TOTAL ENGINEERING SERVICES TEAM, INC.

RTU / SCADA SYSTEMS

GRAHICS OPTION

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1.0 INTRODUCTION

The TEST INC. RTU/SCADA program has the capability of displaying data graphically. The data to be graphed can come from a variety of sources and can represent dynamic values or static values. For example, a unit's local channels can be graphed to visually display the current values. Remote channels can be graphed to display the values of another unit at the time of the last update. Other values can come user defined variables or from databases that are used to store data over periods of time. Following is a list of supported graph types and an explanation of each.

ANNUNCIATOR PANELS - Annunciator panels are an efficient way of displaying the alarm status and current values of real-time data. If an annunciator channel is in alarm, then the background color of the channel's cell will change color, giving a very strong visual indication that an alarm has occurred. For annunciator graphs only, the **F2** and **F3** keys allow channels to be acknowledged and reset during window updates.

METERS - Meters (gauges) are used to display analog data much like a voltmeter or car speedometer. A digital readout of each channel is displayed at the bottom of each meter window.

BARGRAPHS - This program supports both vertical and horizontal bargraphs. Bargraphs are used to display analog data in a style familiar to process control engineers. A digital readout of each channel is displayed at the bottom of each bargraph window.

SCROLL GRAPHS - Scroll graphs are used to display analog data in the same fashion as an oscilloscope or strip chart recorder. This graph type is most appropriate for graphing data stored in a database.

A graphics window must be defined before any graph can be displayed. Each graphics window contains such information as the graph type, window size, colors, and traces (the variables to graph). There can be up to 10 windows displayed on a screen at the same time. Each window is independent of the others and any mixture of graph types can be used. Up to 8 traces can be displayed and updated for any window.

2.0 GRAPHICS DRIVER

The graphics routines in this program require one of Borland's graphics interface (BGI) drivers to be present. These drivers support IBM CGA, EGA and VGA graphics boards. The corresponding driver files are CGA.BGI and EGAVGA.BGI. The program assumes that the driver file being used will either be located in the same directory that the program is started from or in the root directory of the default drive. If the proper driver file is not located in one of these directories the program will display an error message when an attempt is made to display a graph.

3.0 ENABLING GRAPHICS

The RTU program can operate in one of three modes (RTU, Host, and Demo mode). The mode is determined by a security lock (dongle) which is attached to the parallel port of the computer running the software. If the program is operating without the security lock, the system will operate in DEMO mode. Otherwise, the mode is determined by the type of dongle being used. Graphics are disabled only when the program is operating in Host mode. The VER command can be used at any time to see which mode the program is currently operating under. If operating in Host mode and graphic capabilities are a necessity, the Host dongle on the computer will have to be replaced with an RTU type dongle.

4.0 CREATING A GRAPH

Creating a graph involves setting up all the variables that define a graphics window and saving that information to a file. Although it is possible to manually create a file that defines a graphics window, it is much easier to provide the necessary information and let the program create the file for you. By using one of the available setup screens, a graphics window can easily and quickly be defined and saved to a file.

There are two ways to access a graphics window setup screen. One way is to use the program's Main menu system. The Main menu can be displayed either by using the MENU command or by pressing the F9 function key (or possibly SHIFT-F9). Selecting the GRAPH option from the Main menu will cause a submenu to appear which will display the different graphic functions available. Selecting the CREATE GRAPH option from that menu will cause another submenu to appear from which the user will have to select the type of graph to be created. Once a selection is made from that menu, a setup screen will appear which will enable a graphics window to be created.

The second way to access a graphics window setup screen is to use the CONFIG command followed by a keyword which indicates the type of graphics window to create. The available keywords are:

ANNUN
METER
VBAR
HBAR
SCROLL

For example, the command

```
CONFIG ANNUN
```

could be used to access a setup screen used to create an annunciator type graphics window.

Since each type of graph requires different information there is a different setup screen for each type of graph. Some of the information found on each setup

screen is unique to that particular type of graph while other information is common to all graph types. Refer to the following section in this manual called GRAPH SETUP SCREENS for detailed information about how to use the setup screens to create each graphics window.

One of the fields common to all graph setup screens is the name of the file to which the setup will be saved. This file name must be provided but it is not necessary for a file extension to be specified. Although any valid file extension can be used, the program will automatically assume the extension .RTG (for Real Time Graph) if one is not specified.

If the CONFIG command is used to access the graphics window setup screen, an optional parameter can be provided after the required keyword. This parameter would represent the name of the file to be created and would automatically appear on the entry screen in the space provided for the file name. Again, any valid file extension can be specified or the file extension can be omitted and the default extension .RTG will be assumed. For example, the command

```
CONFIG ANNUN DISP1
```

will cause an annunciator graph setup screen to appear with the name DISP1 already entered as the file name. When the data is saved the file DISP1.RTG will be created.

5.0 GRAPH SETUP SCREENS

The are 5 different setup screens which are used to create or modify graphic windows. These entry screens can be accessed either by using the Main menu system or by using the CONFIG command as explained above. At any time during data entry the **ESC** key can be used to cancel the setup or the **F2** key can be used to save the data to the graphics file and return to the Main menu or command line. Before overwriting any existing files the user will be prompted and have the option to overwrite, cancel, or enter another file name.

Some of the entry fields found on the graphic setup screens are common to all types of graphs and therefore appear on all setup screens. Other fields are unique to particular graph types and are found on just one or two of the setup screens. Below is a list of fields that are common to several graph setup screens. Following the explanation of these fields is a display of each graph setup screen immediately followed by an explanation of any fields unique to each screen.

Fields common to most graph setup screens are:

File Name - This specifies the name of the file that will contain the setup for a graph window. Each file created using a graph setup screen contains the setup for only one graph window. The format of the file is a list of WINDOW commands which define the graph variables. If no extension is provided in the file name the extension .RTG will be used.

Up Left Col & Up Left Row - These values define the location of the top left corner of the graph window. The values are specified as a percent of

the entire CRT screen and can range from 0.0 to 1.0. The first value is the distance from the left side of the screen and the second value is the distance from the top of the screen. The point (0.0, 0.0) represents the upper left corner of the screen and the point (1.0, 1.0) represents the lower right corner of the screen.

Low Right Col & Low Right Row - These values define the lower right corner of the graph window. The values are specified as a percent of the entire CRT screen and can range from 0.0 to 1.0. The point (0.0, 0.0) represents the upper left corner of the screen and the point (1.0, 1.0) represents the lower right corner of the screen.

Graph Title - This specifies the text that will appear at the top of the graph window.

Databases - This allows all databases that will be used by the graph window to be listed. Database file names can be separated by spaces or commas. When saved to a file, these database names are stored in the format of a WINDOW DATABASES command. When processed later, the program will open all database files listed and make the first one in the list the current database. These databases will remain open until each is closed using the DB CLOSE command.

Trace Names - There can be up to 8 traces defined for a graph window. A trace can be either a channel name, channel tag, local variable, public variable, or a database field name. If the trace is a channel name or channel tag, the RTU that the channel belongs to can be specified in the trace name using the dot notation (RTU.TAG). If the trace is a database field name, it is recommended that a # sign be included at the end of the trace name. Although this is not required, it is recommended to avoid a conflict when a channel or variable has the same name as a database field. Also, a database file name can be specified after the # sign. This will avoid conflict when more than one database is being used (FIELD#DATABASE).

