

## MULTI-MODE GRAPHIC DISPLAY FOR A TEST AND/OR MEASUREMENT DEVICE

### CROSS-REFERENCE TO RELATED APPLICATIONS

5 This patent application claims priority benefit under 35 U.S.C. §119(e) of copending, U.S. Provisional Patent Application, Ser. No. 61/338,612, filed February 20, 2010, the disclosure of this U.S. patent application is incorporated by reference herein in its entirety.

### BACKGROUND OF THE INVENTION

#### 10 1. Field of the Invention

The present invention relates generally to electronic test and measurement devices and, more particularly, to an electronic test and measurement device having a multi-mode display for selectively exhibiting data and information thereon.

#### 15 2. Description of Related Art

Generally speaking, test and measurement devices and controllers such as, for example, panel meters, receive and process signals from probes or sensors and exhibit data and information encoded in the signals including, for example, pressure, temperature, humidity, gas, pH, voltage, current, power, conductivity, strain or acceleration measurements, on a display portion. The display portion of conventional test and measurement devices and controllers typically include either an analog display (e.g., a dial type gauge) or, more commonly, a digital display (e.g., a seven-segment display). With the advent of affordable digital technology, there has been an increase in use of digital displays. As shown in FIG. 1, a conventional test and measurement device and/or controller 10 includes at least one display portion 20 such as, for example, a seven-segment or fourteen-segment digital display portion, that graphically exhibits data and information in an alphanumeric format 22. An exemplary test and measurement device is offered under a brand name OMEGA® DP25 signal conditioner (Omega is the registered trademark of OMEGA Engineering, Inc., Stamford, Connecticut USA).

30 The inventors have recognized that conventional digital displays can be improved. For example, some applications still dictate a use of an analog display. Moreover, most conventional digital displays have fixed display elements such that selective configuration of, for example, a size, orientation or the like, of alphanumeric characters presented on the display, is not permitted.

Accordingly, the inventors have discovered that it would be advantageous to provide an electronic test and measurement device having a selectively configurable multi-mode display for selectively exhibiting data and information.

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## SUMMARY OF THE INVENTION

This invention relates to a measurement device including a processor, one or more probes, one or more switch and a multi-mode graphic display. The probes are coupled to and provide first signals including measurement data and information to the processor. The switches are coupled to and provide second signals indicating a desired one of a plurality of operational modes. The plurality of operational modes includes a plurality of display modes. The display is coupled to the processor and is selectively configurable in response to the second signals to exhibit the measurement data and information received by the processor in the plurality of display modes. The display modes include a plurality of exhibition formats of text, graphics and images representing the received measurement data and information.

In one embodiment, the plurality of exhibition formats include one or more of a character size, color, brightness, location, orientation, language and value display type of the text, graphics and images representing the received measurement data and information. In one embodiment, the text, graphics and images for a plurality of measurement data and information values are exhibited one at a time on the display, and in another embodiment, the text, graphics and images for a plurality of measurement data and information values are exhibited simultaneously on the display.

In one embodiment, the first and the second signals indicate that at least one of a warning and status message should be exhibited on the display. The message is generated in response to one or more of a measured condition, a sensed condition, reaching a predetermined threshold value, exceeding a predetermined threshold value, and falling below a predetermined threshold value.

In one embodiment, the measurement device further includes a display rotation sensor. The display rotation sensor automatically senses an orientation of the display in a horizontal position of the device, in a vertical position of the device and at an angularly position between the horizontal and vertical positions of the device. In one embodiment, one of the one or more switches provides a signal indicating an orientation of the display in the horizontal position of the device, in the vertical position of the device and at the angularly position between the horizontal and vertical positions of the device.

In one embodiment, the measurement device further includes an audio module having a speaker and a microphone to provide sound in response to a measured condition, a sensed condition, reaching of a predetermined threshold value, exceeding a predetermined threshold value, and falling below a predetermined threshold value. In one embodiment, the audio module receives the signals as sound to select one of the plurality of operational modes.

In one embodiment, the measurement device further includes a transceiver to receive, store and send data and information over a communication network from and to computing, output and other devices coupled to the communication network.

