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ALMATY
UNIVERSITY OF POWER ENGINEERING
AND
TELECOMMUNICATION

Department of "Computer and infocommunication security"

PRINCIPLES OF VIDEOIMAGE PROCESSING

The methodical instructions to laboratory works
for English class students of the specialty
5B071900 – Radio engineering, electronics and telecommunication.

Almaty 2016

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The methodical instructions contain descriptions for laboratory works, methods of experimental data conducting and processing, literature and question reviews. In the execution of all works have 15 hours of classroom lessons.

Illustrations - 9, tables - 2, Bibliogr. - 3 neim.

Reviewer: candidate of technical Sciences, Professor A. Z. Aytmagambetov

Introduction. General description of the laboratory unit UTC-2010

The unit UTC-2010 includes: desk, table, oscilloscope, coaxial cable set of CP-50, remote control DVD - player, remote monitor, surge protector, PC system unit, keyboard, mouse. The front panel has three unit. The left panel has a switch inputs, DVD-player, generator test signals and switch "Power".

Switch input source contains the video camera power connector for video camera, a connector for an external video source, switch to "Camera / external", the video output connector.

DVD-player for video playback with DVD-ROM drive, and is in the installation source composite (slot TTVS) and component (slots R / Cr, G / Y, B / Cb) video, also has outputs of line (slot CC) and frame (slots KC) synchronization (upper slots). Switching between formats of (RGB and Y_Cb_Cr) video signaling components is carried out using the remote control to the settings menu DVD-Player.

Most labs use the RGB format, so when you first start the installation, make sure that the player is transferred in this mode. To do this, connect the TTVS of DVD-player to the input of the monitor and TTVS tumbler "TTVS / RGB» translate a video monitor in TTVS mode. Navigate to the player and select the desired format.

Test signal generator (TSG) generates 10 test images options. TSG is a composite source (slot TTVS) and component (slot R / Cr, G / Y, B / Cb) video, also has outputs of line (slot CC) and frame (slot KC) synchronization (bottom slots). Switching between formats of (RGB and Y_Cb_Cr) video signaling components is carried out by the button «RGB / Y_Cb_Cr» located on the panel of the TSG. With this version of the software TSG installation generates TTVS only PAL.

"Power" toggle is designed to turn on/off the unit. Attention! Switching on the unit should be before the PC system unit and switch off after the PC is turned off. Otherwise, this can lead to errors in the installation, and the loss of expansion Windows desktop settings when using this mode.

The middle panel of the installation is a display for demonstration of the lab with the scheme and the auxiliary unit (for example: an oscilloscope unit for line selection). To start the lab, go to TV2 _ **** exe, using the shortcut on the desktop. Select the desired job in the menu that appears. On the left, right and bottom of the display are slots for supplying signals from various sources on the investigated scheme or removing the signals on measuring instruments (oscilloscope). Slots, used in the work, signed by or have suitable tires from the test circuit indicating the input or output of the slots.

Attention! Do not connect any signal sources to the slot, if it works on the output. Five knobs, located below the display, are used to change various parameters of the circuit (for example, the gain of the amplifier) or settings of the auxiliary units (for example, the line number in the oscilloscope unit).

Switching between the composite ("TTVS" jack) and component (nests «R», «G», «B») video signals carried by tumbler "TTVS / RGB». In order to use as a computer with two monitors in the expansion mode, the Windows desktop translates a video monitor in "PC" mode. The "TV" mode, the video monitor works as a receiver of TV signals. At the rear of the rack is RF input for connecting the antenna cable.

Attention! Some models of video monitors in the "external" mode + "RGB" are not synchronized from an RGB component signal and require feed on socket "TTVS" signal containing sinhromix. Therefore, in some labs for this purpose provided socket "sync.". If the monitor does not sync, connect the "Sync." to the input of the "TTVS" monitor.

1 Laboratory work № 1. Examination of PAL encoder

1.1Objective

Examine the principle of formation of TTVS in PAL format from the original RGB component signal. Secure the theoretical knowledge, to examine the waveform in the main control points PAL encoder, as well as to evaluate the effect of the delay of the luminance signal, the compression ratio of Kv-Ku, flash level of subcarrier for image formation.

1.2 Description of laboratory work

To perform the lab, you must run TV2_XXXX.exe program using a shortcut on the desktop. There appears labs selection menu (figure 1.1). By clicking on the button with the name of the work "Study PAL encoder" will open the scheme for the study (figure 1.2).

