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RF360 Europe GmbH

A Qualcomm – TDK Joint Venture

## SAW Components

### SAW Rx Filter

Automotive telematics

Series/type:	B4335
Ordering code:	B39202B4335P810
Date:	May 12, 2014
Version:	2.0

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Automotive telematics

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<b>Version:</b>	<b>2.0</b>

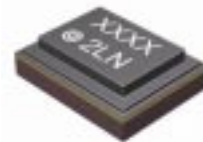
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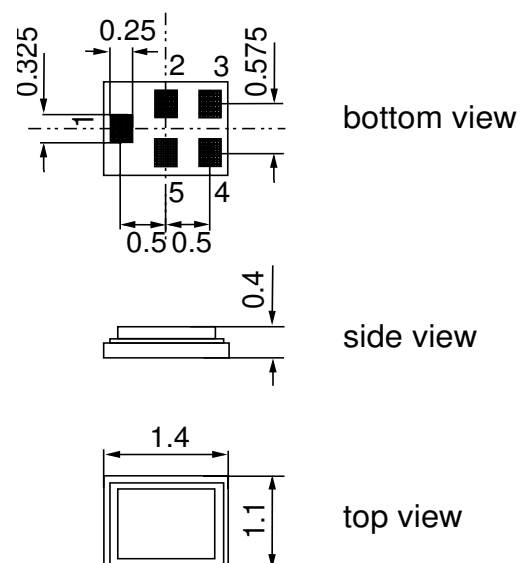
Data sheet


**Application**

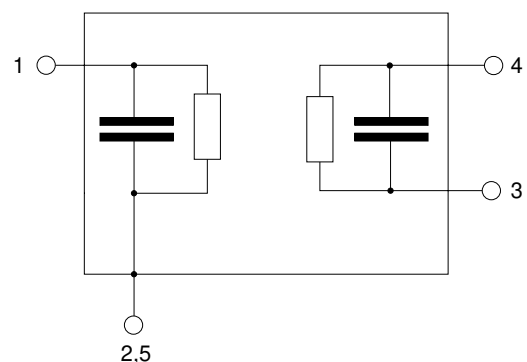
- Low-loss RF filter for LTE Band 2 systems (Rx)
- Impedance transformation from 50 Ω to 100 Ω
- Unbalanced to balanced operation
- Usable passband 60 MHz


**Features**

- Package size 1.4 x 1.1 x 0.4 mm<sup>3</sup>
- Package code QCS5P
- RoHS compatible
- Approximate weight 0.003 g
- Package for **Surface Mount Technology (SMT)**
- Ni, gold-plated terminals
- AEC-Q200 qualified component family (operable temperature range -40°C to +85°C)
- **Electrostatic Sensitive Device (ESD)**


**Pin configuration**

- 1 Input
- 3,4 Output, balanced
- 2,5 To be grounded





**Data sheet**

**Characteristics**

Temperature range for specification:	$T = -30\text{ °C to }+85\text{ °C}$
Terminating source impedance:	$Z_S = 50\ \Omega$
Terminating load impedance:	$Z_L = 100\ \Omega \parallel 27\text{ nH (balanced)}$