Colors - Each graph setup screen also contains several fields for defining the colors of each graph. The colors that are specified are used differently by different types of graphs. When providing this information the first 3 letters of any color must be correctly spelled. The available colors are:

BLACK	MAGENTA
BLUE	BROWN
GREEN	GRAY
CYAN	YELLOW
RED	WHITE

Trace Tags - This specifies the tag name to be displayed for each trace in the graphic window. No tag name will be saved in the file if this parameter is left blank when the setup screen is saved. However, if the trace is a channel, the tag name will automatically be filled in when the file is processed. This could be during a graph display or when an existing graph file is being modified using a setup screen. Since the

program will automatically use the actual tag name for a channel, it is not necessary to fill in the trace tags for channel traces unless you want a tag name to appear on the graph that is different from the actual channel tag name.

Trace Colors - This specifies the colors that will be used to display each trace. These fields control the color of the needles in Meter graphs, the color of the bars in Bar graphs, and the color of each line trace in Scroll graphs. Specifying these colors is exactly the same as specifying the colors for the other parts of each graph. The first 3 letters of any color must be correctly spelled and again the available colors are:

BLACK	MAGENTA
BLUE	BROWN
GREEN	GRAY
CYAN	YELLOW
RED	WHITE

Following is a display of each graph setup screen with default values and an explanation of any fields unique to each screen.

```
                    ANNUNCIATOR GRAPH SETUP

File Name                       # of Rows     1          Border Color     BLACK
Up Left Col     0               # of Columns  8          No Alarm Color   BLACK
Up Left Row     0                                       New Alarm Color  BLUE
Low Right Col   0.999                                   In Alarm Color   GREEN
Low Right Row   0.15                                    DeadBand Color   CYAN
Graph Title                                             Reset Color      RED
Databases                                               Title Color      WHITE
                                                        Axis Color       WHITE

          Trace Names           Trace Text
Trace 1
Trace 2
Trace 3
Trace 4
Trace 5
Trace 6
Trace 7
Trace 8

                        <F2> Save    <Esc> Cancel
```

# of Rows - Number vertical cells in an annunciator window.

# of Columns - Number horizontal cells in an annunciator window.

Trace Text - Each cell of an annunciator window can have up to 4 lines of information. These lines can contain text, the current value of the trace, or the alarm status of the trace. Each line of information is derived from a single string which uses the "|" character to separate one line from another. To skip a line in a cell simply enter two separator characters in a row. To display the current value of a trace use the special code "*V". To display a text description of the alarm status of a trace use the special code "*A". Everything else provided for this parameter will appear simply as text. This allows the name or a description of the trace to appear in its cell.

```
                              METER GRAPH SETUP

File Name                     Dec Places    0          BkGround Color  CYAN
Up Left Col      0.35         Lo Alarm Val  0          Lo Alarm Color  RED
Up Left Row      0.2          Hi Alarm Val  99999      Hi Alarm Color  RED
Low Right Col    0.69         Graph Units              No Alarm Color  WHITE
Low Right Row    0.615        Lo Alarm Msg  LOW        Title/Lbl Color WHITE
Graph Title                   No Alarm Msg  OK         Axis Color      WHITE
Min Y Value      0            Hi Alarm Msg  HIGH
Max Y Value      1000         Show Text?    Y
Databases
          Trace Names         Trace Tags               Trace Colors
Trace 1                                                WHITE
Trace 2                                                BLUE
Trace 3                                                GREEN
Trace 4                                                CYAN
Trace 5                                                RED
Trace 6                                                MAGENTA
Trace 7                                                BROWN
Trace 8                                                GRAY

                          <F2> Save     <Esc> Cancel
```

Min Y Value - Minimum value for y axis scaling.

Max Y Value - Maximum value for y axis scaling.

Dec Places - Number of digits to the right of the decimal point for a graph's scale. This does not affect the display of a trace's value. The number of digits to the right of the decimal point to display for a trace's value is configurable for each channel individually or is controlled by the SET PLACES command.

Lo Alarm Val - Low alarm setpoint.

Hi Alarm Val - High alarm setpoint.

Graph Units - Text string displaying units on graph.

Lo Alarm Msg - Message displayed when trace is in low alarm condition.

No Alarm Msg - Message displayed when trace is not in alarm.

Hi Alarm Msg - Message displayed when trace is in high alarm condition.

Show Text - Specify whether or not to include trace tags, trace values, and alarm strings on a graph.

```
                    VERTICAL BAR GRAPH SETUP

File Name                    Dec Places    0          BkGround Color  BLACK
Up Left Col     0.35         Lo Alarm Val  0          Border Color    CYAN
Up Left Row     0.2          Hi Alarm Val  99999      Lo Alarm Color  RED
Low Right Col   0.69         Graph Units              Hi Alarm Color  RED
Low Right Row   0.615        Lo Alarm Msg  LOW        No Alarm Color  WHITE
Graph Title                  No Alarm Msg  OK         Title/Lbl Color WHITE
Min Y Value     0            Hi Alarm Msg  HIGH       Axis Color      WHITE
Max Y Value     1000         Show Text?    Y
Databases
          Trace Names              Trace Tags              Trace Colors
Trace 1                                                   WHITE
Trace 2                                                   BLUE
Trace 3                                                   GREEN
Trace 4                                                   CYAN
Trace 5                                                   RED
Trace 6                                                   MAGENTA
Trace 7                                                   BROWN
Trace 8                                                   GRAY

                    <F2> Save     <Esc> Cancel
```

All fields on the Vertical Bar graph setup screen are the same as the fields on the Meter graph setup screen.

```
                    HORIZONTAL BAR GRAPH SETUP

File Name                    Dec Places    0          BkGround Color  BLACK
Up Left Col     0.35         Lo Alarm Val  0          Border Color    CYAN
Up Left Row     0.2          Hi Alarm Val  99999      Lo Alarm Color  RED
Low Right Col   0.69         Graph Units              Hi Alarm Color  RED
Low Right Row   0.615        Lo Alarm Msg  LOW        No Alarm Color  WHITE
Graph Title                  No Alarm Msg  OK         Title/Lbl Color WHITE
Min X Value     0            Hi Alarm Msg  HIGH       Axis Color      WHITE
Max X Value     1000         Show Text?    Y
Databases
         Trace Names                 Trace Tags              Trace Colors
Trace 1                                                      WHITE
Trace 2                                                      BLUE
Trace 3                                                      GREEN
Trace 4                                                      CYAN
Trace 5                                                      RED
Trace 6                                                      MAGENTA
Trace 7                                                      BROWN
Trace 8                                                      GRAY

                    <F2> Save    <Esc> Cancel
```

Except for the following two fields, all fields on the Horizontal Bar graph setup screen are the same as the fields on the Meter graph setup screen. The two unique fields are:

Min X Value - Minimum value for x axis scaling of horizontal bargraph.

Max X Value - Maximum value for x axis scaling of horizontal bargraph.

```
                        SCROLL GRAPH SETUP

File Name                       Dec Places    0          BkGround Color  BLACK
Up Left Col     0.35            Lo Alarm Val  0          Border Color    CYAN
Up Left Row     0.2             Hi Alarm Val  99999      Lo Alarm Color  RED
Low Right Col   0.69            Graph Units              Hi Alarm Color  RED
Low Right Row   0.615           Segments      100        Title/Lbl Color WHITE
Graph Title                     Thick Trace?  Y          Axis Color      WHITE
Min Y Value     0               Label 1
Max Y Value     1000            Label 2
Databases
          Trace Names           Trace Tags               Trace Colors
Trace 1                                                  WHITE
Trace 2                                                  BLUE
Trace 3                                                  GREEN
Trace 4                                                  CYAN
Trace 5                                                  RED
Trace 6                                                  MAGENTA
Trace 7                                                  BROWN
Trace 8                                                  GRAY

                        <F2> Save    <Esc> Cancel
```

Segments - This determines the number of segments a scroll graph is broken into. That is, the number of updates required for a trace to reach the rightmost edge of the graph. Each time a trace reaches the edge the scrolling will stop and wait for a key press. When a key is pressed the graph will be scrolled back to 75% of the x-axis time interval and plotting will continue.

