



«Vremya-CH»

ACTIVE HYDROGEN MASER

VCH-1003M

**User Guide
411141.032UG**

*67, Osharskaya street, Nizhny Novgorod, 603105, Russia
"VREMYA-CH" JS Company,
Tel.- Fax: +7-831-421-02-94
E- mail: admin@vremya-ch.com, Web site: <http://www.vremya-ch.com>*

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I. Introduction

This manual describes how to set up and use Active Hydrogen Maser VCH-1003M (hereinafter named as “Standard”). The standard is intended for the use as the source of precision signals for time and frequency measurements.

The possibility of the remote control of the Standard and the diagnostics of its status by means of the communication line and Internet is provided.

The complete configuration of the Standard has the structure shown in Fig.I.1.

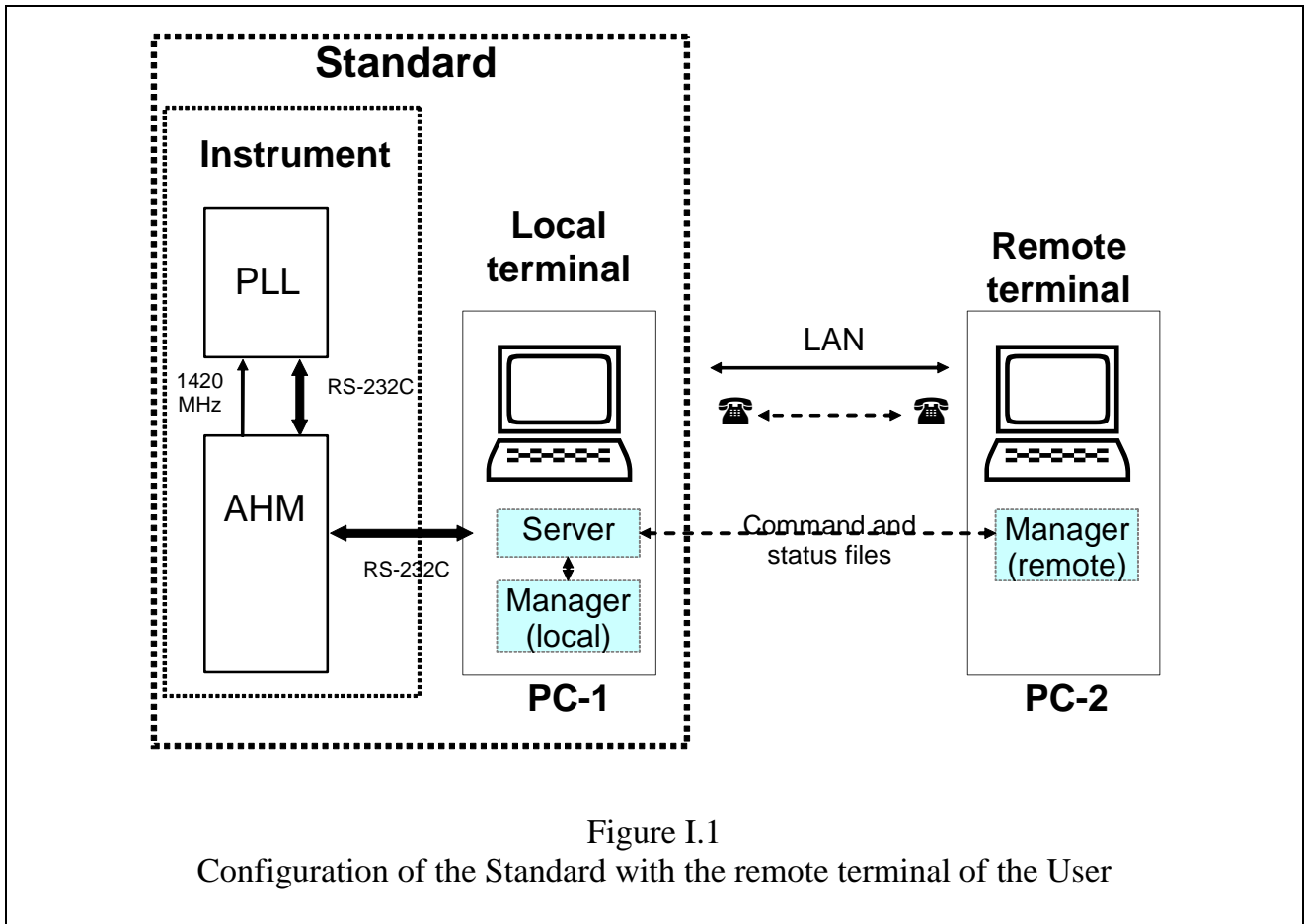


Figure I.1

Configuration of the Standard with the remote terminal of the User

The following units are allocated here:

Standard – H-maser VCH-1003M;

Remote terminal – the remote terminal of the User PC-2.

Standard consists of the following main blocks:

AHM – H-maser (physical package);

PLL – radioelectronic system (PLL Unit);

PC-1 – the Host computer or Local control terminal. The program Server and the program Manager are installed here;

PC-2 – optional remote terminal of the User. Only the program Manager is installed there.

The terminals PC-1 and PC-2 provide:

- 1) The generation of commands for Standard management.
- 2) The processing of the data that characterize the operation mode of the Standard.
- 3) The dialogue mode of the management through the screen interface.

There are two possible ways of the link between terminals providing the functions of the remote management by the Standard:



– Local or global network.



– Telephone communication line.

The Standard management, on the choice of the User, can be executed:

- 1) By the Local Control terminal PC-1.
- 2) By the Remote Control terminal PC-2:
 - Through the local network.
 - Through the telephone communication line.
 - Through the Internet.

The choice of the way for the remote management by the Standard is executed with the help of the software installed on the User remote terminal PC-2.

1. Installation of the software

To install the software of the Standard the certain requirements to the configuration and software of personal computers must be fulfilled.

1.1. Requirements to personal computers

1.1.1. Host computer PC-1

For the functioning of the Standard the usage of the host computer with the type not lower than Pentium, RAM 512 Mb, free space 500 Mb on the hard disk, one free RS-232C serial port or USB port with USB – RS-232C converter is necessary.

The host computer **PC-1** executes the functions of the Control terminal. The operational system Windows™ 2000,XP,Vista,7 should be installed on this computer.

To provide the function of the remote management through the phone it is necessary to connect a modem to the computer, and to install the software **Dial up server** or use OS Windows™ XP Professional.

To provide the function of the remote management through **Internet** the computer should be continually connected to **Internet** and have the fixed IP address. Besides, it is necessary to launch the program of the **FTP-server** on the host computer.

There is an alternative way of remote control – using a remote desktop.

1.1.2. Remote computer PC-2

The remote computer **PC-1** executes the functions of the distant user terminal. It is possible to use a computer of the type IBM PC/AT with the following minimal configuration: the processor Pentium, RAM 512 Mb, free space 500 Mb on the hard disk.

The operational system Windows™ 2000,XP,Vista,7 should be installed on the remote computer.

To provide the function of the remote management through the phone it is necessary to connect a modem to the computer.

1.2. Installation of the software

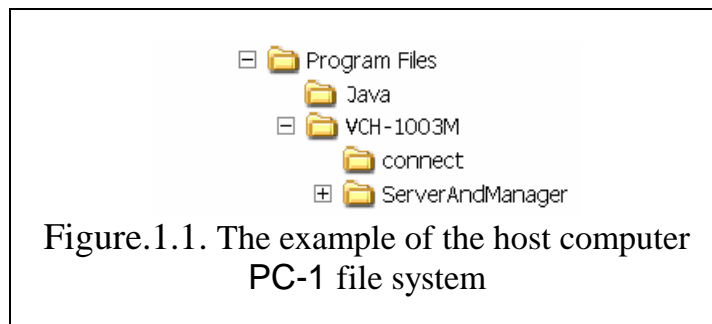
The installation of the software is to be executed from the CD. The CD contains two folders: *Server And Manager Software* and *Manager Software*.

