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(54) **Elevator electroluminescent (EL) display system.**

(57) An elevator information display system including an electroluminescent (EL) screen displaying elevator and building related information (**Figs. 1-5**), one in each car and one in the lobby for each car (**Fig. 7**). An additional remote screen, which displays the same information as the primary screen, can be mounted some distance away from the primary screen. The ELD is controlled from two sources. The elevator management/monitoring system (EMS), if it exists in the elevator system, communicates commands and data to the ELD via an appropriate communications link, and for the most part these commands cause the ELD to store and display the building related information. The ELD also receives serial display information (discrete and data) from the remote station link (RSL). This path provides the information required for the ELD to display the elevator related information. The basic display elements or components of the ELD system include - an ELD glass (screen), an ELD interface printed circuit board (PCB) mounted behind the glass, an ELD remote station interface PCB (directly connected to the ELD interface PCB), all mounted together in a common package frame (**Fig. 15**); and an associated ELD power supply assembly. The ELD receives commands and data from the EMS, which cause it to display specific information or to receive downloaded data required for later display commands. The EL display screen displays elevator related information in the upper portion of the screen and separate, business related information in the lower portion, divided by a horizontal line displayed on the EL display screen.

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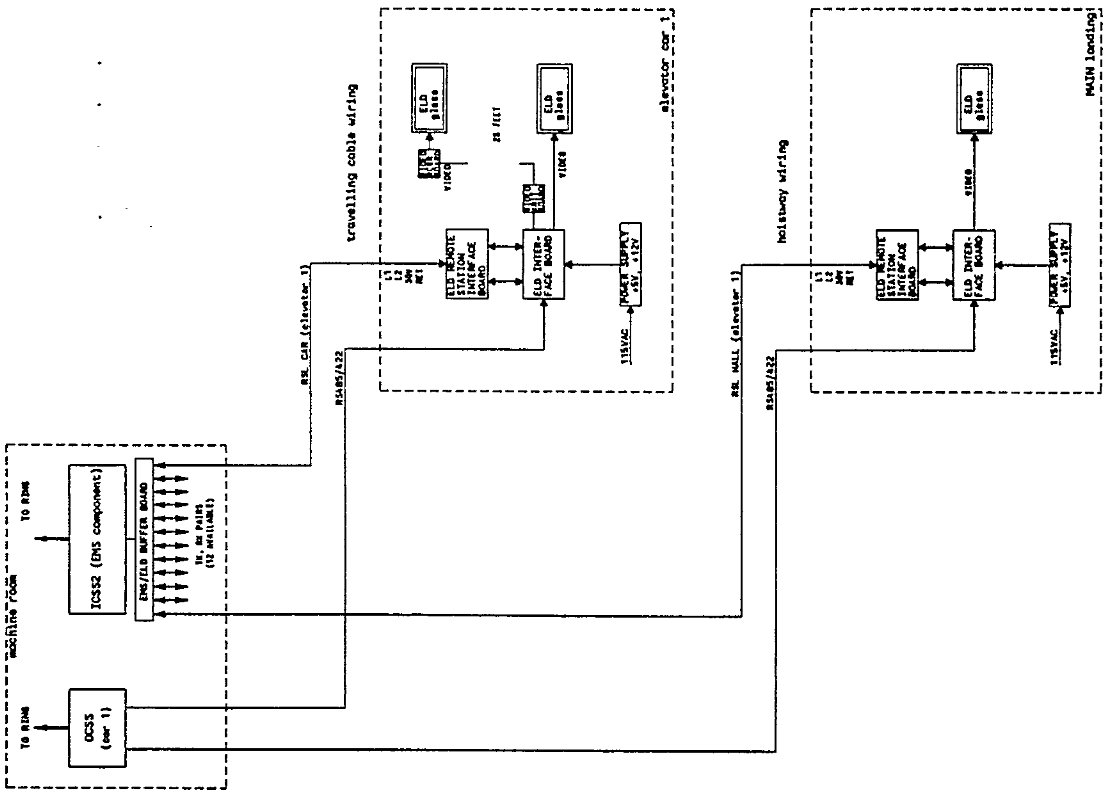


FIGURE 7 ELD SYSTEM BLOCK DIAGRAM

Elevator Electroluminescent (EL) Display System

The present invention relates to elevator systems and more particularly to informational displays for elevators in which information on, *inter alia*, the status of an elevator car is displayed in, for example, the car itself and in the hall, especially at the main floor or lobby.

In order to inform passengers in an elevator car of the status of the car, particularly what floor the car is approaching, it is the common practice to include such information on a display in the car itself. In this display it is typical to use "nixie" tubes or other like numerical indicators.

Additionally, it is common to include, for each car, car information displays at, for example, the main floor landing or lobby, including which direction the car is moving in,*i.e.*, "up" or "down," and to indicate at what floor the car is then currently located. To display both types of information, it is the typical practice to use two, separate, illuminated displays, one located at each car entrance indicating the direction of travel of that car in the form of a hall lantern and an integrated, illumi nated display with separate row of lights for each floor and with a separate column of lights for each car. In these displays it is the typical practice to use incandescent bulbs for the display.

However, such displays require a substantial amount of maintenance in bulb replacement and expense. Additionally, the type and amount of information displayed or indicated is limited and restricted and not as clear or as readily understood as desired.

It also has long been possible to dispatch specific elevator cars to serve specific floors. This is especially desirable in very tall buildings. The floors which the car (or cars) serves is usually displayed permanently near the respective car(s) at the main landing. For example, a brass plate may be located near a bank of elevators that reads "SERVING FLOORS 30-35," limiting the assignability of the cars or making information displays for varying assigned cars a difficult challenge for the building owner.

Thus, with the use of varying, multi-zone "channeling" of the various cars, it is desired to be able to easily and on a customized basis display what range of floors a particular car is assigned to, which assignment may vary from time to time, depending, for example, on changing traffic volume and conditions. Thus, a car serving floors "10-15" in one run, may serve floors "35-40" in the next run. Most displays in use today are incapable of such displays, requiring multiple types of displays being made available for various applications, increasing costs, inventory and training requirements, etc.

The present invention is designed to overcome these short-comings and to provide in contrast a cost effective, reliable, flexible elevator car information display system, which can handle all types of elevator applications, with the type of displayed information being easily changeable, even after the display has been installed in a building. Additionally, it is an object to provide such a display, which will allow the displaying of supplemental information not directed to information concerning the status of the elevator cars themselves.

To achieve these goals and objects, the present invention utilizes an electroluminescent display (ELD) system to provide apparatus by which, *inter alia*, certain, varying elevator information can be conveyed to the public via a flat-panel, electroluminescent, raster-type display (ELD) panel or screen. Thus, the present invention provides an elevator display system which is designed to provide dynamic video information to passengers in the car and/or the lobby or other main floor using EL display screens.

Such a display is relatively flat, allowing for flush or near-flush wall mounting, and is bright, has good viewing angles and a relatively long life expectancy.

The type of information the ELD provides is divided into two categories -

- elevator related information, including floor position, direction of travel, hall lantern, "jewel" messages and channeling range; and
- building related information, including directories, messages (advertising), time and temperature, relative floor position and, if so desired, logos. Each of the information types preferably is displayed at assigned locations on or portions of the EL screen.

In general there is one ELD system in each car and one ELD in the lobby (or other main floor) for each car. An additional remote screen, which preferably displays the same information as the primary screen, may also be made available.

The ELD preferably is controlled from two sources.

The elevator management or monitoring system (EMS), if it exists in the elevator system, communicates commands and data to the ELD via an appropriate communications link (*e.g.*, an RS-485 serial communication link). For the most part these commands cause the ELD to store and display on the screen the building related information.

The ELD also receives serial display information (discrete and data) from a remote serial link (RSL). This path provides the information required for the ELD to display the elevator related information.

The basic display elements of the ELD system of the present invention typically will include the following interconnected components:

an ELD glass (screen);

an ELD interface printed circuit board (PCB) mounted behind the glass;

an ELD remote station interface PCB (directly connected to and mounted on the ELD interface PCB); and

an ELD power supply assembly (typically in a separate enclosure located within, for example, twenty feet of the other three components, with the other three components mounted together in a framing structure).

The ELD receives commands and data from the EMS, which cause it to display specific information or to receive downloaded data required for later display commands.

The ELD system includes particularly efficacious informational displays, preferably with the elevator related information displayed at the top portion of the screen and building information displayed at the bottom portion of the screen, preferably with the two portions divided by a horizontal line. Such building information can include, as noted, building directory information, advertising messages, logos, *etc.*

The ELD system thus, preferably, includes a flat panel raster display and an associated display controller which receives and displays the following information from the elevator system at various times during the elevator run:

- floor number position
- relative position of the car in the hoistway
- hall lantern (car arrival)
- dispatching information
- directories
- time/temperature
- messages (ads)
- custom logos

A main computer in the elevator machine room preferably makes all dispatching decisions. Standard RS-422/485 serial communication preferably is used for relaying elevator dispatching information to each display. This port is also used to convey directory and message information to the display. Since one port of the machine room computer is used, each display is addressable. In this way, information relating to a particular elevator display can be extracted from the "party line" by using addressed "packets" of information.

The invention may be practised in a wide variety of elevator applications using a great variety of circuit and electrical or electronic components, in the light of the teachings of the invention, all of which are discussed in further detail hereafter.

Other features and advantages will be apparent from the specification and claims and from the accompanying drawings, which illustrate an exemplary embodiment of the invention.

Brief Description of Drawings

Figure 1A is a frontal view of a first embodiment of an elevator car informational display format in accordance with the present invention, with a triangular symbol indicating the direction of movement of the car and with floor information in numerical form both being presented in side-by-side array in the upper portion of the display, with the lower portion of the display being blank, with the upper and lower portions being divided by a horizontal line.

Figure 1B is a frontal view of a second embodiment of an elevator car informational display format in accordance with the present invention, with a triangular symbol indicating the direction of movement of the car and with floor information in numerical form both being presented in side-by-side array in the upper portion of the display, and with the lower portion of the display providing supplemental information, with the upper and lower portions being divided by a horizontal line.

Figure 1C is a frontal view of a third embodiment of an elevator car informational display format in accordance with the present invention, with a range of floor information in numerical form being presented in the upper portion of the display, and with the lower portion of the display providing supplemental information including the textual information "FLOORS", with the upper and lower portions being divided by a horizontal line.

Figure 1D is a frontal view of a fourth embodiment of an elevator car informational display format in accordance with the present invention, with a triangular symbol indicating the direction of movement of the car in line with a segmented, vertically elongated rectangle in vertical alignment therewith indicating by darker shading on the lower part of the vertically elongated rectangle the floor position relative to the other floors on one side of the display, and with floor information in numerical form being presented on the other side of the display in side-by-side array.

Figure 1E is a frontal view of a fifth embodiment of an elevator car informational display format in accordance with the present invention, with a triangular symbol indicating the direction of movement of the car on one side of the display, and with floor information in numerical form being presented on the other side of the display in side-by-side array.

Figure 1F is a frontal view of a sixth embodiment of an elevator car informational display format in accordance with the present invention, with a triangular symbol indicating the direction of movement of the car dominating the entire display, with the display serving as a hall lantern.

Figure 2 is a frontal view of a seventh embodiment of an elevator car informational display in accordance with the present invention, with a triangular symbol indicating the direction of movement of the car and with floor information in numerical form both being presented in side-by-side array in the upper portion of the display, and with a graphical logo symbol being presented in the lower portion of the display, with the upper and lower portions being divided by a horizontal line.

Figure 3 is a frontal view of an eighth embodiment of an elevator car informational display in accordance with the present invention, with a triangular symbol indicating the direction of movement of the car in line with a segmented, vertically elongated rectangle in vertical alignment therewith indicating by darker shading on the lower part of the vertically elongated rectangle the floor position relative to the other floors on one side of the display, and with floor information in numerical form being presented on the other side of the display with supplemental information being displayed below the floor information.

Figure 4 is a frontal view of a ninth embodiment of an elevator car informational display in accordance with the present invention, with a triangular symbol indicating the direction of movement of the car and with floor information in numerical form both being presented in side-by-side array in the upper portion of the display, with the lower portion of the display providing supplemen tal information, with the upper and lower portions being divided by a horizontal line.

Figure 5 is a frontal view of a tenth embodiment of an elevator car informational display in accordance with the present invention, with a triangular symbol indicating the direction of movement of the car and with floor information in numerical form both being presented in the upper portion of the display in side-by-side array, along with supplemental graphical information, with the lower portion of the display providing supplemental information, with the upper and lower portions being divided by a horizontal line.

Figure 6 is a chart tabulating the fixture functions of the ELD system to provide the exemplary displays of, for example, **Figures 1-5**.

Figure 6A is a simplified diagram illustrating four, exemplary area locations of the EL display screen in which certain types of information can be displayed in the ELD of the present invention using the fixture functions of **Figure 6.**

Figure 7 is a block diagram of an exemplary electroluminescent display (ELD) system in accordance with the present invention and shows an exemplary location of the ELD interface board in the elevator system architecture.

Figure 8 is a block diagram of an exemplary circuit for the ELD interface board usable in the present invention.

Figure 9 is a generalized diagram showing the relative address spaces of the memories of the ELD interface board for -

- electrically programmable read-only-memory (EPROMs) for program and fixed data memory,
- static random-access-memory (SRAM) for variable data entry and for a "scratchpad," and
- the computer's memory for space for communications to the video storage and display device (**VSDD**); with the origin of each chip select.

Figure 10 is a generalized diagram illustrating the locations in input/output (I/O) space for the functions of remote station link (RSL) communication via the ELD remote station interface board, for the UART communication port, for the programmable peripheral interface, for re-triggering a "WATCHDOG" timer, and for causing an automatic "RESET" from the WATCHDOG in the exemplary ELD of the present invention.

Figure 11 is a generalized diagram illustrating exemplary interrupts which affect the software operation of the central processing unit (CPU) for the microprocessor for the ELD interface board, including a description of these exemplary interrupts and their origins.

Figure 12 is a generalized, comparative graph contrasting the CRT signals versus the ELD signals used in the ELD of the present invention.

Figures 13A-E are circuit schematics for the exemplary circuit for the ELD interface board; while

Figures 14A-C are circuit schematics for the exemplary circuit for the ELD remote station interface board.

Figure 15 is an exploded, perspective view of the various basic display elements, including, *inter alia*, the glass display screen, the interface boards and associated framing and standoff members, which are mounted together in a common packaging frame for flush or near-flush mounting in a wall opening associated with the elevator car for which it is to display car related information.

- EL Display Panel -

An electroluminescent display (ELD) screen typically is in the form of a flat, glass panel, with the display having a matrix of pixels, each of which in operation is either turned "on" or "off" on command, producing variable, relative darkened and lightened areas on the screen to display graphical

or textual images. An exemplary embodiment useful with the system of the present invention is an EL screen having a matrix using a "640 X 200" format, having an exemplary size of
4.8" X 7.7" (122 X 196mm).

In general, in the exemplary embodiment of the invention, there is one ELD system in each car of the elevator system and one ELD in the lobby (or other main floor landing) for each of the cars. (Note **Fig.** 7.)

An additional remote screen, which preferably displays the same information as the primary screen, can be mounted up to, for example, 25′ - (7.62m) away from the primary screen. Such a remote screen is particularly useful for, for example, a "double deck" car system, with the "primary" display at one deck and the "secondary" or remote display at the other deck.

