CHARTS

Users Manual

Peter Kravtsov (E-mail: pkravt@gmail.com)

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1 Introduction

The Charts software is intended for the visualization of the experimental system parameters in two-dimensional charts. The software provides data collecting from the main control and data acquisition software through the special buffer, and could serve as server or client for the transfer of system parameters over TCP/IP network.

2 Main software features

2.1 User interface elements

The main window of the Charts software (Fig. 2.1) contains 10 charts, each of them could be assigned to any particular system parameter. All charts display time behavior of the parameters.

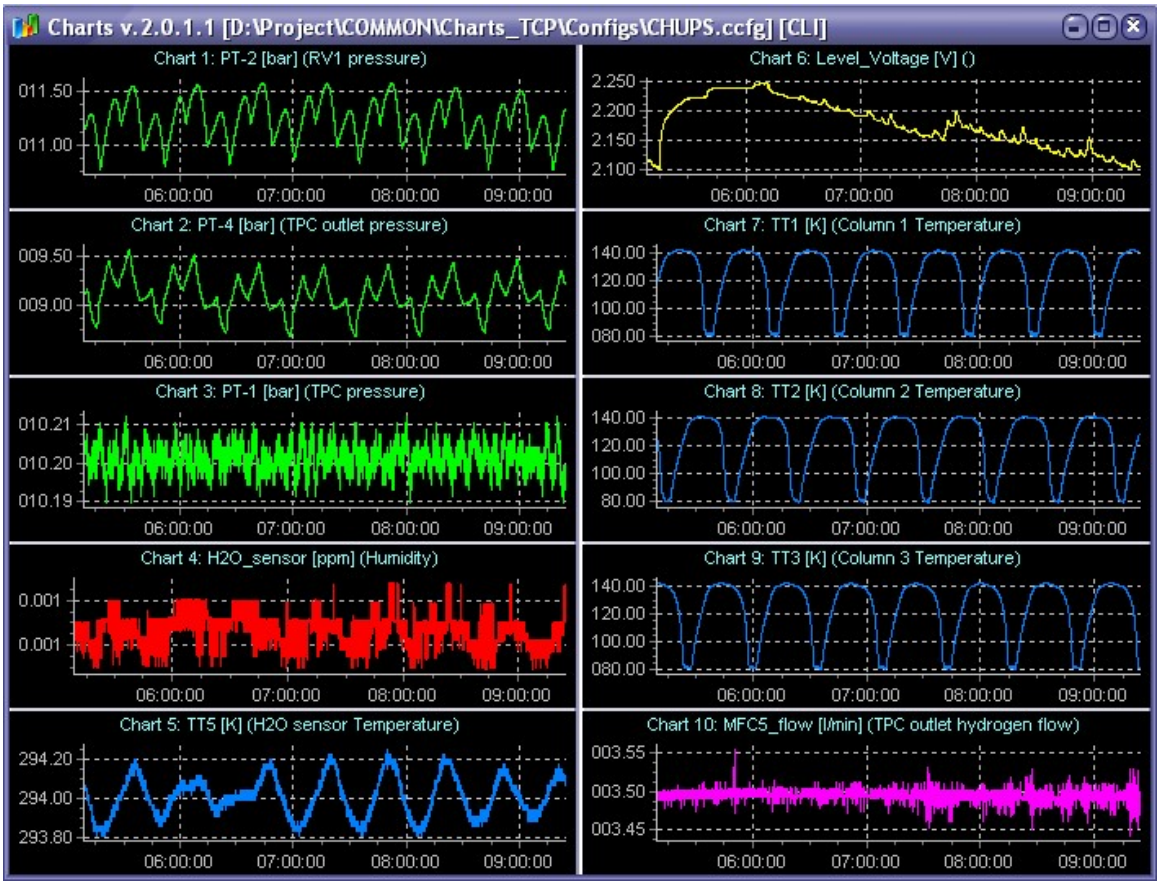


Fig. 2.1. Main window of the Charts software.

The number of charts could be reduced to five with single column vertical layout. After assignment a particular system parameter (channel) to the chart parameter name and units are shown in the chart title.

The Charts software reads all system parameters (channels) automatically from a special buffer immediately after updating of the buffer data by the main control software (see data options in chapter 2.3). Data query in the network client mode is performed by timer. Every parameters update is shown by the blinking asterisk in the main window caption (Fig. 2.1). The history of parameter values is not kept in the software, so the chart starts over again after switching the assigned parameter.

