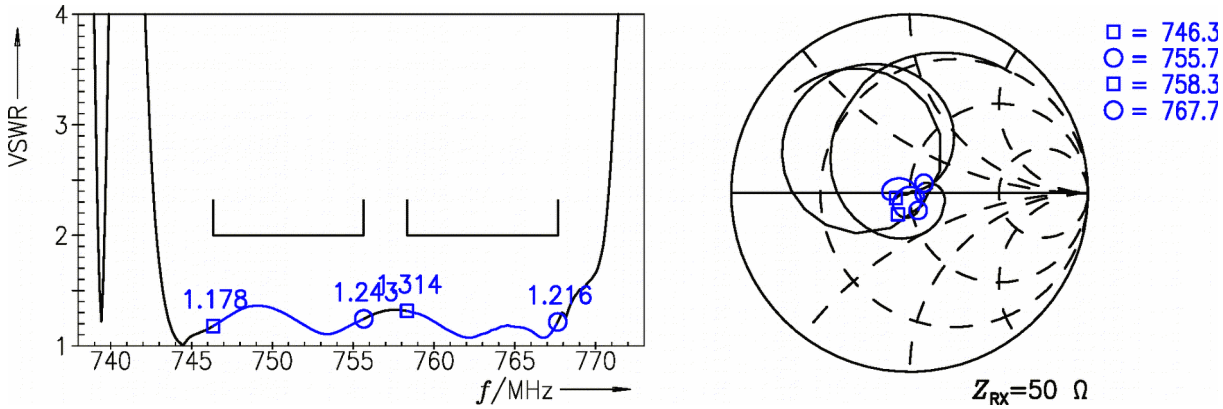



**Figure 9:** Reflection coefficient at RX port.

## 11 Packing material

### 11.1 Tape

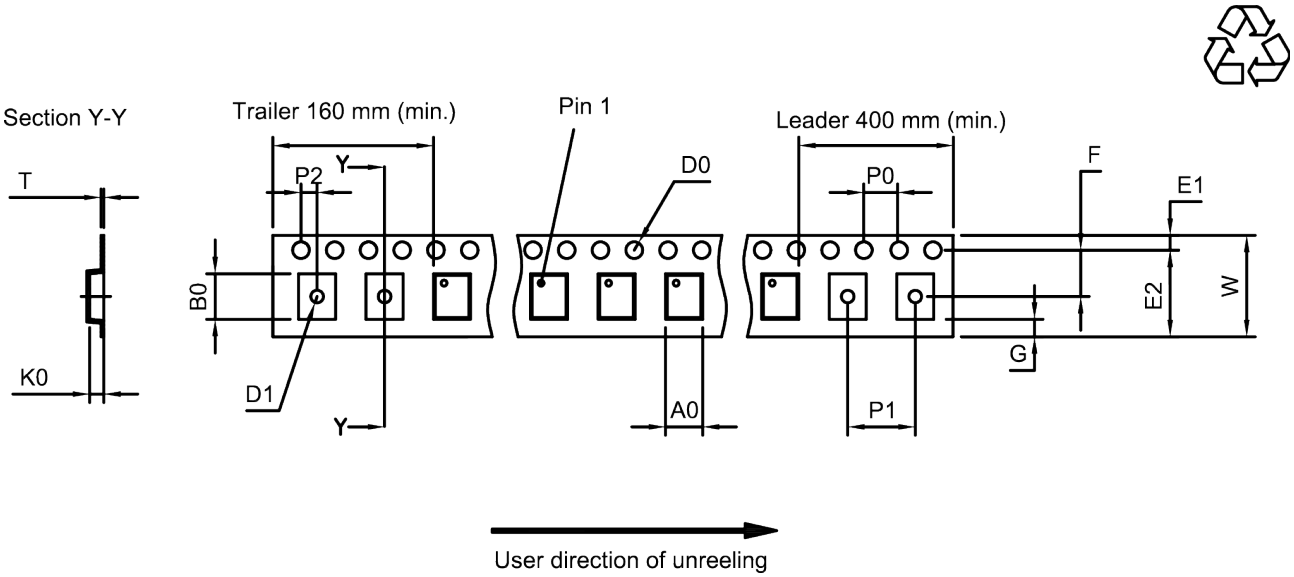



**Figure 10:** Drawing of tape (first-angle projection) for illustration only and not to scale. The valid tape dimensions are listed in Table 1.