In the lobby the glass screen preferably is mounted as flush to the wall as possible and located as near as possible to the elevator or elevator group which it serves. Such flush mounting is likewise desirable in the car display, with the display aesthetically placed as near or above the car operating panel(s) [COP(s)] as feasible. The interface boards for the screen are located as near as possible to the display, while preferably remaining out of sight to the public.

The ELD system of the present invention preferably includes a serial communication link to the EMS, which can be in the form of shielded twisted cable pair(s). This wiring is preferably brought down through the travelling cable for each elevator car, and through the hoistway wiring for the lobby displays. The same is true for the associated, standard, remote station link (RSL) wires. (Note **Fig.** 7.)

The display functions of the exemplary embodiment include:

a car direction indicator preferably in the form of an isosceles triangle-like graphical figure, the apex of which is pointed in the direction of car travel, *viz.* "▲" for the "up" direction and " ▼ " for the "down" direction (note right-hand portions of **Figs. 1A, 1B, 1D** & **1E** and **2-5**), which triangle preferably is animated (blinks "on" and "off" in rapid succession);

a car position or floor indicator preferably in the form of a numerical display (*e.g.*, "44" for the forty-fourth floor; note **Figs. 1A, 1B, 1D & 1E** and **2-5**);

graphical representation of relative position of the car in the hoistway (typically in the hall display only), preferably in the form of a segmented, vertically elongated rectangle, with the relative position being indicated by darkening a lower area of the rectangle proportionally equivalent to the analogous floor position of the car within its total travel distance (note left-hand portions of **Figs. 1D** & **3**; thus, for example, a car at the third floor in a twelve story building would have one-third of the vertically elongated rectangle darkened);

"jewel(s)," including directories (lower part of **Fig. 5**), messages such as advertisements (lower part of **Fig.** 4), logos (note graphical images in the lower parts of **Figs. 2-4** and upper left of **Fig. 5**), *etc.*;

hall lantern (car arrival indicator; note **Fig. 1F**); and any car channelling information display (**Fig. 1C**).

The fixture functions of the ELD system to provide the exemplary displays of **Figures 1-5** are tabulated and charted in **Figure 6**. With respect to the "TYPE" column of the chart, "F" refers to a fixed display, *viz.* a representation of information that is "called up" by a source, and its composition and location on the display cannot be altered; "FV" refers to a display with a variable parameter, *viz.* a representation of information that requires additional information from the source which "calls it up", and the composition and location of the information on the display cannot be altered; and "FV" refers to customer specified information, *viz.* the customer (*e.g.*, the building owner) is free to set up custom information and has some limited flexibility as to where the information is to be displayed, when and how.

The "priority" of the display fixture function refers to its ranking or relative position of importance in the display. As will be described more fully below, since the interface board is listening to both the RSL (remote serial link) and the RS422/485 communication line, the interface board must know which information is first (second, *etc.*) to get update attention for its portion of the display. Of course, to provide for standardization of the hardware, the ELD interface board is preferably configurable as either a car display or a lobby display.

Regardless of the form of the specific items included in the display, preferably the elevator related information is displayed in the top or upper portion of the screen (location areas **A** & **B** of**Figure 6A**), while the building related information is displayed in the bottom or lower portion of the screen (location areas **C** & **D** of **Figure 6A**).

However, many, various informational EL displays are possible for an elevator system, only a few exemplary ones being shown in **Figures 1-5**, and all with the same basic hardware system. Thus, for further example, the darkened area in the graphical display in **Figures 1D** & **3** could be used to indicate direction by the darkened area being displayed at the bottom when the elevator is going up and at the top when the car is going down. Indeed, the leading, darkened segment could be pointed to further indicate the direction of travel, eliminating the need for the separate isosceles triangle-like graphical figure.

As explained more fully below and as generally shown in the chart of **Figure 6**, the ELD accepts an assortment of command blocks from the elevator management or monitoring system (EMS) via an RS422/485 link. These commands cause the ELD to implement displays, including, if desired, channeling (**Fig. 1C**) and directories (**Fig. 5**). The ELD, upon detecting no EMS activity, implements a default display from the remote station link (RSL) data, including at least the car position and direction.

In the exemplary embodiment and as explained more fully below, the ELD receives the following data from the RSL:

Position information, obtained from the standard "PIDATA" and "PICLOCK" outputs of the standard RSL station [an "Industrial Control Unit" (ICU) based decoder for the RSL communications protocol]. It can be encoded as, for example, two sixteen-segment light emitting diode (LED) type characters. As has been previously established, the decoded position value points to a table containing reconfigurable floor labels.

Direction information, which causes the up or down triangular "arrow" to be displayed on the default display (**Figs. D & E**, with the latter used if the installation does not include an EMS or its equivalent).

Hall lantern, which causes the large direction indicator to be displayed (**Fig. 1F**; hall only).

Channelling, which provides the command and data to display channelling (*e.g.*, **Fig. 1C**.

Jewels, which typically would be fixed, but easily updatable or programmable, messages to be displayed when a particular discrete output becomes active from a specific RSL station.

All jewel messages are preferably stored as ASCII (American Standard Code for Information Interchange) characters preferably in an interchangeable PROM. If it is necessary to change the language of the jewels, the PROM thus easily can be replaced with a PROM of the desired language.

Preferably the ELD, upon initialization, supports display of the default display and jewels without requiring any downloaded configuration information.

- ELD PCB Assembly -

A technical, detailed description of an exemplary embodiment of the electroluminescent display (ELD) interface printed circuit board (PCB) assembly, which include related components of the ELD system, which is the primary electrical subsystem of the present invention, will now be provided with reference to **Figures 7-15**, particularly to the exemplary circuitry for the ELD interface boards of **Figures 13A-E** and **Figures 14A-C** (the latter being for the remote station (RS) interface board).

The ELD interface PCB assembly is the component of the ELD system which creates the displays, drives the EL glass, and coordinates communication with the elevator's central processor [the "Operational Control Sub-System" (OCSS)] and the elevator management or monitoring system (EMS).

Figure 7 provides a block diagram of the ELD system and shows the location of the ELD interface board in the standard elevator system architecture.

The ELD interface board is a microprocessor based computer board. The computer runs the firmware which creates the graphic displays for the EL glass. The firmware also interprets communication with the EMS processor and the elevator's central processor ("OCSS"), herein termed the "main processor" to distinguish it from all the various central processor units (CPUs) used in the various boards and subsystems for the elevator.

Hardware termination of the EMS communication resides on the ELD interface board. Communication from the "OCSS" is decoded on the ELD remote station (RS) interface board. The decoded information is sent to the ELD interface board through connectors that also serve to anchor the remote station interface board in a "piggy back" fashion to the ELD interface board, with appropriate standoffs also being used .

Dedicated video circuitry converts activity from the board's central processor to the signals necessary to drive the ELD. Signals and power are fed directly from the board to an ELD located up to, for example, 12"(300mm) from the board's connector. Another set of signals and power are available for use to the video transmitter board (VTB), which is responsible for sending these signals over a distance of up to, for example, 25 feet (7.62m) to the video receiver board (VRB).

A block diagram of the circuit is shown in **Figure 8**. The following sections are a detailed description of the circuitry of the ELD interface board.

The processing unit for the ELD interface board can be, for example, an "80188" microprocessor. The 80188 microprocessor is an eight (8) bit (DATA bus) controller, which can address up to a megabyte (1 MB) of contiguous program/data memory and sixty-four (64 KB) kilobytes of input/output (I/O). [A KB (kilobyte) refers to 2^{10} x 8 bits (8 bits used for processing in parallel is called a byte).]

The 80188 has many functions embedded within the integrated circuit (IC). A further description of the 80188 device is found in the 16-Bit Embedded Controller Handbook (INTEL Corp., Santa Clara, CA; 1989; particularly pp. 9-151 - 9-

207).

The highlights of the device which affect the design of the ELD interface board are as follows:

o an internal oscillator circuit, which runs the central processing unit (CPU) at one-half (½) the speed of the crystal presented at its crystal input pins;

o a RESET pin which puts the CPU in a known state;

o a multiplexed DATA/ADDRESS bus.

o pins to accomplish data/program memory space decoding;

o pins to accomplish I/O space decoding; and

o an internal prioritized interrupt structure.

The ELD interface board may have, for example, a "14.31818 MHz" crystal to run the 80188. The 80188 has internal clock generating circuitry, and the maximum speed which the 80188 can run according to its specifications is eight megahertz (8 MHz). A slightly slower than maximum speed may be chosen (*e.g.* 7.15909 MHz), to accommodate slower, less expensive memories.

The "RESET" circuit exists to ensure that the processor powers up in the correct sequence. Upon power up, the capacitor **C12** holds the "/RES" pin to the CPU "LOW" for approximately one hundred (100 ms) milliseconds. This allows the CPU to receive more than the minimum amount of clock pulses in a "RESET" state, such that the execution of code at a known location can begin.

Once the CPU is running, a "WATCHDOG" in the "RESET" circuitry guards the proper operation of firmware. The multi-vibrator **U11A** is triggered, when it is released from a "CLEAR" state (output /1Q HIGH), after the power up "RESET" sequence. The multi-vibrator begins to "time out". A two hundred and fifty (250 ms) millisecond pulse will go "HIGH" unless its trigger pin **1B** detects a rising edge (thus causing a "re-trigger"). The positive going edge is provided by the CPU pin **/PCS0**. If **/PCS0** is not pulsed, the two hundred and fifty (250 ms) millisecond pulse of **U11A** is released and provides a positive going trigger to the multi-vibrator **U11B**. **U11B** is armed to provide a twenty-eight (28 μs) microsecond pulse to the **/RES** pin of the CPU, which will properly set the CPU into its "RESET" state. **U11A** is then re-triggered, and the process has the potential to reoccur. This operation ensures that the software will not run out of control, since it will regularly update the "WATCHDOG" when running properly.

The CPU can halt its own operation by addressing the "WATCHDOG" by its **/PCS5** pin. This over-rides the normal operation of the multi-vibrator by causing **/RES** to go "LOW" and clearing **U11A**. This causes a "LOW" to "HIGH" transition on the output **/1Q**, which triggers **U11B** (same as allowing **U11A** to "time out").

A push button **SW1** is provided to allow a manual "RESET." Its operation is similar to the "POWER UP" sequence, since actuating the switch drains the capacitor **C12**.

The "RESET" circuitry also consists of a "LOW VOLTAGE DETECTOR." If the power voltage **Vcc** (nominally +5 volts) drops below +4.68 volts (as measured by the comparator **U10A**), the circuitry will "RESET" the processor until the voltage has risen above +4.77 volts.

Latches **U32**, **U37**, and **U41** are used decode the time multiplexed "ADDRESS" bus. Transceiver **U38** buffers the "DATA BUS" to the program/data memory from the communication to the video storage and display device (**VSDD**) **U31**, which also resides in program/data memory space. Transceiver **U35** buffers the "DATA BUS" to the RSL interface board. **U34** buffers the "DATA BUS" to the UART. Both RSL and UART communication buffers reside in I/O space.

As noted above, the 80188 can address up to 1 MB of program/data memory. Six memory chip select pins (**/UCS**, **/LCS**, and **/MCS0-3**) are provided to facilitate memory address decoding. The largest memory space decoded by the pins **/MCS0-3** is 64 KB. Because preferably some larger memory chips are used, **U42** is used in conjunction with the 80188 chip selects to encode selects directly from the "ADDRESS BUS."

The board contains three 128 KB (393,216 bytes) electrically programmable read-only-memory (EPROMs) for program and fixed data memory - one 32 KB (32,768 bytes) static random-access-memory (SRAM) for variable data entry and one 8 KB (8192 bytes) SRAM for scratchpad. The computer's memory also maps into a 64 KB (65,536 bytes) space for communications to the video storage and display device. **Figure 9** shows the address space of these memories and the origin of each chip select.

As noted above, the 80188 can address up to 64 KB of I/O space. Six peripheral "chip" select pins (**/PCS0-5**) are provided to facilitate I/O address space decoding.

I/O space is used for RSL communication via the ELD remote station interface board, for the UART communication port, for the programmable peripheral interface, for retriggering the "WATCHDOG" timer, and for causing an automatic "RESET" from the WATCHDOG. **Figure 10** illustrates the locations in I/O space for these functions.

The programmable peripheral interface **U14** allows three bytes worth of information to be manipulated by the CPU and used for peripheral functions. The "PORT A" of this device is used as "INPUT" to read the configuration of **SW2** (note **Fig. 8**). "PORT B" is also "INPUT" to read the configuration of **SW3**. "PORT C" is used as "OUTPUT." The three most significant bits (MSBs) are used to govern the status of **LED1**, **LED2**, **LED4** and **LED5** of **Fig. 8**. The second LSB (least significant bit) is used to provide a "STATUS" bit to indicate a failure on board to the ELD RS interface board, as explained more fully below. The LSB of the peripheral interface is used to provide an inverted screen display, also as explained more fully below.

At the system level, the elevator management or monitoring system (EMS) communicates to the ELD interface board by, for example, two shielded twisted "24 AWG" pairs. The signals are standard half duplex RS485/422 +5 volts differential, one pair for transmission signals to the ELD and one pair for reception of signals from the ELD.

The pairs are terminated at the ELD interface board at connector **J8**. Discrete protection and filtering elements are self explanatory. The termination resistor **R17** for the differential receiver is jumped in by jumper **JMP3** only if it is the final device in a string of receivers.

The differential signals from the EMS are received by a dual differential receiver **U46** and converted to a single ended signal. The serial stream is provided to the UART **U33**, which translates the data to a byte readable for the CPU. Conversely, parallel data written to the UART from the microprocessor is converted to a serial stream by the UART and sent out via the differential driver **U50**.

The communication may be carried out at 9600 BAUD. The counter **U49A** uses the 4.9152 MHz oscillator as its input. The second MSB yields a frequency of 64 X 9600 Hz (614.4 MHz or 4.1952/8 MHz), which is used by the UART to decode the serial signal. A jumper **JMP1** is available to tap off the MSB of **U49A**, if such is desired.

The RSL signals from the elevator are transmitted by two wires carrying +30 volts, COM, and two wires carrying information synchronous to a clock patterned data frame. A five bit data "frame" can be transmitted to or received from up to, for example, sixty-four (64) stations. The sequence consists of sixty-four (64) transmit frames followed by sixty-four (64) receive frames. The first four (4) frames contain special information, as does the fifth bit of the first thirty-two (32) frames.

The RSL wires are terminated at the ELD remote station interface board. This board connects in a "piggy back" fashion to the ELD interface board via connectors **J1** and **J2**.

Connector **J1** contains control signals necessary to address (**/PCS1**), be interrupted by, read from, and write to the RSL interface board. These signals are separated by a buffer **U40**.

Connector **J2** passes the eight (8) bit "DATA BUS" and the seven LSBs of the "ADDRESS BUS" to the ELD remote station interface board. The "DATA BUS" is buffered by transceiver **U35**, and the "ADDRESS BUS" is separated by the buffer **U36**. The ELD RS interface board contains eight (8) bytes of information for the ELD interface board. With seven (7) address bits, one hundred and twenty-eight (128) addressable locations are possible, allowing for other, supplemental uses.

The interrupts which affect the software operation of the CPU are controlled by input pins directly at the 80188. The CPU provides three interrupt pins ("INT0 -INT3"), which are prioritized by software initialization of the CPU. The method of interrupt of the pins is also programmable to be HIGH, LOW, LOW-to-HIGH, or HIGH-to-LOW. A description of these interrupts and their origins is provided in **Figure 11**.

