ETC M621
Digital Oscilloscope

User's Guide

Contents

ETC company would like to thank you for purchasing the M621 Digital Storage Oscilloscope. We believe it will meet your expectations. To keep you informed, please fill out the registration card, you have obtained with the shipment, or the registration form that can be found on the ETC website.

In case you need any assistance, please do no hesitate to contact us by mail, phone, fax or preferably by e-mail.

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Package Contents

Depending on the hardware version your shipment contains:

M621/I
- EM621/I internal module – 1 pc
- cable (EA600) for connecting the module to the computer – 1pc
- EA601 cable for extending the connection between the device and the parallel port –1 pc
- screws M3 – 4 pcs
- User's Guide
- CD-ROM, or set of diskettes containing the software

M621/A
- EM621/I internal module – 1 pc
- the EA 602 cable for connecting the device to the parallel port – 1 pc
- panel with connector and cable (EA 603) – 1pc
- screws M3 – 4 pcs
- User's Guide
- CD-ROM, or set of diskettes containing the software

M621/E
- EM621/E external module – 1pc
- standard 25 pin printer cable – 1 pc
- power adapter 16 V/0.3 A – 1pc
- User's Guide
- CD-ROM, or set of diskettes containing the software

Warranty conditions

The Limited Warranty set forth below is given by ETC Ltd. with respect to the M621 digital storage oscilloscope package excluding the SCOPE 621 software. This limited warranty is only effective upon presentation of the warranty card. This product is warranted against defective materials or workmanship for half a year (when the registration card is filled out and sent to ETC warranty period extends to one year), and is limited to repair, adjustment and/or replacement of the defective product. Within the warranty period ETC will repair or replace the product free of charge,

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Recommendations for the oscilloscope use.

Keeping the following rules you can avoid many problems concerning the oscilloscope use

- Read the README.TXT file
- before connecting or disconnecting the module from the computer, make sure that the computer is turned off
- Never connect voltage higher than 100 V to the channel inputs
- Never connect voltage other than form –1 V to +6 V to the External synchro input
- Do not connect any voltage source to the compensation generator output while the generator is working

Who is this book addressed to

This book is addressed to the users of the digital storage oscilloscope M621. In order to fully understand the book and the software, the user should have basic knowledge how to operate a device of this type, and some basic knowledge of working with Microsoft Windows. In case you are having problems with the environment, please consult MS Windows User's Guid, MS Windows 95 User's Guide, MS Windows 98 User's Guide or MS Windows NT 4.0 User's Guid.

1. General Information

The information contained in this chapter will help you to understand the features of the M621 digital storage oscillosope.

1.1. Oscilloscope characteristics

The M621 dual channel DSO uses the Enhanced Parallel Port (EPP) for the communication with the computer. Data and command transfer uses the EPB (ETC Printer Bus) protocol. Measurement accuracy is provided through the stability of the parts used, together with the computing power of the computer. Calibration data are part of the HW, which makes it impossible to loose them (oppose to the calibration data located on the diskette). Therefore, it is possible to connect the hardware to any computer. All you have to do is just installing the software.

The M621 DSO allows user to measure waveforms using two independent channels with resolution of 8 bits and sensitivity from 10 mV/div to 5 V/div (80 mVfs to 40 Vfs) in 9 steps. Input impedance matches the oscilloscope standards; therefore, any regular oscilloscope probes can be connected to the device. All 1:1, 1:10 and 1:100 probes are supported by the software. AC, or DC coupling can be independently selected for each input. AC coupling suppresses frequencies lower than 1 Hz. Either one of the inputs can be grounded without disconnecting the probes from the measured system. Vertical track position can be controlled with accuracy better than 1% of the oscilloscope screen. Measurement can be triggered from the Channel A, Channel B or External Trigger Input. Trigger threshold can be set independently for each channel in the range of whole oscilloscope screen. Threshold of the external trigger input is TTL compatible (1.2 V). The M621 DSO has the two level triggering system, which is closely described in chapter 1.1.2. Oscilloscope hardware offers data acquisition with maximum rate of 50 MS/s Therefore, it is not possible to sample non-repetitive waveforms faster than every 20 ns. However, thanks to random sampling method, it is possible to sample repetitive waveform with period of 200 ps, which corresponds with rate of 5 GS/s. For displaying waveforms acquired using the random sampling method, the ETC company has developed system called Shape Prediction (SHP). This system prevents partially sampled, thus very distorted, waveforms from displaying on the screen. Time base can be set up to 1 us/div (1 div = 50 pixels) for real time signals (non-repetitive). However, when sampling repetitive signals, you can set time-base up to the value of

10 ns/div. The oscilloscope hardware can acquire date in one of the following modes.

- Acquiring data after trigger event displays waveforms after trigger event occurred. Waveforms can be up to 32000 samples long depending on the time base settings. There is digital delay implemented in this mode. It allows displaying 40 ns (min.1 sample) before trigger event.

- Acquiring data before trigger event displays up to 32000 samples, where ratio between samples acquired before and samples acquired after trigger event can be set with step of 512 samples. The fastest time base in this mode is 20 ns per samples (i.e. 1 us/div).

- Roll Mode offers a possibility of measuring and storing continuous data flow. Length of acquired data is limited only by the memory of the computer, or by the free space on the computer's hard drive. The shortest sampling period is 20 us (50 kS/s). This; however, depends heavily on the speed of the cooperating computer.

Each channel of the M621 is equipped with own AD converter. It means the M621 is "true dual channel oscilloscope", that eliminates side effects that come up when using an oscilloscope with multiplexed inputs.

Software for controlling the oscilloscope utilizes all features of the hosting operating system. Using the mouse is very fast and convenient. It is also possible to control more devices at the same time.

1.1.1. Digital Shielding (DSH)

Digital Shielding (DSH) circuits remove all interference not synchronized with the measured signal, and it does not affect frequency characteristics of the measured signal. The only negative effect of DSH is longer time period of stabilization. It is, however, very simple to turn the DSH off using the on-screen controls. The level of efficiency of DSH corresponds to the DSH level factor that can be set to 2, 4, 8, 16, 32 and 64. The higher the level you choose, the longer it takes to stabilize. For taking common measurements, we recommend to use default level (4).

1.1.2. Trigger Circuits

Trigger circuits of the M621 DSO are dual-level. It allows user to set up and trigger measurement on the base of relatively complicated trigger events. Block scheme of the triggering circuits is on the figure 1.1.2.1. Data for trigger circuits come either from channel A, channel B or from external trigger input. Threshold can be independently set for both channels (ATl and BTl).

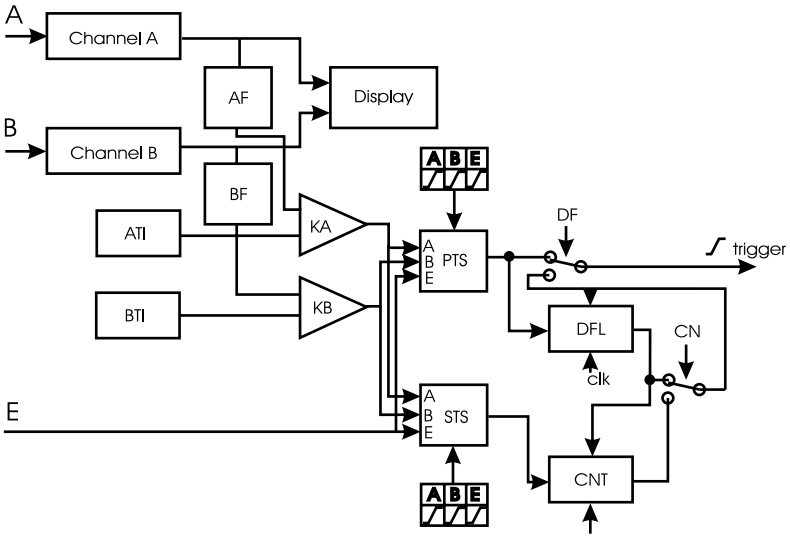


Fig. 1.1.2.1.

On the base of the thresholds for the two channels, the KA and KB comparators produce binary signal, that together with the external trigger input signal can be used as a trigger source for primary and secondary level. Selector PTS is used to select the desired synchronization event for the primary level. Selector STS is bound to the secondary level, and serves the same purpose as the PTS selector. Selectors can suppress and change polarity of any of the trigger signals. In case that only one of the signals is used, trigger event is generated corresponding to the polarity, which is symbolically presented by direction of change of the signal. It is very important to realize, that trigger event is generated with respect to change of the trigger signal; constant level of the signal cannot generate

the event. When there are several inputs used for generating the trigger event, the selector makes the logical addition of all of the inputs. Before adding signals together, ones are adjusted with respect to the polarity settings. Trigger event is generated only when the change of the consequent logical addition occurs form FALSE to TRUE. Logical values of the signals from which the trigger event is generated are created on the basis of following rules: value FALSE is the value that signal has before defined trigger event, and value TRUE is the value that signal has after the event. For example, if triggering for channel A is set to trailing edge, then when the voltage on channel A is higher than threshold voltage, consequent value will be FALSE. Inverse situation will be taken as TRUE. Realizing that when using logical addition all values must be FALSE in order for result to be FALSE, it is relatively easy to find out which are the valid trigger events. Table 1.1.2.1. shows several valid and invalid trigger events.

A	B	E	selected trigger event
			valid
			invalid
			invalid
			valid
			valid

Tab. 1.1.2.1.

Basic synchronization level is primary. Its mode can be controlled using the DF switch. When the DF switch is in default (off) position, the output of the primary selector triggers the measuring directly. This is the standard oscilloscope mode. If we switch the DF switch on (and CN switch is off), the output from the primary selector will be filtered through the digital filter. For signal to pass through filter it has to last at least the time set by the user. This way it is possible to select the most suitable trigger event depending on its duration. It is impossible to use digital filter in the sampling mode (when oscilloscope uses random sampling). Digital filter output can be used for activating the secondary level of the trigger circuits. Turning the CN switch on, oscilloscope will be set into the mode, where the trigger signal from the primary level activates the secondary level counter of trigger events. This counter triggers the measurement after the user-specified number of trigger event occurrences. Thus, trigger is generated after a long enough trigger event on primary and user defined

number of trigger events on the secondary level occurs. Validity of trigger event can be independently set for both levels. A very simple example of use of such dual-level triggering is displaying of selected row of the TV signal. Suppose that TV signal is connected to the channel A. Set the trigger source for both levels to channel A from leading edge. Activate the DF switch and set the time longer then the length of the horizontal synchronization pulse and smaller then the vertical synchronization pulse. Switch the CN on and set the number of occurrences of horizontal pulses to value after which we want to see the row. After setting a threshold for channel A, so that oscilloscope does not trigger from video signal, just from the synchronization pulses, the desired row appears on the screen. The M621 oscilloscope allows to set one of four trigger modes:

AUTO – Data acquisition is triggered by a valid trigger event. However, when after certain time the trigger event does not occur, measurement starts.
NORMAL - Data acquisition is triggered by a valid trigger event.
SINGLE- Data acquisition starts after activation from the control panel and after occurrence of the trigger event. Just one measuring cycle is executed.
MANUAL- One measuring cycle is executed immediately after manual activation.

