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(54) **Signal receiver and method for aligning antenna for reception of at least two signals**

(57) In a signal receiver provided with an antenna (111), an antenna alignment controller (141) incorporates an available signals detector (142) searching for available signals, a critical signals selector (144) selecting critical signals, a critical signals analyzer (145) cyclically measuring the quality of critical signals and a signal information generator (143) providing concurrently the quality of at least two available signals at the alignment interface. The antenna alignment controller (141) can be implemented as software or may constitute a separate hardware element of the receiver or software operated by one of receiver blocks.

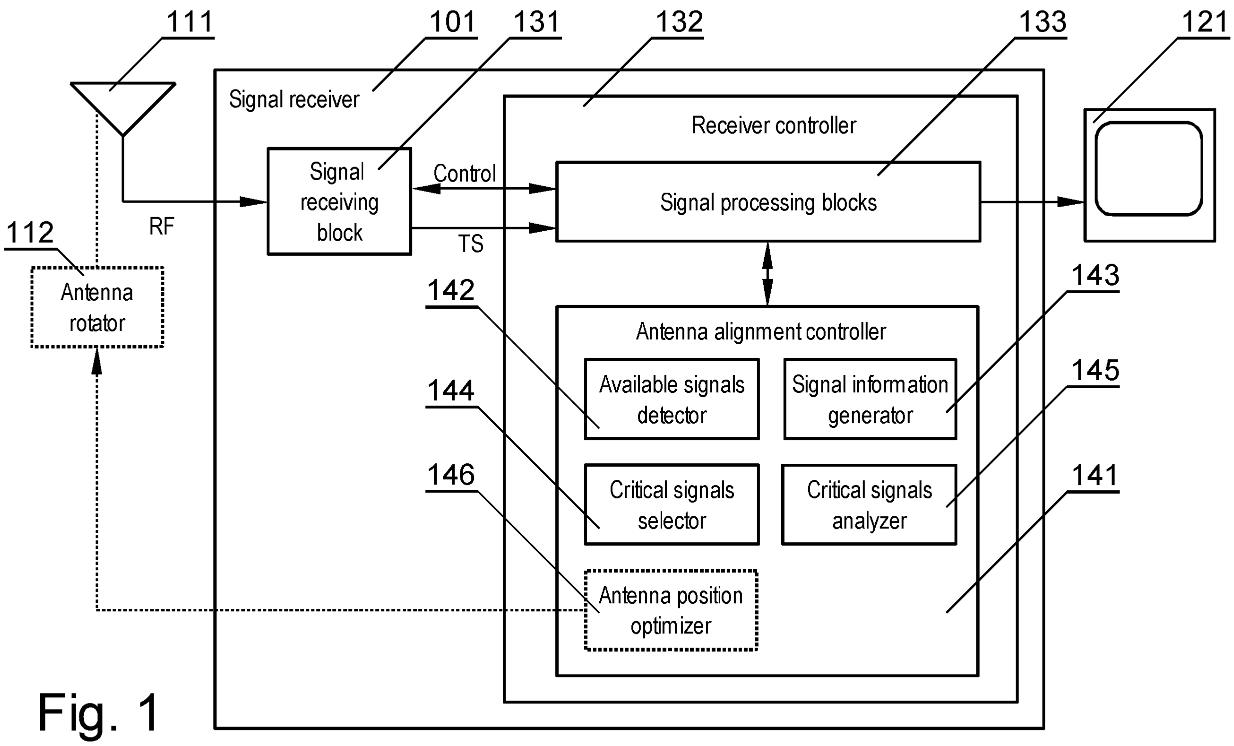

Fig. 1

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Description

[0001] The invention concerns a signal receiver and a method for aligning an antenna for reception of at least two signals.

[0002] The quality of signals received by an antenna depends on an antenna alignment in relation to a signal source. The signals can be received either by adjusting the antenna position for each signal individually, or determining the optimal antenna position for optimal reception of all signals.

[0003] There are many devices equipped with an antenna, where the quality of received signals depends on antenna alignment. For example, a digital terrestrial television receiver (commonly called a "set-top box") is supposed to receive signals broadcast from various terrestrial transmitters. When installing the receiver at a household, the antenna should be placed in an optimal position, which will guarantee good quality of signals available for reception in the area.

[0004] The US Patent No. 4,893,288 entitled "Audible antenna alignment apparatus" presents an arrangement for aligning an antenna, in which an audio signal is produced, which helps in determining the proper antenna alignment. The audio signal parameters are proportional to the quality of the received signal. However, only a single signal is measured, therefore the method is inefficient for aligning the antenna for optimal reception of several signals broadcast from various sources.

[0005] The European Patent No. 1014481 entitled "Antenna alignment method and device" presents a method for aligning an antenna, which involves at least two methods for measuring the quality of the received signal. The first method is used to determine whether a signal has been received, and the second method is used to measure the quality of the received signal. This method also involves measuring of parameters of a single signal.

[0006] The US Patent No. 6,229,480 entitled "System and method for aligning an antenna" presents a system for determining an acceptable antenna alignment for each of a number of channels. Since the acceptable alignment is determined for each channel individually, the antenna position has to be adjusted for each signal source change. This requires antenna rotation means or requires the user to adjust the position manually, which in both cases increases the time of tuning to a selected channel.

[0007] Thus, the drawback of the known methods is that they do not provide an efficient way of aligning an antenna for optimal reception of several signals. The user is provided with data related to a single signal at a time, therefore the antenna alignment may be adjusted only for optimal reception of a signal from a single source.

[0008] The purpose of the invention is to provide a signal receiver and a method for aligning an antenna, where data related to quality of at least two signals are provided concurrently, which allows adjusting the antenna alignment for optimal reception of at least two signals.