The installation of the software on the host computer **PC-1** is executed from the folder *Server And Manager Software* of the CD. The installation of the program-manager on the remote computer **PC-2** is executed from the folder *Manager Software*. To install the software it is necessary to run the file *setup.exe* from appropriate folder.

On computers running Windows Vista or Windows7 it is recommended to install the software in the folder which is not located on the system drive C:. Otherwise it is necessary to set a minimum level of protection, allowing to the installed program to make records of files into working folders. Protection level can be operated by means of section "User accounts" of the Windows Control panel.

An example of a part of the host computer **PC-1** file system is presented in . The folder VCH-1003M with two subdirectories that have the identical level is shown here:

- **connect** – the folder containing files for the providing of the data exchange between the program Server and the program Manager (this folder is created by the program VCH-1003M Server). The program Server writes files with the information about the maser state into the folder **connect**. The program Manager reads those files then represents the information on the screen interface. For one’s part the program Manager writes files with user commands into the folder **connect**. The program Server reads those files then executes the commands, i.e. sends the corresponding messages into the device though serial interface RS-232C. Note, that it is necessary to allow full access (read, write, delete files) to this folder to support remote management by PC-2;
- **ServerAndManager** – the folder containing the program Server and the program Manager.



The arrangement on disks of the computer and the names of all catalogues, except the folder **connect**, can be arbitrary.

The folder **Connect** should be announced as home (or root) with full access for the remote users in case of using of remote management by means of FTP. The appropriate declaration is to be made in FTP server settings.

That folder should be announced as the *shared resource with full access* also to provide the management with the aid of the remote terminal via LAN. In this case it is necessary to set the disk drive of PC-1 with installed software as virtual network disk drive on the PC-2. For the system security the folder **ServerAndManager** should be closed for the external users. All higher level catalogues are also recommended to close for the external users.

The shortcut of the program Server (h_server.exe) is automatically placed into the **Start Up** folder during installation.

When you reinstall the software (for example, to recover faulty files) save existing files h_server.ini, hmanager.ini, sconfig.sav before continuing the installation, Put them into destination folder after installation before running the programs Server and Manager! In this case the mode of operation of the standard will not be changed.

1.3. File h_manager.ini

The installation of the software results in occurrence of the file hmanager.ini in the folder **ServerAndManager**.

The possible content of this file is shown below with brief comments. Almost all records in this file are created automatically by the program Manager except mentioned.

[Server]

ServerPath=d:\Program Files\VCH-1003M\connect – path to the folder connect.
Here “d:” can denote the local disk drive or the virtual disk drive if described file h_manager.ini relates to remote Manager.

Local=-1 – the type of the connection with the program Server.
LAN=0
DialUp=0
TCP/IP=0

[TCP/IP]

Host=192.168.125.1 – IP address of the Control terminal PC1.
User=abcd – remote user name fixed in FTP-server settings for distant manager.
Passv=2222 – password fixed in FTP-server settings for distant manager.

[GaugeAdj]

Adjust=0 – permission to change the set “Limits” of the Standard parameters (see item 3.7). *It should be established by the manufacturer manually.*

[Common]

StartPassv=1 – protection from unauthorized control. If this parameter is equal to 1, the password will be asked when program Manager starts. *It should be established by the user manually.*
ContrlPassv=1 – protection from unauthorized control. If this parameter is equal to 1, the password will be asked before a command sending. *It should be established by the user manually.*
Passv=>:45 – encrypted password.

[ACT]

ReadEnable=1 – permission to read ACT-system settings from PLL-unit. If the parameter is equal to 0, the button “Refresh” on a window “ACT-system parameters” in the program Manager is disabled (see item 2.7). *It should be established by the manufacturer manually.*

1.4. File h_server.ini

The installation of the software results in occurrence of the file h_server.ini in the folder ServerAndManager. In contradistinction to the file described above the content of this file should be changed by the user manually (at necessity of alteration of the program

Server operation mode). After the file `h_server.ini` modification it is necessary to restart the program Server (`h_server.exe`) to actuate the changes.

The possible content of this file is shown below with brief comments.

[Tune] – group of parameters responsible for the tuning of the cavity, drift compensation and output frequency measurements

HLineDriftComp=0 – hydrogen line frequency drift compensation in units of $1e-16$ per day. Compensating is carried out by periodic change of synthesizer code. Number of the steps which are carried out during a day is equal to parameter HLineDriftComp. Value of parameter HLineDriftComp is established manually by results of supervision over the standard.

TCounter=100 – counting interval in seconds for the determination of the frequency difference between output signal of the standard and a reference signal. Results of measurements are shown in the program Manager on the window Control (see item 2.6).

[Mode]

DAC20Period=100 – if not zero, it is period in seconds of recording of DAC20 values (see 411141.0320M) into log-files. New file is created every day with name “YYYYMMDD.dat” and contains two columns: first – MJD date, second – DAC20 code.

[COMM]

HG=COM1 – serial port to which the physical package is connected. Only ports COM1 – COM7 are supported.

PLLU=COM1 – serial port to which the PLL-unit is connected. Usually it is the same port as HG. Only ports COM1 – COM7 are supported.

[ACT]

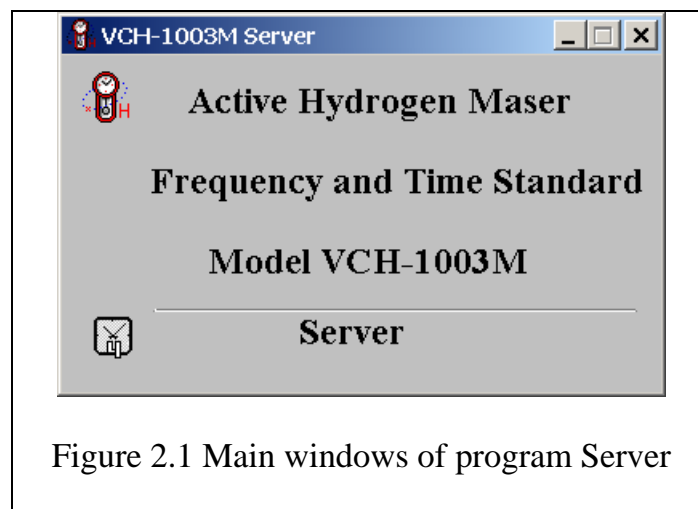
ReadEnable=1 – permission to read ACT-system settings from PLL-unit. If the parameter is equal to 0, the program do not read ACT-system settings (except DAC20) from the PLL-unit.

2. Terminals and screen interfaces

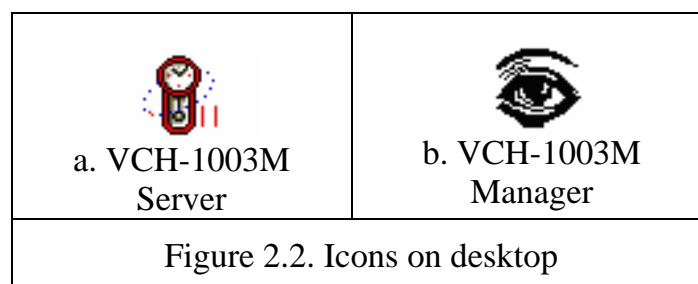
2.1. Control terminal PC-1

While the host computer PC-1 (that provides the functions of the Control terminal) is switched ON, the automatic loading of the system Windows and the activation of the program Server occur.

The open window **Server** is displayed on the desktop of the computer (see Fig.2.1). This window has no control tools (except system functions of the window management). It can be cut down into an icon on Windows Taskbar.



The program Server can be launched manually using the shortcut on the desktop (see Fig.2.2.a). On the desktop of the Control terminal PC-1 the icon VCH-1003M Manager is also displayed (see Fig.2.2.b).



