SAW components

SAW band stop filter

Automotive telematics
ISDB-T

Series/type: B3476
Ordering code: B39731B3476H910

Date: December 22, 2016
Version: 2.0
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1 Application

- Low-loss RF band-stop filter for ISDB-T
- LTE 700 Tx, band 18 and 19 suppression
- Low insertion loss
- Low amplitude ripple and group delay ripple
- Usable pass band width 620MHz
- Impedance at input and output 50Ω

2 Features

- Package size 3.0±0.08 mm × 2.5±0.08 mm
- Package height 0.98±0.115 mm
- Package code QCC10G
- Approximate weight 0.03 g
- RoHS compatible
- Package for Surface Mount Technology (SMT)
- Ni/Au-plated terminals
- Lead free soldering compatible with J-STD20C
- Filter surface passivated
- Electrostatic Sensitive Device (ESD)
- Moisture Sensitivity Level 1 (MSL1)
SAW components

SAW band stop filter

Data sheet

3 Package

4 Pin configuration

- 1 Input
- 4 Output
- 2, 3, 5, 6, Ground
- 7, 8, 9, 10

Figure 2: Drawing of package. See Sec. Package information (p. 15).

Please read Cautions and warnings and Important notes at the end of this document.
5 Matching circuit

- \( C_{c1,4} = 3.9 \text{ pF} \)
- \( C_{s1b} = 9.1 \text{ pF} \)
- \( C_{s4b} = 11 \text{ pF} \)
- \( L_{c1,4} = 7.5 \text{ nH} \)
- \( L_{s1a} = 3.3 \text{ nH} \)
- \( L_{s4a} = 3.3 \text{ nH} \)

**Figure 3:** Schematic of matching circuit.
6 Characteristics

Temperature range for specification

\[ T_{\text{SPEC}} = -40 \, ^\circ\text{C} \ldots +85 \, ^\circ\text{C} \]

Input terminating impedance

\[ Z_{\text{IN}} = 50 \, \Omega \text{ with ext. circuitry.} \]

Output terminating impedance

\[ Z_{\text{OUT}} = 50 \, \Omega \text{ with ext. circuitry.} \]

<table>
<thead>
<tr>
<th>Characteristics</th>
<th>min. for ( T_{\text{SPEC}} )</th>
<th>typ. @ +25 °C</th>
<th>max. for ( T_{\text{SPEC}} )</th>
</tr>
</thead>
<tbody>
<tr>
<td>Center frequency</td>
<td>( f_C )</td>
<td>733 MHz</td>
<td></td>
</tr>
<tr>
<td>Minimum insertion attenuation</td>
<td>( \alpha_{\min} )</td>
<td>0.1 dB</td>
<td>1.0 dB</td>
</tr>
<tr>
<td></td>
<td>470... 710 MHz</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Maximum insertion attenuation</td>
<td>( \alpha_{\max} )</td>
<td>0.1 dB</td>
<td>1.0 dB</td>
</tr>
<tr>
<td></td>
<td>90... 222 MHz</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>470... 692 MHz</td>
<td>2.6 dB</td>
<td>3.5 dB</td>
</tr>
<tr>
<td></td>
<td>692... 710 MHz</td>
<td>6.4 dB</td>
<td>7.5 dB</td>
</tr>
<tr>
<td>Minimum attenuation</td>
<td>( \alpha_{\min} )</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>718... 748 MHz</td>
<td>9 dB</td>
<td>25 dB</td>
</tr>
<tr>
<td></td>
<td>815... 845 MHz</td>
<td>15 dB</td>
<td>18 dB</td>
</tr>
<tr>
<td></td>
<td>900... 915 MHz</td>
<td>40 dB</td>
<td>55 dB</td>
</tr>
<tr>
<td></td>
<td>1574.4... 1576.44 MHz</td>
<td>15 dB</td>
<td>21 dB</td>
</tr>
<tr>
<td></td>
<td>1920... 1980 MHz</td>
<td>18 dB</td>
<td>30 dB</td>
</tr>
</tbody>
</table>

