632112

FORM 1 SPRUSON & FERGUSON

COMMONWEALTH OF AUSTRALIA

PATENTS ACT 1952

APPLICATION FOR A STANDARD PATENT

Telematique Videotex Francaise T.V.F., of Parc d'innovation "Le Strategie", 67404 Illkirch, FRANCE, hereby apply for the grant of a standard patent for an invention entitled:

Portable Microcomputer

which is described in the accompanying complete specification.

Details of basic application(s):-

Basic Applic. No:	Country:	Application Date:
89 04 983	FR	14 April 1989

The address for service is:-

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DATED this SEVENTEENTH day of APRIL 1990

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By: J. Gubinelli.

Registered Patent Attorney

TO: THE COMMISSIONER OF PATENTS
OUR REF: 127244
S&F CODE: 52145

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Spruson & Ferguson

AUSTRALIA
CONVENTION
STANDARD
& PETTY PATENT
DECLARATION
SFP4

COMMONWEALTH OF AUSTRALIA

THE PATENTS ACT 1952

DECLARATION IN SUPPORT OF A CONVENTION APPLICATION FOR A PATENT

In support of the Convention Application made for a patent for an invention entitled:

Title of Invention: Portable microcomputer

Full name(s) and address(es) of Declarant(s):

I/~~We~~ Bernard Bravo, Director General
TELEMATIQUE VIDEOTEX FRANCAISE T.V.F.
(A company organized and existing under the Laws of France)
of Parc d'Innovation "Le Stratège"
67404 ILLKIRCH
FRANCE

do solemnly and sincerely declare as follows:-

Full name(s) of Applicant(s):

~~1. I/We are the applicant(s) for the patent~~

(or, in the case of an application by a body corporate)

1. I am/~~We are~~ authorised by

Telematique Videotex Francaise T.V.F.
the applicant(~~s~~) for the patent to make this declaration on its/~~their~~ behalf.

2. The basic application(~~s~~) as defined by Section 141 of the Act was/~~were~~ made

Basic Country(ies): in FRANCE

Priority Date(s): on April 14, 1989 (N° 89 04 983)

Basic Applicant(s): by TELEMATIQUE VIDEOTEX FRANCAISE T.V.F.

~~3. I am/We are the actual inventor(s) of the invention referred to in the basic application(s)~~

Full name(s) and address(es) of inventor(s):

(or where a person other than the inventor is the applicant)

3. TRUCHET Philippe

of 37, Square Anatole France
91250 SAINT GERMAIN LES CORBEILLES
FRANCE

is/~~are~~ the actual inventor(~~s~~) of the invention and the facts upon which the applicant(~~s~~) is/~~are~~ entitled to make the application are as follows: (~~respectively~~)

Set out how Applicant(s) derive title from actual inventor(s) e.g. The Applicant(s) is/are the assignee(s) of the invention from the inventor(s)

The applicant employs the inventor. The applicant is thus a person who would be entitled to have the patent assigned to it if a patent were granted upon an application made by the inventor.

4. The basic application(~~s~~) referred to in paragraph 2 of this Declaration was/~~were~~ the first application(~~s~~) made in a Convention country in respect of the invention (~~s~~) the subject of the application.

Declared at Paris this 11th day of July 1990

Bernard BRAVO - Directeur Général
(for the firm) Signature of Declarant(s)

SFP4 To: The Commissioner of Patents 11/81

(12) PATENT ABRIDGMENT (11) Document No. AU-B-53619/90
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PORTABLE MICROCOMPUTER

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(56) Prior Art Documents
US 4661655
EP 249417
EP 210063

(57) Claim

1. Portable microcomputer comprising at least one central microprocessor, a central random access memory, a display screen, a plurality of built-in peripherals, a transparent touch-sensitive surface covering the display screen, and electronic means of emulation which are variable at the will of the user of the display screen and of the touch-sensitive surface, allowing the management of any screen one either as an information display zone or as a zone for the display of functions performed on the touch-sensitive surface, wherein the electronic means of variable emulation are connected to the touch-sensitive surface on the one hand in order that they may themselves be controlled from this touch-sensitive surface, and on the other hand in order to manage the emulation, in such a way that no specific keyboard is necessary for carrying out a dialogue with the microcomputer.

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FORM 10

COMMONWEALTH OF AUSTRALIA

PATENTS ACT 1952

COMPLETE SPECIFICATION

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Complete Specification for the invention entitled:

Portable Microcomputer

The following statement is a full description of this invention, including the best method of performing it known to me/us

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ABSTRACT

Portable microcomputer intended to be used either as an information entry terminal or as a genuine interactive personal microcomputer, particularly one which is compatible with other personal microcomputers and therefore able to execute the same application programs (office automation, management, computations, ...), comprising at least one central microprocessor (2), one central random access memory (3), a display screen (4) and a plurality of built-in peripherals (11, 12, 13 ...), characterized in that it comprises a transparent touch sensitive surface (14) covering the display screen (4), and electronical means (15, 16, 17, 18, 19) of emulation which are variable at the will of the user of the display screen (4) and of the touch-sensitive surface (14), allowing the management of any screen zone either as an information display zone or as a zone for the display of functions performed on the touch-sensitive surface (14). and in that the electronic means (15, 16, 17, 18, 19) of variable emulation are connected to the touch-sensitive surface (14) on the one hand in order that they may themselves be controlled from this touch-sensitive surface (14), and on the other hand in order to manage the emulation, in such a way that no specific keyboard is necessary for carrying out a dialogue with the microcomputer.

Figure 2.

PORTABLE MICROCOMPUTER

The invention relates to a microcomputer intended for use either as an information entry terminal or as a genuine interactive microcomputer compatible with other microcomputers, particularly of the IBM-PC (registered trade mark) type.

Micro-data processing, i.e. the technical field of microprocessor based computers, essentially has two radically different types of application respectively corresponding to two types of design and technology which are also radically different. In a first known application, micro-data processing enables the production of complete information management systems which are independent, of low cost and size, and are generally called personal microcomputers. Such microcomputers allow, with a single system, the production of a complete individual work station dedicated to a specific function (office automation, CAD, computations,...). A typical example of such well-known personal microcomputers is provided by the IBM-PC (registered trademark) systems. The technology of these microcomputers has recently been developed for the purpose of network use allowing a multi-user, multi-task,... management. In this field of personal micro-data processing, it has recently been sought to reduce the dimensions and weight of the systems as much as possible in order to make them transportable. Thus, several manufacturers have succeeded in producing what it is appropriate to call "transportable micro-computers" incorporating the majority of the elements conventionally found in personal microcomputers, but in a sufficiently reduced weight and size to allow their easy transport. Conventionally, such transportable microcomputers weigh between 5 and 15 kg and have the general dimensions of a briefcase. In the best cases, it is possible to obtain a weight in the order of 3 kg by doing without certain performance features (absence of certain elements such as hard disks...). A transportable microcomputer is conventionally

constituted from a central microprocessor, a central random access memory, a liquid crystal display screen, an alphanumeric keyboard, a floppy disk reader, a magnetic hard disk and, possibly, a mouse.

Such transportable microcomputers can thus be easily carried from one worksite to another. However, despite the extraordinary progress of technology with regard to miniaturization, none of the transportable microcomputers can be truly used when it is being carried by the user. Thus, the dimensions, weight and ergonomic characteristics of transportable microcomputers necessitate the placing of these microcomputers on a work table in order to be able to use them. For example it is not possible to carry the microcomputer with one hand and to use it simultaneously with the other hand. Also, it is not possible to carry such transportable microcomputers for long distances and for long periods in the same way as an electronic calculator or a simple notebook. Consequently, these transportable microcomputers do not genuinely constitute a portable worktool.

The second type of application of micro-data processing is that of portable information entry terminals for industrial use. In fact, at the same time as personal micro-data processing, and totally independently, industrialists have felt the need, in various applications, to have the use of portable terminals able to automatically and simply enter a large amount of information. For each of the industrial applications concerned, there has therefore been developed portable entry terminals dedicated uniquely to this application, and entirely preprogrammed and designed according to the entry method and the type of data to be entered. Thus, certain manufacturers offer pocket devices comprising a screen of extremely limited size (conventionally 2 lines and 16 characters), a keyboard comprising the necessary keys in relation to the application (conventionally between 20 and 40 keys), a microprocessor and a memory (particularly in the order

of a few tens of kilobytes) allowing the recording of data. The advantage of such a device is its low cost and its perfectly portable character. Such devices are for example used for entering shop inventories. In this application, they are for example connected to a light pen able to read the bar codes appearing on the products.

In the most sophisticated versions of these known portable entry terminals, those including a complete alphanumeric keyboard, a screen of slightly larger size, that is, conventionally, 8 lines and 40 characters, and which have overall dimensions of between 15 and 20 cm of width and 20 and 30 cm of length. These latter devices also comprise an associated microprocessor and an associated memory. They provide a computation and programming capability greater than that of the pocket devices mentioned above, because of the presence of a complete alphanumeric keyboard of conventional type. However, their capabilities are extremely limited and, although they are sufficient in the applications for which they are dedicated, they nevertheless cannot be used as genuine microcomputers. In particular, these intelligent microprocessor based entry terminals are in no way compatible with the known personal microcomputers and cannot therefore support the numerous software packages currently developed in the personal data processing field. The most sophisticated of these entry terminals are for example used by commercial travellers for managing their customer files and entering orders. They are also used for reading meters (water, gas, electricity...) and, in the military field, for recording measurements taken on the land.

Between these two extremes of industrial entry terminals, numerous companies and industries have developed their own terminals adapted according to their own needs. Each device generally comprises a specific keyboard, a microprocessor preprogrammed

according to a specific software package, a memory and a screen adapted according to requirements.

In this context of the prior art, no microcomputer is known which combines the advantages of compatibility and performance of personal microcomputers with the advantages provided by the industrial entry terminals. In fact, up to the present time, each of the two technical fields mentioned above has been limited to the specific standards imposed and which constitute important technical prejudices which, a priori, prevent calling upon related technology. Thus, in the field of personal micro-data processing, it is considered necessary to be able to use magnetic floppy disks with standard formats with a portable microcomputer. In this field, it is also considered necessary to provide the microcomputer with a magnetic hard disk whose capacity is at least 20 megabytes. On the other hand, in the field of industrial entry terminals, no floppy or hard disk is necessary. Furthermore, in this technical field it was considered that the standard known screens and keyboards in personal micro-data processing do not offer advantages in industrial type applications. Thus, none of the intelligent entry terminal manufacturers has, up to now, sought to procure a device which is compatible with conventional personal microcomputers.

Furthermore, in practice, the configuration and type of peripherals greatly affect the compatibility of a microcomputer with IBM-PC (registered trade mark) compatible software packages which are often based on standard peripherals and use their specific features. That is why devices provided with peripherals which are not IBM-PC (registered trade mark) compatible or not provided with all of the peripherals are not truly compatible.

The invention therefore addresses the problem of simultaneously overcoming the disadvantages of the known microcomputers in the personal micro-data processing field on the one hand and in that of intelligent entry terminals on the other hand, by

providing a device which combines the advantages of each of the two technologies.

In accordance with the present invention there is disclosed a portable microcomputer comprising at least one central microprocessor, a central random access memory, a display screen, a plurality of built-in peripherals, a transparent touch-sensitive surface covering the display screen, and electronic means of emulation which are variable at the will of the user of the display screen and of the touch-sensitive surface, allowing the management of any screen one either as an information display zone or as a zone for the display of functions performed on the touch-sensitive surface, wherein the electronic means of variable emulation are connected to the touch-sensitive surface on the one hand in order that they may themselves be controlled from this touch-sensitive surface, and on the other hand in order to manage the emulation, in such a way that no specific keyboard is necessary for carrying out a dialogue with the microcomputer.