Figure 1.1 – Lab selection menu

1. 3 Homework

1.3.1 Learn the basic questions of the theme from the lecture notes and literature [1].

1.3.2 Prepare a report draft.

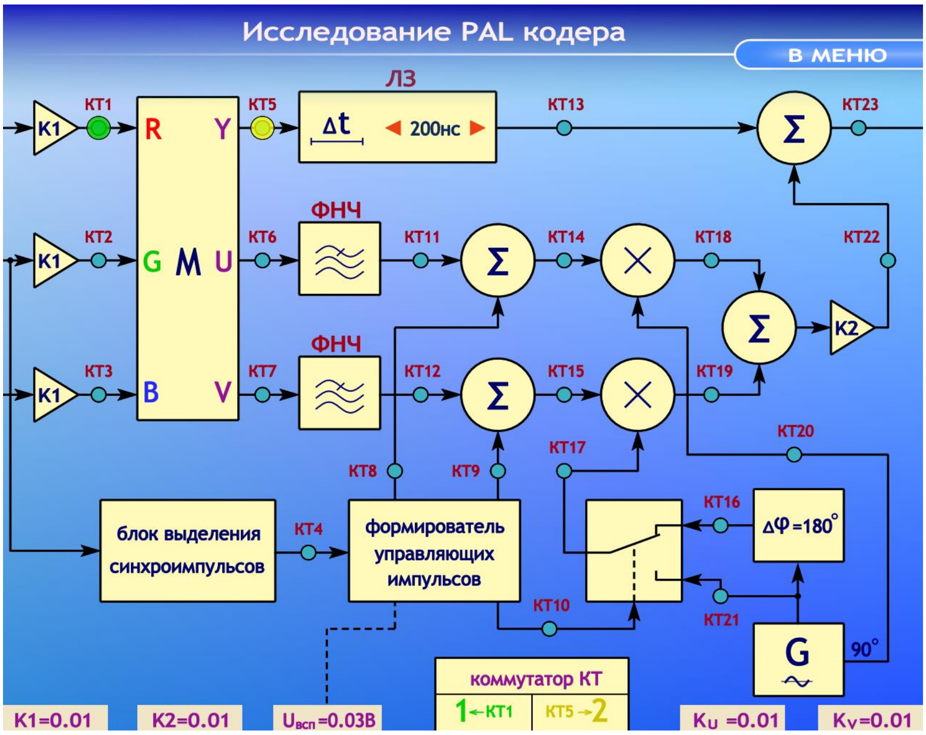

Figure 1.2 - PAL encoder Research

1.4 Laboratory reference

1.4.1 Preview the scheme for studying the PAL encoder.

1.4.2 Examine the waveform in the main control points.

1.4.3 Assess the impact of the values of the coefficients K1, K2, the delay of the luminance signal (Δt), the compression ratio Ku and Kv, flash level of subcarrier Uвсп on the image formation.

1.5 Procedure of work

1.5.1 Warning! Turning the power on during all laboratory work is possible only in the presence of a demonstrator.

1.5.2 Apply the video signal from the TSG with RGB outputs or DVD - player video to the RGB matrix inputs coding PAL encoder.

1.5.3 The output of PAL encoder (KT23) connect to the input of TTVS monitor. The monitor must be set to "external" mode by the button of "input selection" toggle in "TTVS" position.

1.5.4 Both channels of the oscilloscope connect to the output of KT switch.

1.5.5 For normal operation of PAL encoder control, set the following values with the help of knob:

- K1 – amplifier coefficient on a PAL encoder input. Used to set the operating signal level (white level of 700 mV);
- K2 - used to set the level of the chrominance signal. (The normal subcarrier level with K2 = 0.8);
- Uimp - Setting the level of flash impulse. (Average value 0.3V);
- Ku - signal compression ratio Cb. (Normal value 0.49);
- Kv - signal compression ratio Cr. (Normal value 0.88).

1.5.6 By using the monitor, make sure the correctness of the generated image. If the specified values of the picture settings are not synchronized or have poor quality, you must restart the program «PAL encoder Research".

1.5.7 Examine the waveform in the main control points.

1.5.8 By changing the values of K1, K2, (Δt), Ku, Kv, Uimp in large and smaller side of the nominal value, determine how these changes affect the formed image and how changing affects on the waveform at the contrjl points KT1, KT2, KT3, KT22, KT18, KT19, KT23 and KT8.

1.5.9 Remove the dependence of the signal parameter values at the control points:

- KT1, KT2, KT3, KT23 from K1 values;
- KT22, KT23 from K2;
- KT18, KT23 from Ku;
- KT19, KT23 from Kv;
- KT8, KT23 from Uimp.

1.5.10 Draw the graphs of signal parameter values at the control points to the values of K1,K2,Ku, Kv, Uimp.

1.6 The report must contain

1. The dimension tables and graphs of signal parameter values at the control points to the values of K1, K2, (Δt), Ku, Kv, Uimp.
2. Conclusions, reached by comparing the experimental data with the theoretical material.

1.7 Review Questions

1.7.1 What are the main advantages of balanced quadrature modulation (BM)?

1.7.2 What are the conditions of formation of signals in quadrature?

1.7.3 What is the phase relationship between the signals to be studied?

1.7.4 What are the conditions of balance in the BM?

1.7.5 What can cause an imbalance of BM?

1.7.6 What kind of picture distortion may occur in violation formation of chrominance signals in quadrature?

1.7.7 What is the differential-phase distortion of chroma signals, and how they appear on the image?

1.7.8 What is the difference-amplitude distortion and how they appear on the image?

1.7.9 What are the characteristics of the quadrature modulation chroma balanced signals in the encoder PAL?

1.7.10 What formation conditions burst signals in the encoder PAL?

1.7.11 Under what conditions the color subcarrier is suppressed in the encoder of PAL?

1.7.12 What are the reasons of selection of the color subcarrier frequency in the encoder of PAL?

2 Laboratory work № 2. Research of linear distortions of the TV-signal

2.1 Objektive

The objective of the lab work is to investigate the effect of linear distortion in the television video signal path on the shape and quality of the image.

2.2 Description of laboratory work

To perform the lab, you must run TV2_XXXX.exe program using a shortcut on the desktop. At the lab selection menu select “examine the linear distortions in the TV-signal”. Pressing the button will open circuit for the study (figure 2.1). Work allows us to examine the signal flow through the filters with a blockage and surge in low-frequency and high-frequency region.

Figure 2.1 - Examination of linear distortions of the TV-signal

2.3 Homework

2.3.1 Learn the basic questions of the topic from the lecture notes and literature [1].

2.3.2 Prepare the report draft.

2.4 Laboratory reference

2.4.1 Preview the scheme for the study of linear distortions of the TV signal.

2.4.2 To assess the effects of linear distortion in the television video signal path on the shape and quality of the image.

2.4.3 Investigate the signal flow through the filters with a blockage and a surge in low-frequency and high-frequency region.

2.5 Procedure of work

2.5.1 Apply a video signal from the output of TSG of TTVS, video camera or DVD – player to KT2.

2.5.2 Connect KT3 to the input of TTVS monitor. The monitor must be set to "external" mode by "input selection" in position "TTVS".

2.5.3 To observe the waveform of one line image, use the oscilloscope unit to "select 1-line" mode, output Y, or connect an oscilloscope to the output "unit of the oscilloscope."