| | |
|---|---|
| $A_0$ | 1.6±0.05 mm |
| $B_0$ | 2.0±0.05 mm |
| $D_0$ | 1.5+0.1/−0 mm |
| $D_1$ | 0.8+0.1/−0 mm |
| $E_1$ | 1.75±0.1 mm |

| | |
|---|---|
| $E_2$ | 6.25 mm (min.) |
| F | 3.5±0.05 mm |
| G | 0.75 mm (min.) |
| $K_0$ | 0.73±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.

## 11.2 Reel with diameter of 180 mm

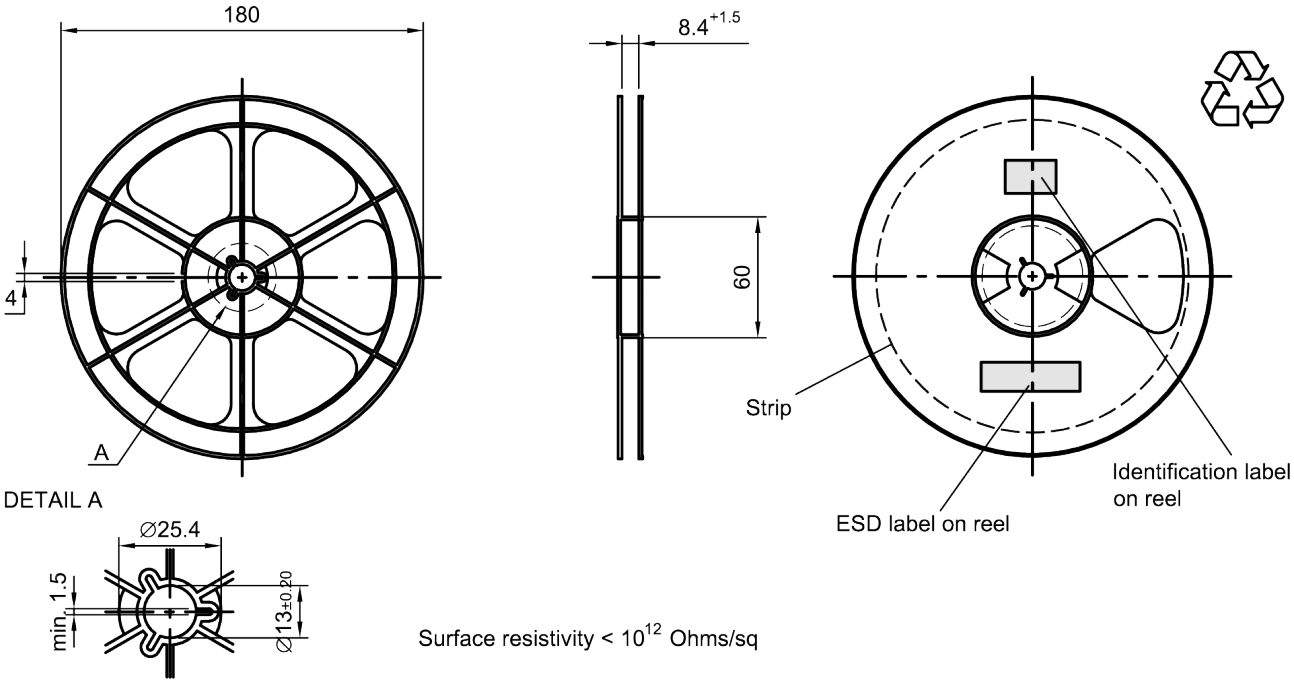



**Figure 11:** Drawing of reel (first-angle projection) with diameter of 180 mm.

Dimensions [mm]
