



# SAW Components

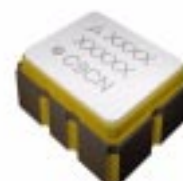
## SAW RF filter

Automotive telematics

|                       |                        |
|-----------------------|------------------------|
| <b>Series/type:</b>   | <b>B3515</b>           |
| <b>Ordering code:</b> | <b>B39202B3515H910</b> |
| <b>Date:</b>          | January 31, 2013       |
| <b>Version:</b>       | 2.3                    |

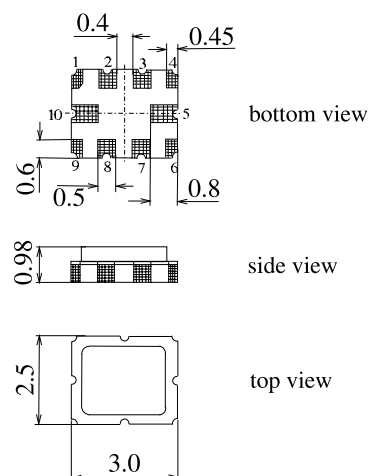
### Application

- Low-loss RF filter for GSM 1800/1900 system, receive path
- Usable passband:  
Filter 1 (GSM1800): 75 MHz  
Filter 2 (GSM1900): 60 MHz
- Unbalanced to balanced operation of both filters
- Impedance transformation from 50  $\Omega$  to 150  $\Omega$  for both filters
- Suitable for GPRS class 1 to 12



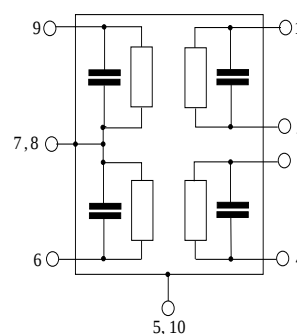
### Features

- Package size 3.0 x 2.5 x 0.98 mm<sup>3</sup>
- Package code QCC10G
- RoHS compatible
- Approximate weight 0.027 g
- Package for **Surface Mount Technology (SMT)**
- Ni, gold-plated terminals
- Lead free soldering compatible with J - STD20C
- AEC-Q200 qualified component family
- **Electrostatic Sensitive Device (ESD)**



### Pin configuration<sup>1)</sup>

- 1,2 Output, balanced [Filter 1]
- 3,4 Output, balanced [Filter 2]
- 6 Input [Filter 2]
- 9 Input [Filter 1]
- 5,7,8,10 Case grounded



1) The recommended pin configuration usually offers best suppression of electrical crosstalk. The filter characteristics refer to this configuration.

**Characteristics Filter 1 (GSM1800)**

Temperature range for specification:  $T = -40\text{ °C to }+85\text{ °C}$   
 Terminating source impedance:  $Z_S = 50\ \Omega$   
 Terminating load impedance:  $Z_L = 150\ \Omega \text{ (balanced)} \parallel 12\text{ nH}$

