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(54) **PHASED ARRAY ANTENNA**

PHASENGESTEUERTE GRUPPENANTENNE

ANTENNE DE RÉSEAU EN PHASE

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Description

Technical Field

[0001] The invention relates to a phased array antenna comprising several antenna elements, a signal feed network from or to which a signal is transmitted to or from the several antenna elements, and for each antenna element a corresponding phase shifting device, whereby the phase of each signal that is transmitted from the signal feed network to the respective antenna element or that is transmitted from the respective antenna element to the signal feed network is modified by the corresponding phase shifting device in order to adjust the superposition of each signal according to the preferred direction of radiation of the phased array antenna, and whereby for each phase shifting device a bias voltage is applied via two bias voltage electrode lines that are connected to a bias voltage driver.

Background of the invention

[0002] For many applications a phased array antenna offers many advantages with respect to the reception and emission of information signals that are wirelessly transmitted between a transmitter and a receiver. By using a phased array antenna, the dominant direction of the information signal transmission or information signal reception of the phased array antenna can be varied over a wide angular range in order to increase the signal strength that is emitted to or received from a given direction.

[0003] Already existing phased array antennas comprise a large number of antenna elements that are usually arranged on a flat level or on a substrate layer in a regular or matrix pattern. Each antenna element is connected to a signal feed network. If the phased array antenna is used for signal emission the signal feed network creates and distributes respective antenna signals that are transferred to the respective antenna elements and result in emission of an information signal that is the result of a superposition of all single antenna signals. If the phased array antenna is used for signal reception the respective antenna signals that are received by the corresponding antenna element are transferred to the signal feed network and the received information signal is composed from a superposition of all single antenna signals. Between the signal feed network and the antenna elements there is for each antenna element a dedicated tunable phase shifting device which allows for adding a tunable phase shift to the signal that runs along the phase shifting device. By adding an individual phase shift to the antenna signals that are emitted or received, the superposition of antenna signals can be controlled in order to provide for a dominant direction of the information signal transmission or information signal reception of the phased array antenna.

[0004] The tunable bias voltage that defines the phase

shift which is generated by a respective phase shifting device is usually applied by a bias voltage driver. It is possible to operate the phase shifting devices with a dedicated bias voltage driver for each phase shifting device.

5 However, connecting each phase shifting device with a suitable bias voltage driver requires costs and efforts for manufacturing and operating the phased array antenna.

[0005] Accordingly, there is a need for a phased array antenna that allows for easy and cost-saving manufacturing and that also allows for easy operation of the corresponding phase shifting devices resulting in a wide range of a respective phase shift of the antenna signal. Prior art document US 2018/287254 A1 discloses a phased array comprising a voltage-controlled liquid crystal phase shifter wherein the bias voltage driver is a TFT driver.

Summary of the invention

20 **[0006]** The present invention relates to a phased array antenna as described above, characterized in that the bias voltage driver comprises several output channel terminal pairs with two output channel terminals whereby the bias voltage driver is able to apply a tunable output channel voltage difference to the terminal pair, and in that the two bias voltage electrode lines of each phase shifting device are connected to a respective terminal pair.

25 **[0007]** According to an advantageous aspect of the invention the bias voltage driver has a common voltage output channel terminal and a number of odd output channel terminals and just as many even output channel terminals, whereby the bias voltage driver is able to operate in a manner that the polarity of a voltage difference between any odd output channel terminal and the common voltage output channel terminal is opposite to the polarity of a voltage difference between any even output channel terminal and the common voltage output channel terminal, and whereby each terminal pair comprises an odd output channel terminal and an even output channel terminal.

30 **[0008]** According to an embodiment of the invention each odd output channel terminal is arranged adjacent to a corresponding even output channel terminal, whereby an odd output channel terminal and the adjacent even output channel terminal form the terminal pair. It is considered a yet further advantage of the invention to allow for using multi output channel drivers that have been developed and that are currently used in a different field of application. Suitable drivers can be multi-channel digital to analog converters that are implemented as integrated circuits and are widely used for many different applications and voltage ranges.

35 **[0009]** There are so called source driver ICs available that are dedicated to controlling and operating liquid crystal displays (LCDs) with a large number of pixels for which an individual bias voltage must be applied with great precision and short response times. Even though within dis-

play applications each channel is connected to a corresponding pixel and dedicated to control said pixel, is it possible and advantageous to respectively combine two channels into terminal pairs and to connect a phase shifting device to such a terminal pair, i.e. to connect a single phase shifting device to two output channels of such a source driver, i.e. preferably to one even channel and one odd channel. Such specialized source driver ICs are usually used for operating LCD panels with dot inversion, whereby the operation control of the source driver IC is adapted to operate each output channel by quickly switching between voltage values of opposite polarity with respect to a fixed common voltage. For instance, specialized source driver ICs for use in display applications have been developed that provide a positive voltage value to a first output channel terminal and a negative voltage value to a second output channel terminal that is in close proximity or adjacent to the first output channel terminal, whereby the positive or negative voltage is produced as voltage difference to a common voltage which is usually in the middle of the voltage range of the source driver IC. The first output channel terminal can be an odd output channel terminal and the second output channel terminal can be an adjacent even output channel terminal. Apart from the opposite polarity, the voltage value of the first output channel terminal can be identical or different to the voltage value of the second output channel. With a preset timing, polarity of paired output channels changes e.g. from positive to negative voltage and from negative to positive voltage with respect to the same common voltage, whereas for each output channel and thus for each terminal pair the corresponding voltage value can be individually preset to a voltage value within the voltage range. Such a specialized source driver IC seems very suitable for use with a phased array antenna according to the invention. Furthermore, such specialized source drivers are commercial off-the-shelf products which are available in large quantities at low cost.