Thick Trace - Control size of traces on scroll graphs.

Label 1 & Label 2 - This allows text messages to be displayed along x-axis of scroll graphs. These messages will appear at the 0%, 25%, 50%, and 75% time intervals. These labels can be literal strings or special strings that get expanded when displayed. For example, since the data being graphed is probably coming from a database, it might be helpful to use labels such as $#T and $#D. These strings will get expanded during a graph update and display the time and date of the current database record.

An explanation of all other fields can be found under the display of the Meter graph setup screen or under the explanation of common setup screen fields.

6.0 WINDOW COMMAND

The WINDOW command is the backbone of all graphic functions. Using different parameters, this command controls the setup and display of all graphs. The WINDOW command can only be processed by task 0 (the local CRT task). Although some variations of the WINDOW command can be processed from the command line, the command that actually displays a graph (WINDOW DRAW) can not. The WINDOW DRAW command can only be processed from within a command file. Therefore, a two step process exists for creating and displaying a graph.

First, a text file must be created containing several WINDOW commands that define a graphics window. This can be done automatically by using the graph setup screens described above.

Second, task 0 must process a command file that contains the setup of the graphics window and the WINDOW DRAW command. More about displaying a graph can be found in the following section called DISPLAYING A GRAPH. The purpose of this section is to focus on the importance of the WINDOW command and explain how the program interprets the various WINDOW command parameters to create and display a graph.

Although up to 10 windows can be displayed at a time, only one window is current at any given moment. The action of the WINDOW command is always performed on the current window. The WINDOW command can be used without any parameters to display the current window number. Valid window numbers range from 1 to 10. If there is no current window a value of -1 is shown.

The format of the WINDOW command is the word "WINDOW" followed by a keyword and possibly other parameters. It is possible to abbreviate the word "WINDOW" and all keywords to just the first 3 letters. The keywords and parameters used by the WINDOW command are listed below followed by an explanation of each. A "|" character is used on a line to separate keywords in situations where several keywords are available and only one must be specified. Brackets are used around some parameters to indicate that they are optional. An optional parameter is one that will assume the default value if a new value is not specified in the command. Usually, each item in a command is separated by commas. To skip a parameter simply use two consecutive commas in the command without specifying a value for that parameter. The supported parameters are:

SELECT x

Make a graphics display window the current window. This command must be used to select a window before any of the other WINDOW commands can be used. When several graph windows are to be displayed on the same screen, the SELECT command must be used to select each window before each graph can be setup and displayed. Once all the windows are displayed, a loop is usually used to continuously select and update each window.

Example: `WIN SELECT 1`

ANNUNCIATOR | METER | VBAR | HBAR | SCROLL [x1, y1, x2, y2]

Define a graph for the current window. The x1, y1, x2, and y2 variables are optional parameters that can be used to define the size of the graphics window and its location on the CRT screen. These values can range from 0.0 to 1.0. The values x1,y1 define the top left corner of the graph window and x2,y2 the lower right corner. These values define a window as a percent of the entire CRT screen. The point (0.0,0.0) represents the upper left corner of the screen while the point (1.0,0.0) represents the upper right corner of the screen. Default values are used for any value not specified.

Examples:
```
WIN ANNUN 0.0 0.0 0.999 0.15
WIN METER 0.05 0.18 0.55 0.65
WIN VBAR, 0.55, 0.69, 0.999, 0.99
WIN HBAR, 0.05, 0.701, 0.499, 0.99
WIN SCROLL, 0.1, 0.1, 0.95, 0.95
```

DRAW

Switch to graphics mode and display a graph for the current window. Before using this command a window must be selected and a graph type defined for that window. Also, all traces, colors, and other window options must be set prior to the initial graph display.

Example: `WIN DRAW`

UPDATE

Update the current window with the current value of all traces. Usually, there is a one-time setup for a graph and then this command is processed repeatedly for a continuous real-time display.

Example: `WIN UPDATE`

CLOSE

Exit the current graphics window and return to text mode. This command will free the memory used by all windows and set the current window to -1. In order to recall a graph window, the entire sequence of setting up and displaying the graph will have to be repeated.

Example: `WIN CLOSE`

TRACE TraceName [Text] (for annunciator windows)
or
TRACE TraceName [Tag] [Trace Color] (for all other windows)

Define a trace for a graph. Each graphics window can have up to 8 traces. A trace can be either a channel name, channel tag, local variable, public variable, or a database field name. If the trace is a local or public variable it must be defined before this command is called or the trace will not be set. If the trace is a database field name the database must be open and selected at the time this command is

processed. If it isn't, the program will not be able to find the field name and the trace will not be set.

Also, if the trace is a database field name it is recommended that a # sign be included at the end of the trace name. Although this is not required, it is recommended to avoid a conflict when a channel or variable has the same name as a database field. When searching to identify a trace the program first looks for a match with a channel, then a variable, and finally a database field name. If the # sign is found at the end of a trace name the program will skip the search for a channel or variable name and go directly to the current database to search for a field name (without the # sign included).

Once the trace name has been identified, the program will scan the rest of the line for other parameters. For annunciator windows, a parameter can be provided to display information in the cell for the current trace. Each cell in an annunciator window can contain up to 4 lines of information. These lines can contain text, the current value of the trace, or the alarm status of the trace. Each line of information is derived from a single string which uses the "|" character to separate one line from another. To skip a line in a cell simply enter two separator characters in a row. To display the current value of a trace use the special code "*V". To display a text description of the alarm status of a trace use the special code "*A". Everything else provided by the parameter will appear simply as text. This allows the name or a description of the trace to appear in its cell.

For all other types of windows, two parameters can be used to specify the tag and color of a trace. For channel traces the current tag name is used if no override is specified by this command. Also, default colors are used for each trace in a window if not explicitly specified by this command.

Examples for annunciator type windows:

```
WIN TRACE, S2, Pipeline|Valve|Closed
WIN TRACE, RTUBATT, Actual|Voltage|*V|Volts
```

Examples for other type windows:

```
WIN TRACE, STATIC_3, H.P., BLUE
WIN TRACE, RTUBATT, Battery, WHITE
WIN TRACE, DIFF_1, Plate 1, RED
WIN TRACE, DIFF_2, Plate 2, RED
```

DATABASES db1, db2, ...

List all databases that will be used by the graph window. The program will open all the databases in the list and make the first one the current database. These databases will remain open until each is closed by the DB CLOSE command.

Examples:

```
WIN DATABASES GA343A
WIN DATABASES, GA343A, GA343B, GA343C
```

SEGMENTS x

Set the number of segments for a scroll graph. This is the number of updates required for a trace to reach the rightmost edge of the graph. Each time a trace reaches the edge it will be scrolled back to 75% of the x-axis time interval. The default number of segments is 100.

Examples:
```
WIN SEGMENTS 40
WIN SEGMENTS 60
```

ROWS [rows] [cols]

Specify the number of rows and columns for an annunciator window.

Example:
```
WIN ROWS 1 8
WIN ROWS 3 2
```

RANGE [min] [max]

Set the minimum and maximum values for scaling a graph. These values are used by all types of graphs except the annunciator. The default values are 0 and 1000.