The software provides wide configuration capabilities for every chart. User may change chart colors (background, axes, chart line, etc.), axes parameters (labels format, axis range etc.), grid appearance and many other options.

All interface controls in this software are implemented in the context menu which pops up by right mouse button. This allows removing all usual interface controls from the main window, leaving the space for the charts.

Every chart in the software can be controlled by a mouse. It can be zoomed using mouse wheel (mouse cursor should point to the desired chart). One can zoom part of the chart using frame that is dragged over the chart by left mouse button ((Fig. 2.2). The chart part selected by the frame will be zoomed after releasing the mouse button. To unzoom the chart, one should drag the frame from bottom to top and from right to left. Right mouse button is used for the scrolling the chart. In order to restore original chart zoom and position, one can use the frame dragged from bottom to top and from right to left.

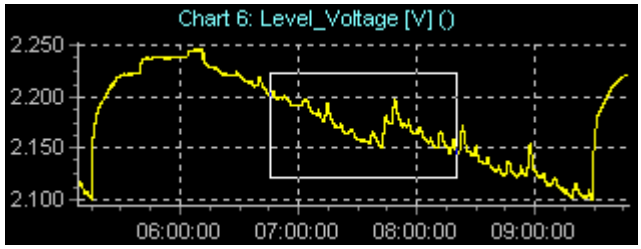


Fig. 2.2. Zooming the part of the chart using frame.

One of the charts could be magnified into separate window using left mouse double click or middle button click. This is useful for enlargement of the single chart to watch the parameter behavior remotely.

Charts positions can be switched using drag and drop with [**Ctrl**] button hold. This operation keeps all data and formatting of both charts that are switched with each other.

2.2 Main menu

The program is controlled using the context menu (Fig. 2.3). It contains sections for all charts together (**ALL** submenu), data options, and configuration of any particular chart under the mouse cursor. Table 1 lists all menu item description.