[0009] The idea of the invention is that in a method for aligning an antenna for reception of at least two signals, where the antenna is connected to a signal receiver provided with an alignment interface, the method comprises an initial scanning performed at an initial antenna position, changing a position of the antenna starting from the initial position and determining an optimal position of the antenna on the basis of information provided at the alignment interface. The specific features of this method is that while the initial scanning, a search is performed for available signals, and while the changing of the position of the antenna, quality of at least two available signals is cyclically measured and the quality of at least two available signals is provided concurrently at the alignment interface for finding the optimal position of the antenna.

[0010] The quality of available signals can measured as a function of the SNR of the available signals.

[0011] Further features of the method for aligning the antenna for reception of at least two signals is that while the initial scanning, quality of available signals is measured, and critical signals are selected from the available signals according to critical signals selection criteria, and while the changing of the position of the antenna, the signals whose quality is cyclically measured are the critical signals.

[0012] Preferably, the critical signals selection criteria are set by the user manually and specify the signals which are to be determined as critical and/or a value of a signal indicator below which a signal is to be determined as critical and/or a number of signals of the worst quality that are to be determined as critical.

[0013] Quality of critical signals can be provided along with an average of critical signals quality and/or a position indicator, which informs about a value of the average of quality of critical signals for antenna positions that have been analyzed.

[0014] Preferably, the antenna position is determined to be optimal when an average of quality of critical signals is above a predetermined level.

[0015] While the changing of the position of the antenna, the end of measurement cycle can be indicated after the quality of all critical signals have been measured and a new set of critical signals can be selected after the end of measurement cycle is indicated.

[0016] Preferably, after the end of measurement cycle is indicated, the measurement of critical signals is paused for a predefined time.

[0017] The alignment interface can be a display.

[0018] The signal receiver can provided with an antenna position optimizer and the alignment interface can be a display and/or the interface of the antenna position optimizer.

[0019] The antenna position can be determined to be optimal by the user of the signal receiver subjectively.

[0020] Preferably, while the changing of the position of the antenna, after the end of the measurement cycle, the position of the antenna is stored as a probable optimal antenna position if the average quality of the received signals is higher than the highest average quality measured in previous measurement cycles, and after all antenna positions have been analyzed, the optimal antenna position is determined to be the last stored probable optimal antenna position.

[0021] Preferably the antenna position is determined to be optimal for all antenna positions at which the quality of all signals provided at the alignment interface is above a predetermined level.

[0022] The antenna position can be determined to be optimal at a position at which quality of signals chosen by a user has the highest value and the antenna position is in a position range in which the quality of signals chosen by the user is above a predetermined level.

[0023] Furthermore, the idea of the invention is that a signal receiver provided with an antenna for reception of at least two signals, an antenna alignment interface, a signal receiving block receiving signals and measuring quality of received signals and a receiver controller connected to the signal receiving block for controlling the signal receiving block, is additionally provided with an antenna alignment controller comprising an available signals detector searching for available signals, a critical signals selector selecting critical signals, a critical signals analyzer cyclically measuring the quality of critical signals and a signal information generator providing concurrently the quality of at least two available signals at the alignment interface.

[0024] The antenna can be provided with an antenna rotator and the antenna alignment controller can comprise an antenna position optimizer determining automatically the optimal antenna position.

[0025] The alignment interface can be the interface of the antenna position optimizer and/or the display.

[0026] The invention will now be described by way of example and with reference to the accompanying drawings in which:

Fig. 1 presents a block diagram of a signal receiver;

Fig. 2 presents a basic method for aligning an antenna;

Fig. 3 presents an extended method for aligning an antenna;

Fig. 4 presents a display screen with signal quality indicators;

Fig. 5 presents an exemplary plot of received signals quality; and

Fig. 6 presents a method for automatic alignment of an antenna.

[0027] A digital terrestrial television receiver 101, shown in Fig. 1, is one of embodiments of signal receivers. Preferably, the digital television receiver 101 is a typical receiver for home use. Alternatively, it can be a special service receiver, which is used only for aligning the antenna, and after the optimal alignment is found, the user receiver for home use is put in place of the special service receiver. The receiver is provided with a signal receiving block 131 comprising a tuner and a demodulator. The signal receiving block 131 receives an RF signal from an antenna 111, which may be provided with an antenna rotator 112 for automatic positioning of the antenna 111. The demodulated signal is transmitted as a digital stream (for example, a Transport Stream TS in accordance with the MPEG-2 standard) to a receiver controller 132, which controls the operation of the signal receiving block 131 and other elements of the receiver. The receiver controller incorporates a signal processing block 133 for demultiplexing, descrambling, decoding and displaying the received digital stream. The signal processing block provides means for presenting information on the display 121, for example, an OSD (On-Screen Display) system. In the embodiment shown, the receiver controller operates an antenna alignment controller 141, which is implemented as software. However, in other embodiments, the antenna alignment controller 141 may constitute a separate hardware element of the receiver or software operated by another receiver block.

[0028] The receiver controller 132 communicates with the signal receiving block 131 via a Control interface, through which it sends various commands, such as a command requesting the reception of a specific signal. The Control interface is also used for transmission of signal quality indicators from the signal receiving block 131 to the receiver controller 132. The demodulated stream of digital data is sent to the signal processing block 133 of the receiver controller 132 via a TS interface.

[0029] The antenna alignment controller 141 provides the functionality for aligning the antenna for optimal reception of at least two signals. It comprises several interoperable blocks, the most important of which are shown in the drawing. An available signals detector 142 is used for searching for available signals that can be received by the antenna. It communicates with the signal receiving block 131 by sending commands for tuning to successive frequencies in the whole frequency spectrum and requesting a signal quality indicator for each available signal. A critical signals selector 144, basing on the critical signals selection criteria, selects the critical signals. A critical signals analyzer 145 operates in a loop, in which the quality of critical signals is cyclically measured and displayed on the screen. The signal information generator 143 provides indicators on quality of signals to the alignment interface. The alignment interface can be the display 121, on which information can be presented by means of the OSD system of the signal processing blocks 133. The display is thus an example of a graphical user interface, which is best suited for manual antenna alignment where the user perceives information presented on the display. Alternatively, the alignment interface may be the interface of the antenna position optimizer 146, which is used for automatic antenna alignment. Furthermore, while automatic alignment, signal quality may be provided both to the antenna position optimizer 146 and to the display 121, which allows the user to observe the alignment process. The signal information generator may calculate the average signal quality and provide it among other indicators.