2.2. Remote terminal PC-2

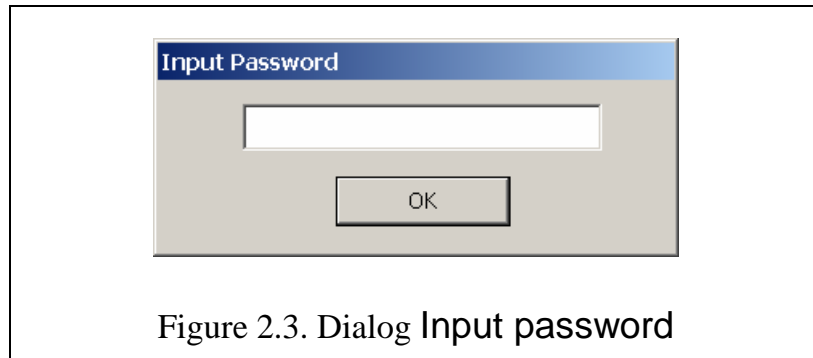
Remote terminal PC-2 differs from PC-1 in that only the program manager is installed here.

2.3. Turning On the user terminal

To turn on the user terminal:

- a) turn on the computer (PC-1 or PC-2) and wait while Windows is loading;
- b) run the program VCH-1003M Manager (hmanager.exe) using icon (Fig.2.2.b) on the desktop.

If the file hmanager.ini contains the string **StartPassv=1**, program Manager will ask you about a password (see Fig.2.3). Type the default password **1003** then press **OK**. Later out can change the password (see item 3.6).



2.4. Screen interface of the program Manager

When the terminal is switched on the screen interface of the program Manager appears on the computer display. It constitutes a main window with menu and a few child windows, two of them – Parameters and Server Link Monitor – are by default open, window Control is by default turned to icon, and other are closed.

The contents of the main menu and windows of the interface are considered below.

2.4.1. Menu File

This menu contains the commands **Print Window** and **Exit**, purpose of these commands is obvious.

2.4.2. Menu View

This menu contains following commands (see Fig.2.4):

- **Control, Device Status, History, Days History, Server Link Monitor, ACT parameters** (this item is hidid when the parameter **RegulEnable** in the file hmanager.ini is equal to zero or absent), **Notes** – expanding of icons to the complete images or opening of the closed windows.
- **Arrange Icons** – the arrangement of icons.

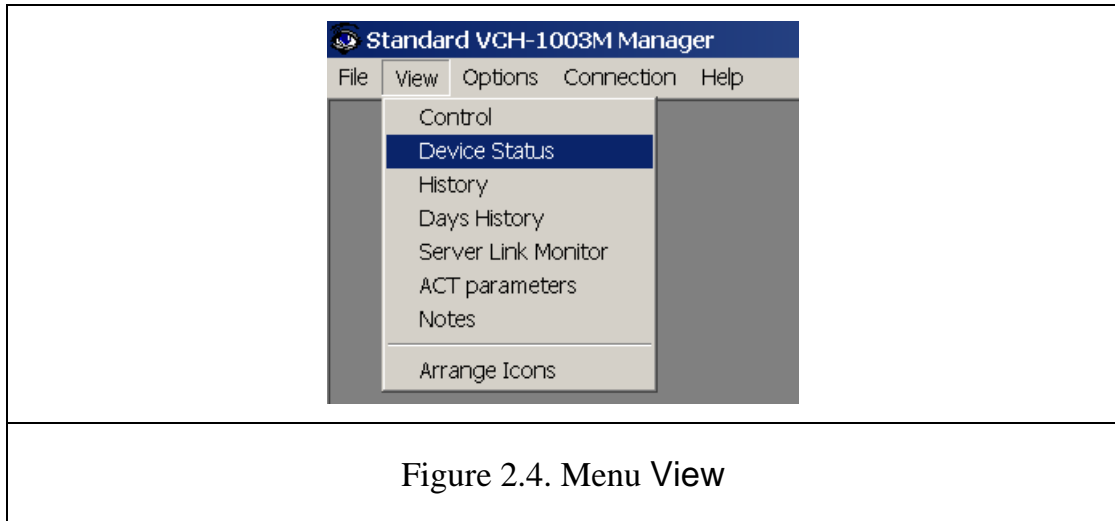


Figure 2.4. Menu View

2.4.3. Menu Options

This menu contains two commands (see Fig.2.5):

- Standard Server Info Location
- Change Password .

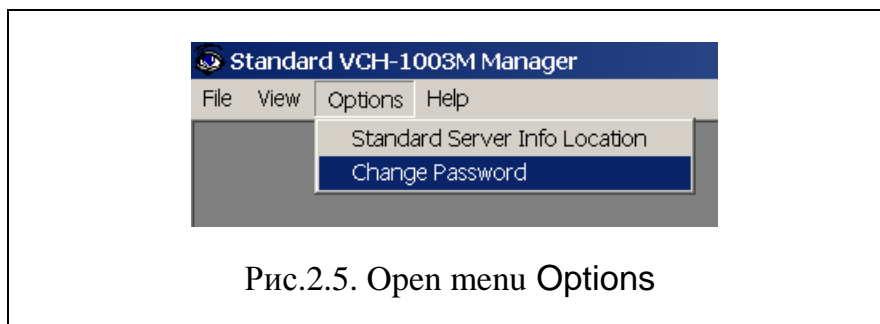


Рис.2.5. Open menu Options

Command Standard Server Info Location

The command **Standard Server Info Location** determines the way of the management: from control (local) or remote terminal, as well as the path to the folder **Connect**. The activation of this command results the opening of the dialog box **Standard Server Info Location** represented in Fig.2.6. This box contains three panels:

- Location/Connection
- Directory
- TCP/IP

The following settings are executed from these panels:

- type of the connection, i.e. management by the Control (local) terminal or by remote terminal using the local network, telephone communication line or Internet is set;
- the complete way to the folder **Connect** on the host computer **PC-1** is specified;

- the data necessary for the remote connection through Internet using FTP are entered.

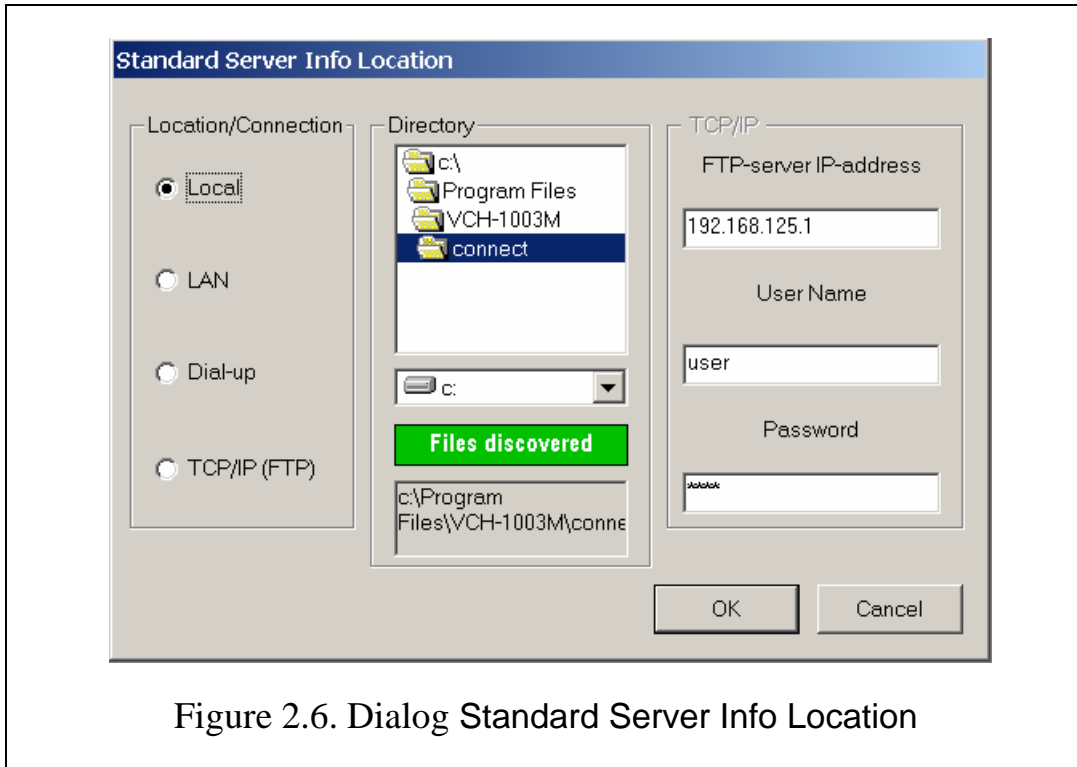


Figure 2.6. Dialog Standard Server Info Location

The panel Location/Connection is intended for the choice of the way of the connection between Server and Manager. It contains the following buttons that ensure the management by the Standard.