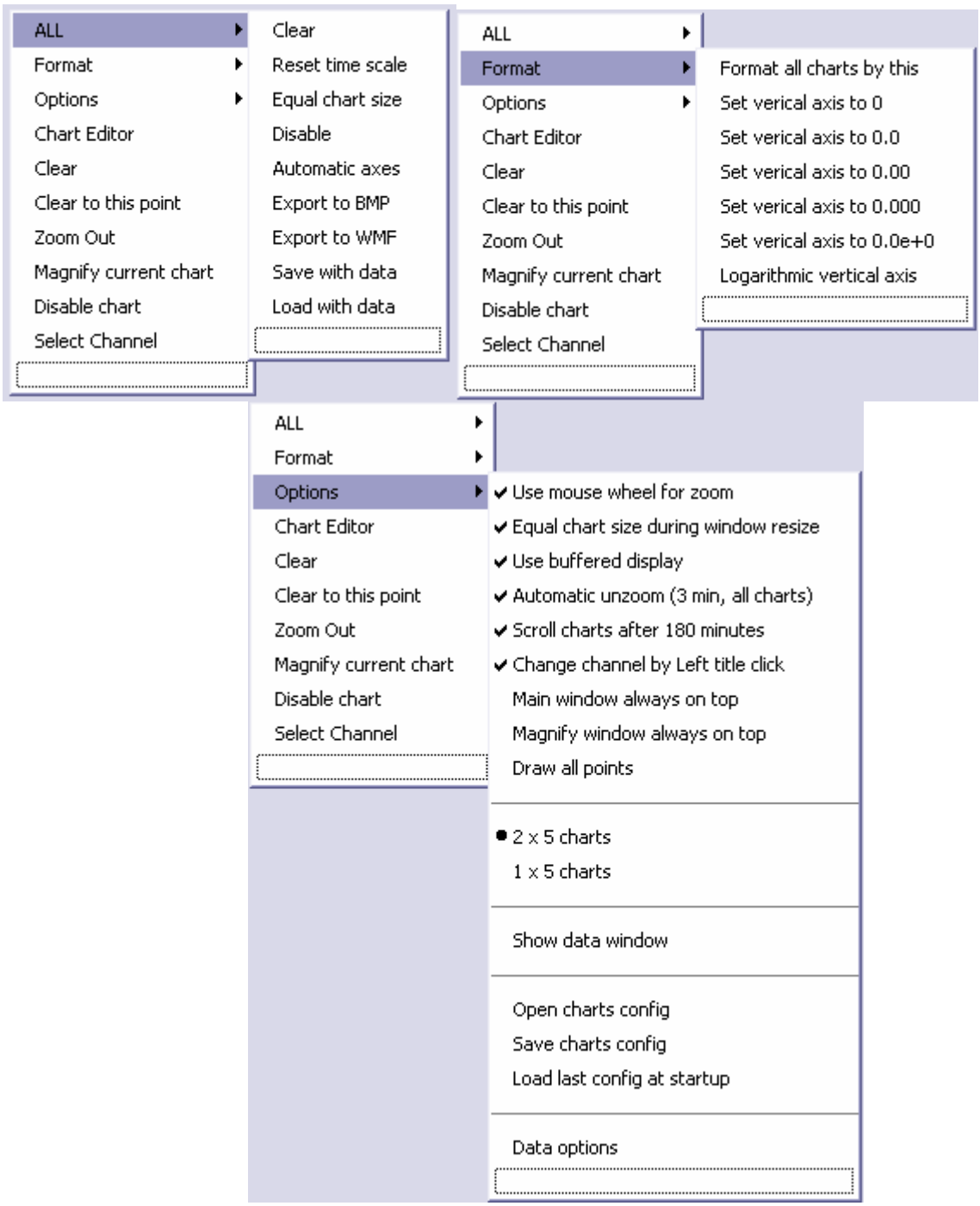


Fig. 2.3. Main menu.

Table 1. Main context menu items.

Menu item	**Description**
Chart Editor	Shows chart editor window with all options for the selected chart (see section 4).

Menu item	Description
Clear	Clears selected chart. The chart starts again after this command, keeping assigned system parameter intact.
Clear to this point	Clears all data from the chart to the left of the mouse cursor (early data).
Zoom Out	Zooms out selected chart.
Magnify current chart	Transfer selected chart to the separate window with possibility to magnify it.
Disable chart	Disables selected chart. After this command no data channel is assigned to the selected chart.
Select channel	Selects system parameters for the current chart (Fig. 2.4).
ALL/Clear	Clears all charts. Removes all data in all charts, keeping assigned system parameters intact. All charts start over again.
ALL/Reset time scale	Aligns the left data border (the earliest time of the data in the chart) by maximum value. If one of the charts started later than others, the time axis of all charts will be aligned by this chart after this command. This is useful to get the equal time axes for all charts and keep the chart data. The right border of time axis is equal for all charts since they are updated simultaneously.
ALL/Equal chart size	Equalizes the size of all charts.
ALL/Disable	Disables all charts. After this command all charts are unassigned to the data channels.
ALL/Automatic axes	Forces automatic scale for both axes at all charts. This command is useful for network client mode which has some problems during charts transfer over the network.
ALL/Export to BMP	Export all charts into single bitmap picture.
ALL/Export to WMF	Export all charts into single windows metafile picture.
ALL/Save with data	Saves all charts into binary file together with the parameters data. Useful for later analysis of the charts.

Menu item	Description
ALL/Load with data	Reads all charts from the previously saved binary file together with the parameters data.
Format/Format all charts by this	Sets the label format of the left axes of all charts identical to the selected chart.
Format/Set vertical axis to 0 … Format/Set vertical axis to 0.0e+0	Sets the left axis labels format for the selected chart to one of the fixed format.
Format/Logarithmic vertical axis	Sets the left axis mode to logarithmic. All other formats turn it back to linear.
Options/Use mouse wheel for zoom	Enables/disables using of the mouse wheel for chart zoom.
Options/Equal chart size during window resize	Enables automatic equalize of the charts size during window resize.
Options/Use buffered display	Enables use of the buffered display (accelerates charts update).
Options/Automatic unzoom (xx min, all charts)	Enables automatic restore of the charts zoom scale after specified idle time. Time interval is specified at checking on this option.
Options/Scroll charts after xxx minutes	Enables automatic scroll of all charts after specified period of time. If checked, the total time period on all charts will not exceed the specified time (logger mode). Time interval is specified at checking on this option.
Options/Change channel by Left title click	Enables channel selection using left mouse click on the chart title.
Options/Main window always on top	Enables “always on top” mode for the program window.
Options/Magnify window always on top	Enables “always on top” mode for the magnify window. It is useful to prevent cover of the magnify window with the main window.
Options/Draw all points	Enables all points mode for charts. Chart update could be accelerated when this option is disabled, but for the price of some dropped points (Fig. 2.5).