A preferred embodiment proposes a portable microcomputer intended to be used either as an information entry terminal or as a genuine interactive personal microcomputer, particularly one which is compatible with other personal microcomputers and therefore able to execute the same application programs (office automation, management, computations, ...), comprising at least one central microprocessor, one central random access memory, a display screen and a plurality of built-in peripherals, characterized in that it comprises a transparent touch-sensitive surface covering the display screen, and electronic means of emulation which are variable at the will of the user of the display screen and of the touch-sensitive surface,

allowing the management of any screen zone either as an information display zone or as a zone for the display of functions performed on the touch-sensitive surface, and in that these electronic means of variable emulation are connected to the touch-sensitive surface on the one hand in order that they may themselves be controlled from this touch-sensitive surface, and on the other hand in order to manage the emulation, in such a way that no specific keyboard is necessary for carrying out a dialogue with the microcomputer. The central microprocessor and the electronic means of variable emulation are capable of managing screen zones according to two possible modes, the user being able to choose one or other of these modes: a picture-in-picture mode in which the screen is divided, at the user's will, into at least one information display zone and at least one function display zone; and a superimposition mode in which the entire screen is used for information display, the display of functions performed on the touch-sensitive surface being able, at the will of the user, to be superimposed on the information display which is then masked by this display. External means of control, in particular at least one key, of the electronic means of variable emulation enable the changing from one screen zones management mode to the other at any time.

The electronic means of variable emulation comprise an independent emulation microprocessor, dedicated to and preprogrammed for the management of the screen and of the touch-sensitive surface depending on the choice of the user, and an electronic interface connecting this emulation microprocessor to the central microprocessor. The electronic means of variable emulation are preprogrammed in such a way as to manage the contact of the user's finger on the touch-sensitive surface in the same way as a mouse. The said interface comprises: a static random access memory (RAM) with double access connected to the data and address buses of each of the central and emulation microprocessors; a FIFO address memory whose input is connected to the

address bus of the central microprocessor, and whose output is connected to the data bus of the emulation microprocessor; a FIFO write memory allowing the transfer of data in blocks in DMA (Direct Memory Access) mode from the data bus of the central microprocessor onto the data bus of the emulation microprocessor to which buses it is connected; a FIFO read memory allowing the transfer of data in blocks in DMA mode, from the data bus of the emulation microprocessor onto the data bus of the central microprocessor to which buses it is connected.

The invention also proposes a portable microcomputer intended to be used either as an information entry terminal or as a genuine interactive personal microcomputer, particularly one which is compatible with other personal microcomputers, and therefore able to execute the same application programs (office automation, management, computations ...) comprising at least one central microprocessor, one central random access memory, a display screen and a plurality of built-in peripherals, characterized in that it comprises a microprocessor which is separate from the central microprocessor, this separate microprocessor being dedicated to and programmed for the management of peripherals and continuously simulating, for the central microprocessor, the functioning of these peripherals. In this way the central microprocessor which is the only one to execute the programs of the operating or application system continuously sees the necessary IBM-PC (registered trade mark) compatible peripherals via the separate microprocessor.

In the case of a microcomputer having a variable emulation screen, the separate peripherals management microprocessor can be the same as the emulation microprocessor managing the screen and the touch-sensitive surface which are special peripherals.

The microcomputer according to the invention therefore comprises two microprocessors: one of them is dedicated to DOS and application programs (central

microprocessor) and the other is dedicated to the management of peripherals. Both microprocessors are connected by the said electronic interface.

According to the invention, the screen is a liquid crystal screen which has a 640 x 400 points definition and which is emulated in CGA (Colour Graphic Adapter) mode, the lines being doubled in superimposition mode, a zone of 640 x 200 points being emulated in CGA mode for the display of information in picture-in-picture mode.

The emulation microprocessor is connected to a static random access (RAM) video memory, receiving from this emulation microprocessor the data allowing the display of functions of the touch-sensitive surface. The central microprocessor is connected to a static random access (RAM) video memory receiving from this microprocessor the data allowing the display of information. A screen controller is connected by a parallel address bus and by a parallel data bus to the two video memories.

The microcomputer according to the invention comprises a central microprocessor made in CMOS technology, and an emulation microprocessor made in CMOS technology. According to the invention, the emulation microprocessor is a microprocessor of the INTEL 80C196 type, and the central microprocessor is a microprocessor of the INTEL 80C186 type.

According to the invention the microcomputer is of overall parallelepipedic shape, and the screen extends over the major portion of one of its large surfaces.

The microcomputer according to the invention comprises a fixed mass memory constituted from an additional electronic random access memory able to be used for storing data or at least in part as an extension of the central random access memory depending on the choice of the user.

The invention also proposes a microcomputer characterized in that it comprises a removable mass memory constituted by a removable electronic board comprising a static electronic random access memory

(RAM) and an electrical power source for the protection of stored data. As a variant, the removable mass memory is constituted by a removable electronic board comprising an electronic memory based on EPROM FLASH components. According to the invention, the removable electronic board comprises at least one microprocessor for managing stored data. According to the invention, the removable electronic board is connected to the microcomputer by an optical link, particularly an infrared serial link whose speed can be chosen between 9, 600 bits/s and 375 kbits/s. The invention also proposes a removable mass memory for a microcomputer, characterized in that it is constituted by a removable electronic board having a permanent electronic memory particularly such as mentioned above.

The invention also proposes a microcomputer, characterized in that it comprises a communications module using an infrared optical link with a separate communications unit which comprises at least one parallel port and at least one serial port in order that it may be connected to a peripheral and/or to another microcomputer and/or to an interface. Thus, only the separate communications unit is connected to the peripheral and/or to the other microcomputer and/or to the interface, and the microcomputer according to the invention communicates with the said communications unit through a high data rate infrared optical link. The communications module comprises an HDLC (High Level Datalink Control) controller connected to the bus of the emulation microprocessor; and a synchronization microsequencer whose sequencing is controlled by a signal transmitted by the separate and remote communications unit, via the infrared optical link. The invention also proposes such a communications unit between a microcomputer and a peripheral and/or another microcomputer, characterized in that it comprises means of communication by optical link, and means of electrical connection, in particular at least one serial port and/or at least one parallel port.

The invention also proposes a method for putting at least one microcomputer into communication with at least one peripheral and/or another microcomputer, characterized in that the said peripheral and/or the other microcomputer is connected to a communications unit by optical link with the said at least one microcomputer.

According to the invention, the microcomputer comprises a fully sealed external casing. Thus, it does not comprise any external electrical connector, all of the communications with the exterior being carried out by infrared optical link. However, the microcomputer according to the invention can comprise an external electrical power supply connector if this proves necessary.

According to the invention, the microcomputer comprises a housing to receive cadmium-nickel batteries for its electrical power supply.

The invention also proposes a microcomputer which comprises, in combination, all or some of the characteristics mentioned above, or only one of these characteristics.

The microcomputer according to the invention can be embodied in the form of a pad having a format equivalent to that of a sheet of paper (A4 format: 21 cm x 29.7 cm), having a thickness in the order of 30 mm, in particular of 28 mm, and having a weight in the order of 1 kg. It is therefore perfectly portable. Furthermore, because of its characteristics, the microcomputer according to the invention is compatible with other conventional personal microcomputers such as the IBM-PC (registered trade mark). It can therefore support the software and application software packages developed for these microcomputers. All of the mass memory being of the silicon electronic type, the microcomputer according to the invention does not include any mechanics. Furthermore, it is perfectly sealed and can therefore be used in a hostile environment without special precautions.

Furthermore, the large sized screen/keyboard occupying the entire surface of A4 format, having a definition of 640 x 400 points, touch-sensitive, graphical and analog with its mouse emulation provides excellent ergonomics and perfect user-friendliness. Even though no specific key is necessary, the microcomputer according to the invention advantageously comprises an on/off switch and several preprogrammed function keys such as: a key allowing the appearance of a window for noting messages, a key allowing the transmission of information according to a mode defined in a configuration menu; a key allowing the appearance of configuration data such as the memory area still available and the capacity or charge state of the batteries or accumulators; a key allowing the screen management mode to be changed (picture-in-picture or superimposition); a key for adjusting the contrast and brightness of the screen; a key allowing the instantaneous display of a numerical keyboard.

The constructive characteristics of the invention allow the obtaining of an extremely fast microcomputer having a high performance despite being of very small size and weight.

The microcomputer according to the invention can have an extremely efficient and simple dialogue with another conventional personal microcomputer, or with another peripheral, or with an interface. It is therefore extremely convenient to use. Finally, because of the constructive characteristics of the invention, the microcomputer has an independent functioning which is very much longer than one day when, for example, 4 cadmium-nickel batteries are used.

Other advantages and characteristics of the invention will appear on reading the following description which refers to the appended figures and in which:

- Figure 1 is a general perspective view of an embodiment of a portable microcomputer according to the invention.

- Figure 2 is a block diagram showing the general structure and functioning of a portable microcomputer according to the invention.

- Figure 3 is a block diagram illustrating the structure and functioning of the central and emulation microprocessors and of their interface, of a portable microcomputer according to the invention.

- Figure 4a is a block diagram showing the structure and functioning of the circuits controlling the display screen management of a portable microcomputer according to the invention.

- Figure 4b is a block diagram showing a variant of Figure 4a.

- Figure 5 is a flowchart illustrating the functioning of Figure 4a.

- Figure 6 is a block diagram illustrating the structure and functioning of the infrared optical links of a portable microcomputer according to the invention.

- Figure 7 is a temporal representation of the sequencing and synchronization signal of the infrared optical link communications module of a microcomputer according to the invention.

- Figure 8 is a flowchart of the BIOS (Basic Input Output System) program of the emulation microprocessor of a portable microcomputer according to the invention.

The invention relates to a portable microcomputer 1. Throughout the present application, the term "portable" means that the microcomputer can not only be carried easily, i.e. "transportable", but also can be used while it is being carried by the users, in the same way as a simple calculator or an information entry or data acquisition terminal.

The portable microcomputer 1 according to the invention is intended to be used either as an information entry or data acquisition terminal or as a genuine interactive personal microcomputer, particularly one which is compatible with other personal microcomputers such as the IBM-PC (registered trade mark) or other and can therefore execute the same application programs (office automation,

management, computation ...). The microcomputer 1 according to the invention therefore comprises at least one central microprocessor 2, one central random access memory 3, a display screen 4, and a plurality of built-in peripherals.

The central microprocessor 2 is a CMOS technology 16-bit microprocessor of the INTEL 80C186 type. The central random access memory is a static RAM memory of 600 kbyte capacity. The central board 5 supporting the central microprocessor 2 and the central random access memory 3 also comprises a 256 kbyte PROM memory 6, a clock 7 and a direct memory access (DMA) controller 8. The central board 5 provides, in a conventional way, an address/control bus 9 and a data bus 10. In the portable microcomputer in the figures, the plurality of built-in peripherals is constituted in particular from a removable memory 11, a fixed mass memory 12, and a mouse emulation circuit 13.

According to the invention, the portable microcomputer 1 comprises a transparent touch-sensitive surface 14 covering the display screen 4, and electronic means 15, 16, 17, 18, 19 of variable emulation of the display screen 4 and of the touch-sensitive surface 14. These means 15, 16, 17, 18, 19 allow the management of the entire screen area either as a zone for the display of information generated by the central board 5, or as a zone for the display of functions performed on the touch-sensitive surface 14. These electronic means 15, 16, 17, 18, 19 of variable emulation are at least partly connected to the touch-sensitive surface 14 on the one hand to be able themselves to be controlled from this touch-sensitive surface 14 by the user, and on the other hand in order to manage the emulation of this touch-sensitive surface 14 in such a way that no specific keyboard is necessary for dialogue with the microcomputer 1. In fact, according to the invention, the electronic means 15, 16, 17, 18, 19 of variable emulation allow the emulation of the touch-sensitive surface 14 as a keyboard whose function and format can be chosen at the

will of the user prior to use, and which can appear on a section of the screen.

According to the invention, the central microprocessor 2 and the electronic means 15, 16, 17, 18, 19 of variable emulation are capable of managing screen zones according to two possible modes, the user being able to choose, at any time, one or other of these modes: one mode called the "picture-in-picture" mode according to which the screen 4 is divided, at the will of the user, into at least one zone for the display of information generated by the central board 5, and at least one zone of the display of functions performed by the transparent touch-sensitive surface 14; and a mode called "superimposition" according to which the entire screen 4 is used for the display of information generated by the central board 5, the display of functions performed on the touch-sensitive surface 14 being able to be, at the will of the user, superimposed on the display of information generated by the central board 5 which is then masked by this display of functions.