- Local – Work from the Control (local) terminal
 - LAN – Through the local network
 - Dial up – Through the telephone communication line
 - TCP/IP – Connection through Internet using FTP protocol.
- } Work from remote terminal

The panel Directory is intended for the indication of the disk drive and the path to the folder Connect. This panel becomes inaccessible when the button TCP/IP is activated, that is the work through Internet.

The choice of the disk drive is executed by the opening of the dialog box of the disk drives (the second window from the top). In case of working with remote manager in this field user have to point the disk drive of PC-1, which should be connected to PC-2 as virtual network disk.

The selection of the way to the folder Connect is executed by the double click by the mouse on the name of the required folder directory in the dialog box Directory (the first box). The complete way to the chosen folder is displayed in the bottom (the third) box of the panel.

As mentioned above, the folder Connect must be declared as a shared resource with full access rights to ensure control from a remote terminal in any method of communication between computers PC-1 and PC-2. The information, confirming correctness of the choice

of the folder **Connect** – the inscription "Files discovered" on a green background, appears on the panel (see Fig. 2. 6).

The panel **TCP/IP** is intended for the data input, necessary for the maintenance of the remote connection through Internet. This panel contains three dialog boxes:

- **FTP-server IP-address**
- **User Name**
- **Password.**

Into the dialog box **FTP-server IP-address** the IP-address of the host computer **PC-1** (performing function of the Control terminal and containing the program Server) is entered (from the keyboard of the remote terminal **PC-2** of the User).

The dialog boxes **User name** and **Password** are intended for the identification of the User, authorized to manage by the Standard. The content of these fields should correspond to the settings of the FTP-server running on **PC-1**.

An alternative way to manage through the network, including the Internet, is the organization of the remote desktop. Remote Desktop is implemented using standard professional versions of Windows or by using special tools such as VNC-server and client.

Command Change Password

The command **Change Password** is intended for the change of the password that ensures the access of the program-manager.

When the program is installed the following fixed password is set.

1003

To change this (or entered earlier) password it is necessary to activate the command **Change Password**. As the result the dialog box, represented in fig. 2.7, appears. After the dialog box **Change Password** is opened it is necessary to execute the following actions.

1. To type (from the keyboard) the old password into the box **Old Password**.
2. To type (from the keyboard) the new password into the box **New Password**.
3. To type again the new password into the box **Confirm New Password**.
4. To click the button **OK** by the mouse.

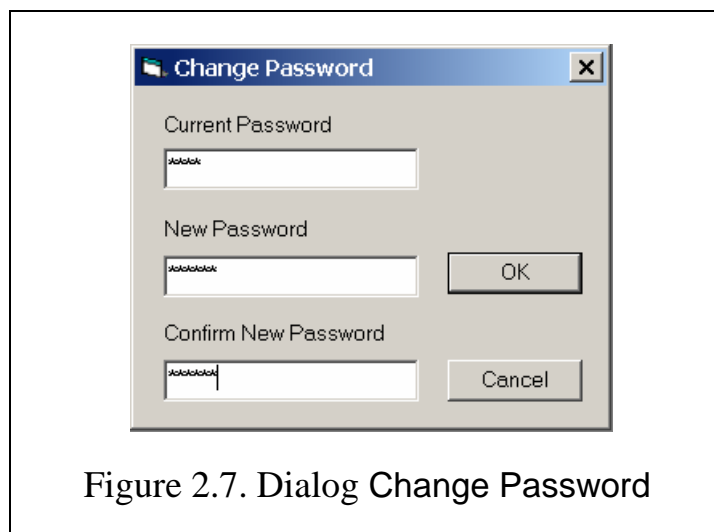


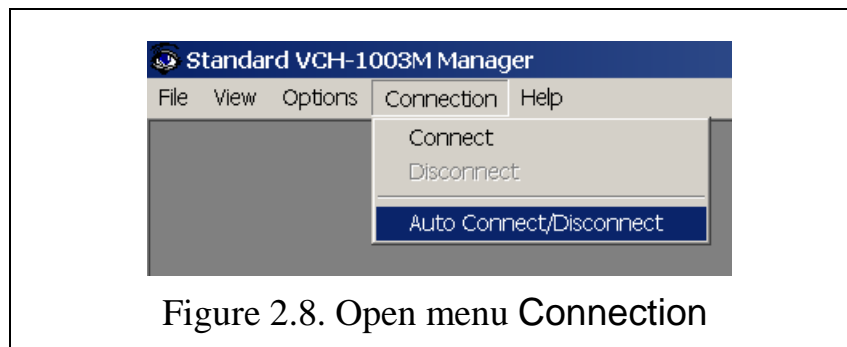
Figure 2.7. Dialog Change Password

You can return the default password at any time simply removing the string “Passv =...” in the group [Common] in the file hmanager.ini.

2.4.4. Menu Connection

If the management from the remote computer PC-2 through Internet is chosen then the menu **Connection** becomes accessible. The content of this menu is represented in Fig.2.8. The menu provides three commands.

- **C**onnect
- **D**isconnect
- **A**uto Connect / Disconnect



The activation of the first two commands provides, accordingly, establishment or closing the connection with the program Server. If the third command is activated then the connection takes place when it is necessary for data with device status or commands transfer.

2.5. Window Status of the Device

The fragment of the screen interface VCH-1003M containing the expanded image of the child window **Status of the Device** is represented in Fig.2.9.

A caption of the window contains the information of Server disposition and the date and time of the last successful reading of device status (in brackets).

The window **Status of the Device** contains the following four panels:

- Status
- PLL Unit
- AHM power
- Active Hydrogen Maser.

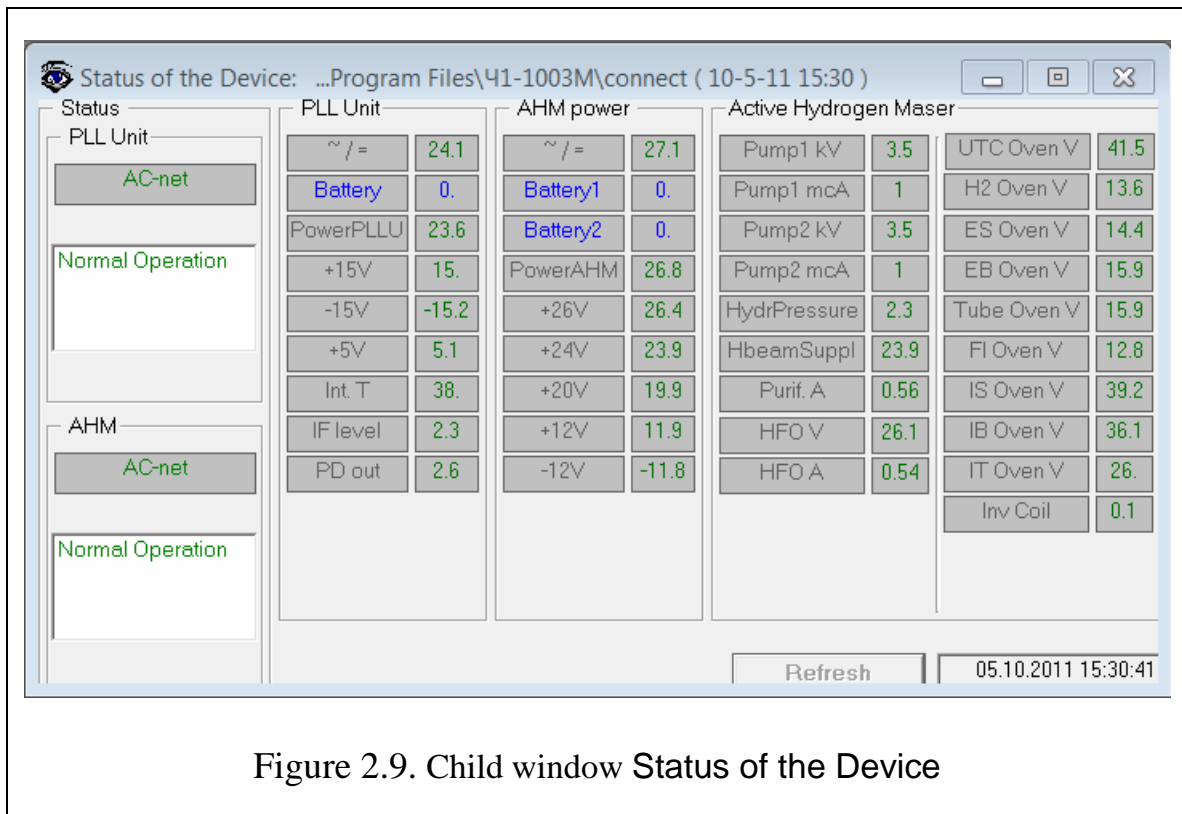


Figure 2.9. Child window Status of the Device

The panel Status contains the following fields.

