



(11) **EP 0 946 079 B1**

(12) **EUROPEAN PATENT SPECIFICATION**

(45) Date of publication and mention
of the grant of the patent:
16.06.2010 Bulletin 2010/24

(51) Int Cl.:
H04S 3/00 (2006.01)

(21) Application number: **98250104.1**

(22) Date of filing: **26.03.1998**

(54) **Method and apparatus for presenting digital surround sound data**

Verfahren und Vorrichtung zur Darbietung von digitalen Raumklangdaten

Procédé et appareil pour la representation de données numériques sonores surround

(84) Designated Contracting States:
DE FR GB

(43) Date of publication of application:
29.09.1999 Bulletin 1999/39

(73) Proprietor: **Thomson Licensing**
92443 Issy-les-Moulineaux Cedex (FR)

(72) Inventor: **Hütter, Ingo**
29223 Celle (DE)

(74) Representative: **Hartnack, Wolfgang**
Deutsche Thomson OHG
European Patent Operations
Karl-Wiechert-Allee 74
30625 Hannover (DE)

(56) References cited:

EP-A- 0 757 506 EP-A- 0 782 372
US-A- 5 386 473

- **FOSTER E J: "MARANTZ DP870 DOLBY DIGITAL SURROUND DECODER" AUDIO, vol. 80, no. 11, November 1996, page 52, 54, 56, 58 XP000641718**
- **"DOLBY SURROUND WHAT IS IT? HOW DOES IT WORK?" ELEKTOR ELECTRONICS, vol. 21, no. 229, 1 January 1995, pages 8-11, XP000495371**
- **"SURROUND SOUND PROCESSOR BASED ON A DESIGN BY D. LAUES" ELEKTOR ELECTRONICS, vol. 21, no. 230, 1 February 1995, pages 26-31, XP000498138**
- **"SURROUND SOUND" ELEKTOR ELECTRONICS, vol. 20, no. 224, 1 July 1994, page 8/9 XP000483894**
- **WILLIS P: "SURROUND-SOUND STANDARD POLARISE" ELECTRONICS WORLD AND WIRELESS WORLD, vol. 101, no. 1716, 1 November 1995, page 952 XP000543319**

Note: Within nine months of the publication of the mention of the grant of the European patent in the European Patent Bulletin, any person may give notice to the European Patent Office of opposition to that patent, in accordance with the Implementing Regulations. Notice of opposition shall not be deemed to have been filed until the opposition fee has been paid. (Art. 99(1) European Patent Convention).

EP 0 946 079 B1

Description

[0001] The invention relates to a method and to an apparatus for presenting digital surround sound data.

Background

[0002] Future consumer electronics equipment like DVD (digital versatile disc) players, DVB (digital video broadcast) settop boxes or DVB TV receivers will be able to supply 5-channel or 6-channel digital surround sound, wherein 6-channel surround sound includes an additional subwoofer signal.

The analogue outputs of such devices typically provide a stereo or 2-channel signal only, while the surround sound signals stem from a multiplexed digital MPEG2 audio or AC-3 signal. Normally, the surround sound channel signals are available at a digital output connector. Typically they are formatted according to the IEC 958 standard. EP-A-0 782 372 discloses how a 5-channel matrixed signal can be downcoded to a stereo signal for recording, and following replay, can be reconstructed to five independent channel signals.

US-A-5 630 175 shows a stereo computer system which produces surround sound using audio cards and additional loudspeakers.

Invention

[0003] Nowadays the decoding and representation of such surround sound data is performed by a single surround sound decoder and five or six channel amplifiers to each of which a loud-speaker or loudspeaker box is connected. Typically, these amplifiers and loudspeaker boxes replace the stereo amplifier and loudspeaker boxes of the HiFi arrangement already existing in the home. Using the complete surround sound equipment standalone, if there is a HiFi rack in the same room, does not make sense, because this arrangement would include 7 or 8 instead of 5 or 6 amplifiers and loudspeakers required for surround sound only.

[0004] It is one object of the invention to disclose a method for providing cheaper surround sound equipment using an existing stereo amplifier and related loudspeakers. This object is achieved by the method disclosed in claim 1.

[0005] It is a further object of the invention to disclose an apparatus which utilises the inventive method. This object is achieved by the apparatus disclosed in claim 2.

[0006] According to the invention, the surround sound equipment is combined with the existing HiFi rack in a specific way in order to save amplifiers and/or loudspeaker boxes.

