



**Siemens Matsushita Components**

## **Switchable SAW Filter K6257K** **Application Notes**

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### **Abstract:**

K6257K is designed for quasi-split-sound, multistandard applications. A BG channel with reduced group delay predistortion and a double nyquist path with flat group delay are selectable. In this application note, a switching circuit with a test layout is proposed and the results are evaluated.

## Switchable SAW Filter K6257K - Application Notes

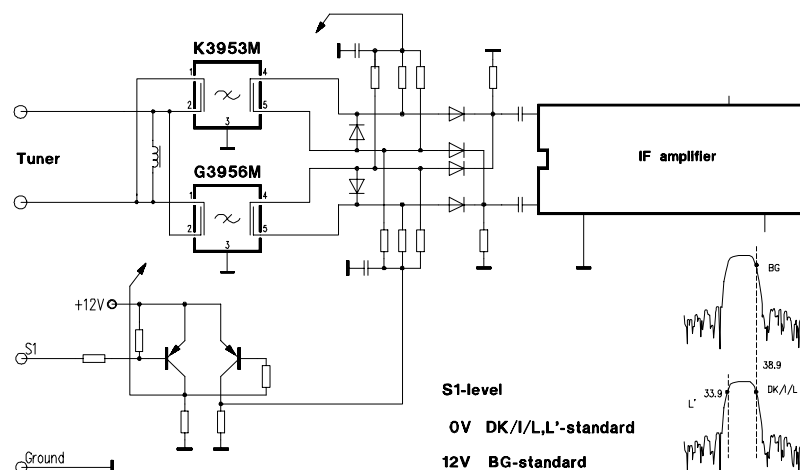
### General

SAW filter OFW K6257K is designed for Multistandard applications (European standards), except M- and M-related standards. A BG- channel with reduced group delay and a double nyquist path with flat group delay are selectable. It is optimized for video-IF signals, used in combination with Quasisplit sound systems. The filter comes in a flat DIP10K plastic case.

Our testboard will help to inform the user. A proposal for a symmetric SAW driver output was worked out. The IF driver of a tuner IC, TUA2007 is used here to provide real conditions on the SAW filter input side. A SAW filters symmetrical output is terminated usually by the differential amplifier of an IF-IC. Here we choose two common collector stages as buffer, the symmetric output is combined by widebandtransformer ( balun) to a practical unsymmetrical output for direct connection to a network analyzer.

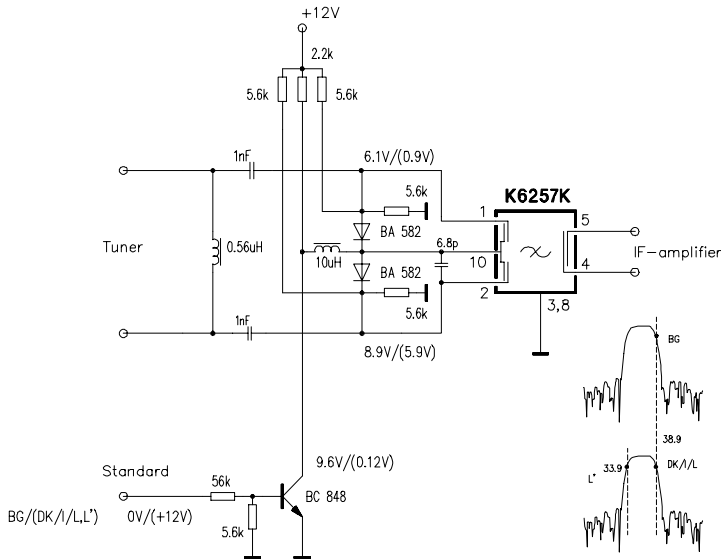
### The circuit

Before the introduction of the switchable SAW filter type, one of a set of two separate SAW filters was switched alternately to the input of the IF amplifier. Acceptable selectivity of the filter selected requires a circuitry with high attenuation of the unwanted signal path which has to be shortened and cut off at both output lines. In addition the circuit is complicated in its layout design. Such a circuit diagram is shown here:



SAW filter OF K6257K, one type of a new generation, opened up a possibility to design a norm select with few components occupying a minimum on space.