Menu item	Description
Options/2 x 5 charts	10 charts window mode.
Options/1 x 5 charts	5 charts window mode.
Options/Show data window	Displays Data window (see section 2.4).
Options/Open charts config	Loads charts configuration file.
Options/Save charts config	Saves charts configuration file with all charts options, including assigned channels, without the channel data.
Options/Load last config at startup	Enables automatic loading last configuration file at program startup.
Options/Data options	Shows data options dialog (see section 2.3).

There is special window with channel list (Fig. 2.4) for the assigning of the system parameter to the chart (**Select channel** menu item). The data channels in this list are grouped by categories. Every channel is accompanied with its measurement units and comment as it was configured in the control software. Channel is selected to be displayed on the chart by double click of the left mouse button. **Select channel** menu item is duplicated with left mouse click at the chart title, if the **Options/Change channel by Left title click** option is enabled. Sometimes it is much more convenient to use simple left click than context menu item.

A special channel group (**FAVOURITES**) keeps up to 30 recently selected channels. This group is not the real channel group; it has only links to the real channels in the real groups.

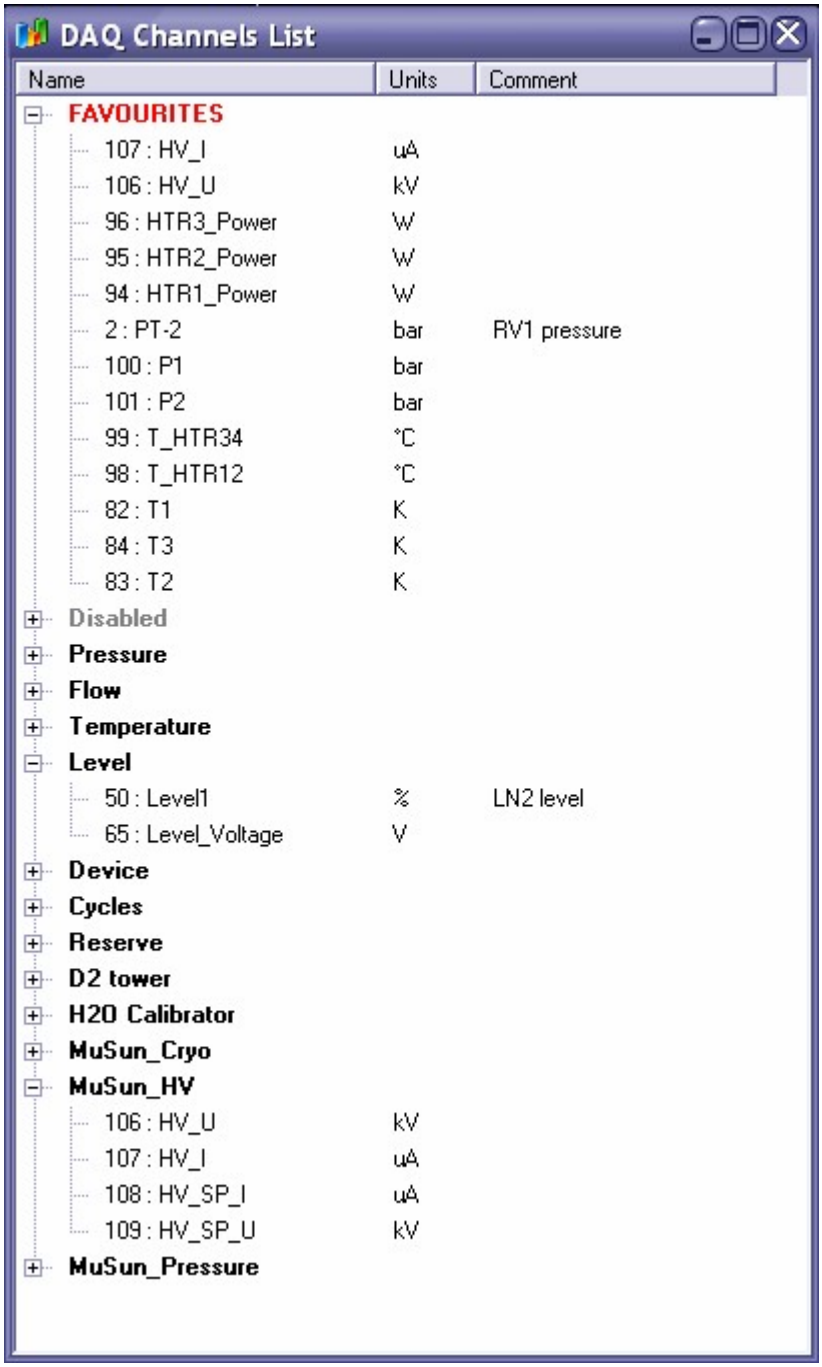
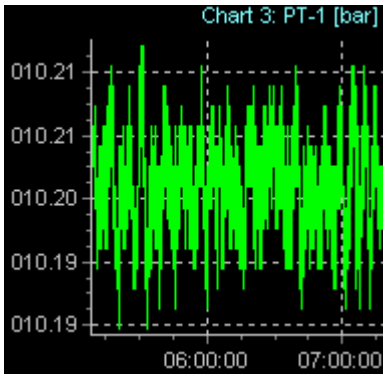


