Automated System for Zoning Measurement

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***Abstract*—**In the last period, the security of information leak has been very intensively discussed in connection with worldwide terrorist menace. Zoning measurement covers measuring methods for building shielding with reference to information leak by radio environment. Principle and design of fully automated system for zoning measurement is presented in this posed paper. System is based on wireless controlling of signal generator, which emits testing signal, by pair of radio modem for SRD band, application of measuring receiver, and PC with service program. Results of measuring process are frequency-leak characteristics of tested buildings and their protective classification.

***Keywords*—**Automated measurement, zoning measurement, SRD band, radio modem, protective classification.

I. Introduction

THE automated system for zoning measurement was developed under contract with Czech National Security Authority. The basic motivation of design such measuring system is an exact shielding classification of strategic buildings in wide radio frequency range. Result of the zoning measurement is frequency characteristic of attenuation between outside and inside space of measured object. The shielding classification is defined by secret national standards specifying an object protective class for information leak in radio-frequency bands.

The architecture of the system for zoning measurement has solved by two stations, the first one is transmitting system located outside of measured building and the second one is receiving system placed inside of object. The receiving system working as master system consists of a notebook with utility program, wide-frequency range measuring receiver, and radio modem for communication with transmitting side. The radio modem is connected with notebook by USB interface. The measuring receiver can be connected to computer by RS232, Ethernet or USB interface depending on applied device (receiver). On the other side, transmitting subsystem working in slave mode includes signal generator and radio modem, which is directly connected to control interface of generator. The radio modem supplies RS232, Ethernet, and USB interface standards. Communication link between receiving and transmitting subsystems provides a necessary synchronization (locking of the same frequency of generator and receiver during the measuring process). A non-licensed SRD (Small Range Device) band operating on frequency 868 MHz is applied for communication between receiving and transmitting workplaces by purpose-built radio modems.

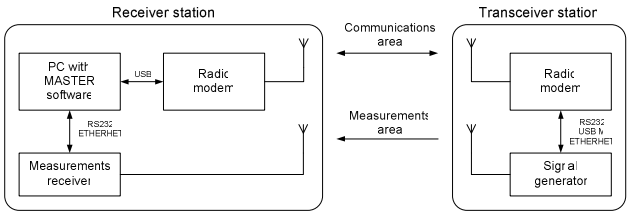

Fig. 1 Basic diagram of zone measurement system

II. Communication in Zone SRD 868 MHz

On the present a few non-licensed bands for ISM (Industrial, scientific and medical) applications are worldwide permitted (in countries, which are members of CEPT). Their conveniences for utilization in zone measurement are summarized in [1]. ISM band 868 MHz referred to as SRD (*Small Range Device*) band was selected from VHF and UHF bands under consideration. SDR band is very convenient due to low occupation of other services, that band has been licensed in Czech Republic since 2000. This band is destined for remote control in automation systems, alarms, signalization and RFID tags with range up to hundreds of meters [10].

In the SRD band, 80 channels with frequency separation 25 kHz is assigned for application of remote control, which is more than in 150/160 MHz or 433/450 MHz bands. The occupation of SRD band don‘t increase, because at the present time, cheaper higher band technology (2.4 GHz, 5GHz) with strong software supporting is more popular and applied. SRD band is generally used for free telemetry wireless transmission (General Telemetry and Telecommand) and warning signaling (Alarms) in member countries of CEPT. Maximum allowed transmitting output power in SRD band is from 5 to 500 mW EIRP. The power up to 500 mW EIRP is allowed in sub-band designated as SRD 1i, i.e. 869,4 - 869,65 MHz, it means 10

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available channels. A supposed minimal communication range is about 2 km in free space for FSK modulation 2,4 kb/s in sub-band SRD 1i, respectively 600 m in sub-band, where the output power is limited up to 50 mW EIRP.

TABLE I
CHANNELS DIVISION IN ZONE SRD 868 – 870 MHZ

Channel	Frequency [MHz]	Maxima Perform. EIRP[mW]	Keying ratio TX/RX [%]	Application
0 - 23	868,0125 - 868,5875	25	< 1	generally usage
24 - 27	868,6125 - 868,6875	10	< 0,1	generally usage
28 - 47	868,7125 - 869,1875	25	< 0,1	generally usage
48 - 51	869,2125 - 869,2875	10	< 0,1	security alarms
52 - 55	869,3125 - 869,3875	10	< 10	home automated
56 - 66	869,4125 - 869,6500	500	< 10	generally usage
67	869,6875	25	< 0,1	generally alarms
68 - 79	869,7125 - 869,9875	5	100	generally usage

In practical application is profitably then both modems are the same and the software designates function of them. The communication protocol was designed for the packet radio transmission that contains packet definitions for opening and closing communication channel and data transmission for measurement. The protocol for SRD band 868 MHz is not standardized and it depends on user. The FSK modulation with Manchester coding (2400 b/s) has been applied for communication between modems for zone measurement.