		min.	typ. @ 25°C	max.	
<b>Center frequency</b>	$f_C$	—	1960.0	—	MHz
<b>Maximum insertion attenuation</b>	$\alpha_{\max}$				
1930.0 ... 1990.0	MHz	—	2.5	4.2	dB
@ $f_{\text{carrier Bd 2}}$ 1932.4 ... 1987.6	MHz $\alpha_{\text{WCDMA}}^{1)}$	—	2.1	3.3	dB
<b>Amplitude ripple (p-p)</b>	$\Delta\alpha$				
1930.0 ... 1990.0	MHz	—	1.2	2.9	dB
<b>Error Vector Magnitude</b>	EVM <sup>2)</sup>				
@ $f_{\text{carrier Bd 2}}$ 1932.4 ... 1987.6	MHz	—	2.5	4.5	%
<b>VSWR</b>					
1930.0 ... 1990.0	MHz	—	2.0	2.5	
<b>CMRR (<math> S_{21}-S_{31}  /  S_{21}+S_{31} </math>)</b>					
1930.0 ... 1990.0	MHz	21	27	—	dB
<b>Attenuation</b>	$\alpha$				
50.0 ... 810.0	MHz	40	65	—	dB
810.0 ... 849.0	MHz	50	65	—	dB
898.0 ... 925.0	MHz	50	65	—	dB
1850.0 ... 1910.0	MHz	40	47	—	dB
@ $f_{\text{carrier Bd 2}}$ 1852.4 ... 1907.6	MHz $\alpha_{\text{WCDMA}}^{2)}$	44	48	—	dB
2400.0 ... 2484.0	MHz	40	65	—	dB
2484.0 ... 5000.0	MHz	36	46	—	dB
5000.0 ... 6000.0	MHz	30	48	—	dB

1) Attenuation of WCDMA signal ("Powertransferfunction"). Please refer to annotation on following page.

2) Error Vector Magnitude (EVM) based on definition given in 3GPP TS 25.141.

Data sheet


**Annotation for characteristics section**

Attenuation of WCDMA signal (“Powertransferfunction”, aWCDMA) is determined by

$$\int_{-\infty}^{\infty} |S_{ds21}(f)H_{RRC}(f - f_{Carrier})|^2 df$$

$f_{Carrier}$  according to 3GPP TS 25.101 (e.g. for Passband,  $f_{Carrier}$  ranges from 1932.4 MHz (lowest Rx channel) to 1987.6 MHz (highest Rx channel)).  $H_{RRC}(f)$  is the transfer function of the root-raised cosine transmit pulse shaping filter according to 3GPP TS 25.101 with the following normalization:

$$\int_{-\infty}^{\infty} |H_{RRC}(f)|^2 df = 1$$

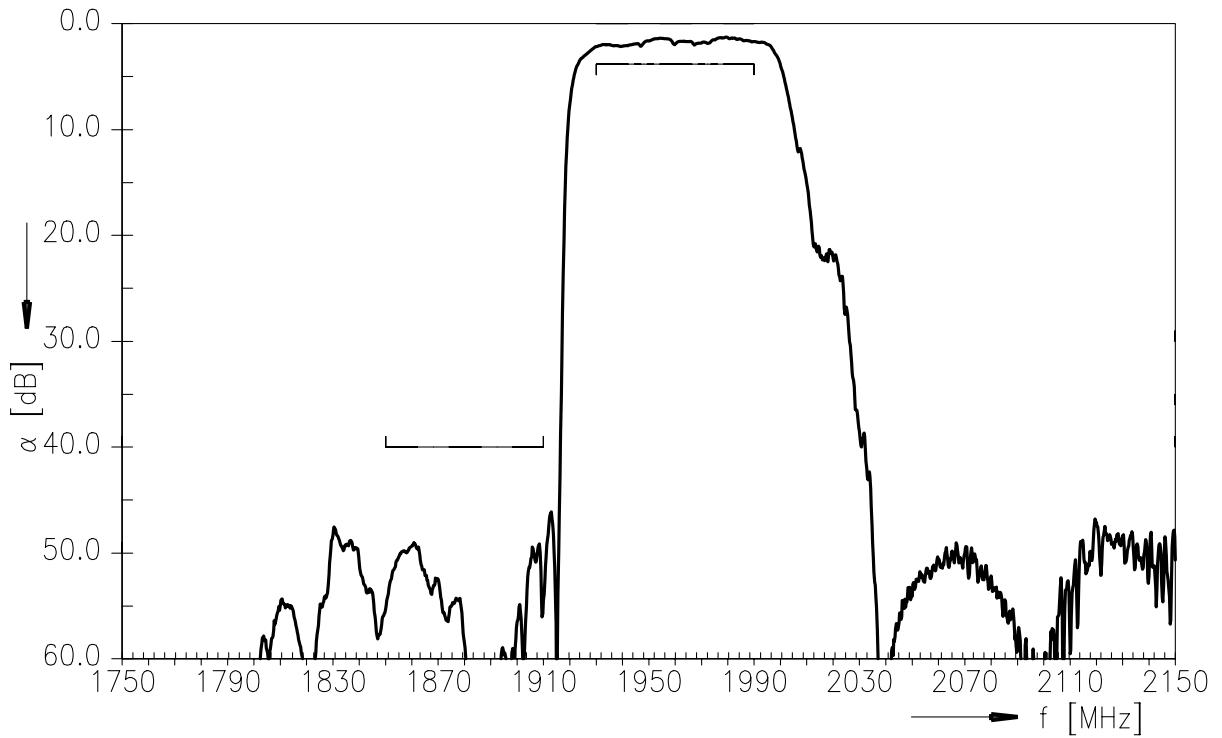
**Maximum ratings**

Operable temperature range	T	-40/+85	°C	
Storage temperature range	T <sub>stg</sub>	-40/+85	°C	
DC voltage	V <sub>DC</sub>	0	V	
Input Power at 1930.0 ... 1990.0 MHz	P <sub>IN</sub>	15	dBm	CW signal for 2000h at T = 50 °C

