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(71) Applicant *(for all designated States except US)*: **MICRO D. LTD.** [IL/IL]; P.O. Box 434, 24104 Akko (IL).

(72) Inventor; and

(75) Inventor/Applicant *(for US only)*: **GOLAN, Gadi** [IL/IL]; 8 Hohit str., 45352 Hod Hasharon (IL).

(74) Agent: **MILLER - SIERADZKI ADVOCATES & PATENT ATTORNEYS**; P.O. Box 6145, 31061 Haifa (IL).

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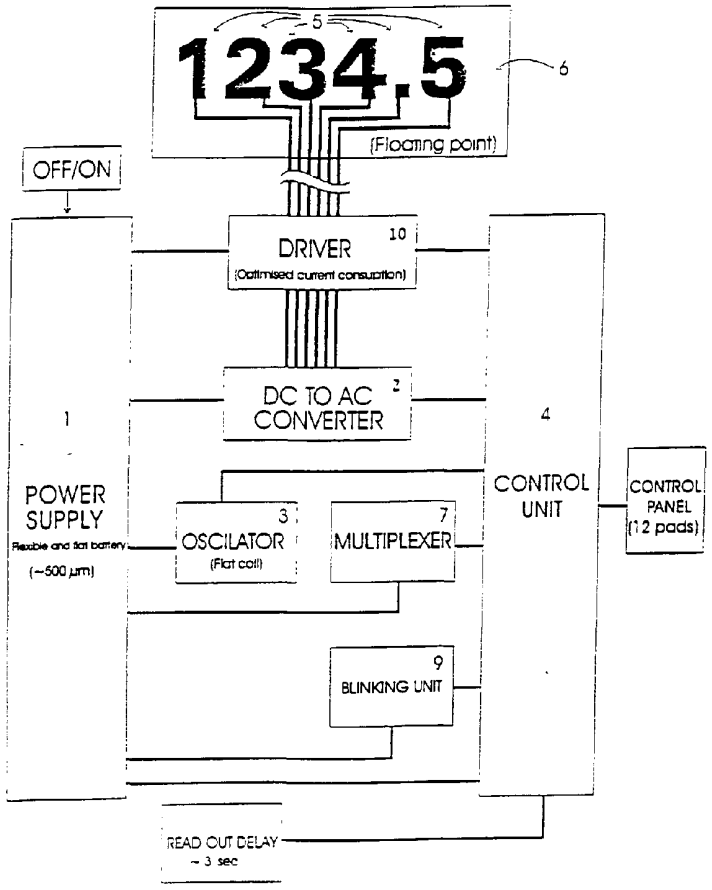
[Continued on next page]

(54) Title: ELECTROLUMINESCENT DISPLAY DEVICE



(57) Abstract: An electroluminescent display device is disclosed, comprising at least one of a number of electroluminescent segments of predetermined shape, size and color of emitted light; a DC power supply (1); a DC to AC converter (2); a driver (10); an oscillator (3); a switching unit (11); and a control unit (4). The oscillator (3) generates a periodical wave which is transmitted to the DC to AC converter (2) converts the input DC power to an output alternating voltage enhanced by the driver (10), to activate the electroluminescent segments through said switching unit which is provided with ON and OFF controllable conditions for powering the EL segments. The control unit (4) controls the system to provide predetermined sequence of powering of the electroluminescent segments. Thus alternating lighting animated effects are produced in the electroluminescent segments.

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ELECTROLUMINESCENT DISPLAY DEVICE

FIELD OF THE INVENTION

The present invention relates to display devices. More particularly it relates to a low power consumption, timed controlled, electro-luminescent display, for touch panel smart cards.

BACKGROUND OF THE INVENTION

Electroluminescense technology is a relatively new technology used in producing light emitting thin surfaces. It was never used as a readout display for smartcard applications, since it needs a complicated electronics support circuitry and a high voltage energy source that take up a large space, whereas smartcards requirements are that smartcards be of relatively small dimensions. Current smartcards consist only of passive built-in flash memories which need an external stationary energy source for the Read/Write process and for the status verification process.

Electroluminescense (EL) is a phenomenon wherein phosphorous crystallites are subjected to alternating current (AC) electrostatic excitation and emit light as a result. The high efficiency attributed to EL, accounts for its relatively low heat dissipation. Therefore, EL light surfaces consume low electric power and do not heat up substantially.