- 1) PLL Unit
 - indication of the power supply used (AC net or Battery);
 - the status of the PLL Unit (see below).
- 2) AHM
 - indication of the power supply used (AC net or Battery);
 - the status of the Active Hydrogen Maser.

In the field Status-PLL Unit one of the following messages is displayed:

Normal operation (in green color) – corresponding error code (see below) 0000

Not connected (in red color) – code 4000 – there is no connection between PC-1 and PLL-unit though interface RS-232C. It is impossible to get the information about PLL-unit state and to send command there. It is necessary to check RS-232 cable and the port number in the file h_server.ini.

No synchronism (in red color) – code 0100 – the output signal of the standard is not locked to hydrogen line. The frequency stability is bad.

No 1 pps (in red color) – code 0200 – the output signal of the standard 1 PPS is absent. A frequency divider is faulty.

1 Hz synchr. fail (in red color) – code 0400 – the attempt to synchronize output signal of the standard 1 PPS to external reference 1 PPS signal was unsuccessful. Check reference signal and try again.

The field **Status-AHM** may contain one of the following messages:
Normal operation (in green color) – code 0000
Not connected (in red color) – code 0040.

All codes are summed and displayed in the column **Errors** of the windows **History** and **Days History** (see item 2.9). For example, the code 0300 means, that no malfunctions is revealed in the **Active Hydrogen Maser** (see two low-order digits of the code), but the synchronization is broken in the **PLL Unit**, and there is no output signal **1PPS**.

The following indication is displayed on the frame **PLL Unit** located to the right of the frame **Status**:

- 1) \sim/\neq – the voltage on AC/DC converter output;
- 2) **Battery** – the battery voltage supplied through **Active Hydrogen Maser**
- 3) **PowerPLLU** – PLL unit power supply voltage
- 4) **+15V** – the output voltage of the source +15V
- 5) **-15V** – the output voltage of the source -15V
- 6) **+5V** – the output voltage of the source +5V
- 7) **Int T** – the temperature (in °C) inside the PLL unit
- 8) **IF level** – the intermediate frequency amplifier output voltage; gives the information of the H-maser signal level.
- 9) **PD out** – the voltage at the phase detector output; gives the information about phase locked loop system functioning.

The panel **AHM power** displays the voltages of the physical package power supply.

The panel **Active Hydrogen Maser** (that contains two columns) displays the mode of the **AHM** operation. The digital gauges located on these panels display the meaning of checked parameters. The exit of the meaning out of the allowable limits is displayed by color of the gauge:

- green color means the normal mode;
- red color – excess of the allowable meaning;
- dark blue color – very low meaning.

The button **Refresh** and the box for the indication of the current date and time are placed at the bottom right corner of the window **Status of the Device**.

The button **Refresh** is accessible only if the management of the Standard through the telephone communication line or through **Internet** using **FTP** is provided. The button **Refresh** provides the call of the server and refreshes the data of the gauges if command **Auto Connect / Disconnect** from the menu **Connection** is activated or a connection already was established by use the command **Connect** from the menu **Connection**.

2.6. Window Control

The open child window **Control** is shown in Fig.2.10. This window is intended both for the management of processes of switching **ON/OFF** and the adjusting of the Standard, and for the displaying of the status of separate units of the Standard.

The indicators of the control tools of the window **Control** provide two following functions:

- 1) giving of the commands entered through this window;
- 2) the displaying of the current status of the Standard.

If the command is sent through the remote terminal of the User PC-2 then its execution is confirmed by the Control terminal PC-1 after some delay determined by the type of the chosen connection with the program Server.

This window contains the following panels:

- On/Off;
- Output frequency
- Fout - Fref
- Synchronisation
- Modulation.

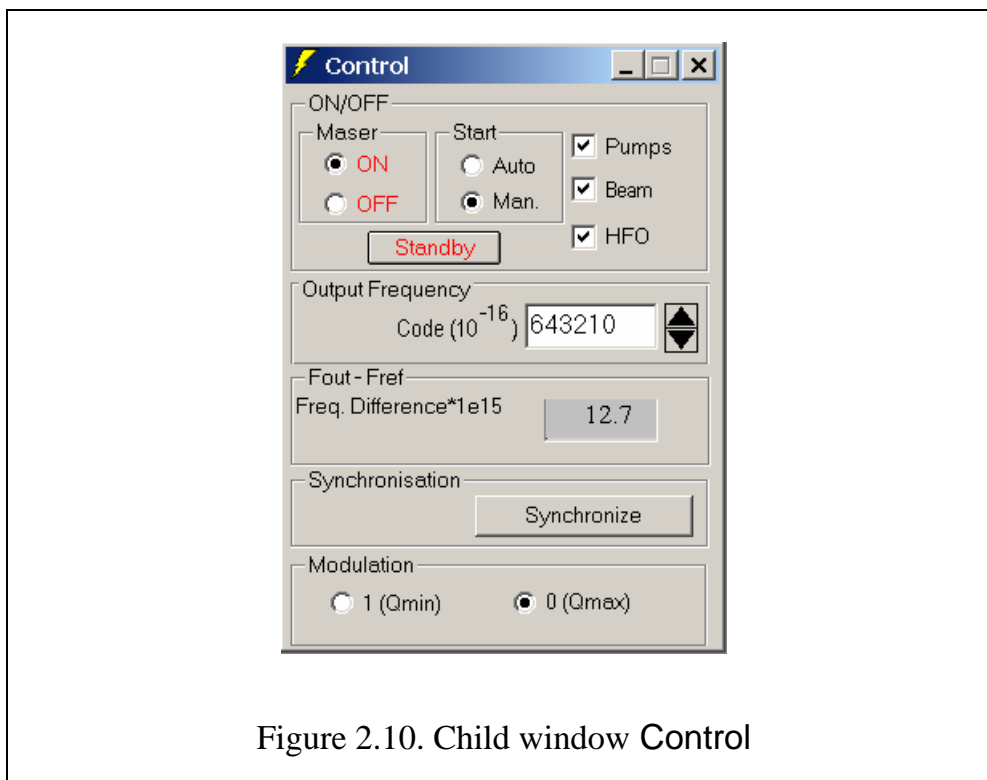


Figure 2.10. Child window Control

The control tools of these panels will be considered in a sequence.

Panel ON/OFF

This panel is intended for the switching blocks of the physical package on and off. This panel contains three groups of managing tools.

The first group **Maser** has two trigger buttons: **ON** and **OFF**. The initial status before the switching on of the maser is **OFF**, thus the tools of the third group (see below) are inaccessible.

The second group **Start** has also two trigger buttons: **Auto** and **Manual**. They are intended for the choice of the way of the switching on some blocks of the maser - automatic or hand-operated.

The third group contains the managing buttons **Pumps**, **Beam** and **HFO**. This group becomes accessible after the switching on of the maser by the button **ON** located in the group **Maser**, provided that the hand-operated way of the switching on by the button **Manual** of the group **Start** is chosen.

At first the button **Pumps** for the switching on of ion pumps (see 411141.032OM) becomes accessible.