According to the invention, the microcomputer 1 comprises external means 20 of control, particularly in the form of a key, of the electronic means 15, 16, 17, 18, 19 of variable emulation allowing the changing from one screen 4 management mode (picture-in-picture or superimposition) to the other at any time.

Such a transparent touch-sensitive surface 14 which can be superimposed on the screen 4 is already known per se (see in particular the European Patent Applications EP-A-249 417, EP-A-210 063, EP-A-186 464 and the American Patent US-A-4- 661 655, and the product marketed by the ELOGRAPHICS Company, Tenessee, United States, bearing the name DURATOUCH). Such a transparent touch-sensitive surface 14 provides an electrical signal allowing the determination of the position of the contact established by the user on this surface 14.

According to the invention, the screen 4 is a liquid crystal screen which has a definition of 640 x

400 points. The electronic means 15, 16, 17, 18, 19 of variable emulation and the central microprocessor 2 emulate this screen 4 in CGA (Colour Graphic Adapter) mode, the lines being doubled in superimposition mode, and a zone of 640 x 200 points being emulated in CGA mode for the display of information generated by the central board 5 in picture-in-picture mode. Thus, in the picture-in-picture mode, half of the screen, in particular the upper half, is emulated in CGA mode as a conventional screen of 640 x 200 points by the central microprocessor 2. The other half of the screen, in particular the bottom half, is reserved for the display of functions performed on the touch-sensitive surface 14 corresponding to a keyboard. On the contrary, in superimposition mode, the entire screen is used for displaying the information generated by the central board 5. As the central microprocessor 2 is of conventional type allowing the emulation of a 640 x 200 points screen, the lines are doubled, i.e. each line emulated in CGA mode by the central microprocessor 2 is displayed on two lines of the screen 4. The functions performed by the touch-sensitive surface 14 in superimposition mode can nevertheless be displayed, at the will of the user, by superimposition of these functions on the display of information generated by the central board 5. Thus, these functions performed on the touch-sensitive surface 14 can be displayed by priority, when the user commands it, with respect to the information coming from the central board 5.

According to the invention, the electronic means 15, 16, 17, 18, 19 of variable emulation comprise an emulation board 15 supporting an independent emulation microprocessor 21, dedicated to and programmed for the management of the screen 4 and of the touch-sensitive surface 14 according to the user's choice. The electronic means 15, 16, 17, 18, 19 of variable emulation also comprise an electronic interface 19 connecting the central microprocessor 2 to the emulation microprocessor 21.

The electronic means 15, 16, 17, 18, 19 of variable emulation are capable of managing the contact of the user's finger on the touch-sensitive surface 14 in the same way as a mouse. In order to do this, the emulation board 15 comprises a circuit 22 for managing peripherals allowing, in particular, the emulation of the touch-sensitive surface 14 as a mouse 13. In this way, the sliding of the finger on the touch-sensitive surface 14 and the point contacts of the finger on the touch sensitive surface 14 are interpreted by the emulation microprocessor 21 in the same way as would be the movements and validations of the cursor of a mouse.

According to the invention, the emulation microprocessor 21 is a CMOS technology 16-bit microprocessor of the INTEL 80C196 type. This emulation microprocessor 21 is responsible for all of the tasks necessary for the management and variable emulation of the peripherals, and for the linking of these peripherals with the central microprocessor 2. In this way, the central microprocessor 2 is released from these tasks and nevertheless continuously sees the IBM-PC (registered trade mark) compatible peripherals necessary for its functioning and for DOS and application programs as these peripherals and their functionings are simulated by the emulation microprocessor 21. By means of the interface 19 connecting these two microprocessors 2, 21 and by means of the general structure mentioned above, the microcomputer 1 according to the invention is extremely fast and of high performance. These microprocessors 2, 21 are timed at 12 MHz , and their BIOSs (Basic Input Output Systems) are specifically adapted to allow the execution of the abovementioned functions of the microcomputer 1. For example, because of its total compatibility with personal microcomputers of the IBM-PC (registered trade mark) type, the central microprocessor 2 is managed by the Digital Research DR-DOS operating system. The BIOS installation program of the emulation microprocessor 21 is designed to allow the variable emulation of the touch-sensitive surface

14 and of the screen 4 as mentioned above, the emulation of the mouse on the touch-sensitive surface 14, and the management of the mass memories 11, 12, and of the communications of the microcomputer 1 with the exterior. The use of CMOS technology microprocessors enables a better integration and a very low consumption of electricity, which gives a greater independence to the microcomputer 1. The BIOS installation program of the emulation microprocessor 21 is also designed to allow communications with the central microprocessor 2 via the interface 19 designed for this purpose.

This interface 19 enables, in particular, the central microprocessor 2 and the emulation microprocessor 21 to manage, at high speed and in CGA mode, according to the picture-in-picture mode or according to the superimposition mode, both the screen 4 and the touch-sensitive surface 14 used as a keyboard.

The emulation microprocessor 21 supported by the emulation board 15 is connected to an address and control bus 29 and to a data bus 30. The address and control buses 9, 29, shown in Figure 2 are shown separated as an address bus 9a, 29a, and a control bus 9c, 29c in Figure 3. In Figures 2 and 3, the crossovers corresponding to actual connections between buses or electrical links are represented by square-shaped dots. The other crossovers do not correspond to actual links.

According to the invention, the interface 19 comprises: a static double access random access memory (RAM) 25 connected to the data 10, 30 and address 9a, 29a buses of each of the central 2 and emulation 21 microprocessors; a FIFO address memory 26 whose input 31 is connected to the address bus 9a of the central micro processor 2, and whose output 32 is connected to the data bus 30 of the emulation microprocessor 21; a FIFO write memory 27 allowing the transfer of the data in blocks in DMA mode from the data bus 10 of the central microprocessor 2 onto the data bus 30 of the emulation microprocessor 21, the FIFO write memory 27

being connected to these data buses 10, 30; a FIFO read memory 28 allowing the transfer of the data in blocks from the data bus 30 of the emulation microprocessor 21 onto the data bus 10 of the central microprocessor 2, the FIFO read memory 28 being connected to these buses 10, 30. In Figure 3, the data buses 10, 30, the address buses 9a, 29a, and the control buses 9c, 29c have been shown directly connected to the central 2 and emulation 21 microprocessors. However, in practice, the link of these buses 10, 30, 9a, 29a, 9c, 29c to the microprocessors 2, 21, is carried out as shown in Figure 2 via the central board 5 and the emulation board 15 and input-output address decoding circuits 33, 34. The address decoding circuit 33 is connected to the central board 5 via the address and control bus 9 and transmits control signals 35, 36, 37 to the double access RAM memory 25, the FIFO address memory 26, the FIFO write memory 27 and the FIFO write memory 28. The signal 35 transmitted to the double access RAM memory 25 by the decoding circuit 33 is a signal for selecting this memory 25. The signal 36 is transmitted by the said decoding circuit 33 simultaneously to the FIFO address memory 26 and to the FIFO write memory 27 and corresponds to a write signal to these FIFO memories. The signal 37 transmitted to the FIFO read memory 28 is a signal controlling the reading of this FIFO read memory 28. Similarly, the input-output address decoding circuit 34 is connected to the emulation board 15 via the address and control bus 29 and transmits signals 38, 39, 40 to the double access RAM memory 25, the FIFO address memory 26, the FIFO write memory 27, and the FIFO read memory 28. The signal 38 transmitted by the decoding circuit 34 to the double access RAM memory 25 is a signal for selecting this memory 25. The signal 39 is simultaneously transmitted by the decoding circuit 34 to the FIFO address memory 26 and to the FIFO write memory 27 and is a signal for reading these FIFOs. The signal 40 transmitted to the FIFO read memory 28 is a signal for writing this FIFO.

The interface 19 furthermore comprises an interrupt management controller 41 connecting the two address and control buses 9, 29 of the central 2 and emulation 21 microprocessors, and allowing the emulation of the zero reset of interrupts previously generated by the emulation microprocessor under the same conditions as though these interrupts had been generated by the emulated peripherals.

The FIFO address memory 26 allows the emulation microprocessor 21 to know the requests of the central microprocessor 2 on the peripherals concerned by the emulation. With the value simultaneously written in this FIFO address memory 26 and in the double access RAM memory 25, the emulation microprocessor is warned of the requests of the central microprocessor 2, and can interpret the data present in the double access RAM memory 25 correctly. Thus, the double access RAM memory 25 allows the transmission of control characters between the central microprocessor 2 and the emulation microprocessor 21 and vice versa. In particular, this double access RAM memory 25 allows the returning to the central microprocessor 2 of data requested by the latter in "character" mode and allows the central microprocessor 2 to see its read requests at addresses compatible with what is carried out in conventional personal microcomputers such as IBM-PC XT (registered trade mark), as though the emulated peripherals truly existed and were perfectly compatible.

The FIFO write memory 27 and the FIFO read memory 28 allow the transfer of data in DMA mode in blocks during writing or reading by the central microprocessor 2.

The interface 19 therefore allows the synchronization of the functioning of the central microprocessor 2 and the emulation microprocessor 21, and allows the emulation microprocessor 21 to translate addresses between the central microprocessor 2 and the peripherals. By means of the double access RAM memory 25 and of the FIFO address memory 26 a link and the transmission of control instructions between the two

microprocessors 2, 21 is established. Furthermore, the FIFO memories 26, 27, 28 have a capacity of 512 bytes corresponding to a sector. In this way, the read and write operations of these memories by one of the microprocessors is not necessarily synchronized with the corresponding write and read operations which must be carried out by the other microprocessor.

According to the invention, the emulation microprocessor 21 is connected by its address and control bus 29 and by its data bus 30 to a static random access RAM type video memory 16 receiving from this microprocessor 21 the data allowing the display of functions of the touch-sensitive surface 14. Thus this display of functions of the touch-sensitive surface 14 is controlled by the emulation microprocessor 21 via the video memory 16 with which is it associated. Similarly, the central microprocessor 2 is connected by its address and control bus 9 and by its data bus 10 to a static random access RAM type video memory 18 receiving from this central microprocessor 2 the data allowing the display of information generated by the central board 5. Thus, this display of information generated by the central board 5 is controlled by the central microprocessor 2 through the intermediary of the video memory 18 with which it is associated. The microcomputer 1 according to the invention furthermore comprises a screen controller 23 which is connected to the two video memories 16, 18 on the one hand by an address bus 42 connected in parallel to these two video memories 16, 18 and on the other hand by a data bus 43, also connected in parallel to the two video memories 16, 18. The screen controller 23 is also connected to the screen 4 via a bus 44, and controls its functioning. The screen controller 23 is a liquid crystal screen controller. It is also directly connected to the address and control bus 9 and to the data bus 10 of the central microprocessor 2, and to the input-output address decoding circuit 33 which supplies it with a control signal 45. In this way, the screen controller 23 is controlled in picture-in-picture mode

or in superimposition mode by the central microprocessor 2 which controls the screen controller 23 in CGA mode for the display of information generated by the central board 5. In picture-in-picture mode, the microprocessor 2 controls the screen controller 23 for a display over a zone of 640 x 200 points, particularly the upper half-screen. In superimposition mode, the central microprocessor 2 controls the screen controller 23 for a display in CGA mode using 640 x 200 points, but doubling each line to be displayed.

The transfer of data on the data bus 43 of the screen controller 23 from one or other of the video memories 16, 18 is selected by a logic circuit 17. The address bus 42 of the screen controller 23 is connected to this logic circuit 17. Furthermore, the emulation microprocessor 21 transmits to this logic circuit 17 a control signal 46 (Figure 4) for controlling this logic circuit 17 according to the picture-in-picture mode or according to the superimposition mode which has been chosen, and it does this in a way which agrees with the method of managing the screen controller 23 by the central microprocessor 2. Thus, in superimposition mode, the logic circuit 17 controls the reading of the video RAMs 16, 18 by the screen controller 23 while doubling the lines. On the contrary, in picture-in-picture mode, the logic circuit 17 does not double the reading of the video memories 16, 18 by the screen controller 23.