The known disadvantages of current known prior art smartcards are:

1. Lack of a readout interface.
2. Lack of a reliable, thin, rechargeable and flexible energy source.
3. Lack of real-time control during the Read/Write process.
4. Can be the subject of an unlawful and unauthorized use in case of theft.
5. Can be used for one application at most.
6. Cannot be programmed by the end-user.
7. LCD readouts are known to be carcinogenic (the organic Benzen Rings)

US Patent 5,731,105 (Fleischer et al.), incorporated herein by reference, discloses a non-liquid electrolyte containing battery power source which operates efficiently at room temperature. The battery includes (1) a non-liquid electrolyte in which protons are mobile. (2) an anode active material based on an organic compound which is a source of protons during battery discharge, or an anode active material including a metal whose caton can assume at least two different non-zero oxidation numbers, and (3) a solid cathode including a compound which forms an electrochemical battery couple with the anode. Anode and Cathode active materials can be chosen so that the battery has the feature that the electrochemical reactions at the anode and cathode are at least partially reversible. It is suitable for electronic consumer products, biochemical applications, electric vehicle applications, and the like. The battery can be fabricated in any desired shape or size without any special production precautions. An important feature of the battery is that no thermal activation is required for its operation, therefore, the battery efficiently operates under ambient temperatures.

US Patent 5,382,481 (Fleischer et al.), incorporated herein by reference, discloses an all solid state battery power source which operates efficiently at room temperature. The battery includes (1) a solid state electrolyte in which protons are mobile, (2) an anode active material based on an organic compound which is a source of protons during battery discharge, or an anode active material including a metal whose caton can assure at least two different non-zero oxidation numbers and (3) a solid cathode including a compound which forms an electrochemical battery couple with the anode. Anode and cathode active materials can be chosen so that the battery has the feature that the electrochemical reactions at the anode and cathode are at least partially reversible. It is suitable for electronic consumer products, biochemical applications, electric vehicle applications, and the like. The battery can be fabricated in any desired shape without any special production precautions.

See also US patent: 5,512,391, US patent: 5,580,681, all to Fleischer et al., incorporated herein by reference.

To the best knowledge of the inventor there are no EL readouts in smartcards, and there are no batteries in smartcards that are less than 0.5 mm thick, rechargeable, flexible and providing up to 10mA-h or similar power.

In WO Pat. Application No. 9,631,730 (Huwitz) an illuminated protective encapsulation for the phosphor was disclosed. It comprised a protective shell with a power unit in it. The EL lamp is secured to the shell and is operated by a power unit, providing intermittent illumination.

In JP Pat. Application (assigned to Nippon Kasei KK) a road sign for pedestrians or vehicles was disclosed. A pair of ultrasonic sensors are arranged on the pavement, and send a signal to a control unit which controls the power feed to an electroluminescent (EL) element. A solar battery serves as the power supply.

US Pat. No. 5,359,341 (Hutchings) disclosed a power supply for sequentially energizing segments of an EL panel to produce animated displays. An electronically programmable EPROM programmed with a predetermined sequence for an EL graphic display controls the sequence of powering (or not powering) of each segment of the EL display.

It is the purpose of the present invention to provide an EL display device, with versatile uses, including constant, intermittent or sequential powering of the EL panel.

BRIEF DESCRIPTION OF THE INVENTION

There is thus provided, in accordance with a preferred embodiment of the present invention, an electroluminescent display device comprising:

at least one of a number of electroluminescent segments of predetermined shape, size and color of emitted light;

a DC power supply;

a DC to AC converter;

a driver;

an oscillator;

a switching unit; and

a control unit;

wherein said oscillator generates a periodical wave which is transmitted to the DC to AC converter and also controls the timing of the entire system, wherein said DC to AC converter converts the input DC power to an output alternating voltage enhanced by said driver, to activate said electroluminescent segments through said switching unit which is provided with On and Off controllable conditions for powering the EL segments, wherein said control unit controls the system and output, and wherein said control unit controls the system to provide predetermined sequence of powering of said electroluminescent segments thus producing alternating lighting or animated effects in said electroluminescent segments.

Furthermore, in accordance with another preferred embodiment of the present invention, said power supply comprises a rechargeable battery.

Furthermore, in accordance with another preferred embodiment of the present invention, said power supply comprises a battery providing up to 10 mA-h.