After the switching on of the pumps by the button **Pumps** the button **Beam** becomes accessible, with the use of which the beam of the hydrogen is switched on.

The switching on of the hydrogen beam by the button **Beam** makes the last button **HFO** of the third group of the control tools to be accessible. The High-Frequency Oscillator that ensures the dissociation and excitation of molecular hydrogen, is switched on by this button.

With the aim to spare the resource, and to shorten the time of preparation to work, the “Stand by” mode is realized in the Standard. This mode means that vacuum pumps are to be switched on, and the system of the beam formation of hydrogen atoms is to be switched off. To set this mode of operation the User must press button “Standby”.

Panel Output Frequency

The panel **Output frequency** is intended for the correction of the Standard output signal frequency with the accuracy up to 1×10^{-16} of relative value. The correction can be made in two ways:

- by the typing of the required value (from the keyboard) after the activation by the mouse of the box containing the meaning of the frequency correction factor;
- by the mouse click on the appropriate control button located on the right side of the box (with the step 10^{-16}).

Panel Fout-Fref

In this field the current value of difference between frequency of the Standard output signal and frequency of an external reference signal in terms of 10^{-15} is displayed. The signal of the external reference should be connected to input of frequency comparator built-in PLL Unit of the Standard. Time of measurement is set by value of the parameter **TCounter** in the file `h_server.ini` (see item 1.4).

Panel Synchronisation

The panel **Synchronisation** contains the unique button **Synchronize** for the synchronization of the time scale signal of the Standard by the external time scale pulse. Before execution of the synchronization be sure

Panel Modulation

This panel is displayed in the window **Control** only if the key **RegulEnable** in the file `hmanager.ini` allowing changing the cavity auto-tuning parameters has a nonzero value. It contains two buttons used for setting the quality factor of the hydrogen emission line:

1 (**Qmin**) - a smaller quality factor,

0 (**Qmax**) – the bigger (normal) quality factor. When you select **Qmin**, hydrogen emission line quality factor is reduced by increasing the purifier current. *Q-factor switching is used to check autonomous cavity tuning system performance only.*

2.7. Window ACT-system parameters

In Fig.2.11 an expanded window ACT-system parameters is shown. This window is available only if the key **RegulEnable** in the file **hmanager.ini** has non-zero value (see item 1.4). The window ACT-system parameters is used in a process of manufacturing of the Standard only! The user should not change any parameters in this window!

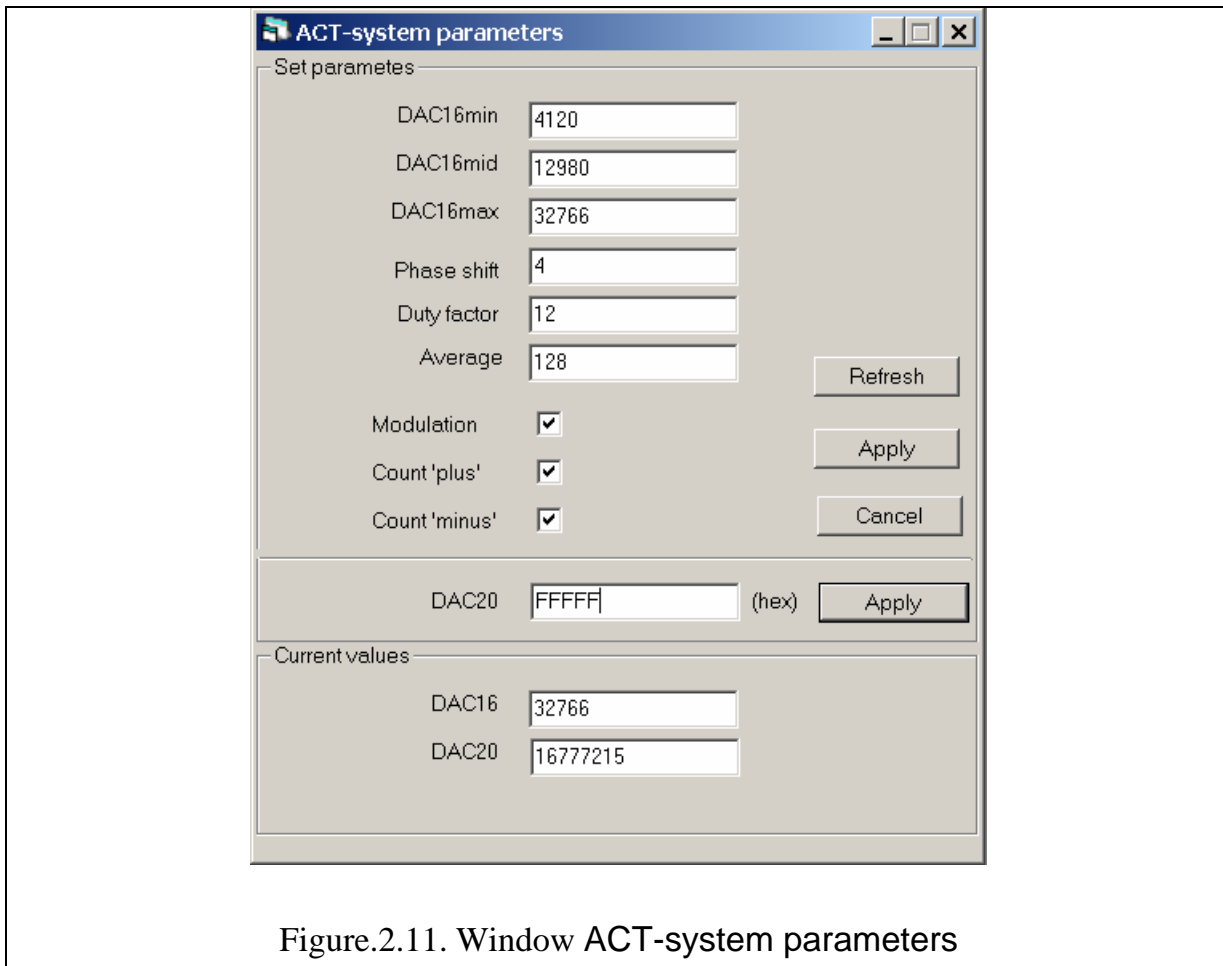
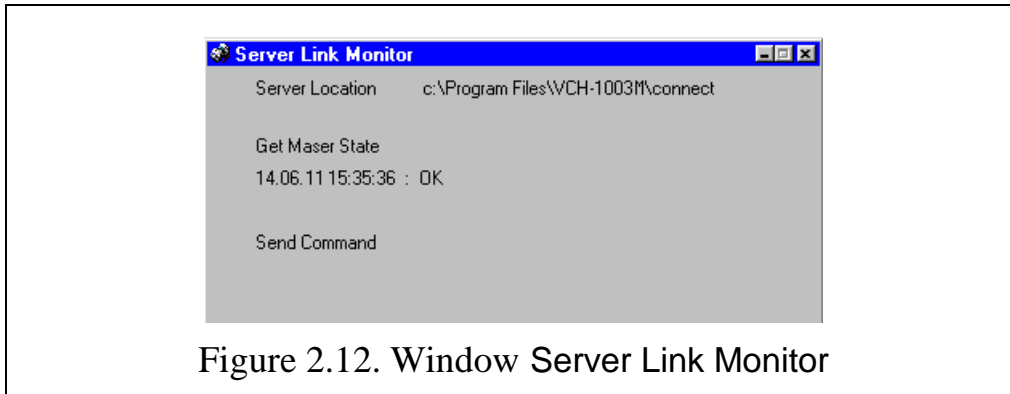


Figure.2.11. Window ACT-system parameters

2.8. Window Server Link Monitor

When the program Manager starts or the command **Server Link Monitor** in the menu **View** is activated the information window is open (see Fig.2.12).



The current status of the connection with the program-server is displayed in this window.

2.9. Windows History and Days History

The child windows **History** and **Days History** are intended for an examination of the Standard status records. The records are displayed as the table, in which the status of all controllable parameters, reflected on-the-fly by the windows **Status** and **Control**, and corresponding date and time are present (see Fig.2.13).