The screen controller 23 generates a refresh frame, and then, successively, the various addresses corresponding to the positions to be displayed on the screen 4 on its address bus 42. For each address presented, corresponding to a position on the screen 4, the logic circuit 17 selects the transmission on the data bus 43 of the information to be displayed, either by the video memory 6 connected to the emulation microprocessor 22, or by the video memory 18 connected to the central microprocessor 2. The video memory 18 connected to the central microprocessor 2 also receives a control signal 47 from the input-output address

decoding circuit 33 associated with the central microprocessor 2 (Figure 2). Similarly, the video memory 16 connected to the emulation microprocessor 21 receives a control signal 48 from the input-output address decoding circuit 34 associated with this emulation microprocessor 21.

In both the picture-in-picture mode and in the superimposition mode, the user can control the images appearing on the screen 4 and can, in particular, cause the appearance of one or more windows for the display of functions, or for personal use, over any area of the screen 4. Even in the picture-in-picture mode, the user can make such a window appear in superimposition on the zone reserved for the isplay of information generated by the central board 5. Thus, the user has a total control of the images which can appear on the screen and has this control in a way which is independent of the software package being executed on the central microprocessor 2. In fact, the video memory 16 associated with the emulation microprocessor 21 comprises data corresponding to the functions of the keyboard type performed on the touch-sensitive surface 14, or to windows for the user's use. On the contrary, the video memory 18 associated with the central microprocessor 2 comprises only data corresponding to the display of information generated by the central board 5 according to the programs being executed on the central microprocessor 2. The logic circuit 17 therefore allows the transmission on the data bus 43 of the screen controller 23, and in a way which is transparent to this controller 23, either of the data coming from the video memory 18 associated with the central microprocessor 2, or the data coming from the video memory 16 associated with the emulation microprocessor 21. Furthermore, the emulation microprocessor 21 controls this logic circuit 17 in such a way as to impose the display of windows at the will of the user on the screen 4.

In order to do this (Figure 4a), the microcomputer 1, according to the invention, comprises a FIFO address

memory 49 connected by an address bus 50 to the emulation microprocessor 21. This emulation microprocessor 21 supplies the FIFO memory 49 with the addresses computed and decoded corresponding to the borders of the screen 4 between the zones for the display of information and the zones for the display of functions or windows, and it does this in the order in which these addresses are generated by the screen controller 23 on its address bus 42. The FIFO address memory 49 is connected to the logic circuit 17 by an address bus 51. The FIFO address memory 49 receives from the logic circuit 17 a control signal 73 initiating the change in the value present in this memory 49 after each equality noted between the address present on the bus 51 and coming from this memory 49 and the address present on the bus 42 coming from the screen controller 23. Thus, the logic circuit 17 is a comparator circuit connected to the bus 42 of the screen controller 23 and to the said FIFO address memory 49, and transmits a control signal 52, 53 to each video memory 16, 18 respectively associated with each microprocessor 2, 21 in order to control the reading of data by the screen controller 23 via the data bus 43 in one or other of these video memories 16, 18, as a function of the address comparison carried out between the address present on the address bus 42 of the screen controller 23 and that present on the address bus 51 coming from the FIFO address memory 49. The control signals 52, 53 are transmitted as a function of the screen emulation mode (picture-in-picture or superimposition) chosen by the user on one or other of the transmission registers of the video memories 16, 18 on the data bus 43 of the screen controller 23. The control signals 52, 53 allow the inhibiting and validating respectively of the bus transmitters of the video memories 16, 18 connected to the data bus 43 of the screen controller 23.

The addresses of the borders of the windows to be dedicated to the emulation microprocessor 21 or to be superimposed on information coming from the central

board 5 are computed and generated on the FIFO address memory 49 by the emulation microprocessor 21 itself, independently from the management of the video memory 16, 18, particularly of the video memory 18 associated with the central microprocessor 2. In this way, the user can open several windows of variable dimensions (for personal use or for the display of the functions of the surface 14) and can place these windows anywhere on the screen, and can do this in a way which is totally independent of the functioning of the software package in progress on the central microprocessor 2. The number of windows and their dimensions, particularly their height, which the user can thus open depends only on the memory capacity of the FIFO address memory 49 which is used.

The functioning method of these circuits controlling the management of the display screen 4 is illustrated in the flowchart shown in Figure 5. This method is carried out at each refresh frame whose start is represented by step 54. In default, the logic circuit 17 transmits the control signal 53 to the video memory 18 of the central microprocessor 2 in order to control the reading of this video memory 18 by the screen controller 23, which is represented by step 55. Such is the case at the start of each refresh frame, and when the emulation microprocessor 21 is not transmitting any value into the FIFO address memory 49, i.e. when the user does not desire to display display zones of functions or windows for personal use on the screen 4. If, on the contrary, the user commands the display of a window on the screen 4, the emulation microprocessor 21 previously loads all of the border addresses into the FIFO address memory 49 corresponding to this window. The start of FRAME signal then initiates the appearance of the first address contained in the FIFO memory on the address comparator 17.

Assuming that the screen controller 23 generates the addresses successively corresponding to the positions on the screen from left to right and from top to bottom, line by line, the first address value loaded

in the FIFO address memory 49 is that which corresponds to the top left corner of the said window to be displayed. The addresses successively loaded into the FIFO address memory 49 by the emulation microprocessor 21 will, chronologically, be as follows:

- top left corner: first line, first column of the window,
- first line, last column of the window,
- second line, first column of the window,
- second line, last column of the window,
- third line, first column of the window,
- third line, last column of the window
- ...,
- ...,
- last line, first column of the window (bottom left corner),
- last line, last column of the window (bottom right corner).

These addresses therefore correspond to the columns representing the border between the screen zone possibly reserved for the display of information generated by the central board 5, and the window generated by the emulation microprocessor 21, at the will of the user.

When the screen controller 23 generates the addresses of positions of the screen 4, these addresses are presented successively by the screen controller 23 to the logic circuit 17, which is represented by step 57 in Figure 5. The logic circuit 17 then carries out, for each address presented by the screen controller 23, the comparison, in 58, between the address presented by the screen controller 23 and the address presented to the comparator from the FIFO address memory 49. If these addresses are not equal, nothing is changed, and the logic circuit 17 continues to transmit the control signal 53 to the video memory 18 associated with the central microprocessor 2. If, on the contrary, the addresses are equal, the logic circuit 17 inhibits the control signal 53 and, on the contrary, transmits the control signal 52 to the video memory 16 associated

with the emulation micro processor 21, which initiates the reading by the screen controller 23 of the values present in this video memory 16, and which is represented by step 59. In such a case, the logic circuit 17 also transmits a control signal 73 to the FIFO address memory 49 in order to initiate the loading from the FIFO address memory 49 of the next comparison address, which is then presented to the comparator. Until the next address equality, i.e. until the next border of the window, the state of the control signals 52, 53 of the video memories 16, 18, is not modified by the logic circuit 17. As it happens, all of the data presented to the screen controller 23 on its data bus 43 up to the next equality of addresses will be data coming from the video memory 16 associated with the emulation microprocessor 21. The loading of the new value in the FIFO address memory 49 by the signal 73 is represented by step 60 in Figure 5. Step 61 corresponds to the next presentation of the address on the bus 42 by the screen controller 23 to the logic circuit 17. This logic circuit 17 makes the comparison at 62 between the successively presented addresses and the new value present on the comparator corresponding to the next border. As long as this screen controller 23 has not reached this new value, nothing is changed, it continues to read the video memory 16 associated with the emulation microprocessor 21 under the effect of the control signal 52, successively, and therefore to display the portion of line corresponding to the window to be displayed. On the contrary, as soon as the address presented by the screen controller 23 on its bus 42 to the logic circuit 17 corresponds to the right border and is equal to the value present in the address memory 49, the logic circuit 17 modifies the state of the signals 52, 53, while inhibiting the signal 52, and transmitting the signal 53 initiating the reading of the video memory 18 associated with the central microprocessor 2 by the screen controller 23, according to step 63 in Figure 5. Then, the control signal 73 is again transmitted to load the next value

from the FIFO address memory 49. The value corresponding to the left border of the next line of the window is then entered in this FIFO address memory 49, according to step 64 in Figure 5. The process is then repeated between the steps 56 and 57 in such a way that the screen controller 23 displays the information from the video memory 18 associated with the central microprocessor 2 until the next address equality, i.e. until the next left border defined by the value present in the FIFO address memory 49.

This method allows the two microprocessors 2, 21, to share, in real time, a common display space on the same screen 4. The central microprocessor 2 transmits to the video memory 18 in 640 x 200 points CGA mode. The method adopted and described above allows the emulation microprocessor 21 to create its own display space in size, position and number of video windows independently from the application in progress in the central microprocessor 2 and in an extremely fast manner.

A variant embodiment is shown in Figure 4b. In this variant, the microcomputer according to the invention comprises an RAM memory 110 connected to the emulation microprocessor 21 which supplies it with the values identifying each byte which must be displayed on the screen 4. This identification value enables the screen controller 23 to know in which video memory 16, 18 it must search for the information to be displayed. Thus, each address sent by the screen controller 23 is presented to this RAM memory 110, which then transmits the identification data bits which then act as a control signal 52, 53 to each video memory 16, 18 in order to control the reading of the data by the screen controller 23 from one or other of these video memories 16, 18.

The RAM memory 100 is connected to the emulation microprocessor 21 by an address bus 111. The RAM memory 110 is connected to the address bus 30 of the screen controller 23.

According to the invention, the microcomputer 1 comprises a fixed mass memory 12 constituted from an additional electronic static random access memory (RAM) which can serve for the storage of data in a way which is similar to that of a hard disk. Such fixed electronic mass memories are also called silicon hard disks by a misuse of language. This fixed mass memory 12 is used by the central microprocessor 2 via the emulation microprocessor 21 and the interface 19. According to the invention, this fixed mass memory 12 is advantageously constituted from static RAMs whose capacity is between 2 and 6 megabytes. According to the invention, this fixed mass memory 12 can be configured at least in part as an extension of the central random access memory 2. In fact, for certain applications (for example the LOTUS 1, 2, 3 software package (registered trade mark) by the MICROSOFT company), it is necessary to be able to have the use of an extension to the central memory at specific times. The presence of this fixed mass memory 12 of the same type as the central memory 2 (static RAM) enables this memory extension to be carried out by simple configuration of the microcomputer 1.

A microcomputer 1 according to the invention is characterized in that it comprises a removable mass memory 11 constituted by a removable electronic board comprising a static electronic random access memory (RAM) 65 and a source of electrical energy 66 for protecting the stored data. As a variant, in order to avoid the presence of such a source of electrical energy in order to supply the static electronic random access memory (RAM) of this electronic board, the removable mass memory 11 according to the invention can be constituted by a removable electronic board comprising an electronic memory based on components of the EPROM FLASH type. Such components, recently placed on the market, allow the storage of data without the necessity of a back-up electrical power source and have sufficient speed to be able to be used as a mass memory.

According to the invention, this removable electronic board 11 constituting the removable mass memory comprises at least one microprocessor 67 for managing stored data. In the embodiment shown, this removable electronic board 11 is constituted from a board in the format according to the ISO standards of the bank format type, and therefore comprises an electronic random access memory 65, an independent source of electrical energy 66 when this memory is of the RAM type, and a microprocessor 67 for managing the stored data. The presence of this microprocessor 67 allows the management of the protected data, provides the possibility of entering automatic error correcting codes at the level of the stored bits, and allows a better management of the serial infrared link 68 described hereafter. In fact, according to the invention, the removable electronic board 11 is connected to the microcomputer 1 by an optical link 68 which is a serial infrared link whose speed can be chosen between 9,600 bits/s and 375 kbits/s. In order to do this, the circuit 22 for managing the peripherals of the emulation board 15 comprises a transmitting photodiode 69 and a receiving photodiode 70 (Figure 6). Similarly, the removable electronic board 11 comprises a transmitting photodiode 71 and a receiving photodiode 72. The serial infrared optical link is managed by the microprocessor 67 of this electronic board 11. This infrared optical link avoids the presence of electrical connectors between the removable electronic board 11 and the casing of the microcomputer 1. In fact, such an electrical connector would necessitate a large number of contact points and would therefore be voluminous and not very reliable in a hostile environment. In practice, the board 11 comprises two electrical connection points for the microcomputer 1 for its electrical power supply.