[0010] Whereas in known display control applications each output channel is used to apply an appropriate voltage difference with respect to a fixed common voltage to a single pixel or cell of the display, according to the invention each phase shifting device is connected to two output channels, but not to a fixed common voltage, which allows for full use of the voltage range of the bias voltage driver irrespective of a fixed common voltage which is usually preset to a middle value within the range of a source driver IC. It is therefore advantageous to enlarge the achievable voltage range by not using the common voltage as a reference voltage that is dedicated and useful to conventional LCD applications, but to combine output channels with opposite polarity with respect to the common voltage. By combining such output channels into a terminal pair the liquid crystal molecules of the corresponding phase shifting device can be driven completely with higher bias voltage which is very advantageous since liquid crystal material suitable for phased array antennas usually require higher saturation voltage than that

of a LCD. With display control applications the maximum voltage difference that is applied to a pixel or cell is the difference between a maximum voltage value or minimum voltage value of the output channel and the fixed common voltage, whereas the maximum voltage difference that can be applied to a phase shifting device is the difference between the maximum voltage value and the minimum voltage value of an output channel terminal pair, which is irrespective of the fixed common voltage.

[0011] Since the voltages in one output channel terminal pair with opposite polarities are allowed to have different magnitudes, a further advantageous aspect of this invention is that, while the tuning voltage range available for a phase shifter device is doubled, the absolute voltage resolution remains the same and the resolution with respect to the full voltage range is doubled compared to the use case of a conventional display application.

[0012] It is advantageous to combine two adjacent output channel terminals to form the terminal pair of the bias voltage driver that is connected with a respective phase shifting device. Due to the close proximity of the two terminals of the terminal pair, the corresponding bias voltage electrode lines can be arranged to run in close proximity to each other from the terminal pair of the bias voltage driver to the phase shifting device. This allows for short bias voltage electrode lines without elaborate arrangements of electrode lines or complex electrode line patterns. Short bias voltage electrode lines of identical or at least similar length allow for fast and undisturbed application of a preset bias voltage to the respective phase shifting devices, thus reducing the response time for adjusting each phase shifting device and for realigning the phased array antenna towards a new direction.

[0013] It is also possible to make use of a flat flexible cable that provides for a flexible connection of the output channel terminal pairs with a rigid flat-pin plug that allows for easy mounting and connecting with the bias voltage electrode lines of each phase shifting device. If required or advantageous, a reordering of some of the connection lines can be included within the flexible section of the flat flexible cable. Thus, it is possible to provide for a low-cost combination of odd and even output channel terminals into a terminal pair, whereby the corresponding odd and even output channel terminals are not adjacent to each other, but at a distance and separated by a number of other odd and even output channel terminals that are arranged in between.

[0014] According to an advantageous aspect of the invention the two bias voltage electrode lines that connect the phase shifting device to the terminal pair of the bias voltage driver are located next to each other in a non-overlapping manner between the terminal pair and the phase shifting device. Non-overlapping electrode lines are easily manufactured and help to reduce an undesired interference of the bias voltage that is applied to the phase shifting device via the bias voltage electrode lines.

[0015] According to an advantageous embodiment of the invention, the two output channel terminals of a ter-

minimal pair are arranged at the same level or at the same surface of a substrate layer, and that one of the two bias voltage electrode lines comprises a conductive cross-over between two different levels or two different surfaces of substrate layers resulting in connecting sections of the two bias voltage electrode lines that run into the corresponding phase shifting device at two different levels or two different surfaces of substrate layers. For some advantageous embodiments of the phase shifting device, such a phase shifting device comprises two electrodes or at least two electrode sections that are arranged at two different levels of the phase shifting device. Usually, such phase shifting devices comprise electrodes that are arranged at two different surfaces of a single substrate layer or that are arranged at two different surfaces of two different substrate layers of the phase shifting device. According to the advantageous embodiment of the invention, the bias voltage electrode lines comprise terminal sections that are arranged on the same level for connecting the bias voltage electrode lines with the bias voltage driver that has terminal pairs on the same level or on the same surface of a substrate layer. The bias voltage electrode lines also comprise connecting sections for connecting the bias voltage electrode lines to the phase shifting devices, but the connecting sections are at a different level or at a different surface of a substrate layer, namely the same level or the same surface of a substrate layer on which the corresponding electrode of the phase shifting device is located. Thus, the cross-over between different levels or different surfaces of substrate layers can be positioned at a distance to the bias voltage driver as well as at a distance to the phase shifting device, which allows for a less complex design and for a reduced space requirement of the bias voltage electrode lines.

Brief description of the drawings

[0016] The present invention will be more fully understood, and further features will become apparent, when reference is made to the following detailed description and the accompanying drawings. The drawings are merely representative and are not intended to limit the scope of the claims.

[0017] Like parts depicted in the drawings are referred to by the same reference numerals.

Figure 1 illustrates a schematic top view of a phased array antenna with a 4 x 4 matrix of antenna elements,

Figure 2 illustrates a sectional view of the phased array antenna shown in figure 1 taken along the line II-II,

Figure 3 illustrates a schematic view of a bias voltage driver of the phased array antenna that is connected to several antenna elements of the phased array antenna shown in figures 1 and 2 in a direct drive con-

figuration,

Figure 4 illustrates a sectional view of the bias voltage driver and the corresponding antenna element connected to the bias voltage driver as shown in figure 3 taken along the line III-III,

Figure 5 illustrates a schematic view of another embodiment of a bias voltage driver of the phased array antenna that is connected to several antenna elements of the phased array antenna shown in figures 1 and 2,

Figure 6 illustrates a perspective view of a commercially available LCD source driver in combination with a flat flexible cable that can be used as bias voltage driver for the phased array antenna,

Figure 7 illustrates an embodiment where the bias voltage driver is suitable to also drive source voltages of a TFT matrix, and

Figure 8 illustrates an enlarged view of the region VIII of the embodiment shown in Figure 7 with an optional addition to this embodiment.