Examples:
```
WIN RANGE 0 1000
WIN RANGE 1000.00 5000.00
```

ALARM [LoAlmVal] [HiAlmVal] [LoAlmStr] [NoAlmStr] [HiAlmStr]

Set the low alarm limit and high alarm limit for all types of graphs except the annunciator. The default limits are 0 and 99999. Also set the text strings that are used to indicate the status of each trace. There is one low, normal, and high alarm string which is used by all traces in the same window. The alarm strings are used by meter, vertical bar, and horizontal bar graphs. The default alarm strings are "LOW", "OK", and "HIGH".

Examples:
```
WIN ALARM, 0, 5000, LOW, OK, HIGH
WIN ALARMS, 100.0, 500.0, LO ALARM, NORMAL, HI ALARM
```

TEXT ON | OFF

Control whether trace tags, trace values, and alarm strings are displayed on a graph. It may be desirable to omit this information from small graphs that can not clearly display all text.

Examples:
```
WIN TEXT ON
WIN TEXT OFF
```

THICK ON | OFF

Control size of traces on scroll graphs.

Examples:
```
WIN THICK ON
WIN THICK OFF
```

DECIMALS x

Set the number of digits to display to the right of the decimal point on a graph's scale. This setting is used by all types of graphs except the annunciator. The default value is 0.

Examples:
```
WIN DECIMALS 0
WIN DECS 2
```

TITLE TitleStr

Specify a title for a graph window.

Examples:
```
WIN TITLE, STATUS DISPLAY
WIN TITLE, GAS PRESSURES
```

UNITS UnitStr

Specify a string to be displayed as the units for a graph window. This string is used by all types of graphs except the annunciator.

Examples:
```
WIN UNITS PSI
WIN UNITS VOLTS
```

LABELS [Label1] [Label2]

Specify x-axis labels for scroll graphs. Each scroll graph can have two labels along the x-axis that appear at the 0%, 25%, 50%, and 75% time intervals. These labels can be literal strings or special strings that get expanded when displayed. For example, since the data being graphed is probably coming from a database, it might be helpful to use labels such as $#T and $#D. These strings will get expanded during a graph update and display the time and date of the current database record.

NOTE: When a file is created which defines the setup of a graph, any labels that contain special $ codes should be defined inside of double quotes (" "). For example, the code $#T should be stored in the file as "$#T". By doing this, the label string will get expanded each time the label is updated rather than only once at the time the LABEL command is processed. When using a CONFIG SCREEN to define a graph, the special code labels do not have to be specified with the quotes. The program will automatically add these to the label strings when the setup is saved to a file.

Example:
```
WIN LABELS $#T $#D
```

COLORS [c1] [c2] [c3] [c4] [c5] [c6] [c7] [c8]

Set the colors of a graphics window. The parameters in this command affect different parts of a window depending on the type of graph defined for the window. Most parameters represent colors for specific

parts of a window. However, for annunciator windows, most parameters represent the colors of a cell based on the alarm status of the trace. A list of graph types and the parts of the window that each parameter controls is as follows:

	ANNUN	METER	HBAR & VBAR	SCROLL
c1	Border	BkGround	BkGround	BkGround
c2	No Alm	Lo Alm	Border	Border
c3	New Alm	Hi Alm	Lo Alm	Lo Alm
c4	In Alm	No Alm	Hi Alm	Hi Alm
c5	DeadBand	Title/Label	No Alm	Title/Label
c6	Reset	Axis	Title/Label	Axis
c7	Title		Axis	
c8	Axis			

Examples:
```
WIN COLORS BLUE BLACK RED RED BLUE WHITE WHITE WHITE
WIN COLORS GRAY RED RED GREEN BLACK WHITE
```

7.0 DISPLAYING A GRAPH

The WINDOW DRAW command is used within a command file to display a graph. This command can only be processed by task 0 and from within a command file. Also, the WINDOW DRAW command can be processed only if a current graphics window is selected and a graph is defined. The Main menu system can be used to help automate this process and display a graph.

Selecting the GRAPH option from the Main menu will cause a submenu to appear which will display the different graphic functions available. Selecting the DISPLAY GRAPH option from that menu will cause a pick list to appear containing all the files with the extension .RTG. These files contain the setup for different graphic windows and can be created as described above. The **ESC** key can be used to exit the pick list and allow a file name to be entered that does not have the standard .RTG extension. Once a graph file is selected the program will attempt to process a file called CHKGRAPH.RTU. The selected file name will be passed as a parameter to the CHKGRAPH.RTU file and can be accessed within the CHKGRAPH file by using the notation $1. For example, if a file called OIL_DISP.RTG is selected from the pick list, the program will attempt to process the following command:

```
READ CHKGRAPH OIL_DISP.RTG
```

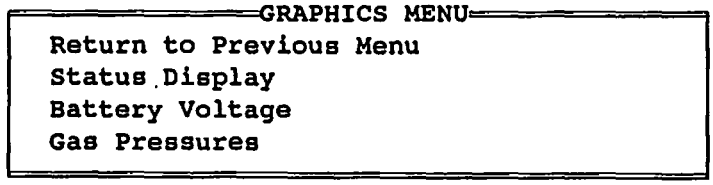
The CHKGRAPH.RTU file is responsible for selecting a graphics window, defining a graph, and then displaying the graph. The graph can be defined by simply having the CHKGRAPH file read the graph setup file that was passed to it as a parameter. For example, a typical CHKGRAPH.RTU file might look like this:

```
WIN SEL 1          ; select a current graph window
GOSUB $1           ; process graph file to load all variables
WIN DRAW           ; display the graph
:LOOP              ; continue to update graph until key pressed
IF @KEY(0) > 0     ; if a key has been pressed
  WIN CLOSE        ; exit graph and return to text mode
  RETURN           ; terminate execution of this file
ENDIF
WIN UPDATE         ; update graph window with current trace values
GOTO LOOP          ; continue to update graph until key pressed
```

Notice that the CHKGRAPH file contains a loop that will cause the graph to continuously be updated until a key is pressed. When a key is pressed the current graphics window will be closed and the program will return to the Main menu.

The CHKGRAPH file is used primarily as a way to quickly check the appearance of a graph as it is being created. The file can be modified in any way to do special things such as close any databases that might be opened during a graphics display or check for database errors during the display. For more information about using databases refer to a later section in this manual called DISPLAYING VALUES FROM A DATABASE.

The User meun system can also be used as a convenient way to display various graphs. For example, assume that the setup of three graphs exist in the files StatDisp.RTG, BattDisp.RTG, and GasPress.RTG. Also assume that a file called GrDisp.RTU, which is similar to the CHKGRAPH.RTU file, has been created to display each of these graphs. The following User menu could be used to easily choose and display each graph:



The User menu file associated with this menu would appear as follows:

```
`GRAPHICS MENU ~ 20 ~ 5
|Return to Previous Menu
  menu return
|Status Display
  read GrDisp StatDisp.RTG
|Battery Voltage
  read GrDisp BattDisp.RTG
|Gas Pressures
  read GrDisp GasPress.RTG
```

8.0 MODIFYING A GRAPH

Once a graph has been created and saved to a (.RTG) file it can be modified by any of several ways. Although it can be manually modified by simply editing the existing file, it is probably easier to use a setup screen to make the changes and have the program recreate the file for you. Again, either the Main menu or the CONFIG command can be used to access the graph setup screens.