|                                                                              |                       | min.  | typ.<br>@ 25 °C | max. |        |
|------------------------------------------------------------------------------|-----------------------|-------|-----------------|------|--------|
| <b>Center frequency</b>                                                      | $f_C$                 | —     | 1842.5          | —    | MHz    |
| <b>Maximum insertion attenuation</b>                                         | $\alpha_{\max}$       |       |                 |      |        |
| 1805.0 ... 1880.0 MHz                                                        |                       | —     | 2.6             | 3.0  | dB     |
| <b>Amplitude ripple</b>                                                      |                       |       |                 |      |        |
| 1805.0 ... 1880.0 MHz                                                        |                       | —     | 1.2             | 1.6  | dB     |
| <b>VSWR</b>                                                                  |                       |       |                 |      |        |
| 1805.0 ... 1880.0 MHz                                                        |                       | —     | 2.2             | 2.4  |        |
| <b>Output amplitude balance</b> ( $ S_{31}/S_{21} $ )                        |                       |       |                 |      |        |
| 1805.0 ... 1880.0 MHz                                                        |                       | −1.5  |                 | 1.5  | dB     |
| <b>Output phase balance</b><br>( $\phi(S_{31}) - \phi(S_{21}) + 180^\circ$ ) |                       |       |                 |      |        |
| 1805.0 ... 1880.0 MHz                                                        |                       | −15.0 |                 | 15.0 | degree |
| <b>Attenuation</b>                                                           | $\alpha_{\text{abs}}$ |       |                 |      |        |
| 10.00 ... 1000.00 MHz                                                        |                       | 40    | 50              | —    | dB     |
| 1000.00 ... 1700.00 MHz                                                      |                       | 26    | 30              | —    | dB     |
| 1700.00 ... 1785.00 MHz                                                      |                       | 10    | 17              | —    | dB     |
| 1920.00 ... 1980.00 MHz                                                      |                       | 15    | 20              | —    | dB     |
| 1980.00 ... 2030.00 MHz                                                      |                       | 24    | 28              | —    | dB     |
| 2030.00 ... 3000.00 MHz                                                      |                       | 30    | 32              | —    | dB     |

