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Frandsen et al.

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(54) **CONTROL HEAD WITH
ELECTROLUMINESCENT PANEL IN LAND
MOBILE RADIO**

H01H 13/83 (2013.01); *H04B 1/401*
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(51) **Int. Cl.**
G09G 3/3258 (2016.01)
G09G 3/30 (2006.01)

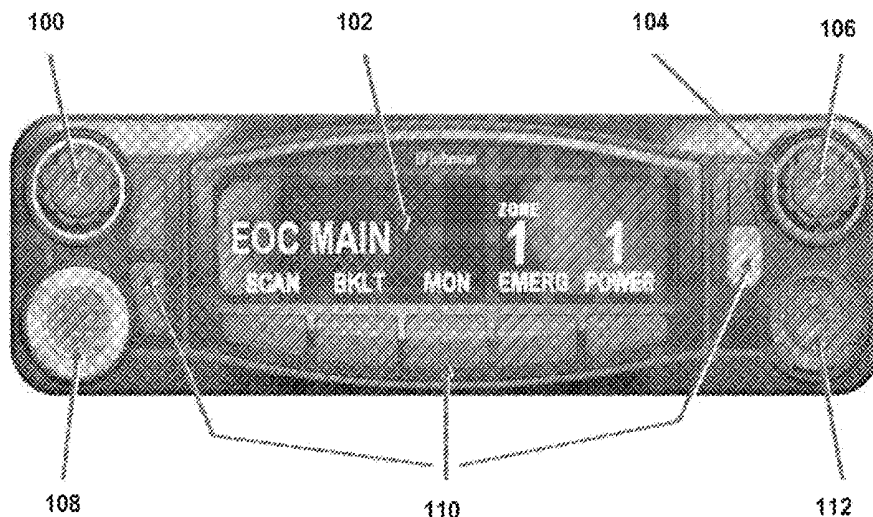
(Continued)

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(57) **ABSTRACT**

An exemplary land mobile radio control head and method
are provided. In one embodiment, the control head has the
capability to utilize halo light of the control head to imple-
ment a multi-function indicator that communicates a state of
the land mobile radio. In another embodiment, the control
head has the capability to provide buffer images constructed
from data received from the land mobile radio into a video
stream for rendering on an electroluminescent display. In
another embodiment, the control head provides the capabil-
ity for a user to modify a configuration stored on the land
mobile radio that defines one of several display modes to be
utilized in generating data for use in forming images to be
rendered on an electroluminescent display.

10 Claims, 15 Drawing Sheets



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H05B 33/08 (2006.01)
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F21Y 115/20 (2016.01)
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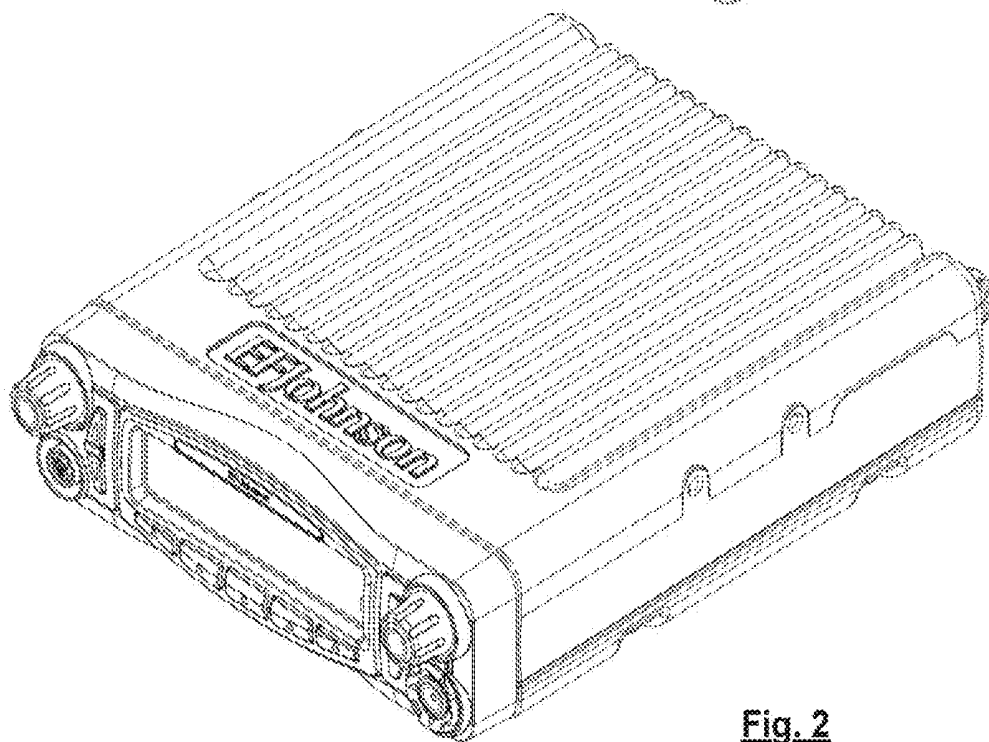
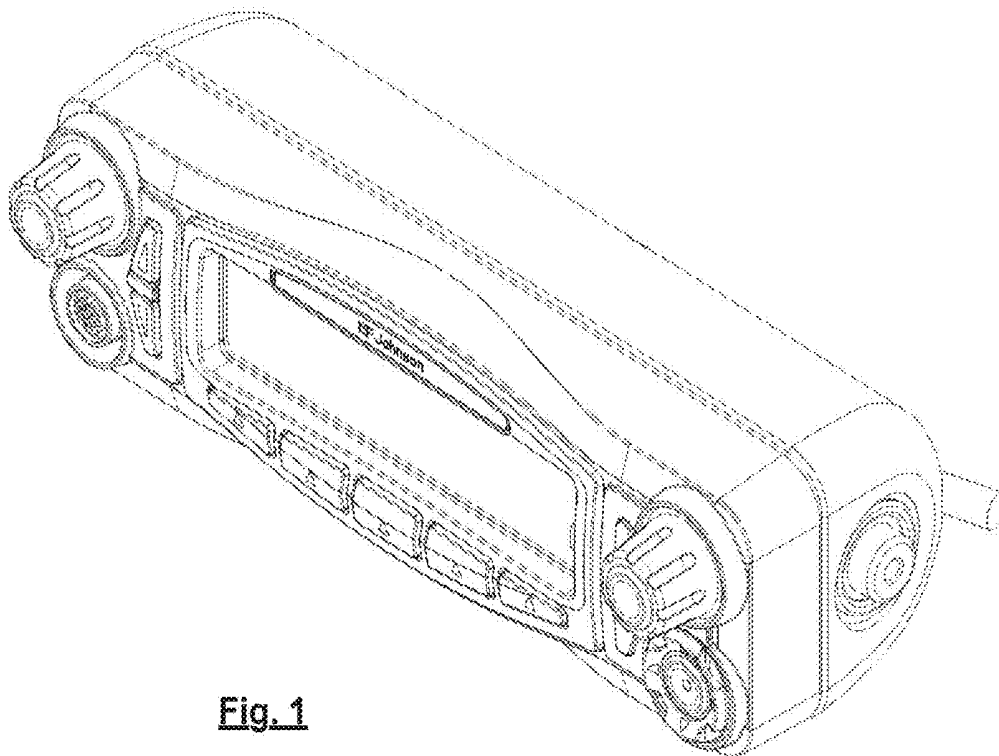
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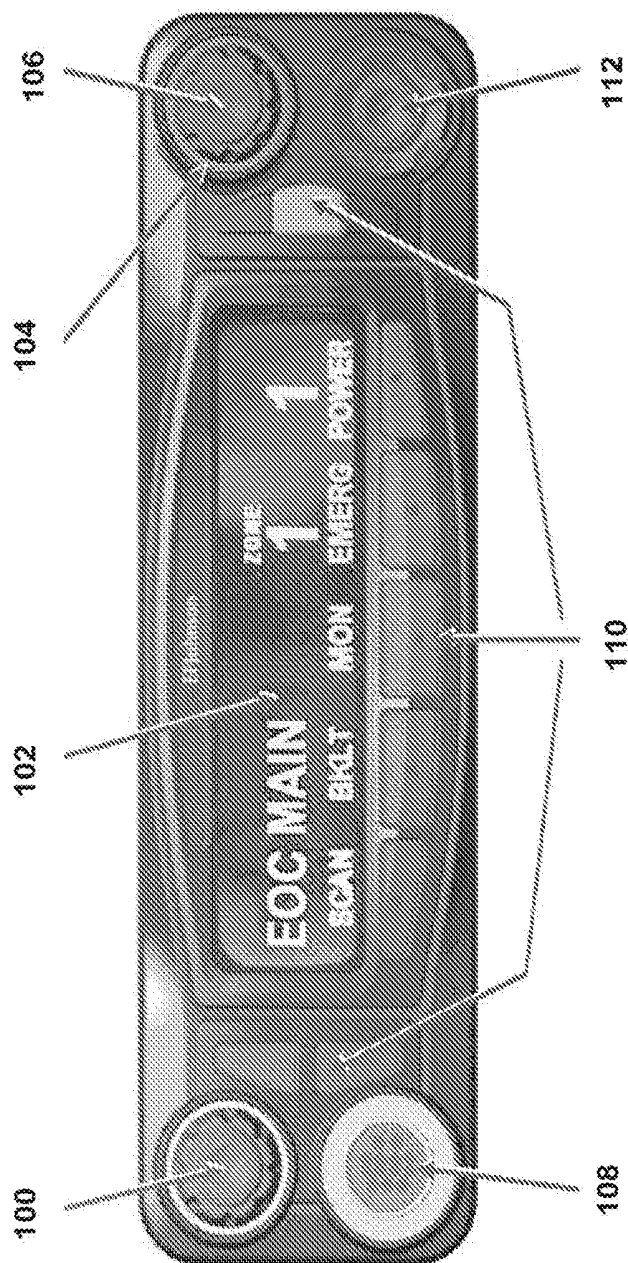