Furthermore, in accordance with another preferred embodiment of the present invention, said battery is not more than 0.5 mm in thickness.

Furthermore, in accordance with another preferred embodiment of the present invention,said power supply comprises a solar cell battery.

Furthermore, in accordance with another preferred embodiment of the present invention, said power supply is the main electric supply.

Furthermore, in accordance with another preferred embodiment of the present invention, said power supply comprises a plurality of batteries.

Furthermore, in accordance with another preferred embodiment of the present invention, said DC to AC converter voltage output is in the range of 80 – 120 V AC.

Furthermore, in accordance with another preferred embodiment of the present invention, said control unit includes a multiplexer which controls the switches of each of the EL segments separately in a predetermined sequence.

Furthermore, in accordance with another preferred embodiment of the present invention, said oscillator provides a sine wave in a frequency ranging between 400 Hz and 4000 Hz.

Furthermore, in accordance with another preferred embodiment of the present invention, said oscilator comprises a flat coil capable of providing up to 1000 μH.

Furthermore, in accordance with another preferred embodiment of the present invention, said coil has a thickness of about 0.6 mm.

Furthermore, in accordance with another preferred embodiment of the present invention, a blinking unit is further provided to provide intermittent blinking of the EL segments.

Furthermore, in accordance with another preferred embodiment of the present invention, said control unit comprises a computer program controlled control unit.

Furthermore, in accordance with another preferred embodiment of the present invention, said computer program is designed to allow end-user programming of the desired sequence of powering of each segment on the EL display.

Furthermore, in accordance with another preferred embodiment of the present invention, said electroluminescent segments are printed on a surface using the silk print technique.

Furthermore, in accordance with another preferred embodiment of the present invention, a network of electrical connections to the EL segments is provided.

Furthermore, in accordance with another preferred embodiment of the present invention, the EL segmentation is reduced to very small pixels.

Furthermore, in accordance with another preferred embodiment of the present invention, the device is used for an informing sign.

Furthermore, in accordance with another preferred embodiment of the present invention, the device is used for commercial advertising.

Furthermore, in accordance with another preferred embodiment of the present invention, the device is used for a business sign.

BRIEF DESCRIPTION OF THE DRAWINGS

In order to better understand the present invention, and appreciate its practical applications, the following Figures are provided and referenced hereafter. It should be noted that the Figures are given as examples only and in no way limit the scope of the invention as defined in the appending Claims. Like components are denoted by like reference numerals.

Fig. 1 illustrates a bar diagram of a typical embodiment of the electroluminescent display device according to the present invention.

Fig. 2 illustrates an optional arrangement of the control unit of the electroluminescent display device according to the present invention, having *n* number of EL segments, serving as a multiplexer.

DETAILED DESCRIPTION OF THE INVENTION

The electroluminescent display device of the present invention typically comprises alphanumerical, or seven segments, EL display plus a flexible rechargeable thin battery, for smartcard applications, and has the following characteristics:

1. Low power consumption.

2. Bright readout (typically of more than 2 Cd/cm^2)
3. Easy to read under most types of conventional illuminations.
4. Flexible as required in conventional smartcards standardization.
5. Thin and flexible electronics circuitry (feasibly less than 1 mm in thickness).
6. Thin (about 0.5 mm) rechargeable and flexible battery of up to 10 mA-h.
7. Touch-panel typically consisting of 10 digits (0-9) and #, *.
8. Timing circuitry for energy saving.
9. Low weight of the electrical components.
10. Can be programmed by the end-user in real-time.
11. Can become a multipurpose smart card following an appropriate encoding, done by the end user.
12. Can be password-protected.
13. Can be recharged during the Read/Write process.
14. The EL materials as well as the rechargeable battery are made of "green materials". They are of no hazards to the environment and they are not known as carcinogenic materials.

The novel aspects of the said invention and its new features are as follows:

1. Low power consumption.

The EL readout average consumption is about 5 mA. This feature is achieved by a novel design of the inverter circuit and its electrical flat coil. The main parameter that controls the EL readout power consumption is the DC/AC inverter frequency.

2. Bright readout of more than 2 Cd/cm^2.

The high intensity readout is achieved via a precise circuit design of the inverter circuitry and its electrical components.

3. Easy to read under most types of conventional illuminations.

Unlike LCD readouts, which need an external illumination, the EL readout is an illumination source typically of blue/green light.