INTO is derived from the UART and EMS COMMUNICATION port. By the software protocols of EMS/ELD communication, the processor is only to be interrupted when the ELD is properly addressed. Each ELD is given a unique address. The protocol further defines that a "DLE" signal (10H) will precede the address byte. Thus, the EMS COMMUNICATION hardware uses the "DLE" to "wake up" the UART RCV CHAR (received character) interrupt circuit. The signal as received by the UART **U48** causes the "RXRDY" pin to go "HIGH." This signal triggers the multi-vibrator **U53A**, causing 1Q to create a one hundred and eighty-one (181 ns) nanosecond positive (+) pulse. This will be enough time to send the **/UARD** signal (through the NOR gate **U51C**) to the UART **/RD** pin, thus putting the received byte on the **XD0-XD7** bus pins. This byte is then compared to "10H" via the comparator **U33**. If a match is detected, **/Y** of the comparator goes "LOW," allowing the "RXRDY" signal from the UART to be sent to the CPU on the reception of the next (address) byte. If the CPU detects that the next byte is its address, it will continue to receive bytes. If the address does not match, or in the case that communication is over, the CPU will re-mask the interrupts by clearing the D-latch **U47A**. A break detect ("BRKDET") from the UART will also trigger the interrupt, /INT0. The CPU must read a special byte in the UART to determine which interrupt has occurred.

INT1 for the CPU is simply the vertical sync (VS) to the ELD. This provides some critical timing to the software of the board. INT2 is received from the UART when a byte, which has been sent to the UART for transmittal by the CPU, is finished being processed. INT3 is sent by the remote station interface board when the RSL has completed a communication cycle.

The portion of the board which must format the pictures for the ELD is coordinated by the video storage and display device (VSDD) **U31**. This device accepts commands from the CPU in order to coordinate video activity. A detailed description of the VSDD is available in Microprocessor and Peripheral Handbook. Vol. II (INTEL Corp., Santa Clara, CA, 1988).

Features of the VSDD which affect the ELD interface board design are:

o the VSDD provides a sixty-four (64) KB window for the CPU on the two hundred and fifty-six (256) Kwords (512 KB) of memory which it manages;

o the VSDD has an external clock and can insert "WAIT" states on the CPU access cycles to the VSDD;

o the CPU has access to a control block in the VSDD (this control block allows the CPU to set up the video timing and video memory management parameter);

o DRAM (dynamic memory) is used for video memory; and

o video signals provided by the VSDD are cathode ray tube (CRT) compatible and are based upon an external video clock frequency.

The VSDD is connected directly to the CPU multiplexed "ADDRESS/DATA BUS." The address latch signal "ALE" is provided such that the busses are de-multiplexed internally. Sixteen bits of address are used. Hence, a sixty-four (64) KB window is provided to the CPU. The pin **A16** of the VSDD is used by the CPU to select the device which resides in its memory space, as explained above with respect to **Figure 9**.

Sixteen, word wide VSDD memory locations are programmed by the CPU to begin proper operation of the device. These registers are explained in detail in Microprocessor and Peripheral Handbook, Vol. II, *supra*. Among the parameters which affect the hardware are the type of DRAM used (*e.g.*, 64 K X 4 bits), the video signals format (*e.g.*, non-interlaced, digital signals), the horizontal and vertical sync timing generation parameters, and the video clock basis (*e.g.*, an external oscillator **U30**, 12 MHz).

The VSDD is constantly refreshing the DRAM and sending out the proper video signals. An oscillator **U29** of, for example, ten (10) MHz is used to control internal VSDD task timing. (The VSDD generally will not operate properly under 10MHz due to the time required to set up and display objects on the screen.)

Interlaced with these tasks, the VSDD allows communication with the CPU. If communication can not be serviced, the VSDD can "hold" the CPU by inserting a "WAIT" state (extending the read or write cycle), until the VSDD is no longer busy.

Sixteen 64 K X 4 DRAM chips are used to provide the 256 Kwords of video memory to the VSDD. This allows patterns to be stored in memory which may not be shown on the screen. However, because they reside in DRAM, it is possible to switch the display to them quickly.

The DRAM refresh task is handled by the VSDD, which uses its 10 MHz task clock and the CPU programmed parameters to accomplish the refresh function. The D-latch **U23A** and the multiplexers of **U9** are used to decode the refresh signals to the memories.

Video signals emitting from the VSDD are in a format suitable to run a cathode ray tube (CRT). An electroluminescent display requires slightly different timing. The signals are therefore conditioned by combinational logic to yield the correct timing. A contrast of the CRT signals versus the ELD signals is graphically shown in **Figure 12**.

The video clock signal "CLOCK" (the output of the 12 MHz oscillator **U30**) is passed through two inverters (**U54A** & **U54B**), before being sent to the ELD glass connector **J5** as "VCLK." This provides enough delay so that the video signal "VID" will be valid at the rising edge of the "VCLK." It should be noted that "VID" is derived from the "VIDEO" directly out of the VSDD. The "VIDEO" is sent through an "EX-OR" gate with the CPU generated signal "INV" which allows the "VIDEO" signals to be inverted if the "INV" signal is set "LOW."

"HSYNC" from the VSDD must become the "HS" for the ELD. Two 8-bit counters (**U59** & **U62**) are cascaded in parallel to provide a sixteen (16) bit counter. Sixteen bits are needed since "HS" must go "LOW" six hundred and eighty (680) clock pulses after "HSYNC" goes "HIGH." This will insure that the six hundred and forty (640) bits of "VID," which occur before "HS" goes "LOW," will be latched in as a line of video for the ELD.

The lower significant bits of the preloadable counter **U59** are manually programmable. This is because the specifications of the VSDD show that there may be a clock pulse delay from the assertion of the "HSYNC" signal from where it is expected in the video cycle time frame.

"VSYNC" from the VSDD triggers the counter **U56** to count down from three (3). On the fourth "HS" pulse detected, the first line of one complete frame will be valid. Thus, the video sync (VS) is derived for the ELD.

Raw video signals (HSYNC, VSYNC, and CLOCK) are boosted by the buffer **U60** and sent to the connector **J6**. The signal VID is also buffered and sent to **J6**. This connector allows the video to be sent to the video transmitter board (VTB), which can process the signals and send them over, for example, twenty-five (25) feet to a remote glass in the elevator cab to a video receiver board (VRB), as generally illustrated in **Figure 7**, which board preferably is mounted on the back of the remote EL screen. As configured, this remote glass will show the same information as the glass connected directly to the ELD interface board.

The ELD interface board preferably is packaged in a unit along with the ELD remote station interface board, which mounts piggy-back to the ELD interface board via connectors **J1** and **J2**, as generally shown in **Figure 15**. Appropriate standoffs are added to give further support.

When the ELD interface board is used as a hall display, it is mounted in the wall with the glass preferably being the only visible portion of the entire ELD system which can be seen by the passengers. The glass and boards preferably are packaged in a steel box with the chime speaker, as illustrated in **Figure 15**.

When the ELD is used as a car display, the board set is located inside the elevator cab behind the car or cab operating panel (COP). The boards are accessed by opening the COP panel.

For power the ELD interface board requires:

+5 volts + 5%, 1.5 A.

+12 volts + 10%, 4 A.

Power enters the ELD interface board via connector **J4**. This connector accommodates, for example, "14 AWG" wire from the power supply that is either mounted at the top of the cab, or inside the hoistway. No local regulation of the power is required, but filtering of the +5 volts is provided by capacitor **C65**. The +5 volts is used by the ELD interface board for its logic functions. +5 volts is sent to the connector **J6** for use by the video transmitter board logic. Both +5 volts and +12 volts are sent to the connector **J5** for use by the EL display and to connector **J7** for use by the video receiver board (VRB), which may be located up to twenty-five (25) feet from the ELD interface board.

The ELD interface board typically will be tested and assembled at the factory in its final configuration for the field site. DIP switch **SW2** controls various test and indication parameters. The functions and final settings are:

o **SW2-1**: This switch controls the functions of **LED1**, **LED2**, **LED4** and **LED5**. When this switch is "OPEN" (1), **LED1**, **LED2**, **LED4**, and **LED5** are used to show the results of tests which run at power up. If all tests have passed, **LED1** and **LED5** blink alternately with **LED2** and **LED4**. If the switch is "CLOSED" (0), **LED4** indicates the presence of interrupts from the RSL, and **LED5** indicates the "VSYNC" interrupt from the video circuitry. This switch can be left open or closed.

o **SW2-2**: This switch allows a full on screen to be displayed when the switch is "CLOSED" (0). It is used to test the ELD glass to insure that all pixels are being activated. It should be left "OPEN" (1) for installation.

o **SW2-3**: This switch allows the UART port to be tested on power up when the switch is left "CLOSED" (0). It should be left "OPEN" (1) for installation.

o **SW2-4**: When this switch is "CLOSED" (0), initial power up tests are run. The switch should be left "OPEN" (1), so that tests will be bypassed on power up at installation.

o **SW2-5** to **SW2-8**: These switches are spares.

DIP switch **SW3** contains configuration parameters. Specifically, the settings are as follows:

o **SW3-6** to **SW3-1**: These six bits are set to the ELD's binary address used for EMS communication. **SW3-6** is the MSB. An "OPEN" switch represents a "1" and a "CLOSED" switch represents a "0".

o **SW3-7**: This switch is unused.

o **SW3-8**: This switch determines whether the display is to be configured as a "HALL" display or a "CAR" display.

Initial adjustment requires setting DIP switch **SW4** such that the correct timing of the horizontal video is set on the screen. Initially, the setting should be at "10100111".

Jumper **JMP1** should be in position "1" and "2", and jumper **JMP2** should be installed.

Once these initial settings have been made, no further adjustment of the ELD interface board are required. No adjustment is necessary over the life of the board.

Thus, the ELD of the present invention allows for the use of a single hardware system with built-in flexibility that allows the same basic hardware to be used for basically any elevator application.

LED3 (green) is provided to indicate that the processor is running and is not in a "RESET" state. **LED1**, **LED2**, **LED4** and **LED5** (red) are used by the software to show that the CPU is executing various functions, the operation of which has been explained *supra*. Using these LEDs, a field mechanic can determine whether any problems are originating from the ELD interface board, the RS interface board, or such things as the power coming into the board.

Production test features of the ELD interface board are embedded within the CPU for internal self-testing at power up. DIP switches are provided to further guide the software to determine what test mode is desired. Produc tion testing can consist of providing signals to the connectors which allow the ELD interface board to communicate with the ELD RS interface board and the EMS (RS485/422).

Although this invention has been shown and described with respect to detailed, exemplary embodiments thereof, it should be understood by those skilled in the art that various changes in form, detail, methodology and/or approach may be made without departing from the scope of this invention.

Claims

1. An elevator informational display system for displaying information to passengers pertinent to the status of an elevator car in an elevator system, which elevator system has a main processor which processes informational data including the direction and location of the elevator car, **comprising**:
an electroluminescent (EL) display screen having a matrix of pixels which in operation are either "on" or "off" producing varying, relative darkened and lightened areas on the screen located in association with the elevator car displaying information pertinent to the status of the elevator car, including at least the car's direction in a graphical display and its floor location in a numerical display; and
an electroluminescent display interface board connected between said display screen and the main processor and communicating through electrical signals with the main processor for the elevator system and providing display command information through electrical signals to said EL display screen based on data on the car's status received from the main processor.

2. The EL elevator display system of **Claim 1**, wherein:
the information displayed by said EL screen includes a car direction indicator in the form of an isosceles triangle-like graphical figure, the apex of which is pointed in the direction of car travel, with some of the same area of the EL screen display being used for both the "up" and the "down" indicator.

3. The EL elevator display system of **Claim 2**, wherein:
said triangle-like graphical figure is animated, blinking "on" and "off" varying between being darkened and lightened in rapid succession.

4. The EL elevator display system of Claim 1, 2or3 wherein:
the information displayed by said EL screen includes a car floor position floor indicator in the form of a numerical display.

5. The EL elevator display system of any preceeding claim, wherein:
the information displayed by said EL screen includes a graphical representation of relative position of the car in the hoistway in the form of a segmented, vertically elongated rectangle, with the relative position being indicated by darkening an area of the rectangle proportionally equivalent to the analogous floor position of the car within its total travel distance.

6. The EL elevator display sytem of any preceding claim, wherein:
the information displayed by said EL screen includes a jewel including building related information.

7. The EL elevator display system of **Claim 6**, wherein:
said building related information comprises building directory information, including a floor location different from the main floor landing.

8. The EL elevator display system of claim 6 or 7, wherein:
said building related information comprises building information, including an advertising message.

9. The EL elevator display system of any preceding claim, wherein:
the information displayed by said EL screen includes channeling information, including a range of floors to which the car is assigned to, with the floor information being displayed in numerical form.

10. The EL elevator display system of any preceding claim, wherein the elevator system includes an elevator management/monitoring system (EMS) and a remote station link; and wherein:
the information displayed on said EL screen is controlled from two sources through said interface board -
- the elevator management/monitoring system (EMS), with the EMS communicating commands and data to the interface board via a communications link through electrical signals, the commands from the EMS causing the EL display screen to display building related information, and
- a remote station link (RSL), the interface boards receiving display information (discrete and data) from the RSL, providing through electrical signals the information required for the EL display screen to display the elevator related information.

11. The EL elevator display system of any preceding claim, wherein said display interface board and said display screen together form part of an EL display (ELD) and further comprise:
an ELD glass (screen),
an ELD interface printed circuit board (PCB) mounted behind the glass, and
an ELD remote station interface PCB, directly connected to and mounted on the ELD interface PCB, with said glass and said interface PCBs mounted together in a combined framing structure.

12. The EL elevator display system of **Claim 11**, wherein there is further included:
an ELD power supply assembly located in a separate enclosure spaced from said combined framing structure but located within about twenty feet (6.1m) of said combined framing structure.

13. The EL elevator display system of claim 11 or 12 wherein there is included a wall visible to passengers and associated with the elevator car in juxtaposition thereto; and wherein:
said glass is mounted on the outside surface of the wall, with said interface PCBs located behind the wall out of sight of the passengers.

14. The EL elevator display system of any preceding claim, wherein said elevator includes a

multiple number of elevator cars; and wherein there is further included at least two of said EL display screens, each with its own interface board, associated with each car:
one EL display screen located within each car of the elevator system and one EL display screen for each car located at the main floor landing.

15. The EL elevator display system of **Claim 14**, wherein:
each of said interface boards is selectably configurable for a car display and a lobby display, allowing the same hardware to be used in association with either of said EL display screens.

16. The EL elevator display system of **Claim 10** and claim 14 or 15 wherein the elevator system includes a travelling cable for each car and hoistway wiring to the lobby; and wherein:
the communication link from the EMS is brought down to the interface board in each elevator car through the travelling cable for each elevator car, and through the hoistway wiring for the lobby displays.

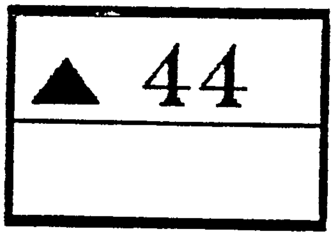
17. The EL elevator display system of **Claim 14**, 15 or 16 wherein there is further included:
an additional, remote EL display screen, associated with at least one of said EL display screens as the remote's primary screen and connected to its interface board, said remote screen concurrently displaying the same information as the primary screen and being located within about twenty-five feet of said primary screen.