2.5.4 Set the № of line by the guidance of demonstrator.

2.5.5 Switching between filters is produced by "up / down" buttons.

2.5.6 Following control knobs are used at work:

- R1 - to normalize the level of the signal when passing through the filters with the distortions of frequency response distortion in the low frequency;
- the area of LF - to adjust the crossover frequency/filter cutoff frequency with the distortions in LF;
- the area of HF - to adjust the crossover frequency / filter cutoff frequency with the distortions in the HF.

Other handles are used to control the oscilloscope unit.

2.5.6 At the output of TSG set the "Colored horizontal stripes."

2.5.7 Make sure you have dependence of the signal amplitude level at the output of the KT3 to the cutoff frequencies in the HF and LF with an oscilloscope and the image on the video monitor.

2.5.8 Set both switches in the up position. By changing the cutoff frequency in the low and high frequency fields, remove the dependence of the signal amplitude at the output of the KT3 to cutoff frequency. It is necessary to carry out a visual check on the video monitor and celebrate the values of the frequencies on which the image quality significantly deteriorates.

2.5.9 Set both switches to the lower position. Implement measurements according to p.2.5.8.

2.5.10 Install the left switch in the up position, and the right to the bottom position. Implement measurements according to p.2.5.8.

2.5.11 Set the right switch to the upper position, and the left in the lower position. Implement measurements according to p.2.5.8.

2.5.12 According to the results, build charts levels depending on magnitude of the signal from the filter cutoff frequency.

2.6 The report must contain

2.6.1 Measurement tables and graphs of levels depending on magnitude of the signal to the filter cutoff frequency.

2.6.2 Conclusions reached by comparing the experimental data with the theoretical material.

2.7 Review Questions

2.7.1 What kind of distortion will be at decline (rise) frequency response in the lower passband frequencies and how they appeared on TV image?

2.7.2 What determines the image sharpness in the horizontal direction?

2.7.3 What kind of distortion of the TV signal and the TV image will occur in decline (rise) amplitude-frequency characteristics in the high-pass path bandwidth?

3 Laboratory work № 3. The formation of primary color transmission signals

3.1 Objective

Preparation of the luminance and color difference signals from the RGB component signal using a coding matrix. Preparation RGB component signal from the luminance and color difference signals via decoding matrix.

3.2 Description of laboratory work

Run the program and choose the work "The formation of primary color transmission signals" from the menu.

Give a video signal from the TSG RGB output to RGB input circuit shown in the display (figure 3.1). RGB circuit output is connected to the monitor RGB inputs. The monitor mode is transferred to an "external" mode with key "input select" in "the RGB" position. Both channels of the oscilloscope connected to the output switch KT.

In this paper, use the following control knobs:

- α – coefficient of relative brightness of the primary color R;
- β - coefficient of relative brightness of the primary color G;
- γ - coefficient of relative brightness of the primary color B;

- K – coefficient of amplifiers in the input circuit. Used to set the operating signal level (white level of 700 mV).

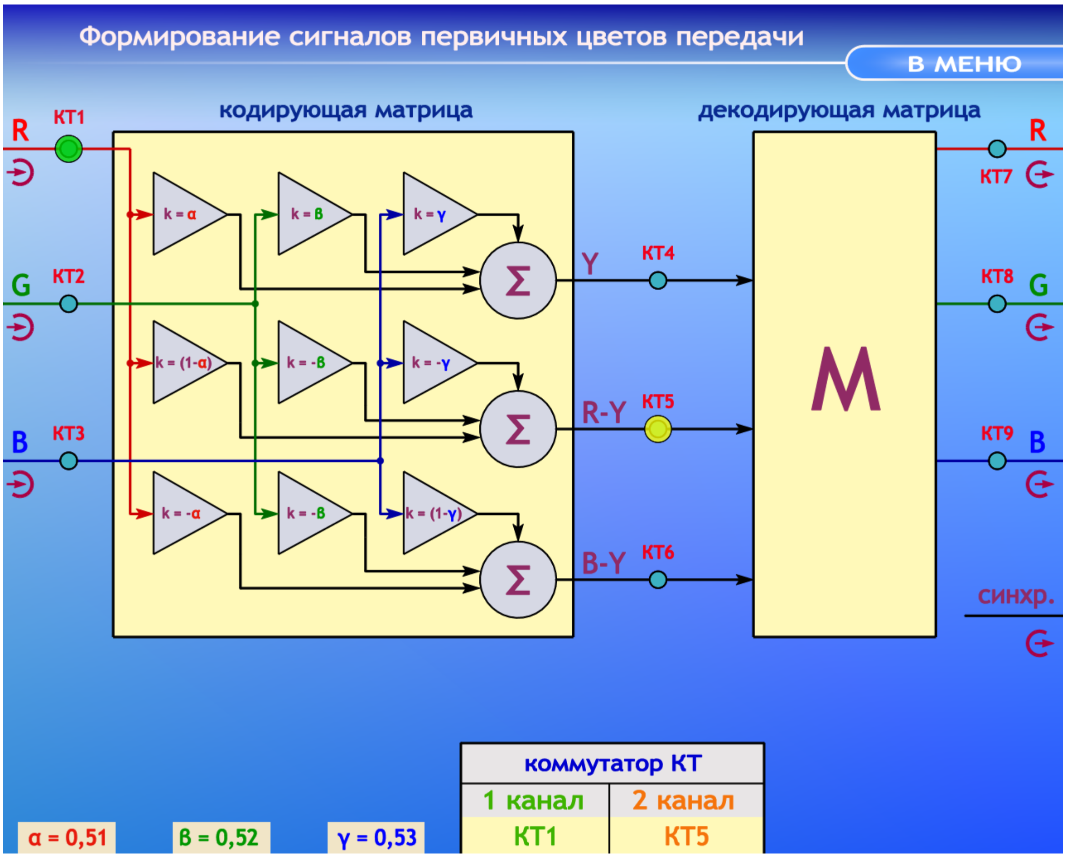

Figure 3.1 – Formation of the primary transmission signal colors

3.3 The order of performance

3.3.1 Align factors knob α, β, γ according to the formula of formation of luminance signal:

$$E_Y = 0{,}3E_R + 0{,}59E_G + 0{,}11E_B. \quad (3.1)$$

3.3.2 Sketch of an image and color bar signal waveform source of primary colors in the active line (KT-1,2,3 nest), comparing them over time (figure 3.2).