Detailed description of the invention

[0018] Figures 1 and 2 show a schematic top view and a schematic sectional view of an exemplary phased array antenna 1 with a 4 x 4 matrix pattern of antenna elements 2 that are arranged on the same level of a flat surface of a substrate layer 3 of the phased array antenna 1. However, for most applications the phased array antenna 1 comprises several hundred or several thousand antenna elements 2. Each antenna element 2 is connected to a signal feed network 4 via respective phase shifting devices 5. In order to allow for a suitable superposition of antenna signals of all antenna elements 2, each phase shifting device 5 is controlled by a bias voltage driver that applies individual bias voltages to the respective phase shifting devices 5. Each phase shifting device 5 generates a predetermined phase shift of the corresponding antenna signal that runs along the phase shifting device 5 which results in an advantageous superposition of the several antenna signals that are emitted or received by the antenna elements 2 of the phased array antenna 1. By applying suitable bias voltages to all of the phase shifting devices the superposition of all antenna signals emitted or received by the respective antenna elements 2 will result in an advantageous enhancement of a predetermined direction for emission or reception of the information signal emitted or received with the phased array antenna 1, thus enhancing the information signal quality and the signal to noise ratio of the information signal transmission along said direction.

[0019] Each phase shifting device 5 comprises two phase shifting electrodes 6, 7 that are usually arranged

at different surfaces 8, 9 of two different substrate layers 3, 10. In between the two phase shifting electrodes 6, 7 at different substrate layers 3, 10 a tunable dielectric material 11 like e.g. liquid crystal material is arranged. For each phase shifting device 5 a dedicated reservoir of the tunable dielectric material 11 is confined by the two substrate layers 3, 10 and separator elements. By applying a bias voltage to the two phase shifting electrodes 6, 7 the dielectric characteristics of the tunable dielectric material 11 in between said two phase shifting electrodes 6, 7 is modified and set to a predetermined value, resulting in a corresponding phase shift that is applied to an antenna signal that is transferred along this phase shifting device 5. The appropriate bias voltage must be provided by a bias voltage driver that is not shown in figures 1 and 2, and then applied to each of the phase shifting devices 5.

[0020] Figures 3 and 4 each illustrate a schematic view and a schematic sectional view of a part of the phased array antenna 1 with a bias voltage driver 12 of the phased array antenna 1 that is connected to several phase shifting devices 5 for respective antenna elements 2 of the phased array antenna 1. In figure 3 the bias voltage driver 12 is connected in direct drive configuration, i.e. one out channel terminal pair 15 is connected to exactly one phase shifting device 5. The bias voltage driver 12 is a commercial off-the-shelf source driver that is common and usually used for operating LCDs or similar display panels. Making use of a common LCD source driver allows for a very low-cost manufacture of the phased array antenna. The bias voltage driver 12 may also be a modified off-the-shelf source driver whereby the required modifications e.g. for pairing output channel terminals can be performed with low cost and reduced efforts. Each phase shifting device 5 requires an individual bias voltage that is applied to the phase shifting device 5 and determines the phase shift that is imposed onto an antenna signal that is transmitted by the corresponding phase shifting device 5.

[0021] The bias voltage driver 12 comprises a number of odd output channel terminals 13 and just as many even output channel terminals 14. Two adjacent output channel terminals 13, 14 of the bias voltage driver 12 form a terminal pair 15 that is indicated by a dashed border. Each output channel terminal 13, 14 of a terminal pair 15 is conductively connected to a dedicated phase shifting device 5 by two bias voltage electrode lines 16, 17. The two bias voltage electrode lines 16, 17 run from the terminal pair 15 to the corresponding phase shifting electrodes 6, 7 of the phase shifting device 5. For each phase shifting device 5 the corresponding two bias voltage electrode lines 16, 17 run next to each other in a non-overlapping manner between the terminal pair 15 and the phase shifting device 5, i.e. the two phase shifting electrodes 6, 7.

[0022] The bias voltage driver 12 is mounted on the same surface 9 of the same substrate layer 10 as one of the phase shifting electrodes 7 of the phase shifting de-

vice 5. The bias voltage electrode line 17 that connects the phase shifting electrode 7 with the terminal pair 15 runs along this surface 9 of said substrate layer 10. The other bias voltage electrode line 16 that connects the phase shifting electrode 6 mounted on the surface 9 of the substrate layer 3 comprises a conductive cross-over 18 between the two different surfaces 8, 9 of the corresponding substrate layers 3, 10. Thus, both bias voltage electrode lines 16, 17 comprise a connecting section 19, 20 that runs on the same surface 8, 9 of the substrate layer 3, 10 as the corresponding phase shift electrode 6, 7 to which the respective bias voltage electrode line 16, 17 is connected.

[0023] Figure 5 illustrates a schematic view of a part of another embodiment of the phased array antenna 1. The bias voltage driver 12 of the phased array antenna 1 is connected to several phase shifting devices 5 for respective antenna elements 2 of the phased array antenna 1. However, contrary to the embodiment shown in figure 3, some terminal pairs 15 comprise an odd output channel terminal 13 and an even output channel terminal 14 that are separated by two output channel terminals 13, 14 in between. Thus, some of the terminal pairs 15 are formed by adjacent output channel terminals 13, 14 and some other terminal pairs 15 are formed by output channel terminals 13, 14 that are at a distance towards each other. Within the exemplary embodiment shown in figure 5, a suitable arrangement of the bias voltage electrode lines 16, 17 allows for a connection of the phase shifting devices 5 in a non-overlapping manner.

[0024] In both embodiments illustrated in figures 3 and 5, the bias voltage driver 12 is a common LCD source driver that is commercially available at low cost. A common voltage terminal 21 that is used for operating thin film transistor LCDs is not used within the phased array antenna 1 and is thus not connected to a phase shifting device 5.

[0025] Figure 6 shows a perspective view of a commercially available LCD source driver 22 in combination with a flat flexible cable 23 that can be used as bias voltage driver 12 for the phased array antenna 1. Within the flat flexible cable 23 some conducting wires may overlap and cross other conducting wires which allows for pairing distant or remote output channel terminals 13, 14 into a terminal pair 15 if need arises. However, in Figure 6 a non-overlapping arrangement of the conducting wires is shown. The conducting wires on or within the flat flexible cable 23 connects the bias voltage driver 12 with respective rigid flat-pin plugs 24 that allow for easy mounting and connection with the bias voltage electrode lines that run to the phase shifting devices 5.