Because the single surround sound decoder solution typically replaces a high quality stereo amplifier, the surround sound decoder must include this high quality amplifier. Therefore the inventive low cost surround sound decoder uses the available stereo amplifier for the left

and right channel signals, while the effect channels can advantageously be amplified with simplified amplifiers which are contained in the low cost surround sound decoder cabinet. In order to commonly select with a single remote control or manual control the volume of all surround sound channels the stereo amplifier output signal, or - if available - the corresponding internal volume control signal, is fed back to the surround sound decoder for controlling in addition the volume of the remaining channel output signals.

Drawings

[0007] Embodiments of the invention are described with reference to the accompanying drawings, which show in:

- Fig. 1 connection of surround sound decoder with other components;
- Fig. 2 block diagram of the surround sound decoder;
- Fig. 3 volume setting calculation circuit VCAL in more detail.

Embodiments

[0008] In Fig. 1 a DVD player DVD and a DVB settop box or a digital TV receiver DVB or any other sources for surround sound channels are connected to a digital low-cost surround sound decoder DSD, preferably using IEC 958 connections. DSD may also comprise analog or digital inputs for the left and right channel signals from the HiFi rack (not depicted).

The left and right channel signals LE and RI from DSD pass through a stereo HiFi amplifier to corresponding loudspeaker boxes.

The outputs of stereo amplifier SA are coupled back to volume control inputs of the surround sound decoder DSD so that the amplification of the external stereo amplifier SA can be measured and depending on its value the amplifiers for the 3 (or 4) effect channels of DSD can be controlled. These channels are: left effect LEE, right effect RIE, centre CE and subwoofer SUB. So the overall volume is controlled merely by the already existing HiFi rack or stereo amplifier remote control or manual control. No separate volume control is required for DSD.

For convenience of the user the two loudspeaker outputs of stereo amplifier SA can return to the surround sound decoder which also contains output connectors for the stereo loud-speakers directly connected with these returning inputs. Thereby the user can connect all five or six loudspeaker boxes to the surround sound decoder cabinet only and possible confusion caused by separate connection of loudspeakers to SA can be avoided. From these returning inputs the above described volume control for the surround sound decoder volume control inputs is derived internally, thereby avoiding an additional cable connection.

[0009] In Fig. 2 the main input signal of DSD at input

IN may pass through a FiFo buffer FIFO and an IEC 958 decoder (not depicted) to an MPEG2 audio decoder and/or AC-3 decoder and/or any other kind of multi-channel decoder DEC which is controlled by a controller CO. DEC has five or six audio channel outputs which are connected to corresponding D/A converters. The D/A converted left and right channel signals are connected to an output TSA to the above mentioned HiFi stereo amplifier SA. The D/A converted effect channel signals become amplified in corresponding volume-controlled amplifiers V, the outputs of which are connected to the LEE, RIE, CE, and SUB outputs. For the D/A converters and the amplifiers V of the effect channels standard ICs can be used. Inputs FSA receive the two output signals of the HiFi stereo amplifier and provide on one hand corresponding left and right outputs LE and RI and on the other hand corresponding signals for automatically determining the current volume setting in SA in a volume setting calculator VCAL. VCAL may also receive the two TSA output signals. The output of VCAL is fed to the volume control inputs of the V amplifiers. The V amplifiers may be connected to a separate power supply.

[0010] In Fig. 3 the two FSA inputs are fed to the negative inputs of differential amplifiers V33 and V34. The both TSA signals are fed to the inputs of controllable amplifiers V31 and V32, the outputs of which are input to the positive inputs of amplifiers V33 and V34. The output signals of V33 and V34 become combined in a combiner A30, the output signal of which passes through a low pass R/C in order to form VCAL output signal VO and to control the amplification factor of V31 and V32.

[0011] V31 to V34 can be implemented using a standard ICs, too.

[0012] The stereo amplifier SA and/or the V amplifiers can also be digital amplifiers. In that case the corresponding D/A converters are located within the corresponding amplifier. Correspondingly, the automatic volume control can operate digitally, wherein in case the volume control signal from SA is of analog type an A/D conversion takes place at the input of the automatic volume control.

[0013] A balance control can be added which allows to increase or decrease the volume of the effect channels LEE/RIE and/or SUB with respect to the front channels LE/RI and/or CE.

[0014] The automatic volume control can also be changed in such a way that the volume of LE automatically controls the volume of LEE and that the volume of RI automatically controls the volume of RIE.