\(^1\) See Sec. Matching circuit (p. 5).
7 Maximum ratings

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Operable temperature</td>
<td>$T_{OP} = -40 , ^\circ C \ldots +125 , ^\circ C$</td>
</tr>
<tr>
<td>Storage temperature</td>
<td>$T_{STG} = -40 , ^\circ C \ldots +125 , ^\circ C$</td>
</tr>
<tr>
<td>DC voltage</td>
<td>$</td>
</tr>
<tr>
<td>ESD voltage</td>
<td></td>
</tr>
<tr>
<td>$V_{ESD}^{(2)}$</td>
<td>$175 , V$</td>
</tr>
<tr>
<td>$V_{ESD}^{(3)}$</td>
<td>$350 , V$</td>
</tr>
<tr>
<td>$V_{ESD}^{(4)}$</td>
<td>$1000 , V$</td>
</tr>
<tr>
<td>Input power @ input port:</td>
<td>$P_{IN} = 20 , \text{dBm}$</td>
</tr>
<tr>
<td>718 ... 748 MHz</td>
<td>Continuous wave for 10000 h</td>
</tr>
<tr>
<td></td>
<td>@ $85 , ^\circ C$.</td>
</tr>
</tbody>
</table>

1) Not valid for packaging material. Storage temperature for packaging material is $-25 \, ^\circ C$ to $+40 \, ^\circ C$.

2) According to JESD22-A115B (MM – Machine Model), 10 negative & 10 positive pulses.

3) According to JESD22-A114F (HBM – Human Body Model), 1 negative & 1 positive pulse.

4) According to JESD22-C101C (CDM – Field Induced Charged Device Model), 3 negative & 3 positive pulses.
Figure 4: Attenuation.
9 Packing material

9.1 Tape

Figure 5: Drawing of tape (first-angle projection) with tape dimensions according to Table 1.

Table 1: Tape dimensions.

<p>| | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>(A)</td>
<td>2.85±0.1 mm</td>
<td>(E_2)</td>
</tr>
<tr>
<td>(B)</td>
<td>3.3±0.1 mm</td>
<td>(F)</td>
</tr>
<tr>
<td>(D_0)</td>
<td>1.5±0.1~0 mm</td>
<td>(G)</td>
</tr>
<tr>
<td>(D_1)</td>
<td>1.5 mm (min.)</td>
<td>(K_0)</td>
</tr>
<tr>
<td>(E_1)</td>
<td>1.75±0.1 mm</td>
<td>(P_0)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(P_1)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(P_2)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(T)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(W)</td>
</tr>
</tbody>
</table>
9.2 Reel with diameter of 330 mm

Figure 6: Drawing of reel (first-angle projection) with diameter of 330 mm.

Figure 7: Drawing of folding box for reel with diameter of 330 mm.
10 Marking

Products are marked with device designation, lot number, as well as production location and date code.

- Device designation: The 4-character device designation of the ordering code is used for the marking.
  
  Example for 4-character device designation: B3xxxxB12345

- Lot number: The last 5 digits of the lot number are used for the marking.
  
  Example: 12345

- Production location and date code: The production location is Wuxi (encoded in the first character 'C'). The production date code is encoded in the last three characters according to Table 2.

<table>
<thead>
<tr>
<th>1st digit (day)</th>
<th>2nd digit (year)</th>
<th>3rd digit (month)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Day Code</td>
<td>Year Code</td>
<td>Month Code</td>
</tr>
<tr>
<td>1   1   11   A</td>
<td>2010 A</td>
<td>Jan 1</td>
</tr>
<tr>
<td>2   2   12   B</td>
<td>2011 B</td>
<td>Feb 2</td>
</tr>
<tr>
<td>3   3   13   C</td>
<td>2012 C</td>
<td>Mar 3</td>
</tr>
<tr>
<td>4   4   14   D</td>
<td>2013 D</td>
<td>Apr 4</td>
</tr>
<tr>
<td>5   5   15   E</td>
<td>2014 E</td>
<td>May 5</td>
</tr>
<tr>
<td>6   6   16   F</td>
<td>2015 F</td>
<td>Jun 6</td>
</tr>
<tr>
<td>7   7   17   H</td>
<td>2016 H</td>
<td>and so on</td>
</tr>
<tr>
<td>8   8   18   J</td>
<td>2017 J</td>
<td></td>
</tr>
<tr>
<td>9   9   19   K</td>
<td>2018 K</td>
<td></td>
</tr>
<tr>
<td>10  0   20   L</td>
<td>2019 L</td>
<td></td>
</tr>
<tr>
<td>31   Z</td>
<td>2020 M</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>2021 N</td>
</tr>
</tbody>
</table>

Table 2: Production date code.

