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HOME BUS SYSTEM

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Abstract. This paper deals with the practical realization of Home Bus System (HBS). The global structure of this system is given as well as the practical hardware realization of secondary interface for connecting of TV set to HBS bus. On the concrete realization the measurements of influence of the base band signal on linear distortion of the TV signal were carried out.

Key words: Home Bus System, television, interface, measurement, linear distortion.

1. Introduction

At the beginning of 80–ies there started very intensive work on design of Home Bus System (HBS) in Japan and USA. Such a system should contain the possibility to control operation of all home appliances, as well as control of a whole house (including courtyard) for safety reasons (housebreaking, fire, flood ets.). In 1981 in Japan, development teams from seven companies (Daikin Industry, NEC Home Electronics, Matsushita Electric,...), two Universities (Osaka, Himeji University), and Kansai Elektronics Industries Development Center (KEC) as a coordinator, formed a team of experts which worked on suggestions for standardization of HBS [1]. In November 1983 a suggestion was given for standardization of the system named Home Bus System [2]. This suggestion anticipates that all home appliances should be connected to the common bus (HBS bus) for command and data transfer. Physical realization of the bus is by means of coaxial cable and transmission is realized by frequency multiplexing of three bands, and they are: base band for transmission of control signals (0–10kHz), sub–band for analog and digital signal transmission (10–75 MHz), and FM–TV band for radio and TV

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signals transmission (76MHz upwards). Number of terminals which could be possibly connected to the bus is 256.

In [3] there is treated possibility of making four groups of devices similar by purpose (information systems, control systems, audio–video systems and safety system). HBS which uses 1–2 coaxial and 1–4 wiring cable thus enabling connection to other networks (type of public telephone network, information system etc.), is shown in paper [4]. Home system, being developed in Thomson laboratory (France), under the name EUREKA is shown in [5]. Transmission media is coaxial cable and signal transmission is performed according to AMI standards.

In paper [6] there is shown design of Main Interface (MIF) on the bases of microcontroler i8051, which enables connection of Personal Computer (PC) to HBS realized in plant laboratory Ei HOLDING CO. DD TELEVIZIJA Nis (Serbia, Yugoslavia). In the papers [7] and [8] there is shown organization of more single HBS, to a global Super Home Bus System (SHBS). In the above mentioned papers, problem of connecting TV set to HBS bus is not treated. It is also shown practical realization of secondary interface (named HBS–TV) which enables connection of TV set to HBS bus. Besides, there are presented lab. measurements of base band digital signals influence on linear distortions of TV signals in FM–TV band.

2. Home bus system structure

Global structure of HBS, organized around single bus (HBS bus) for command and data transmission, is shown on Fig.1. Physical medium (HBS bus) for signal transmission is coaxial cable. Central place in HBS takes computer (in this case PC). It is connected to the HBS bus by MIF [6]. Other home devices (fridge, microwave oven, TV set, security camera etc.) are connected to the HBS bus by means of Secondary Interface (SIF). The computer controls operation of other devices, events and state in a house (temperature, presence of smoke, water etc.). On the bases of collected data it takes certain activities anticipated by protocol. Communication between computer and other devices is realized by means of MIF. It is made like hardware–software assembly and supports two lowest levels of OSI–RM (Open System Interconnection Reference Model) and they are: Physical and Data Link levels. MIF is different in design from SIF, which is designed by purpose for each device separately.

In the text below it will be described SIF which enables connection of a TV set to HBS.

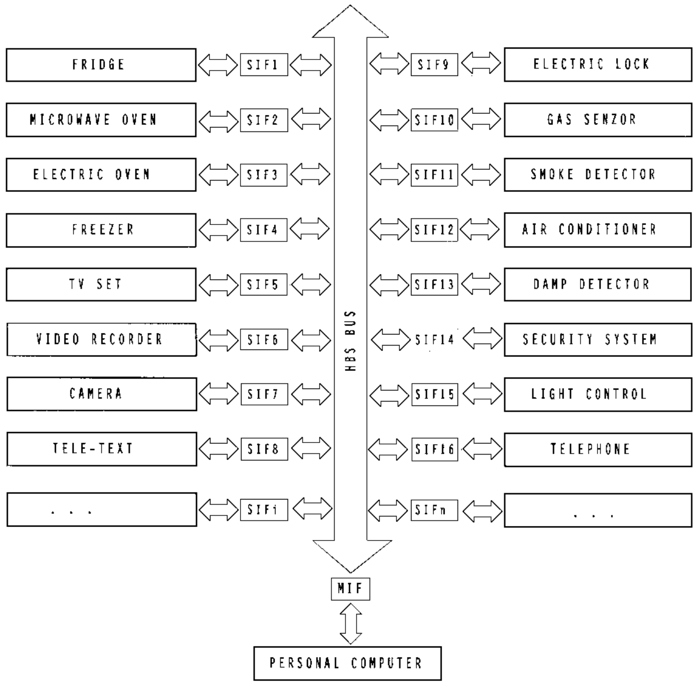


Fig. 1. Home bus system structure.