[0015] It is also possible that amplifier SA is not used for the LE and RI channels but for other channel combinations, e.g. for the RI and RIE channels.

Claims

1. Method for presenting digital surround sound data using a surround sound decoder (DSD) and stereo sound equipment that includes a stereo amplifier

(SA), wherein:

- said stereo amplifier (SA) is a device separate from said surround sound decoder (DSD), and
- said surround sound decoder (DSD) includes a multi-channel decoder (DEC) and an amplifier (V) for each output of said multi-channel decoder; and
- the left and right channel outputs of the multi-channel decoder (DEC) are fed to left and right channel inputs of said stereo amplifier (SA), and wherein the remaining channel outputs of said multi-channel decoder (DEC) are fed to respective amplifiers (V) and loudspeakers or loudspeaker boxes,

characterised in that

an output signal (FSA) of said stereo amplifier (SA) is fed back to said surround sound decoder (DSD) for automatically controlling (VCAL) the volume (VO) of said remaining channel outputs, so that the volume (VO) of said remaining channel outputs corresponds to a volume setting of said stereo amplifier.

2. Digital surround sound decoder (DSD) including:

- at least six output connectors (TSA, LE, RI, LEE, RIE, SUB);
- an MPEG2 audio decoder and/or an AC-3 decoder and/or any other kind of multi-channel decoder (DEC);
- a D/A converter for each one of output channels of said multi-channel decoder (DEC), wherein the D/A converted left and right channel outputs of the multi-channel decoder (DEC) are fed to an output connector (TSA) of said digital surround sound decoder (DSD) to which a separate stereo amplifier (SA) is to be connected;
- an amplifier (V) for each one of the remaining D/A converted channel outputs of the multi-channel decoder;

characterised in that

said digital surround sound decoder (DSD) further includes an input connector (FSA) for receiving a feed-back output signal from said stereo amplifier (SA), wherein said feed-back signal is used in said digital surround sound decoder (DSD) for automatically controlling (VCAL) the volume (VO) of said amplifiers (V) for said remaining D/A converted channel outputs of said multi-channel decoder (DEC), so that the volume (VO) of said amplifiers corresponds to a volume setting of said stereo amplifier, wherein said input connector (FSA) for receiving a feed-back output signal receives the loudspeaker output signals from said stereo amplifier (SA) and wherein these stereo amplifier loudspeaker output signals are passed to left (LE) and right (RI) loudspeaker output

connectors of said digital surround sound decoder (DSD).

3. Digital surround sound decoder according to claim 2, wherein the input signal (IN) for said MPEG2 audio decoder and/or AC-3 decoder and/or other kind of multi-channel decoder (DEC) is formatted according to the IEC 958 standard and passes through a FiFo buffer (FIFO).

Patentansprüche

1. Verfahren zum Darstellen digitaler Raumklangdaten unter Verwendung eines Raumklangdekodierers (DSD) und einer Stereotonausrüstung, die einen Stereoverstärker (SA) enthält, wobei der Stereoverstärker (SA) eine von dem Raumklangdekodierer (DSD) getrennte Vorrichtung ist und der Raumklangdekodierer (DSD) einen Mehrkanaldekodierer (DEC) und einen Verstärker (V) für jeden Ausgang des Mehrkanaldekodierers enthält, und wobei die Ausgänge des rechten und linken Kanals des Mehrkanaldekodierers (DEC) den Eingängen des linken und rechten Kanals des Stereoverstärkers (SA) zugeführt werden, und wobei die verbleibenden Kanalausgänge des Mehrkanaldekodierers (DEC) entsprechenden Verstärkern (V) und Lautsprechern oder Lautsprecherboxen zugeführt werden, **dadurch gekennzeichnet, dass** ein Ausgangssignal (FSA) des Stereoverstärkers (SA) zu dem Raumklangdekodierer (DSD) zurückgeführt wird, um automatisch die Lautstärke (VO) der verbleibenden Kanalausgänge zu regeln (VCAL), so dass die Lautstärke (VO) der verbleibenden Kanalausgänge einer Lautstärkeeinstellung des Stereoverstärkers entspricht.
2. Digitaler Raumklangdekodierer (DSD), umfassend:
 - wenigstens sechs Ausgangsanschlüsse (TSA, LE, RI, LEE, RIE, SUB);
 - einen MPEG2-Audio-Dekodierer und/oder einen AC-3-Dekodierer und/oder irgendeine andere Art eines Mehrkanaldekodierers (DEC);
 - einen D/A-Umsetzer für jeden der Ausgangskanäle des Mehrkanaldekodierers (DEC), wobei die D/A-umgesetzten Ausgänge des linken und rechten Kanals des Mehrkanaldekodierers einem Ausgangsanschluss (TSA) des digitalen Raumklangdekodierers (DSD) zugeführt werden, an den ein getrennter Stereoverstärker (SA) angeschlossen werden soll;
 - einen Verstärker (V) für jeden der verbleibenden (D/A-umgewandelten) Kanalausgänge des Mehrkanaldekodierers; **dadurch gekennzeichnet, dass** der digitale Raumklangdekodierer (DSD) ferner einen Eingangsanschluss

