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(54) Electronic system for the transfer of digital data strictly in real time

(57) Electronic system for the transfer of digital data between an acquisition unit (2), from which the data flow arrives with a pre-established temporization and strictly in real time, and a processing unit (3) including a display unit (32) of said data in images.

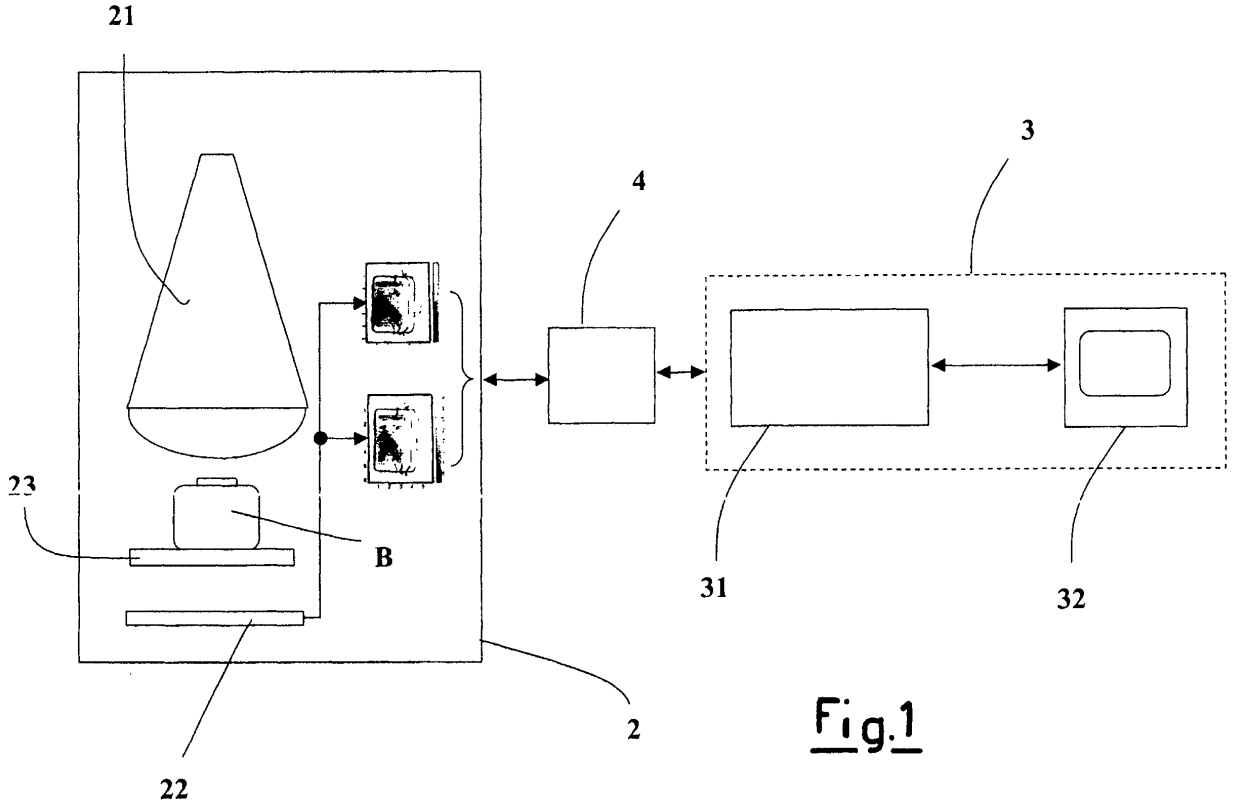

Fig.1

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Description

[0001] The present invention relates to an electronic system for the transfer of digital data strictly in real time between a data source and a data processing and/or display unit.

[0002] In particular, the present invention relates to an electronic transfer system of digital data which makes use of a known communication protocol such as USB (Universal Serial Bus).

[0003] The known digital communication protocol USB was introduced for providing a standard which could surpass the performances of traditional serial, parallel ports; USB is therefore an ideal solution for medium-speed peripheral devices such as external ISDN modems, webcams in general, external CD-Rom players etc. The USB protocol also offers two further important characteristics: the possibility of connecting peripheral devices with the PC already switched on and directly providing the feeding to various types of peripherals.