4. Flexible as required in conventional smartcard standardization.
The EL readout of the device of the present invention can be bent and folded up to 180 ° and still keep on working without degrading its performance.
As the printed circuit board (PCB) is flexible as well as the readout they can be bent much more than the required standard.

5. Thin and flexible electronic circuitry (less than 1 mm in thickness).
All the electrical parts thickness (already installed on the PCB in a special installation process) is less than 1 mm.

6. Thin (about 0.5 mm) rechargeable and flexible battery of up to 10 mA-h.
Incorporating patented battery (see US Patent 5,731,105, US Patent 5,382,481, US patent: 5,512,391, US patent: 5,580,681).

7. Twelve buttons key pad consisting of 10 digits (0-9) and the #, * keys.
Since there are no current keypads on conventional smartcards, our invention is the first digitized panel of smartcards. The functions of the # and * are not known yet.

8. Timing circuitry for energy saving.
Readout time was taken between one to three seconds in order to save as much energy power as possible.

9. Low weight of the electrical components.
The total weight of the electronic circuit is less than 10 grams.

10. Programming by the end-user in real-time.
Instead of the conventional magnetic bar present in conventional bank cards, which can be duplicated and stolen, the smartcard device of the present invention can be programmed for encoding and decoding purposes.

11. Multipurpose smart card following an appropriate encoding, performed by the end user.

The device of the present invention can be easily converted for example from Visa to American Express or similar conversion.

12. Password-operated smart card.

Using the key pad on top, the device of the present invention can become password operated for coding and decoding purposes.

13. Rechargeable during the Read/Write process.

In order to save time the rechargeable battery is recharged during the Read/Write process.

14. The EL materials as well as the rechargeable battery are made of "green materials". They are of no hazards to the environment and they are not known as carcinogenic materials.

The EL lamp is equivalent to a capacitor, with a phosphorous layer sandwiched between upper and lower electrodes. A typical EL structure consists of a transparent or translucent electro-conductive layer, a phosphorous layer (the active light-emitting layer), an electro-conductive layer, placed parallel to the phosphorous layer, several insulation layers which separate the electro-conductive layer from adjacent layers (the phosphorous layer being one of these layers) and transparent lamination layers. Electrostatic excitation of the phosphorous layer is achieved by applying AC voltage across the electro-conductive layers. As a result, light is emitted from the phosphorous layer . The color of the emitted light is controlled by adding coloring pigmentation for the desired color and by changing the frequency of operation of the control electronic circuitry.

As phosphor is known to be a hygroscopical material and as moisturized phosphor enhances the decay of its light emission property – it is imperative that moisture barriers must be engaged in order to avoid moisture penetration to the active emitting layers of the phosphor.

Integration of EL readouts in smart card applications was never done before as no electrical energy source was thin enough to be incorporated in a thin card. Other factors impeding the integration of EL readouts in smart cards were: the necessity in high flexibility of the whole system (including the electronic circuitry), the necessity in no more than 0.9 mm thickness electronic circuitry and the necessity in low consumption electronics, in order to enable hundreds of operations before recharging the built-in battery. Above all these factors, the materials comprising the EL readout and the sheet rechargeable battery should be made of "green" materials that are not hazardous to the environment.

The present invention introduces for the first time a rechargeble battery, as a source of energy, in connection with a smart card. This energy source of up to 10 mA-h is mechanically flexible, rechargeable, and of less than 0.5 mm thick. Using this special flat source of energy, an EL flat readout and its adjoining electronic circuitry were designed and fabricated. The total thickness of the electronic circuitry is less than 1 mm, it is mechanically flexible, and its power consumption is tuned to minimum in order to meet the sheet battery requirements. Expansion of the electronic circuitry includes timing control for the active readout in order to save in electric power, and a key pad touch panel for the smart card users.

The electroluminescent display device of the present invention comprises:

- at least one of a number of electroluminescent segments of predetermined shape, size and color of emitted light;
- a DC power supply (a flat rechargeable battery);
- a DC to AC converter;
- a power driver;
- an oscillator;
- a switching unit; and
- a control unit

wherein said oscillator controls the light intensity of the entire system, wherein said DC to AC converter converts the input DC power to an output alternating

voltage through said driver, to activate said electroluminiscent segments through said switching unit which is provided with On and Off controllable conditions for powering or not powering the EL segments, wherein said control unit controls the system and output, and wherein said control unit controls the system to provide predetermined sequence of powering of said electroluminiscent segments thus producing alternating lighting or animated effects in said electroluminescent segments.