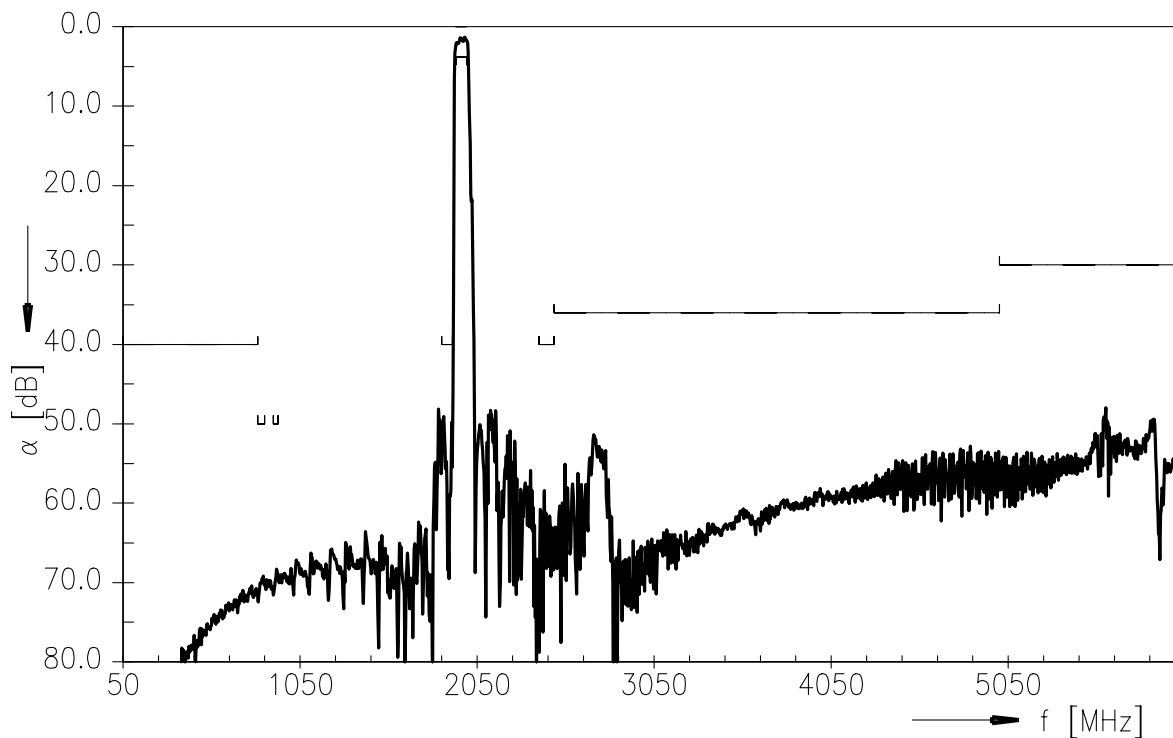
Data sheet



**Transfer function**



**Transfer function (wideband)**



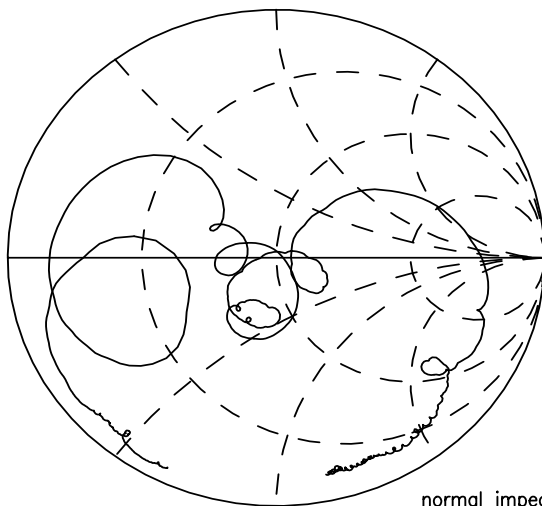


Data sheet

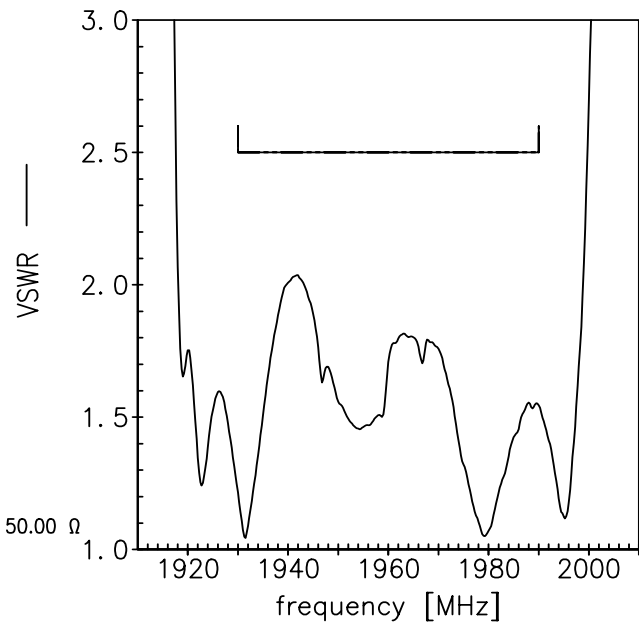


Smith chart

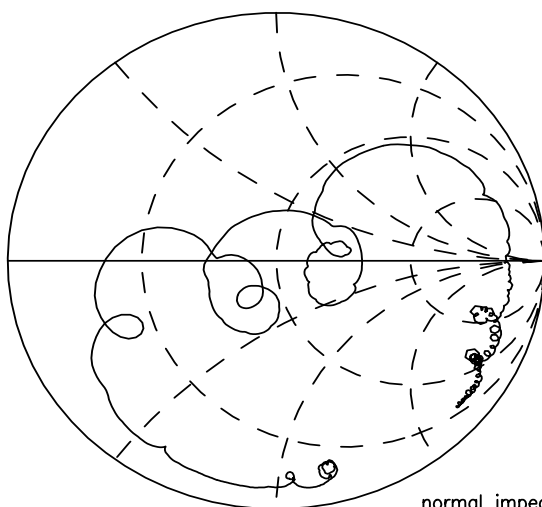
$S_{11}$  function



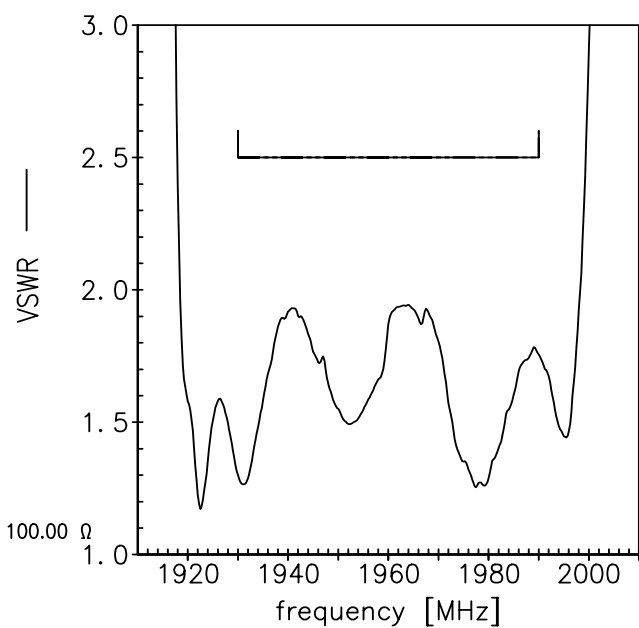
normal impedance: 50.00  $\Omega$



$S_{22}$  function



normal impedance: 100.00  $\Omega$





### ESD protection of SAW filters

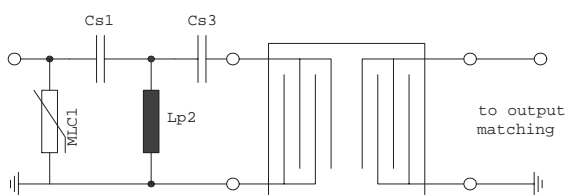
SAW filters are **E**lectro **S**tatic **D**ischarge sensitive devices. To reduce the probability of damages caused by ESD, special matching topologies have to be applied.

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

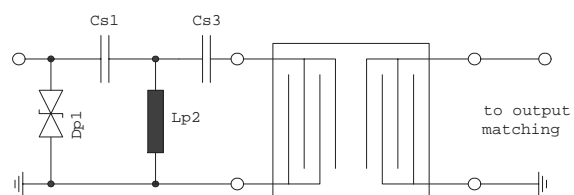
Electrostatic discharges predominantly appear at the antenna input of RF receivers. Therefore only the input matching of the SAW filter has to be designed to short circuit or to block the ESD pulse.