[0030] The antenna alignment controller 141 may also comprise an antenna position optimizer 146 for automatic determining of the optimal antenna position. The optimizer 146 has an interface for reading signal quality indicators from the signal information generator 143. It has the functionality of calculating the changes of the antenna position by the antenna rotator and determining which position of the antenna is optimal.

[0031] The quality of received signals can be measured in one of several ways, such as: the AGC (Automatic Gain Control) signal of the tuner, or the SNR (Signal-to-Noise ratio) or BER (Bit-Error Rate) indicator of the signal received by the demodulator. AGC measurement is the quickest method, but least reliable, since it provides only the strength of the signal received by the tuner, not taking into account the number of errors in the signal. The SNR indicator provides basic information on the quality of signal in relation to noise and can be calculated relatively fast. The BER indicator provides the most reliable results, but its calculation is an order of magnitude slower than the SNR indicator. The preferred signal quality indicator is SNR, which provides quick and relatively reliable results. The choice of the indicator can be adjusted to the specific configuration of the system.

[0032] The signal quality, depending on its value, may be further classified into one of three categories, namely "poor", "good" and "excellent".

[0033] The critical signals may be selected according to critical signals selection criteria. The criteria specify the conditions for signals to be classified as critical. For example, critical signals may include all signals whose quality is below a specific level, for example all "poor" signals, or if there are no "poor" signals, all "good" signals. Alternatively, a predefined number (for example, 5) of worst quality signals may be selected. Alternatively, some or all of critical signals may be specified by the user - this allows to align the antenna for optimal reception of signals in which are most important for the user.

[0034] Fig. 2 presents a basic method for aligning an antenna according to the invention. The method consists of two parts, i.e. the initial scanning and the determining the optimal position. The initial scanning, involving steps 201 and 202, is performed for an initially fixed antenna position. In step 201 a search is performed for available signals, and the quality of each available signal is measured. In the next step 202, the critical signals are selected from the available signals according to critical signals selection criteria. The optimal position is determined in steps 203 to 205 for a changeable antenna position. Steps 203-205 are performed cyclically until the antenna position, and so the quality of the received signals, is determined to be optimal. The antenna position may be determined to be optimal by the user of the signal receiver subjectively (assisted by signal quality indicators presented at the screen), or it may be determined automatically, as described in more details in Fig. 3 and Fig. 6. While the quality of successive critical signals is cyclically measured, the position of the antenna changes, i.e. it may be changed automatically by the use of antenna rotator or manually by the user. The cyclical measurement is to be understood as a measurement where the quality of successive signals is measured and after the quality of the last signal has been measured, the measurement starts from the first signal. The cyclical measurement may be paused for performing additional computations, selecting new set of signals or changing the antenna position, but such pauses do not alter its cyclical nature. The current quality of signals, as well as changes corresponding to the antenna rotation, may be observed on the alignment interface. This may be judged by the user subjectively (when the interface is the display), or by the antenna position optimizer as shown in Fig. 3 and Fig. 6. In step 203 the signal quality of a critical signal is measured. Next, in step 204, it is provided at the alignment interface concurrently with the qualities of other signals. The concurrent provision of signal quality indicators in case when the alignment interface is a display is to be understood as concurrent displaying the quality of at least two signals. In case when the alignment interface is the interface of the antenna position optimizer, is to be understood as concurrent access of the optimizer to at least two signal quality indicators, for example by buffers which store the quality of at least two signals and the quality of one signal is updated at each measurement cycle. Next, in step 205, the signal receiving block is tuned to the next critical signal.

[0035] Fig. 3 presents an extended method for aligning an antenna. The initial scanning is performed in steps 301 and 302. Next, the quality of a critical signal is measured in step 303. The quality indicators are provided in step 304 along with the average signal quality indicator, described in details in Fig. 4. In step 305 it is checked if all critical signals have been measured in the current execution of the loop. If not, the signal receiving block is tuned to the next signal in step 306. If all critical signals have been measured in the current execution of the loop, the end of loop, which is the end of measurement cycle, is indicated in step 307, for example by an audio tone. The audio tone may be useful for the user as an indication on when the antenna position can be changed. Then, in step 308, a pause for a predetermined time (for example, 2 seconds) may be introduced to allow for antenna position change before the next cycle of measurements is started. If the antenna is equipped with an antenna rotator, the antenna position optimizer may calculate the change of the antenna alignment and send an appropriate command to the antenna rotator in step 309. Alternatively, the antenna position optimizer may decide that the antenna alignment is optimal and finish the procedure. Next, a new set of critical signals may be selected in step 310. By selecting new critical signals after a change of antenna position, the possible loss of quality of previously-acceptable signals can be noticed. New signals may be selected by analyzing the quality of available signals that were not included in the critical signals set and selecting from all available signals the worst signals according to critical signals selection criteria. Alternatively, for a quicker procedure, the quality of a randomly chosen signal (not being a critical signal) can be analyzed and if it is worse than the quality of the best critical signal, it can take its place as a critical signal.

[0036] Fig. 4 presents a display screen (being one of possible alignment interfaces) with signal quality indicators. The indicators are presented as three-segment horizontal bars, the bars presenting the quality level in one of three categories: "poor", "good" and "excellent". The bar segments may be represented by different colors or fill patterns. Next to each signal indicator there is an arrow pointing upwards or downwards, indicating the recent change of the signal quality - improvement or degradation, respectively. The average signal indicator shown at the bottom of the screen presents the calculated average signal quality. The average signal quality indicator may present the arithmetic average of qualities of all critical signals. Alternatively, it may present the arithmetic average of qualities of critical signals below a predetermined level, for example those of a poor quality, which clearly indicates to the user that there are signals of poor quality. Fig. 4 presents the average of two "poor" signals (624, 700 MHz). The display screen may also present an "OPTIMAL" box, which is activated when the system determines the antenna position to be optimal. This may help the user to determine the antenna position subjectively. Alternatively, this may end the procedure automatically. The antenna position may be determined to be optimal when the quality of all signals presented at the alignment interface (for example, the display screen) is above a predetermined level - for example, above the "poor" quality. Alternatively, the antenna position may be determined to be optimal when the average of critical signals quality is above a predetermined level - for example, above the "poor" quality. Another alternative method for determining the optimal antenna position is shown in Fig. 6.

