

# 1. General Information

## 1.1.1. Minimum Hardware requirements

- PC 386 compatible computer
- 4 MB RAM
- 3.5" FDD
- VGA
- Mouse
- 2 MB free hard disk space
- ETC EM221 digital oscilloscope
- ETC EM321 waveform generator

## 1.1.2. Recommended hardware

- PC 486/120 MHz or better
- 8 MB RAM or more
- ETC E261/13 Oscilloscope probe with selectable attenuation
- ETC EA424 External attenuator module 2x24 dB
- Others same as in Minimum requirements

## 1.2. Features

The main purpose of the ETC Wobbler is measuring the frequency – amplitude characteristics simultaneously on both channels. The frequency range is 0.1 Hz to 500 kHz with gain from 0.01 to 62500. The above-mentioned information concerning the gain range is accurate with the use of EA424 attenuators and E261/13 oscilloscope probes. Following table shows the valid values with respect to the connected hardware. It shows the input voltage ( $U_b$ ) and the output voltage of the measured module.

EA424	E261/13	$U_b$ [mVeff]	$U_o$ [Veff]	Au
-	1:1	220 – 3500	0.035 – 5.6	0.01 – 25
-	1:10	220 – 3500	0.35 – 56	0.001 – 2.5
-24 dB	1:1	14 – 220	0.035 – 5.6	0.16 – 400
-24 dB	1:1	14 – 220	0.35 – 56	1.6 – 4000
-48 dB	1:1	0.9 – 14	0.035 – 5.6	2.5 – 6250
-48 dB	1:10	0.9 – 14	0.35 – 56	25 – 62500

*Please note that when we mention the 1:1 attenuation, we speak about using a 1:1 probe or no probe at all.*

The measurement accuracy is better than  $\pm 0.5$  dB in the whole frequency range.

Dynamic range of the measurement depends on the appropriate setting of the generator output voltage. Technically, the dynamic range is derived from the gain span of each configuration of the hardware. Its value is 2500, i.e. approximately 68 dB. Reaching such a result means optimal use of the hardware; therefore the practical results will always be a little worse. If we, for example, use the constant excitement voltage for the whole bandwidth, the measurement range drops to 44 dB. Dynamic range of gain measurement, using the constant excitement voltage, depends on the maximum output voltage of the measured object.

$$R_d = U_r / U_{om}$$

where  $U_r$  is maximum value of the output voltage of the measured object  
 $U_{om}$  is minimum value of the  $U_o$  voltage according to the above-mentioned table.