Fig. 2.4. Data channel selection window.

The charts are drawn in two modes (**Options/Draw all points** menu item). When Draw all points option is checked, every data point is drawn in the chart, despite the number of data points may exceed the number of screen pixels in the chart. Accelerated mode with unchecked all points option is useful for the slow changing parameters (Fig. 2.5). In this mode the software draws only data points with different screen pixel

coordinates. For the fast changing data this option may lead to some data averaging.

(a) 

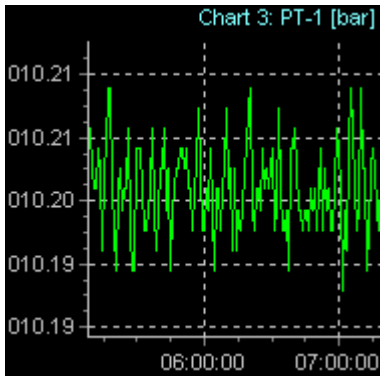
(b) 

Fig. 2.5. Chart drawing: (a) – all points; (b) – accelerated mode.

2.3 Data options

Data options window (Fig. 2.6), shown by **Options/Data options** menu item, is used for the configuration of the data exchange with control software. The data transferred through the memory mapped file and synchronized using system event that triggers when the data is updated. The memory mapped file and system event names are specified in this window. The data channels parameters ini-file is also specified here. It contains all information about system parameters, like names, measuring units etc. This file is also generated by the control software during adjustment procedures.

There are two buttons at the right of the ini file name. Left one is used to open ini file. Right button forces update of the system parameters information from the specified ini file. This button is useful during adjustment of the system parameters information in the control software. Data channel assignment to the charts is kept intact. This button changes only chart titles.

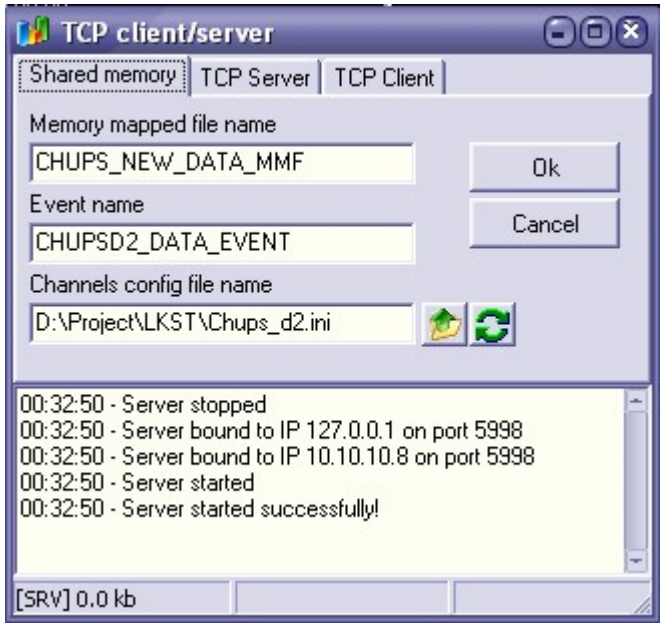


Fig. 2.6. Data options window.

Network client server mode is also configured in this window. It is described in details in section 3.

2.4 Data window

The data window is dedicated for the numerical output of the system parameters data and thus supplements the charts. Data window may contain up to 60 system parameters that are shown in the table form (Fig. 2.7). Every row in this table corresponds to single system parameter. The name, current value and units of the parameter are shown in table columns.