[0037] The display screen may also comprise a position bar, on which the average quality of signals is shown for already analyzed antenna positions. The position bar is generated on the basis of information from the antenna position optimizer, which provides information about the position of the antenna, for example the alignment angle. A vertical marker on top of the position bar indicates the current antenna position. The position bar allows the user to return to the position at which the signal quality was the best. The signal quality on the position bar may be represented similarly as the signal quality indicators, i.e. by corresponding colors or fill patterns.

[0038] Fig. 5 presents an exemplary plot of received signals quality for a range of antenna alignment angles. The plot may be provided at the alignment interface. The y axis represents the signal quality, for example, the SNR indicator values. The x axis represents the alignment angle, from 0 to 360 degrees. The presented example refers to a directional antenna, which may receive signals with its front and back portions. Therefore, the pattern is repeated after 180 degrees. For clarity, the quality of only four signals, 501, 502, 503, 504 has been shown. The signals 501, 502 and 503 are the critical signals. The quality of the signal 504 is much better than that of the signals 501, 502, 503, therefore it is not included in the critical signals set. The plot 511 shows a sum (or, alternatively, this may be the average) of the three critical signals 501, 502, 503. The "poor" level is the level below which the quality of signals is considered to be unacceptable. Therefore, the optimal reception of all signals is for the ranges R1 and R2, where the quality of all signals is better than "poor". The "best" level refers to the point at which the quality of all signals is the best. The "current" level refers to the current measurement point.

[0039] Fig. 6 presents a method for automatic alignment of an antenna. It is a detailed embodiment of the procedure shown in Fig. 3. Steps 601-606 are similar to respective steps 301-306 shown in Fig. 3. In step 604, the average signal quality indicator is provided together with the quality indicators of other signals. In step 607 it is checked if the quality of all measured signals is better than "poor" and if so, and if the current average signal quality indicator is the best of average signal quality indicators measured before, the current position of the antenna is stored as a probable optimal position. In step 608 it is checked if all antenna positions have been analyzed. If not, the antenna alignment is changed by a predetermined value in step 609 and the procedure returns to step 603. If all antenna positions have been analyzed, in step 610 the optimal antenna position is determined to be the last stored probable optimal position and the antenna is aligned to that position.

[0040] The preferred embodiments having been thus described, it will now be evident to those skilled in the art that further variations thereto may be introduced. Such variations are not to be regarded as a departure from the invention, the true scope of the invention being set forth in the claims appended hereto.

Claims

1. A method for aligning an antenna for reception of at least two signals, the antenna being connected to a signal receiver provided with an alignment interface, the method comprising the following steps
an initial scanning performed at an initial antenna position;
changing a position of the antenna starting from the initial position; and
determining an optimal position of the antenna on the basis of information provided at the alignment interface, **characterized in that**
while the initial scanning, a search is performed for available signals,
and while the changing of the position of the antenna, quality of at least two available signals is cyclically

measured and the quality of at least two available signals is provided concurrently at the alignment interface for finding the optimal position of the antenna.

2. The method according to claim 1, **characterized in that** the quality of available signals is measured as a function of the SNR of the available signals.

3. The method according to claim 1, **characterized in that** additionally,
while the initial scanning, quality of available signals is measured, and critical signals are selected from the available signals according to critical signals selection criteria,
and while the changing of the position of the antenna, the signals whose quality is cyclically measured are the critical signals.

4. The method according to claim 3, **characterized in that** the critical signals selection criteria are set by the user manually and specify the signals which are to be determined as critical.

5. The method according to claim 3, **characterized in that** the critical signals selection criteria specify the value of a signal indicator below which a signal is to be determined as critical.

6. The method according to claim 3, **characterized in that** the critical signals selection criteria specify a number of signals of the worst quality that are to be determined as critical.

7. The method according to claim 3, **characterized in that** quality of critical signals is provided along with an average of critical signals quality.

8. The method according to claim 7, **characterized in that** the antenna position is determined to be optimal when an average of quality of critical signals is above a predetermined level.

9. The method according to claim 3, **characterized in that** quality of critical signals is provided along with a position indicator, which informs about a value of the average of quality of critical signals for antenna positions that have been analyzed.

10. The method according to claim 3, **characterized in that** while the changing of the position of the antenna, the end of measurement cycle is indicated after the quality of all critical signals have been measured.

11. The method according to claim 10, **characterized in that** while the changing of the position of the antenna, a new set of critical signals is selected after the end of measurement cycle is indicated.

12. The method according to claim 10, **characterized in that** after the end of measurement cycle is indicated, the measurement of critical signals is paused for a predefined time.

13. The method according to claim 1, **characterized in that** the alignment interface is a display.

14. The method according to claim 1, **characterized in that** the signal receiver is provided with an antenna position optimizer and the alignment interface is a display and/or the interface of the antenna position optimizer.

15. The method according to claim 1, **characterized in that** the antenna position is determined to be optimal by the user of the signal receiver subjectively.

16. The method according to claim 1, **characterized in that** while the changing of the position of the antenna, after the end of the measurement cycle, the position of the antenna is stored as a probable optimal antenna position if the average quality of the received signals is higher than the highest average quality measured in previous measurement cycles, and after all antenna positions have been analyzed, the optimal antenna position is determined to be the last stored probable optimal antenna position.

17. The method according to claim 1, **characterized in that** the antenna position is determined to be optimal for all antenna positions at which the quality of all signals provided at the alignment interface is above a predetermined level.