18. The EL elevator display system of any preceding claim wherein:
said EL display screen displays both elevator related and separate, business related information, said business related information including fixed, jewel messages, the electrical signals representing the information being based on stored ASCII characters located in an easily removable PROM.

19. The EL elevator display system of any preceding claim wherein:
said EL display screen displays both elevator related and separate, business related information, with said elevator related information being displayed in the top, upper portion of the screen, and the building related information being displayed in the bottom, lower portion of the screen, with the upper and lower portions being divided by a horizontal line displayed on the EL display screen.

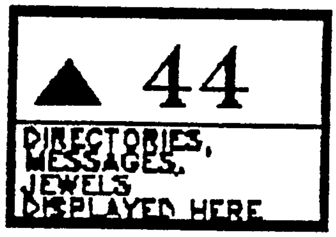
20. The EL elevator display system of any preceding claim wherein said interface board includes circuitry for displaying information and for receiving downloaded data required for later display commands.

21. The EL elevator display system of any preceding claim wherein the interface board has means for defining a unique address and circuitry responsive to data addressed to that board.



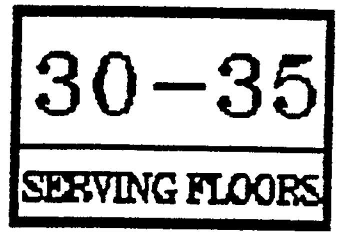
Default Display
(car)

FIG. 1A



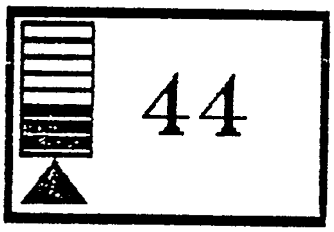
Default Display
with Directory/Message.

FIG. 1B



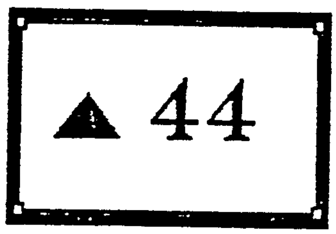
Channelling Display

FIG. 1C



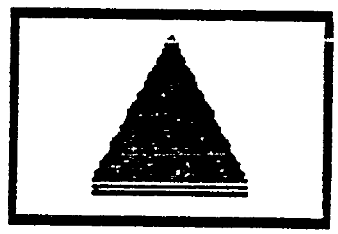
Default Display
(hall with EMS)

FIG. 1D



Default Display
(hall and no EMS)