Fig. 3

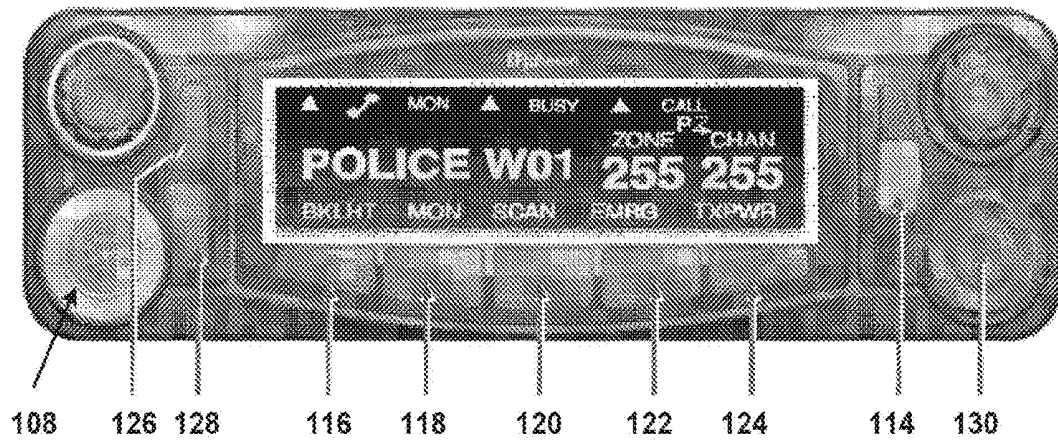


Fig. 4

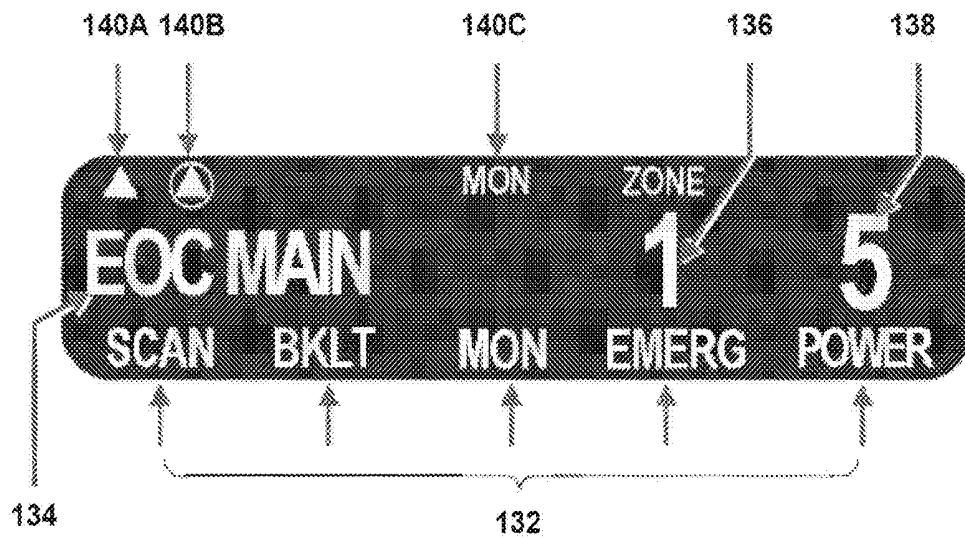


Fig. 5

	Keypad programming/edit mode. Displayed when the radio is in a mode where you can edit radio settings
	Monitor mode enabled
	Repeater Talk-Around mode enabled
	Scan Enabled
	Security Enabled
	The current channel is in the enabled scan list (only when scan is on or when in scan edit mode)
	The current channel is the priority channel in the enabled scan list (only when scan is on or when in scan edit mode)
	The current channel is the priority 2 channel in the enabled scan list (only when scan is on or when in scan edit mode)
	Interconnect mode enabled
	Private call mode enabled
	Radio is in Roaming mode (only used with Multi-Net trunking)
	P25 data context enabled (radio is ready for data operations)
	P25 data channel grant (radio is operating on a data channel)
	Site lock mode
	Multi-Net trunking group scan enabled
	Signal strength (indicates an acceptable site, and may range from 4 bars to no bars)
	GPS link active
	Call history (only when radio is in conventional unit call, call alert or text messaging and an applicable unit ID is selected)
	Text message mode active
	Radio wide scan mode enabled
	Busy (displayed when radio enters a busy transmit state)