3.3.3 Sketch the waveform of the luminance signal -Y (KT4) in the same time scale with the previous. Make sure that it has a stepped form, when properly installed coefficients α, β, γ in accordance with the formula 3.1.

3.3.4 Calculate the brightness levels of signals on main and additional colors.

3.3.5 Measure Ey signal levels on the basic and additional colors. Compare the measurement results with the calculation. Sketch waveforms.

3.3.6 Sketch the waveform of color difference signals E_{R-Y}, E_{B-Y} (KT-5, KT-6).

3.3.7 Calculate the levels of the color difference signals and measure them on the basic and additional colors. Compare the measurement results with the calculation.

3.3.8 View waveforms of primary colors at the output of the decoding matrix, is recovered from the transmitted luminance and chrominance signals - R, G, B. Make sure that the shape of the recovered signals (KT-7,8, 9) corresponds to the shape of the original signals of primary colors R, G, B. (KT-1,2,3)

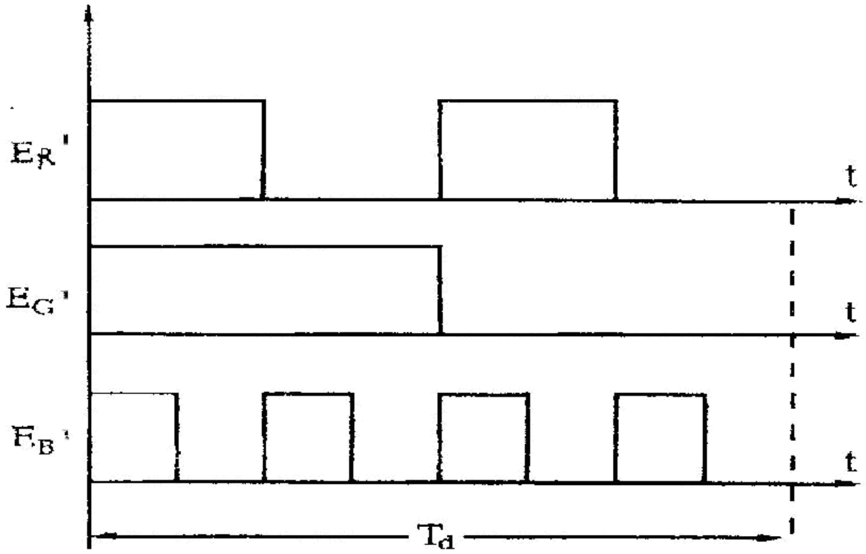

Figure 3.2 - Waveforms of signals

3.3.9 In the menu select the work "Formation of signals of primary color reproduction (part 2)" scheme decoding matrix explains the color difference signal recovery mechanism of G-Y (figure 3.3), by subtracting the mixture transferred to the color difference signals R-Y and B-Y from the luminance -Y signal.

3.3.10 For proper formation of G-Y need to calculate the coefficients $k = \alpha/\beta$ $k = \gamma/\beta$ i and mix them in accordance with the formula 3.2:

$$E_{G-Y} = -\alpha/\beta\,(E_{R-Y}) - \gamma/\beta\,(E_{B-Y}). \qquad (3.2)$$

3.3.11 View the form G-Y signal at the output of the adder color difference signals (KT9).

3.3.12 Compare the form received in the nests of KT-10, 11, 12 with the shape of the original signals of primary colors in the KT-1, 2, 3 nests:

$$E_{R-Y} + E_Y = E_R;$$

$$E_{G-Y} + E_Y = E_G; \qquad (3.3)$$

$$E_{B-Y} + E_Y = E_B.$$

3.3.13 Disable alternating signals of primary colors from the input terminals R, G, B video monitor. Explain how the image is displayed on the screen in each of the cases and why? Justification of the resulting images result in a report.