The electroluminescent display device of the present invention is hereafter explained with reference to the attached Figures. Fig. 1 illustrates a bar diagram of a typical embodiment of the electroluminescent display device according to the present invention. The DC power supply (1) is preferably a rechargeable flat battery, or a pile of flat batteries, of small size, for easy handling, such as the battery disclosed in US Patent 5,731,105 or in US 5, 382,481. However, a solar cell battery or even the main electric supply can suit. The DC voltage is transformed into an AC voltage by a DC to AC converter (2). As higher voltages and frequencies tend to degrade the EL efficiency and therefore recommended values for the AC voltage output range should lie between 80 – 120 V AC. An oscillator (3) employing a thin flat coil of up to 1000 μH, with a thickness of 0.6 mm, provides a sine wave in a frequency ranging between 400 Hz and 4000 Hz, for the DC to AC converter (2), and also serves for the timing of the entire device through the control unit (4). The control unit sends the powering command to the EL segments (5) of the sign display (6), in a predetermined sequence. This is achieved by means of a multiplexer (7), which controls the switches of each of the EL segments separately in a predetermined sequence. An optional photo-resistor sensor (8) is added to the device in order to detect a day/night condition, and allows activation of the EL display only when it is dark. An optional blinking unit (9) is added to provide intermittent blinking of the EL segments, if desired. The output voltage of the DC to AC converter passes through a driver (10), which enhances the activating power for the EL segments.

Optionally the multiplexer can be replaced with another controlling hardware or even a computer program controlled control unit. The control unit can send a constant On command, a periodical On/Off signal (blinking) or it can send sequential signals in a predetermined order to provide animated effects. The computer program can be designed to allow end-user programming of the desired sequence of powering commands for each segment on the EL display.

The El display device of the present invention can be used for commercial credit cards, personal data cards, field kits, electronic purse, receiver cards and for advertisement applications, etc.

Fig. 2 illustrates an optional arrangement of the control unit of the electroluminescent display device according to the present invention, having *n* number of EL segments, serving as multiplexers. The oscillator (3) generates a periodical wave which is transmitted to a digital decoder (11). The digital decoder controls *n* switches, connected in parallel, each to a separate EL segment. The digital decoder generates On/Off commands to each of the separate switches, in a predetermined sequence.

The EL display surface can be produced using the silk print technique, which allows the production of a fine network of electrical connections and subsequently yields a high resolution display, as the EL segmentation can be reduced to very small pixels, each controlled separately using the electroluminescent sequential display device of the present invention.

The overall width of the device depends on the widths of its components, the widest component defining the minimum width of the entire device. The introduction of flat yet powerful enough power source (US 5,731,105) as well as the flat coil brings about the possibility of producing this thin EL display device for the first time.

The advantages of the device of the present invention as display means for smart cards over the conventional smart cards are as follows:

1. Conventional smart cards do not have in general an energy source due to the following problems: This battery should be thinner than 1 mm, it should be enough flexible to meet the required standards, it should be (required) a rechargeable battery, it should be of at least 5 mA-h.

The present invention employs this type of battery: Thinner than 1 mm, flexible, rechargeable, and heavy duty.

2. Power consumption of conventional EL readouts is high if not designed properly.

The present consists of an advanced design of EL readout (electrical circuit and materials composition). Thus, a bright readout of more than 2 Cd/cm^2 is achieved.

3. Easy to read under most types of conventional illuminations.

As Liquid Crystal Displays (LCD) can not be read in darkness, EL readout can be read either with or without external illumination.

4. Flexible as required in conventional smart cards standardization.

As LCD displays can not be bent, whereas EL readout is easy to bend even over 90^0.

5. Thin and flexible electronics circuitry (less than 1 mm in thickness).

This is achieved by employing a thin coil of up to 1000 μH, with a thickness of 0.6 mm.

6. Thin (about 0.5 mm) rechargeable and flexible battery of up to 10 mA-h.

Already patented by ECR Ltd.

7. Twelve buttons touch-panel consisting of 10 digits (0-9) and #, *.

No smart card up today has got a touch-panel on top. With our smart card one can encode or decode the card with the required information.

8. Timing circuitry for energy saving.
An auto-stop circuitry ends the readout operation after a given period of seconds (can be programmed).