FIG. 6

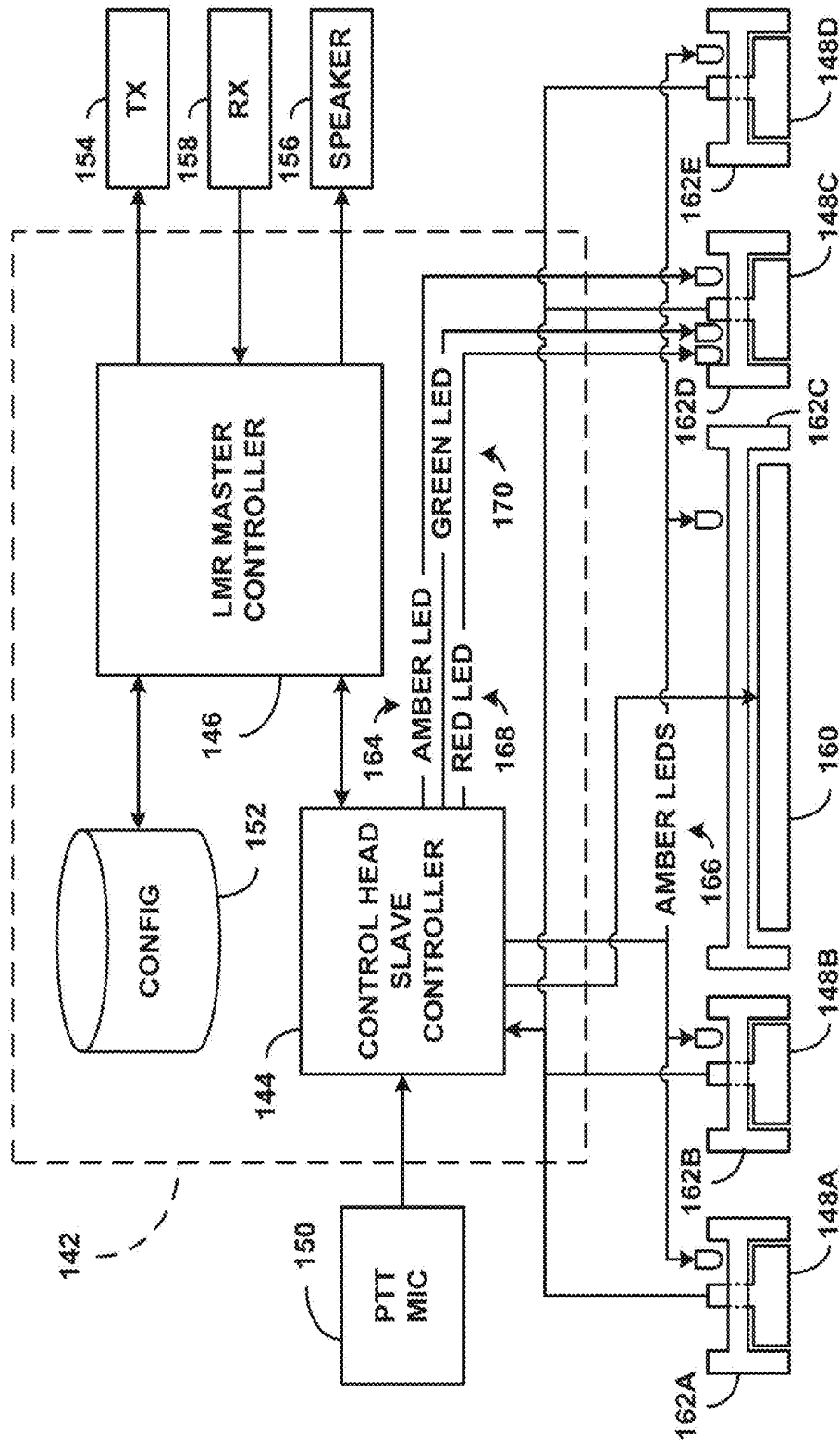


Fig. 7

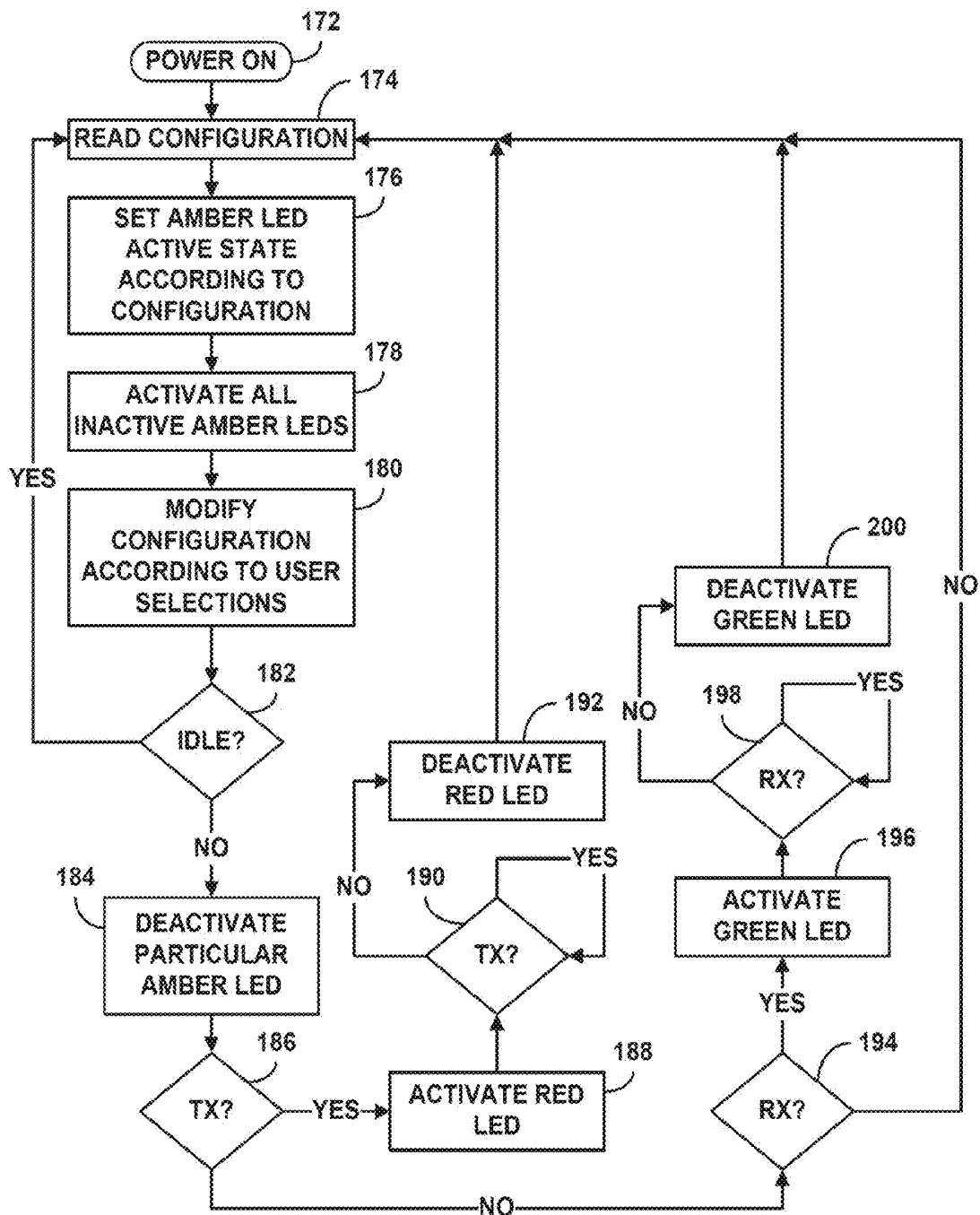
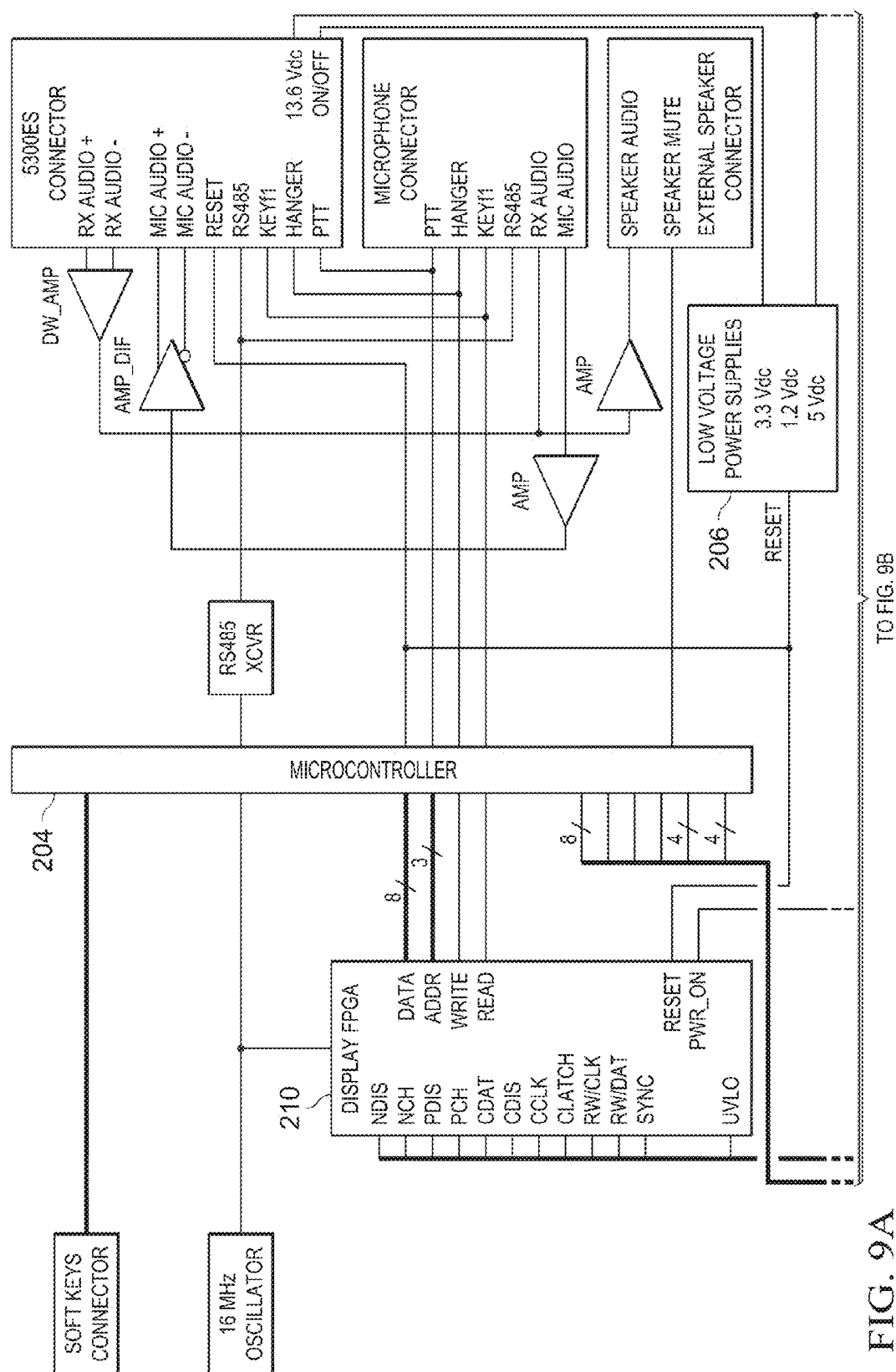