All adjustments of the data window are performed through the context menu, the same like in the charts window. In contrast to the main window with chart menu, the menu here belongs to the channel row (Fig. 2.7). One can select the channel for the specified row (**Select channel** menu item or double click at the table row) or clear the row (**Disable channel** menu item). Additional row options could be configured using **Row options** menu item.

Fig. 2.7. Data window with context menu.

In addition to the numerical output of the channels data, the data window may be used for alarm signaling (for instance, the L_DTOP row in Fig. 2.7 shows alarm). Two alarm levels are implemented in the software: warning signal (whistle) and alarm signal (siren). User can enable or disable sound for every separate table row using checkboxes in the left side of the table. **Play Sound** menu item enables or disables audible signaling for the whole data window.

Alarm signaling conditions are configured in the row options window (Fig. 2.8). Every row could have up to four alarm conditions. In general case it should be high and low warning and high and low alarm levels. For every alarm condition user can configure triggering threshold (**Threshold**), condition sign (**High alarm** means triggering in case of the channel value higher than the threshold), warning or alarm option (**Red** corresponds to the alarm), and **Enabled** option.

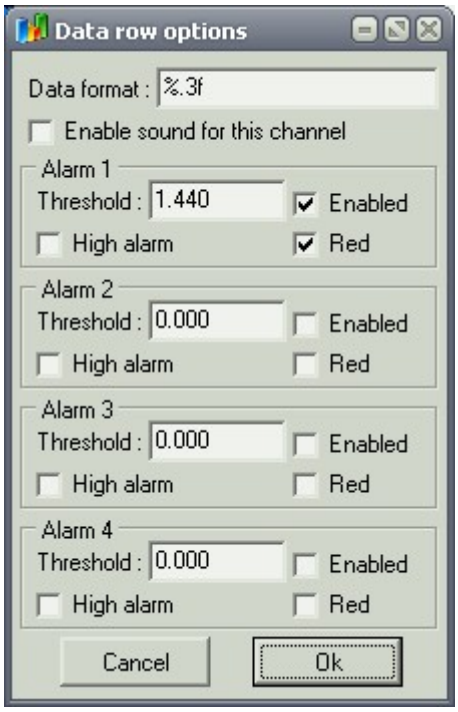


Fig. 2.8. Row options window.

Triggered warnings are displayed in the data window in yellow color and, if **Play Sound** option is enabled and row checkbox is checked, are accompanied with whistle sound. Triggered alarms are shown in red color and accompanied with siren sound.

Row options window allows one to configure also sound enable option for the current row and numerical format of the parameter data. Format string is specified in the following form:

"[**width**][**.prec**]**type**"

where optional width specifier, [**width**], represents the full length of the output string (generally not used); optional precision specifier, [**.prec**], denotes number of significant digits depending of the type conversion character **type**.

The following type characters are possible:

e – scientific. The value is converted to a string of the form "-d.ddd...E+ddd". The resulting string starts with a minus sign if the number is negative. One digit always precedes the decimal point. The total number of digits in the resulting string (including the one before the decimal point) is given by the precision specifier in the format string—a default precision of 15 is assumed if no precision specifier

is present. The "E" exponent character in the resulting string is always followed by a plus or minus sign and at least three digits.

f – fixed. The value is converted to a string of the form "-ddd.ddd...". The resulting string starts with a minus sign if the number is negative.The number of digits after the decimal point is given by the precision specifier in the format string—a default of 2 decimal digits is assumed if no precision specifier is present.

g – general. The value is converted to the shortest possible decimal string using fixed or scientific format. The number of significant digits in the resulting string is given by the precision specifier in the format string—a default precision of 15 is assumed if no precision specifier is present.Trailing zeros are removed from the resulting string, and a decimal point appears only if necessary. The resulting string uses fixed point format if the number of digits to the left of the decimal point in the value is less than or equal to the specified precision, and if the value is greater than or equal to 0.00001. Otherwise the resulting string uses scientific format.

n – number. The value is converted to a string of the form "-d,ddd,ddd.ddd...". The "n" format corresponds to the "f" format, except that the resulting string contains thousand separators.

By default all rows are displayed with the format «%.3f». Below are some examples of various formats applied to the 1.2345678 value:

Format	Resulting string
%.3f	1.234
%.6f	1.234567
%.3e	1.23E+000
%.7e	1.234567E+000
%.5g	1.2345

3 TCP/IP client-server mode

TCP server and client modes are configured in the data options window shown by **Options/Data options** menu item (Fig. 3.1 и Fig. 3.2).

