1. General

The filter is symmetrical, i.e. input and output are exchangeable with each other. But the external coupling coil has to be connected to pin 3 in any case.

The filter can be driven both, balanced and unbalanced. The current specification is valid only for unbalanced use. Please contact us if the filter shall be used balanced at one or both ports.

The termination impedances are : **480 Ω || -1.6 pF**

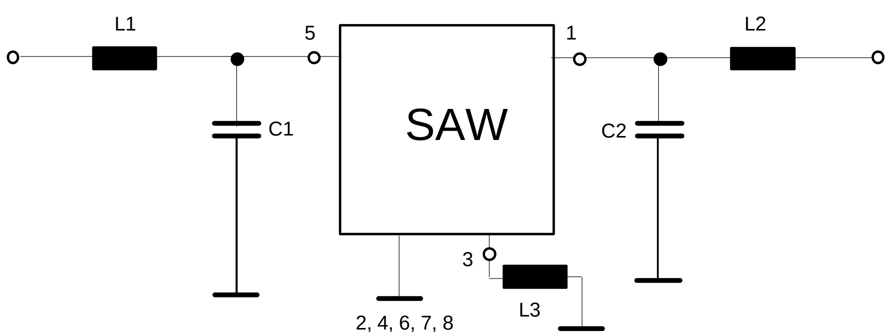
This impedance is equal for the input and the output. It has to be realized at the point were the filter is mounted. To match this impedance to the impedance of the system a matching circuit is required.

The matching elements have been chosen from the E12- series (European standard series with fixed tolerances) to get the best agreement between the PCB measurement and the measurement in a reference test fixture.

2. Theoretical matching

For the matching of termination impedances to 50 Ohm there can be used two different matching circuits

50 Ohm Test circuit 1



The theoretical values of the stated elements are:

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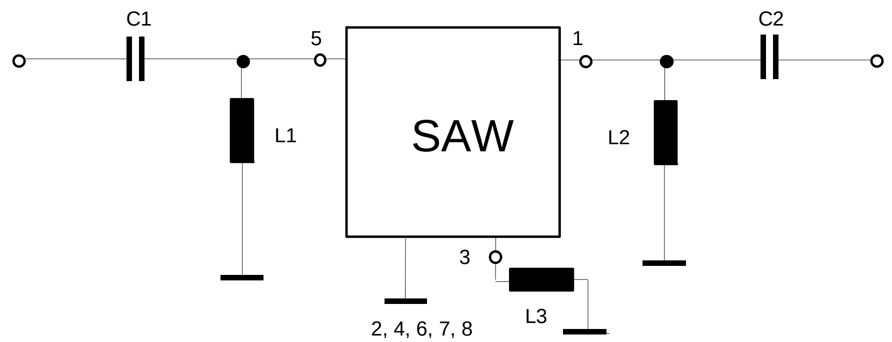
L1 = L2 = 72.6 nH, C1 = C2 = 1.43 pF, L3 = 175 nH

50 Ohm Test circuit 2



The theoretical values of the stated elements are:

C1 = C2 = 3.38 pF, L1 = L2 = 53 nH, L3 = 175 nH

3. Matching on PCB

The theoretical matching was done without consideration of parasitics. The elements which have to be used on the PCB are slightly different from the stated above.

For example for our PCB with 50 Ω test circuit 1 we had to split the serial inductors in two elements to get identical results compared to our golden fixture using E12 series inductors.

L1 = 47 nH + 27 nH
L2 = 47 nH + 27 nH
C1 = C2 = 0 pF
L3 = 100 nH
All other components are 0 Ω jumpers.

But if the parasitics on the customer board (mentioned parasitics, additional parasitics of active parts) are different to this PCB the matching elements have to be slightly adjusted. Both in line and shunt elements change both pass band tilt and pass band ripple. But
- The in line coils mainly influences the pass band ripple a decrease of the inductance of the in line coils will decrease pass band ripple or change a round pass band shape towards a flat one

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- The shunt capacitors mainly influences the pass band tilt an increase of the capacity value will change the tilt to lower attenuation on the high frequency side of the pass band

The coupling coil mainly influences the bandwidth in pass band of the filter

The strategy to match the filter on the customers board should be as follows:

- match the filter according to theoretical values to 50 Ohm.
  Use your final PCB for this matching to be sure to have the stray elements of the PCB then before.
- Adjust external coil according to stray elements of the PCB
  The external coil influences the bandwidth of the filter by influencing the upper transition band of the filter only. The position of the lower transition band is not influenced. That means a wrong value for the external coil will lead to wrong bandwidth and wrong centre frequency. The group delay of the filter is influenced in the same way. There are two peaks in group delay behaviour for the matched filter. The peaks in group delay are located at the pass band edges of the filter. Finally this means that only the higher frequency peak in group delay is influenced by the external coil. This makes the adjustment of this coil very easy. Make sure that the distance in frequency of the two group delay peaks is identical with the distance shown in the delivered plots. (around 340 kHz) The matching of the filter will influence the position of the filter only slightly. The height of the peaks is influenced mainly.
- Adjust matching at filter input and filter output
  Check VSWR for filter input and output.
- Carry out the matching for the actual source and load impedance in three steps.
  Steps one and two are matching of the filter for input or output to source or load impedance respectively. The result of the matching of the filter input to the actual source can be checked via the VSWR at the filter output which is still matched to 50 Ohms and vice versa.
  The third step is the matching of the filter input to the actual source and the filter output to the actual load.

If you match the filter immediately to your source and load impedance without following the steps before you will probably find a quite good matching for filter amplitude and group delay performance. But there is no guarantee that VSWR is as specified. This may increase insertion loss and the stability of filter parameters in production.

In case of questions please contact us to

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