[0026] Figure 7 shows a schematic view of a part of yet another embodiment of the phased array antenna 1. This embodiment applies the pairing of odd and even output channel terminals 13, 14 to terminal pairs 15 not to a direct drive topology as shown in Figure 3 but to a TFT matrix topology that is commonly used for operating TFT displays. The phase shifting devices 5 are arranged

in an array of rows 25 and columns 26. In addition to the bias voltage driver 12 an additional gate driver IC 27 is required which is also available off-the-shelf. For each phase shifting device 5 a corresponding Thin-Film-Transistor (TFT) 28, 29 is provided. Source terminals 30 of all TFTs 28 related to phase shifting electrodes 6 are connected to odd output channel terminals 13. Likewise, the source terminals 31 of all TFTs 29 related to phase shifting electrodes 7 are connected to even output channel terminals 14. Equivalent to regular display applications, short gate voltage pulses are applied from the gate driver terminals 32 column 26 by column 26 to the gate voltage lines 33 to the gate terminals 34 of the TFTs 28, 29 in order to control and apply the voltages on all bias voltage electrode lines 16 or 17 to the drain of TFTs 28 and 29 and thereby to the phase shifting electrodes 6 and 7 of each phase shifting device 5.

[0027] Figure 8 illustrates an enlarged view of the region VIII of Figure 7. For each phase shifting device 5 a holding capacitor 35 can be arranged parallel to the respective phase shifting device 5. The TFTs 28, 29 are activated row by row with a given refresh rate of the gate driver IC 27. These capacitors 35 may be required for upholding and supporting the bias voltage if the tunable dielectric material 11 cannot hold the bias voltage for a long enough, or if the refresh rate of the gate driver IC 27 is low.

Claims

1. Phased array antenna (1) comprising several antenna elements (2), a signal feed entry (4) from or to which a signal is transmitted to or from the several antenna elements (2), and for each antenna element (2) a corresponding phase shifting device (5), two bias voltage electrode lines (16, 17) that are connected to a bias voltage driver (12), wherein the bias voltage driver (12) comprises several output channel terminal pairs (15), wherein each output channel terminal pair (15) comprises two output channel terminals (13, 14), and wherein each terminal pair (15) comprises an odd output channel terminal (13) and an even output channel terminal (14), each odd output channel terminal (13) is arranged adjacent to the corresponding even output channel terminal (14), wherein the odd output channel terminal (13) and the adjacent even output channel terminal (14) form the terminal pair (15), wherein the two bias voltage electrode lines (16, 17) of each phase shifting device (5) are connected to a the respective terminal pair (15), wherein the bias voltage driver (12) has a common voltage output channel terminal (21) and a number of odd output channel terminals (13) and just as many even output channel terminals (14), whereby the phase difference of each signal that is transmitted from the signal feed entry (4) to the respective antenna element (2) or that is transmitted from the

respective antenna element (2) to the signal feed entry (4) is modified by the corresponding phase shifting device (5) in order to adjust the superposition of each signal according to the preferred direction of radiation of the phased array antenna (1), whereby for each phase shifting device (5) a bias voltage is applied via the two bias voltage electrode lines (16, 17), whereby the bias voltage driver (12) is configured to apply a tunable output channel voltage difference to each terminal pair (15), whereby the bias voltage driver (15) is configured to operate in a manner that the polarity of a voltage difference between any odd output channel terminal (13) and the common voltage output channel terminal (21) is opposite to the polarity of a voltage difference between any even output channel terminal (14) and the common voltage output channel terminal (21).

2. Phased array antenna (1) according to claim 1, **characterized in that** the bias voltage driver (12) is suitable for use as a source driver for a thin film transistor matrix.
3. Phased array antenna (1) according to any preceding claim, **characterized in that** the two bias voltage electrode lines (16, 17) that connect the phase shifting device (5) to the terminal pair (15) of the bias voltage driver (12) are located next to each other in a non-overlapping manner between the terminal pair (15) and the phase shifting device (5).
4. Phased array antenna (1) according to any preceding claim, further comprising a substrate layer, wherein the two output channel terminals (13, 14) of the terminal pair (15) are arranged at the same level or at the same surface (8, 9) of the substrate layer (3, 10), and that one of the two bias voltage electrode lines (6) comprises a conductive cross-over (18) between two different levels or two different surfaces (8, 9) of substrate layers (3, 10) resulting in connecting sections of the two bias voltage electrode lines (16, 17) that run into the corresponding phase shifting device (5) at two different levels or two different surfaces (8, 9) of substrate layers (3, 10).

Patentansprüche

1. Phasengesteuerte Gruppenantenne (1), aufweisend mehrere Antennenelemente (2), einen Signalführungseingang (4), von dem oder an den ein Signal an die oder von den mehreren Antennenelementen (2) übertragen wird, und für jedes Antennenelement (2) eine entsprechende Phasenverschiebungsvorrichtung (5), zwei Vorspannungselektrodenleitungen (16, 17), die mit einem Vorspannungstreiber (12) verbunden sind, wobei der Vorspannungstreiber (12) mehrere Ausgangskanalan-