III. THE CONSTRUCTION AND WORKING PRINCIPLE OF RADIO MODEMS

The chip CC1020 Texas Instruments has been chosen as the best chip core for a transceiver unit. The producer indicates its sensitivity -108 dBm for bit error rate BER = 10^{-3}. The output power of the CC1020 is 5 dBm. The transceiver unit includes also a microcontroller of AVR family for preparing data (coding and packet building) for transmission and decoding and application data extraction for receiving. The interface with superior system is solved by I2C bus.

The architecture and principle of complete system of the radio modem is shown in the Fig. 2. The features of system are drawing up by following points:

- panel with graphical display and microcontroller is serving for easier control by operating staff (parameter setting, status indication),
- power supply and internal accumulators (2x 6V) charger is controlled by own microcontroller system with measuring of accumulators status and controlling of their charging in thrifty pulse mode,
- multiprocessor system with distributed control of functional units with communication by I2C bus,
- directional patch antenna and omnidirectional collinear antenna is applied for radio communication.

The main processor unit performs communication with PC over USB bus and communication with devices (RS232, USB or ETHERNET). The transceiver is activated when the requirement is generated for transmission by the relevant command. The transmitting message is displayed on the

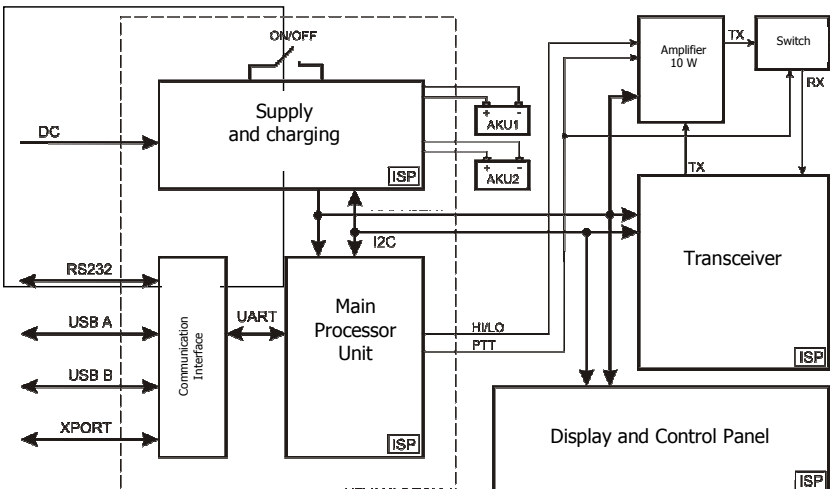

Fig. 2 Block diagram of radio modem for zone measurement

Fig. 3 Main window of application software running on PC

display unit. After transmitting of packet, the system goes to the receiving mode and expects an answer. Next operation is a signal detecting, data decoding and forwarding the message to the main processor unit.

IV. Control Software

The software for radio modem control has been written in C++ Builder 2007. The software can be divided to the three parts:

- automated measurement,
- results,
- import and export of results.

A. Automated Measurement

The reference data are reading after start of software and the zones are set based on reference data. Next task is testing of transceiver connection. If the initialization is successfully, it can be run the measurement process. During the measurement the frequencies defined by prescription (table) are set and levels on the receiving side are measured. The measured values are displayed in the table (Fig. 3). The wrong values (usually low signal to noise ratio) are marked in table for easier orientation and possibility to perform a new measurement. The results are shown in the graph too for better evaluation.

B. Results

During the measurement process are calculated and evaluated results, as it is evident in bottom of window. This data serves for deciding process what type of zone classification is measured and if the measurement is relevant?

C. Import and Export of Results

The redisplaying previous measurements can be provided by import and export from/to file. If the results are read from file, the evaluation is calculated and so it can be compared results odd old measurements.

V. Conclusion

The automated system for zone measurement was designed based on chip CC1020. The radio modems with generator, measurement receiver and PC complex flexible system, which can make zone measurement and display results.

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