SLOVENSKI STANDARD
oSIST prEN 62604-2:2017

01-september-2017

Radiofrekvenčni (SAW) in visokofrekvenčni (BAW) duplekserji ocenjene kakovosti - 2. del: Navodila za uporabo

Surface Acoustic Wave (SAW) and Bulk Acoustic Wave (BAW) duplexers of assessed quality - Part 2: Guidelines for the use

Oberflächenwellen-(OFW-) und Volumenwellen-(BAW-)Duplexer mit bewerteter Qualität – Teil 2: Leitfaden für die Anwendung

Duplexeurs à ondes acoustiques de surface (OAS) et à ondes acoustiques de volume (OAV) sous assurance de la qualité - Partie 2: Lignes directrices d'utilisation

Ta slovenski standard je istoveten z: prEN 62604-2:2017

ICS:

31.140	Piezoelektrične naprave	Piezoelectric devices

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COMMITTEE DRAFT FOR VOTE (CDV)

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IEC TC 49 : PIEZOELECTRIC, DIELECTRIC AND ELECTROSTATIC DEVICES AND ASSOCIATED MATERIALS FOR FREQUENCY CONTROL, SELECTION AND DETECTION	
SECRETARIAT: Japan	SECRETARY: Mr Masanobu Okazaki
OF INTEREST TO THE FOLLOWING COMMITTEES:	PROPOSED HORIZONTAL STANDARD: ☐ Other TC/SCs are requested to indicate their interest, if any, in this CDV to the secretary.
FUNCTIONS CONCERNED: ☐ EMC ☐ ENVIRONMENT	☒ QUALITY ASSURANCE ☐ SAFETY
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TITLE:

Surface acoustic wave (SAW) and bulk acoustic wave (BAW) duplexers of assessed quality - Part 2: Guidelines for the use

NOTE FROM TC/SC OFFICERS:

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INTERNATIONAL ELECTROTECHNICAL COMMISSION

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SURFACE ACOUSTIC WAVE (SAW) AND BULK ACOUSTIC WAVE (BAW) DUPLEXERS OF ASSESSED QUALITY –

Part 2: Guidelines for the use

FOREWORD

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International Standard IEC 62604-2 has been prepared by IEC technical committee 49: Piezoelectric, dielectric and electrostatic devices and associated materials for frequency control, selection and detection.

NOTE:In this standard, SAW and BAW duplexers are treated simultaneously because both duplexers are used in the same manner especially in mobile phone systems and have same requirements of characteristics, test method and so on.

This second edition cancels and replaces the first edition published in 2011. This edition constitutes a technical revision.

This edition includes the following significant technical changes with respect to the previous edition:

- Diplexer is described;
- Duplexer with balanced RX port is considered at the measurement method subclause.

The text of this standard is based on the following documents:

FDIS	Report on voting
49/xxx/FDIS	49/xxx/RVD

Full information on the voting for the approval of this standard can be found in the report on voting indicated in the above table.

This publication has been drafted in accordance with the ISO/IEC Directives, Part 2.

A list of all parts of IEC 62604 series under the general title: *Surface acoustic wave (SAW) and bulk acoustic wave (BAW) duplexers* , can be found on the IEC website.

The committee has decided that the contents of this publication will remain unchanged until the stability date indicated on the IEC web site under "http://webstore.iec.ch" in the data related to the specific publication. At this date, this publication will be

- reconfirmed,
- withdrawn,
- replaced by a revised edition, or
- amended.

The National Committees are requested to note that for this publication the stability date is 2020.

THIS TEXT IS INCLUDED FOR THE INFORMATION OF THE NATIONAL COMMITTEES AND WILL BE DELETED AT THE PUBLICATION STAGE.

IMPORTANT – The 'colour inside' logo on the cover page of this publication indicates that it contains colours which are considered to be useful for the correct understanding of its contents. Users should therefore print this document using a colour printer.

SURFACE ACOUSTIC WAVE (SAW) AND BULK ACOUSTIC WAVE (BAW) DUPLEXERS OF ASSESSED QUALITY –

Part 2: Guidelines for the use

1 Scope

This part of IEC 62604 concerns the duplexers, which can separate receiving signal from transmitting signal and are key components for two-way radio communications, are generally used in mobile phone sysytems compliant with CDMA systems such as N-CDMA in 2nd generation mobile telecommunication systems (2G), W-CDMA / UMTS (3G) or LTE (4G). While in 2G systems mainly dielectric duplexers have been used, the ongoing miniaturization in 3G and 4G mobile communication systems promoted the development and application of acoustic wave duplexers due to their small size, light weight and good electrical performance. While for applications with moderate requirements regarding the individual filters' steepness, standard surface acoustic wave (SAW) duplexers have been employed, applications with narrow duplex gap (e.g. Bands 2, 3, 8, 25), i.e. the frequency gap between receiving and transmitting bands, require the application of temperature-compensated (TC) SAW or bulk acoustic wave (BAW) technology because of their better temperature characteristics and resonator Q-factors.