FIG. 1E



Hall Lantern

FIG. 1F

ELD Display Configurations

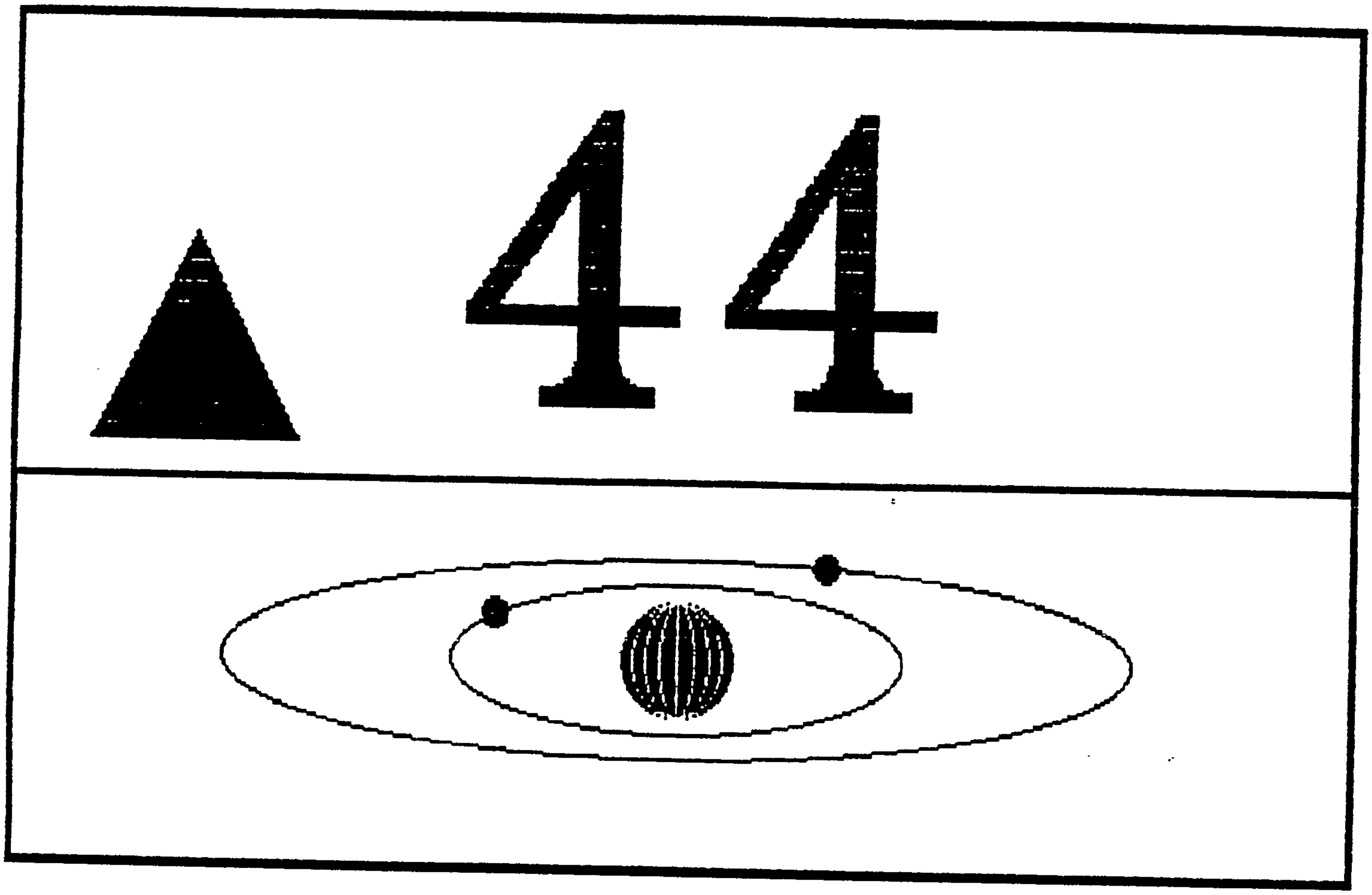


Figure 2

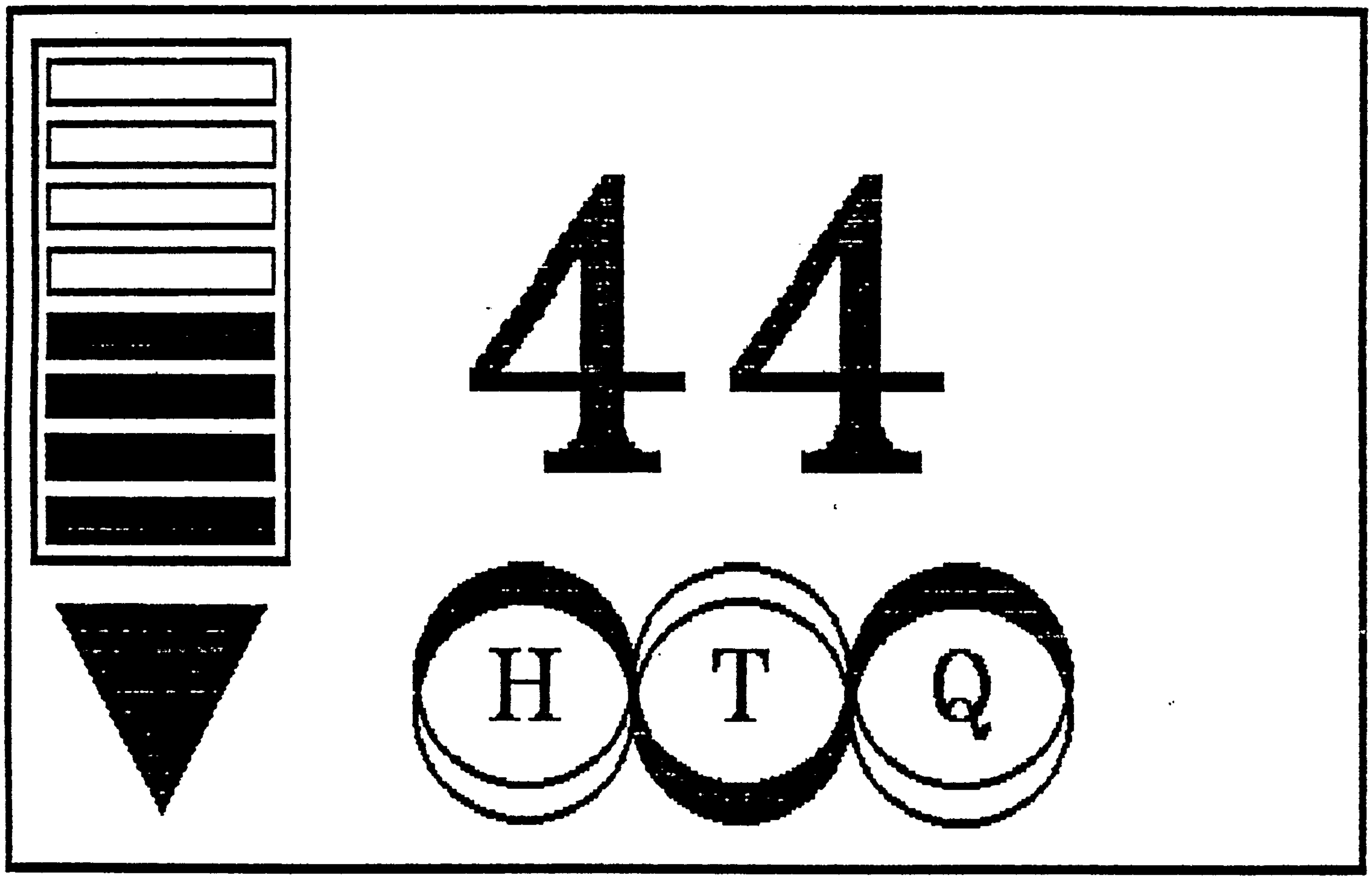


Figure 3

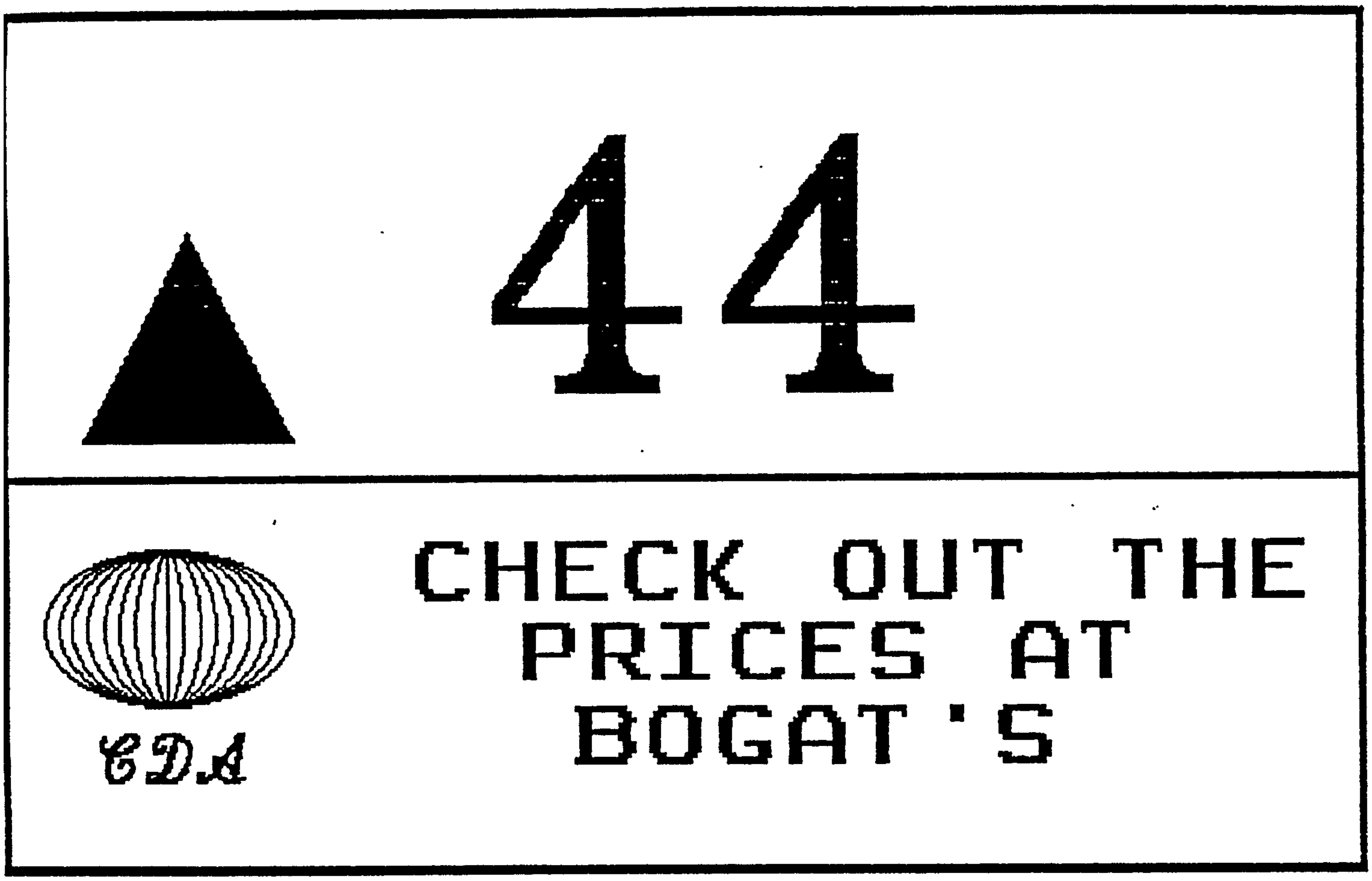


Figure 4

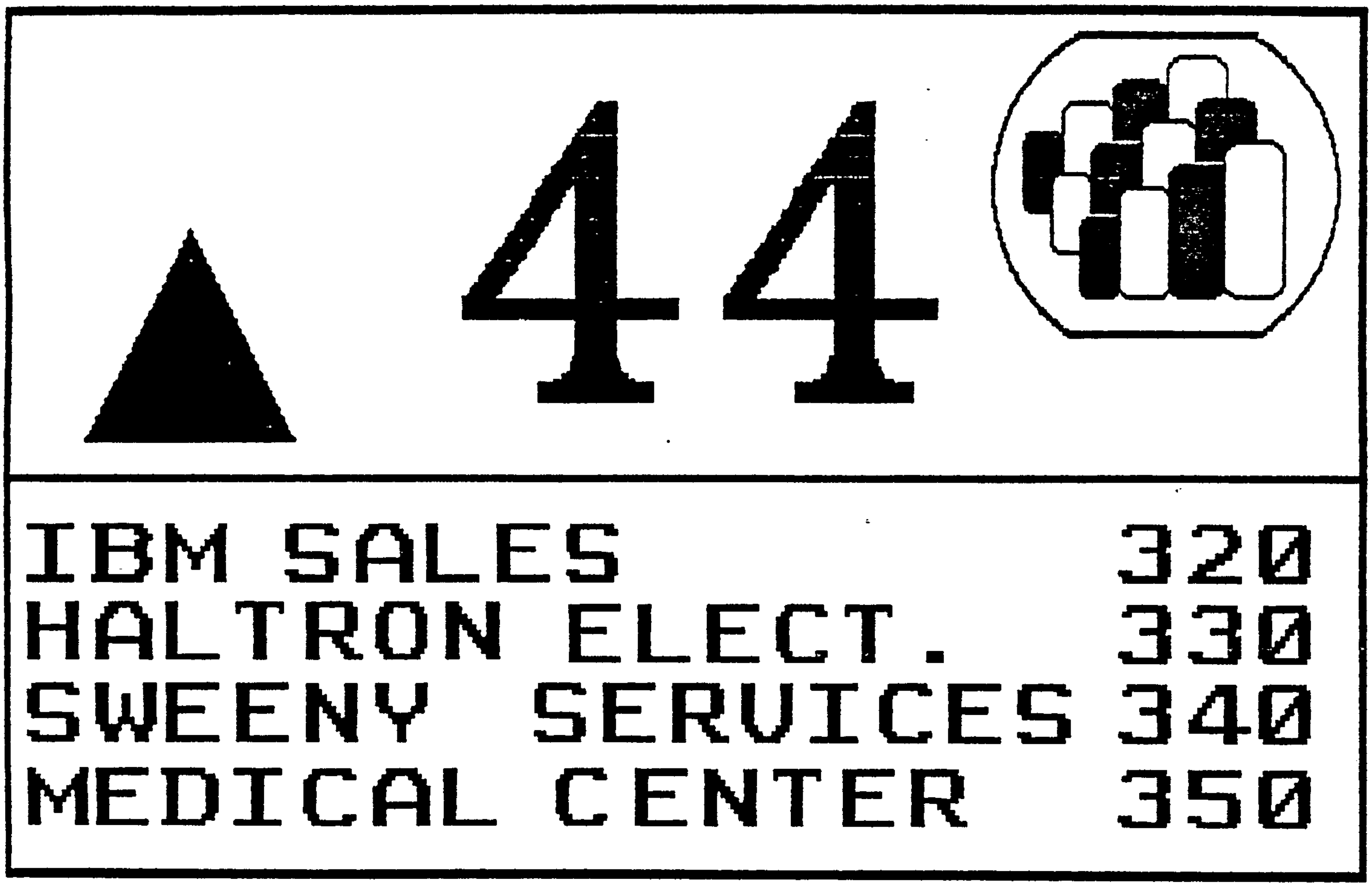

44
IBM SALES 320
HALTRON ELECT. 330
SWEENY SERVICES 340
MEDICAL CENTER 350

Figure 5

FIGURE 6 ELD FIXTURE FUNCTIONS REQUIREMENTS

DISPLAY COMPONENT	TYPE	DYNAMIC INFO. REQUIRED	DYNAMIC INFO. SOURCE	CUSTOM INFO. REQUIRED	CUSTOM INFO. SOURCE	WHEN DISPLAYED	WHERE DISPLAYED ON ELD GLASS	PRIORITY
C A R D I S P L A Y								
Position Indicator (DEFAULT)	FV	-level number -express zone indication	OCSS (RSL)	none	N/A	continuously except when in channeling mode at lobby	-location "B" -fixed config.	3
(SPECIAL)				special floor labels (stored at ELD infc bd)	-EMS at power up OR alternate setup device			
Direction Indicator (DEFAULT)	F	-distinct info for UP,DOWN	OCSS (RSL)	none	N/A	same as above	-location "A" -fixed config.	2
(OPTIONAL)		-animate arrow when car is stopped	EMS (RS422/485)			-also, arrow is in motion when car is stopped		
Jewels	F	-distinct info to select desired jewel	OCSS (RSL)	none	N/A	as directed by OCSS	-"C" and "D" -fixed config.	1
Channelling (static)	FV	-bottom level of service -top level of service	OCSS (RSL)	none	N/A	at lobby only	-"A" and "B" for floor numbers -"C" and "D" for message -fixed config.	2
(dynamic)			EMS (RS422/485)					
Floor Directories/ Information Display	V	-when to show information	EMS (RS422/485)	-directory for each floor -information display msg. (stored at ELD infc bd)	-EMS on power up OR alternate setup device	-at correspding floor stop -IF no chnling (at lobby) -IF no jewels	-"C" and "D" -fixed config. -max #dir/floor -max #char/dir -max #char/msg.	4

FIGURE 6 (continued) ELD FIXTURE FUNCTIONS REQUIREMENTS

DISPLAY COMPONENT	TYPE	DYNAMIC INFO. REQUIRED	DYNAMIC INFO. SOURCE	CUSTOM INFO. REQUIRED	CUSTOM INFO. SOURCE	WHEN DISPLAYED	WHERE DISPLAYED ON ELD GLASS	PRIORITY
L O B B Y D I S P L A Y								
Position Indicator	FV	-level number -express zone indication	OCSS (RSL)	none	N/A	continuously except when in channeling mode car is at lobby	-"B" and "D" -fixed config.	2
(SPECIAL)				special floor labels (stored at ELD infc bd)	-EMS at power up OR alternate setup device			
Direction Indicator	F	-distinct info for UP,DOWN	OCSS (RSL)	none	N/A	same as above	-location "C" -whole screen at car arrival	2
Hall Lantern (Car Arrival Indicator)	F	-car has arrived	OCSS (RSL)	none	N/A	when car has arrived	-whole glass -fixed config.	2
Relative Pos. Indicator	FV	-modify disp to show pos of car in hwy	EMS (RS422/485)	none	N/A	continuously except when car is in lobby	-location "A" -fixed config.	4
Channelling (static)	FV	-bottom level of service -top level of service	OCSS (RSL)	none	N/A	at lobby only	-"A" and "B" for floor numbers -"C" and "D" for message -fixed config.	3
(dynamic)			EMS (RS422/485)					

A-D= EL Glass locations:

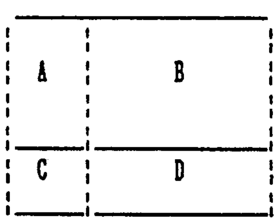


FIGURE 6A

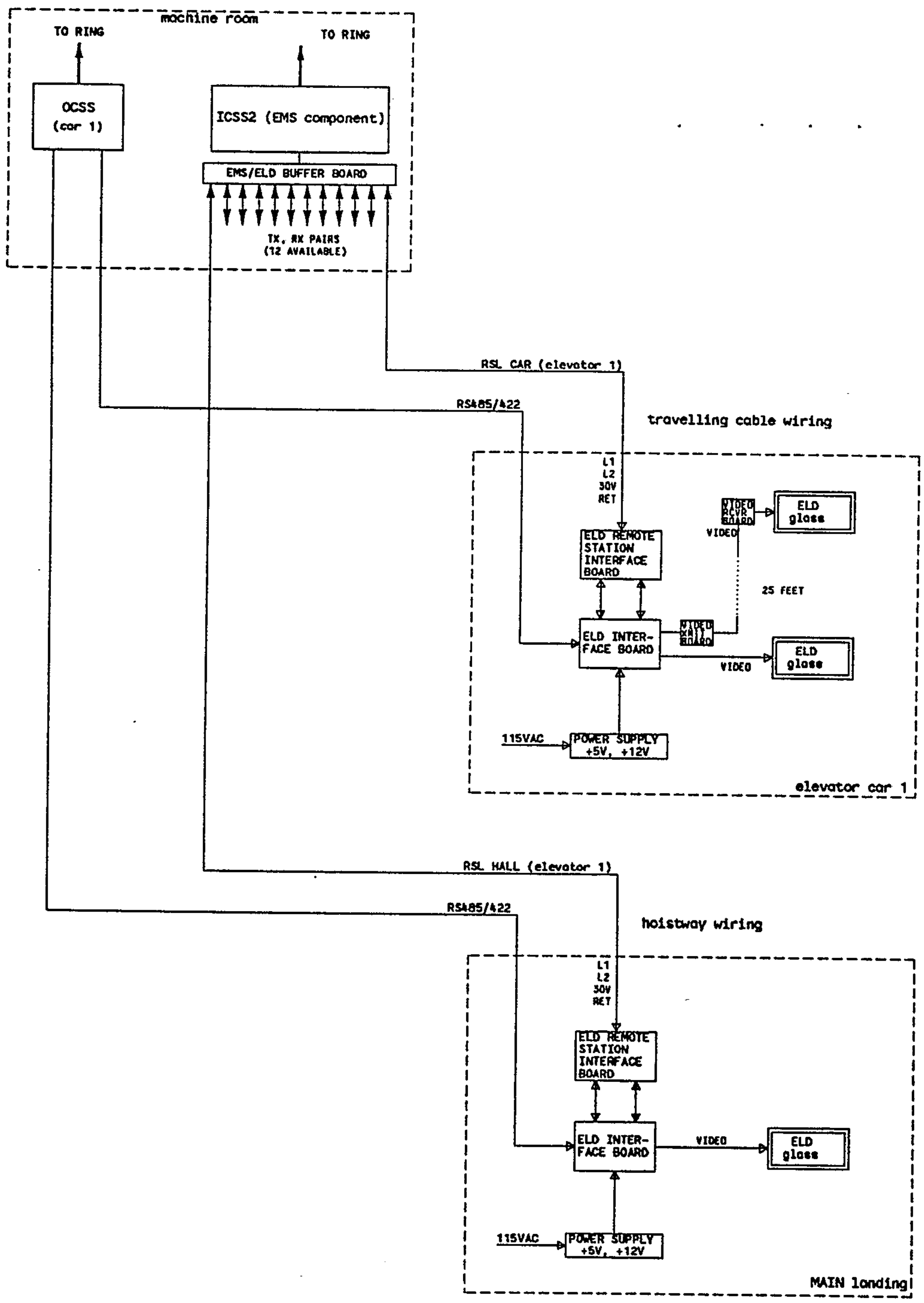


FIGURE 7 ELD SYSTEM BLOCK DIAGRAM

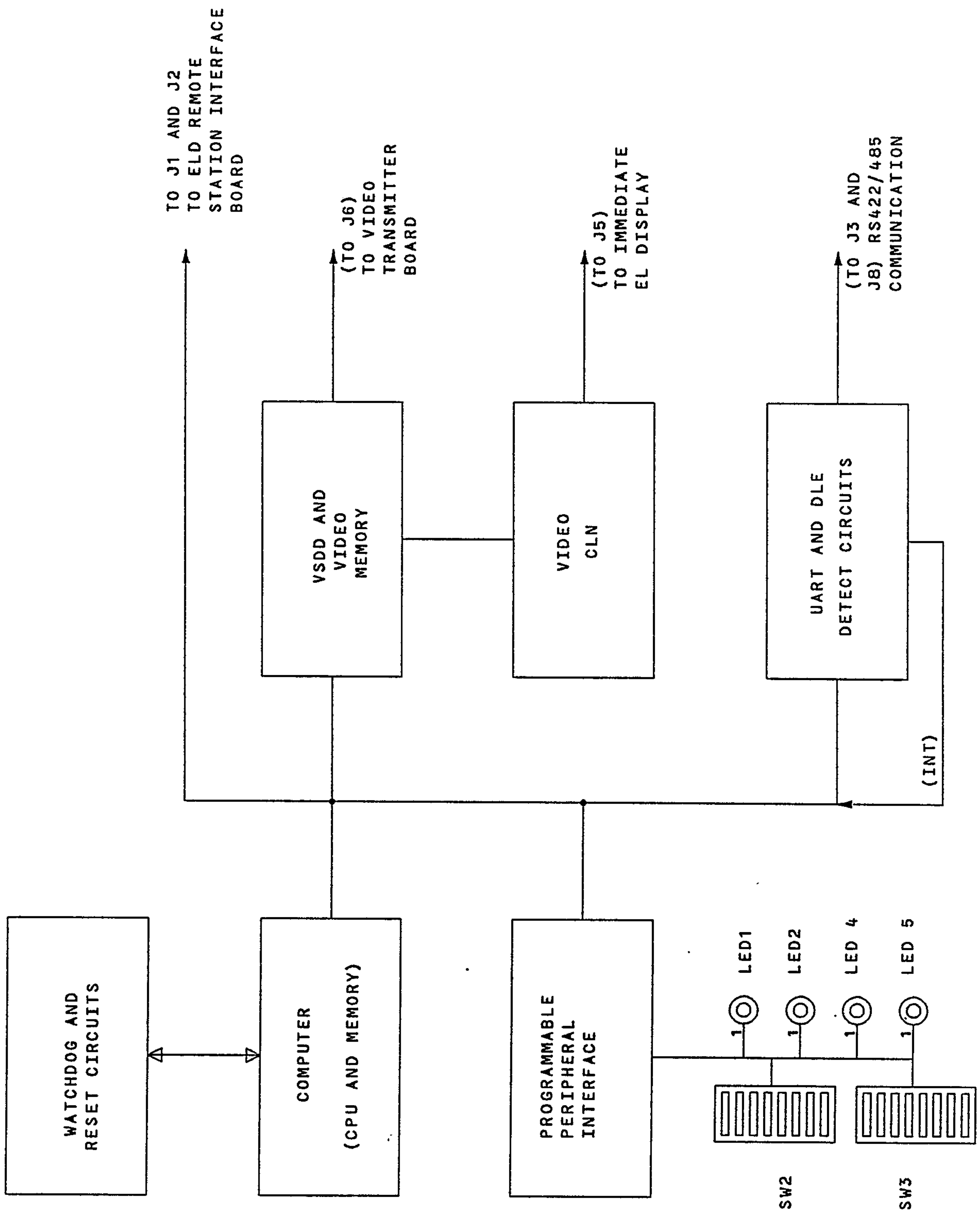


FIGURE 8 ELD INTERFACE BOARD BLOCK DIAGRAM

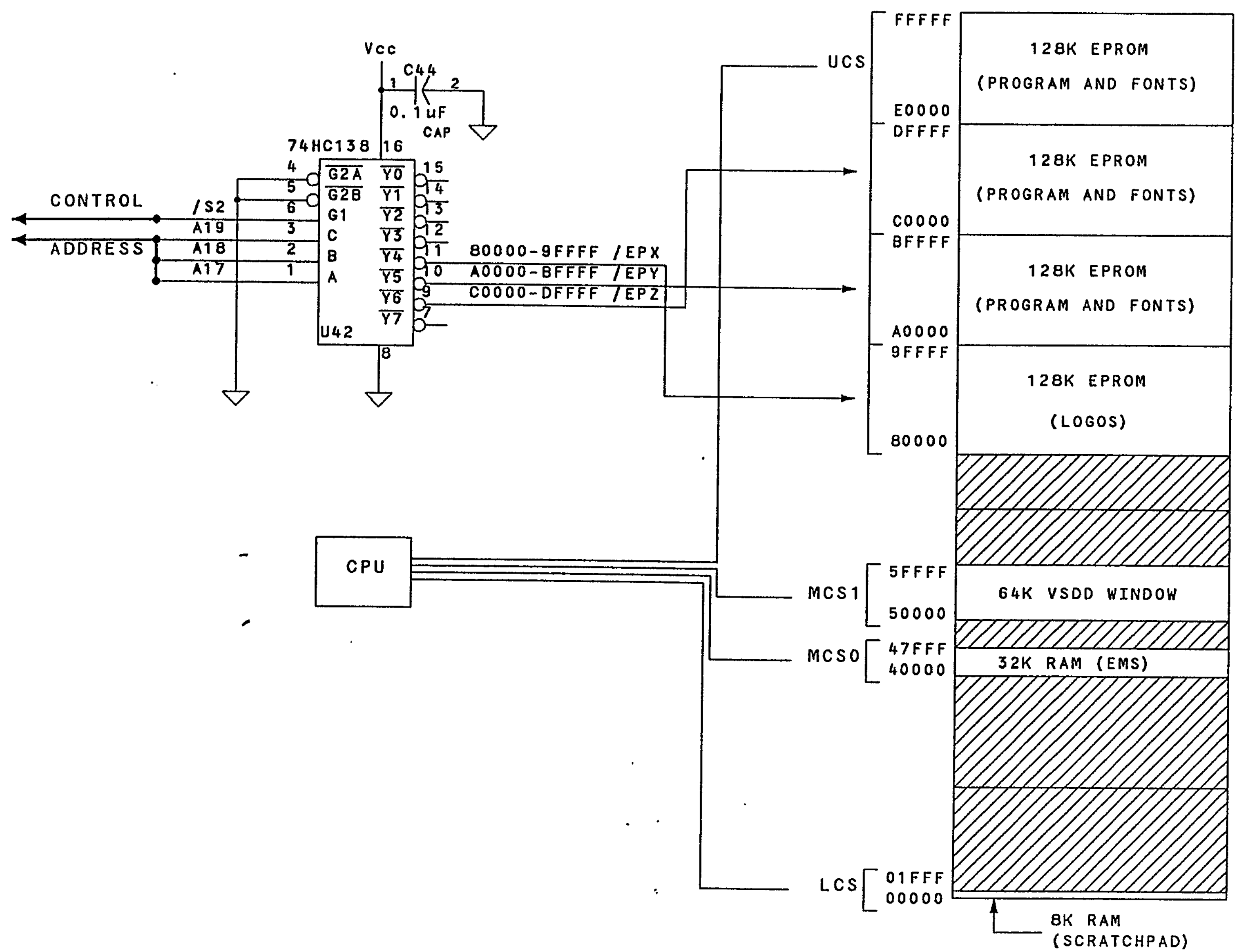


FIGURE 9 MEMORY SPACE

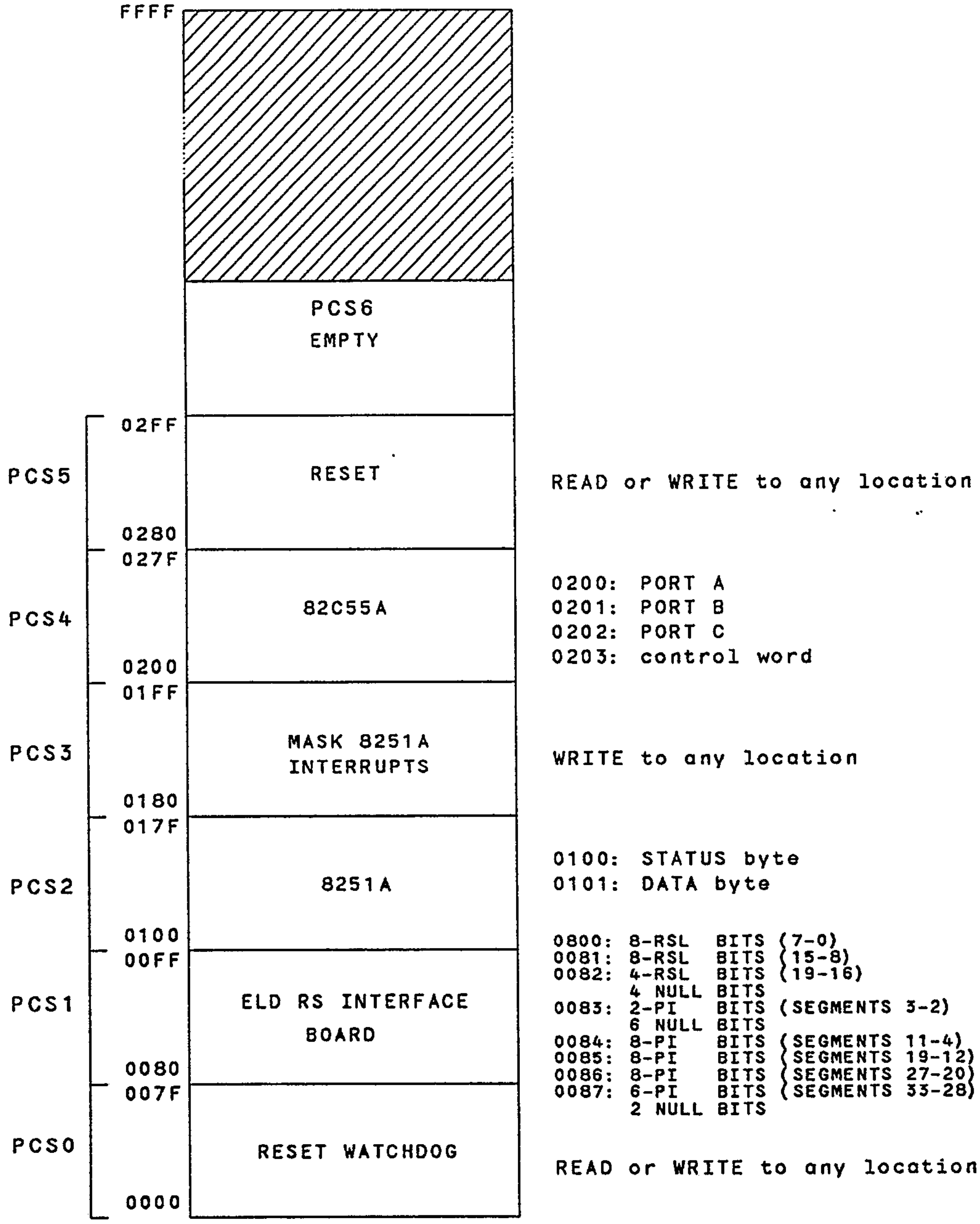


FIGURE 10 I/O SPACE

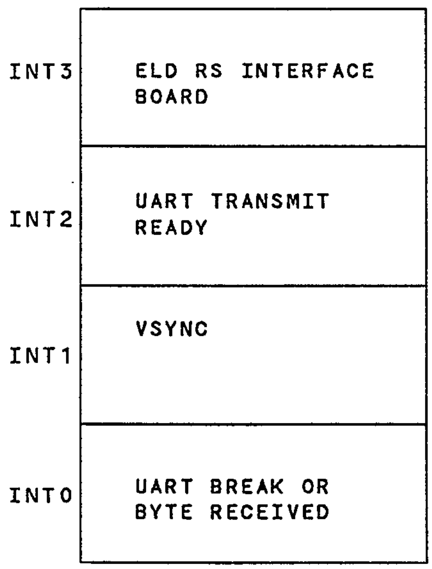


FIGURE 11 INTERRUPTS

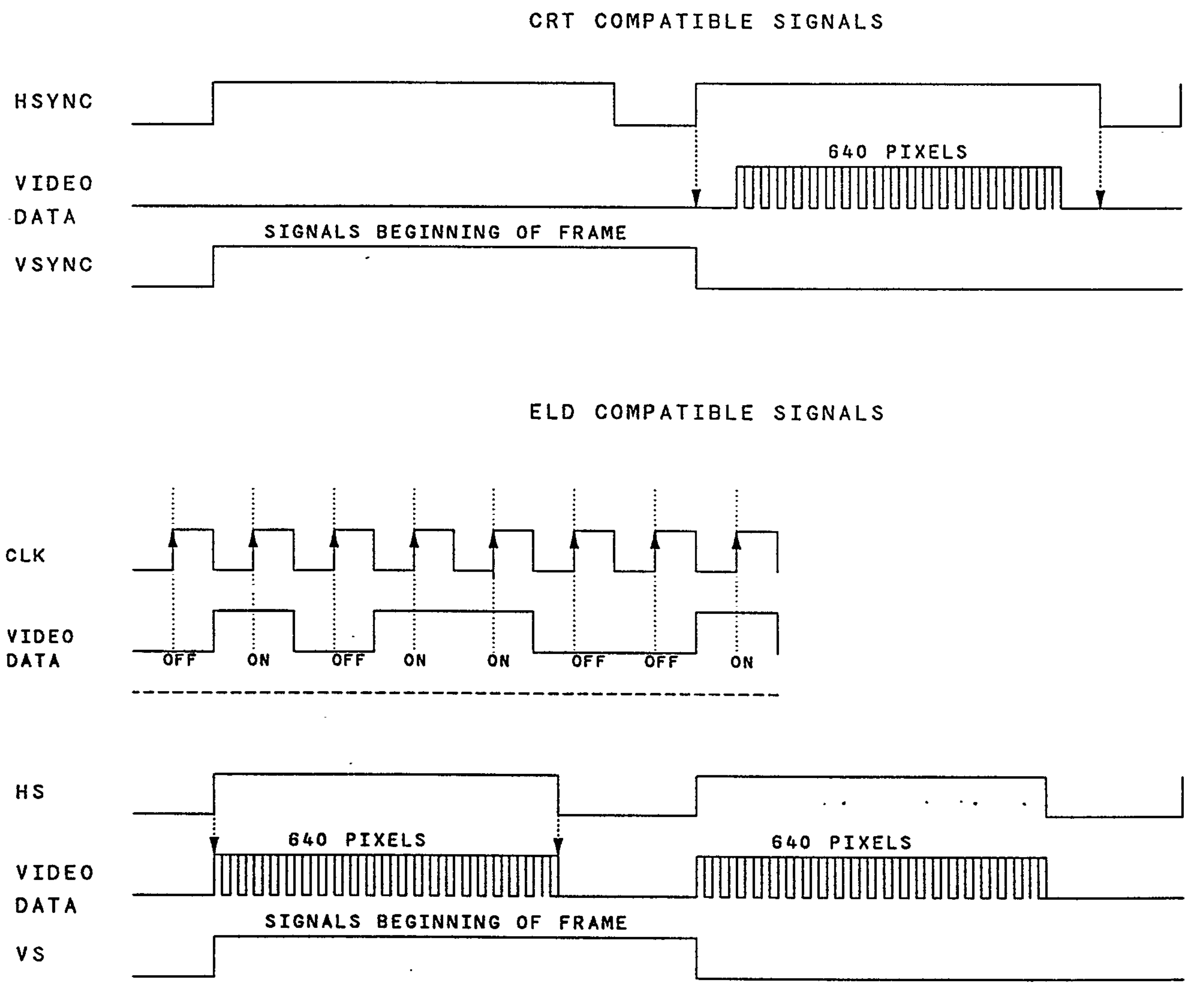


FIGURE 12 CRT SIGNALS VS. EL SIGNALS

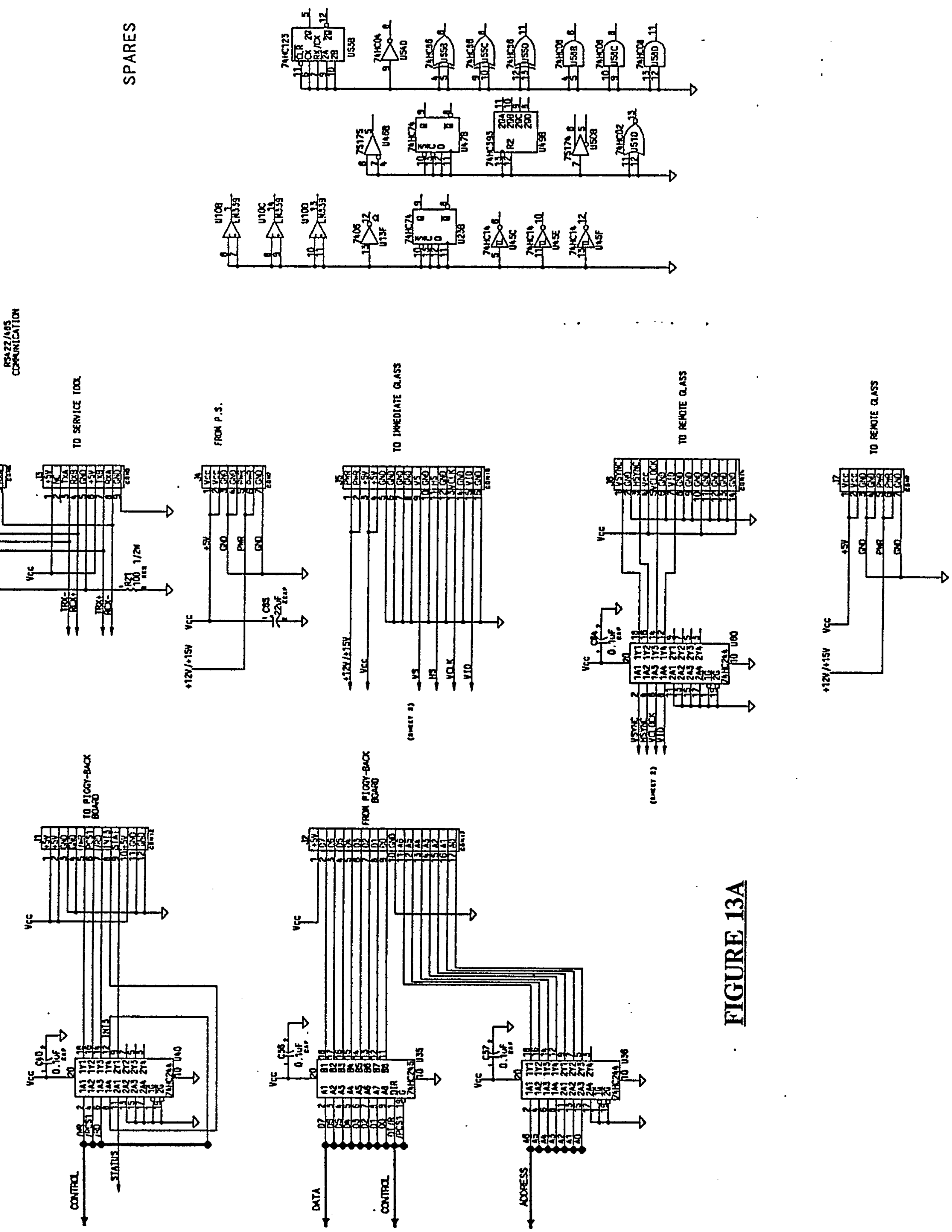

SPARES
RS422/485 COMMUNICATION
TO EMS
TO SERVICE TOOL
FROM P.S.
TO IMMEDIATE GLASS
TO REMOTE GLASS
TO REMOTE GLASS
TO PIGGY-BACK BOARD
FROM PIGGY-BACK BOARD
CONTROL
STATUS
DATA
CONTROL
ADDRESS
VCC
+12V/+15V