schlusspaare (15) aufweist, wobei jedes Ausgangskanalanschlusspaar (15) zwei Ausgangskanalanschlüsse (13, 14) aufweist und wobei jedes Anschlusspaar (15) einen ungeradzahligen Ausgangskanalanschluss (13) und einen geradzahligen Ausgangskanalanschluss (14) aufweist, jeder ungeradzahlige Ausgangskanalanschluss (13) benachbart zu dem entsprechenden geradzahligen Ausgangskanalanschluss (14) angeordnet ist, wobei der ungeradzahlige Ausgangskanalanschluss (13) und der benachbarte geradzahlige Ausgangskanalanschluss (14) das Anschlusspaar (15) bilden, wobei die zwei Vorspannungselektrodenleitungen (16, 17) jeder Phasenverschiebungsvorrichtung (5) mit dem jeweiligen Anschlusspaar (15) verbunden sind, wobei der Vorspannungstreiber (12) einen gemeinsamen Spannungsausgangskanalanschluss (21) und eine Anzahl an ungeradzahligen Ausgangskanalanschlüssen (13) und genauso viele geradzahlige Ausgangskanalanschlüsse (14) aufweist, wodurch die Phasendifferenz jedes Signals, das von dem Signalführungseingang (4) an das jeweilige Antennenelement (2) übertragen wird oder das von dem jeweiligen Antennenelement (2) an den Signalführungseingang (4) übertragen wird, durch die entsprechende Phasenverschiebungsvorrichtung (5) modifiziert wird, um die Überlagerung jedes Signals gemäß der bevorzugten Strahlungsrichtung der phasengesteuerten Gruppenantenne (1) einzustellen, wodurch für jede Phasenverschiebungsvorrichtung (5) mittels der zwei Vorspannungselektrodenleitungen (16, 17) eine Vorspannung angelegt wird, wodurch der Vorspannungstreiber (12) eingerichtet ist, um eine abstimmbare Ausgangskanalspannungsdifferenz an jedes Anschlusspaar (15) anzulegen, wodurch der Vorspannungstreiber (12) eingerichtet ist, um in einer solchen Weise zu verfahren, dass die Polarität einer Spannungsdifferenz zwischen einem beliebigen ungeradzahligen Ausgangskanalanschluss (13) und dem gemeinsamen Spannungsausgangskanalanschluss (21) der Polarität einer Spannungsdifferenz zwischen einem beliebigen geradzahligen Ausgangskanalanschluss (14) und dem gemeinsamen Spannungsausgangskanalanschluss (21) entgegengesetzt ist.

2. Phasengesteuerte Gruppenantenne (1) nach Anspruch 1, **dadurch gekennzeichnet, dass** der Vorspannungstreiber (12) zur Verwendung als Source-Treiber für eine Dünnschichttransistormatrix geeignet ist.
3. Phasengesteuerte Gruppenantenne (1) nach einem vorhergehenden Anspruch, **dadurch gekennzeichnet, dass** die zwei Vorspannungselektrodenleitungen (16, 17), welche die Phasenverschiebungsvorrichtung (5) mit dem Anschlusspaar (15) des Vorspannungstreibers (12) verbinden, in einer sich nicht

überschneidenden Weise zwischen dem Anschlusspaar (15) und der Phasenverschiebungsvorrichtung (5) nebeneinander liegen.

4. Phasengesteuerte Gruppenantenne (1) nach einem vorhergehenden Anspruch, ferner aufweisend eine Substratschicht, wobei die zwei Ausgangskanalanschlüsse (13, 14) des Anschlusspaars (15) auf derselben Ebene oder auf derselben Oberfläche (8, 9) der Substratschicht (3, 10) angeordnet sind und eine der zwei Vorspannungselektrodenleitungen (6) eine leitfähige Überkreuzung (18) zwischen zwei unterschiedlichen Ebenen oder zwei unterschiedlichen Oberflächen (8, 9) von Substratschichten (3, 10) aufweist, woraus sich Verbindungsabschnitte der zwei Vorspannungselektrodenleitungen (16, 17) ergeben, die auf zwei unterschiedlichen Ebenen oder zwei unterschiedlichen Oberflächen (8, 9) von Substratschichten (3, 10) in die entsprechende Phasenverschiebungsvorrichtung (5) hinein verlaufen.

Revendications

1. Antenne réseau en phase (1) comprenant plusieurs éléments d'antenne (2), une entrée d'alimentation en signal (4) depuis ou vers laquelle un signal est transmis à ou depuis les plusieurs éléments d'antenne (2), et pour chaque élément d'antenne (2) un dispositif de décalage de phase correspondant (5), deux lignes d'électrodes de tension de polarisation (16, 17) qui sont connectées à un pilote de tension de polarisation (12), dans laquelle le pilote de tension de polarisation (12) comprend plusieurs paires de terminaux de canal de sortie (15), dans laquelle chaque paire de terminaux de canal de sortie (15) comprend deux terminaux de canal de sortie (13, 14), et dans laquelle chaque paire de terminaux (15) comprend un terminal de canal de sortie impair (13) et un terminal de canal de sortie pair (13), chaque terminal de canal de sortie impair (13) est agencé adjacent au terminal de canal de sortie pair correspondant (14), dans laquelle le terminal de canal de sortie impair (13) et le terminal de canal de sortie pair adjacent (14) forment la paire de terminaux (15), dans laquelle les deux lignes d'électrodes de tension de polarisation (16, 17) de chaque dispositif de décalage de phase (5) sont connectées à la paire de terminaux respectifs (15), dans laquelle le pilote de tension de polarisation (12) présente un terminal de canal de sortie de tension commun (21) et un nombre de terminaux de canal de sortie impairs (13) et le même nombre de terminaux de canal de sortie pairs (14), moyennant quoi la différence de phase de chaque signal qui est transmis à partir de l'entrée d'alimentation en signal (4) à l'élément d'antenne respectif (2) ou qui est transmis à partir de l'élément d'antenne

respectif (2) à l'entrée d'alimentation en signal (4) est modifiée par le dispositif de décalage de phase correspondant (5) afin de régler la superposition de chaque signal en fonction de la direction de rayonnement préférée de l'antenne réseau en phase (1), moyennant quoi pour chaque dispositif de décalage de phase (5) une tension de polarisation est appliquée par le biais des deux lignes d'électrodes de tension de polarisation (16, 17), moyennant quoi le pilote de tension de polarisation (12) est configuré pour appliquer une différence de tension de canal de sortie réglable à chaque paire de terminaux (15), moyennant quoi le pilote de tension de polarisation (15) est configuré pour fonctionner de sorte que la polarité d'une différence de tension entre un quelconque terminal de canal de sortie impair (13) et le terminal de canal de sortie de tension commun (21) est opposée à la polarité d'une différence de tension entre un quelconque terminal de canal de sortie pair (14) et le terminal de canal de sortie de tension commun (21).