It is neither the aim of these guidelines to explain theory, nor to attempt to cover all the eventualities which may arise in practical circumstances. These guidelines draw attention to some of the more fundamental questions, which should be considered by the user before he places an order for SAW and BAW duplexers for a new application. Such a procedure will be the user's insurance against unsatisfactory performance. Because SAW and BAW duplexers have very similar performance for the usage, it is useful and convenient for users that both duplexers are described in one standard.

Standard specifications, such as those of IEC of which these guidelines form a part, and national specifications or detail specifications issued by manufacturers, will define the available combinations of centre frequency, pass bandwidth and insertion attenuation for each of transmitting and receiving filters and isolation level between transmitter and receiver ports, etc. These specifications are compiled to include a wide range of SAW and BAW duplexers with standardized performances. It cannot be over-emphasized that the user should, wherever possible, select his duplexers from these specifications, when available, even if it may lead to making small modifications to his circuit to enable the use of standard duplexers. This applies particularly to the selection of the nominal frequency band.

2 Normative references

The following referenced documents are indispensable for the application of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

IEC 60862-1:2015, *Surface acoustic wave (SAW) filters of assessed quality – Part 1: Generic specification*

IEC 60862-2:2012, *Surface acoustic wave (SAW) filters of assessed quality – Part 2: Guidelines for the use*

IEC 61019-2:2005, *Surface acoustic wave (SAW) resonators – Part 2: Guide to the use*

3 Technical considerations

It is of prime interest to a user that the duplexer characteristics should satisfy particular specifications. The selection of the front-end circuits in user equipments and SAW and BAW duplexers to meet such specifications should be a matter of agreement between the user and the manufacturer.

Duplexer characteristics are usually expressed in terms of centre frequency, pass bandwidth and insertion attenuation for each of transmitting and receiving filter parts in the duplexer and isolation level between transmitter and receiver ports. Since the SAW and BAW duplexer is used in RF front-end of the user equipments, lower insertion attenuation, higher isolation/rejection level, stronger power durability and smaller/thinner package dimensions are strictly required.

4 Fundamentals of SAW and BAW duplexers

4.1 Basic function

Duplexers are necessary for user equipments to receive and transmit signals simultaneously. Duplexers are 3-port devices which consist of Antenna port, Transmitter port (TX port) and Receiver port (RX port) shown in Figure 1. It has three basic functions. First one is to transfer transmitting signal from the TX port to the Antenna port. Second one is to transfer receiving signal from the Antenna port to the RX port. Last one is to prevent the transmitting signal and noise from the TX port to the RX port. The transmitting and the receiving frequencies are determined corresponding to each mobile communication system. For example, Table 1 shows typical allocated frequency bands for UMTS.

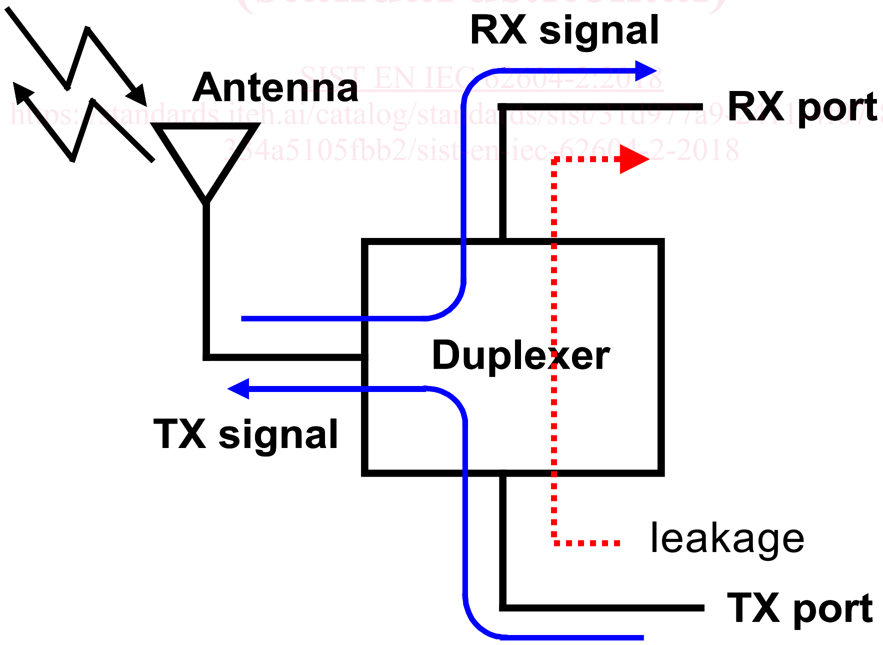

Figure 1 – Basic duplexer configuration

Table 1 – Frequency allocation for typical LTE frequency division duplex (FDD) bands