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.

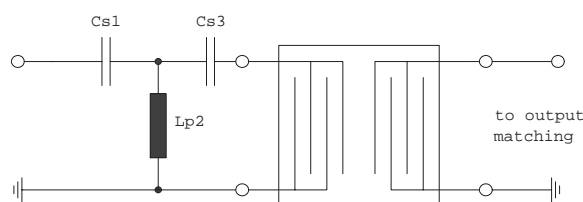


**Fig. 1 MLC varistor plus ESD matching**



**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”.

Data sheet


**References**

<b>Type</b>	B4335
<b>Ordering code</b>	B39202B4335P810
<b>Marking and package</b>	C61157-A8-A9
<b>Packaging</b>	F61074-V8237-Z000
<b>Date codes</b>	L_1126
<b>S-parameters</b>	B4335_NB_UN.s3p, B4335_WB_UN.s3p 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 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.
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<b>Matching coils</b>	See Inductor pdf-catalog <a href="http://www.tdk.co.jp/tefe02/coil.htm#aname1">http://www.tdk.co.jp/tefe02/coil.htm#aname1</a> and Data Library for circuit simulation <a href="http://www.tdk.co.jp/etvcl/index.htm">http://www.tdk.co.jp/etvcl/index.htm</a> for a large variety of matching coils.

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