2. Antenne réseau en phase (1) selon la revendication 1, **caractérisée en ce que** le pilote de tension de polarisation (12) est adapté à être utilisé comme pilote de source pour une matrice de transistors en couches minces.
3. Antenne réseau en phase (1) selon une quelconque revendication précédente, **caractérisée en ce que** les deux lignes d'électrodes de tension de polarisation (16, 17) qui connectent le dispositif de décalage de phase (5) à la paire de terminaux (15) du pilote de tension de polarisation (12) sont situées l'une à proximité de l'autre sans chevauchement entre la paire de terminaux (15) et le dispositif de décalage de phase (5).
4. Antenne réseau en phase (1) selon une quelconque revendication précédente, comprenant en outre une couche de substrat, dans laquelle les deux terminaux de canal de sortie (13, 14) de la paire de terminaux (15) sont agencés au même niveau ou à la même surface (8, 9) de la couche de substrat (3, 10), et une des deux lignes d'électrodes de tension de polarisation (6) comprend une liaison conductrice (18) entre deux différents niveaux ou deux différentes surfaces (8, 9) de couches de substrat (3, 10) résultant en sections de connexion des deux lignes d'électrodes de tension de polarisation (16, 17) qui s'étendent dans le dispositif de décalage de phase correspondant (5) au niveau de deux niveaux différents ou de deux surfaces différentes (8, 9) de couches de substrat (3, 10).