## BRIEF DESCRIPTION OF THE DRAWINGS

The foregoing aspects and other features of the presently disclosed embodiments are explained in the following description, taken in connection with the accompanying drawings, wherein:

FIG. 1 illustrates a conventional electronic test and measurement device having a digital display portion;

FIG. 2 is a simplified schematic diagram of a test and measurement device and/or controller having a multi-mode, high resolution graphic display, in accordance with one embodiment of the present invention; and

FIGS. 3 and 4 depict a plurality of display modes presented by the device and/or controller of FIG. 2.

## DESCRIPTION OF PREFERRED EMBODIMENTS OF THE INVENTION

The present invention is directed to a multi-mode, high resolution graphic display for a test and measurement device and/or controller 100 such as, for example, a panel meter, multi-meter, or like electronic device/controller, hereinafter referred to as device 100. As shown in FIG. 2, the device 100 includes a microprocessor 110 operable to receive and process signals D from one or more probes or sensors 150 and exhibit data values and information encoded in the signals D pertaining to, for example, pressure, temperature, humidity, gas, pH, voltage, current, power, conductivity, strain, acceleration or like measurements, on the multi-mode, graphic display 120. It should be appreciated that the probes and/or sensors 150 may be physically or logically coupled to the device 100 such that the signals D are transmitted to the microprocessor 110 over wired or wireless communication connections 152. The device 100 also includes one or more switches or selectors 130 that provide signals M for indicating a desired one of a plurality of operational

modes of the device 100 such as, for example, one or more of a plurality of display modes, a plurality of test and/or measurement modes, or the like. It should be appreciated that the switches or selectors 130 may be physically or logically coupled to the device 100 such that the signals M are transmitted to the microprocessor 110 over wired or wireless communication connections 132 from hardware devices as well as signals generated by a software routine in response to a measured or sensed condition, data value (e.g., reaching, exceeding or falling below a predetermined threshold), and the like.

As shown in FIG. 2, the microprocessor 110 receives the signals D and M, and directs operation of the device 100. In one embodiment, the microprocessor 110 processes the signals M indicating one or more of the plurality of test and/or measurement modes by executing one or more test and/or measurement routines such that the device 100 collects data and information within the signals D pertaining to one or more of, for example, a pressure, temperature, humidity, gas, pH, voltage, current, power, conductivity, strain, acceleration or like measurements, of an object, process or environment of interest. It should be appreciated that the signals M include an indication/selection of one or more of the routines to execute (e.g., test and/or measurement steps, procedures, calculations), a parameter to be collected (e.g., pressure, temperature, and the like), a threshold or setup value or range of values, a scale for the measurement, and any other parameter, variable or the like, to support a selected test and/or measurement routine.

In accordance with the present invention, the microprocessor 110 processes the signals M to indicate one or more of the plurality of display modes by executing one or more routines to configure the multi-mode, graphic display 120 of the device 100 and the exhibition/presentation of data and information thereon. In one embodiment, the graphic display 120 is comprised of high resolution, liquid crystal display (LCD) components having, for example, an about 480-by-320 pixel resolution at 163 ppi on an about 3.5-inch wide multi-touch display such as is available on, for example, Apple, Inc.'s iPhone® (iPhone is a registered trademark of Apple, Inc., Cupertino, CA USA). In one embodiment, the microprocessor 110 processes the signals M and selectively configures an exhibition on the display device 120 in accordance with input received from a designer (e.g., manufacturer's default setting) and/or a user (e.g., operator) of the device 100. For example, the microprocessor 110 and the display device 120 cooperate to provide graphic capabilities that allow the designer and/or the user to make changes to how data and information is accessed, formatted and exhibited on the display device 120. The graphic capabilities include, for example, an ability to selectively configure and save predetermined parameters that adjust the

presentation/exhibition of text, graphics and images of the data and information (or other information) on the display device 120. That is, the microprocessor 110 and the display device 120 cooperate to selectively provide one of the plurality of display modes such as, for example, about fifteen (15) modes illustrated in FIGS. 3 and 4, having different exhibition formats including, for example, character size, color, brightness, location, orientation, value display type (e.g., digital versus analog display), and the like. For example, the display device 120 has a capability to exhibit many different text and graphics presentations one at a time and/or simultaneously such as a standard multi segment digital presentation of data and information (e.g., MODE 1 – Standard Display), a multi showing process (e.g., MODE 3 – Standard Controller), average, min, or max readings (e.g., MODE 2 – Multi), an analog style gauge or dial display (e.g., MODE 14 – Analog), charting with graphs and lines (e.g., MODE 4 – Charting), a trend display (e.g., MODE 5- Trend), a data logging format with dates, time and readings (e.g., MODE 6 – Logging), and also a bargraph display (e.g., MODE 7 – Bargraph Display), to name just a few possible presentations. It should be appreciated that it is within the scope of the present invention to combine one or more of the aforementioned and other display modes.