In the server mode program waits for the client connection at the specified IP address and port. [**Start server**] and [**Stop server**] buttons are used for the server control. TCP server will be started automatically upon the program startup if **Start server at startup** checkbox is checked. Server and client messages are logged in the bottom part of the data options window. Status bar of the window displays the number of bytes transferred for both server [SRV] mode and client [CLI] mode.

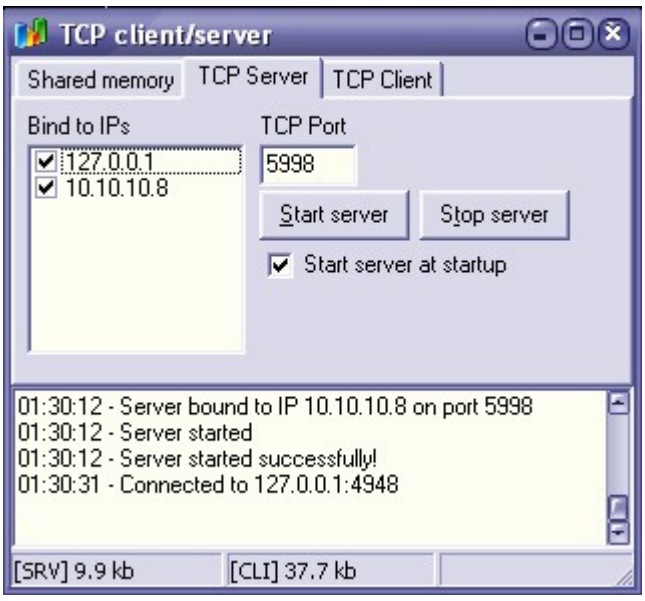


Fig. 3.1. TCP server options.

In the client mode user has to specify IP address or domain name and IP port of the server. [**Connect**] and [**Disconnect**] buttons are used for the client control. [**Read all charts**] button reads all charts from the server together with all options (colors, axes format etc.) and accumulated data. **Enable periodic poll** checkbox switches periodic data requests for the server. **Poll period** specifies the period of these requests in seconds. Periodic poll is used for the reading of the last channel data from the server. **Use short poll** checkbox enables short data packet exchange with the packet size of about 2kb without system messages log. The size of the full data packet with the message log is 7.5kb. It is used when checkbox is cleared.

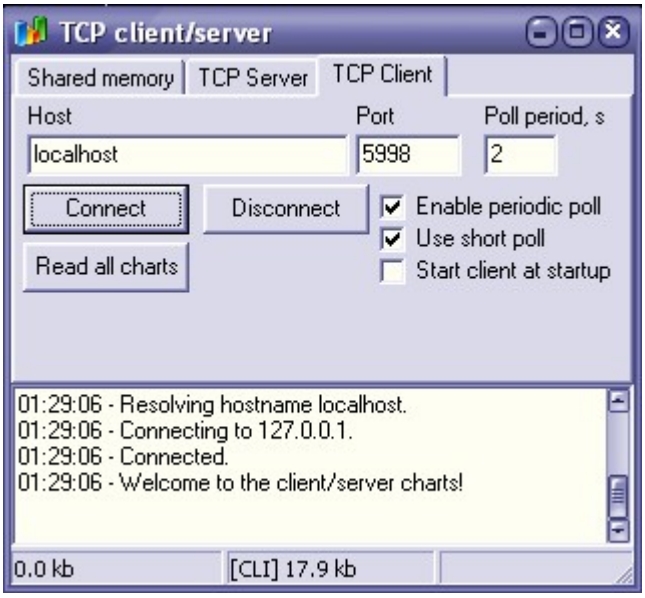


Fig. 3.2. TCP client options.

TCP client starts automatically upon the program startup if **Start client at startup** checkbox is checked. After successful connection to the server program asks user to read all charts from the server.

TCP/IP client-server mode allows running multiple instances of the Charts software at one or multiple computers. One instance must run as a server at the control computer together with the control software. All clients could be used for remote system monitoring or for the visualization of the various sets of more than ten parameters.

The TCP/IP client and server modes are shown in the main window caption: [SRV] for server and [CLI] for client.

3.1 TCP server commands

TCP server in the Charts software understands simple text commands. If client is connected to the server, it sends the greeting string "Welcome to the client/server charts!". The commands for the server are the following (every command should end with CR LF):

TIME - responds with the current time of the server

CHART x - transmits text stream with the chart number x. The stream contains not only chart data, but also all formats, colors, labels etc. This commands is used to obtain whole chart as it is displayed in the server.