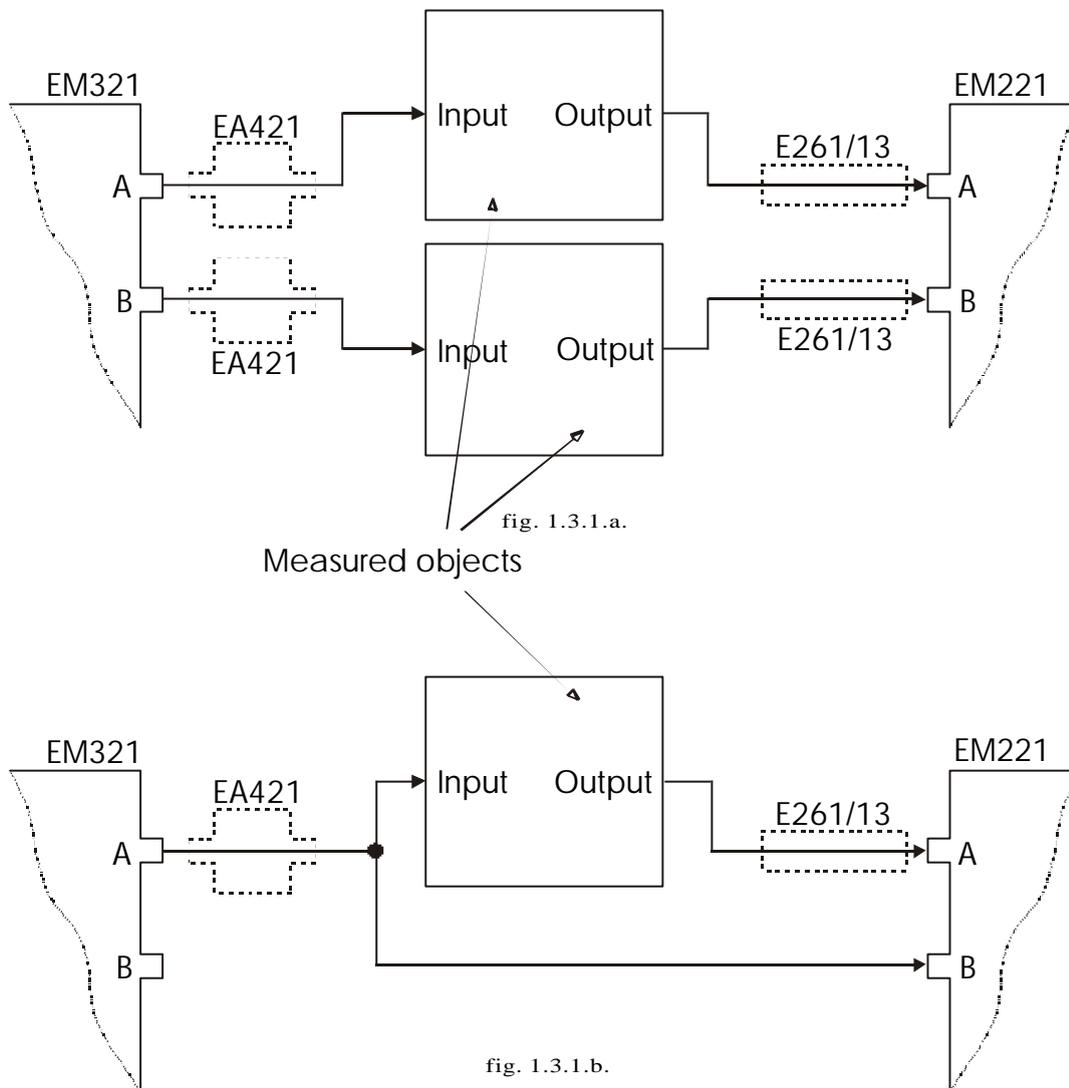
When, for example, the maximum value of output voltage of the measured object is 1.55 Veff, the measuring range is 33 dB (when using 1:1 probe) and 13 dB, when using 1:10 probe. Thus, you can see that it is essential to optimize measuring configuration with respect to the expected value.

You can determine whether you are getting valid results by watching the shape of the waveform that comes out of the measured object.

Time needed for measuring depends on the number of measurements taken within the measurement of one characteristic and on the lowest frequency where is the measurement taking place, because measuring on lower frequencies takes more time than on high frequencies. Measuring times can; therefore, vary. They can extend from seconds to even minutes.

### 1.3. Connecting the hardware

There are, generally, two different ways how to connect the hardware to work with the ETC WOBBLER software. Both ways are pictured on the following figure. (1.3.1a and 1.3.1b)



The hardware setup shown on figure 1.3.1a allows you to measure frequency characteristics of two systems on a same bandwidth simultaneously. “Two systems” mean two channels of the same device or even two completely independent devices. Input voltage, usage of the EA421 Attenuator unit, and the type of the probe can be set individually for each channel. Measurement is taking place on both channels simultaneously. The described setup allows you to measure in a full range of gains according to the above mentioned table. In order for the results to be correct, the input impedance of the measured object has to be much higher than output impedance of the M321 AWG (75 Ohm), or has to be defined by one of the circuits that are offered by the ETC WOBBLER software. If there is a input impedance drop from 1MOhm to 7500 Ohm as a consequence of the frequency change, and it cannot be described by any of the offered circuits, the measurement will be approximately 1% inaccurate. However, if the impedance fluctuation is greater, the measurement error could rise. In this case, we recommend using the setup shown on figure 1.3.1b. In this setup, the B channel of the oscilloscope is used for measuring the real value of the input voltage. However, considering the oscilloscope technical specifications the input voltage has to be higher than 70 mVeff. When you use lower values, the measurement error could increase above the guaranteed value.

# 1. Installation

Run "Setup" from the enclosed disk. It will guide you through the installation process.