X = 220+5
Y = 235+5
Sealing area 10±3

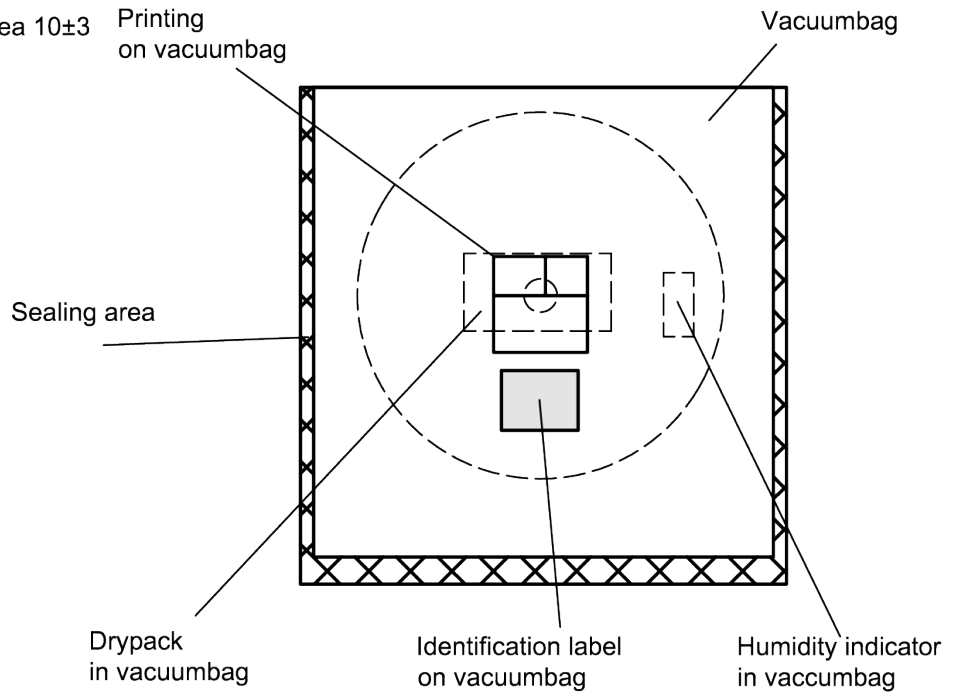



**Figure 12:** Drawing of moisture barrier bag (MBB) for reel with diameter of 180 mm.

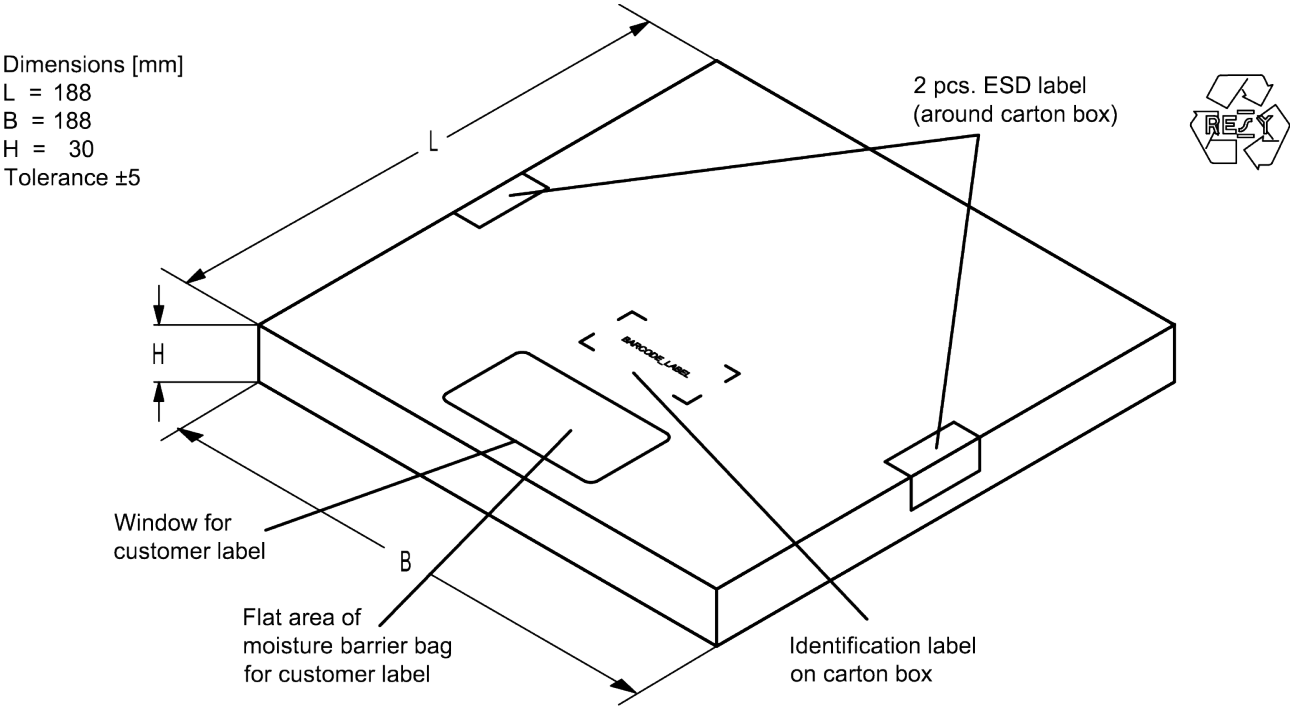



**Figure 13:** Drawing of folding box for reel with diameter of 180 mm.

### 11.3 Reel with diameter of 330 mm

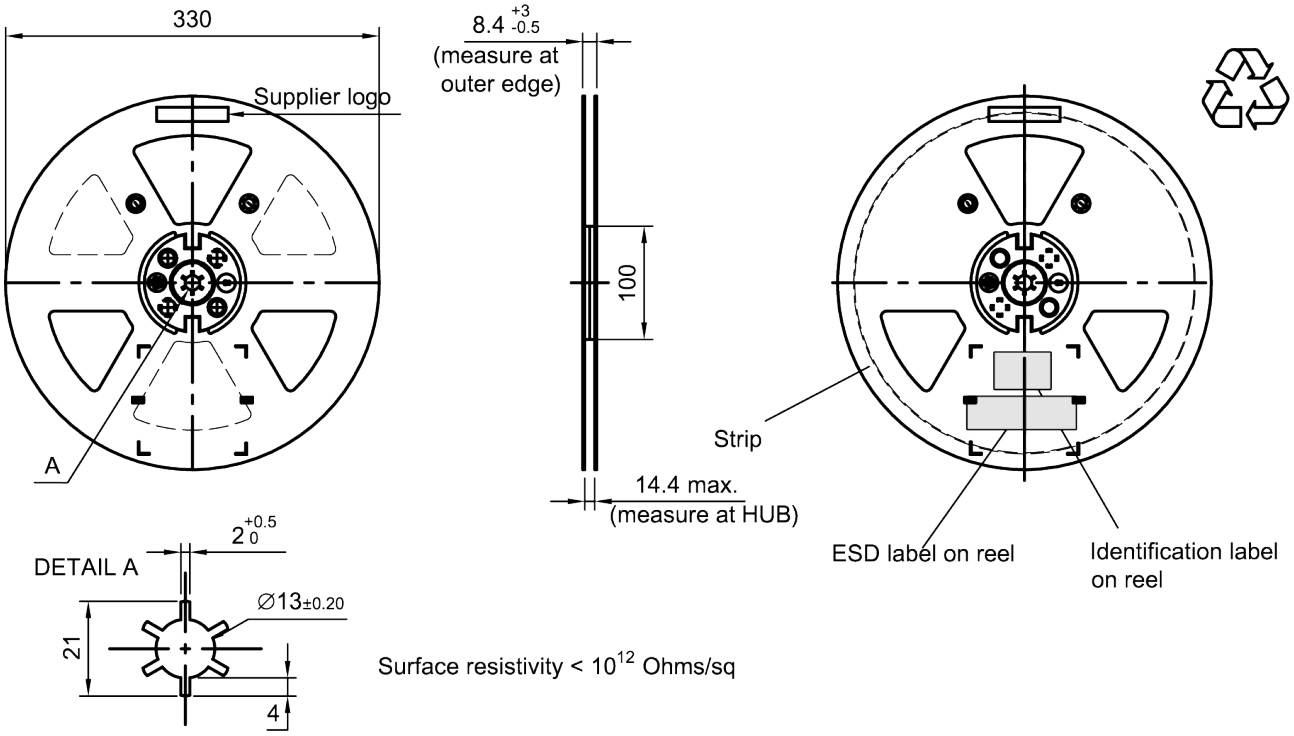



