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(54) **ERROR DETECTION UNIT, SATELLITE RECEIVER AND METHOD**

(57) The present invention provides an error detection unit (101) for a satellite receiver (100) for detecting cabling errors, the error detection unit (101) comprising a current sensor (102) configured to measure a supply current (103) for a low noise block downconverter, LNB (150), that is connected to the satellite receiver (100), and a control unit (104) configured to store as reference current value (106) a current value measured by the current sensor (102) during a first time installation of the satellite receiver (100) and to compare an operating cur-

rent value measured by the current sensor (102) during normal operation of the satellite receiver (100) with the stored reference current value (106), wherein the control unit (104) is configured to output a warning signal (107) if the operating current value is larger than the reference current value (106) by at least a current threshold value (108). In addition, the present invention provides a satellite receiver (100) and a respective method for detecting errors.

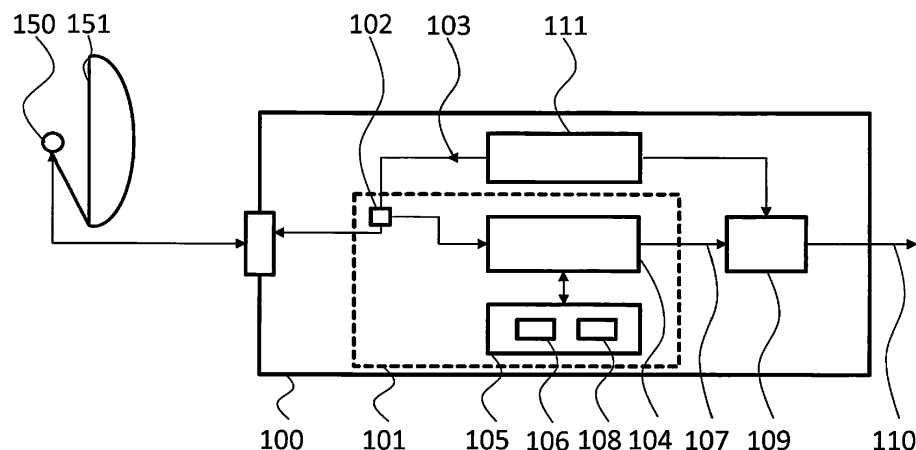


Fig. 1

Description

TECHNICAL FIELD

5 [0001] The invention relates to an error detection unit for a satellite receiver, a satellite receiver and a respective method.

BACKGROUND

10 [0002] Although applicable to any receiving device, the present invention will mainly be described in conjunction with satellite receivers for receiving TV signals.

[0003] Modern media distribution networks provide TV channels and radio channels to the homes of users. Possible network technologies include cable networks, streaming e.g. via the internet and wireless signal transmission, such as terrestrial video broadcasting, DVB-T, or satellite based video broadcasting, DVB-S.

15 [0004] Satellite based video broadcasting may especially be used to provide video and radio channels to remote locations, since no terrestrial broadcasting installations are necessary around the receiving location. The receiving user may simply install a satellite antenna or dish with a respective receiver to consume the respective TV channels and radio channels.

[0005] A system for receiving satellite signals usually comprises the satellite dish with a so called LNB, Low Noise Block downconverter that is connected via a cable to the receiver. In order to operate the LNB, the receiver will usually provide an operating voltage of 13 V or 18 V, depending on whether horizontally polarized or vertically polarized signals should be received.

20 [0006] In case of an error like e.g. a short circuit in the cable the power supply in the receiver may detect an overcurrent that is higher than a fixed current level and provide a respective error signal to a user. The user may then exchange the cable or the LNB for a fully functional cable or LNB. However, not all errors may be detected using a fixed current level for error detection.

25 [0007] Accordingly, there is a need for an improved error detection in satellite receivers.

SUMMARY OF THE INVENTION

30 [0008] The present invention provides an error detection unit with the features of claim 1, a satellite receiver with the features of claim 6, and a method for detecting errors with the features of claim 8.