From the Main menu you can select "GRAPH" and then "EDIT EXISTING GRAPH". A pick list will then be displayed listing all files with the extension .RTG (if any exist). You can either select one of these graph files or press the **ESC** key which will respond with a prompt to enter a file name. If the **ESC** key is pressed again the program will return to the Main menu. Otherwise the program will read the selected file and put up an entry screen for which to modify the existing graph setup. The entry screens used to modify an existing graph are the same as the ones used to create a graph. The only difference is that the entry screens are filled with default values when creating a graph and filled with the existing values when modifying a graph.

Another way to modify an existing graph is to use the CONFIG GRAPH command at the command prompt. In order for this command to work there must be a current graph window and a graph type defined for that window. Otherwise, the program will not know what type of graph to modify or which entry screen to use. The following list of commands can be used to demonstrate how this might work:

```
WIN SEL 1          ; select a current graph window
READ X.RTG         ; read a graph file to define a graph type
CONFIG GRAPH X     ; make changes to existing graph
```

Note that the file name "X" appears at the end of the CONFIG GRAPH command. This will cause the entry screen to appear with the name "X" already filled in at the file name prompt. If no file name is provided in the command line it will have to be specified within the entry screen. Nevertheless, all settings for the current graph will still appear when the entry screen is displayed.

9.0 DISPLAYING SEVERAL GRAPHS ON THE SAME SCREEN

Displaying several graphs on the same screen is similar to displaying a single graph. To begin, each graph must individually be created and saved to a file in the manner described above. A single file must then be created to read each graph file and display all graphs on the screen at one time. A maximum of 10 graphs can be displayed on a screen at the same time. The file used to display and update multiple graphs is similar to the file used to display a single graph. The only real difference is that each window associated with a graph must be selected before each graph file is read, each graph is displayed, and each graph is updated. For example, consider the setup of the following three graphs:

1)

ANNUNCIATOR GRAPH SETUP

File Name	ANNUN.RTG	# of Rows	1	Border Color	BLUE
Up Left Col	0.125	# of Columns	6	No Alarm Color	BLACK
Up Left Row	0.2			New Alarm Color	RED
Low Right Col	0.874			In Alarm Color	RED
Low Right Row	0.35			DeadBand Color	BLUE
Graph Title	STATUS DISPL			Reset Color	WHITE
Databases				Title Color	WHITE
				Axis Color	WHITE

	Trace Names	Trace Text
Trace 1	S2	Pipeline|Valve|Closed
Trace 2	S4	Gas Line|Hi Flow|Shutdown
Trace 3	S5	RTU Batt|Lo Volt|Alarm
Trace 4	S6	Status|Channel|Six
Trace 5	S7	Status|Channel|Seven
Trace 6	RTUBATT	Actual|Voltage|*V|Volts
Trace 7		
Trace 8		

<F2> Save <Esc> Cancel

2)

HORIZONTAL BAR GRAPH SETUP

File Name	HORIZ.RTG	Dec Places	1	BkGround Color	GRAY
Up Left Col	0.03	Lo Alarm Val	0	Border Color	CYAN
Up Left Row	0.501	Hi Alarm Val	75	Lo Alarm Color	BLACK
Low Right Col	0.479	Graph Units	Flow Rate	Hi Alarm Color	RED
Low Right Row	0.79	Lo Alarm Msg	LOW	No Alarm Color	GRAY
Graph Title	GAS METERS	No Alarm Msg	OK	Title/Lbl Color	BLACK
Min X Value	0	Hi Alarm Msg	HIGH	Axis Color	WHITE
Max X Value	5	Show Text?	Y		
Databases					

	Trace Names	Trace Tags	Trace Colors
Trace 1	M1	Sales	RED
Trace 2	M2	TEST	BLUE
Trace 3	M3	H.P.	WHITE
Trace 4	M4	FLARE	BLACK
Trace 5			RED
Trace 6			MAGENTA
Trace 7			BROWN
Trace 8			GRAY

<F2> Save <Esc> Cancel

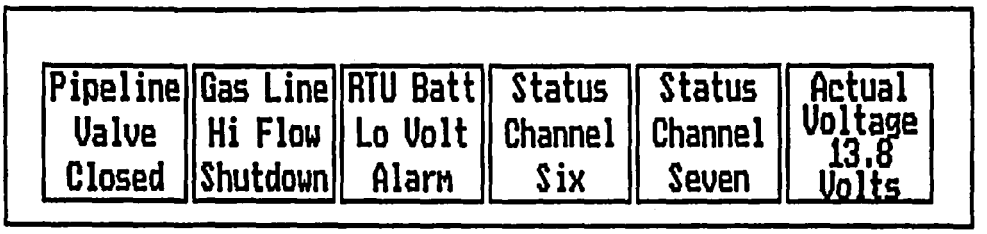
3)

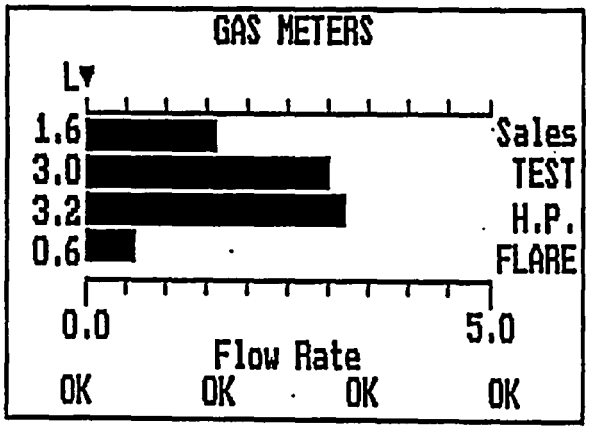
```
                    VERTICAL BAR GRAPH SETUP

File Name       VERTICAL.RTG   Dec Places    0          BkGround Color  GRAY
Up Left Col     0.53           Lo Alarm Val  0          Border Color    CYAN
Up Left Row     0.49           Hi Alarm Val  1000       Lo Alarm Color  BLACK
Low Right Col   0.979          Graph Units   Inches     Hi Alarm Color  RED
Low Right Row   0.79           Lo Alarm Msg  LOW        No Alarm Color  YELLOW
Graph Title     Meter Differ   No Alarm Msg  OK         Title/Lbl Color BLUW
Min Y Value     0              Hi Alarm Msg  HIGH       Axis Color      WHITE
Max Y Value     150            Show Text?    Y
Databases
          Trace Names           Trace Tags              Trace Colors
Trace 1   DIFF_1                Plate 1                 RED
Trace 2   DIFF_2                Plate 2                 BLUE
Trace 3   DIFF_3                Plate 3                 WHITE
Trace 4   DIFF_4                Plate 4                 BLACK
Trace 5                                                 RED
Trace 6                                                 MAGENTA
Trace 7                                                 BROWN
Trace 8                                                 GRAY

                        <F2> Save    <Esc> Cancel
```