FIG 1

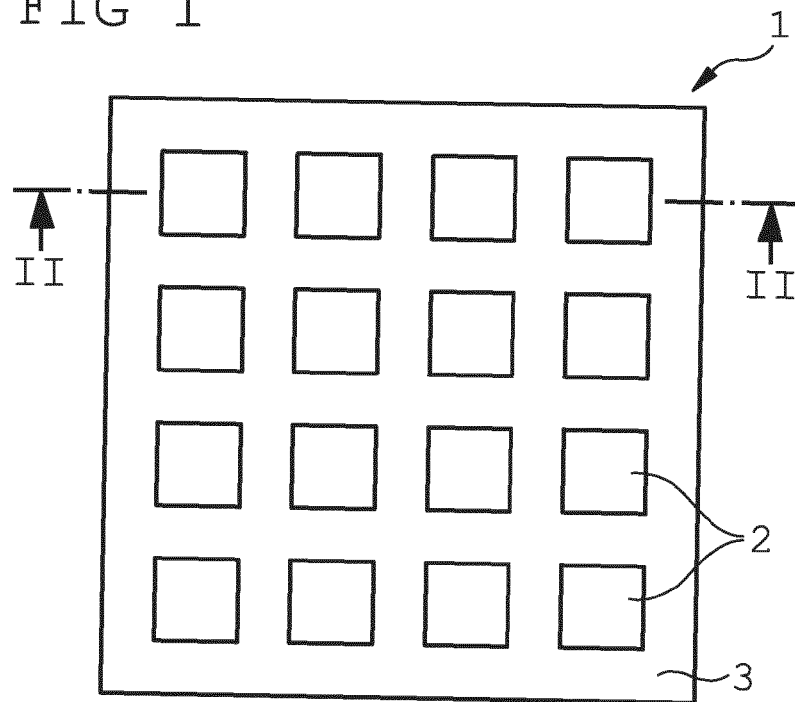


FIG 2

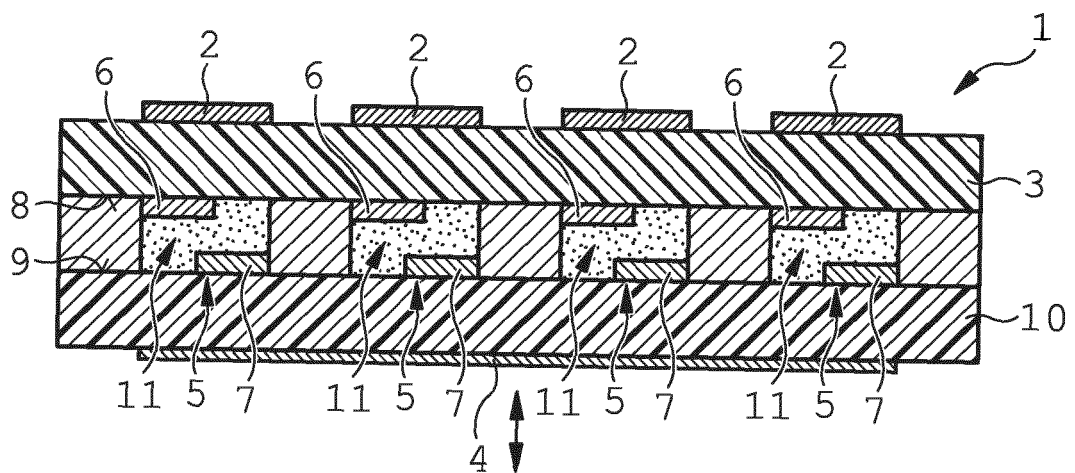


FIG 3

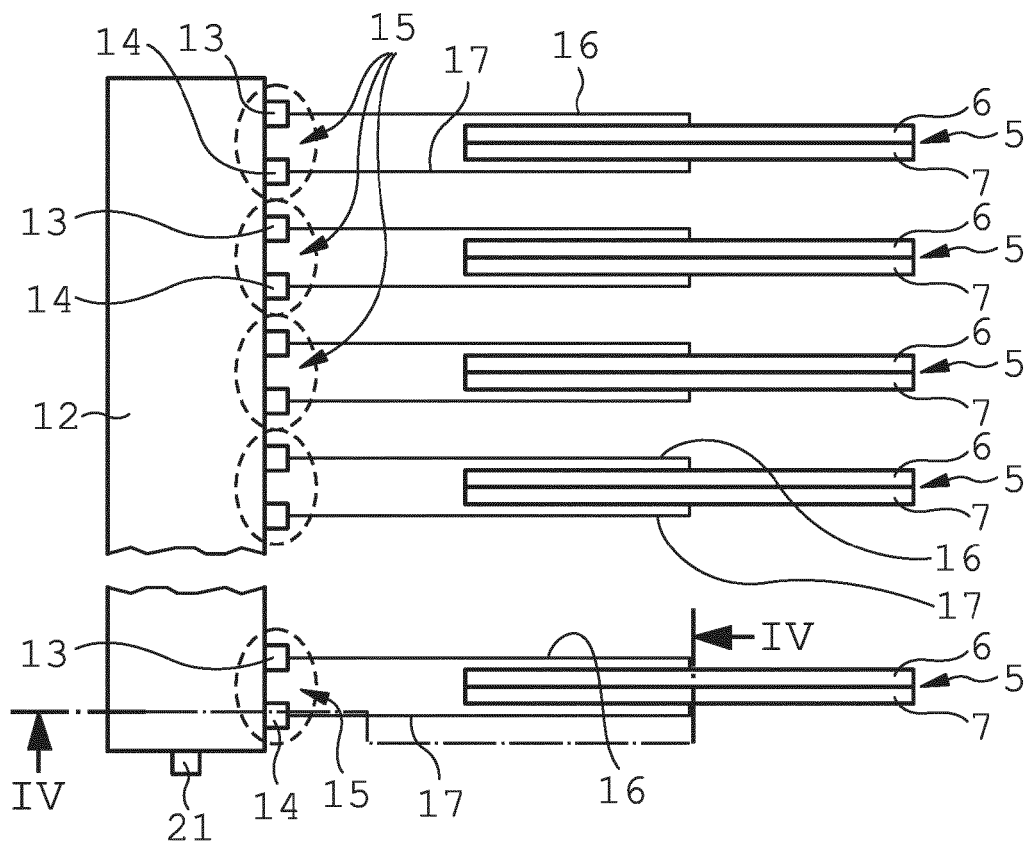


FIG 4

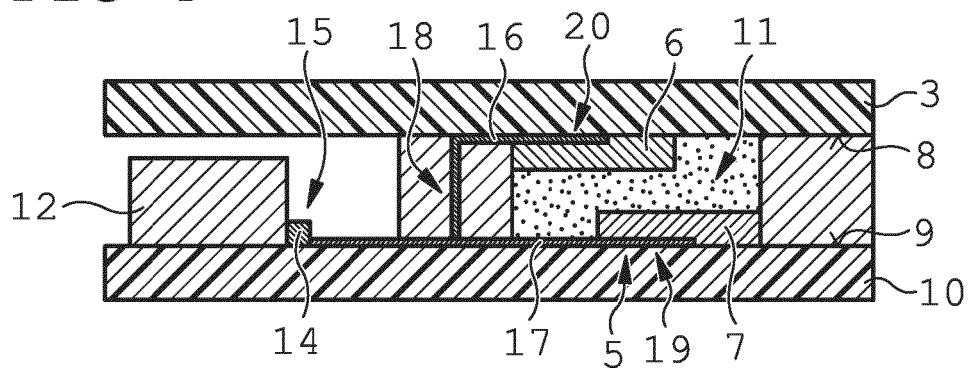


FIG 5

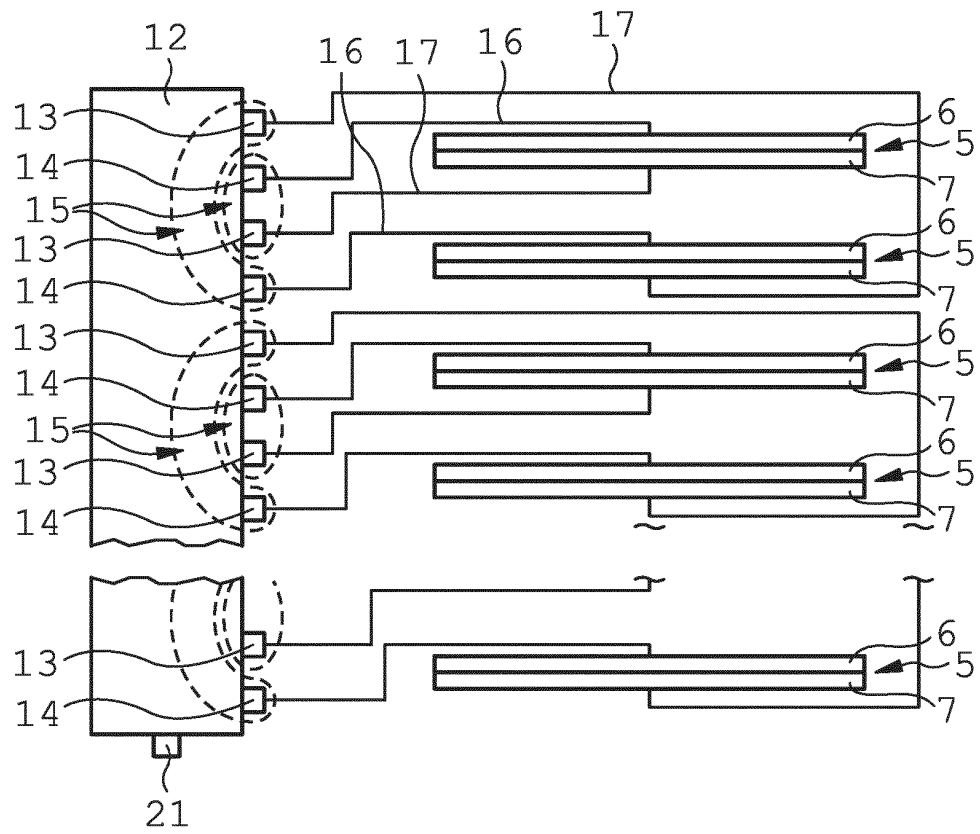


FIG 6