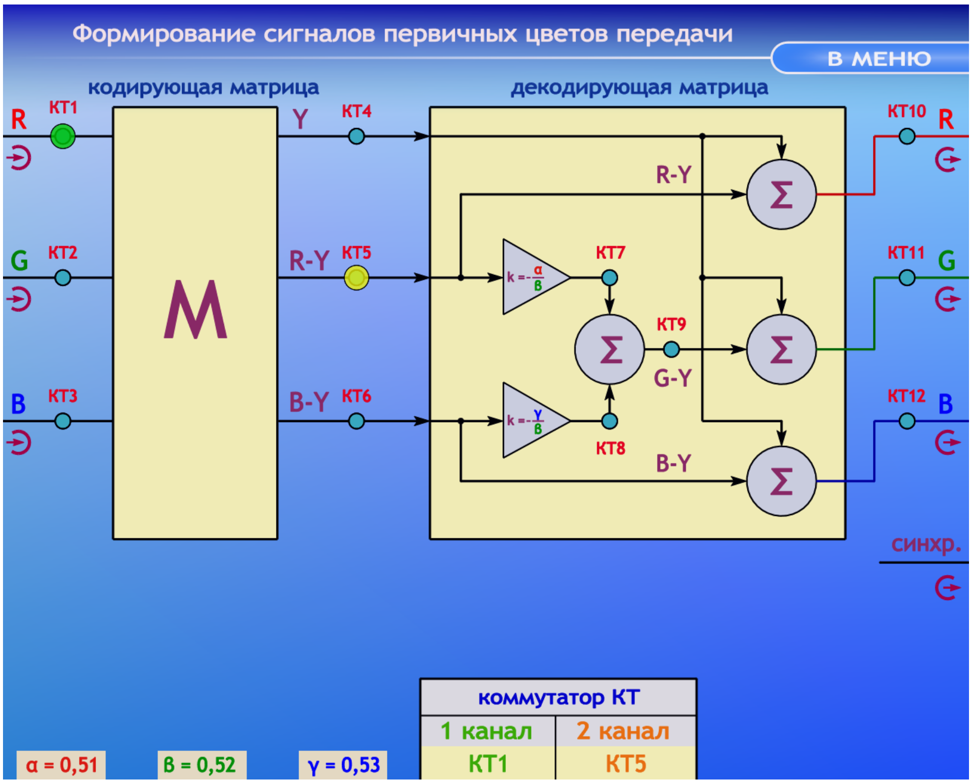

Figure 3.3 – Formation of the primary transmission signal colors

3.4 The report must contain

3.4.1 Test pictures of colored stripes.

3.4.2 Waveforms of all signals in the active part of the line, in the same time scale agreed with the image of the color bars on the screen TSVKU.

3.4.3 The results of the calculations. Necessary clarification. Conclusions.

3.5 Checklist

3.5.1 Write down the equation E_Y formation of the luminance signal in the broadcast TV color system.

3.5.2 Why can the chrominance signal transmission in abbreviated in comparison with the brightness signal bandwidth?

3.5.3 Draw a diagram of the matrix E_{R-Y} color difference signal in the three resistances.

3.5.4 What components included in the E_{R-Y} color-difference signal?

3.5.5 What is the eye characteristic determined by the coefficients of the components of the luminance signal in a color television?

3.5.6 Draw a diagram of the color difference signal matrix E_{B-Y} in the three resistances.

3.5.7 What are the components included in the color difference signal E_{B-Y}?

3.5.8 What are the color difference signals are transmitted in the broadcast TV color system?

3.5.9 Draw a diagram of the matrix E_Y luminance signal four resistors.

3.5.10 As the color difference signal formed E_{G-Y} in the television receiver?

3.5.11 What are the main features of the color difference signals?

3.5.12 What are the receive signals of primary colors when playing yellow 100% saturation?

3.5.13 What signals are part of TTVS?

3.5.14 What is the amplitude of the color difference signals in the transmission of black-and-white scenes?

4 Laboratory work №4. The study of brightness and contrast distortion

4.1 Objective

To study the method of adjusting the brightness and contrast of images and methods of correction of distortion.

4.2 Description of laboratory work

To perform the operation, run the program and choose the work "The study of distortion brightness and contrast" in the menu.

Give a video signal of colored vertical stripes from the RGB TSG output to the RGB inputs of the circuit shown in the display (figure 4.1). RGB circuit output is connected to the monitor RGB inputs. The monitor shall be transferred to the regime of "external" key "input select" switch in "the RGB" position. Both channels of the oscilloscope connected to the output switch KT.

The signal from the source passing through the amplifier with adjustable amplification factor is applied to the source of the distortion and the switch. The source of distortion signal gets distorted contrast (buttons 1 and 2), brightness (buttons 3 and 4), the brightness and contrast (button 5) passes without any distortion (button 6) and goes to the unit adjusting brightness and contrast.

On the switch receives two signals: a distorted, and then revised and the original signal. The switch has 3 operating modes, which are set buttons on the switch control unit. In one mode, the monitor screen shows the original image, mode 2, and the corrected image is distorted, in mode 3 on the upper half of the screen - starting at the bottom - a distorted and corrected.

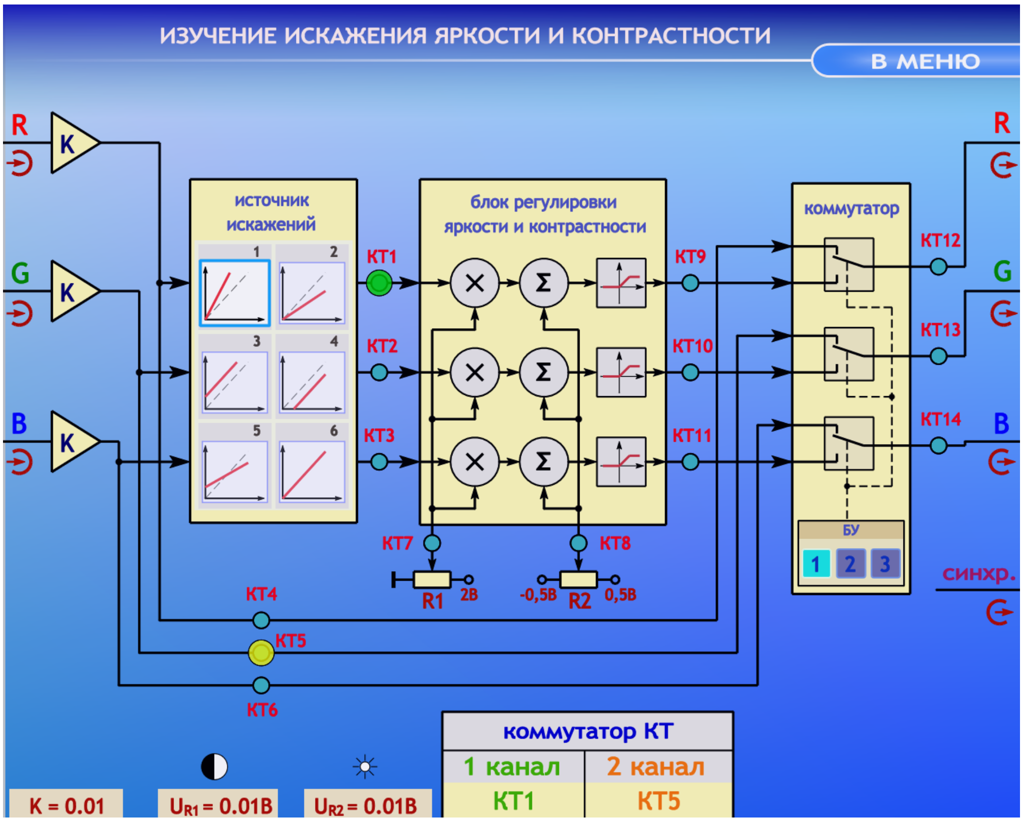

Figure 4.1 – Study of the distortion of brightness and contrast

If after receiving the distortion signal level is higher or lower 1B black level (0 V), it undergoes a limitation, however, in some cases the source control signal is not possible to receive. This is especially noticeable in the form №4 distortion. In this paper, the following knobs:

- K - coefficient of amplifiers at the input circuit. Used to set the operating signal level (white level of 700 mV);
- Ur1 - voltage adjustable potentiometer R1. It used to adjust the contrast;
- Ur2 - voltage adjustable potentiometer R2. It used to adjust the brightness.