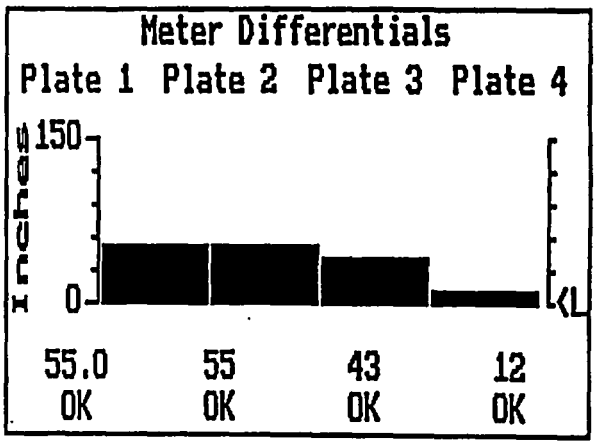
Now consider the following file which could be used to display these three graphs at the same time.

```
WIN SEL 1          ; make graph window #1 current
GOSUB ANNUN.RTG    ; process graph file to define window #1
WIN DRAW           ; display graph in 1st window
WIN SEL 2          ; make graph window #2 current
GOSUB METER.RTG    ; process graph file to define window #2
WIN DRAW           ; display graph in 2nd window
WIN SEL 3          ; make graph window #3 current
GOSUB BAR.RTG      ; process graph file to define window #3
WIN DRAW           ; display graph in 3rd window

:LOOP
WIN SEL 1          ; make graph window #1 current
WIN UPDATE         ; update 1st window with current values
WIN SEL 2          ; make graph window #2 current
WIN UPDATE         ; update 2nd window with current values
WIN SEL 3          ; make graph window #3 current
WIN UPDATE         ; update 3rd window with current values

IF @KEY(0) > 0     ; if key has been pressed
  WIN CLOSE        ; close all windows and return to text mode
  RETURN           ; terminate execution of this file
ENDIF
GOTO LOOP          ; continue to update windows until key pressed
```

Assuming that the above commands are saved in a file called GRDISP.RTU, the command READ GRDISP could be used to simultaneaously display the three graphs as shown below:







10.0 DISPLAYING VALUES FROM A DATABASE

Databases can be used to track the values of channels over time. Usually, a Host unit will contain a database for which data accumulated from an RTU is stored. The data in the database can then be graphically displayed to examine the values of different channels over a period of time. Although all types of graphs are capable of displaying values from a database, the scroll graph is the only type that can truly display a history of values.

When graphically displaying values from a database, the file used to display and update the graph should contain extra lines to check for database errors and to close the database when the graph is erased. The following lines are an example of a file that can be used to display values from a database. In this example, the traces of the graph and the database to use are defined in the file A.RTG.

```
WIN SEL 1           ; make graph window #1 current
GOSUB A.RTG         ; process file to define window & open database
WIN DRAW            ; display the graph
DB LOCATE xx        ; advance database to first record to display

:LOOP
IF @DBERR(0) = 0    ; make sure there is no database error
  WIN UPDATE        ; display values from current database record
  DB NEXT           ; get next database record
ENDIF

IF @KEY(0) > 0      ; if key has been pressed
  WIN CLOSE         ; close window and return to text mode
  DB CLOSE          ; close current database
  RETURN            ; terminate execution of this file
ENDIF

GOTO LOOP           ; continue to update window until key pressed
```

Each graph is capable of displaying values from several databases at the same time. When doing so, each database must be open and currently selected before any reference to that database can be made. A list all databases used by a graph can be specified when creating a graph using the configuration screen (either from the Main menu or the command prompt). This list of databases is saved in the graph (RTG) file with all other graph setup variables. When that file is processed all databases listed will be opened and the first one in the list will be selected as the current database. All that is necessary after that is to select the proper database before processing any commands associated with a particular database. The following is an example of a file that can be used to display a graph that uses two databases X and Y. The graph setup is saved in the file A.RTG and the databases to use are listed with X first followed by Y.

```
WIN SEL 1           ; make graph window #1 current
GOSUB A.RTG         ; define graph, open databases, make X current
WIN DRAW            ; display the graph
DB LOCATE xx        ; get desired record from database X
DB SEL Y            ; make database Y current
```

```
DB LOCATE xx        ; get desired record from database Y

:LOOP

DB SEL X            ; make database X current
IF @DBERR(0) = 0    ; if there is no error with database X
  DB NEXT           ; get next record from database X
ENDIF

DB SEL Y            ; make database Y current
IF @DBERR(0) = 0    ; if there is no error with database Y
  DB NEXT           ; get next record from database Y
ENDIF

WIN UPDATE          ; display values of current database records

IF @KEY(0) > 0      ; if key has been pressed
  WIN CLOSE         ; close window and return to text mode
  DB CLOSE          ; close database Y (current database)
  DB SEL X          ; make database X current
  DB CLOSE          ; close database X
  RETURN            ; terminate execution of this file
ENDIF

GOTO LOOP           ; continue to update window until key pressed
```

The function @DBERR(0) is used to check for database errors. As long as there are no errors with the current database this function will return a value of 0. For more information on the @DBERR(0) function and a list of error codes refer to the RTU/SCADA DATABASE manual.

11.0 DISPLAYING TEXT ON A GRAPHICS SCREEN

Text can be placed anywhere on the screen while in graphics mode by using the CURSOR command. The format of the command is

```
CURSOR col, row, text
```

The col and row parameters are specified as a percentage of the entire screen and must be in the range 0 to 1.

12.0 GRAPH EXAMPLES

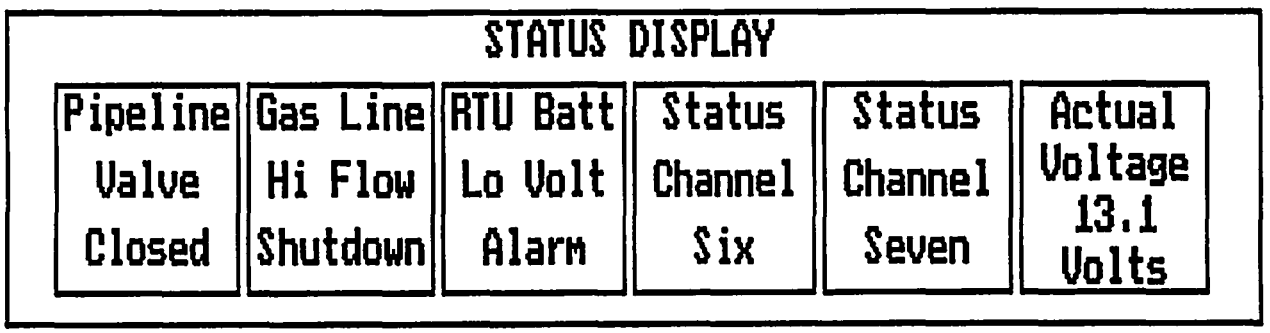
This section contains a list of graph setup screens along with the graphs created by each setup. The purpose of this section is to provide visual examples of the different types of graphs available as well as illustrate how each graph can be created. Remember, each graph can contain a maximum of 8 traces. Some examples are as follows:

ANNUNCIATOR GRAPH SETUP

File Name	STATUS.RTG	# of Rows	1	Border Color	BLUE
Up Left Col	0.125	# of Columns	6	No Alarm Color	BLACK
Up Left Row	0.2			New Alarm Color	RED
Low Right Col	0.874			In Alarm Color	RED
Low Right Row	0.37			Deadband Color	BLUE
Graph Title	STATUS DISPL			Reset Color	WHITE
Databases				Title Color	WHITE
				Axis Color	WHITE

	Trace Names	Trace Text
Trace 1	S2	Pipeline|Valve|Closed
Trace 2	S4	Gas Line|Hi Flow|Shutdown
Trace 3	S5	RTU Batt|Lo Volt|Alarm
Trace 4	S6	Status|Channel|Six
Trace 5	S7	Status|Channel|Seven
Trace 6	RTUBATT	Actual|Voltage|*V|Volts
Trace 7		
Trace 8		

