Ethernet to the Troposphere

Matthias Fuster

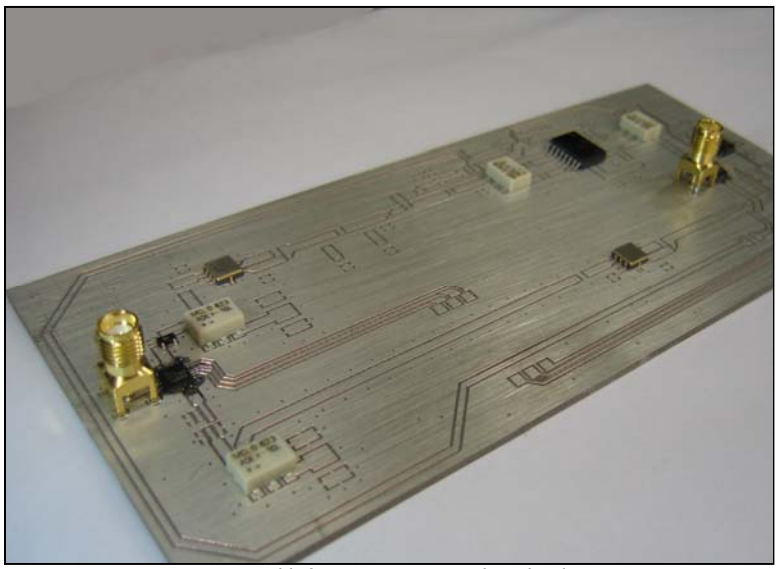
Diplomand / in	Matthias Fuster
Examinator / in	Prof. Dr. Heinz Mathis
Experte / in	Stephan Hänggi, Phonak Communications
Themengebiet	Mobile Communications
Projektpartner	Meteolabor AG

Earth from 30'000 ft altitude

Goal: The company Meteolabor AG produces weather balloon sondes to measure air temperature, air humidity, air pressure, dew point, wind conditions and others, in heights up to 20km above ground. These values are transmitted via a 20kbit/s datalink to the base station. Such an existing sonde shall now be enhanced to produce live pictures. A Japanese researcher team wants to obtain pictures of snow and ice particles at high altitudes. Since the 20kbit/s link isn't sufficient to transmit live footage, a high speed Ethernet link between the troposphere and the ground shall be developed.

Problem: In America an ISM band at 902MHz-928MHz is available. The 900-ISM band is a good trade-off between broadband (high frequencies) and long range (low frequencies). Therefore, many 900-ISM band modules exist on the American market. These modules provide high data rate, long range and plug-and-play mode. In Europe and Japan the situation is different. In Europe the frequency band between 902MHz and 928MHz is occupied by GSM900, UIC railway systems and TETRA (PMR). In Japan the 900-ISM band is covered by regional emergency radio communication, personal radio communication, and portable radio communications.

Solution: The first problem was to identify a suitable license-free frequency band. The best qualified one is the 400 MHz METAIDS band which is intended for use with weather sondes. It was decided to take a US 900MHz module and extend it to the 400MHz frequency range. This is manageable with a PCB connected directly at the RF port of the 900MHz module.
The frequency conversion is made by two mixers. The first mixer in the transmit circuit converts from 900 to 400 MHz, the second one in the receive circuit from 400 to 900 MHz. To improve the receiver sensitivity and equalize the conversion loss, amplifiers are included in both circuits.



PCB with frequency-conversion circuit