Multimedia applications

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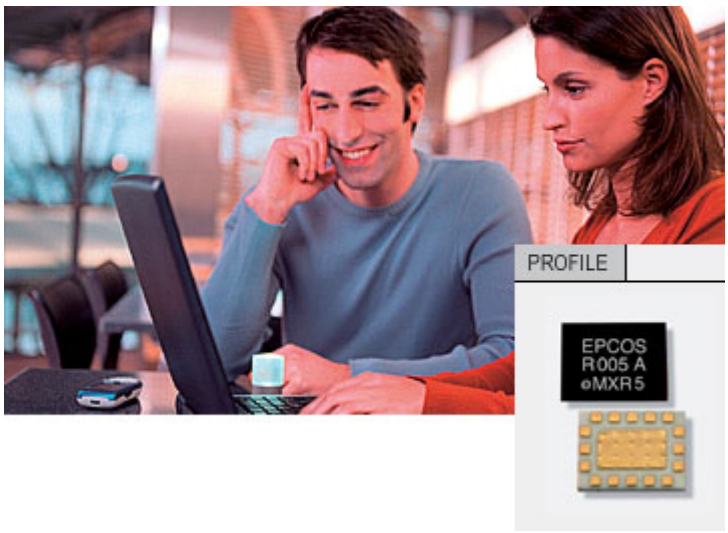
Ultracompact WLAN front-end modules

Vigorous growth in the WLAN market calls for miniaturized, competitively priced components for new applications in notebooks, PDAs and mobile phones. EPCOS has developed a new family of highly integrated front-end modules based on LTCC technology.



WLAN FRONT-END MODULES

Customer benefits

In comparison with discrete solutions, integrated FEMs reduce costs and space requirements while simplifying design.

- Cost reduction of total solution.
- Reduced component count:integration significantly shortens the bill of material.
- Miniaturization saves up to 95%of board space.
- Integrated filters can be optimized for specific RF chipsets.
- Reduced losses.
- Temperature stability and insensitivity to ambient influences.
- Short time to market.
- Higher yield than discrete solutions.

Wireless communication based on the IEEE 802.11 standard has recently become very popular. Wireless LAN technology permits fast and economical configuration of private networks, connecting terminals with each other and the Internet at data rates up to 54 Mbit/s. WLAN capability is becoming a standard feature embedded in portable computers. It offers wireless Internet access from a rapidly growing number of public hot spots in hotels, airports and city centers. A host of new multimedia applications will boost growth further.

A wide selection of WLAN extension cards operating in the bands from 2.4 to 2.5 GHz (IEEE 802.11 b/g) and from 4.9 to 5.9 GHz (IEEE 802.11 a) is already on the market. As most cards mainly use discrete components, they have bulky formats such as PCMCIA and mini PCI that cannot be used in PDAs, mobile phones or multimedia handhelds. These

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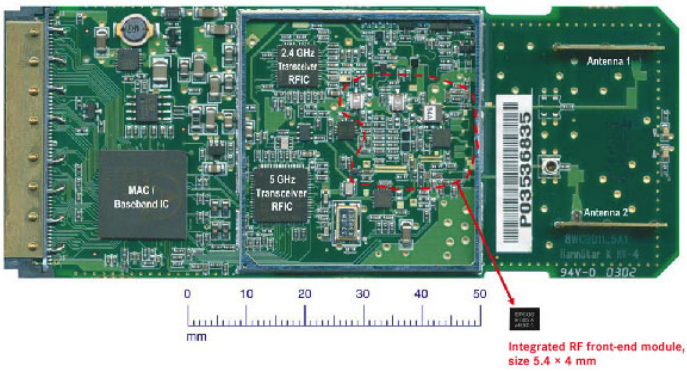
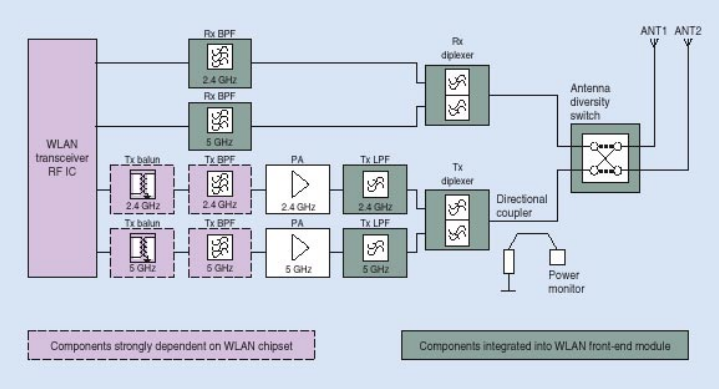
devices call for much smaller formats, such as compact flash cards, SD cards and USB keys. New dual-band triple-mode solutions (802.11 a/b/g) are rapidly gaining ground and will oust today's predominantly single-band devices because the increasing data traffic now cramming the 2.4 GHz ISM band calls for extra bandwidth available in the 5 GHz band. A dual-band multimode solution (to 802.11a/b/g) is obviously more complex than a single-band design.