One switching input pin, pin10, has to be toggled between the two input pins 1 and 2, in case of symmetric SAW drivers. Two switching diodes only, of those types which



are used in a tuner as a bandswitch, connect the switchable input pin10 properly to the wanted input pin. A bias of +6V is used to block one diode only if the dc level at their common connection at pin10 changes between <1V and >9V. A 10uH RF choke allows the diodes to draw a current of almost 2mA. 0V or open at the standard select will set the lower diode BA582 to the on state. Then pin10 is connected with pin2 of the filter, and BG standard is selected. A +12V dc level

selects L/L' norm when the upper diode connects pin10 with pin1. The input capacitance of the SAW filter is 23.6pF for BG- and 16.9pF for L-mode. In L-mode an additional 6.8pF is recommended parallel to the SAW filter input for equal resonance conditions with the parallel inductance at the tuner output in both modes. We consider the data received from a measurement in a SAW test jig to be a reference, because low signal bypass, low noise floor and a flat frequency response is provided. The data sheet is based on that.

Under practical conditions (SAW filter inserted in a chassis) a layout crosstalk or bypass and the noise of the amplifier will deteriorate the trap attenuation and the sidelobes. Signals passing through the SAW filter and signals bypassing may add to deep traps or to unwanted peaks in the sidelobe range, depending on their phase conditions at the ICs input.

This effect is responsible for the quality differences of traps and sidelobes (attenuation levels below 40dB) in different layout structures.

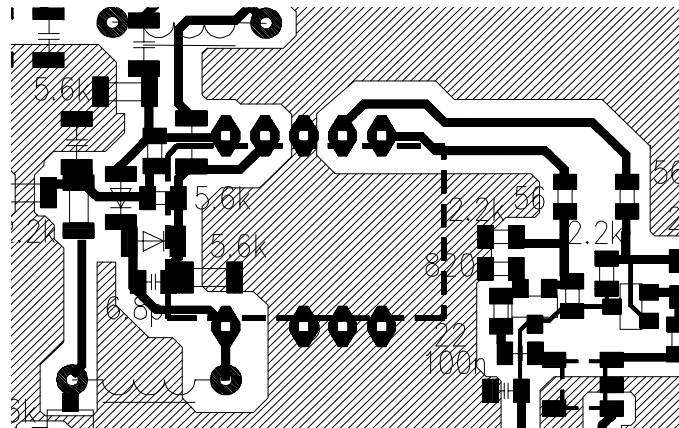
## **The layout**

The layout in the vicinity of the SAW filter is of vital importance, especially when additional components are needed at the filters in- or outputpins. A separation of -61dB BG / -60dB L,L' was measured in our testpcb for an open layout with the SAW filter extracted.

With a metal sheet different components were shielded to block part of a direct signal flow bypassing the SAW filter. Here, in this IF unit the layout for the SAW filter offers in general good separation between input and output. Slight improvement may be possible if the copper tracks of pin4 and 5 of the SAW filter are kept small.

Normally, no components at the filter output are needed when S+M filters are used. The complete layout for a standard select using OFW K6257K is shown on page 6.

Here, the details of the nor select can be seen. SMD components are perfect for a layout, with limited space close to the SAW filter directly at the filter pins. The SMD components of the switching circuit cannot make use of the area directly below the SAW filter even when limited space in a tuner-/IF unit would need that.



Experimental boards showed heavy bypass with deteriorated traps. Signal injection from components connected to pin2 or pin10 into pin4 is intolerable. Only a deliberate bypass injection path from pin 2 to pin5 may compensate that, however the exact design proved to be difficult. A SAW filter unsymmetrically driven shows less bypass because two pins between input and output are grounded. Symmetrical input signals pass the filter structure in a symmetrical mode, however bond wires and the filter terminals are unsymmetrical in their position. The main bypass is unavoidable between close pins and their copper tracks, namely from pin2 to pin4. The bypass difference is handed over to the differential input amplifier of the IF IC; the selectivity is more or less deteriorated then. Concerning copper tracks of the layout in the filter area, unnecessary or blind parts (different case of a competitors SAW filter) would pick up an unwanted bypass signal. The tracks to SAW filter input pins1 and pin2 carry a high-level IF-signal and should be separated well by ground from the filters output.