[0004] Unfortunately this protocol was not conceived for data transfer applications strictly in real time. The latency on the transmission of these is not, in fact, guaranteed and this problem is solved by the present invention.

[0005] The present invention is linked to synchronized transmission techniques of digital data and has been developed parallel to an data transmission application obtained from systems using X-ray sources, to obtain the identification of objects subjected to said rays with particular reference to the materials of which said objects are made.

[0006] In these X-ray machines for the recognition of objects, a data display is required in real time on a display station. If the system is used with a variable scanning rate, in order to preserve space resolutions, the transmission system must be capable of having a variable transmission rate. A correct handling of the data also requires the possibility of equalizing the values received and this can be obtained by providing the possibility of modifying the signal level directly on analogical inputs.

[0007] The Applicant considered the problem of making the information flow coming from an X-ray scanning unit of an object in which the data flow arrives with a pre-established temporization, compatible with a processing and display unit which processes and creates images starting from said data flow.

[0008] The Applicant has produced a synchronous data transfer protocol, strictly in real time, through USB communication ports and a specific synchronization signal which start from the processing unit and arrive at the acquisition or scanning unit. The necessity for synchronization derives from the fact that the input data, suitably processed, are displayed strictly in real time on a display unit. The system must not only be synchronized with the display unit but must also operate with a variable transmission rate, on the basis of the operative configuration and this transmission rate must be able to be modified in real time; a bidirectional transmission capacity must be guaranteed for allowing both the acquisition parameters and regulation of the return of the amplifiers situated in the scanning and acquisition system, to be established. The system also guarantees a transmission capacity in the configuration in which there are amplifiers positioned up to various metres from the transmission system.

[0009] One of the aspects of the present invention relates to an electronic system for the transfer of digital data strictly in real time between an acquisition unit of digital images from which the data flow arrives with a pre-established temporization, and a processing unit including a display unit of said images characterized in that it comprises at least one electronic data transfer card strictly in real time situated between the acquisition unit and the processing unit, which receives the data from said acquisition unit and which synchronizes them in real time by means of a synchronization signal generated by said processing unit and transfers said data to the display unit by means of a USB communication.

[0010] The characteristics and advantages of the system according to the present invention will appear more evident from the following illustrative and nonlimiting description, of an embodiment with reference to the enclosed figures in which:

- figure 1 is a main scheme of the electronic system according to the present invention;
- figure 2 is a block scheme of the electronic remote communication card which implements the data communication protocol according to the present invention;
- figure 3 is a graph which illustrates the trend of the signals characteristic of the system according to the present invention.

[0011] With reference to the above figures, the electronic system according to the present invention comprises a digital image acquisition unit, such as, for example, an X-ray scanning unit 2 for at least one object B, which in figure 1 is illustratively represented by a piece of luggage.

[0012] The scanning unit 2 comprises at least one X-ray source 21, a detection structure 22 of the radiations emitted from said source and a support 23 for sustaining and/or moving said objects. Said structure 22 is suitable for generating at least one digital X-ray image of each object which is situated on said support 23.

[0013] The X-ray image detection structure envisages the presence of at least two separate sensor units, each comprising a series of photodiodes parallel to each other, separated by a metallic filter, each unit being suitable for detecting a pre-established spectral distribution of said rays.

[0014] In this way, each sensor unit supplies an X-ray image relating to a different energy spectrum. These images and the data associated therewith are indicated hereunder as high energy images (H) and low energy

images (L).

[0015] These images are sent to a processing unit 3, typically a personal computer, which extracts specific information on the materials of which the object present in the images H and L is composed. Said process unit comprises a calculation unit 31 and a display unit 32, typically comprising at least one video.

[0016] Said processing unit generates at least one resulting image in which each specific characteristic of the material or object analyzed in general, is shown in a distinguishable manner.

[0017] At least one electronic data transfer card 4 situated between the acquisition unit and the processing unit effects the synchronized transmission in real time of the data associated with the images to be visualized in said display unit.

[0018] The present invention relates to the use of this type of protocol on a data acquisition card having at least a pair of small local buffers (for example having a dimension of a few tens of KByte) and an external synchronism signal, supplied for example by the display unit equipped with an operative system of the hard real time type.