In one embodiment, one or more of the signals M directs the microprocessor 110 and the display device 120 to exhibit data and/or information in one or more of a plurality of orientations such that, for example, the data and information can be read as the device 100 is positioned horizontally on a surface (FIG. 3), vertically on a surface (FIG. 4) or at a predetermined angle between the aforementioned horizontal and vertical orientations. In one embodiment, a display rotation feature or sensor 122 determines an orientation that the designer/user has installed the device 100 and informs the microprocessor 110 such that the presentation of data and information on the display device 120 is vertically or horizontally oriented in a manner that is compatible for easy viewing of the text, graphics and images presented on the display device 120. In one embodiment, the display rotation feature is automatic (e.g., is sensed by the sensor 122). In another embodiment, the designer/user engages one of the switches or selectors 130 to inform the microprocessor 110 (e.g., via signals M) of the desired display orientation. As shown in FIG. 2, the device 100 includes memory 140 that stores the data and/or information 142 provided via signals D and/or M, predetermined parameters including one or more of the display mode presentation formats 144 (e.g., MODE 1 through MODE 15 of FIGS. 3 and 4), parameters dictating an orientation 146, range 147 (e.g., numeric range or units of measure), or size 148 of text, graphics and images presented on the display device 120, a language or languages 149 for presenting

labels 124 and/or messages 126 such as, messages to configure or reconfigure system parameters, warning and/or status signals generated in response to measured or sensed condition, data value, reaching, exceeding or falling below a predetermined threshold or setup value or range of values, and the like.

5           Some perceived advantages of the test and measurement device and/or controller 100 include, for example:

1.       The device 100 includes a multi-mode display device 120 that can be configured to exhibit a plurality of readouts including, for example, a standard digital readout, an analog readout, a chart, a bargraph, a user defined image alone and/or in any  
10       combination simultaneously.

2.       The device 100 has the capability to change font size, font style, or graphic size exhibited on the display device 120 on user input (via signals M) or change automatically when a predetermined condition (e.g., status, warning mode) occurs that was defined by the designer and/or the user.

15       3.       The device 100 includes a feature 122 for automatically rotating the exhibition/presentation of data and information on the display device 120 to be vertically, horizontally or any angular orientation therebetween, when the meter is rotated or installed at various orientations. For example, as shown in FIGS. 3 and 4, Mode 1 – Standard Display of a reading “300.5” is exhibited horizontally, and Mode 9 – Standard Display of the reading  
20       “300.5” is exhibited vertically.

4.       The graphics presented on the display device 120 can change at least one of color, size or orientation, based on user input or change automatically, when a predetermined condition occurs or data type is received that was defined by the user.

5.       The graphics and/or backlighting of the display device 120 has the capability  
25       to change brightness level based on user input or change automatically, when a predetermined condition occurs that was defined by the user.

6.       The text and graphic presentation on the display device (e.g., the labels 124 of Mode 14 – Analog Mode, or the message 126 of Mode 15 – Status Mode of FIG. 3) can be in one or more of a plurality of different languages singularly and/or in combination such as, for  
30       example, English, Spanish, French, German, Italian, Japanese, Chinese, Russian, Portuguese, Greek or any other language that can be displayed alone and/or a combination of languages simultaneously.

7.       The display backlighting has the capability to change color based on user input or change automatically, when a predetermined condition occurs that was defined by the user.

8. The graphic presentation on the display device 120 has the capability to change style and format based on user input or change automatically, when a predetermined condition occurs or data is received that was defined by the user.

5 9. The device 100 has the capability to send, receive and display data, information and messages 126 either through a wireless or wired connection.