**Figure 14:** Drawing of reel (first-angle projection) with diameter of 330 mm.

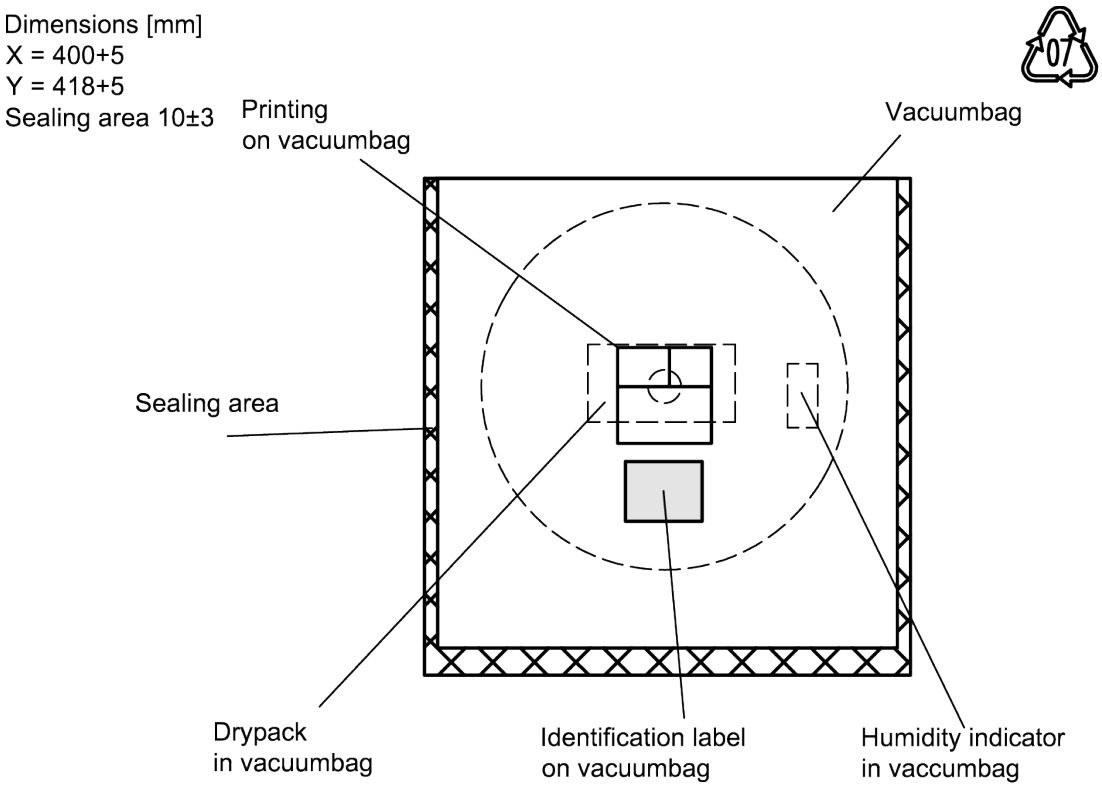



**Figure 15:** Drawing of moisture barrier bag (MBB) for reel with diameter of 330 mm.

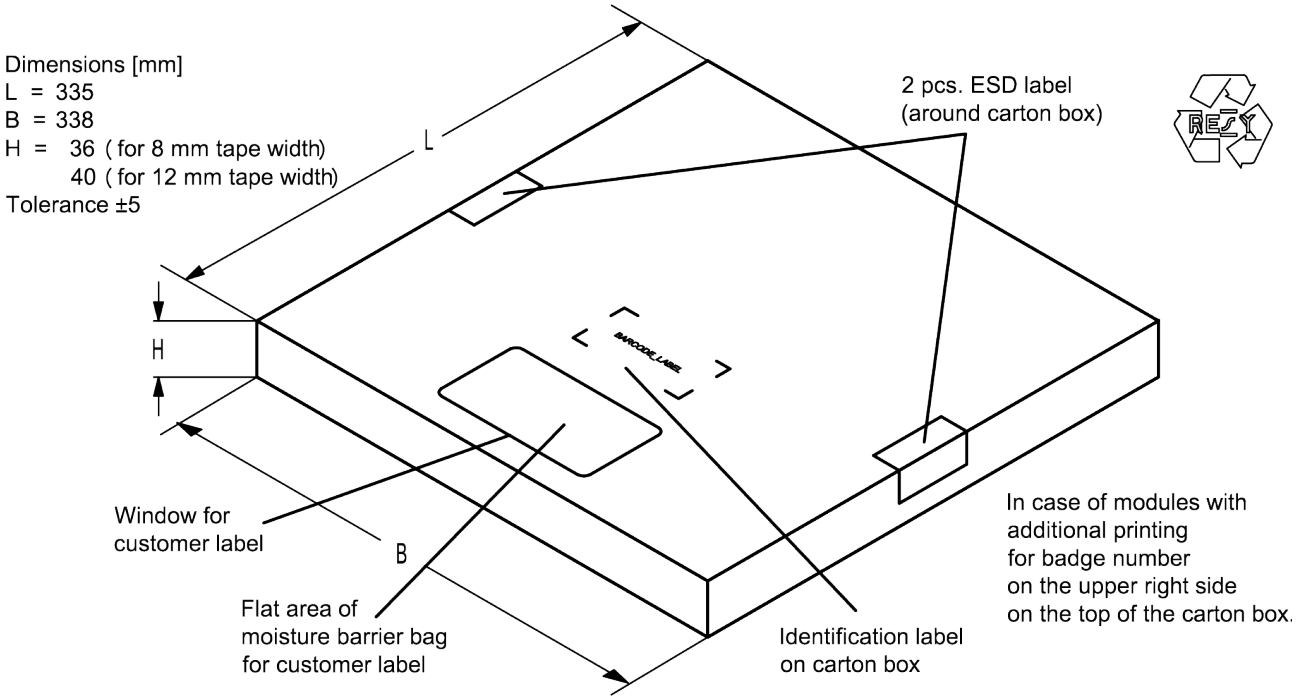



**Figure 16:** Drawing of folding box for reel with diameter of 330 mm.

## 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** **=>** **1234**
  **1** x $32^2$ + **6** x $32^1$ + **18 (=J)** x $32^0$ **=** **1234**
  The BASE32 code for product type B1294 is 18E.

- 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.

## 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 |
| $T$ ≥ 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).

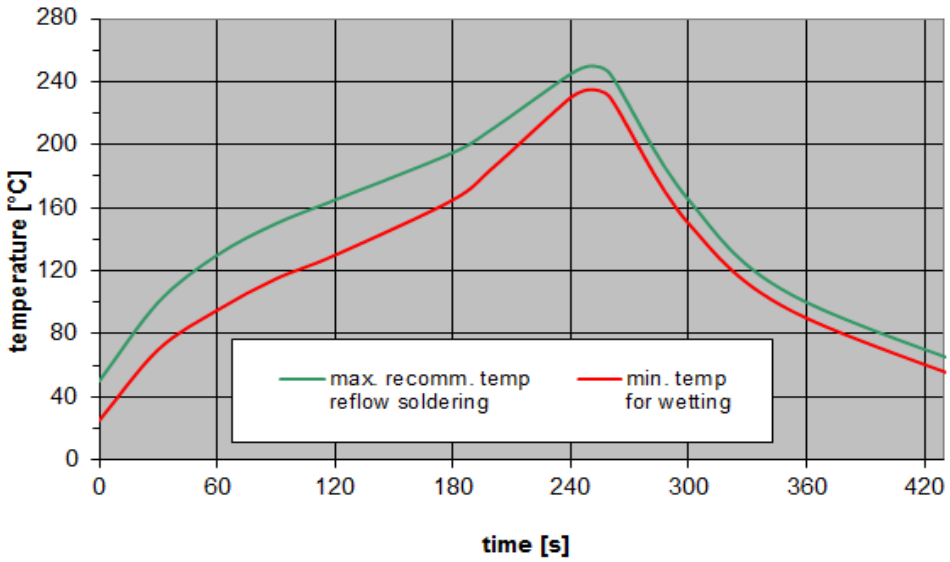



**Figure 17:** Recommended reflow profile for convection and infrared soldering – lead-free solder.

# 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 and packing units

| Ordering code | Packing unit |
|---|---|
| B39781B1294L210 | 15000 pcs |
| B39781B1294L210S 5 | 5000 pcs |

**Table 4:** Ordering codes 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).

### Projection method

Unless otherwise specified first-angle projection is applied.

## 16 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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