[0019] The synchronized and programmable transmission is preferably effected by synchronization impulses having frequencies with typical values of the video systems based on Personal Computers.

[0020] Said remote electronic card effects the acquisition and communicates the data to the USB card with specific digital lines.

[0021] The remote card comprises a first series of optical sensors s1, for example 64 sensors, belonging to a first channel and a second series of optical sensors s2, belonging to a second channel; each channel envisages the presence of a digital analogical converter ad1 and ad2. The functioning of the remote card is controlled by a programmable device 41 which, upon receiving a "Start Acquisition" signal, activates the card circuits for sequentially scanning the optical sensors, for example starting from sensor number 1 to sensor number 64; the scanning is preferably effected contemporaneously on both channels. At the end of the scanning of the last optical sensor, if the "Start Acquisition" signal (Start_Acquisition in figure 3) is still active, the conversion cycle is restarted. After a further format conversion into "serial form", the converted data are electrically insulated and sent to a data collector card. This collector card communicates with a USB or USB 2.0 connection controller of the display unit so as to appropriately send the data received from each remote card to said unit.

[0022] Said remote card also comprises a feeding circuit 42, an insulation block 43 and a piloting circuit 44 for the output of the two transmission channels and for the input of the start acquisition signals.

[0023] The system according to the present invention acquires, for each synchronization impulse, the digital data coming from the remote cards 4 with electric transmission protocol with the low voltage remote cards of the differential type, and with specific functional protocol. The data transmission rate is variable and ensures a transmission capacity higher than several tens of Mbit/sec (in the case of the use of USB 2.0 protocol). In practice, said electronic card allows, by means of this synchronization signal, a non-synchronized communication protocol, such as, for example, the USB 2.0 communication protocol.

[0024] For example, the duration of the scanning of the 64 optical sensors can be set within a time range of 0.100 msec to 1,000 msec, whereas the maximum distance between the remote card and the data collector can reach a distance of about nine metres.

[0025] Each remote card is connected with the collector card by means of differential signals: ("Channel Nr. 1" as Output, "Channel Nr. 2" as Output and the above-mentioned "Start Acquisition" as Input.

[0026] The collector card can receive a series of remote cards, for example up to twenty remote cards. Each connection with the remote card corresponds, on the collector card, to a specific input.

[0027] Furthermore, the system according to the present invention ensures the generation, towards each remote card, of a programmable number of acquisitions, per synchronization impulse, so that various acquisitions can correspond to each synchronization impulse.

[0028] Figure 3 shows the external synchronization signal Ext-Synch, the start acquisition signals for each channel (Start_Acquisition) and the data transfer packages for each channel synchronized by the above synchronization signal.

Claims

1. An electronic system for the transfer of digital data between an acquisition unit of digital images (2), from which the data flow arrives with a pre-established temporization and substantially in real time, and a processing unit (3) including a display unit (32) of said images,
   characterized in that it comprises at least one electronic data transfer card (4) situated between the acquisition unit and the processing unit which receives data from said acquisition unit and transmits them in real time by means of a synchronization signal generated by said processing unit, to the display unit so as to allow the use of a non-synchronized communication protocol.

2. The system according to claim 1, wherein said non-synchronized communication protocol is a USB or USB 2.0 communication protocol.

3. The system according to claim 1, wherein said electronic data transfer card comprises a series of optical sensors subdivided into at least two channels, an analogical digital converter for each channel and a controller capable of sending the signals received

from the sensors and relating to said images, in response to a start acquisition signal and according to a temporization determined by said synchronization signal, to a data collector card.

4. The system according to claim 3, wherein said remote card also comprises a feeding circuit, an insulation block and a piloting circuit for the output of the two transmission channels and for the input of the start acquisition signals.

5. The system according to claim 3, wherein said data collector card is suitable for being connected to a series of remote cards.

6. The system according to claim 1, wherein said image acquisition unit is an X-ray scanning unit for at least one object B and comprises at least one X-ray source, a detection structure of the radiations emitted from said source and a support for the resting and/or moving of said objects.

7. The system according to claim 6, wherein said structure is suitable for generating at least one digital X-ray image of each object which is situated on said support.