A typical first-generation dual-band WLAN product is shown in ➔ 1. The RF section, comprising two RF transceivers and the RF front-end, occupies 40 × 40 mm of board space. The next-generation models currently being developed will be simplified in design, but their RF sections will still require 25 × 25 mm.



A front-end topology as shown in ➔ 2 is used in the latest reference designs of all major dual-band chipsets. The front end includes four different paths for the operating modes 2.4 GHz transmit, 5 GHz transmit, 2.4 GHz receive and 5 GHz receive. Two diplexers and an antenna diversity switch handle mode selection between the four paths and the two antennas. In the receive path, bandpass filters provide out-of-band rejection of GSM, PCN or PCS signals. Spurious emission of the first and second harmonics of the transmit signal is effectively suppressed by low-pass filters, while bandpass filters in the transmit path eliminate spurious signals from the transceiver's local oscillator. Between the antenna switch and transmit diplexer, the transmit output power is monitored by a directional coupler with power detector. The filter requirements and transceiver interface vary from chipset to chipset.



Filters, diplexers, balun transformers and directional couplers are promising candidates for integrated solutions based on multilayer ceramic technology (LTCC). Simplification and miniaturization are essential for future dualband systems. Similar to the growth of integrated GSM modules, a distinct trend toward FEMs can now be observed for WLANs.

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GLOSSARY

Diplexer

A device,usually implemented as a high-pass/low-pass configuration,that separates two different frequency bands.Diplexers are,for example,used in the front-end sections of WLAN terminals to separate the RF signals in the 2.4-2.5 GHz and 4.9-5.85 GHz bands.

Duplexer

A device,usually implemented in mobile phone applications with two steep-edged bandpass filters,that separates transmit and receive channels.In an AMPS duplexer, for example,it separates the 824-849 MHz from the 869-894 MHz band.

World's smallest front-end module for WLAN devices

Launching the industry's first WLAN front-end module in LTCC technology, EPCOS has scored a breakthrough in miniaturization of WLAN front-ends. A complete dualband FEM was integrated into a package measuring only 5.4 × 4.0 × 1.4 mm. It was made with the same proven production technology as used for GSM modules. With the new WLAN modules, EPCOS has extended its module range in a key growth market and once again demonstrated its acclaimed high competence in integration. The high reliability of the modules is based on years of experience in ceramic technology and packaging.

Integrated functions	Single-band FEM IEEE 802.11 b/g		Dual-band FEM IEEE 802.11 a/b/g		
	R010	R012	R005	R027	R019
Antenna switch	●	●	●	●	●
Rx BPF 2.4 GHz	●	●	●	●	●
Rx BPF 5 GHz			●	●	●
Tx LPF 2.4 GHz	●	●	●	●	●
Tx LPF 5 GHz			●	●	●
Rx diplexer			●	●	●
Tx diplexer			●	●	●
Power amplifier (PA)		●			
Power monitor	●	●	●	●	
Dimensions	5.4 × 4.0 × 1.4 mm	5.4 × 4.0 × 1.4 mm	5.4 × 4.0 × 1.4 mm	5.4 × 4.0 × 1.4 mm	5.4 × 4.0 × 1.4 mm
Chipset compatibility	Universal FEM	Universal FEM with integrated PA	Atheros AR5xxx dual-band chipsets	Infineon PMB8680; Agere WL54040	Intel Centrino chipsets

● = integrated ● = optional

An overview of WLAN front-end products with a footprint of 5.4 × 4 mm and an insertion height of 1.4 mm is presented in 3. Recommendations on the compatibility of FEMs with major WLAN RF chipsets are given as well.

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Integration roadmap

In mid-2002, EPCOS began to set up a new generation of LTCC building blocks for 2.4 GHz and 5 GHz based on its long-term experience in microwave ceramics and volume production of GSM modules. In close cooperation with customers, the first prototype front-end modules were completed in the first half of 2003. Several single and dual-band FEMs have meanwhile passed pre-production runs and are being considered by lead customers for WLAN products rolling out in 2004. The product range is being systematically extended and optimized for new chipset generations under development. EPCOS FEMs with modern transceivers provide an optimum solution in terms of size, total cost and performance.

The next development, currently in the prototyping phase, is the integration of power amplifiers and low-noise amplifiers, which will enable EPCOS to offer fully featured single-package FEMs. Further down the road, the transceiver RF chip will be integrated as well, ultimately leading to a single-package WLAN RF terminal.