3. HBS–TV secondary interface

HBS–TV interface has to satisfy base band conditions as it is connected to HBS bus (transmission rate 9600 bit/sec, byte length 1.146 msec, start and stop bit, frame check code (FCC), access to the HBS bus according to CSMA/CD protocol) [1]. In relation to TV set it has to support the TV set standard (horizontal frequency 15625 Hz, vertical frequency 50 Hz).

Block diagram of HBS–TV interface is shown on Fig. 2 realized on the bases of i8051 microcontroller. Clock frequency is determined by external crystal and it amounts 11.059 MHz. Program memory amounts 32 kB (EPROM 27256), data memory 64 kB and it is realized by means of two memory circuits 62256 (RAM). Access to the HBS bus is realized by coupling network, in frames of which there is output stage with open collector, decoupling circuit of transmission and reception signal, as well as bandpass filters for base and FM–TV band [6]. Generation of video and synchronization signals is performed in 'picture generator' block, which is realized on the base of i8276 CRT controller. In 'interface of remote control' block there are generated signals for driving of TV set operation.

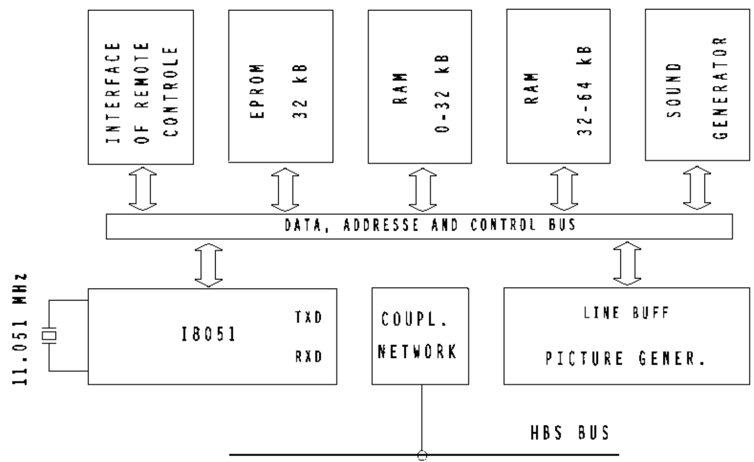


Fig. 2. Block diagram of HBS–TV interface.

Fig. 3 shows the coupling of HBS–TV interface control block and certain stages of a TV set. From the 'interface of remote control' block driving signals are supplied to the 'remote control' unit. In that way control by operation of a TV set is enabled (switch on/switch off, volume up and down, channel selection etc.) The signals from 'sound generator' are applied to the input of LF amplifier. Sync pulses from 'picture generator' are applied to the oscillator. In that way, TV set synchronization is provided. Video signals are applied to the RGB amplifiers via PAL decoder stage.

HBS–TV interface realized in such a way, enables PC program control by operation of a TV set. In combination with other devices it is possible to display the data on a TV set screen about the state in a house (temperature in certain rooms etc.). It is also possible to control operation of home devices which are switched–on at that moment, and other actual informations. These data are shown on a TV set by election of HBS channel. Besides, in alarming cases (fire, flood, burglary) regular program is automatically stopped (TV set switches–on ig it was switched–off) and displays the message about the events at that moment (with the possibility to switch–on the camera in the case of burglary). It is possible to continue watching the

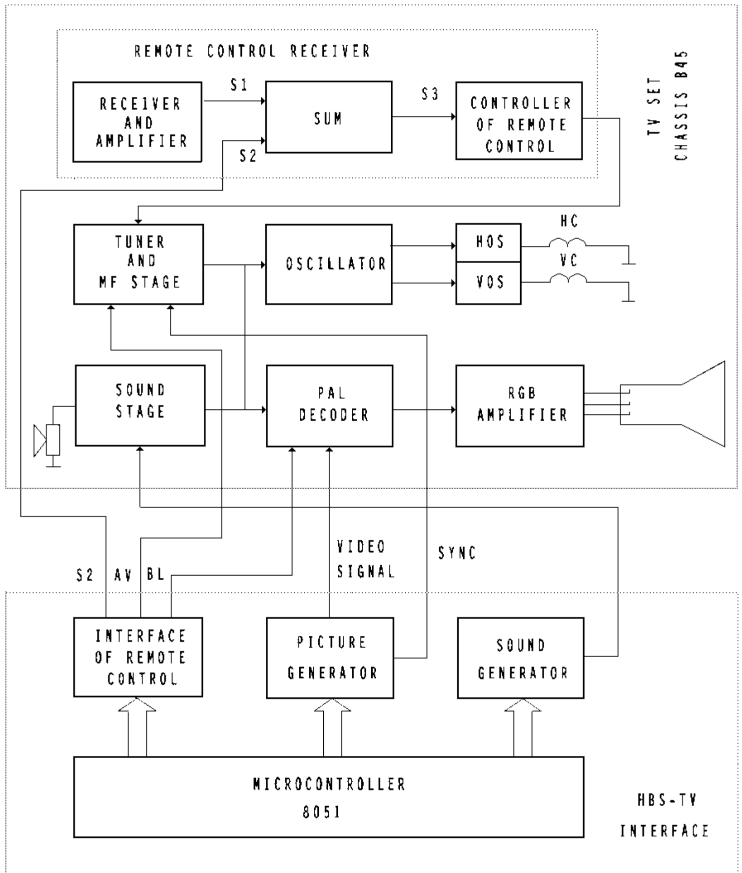


Fig. 3. Coupling of HBS–TV interface with TV set.

regular when alarming case is over.

