

PROGRAMMABLE SYSTEM FOR CONTROLLING THE TELEVISION PROGRAMS TRANSMISSION

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This article presents the functioning and construction principle of a programmable system for controlling the TV programs transmission. The TV transmission scanning is programmed and brought up to date by the operator (user). The TV scanning transmission has as purpose the functioning state's establishing of the communication system for television. Thus can be known any moment what TV channels are in normal functioning parameters. The measuring and scanning process takes place on the basis of a scanning process introduced in the system's memory. The information concerning the TV signal level, the video and audio signal can be displayed on a LCD screen, or stocked in the system's memory. The proposed system is useful in the situations of TV cable programs' transmission for monitor sing the transmission in a view to intervention. Also, the system can be used in the terrestrial television for establishing the quality of the TV program reception in different points in the covered area.

Keywords: TV scanner system, TV transmission management, system with microprocessor.

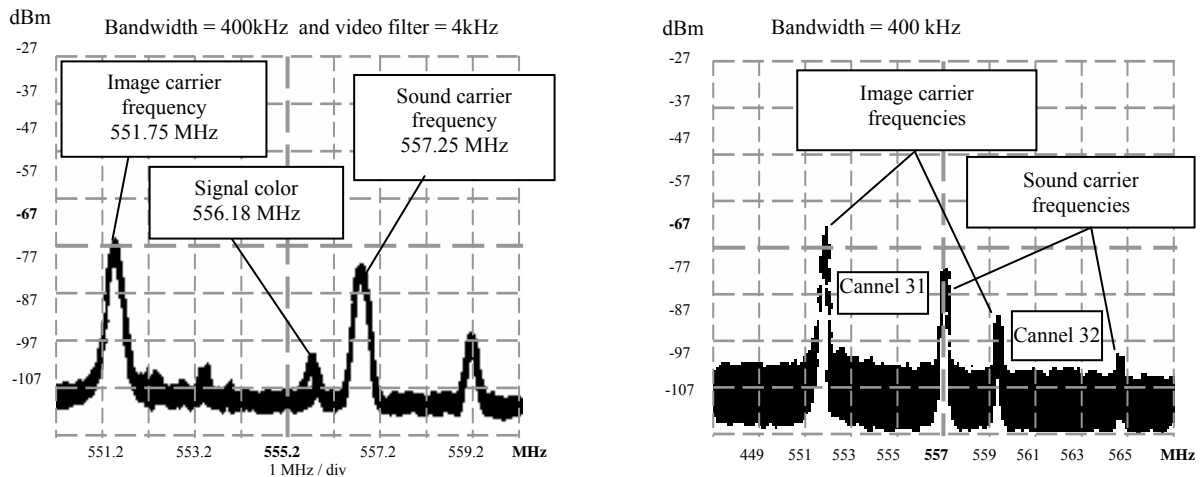
1. INTRODUCTION

The management of the TV program transmission through ground television systems or TV cable systems is a constant preoccupation of the radiobroadcast. The quality of the TV program reception depends on the level of the TV signals, which is transmitted in the radio communication channel and on the level of the signal, which arrives to the users. The video signal corresponding to the TV image occupies a frequency band with the length of $4.5 \div 6.4$ MHz. Simultaneously with the video signals transmission are transmitted corresponding audio signals. The video and audio signals are multiplications in frequency and form together the radio frequency signal corresponding to the TV channel. The frequency band of the TV channel contains two carrying frequencies, one for the image and other for sound, presented in fig. 1. The carrying frequencies are willing at a frequency interval of 5.5 or 6.5 MHz depending on the TV system. The colour information is transmitted using a radio frequency signal with standard value named the colour carrier. The colour carrier frequency is situated on the superior part of the TV channel's radio frequency spectrum.

The TV signal is a complex one with a bandwidth of 7 or 8 MHz and contains modulated signals in amplitude, in frequency, in phase and signals for date

transmission. The modulated signal in amplitude contains information about image luminance, synchronization signals and blanking signals. The modulated signal in frequency contains sound information. The modulated signal in phase contains colour information of the TV image.