For even more comfort, it is possible to put analog low-pass filter with threshold frequency of 3.5 MHz to the way of the synchronization signal.

1.1.3. ETC Printer Bus

The M621 digital storage oscilloscope connects to the computer through the EPP (EPP V1.9). This interface is implemented to almost every PC since year 1997. On the basis of the interface, the ETC Ltd. has created new protocol, that allows to connect up to 16 modules, with no influence whatsoever to functionality of the printer. Each of the devices is connected to the port and has different address, which can be set individually for each of the devices. Devices connected to computer can be easily accessed by the software directly, or using the interrupt.

Interrupts are not used in the EML II system. The only restriction is that one of the devices has to have address 0.

2. Installation

This chapter contains all the necessary information needed to install the hardware and software of the ETC M621 DSO.

2.1. Minimum computer requirements

- PC 486 compatible computer
- 4 MB RAM
- 3.5 inch FDD
- VGA display adapter
- EPP V1.9
- mouse or other pointing device
- 2 MB hard disk free space
- CD ROM Drive
- MS Windows 3.1, MS Windows 95, 98 or MS Windows NT 4.0

2.2. Hardware installation

The oscilloscope you own is one of the following modifications

M621/I – internal modification, that has to be installed either into the free 5.25" floppy disk drive, or into the EM901 external adapter.

M621/A – internal modification designed for installation into either ATX computer or the ETC EM901 external adapter.

M621/E – external modification, which does not require any installation; just plug in the power cable from power adapter and connect the device with EPP

Before installing the device, make sure that the parallel port is set to EPP mode. If there is a choice of the version of EPP, select version 1.9. Way how to change settings of the parallel port is described in the user's guide, which came with you computer.

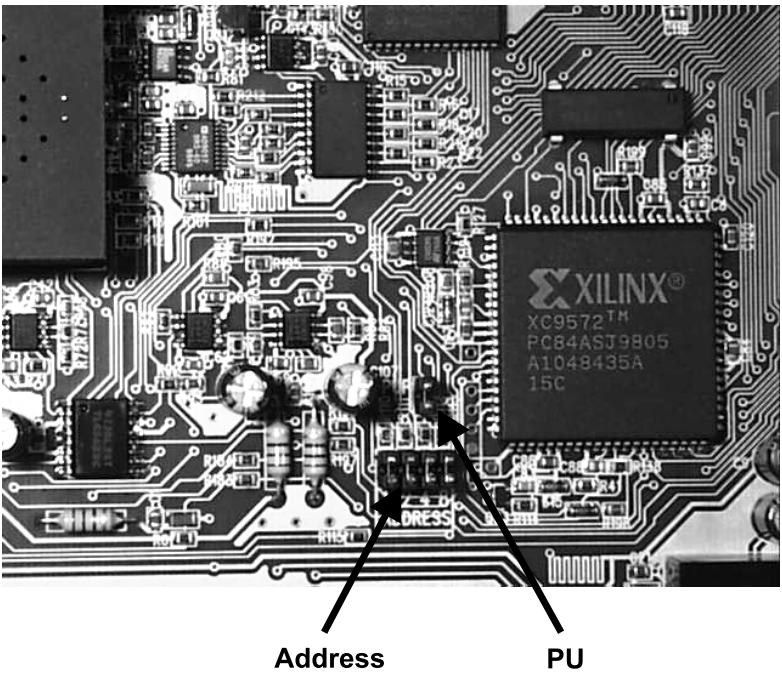
WARNING: In case the parallel port of your computer is not set to EPP mode, the software reports a communication error when starting.

2.2.1. M621/I hardware installation

Before installing the M621/I it is necessary to check its configuration. When looking at the PCB, you see two configuration areas.

- four pairs of pins labeled as ADDRESS serve for setting the address of the device. Pairs have values 1,2,4 and 8 only when jumper is NOT installed. If the jumper IS installed, the value of the pair is 0.

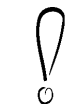
- a pair of pins labeled as PU serves of activating the pull up resistors. It enhances quality of communication. When jumper is installed, resistors are active, and vice versa



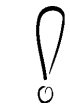
You can set address using the following table:

Address	1	2	4	8	PU
0	installed	installed	installed	installed	installed
1	open	installed	installed	installed	open
2	installed	open	installed	installed	open
3	open	open	installed	installed	open
4	installed	installed	open	installed	open
5	open	installed	open	installed	open
6	installed	open	open	installed	open
7	open	open	open	installed	open
8	installed	installed	installed	open	open
9	open	installed	installed	open	open
10	installed	open	installed	open	open
11	open	open	installed	open	open
12	installed	installed	open	open	open
13	open	installed	open	open	open
14	installed	open	open	open	open
15	open	open	open	open	open

TIP: If you want to connect only one EML II device, do not change the factory preset jumper settings.



WARNING: One of the devices has to be configured with address of 0.



WARNING: No two devices can have the same address.

TIP: If you change the jumper settings, you have to make corresponding changes to the configuration of the software.

Install the device after turning it off, opening the computer, and removing the plastic blinder from the free 5.25" slot. Slide device into the free slot from the front side of the computer and secure it with four screws, you have obtained with the package.

WARNING: Do not use screws longer than 6 mm. Longer screws could damage the device.

Connect any of the disk power cables to the device. Disconnect the flat cable that connects the parallel port connector from the mainboard. Find the flat cable with three connectors in oscilloscope's accessories and connect the side with one connector to the place you removed the previous flat cable from. Connect any of the connectors on the other end of the cable to the oscilloscope. Make sure that colored wire is connected to pin 1 at the motherboard. Connect flat cable used for connecting the parallel port with the mainboard, to the PRINTER connector of the oscilloscope. In case the cable is too short, use the extension form the oscilloscope accessories. After completing the installation, put the computer cover back on. Figure 2.2.1.1. shows oscilloscope connectors.

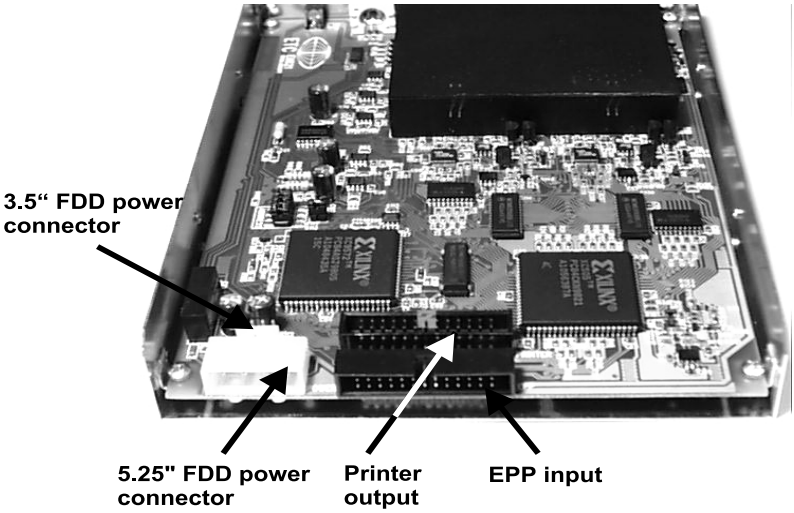


Fig. 2.2.1.1.

In case there is one device already installed in the computer, install the other one using the remaining connector of the flat cable. Do not forget; however, to change its address.

WARNING: Printer has to be connected to the device with address of 0, otherwise it will not work.

2.2.2. M621 installation into ATX computer

If you want to use the M621 oscilloscope inside the ATX computer, you have to use the EM907 kit. It can be ordered, or comes together with the shipment, if the device you have ordered is M621/A. The installation of the device is the same as described in the previous chapter. Only connecting the device to the computer is somehow slightly different.
The EM907 kit contains:

- cable for connecting the device to the computer,
- printer connector and cable for connecting to the device.

Follow these steps to make a new printer connector.

- disconnect the printer from the computer, if there is one.
- remove one of the I/O slot blinder (we recommend the one closest to the parallel port connector).
- flat cable for connecting the device with the computer slide trough the opening in the I/O slot front panel, so that the parallel port connector is on the outer side of the computer.
- install panel with printer connector to the free position. Fold the flat cable used to connect the device with the computer to half and slide it through the opening in front panel.
- connect connector on the cable, located on the outer side to the parallel port of the computer, and one of the connectors on the other end to the oscilloscope connector labeled as EPP.
- plug the other end of the new printer port into the oscilloscope connector labeled as PRINTER.
- you can connect the printer to the newly created connector.

Figure 2.2.2.1. shows the ATX computer with the installed device from the back side.

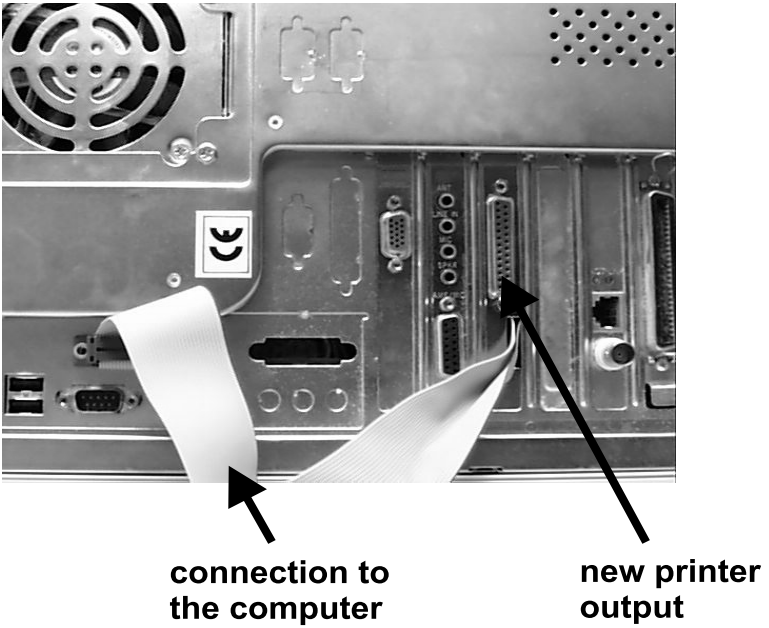


Fig. 2.2.2.1.