Furthermore, a microcomputer 1 according to the invention is characterized in that it comprises a communications module 74 using an infrared optical link 85 with a separate communications unit 75. The

separate communications unit 75 comprises at least one parallel port 76 and at least one serial port 77 such that it can be connected to a peripheral and/or to another microcomputer and/or to an interface. The communications module 74 which communicates by an infrared optical link 85 with the separate communications unit 75, is an integral part of the circuit 22 for managing the peripherals of the emulation board 15.

The communications module 74 comprises a transmitting diode 78 and a receiving diode 79. Similarly, the separate communications unit 75 comprises a transmitting diode 80 and a receiving diode 81. The separate communications unit 75 comprises a circuit 82 transmitting a synchronization signal shown in Figure 7. The FRAME period of highest value of this synchronization signal is variable and corresponds to the predefined transmission speed on the infrared link 85. The separate communications unit 75 transmits the synchronization signal shown in Figure 7 to the communications module 74. The communications module 74 comprises an HDLC (High Level Data Link Control) controller 83 connected to the address and control bus 29 and the data bus 30 of the emulation microprocessor 21. The communications module 74 also comprises a microsequencer 84 the synchronization of which is controlled in sequencing by a signal transmitted by the circuit 82 of the communications unit 75, which is remotely positioned, via the infrared optical link 85. The HDLC controller 83 transforms the information coming from the emulation microprocessor 21 into signals which can be used on the infrared link 85 to the microsequencer 84 which synchronizes the transmission and reception of these signals intended for the separate communications unit 75 on an appropriate transmitting/receiving time channel. The microsequencer 84 is therefore connected to the transmitting 78 and receiving 79 diodes of the communications module 74 of the microcomputer 1 according to the invention.

The functioning of this infrared optical link 85 is as follows.

When the emulation microprocessor 21 wishes to communicate with an external peripheral, the circuit 82 transmits a synchronization signal to the microsequencer 84, via the infrared link 85, which is a square signal whose FRAME period corresponds to the said transmission speed. The synchronization signal (Figure 7) also comprises a series of square signals at a higher frequency corresponding to the number of microcomputers 1 able to be connected to the communications unit 75, i.e. to the number of channels which the communications unit 75 can manage. In the example shown, the synchronization signal is divided into eight channels.

As a function of this signal transmitted by the communications unit 75, the microsequencer 84 of each microcomputer 1 which wishes to communicate with this unit 75 synchronizes itself on the said signal in order to transmit or receive the signals on the infrared link 85 during the time which corresponds to the channel which is allocated to it. One of the channels of the synchronization signal, particularly channel 8, is reserved for allowing the microsequencer 84 to find a free channel and to reserve this channel for itself. Thus, as a function of the information received by channel 8, the microsequencer 84 will be able to know if there is a free channel and, if there is, which one. After determination of the free channel, the microsequencer 84 transmits a signal allocating this channel and synchronizes itself on this channel. Then, the microsequencer 84 formats the signal coming from the HDLC controller 83 in such a way as to transmit only during the allocated time interval corresponding to this channel, and conversely receives during this interval the signals coming from the receiving diode 79 and converts them into signals which can be used by the HDLC controller 83.

In this way it is possible to manage a multichannel access to the separate communications unit

75. In the example shown in Figure 7 in which the synchronization signal comprises eight channels, it is therefore possible to manage seven simultaneous accesses to the communications unit 75, and therefore to its interface ports 76, 77 with the external peripherals.

This multichannel time management method has the advantage of generating on the diode 78 of the communications module an active signal of low duty cycle and therefore of being able to transmit more instantaneous power into this diode while retaining an average value which is compatible with their characteristics. The transmission range is thus increased in this way. In fact, during each period of the synchronization signal, the diode 78 is only active during the time corresponding to the allocated channel. As the power capacity of the diodes essentially depends on the average current intensity carried, it is possible to considerably increase this average current intensity with respect to the nominal characteristics determined according to a functioning over a complete signal period. Obviously, there is still an upper limit not to be exceeded for the instantaneous current intensity which the diodes can withstand.

In practice, the diodes 78, 79, 80, 81 of the infrared serial link 85 are chosen to have a passband matched to the data rate and speed required for the transmission. Thus, diodes having a passband in the order of 1MHz enable the management of eight channels, i.e. the connection of seven microcomputers 1 at 64 kbits/s to the same separate communications unit 75, and the transmission can be validly carried out up to distances of between 5 and 10 m. Thus, in a same room, several microcomputers 1 according to the invention will be able to simultaneously communicate with the same communications unit 75 which is physically connected by its ports 76, 77 to a peripheral and/or to a personal microcomputer and/or to an interface.

The invention also proposes such a communications unit 75 and a method of communications using such a unit and an infrared optical link.

All of the logic and electronics circuits mentioned above are largely known per se by those skilled in the art who know how to execute the functions with the help of electronic components, particularly those based on integrated circuits, and will not therefore be described in greater detail.

The microcomputer 1 according to the invention comprises an external casing 86 having an overall parallelepipedic shape. The screen 4 extends over the major part of one 87 of its large surfaces. The external casing 86 is totally sealed and does not comprise any external electrical connector, all of the communications with the exterior being made by means of the infrared optical links 68, 85 mentioned above. However, the microcomputer 1 according to the invention can comprise an external electrical power supply connector 88 enabling this microcomputer 1 to be connected to the mains. Furthermore, the microcomputer 1 according to the invention comprises a housing 89 to receive batteries or accumulators for its independent electrical power supply. In the embodiment shown, the housing 89 can receive four cadmium-nickel batteries.

The external casing 86 also supports an infrared transmission unit 90 incorporating the elements necessary for the infrared optical link 85 with a separate communications unit 75, and also the elements necessary for the infrared optical link 68 for communication with the removable electronic board 11. This transmission unit 90 therefore incorporates, in particular, the various transmitting and receiving diodes, 78, 79, 69 and 70. Furthermore, the external casing 86 defines a housing 91 for the removable electronic board 11. The infrared transmission unit 90 is situated near the internal end of the housing 91 of the electronic board 11 in order to enable a good transmission of data between this unit 90 and the electronic board 11 via the infrared link 68.

The external casing 86 also carries an on/off button 92 and the key 20 allowing the change from the picture-in-picture mode to the superimposition mode mentioned above.

In the embodiment shown, other preprogrammed function keys are also provided, these keys facilitating the use of the microcomputer 1 according to the invention. These keys are disposed along one of the shorter edges of the screen 4. In particular the following are provided:

- a note key 93 allowing a window to appear for the personal use of the user, for example to note messages in it.
- a transmission key 94 allowing the control of data transmission via the infrared link 85,
- a configuration key 95 allowing the appearance on the screen of information relating to the configuration of the microcomputer 1 (memory capacity still available, charge state of batteries, configuration of the infrared transmission link ...)
- a key 96 for adjusting the contrast and bright ness of the screen 4,
- a key 97 automatically managing the display, on the screen 4, of an alphanumeric keyboard or of a specific predetermined keyboard,
- a key 98 automatically managing the display, on the screen 4, of a digital keyboard.

In practice it has been possible to produce a microcomputer 1 according to the invention having a thickness of 28 mm, and having a format corresponding to the standard A4 format and whose weight is in the order of 1 kg, such as shown in Figure 1. Such a microcomputer 1 is totally compatible with the known personal micro computers, and in particular is PC (registered trade mark) compatible and offers all of the advantages of such a known microcomputer. It can support and perfectly use all of the software and applications software packages developed for these personal microcomputers. It has a fixed mass memory and a removable mass memory.

Furthermore, the infrared optical link with a separate communications unit 75 and the presence of the removable electronic board 11 of ISO format provides additional advantages for the microcomputer 1 according to the invention. These features of the invention are nevertheless applicable to other microcomputers, whether they are transportable, portable or neither.

Figure 8 shows a flowchart of the BIOS (Basic Input Output System) program installed in the INTEL 80C196 emulation microprocessor 21 according to the invention. This flowchart can be understood in itself and does not require a more detailed description for those skilled in the art.

The claims defining the invention are as follows:

1. Portable microcomputer comprising at least one central microprocessor, a central random access memory, a display screen, a plurality of built-in peripherals, a transparent touch-sensitive surface covering the display screen, and electronic means of emulation which are variable at the will of the user of the display screen and of the touch-sensitive surface, allowing the management of any screen one either as an information display zone or as a zone for the display of functions performed on the touch-sensitive surface, wherein the electronic means of variable emulation are connected to the touch-sensitive surface on the one hand in order that they may themselves be controlled from this touch-sensitive surface, and on the other hand in order to manage the emulation, in such a way that no specific keyboard is necessary for carrying out a dialogue with the microcomputer.

2. Microcomputer according to claim 1, wherein the central microprocessor and the electronic means of variable emulation are capable of managing screen zones according to two possible modes, the user being able to choose one or other of these modes; a picture-in-picture mode in which the screen is divided, at the user's will, into at least one information display zone and at least one function display zone; and a superimposition mode in which the entire screen is used for information display, the display of functions performed on the touch-sensitive surface being able, at the will of the user, to be superimposed on the information display which is then masked by this display.

3. Microcomputer according to claim 2, further comprising external means of control, in particular one key, of the electronic means of variable emulation enabling the changing from one screen management mode to the other at any time.

4. Portable microcomputer as claimed in claim 1, further comprising a further microprocessor which is separate from the central microprocessor, and dedicated to and programmed for the management of peripherals and continuously simulating, for the central microprocessor, via an interface, the functioning of these peripherals.

5. Microcomputer according to any one of claims 1 to 4, further comprising electronic means of variable emulation comprising an independent emulation microprocessor, dedicated to and preprogrammed for the management of the screen and of the touch-sensitive surface depending on the choice of the user, and an electronic interface connecting the central microprocessor to the emulation microprocessor.

6. Microcomputer according to any one of claims 1 to 3 or 5, wherein the electronic means of variable emulation are capable of managing the contact of the user's finger on the touch-sensitive surface in the same way as a mouse.

7. Microcomputer according to any one of claims 4 to 6, wherein the interface comprises:

a static random access memory (RAM) with double access connected to the data and address buses of each of the central and emulation microprocessors;

a FIFO address memory whose input is connected to the address bus of the central microprocessor, and whose output is connected to the data bus of the emulation microprocessor;

a FIFO write memory allowing the transfer of the data in blocks from the data bus of the central microprocessor onto the data bus of the emulation microprocessor to which buses it is connected; and

a FIFO read memory allowing the transfer of the data in blocks from the data bus of the emulation microprocessor onto the data bus of the central microprocessor to which buses it is connected.

8. Microcomputer according to any one of claims 1 to 7, wherein the screen is a liquid crystal screen which has a 640 x 400 points definition and which is emulated in CGA mode, the lines being doubled in superimposition mode, a zone of 640 x 200 points being emulated in CGA mode for the display of information in picture-in-picture mode.

9. Microcomputer according to any one of claims 5 to 8, wherein the emulation microprocessors is connected to a static random access (RAM) video memory receiving from this microprocessor the data and the addresses allowing the display of the functions of the touch-sensitive surface, in that the central microprocessor is connected to a static random access video memory receiving from this microprocessor the data and the addresses allowing the display of information, and in that it

comprises a screen controller connected by an address bus in parallel to the two video memories and by a data bus in parallel to the two video memories.

10. Microcomputer according to any one of claims 4 to 9, wherein the central microprocessor and the separate or emulation microprocessor are each made in CMOS technology.

11. Microcomputer according to claim 5 or 10, wherein the electronic means of variable emulation comprise an INTEL 80C196 emulation microprocessor and in that the central microprocessor is an INTEL 80C186 microprocessor.