## 1.4. Running the program for the first time

When the base address or MUC of the EM221 and EM321 are different than factory defaults, the Setup window appears on the screen. There you can set the current values, or run a Demo mode, if you do not have your EM221 and EM321 connected.

## 1.5. Testing the program functionality

Using a coaxial cable, connect the EM321 output A to the M221 input A and click on "START" button. You should see a horizontal line appearing at the level of 0.00 dB with error max 0.5 dB.

If there are vertical shaded areas, it means that there is a interference, therefore it is necessary to eliminate its source.

However, when you still do not get the results described above even after checking the connection and eliminating the interference source please do not hesitate to contact the manufacturer.

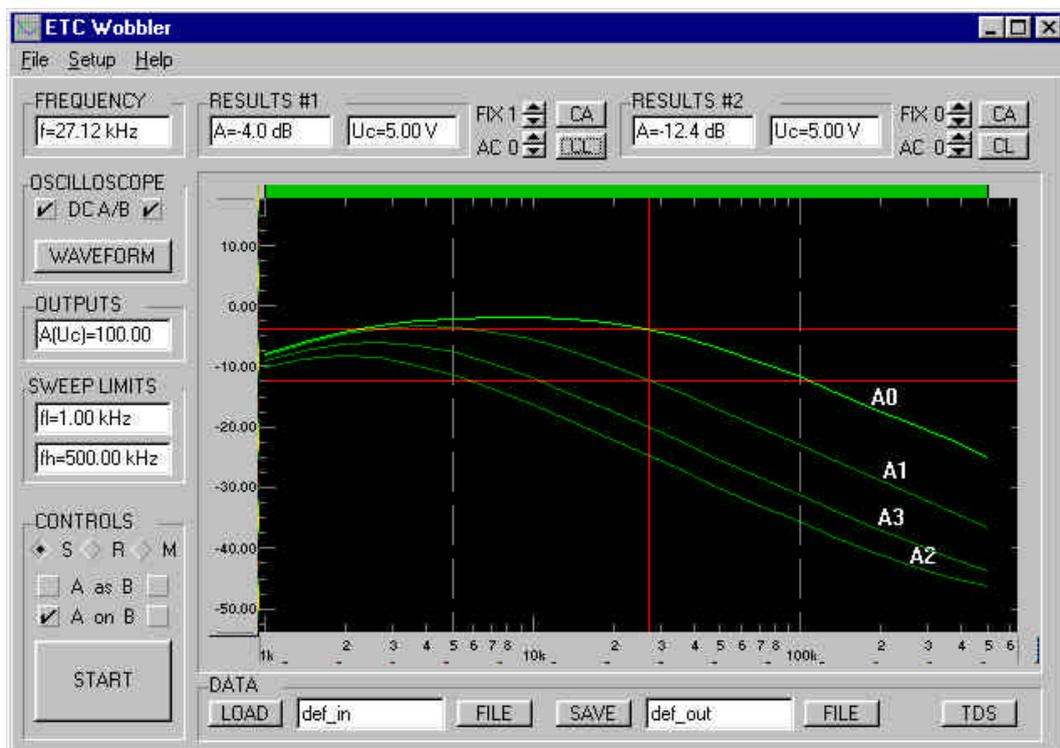
# 2. Using the system

## 3.1. Main screen

There are all necessary control elements used for running and controlling the measurement on the main screen.

It can be divided into following main parts:

- Displaying the measured values and controlling the storage area. (FREQUENCY, RESULTS #1, #2, FIX, AC, CA, CL)
- Controlling the Oscilloscope and the Generator (OSCILLOSCOPE, OUTPUTS)
- Measurement bandwidth limits (SWEEP LIMITS)
- Storing, restoring and labeling measured data (DATA LOAD, SAVE, TDS)
- Controlling measurement modes and starting the measurement (CONTROLS, AS A/B, ON A/B, START)



## FREQUENCY

In case the mouse cursor is located over the displaying area, it shows its position with respect to the frequency (horizontal) scale. During measurement it shows the frequency value where is the measurement taking place.

## RESULTS #1, #2

The RESULTS box shows the cursor position with respect to the voltage (vertical) scale. The **A** box shows gain in dB, and **Uc** shows the corresponding amplitude.