Band	Uplink frequency (MHz)	Downlink frequency (MHz)	Band	Uplink frequency (MHz)	Downlink frequency (MHz)
1	1 920 – 1 980	2 110 – 2 170	16	2 010 – 2 025	2 585 – 2 600
2	1 850 – 1 910	1 930 – 1 990	17	704 - 716	734 - 746
3	1 710 – 1 785	1 805 -1 880	18	815 - 830	860 - 875
4	1 710 – 1 755	2 110 – 2 155	19	830 - 845	875 - 890
5	824 - 849	869 - 894	20	832 - 862	791 - 821
6	830 - 840	875 - 885	21	1 447,9 – 1 462,9	1 495,5 – 1 510,9
7	2 500 – 2 570	2 620 – 2 690	22	3 410 – 3 490	3 510 – 3 590
8	880 - 915	925 - 960	23	2 000 – 2 020	2 180 – 2 200
9	1 749,9 – 1 784,9	1 844,9 – 1 879,9	24	1 626,5 – 1 660,5	1 525 – 1 559
10	1 710 – 1 770	2 110 – 2 170	25	1 850 – 1 915	1 930 – 1 995
11	1 427,9 – 1 447,9	1 475,9 – 1 495,9	26	814 - 849	859 - 894
12	699 - 716	729 - 746	27	807 - 824	852 - 869
13	777 - 787	746 - 756	28	703 - 748	758 - 803
14	788 - 798	758 - 768	30	2 305 – 2 315	2 350 – 2 360
15	1 900 – 1 920	2 600 – 2 620	31	452,5 – 457,5	462,5 – 467,5

NOTE: For a user equipment, uplink frequency means transmitting frequency and downlink frequency means receiving frequency respectively.

4.1.1 TX filter response (Filter response from TX port to antenna port)

Figure 2 shows frequency characteristics example of the TX filter. The required frequency characteristics are low insertion attenuation in transmitting frequency band (f_T), high insertion attenuation in receiving frequency band (f_R) and good impedance matching.

4.1.2 RX filter response (Filter response from antenna port to RX port)

Figure 3 shows frequency characteristics example of the RX filter. The required frequency characteristics are low insertion attenuation in receiving band (f_R) and high insertion attenuation in transmitting frequency band (f_T).

4.1.3 Isolation (Isolation from TX port to RX port)

Figure 4 shows isolation characteristics example. One of the important functions for the duplexers is isolation characteristics which show the frequency dependence of the leakage power from the TX port to the RX port.