[0009] Accordingly, it is provided:

35 An error detection unit for a satellite receiver for detecting cabling errors, the error detection unit comprising a current sensor configured to measure a supply current for a low noise block downconverter, LNB, that is connected to the satellite receiver, and a control unit configured to store as reference current value a current value measured by the current sensor during a first time installation of the satellite receiver and to compare an operating current value measured by the current sensor during normal operation of the satellite receiver with the stored reference current value, wherein the control unit is configured to output a warning signal if the operating current value is larger than the reference current value by at least a current threshold value.

[0010] Further, it is provided:

45 A satellite receiver for receiving satellite signals from a LNB, the satellite receiver comprising a power source configured to provide an operating power to the LNB via a cable, and an error detection unit according to any one of the preceding claims, wherein the current sensor is coupled to the power source and configured to measure a current provided by the power source.

[0011] Finally, it is provided:

50 A method for detecting errors in a satellite receiver arrangement, the method comprising measuring a supply current for a low noise block downconverter, LNB, that is connected to the satellite receiver during a first time installation of the satellite receiver, storing as reference current value the measured current value, comparing an operating current value measured during normal operation of the satellite receiver with the stored reference current value, and outputting a warning signal if the operating current value is larger than the reference current value by at least a current threshold value.

[0012] The present invention is based on the finding that using a fixed current threshold for error detection may serve

to detect short circuit errors but may not serve to detect other errors. The present invention further takes into account, that there may exist errors that slightly increase the current consumption or current drain from the power supply for the LNB in the satellite receiver, but that do not increase the current drain above the fixed current threshold value.

[0013] It is understood, that a dedicated power supply for the LNB may be provided or that a power supply of the satellite receiver may supply operating power to the LNB and all other elements of the satellite receiver. In this case, any referenced current value refers to the current that is provided to the LNB only. The current sensor may therefore be arranged in a current path that provides the current to the LNB only.

[0014] Possible errors that slightly increase the current drain may e.g. comprise degradations of the isolation of the cable that connects the satellite receiver to the LNB. A degradation of the isolation may e.g. lead to leakage currents that increase the current drain from the power source just a little, such that the total current does not raise above the fixed current limit.

[0015] However, such degradations of the isolation may in addition to an increase of the power consumption also lead to a loss of signal quality and therefore to a degradation of the image quality and e.g. block artefacts that may be visible on the screen when a TV channel is shown to a user. An increase of the current drain may also shorten the life time of the power supply for the LNB in the receiver.

[0016] The present invention therefore provides the error detection unit that is capable of identifying changes in the current drain from the power supply for the LNB of the satellite receiver that deviate from a reference current value that is not fixed but determined in the respective application.

[0017] The current sensor may be any type of current sensor, for example a voltage sensor that provides a voltage that is proportional to the current that is provided by the power supply for the LNB, e.g. a shunt resistor, the resistance of a switching element in the power supply for the LNB, or a hall based sensor or the like, or. The control unit may therefore evaluate measurement values provided by the current sensor to determine the current drain from the power supply for the LNB.

[0018] The control unit may determine the reference current value as a current value that is provided by the power supply during an initial or first time installation of the satellite receiver. This means that the control unit may determine the reference current value for example as the current value of the current that is provided by the power supply when the satellite receiver is turned on for the first time, e.g. in the user's premises after the user connected the satellite receiver via a cable to a LNB.

[0019] It is assumed that after the first time installation, the receiving system or arrangement is free of any faults and that therefore the reference current value represents the current value that is required by the LNB to operate under fault-free or normal operating conditions. This means that any increase of the measured current value that may be detected by the control unit during normal operation of the satellite receiver, may indicate a degradation of the cabling or the LNB that are connected to the satellite receiver. It is understood, that slight variations of the power consumption may e.g. be caused by temperature variations of the cabling and especially the LNB. Therefore, the current threshold value may be provided. It is further understood, that the current threshold value may be any value equal or larger than 0 mA. The current threshold value may e.g. be determined experimentally by analyzing a plurality of LNBs and cables under different temperatures. Possible values of the current threshold value may e.g. comprise values between 10 mA and 100 mA, e.g. 40 mA, 50 mA or 60 mA.