4.3 Procedure of work

4.3.1 Select switch on the CU 2 mode.

4.3.2 Measure the amplitude of Er and sketch the waveform in KT1 nest signal for various values of the contrast of the image by toggling the button 1.2. Track changes while the image on the monitor screen.

4.3.3 Measure the amplitude Eg and sketch the waveform in the nest KT2 signal for various values of the image brightness by switching the button 3.4. Track changes while the image on the monitor screen.

4.3.4 Measure the amplitude of the signal Eb and sketch the waveform in KT3 nest when choosing 5 characteristics, allows you to adjust both the brightness and contrast of the image. Use the mouse to select the characteristic 6 without distortion and also to measure the amplitude of the signal, record it for the record.

4.3.5 Select switch on the CU 3 mode. In this mode, a frame is divided into two halves - the top of the undistorted, the bottom of the corrected image.

4.3.6 Measure and compare the amplitude of the signal Er in the sockets KT1 KT9 And, to achieve their equality with dial UR1 contrast, fix the value for the report.

4.3.7 Compare the UWC screen top and bottom of the screen, to evaluate the extent of their identity.

4.3.8 Measure and compare the signal amplitude Eg in the nests and KT2 KT10, to achieve their equality through the UR2 dimmer, fix the value for the report.

4.3.9 Compare the UWC screen top and bottom of the screen, to evaluate the extent of their identity.

4.3.10 Measure and compare the EB signal amplitude in the nests of KT3 and KT11, ensure they are tracking the correspondence to the video monitor screen. Measurement and comparative analysis of lead in the statement. Draw conclusions.

4.4 The report must contain

4.4.1 Block diagram of the laboratory work.

4.4.2 Parameters and waveforms of the signals with an explanation of their features.

4.5 Review Questions

4.5.1 Specify the causes of the luminance signal distortion in the lower frequencies of the spectrum.

4.5.2 Specify the causes linear distortion of high-frequency components of the luminance signal in the amplification path.

4.5.3 Indicate the methods of the luminance signal distortion correction in low and high frequency spectrum.

5 Laboratory work №5. Analog-to-digital conversion of TV signals

5.1 Objective

To study the influence of quantization effects and sampling on the TTVS distortion and image quality of the TV signal.

5.2 Descriptions of laboratory work

Run the program and select paper "Analog-to-Digital conversion of TV signals" from the menu.

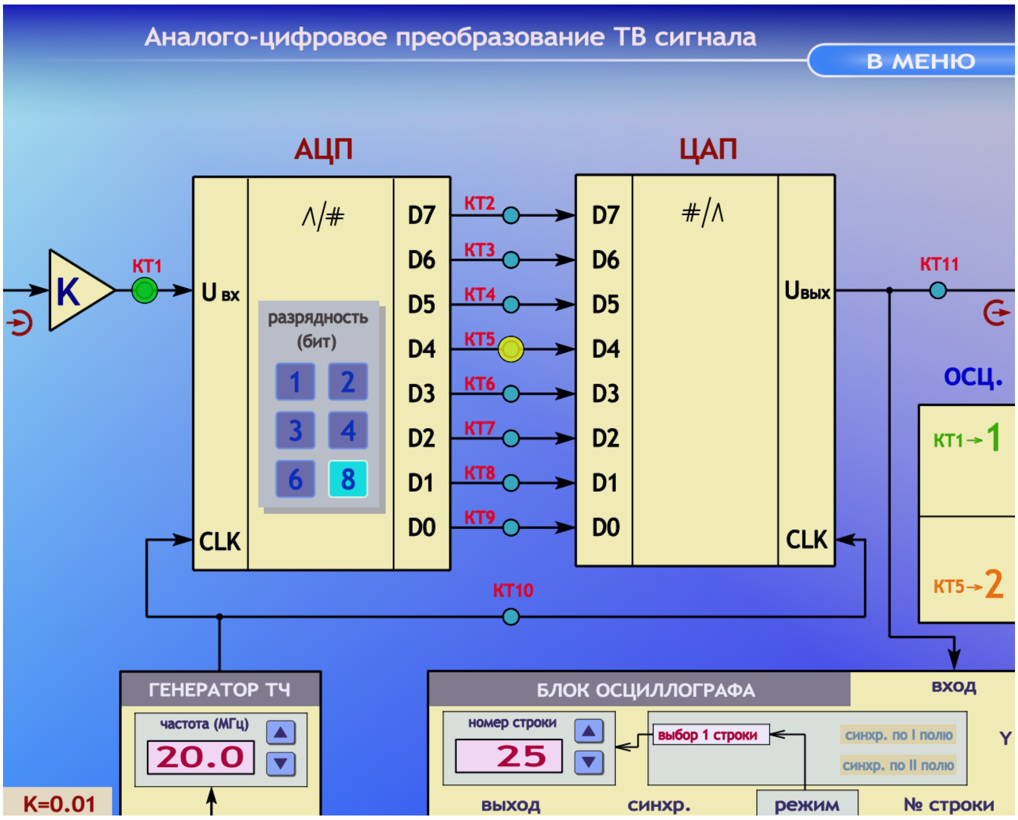

Figure 5.1 - Analog-to-digital conversion of the TV signal

The Work carried out by using the luminance signal, so the switch TSG and DVD-player in the «Y_Cb_Cr» format. Serve with exit «G / Y» TSG video black / white vertical stripes to the ADC input. DAC output is connected to the input PTSTVS monitor. The monitor must be set to "external" key "input selection" mode switch in position "PTSTVS". Channel oscilloscope, connect to the output of the switch CT. Sampling and quantization of the video signal is carried out by means of the ADC. Besides ADC counts obtained encodes a binary code, so there is the DAC for conversion of digital counts back to analog form. ADC, buttons installed determines the quantization step. Clocking ADC and DAC is provided by a generator. PM generator pulse frequency is the frequency of the sampled signal. In this paper, the following knobs:

- K - factor of the amplifier to the ADC input. Used to set the operating signal level (white level of 700 mV).