9. Low weight of the electrical components.
Advantageous on the heavy cards.

10. Can be programmed by the end-user in real-time.
Unlike the conventional cards that can not be programmed either due to lack of means or due to lack of readout.

11. Can become a multipurpose smart card following an appropriate encoding, done by the end user.
Using the touch-panel each smart card can be varied to any other required credit card.

12. Can become a password-operated.
Unlike the conventional smart card.

13. Can be recharged during the Read/Write process.
Instead of loosing time during the read/write process the said invention is being recharged during this read/write process.

14. The EL materials as well as the rechargeable battery are made of "green materials". They are of no hazards to the environment and they are not known as carcinogenic materials.
Unlike the LCD that consists of carcinogenic materials (Benzen rings), the EL is safe to its user and its environment.

It should be clear that the above description of the embodiments of the present invention and the Figures disclosed are given for illustrative purposes

only and in no way limit the scope of the invention as defined in the appending Claims.

It should also be clear that a person skilled in the art, after reading the present specification could make adjustments or amendments to the attached Figures and above described embodiments that would still be covered by the following Claims.

CLAIMS

1. An electroluminescent display device comprising:

at least one of a number of electroluminescent segments of predetermined shape, size and color of emitted light;

a DC power supply;

a DC to AC converter;

a driver;

an oscillator;

a switching unit; and

a control unit;

wherein said oscillator generates a periodical wave which is transmitted to the DC to AC converter and also controls the timing of the entire system, wherein said DC to AC converter converts the input DC power to an output alternating voltage enhanced by said driver, to activate said electroluminescent segments through said switching unit which is provided with On and Off controllable conditions for powering the EL segments, wherein said control unit controls the system and output, and wherein said control unit controls the system to provide predetermined sequence of powering of said electroluminescent segments thus producing alternating lighting or animated effects in said electroluminescent segments.

2. The electroluminescent display device according to Claim 1, wherein said power supply comprises a rechargeable battery.

3. The electroluminescent display device according to Claim 1, wherein said power supply comprises a battery providing up to 10 mA-h.

4. The electroluminescent display device according to Claim 3, wherein said battery is not more than 0.5 mm in thickness.

5. The electroluminescent display device according to Claim 1, wherein said power supply comprises a solar cell battery.

6. The electroluminescent display device according to Claim 1, wherein said power supply is the main electric supply.

7. The electroluminescent display device according to Claim 1, wherein said power supply comprises a plurality of batteries.

8. The electroluminescent display device according to Claim 1, wherein said DC to AC converter voltage output is in the range of 80 – 120 V AC.

9. The electroluminescent display device according to Claim 1, wherein said control unit includes a multiplexer which controls the switches of each of the EL segments separately in a predetermined sequence.

10. The electroluminescent display device according to Claim 1, wherein said oscillator provides a sine wave in a frequency ranging between 400 Hz and 4000 Hz.

11. The electroluminescent display device according to Claim 1, wherein said oscilator comprises a flat coil capable of providing up to 1000 μH.

12. The electroluminescent display device according to Claim 11, wherein said coil has a thickness of about 0.6 mm.

13. The electroluminescent display device according to Claim 1, wherein a blinking unit is further provided to provide intermittent blinking of the EL segments.

14. The electroluminescent display device according to Claim 1, wherein said control unit comprises a computer program controlled control unit.

15. The electroluminescent display device according to Claim 11, wherein said computer program is designed to allow end-user programming of the desired sequence of powering of each segment on the EL display.

16. The electroluminscent display device according to Claim 1, wherein said electroluminescent segments are printed on a surface using the silk print technique.

17. The electroluminescent display device according to Claim 13, wherein a network of electrical connections to the EL segments is provided.

18. The electroluminescent display device according to Claim 13, wherein the EL segmentation is reduced to very small pixels.