[0020] The control unit may monitor the measured operating current value and compare the operating current value with the reference current value. If the operating current value is larger than the reference current value plus the current threshold value, an error may be detected. In this case the control unit may provide a warning signal. The warning signal may e.g. be shown as a visual warning on a TV screen to a user. The warning may e.g. indicate to the user that although no short circuit is detected a degradation of the satellite installation is detected that may lead to signal and quality loss.

[0021] It is understood, that the control unit may be a hardware based control unit, a software based control unit or may comprise a combination of hardware and software, e.g. a controller with a respective firmware.

[0022] With the present invention it is possible to detect degradations of a satellite installation prior to the occurrence of short circuits.

[0023] Further embodiments of the present invention are subject of the further subclaims and of the following description, referring to the drawings.

[0024] In an embodiment, the control unit may be configured to store the reference current value only if the measured current value is larger than a predetermined minimum current value.

[0025] A user may e.g. turn on the satellite receiver prior to connecting the satellite receiver to a LNB. In this case no current may be drawn from the power supply for the LNB and an initial or reference current value of 0 mA may be measured.

[0026] To prevent the control unit from storing such a 0 mA current value as the reference current, a minimum current value may be provided in the control unit. The minimum current value represents the current value that must at least be measured to detect the first time installation of the satellite receiver.

[0027] The control unit may e.g. store a flag that indicates if the first time installation was already detected. If this flag comprises a negative value, no first time installation was performed and the control unit will wait for a current value that

is larger than the minimum current value to perform the determination of the reference current value. The stored reference current value may be used as the flag. For example a value of 0 mA may be stored as factory default value. The control unit will then automatically know that no initial current determination has been performed as long as the value of 0 mA is stored as the reference current value. Any other value will indicate that the initial or reference current value is already determined.

[0028] In another embodiment, the control unit may be configured to provide a short circuit warning if the measured operating current value is larger than a maximum threshold current value.

[0029] The control unit may not only monitor a degradation of the satellite receiver installation but may also monitor hard faults like a short circuit. Therefore, if a real short circuit occurs in the installation between the satellite receiver and the LNB, the control unit may directly indicate this type of error to the user. This will help the user in identifying the error source. The maximum threshold current value may e.g. be between 200 mA and 1 A, especially around 500 mA.

[0030] In a further embodiment, the control unit may be configured to store a measured current value as new reference current value on request.

[0031] The request may e.g. be provided to the control unit as a request signal from a central control unit of the satellite receiver. It is understood, that the control unit may also be provided as a single control unit with the central control unit of the satellite receiver. In such an embodiment, the request signal may be a software variable or flag or function invocation or the like.

[0032] To initiate the re-evaluation or re-determination of the reference current value, the satellite receiver may e.g. provide the user with a menu option in a user menu that may be displayed on a TV. The user may e.g. manually trigger the determination of the reference current value after changing the LNB and/or the cable that couples the satellite receiver to the LNB.

[0033] The control unit will then store the currently or most recent measured current value as new reference current value.

[0034] In another embodiment, the control unit may be configured to store a first reference current value for an operating voltage of the LNB that selects vertically polarized signals for reception and a second reference current value for an operating voltage of the LNB that selects horizontally polarized signals for reception.

[0035] As explained above, the LNB may be provided with different operating voltages to select either vertically or horizontally polarized signals for reception by the LNB. Usually, a 13 V voltage will select vertically polarized signals and an 18 V voltage will select horizontally polarized signals. It is understood, that different operating voltages may lead to different current demands in the LNB. Therefore, the control unit may store two different reference current values that allow the control unit to compare any measured operating current value with an adequate reference current value.

[0036] It is understood, that with a single reference current value, the reference current value may either be stored for an operating voltage of the LNB that selects vertically polarized signals or for an operating voltage of the LNB that selects horizontally polarized signals. The control unit may then perform the evaluation of the operating current value only when the respective polarization is selected.

[0037] In an embodiment, the satellite receiver may comprise a central control unit, and the control unit of the error detection unit may be integrated into the central control unit.