18. The method according to claim 1, **characterized in that** the antenna position is determined to be optimal at a position at which quality of signals chosen by a user has the highest value and the antenna position is in a position range in which the quality of signals chosen by the user is above a predetermined level.

19. A signal receiver provided with an antenna for reception of at least two signals, an antenna alignment interface, a signal receiving block for receiving signals and measuring the quality of received signals and a receiver controller connected to signal receiving block and controlling the signal receiving block, **characterized in that** to the antenna is linked an antenna alignment controller (141) comprising an available signals detector (142) searching for available signals, a critical signals selector (144) selecting critical signals, a critical signals analyzer (145) cyclically measuring the quality of critical signals and a signal information generator (143) providing concurrently the quality of at least two available signals at the alignment interface.

20. The signal receiver according to claim 19, **characterized in that** the antenna (111) is provided with an antenna rotator (112) and the antenna alignment controller (141) comprises an antenna position optimizer (146) determining automatically the optimal antenna position.

21. The signal receiver according to claim 20, **characterized in that** the antenna alignment interface is the interface of the antenna position optimizer (146) and/or a display (121).

22. The signal receiver according to claim 19, **characterized in that** the antenna alignment interface is a display (121).

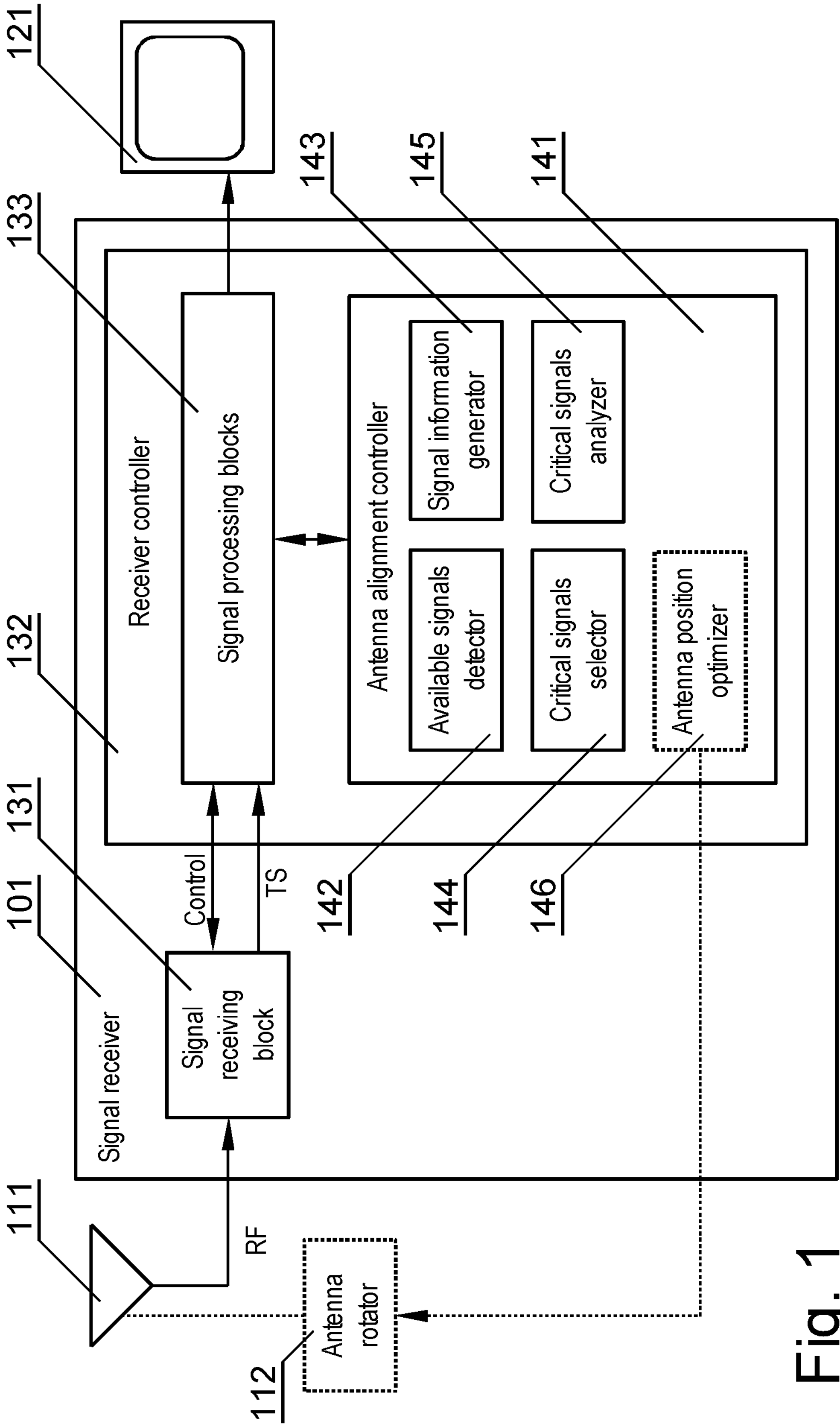
121
133
132
131
101
111
143
145
141
Receiver controller
Signal processing blocks
Antenna alignment controller
Signal information generator
Critical signals analyzer
Available signals detector
Critical signals selector
Antenna position optimizer
Control
TS
142
144
146
Signal receiver
Signal receiving block
RF
Antenna rotator
112