WARNING: Some of the computer cases have very sharp edges. Please make sure not to cut the flat cable at these edges.

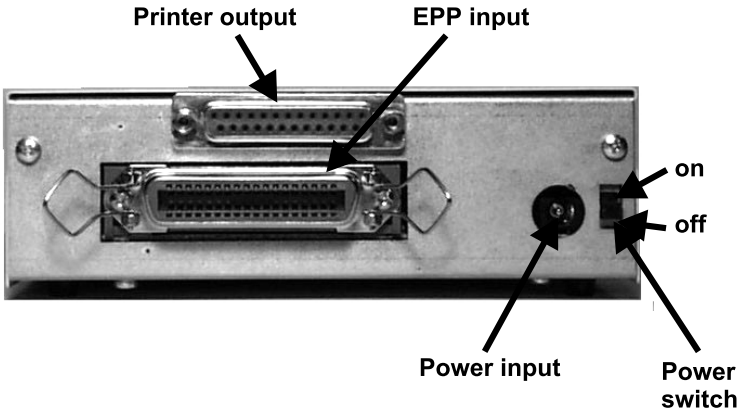
In case there is one device already inside the computer, you do not need the EM907 kit for installing the next one. After sliding the device into computer and connecting power, simply connect the device to the second connector located on the flat cable. Make sure you do not forget the address of the second device.

2.2.3. M621/E hardware installation

Installation of this modification is the simplest one. Just follow the following steps:

- make sure that oscilloscope is turned off
- connect the power adapter to the device
- connect the oscilloscope using the standard 25 pin cable from the accessories

- turn oscilloscope on
- you can also connect printer to the connector located on the back side of the oscilloscope



WARNING: For connecting the device with the computer use the cable from the oscilloscope accessories. Connecting the device to the computer via wrong type of cable, can cause problems with communication or even block the transfer at all.

WARNING: Do not use the cable longer than 2 m for connecting the printer to the device. Longer cable can reduce the quality of communication.

2.3. Software installation

Following operating system modifications of the SCOPE 621 are available: MS Windows 3.X, MS Windows 95, MS WIndows 98 and MS Windows NT 4.0. Controlling software, SCOPE 621, is inside the package you have obtained. A CD version contains all versions of the software in all available language mutations. In case you chose the diskette version, you have just version you ordered.

TIP: In case you have the diskette version, make the backup copies of the diskettes and store them at the safe place.

WARNING: When installing more than one device into the computer is not necessary to install a copy of SW for each device. You can use one software co control all of the devices.

In case you own the CD version of the software, run the SETUP.EXE program to start the installation. Follow the installation procedure, which will allow you to choose the environment and the language mutation.

TIP: You can run the SCOPE 621 software directly from the CD.

In case of the diskette version you cannot choose neither the OS, nor the language version.

After successful installation, setup.exe program creates the ETC Measuring Lab group with the SCOPE 621 icon. You can run the program by double-clicking on the icon.

When the program is run for the first time, it uses device address 0 and EPP address 0x378. If you have not change the jumper settings on the device, you can start measuring right on. If the EPP address or device address is different, or any other error with communication occurred, program displays a message on startup and runs demo. For more information see chapter 3.3.1.

TIP: We recommend you to watch our website, where you can download a software update. This service is provided free of charge, at the present time.

2.3.1. Exiting the program

It is possible to exit the program by several different ways:

- Select the item File/Exit from the main menu and press ENTER
- Press ALT+F and then ALT+X
- Use the host environment controls for exiting the running program

When exiting the program, program will ask whether you really want to exit. If your answer is positive, it will end. In case your reply was negative, it will keep running.

2.4. Probe test and compensation

This test serves as a simple oscilloscope check. To perform the test follow the subsequent steps:

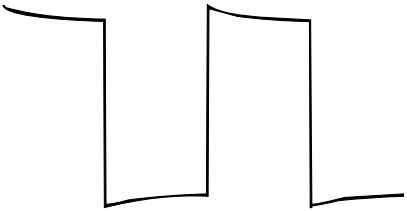
Connect the 1:10 probe to channel A. In case you do not have the 1:10 probe available, you can connect the Ext/Cmp output to the channel A input through coaxial cable.

Connect the probe tip to the Ext/Cmp connector.

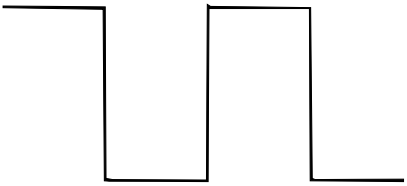
Activate testing mode by selecting Device/Test from the main menu.

After this a waveform similar to either 2.4.1.a, b or c figure should appear on the screen. If it does not, there is an error in the oscilloscope circuits or probe.

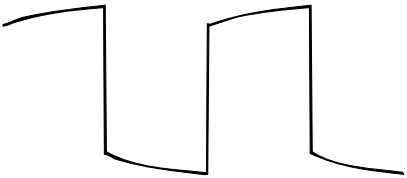
It is possible to use this test to adjust the probe precisely for the particular oscilloscope. Probe is not adjusted by the manufacturer; therefore, we recommend you to adjust it before the first use. To adjust the probe keep twisting the adjustable capacitor on the probe, until the waveform looks exactly like the 2.4.1.b. figure.



2.4.1.a



2.4.1.b

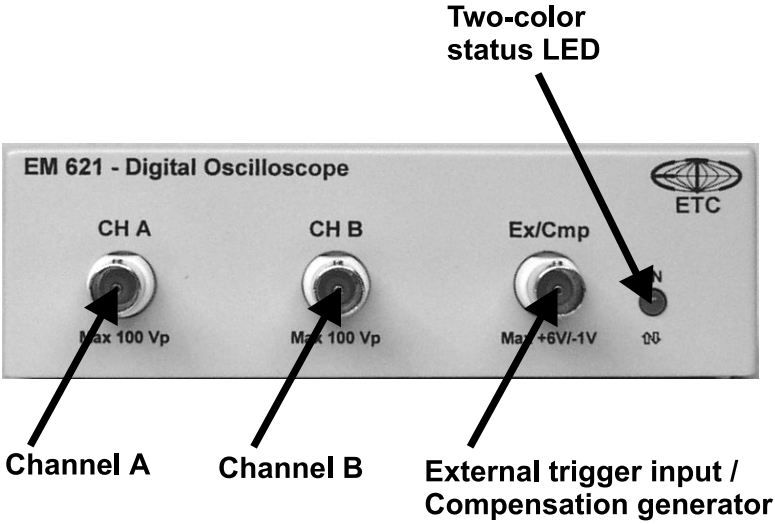


2.4.1.c

3. Using the oscilloscope

3.1. Front panel

All connectors are located on the device's front panel (see fig. 3.1.1.)



Fig, 3.1.1.

Channel A and B inputs are standard inputs with input impedance 1 MOhm and capacity 20 pF. External synchronization input, in input mode, is TTL compatible with input impedance of 47 kOhm. In output mode, as compensation generator output, it has output impedance cca 150 Ohm and it generates signal with amplitude cca 3.5 V
Status LED has two colors. Green indicates power on status and red indicates ongoing data or command transfer between the device and the computer. Depending on the rate of the transfer, color can change from greenish-yellow to red, where red indicates very intensive communication.

3.2. Main window

After running the SCOPE 621 program, the oscilloscope screen and control panel is displayed on your monitor. (See fig. 3.2.1). All

common functions are easy to access on the control panel. Others can be reached through the main menu.

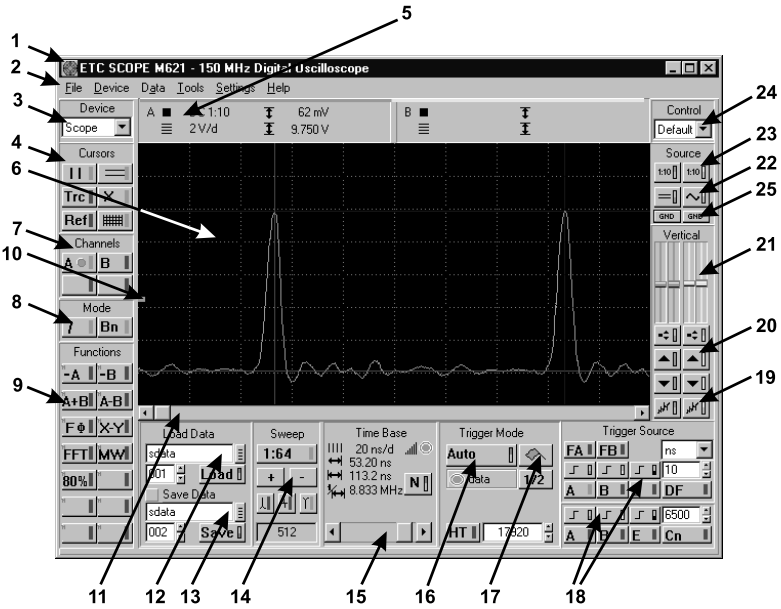


Fig. 3.2.1. Main screen

Short on-screen controls description:
1. System menu
2. Main menu
3. Current device
4. Cursors and grid switches
5. Data of vertical deflection system of A, B channels
6. Oscilloscope screen
7. Active channels switches
8. Waveform display mode
9. Special functions
10. Trigger level mark
11. Scroll bar for moving within the measured data array
12. Load data
13. Save Data
14. Displayed data control
15. Time base control and time base data

16. Triggering mode control
17. Trigger control
18. Trigger source switch
19. Digital shielding switch
20. Vertical range controls
21. Vertical shift controls
22. Coupling control (AC/DC)
23. Probe attenuation setting (1:1, 1:10, 1:100)
24. Optional control setting
25. Input grounding controls

All control elements having direct relation to any of the measuring channels are color coded. It means that they are marked by the color of the channel they are related to. For example, channel B color is yellow; therefore, all control elements related to channel B (i.e., deflection factor, synch, probe setting, coupling, etc.) are yellow.

TIP: In case you are not satisfied with channel colors, it is possible to change them. See Main menu *Settings | Color*.

Control elements, which turn functions on and off are green when they are ON and red when they are OFF. Every single element can be controlled by either keyboard or mouse. Software was designed to be easy-to-use, keeping all MS Windows control standards. In the following text, the mouse control will be described as a main, and the keyboard one as an additional. You should understand the following terms in order to understand the rest of the text in this manual.