10. The display device 120 may include touch screen capability for making programming changes, changing one or more of the operating modes of the device 100, or changing the display presentation.

10 11. The device 100 has the capability to receive data (e.g., signals D) from a wireless probe and/or sensor 150.

12. The device includes memory 140 and has the capability to store, access and transmit measured data and information (e.g., signals D and M) for later retrieval by a wireless or wired connection.

15 13. The device 100 has the capability to testing and measuring a plurality of parameters such as, for example, a temperature rise and response time to process, and display what the final temperature would be sooner than the actual sensor output has reached the final reading.

14. The device 100 has the capability to generate, record, receive, display and store digital images and movies.

20 15. The device 100 has the capability (e.g., audio module 240 having a speaker 242, a microphone 244 and the like) to provide speech or sound (alarm tone) based indications of a value or condition upon user input or automatically when a predetermined condition occurs that was defined by the user.

25 16. The device 100 has the capability to hear and understand speech or sounds (e.g., the audio module 240) to make changes to programming or how the graphic presentation is displayed.

30 17. The device 100 has the capability (e.g., a transceiver 160) to interact through a wireless or wired connection 162 to a communication network 200 such as, for example, an intranet, extranet or the Internet, to receive, store and send data, information, and messages such as, for example, printed output, email messages, web pages and the like, from other computing, output and/or printing devices 210 coupled to the network 200.

The foregoing description is only illustrative of the present embodiments. Various alternatives and modifications can be devised by those skilled in the art without departing from the embodiments disclosed herein. Accordingly, the embodiments are intended to

embrace all such alternatives, modifications and variances which fall within the scope of the present disclosure and one or more of the appended claims.

What is Claimed Is:

1. A measurement device (100), comprising:  
a processor (110);  
one or more probes (150) coupled to and providing first signals (D) including measurement data and information to the processor;  
one or more switches (130) coupled to and providing second signals (M) indicating a desired one of a plurality of operational modes, the plurality of operational modes including a plurality of display modes (MODE 1- MODE 15); and  
a multi-mode graphic display (120) coupled to the processor, the display being selectively configurable in response to the second signals to exhibit the measurement data and information received by the processor in the plurality of display modes, the display modes including a plurality of exhibition formats of text, graphics and images representing the received measurement data and information.
2. The measurement device of claim 1, wherein the plurality of exhibition formats include one or more of a character size, color, brightness, location, orientation, language and value display type of the text, graphics and images representing the received measurement data and information.
3. The measurement device of claim 1, wherein the text, graphics and images for a plurality of measurement data and information values are exhibited one at a time on the display.
4. The measurement device of claim 1, wherein the text, graphics and images for a plurality of measurement data and information values are exhibited simultaneously on the display.
5. The measurement device of claim 1, wherein the measurement data and information within the signals D include a data value pertaining to one or more of a pressure, temperature, humidity, gas, pH, voltage, current, power, conductivity, strain, acceleration or like measurements, of an object, a process or an environment of interest.

6. The measurement device of claim 1, wherein the signals D and M indicate that at least one of a warning and status message is exhibited on the display.

7. The measurement device of claim 6, wherein the message is generated in response to one or more of a measured condition, a sensed condition, reaching a predetermined threshold value, exceeding a predetermined threshold value, and falling below a predetermined threshold value.

8. The measurement device of claim 1, further including a display rotation sensor (122) coupled to the processor, the display rotation sensor automatically sensing an orientation of the display in a horizontal position of the device, in a vertical position of the device and at an angularly position between the horizontal and vertical positions of the device.

9. The measurement device of claim 1, wherein one of the one or more switches provides a signal indicating an orientation of the display in a horizontal position of the device, in a vertical position of the device and at an angularly position between the horizontal and vertical positions of the device.

10. The measurement device of claim 1, further including an audio module (240) having a speaker (242) and a microphone (244) to provide sound in response to a measured condition, a sensed condition, reaching of a predetermined threshold value, exceeding a predetermined threshold value, and falling below a predetermined threshold value.

11. The measurement device of claim 10, wherein the audio module (240) receives the signals (M) to select one of the plurality of operational modes.

12. The measurement device of claim 1, further including a transceiver (160) to receive, store and send data and information over a communication network (200) from and to devices (210) coupled to the communication network.