Applications

Surface acoustic wave filters play a key role in telecommunications. Because of their special features different products are being used increasingly in various transmission systems:

- Passband filters in general as RF or IF filters for data processing in communication systems. A few examples for these applications are mobile phone basestations, radio link systems, point to multipoint systems, Wireless Local Loop (WLL) systems and Professional Mobile Radio (PMR) systems.
- Passband filters for basestations include filters for all worldwide standards (GSM, CDMA, TDMA and W-CDMA). Filters for WLL systems are available for products based on DECT, GSM, CDMA, W-CDMA and proprietary standards. Trunked radio filters for PMR basestation, mobile and handheld applications are offered for the digital standard TETRA.
- Vestigial sideband and Nyquist filters in television transmission systems, e.g. in modulators/demodulators and converters of CATV head-ends, TV transmitters and high quality receivers, etc.
- Spectrum-shaping filters in radio link systems in transmitters (modulators) and receivers (demodulators)
- Clock recovery filters for digital regeneration in fiber-optic systems, e.g. ISDN, LAN, FDDI, etc.

Products

Basestation filters

Low loss passband filters for mobile phone basestation transmitters and receivers are used at the IF stage and also at the RF stage of the front-end. Their main purpose at the IF stage is to separate wanted frequency channels from unwanted ones in a frequency multiplex. At the RF stage basestation filters provide image rejection.

Passband filtering in the RF stage of a receiver improves large-signal rejection, thus reducing intermodulation interference in amplifier stages. Crossmodulation characteristics and blocking response are additionally improved.

Basestation filters are mainly used in SMT. These surface mounted devices more and more substitute the former drop in filters in all state-of-the-art systems. The center frequency position of an IF filter for basestations is not subject to any standard. Any manufacturer chooses the center frequencies used in the system according to the respective architecture. Consequently, EPCOS is currently offering basestation filters with center frequencies from 70 MHz to 400 MHz. The characteristics of these filters depend on the mobil communication standard the basestation works at. EPCOS develops custom basestation IF filters for all worldwide standards including TDMA systems like D-AMPS in the USA, the widely spread GSM systems mainly developed in Europe and CDMA systems.

The new UMTS/W-CDMA standard for third generation mobile communication being introduced in 2001 to 2002 requires very different and broadband IF filters. The reason is the need for higher data rates up to 2 Mbit per second enabling network providers to offer faster transmission and new applications like video conferencing, etc. EPCOS also works on IF filters for these future systems.

Wireless Local Loop filters

Low loss passband filters for Wireless Local Loop systems also separate wanted frequency channels from unwanted ones in a frequency multiplex. This is done at the IF stage as well as at the RF stage of the front-end.

Wireless Local Loop (WLL), Fixed Wireless Access (FWA), Point to Multipoint (PMP) and Local Multipoint Distribution Service (LMDS) systems provide wireless access in the so-called “last mile” between the backbone telecommunication network and the end user. The advantages compared to the conventionally deployed access via copper or fibre optic cables are the faster development of remote regions and the lower costs for building up a telecommunication network.

Wireless ”last mile” access systems consist of compact base stations used as distribution site and small roof or wall mounted transmit and receive antennas for each individual subscriber.

A vast number of systems based on different transmission standards is offered:

- Systems operating on GSM or PCS frequencies, e.g. 1800 and 1900 MHz.
- Systems operating in the ISM frequency band at 2.45 GHz.
- Systems operating in regionally available frequency bands, e.g. 3.5 GHz.
- Systems like PMP and LMDS operating on frequencies around and above 20 GHz.

Accordingly, the IF stage as well as the RF stage follows typical architectures used in mobile phone basestations. EPCOS offers IF and RF filters for systems based on DECT, GSM, CDMA, W-CDMA and proprietary standards.

Trunked Radio filters

Low loss passband filters especially for digital trunked radio systems are required increasingly. These filters are used in handhelds, terminals and basestations. The main focus is on RF front end filters based on the ETSI standard TETRA and the competing industry standard Tetrapol. Allocated frequency bands include 380 to 400 MHz for Professional Mobile Radio (PMR) used by public security organisations and 410 to 430 MHz for Public Access Mobile Radio (PAMR) used by transport and taxi enterprises, for communication within factory sites, etc. Additional frequency bands will be opened in future.

For all current frequency bands EPCOS offers Rx and Tx filters with different bandwidths between 5 and 20 MHz.

Videofilters for industrial applications

Vestigial sideband and Nyquist filters are offered for various TV transmission standards including B/G, D/K, I, L and M/N. Two sidebands of the same content are produced when a television signal is modulated onto the carrier. For reasons of frequency economy it is best to transmit only one of these two sidebands.

The general purpose of Videofilters is to select the sideband starting precisely at the picture carrier. A part of the unnecessary sideband is also transmitted as a vestigial sideband.

Spectrum shaping filters

The intersymbol interference inherent to any QAM or QPSK transmission of digital signals can be minimized by appropriate matching of the filter function (spectrum shaping) to the transmitted signal. What is important for matching is the symbol rate, the shape of the transmitted pulse plus the frequency characteristic of the modules between modulator and demodulator. A further feature of spectrum shaping filters is their roll-off factor, which is determined by the bandwidth efficiency of the transmission channel.

Passband filters for industrial applications

The main purpose of a passband filter is to separate wanted frequency bands from unwanted ones in a frequency mixture. In transmitters and receivers this is usually done at the IF stage.

In a transmitter the frequency spectrum following the modulator is limited to keep adjacent channels free of interference. The signals rejected by the passband filters are not necessarily modulated. The pilot tones in a cable TV network are an example of non-modulated signals. Modulated signals may be single voice channels (narrowband) or also very complex, i.e. broadband, data and broadcast channels.

Clock recovery filters

The data stream has to be regenerated at regular intervals when digital signals are transmitted. This avoids bit errors as caused by phase jitter or amplitude errors. The signal is sampled in the center of a data bit and given a 1 or 0. The information about where this center is to be found is derived from the incoming data stream with the assistance of clock recovery filters.

A distinction is made between active and passive clock recovery.

In active clock recovery systems the filter is part of the PLL oscillator.

The clock recovery filter in passive systems is used to filter the clock signal out of the incoming data stream after signal conversion.