Fig. 1

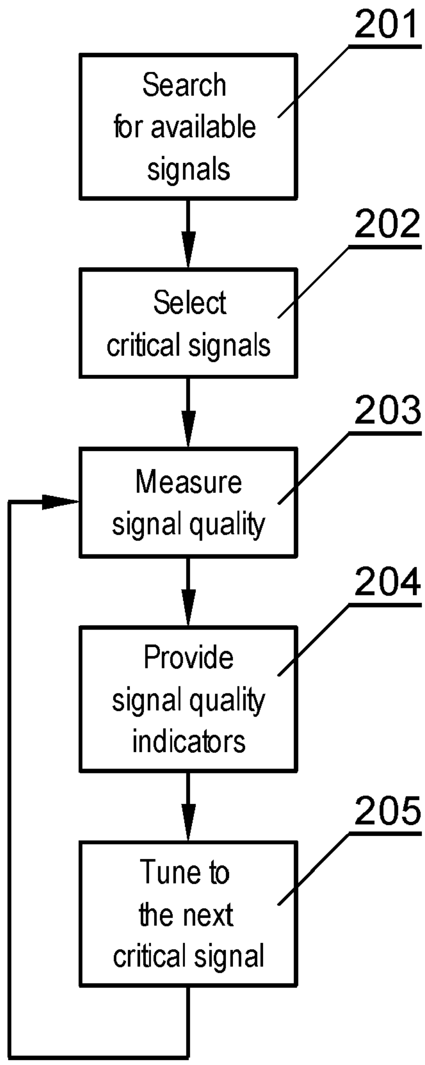
201
Search for available signals
202
Select critical signals
203
Measure signal quality
204
Provide signal quality indicators
205
Tune to the next critical signal

Fig. 2

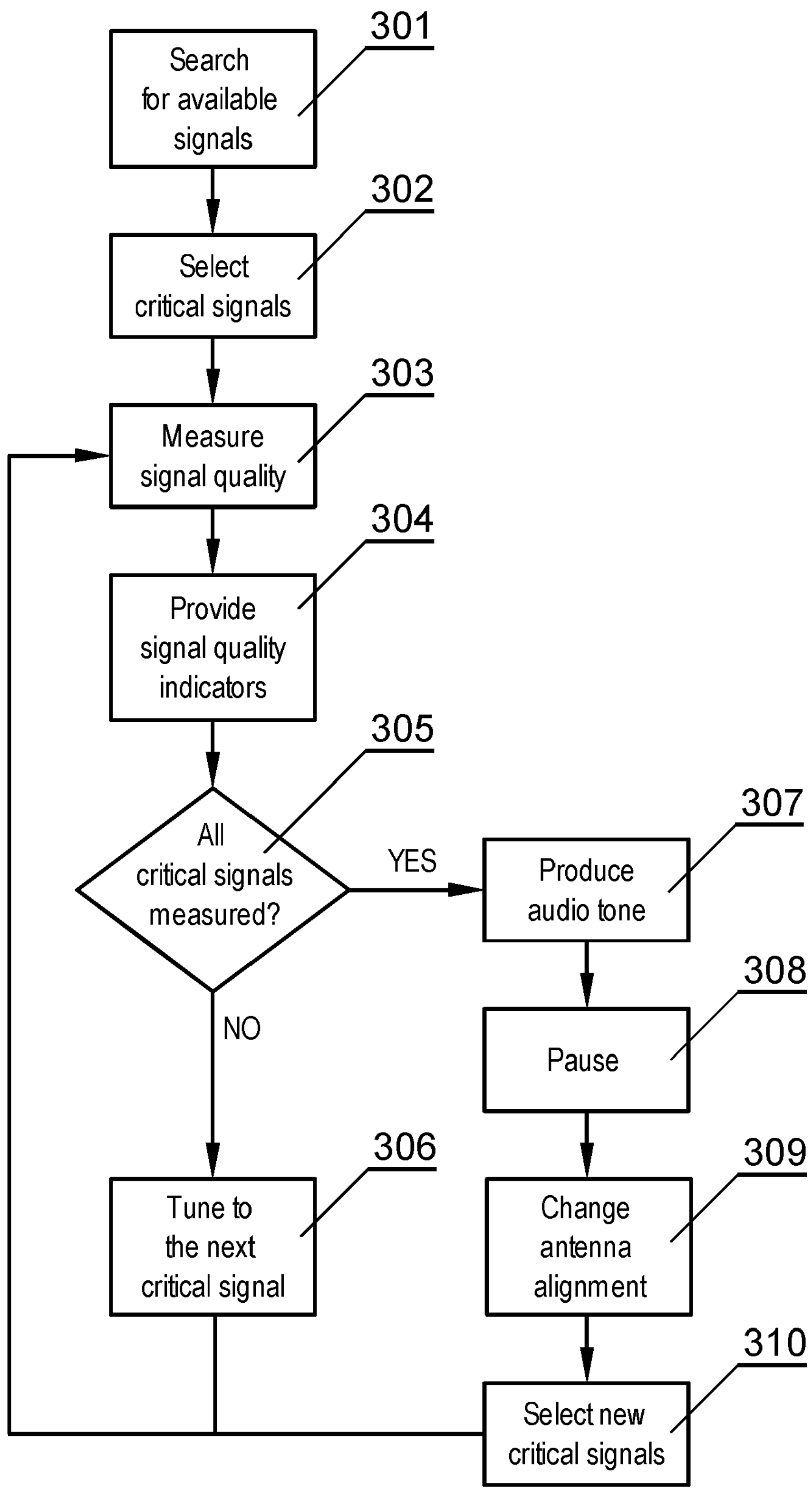
301
Search for available signals
302
Select critical signals
303
Measure signal quality
304
Provide signal quality indicators
305
All critical signals measured?
YES
NO
306
Tune to the next critical signal
307
Produce audio tone
308
Pause
309
Change antenna alignment
310
Select new critical signals