Click - point the mouse cursor over the component and shortly press the left mouse button.

Double click - point the mouse cursor over the component and click twice quickly.

Grab - point the mouse cursor over the component you want to move and press the left mouse button (do not release). Move the mouse cursor together with the component. After releasing the mouse button, component will move to its final position.

Recommendation: To work with the SCOPE software, we recommend you to use a mouse or other pointing device. Operating the software through the keyboard seems very clumsy compared to using a mouse.

3.2.1. Setting up the active device

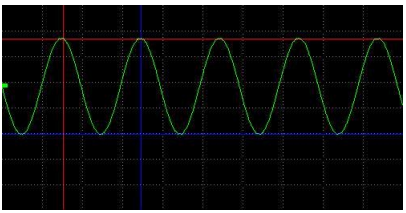
The SCOPE 621 program allows the user to work with more measuring devices connected to the same computer. To choose the active device (i.e., the device you are currently working with) click on the element in upper left hand corner and the list of devices configured to work with the SCOPE 621 software will appear. To select the desired device just simply click on it. It is possible to change the list of configured devices. See chapter 3.3.1. "Setting up the individual devices".

TIP: In case you want to control more devices from the SCOPE 621 software, you can do it in two different ways:

1. **Run the SCOPE 621, set up two oscilloscopes using menu Device|Add device (see chapter 3.3.1.) and using the Device control element switch between the two devices.**
2. **Set up two oscilloscope the same way as in first way, but run two copies of SCOPE 621. In each window use the Device control element and activate different device.**

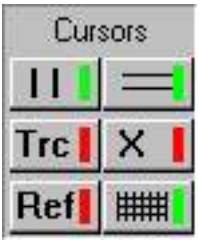
WARNING: Do not expect oscilloscopes to measure synchronously, even when using the same synchronization for both devices.

3.2.2. Oscilloscope screen



By the term "Oscilloscope screen" we understand the rectangle part in the middle of the monitor screen; waveforms measured by the oscilloscope, grid, horizontal and vertical cursors, a reference cursor and a trigger mark can be displayed there.

3.2.3. Cursors and grid



Next to the left of the oscilloscope screen, there is a group of elements, which controls the cursor and the grid display. To move the cursor around the oscilloscope screen, just simply grab it, and move it to the desired location. While moving the cursor, you will notice, the measured data of the time base and each channel changing. You can also notice that cursors have different colors; the red one has a special function (See Next Chapter)

 - turns vertical cursors ON and OFF. Using the vertical cursors, it is possible to measure time or frequency characteristics of the waveform. The measured data is displayed beneath the oscilloscope screen, where the time base is set.

 - turns horizontal cursors ON and OFF. Using the horizontal cursors, it is possible to measure the voltage of the waveform. The measured values are displayed among the data of each channel above the oscilloscope screen.

TIP: If you want to set horizontal cursors so that they show the amplitude of the signal double click on the oscilloscope screen. Cursors will be set automatically.

 - turns Track cursors mode ON and OFF. With this mode on, it is possible to move both vertical or horizontal cursors at the same time by moving the red cursor. The distance between the cursors is kept at all times.

 - turns XCursors mode ON and OFF. With XCursors mode on, it is possible to move two cursors together at the same time. To do so, just grab the cursors at the place where they cross and move them. When you do not grab them at the place of intersection, they can be moved independently.

 - turns reference cursor ON and OFF. It belongs to the group of horizontal cursors and is used for measuring in combination with

the red cursor. Using the reference cursor we can, for example, measure voltage with respect to the ground:

1. Ground the channel input (see chapter 3.2.15)
2. Set the reference cursor to position corresponding with the zero voltage.
3. Turn off grounding of the channel input.
4. Using the red cursor, it is now possible to measure the voltage with respect to the ground.

TIP: In case both types of cursors are turned off, and you want to turn them on in the XCursor mode, simply click on the XCursor. The SCOPE software understands, that horizontal and vertical cursors are also required to be turned on; therefore, they will be turned on automatically.

WARNING: When using 1:10, or 1:100 probe, do not forget to turn each channel's probe attenuation switch to 1:10 or 1:100. If you fail to do so, the measured data will be approximately 10 or 100 times smaller (depending on the probe you are using) and not precise.

 - turns grid ON and OFF. You can use the grid to find out the approximate characteristics of a waveform.

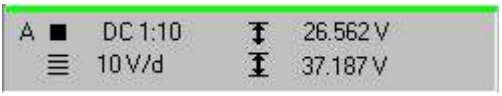
Grid dimensions:

Horizontal: *1 division per 50 pixels; i.e. 10 divisions, 500 pixels whole screen*

Vertical: *1 division per 32 pixels; i.e. 8 divisions, 256 pixels whole screen*

3.2.4. Channels A, B vertical data

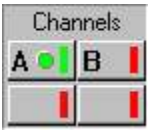
Above the oscilloscope screen, there are two boxes (one for each channel) containing these data:



- Channel name (the box is also marked by a colored strip in the upper part)
- Probe attenuation (i.e. 1:1, 1:10, or 1:100)
- Coupling status (i.e. AC or DC)

- Voltage per division
- Voltage between red and reference cursors
- Voltage between horizontal cursors

3.2.5. Selecting active channels



Next to the left of the oscilloscope screen there are two buttons, that control channels A, B and two unlabeled channels.

Channels A,B

By switching channels on and off, you turn measuring on corresponding channel on and off.

Unlabeled channels

You can use these channels for displaying results from special functions (see chapter 3.2.7.) In case you want to see data on channels A, B and also their sum, simply grab and place the "A+B" special function on one of the unlabeled channels.

TIP: In case you are measuring only on one channel, turn off the other one; it will speed up the performance.

3.2.6. Display Mode

Next to the left of the oscilloscope screen there are two buttons for controlling the waveform display mode.

 - turns the "Interpolation mode" ON and OFF. With the interpolation mode on, the software connects the measured data into a continuous line, otherwise the waveform is displayed as an independent series of dots.

TIP: In case oscilloscope runs in random sampling mode, this control element turns the SHP system on, that is able to estimate the waveform shape even before all samples are acquired.

A LED located below the oscilloscope screen, in area of time base controls, shows status of the data acquisition in sampling mode.

TIP: The convenience of this mode being on or off depends on the waveform characteristics; therefore, we recommend to set the mode off first and then to turn it on. This is to assure the exclusion of errors of comprehension concerning the waveform shape.

Bn - turns "Beam Finder mode" ON and OFF. When the BF mode is on, all measured data exceeding the range of the oscilloscope screen is displayed on either the top or bottom of the oscilloscope screen. When this mode is off, data exceeding the range of the oscilloscope screen is not displayed.

TIP: Before taking the actual measurement it is advisable to turn the Beam finder mode on, because the line either on top or bottom of the oscilloscope screen gives us a clue whether the actual track is located above or below the oscilloscope screen.

WARNING: The Beam finder mode may lead to some distortions on the bottom or top edge of the oscilloscope screen. When you are not quite sure about the shape of the waveform, turn the Beam finder mode off.

3.2.7. Special Functions

In the left hand corner of the screen, there are 14 buttons. Using these buttons it is possible to execute functions that work with the measured data.
To execute a function follow these steps:

- Grab the desired function.
- Move it to the channel that you have chosen to show function results. In case the channel was not active, it will be turned on automatically.

In case you want to execute the function from the keyboard follow these steps:

- Set the rectangle on the desired function (using TAB key) and press space.
- In the dialog window you indicate the desired channel (unlabeled channels are marked as C and D).

You can turn the function on either by clicking on the channel button or clicking on the function button. Using the first way you turn off the whole channel; however using the other way you turn off just the function and measuring on channel keeps running.

While a function is being performed on certain channel, all control elements of the function will be colored by channel's color.

WARNING: It is not possible to use the same functions on two channels at the same time.

1. **Channel A inversion** – shows inverted waveform to waveform on channel A.

2. **Channel B inversion** – shows inverted waveform to waveform on channel B.

3. **Sum of channels A and B** - shows sum of the waveforms measured on channels A and B.

4. **Difference of channels A and B** – shows the difference between data on channel A and data on channel B

5. **Average** - shows the average value if data measured on channel where you placed the function. For example, if you placed the function on channel A, you will se the average of channel A instead of data of channel A.

6. **X-Y** (channel A=X, channel B=Y) – this function shows Lissajous' diagrams. Turn the Interpolation mode off and you will see the Lissajous's diagram corresponding to the data on channels A and B.

7. **Multiwave** – After placing this function on channel A or B, waveforms are not removed from the screen every time they are redrawn. After a while an area that envelopes the waveform appears.

8. This function sets the distance between horizontal cursors to 80 % of original value.

9. **Fast Fourier Transformation** – This function allow user to display frequency spectrum of the measured signal.
- Mark one period of the measured signal using the vertical cursors.
- Execute the function on any of the available channels and a windows with results (frequency spectrum) will appear on the screen.

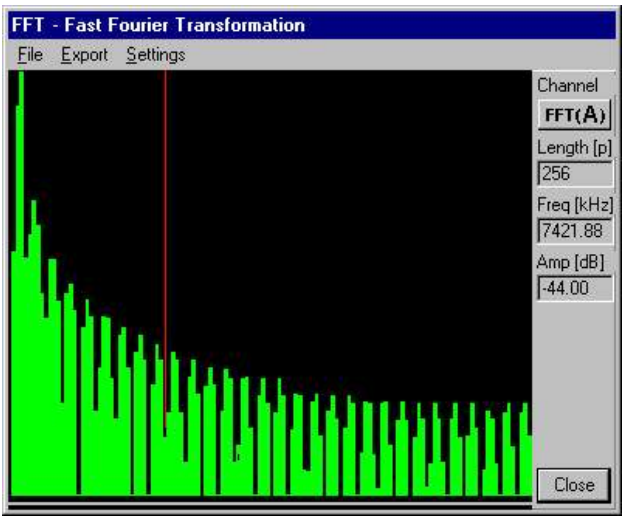
Using the cursor inside the window , you can find out what frequency corresponds to what amplitude. Values are displayed with respect to maximum amplitude on one of the frequencies.

The X-axis can be decimal or logarithmic. To switch between these two, use menu Settings|Logarithmic and Settings|Decimal.