The transmission of the TV signal is made through atmosphere using the radio waves or through cable (coaxial or glass fibers). The transmission medium influences the TV signal quality disturbing the contained information. To ensure a good quality of the TV signals reception it is necessary to respect the regulations in domain which establish the signal's level both to the exit of the transmitter and to the entering of the TV receiver [1].



a) The RF spectral components of the 31 TV channel from the UHF band, nr. IV.

b) RF spectrum for two adjoining channels. TV channels 31 and 32 from the UHF band, nr. IV

Fig. 1. Electromagnetic field spectrums for the TV channels of the terrestrial television.

In the TV cable television systems, the power of the transmitted signal depends on the value of the TV signal intensity and the impedance of the link cable, according to the relation:

$$P = \frac{U^2}{Z_c} [W] \quad (1)$$

where: Z_c – cable's impedance. For the coaxial cable Z_c the value is 75Ω .

In the measuring process of the TV signal's level is used as measure the dB, defined by the relation:

$$dB = 10 \cdot \log_{10} \frac{P_2}{P_1} \quad (2)$$

where: P_1 - the power considered the reference power. For small levels of the signals is used as reference power 1mV; P_2 - the power of the measured signal.

The signal's level can be expressed in dBmV according to the relation:

$$dBmV = 20 \cdot \log_{10} \frac{U_2}{10^{-3}} \quad (3)$$

As a conclusion, for an increase of 3dB of the signal level, it correspond a double power of this. The propagate medium of the RF signals, the atmosphere or the TV cable, influence the TV signal parameters, which arrives to the receiver introducing attenuation and distortion. The attenuation introduced by the propagated medium depends on the length of the channel and of the frequency of the carrier signal.

The automatic control system of the AGC amplification (*Automatic Gain Control*), used in transmitters and receivers, contributes to the control of signals' linearity, from the radio communication channel. The noise is the main cause for the deterioration of the reception quality. The noise has a very large frequency spectrum; it overlaps the useful signal, introducing distortion [2]. The signal-noise-ratio represents important parameters in the estimating transmission quality in the communication channel.

The transmission of the luminance information and of the blanking-synchronization signals is made through modulation in amplitude of the image carrier radio frequency signal. In the PAL, SECAM, NTSC television systems, the horizontal synchronization impulses correspond to the higher level of the carrier. The modulation grade of the image carrier in time of the TV signals transmission leads to the diminution of the received video and audio information quality.

2. THE SYSTEMS DESCRIPTION

The programmable scanning system is formed with specialized integrated circuits and enables the settled control of the TV programs transmission, the recording of some functional parameters and the signalize of the damage situations (transmission trouble). The noticing can be made optic or acoustic, is accompanied by the display of the TV signals parameters and takes place in situations when the video or audio signal is missing, or the TV signal level diminishes under the right limit.

The machine is formed of two constructive parts (see fig. 3): the reception and demodulation TV unit and the control and signalize unit. The reception and TV demodulation unit is connected to the TV communication channel; it offers signals to the control and signalize unit and to the TV screen. The control and signalize unit commands through I2C interface, the channels selector and processes the signals received from the TV modulator. The control of scanning is ensured by a microcontroller, which can be programmed straight on the application board.

2.1 The reception and demodulation TV unit

The reception and demodulation unit of the TV signals is formed of 2 modules with specialized integrated circuits for the TV receivers. The first module is the channels selector, which has I2C interface for working with the microcontroller. The selector contains entrance filters, the TSA-5522 frequency synthesizer and the TDA-5630 mixer. These circuits form the UV-916 TV tuner. Details about these circuits can be found in the producer's catalogue. The TV tuner presents the following main control pines: SCL (*Serial Clock Line*)-clock signal of the I2C interface, SDA (*Serial Data Line*)- dates line of the I2C interface, AS (*Address Select*)- the selection pine of the internal address of the TV tuner, U_{tuning} (+33V) - adjustment intensity of the

tuning frequency on the TV channel. The TV demodulator module is made with the TDA-9800 integrated circuit, produced by Philips brand. This circuit implies the intermediate frequency amplifier, the video demodulator, the audio demodulator and AGC - the automatic gain control. The TDA-9800 circuit ensures a linear demodulation with minimal distortion [3].