<F2> Save <Esc> Cancel

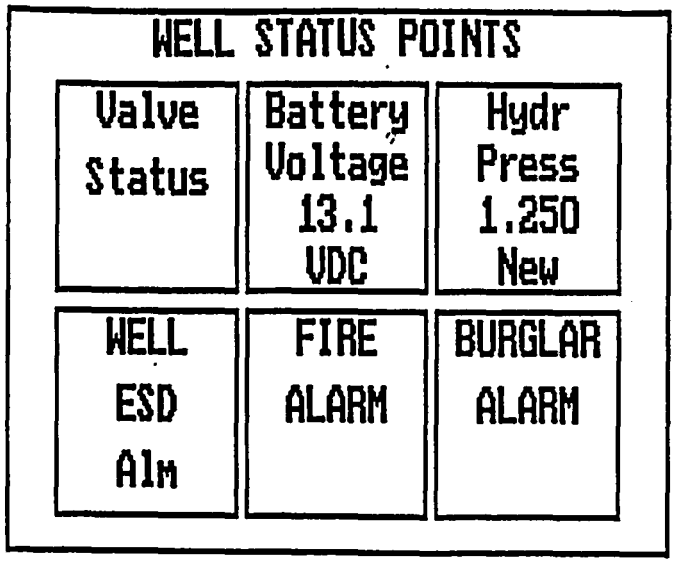


ANNUNCIATOR GRAPH SETUP

File Name	STATUS.RTG	# of Rows	2	Border Color	BLUE
Up Left Col	0.25	# of Columns	3	No Alarm Color	BLACK
Up Left Row	0.3			New Alarm Color	RED
Low Right Col	0.65			In Alarm Color	RED
Low Right Row	0.6			Deadband Color	BLUE
Graph Title	WELL STATUS			Reset Color	WHITE
Databases				Title Color	WHITE
				Axis Color	WHITE

	Trace Names	Trace Text
Trace 1	S2	Valve|Status|*A
Trace 2	RTUBATT	Battery|Voltage|*V|VDC
Trace 3	HYDRPRES	Hydr|Press|*V|*A
Trace 4	S6	WELL|ESD|*A
Trace 5	S7	FIRE|ALARM|*A
Trace 6	S8	BURGLAR|ALARM|*A
Trace 7		
Trace 8		

<F2> Save <Esc> Cancel



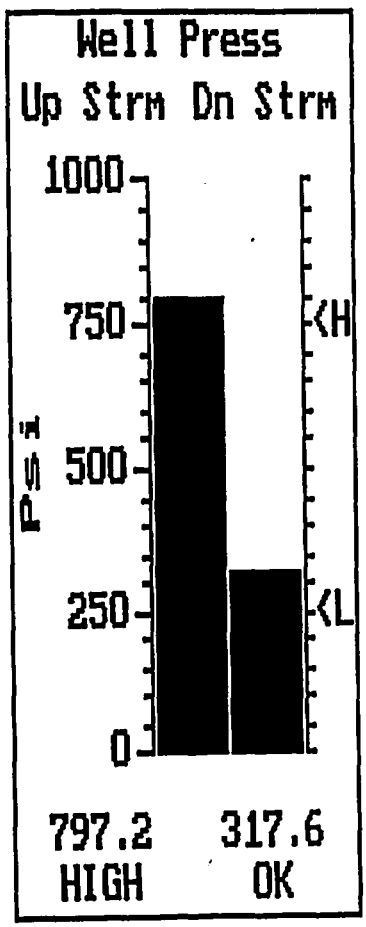
VERTICAL BAR GRAPH SETUP

File Name	WELL2.RTG	Dec Places	0	BkGround Color	GRAY
Up Left Col	0.4	Lo Alarm Val	250	Border Color	CYAN
Up Left Row	0.4	Hi Alarm Val	750	Lo Alarm Color	RED
Low Right Col	0.6	Graph Units	Psi	Hi Alarm Color	RED
Low Right Row	0.9	Lo Alarm Msg	LOW	No Alarm Color	WHITE
Graph Title	Well Press	No Alarm Msg	OK	Title/Lbl Color	BLUE
Min Y Value	0	Hi Alarm Msg	HIGH	Axis Color	WHITE
Max Y Value	1000	Show Text?	Y		

Databases

	Trace Names	Trace Tags	Trace Colors
Trace 1	STAT_1	Up Strm	RED
Trace 2	STAT_2	Dn Strm	BLUE
Trace 3			GREEN
Trace 4			CYAN
Trace 5			RED
Trace 6			MAGENTA
Trace 7			BROWN
Trace 8			GRAY

<F2> Save <Esc> Cancel



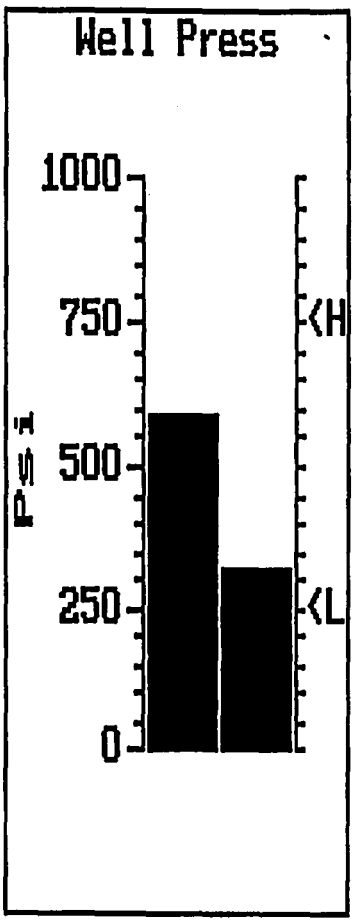
VERTICAL BAR GRAPH SETUP

File Name	WELL2.RTG	Dec Places	0	BkGround Color	GRAY
Up Left Col	0.4	Lo Alarm Val	250	Border Color	CYAN
Up Left Row	0.4	Hi Alarm Val	750	Lo Alarm Color	RED
Low Right Col	0.6	Graph Units	Psi	Hi Alarm Color	RED
Low Right Row	0.9	Lo Alarm Msg	LOW	No Alarm Color	WHITE
Graph Title	Well Press	No Alarm Msg	OK	Title/Lbl Color	BLUE
Min Y Value	0	Hi Alarm Msg	HIGH	Axis Color	WHITE
Max Y Value	1000	Show Text?	N		

Databases

	Trace Names	Trace Tags	Trace Colors
Trace 1	STAT_1	Up Strm	RED
Trace 2	STAT_2	Dn Strm	BLUE
Trace 3			GREEN
Trace 4			CYAN
Trace 5			RED
Trace 6			MAGENTA
Trace 7			BROWN
Trace 8			GRAY

<F2> Save <Esc> Cancel



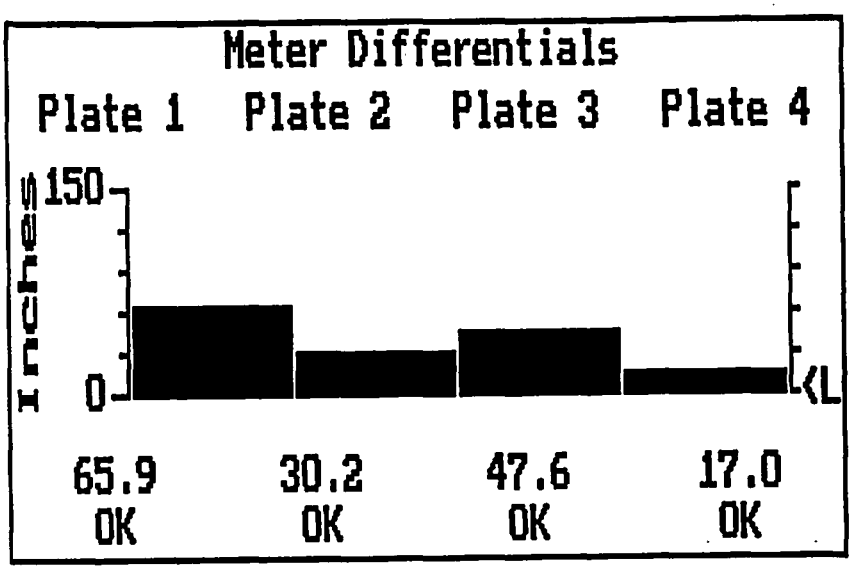
VERTICAL BAR GRAPH SETUP

File Name	METER.RTG	Dec Places	0	BkGround Color	BLACK
Up Left Col	0.25	Lo Alarm Val	0	Border Color	BLACK
Up Left Row	0.35	Hi Alarm Val	1000	Lo Alarm Color	RED
Low Right Col	0.75	Graph Units	Inches	Hi Alarm Color	RED
Low Right Row	0.65	Lo Alarm Msg	LOW	No Alarm Color	BLACK
Graph Title	Meter Differ	No Alarm Msg	OK	Title/Lbl Color	WHITE
Min Y Value	0	Hi Alarm Msg	HIGH	Axis Color	WHITE
Max Y Value	150	Show Text?	Y		