In a right-hand upper corner, there is a value labeled as "Length". It is the length of data that are being analyzed by FFT. As you can see, value changes with step of power of 2, because the FFT algorithm used allows to analyze data with length of N-th power of 2. However, the SCOPE 621 allows you to select any length of Data and adjusts them to meet the requirements of the algorithm. It uses two different methods for adjusting. They are padding zeroes and oversampling. Both give satisfactory results. You can find closer description of these two methods in specialized literature concerning digital signal processing.

TIP: In case you have doubts about accuracy of the FFT results, try to use first one and then the other method of adjusting data.

WARNING: In case you want the FFT to be accurate even for the lower harmonics, it is crucial that you select exactly one or more periods of the waveform.



TIP: You can move cursors used for selecting data for FFT even in time when analysis is running.

In the right-hand upper corner there is a control element, that allows you to select source for FFT (channel A, or B). Below the frequency spectrum area there is a control element that serves a following purpose.

You can synthesize an analyzed signal back. This control element allows you to select harmonics using which the signal has to be synthesized, thus simulate a filter.

Results of a filtered inverse FFT is displayed on the oscillscope screen.

Controlling the virtual filter

Using the left mouse button on the above mentioned control element you can add or using right button remove frequencies from which the signal is synthesized.

TIP: In case you want to add only small frequency band, doubleclick right button above the filter control. All frequencies will be removed. After that, using the left mouse button, select only frequencies you desire. Similarly, doubleclicking the left button adds all frequencies.

There is a menu in the FFT window. Menu items have following meaning:

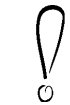
File|*Print* – prints out the FFT results
File|*Exit* – closes this window
Export|*Save as bitmap* - saves the FFT result to *.bmp file
Export|*Export to clipboard* – stores results to clipboard
Settings|*Decimal*- sets the X-axis to decimal
Settings|*Logarithmic* – sets the X-axis to logarithmic
Settings|*Oversampling* – sets the data adjusting mode to oversampling
Settings|*Padding zero* – sets the data adjusting mode to padding zero

3.2.8. Storing Data

Underneath the oscilloscope screen, there is group of control elements that control data storage. Only waveforms displayed on the oscilloscope screen are stored into file. To enter the filename there are two input lines, one for the name (sdata by default) and the other one for the extension (001 by default), which combined together make a filename (sdata.001 by default). It is possible to change the name simply by clicking on it, and entering a new one. The extension is required to be a number from 000 to 999. For example, if we want to save the third measurement under the name "VIDEO", type "VIDEO" to the upper field and 003 to the lower field.

-clicking this button pulls out a standard file-handling dialog window, and there you can pick a file where data will be stored .

Save - this button starts the process of data storage. After a successful operation, the value of extension will increase by one.



WARNING: Only displayed data are stored to file, it is therefore impossible to trace stored and then loaded data.

TIP: Store data are in Windows Profile format; therefore it is possible to add your own comments by simply adding a new line in the very beginning of the file and writing ";" character followed by your comments. The number of comment lines is not limited. After this you can, for example, send this file to your colleague by E-mail.

☑ Next to the left of the Save Data label, there is a control element (Autosave) that will allow you to store data periodically. Data are stored in the period of 1 second when in AUTO mode. When trigger mode is set to NORMAL, SINGLE or MANUAL every single measured waveform is stored.
Waveforms are stored to the file with the name, that is set in the upper field. Extension changes from 0 thru 999 with every single stored waveform. When it reaches 999 it resets back to 000. This means that the maximum space used on the hard drive is 2 MB. You can turn data storing

off anytime by turning the control element off.

WARNING: Running this function causes slowing down measurement a bit.

3.2.9. Loading Data

Beneath the oscilloscope screen, there is a group of control elements, that control data loading. Entering the filename works in the same way as described in chapter 3.2.8. Storing the data.

It is possible to load only the file which were created with the use of the function described in previous chapter. When data is read from the file, the time base and vertical parameters are set in the same way as when the file was created. The color of the loaded data is easy to adjust form the menu. They are gray by default. Loaded waveforms will stay on the screen until the time base or vertical parameters are changed.

TIP: You can display restored data in all modes (see chapter 3.2.6). Restored data are not removed even when switching between these modes.

3.2.10. Controlling the Data Display Length

Beneath the oscilloscope screen there is a group of elements controlling the data display length. There are 32000 samples measured and stored into memory for each channel. Oscilloscope screen, however, can display a maximum of 500 samples, it is therefore very important to indicate which samples are to be displayed on the oscilloscope screen. Default setting is first 500 samples from 32000. This is indicated in the upper part of the B Sweep window by 1:64 label, because just 1/64 of stored samples is displayed. By clicking the "+" or "-" buttons it is possible to change the display ratio form 1:2 to 1:64 (See tab. 3.2.10.1.)

ratio	displayed data length	one pixwl on screen represents x measured samples
1:64	500	1
1:32	100	2
1:16	2000	4
1:8	4000	8
1:4	8000	16
1:2	16000	32
1:1	32000	64

Table 3.2.10.1.

When the ratio button is on, you can scroll through data that are displayed in 1:64, 1:32, 1:16, 1:8, 1:4, 1:2 ratio. When you turn ratio button off, data is displayed in a 1:1 ratio (32000 samples).

In 1:32, 1:16, 1:8, 1:4, 1:2 and 1:1 modes are several measured samples displayed as 1 pixel on screen. You can use one of three modes of transforming several samples into one pixel. You can set up desired mode using following control elements:

Maximum: -  - the computer displays the maximum out of the measured samples

Average: -  - the computer computes the average value and displays it on screen

Minimum: -  - from x measured samples the computer displays the minimal one

The standard setting of these control elements is Average. The Average mode has a special feature of smoothing out the waveform; therefore it does not display any glitches. If you are looking for any imperfections switch the transformation mode to Minimum or Maximum.

TIP: When the ratio selected is other than 1:1, the user is able to scan through all 32000 samples. See next chapter.

WARNING: Basic setting for displaying data is 1:64, since only in this mode data is displayed exactly like they were measured and one pixel on screen represents one measured sample. Therefore, we recommend working in this mode and using the rest of the modes to gain some additional information about the shape of the waveform.

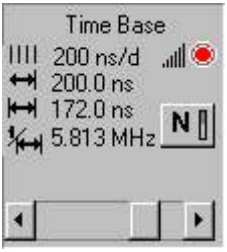
On the bottom of this group of control elements a value displays. This value informs you about number of samples that has to be measured in order to display the waveform.

Note, that when this value is lower, the speed of redrawing the data on the oscilloscope screen increases.

3.2.11. Scanning through samples

A scroll bar is  located right under the oscilloscope screen. Using this scroll bar the user is able to scan through the samples. The very left position corresponds to data displayed from the very beginning of the whole array of 32000 samples. The very right position corresponds to the end of the 32000 samples array. When using 1:1 ratio any scroll bar movement causes two grid colored cursors to appear. The area between these two cursors will be zoomed to the whole oscilloscope screen when switched to the B sweep (1:2, 1:4, 1:8, 1:16, 1:32, 1:64).

3.2.12. Controlling the time base and time base data



To control the time base there is a scroll bar located in the lower part of the time base window. Above this scroll bar there are values representing time base settings. To set the time base simply grab the scroll bar and move it either left or right. Moving it left causes the time base to lengthen (i.e. allows measuring slower events). Moving the scroll bar right causes the time base to shorten (i.e. allows measuring faster events). By clicking on the arrows on the sides of the scroll bar we can change the time base in steps.

The current time base is displayed above the scroll bar in seconds per division.

 - this mark is displayed only when the oscilloscope works in sampling mode.

Sampling mode is closely described in chapter 1.1. To use this method, signal has to be periodic and well synchronized.

 Next to the right of the sampling mode indicator there is a LED, which informs you about the sampling mode status.
It can be in one of following three states:

red - less than 50 % of samples were acquired
yellow - more than 50 % of samples were acquired, and waveform shape is not too distorted
green - all samples were acquired

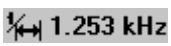
In case you are running measurement on both channels, left side of the LED represents channel A status, and right side represents channel B. Channel A and B states may differ. This depends on the characteristics of measured signals.

WARNING: You may notice, that sometimes when LED is green, it suddenly turns red. This happens when oscilloscope reacts to some imperfections with regards to periodicity, and has started the measurement from the beginning. You can suppress this, by better synchronization of signal.

Besides the values corresponding directly to the time base setting, the software also displays the following data measured with the use of vertical cursors (only if they are on):

- time from beginning of displayed data to red vertical cursor

- value represents time between vertical cursors



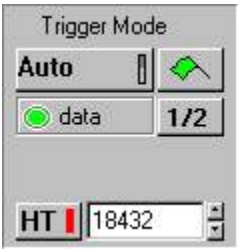
- value representing frequency in hertz between vertical cursors

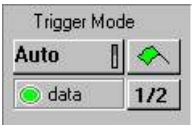
WARNING: The time base and other values in this window change with the changing display ratio. It is because time is in time units per division, and when the ratio changes, the amount of samples per division changes too.

TIP: If you want to know the sampling frequency, simply move the vertical cursors together, so that there is no space between them. The frequency between these two cursors is the sampling frequency.

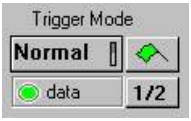
3.2.13. Triggering mode controls

Next to the right of the oscilloscope screen there are two control elements. Using these two elements it is possible to control the triggering mode. Right, flag marked button is called "Start" button. By clicking on the left button it is possible to set following modes:

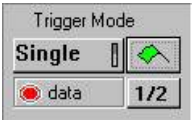




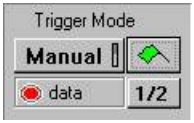
- Measurement is repeatedly triggered. If the trigger does not occur until half the time required to fill the whole buffer, the sweep free-runs without the trigger signal; otherwise it is triggered by trigger. This mode is recommended when you are trying to display an unknown waveform. When you click on the start button (flag marked button), the software will try to get the signal on the screen using the vertical shifting and voltage range switching. While the program is performing this action, flag button turns to red color.



- Measurement is repeatedly triggered. It produces a sweep only when the trigger signal meets the level and slope criteria. The start (flag marked button) does not have any function in this mode.



- Single measurement. Starts by clicking on the start button (flag marked button). The sweep runs after trigger signal occurred. While waiting for trigger signal flag button color changes to red .It is possible to repeat the measurement by clicking on start button (flag marked button).



- Single measurement. It starts by clicking on the start button (flag marked button). The sweep runs immediately, it does not wait for the trigger signal. It is possible to repeat the measurement by clicking on the start button (flag marked button).