Other handles are used to control the oscilloscope unit.

5.3 Procedure of work

5.3.1 Align the amplifier to the ADC coefficient K = 0,7 input.

5.3.2 Give a signal "black / white vertical stripes" to the TSG ADC input

5.3.3 Changing bit quantization from 1 to 8, sketch a waveform corresponding to each category of quantization KT11 socket, monitor at the same time changing the number of vertical bands played on a video screen.

5.3.4 Explore image quality dependent on the sampling frequency of the signal by changing the PM generator frequency corresponding knob on the front panel of the stand.

5.3.5 Rate the quality of the image on the monitor screen at 3 different values of the PM generator frequency (appropriate and inappropriate conditions of the theorem Nyquist: less than equal to and greater than 10 MHz (2fgr).).

5.3.6 Sketch for 3 waveform frequency values KT10 nest, calculate, putting an appropriate scale oscilloscope, filling HF frequency and compare the value obtained with the on-screen in the "PM generator."

5.3.7 Switch on the ADC input signal from your camera. Follow steps 5.3.3-5.3.5.

5.3.8 Switch on the ADC input signal with DVD-Player. Insert the disc with the test image "Portrait", "City", and "text" and apply them consistently to the processing unit of the laboratory setup:

-map "Portrait" comprises mainly large parts with a large number of low frequency halftone transitions;

-map "City" consists primarily of facilities overall plan;
-map "Text" contains small parts.

5.3.9 Evaluate the quality of test images on a 5-point scale, varying bit quantization bits and enter them in table 5.1 as depicted in the figure.

T a b l e 5.1 - The quality of test images

Test images	Bit quantization bits					
	1	2	3	4	6	8
B / W stripes						
Color stripes						
Camera						

5.3.10 Changing the PM generator frequency will also appreciate the quality of the test images on a 5-point scale, tracking changes on the monitor screen. Record the estimates in table 5.2 as set out below.

5.3.11 According to the results, draw the graph the dependency of quality evaluation (in points) to the value of the quantization step and the sample rate.

5.3.12 Draw conclusions about the impact of quantization bit depth and sample rate on the amount of information in an image. Explain the results.

5.4 The report must contain

5.4.1 The measured parameters of the TV system (bit quantization and sampling frequency) and waveform through experiments, and comparative analysis tables.

5.4.2 To draw conclusions on the result.

T a b l e 5.2 - The quality of test images

Test images	Sampling frequency (PM generator)		
	2MHz	10MHz	20MHz
B / W stripes			
Color stripes			
Camcorder			

5.5 Review Questions

5.5.1 What are the criterions for selecting the sampling frequency? Confirm your choice of the sampling frequency results of the experiment in their work.

5.5.2 Which of the sampling structures increasingly takes into account the characteristics of visual perception?

5.5.3 What is the number of quantization levels is provided, if the number of digits equal to 8? Is the eight-bit quantization corresponds to the modern requirements to the quality of the image?

5.5.4 Explain differences in the quality of images transmitted in accordance with the sampling format 4: 2: 2, 4: 2: 0, 4: 1: 1, 4: 4: 4.

5.5.5 Why do different images “suffer” differently from deepening the quantization scale?

6 Laboratory work № 6. The study of the basic principles of the formation of the composite signal and the measurement of its parameters

6.1 Objective

Explore the process of forming the image of the TTVS and clock signal.

6.2 Descriptions of laboratory work

Run the program and choose the work "The study of the basic principles of the formation of the composite signal and the measurement of its parameters" in the menu.

Connect the output TTVS (KT13) to the input of TTVS monitor. The monitor translate into "external" key "input selection" mode switch in position "TTVS". To monitor the signals at the control points using KT1 switch (figure 6.1). Use the oscilloscope unit to "select 1-line" mode to observe the waveform of one line of the image.

Work allows us to study the waveform in the main control points generator TTVS. It is possible to disable the pulse generator (a button "on" each generators) for a visual study of the formation of TTVS.