(FSA) zum Empfang eines Rückführ-Ausgangssignals von dem Stereoverstärker (SA) enthält, wobei das Rückführsignal in dem digitalen Raumklangdekodierer (DSD) dazu verwendet wird, um automatisch die Lautstärke (VO) der Verstärker (V) für die verbleibenden D/A-umgewandelten Kanalausgänge des Mehrkanaldekodierers (DEC) zu regeln (VCAL), so dass die Lautstärke (VO) der Verstärker einer Lautstärkeeinstellung des Stereoverstärkers entspricht, wobei der Eingangsanschluss (FSA) zum Empfang eines Rückführ-Ausgangssignals die Lautsprecher-Ausgangssignale von dem Stereoverstärker (SA) empfängt, und wobei diese Stereoverstärker-Lautsprecher-Ausgangssignale linken (LE) und rechten (RE) Lautsprecher-Ausgangsanschlüssen des digitalen Raumklangdekodierers (DSD) zugeführt werden.

3. Digitaler Raumklangdekodierer nach Anspruch 2, bei dem das Eingangssignal (IN) für den MPEG2-Audio-Dekodierer und/oder den AC-3-Dekodierer und/oder eine andere Art eines Mehrkanaldekodierers nach der IEC 958-Norm formatiert wird und durch einen FiFo-Puffer (FIFO) verläuft.

Revendications

1. Procédé pour la représentation de données numériques sonores surround utilisant un décodeur sonore surround (DSD) et un équipement sonore stéréo incluant un amplificateur stéréo (SA), où :
 - ledit amplificateur stéréo (SA) est un dispositif distinct dudit décodeur sonore surround (DSD), et
 - ledit décodeur sonore surround (DSD) inclut un décodeur à canaux multiples (DEC) et un amplificateur (V) pour chaque sortie dudit décodeur à canaux multiples ; et

les sorties de canal gauche et droite du décodeur à canaux multiples (DEC) sont envoyées aux entrées de canal gauche et droite dudit amplificateur stéréo (SA), et où les sorties de canal restantes dudit décodeur à canaux multiples (DEC) sont envoyées à des amplificateurs respectifs (V) et des haut-parleurs ou des enceintes de haut-parleur, **caractérisé en ce que** un signal de sortie (FSA) dudit amplificateur stéréo (SA) est renvoyé audit décodeur sonore surround (DSD) pour commander automatiquement (VCAL) le volume (VO) desdites sorties de canal restantes, de sorte que le volume (VO) desdites sorties de canal restantes corresponde à un réglage de volume dudit amplificateur stéréo.

2. Décodeur numérique sonore surround (DSD) incluant :

- au moins six connecteurs de sortie (TSA, LE, RI, LEE, RIE, SUB) ; 5
- un décodeur audio MPEG2 et/ou un décodeur AC-3 et/ou tout autre type de décodeur à canaux multiples (DEC) ;
- un convertisseur N/A pour chacun des canaux de sortie dudit décodeur à canaux multiples (DEC), où les sorties de canal gauche et droite converties N/A du décodeur à canaux multiples (DEC) sont envoyées à un connecteur de sortie (TSA) dudit décodeur numérique sonore surround (DSD) auquel un amplificateur stéréo distinct (SA) doit être connecté ; 10 15
- un amplificateur (V) pour chacune des sorties de canal converties N/A restantes du décodeur à canaux multiples ; 20