12. Microcomputer according to any one of claims 1 to 11, further comprising a fixed mass memory constituted from an additional electronic random access memory able to be used for storing data or at least in part as an extension of the central random access memory.

13. Microcomputer as claimed in any one of the preceding claims further comprising a removable mass memory constituted by a removable electronic board comprising a static electronic random access memory and an electrical power source for the protection of stored data.

14. Microcomputer as claimed in any one of claims 1 to 12, further comprising a removable mass memory constituted by a removable electronic board comprising an electronic memory based on EPROM FLASH components.

15. Microcomputer according to either one of claims 13 and 14, when the removable electronic board comprises at least one microprocessor for managing stored data.

16. Microcomputer according to any one of claims 13 to 15, wherein the removable electronic board is connected to it by an optical link.

17. Microcomputer according to claim 16, where the said optical link is an infrared serial link whose speed can be chosen between 9,600 bits/s and 375 kbits/s.

18. Microcomputer, as claimed in any one of the preceding claims, further comprising a communications module, using an infrared optical link, with a communications unit which comprises at least one parallel port and at least one serial port in order that it may be

connected to a peripheral and/or to another microcomputer and/or to an interface.

19. Microcomputer according to claim 18, wherein the communications module comprises an HDLC controller connected to the buses of the emulation microprocessor.

20. Microcomputer according to either of claims 18 or 19, wherein the communications module comprises a synchronization microsequencer whose sequencing is controlled by a signal transmitted by the remotely positioned communications unit via the infrared optical link.

21. Microcomputer according to any one of claims 1 to 20, further comprising an external casing having an overall parallelepipedic shape and in that the screen extends over the major part of one of its large surfaces.

22. Microcomputer according to any one of claims 1 to 20, further comprising an external casing which is fully sealed and which does not comprise any external electrical connector, all of the communications with the exterior being carried out by optical link.

23. Microcomputer according to any one of claims 1 to 22, further comprising a housing to receive batteries or accumulators for its electrical power supply.

24. A portable microcomputer substantially as described herein with reference to the drawings.

DATED this NINTH day of OCTOBER 1992

Telematique Videotex Francaise T.V.F.

Patent Attorneys for the Applicant
SPRUSON & FERGUSON

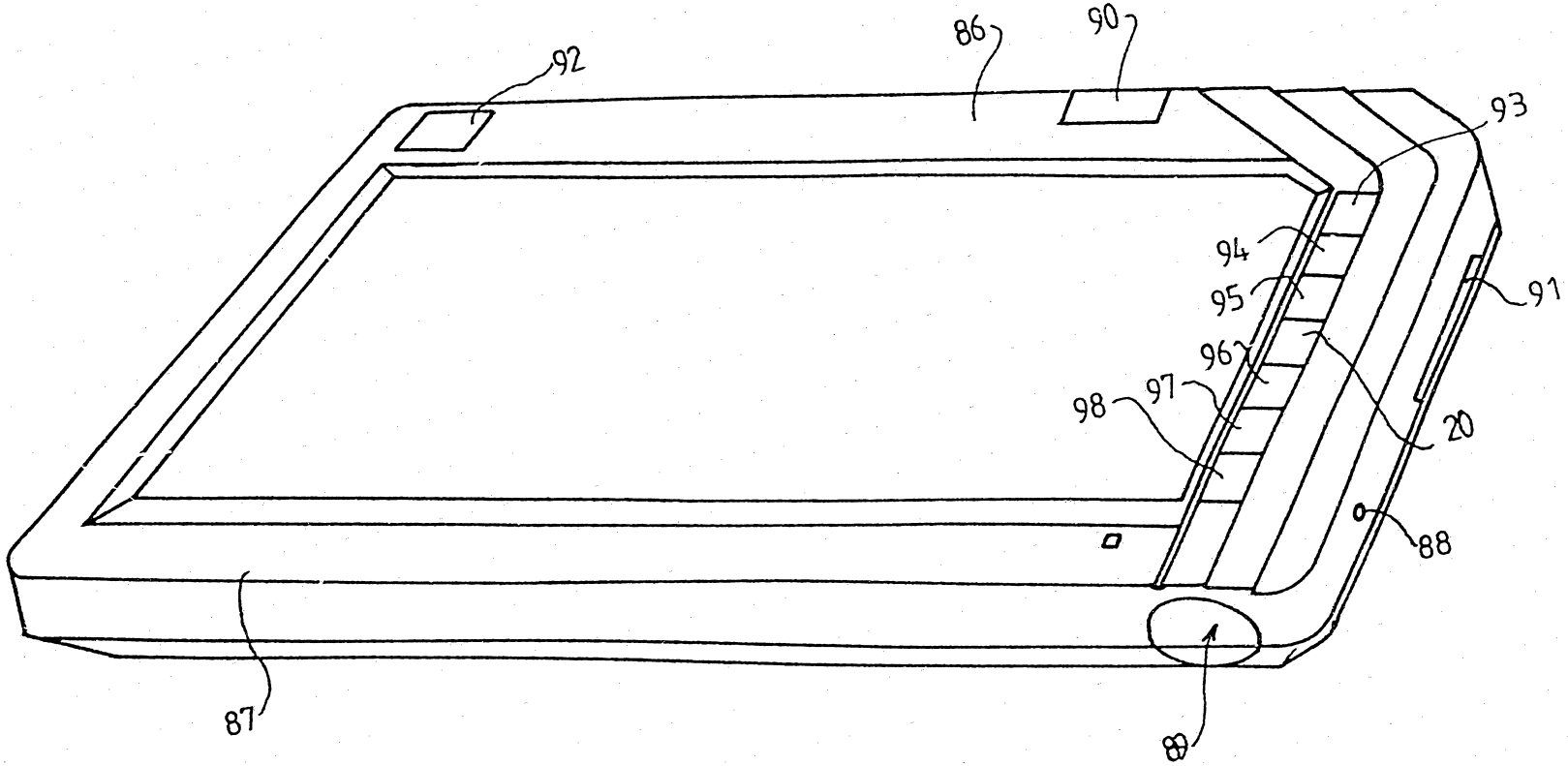

FIG.1

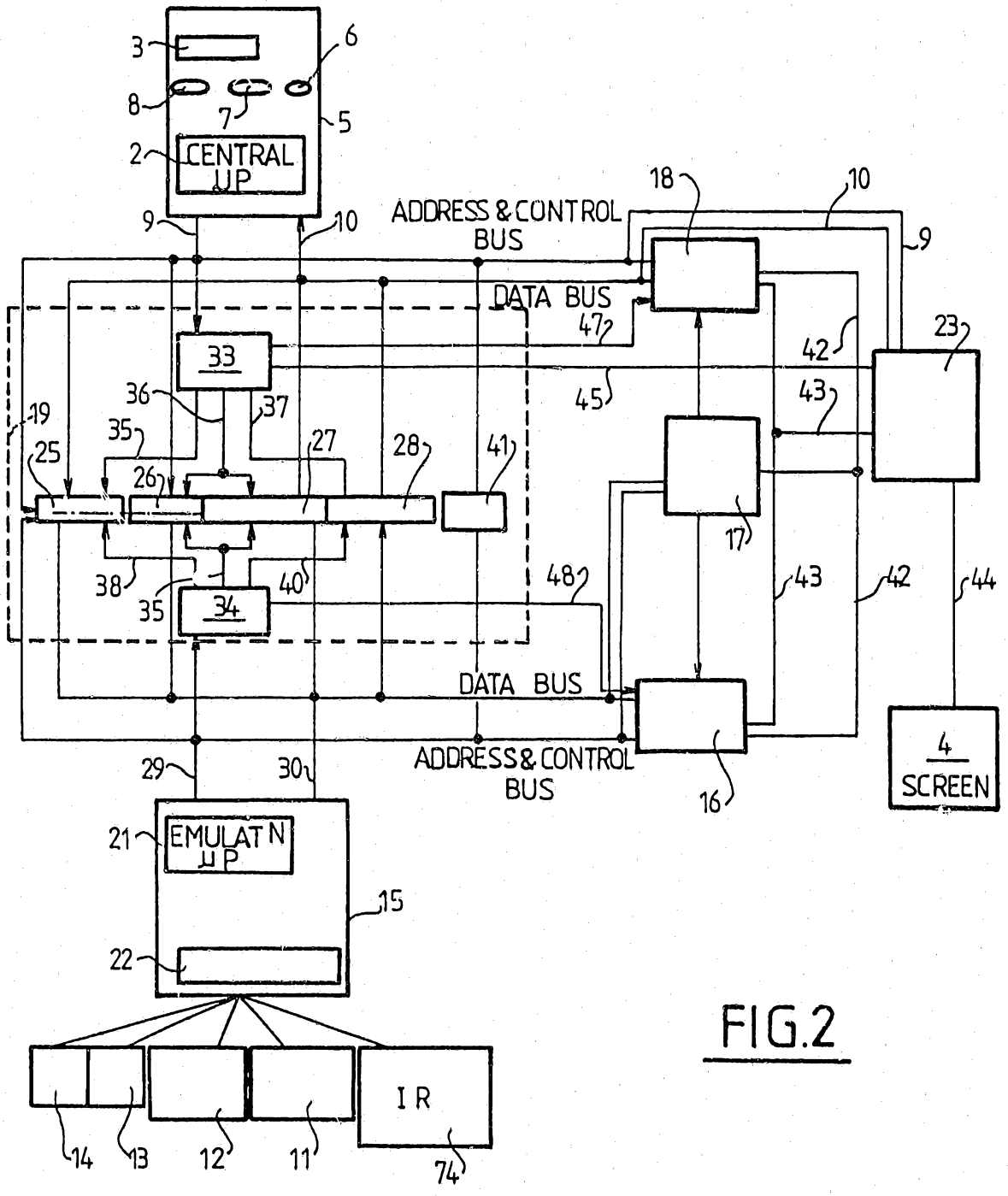
3
6
8
7
5
2
CENTRAL UP
9
10
ADDRESS & CONTROL BUS
18
10
9
DATA BUS
47
42
23
33
36
37
45
43
19
35
25
26
27
28
41
17
38
35
34
40
48
43
42
44
DATA BUS
ADDRESS & CONTROL BUS
4
SCREEN
16
29
30
21
EMULAT N UP
15
22
I R
14
13
12
11
74