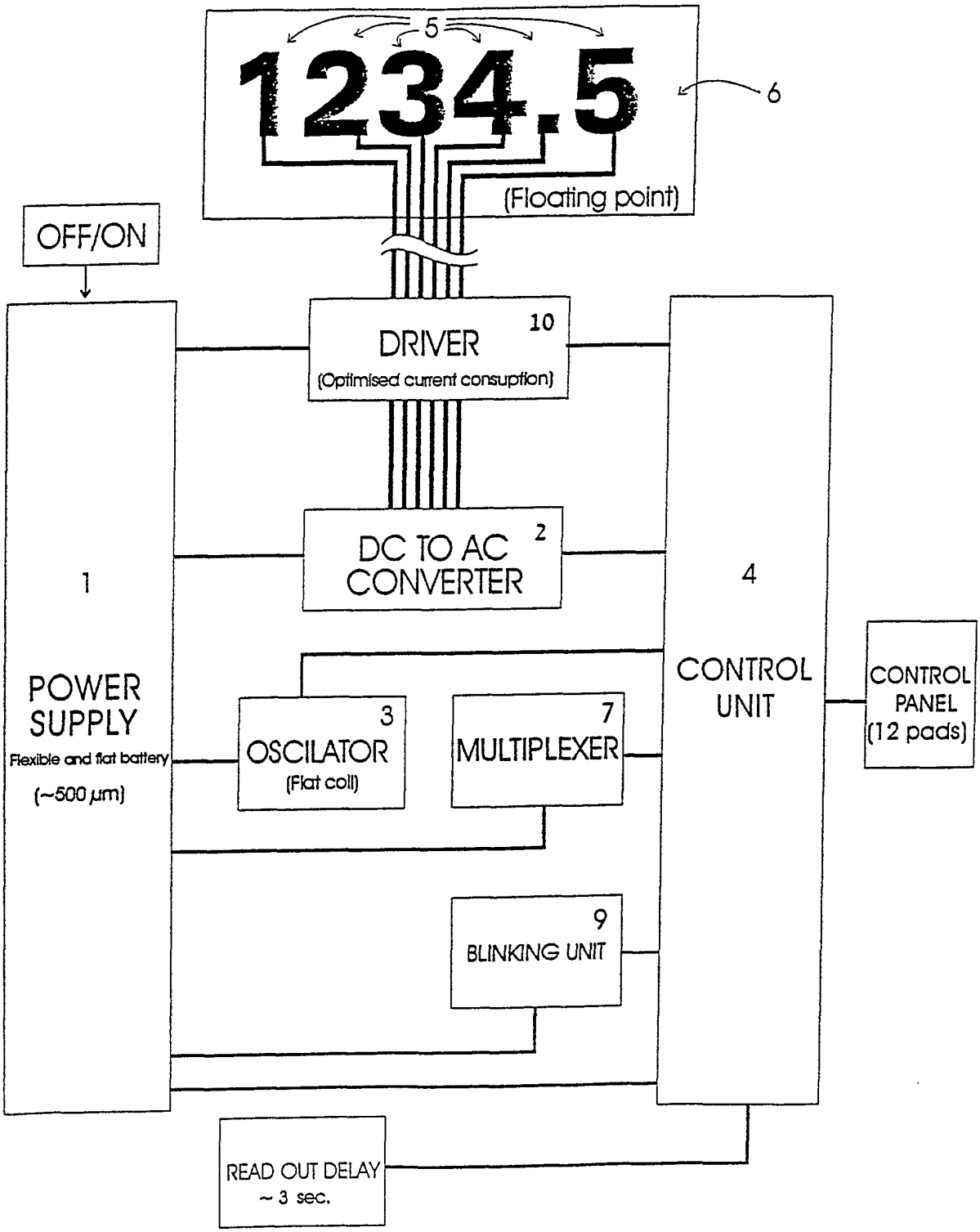
19. An electroluminescent display device according to Claim 1, wherein it is used for an informing sign.

20. An electroluminescent display device according to Claim 1, wherein it is used for commercial advertising.

21. An electroluminescent display device according to Claim 1, wherein is used for a business sign.

22. An electroluminescent display device substantially as described in the above specification, attached Figures and appending Claims.