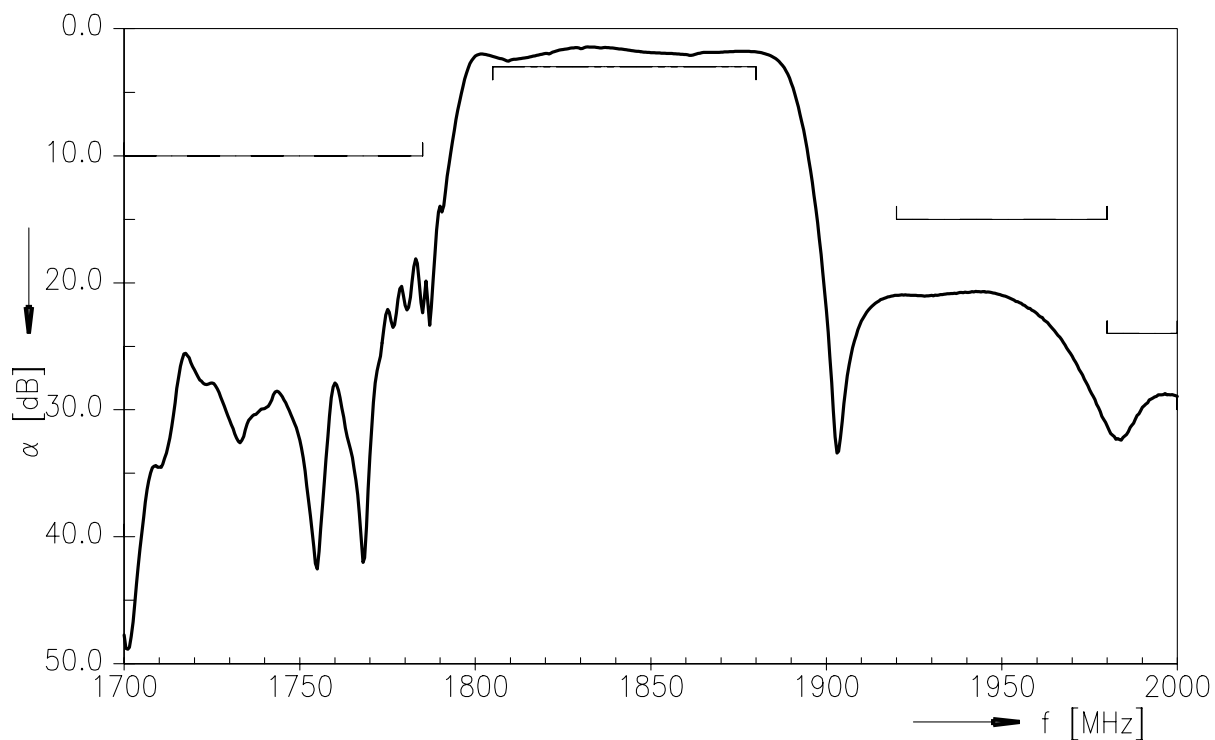
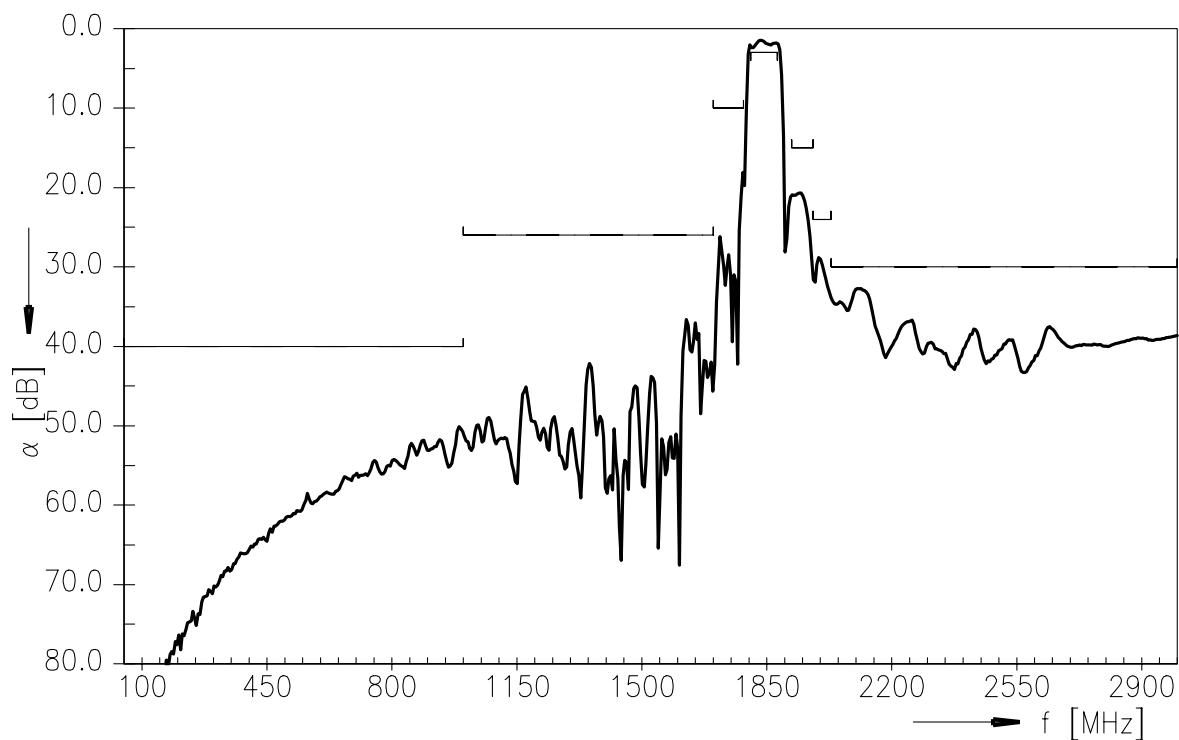
**Characteristics Filter 2 (GSM1900)**