Fig. 8



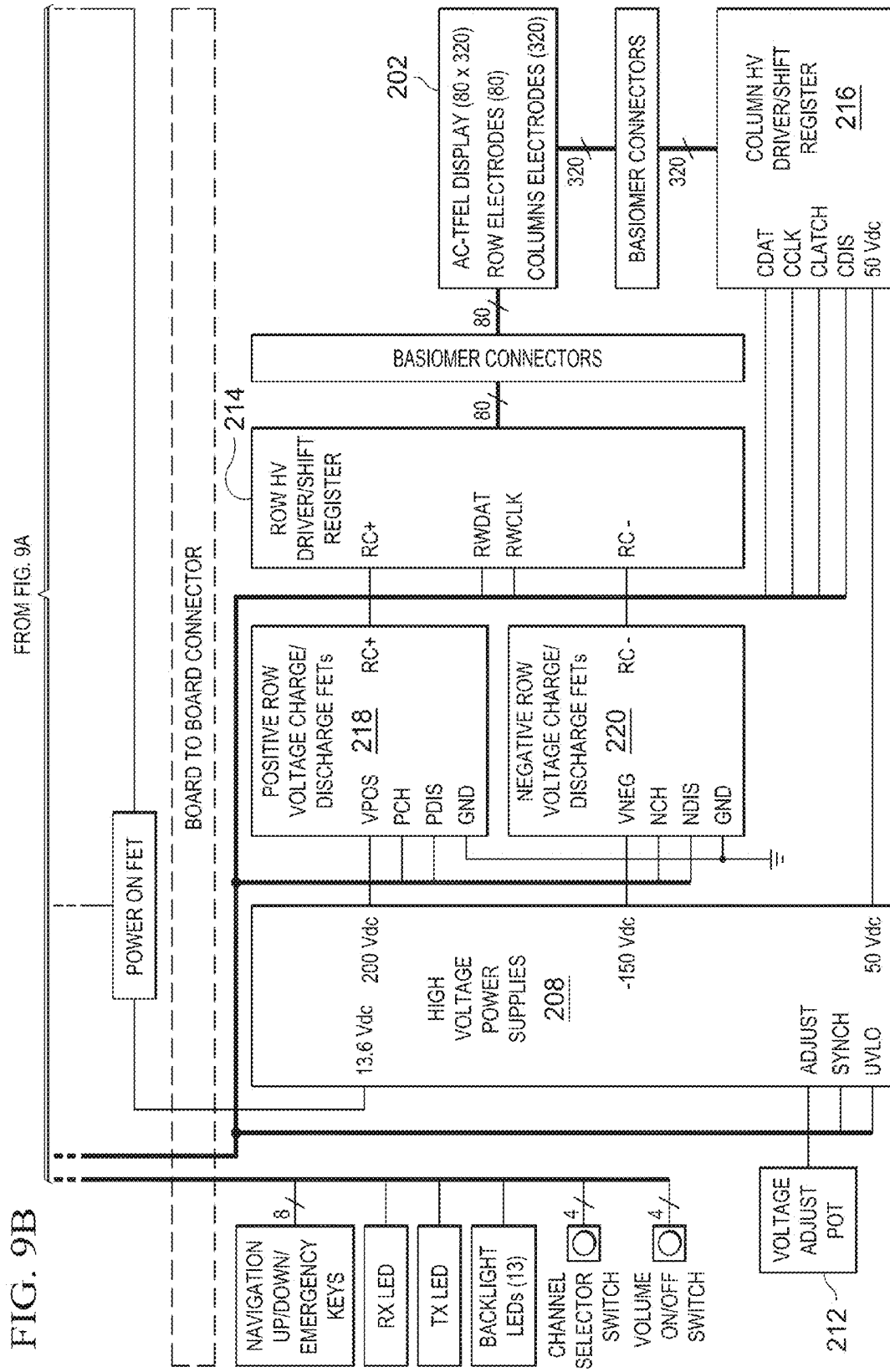


FIG. 10

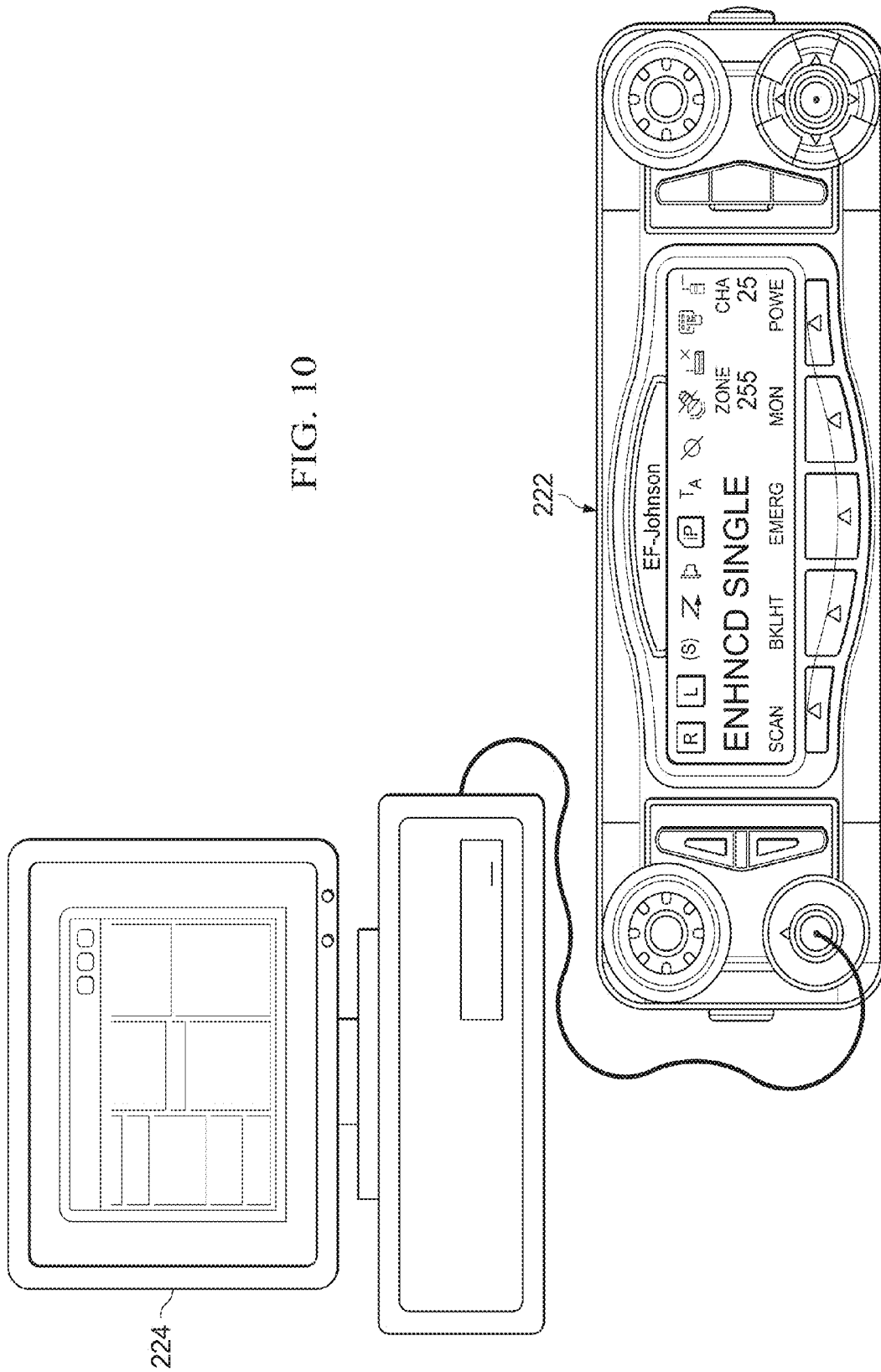
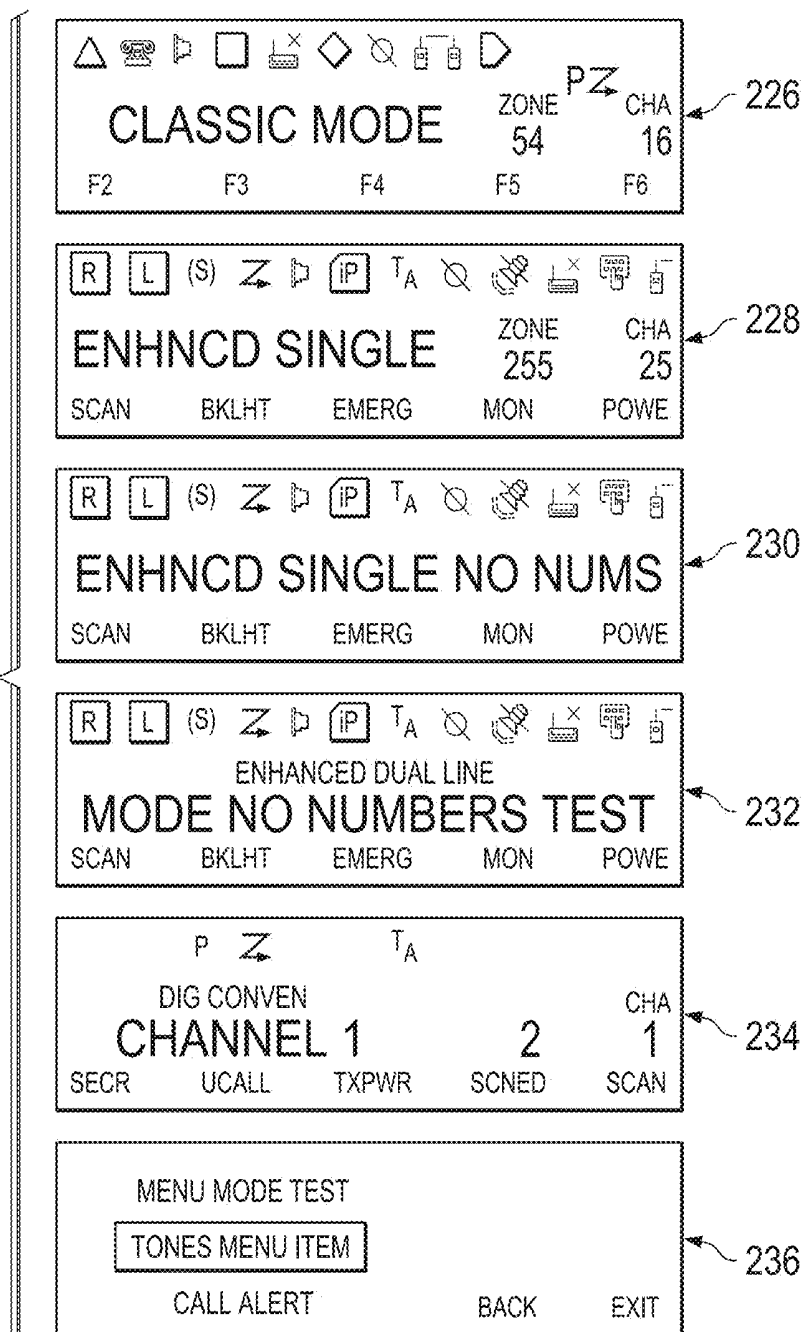