## Intermodulation

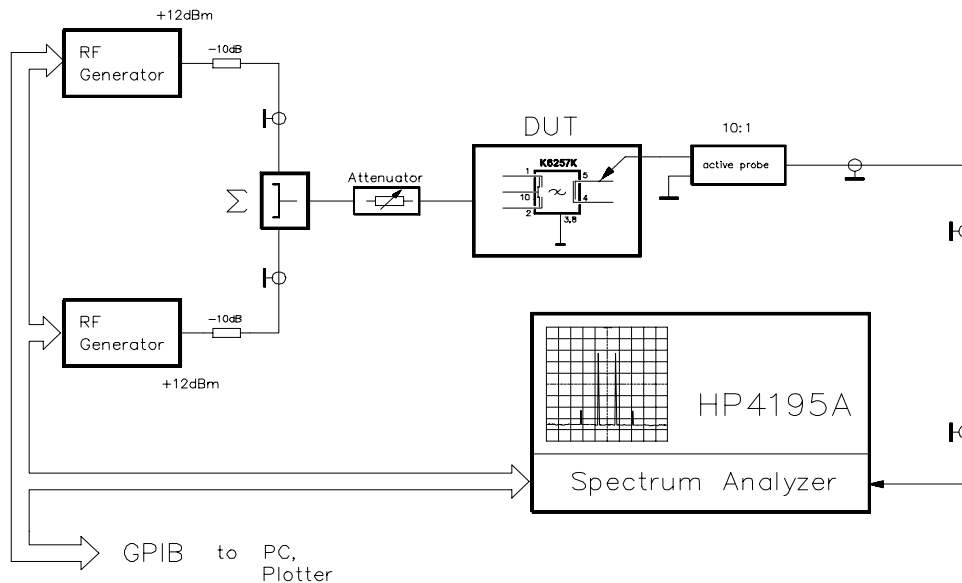
For the intermodulation test, two carriers, having a frequency offset of 200kHz, were stepped up 50 times through the 10MHz range; for both carriers 200mV were applied at the pcbs input.

The SAW driver requires a resistive load to get low intermodulation products. The input capacitance of a switchable SAW filter has different values for the two channels to compensate; in BG mode 23pF, in L mode only 17pF. The optimal inductance value was found for BG-mode to be 0.56uH. To avoid a change of the chokes value, an additional 6.8pF is switched in L mode across 1 and 2. In BG mode the capacitor is shorted by the diode.

Within a 40MHz range the fundamentals and the intermodulation products were taken. The SAW driver developed with such high input signal a -48dB intermodulation level, which is slightly better than normal. We checked the intermodulation ratio of the SAW driver and the switching circuit, picked up with an active probe at the SAW filters input pins. Then we measured the intermodulation ratio with the diodes taken out and wired pin10 to pin1 and after that to pin2 at the

SAW filters in- and output. Within the passband the select circuit is of no influence on the intermodulation performance. A choke of 0.68uH may be a compromise (ratio worsens by 4dB ) for both modes when the additional capacitor of 6.8pF is not accepted.

The testsetup for intermodulation is shown below:



The switching diodes do not create additional intermodulation products, even with the high input level of -2dBm at the testpcb input (+13dBm at TUA 2007 output). Usually, in a TV set within the AGC range an IF signal of 25mV at the SAW drivers input (about 300mV at SAW input) can be stated. Then, intermodulation is far below -60dB and out of consideration.

### **CENELEC test**

The response of SAW filter OFW K6257K provides good sidelobes and a standard picture carrier attenuation. The traps attenuations now are well beyond a critical value for the CENELEC-approval.

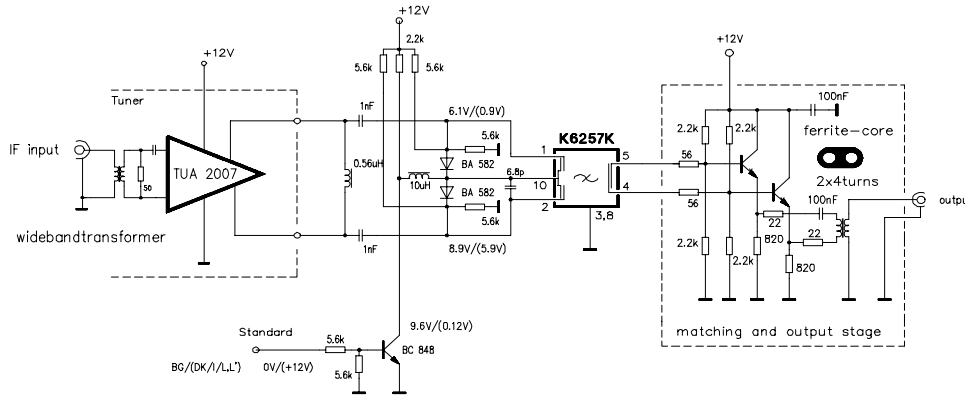
Concerning the SAW filter, the test S1 - the ANTENNA INPUT RESISTANCE test - for the N+1 and for the N-1 channels might be tough, if the traps will not reach lower than -40dB.

Furthermore the sidelobes attenuation is of some importance when the test S3 - the RADIATION RESISTANCE test - is conducted.