Underneath the triggering mode control element, there is an indicator. It informs you about the oscilloscope status. This LED can have one of the following colors.

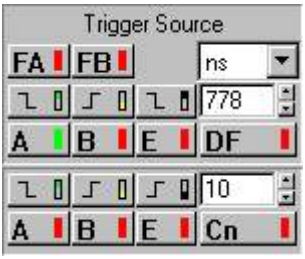
red - Trigger event did not occur, yet. Oscilloscope is waiting for trigger event.

yellow - Trigger event has occured, but not sufficient number of samples was acquired, yet.

green - oscilloscope has acquired all samples, and they are being displayed on the oscilloscope screen

Sometimes this element changes its color so quickly, that is not possible to notice each status. By the major color you can tell which of the states consumes most of the time in measuring cycle.

3.2.14 Trigger controls



Next to the right of the oscilloscope screen there is a group of six control elements. Using these elements, the user is able to set up the trigger conditions. It is possible to set the trigger source on channel A, B or external input using the lower row of buttons (A, B or E button). The upper button row indicates whether the oscilloscope triggers on the leading or the trailing edge. Clicking them switches the function to opposite state.

 - triggers on leading edge

 - triggers on trailing edge

WARNING: When the trigger source is either channel A or channel B, it is also important to adjust the trigger level.

Upper group of control elements controls the primary trigger level. Besides already described control elements, there is DF button. Using this button, you activate the digital filter. It filters all trigger events shorter than time set by the user. This value depends on the time base, therefore it may happen that when you change the time base, constant changes too.

When the digital filter is active, you can activate the secondary level of the trigger circuits. When you turn the Cn button on, measurement starts only when, there is long enough trigger event on primary level (depends on digital filter) and then number of trigger events set by the user on secondary level.

You can filter the signal through the low-pass filter using the 

control elements. It is advisable to turn filter on only when signal contains high frequency noise and oscilloscope has problem to synchronize this signal.

Threshold frequency of this filter is about 3.5 MHz.

WARNING: Turning the filter on and off has no effect on the shape of the signal. It affects only the "quality" of synchronization.

WARNING: FA and FB filters affect synchronization signals on both primary and secondary level.

Topic of synchronization is quite complex. You can read about synchronization circuits more in chapter 1.1.2.

3.2.15. Grounding the oscilloscope inputs

Next to the right of the oscilloscope screen there are two control elements 

for channels A and B. Using these control elements you ground the oscilloscope input even without disconnecting or shorting the probe. Input signal is not grounded.

3.2.16. Controlling the Digital Shielding

Next to the right of the oscilloscope screen there are two control elements corresponding to channels A or B. Using them, the user is able to turn the Digital shielding on or off.

 - switch turned on

 - switch turned off

When the Digital shielding is on, the oscilloscope tries to separate the repetitive waveform from the noise (See chapter 1.1.1.). To turn Digital shielding on is advisable only for a well synchronized waveform.

TIP: It is possible to change the Digital shielding level. See chapter 3.3.5. Setting other parameters.

WARNING: It is advisable to apply digital shielding only on well synchronized waveforms.

3.2.17. Setting the range

Next to the right of the oscilloscope screen there are four control elements. Their function is to control the setting of the oscilloscope voltage range. There are two buttons for each channel. By clicking them, you can either increase or decrease the voltage range.

 - increase the voltage range

 - decrease the voltage range

The value of the voltage range is displayed for each channel individually in the channel parameter box above the oscilloscope screen. For the M621 it is possible to set the following ranges:

voltage per division	voltage per whole screen
10 mV	80 mV
20 mV	160 mV
50 mV	400 mV
100 mV	800 mV
200 mV	1.6 V
500 mV	4 V
1 V	8 V
2 V	16 V
5 V	40 V

Tab. 3.2.17.1. Ranges for 1:1 probe

voltage per division	voltage per whole screen
100 mV	800 mV
200 mV	1600 mV
500 mV	4 V
1 V	800 mV
2 V	16 V
5 V	40 V
10 V	80 V
20 V	160 V
50 V	400 V

Tab. 3.2.17.2. Ranges for 1:10 probe

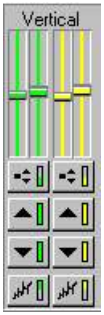
voltage per division	voltage per whole screen
1 V	8 V
2 V	16 V
5 V	40 V
10 V	8 V
20 V	160 V
50 V	400 V
100 V	800 V
200 V	1600 V
500 V	4000 V

Tab. 3.2.17.3. Ranges for 1:100 probe

TIP: Before you change the range we recommend you to set the triggering mode to Auto. Thus, the waveform does not disappear from the screen.

WARNING: When measuring on the most sensitive ranges, remember that when you connect the signal with far bigger amplitude than it is possible to display, you can overload the vertical amplifier of the oscilloscope and waveforms may be heavily distorted.

3.2.18. Controlling the vertical shift



To control the vertical shift there are four scroll bars (two for each channel) located next to the right of the oscilloscope screen. The purpose of the right scroll bar is to make an approximate shift. However, the left one helps to make a fine shift. To control these scroll bars simply grab one and move it to the desired location. If you wish to move the scroll bar only one step up or down simply click on the upper or lower edge.

Under the scroll bars there is a button, which controls the vertical shifting mode.

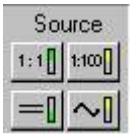
 - when attempting to make a vertical shift using the approximate scroll bar, the fine scroll bar will be centered

 - changing the location of the approximate scroll bar does not influence the fine scroll bar.

TIP: To find and get the measured waveform on the oscilloscope screen quickly, set triggering mode to Auto and click on Start (flag marked button) (see 3.2.13).

3.2.19. Setting the coupling

Next to the right side of the oscilloscope screen there is a group of control elements. Using them, the user is able to switch the coupling either on AC or DC.



 - DC coupling

 - AC coupling

WARNING: When measuring slow waveforms (100 Hz or less) switch to DC coupling, otherwise oscilloscope may display somehow distorted waveforms.

3.2.20. Setting the probe attenuation

Using the two buttons located next to the right side of the oscilloscope screen, the user is able to set each channel's probe attenuation (1:1, 1:10, or 1:100). When you switch the probe, always switch the corresponding button by clicking on it.

WARNING: When the probe attenuation switch does not correspond to the actual probe setting, the measured values are not accurate.

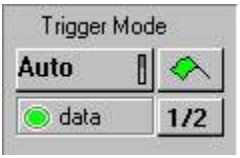
3.2.21. Setting up the optional control

This control element is reserved for future use with other ETC Measuring Lab II line devices.

3.2.22. Trigger level mark

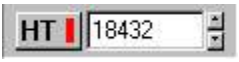
After setting the trigger source on channel A or B, the trigger level mark in the same color as the channel appears on the left-hand edge of the oscilloscope screen. The mark location represents the level. To set a different level, simply grab the level mark and move it to the desired location.

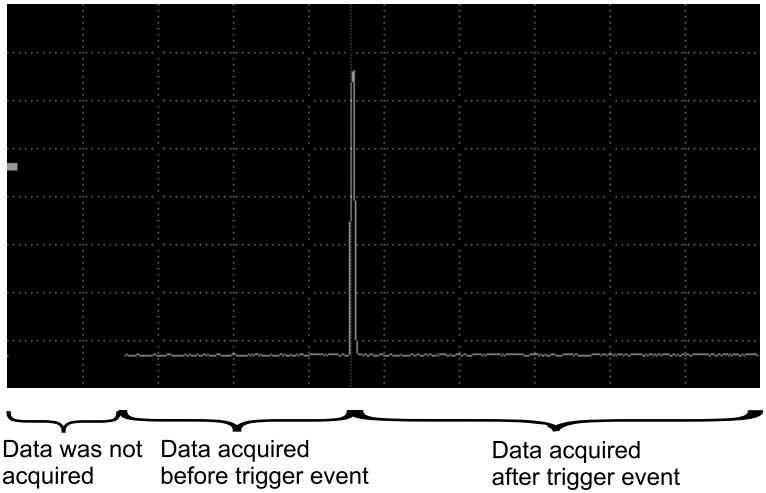
In the lower right corner of screen there is a button labeled "1/2". After clicking on this button the trigger level mark (if it is turned on) moves to the location representing the half of the waveform.



3.2.23. Sweep before trigger mode

On the right-hand side, underneath the oscilloscope screen, there is a control element labeled as "HT". This control element turns sweep before trigger mode on, or off.





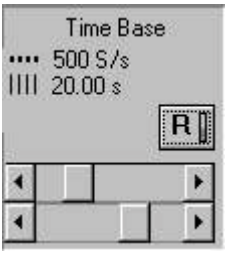
Editable area next to the right of the button allows user to set the number of samples to be collected after trigger event occurs. It also displays the current value. User can change this value by clicking on little arrows right next to the field. Value changes with step of 512. This means that

you can divide data from 512 before trigger event and 32000-512=31488 after trigger event to 32000 before trigger event. Place, where trigger event occurs, oscilloscope highlights by vertical red line.

WARNING: In case trigger event occurs too quickly, number of acquired samples before trigger event may be smaller. Typical example is measuring periodical waveform with period smaller than time of one whole screen.

WARNING: In Sweep before trigger mode, the oscilloscope is not able to work in sampling mode; therefore the sampling speed is limited to be less or equal to 50 MS/s.

3.2.24. Roll Mode



The main difference between Roll Mode and the rest of the modes is that in this mode oscilloscope measures and displays data on the screen, and/or stores it on disk continuously. Only time when a problem may occur is when data cannot be transferred to computer fast enough. However, oscilloscope has no problem with detecting such a situation.

You can turn the Roll Mode on by pressing the button located above the time base control.

- roll mode turned on

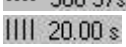
- roll mode turned off

When the roll mode is turned on, measured data are displayed on the right side of the screen, and are "rolling: from right to left.

The oscilloscope in roll mode is capable of measuring up to 50 000 samples/s. Since it is impossible to watch waveforms on the screen so fast, there are two scroll bars for controlling the roll mode time base. The upper bar controls the speed of displaying the measured data, and can be set from 10000 s/div to 100 ms/div. Lower bar controls the sampling rate

and can be set from 0.005 samples/s to 50000 samples/s. When you change position of lower bar, upper bar moves, so that the sampling frequency is equal or higher than the display rate. If we move upper bar, lower bar adjusts so that the mentioned rule is kept. Data concerning the time base is shown in the time base window.

- sampling rate



- display rate

In case the display rate is lower than sampling rate, several samples are displayed into a single pixel. There are three ways how to display this pixel.