To get the recorded information on the status of the Standard it is necessary to activate the button **Open**. The new history file is created every day, so the user can select any date he is interested in. To watch current today's status it is necessary to select file `histYYYYMMDD.dat` (YYYYMMDD – today's year, month and day) or the file named simply `history.dat` (lhistory.dat for local user). Press the button **Refresh** to renew the information about current status if the file is already selected.

The table of the records contains up to 1000 rows. The separate row reflects the status of the Standard in the moment of the record. The record is being made each hour, at the occurrence of the failure, and at the change of the Standard operation mode by the User. The updating of the table is made by the displacement of the old records (if number of records exceeds 1000).

The number of the records in the window **Days History** is not limited. The writing to days history file is performed once per day at midnight.

To view various parts of the table it is possible to use the scroll bars.

The width of each column may be changed with the purpose of viewing of its full contents. To change the column width its right border is to be sized by the mouse pointer. Then, at the pressed left-hand button of the mouse, it is necessary to move the border into the new position.

The content of the group of the cells can be copied to the **Clipboard** for further copying into the worksheet **Excel**. For this purpose the following actions are to be executed:

1. To select by the mouse (at the pressed left-hand button) the required group of cells.
2. To click the button **Copy**.

As a result the data contained in the selected group of cells are copied into the **Clipboard**. These data may be copied into an **Excel** worksheet with the help of command **Paste** from the menu **E**dit.

The current information from window History can be saved in an ASCII-file ..\connect\YYMMDDhhmm.his by pressing the button Save.

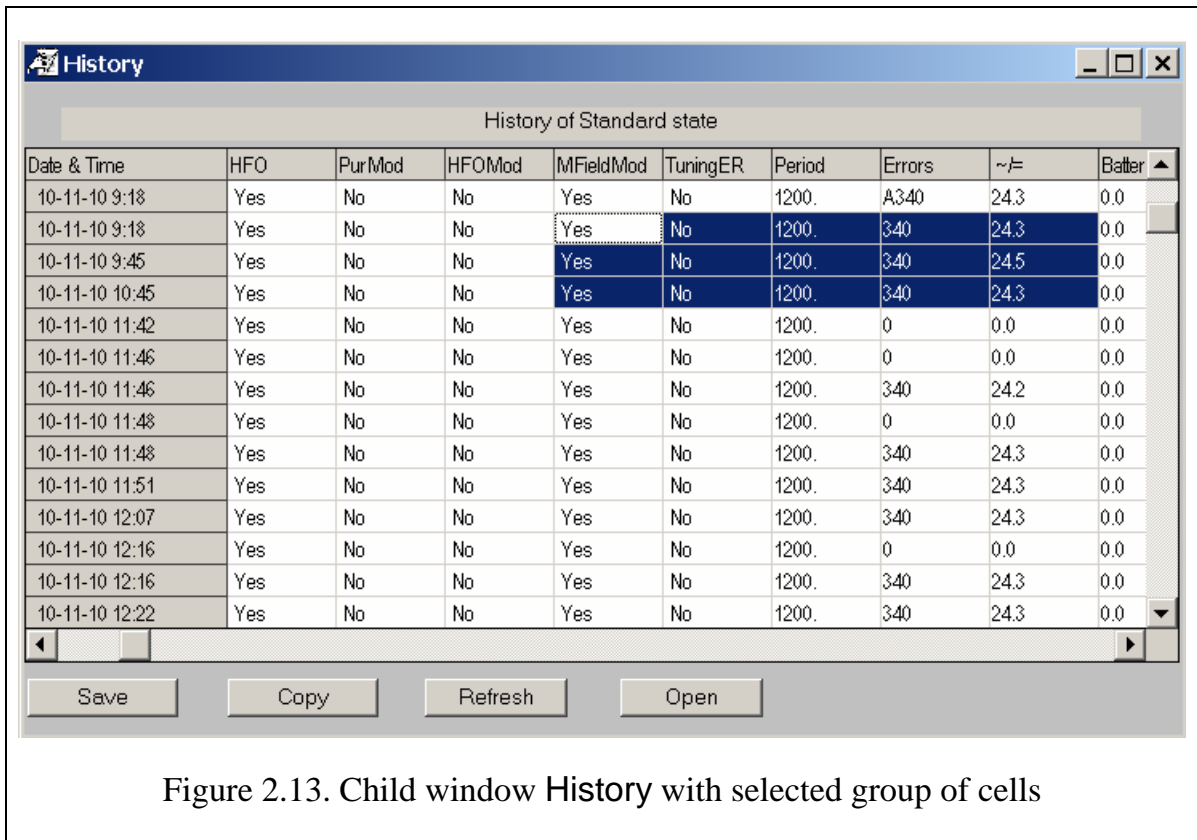


Figure 2.13. Child window History with selected group of cells

2.10. Window Notes

In this window you can enter any text information, which, as well as the size and location of the window, is automatically saved when you close the program. Information in a window (for example, standard number) may be useful when a few specimens of maser software are installed on a single computer to manage the multiple standards.

3. User guide

3.1. Switching the Standard on

The turning the Standard on is executed by a powering two blocks, that have independent power supply systems: the H-maser itself and the host computer, executing the functions of the control terminal PC-1. To switch the Standard on

- a. Engage the switch “Power” located on the front panel of the maser. It provides the switching on blocks Active Hydrogen Maser and PLL Unit.

At powering of the Active Hydrogen Maser the system of microvawe cavity thermostabilization (see 411141.032OM) is powered too.
Complete warming up of maser takes 5 days.

- b. Turn the PC-1 on, the programs Server and Manager will start automatically. Launch them manually if they are not running. Set the connection between the program Manager and program Server (see items 2.4.3 and 3.3). These settings is necessary to do only once at first after the installation execution of the software.

All other manipulations are executed from the terminal by the activation of the control tools of the window Control (see Fig.2.10). The examination of parameters, that describe the status of the Standard, is to be made via the gauges of the window Status of Device (see Fig.2.9).

There are two variants: manual and automatic modes of switching the blocks on.

Manual mode

The hand-operated mode of the switching of the maser on is executed as follows:

1. Activate the trigger button **Manual** in the group **Start**. Activate the button **ON** in the group **Maser**. A check-box **Pumps** destined for managing powering of ion pumps will be available.
2. Switch the ion pumps on by the control **Pumps**. Check pumps current by watching gauges **Pump1, mA** and **Pump2, mA**.
3. After the current of pumps becomes lower than the set limit (that is displayed by green color of the gauges **Pump1,2, mA**), switch on the purifier of the molecular hydrogen by the control **H-beam**. The flow of the hydrogen from the purifier is checked by the gauge **Vacuum**.
4. When the required flow of the molecular hydrogen (indicated by green color of the gauge **Vacuum**) is reached but not earlier than in 4 minutes after powering the purifier, switch on the high-frequency oscillator by the control **HFO** for the initiation of the discharge, that ensures the dissociation and excitation of hydrogen.

The operation of the high-frequency oscillator is to be tested by the voltage (gauge **HFO V**) and the current (gauge **HFO A**).

After the glow discharge is appeared the hydrogen maser begins to generate, and the synchronization in the LCO-PLL system occurs. The status of the system is tested by the following parameters:

- a) the voltage of the intermediate frequency signal (gauge IF level), this voltage is proportional to the H-maser signal;
- b) the voltage on the phase detector output (PD out);
- c) the status of the LCO-PLL system that is displayed in the field PLL Unit of the panel Status (messages “No synchronism” should change to “Normal Operation”).

Autonomous cavity tuning system begins to function automatically after establishing the synchronous mode of operation.

The Standard is ready for using when the message “Normal Operation” is displayed in the Status fields of both PLL Unit and AHM while all the controllable parameters have values within the allowed limits (all gauges are green).

Automatic mode

To switching the blocks of maser on in automatic mode activate the trigger button **Manual** in the group **Start**. Activate the button **ON** in the group **Maser**. Wait the appearance of the message “Normal Operation” in the Status fields of AHM.

In automatic mode the program determines itself when is allowed to switch on the hydrogen beam and the HFO.