The strong interference carrier employed in that test, running between 10kHz and 150MHz, will be picked up easily and then it might be visible as an ugly pattern on the screen.

A 16dB insertion loss of SAW filter OFW K6257K was measured in a SAW tester. The level of a balun/wideband transformer inserted into the tester first was set to 0dB as a reference.

The circuit of testboard K6257KS is shown here:



The complete layout of testboard K6257KS can be seen below:

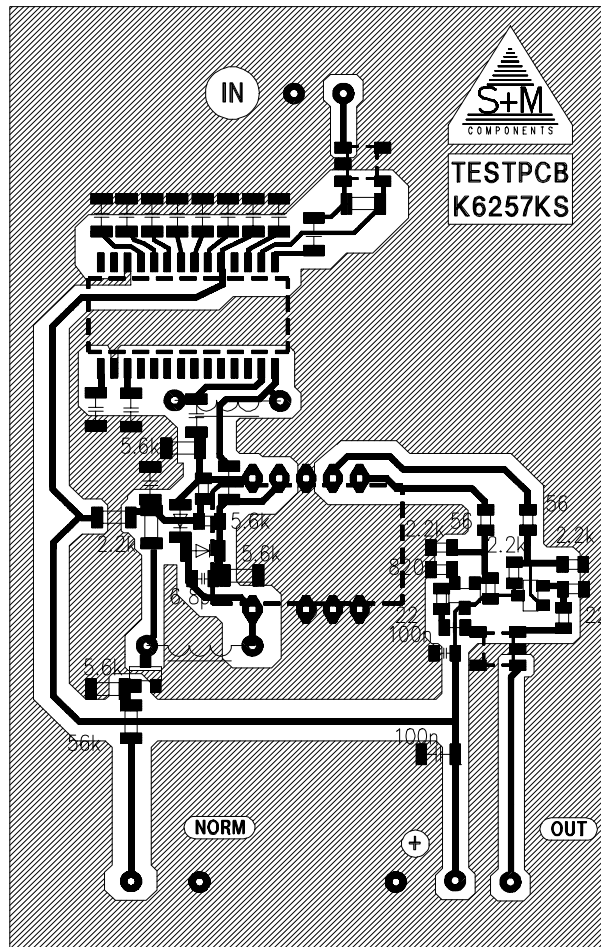


Fig.1a: IF response SAW Filter K6267K; BG standard

select input  
at 0V;

pin10 switched  
to pin2;

38.90MHz: -6.3dB;  
34.47MHz: -1.7dB;  
33.40MHz: -41.3dB;  
31.90MHz: -52.7dB;  
30.90MHz: -59.4dB;  
40.40MHz: -51.6dB;  
41.40MHz: -49.1dB;  
32.40MHz: -71.8dB;

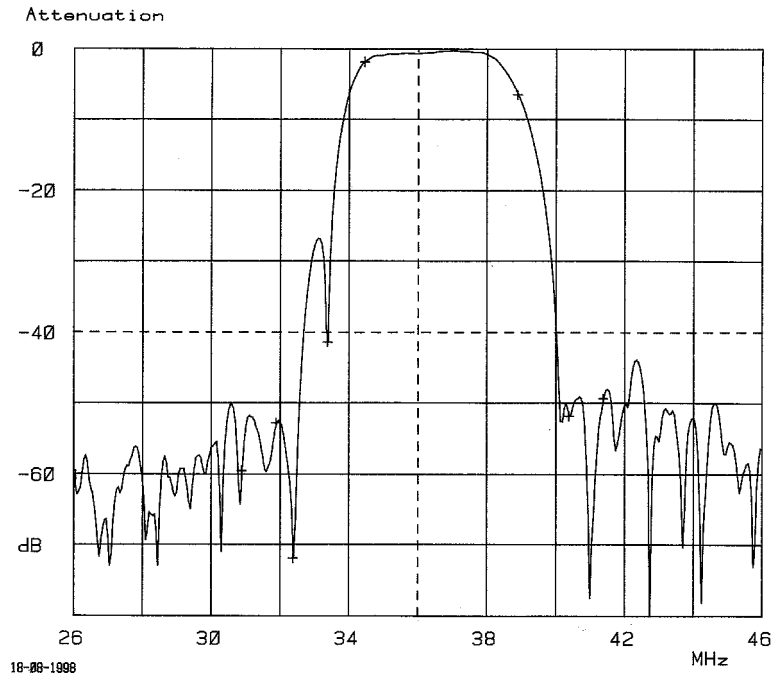


Fig.1b: IF response SAW Filter K6267K; L/L' standard

select input at +12V;

pin10 switched  
to pin1;