FIGURE 13A

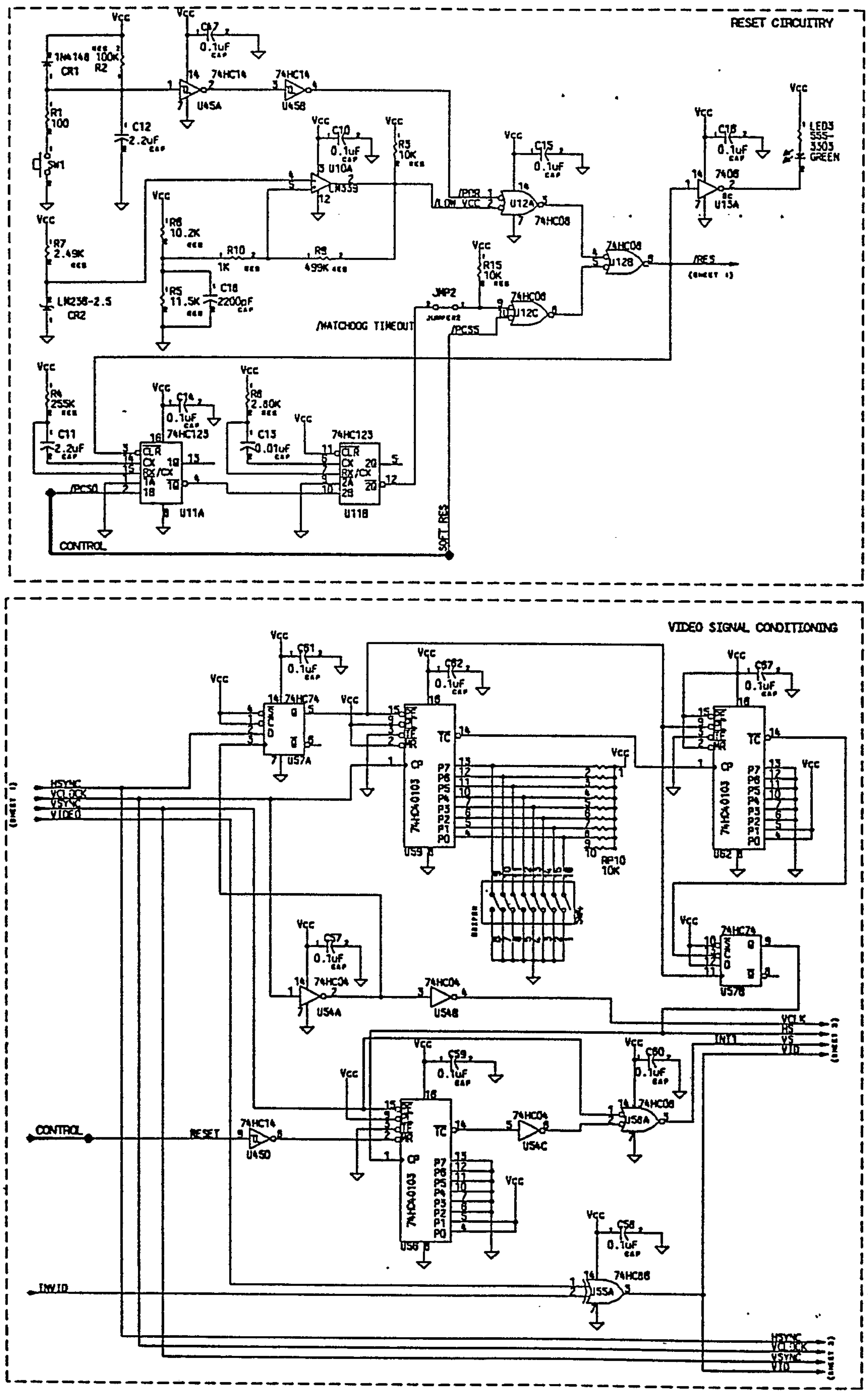


FIGURE 13B

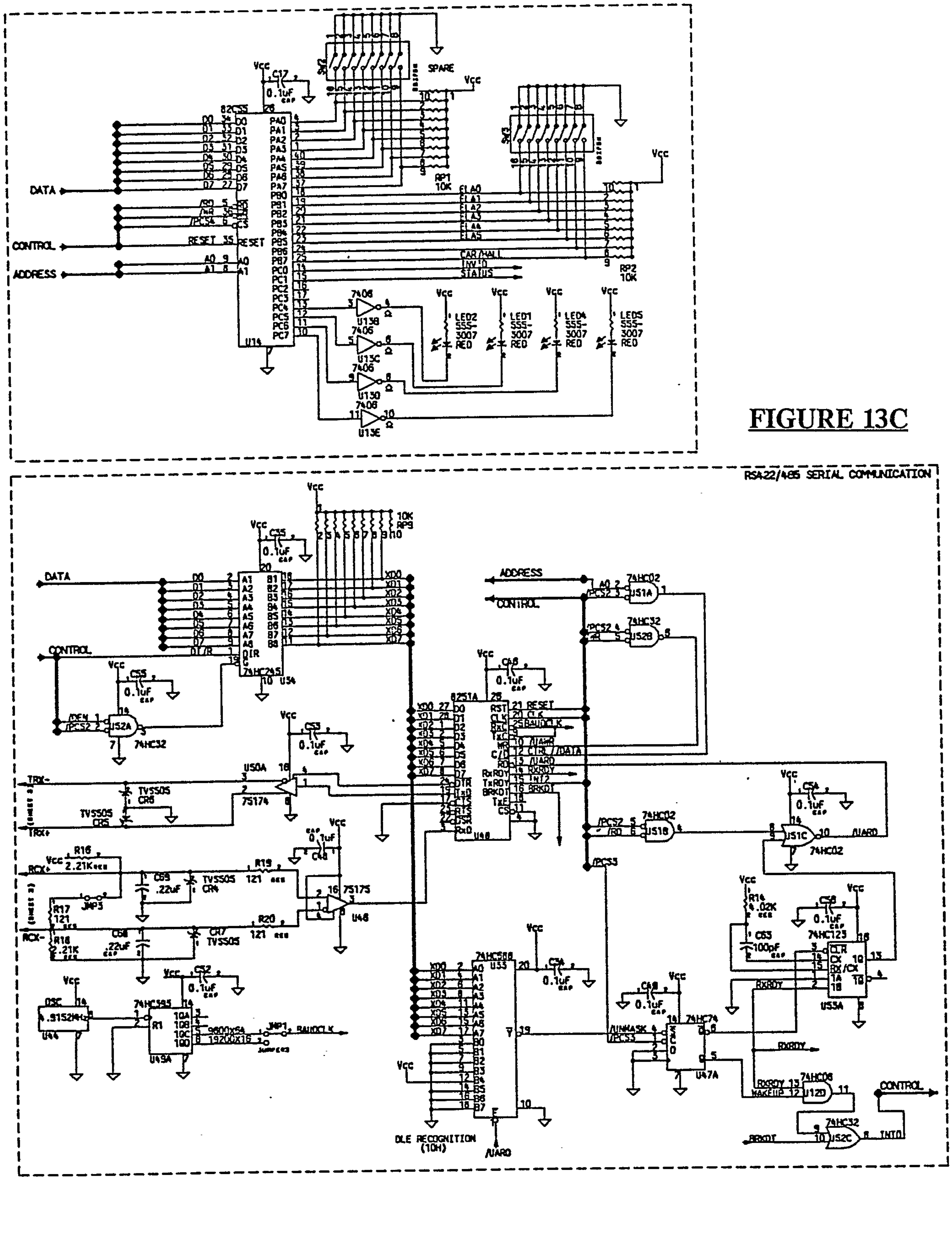

RS422/485 SERIAL COMMUNICATION
DATA
CONTROL
ADDRESS
DLE RECOGNITION (10H)