4. Measurement of linear distortion

It was already mentioned that HBS bus transmits signals from three frequency bands (base band, sub–band and FM–TV band). Signal level from the base band changes from logic level 0 to logic level 1 (TTL) and signal level in FM–TV band is about $100\mu V$. Output stage of MIF and SIF is realized by transistor with open collector and corresponding low bandpass filter [6]. Logic level 1 corresponds to the case when output transistor is in cut–off, and logic level 0, in the case when output transistor is in saturation in certain interface on the HBS bus. In that case, there is short–circuit on the HBS bus which influences to the signal load from FM–TV band.

In the above mentioned references, the problem of base band signal' influence on FM–TV band signal i.e. linear distortion of TV signals, was not treated. In the text below there are given results of measurements performed on the realized system, and they treat the above mentioned problems.

Fig. 4 shows configuration of HBS which is formed on purpose for measurements of signal influence on additional linear distortion in video signal [9]. Measurements of distortion are performed on the output video detector of a TV set for the following cases: a) for signal transmission in base band and b) when there is no transmission. Change of frequency of the base band signal from 50 Hz to 16 kHz, was the aim to prove visual influence of vertical and horizontal synchronization.

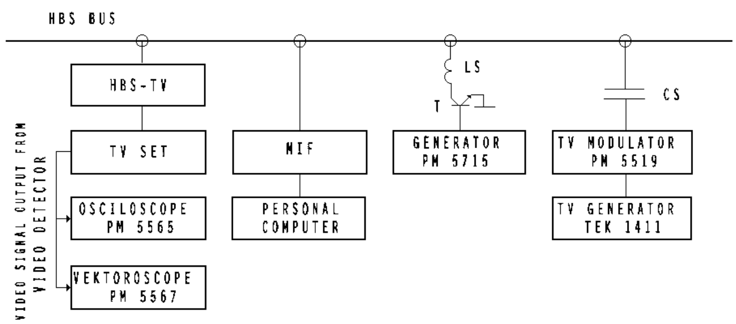
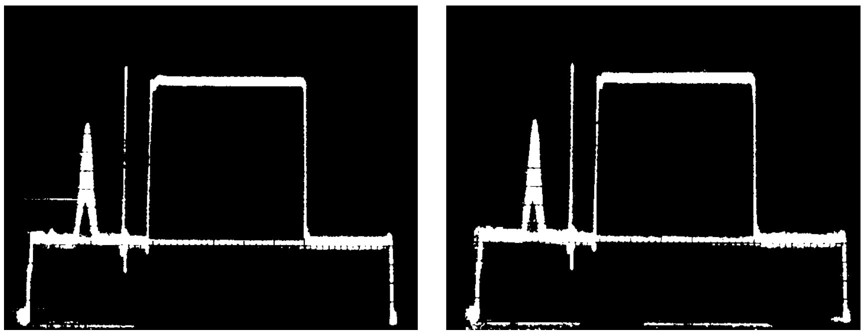


Fig. 4. Measurement configuration.

4.1 Results of measurements

Experimental measurements are performed in the following way: output from TV generator (TEK 1411) was modulated by TV generator/modulator (PM 5519) and its output connected to HBS bus via coupling network. TV generator TEK 1411 enables generating of standardized measuring signals with inserted pulses 0.5T, T, 2T, 20T, 250 kHz, etc. Signal measurements are performed on the output from video signal detector in the TV set. Linear distortions are measured by means of TV study oscilloscope (PM 5565) and vectorscope (PM 5567). Also, measurements were performed for signal distortions 0.5T, T, 2T and 250 kHz which refer to the luminance signal, and measurements with 20T which refer to chrominent signal. The results of measurements show that there is no additional influence on linear distortions in TV signal, when transmitting signals from base band and FM–TV band simultaneously. Fig. 5(a) shows test signal look at the output from video detector for the case when there are not any signals in the base band, and Fig. 5(b) shows the signal with the case with signals in the base band. Also, by visual inspection of picture reproduction quality on a TV screen, we didn't notice degradations as a result of digital signal presence in the base band.



(a) *(b)*

Fig. 5. Test signal look at the output from video detector when signals from the base band are: (a) not present and (b) present

5. Conclusion

In this paper it is described practical realization of secondary interface. It enables connection of TV set to the HBS. On the realized experimental HBS, which is formed of a PC and a TV set, additional linear distortions in TV signal are measured. They are the result of digital signals from base band. Results of measurement show that there is no influence of base band signals to the quality of reproduced picture.

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