[0038] The control unit may e.g. be integrated as a software component, e.g. a program or a function of a firmware, into the central control unit.

BRIEF DESCRIPTION OF THE DRAWINGS

[0039] For a more complete understanding of the present invention and advantages thereof, reference is now made to the following description taken in conjunction with the accompanying drawings. The invention is explained in more detail below using exemplary embodiments, which are specified in the schematic figures of the drawings, in which:

Fig. 1 shows a block diagram of an embodiment of a satellite receiver according to the present invention;

Fig. 2 shows a flow diagram of an embodiment of a method according to the present invention; and

Fig. 3 shows a flow diagram of another embodiment of a method according to the present invention.

[0040] In the figures like reference signs denote like elements unless stated otherwise.

DETAILED DESCRIPTION OF THE DRAWINGS

[0041] Fig. 1 shows a block diagram of a satellite receiver 100. The satellite receiver 100 is coupled to a LNB 150 on a satellite dish 151. The satellite receiver 100 comprises a power source 111 that provides a supply current 103 for

operating the LNB 150. The power source 111 may be a power source that can be configured to provide the supply current 103 at two different voltage levels, e.g. 13 V and 18 V, for selecting horizontally or vertically polarized signals in the LNB 150. The satellite receiver 100 further comprises a central control unit 109 that is also powered by the power source 111 and may control the voltage level that the power source 111 provides to the LNB 150. Further, the central control unit 109 may also generate a video signal 110 that may e.g. be displayed on a TV screen. It is understood, that the central control unit 109 may comprise a plurality of different components that are required to demodulate and/or decode the satellite signals received via the LNB 150 and to generate the video signal 110. Further, the central control unit 109 may comprise a video controller that e.g. allows displaying a user menu or other information to a user as overlay over a video image.

[0042] The satellite receiver 100 further comprises an error detection unit 101. The error detection unit 101 is used to detect errors in the receiver-LNB arrangement. Such errors may e.g. comprise leakage currents in the cable that connects the LNB 150 to the satellite receiver 100.

[0043] The error detection unit 101 comprises a current sensor 102 that is coupled to a control unit 104. The control unit 104 is further coupled to a memory 105 and to the central control unit 109. The current sensor 102 measures the supply current 103 and provides respective measurement values to the control unit 104.

[0044] The control unit 104 may use the measured current values in two different ways. If the satellite receiver 100 is initially installed, the control unit 104 may store the measured current value in the memory 105 as a reference current value 106. The reference current value 106 serves as a base value for later monitoring the function of the satellite receiver 100 and the LNB 150.

[0045] The control unit 104 may further verify certain conditions prior to storing the reference current value 106. The control unit 104 may e.g. verify that the measured operating current value is larger than a minimal current value to make sure that the satellite receiver 100 is connected to a LNB 150. If e.g. the central control unit 109 is capable of providing a respective indication if the satellite receiver 100 is connected to a LNB 150, the control unit 104 may also use this indication to determine whether to store the reference current value 106 or not.

[0046] Further, it may be possible for a user to trigger the determination of the reference current value 106. For example, the central control unit 109 may provide an option in an on-screen menu that triggers the determination of the reference current value 106 if it is selected by the user.

[0047] During normal operation the control unit 104 will therefore compare the measured operating current values to the reference current value 106. In the memory 105 in addition to the reference current value 106 a current threshold value 108 is provided. The control unit 104 may compare the measured operating current values to the reference current value 106 plus the current threshold value 108. This will prevent false alarms that may be caused e.g. by temperature induced current increases in the LNB 150.

[0048] If however the measured operating current values are larger during normal operation of the satellite receiver 100 than the reference current value 106 plus the current threshold value 108, the control unit 104 will output a warning signal 107 to the central control unit 109. The central control unit 109 may then e.g. include in the video signal 110 a warning message for a user that will indicate to the user that the connection between the satellite receiver 100 and the LNB 150 is faulty. The user may then easily exchange the cable or the LNB 150 to eliminate the problem.