FIG. 11



PCConfigure

File Radio Transfer Tools Help

Global Radio Wide Per System Zone

Global / Additional Parameters

PA

☐ Rx Audio to External PA

☐ External PA Display Indication

OTAR

Unit RSI: 1

Key Management

Mode: PID/ASN

Keys Table

Infinite Key Retention: Off

☐ Erase Previous Keyset on OTAR Changeover

GPS

☐ Auto Transmit

Interval: 300 (s)

Time Zone: US - Pacific

☐ Emergency Transmit

External Serial Connector

Serial Protocol: GPS

Baud Rate: 4800

Side Port

Settings

Network Settings

Subscriber IP Address: 000.000.000.000

Subnet Mask: 000.000.000.000

Default Gateway: 000.000.000.000

Host IP Address: 000.000.000.000

Data Gateway: ☐ Enabled

Mode: Rx

Surveillance: ☐ Enabled

☐ Disable Lights

☐ Disable Tones

☐ Disable Internal Speaker Audio/Tones

DSP Enhancements

☐ 2.7 kHz Rx Filter Enabled

☐ Enhanced Analog Modulation Limiting

Soft Power Down

Enable Via Button: Disabled

☐ Disable Emergency

☐ Disable PTT

☐ Disable Other Buttons

54 Channels / 16 Zones: ☐ Enabled

Zone Alias

Other

Auxiliary B Output: Disabled

Auxiliary B Input: Disabled

Button Press/Hold Duration: 1 (s)

On OTAP Finish: Prompt

☐ Zone Selector Locked

☐ Disable Home Press and Hold

☐ LED Disabled w/Backlight OFF

☐ Channel 1 Audio Alert

☒ Inhibit Zone/Channel Indicators

☐ Lock Channel Indicator

238

FIG. 12

PCConfigure

File Radio Transfer Tools Help

Global Radio Wide Per System Zone

Global Parameters

Systems

Number of Systems: 1

Display

Display Mode: Standard

Edit Display Options

Zones

Number of Zones: 1

Home: ZONE1

Home 2: ZONE1

Power Up in: Last Zone

Max Zone Display: All Zones

Favorites

Channels

Home: 1

Home 2: 1

Power Up in: Last Channel

Global Emergency Channel

Zone: Zone1

Channel: 1

Power

Battery Saver (Low Tx Power)

Low Battery Indicators

Low Battery Beep

Tx Chirp

LED Indicator

Low Tx Power

Ignition Power Down: 1 (m)

Inf.

Radio ID

Enabled

Sound

Tone ON

Horn Cadence: Style 1 0 2 (s)

Minimum Volume: 0

Alert Tone Volume: 0

Keypress Tone Vol: 0

Beep on Select, Channel, or Volume Change

Rx Gains

Mic Levels

Keypad

Keypad Type: Full Keypad

Permanent Keypad Lockout

Lock Channel Selector

Lock Volume Knob

Front Only Keypad Lockout

Backlight during Keypad Lockout

Other

Hangup Box Monitor

Backlight on Keypress

Programmed Channels Only on Display

Backlight ON Time: 1 (s) 10X

Backlight Level: Off

Controller Type: Normal

Microphone Type: Normal

Volume Ticks: Hand held Lighting

Menu Enabled

Channel Selector Enabled

Ignore Clear/Secure Switch when Strapped

240

EFJ

FIG. 13

PCConfigure
File Radio Transfer Tools Help

Global Radio Wide Per System Zone

Global Parameters

Systems
Number of Systems: 1 242

Display
Display Mode: Standard Standard Enhanced
Edit

Zones
Number of Zones: 1
Home: ZONE1
Home 2: ZONE1
Power Up In: Last Zone
Max Zone Display: All Zones
Favorites

Channels
Home: 1
Home 2: 1
Power Up In: Last Channel

Global Emergency Channel
Zone: Zone1
Channel: 1

Power
☐ Battery Saver (Low Tx Power)
Low Battery Indicators
☐ Low Battery Beep ☒ LED Indicator
☐ Tx Chirp ☐ Low Tx Power
Ignition Power Down: 1 (m) Inf. ☐

Keypad
Keypad Type: Full Keypad
☐ Permanent Keypad Lockout
☐ Lock Channel Selector
☐ Lock Volume Knob
☐ Front Only Keypad Lockout
☐ Backlight during Keypad Lockout

Other
☐ Hangup Box Monitor
☒ Backlight on Keypress
☒ Programmed Channels Only on Display
Backlight ON Time: 1 (s) 10X
Backlight Level: Off
Controller Type: Normal
Microphone Type: Normal
Volume Ticks: 10
☒ Menu Enabled
☒ Channel Selector Enabled
☒ Ignore Clear/Secure Switch when Strapped

Sound
☒ Tone ON
Horn Cadence: Style 1 2 (s)
Minimum Volume: 0 Rx Gains
Alert Tone Volume: 0
Keypress Tone Vol: 0 Mic Levels
☐ Beep on Select, Channel, or Volume Change

Cursor
Cursor Time Out: 0 (s)
Cursor Position: Zone

EFJ

FIG. 14

PCConfigure
File Radio Transfer Tools Help

Global Radio Wide Per System Zone

Global Parameters

Systems
Number of Systems: 5 242

Display
Display Mode: Enhanced Standard Enhanced

Zones
Number of Zones: 4
Home: SITE-2
Home 2: Selected
Power Up in: Last Zone
Max Zone Display: All Zones

Channels
Home: 1
Home 2: 1
Power Up in: Last Channel

Global Emergency Channel
Zone: ADDISON
Channel: 1

Power
☒ Battery Saver (Low Tx Power)
Low Battery Indicators
☒ Low Battery Beep ☒ LED Indicator
☐ Tx Chirp ☐ Low Tx Power

Ignition Power Down: 0 (m) Inf. ☐

Radio ID
☒ Enabled APCO 2009

Sound
☒ Tone ON
Horn Cadence: Style 1 2 (s)
Minimum Volume: 0 Rx Gains
Alert Tone Volume: 0 Mic Levels
Keypress Tone Vol: 18
☐ Beep on Select Channel, or Volume Change

Keypad
Keypad Type: Limited Keypad
☐ Permanent Keypad Lockout
☐ Lock Channel Selector
☐ Lock Volume Knob
☐ Front Only Keypad Lockout
☐ Backlight during Keypad Lockout
☐ Disable Toggle during Keypad Lockout

Other
☒ Menu Enabled
☒ Ignore Clear/Secure Switch when Strapped
☐ Disable Home Press and Hold
☐ LED Disabled w/ Backlight OFF
Button Press/Hold Duration: 0.5 (s)
On OTAP Finish: Prompt