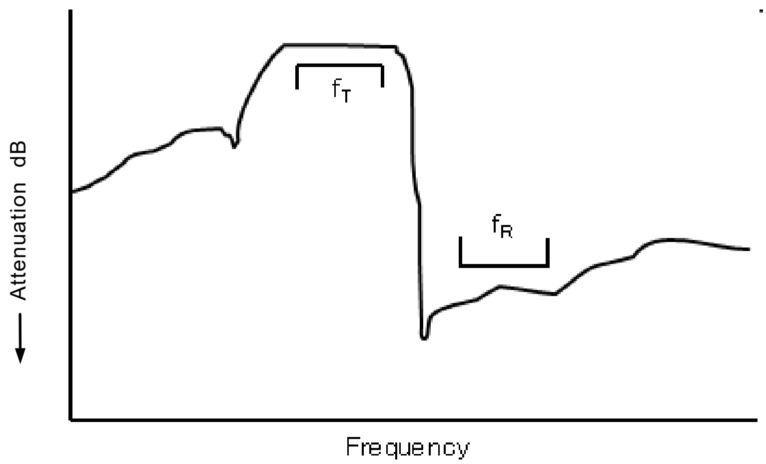

Figure 2 – Basic TX filter response example of SAW and BAW duplexers

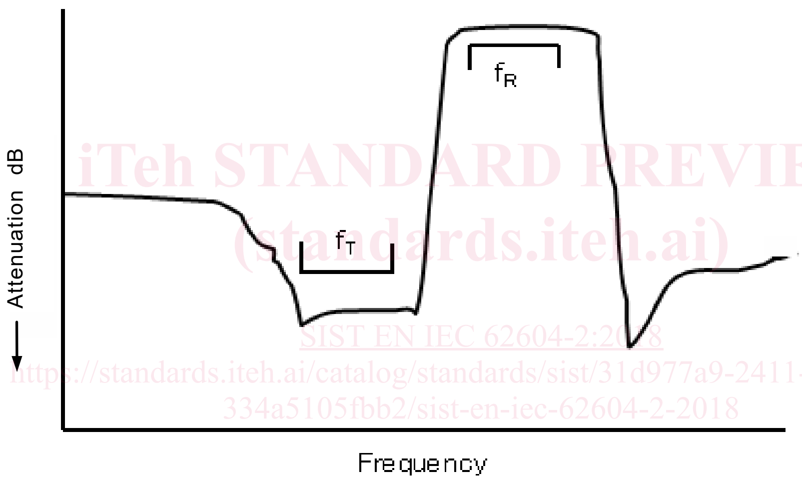

Figure 3 – Basic RX filter response example of SAW and BAW duplexers

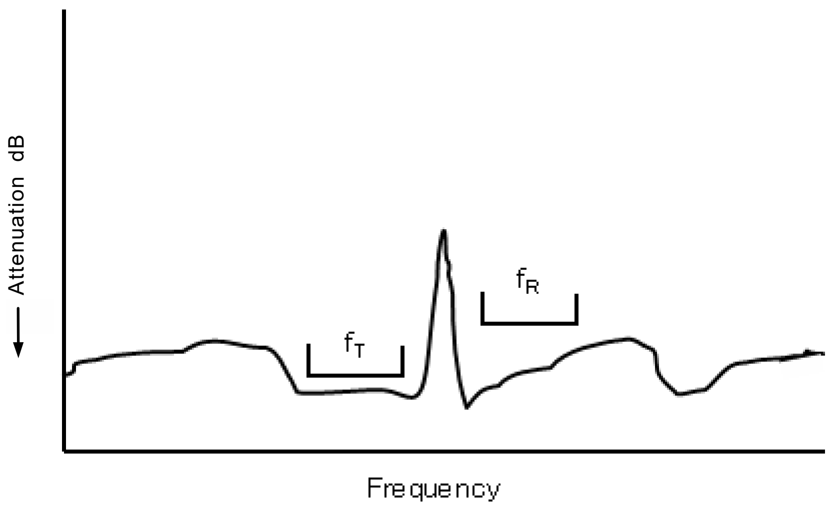

Figure 4 – Basic isolation characteristics example of SAW and BAW duplexers

4.2 Basic structure

Duplexers are 3-port devices/modules, which enable to transmit and receive signals simultaneously through a common antenna. A basic structure of duplexers is shown in Figure 5. SAW and BAW duplexers consist of a transmitter (TX) part and a receiver (RX) part. These two parts, which may add a phase shifter, are connected to antenna port. The phase shifter is utilized to prevent the interaction between the filters. In the Figure 5, Z_t and Z_r correspond to the impedance of TX and RX part at the antenna port side, whereas Z_o is the impedance of antenna port. The following conditions must be fulfilled to achieve the duplexer functions.

$Z_o \cong Z_t$ and $|Z_o| << |Z_r|$ in the TX pass band

$Z_o \cong Z_r$ and $|Z_o| << |Z_t|$ in the RX pass band

DMS(Double Mode SAW) type filters which are also known as LCRF (Longitudinally Coupled Resonator Filters)[1], ladder type SAW[2] & BAW filters and other type of SAW filters such as interdigitated interdigital transducer (IIDT) resonator filters[3] can be adopted as TX and RX filters. High power durability is required in the TX filters.

4.3 Principle of operation

In the TX pass band, the impedance of the TX part in the antenna port side (Z_t) is almost the same as that of antenna(Z_o), while that of the RX part (Z_r) is much higher, which means that at the antenna port, the RX part has large reflection coefficient in this band.

$Z_o \cong Z_t$ and $|Z_o| << |Z_r|$ in the TX pass band

On the other hand, in the RX pass band, the impedance of the RX part at the antenna port side (Z_r) is almost the same as that of antenna (Z_o), while that of the TX part (Z_t) is much higher. This also means the TX part has large reflection coefficient in this band.

$Z_o \cong Z_r$ and $|Z_o| << |Z_t|$ in the RX pass band

[1] See IEC 60862-2:2012 Chapter 5.3.

[2] See IEC 60862-2:2012 Chapter 5.2.

[3] See IEC 60862-2:2012 Chapter 5.4.