[0049] The error detection unit 101 is shown as storing only one reference current value 106. It is understood, that this reference current value 106 may refer to one of the possible supply voltages that the power source 111 may provide to the LNB 150. It is also understood, that the control unit 104 may store more reference current values in the memory 105. The control unit 104 may e.g. store one reference current value for every possible supply voltage of the LNB 150. It is understood, that the control unit 104 may also take into account other parameters and store respective reference current values, e.g. temperature dependent reference current values. The same applies to the current threshold value 108. This means that more than one current threshold value 108 may be provided.

[0050] The control unit 104 may further comprise a short circuit detection that may instantly show a short circuit warning to the user, if the measured operating current values are higher than a maximum threshold current value.

[0051] It is understood, that although shown as separate entities, the control unit 104 and the central control unit 109 may be integrated into a single entity.

[0052] For sake of clarity in the following description of the method based Figs. 2 and 3 the reference signs used above in the description of apparatus based Fig. 1 will be maintained.

[0053] Fig. 2 shows a flow diagram of a method for detecting errors in a satellite receiver arrangement.

[0054] The method comprises measuring S1 a supply current 103 for a low noise block downconverter, LNB 150, that is connected to the satellite receiver 100 during a first time installation of the satellite receiver 100, storing S2 as reference current value 106 the measured current value, comparing S3 an operating current value measured during normal operation of the satellite receiver 100 with the stored reference current value 106, and outputting S4 a warning signal 107 if the operating current value is larger than the reference current value 106 by at least a current threshold value 108.

[0055] To prevent storing a reference current value 106 while no LNB 150 is connected to the satellite receiver 100, the reference current value 106 may e.g. only be stored if the measured current value is larger than a predetermined

minimum current value. In addition, a measured current value may be stored as new reference current value 106 on request, e.g. a user request that is provided via a user interface of the satellite receiver 100.

[0056] Further, a first reference current value 106 for an operating voltage of the LNB 150 that selects vertically polarized signals for reception and a second reference current value 106 for an operating voltage of the LNB 150 that selects horizontally polarized signals for reception may be separately stored.

[0057] A short circuit warning may be provided if the measured operating current value is larger than a maximum threshold current value.

[0058] Fig. 3 shows a flow diagram of another method for detecting errors in a satellite receiver arrangement.

[0059] Step S11 marks the first time installation of the satellite receiver 100 with a satellite dish 151 and a LNB 150. In step S12 the current that is provided to the LNB 150 either at an operating voltage of 13 V or at an operating voltage of 18 V is measured and in case of an initial installation stored as reference current value 106.

[0060] In decision D11 that is performed during normal operation of the satellite receiver 100, it is verified if the measured operating current values are larger than the reference current value 106. If the measured operating current values are not larger, i.e. lower, than the reference current value 106, the method returns to step S12.

[0061] However, if the measured operating current values are larger than the reference current value 106, the warning signal 107 is provided in step S14.

[0062] Although specific embodiments have been illustrated and described herein, it will be appreciated by those of ordinary skill in the art that a variety of alternate and/or equivalent implementations exist. It should be appreciated that the exemplary embodiment or exemplary embodiments are only examples, and are not intended to limit the scope, applicability, or configuration in any way. Rather, the foregoing summary and detailed description will provide those skilled in the art with a convenient road map for implementing at least one exemplary embodiment, it being understood that various changes may be made in the function and arrangement of elements described in an exemplary embodiment without departing from the scope as set forth in the appended claims and their legal equivalents. Generally, this application is intended to cover any adaptations or variations of the specific embodiments discussed herein.

[0063] Thus, the present invention provides an error detection unit 101 for a satellite receiver 100 for detecting cabling errors, the error detection unit 101 comprising a current sensor 102 configured to measure a supply current 103 for a low noise block downconverter, LNB 150, that is connected to the satellite receiver 100, and a control unit 104 configured to store as reference current value 106 a current value measured by the current sensor 102 during a first time installation of the satellite receiver 100 and to compare an operating current value measured by the current sensor 102 during normal operation of the satellite receiver 100 with the stored reference current value 106, wherein the control unit 104 is configured to output a warning signal 107 if the operating current value is larger than the reference current value 106 by at least a current threshold value 108. In addition, the present invention provides a satellite receiver 100 and a respective method for detecting errors.