FIG.2

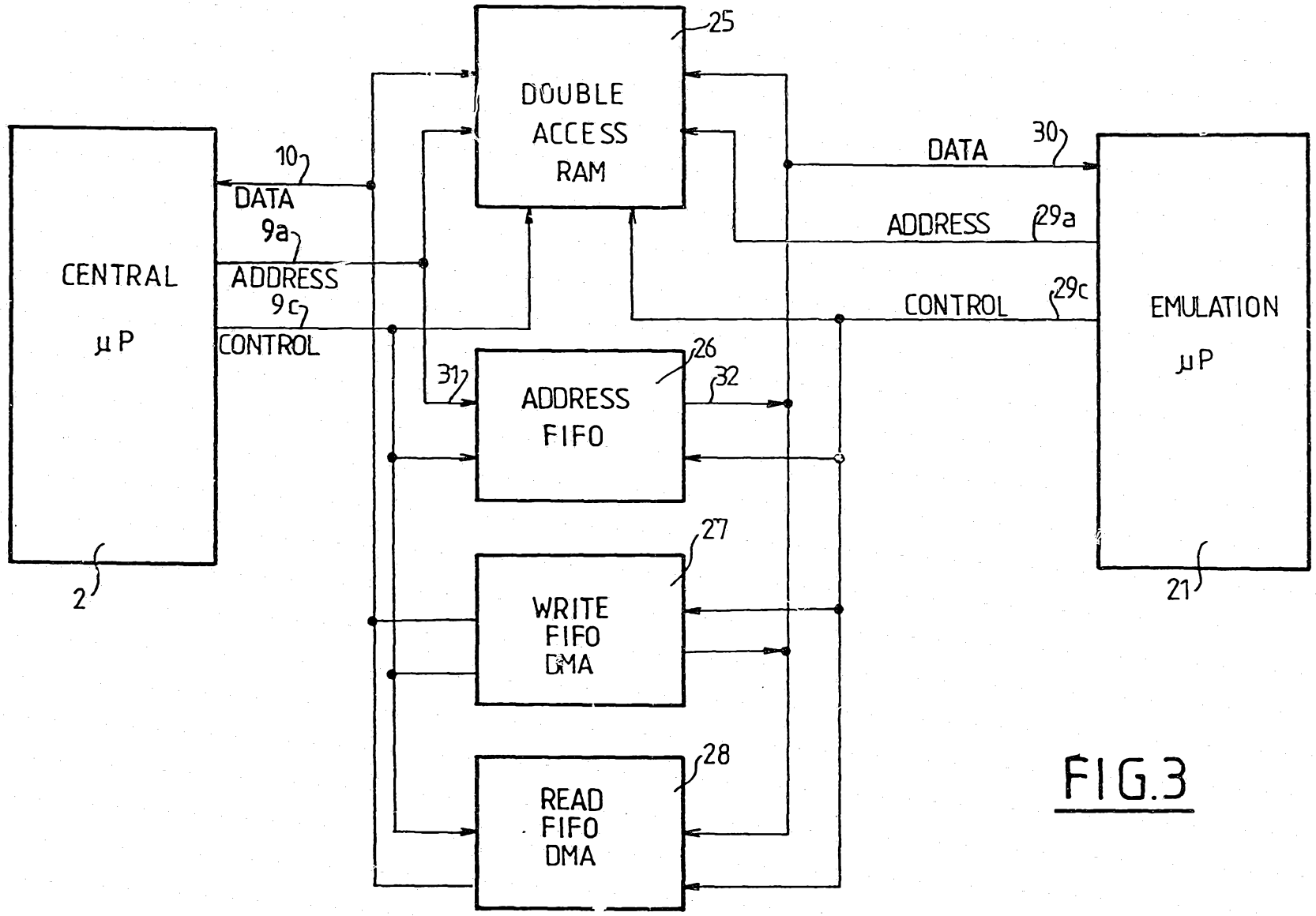
CENTRAL
µP
2
10
DATA
9a
ADDRESS
9c
CONTROL
DOUBLE
ACCESS
RAM
25
31
ADDRESS
FIFO
26
32
WRITE
FIFO
DMA
27
READ
FIFO
DMA
28
DATA
30
ADDRESS
29a
CONTROL
29c
EMULATION
µP
21

FIG.3

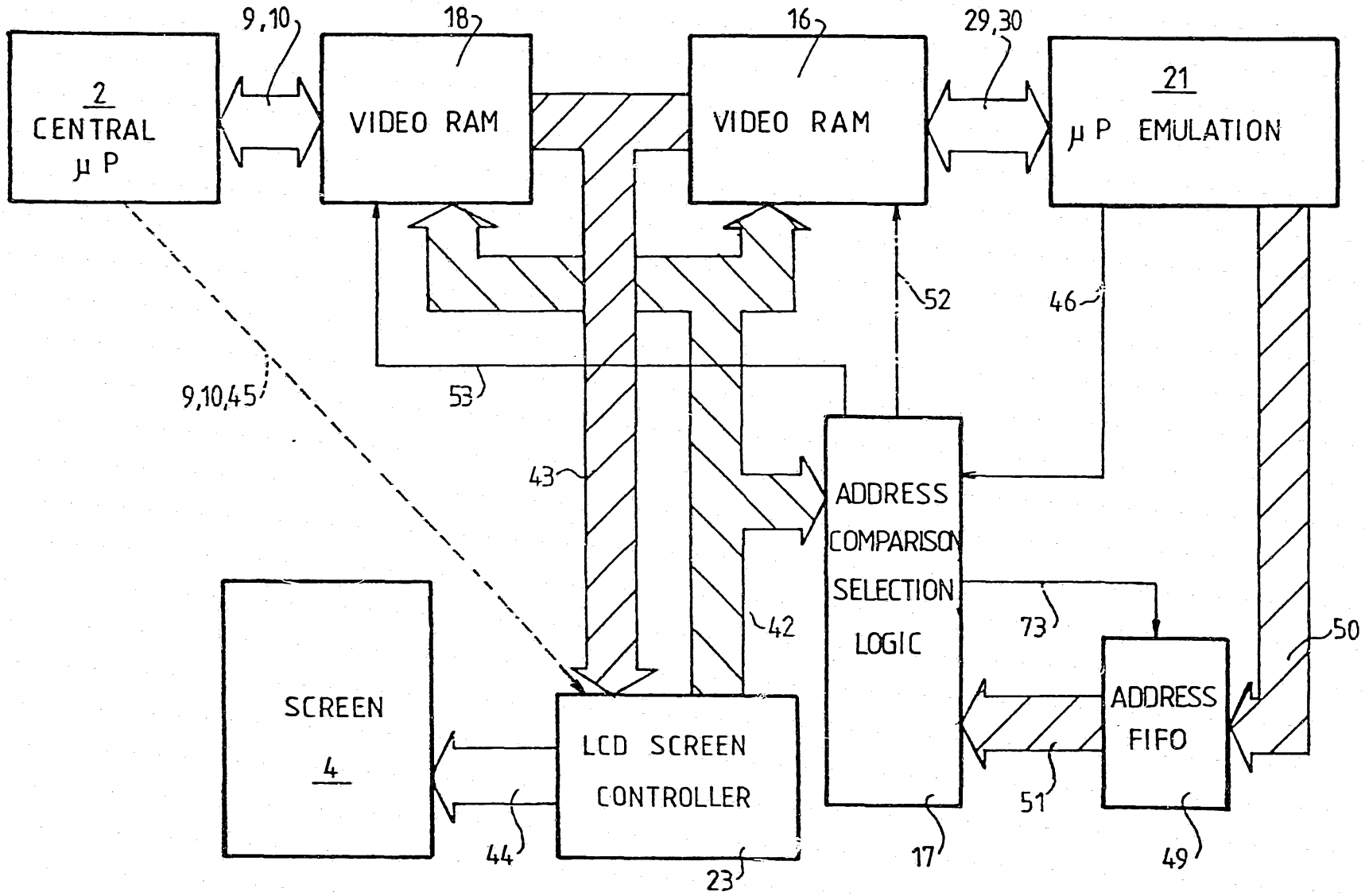
2
CENTRAL
μ P
9,10
18
VIDEO RAM
16
VIDEO RAM
29,30
21
μ P EMULATION
52
46
9,10,45
53
43
ADDRESS
COMPARISON
SELECTION
LOGIC
42
73
50
SCREEN
4
LCD SCREEN
CONTROLLER
ADDRESS
FIFO
44
23
17
51
49

FIG.4a

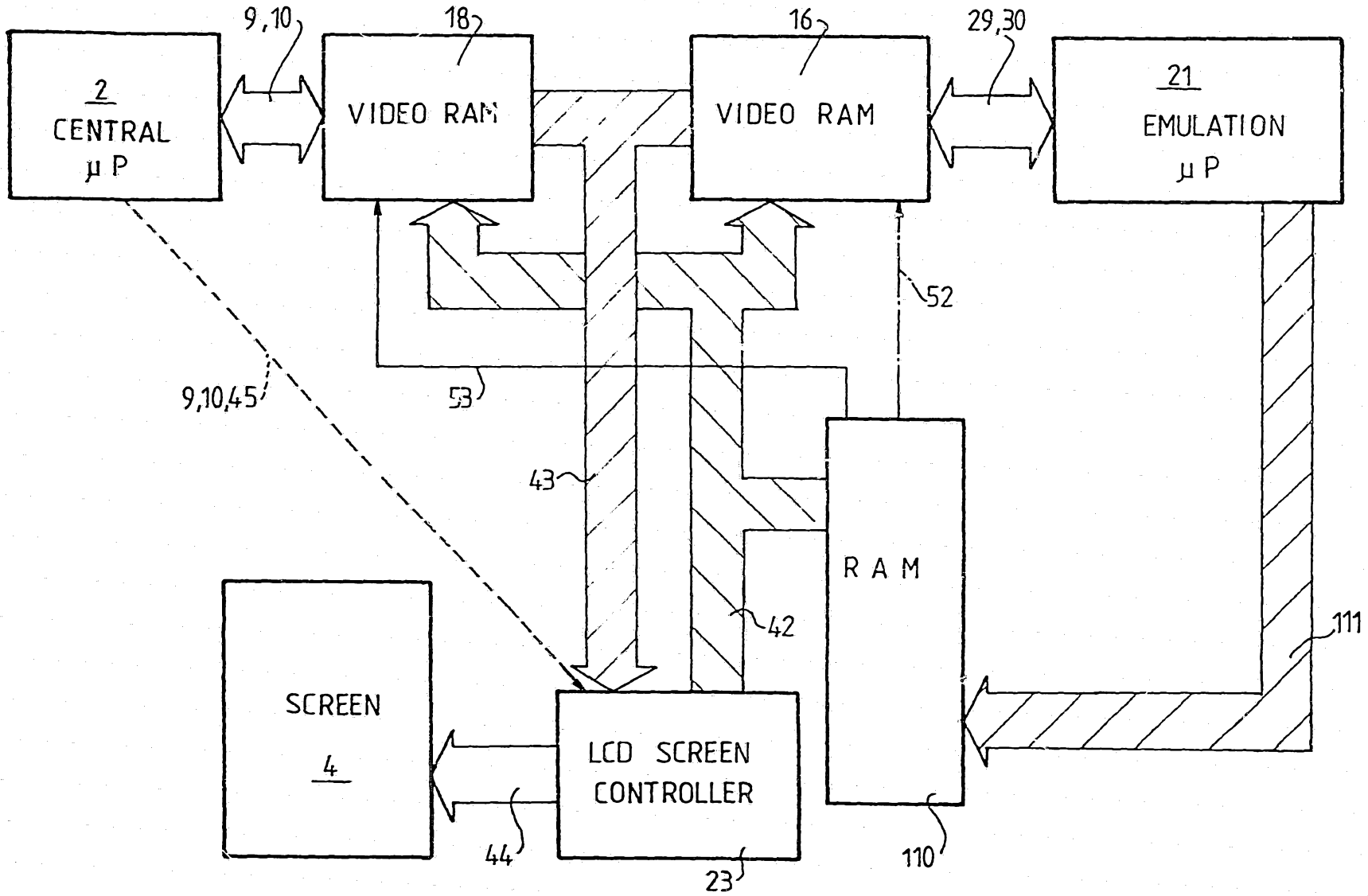
2
CENTRAL
µ P
9,10
18
VIDEO RAM
16
VIDEO RAM
29,30
21
EMULATION
µ P
52
9,10,45
53
43
R A M
42
111
SCREEN
4
LCD SCREEN
CONTROLLER
44
23
110