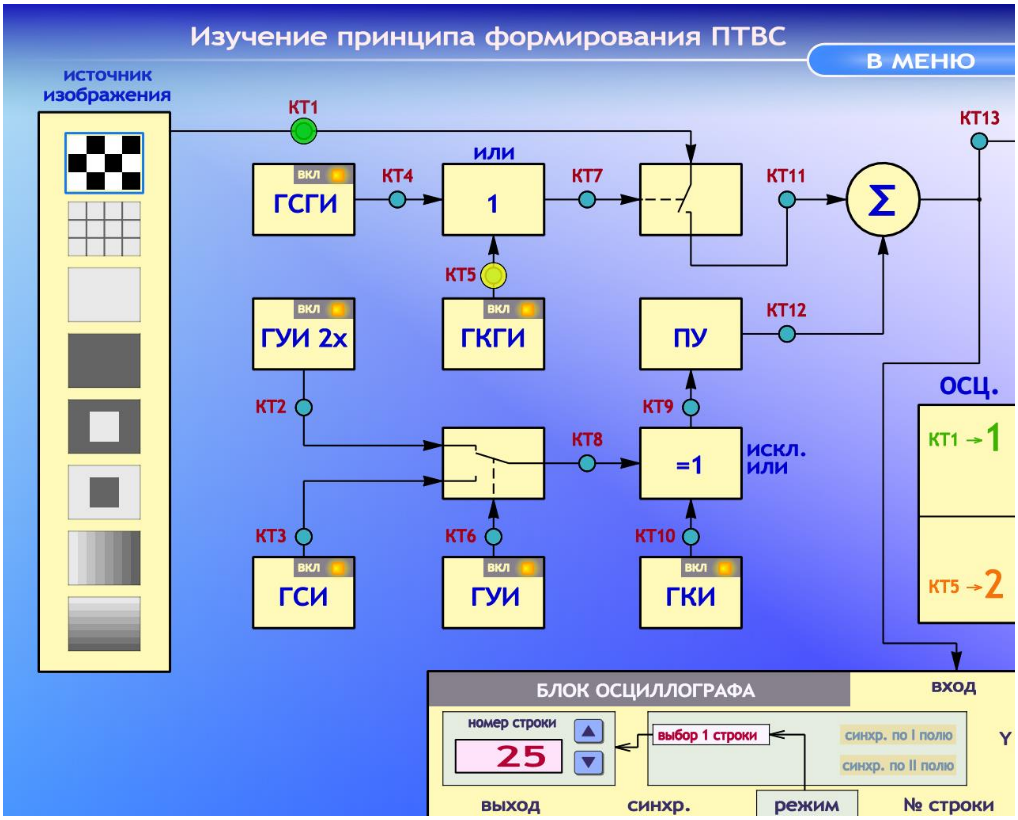

Figure 6.1 - Study of the principle of formation of TTVS

The pulse generator included in the generator circuit TTVS: GSGI - generator of horizontal blanking, gooey 2x - generator equalizing pulses at twice the horizontal frequency GKGI - Generator Blanking, GSI - generator of line pulses, SUI - generator equalizing pulses SCI - generator vertical pulses.

6.3 Procedure of work

6.3.1 Apply for an oscilloscope series signals:
- GSGI - generator of horizontal blanking (KT4);
- CIO - lowercase pulse generator (KT3);
- SUI - equalizing pulse generator (KT10);
- SCI - frame pulse generator (KT6).

Measure using an oscilloscope sweep, repetition frequency, the duration of these pulses, sketch the waveform in each of the cases (two or three of the test signal period).

6.3.2 Sequentially turning on and off click GSGI, ICG, gooey, the SPC to monitor changes occurring on the screen. On the basis of observations, draw conclusions about the appointment of pulses generated by these generators.

6.3.3 The study TTVS parameters and its components.

6.3.4 Secure to report TTVS waveform at the time of the oscilloscope sweep, fold the length of the line and the length of the field (two to three periods of the signals) in the TR. KT1 for different test signals supplied by the image source.

6.3.5 For a test signal "gradation wedge" (8 vertical strips brightness) measured with an oscilloscope (KT13) scope TTVS (B) and the ratio of its components range (%). Explain components TTVS.

6.3.6 Measure using an oscilloscope duration line clock pulse (mcs) KT3 and frame clock pulse (мкс) KT6 and calculate the value of the ratio:

$$Q = \tau_{ск} / \tau_{сс.} \qquad (6.1)$$

Explain why such a chosen value of the ratio.

6.3.7 Estimate:

6.3.8 The duration of active line:

$$T_{са} = T_с\,(1 — \alpha)\ (\text{mcs}); \qquad (6.2)$$

where $T = l / f_c = 1 / nz$ - horizontal period;

$\alpha = \tau_{гс} / T_c$;

$f_c = nz$ - frequency horizontal;

n - number of frames transmitted per second;

z - the normal number of lines decomposition.

6.3.9 The relative length Blanking:

$$\beta = \tau_{гк} / T_K, \qquad (6.3)$$

where $T_к = 1/ f_K = 1/2n$ — frame period (ms);

f_K — vertical frequency.

6.3.10 The number of active video lines of decomposition:

$$Z_a = z\,(\,l — \beta), \qquad (6.4)$$

where z = 625.

6.3.11 The number of expansion elements in the active part of the line:

$$N_{ca} = kz_a\,, \qquad (6.5)$$

where k = 4/3 frame format.

6.3.12 The number of elements in the active part of the frame:

$$N_{Ka} = Z_a * kz_a = kz^2_{a.} \qquad (6.6)$$

6.3.13 Duration luminance signal from one element (ns):

$$\tau_э = T_{ca}/N_{ca} \;. \qquad (6.7)$$

6.3.14 Upper cutoff frequency spectrum of the luminance signal which upper limit of the transmission path bandwidth luminance signal (MHz):

$$f_в = 1/2\tau_э \; = кz^2(1 - \beta)\, f_к/ 2\,(1- \alpha) \;. \qquad (6.8)$$

6.3.15 Compare the values of $N_{ка}$ = kz = 0,5 x 10^6 and with the upper boundary frequency bandwidth $f_в$ ~ 6 МГц. Draw conclusions.

6.4 The report must contain

6.4.1 Measuring time and amplitude ratios of TV system, waveform through experiments and calculations.

6.4.2 Conclusions.

6.5 Review Questions

6.5.1 Explain the purpose of all the elements and signals functional circuit TV system laboratory.

6.5.2 What is the Blanking? What happens to the image of the TV if the video monitor will not be filed or lowercase Blanking?

6.5.3 Explain why the options expansion which depend on the speed of scanning (number of rows, the number of frames per second, aspect ratio, etc.), determined band of TV signal transmission path bandwidth.

6.5.4 What are the advantages, disadvantages and features sweep compared to progressive? What TV system parameters are changed using the Interlace progressive instead?

Literature review

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Content

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PRINCIPLES OF VIDEOIMAGE PROCESSING

The methodical instructions to laboratory works
for English class students of the speciality
5B071900 – Radio engineering, electronics and telecommunications

Editor G. Nurzhaubaeva
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