## FIX, AC, CA, CL

The purpose of these elements is to control waveform memory, where elements located by RESULTS #1 control waveforms measured via the A channel, and ones located by RESULTS #2 control memory that belongs to the B channel.

**FIX** is a number of *fixed* function, that is used as reference in comparative processing of measured data.

**AC** – number of the storage area where the measured waveform is stored.

**CA** – erases entire storage area and **CL** clear current waveform.

## OSCILLOSCOPE

**WAVEFORM** shows the shape of the measured object output signal

**DC A/B** turns on/off DC coupling on the oscilloscope. In case you are measuring characteristics under 5.0 Hz, it is necessary to turn DC on.

## OUTPUTS

Generator output voltage (in %) with respect to the bands properties.

## SWEEP LIMITS

These values specify start and end frequency, between which the characteristics will be measured. It is not possible to specify values out of the range defined in bands properties.

## DATA LOAD, SAVE

Using these elements you can store and restore measured waveforms together with its settings. Edit boxes show current file name in current directory (without extension). In case you need to handle files in different directory you have to use the **FILE** button.

## CONTROLS

This group of control elements controls program during the measurement.

**START** starts the measurement. After the measurement is started, it changes its label to **STOP (STOPPING)**, and allows user to stop the running measurement.

Buttons **S, R, M** allow you to select the measurement mode.

- **S (SINGLE)** – after pressing start, program measures characteristics on a whole bandwidth, but just once and the stops.
- **R (REPETITIVE)** – after pressing start, program measures through the whole bandwidth repetitively. After clicking on STOP its label changes to STOPPING and program stops after finishing current measurement. When you press this butt once more measurement stops instantly.
- **M (MANUAL)** - after starting the measurement program waits for you to select the frequency where should the measurement take place. You can do this by pointing mouse cursor over the desired frequency and clicking on the left mouse button. Horizontal cursors show the measured and the original value of the frequency characteristic. These values are also shown in RESULTS #1 and RESULTS #2. During the measurement it is possible to change the frequency by dragging a vertical cursor to different frequency. During dragging the measurement stops and it restarts when dragging is finished. By clicking on STOP you terminate the measurement.

**WARNING: While measuring, we recommend not to manipulate with control elements, because when using slower computer it can lead to instability of the whole system.**

## AS A/B

Turns on the AUTOSTEP mode. When turned on, the AC index increases by one after finishing measurement.

## ON A/B

Enables measurement on corresponding channel. In case no channel is selected, it switches to so-called *comparative mode* (fig. 1.3.1b).

### 3.1.1. Displaying measured waveform

#### 3.1.1.1. Displaying description

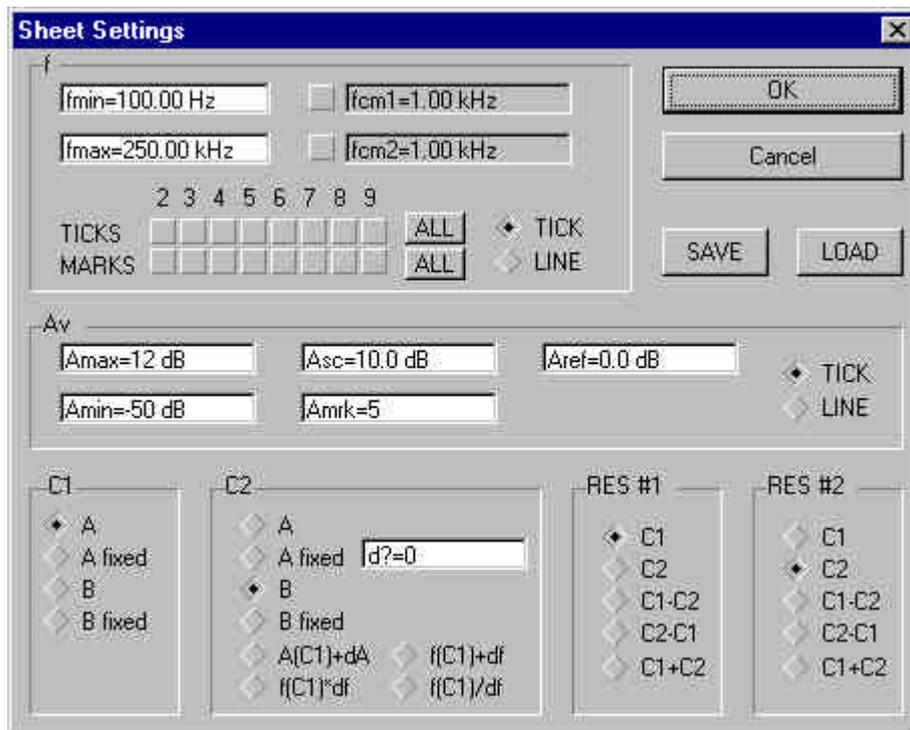
The central area of main window graphically shows the measured data. Two measuring cursors copy to position of the mouse cursor and show the frequency and measured value according to the frequency. There can be up to two vertical cursors on the screen, and each one shows results of assigned waveform. All values are shown in RESULTS area.