Fig. 3

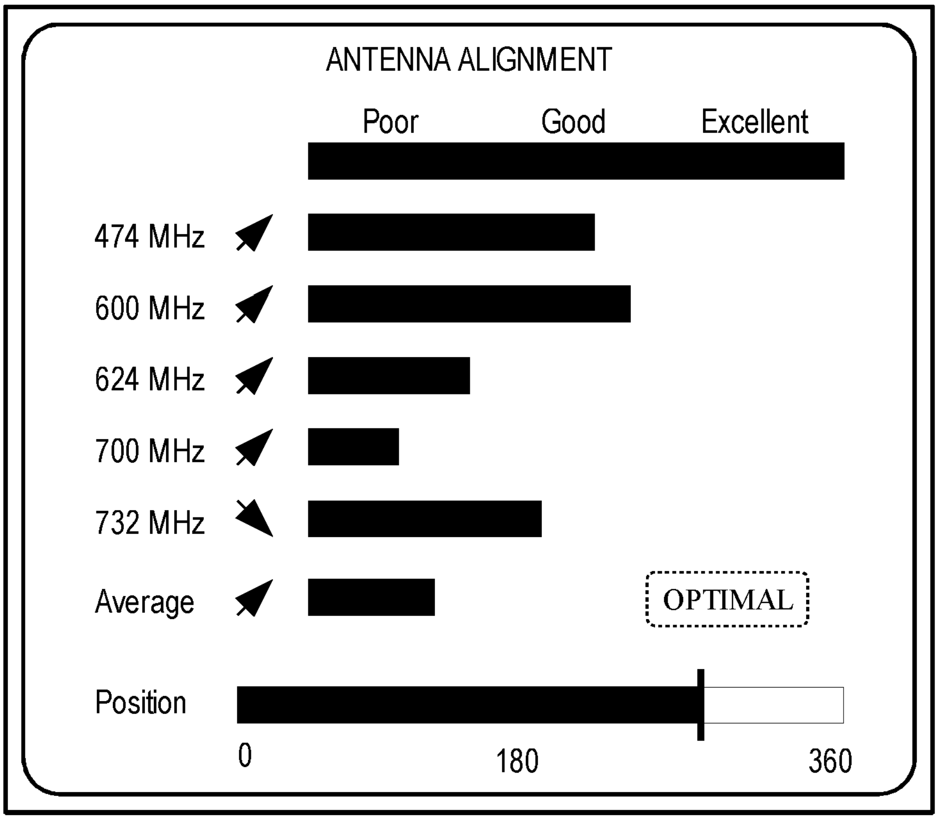
ANTENNA ALIGNMENT
Poor
Good
Excellent
474 MHz
600 MHz
624 MHz
700 MHz
732 MHz
Average
OPTIMAL
Position
0
180
360

Fig. 4

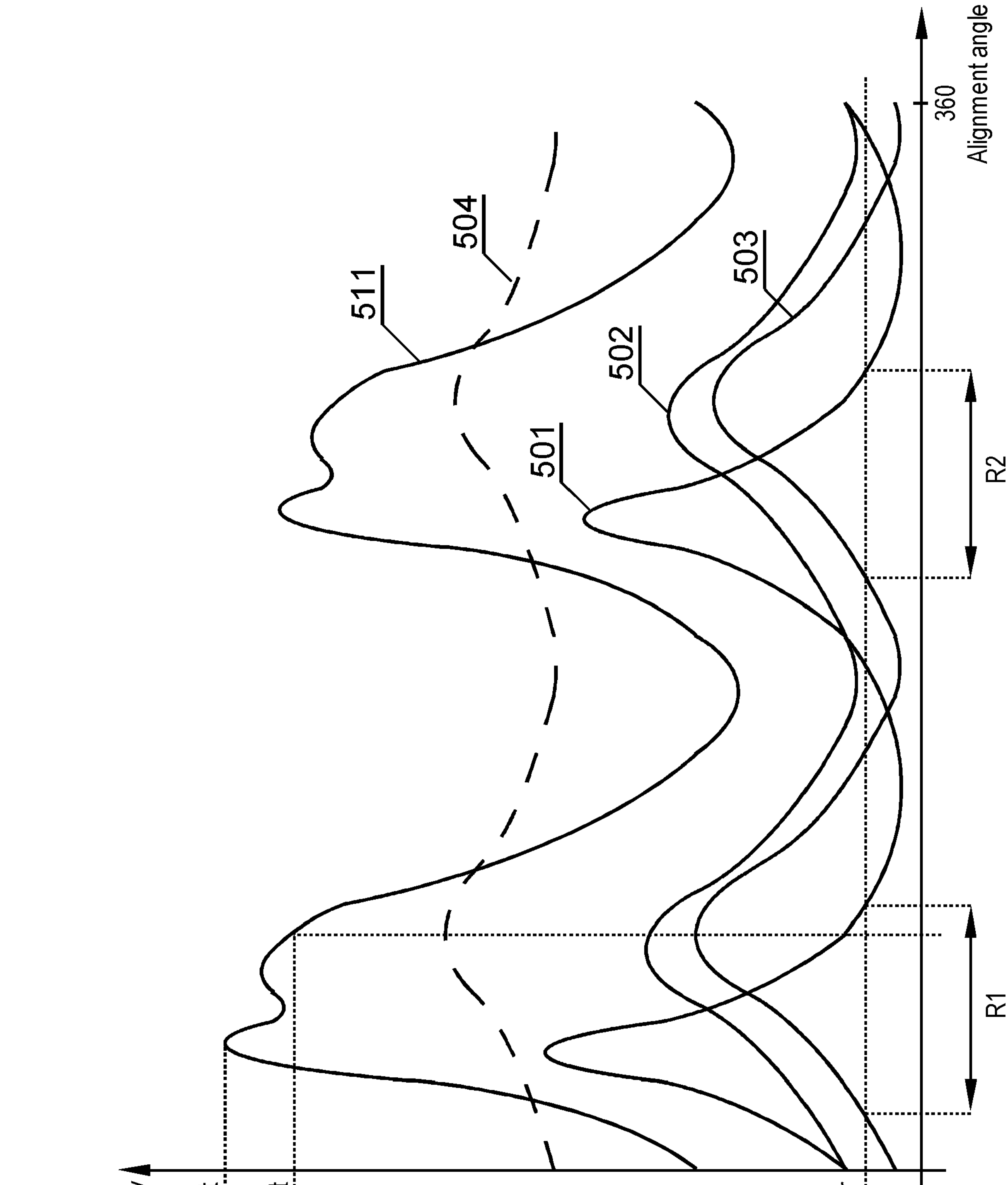
Quality
Best
Current
Poor
511
504
503
502
501
R1
R2
360
Alignment angle