Maximum –  **-** maximum value is displayed

Average –  **-** average value is displayed

Minimum-  - minimum value is displayed

Storing Data in Roll Mode

All data are stored onto the hard-drive, when the "Autosave" control element is active (see 3.2.8.) The name of the file is the same as the name for saving data in normal mode. It can be changed by 

control element. The extension of this file is .dta, or .dtb. It depends on whether data were measured on channel A, or B. Stored data can be viewed with specialized viewer (see chapter 3.3.5.).

WARNING: While measuring in roll mode, data can be displayed and stored onto hard drive. The speed of your computer is a very relevant factor. When running one of the fastest roll modes, it may happen that not all data can be transferred into the computer and processed. In this case a vertical red line appears on the screen, which means that some data were lost. In this case we recommend following:
- exit all other applications
- close the window, where you can view the measured data
- lower the displaying rate
- turn off Autosave
- lower the sample rate

Synchronization in Roll Mode

You can select one of the four trigger modes.

AUTO – measurement runs continuously. Triggering does not affect the measurement.

NORMAL – measurement starts after trigger event occurs, and runs for time specified by the user.

SINGLE – user starts the measurement by pressing "Start" button. After that, oscilloscope waits for the trigger event to occur. Measurement time is set by the user.

MANUAL – user starts the measurement by pressing "Start" button. The user sets measurement time.

Mesurement time for Normal, Single and Manual mode can be set by the "Time" control element. This control element is located underneath the trigger mode control. Value represents time in seconds.

3.3. Main menu

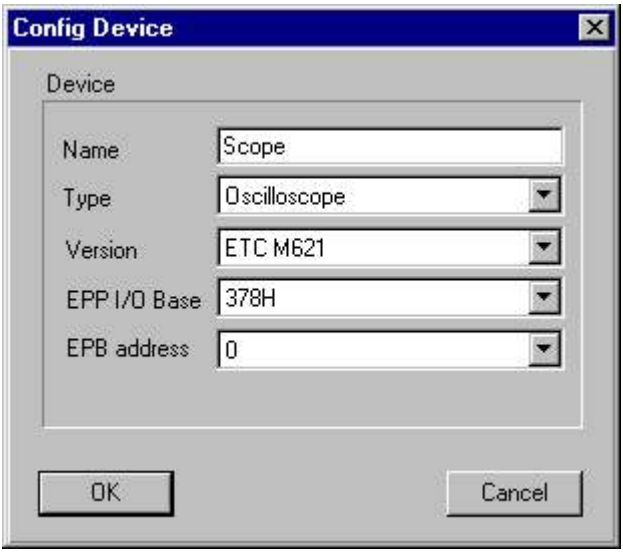
The menu bar allows the user to access all menu commands. To pick an individual menu item using the mouse, simply click on it. When using the keyboard you can access individual items using a combination of ALT and the underlined letter. It is possible to use arrow keys within the menu. If the item is followed by three dots (...), it causes the dialog window to open. If the item is followed by a right arrow (>), it opens another submenu.

WARNING: When using the menu, measurement stops. It comes back on after exiting the menu.

3.3.1. Setting parameters of individual devices

To set parameters such as base address and user code (MUC) simply pick *Device* | *Setup* from the main menu. It opens a dialogue window in which the user is able to change the device parameters.

To add a new device, pick Device | Add device from the main menu. It opens the same dialog window. The user is expected to state the device name, type, version, EPP address and EPB address. After confirmation, it will be possible to pick the device in the upper left corner of the screen.



Name - device's user given name (can be anything). This name will represent the relevant measuring device in the list of measuring devices.
Type - when using the SCOPE 621 software, always enter "Oscilloscope".
Version - when using the SCOPE 621 software, always enter "M621".
Parallel port base address – address of the EPP. Most of the time, this value is 0x378. You can find out this value in BIOS Setup.

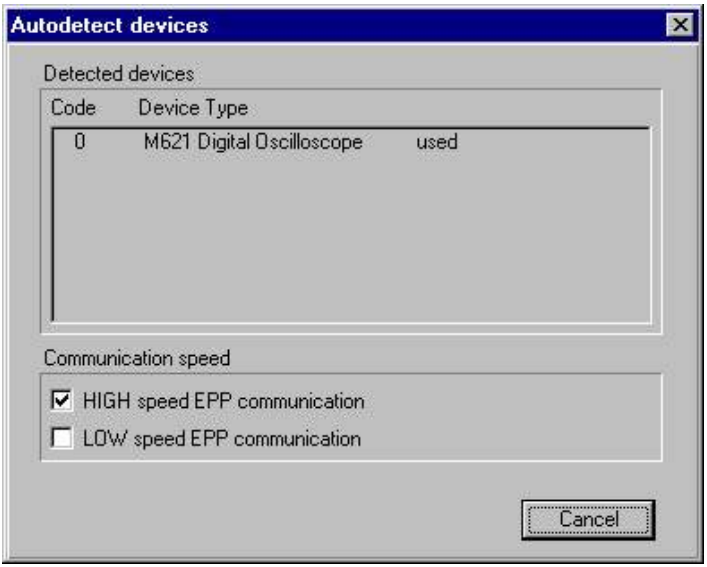
WARNING: Oscilloscope will not work in Normal, SPP, Bi-Dir or ECP mode.

EPB address- device address corresponding to the jumper settings on the M621 board.

Picking the item *Device|Remove* from main menu opens the dialog window, in which the user can select the device to be removed.

3.3.2. Automatic detection of measuring devices

The SCOPE 621 software includes the built-in possibility of detecting all EML II devices. After clicking on the *Device|Autodetect* item in the main menu, a dialog window opens, where the list of detected devices appears.



Besides the list of devices, software also displays the EPP communication status in the lower side of the window. Quality of communication depends on several factors, such as cable length, computer features, etc.

3.3.3. Device Testing

Item *Device | Test*, that can be pulled out from the main menu, is used to test the measuring device. After selecting this item, the dialogue window containing all instructions for device testing and probe compensation will appear.

3.3.4. Printing the measurement report

To print out the measurement report simply click on the *File|Print* item from the main menu. A window, where you can set up and preview the protocol. After pressing OK a standard dialog window opens, in which you can choose a printer. After selecting the desired printer, the software prints out the report.

In case you want to set up the printer before printing, just click on *File|Printer setup* item in the main menu.

TIP: The SCOPE 621 software supports color printing. It enhances the clarity of the report.

TIP: In case the printer report does not meet your requirements, you can export data into various different applications such as MS Excel.

3.3.5. Viewing data measured in Roll Mode

There are two menu items *Data|Viewing data* and *Data|Roll Mode* for displaying data measured in Roll Mode. Displayed data are acquired and stored into file in roll mode. In first case, you will be prompted by software for the name of the file where the data are stored in. The other menu causes currently measured data to be displayed. Data are displayed in window. Along the displayed data, there are two scroll bars. One, located below the displaying area serves for moving within the data file. The other, smaller one, located in the left-hand lower corner, you can set the ratio between number of measured and displayed samples.

In case you have changed the time base settings while the

measurement was running, it will be indicated by a vertical line.

WARNING: The *Data*|*Roll Mode*menu item is accessible only when Roll Mode and Autosave are turned on at the same time.

3.3.6. Setting up some features

The SCOPE 621 software allows you to store and restore the configuration of all control elements. Configuration is stored into a file, which is indicated by the user. Such a file has the default extension INI. There is also the SCOPE.INI file, in which the software stores the configuration of control elements when exiting the program. This data is used to set up the device when the program is restarted. For storing and loading the configuration data use the *Settings* | *Save* item or *Settings* | *Load* item from the main menu.

In case you are not comfortable with the present set colors of channels, cursors and some other elements, it is possible to change them by clicking on the *Settings* | *Colors* item from the main menu. In the dialogue window which appears after choosing this item, the program displays control elements and their colors. To change the color, click on Set color button, and pick the color in the dialog window, that follows it.

WARNING: After changing the color of channels A or B all elements related to certain channel in any way will change their color too.

After clicking on the *Settings* | *Shielding* item in the main menu, a dialog window, allowing user to set the digital shielding level, appears on the screen. It is possible to set shielding level to values: 2, 4, 8, 16, 32 or 64. The default value is 4.

TIP: We recommend you to use higher levels of Digital shielding for well synchronized signals only.

The last item in the Settings submenu is Commix. If there is a "√ " in front of the word Commix, it means, that this option is on. With Commix help on, when you point the mouse cursor over any element, after a short period of time a brief help text is displayed.

TIP: For the user, who has already mastered the oscilloscope, it would be better to turn the Commix help off, so as not to be disturbed from the measurement.

3.4. Exporting data

In case you need to transfer the measured data to other software for further processing, use the function Export. This function was designed to allow user to export data to any Windows oriented software. This is why it uses a clipboard. As an example we will describe exporting data to MS Excel. Using the controls for storing and restoring, choose which data to export. Click on the Export item in the main menu, and the program will store the selected data to the clipboard. Now you have to run the destination application, which in this case is MS Excel, and select Paste from the main menu, which makes data to form a table of up to 4 columns (1 column per channel). Following the same steps, it is possible to copy data into any program that works under the MS Windows and allows working with clipboard.

TIP: This feature stores all data to clipboard (not just displayed). Number of acquired data changes with measuring mode.

In case you want to save data exactly how they were acquired, you can use *Export|Save as a bitmap|White background* or *Export|Save as a bitmap|Black background*. Program saves the oscilloscope screen to file. File is standard bitmap format, and is using the same color depth as you have on your computer.

WARNING: Not all application supports all color resolutions when working with BMP files. For further processing, we recommend you to use MS Office package.

Pressing Alt+Printscreen, or Printscreen you save the screen to clipboard. Then you can Paste it into any application for further processing.