In case it was not possible to measure any reasonable value (due to interference, or so...) the area is shaded and results are not defined.

Vertical and horizontal range can be adjusted using the rulers located on the sides of the display area.

#### 3.1.1.2. Sheet settings

Clicking the right mouse button above the display area the Sheet Settings window opens. There you can set cursors and display properties.



##### 3.1.1.2.1. Group *f*

This control element sets properties concerning the horizontal (frequency) axis

- *fmin*, *fmax* minimum and maximum values of displaying frequency on the horizontal ruler
- *fcm1*, *fcm2* set frequencies where user defined marks will be placed. This way you can highlight important frequencies.
- *TICKS* turns the displaying of the mark on and off.
- *MARKS* turns the label of each tick on or off.

##### 3.1.1.2.2. Group *Av*

- *Amax*, *Amin* minimum and maximum for vertical axis
- *Asc* specifies the step of marks from the *Aref* level.
- *Amrk* specifies the step using which the marks will be labeled.

- **TICK, LINE** selects the way of displaying marks. (as ticks or long lines).

### 3.1.1.2.3. **Group C1**

Sets properties of horizontal cursor 1

- **A, B** currently selected waveforms (AC)
- **A fix, B fix** - cursor displays values of the fixed waveform (see FIX in 3.1. Main screen).

When in Manual mode, the A, and B display current values measured on each channel.

### 3.1.1.2.4. **Group C2**

Sets properties for horizontal cursor 2. It has the same options as C1, plus following:

- **A(C1) + dA** displays the value of C1 increased by dA
- **f(C1) + df, f(C2)\*df, f(c1)/df** – creates secondary vertical cursor, which is df away from the primary one. It displays the same waveform as C1, at the frequency determined by the secondary vertical cursor.

### 3.1.1.2.5. **RES #1, RES #2**

This property determines what values will be displayed in RESULTS fields on the main screen.

The displaying options are following:

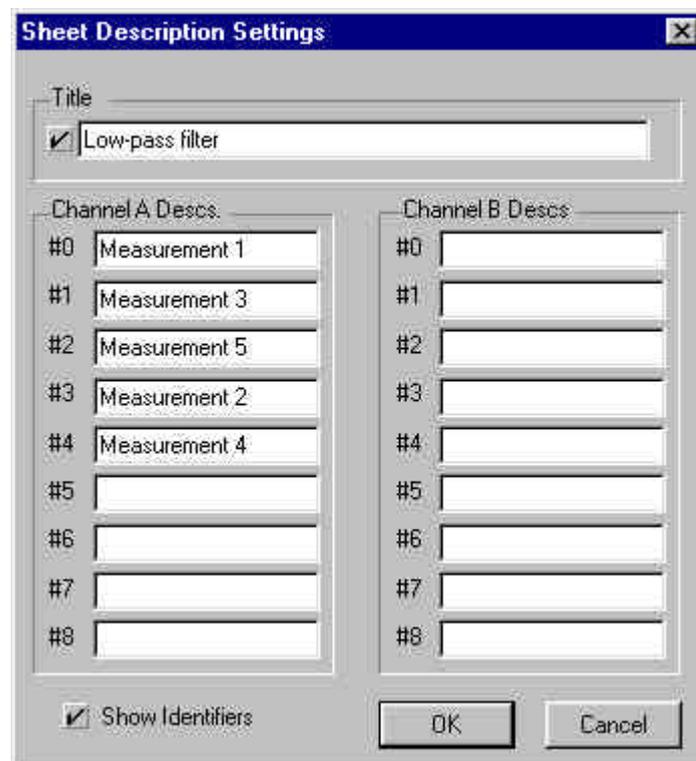
- C1 – values according to the position of C1 cursor
- C2 – values according to the position of C2 cursor
- C1 – C2 – difference between C1 and C2
- C2 – C1 – difference between C2 and C1
- C1 + C2 – sum of C1 and C2