The automatic gain control circuit supplies to the AGC pin a tension whose value gives information concerning the RF signal level from the antenna entrance of the channels selector.

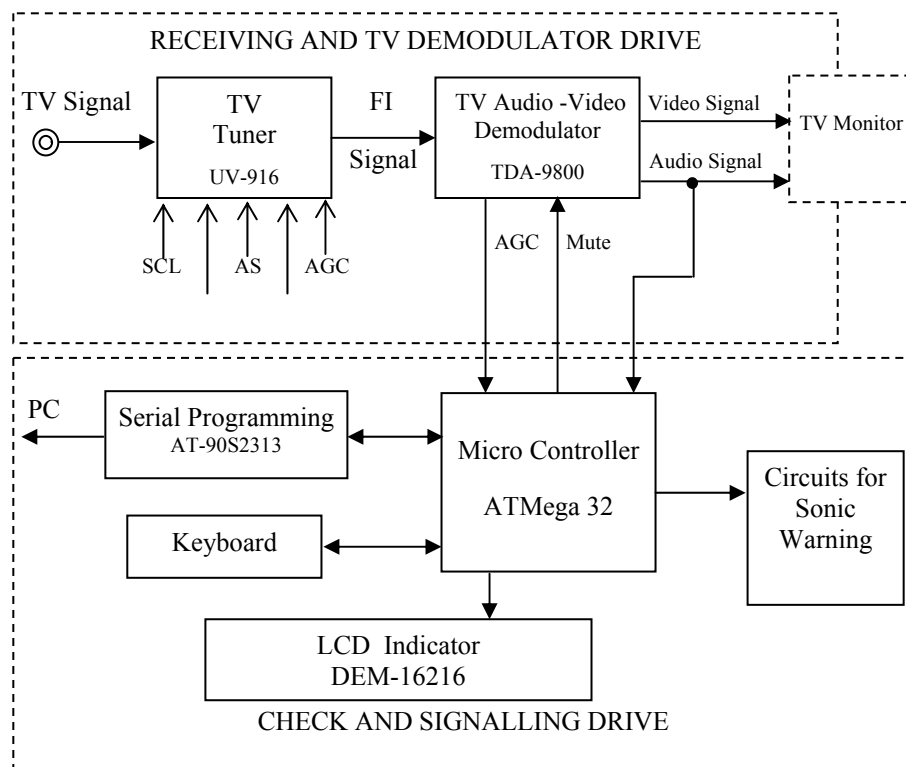


Fig. 3. Block diagram the programmable system for controlling TV programs transmission

The TV demodulator circuit made with TDA-9800 has an automatic control exit of the frequency through which is controlled the continuous agreement of the channels selector. This facility ensures a maximum level of the video signal at the exit of the TV demodulator. Details about construction and connecting are presented in the producer's circuits' catalogue [3, 4].

Between the channels selector and the TV demodulator is connected a filter for the forming of the intermediate frequency asymmetrical feature. The exit video signal with the 2V_v level and the exit audio signal with the 350 mV are applied to a video screen for the audio-visual control of the quality reception.

2.2 The control and signalize unit

The control and signalize unit is the main part of the control programming system and fulfils the next functions: stocks in memory the scanning program and the achieved dates; enables the up to dating the scanning program; measures the video ad

audio signal for the controlled TV channels; displays the parameters of the measured signals; signalizes visual and audited the detecting of the reception errors; ensures the display on the TV screen of the audio and video information for the programmed TV channels.

The control and signalized unit has as main electronic circuit the ATmega 32 microcontroller and is formed of the following functioning modules: the microcontroller module, the programming module, the signalize module and the LCD indicator module (display module). The technical features of the ATmega 32 microcontroller can be finding in the documentation offered by the producer [4].