List of reference signs

[0064]

100	satellite receiver
101	error detection unit
102	current sensor
103	supply current
104	control unit
105	memory
106	reference current value
107	warning signal
108	current threshold value
109	central control unit
110	video signal
111	power supply
150	low noise block downconverter
151	satellite dish
S1 - S4, S11 - S14	method steps
D11	decision

Claims

1. Error detection unit (101) for a satellite receiver (100) for detecting cabling errors, the error detection unit (101) comprising:

a current sensor (102) configured to measure a supply current (103) for a low noise block downconverter, LNB (150), that is connected to the satellite receiver (100), and
 a control unit (104) configured to store as reference current value (106) a current value measured by the current sensor (102) during a first time installation of the satellite receiver (100) and to compare an operating current value measured by the current sensor (102) during normal operation of the satellite receiver (100) with the stored reference current value (106),
 wherein the control unit (104) is configured to output a warning signal (107) if the operating current value is larger than the reference current value (106) by at least a current threshold value (108).

2. Error detection unit (101) according to claim 1, wherein the control unit (104) is configured to store the reference current value (106) only if the measured current value is larger than a predetermined minimum current value.

3. Error detection unit (101) according to any one of the preceding claims, wherein the control unit (104) is configured to provide a short circuit warning if the measured operating current value is larger than a maximum threshold current value.

4. Error detection unit (101) according to any one of the preceding claims, wherein the control unit (104) is configured to store a measured current value as new reference current value (106) on request.

5. Error detection unit (101) according to any one of the preceding claims, wherein the control unit (104) is configured to store a first reference current value (106) for an operating voltage of the LNB (150) that selects vertically polarized signals for reception and a second reference current value (106) for an operating voltage of the LNB (150) that selects horizontally polarized signals for reception.

6. Satellite receiver (100) for receiving satellite signals from a LNB (150), the satellite receiver (100) comprising:

a power source configured to provide an operating power to the LNB (150) via a cable, and
 an error detection unit (101) according to any one of the preceding claims, wherein the current sensor (102) is coupled to the power source and configured to measure a current provided by the power source.

7. Satellite receiver (100) according to claim 6, comprising a central control unit (109), wherein the control unit (104) of the error detection unit (101) is integrated into the central control unit (109).

8. Method for detecting errors in a satellite receiver arrangement, the method comprising:

measuring (S1) a supply current (103) for a low noise block downconverter, LNB (150), that is connected to the satellite receiver (100) during a first time installation of the satellite receiver (100),
 storing (S2) as reference current value (106) the measured current value,
 comparing (S3) an operating current value measured during normal operation of the satellite receiver (100) with the stored reference current value (106), and
 outputting (S4) a warning signal (107) if the operating current value is larger than the reference current value (106) by at least a current threshold value (108).

9. Method according to claim 8, wherein the reference current value (106) is only stored if the measured current value is larger than a predetermined minimum current value.

10. Method according to any one of the preceding claims 8 and 9, wherein a short circuit warning is provided if the measured operating current value is larger than a maximum threshold current value.

11. Method according to any one of the preceding claims 8 to 10, wherein a measured current value is stored as new reference current value (106) on request.

12. Method according to any one of the preceding claims 8 to 11, wherein a first reference current value (106) for an

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operating voltage of the LNB (150) that selects vertically polarized signals for reception and a second reference current value (106) for an operating voltage of the LNB (150) that selects horizontally polarized signals for reception are stored separately.

