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Features of the Estimation of the Compromising Emanations Level of a Modern Electronic Computer Videotract

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Abstract. *The paper shows the features of the estimation of the compromising emanations level of a modern electronic computer videotract. Particular attention is paid to describing the differences between analog and digital data transfer interface, as well as the structural characteristics of the respective signals. It is proved that there are no differences in the context of digital signal reception due to compromising emanations of the modern computer videotract by the optimal receiver of a technical intelligence device, which allows the application of appropriate techniques designed to receive an analog signal.*

Keywords: *compromising emanations, technical protection of information, information leakage, analog signal, digital signal, distant zone, optimal receiver.*

I. Introduction and Problem statement

Leakage of information due to compromising emanations occurs by an interception by receivers of technical reconnaissance of compromising electromagnetic fields, which are formed around electronic elements and conductors of computer equipment during the circulation of information signals in them and propagation of these fields outside the controlled area [1]. The most dangerous mode of the personal computer (PC) operation, in terms of information leakage, is the mode of the image playback on the monitor screen. The information signal in this case is an electric current that flows in the electrical circuits of the electronic computer videotract. Most likely, the role of random antennas in the compromising emanations is performed by conductors connecting the output of the digital-to-analog converter of the video adapter and the cable connecting the system unit to the monitor.

The need to protect the cable that connects the system unit to the monitor from the compromising emanations leakage was canceled in previous work [2], because due to the proper shielding of the cable, the compromising emanation level is significantly reduced and their protection is provided by the established controlled zone where the compromising emanation level of a signal will meet the protection standards. The issue of protection against information leakage at the expense of the compromising emanations in electronic circuits of the computer videotract remains open.

Since monitors based on cathode ray tubes (CRT) are being actively replaced by a new generation of liquid crystal monitors with discrete signals, it is advisable to analyze the features of the methodology of compromising emanations estimation based on previous studies [3]. The purpose of the work is the features of the estimation of the compromising emanations level of a modern electronic computer videotract.

II. Problem solution and Results

The transition to Video Graphics Array (VGA) and Digital Visual Interface (DVI) interfaces has significantly complicated the compromising emanations interception task. For typical monitors with a VGA interface, the signals from the video card are transmitted in analog form over a cable line. Intensity signals for each of the three primary colors - RGB (red, green, blue), as well as synchronization signals of horizontal and vertical scans, are used to transmit the image to the monitor. Composing the signals of compromising emanations of the channels in the space at the output of the receiver, it is possibly getting an informative signal that creates an image, such as text on the monitor screen. In the general case, such a signal is quite simple to decode by a reconnaissance device, even when the space emits a signal from only one of the RGB channels. At the same time, only information about the color of the displayed image or text is lost [4]. To date, almost all manufacturers of video cards and monitors have abandoned this interface, preferring digital one.

The Digital Video Interface (DVI) is designed to transmit video images to digital display devices, such as liquid crystal display (LCD) monitors. The successor to the DVI standard is the High Definition Multimedia Interface (HDMI) standard, which is compatible with DVI in terms of electrical characteristics and signal coding, but also with the ability to transmit digital audio. HDMI provides digital DVI connection of several digital devices using the appropriate cables. There is also a digital display interface Display Port (DP), developed by a consortium of personal computer and chip manufacturers and standardized by VESA - the Association of Video Electronics Standards. The interface is mainly used to connect a video source to a display device, such as a computer monitor, and can also transfer audio, USB and other forms of data. DisplayPort was designed to replace VGA and DVI. This is the first packet-based display interface widely used in technologies such as Ethernet, USB and PCI Express. It allows the use of internal and external display connections, and unlike outdated standards that transmit the tact signal separately, the DisplayPort protocol, based on small data packets known as micropackets, can embed the tact signal into the data stream. This allows you to get high resolution with fewer lines.

The monitor with CRT receives a continuous in time analog signal, the digital monitor receives a discrete signal in the form of a digital code. The analog signal is defined in continuous time (ie at any time moment), and digital is defined in discrete time (ie only at the selected time moment) [5]. In digital electronics, a digital signal is a sequence of electrical pulses of square shape with a fixed length, each of which can occupy one of the amplitude levels, which can be a discrete number. In fact, a digital signal transmits information by several

(preferably two) levels and by changing these levels, while an analog signal is more capacious because it carries information with each of its current values, roughly speaking, containing information in the signal length.