caractérisé en ce que

ledit décodeur numérique sonore surround (DSD) inclut en outre un connecteur d'entrée (FSA) pour recevoir un signal de sortie de réaction provenant dudit amplificateur stéréo (SA), où ledit signal de réaction est utilisé dans ledit décodeur numérique sonore surround (DSD) pour commander automatiquement (VCAL) le volume (VO) desdits amplificateurs (V) desdites sorties de canal converties N/A restantes dudit décodeur à canaux multiples (DEC), de sorte que le volume (VO) desdits amplificateurs corresponde à un réglage de volume dudit amplificateur stéréo, où ledit connecteur d'entrée (FSA) pour recevoir un signal de sortie de réaction reçoit les signaux de sortie des haut-parleurs provenant dudit amplificateur stéréo (SA) et où ces signaux de sortie des haut-parleurs de l'amplificateur stéréo sont transmis aux connecteurs de sortie des haut-parleurs gauche (LE) et droit (RI) dudit décodeur numérique sonore surround (DSD). 25 30 35 40

3. Décodeur numérique sonore surround selon la revendication 2, où le signal d'entrée (IN) dudit décodeur audio MPEG2 et/ou du décodeur AC-3 et/ou d'un autre type de décodeur à canaux multiples (DEC) est formaté selon la norme CEI 958 et transite via une mémoire tampon FiFo (FIFO). 45