### 3.1.1.2.6. **SAVE, LOAD**

Storing and restoring the setting to and from the disk.

### 3.1.1.3. **Labeling the measured waveforms**

By pressing a TDS button in right hand bottom side of the main screen you open the following window.



#### 3.1.1.3.1. **Title**

You can enter the title into the field and check the checkbox on the left side and the entered text appears on the screen and on the printer output.

### 3.1.1.3.2. Channel A, B Descs, #0 ... #8

Here you can enter the labels for each of the waveforms measured either by channel A or channel B. In case you enter the text, it will be displayed ONLY on the printer output.

### 3.1.1.3.3. Show Identifiers

Showing small labels clearly identifying waveforms. When the box is checked labels will be shown on screen and on the printer output. The horizontal position of the labels can be easily set using mouse by setting a cursor to the desired position and clicking the left mouse button.

## 3.2. Bands properties

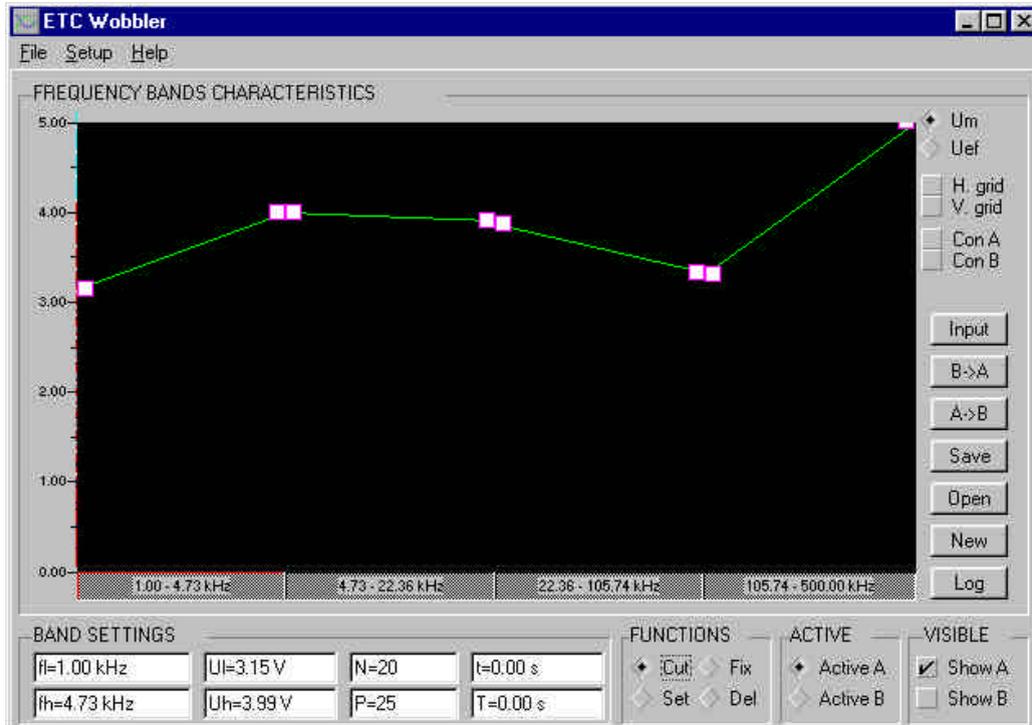
You can enter the Band properties window through the *Setup/Bands* menu.

