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CONTACTLESS POSITION MEASUREMENT FOR EMC APPARATUS

BEZKONTAKTOWY POMIAR POZYCJI W APARATURZE DO BADAŃ KOMPATYBILNOŚCI ELEKTROMAGNETYCZNEJ

Abstract: The measurement of radio disturbance power in the frequency range between 30 MHz and 1 GHz is usually conducted using an absorbing clamp. The absorbing clamp assembly that incorporates also a current transformer is moved along the track of the power supply cable and is used to measure electromagnetic interference radiated from the equipment under test (EUT) through its connecting mains cable, to pick up the location of the maximum disturbance and to check the compliance with relevant EMC standards. Manual operation of the clamp is time consuming and tedious, it requires a hand-driven advance of the clamp, sealing the screened room, conduction a next test and doing this many times. This paper reports on the development of the remote sensing of an absorber clamp system that has the potential of reducing the EMC test time and increasing its accuracy. An overview of the implementation method and background reasoning is given on the developed system. The EMC emission tests confirm that the position measurement system complies with the EMC norms.

1. Introduction

The measurement of radio disturbance power in the radiation frequency range of 30 MHz-1 GHz is typically conducted using an absorbing clamp mechanism [1], [2]. An absorbing clamp consists of a calibrated ferrite-core current transformer and two sets of ferrite rings.

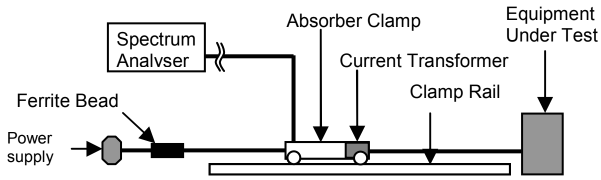

Figure 1. The test setup

One set of ferrite rings surrounds the supply cable from the equipment under test (EUT) and acts as an absorber of energy and an impedance stabiliser to isolate the EUT from the external power source. The second set of ferrite rings is contained within the clamp body. This set surrounds the lead from the transformer to the electromagnetic interference (EMI) meter to minimise standing waves. The absorbing clamp is moved along the track with the mains cable of EUT running through it as shown in Fig. 1. The clamp itself is shown in Fig.2.

Manual operation of the system is tedious and time consuming; therefore an automated control and surveillance system has been developed and tested against EMC requirements [2]. It has included at first a camera to monitor the clamp movements within the screened room. After implementing a number of EMI mitigating measures, the camera did not introduce any significant disturbances to the measurement environment [2].

Figure 2. The clamp

In this paper we report on a further enhancement of the system by introducing remote movement control of the clamp [3] and by identifying precisely the position of the clamp remotely using an optical encoder [4].

2. Position sensor

The operation of optical encoder selected for the implementation is shown in Fig. 3 [5].

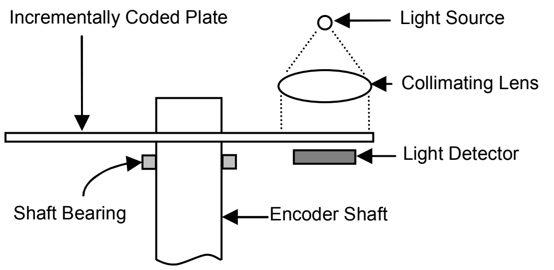

Figure 3. The principle of an optical decoder

An encoder is an electrical mechanical device that can monitor motion, position or direction. The encoder operates on the logic of continuous photo detection of a light source. When the coded disk lines up so that the light from the light source is focused on the detector, in this case a phototransistor, it becomes saturated and an electrical square wave pulse is produced. In order to detect the rotational direction of the encoder's shaft, two light sources are applied to produce two quadrature signals that are 90^{o} out of phase. The output signals (channels A and B) of the encoder are shown in Fig. 4 for the two rotational directions of the shaft.