The non-volatile Flash Memory of the microcontroller can be programmed through the serial SPI interface, using an external programmer. The microcontroller has an EEPROM memory for stocking the information concerning the TV channel frequency and it's naming. The microcontroller's ports have the Read-Modify-Write function, when these are used as input/output ports (I/O). The ADC (*Analog Digital Converter*) integrated in the microcontroller has a resolution of 10 bits and a precision of ± 2 LSB.

The I2C interface is used in the communication with the channel selector for changing its agreement frequency on the scheduled TV program. The I2C interface has two bi-directional lines, one for (SCL) clock signals and other for dates (SDA). The address packs from the I2C interface have 9 bits, one bit for read/write, 7 bits of address and one bit of Acknowledge. The data packets transmitted on the data highway have 9 bits, 8 bits of data and one bit of Acknowledge.

2.3 Functioning principles

The TV signal is applied to the TV terminal of the channel selector's entrance from the scanning system construction. The selection of the frequency band and have the local oscillator's frequency for the channel selector's agreement is made with the help of the I2C interface, by the programming and control unit's microcomputer. The selection of the TV channel through the scanning program is made by the digital command of the TSA-5522 frequency synthesizer circuit from the channel selector composing. The frequency synthesizer has in its internal structure a PLL lock connected to the local oscillator of the channel selector. The frequency synthesizer contains a referential programmable divisor. The referential divisor's rate can be of 512, 640 or 1024 ad is programmed through the I2C interface. Through the I2C interface is programmed the frequency band corresponding to the channel ad the tuning intensity value for the agreement on the TV channel.

For determining the radio frequency signal level of each TV channel, is necessarily that the channel selector amplification to be constant. That's why the tension on the AGC pine has to be constant, 0.3V for minimal amplification ad 4V for maximum amplification (36dB). To the U_{tuning} pine must be applied a constant tension of +33V, used as regulating tension of the agreement frequency on the TV channel.

The intermediate frequency signal FI from the TV tuner output is applied to the TV demodulator for obtaining the TV video and audio signals and of the automatic

regulating intensity of the amplifier. For determining the existence of the audio signal, the audio signal output is connected through a rectifier to the input of the ADC (*Analog Digital Converter*) from the microcontroller's structure. The ADC is on 10 bits and has a resolution of 0.01V. As a result of the calculation, for the 350mV audio signal level it will be followed the existence of an audio signal higher than 10 mV, for confirming the existence of an audio signal on the scanned program.

For determining the existence of a video signal and its level is used the automatic gain control intensity of the amplifier from the output of the TDA-9800 integrated circuit. For measuring the AGC intensity value is used the ADC integrated in the microcontroller. The maximum value of the AGC intensity is of 4V and is obtained on the maximum level of the intermediate frequency signal. The "mute" function of the TV demodulator can be activated by using an I/O port of the microcontroller.

In case of is detected a broadcast error (lack of image or sound), the lightning signalize circuits and/or sonorous gets into functioning through a command from the microcontroller. The scheme of the microcontroller's connection with the other devices is presented in fig. 4. The microcontroller's clock signal can be obtained with a quartz crystal with a frequency of 4 MHz.

The scanning system of the TV program needs own source of alimentation from the 220V alternative electric power web. The alimentation source must supply to the necessary power of the tension of 38V, 12V and 5V for the alimentation of the machine's circuits. The source can be formed with the transformer, the straighter, capacity filter and stabilization intensity or with specialized integrated circuits.

3. CONCLUSIONS

The television channels scanning system is a complex device, projected with the specialized integrated circuits and programmable microcontroller on the application board. The device is useful in the measuring and control process of the cable TV signals transmission quality or through terrestrial radiocommunication channels or through satellite [5]. The system allows the successively rendering of some TV programs on a TV screen. If the transmission on a TV channel is not in normal parameters, it is generated a shiny and acoustic warning signals

The device's portable, the cost price, the programming and actualization of the scanning program facilities made useful in practical control applications and measuring the level of the TV signals, transmitted through different frequency bands and reception TV channels in different points of the covering area with TV signals.

4. REFERENCES

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