### 3.2.1. Specifying bands

The following screen is used for specifying the characteristics using which the generator output waveform is generated.

Description of each part of the screen:

- Displaying the output voltage with respect to the frequency
- Entering amplitude (Um) or effective voltage (Ucf)
- Displaying the band characteristics (SWEEP BAND LAYOUT)
- Tools for manipulating with bands (FUNCTION, #A->#B, #B->#A, New)
- Displaying the ACTIVE and VISIBLE band.
- Storing (SAVE) and restoring (LOAD) the band settings to and from the disk.
- Specifying the input impedance of the measured object (input)
- Selecting between logarithmic or linear scale (Log, Lin)
- Displaying horizontal (H. grid) and vertical (V. grid) grid.
- Displaying the connection between end points of the voltage curve (Con #A, Con #B).



Measurement is done through the whole bandwidth that comprises of many user-defined bands. All user-defined bands have to be next to each other, i.e. there cannot be any empty space between them. It is possible to set the properties for each of the user-defined band.

**WARNING:** *Active channel means the channel you are currently editing. Visible channel is the one that is currently displayed.*

There are following tools to manipulate with bands.

- **Cut** – Dividing the band into two. When you move the cursor over band stripe, it changes its shape to scissors. By pressing the left mouse button, the band splits into two at that point.
- **Set** – Setting the current band. The band characteristics can be changed using the mouse or entering the values.
- **Fix** – Setting an active band. Measurement runs only through active bands. If there is a need to measure on a non-continuous band, you can set bands you want to measure as active and rest as inactive.
- **Del** – Deleting the band. When you move the cursor at the edge of the bands, its shape changes to hand. By clicking the mouse button you merge the two bands together.
- **New** – Clears the old and creates the new output voltage characteristic.
- **#A->#B, #B->#A** – copying characteristics between the channels

### 3.2.2. Bands characteristics

Each band is defined by following values:

$f_l, f_h$  – low (initial) frequency and high (ending) frequency of the band.

**TIP:** *The  $f_l$  and  $f_h$  values can be changed using a mouse. Move the cursor to the edge of the band and drag the edge to the desired frequency.*

$U_l, U_h$  – Values of the generator output voltage at the beginning and at the end of the band. The voltage level changes logarithmically from  $U_l$  to  $U_h$ . It is possible to enter the amplitude value ( $U_m$ ) or effective value ( $U_{ef}$ )

**TIP:** *The  $U_l$  and  $U_h$  values can be changed using a mouse. It can be done by dragging a small square on the side of the voltage level line. To change a vertical resolution, just grab the upper side of the vertical ruler and move it.*

$N$  – Number of measurements done within the band

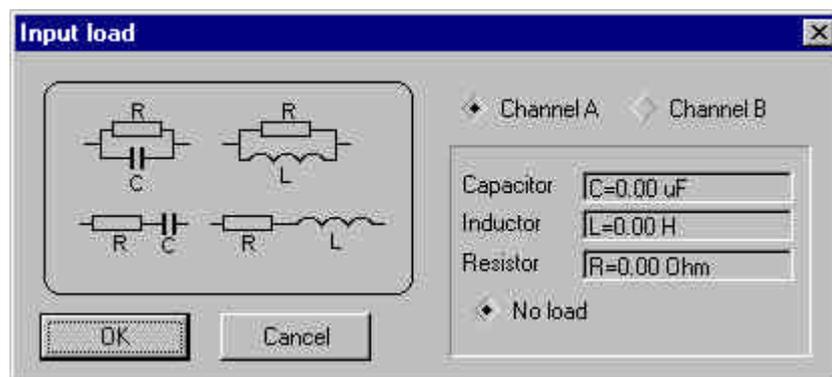
$P$  – number of measured periods. Defines a minimum number of periods that determine the amplitude.

$t$  – wait time before measurement, i.e. time that device waits between setting up an input voltage and measuring output.

$T$  – wait time when software finishes measurement within one band and starts in another.