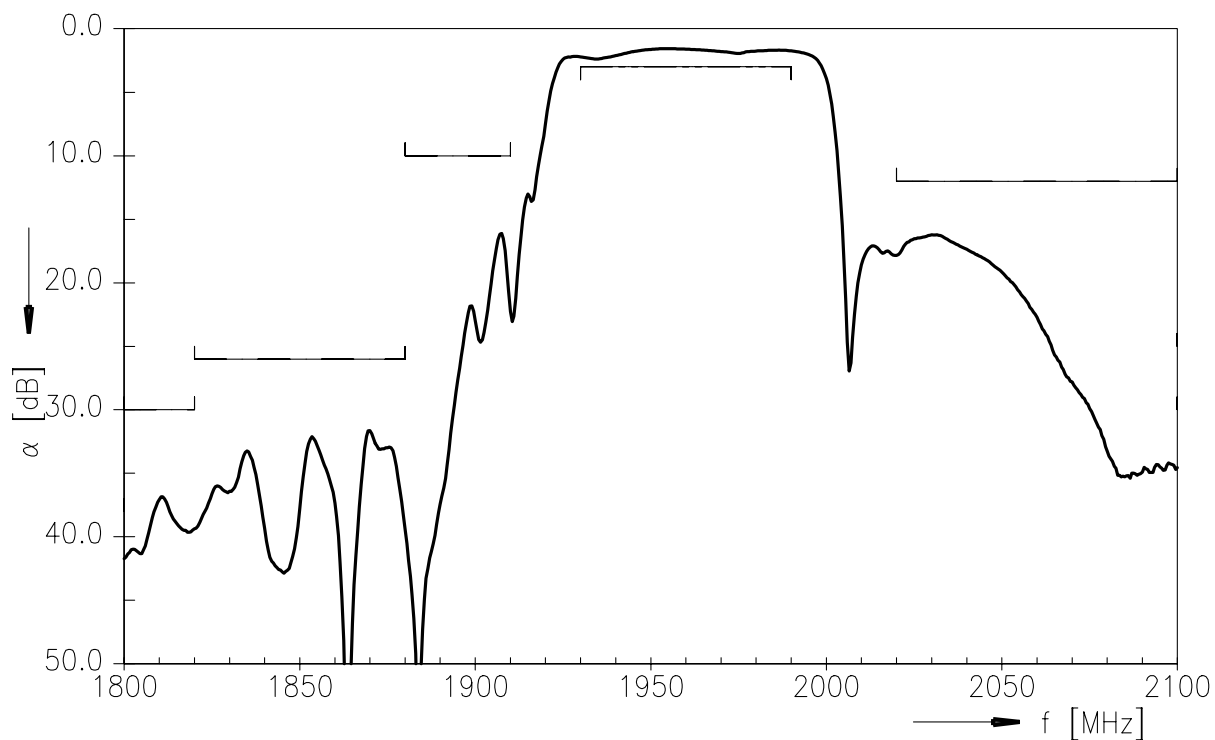
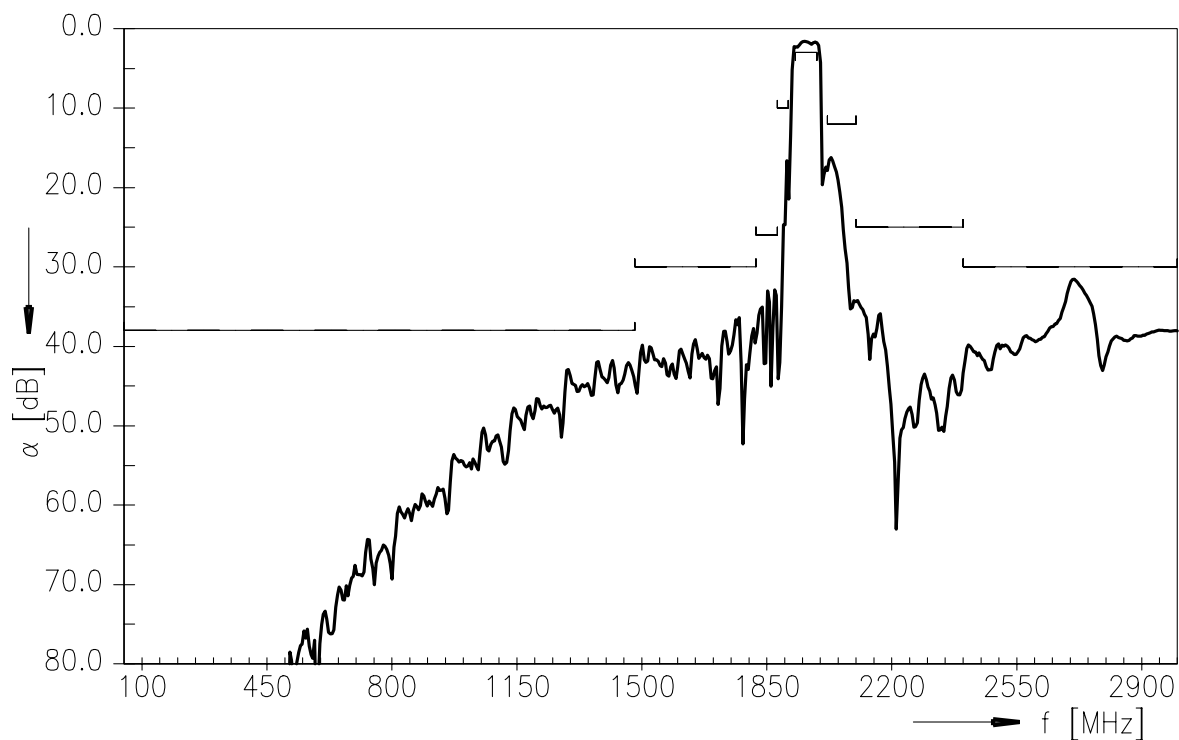
Temperature range for specification:  $T = -40\text{ °C to }+85\text{ °C}$   
 Terminating source impedance:  $Z_S = 50\ \Omega$   
 Terminating load impedance:  $Z_L = 150\ \Omega \text{ (balanced)} \parallel 12\text{ nH}$