3.5. Help

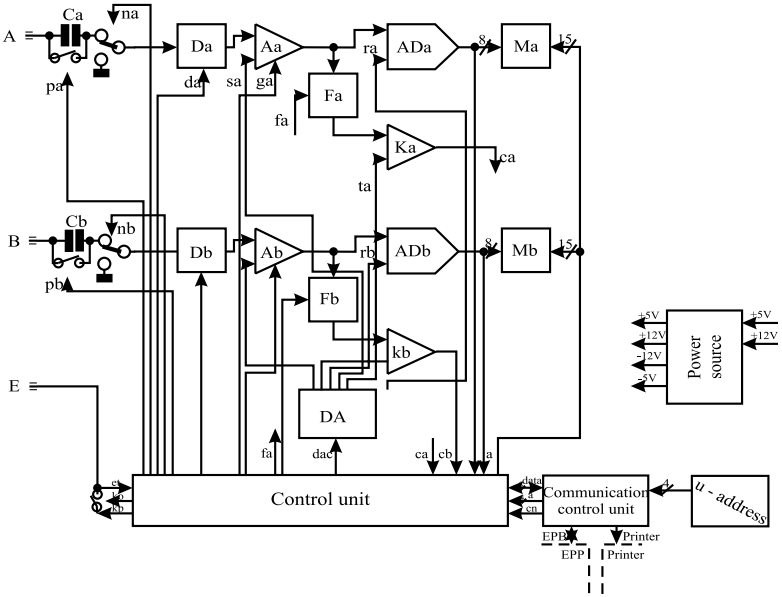
When you are struck by a problem while working with the SCOPE 621 software, you can find help either in the User's guide or in the SCOPE

621 software by selecting the Help item in the main menu. The help option in the SCOPE 621 software is written with respect to the standards of MS Windows environment. You can find more thorough information concerning Help and its use in the MS Windows User's guide.

Using *Help|Technical support* menu item you can find out how you can contact us in case you need any assistance with the M621 oscilloscope.

4. Hardware

The block scheme of the EM621 module is on figure 4.1. It consists of two parts analog and digital. Through the standard BNC connector and capacitor Ca (Cb), the measured signal is connected to the digitally controlled attenuator Da (Db). The Ca (Cb) capacitor can be shorted, using the pa (pb) signal. This allows to change input coupling (AC or DC). Grounding switch is controlled by the na (nb) signal. Digital signals da (db) control the input attenuator ratio (1:1, 1:10 or 1:100). Atteneuator output is connected to the input of amplifier with adjustable offset and gain. Using the ga (gb) signals, gain can be adjusted. Signals sa (sb) control amplifier's offset. Amplifier's outputs are connected to the fast A-D converter ADa (ADb) inputs, which provides digitization of the measured waveform. Amplifier's outputs are also connected to the comparator Ka (Kb) inputs through the controlled low-pass filter. Comparator generates the trigger signal for corresponding channel. Using the digital signals, the cut-off frequency of the filter is adjustable from about 200 MHz to 3.5 MHz.



The waveform's digitized pattern is stored into Ma (Mb) memory.

The device's control unit is equipped with sufficient logic to generate control signals for analog part and block of D-A converters (DA). These D-A converters provide signals for controlling the vertical shift, comparators' threshold voltage and A-D converters' reference voltage. The control unit also controls data acquisition and communication with data memory. The External trigger input E can be utilized in two different ways. The primary mode is the External trigger input. The secondary mode is the Compensation generator output. Modes are controlled by signal ko.

Communication with the EPB (ETC Printer Bus) provides the communication control unit using the device's address (ADDRESS). This unit also provides communication with the printer.

Oscilloscope is powered by voltages located on standard disk drive power connector (+5 V and +12 V). These are tranformed in the power block to voltages necessary for running the oscilloscope (+5V, -5V, +12V, -12V).

5. Technical specification

5.1. Vertical deflection system

Number of divisions per screen	8
Number of pixels per division	32
Deflection factor range	10 mV/div to 5 V/div in 1-2-5 sequence
Accuracy	± (2% of current value + 1 pixel)
Resolution	8 bits
Frequency response in +2 -3 dB range	DC coupling - 0 Hz to 150 MHz AC coupling - 1.2 Hz to 150 MHz
Step response rise time	max 2.33 ns
Channel isoloation	min -40 dB on whole frequency range
Input impedance	1 MOhm +5 % -3 %
Input resistance inaccuracy adjustment	Digital for absolute accuracy ± (2 % of current voltage + 1 pixel) + probe inaccuracy
Input capacity	20 pF ± 1 pF
Maximum input voltage	± 100 V on any range

5.2 Triggering

Triggering system type	dual level
Trigger source for primary level	Channel A, Channel B and external trigger input
Trigger source for secondary level	Channel A, Channel B and external trigger input
Threshold setting	Channel A and Channel B on the whole display range. External fixed about 1.2 V
Triggering signal slope selection	Leading or trailing edge independently on each input
Minimum trigger pulse period	6.5 ns from Channels A, B 20 ns from External trigger input
Minimum pulse trigger length	3 ns from Channels A, B 10 ns from External trigger input
Maximum voltage on external trigger input	-1 V to +6 V
Trigger coupling and adjustments	Analog low-pass filter of synchronization signals from channels A,B with cut-off frequency of 3.5 MHz. Digital filter with user-selectable length of trigger event. Counter of number of secondary trigger events.
Range of primary digital filter	2 to 65534 Ts (Ts = current sampling period)
Range of secondary counter	1 to 32768

5.3. Horizontal Deflection System

Available modes	Sweep after trigger (Normal Mode) Sweep before trigger (Pretrigger Mode) Continuous data acquisition (Roll Mode)
Data length	Normal Mode - 512 to 32256 samples for each channel selectable with 512 sample step Pretrigger Mode - totally 32768 samples per channel, with ratio of data before and after trigger selectable with step of 512 samples Roll Mode - limited only by the capacity of computer's hard disk
Sweep time base range	Normal Mode - 10 ns/div to 200 ms/div in 1-2-5 sequence 200 ms/div to 3.2 s/div in 2-4-8-... sequence Pretrigger Mode - 1 us/div to 200 ms/div in 1-2-5 sequence 200 ms/div to 3.2 s/div in 2-4-8-... sequence Roll Mode - 1 ms/div to 50 000 s/div with 1-2-5 sequence for recording (fastest rate depends on the speed of the computer) 100 ms/div to 10 000 s/div in 1-2-5 sequence for displaying
Sweep accuracy	Normal Mode ± 0.1 % for ranges from 1us/div to 2.3 s/div ± 0.5% for ranges from 100 ns/div to 500 ns/div ± 2% for ranges from 10 ns/div to 50 ns/div Pretrigger Mode - ± 0.1 % of whole displayed range Roll Mode - ± 0.1 % of whole displayed range
Sampling frequency range	Normal Mode - real time 1000 Hz to 50 MHz repetitive 1000 Hz to 5 GHz Pretrigger Mode - 1000 Hz to 50 MHz Roll Mode - 50 Hz to 50 kHz

5.4. Compensation Generator

Output connector	BNCtogether with External trigger input
Output impedance	about 150 Ohm
Output waveform	Rectangle with 1:1 ratio
Output waveform period	Automatically with respect to the time base, so that two periods are displayed on screen (when in 1:64 B Sweep mode)
Output voltage	about 3.5 Vpp

5.5. Power sources

Power sources	M621/I -	+5 V ± 5% max 750 mA +12 V ± 10% max. 80 mA
	M621/E -	+12.5 V to 20 V DC; max 4.8 VA

Appendix A: Time base ranges - sweep after trigger

No	mode	t/div 1:64	t/div 1:1	acquisition of 512 samples	acquisition of 32256 samples	equivalent sampling period	equivalent sampling frequency
1	R	10 ns/d	640 ns/d	10.1 µs	645 µs	200 ps	5 GHz
2	R	20 ns/d	1.28 µs/d	10.1 µs	645 µs	400 ps	2.5 GHz
3	R	50 ns/d	3.2 µs/d	10.1 µs	645 µs	1 ns	1 GHz
4	R	100 ns/d	6.4 µs/d	10.1 µs	645 µs	2 ns	500 MHz
5	R	200 ns/d	12.8 µs/d	10.1 µs	645 µs	4 ns	250 MHz
6	R	500 ns/d	32 µs/d	10.1 µs	645 µs	10 ns	100 MHz
7	N	1 µs/d	64 µs/d	10.1 µs	645 µs	20 ns	50 MHz
8	N	2 µs/d	128 µs/d	20.5 µs	1.3 ms	40 ns	25 MHz
9	N	5 µs/d	320 µs/d	51.2 µs	3.2 ms	100 ns	10 MHz
10	N	10 µs/d	640 µs/d	102 µs	6.5 ms	200 ns	5 MHz
11	N	20 µs/d	1.28 ms/d	205 µs	12.9 ms	400 ns	2.5 MHz
12	N	50 µs/d	3.2 ms/d	512 µs	32.3 ms	1 µs	1 MHz
13	N	100 µs/d	6.4 ms/d	1.02 ms	65 ms	2 µs	500 kHz
14	N	200 µs/d	12.8 ms/d	2.05 ms	129 ms	4 µs	250 kHz
15	N	500 µs/d	32 ms/d	5.1 ms	323 ms	10 µs	100 kHz
16	N	1 ms/d	64 ms/d	10.2 ms	645 ms	20 µs	50 kHz
17	N	2 ms/d	128 ms/d	20.5 ms	1.29 s	40 µs	25 kHz
18	N	5 ms/d	320 ms/d	51.2 ms	3.23 s	100 µs	10 kHz
19	N	10 ms/d	640 ms/d	102 ms	6.45 s	200 µs	5 kHz
20	N	20 ms/d	1.28 s/d	205 ms	12.9 s	400 µs	2.5 kHz
21	N	50 ms/d	3.2 s/d	512 ms	32.3 s	1 ms	1 kHz

Appendix B: Time base ranges - Roll Mode

Number	sampling	displaying time/div
1	50 kS/s	
2	25 kS/s	
3	10 kS/s	
4	5 kS/s	
5	2.5 kS/s	
6	1 kS/s	
7	500 S/s	100 ms/d
8	250 S/s	200 ms/d
9	100 S/s	500 ms/d
10	50 S/s	1s/d
11	25 S/s	2s/d
12	10 S/s	5s/d
13	5 S/s	10 s/d
14	2.5 S/s	20 s/d
15	1 S/s	50 s/d
16	0.5 S/s	100 s/d
17	0.25 S/s	200 s/d
18	0.1 S/s	500 s/d
19	0.05 S/s	1000 s/d
20	0.025 S/s	2000 s/d
21	0.01 S/s	5000 s/d
22	0.005 S/s	10000 s/d

Appendix C: Format of data stored onto hard disk by the SCOPE 621

The SCOPE 621 software allows you to store data onto the disk. There are two different formats used for storing the data.

1. Data stored in Normal Mode

Data are stored using the Windows Profile format. The detailed description of this format can be found in MS Windows Programmer's Guide. This format allows to store data in text file. Each file contains 500 samples, which were on the oscilloscope screen.

2. Data stored in Roll Mode

Data are stored in specialized format (*.DTX). The complete description of this format is in M621 Development Kit, or on the ETC website (http://www.etcsk.com).

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