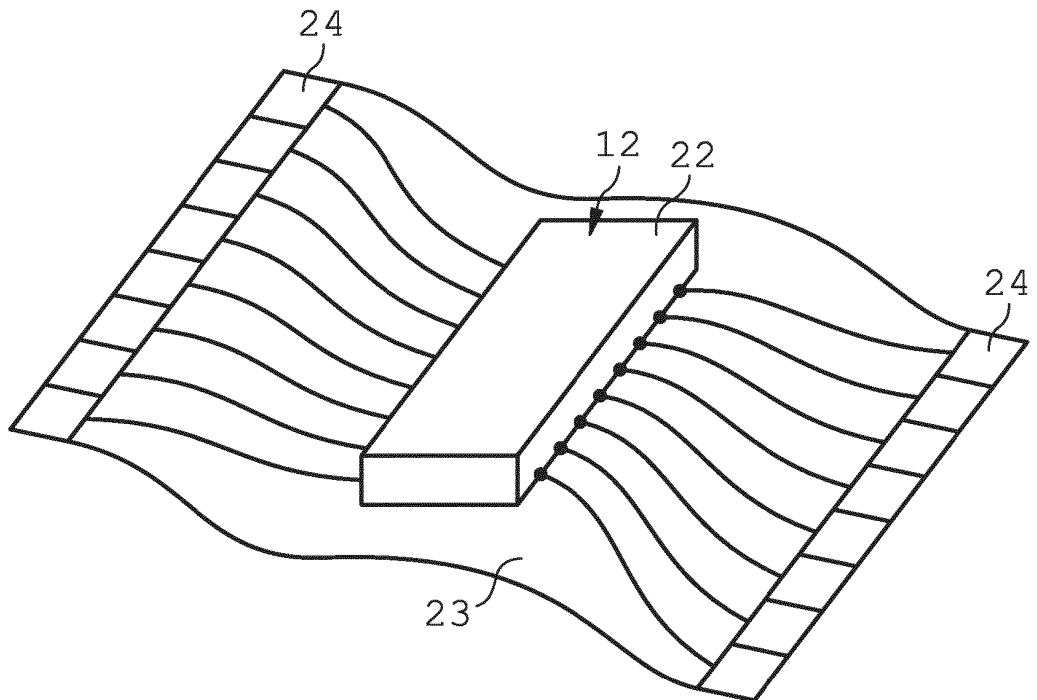


FIG 7

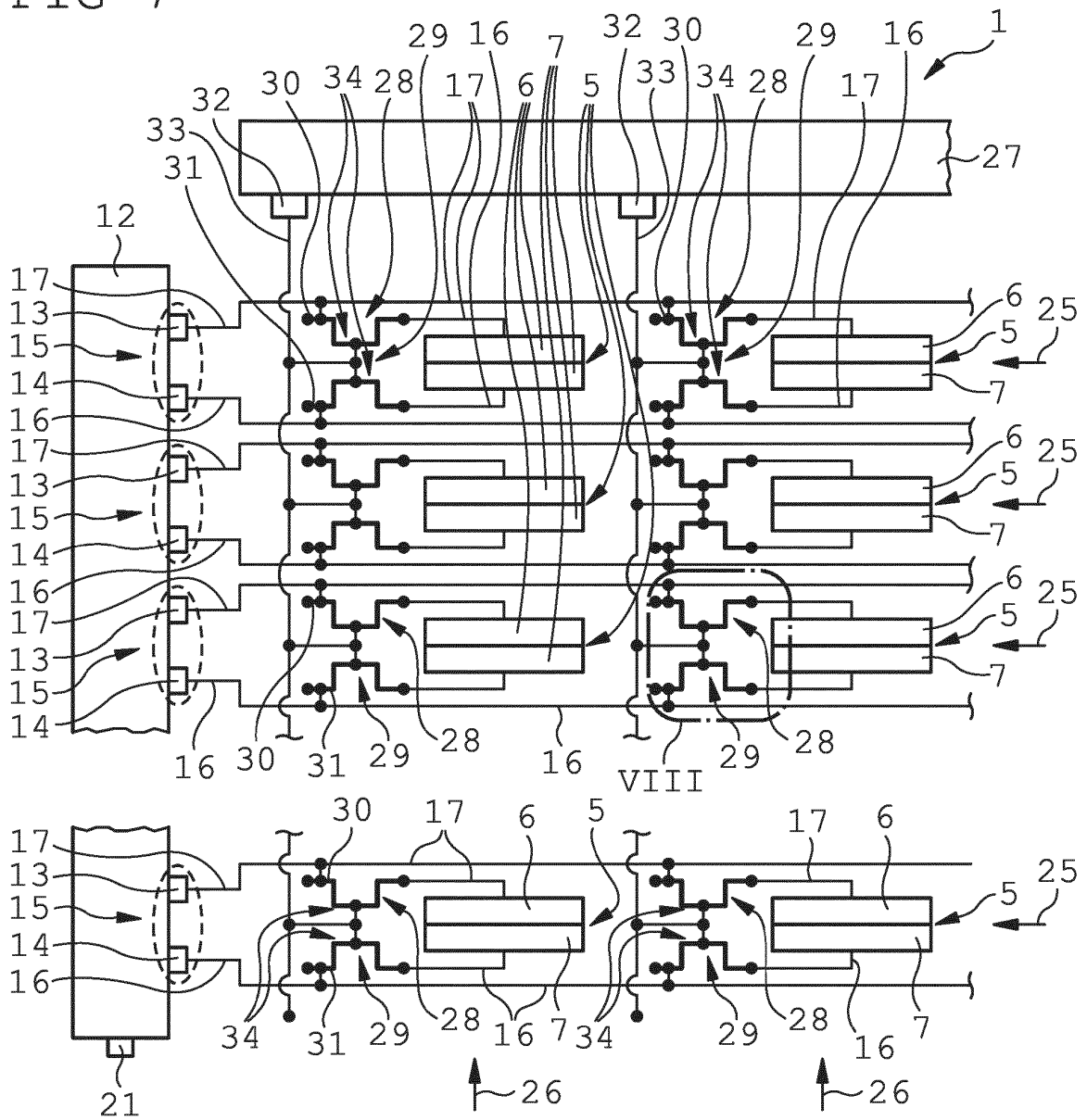
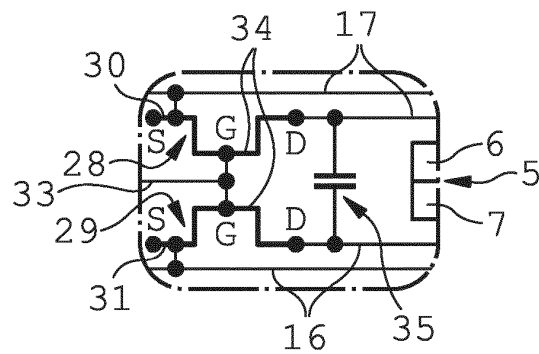


FIG 8



REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

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