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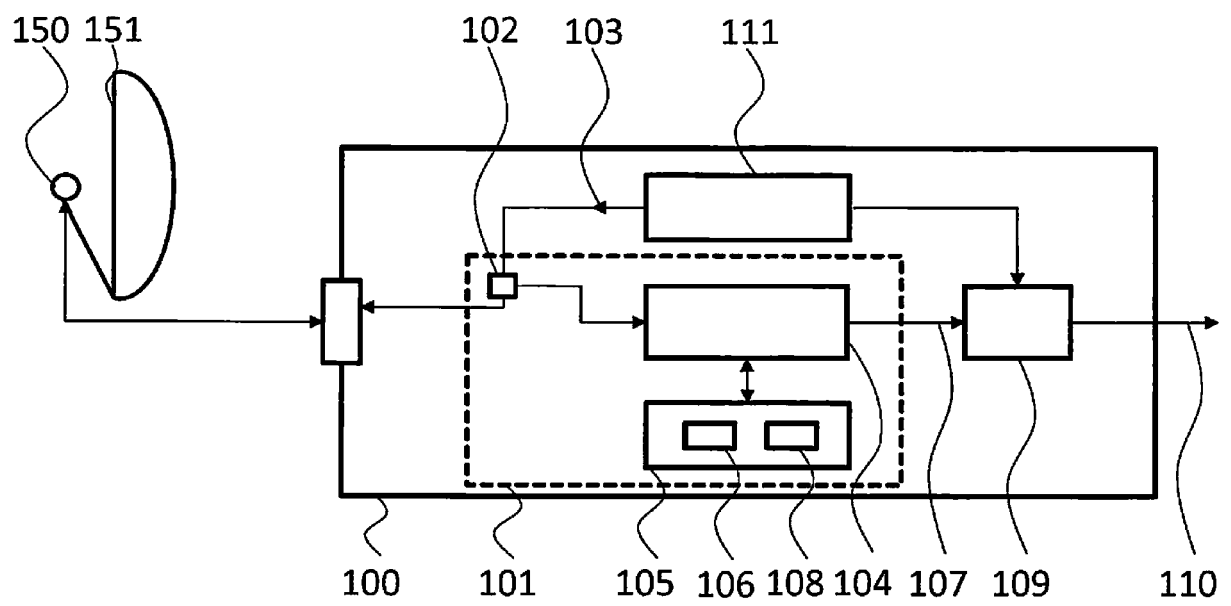