Example of how to decode production location and date code:

Code: C T F 6

Location: C → Wuxi
Day: T → 26th
Year: F → 2015
Month: 6 → June
11 Soldering profile

The recommended soldering process is in accordance with IEC 60068-2-58 – 3rd edit and IPC/JEDEC J-STD-020B.

Table 3: Characteristics of recommended soldering profile for lead-free solder (Sn95.5Ag3.8Cu0.7).

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td>ramp rate</td>
<td>≤ 3 K/s</td>
</tr>
<tr>
<td>preheat</td>
<td>125 °C to 220 °C, 150 s to 210 s, 0.4 K/s to 1.0 K/s</td>
</tr>
<tr>
<td>T &gt; 220 °C</td>
<td>30 s to 70 s</td>
</tr>
<tr>
<td>T &gt; 230 °C</td>
<td>min. 10 s</td>
</tr>
<tr>
<td>T &gt; 245 °C</td>
<td>max. 20 s</td>
</tr>
<tr>
<td>T ≥ 255 °C</td>
<td>–</td>
</tr>
<tr>
<td>peak temperature $T_{\text{peak}}$</td>
<td>250 °C +0/-5 °C</td>
</tr>
<tr>
<td>wetting temperature $T_{\text{min}}$</td>
<td>230 °C +5/-0 °C for 10 s ± 1 s</td>
</tr>
<tr>
<td>cooling rate</td>
<td>≤ 3 K/s</td>
</tr>
<tr>
<td>soldering temperature T</td>
<td>measured at solder pads</td>
</tr>
</tbody>
</table>

Figure 8: Recommended reflow profile for convection and infrared soldering – lead-free solder.
12 ESD protection of SAW filters

SAW filters are Electro Static Discharge sensitive devices. To reduce the probability of damages caused by ESD, special matching topologies have to be applied.

In general, “ESD matching” has to be ensured at that filter port, where electrostatic discharge is expected.

Electrostatic discharges predominantly appear at the antenna input of RF receivers. Therefore, only the input matching of the SAW filter has to be designed to short circuit or to block the ESD pulse.

Below three figures show recommended “ESD matching” topologies.

For wide band filters the high-pass ESD matching structure needs to be at least of 3rd order to ensure a proper matching for any impedance value of antenna and SAW filter input. The required component values have to be determined from case to case.

Figure 9: MLC varistor plus ESD matching.

Figure 10: Suppressor diode plus ESD matching.

Figure 11: 3rd order high-pass structure for basic ESD protection.

In cases where minor ESD occur, following simplified “ESD matching” topologies can be used alternatively.

In all three figures the shunt inductor \( L_{p2} \) could be replaced by a shorted microstrip with proper length and width. If this configuration is possible depends on the operating frequency and available PCB space.

Effectiveness of the applied ESD protection has to be checked according to relevant industry standards or customer specific requirements.

For further information, please refer to EPCOS Application report: “ESD protection for SAW filters”. This report can be found under www.epcos.com/rke. Click on “Applications Notes”.

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Please read Cautions and warnings and Important notes at the end of this document.
13 Annotations

13.1 Matching coils


13.2 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.

13.3 Scattering parameters (S-parameters)

The pin/port assignment is available in the headers of the S-parameter files. Please contact your local EPCOS sales office.
### 14 Cautions and warnings

#### 14.1 Display of ordering codes for EPCOS products

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#### 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 EPCOS sales office.

#### 14.4 Package information

##### Landing area

The printed circuit board (PCB) land pattern (landing area) shown is based on EPCOS 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 EPCOS, 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.
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