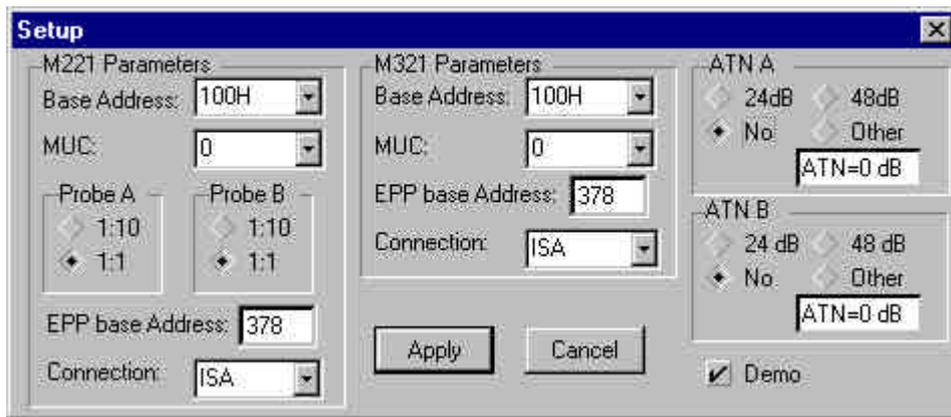
### 3.3. Input Load

In following window you can set up an estimate load of the circuits that are connected to the generator's output.



By clicking to one of the schemes you will be able to enter values of each element. In case you do not specify any value, it is taken as infinite. The generator output impedance is 75 Ohm.

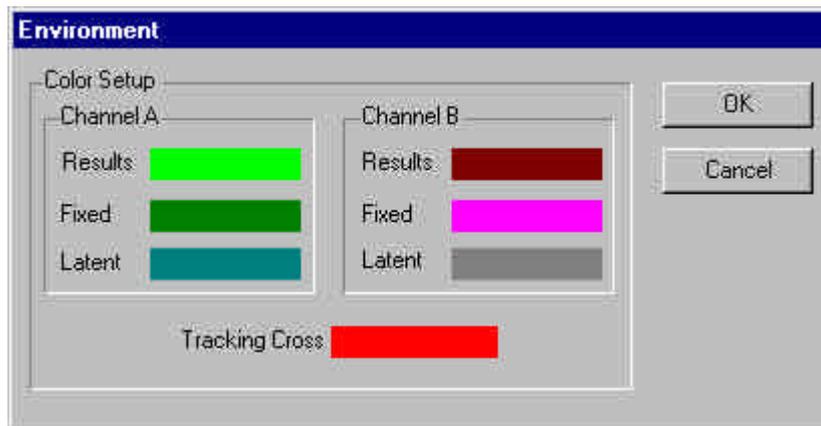
### 3.4. *Setting up the hardware*



**M221 Parameters** setting up the MUC and Base address of the M221  
**Probe A,B** specifies attenuation of the probe connected to the oscilloscope  
**M321 Parameters** BI setting up the MUC and Base address of the M321  
**ATN A,B** specifies the EA424 attenuator characteristics.  
**Demo** runs Demo mode

In case of misconfiguration this window will reappear when you attempt to start the measurement.

### 3.5. *Setting up the Environment*



Here you can change basic colors of the software user interface. Color specified for **Results** is valid for AC waveforms. Color by **fixed** is for FIX waveforms. The rest waveforms are drawn with color specified by **latent**. **Tracking cross** is a color of cursors.

You can change colors by clicking the left button of the mouse over the colored area.

### 3.6. *Menu*

#### 3.6.1. *File*

**New** – clears all setting and sets them to default values.

**Open** - Restores the settings and measured waveforms from disk.

**Export** – Exports the data into MS Excel, or MS Word using the clipboard. It is possible to select which data are to be exported.

**Print** –Printing the measured data. Printer output should look exactly like screen. It is advisable to check the output before printing using **Print Preview**.

**Print preview** – previews printer output before printing

**Printer setup** – setting concerning the printer

**Save & Exit**- Saves the current setting on disk and exits.

**Exit**- Exits program

### **2.6.2. Setup**

**Bands** – Opens the Band setup window

**Main**- Opens main window

**Environment** - Opens the window concerning the Environment settings

**Setup** – Hardware setup

### **3.6.2. Help**

**Topic** – online documentation

**ETC on WWW**- Connection to the ETC Home page

**About**- about the application