3.2. Temporary switching the Standard off

If the Standard will not be used more than 10 days, it can temporarily be switched off to save hydrogen reserve. For this purpose it is necessary to activate the button **OFF** of the group **Maser** on the panel **ON/OFF**.

However, it is more preferable to switch the maser off without the turning the pumps off. Such mode guarantees the preservation of the vacuum in the maser at long-duration break. To activate this mode press the button **Standby** on the panel **ON/OFF** (the button **ON** in the group **Maser** should be activated).

3.3. Local and remote management

To ensure management of the Standard a connection between the program manager and the server program should be established. To do this, activate the command **Standard Server Info Location** in the menu **Options** (only once at first after the installation execution of the software). The activation of this command results the opening of the dialog box **Standard Server Info Location** represented in Fig.2.6. The sequence of further actions is determined by the chosen manner of the connection.

Management through Control terminal PC-1

To ensure the management of the Standard using host computer PC-1 execute following actions:

1. Activate the button **Local** on the panel **Location/Connection**.
2. Set the path to the folder **Connect** (through the panel **Directory**) intended for the organization of the data exchange. The information, confirming correctness of the choice of the folder **Connect** – the inscription "Files discovered" on a green background, appears on the panel (see Fig. 2. 6).

3. Close the dialog box **Standard Server Info Location** by the click on the button **OK**.

The local terminal is ready for the management of the Standard.

Management through LAN

To ensure the management of the Standard using the remote computer **PC-2** through the local network execute following actions:

1. Connect the drive on **PC-1** where the program **Server** is installed as the network drive of **PC-2** (set the connection permanent).
2. Activate the button **LAN** on the panel **Location/Connection**.
3. Set the path to the folder **Connect** on the network drive (through the panel **Directory**) intended for the organization of the data exchange. The information, confirming correctness of the choice of the folder **Connect** – the inscription "Files discovered" on a green background, appears on the panel (see Fig. 2. 6).
4. Close the dialog box **Standard Server Info Location** by the click on the button **OK**.

The remote terminal is ready for the management of the Standard.

Management through Internet

When working from a remote user's computer **PC-2** through the Internet the connection between the **Server** and **Manager** is realized by using the transfer command and data files via ftp. To ensure such a transfer an **FTP-server** should run on the control terminal **PC-1**. The folder **Connect**, designed to communicate with a remote terminal **PC-2** should be declared as "home" for a remote user with full access permitted (read, write and delete files).

To ensure the management of the Standard using the remote computer **PC-2** through the Internet using ftp execute following actions:

1. Activate the button **TCP/IP** on the panel **Location/Connection**.
2. Set the address of the host computer **PC-1** (that contains the program **Server** and the **FTP-server**), the User's name and password using the panel **TCP/IP**.
3. Close the dialog box **Standard Server Info Location** by the click on the button **OK**.

The remote terminal is ready for the management of the Standard.

For communication with the control terminal via the Internet it is convenient to choose **Auto Connect/Disconnect** in the menu **Connection**.

3.4. Standard output signal frequency correction

The initial setting of the Standard output signal frequency is made by the manufacturer. Nevertheless, the necessity to make the correction may arise.

To correct the frequency it is necessary to open the child window **Control** (see Fig. 2.10). Then the correction of the frequency is performing through the dialog box on the panel **Output frequency** with the relative accuracy up to the 16th digit after the decimal point.

3.5. Time scale synchronization

For synchronization of output signal 1 PPS with an external reference it is necessary to put required signal on the Standard input marked as 1 PPS then to click the button **Synchronize** of the group **Synchronisation** on the window **Control**.

If after the synchronization you see the error message 1 Hz synchr. fail (in red color) on the field **PLL Unit/Status** on the window **Status of the Device**, it means that the attempt to synchronize output signal of the standard 1 PPS to external reference 1 PPS signal was unsuccessful. Check reference signal and try again

3.6. Password change

To change the password for the access to the program manager or for sending the command (see item 1.3) execute the following actions:

1. Activate menu **Options/Change Password**.
2. Type (from the keyboard) the old password into the box **Old Password**.
3. Type (from the keyboard) the new password into the box **New Password**.
4. Type again the new password into the box **Confirm New Password**.
5. Click the button **OK** by the mouse.

For the restoring of the default password it is necessary to modify the file **hmanager.ini**. For this purpose delete the line **Passv= ...** with the encrypted password in the block **[Common]**.

3.7. Change of admissible limits of parameters

Attention!

The procedures, described in this Section, are to be executed by the manufacturer of the Standard.

In the Standard software the opportunity of the change of the allowable limits for controllable parameters is provided. To get the opportunity of the change of allowable limits the file **hmanager.ini** is to be modified. For this purpose it is necessary to assign the value 1 to the variable **Adjust** in the group **[GaugeAdj]**. This setting should be executed before the activation of the program Manager. After that the content of menu **Options** of the program Manager main menu is changed (see Fig.3.1).

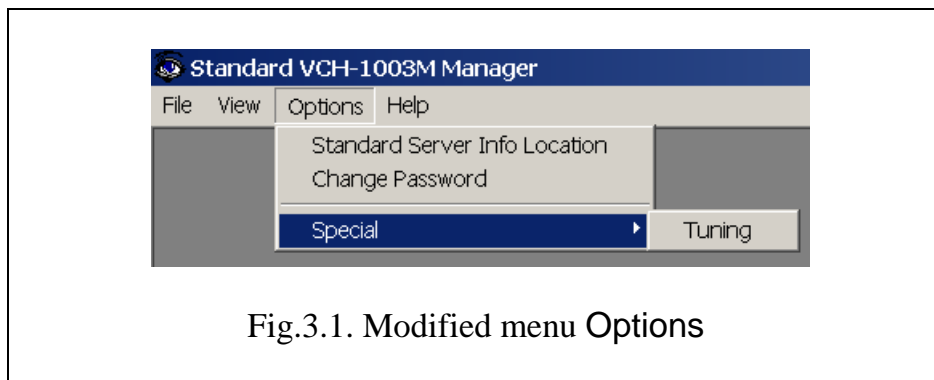
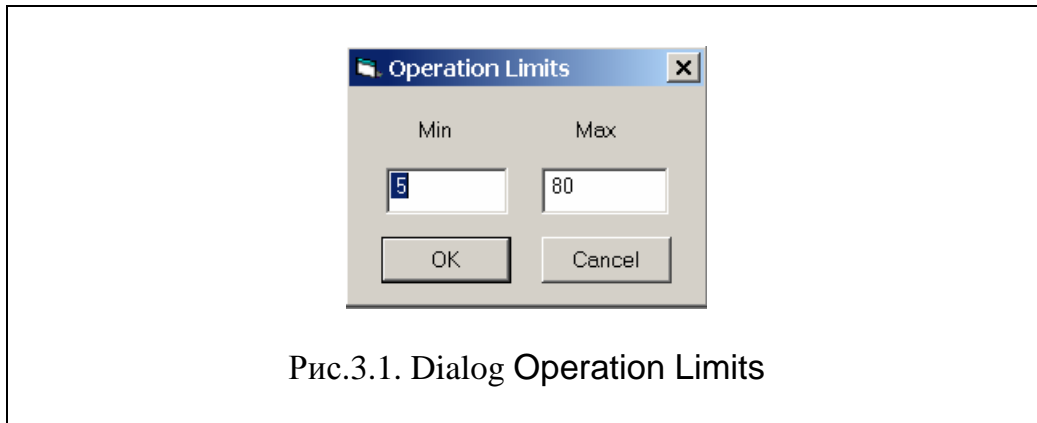


Fig.3.1. Modified menu Options

To change the allowable limits the command Tuning in menu Special is to be activated. The change of limits is to be executed by the click of the right button of the mouse on the required gauge of panel Status of Device, that results the opening of the dialog box Operation Limits (see Fig.3.2).



The change of allowable limits is to be made by the typing of the required values (from the keyboard) into the boxes Min and Max been previously activated by the mouse. After change of limits it is necessary to restart the program Server as the values of limits established by the user are read by the program Server at start.