FIGURE 13C

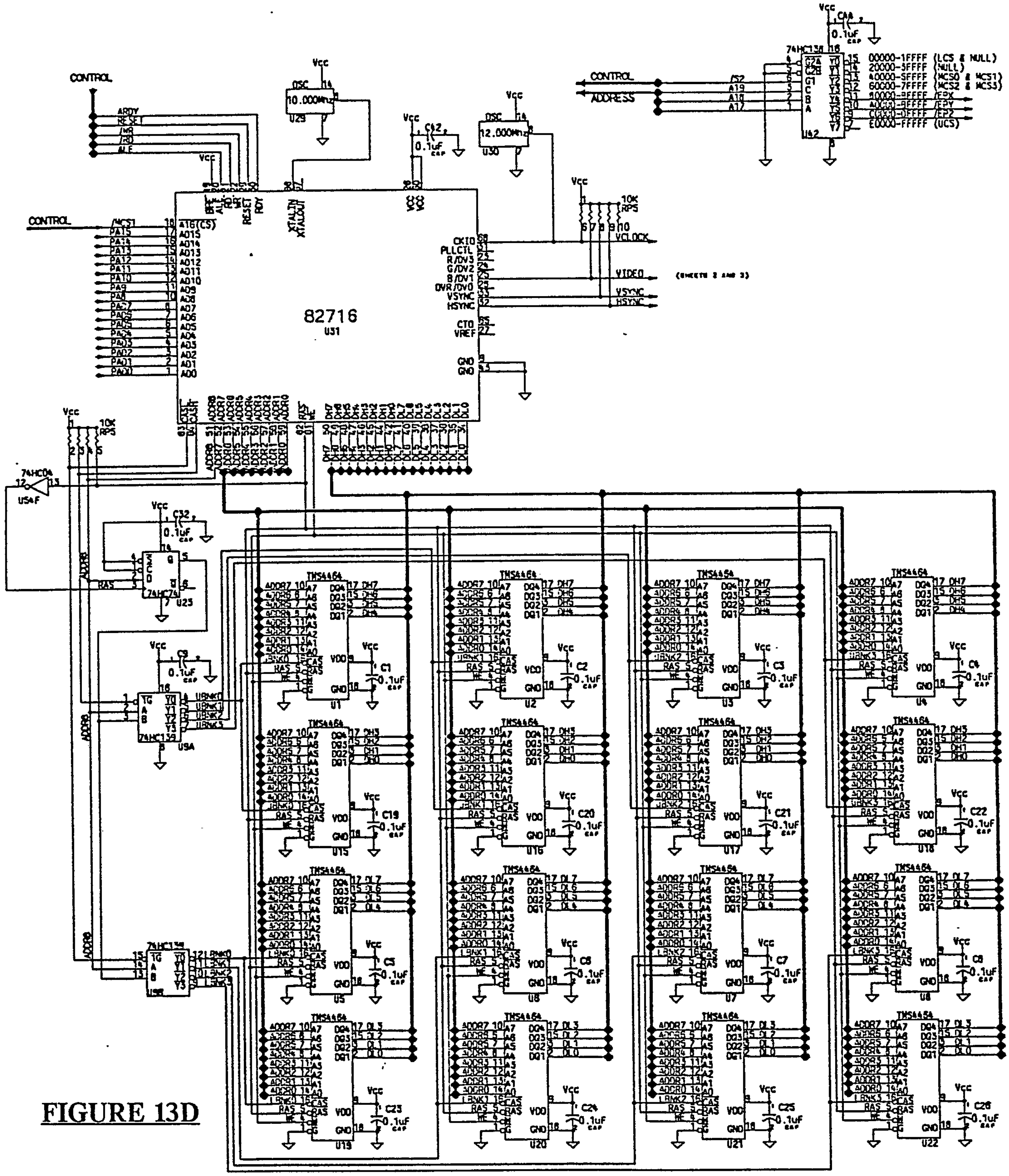

CONTROL
ADDRESS
82716
U31
74HC138
74HC74
74HC139
74HC04
TMS4464
VCLOCK
VIDEO
VSYNC
HSYNC
10.000Mhz
12.000Mhz

FIGURE 13D

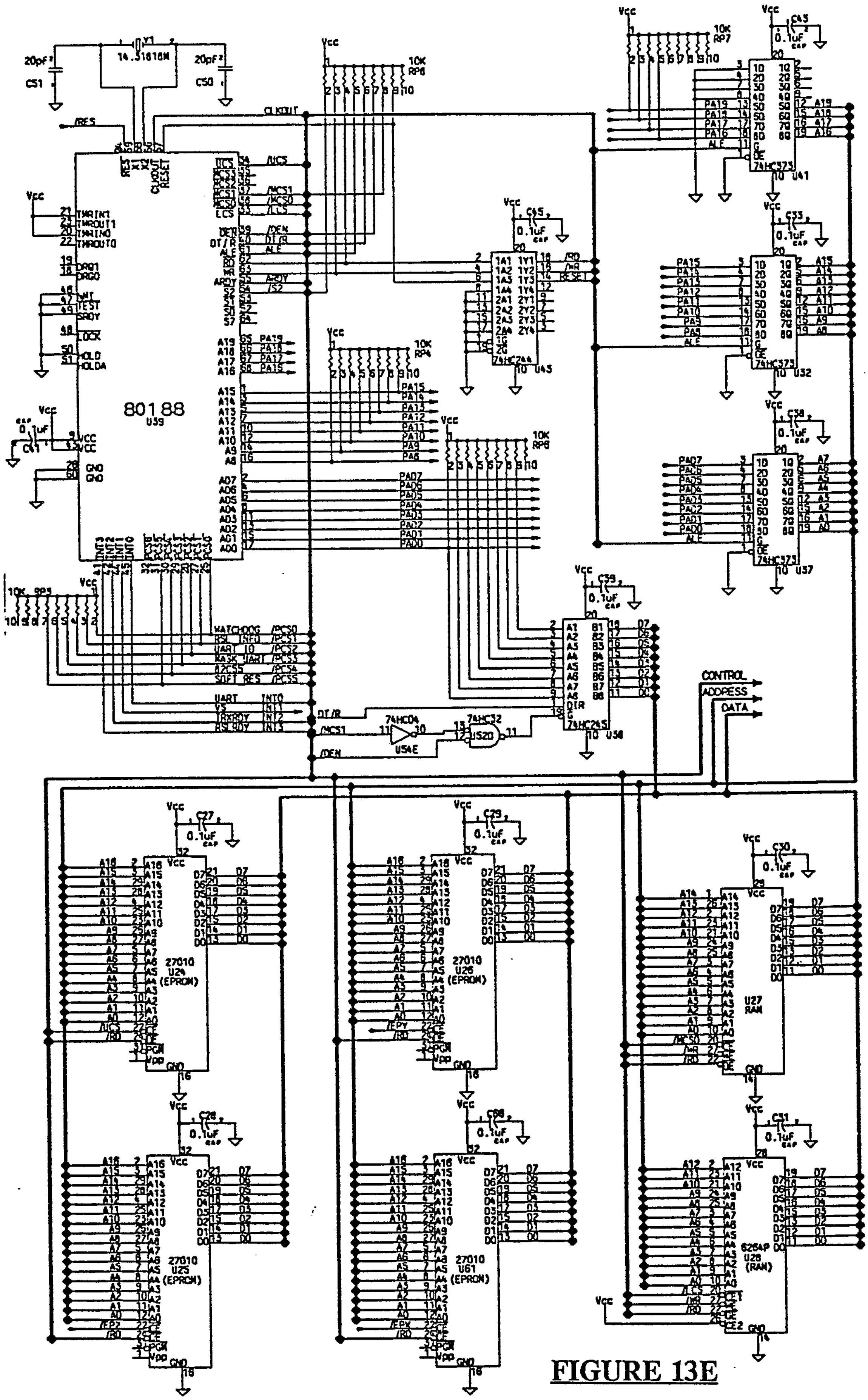


FIGURE 13E

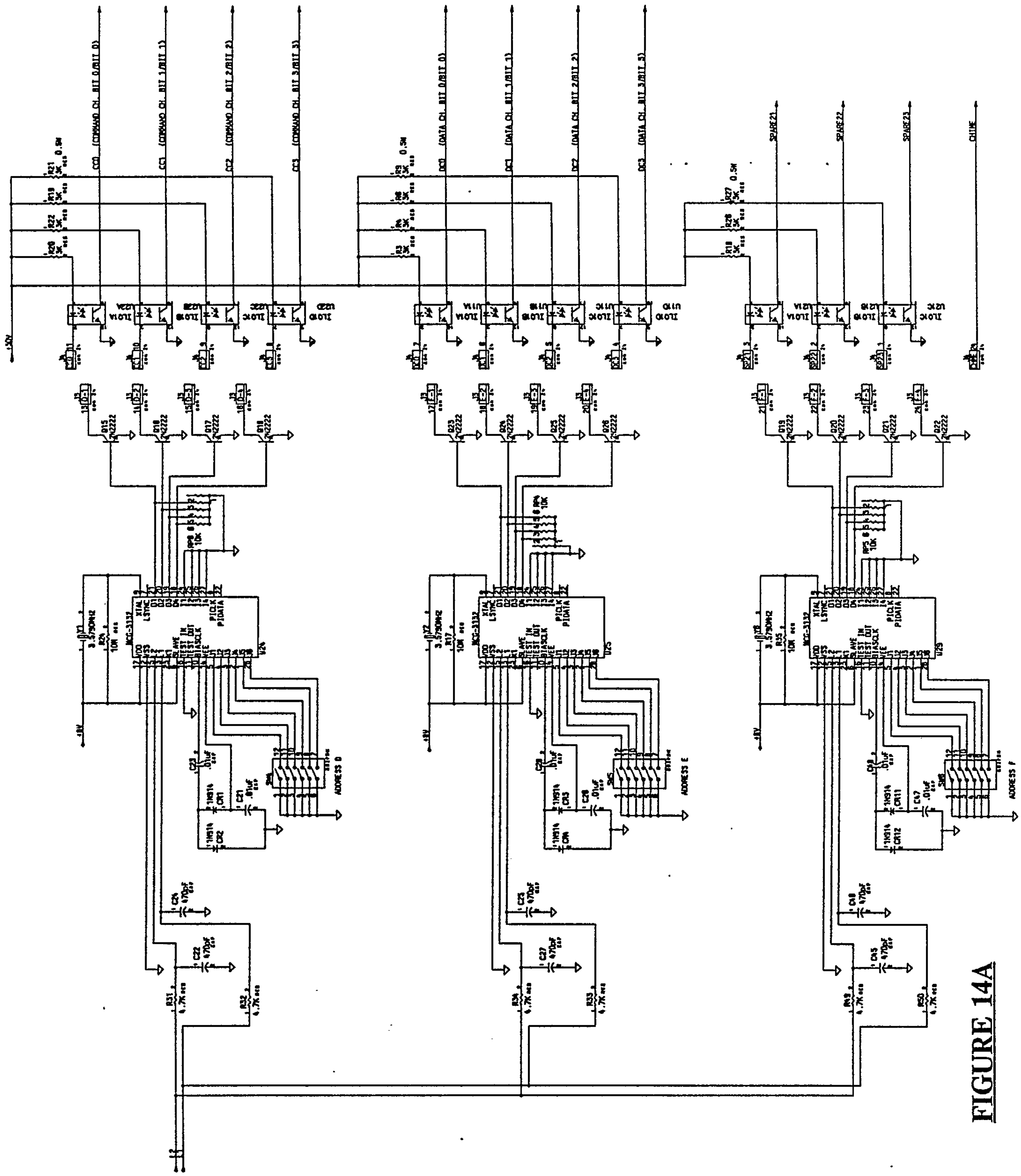

ADDRESS D
ADDRESS E
ADDRESS F
SPARE21
SPARE22
SPARE23
CHIME

FIGURE 14A

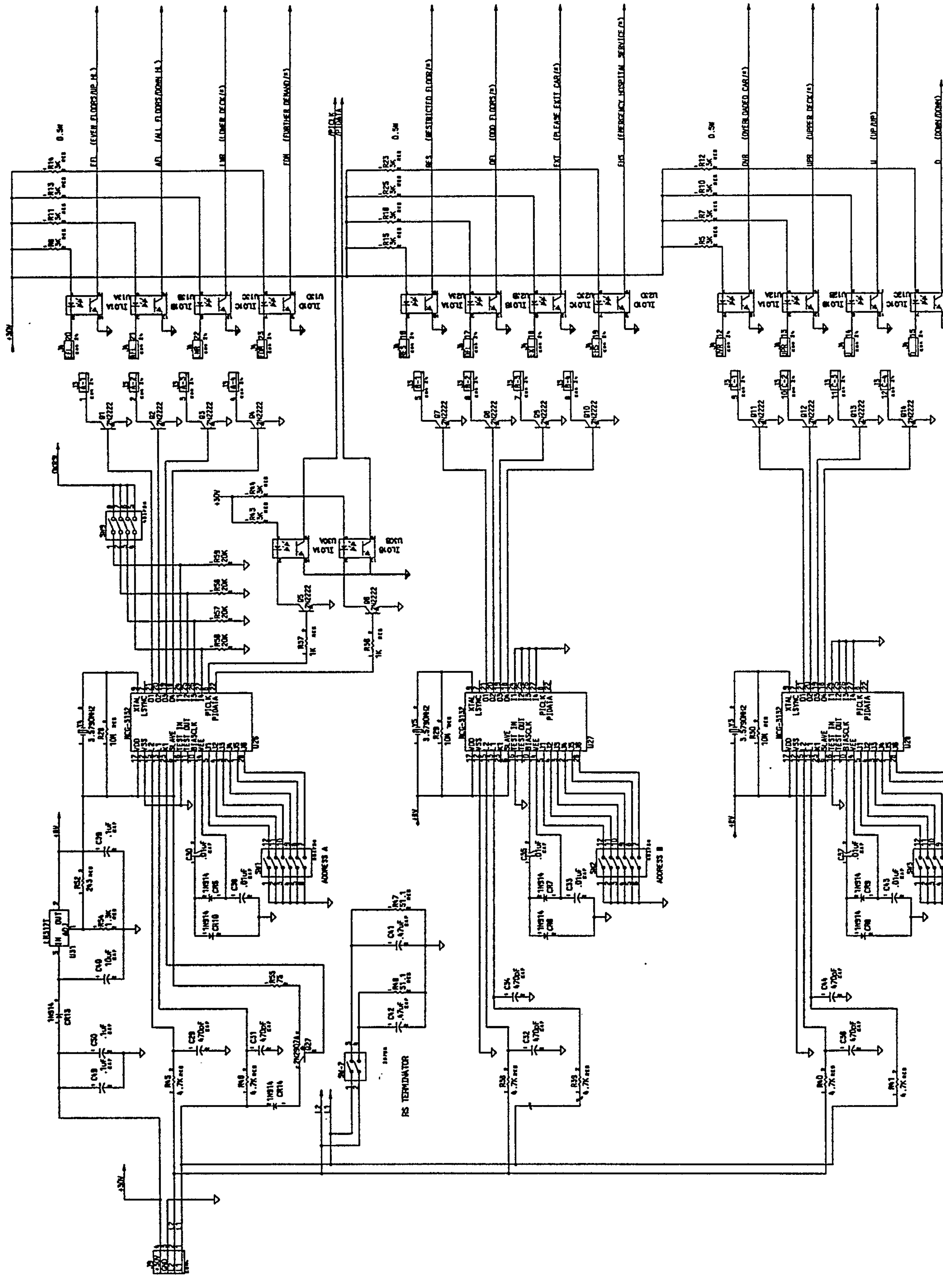


FIGURE 14B

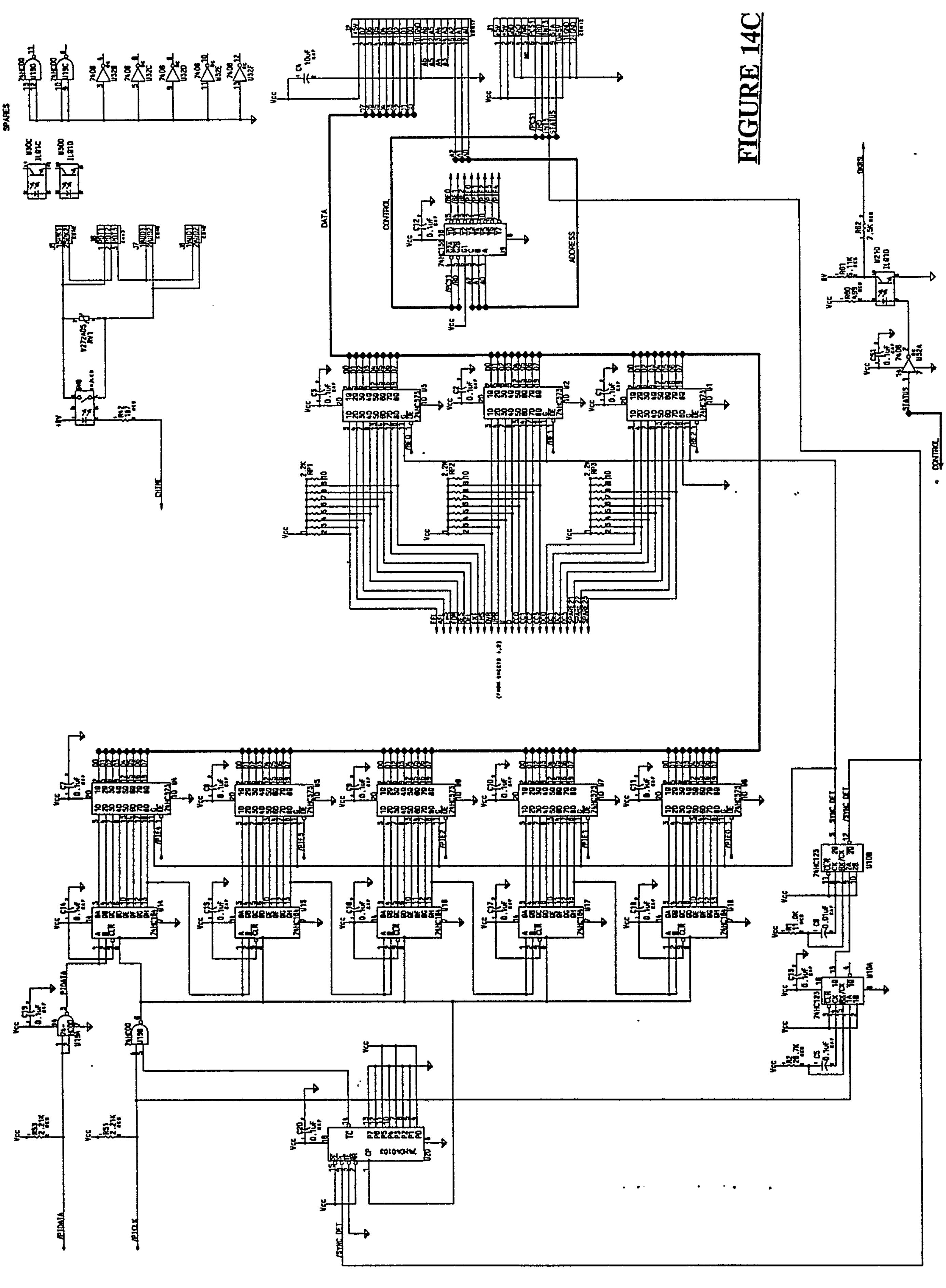


FIGURE 14C

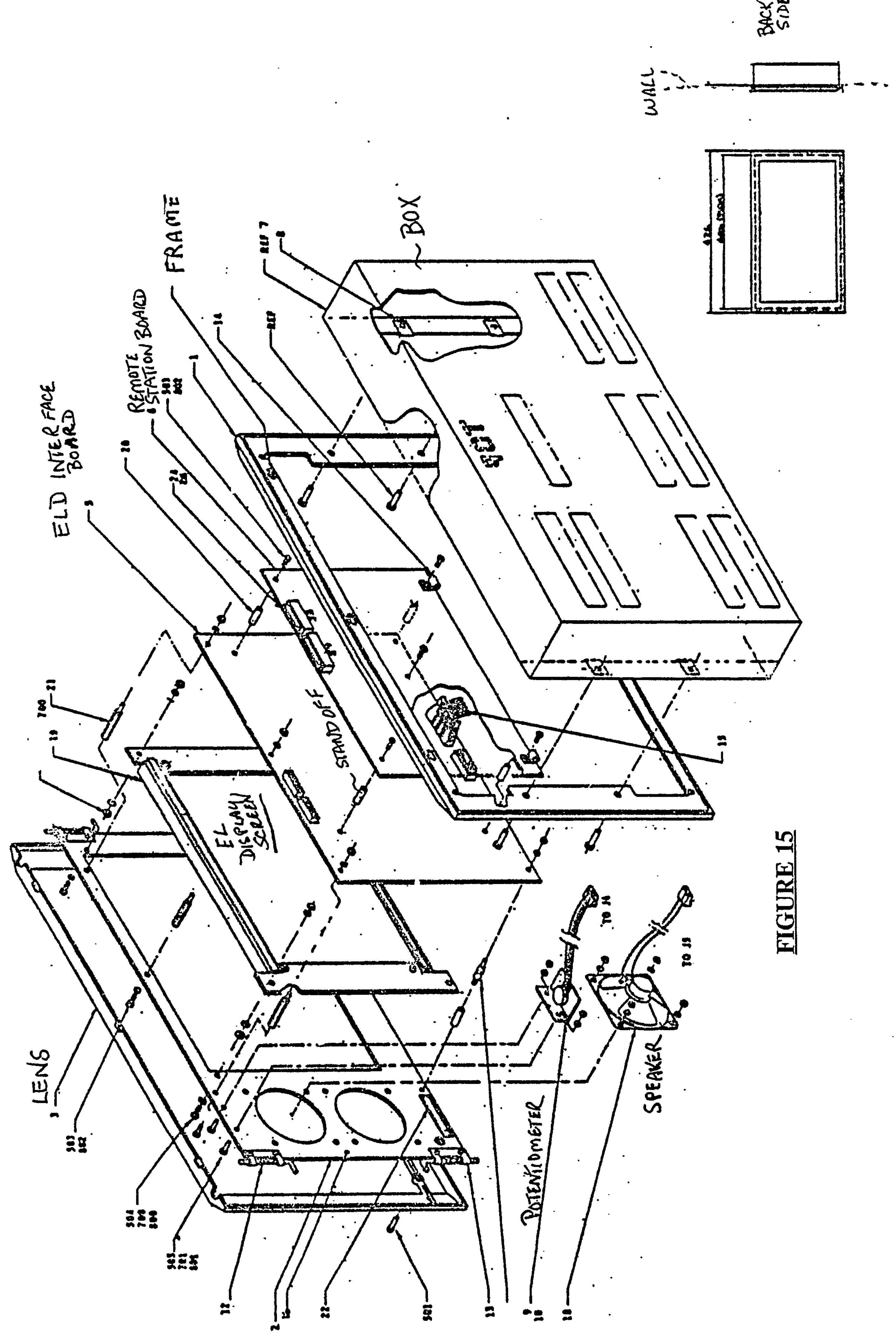

LENS
ELD INTERFACE BOARD
REMOTE STATION BOARD
FRAME
BOX
EL DISPLAY SCREEN
STANDOFF
POTENTIOMETER
SPEAKER
WALL
BACK SIDE

FIGURE 15