38.90MHz: -6.1dB;  
33.90MHz: -6.7dB;  
34.40MHz: -1.6dB;  
38.30MHz: -1.6dB;  
32.40MHz: -68.8dB;  
40.40MHz: -62.9dB;  
30.90MHz: -57.8dB;  
41.90MHz: -51.7dB;

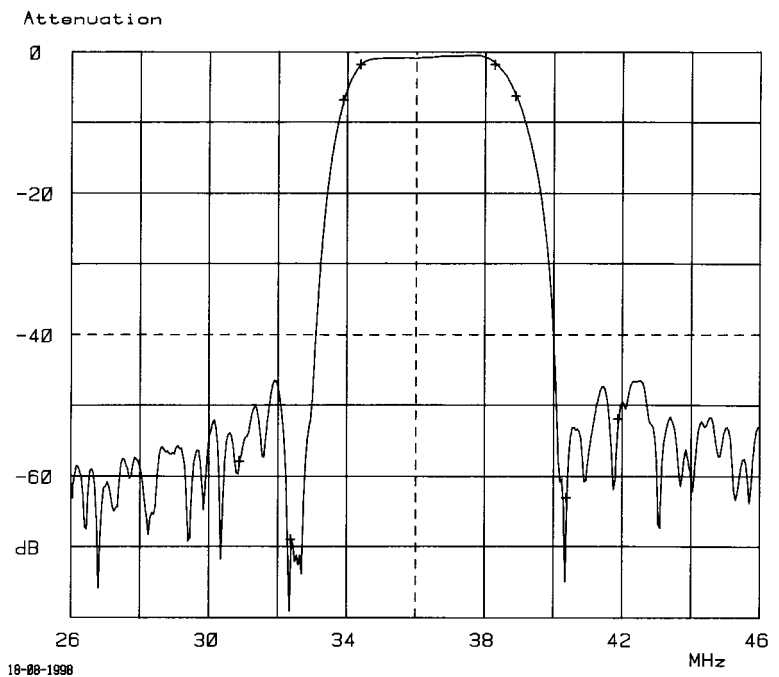


Fig.2a: IF response SAW Filter K6267K; BG standard

select input  
at 0V;

pin10 switched  
to pin2;

38.90MHz: -6.3dB;  
34.47MHz: -1.7dB;

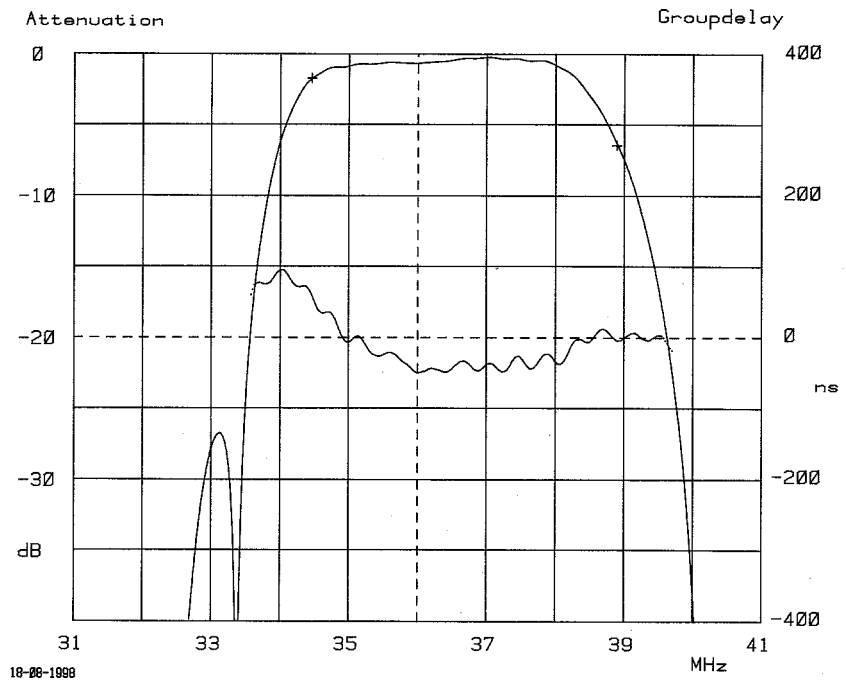


Fig.2b: IF response SAW Filter K6267K; L/L' standard

select input at +12V;

pin10 switched  
to pin1;

38.90MHz: -6.1dB;  
33.90MHz: -6.7dB;  
34.40MHz: -1.6dB;  
38.30MHz: -1.6dB;