|                                                       |                       | min.  | typ.<br>@ 25 °C | max. |        |
|-------------------------------------------------------|-----------------------|-------|-----------------|------|--------|
| <b>Center frequency</b>                               | $f_C$                 | —     | 1960.0          | —    | MHz    |
| <b>Maximum insertion attenuation</b>                  | $\alpha_{\max}$       | —     | 2.6             | 3.1  | dB     |
| 1930.0 ... 1990.0 MHz                                 |                       | —     |                 |      |        |
| <b>Amplitude ripple</b>                               |                       | —     | 1.0             | 1.5  | dB     |
| 1930.0 ... 1990.0 MHz                                 |                       | —     |                 |      |        |
| <b>VSWR</b>                                           |                       | —     | 2.2             | 2.4  |        |
| 1930.0 ... 1990.0 MHz                                 |                       | —     |                 |      |        |
| <b>Output amplitude balance</b> ( $ S_{31}/S_{21} $ ) |                       | —1.5  |                 | 1.5  | dB     |
| 1930.0 ... 1990.0 MHz                                 |                       | —1.5  |                 | 1.5  |        |
| <b>Output phase balance</b>                           |                       | —15.0 |                 | 15.0 | degree |
| $(\phi(S_{31}) - \phi(S_{21}) + 180^\circ)$           |                       | —15.0 |                 | 15.0 |        |
| 1930.0 ... 1990.0 MHz                                 |                       | —15.0 |                 | 15.0 |        |
| <b>Attenuation</b>                                    | $\alpha_{\text{abs}}$ | 38    | 42              | —    | dB     |
| 10.00 ... 1480.00 MHz                                 |                       | 38    | 42              | —    |        |
| 1480.00 ... 1820.00 MHz                               |                       | 30    | 34              | —    | dB     |
| 1820.00 ... 1880.00 MHz                               |                       | 26    | 30              | —    | dB     |
| 1880.00 ... 1910.00 MHz                               |                       | 10    | 13              | —    | dB     |
| 2020.00 ... 2100.00 MHz                               |                       | 12    | 16              | —    | dB     |
| 2100.00 ... 2400.00 MHz                               |                       | 25    | 31              | —    | dB     |
| 2400.00 ... 3000.00 MHz                               |                       | 30    | 32              | —    | dB     |