SHOT - transmits binary data structure with all actual system parameters and log messages (see structure below).

SHORTSHOT - transmits the same binary structure with all actual system parameters, but without log messages (which takes 2kb per snapshot instead of 7.5kb for the full SHOT).

SHOT data structure is defined as follows (all integers are 4-byte long):

```
typedef struct
{
 double Time;      // date and time in the double format
 DWORD  tickcount; // system millisecond counter
 int    NumChan;   // number of parameters
 int    NumFast;
 int    NumSlow;
 int    NumCont;
 float  Data[500]; // Parameter values
 int    LogN;      // number of the last log message
 TLOG   Log[21];   // array of log messages
} SHOT_DATA;

typedef struct
{
 double Time;      // date and time in the double format
 int    MSGType;   // type of the message
 char   MSG[250];  // message string
} TLOG;
```

The float Data[] array contains values of all system parameters. The control system channels are distributed over three tables (Fast, Slow and Control data). Fast channels (channel ID from 1 to 200) are located in Data[0] – Data[199] array items. Slow channels (channel ID from 301 to 400) are located in Data[200] – Data[299] array items. Control channels (channel ID from 601 to 700) represent parameters changed by system operator and are located in Data[300] – Data[399] array items. The list of channels depends on the control system and should be provided separately.

4 Additional software capabilities

A chart editor can be executed for every chart in the software (Fig. 4.1). One can adjust chart appearance in this editor (Chart tab), line color and format (Series tab) and other options. There is also a possibility to export chart into one of the graphic formats (BMP, WMF, PNG, PDF, – Export tab), and print it (Print tab).

Since huge number of chart options it is impossible to list them here. They are well described in the help file of the editor, which can be called by [Help] button or using [?] button in the editor caption and clicking at the editor element afterwards (Fig. 4.1).

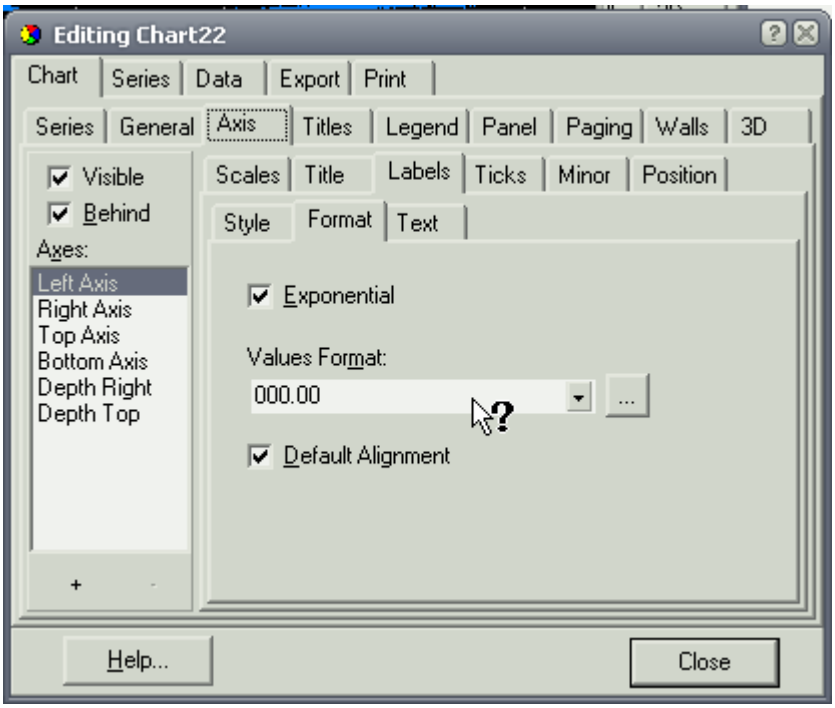


Fig. 4.1. Chart editor.

Chart line color can be changed by double click at the series line in the list. Background and border colors are available in **Panel** tab. Chart title – in **Titles** tab. Axes scale, position, titles, labels format etc. –in **Axis** tab (Fig. 4.1).

Export capabilities are located in **Export** tab, print capabilities – in **Print** tab. All charts options can be saved in the configuration file (**Options/Save charts config** menu item) and restored afterwards (**Options/Load charts config** menu item).