Databases

	Trace Names	Trace Tags	Trace Colors
Trace 1	DIFF_1	Plate 1	BLUE
Trace 2	DIFF_2	Plate 2	WHITE
Trace 3	DIFF_3	Plate 3	YELLOW
Trace 4	DIFF_4	Plate 4	RED
Trace 5			RED
Trace 6			MAGENTA
Trace 7			BROWN
Trace 8			GRAY

<F2> Save <Esc> Cancel



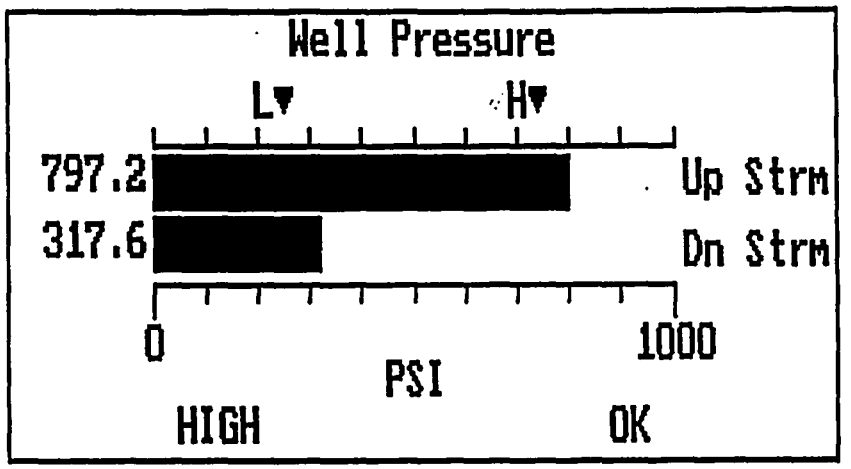
HORIZONTAL BAR GRAPH SETUP

File Name	WELL2.RTG	Dec Places	0	BkGround Color	GRAY
Up Left Col	0.2	Lo Alarm Val	250	Border Color	CYAN
Up Left Row	0.32	Hi Alarm Val	750	Lo Alarm Color	RED
Low Right Col	0.7	Graph Units	Psi	Hi Alarm Color	RED
Low Right Row	0.6	Lo Alarm Msg	LOW	No Alarm Color	WHITE
Graph Title	Well Press	No Alarm Msg	OK	Title/Lbl Color	BLUE
Min X Value	0	Hi Alarm Msg	HIGH	Axis Color	WHITE
Max X Value	1000	Show Text?	Y		

Databases

	Trace Names	Trace Tags	Trace Colors
Trace 1	STAT_1	Up Strm	RED
Trace 2	STAT_2	Dn Strm	BLUE
Trace 3			GREEN
Trace 4			CYAN
Trace 5			RED
Trace 6			MAGENTA
Trace 7			BROWN
Trace 8			GRAY

<F2> Save <Esc> Cancel



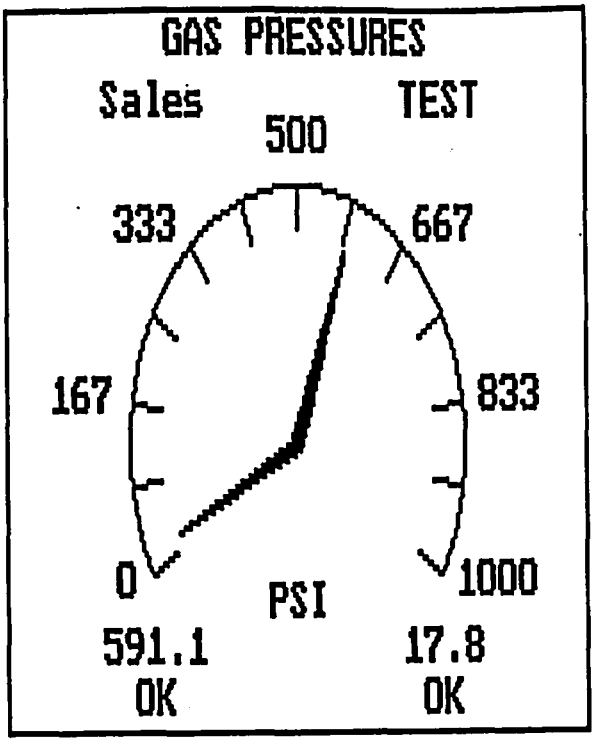
METER GRAPH SETUP

File Name	B.RTG	Dec Places	0	BkGround Color	GRAY
Up Left Col	0.05	Lo Alarm Val	0	Lo Alarm Color	RED
Up Left Row	0.3	Hi Alarm Val	5000	Hi Alarm Color	RED
Low Right Col	0.4	Graph Units	PSI	No Alarm Color	GREEN
Low Right Row	0.7	Lo Alarm Msg	LOW	Title/Lbl Color	BLACK
Graph Title	GAS PRESSURE	No Alarm Msg	OK	Axis Color	WHITE
Min Y Value	0	Hi Alarm Msg	HIGH		
Max Y Value	1000	Show Text?	Y		

Databases

	Trace Names	Trace Tags	Trace Colors
Trace 1	STAT_1	Sales	RED
Trace 2	STAT_2	TEST	WHITE
Trace 3			GREEN
Trace 4			CYAN
Trace 5			RED
Trace 6			MAGENTA
Trace 7			BROWN
Trace 8			GRAY

<F2> Save <Esc> Cancel



SCROLL GRAPH SETUP

File Name	SCRDISP.RTG	Dec Places	0	BkGround Color	CYAN
Up Left Col	0.01	Lo Alarm Val	200	Border Color	GRAY
Up Left Row	0.01	Hi Alarm Val	800	Lo Alarm Color	BLACK
Low Right Col	0.95	Graph Units	PSIG	Hi Alarm Color	WHITE
Low Right Row	0.95	Segments	40	Title/Lbl Color	BLACK
Graph Title	UPRC Flowing	Thick Trace?	N	Axis Color	YELLOW
Min Y Value	0	Label 1	$#T		
Max Y Value	1000	Label 2	$#D		
Databases	WELLINFO				

	Trace Names	Trace Tags	Trace Colors
Trace 1	MAIN_1#	Main Well	RED
Trace 2	MAIN_2#	Second Well	WHITE
Trace 3	MAIN_3#	Third Well	BLUE
Trace 4			CYAN
Trace 5			RED
Trace 6			MAGENTA
Trace 7			BROWN
Trace 8			GRAY

<F2> Save <Esc> Cancel