Fig. 1

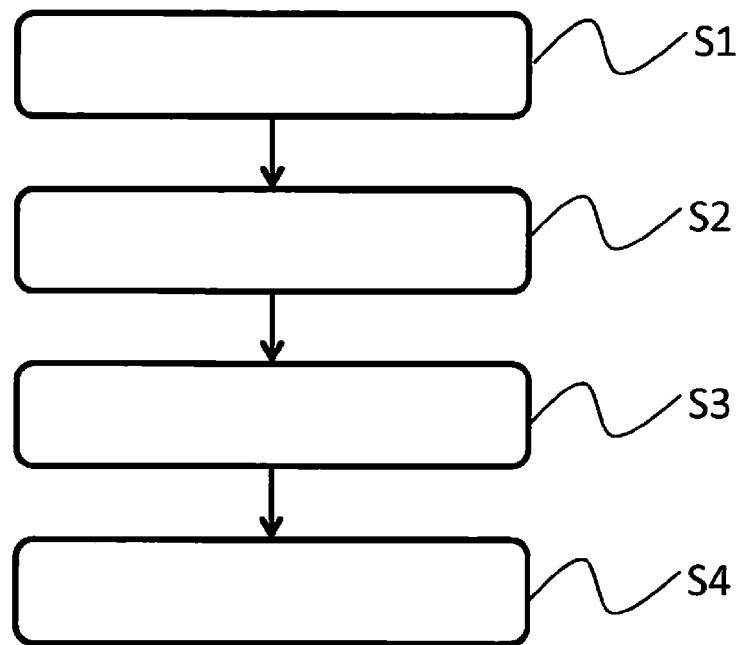


Fig. 2

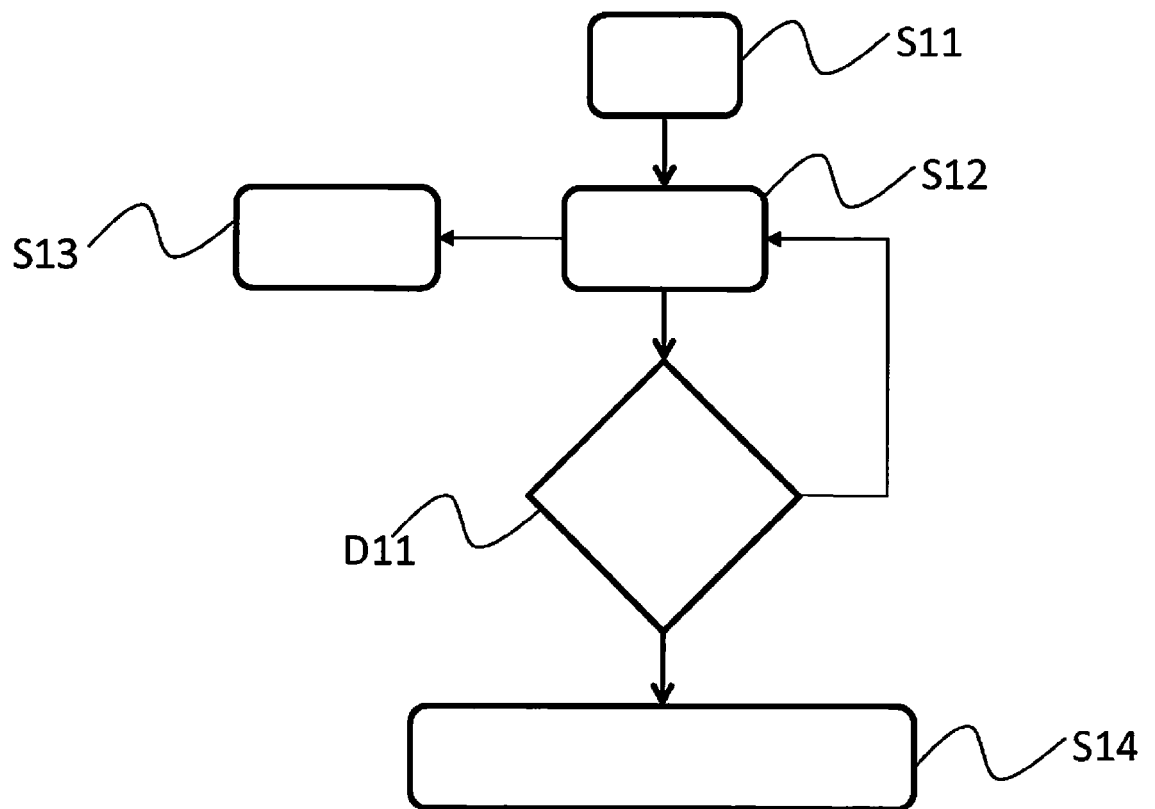


Fig. 3



EUROPEAN SEARCH REPORT

Application Number
EP 17 20 5977

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DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
Y	US 2014/256246 A1 (EITAN ALECSANDER P [IL] ET AL) 11 September 2014 (2014-09-11) * paragraph [0004] * * paragraph [0024] * * paragraph [0030] * * paragraph [0035] * * paragraph [0041] * * paragraph [0043] * * paragraph [0046] * * claim 16; figure 4 *	1-12	INV. H04H40/90 H04H20/12 H04H60/32
Y	DE 91 12 565 U1 (CONRAD ELECTRONIC GMBH) 16 January 1992 (1992-01-16) * page 13, lines 28-38 * * page 14, lines 17-23 * * claims 2,11; figure 2 *	1-12	
			TECHNICAL FIELDS SEARCHED (IPC)
			H04H
The present search report has been drawn up for all claims			
Place of search The Hague		Date of completion of the search 15 January 2018	Examiner Pantelakis, P
CATEGORY OF CITED DOCUMENTS X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document		T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document	

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**ANNEX TO THE EUROPEAN SEARCH REPORT
ON EUROPEAN PATENT APPLICATION NO.**

EP 17 20 5977

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This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report.
The members are as contained in the European Patent Office EDP file on
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For more details about this annex : see Official Journal of the European Patent Office, No. 12/82