8. The system according to claim 1, wherein said synchronized and programmable transmission is preferably effected by synchronization impulses having frequencies with typical video system values based on Personal Computers.

9. The system according to claim 1, wherein said remote electronic card effects the acquisition and communicates the data to a USB card with specific digital lines.

10. The system according to claim 1, wherein each remote card can effect a programmable number of acquisitions for each impulse of the synchronization signal, so that various acquisitions can correspond to each synchronization impulse.

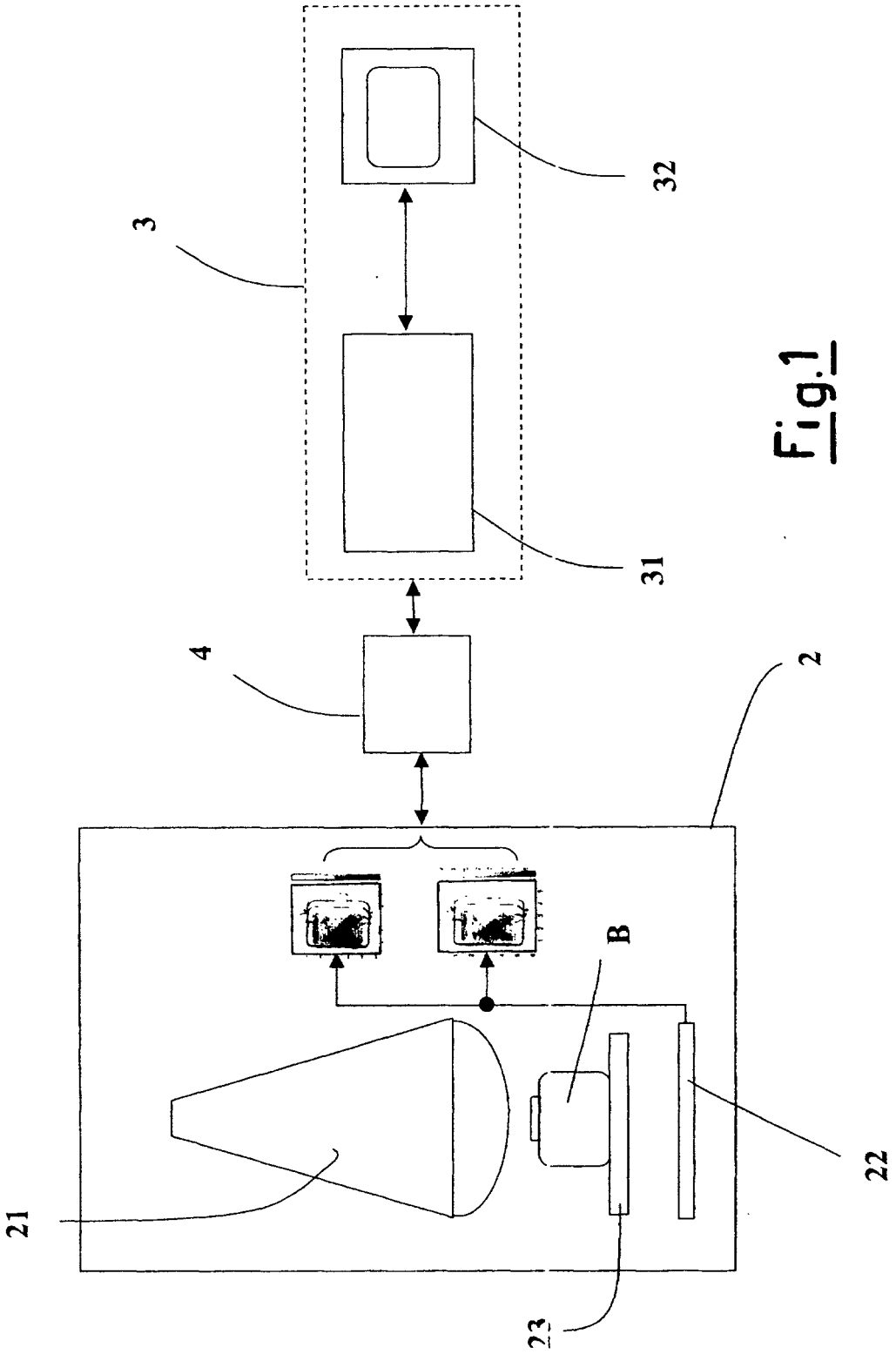

Fig.1

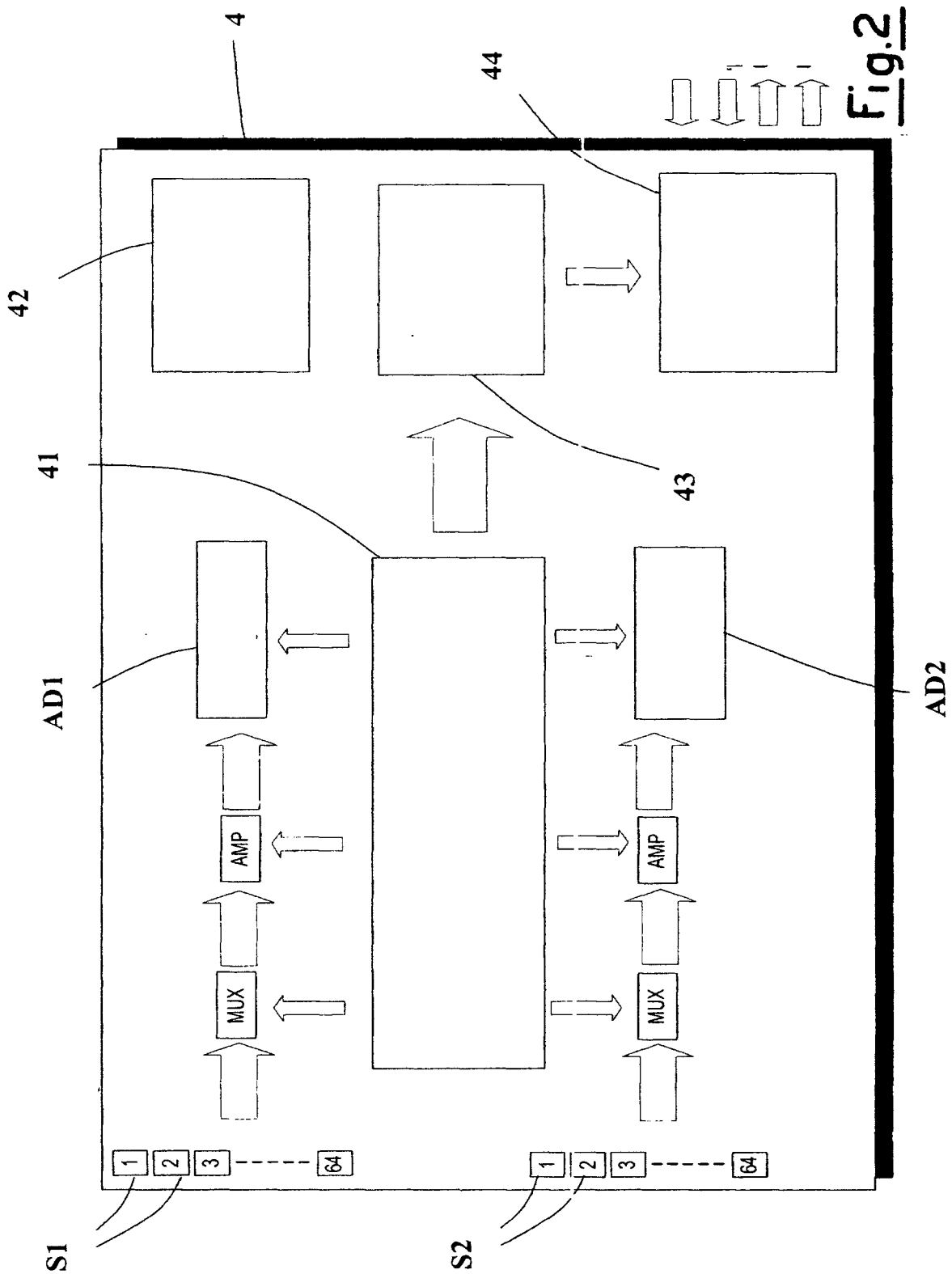

Fig.2

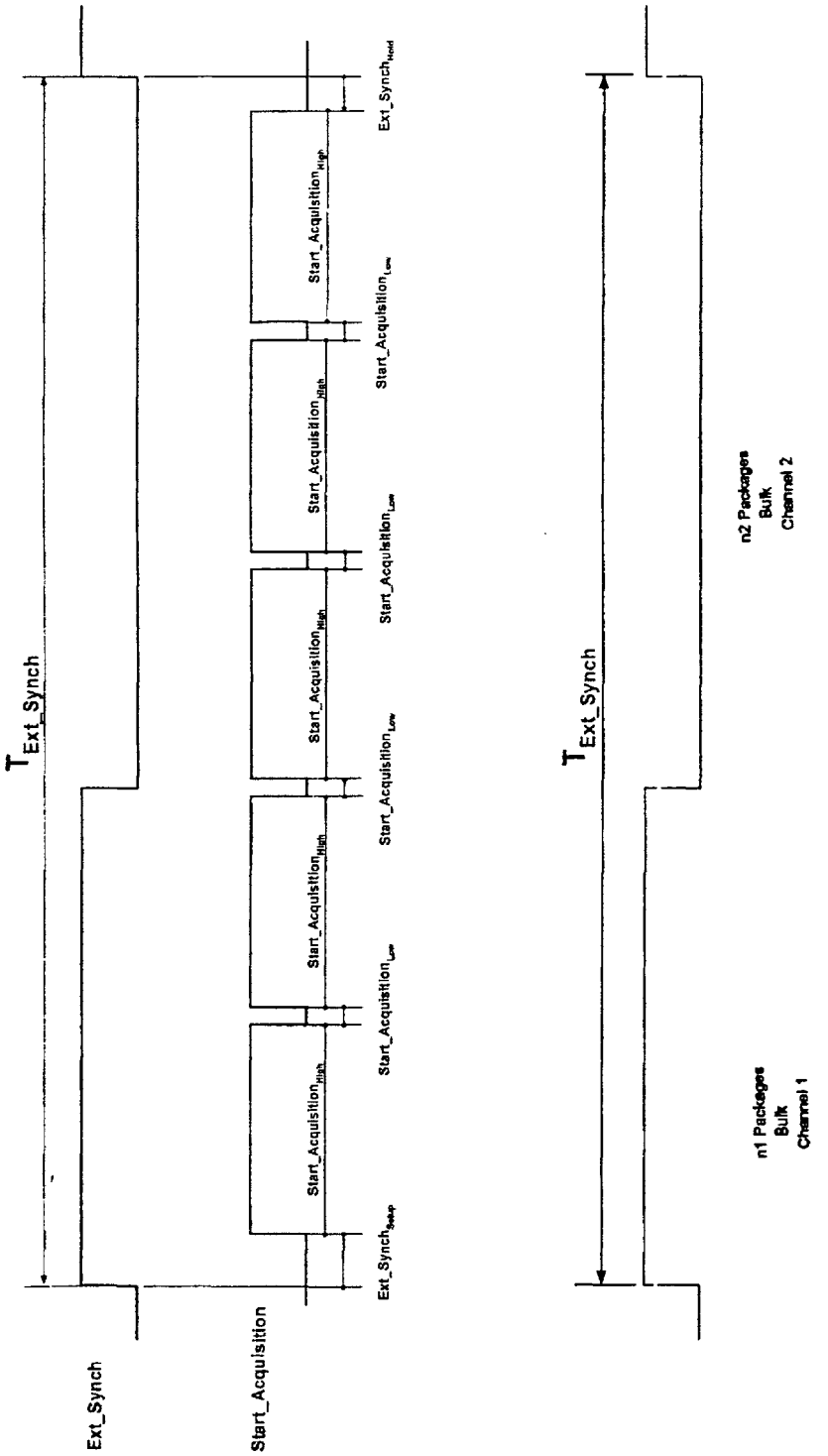
Ext_Synch
Start_Acquisition
T Ext_Synch
Ext_Synch_Setup
Start_Acquisition_High
Start_Acquisition_Low
Ext_Synch_Hold
n1 Packages Bulk Channel 1
n2 Packages Bulk Channel 2

Fig.3