Fig.1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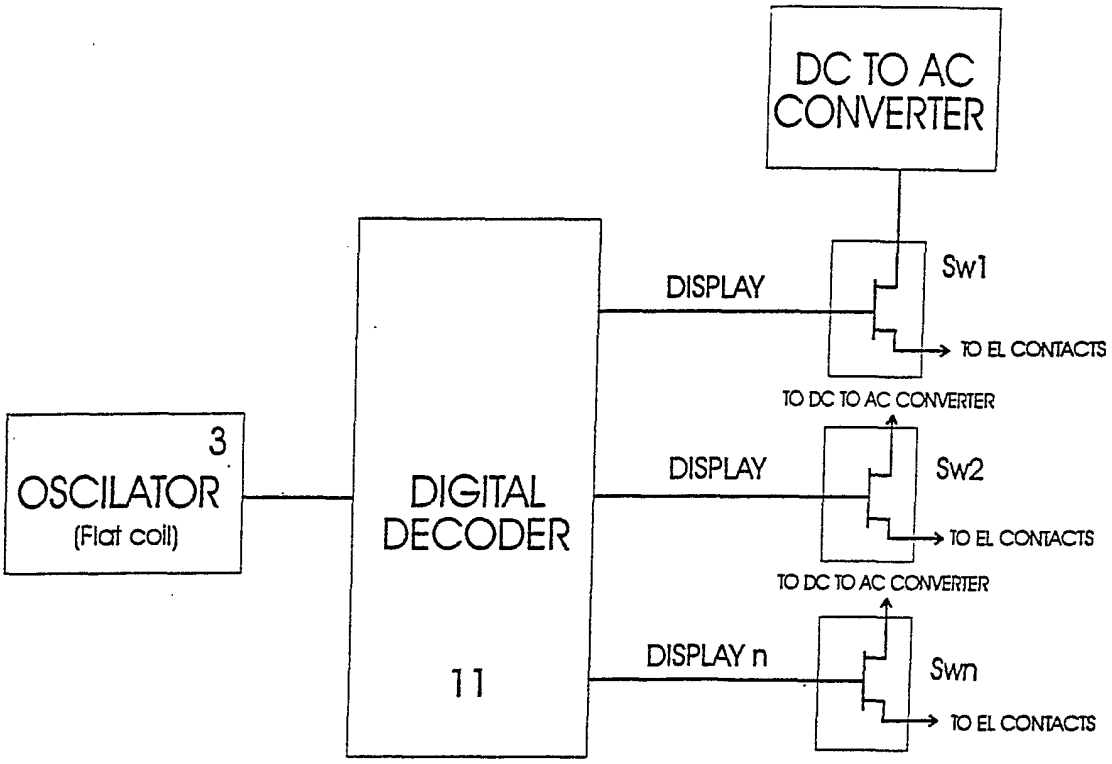
6
(Floating point)
OFF/ON
DRIVER
10
(Optimised current consuption)
DC TO AC
CONVERTER
2
1
POWER
SUPPLY
Flexible and flat battery
(~500 µm)
3
OSCILATOR
(Flat coil)
7
MULTIPLEXER
4
CONTROL
UNIT
CONTROL
PANEL
(12 pads)
9
BLINKING UNIT
READ OUT DELAY
~ 3 sec.

Fig.2



DISPLAY ≙ ALPHA NUMERIC READOUT OR SEVEN SEGMENTS READOUT

INTERNATIONAL SEARCH REPORT

International application No.
PCT/IL01/00490

A. CLASSIFICATION OF SUBJECT MATTER

IPC(7) :G09G 3/10; H03B 1/00
US CL :Please See Extra Sheet.
According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

U.S. : 315/169.3, 307, 308, 314, 291, 158, 194, 247, 291, DIG. 4, DIG. 7; 327/108, 110; 340/781, 811

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

NONE

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

NONE

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	US 5,754,064 A (CHIEN) 19 May 1998 (19.05.1998), see entire document.	1-22
Y	US 5,440,208 A (USKALI et al.) 08 August 1995 (08.08.1995), see entire document.	1-22

☐ Further documents are listed in the continuation of Box C. ☐ See patent family annex.

*	Special categories of cited documents:	"T"	later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
"A"	document defining the general state of the art which is not considered to be of particular relevance	"X"	document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
"E"	earlier document published on or after the international filing date	"Y"	document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
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"O"	document referring to an oral disclosure, use, exhibition or other means		
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Date of the actual completion of the international search 24 OCTOBER 2001	Date of mailing of the international search report 15 NOV 2001
Name and mailing address of the ISA/US Commissioner of Patents and Trademarks Box PCT Washington, D.C. 20231 Facsimile No. (703) 305-3230	Authorized officer Sharon J. Hoppe CHUC TRAN Telephone No. (703) 306-5984

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INTERNATIONAL SEARCH REPORT

International application No.
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A. CLASSIFICATION OF SUBJECT MATTER:
US CL :

315/169.3, 307, 308, 314, 291, 158, 194, 247, 291, DIG. 4, DIG. 7; 327/108, 110; 340/781, 811