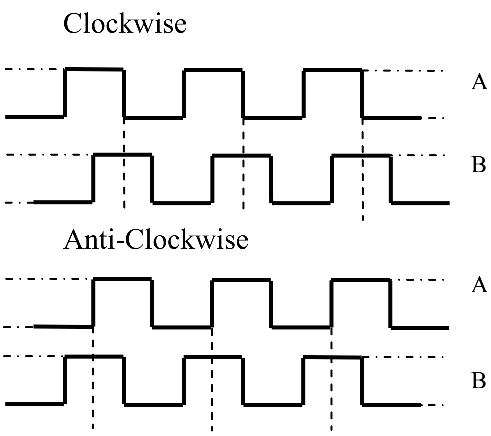

Figure 4. Output signals of the encoder

The quadrature signals shown above need to be decoded, a simple microcontroller can be used for the purpose.
The microcontroller that was chosen for the implementation was the Atmel ATtiny2313V 8-bit microcontroller with Reduced Instruction Set Computer (RISC) architecture.

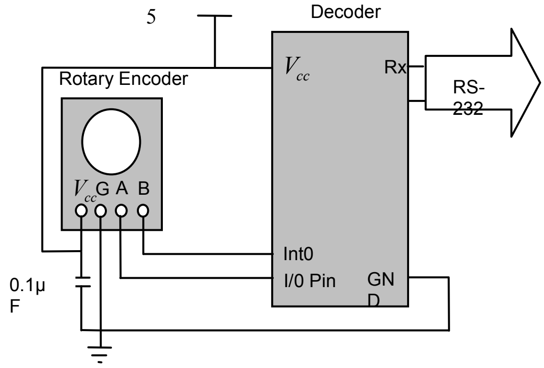

Figure 5. Rotary encoder interface

Fig. 5 illustrates how the decoder, placed outside the screened room to limit EMI, is connected to the optical encoder. C language was used to program the decoder, using the external interrupt routine of the chip. The number of rotations was converted into two-byte integer format within the microcontroller. The data was sent to the computer via the serial interface and then fed into a LabVIEW program to obtain the position readings.

3. EMC Testing

After the implementation of the system for the position determination of the clamp system, a number of EMC tests were conducted to check its EMC compliance [1].

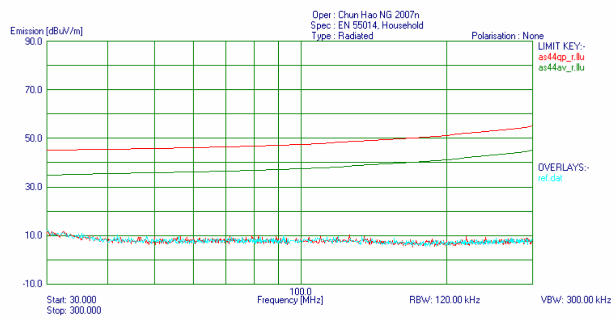

Figure 6. 30 MHz – 300 MHz radiation test results of the positioning system

The test results for 30 MHz – 300 MHz are shown in Fig. 6 and for the range of 300 MHz – 1 GHz in Fig. 7. Both of them prove that the clamp positioning system is well within the standard requirements; as a matter of fact the emission level is similar to the background noise.

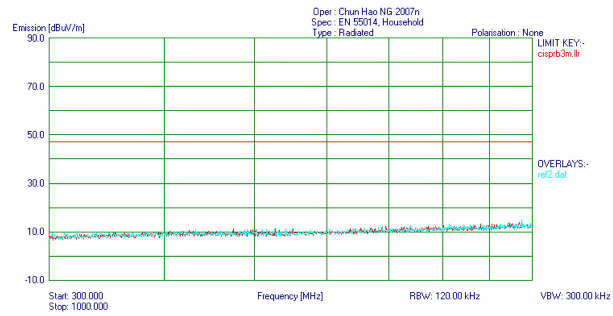

Figure 7. 300 MHz – 1 GHz radiation test results of the positioning system

4. Conclusions

The system has been successfully tested for its technical performance as well as for the EMI standard compliance. This cost effective solution has provided a fairly accurate position measurement of the clamp mechanism according to the design specifications.

5. Bibliography

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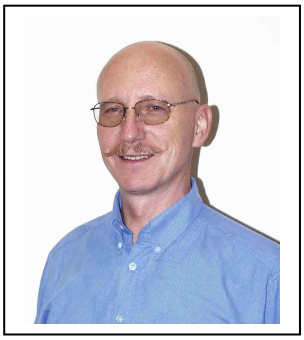

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