Unlike CRT monitors, where pixels are formed by a group of dots (triads) or stripes, images in digital LCD monitors are formed by pixels, the number of which depends only on the specific extension of the LCD panel. The step of the pixels depends only on the size of the pixels themselves, but not on the distance between them. Each pixel is formed individually, which provides excellent focus, clarity, and sharpness. The image is more cohesive and smoother. Color Depth, Bits per Pixel - is determined by the number of bits used to represent the color of one pixel of a bitmap image.

Structurally, an analog-to-digital converter (ADC) is used to transform an analog signal into a digital one, and a digital-to-analog converter (DAC) is used for inverse conversions. The analog-to-digital converter is designed to convert a voltage or current that is proportional to the value of the digital code to a number, usually defined as a binary code. In fact, it is a complex process that consists of two main stages, namely signal discretization, and quantization by the level. Signal discretization is the definition of the time intervals over which the signal is measured. The shorter these intervals, the more accurate the measurement. So, with quantization by level, the more quanta, the more accurate measurements [5].

As an example, figure 1 shows the conversion of an analog signal S(t) to digital form. The vertical axis is a digital 8-bit signal value and the horizontal is the time moment.

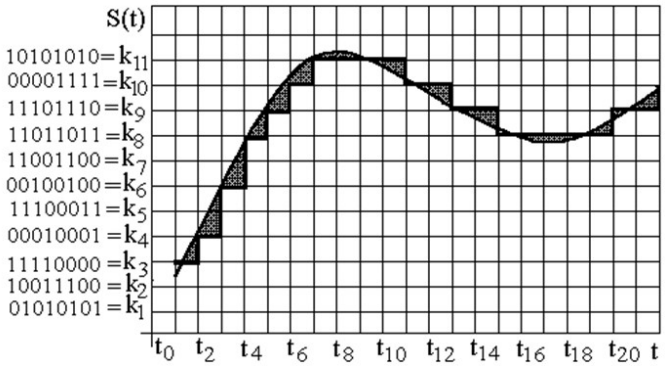

Figure 1. The conversion of an analog signal to digital form

The tasks of the theory of optimal signal reception are signal detection, signal distinction, evaluation of signal parameters, message filtering, signal resolution determination, and pattern recognition [6]. Optimal methods are understood as those that provide the best, in one sense or another, reception of signals against the background of interference. That is, the optimal receiver is a receiver that provides maximum noise immunity for given signals and given interference. Potential noise immunity – that limit of reception noise immunity for a given transmission method and a given interference level. The optimal receiver processes the signal at its input in the best way. It provides a large signal-to-noise ratio and a small error probability at the same time. Such a receiver is called a Kotelnikov receiver. The Kotelnikov receiver is also called coherent since you need to know all the parameters of the signal and when it was transmitted. In an ideal Kotelnikov receiver, the decision is made in favor of the signal for which the minimum root-mean-square deviation from the mixture of signal and noise arriving at the input or by calculating the correlation function, where the decision is made in favor of the signal in which the correlation function is more similar to the resulting one.

The result of the research is the expansion of knowledge about the properties and essence of discrete signals in comparison with analog signals, about the features of image formation on the screen of a liquid crystal monitor in comparison with a monitor on a cathode-ray tube, as well as deepening the methodology for conducting research on the reception of a discrete signal due to compromising emanations by the optimal receiver of a technical intelligence device. This will make it possible to effectively detect the informative component of the signal and recover confidential information from signals due to compromising emanations and will also allow developing processing algorithms with various known a priori parameters about the signal and interference.

III. CONCLUSIONS

Analysis of the main properties of signals contained in the compromising emanations the creation of a signal model and a communication channel makes it possible to synthesize algorithms for optimal reception by technical intelligence devices and to substantiate expediency of use on objects of information activity of these or those technical means of information protection.

Thus, in the course of work it was determined that the structure of discrete video signals in ADC and DAC is standard and their reception by means of a reconnaissance device in the far zone does not differ from reception of analog video signals.

Given that one or more lengths of each of the video pulses are standard, estimating the maximum signal-to-noise ratio on signal detection makes it possible to use the classical theory of optimal methods of signal reception with known parameters.

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