50

55

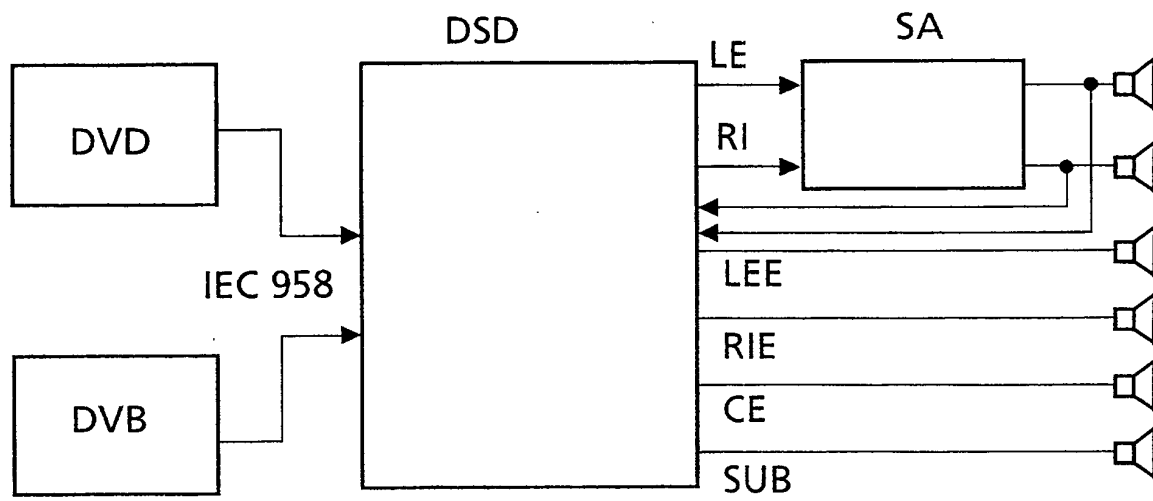


Fig.1

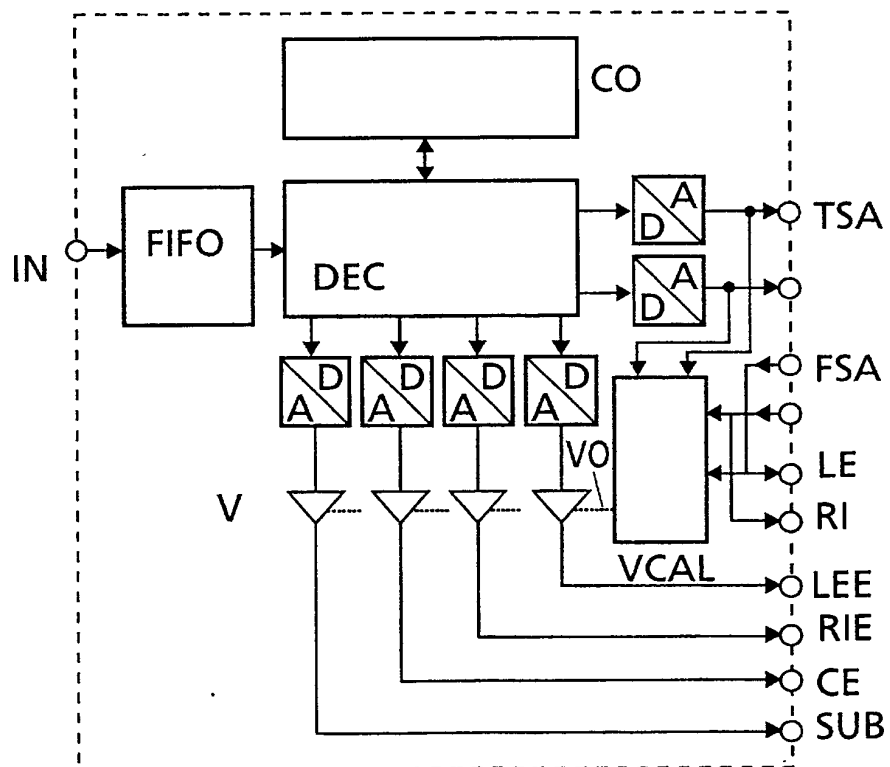


Fig.2

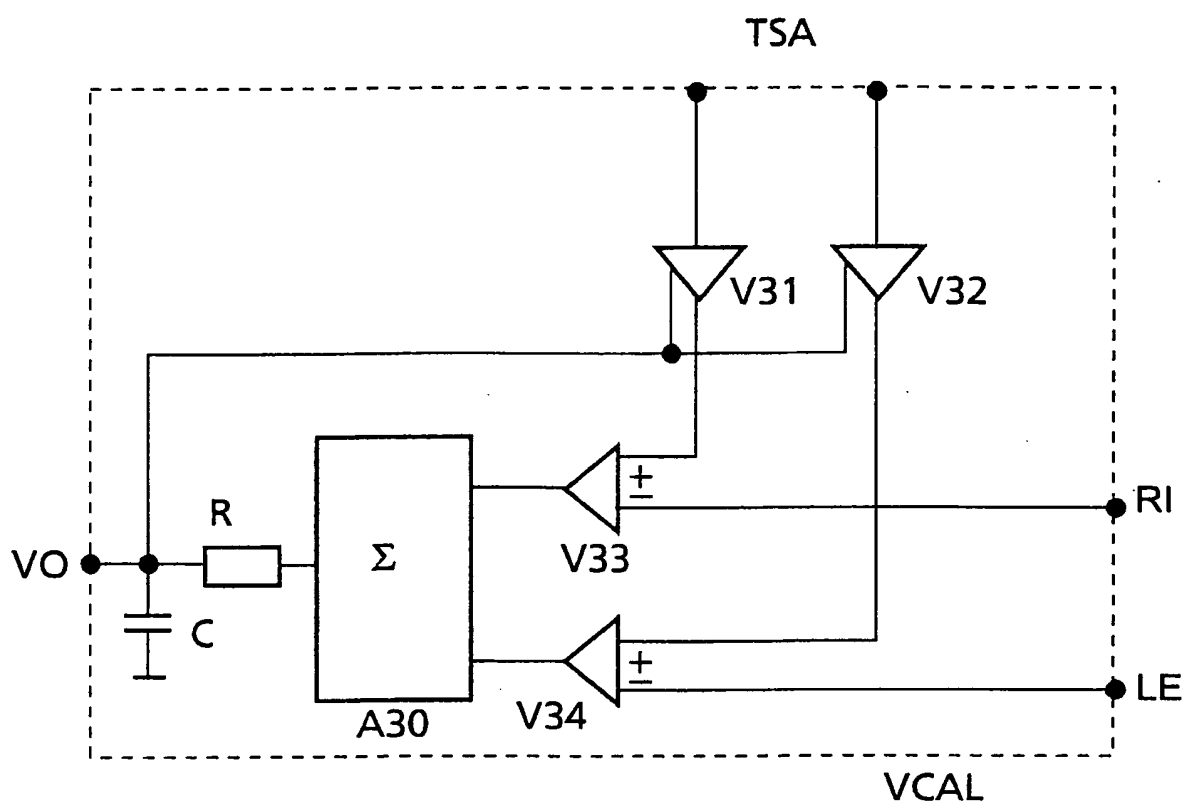


Fig.3

REFERENCES CITED IN THE DESCRIPTION

This list of references cited by the applicant is for the reader's convenience only. It does not form part of the European patent document. Even though great care has been taken in compiling the references, errors or omissions cannot be excluded and the EPO disclaims all liability in this regard.

Patent documents cited in the description

- EP 0782372 A [0002]
- US 5630175 A [0002]