FIG.4b

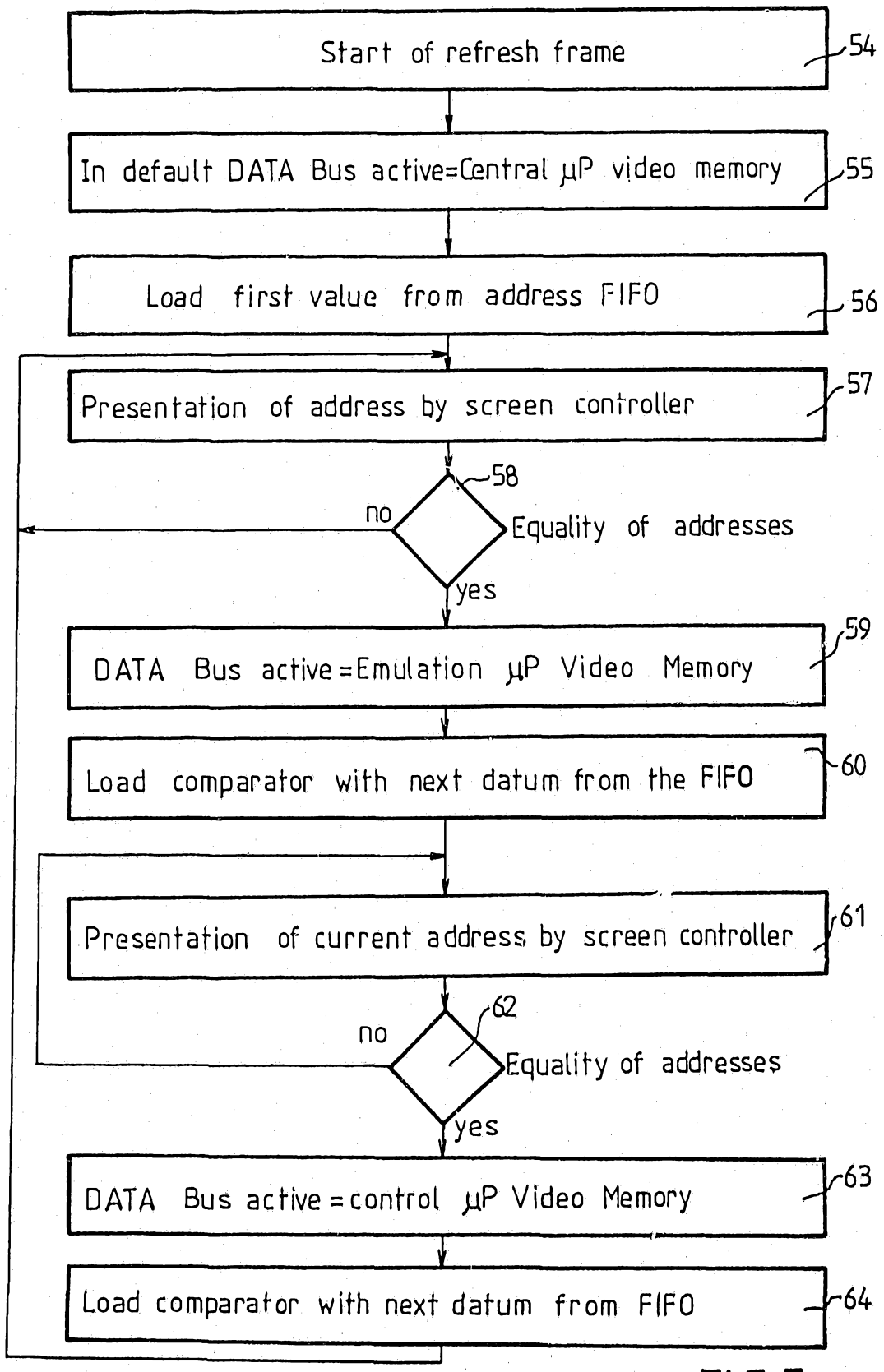
Start of refresh frame
54
In default DATA Bus active=Central µP video memory
55
Load first value from address FIFO
56
Presentation of address by screen controller
57
58
no
Equality of addresses
yes
DATA Bus active=Emulation µP Video Memory
59
Load comparator with next datum from the FIFO
60
Presentation of current address by screen controller
61
62
no
Equality of addresses
yes
DATA Bus active=control µP Video Memory
63
Load comparator with next datum from FIFO
64

FIG.5

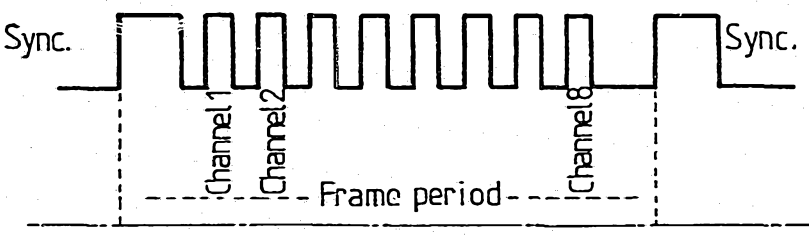
Sync.
Channel 1
Channel 2
Channel 8
Frame period
Sync.

FIG.7

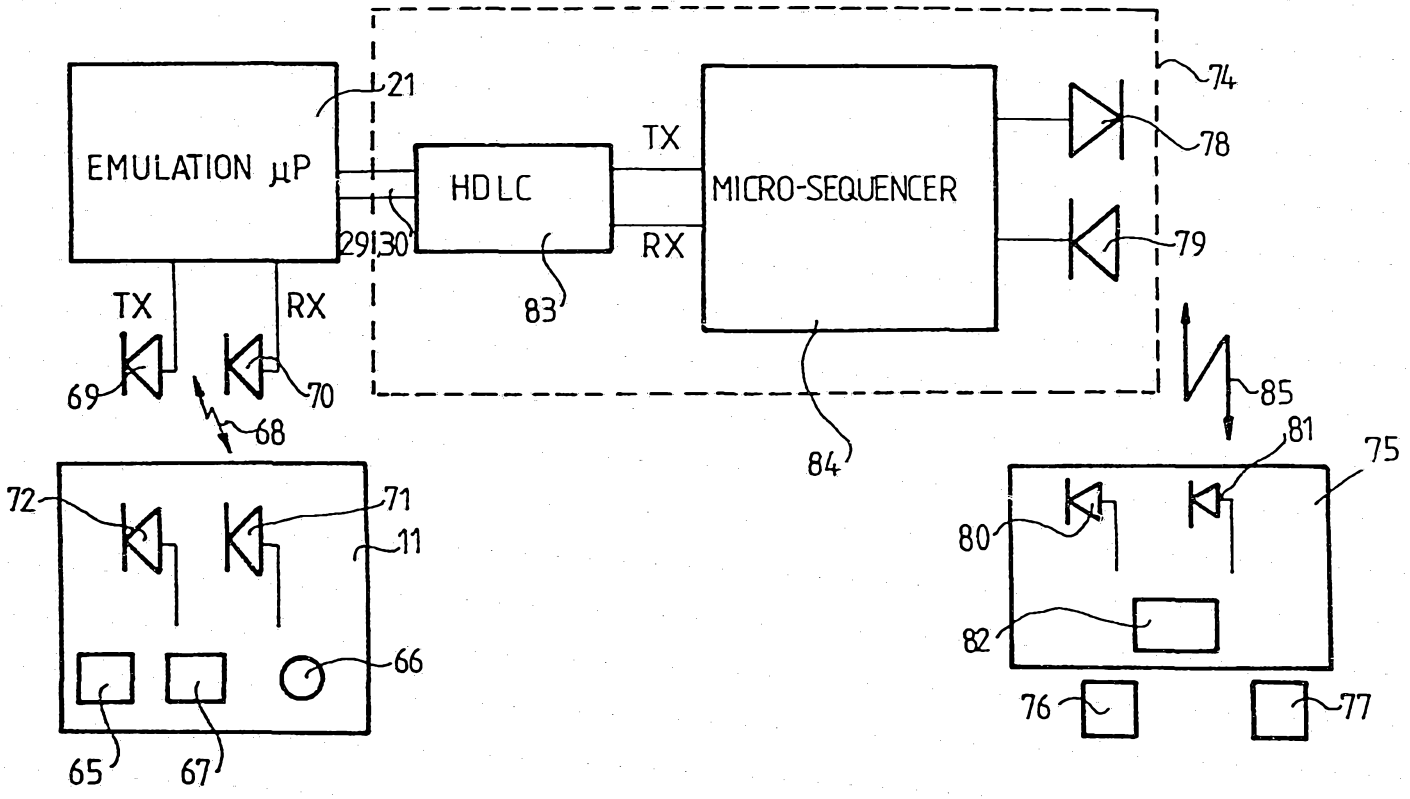
EMULATION µP
21
HDLC
TX
RX
29
30
MICRO-SEQUENCER
74
78
79
83
84
85
TX
RX
69
70
68
72
71
11
66
65
67
81
75
80
82
76
77

FIG.6

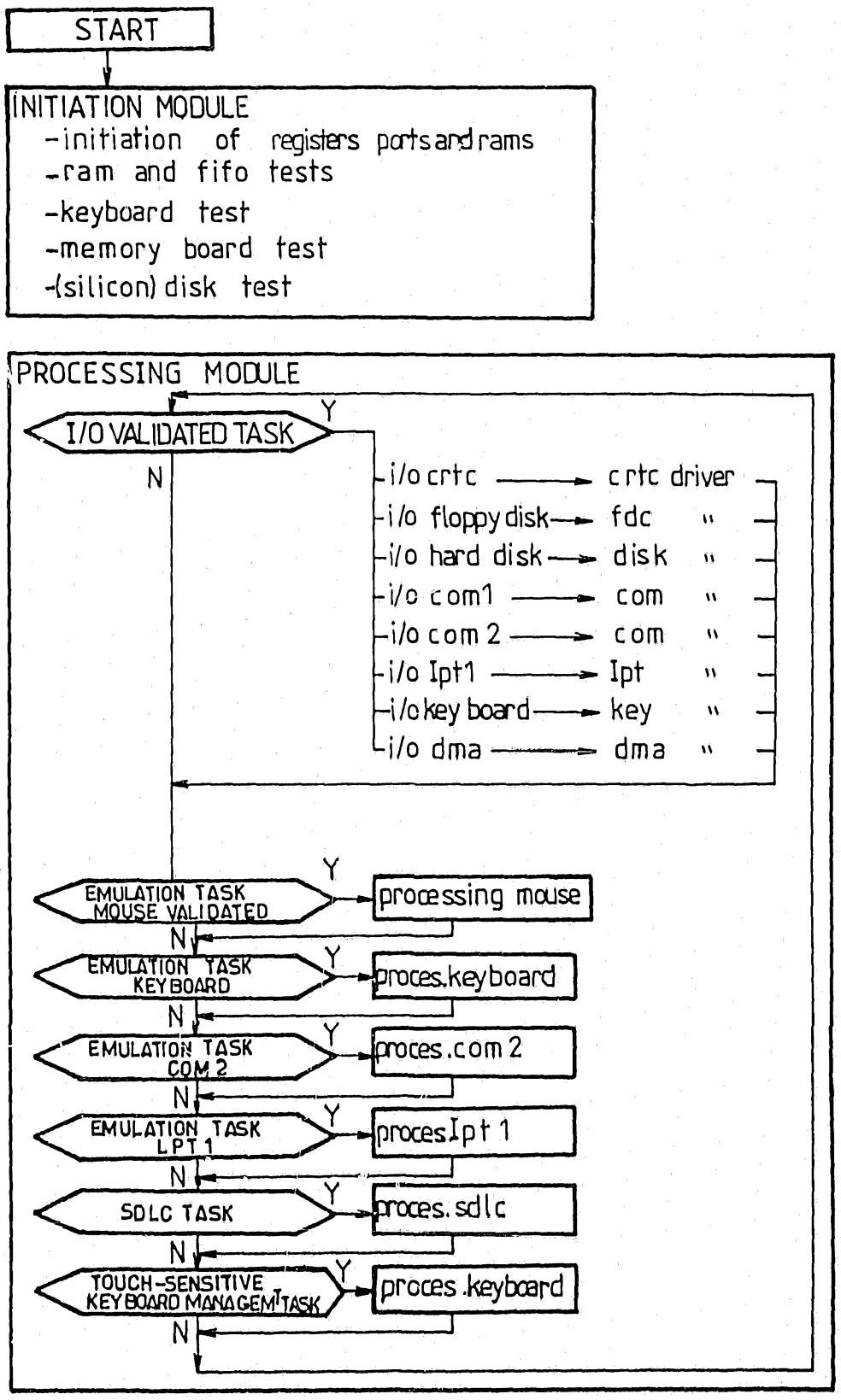
START
INITIATION MODULE
-initiation of registers ports and rams
-ram and fifo tests
-keyboard test
-memory board test
-(silicon) disk test
PROCESSING MODULE
I/O VALIDATED TASK
Y
N
i/o crtc → crtc driver
i/o floppy disk → fdc "
i/o hard disk → disk "
i/o com1 → com "
i/o com 2 → com "
i/o Ipt1 → Ipt "
i/o key board → key "
i/o dma → dma "
EMULATION TASK MOUSE VALIDATED
processing mouse
EMULATION TASK KEYBOARD
proces.keyboard
EMULATION TASK COM 2
proces.com 2
EMULATION TASK LPT 1
proces.Ipt 1
SDLC TASK
proces.sdlc
TOUCH-SENSITIVE KEYBOARD MANAGEM TASK
proces.keyboard

FIG.8