EFJ

FIG. 15

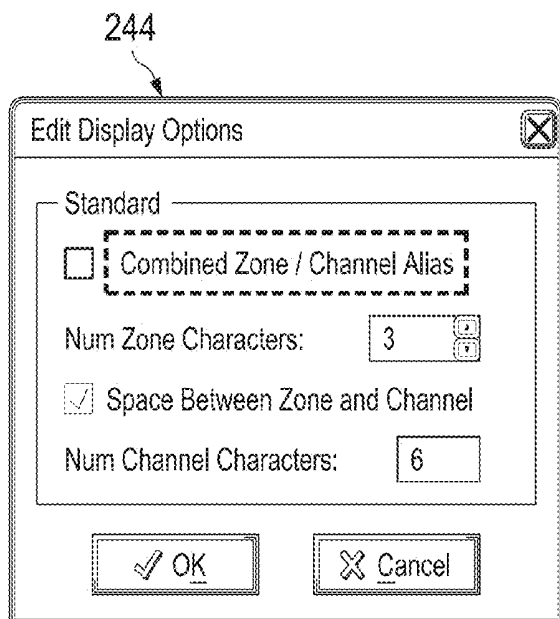


FIG. 16

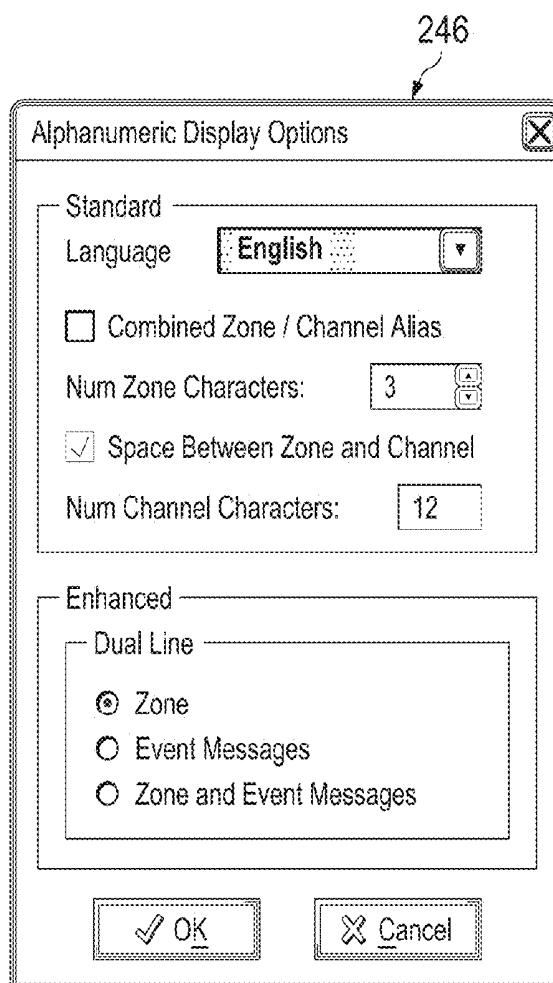


FIG. 17

CONTROL HEAD WITH ELECTROLUMINESCENT PANEL IN LAND MOBILE RADIO

CROSS-REFERENCE TO RELATED APPLICATIONS

Pursuant to 35 U.S.C. §121, this application is a divisional application claiming priority to U.S. patent application Ser. No. 12/614,348, entitled "Control Head with Electroluminescent Panel in Land Mobile Radio," filed Nov. 6, 2009, which claims the benefit of U.S. Provisional Patent Application Ser. No. 61/112,086, entitled "Control Head with Electroluminescent Panel in Land Mobile Radio," filed Nov. 6, 2008, all of which are incorporated herein by reference for all purposes.

TECHNICAL FIELD

The present disclosure relates generally to the field of land mobile radio and more particularly, but not by way of limitation, to a control head having an electroluminescent panel.

BACKGROUND

Land Mobile Radio (LMR) systems are deployed by organizations requiring instant communication between geographically dispersed and mobile personnel. Typical users of LMR systems include police departments, fire departments, medical personnel, EMS and the military.

SUMMARY

According to an exemplary aspect of the present disclosure, a control head for land mobile radio comprises an electroluminescent panel. As described below, it comprises several aspects capable of enabling one or more of a multitude of advantages and benefits.

One technical aspect of the exemplary control head may be the capability to utilize halo light of the control head to implement a multi-function indicator that communicates a state of the land mobile radio.

Another aspect may be the capability to buffer images constructed from data received from the land mobile radio into a video stream for rendering on an electroluminescent display.

Another aspect may include the capability for a user to modify a configuration stored on the land mobile radio that defines one of several display modes to be utilized in generating data for use in forming images to be rendered on an electroluminescent display.

Other technical advantages may be readily apparent to one skilled in the art after review of the following figures and description associated herewith.

BRIEF DESCRIPTION OF THE DRAWINGS

For a more complete understanding of the present disclosure and the advantages thereof, reference is now made to the following brief description, taken in connection with the accompanying drawings and detailed description, wherein like reference numerals represent like parts, in which:

FIG. 1 is a perspective view of a control head remote from a land mobile radio.

FIG. 2 is a perspective view of a control head attached to or integrated with a land mobile radio.

FIG. 3 is a frontal view of an electroluminescent panel of a control head.

FIG. 4 is another frontal view of the electroluminescent panel of a control head.

FIG. 5 is a view of a display of a control head.

FIG. 6 is a list of symbols that may be used on the display to indicate various operating modes and status.

FIG. 7 is a functional block diagram illustrating a land mobile radio system implementing a control head.

FIG. 8 is a flow diagram illustrating a method of operation for controlling a multi-function indicator implemented utilizing a halo light of a control head.

FIGS. 9A and 9B illustrate an electronic circuit diagram for a control head.

FIG. 10 is a perspective view illustrating programming of a configuration of a control head utilizing a computer processor.

FIG. 11 is a set of views illustrating results of varying configurations of a control head to provide different display modes.

FIG. 12 is a screenshot illustrating a user interface component whereby a selection is made for the control head configuration whether to inhibit a zone/channel indicator.

FIG. 13 is a screenshot illustrating a user interface component whereby a selection is made for a control head configuration of a controller head type.

FIG. 14 is a screenshot illustrating a user interface component whereby a selection is made for a control head configuration of a display mode.

FIG. 15 is a screenshot illustrating the user interface component of FIG. 14 whereby another selection is made for the control head configuration of a different display mode.

FIG. 16 is a screenshot illustrating a user interface component whereby a selection is made for a control head configuration of display options for the display mode selected in FIG. 14.

FIG. 17 is a screenshot illustrating a user interface component whereby a selection is made for a control head configuration of display options for the display mode selected in FIG. 15.

DETAILED DESCRIPTION

It should be understood at the outset that although exemplary implementations of the present disclosure are illustrated below, the present disclosure may be implemented using any number of techniques, whether currently known or in existence. The present invention should in no way be limited to the exemplary implementations, options, drawings, and techniques illustrated below, including the exemplary design and implementation illustrated and described herein. Additionally, the drawings contained herein are not necessarily drawn to scale.

A component for land mobile radios is a control head that offers superior readability and display options for the radio user. Referring to FIG. 1, the control head can be fitted to a remote mount in a land mobile radio installation. Alternatively, referring to FIG. 2, the control head can be fitted or integrated as a dash mount in a land mobile radio installation.

Turning to FIG. 3, the front panel of the control head can have multiple features. For example, it can have an on/off/volume switch **100** for turning the power on/off function to the radio. When the power is on, this control can be rotated to adjust the radio speaker volume. Also, an electroluminescent display **102** can show all primary operating information, such as active channel, zone, channel/zone alias,

status symbols, and labels for the function buttons under the display. In the embodiment shown in FIG. 3, five buttons are provided under the display on the control head. Additionally, a multi-function indicator **104** can be provided in which halo light surrounding a button or switch, such as a select zone/channel switch **106**, is used to indicate radio transmit and receive status. A steady red halo, in one embodiment, may indicate that the radio is transmitting, while a steady green halo may indicate that the radio is receiving, and a steady amber halo may indicate that the radio is idle. Further, the select zone/channel switch **106** may be implemented with two actions: rotation and press. In normal nonmenu mode, pressing the control can select either the zone or the channel. Then, rotation of the control can change either the zone or channel. An indication can be provided on the display whether zone or channel is selected. Yet further, a microphone connection **108** can be provided that allows a compatible microphone to plug into this jack connector. Further still, the control head can have a number, such as eight, one-touch buttons **110**, including two on the left of the display, five under the display, and an orange button on the right of the display. These buttons in certain embodiments may be programmed with different radio functions. Finally, a 4-way navigation pad **112** may be provided for navigating through various radio functions and menus. In other embodiments the navigation pad **112** may be implemented with either more or less than a 4-way pad. Like the buttons **110**, the pad **112** can be programmed with different radio functions.

Turning now to FIG. 4, as mentioned above, the control head can have a number, such as nine, of programmable controls **114-130**. A number of land mobile radio functions can be assigned to these buttons using a computer processor that connects to the land mobile radio control head via the microphone connection **108**. Example radio functions that the user can configure include scan, backlight level, monitor, emergency, and transmitter power.

Referring now to FIG. 5, an advantageous feature of the control head is a highly readable electroluminescent display. In some embodiments, the display is a monochrome display with 320x80 pixels. This display can support a Classic Single Line display mode familiar to users of previous types of land mobile radio control head displays. In Classic Single Line display mode, the display can have primary fields corresponding to the fields available on earlier model(s) of control heads, but with the addition of the soft menu keys and display of labels **132** of functions assigned to those soft menu keys as described above. More familiar display contents include channel name **134**, zone number **136**, channel number **138**, and symbols **140A-140C** to indicate operating mode and status. A list of symbols used on the display to indicate various operating modes and status that may be implemented in certain embodiments is provided in FIG. 6.

The electroluminescent display panel provides a clear, bright and readable display, which is advantageous in public safety applications. In some embodiments, the electroluminescent display features high brightness and contrast, resists fading, provides long operating life, has a viewing angle greater than 160°, and provides 200 G shock durability. Furthermore, the electroluminescent display incorporates, in some embodiments, emissive pixel technology, which makes small text more legible. The electroluminescent display may be operated in a reflective mode to provide crisp, clear viewing of the electroluminescent display in bright light, even through polarized lenses. Additionally, the size of alphanumeric characters presented on the electroluminescent display may be adjusted.