Fig. 5

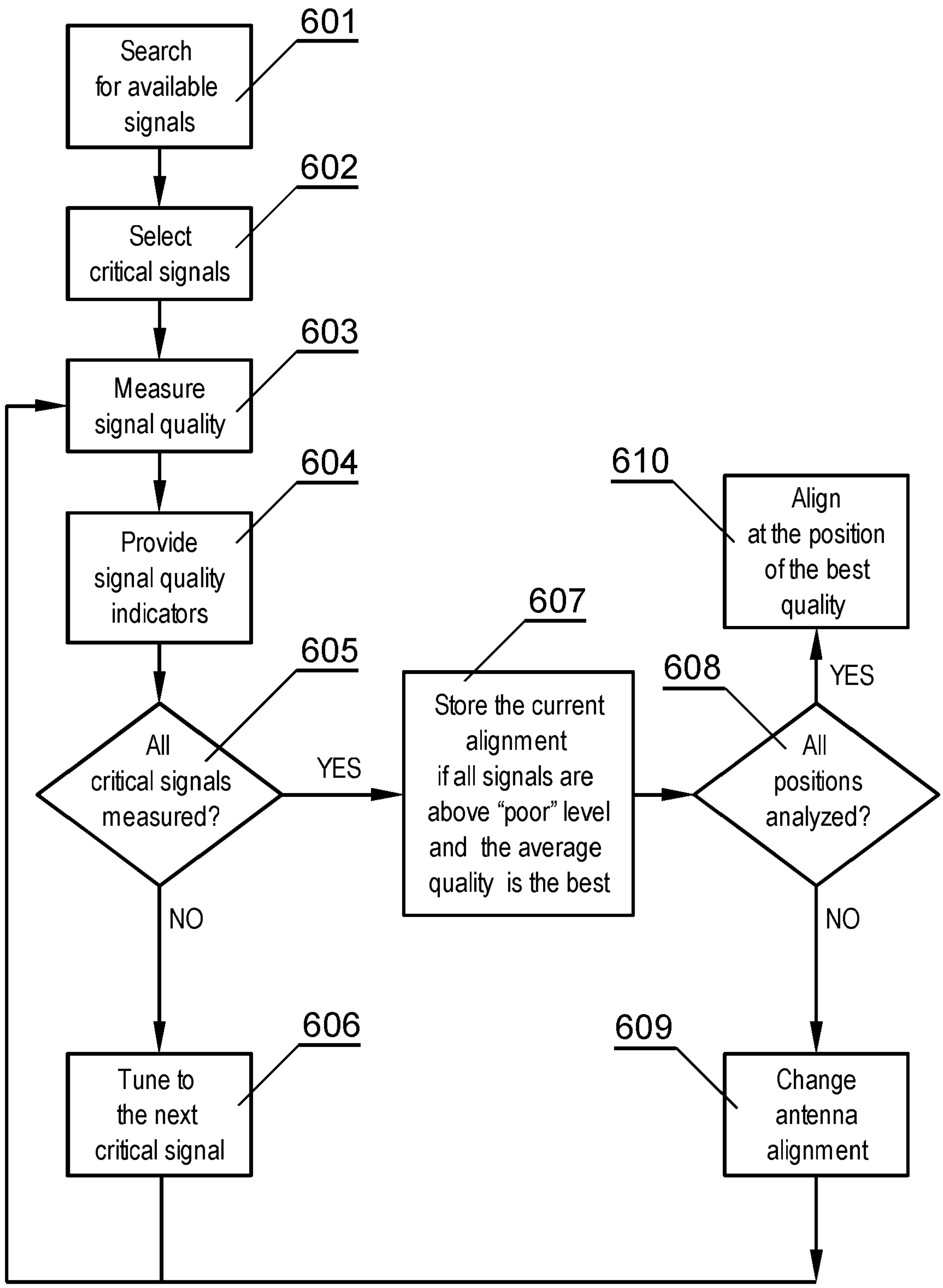
Search for available signals
601
Select critical signals
602
Measure signal quality
603
Provide signal quality indicators
604
All critical signals measured?
605
YES
NO
Tune to the next critical signal
606
Store the current alignment if all signals are above “poor” level and the average quality is the best
607
All positions analyzed?
608
YES
NO
Change antenna alignment
609
Align at the position of the best quality
610

Fig. 6

European Patent Office

EUROPEAN SEARCH REPORT

Application Number
EP 05 10 6576

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
X	US 6 693 587 B1 (KUETHER DAVID J ET AL) 17 February 2004 (2004-02-17) * column 3, line 6 - column 5, line 64 * * figures 1-9 * * abstract * -----	1-22	H01Q3/00 H01Q1/12
A	WO 00/39885 A (MANUFACTURE D'APPAREILLAGE ELECTRIQUE DE CAHORS; DHELLEMMES, OLIVIER;) 6 July 2000 (2000-07-06) * page 6, line 20 - page 9, line 30 * * figures 6-8 * * abstract * -----	1,19	
A	FR 2 764 124 A (DATENO SA) 4 December 1998 (1998-12-04) * page 4, line 30 - page 7, line 5 * * figure 1 * * abstract * -----	1,19	
A	EP 1 014 477 A (MITSUBISHI DENKI KABUSHIKI KAISHA) 28 June 2000 (2000-06-28) * column 3, line 37 - column 6, line 5 * * figures 1-5 * * abstract * -----	1,19	TECHNICAL FIELDS SEARCHED (IPC) H01Q
A,D	US 6 229 480 B1 (SHINTANI PETER RAE) 8 May 2001 (2001-05-08) * column 3, line 23 - column 6, line 15 * * figures 2-5 * * abstract * -----	1,19	

The present search report has been drawn up for all claims

1

Place of search	Date of completion of the search	Examiner
Munich	13 December 2005	von Walter, S-U

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
Y : particularly relevant if combined with another document of the same category
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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

ANNEX TO THE EUROPEAN SEARCH REPORT ON EUROPEAN PATENT APPLICATION NO. EP 05 10 6576

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