**Maximum ratings**

|                             |                  |          |     |                                            |
|-----------------------------|------------------|----------|-----|--------------------------------------------|
| Operable temperature range  | T                | −45/+125 | °C  |                                            |
| Storage temperature range   | T <sub>stg</sub> | −45/+125 | °C  |                                            |
| DC voltage                  | V <sub>DC</sub>  | 6        | V   |                                            |
| ESD voltage                 | V <sub>ESD</sub> | 50       | V   |                                            |
| Input power at<br>Tx bands: |                  |          |     |                                            |
| GSM1800, GSM1900            | P <sub>IN</sub>  | 15       | dBm | peak power of GSM signal<br>duty cycle 4:8 |

**Transfer function Filter 1**

**Transfer function Filter 1 (wideband)**


**Transfer function Filter 2**

**Transfer function Filter 2 (wideband)**


### ESD protection of SAW filters

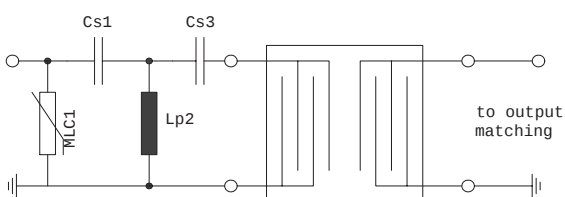
SAW filters are **E**lectro **S**tatic **D**ischarge sensitive devices. To reduce the probability of damages caused by ESD, special matching topologies have to be applied.

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

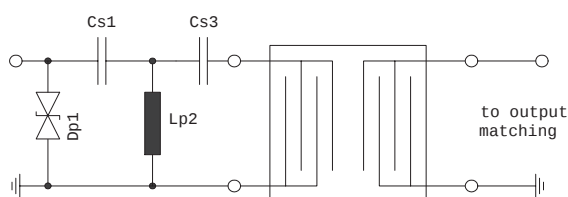
Electrostatic discharges predominantly appear at the antenna input of RF receivers. Therefore only the input matching of the SAW filter has to be designed to short circuit or to block the ESD pulse.

Below three figures show recommended “ESD matching” topologies.

For wideband filters the high-pass ESD matching structure needs to be at least of 3<sup>rd</sup> 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.

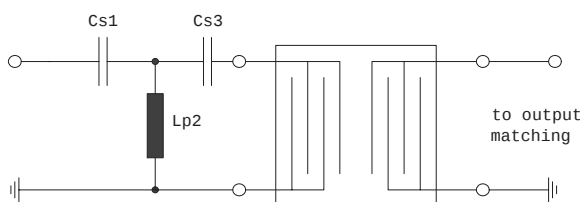


**Fig. 1 MLC varistor plus ESD matching**



**Fig. 2 Suppressor diode plus ESD matching**

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



**Fig. 3 3<sup>rd</sup> order high-pass structure for basic ESD protection**

In all three figures the shunt inductor Lp2 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](http://www.epcos.com/rke). Click on “Applications Notes”.



## References

|                            |                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
|----------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Type</b>                | B3515                                                                                                                                                                                                                                                                                                                                                                                                                                               |
| <b>Ordering code</b>       | B39202B3515H910                                                                                                                                                                                                                                                                                                                                                                                                                                     |
| <b>Marking and package</b> | C61157-A7-A142                                                                                                                                                                                                                                                                                                                                                                                                                                      |
| <b>Packaging</b>           | F61074-V8174-Z000                                                                                                                                                                                                                                                                                                                                                                                                                                   |
| <b>Date codes</b>          | L_1126                                                                                                                                                                                                                                                                                                                                                                                                                                              |
| <b>S-parameters</b>        | B3515_LB_NB.s3p, B3515_LB_WB.s3p<br>B3515_UB_NB.s3p, B3515_UB_WB.s3p<br>See file header for port/pin assignment table.                                                                                                                                                                                                                                                                                                                              |
| <b>Soldering profile</b>   | S_6001                                                                                                                                                                                                                                                                                                                                                                                                                                              |
| <b>RoHS compatible</b>     | 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 8 <sup>th</sup> , 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. |
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**Published by EPCOS AG**

**Systems, Acoustics, Waves Business Group**

**P.O. Box 80 17 09, 81617 Munich, GERMANY**

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