Turning now to FIG. 7, a land mobile radio system **142** generally has a control head controller **144** that operates as a slave to a land mobile radio master controller **146**. The control head controller **144** detects user actuations of controls **148A-148D** and signals the master controller **146**. Controller **144** also reacts to user actuation of a push to talk microphone by signaling transmission and passing the audio data.

The master controller **146** transmit audio data from microphone **150** via transmitter **154**, and drive speakers **156** to output audio data received via receiver **158**. Also, the master controller **146** constructs user interface data frame contents of electroluminescent display **160** in accordance with a configuration stored in data store **152**. Additionally, the master controller **146** operates the UI in response to the user actuations at least partly in accordance with the configuration. Controller **144** constructs UI data received from master controller **146** into images that are buffered into a video stream for rendering on electroluminescent display **160**.

Additional components of the control head operated by master controller **146** in accordance with the configuration include indicators, such as lights or LEDs, located behind light pipes **162A-162E**. These light pipes provide halo light for controls **148A-148D**, and for display **160**. In one embodiment, each of the light pipes **162A-162E** has an amber LED that provides the halo light at an intensity level recorded in the configuration, and that can be adjusted by user actuation of one of the controls **148A-148D**, or another control. At least one of the light pipes additionally may include red and green LEDs collocated with its amber LED. A signal line **164** to that amber LED can be controlled independently of signal lines **166** to the other amber LEDs. The red and green LEDs may also have independently controllable signal lines **168** and **170**.

Turning now to FIG. 8, the controllers operate the LEDs according to a method that accomplishes indication of the LMR transmit/receive status. Beginning at power up **172**, the configuration is read at step **174** to determine an intensity level for the amber LEDs, and an active state is set for the amber LEDs at step **176** according to the configuration. Next, one or all inactive amber LEDs may be activated at step **178**. Thereafter, the user can adjust intensity of the LEDs by actuation of one of the controls of the control head, resulting in modification of the configuration according to the user selections at step **180**. If the radio is determined to be idle at decision step **182**, then processing may return to step **174** and steps **174-182** are traversed continually, resulting in adjustment of the intensity level of the amber LEDs according to the user selections.

When the radio is transmitting or receiving, this state change will be detected at step **182**, resulting in deactivation at step **184** of the amber LED that is collocated with the red and green LEDs. Then, if the radio is determined to be transmitting at decision step **186**, then the red LED, in one embodiment, is activated at step **188**. Thereafter, as long as the radio is determined to still be transmitting at decision step **190**, the red LED will remain active. Once a determination is made at step **190** that the transmission has ended, then the red LED is deactivated at step **192**, and processing returns to step **174**. Thereafter, the amber LED is reactivated at step **178** and remains active as long as the radio is determined to be idle at step **182**.

Processing during a receive state similar to that during the transmit state. If the radio is determined to be receiving at decision step **194**, then the green LED, in one embodiment, is activated at step **196**, and it remains activated as long as the radio is determined to be receiving at decision step **198**.

Once the receipt is determined to have ended at step **198**, the green LED is deactivated at step **200**, and processing returns to step **174**. Thus, a halo light behind one of the user interface components serves as a multifunction indicator without interfering with the halo function of the other components, and while allowing the intensity of the amber halo light of the components to be adjusted independently of the red and green indicator lights.

Turning now to FIGS. **9A** and **9B**, the control head display **202**, in one embodiment, can be implemented as an alternating-current thin-film electroluminescent (AC-TFEL) display. In this case, the display glass panel can be covered by two sets of electrodes (80 row electrodes and 320 column electrodes) in the horizontal and vertical directions. The electrodes are separated by thin film insulating layers. The sensor layer can be a phosphor layer that emits light when exposed to a strong electric field. A single light emitting pixel is created at the intersection of each row and column electrode. The brightness of the pixel is determined by the voltage between the two electrodes. In other embodiments, the control head display **202** may be implemented using other known or available display technology.

The control head controller **204**, in one embodiment, may be Freescale MC9S08QE128 which has internal FLASH and SRAM for program and data storage, general purpose I/O ports, and a UART port for communication with the master controller in the land mobile radio. In some embodiments, the control head controller **204** is configured to operate as a slave to the master controller in the land mobile radio for most I/O. In this case, it reports keypresses, switch changes, and microphone inputs to the master controller via RS485 serial data links. In one embodiment, the control head controller **204** does not act on these data. Similarly, control of LEDs and other output functions can be directed by the master controller. In one embodiment, the control head controller **204** formats the data, from the master controller, into a pixel image that is displayed on the AC-TFEL Display.

The low voltage power supply **206** can be one or more switching and low drop out linear regulators which provide power to the logic and analog circuits. Contained within this plot is a circuit that generates a reset signal if the battery (13.6 Vdc nominal) supply from the radio, the 3.3 Vdc supply, or 1.2 Vdc supply, for example, is out of tolerance.

The high voltage (HV) power supply **208** may be a PWM controlled flyback transformer design which provide nominal 220 Vdc, 50 Vdc, and -150 Vdc outputs to power the AC-TFEL Display. Input power to supply may be provided in one implementation from the radio battery supply (13.6 Vdc nominal) through a FET switch controlled by the Display FPGA **210**. The output voltage levels can be adjusted by volume adjustment potentiometer **212** to set the brightness level of the AC-TFEL Display. The power supply switching frequency (150 kHz) is controlled by Display FPGA **210**.

A display frame in one implementation may be composed of 80 lines of 320 bits (pixels) for a total of 25600 pixels per frame. In operation, a line of pixels (320) can be shifted into a Column HV Driver/Shift Register **216** and latched into output registers which control the outputs of the HV output drivers attached to the column electrodes on the AC-TFEL Display. A new line of pixels is shifted into the register **216** after the pixels for the line have been latched into the output registers.

When the column data is latched, a HV pulls from the Row HV Driver/Shift Register **214** can be applied to the AC-TFEL Display row electrode associated with that line of pixels. The HV pulse on the active row electrode is either

200 Vdc or -150 Vdc. A pixel will begin to emit light when the voltage across its row and column electrode exceeds approximately +/-180 Vdc. For a positive row voltage of pulse of 200 Vdc, a column voltage of 0 Vdc will light the pixel and a column voltage of 50 Vdc will turn it off. For a negative row voltage of pulse of -150 Vdc, a column voltage of 50 Vdc will light the pixel and a column voltage of 0 Vdc will turn it off.

The Row HV Driver/Shift Register **214** may be loaded at the beginning of each frame, in one embodiment, with a seed bit that enables a single row HV driver output. After a row is pulsed, the seed bit is shifted to the next row to enable its HV driver output. The polarity of the row voltage pulse alternates with each line of pixels. The Positive Row Voltage Charge/Discharge FET **218** and Negative Row Voltage Charge/Discharge FET **220** circuits generate the HV pulses applied to the row electrode through the HV output drivers in the Row HV Driver/Shift Register **214** and discharge the electrode after the pulse has been applied.

The Display FPGA **210** controls the operation of the circuitry associated with the AC-TFEL Display **202** to display images on the display that are generated by the control head controller **204**. Functionally the Display FPGA **210** contains a display data buffer, a frame timing generator, and display control logic to control operation of the Negative Row Voltage Charge/Discharge FET **220**, Positive Row Voltage Charge/Discharge FET **218**, Row HV Driver/Shift Register **214**, and Column HV Driver/Shift Register **216**.

The display buffer can be a 3200 byte dual port RAM that is accessed by the control head controller **204** to load pixel data for screen images and by the internal frame generator logic to read the pixel data. The control head controller can load data into the display buffer through an eight bit parallel data port. Two internal eight bit registers form the byte address of the display buffer to which the control head controller writes data. The control head controller **204** can load an address into these registers through the eight bit parallel data port. The combined address register can be auto-incremented each time the control head controller **204** writes to the display buffer.

The frame timing generator can generate internal frame start, line start, pixel data, and pixel clock signals that are used by the display control logic to control the circuitry surrounding the AC-TFEL Display **202**. The frame refresh rate can be controlled by register that is set by the control head controller **204** via the eight bit parallel data port.

The display control logic can use the framing, clock, and pixel data from the frame timing generator to generate the actual signals used by the AC-TFEL Display electronics. This signal generation can include timing for HV row charge/discharge pulses, shifting and latch column and row data, and alternating polarity of row charge/discharge pulses. Additionally, the display control logic can provide for an orderly start up/shut down of the AC-TFEL Display **202** after reset or if the High Voltage Power Supply **208** is in an under voltage condition.

Turning now to FIG. **10**, the display mode of the land mobile radio **222** can be programmed by the end user, in one implementation, employing a computer processor **224** to define a display configuration of the land mobile radio **222**. To this end, the computer processor **224** can communicate with the land mobile radio **222** by a cable that connects to the microphone port on the control head. The computer processor **224** runs a program that allows the user to define the configuration stored in a processor memory of the radio through a set of menus. By defining this configuration, a number of different display modes can be realized.

Turning to FIG. 11, there are a variety of display modes that can be available in some embodiments. For example, a classic mode **226** can be available that provides a display mode like that provided by previous land mobile radios not having electroluminescent displays. There can also be an enhanced single line mode **228** with zone/channel display similar to that of the classic mode, but with soft key function labels and additional or different symbols or indicating operational modes and statuses of the radio.

Another display mode **230** can be an enhanced single line mode in which display of zone and channel is inhibited, permitting display of additional text. An additional display mode **232** can be an enhanced dual line display mode allowing display of even more text with zone and channel display inhibited.

Yet another display mode **234** can be a dual line display mode in which zone and channel are displayed. Finally, an enhanced menu **236** can be displayed with user configurable options that are navigable by use of a control on the control head. These modes can be selected by the user selecting options for controller head type, whether to inhibit zone/channel display, a classic versus enhanced display mode, and if in the enhanced mode, whether to exercise the option to display two lines of text, as indicated below in table 1.

TABLE 1

	Control Head Type Normal/ Lightning	Inhibit Zone Chan Indicator Checkbox	Display Mode Standard/ Enhanced
Classic with Zone Chan	Normal	Off	Standard
Classic without Zone Chan	Normal	On	Standard
Enhanced Single with Zone/Chan	Lightning	Off	
Enhanced Single without Zone Chan	Lightning	On	
Enhanced Dual with Zone/Chan	Lightning	Off	
Enhanced Dual without Zone/Chan	Lightning	On	

There are a number of menus that allow the user to configure the display mode of the control head in addition to other functions of the radio. For example, turning to FIG. 12, one of the menus that allows the user to make a selection for configuring the display mode can contain a checkbox **238** for exercising an option to inhibit the zone/channel indicator. Selecting this checkbox can inhibit the display of the zone/channel indicator even in the classic mode. Also, turning to FIG. 13, a controller type drop down menu **240** can allow the user to select controller type. Turning to FIGS. **14** and **15**, a display mode drop down menu **242** allows the user to select a standard or enhanced display mode, which can affect options provided for configuring the radio. Some of these options relate to display options. For example, turning to FIGS. **16** and **17**, display options **244** for the standard display mode do not permit selection to display two lines of text. In contrast, the display options **246** in the enhanced mode permit selection to display two lines of text.

Thus, it is apparent that there has been provided, in accordance with the present disclosure, a control head that satisfies one or more of the advantages that forth above. Although the preferred embodiment has been described in detail, it should be understood that various changes, substitutions, and alterations can be made herein without departing from the scope of the present disclosure, even if all of the advantages and benefits identified above are not present. For

example, the various embodiments and examples shown in the drawings and descriptions provided herein illustrate that the present disclosure may be implemented and embodied in numerous different ways that still fall within the scope of the present disclosure, whether expressly shown herein or not. For example, the various elements or components may be combined or integrated in another system or certain features may not be implemented. Also, the techniques, systems, sub-systems, and methods described and illustrated in the preferred embodiment discrete or separate may be combined or integrated with other systems, designs, techniques, or methods without departing from the scope of the present disclosure. For example, the control head can be used with a wide variety of types of LMR systems and networks, including those not specifically discussed herein. Other examples of changes, substitutions, and alterations are readily ascertainable by one skilled in the art and could be made without departing from the spirit and scope of the present disclosure.

What is claimed is:

1. A control head of a land mobile radio, the control head of the land mobile radio comprising:

an electroluminescent display of the land mobile radio showing labels for a plurality of function buttons under the electroluminescent display and a symbol indicating operating status of the land mobile radio;

a plurality of indicator LEDs comprising at least a red LED, a green LED, and an amber LED controllable independently of the red LED and independently of the green LED,

a signal line to the amber LED and connected to the control head controller;

a control head controller configured to receive data from a land mobile radio, to construct the data into one or more images, and to determine a state of the land mobile radio as being one of a transmit state, a receive state, or an idle state; and

an FPGA video driver connected to said control head controller and buffering the one or more images into a video stream for rendering on said electroluminescent display,

the one or more images comprising the labels and the symbol, the symbol comprising at least one two-dimensional representation of a radio transmitter depicted on the electroluminescent display of the land mobile radio proximate to the labels for the plurality of function buttons,

wherein the one or more images comprising the labels is displayed continuously,

wherein the one or more images comprising the symbol is displayed concurrently with a deactivation of the amber LED and an activation of the red LED,

wherein the control head controller is further configured to detect a change in the state of the land mobile radio and to control activation of the plurality of indicator LEDs to indicate the changed state of the land mobile radio by illuminating at least one of the indicator LEDs a first hue to indicate the changed state is the idle state, illuminating at least one of the indicator LEDs a second hue to indicate the changed state is the transmit state, and indicating at least one of the indicator LEDs a third hue to indicate the changed state is the receive state, wherein the first hue is an amber hue of the amber LED, and

wherein the first hue comprises a brightness separately controllable by the control head controller and different than a brightness of the red LED when the red LED is

illuminated and different than a brightness of the green LED when the green LED is illuminated.

2. The control head of claim 1, further comprising a high voltage power supply receiving input power from a radio battery supply through a FET switch controlled by said FPGA video driver, wherein output voltage levels are adjustable by a volume adjustment potentiometer to set a brightness level of said electroluminescent display, and power supply switching frequency is controlled by the FPGA video driver.

3. The control head of claim 1, wherein said FPGA video driver contains a display data buffer, a frame timing generator, and display control logic to control operation of a negative row voltage charge/discharge FET, a positive row voltage charge/discharge FET, a row HV driver/shift register, and a column HV driver/shift register.

4. The control head of claim 1, wherein said FPGA video driver contains a display data buffer that is a RAM that is accessed by said control head controller to load pixel data for the one or more images and by internal frame generator logic to read the pixel data, and said control head controller load data into the display buffer through a parallel data port.

5. The control head of claim 1, wherein said FPGA video driver contains a frame timing generator that generates internal frame start, line start, pixel data, and pixel clock signals that are used by display control logic to control the circuitry connected to said electroluminescent display.

6. A system for configuring a control head of a land mobile radio having an electroluminescent panel in the land mobile radio, the system comprising:

the land mobile radio having a computer memory storing a configuration and a controller configured to generate display data according to one of various display modes as defined by the configuration;

a control head connected to the land mobile radio and having the electroluminescent display rendering images formed of the display data, and having a plurality of indicator LEDs for indicating a state of the land mobile radio,

wherein the images comprise labels for a plurality of function buttons under the electroluminescent display,

wherein the images comprise a symbol indicating operating status of the land mobile radio;

a computer processor in communication with the land mobile radio via the control head and executing a process whereby a user of the computer processor specifies the display mode to be defined by the configuration; and

a control head controller configured to determine the state of the land mobile radio as being one of a transmit state, a receive state, or an idle state, to detect a change in the state of the land mobile radio, and to control activation of the plurality of indicator LEDs and the images displayed on the electroluminescent panel to indicate the changed state of the land mobile radio by illuminating at least one of the indicator LEDs a first hue comprising an amber hue to indicate the changed state is the idle state, illuminating at least one of the indicator LEDs a second hue to indicate the changed state is the transmit state and displaying the symbol indicating operating status of the land mobile radio proximate to the labels for the plurality of function buttons to indicate the changed state is the transmit state, and indicating at least one of the indicator LEDs a third hue to indicate the changed state is the receive state,

wherein the control head controller is further configured to control a variable brightness of the first hue and different than a fixed brightness of the second hue and different than a fixed brightness of the third hue.

7. The system of claim 6, wherein said computer processor utilizes a menu whereby a user selects whether to inhibit display of a zone and channel to modify the configuration.

8. The system of claim 6, wherein said computer processor utilizes a menu whereby a user selects a type of control head to modify the configuration.

9. The system of claim 6, wherein said computer processor utilizes a menu whereby a user selects a display mode to modify the configuration.

10. The system of claim 6, wherein said computer processor utilizes a menu whereby a user selects an option for display of more than one line of text to modify the configuration.

* * * * *

专利名称(译)	在陆地移动无线电中使用电致发光面板的控制头		
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[标]申请(专利权)人(译)	公司的特洛伊 邓尼根表示威廉伯爵 李维dolie		
申请(专利权)人(译)	FRANDSEN , TROY 邓尼根 , WILLIAM EARL REAVILL , DULIE		
当前申请(专利权)人(译)	E.F.强生公司		
[标]发明人	FRANDSEN TROY DUNNIGAN WILLIAM EARL REAVILL DULIE		
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摘要(译)

提供了示例性陆地移动无线电控制头和方法。在一个实施例中，控制头具有利用控制头的晕光来实现传递陆地移动无线电的状态的多功能指示器的能力。在另一个实施例中，控制头具有将从陆地移动无线电接收的数据构成的缓冲图像提供到视频流中以便在电致发光显示器上呈现的能力。在另一个实施例中，控制头为用户提供修改存储在陆地移动无线电上的配置的能力，该配置定义了若干显示模式中的一种，用于生成数据以用于形成要在电致发光显示器上呈现的图像。

