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INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(51) International Patent Classification 6 :		(11) International Publication Number:
H03J 5/24	A2	WO 99/48201
		(43) International Publication Date: 23 September 1999 (23.09.99)

(21) International Application Number: PCT/IB99/00332

(22) International Filing Date: 25 February 1999 (25.02.99)

(30) Priority Data:
98200802.1 13 March 1998 (13.03.98) EP

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(81) Designated States: CN, JP, KR, European patent (AT, BE, CH, CY, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE).

Published
Without international search report and to be republished upon receipt of that report.

(54) Title: TUNING WITH DIODE DETECTOR

(57) Abstract

A tuner for example for a television receiver, comprises a UHF and a VHF section and a mixer oscillator stage. It is known that the VHF frquency band has to be splitted in at least two parts to handle the VHF signals. The invention proposes to use two separate VHF oscillators in the mixer oscillator stage and detecting means to switch tuned parts of the VHF section. In this way the performance of the tuner is improved.

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Tuning with diode detector

The invention relates to a tuner as described in the preamble of claim 1. The invention further relates to a mixer oscillator stage.

The invention further relates to a receiver, more particularly but not exclusively to a television receiver.

Such a tuner is used in for example television receivers. For such a tuner different solutions are known. As is known television signals comprise signals in the so called UHF and VHF band, which are tuned with a UHF section and a VHF section. Tuning can for example be accomplished by the change in capacitance with an applied dc voltage to varicap diodes. One diode is used in each tuned circuit. Tuning the signals of the UHF band can be covered by a single varicap diode whereas the tuning of the signals of the VHF band has to be splitted in at least two ranges and at least two varicap diodes are necessary. The most straight forward solution is to use a so called 3-band concept (UHF, VHFL and VHFH) having for each band its own path : a tuned input circuit, so called RF amplifier and a bandpass filter. The UHF, VHFL and VHFH sections are then followed by a mixer oscillator (and PLL) stage.

As the above solution is quite complex nowadays to reduce the costs of three separate bands a switching between the low and high VHF signals (channels) is used. A solution to perform this is to simply short-circuiting, with a switching diode, a part of the tuning coil in the relevant resonant circuit to change the tuning frequency range. To obtain the off state of the switching diode it is well known in the art to supply a negative voltage to the anode of the switching diode. Further it is known that when the negative voltage is not connected to the switching diode, the switching diode in the oscillator circuit would operate as a detector and will provide a negative voltage for the other tuned circuits.

See for example "Television and Audio Handbook, page 9.22, figure 9.15".

One of the disadvantages of the use of a diode detector is that a good switching diode is a poor detector. Sometimes the switching diode for the oscillator circuit was elected from the switching diodes using a so-called detector test.

An object of the invention is to provide a tuner, a mixer oscillator stage and a receiver that have not the disadvantages of the prior art and further to improve the performance and to lower the costs of a tuner. To this end a first aspect of the invention provides a tuner as claimed in claim 1. A second aspect of the invention provides a mixer oscillator stage as claimed in claim 4. A third aspect of the invention provides a receiver as claimed in claim 5.

The invention is based on the recognition that by using two separate oscillators for the VHF signals, less parallel capacitance on the lower band VHF oscillator circuit exists than with a biased switching diode in a combined VHF tuning circuit of one VHF oscillator. Further the tuner is much less complex as the known 3-band concept and as the known switched version. By detecting the VHFL oscillator signal when this oscillator is switched on, the detecting means provides a negative voltage to switch-off the switching diodes of the other tuned circuits.

An embodiment of a tuner according to the invention comprises the features of claim 2.

All tuned circuits of the VHF section are supplied with the switching signal of the detecting means.

An embodiment of a tuner according to the invention comprises the features of claim 3.

Normally capacitance can be added to further improve tracking in the lower VHF band, but by adding a diode detector as detecting means instead a negative voltage can be generated. This negative voltage can then be used as switching signal for the other switchable tuned circuits of the VHF section.

The invention and additional features which may optionally be used to implement the invention to advantage will be apparent from and elucidated with reference to the examples described hereinafter and shown in the figures. Herein shows:

Figure 1 a block schematic example of a tuner according to the invention,

Figure 2 a block schematic example of a tuner according to the invention in more detail,

Figure 3 a more detailed example of a tuner of the invention, and

Figure 4 part of a an example of a mixer oscillator stage according to the invention.

Throughout the description same elements will be indicated with corresponding reference signs.

Figure 1 shows an block schematic example of a tuner 1 according to the invention. The tuner has an input AI, for example for an antenna, or a cable input. Further the tuner comprises a UHF section US and a VHF section VS for handling respectively the UHF and VHF signals. The outputs of the UHF section and the VHF section are coupled to a mixer oscillator stage MIOS, which mixer oscillator stage comprises a UHF oscillator OSU with a UHF tuned circuit with a tuned circuit UTC, and a first and a second VHF oscillator OSVL and OSVH with respective VHF tuned circuit VTCL and VTCH, whereby the tuned circuits normally will be located outside a integrated circuit whereas the other parts of the mixer oscillator stage MIOS can be located inside the integrated circuit.

An output of the mixer oscillator stage is coupled to an output MFO of the tuner 1 for supplying the MF signal.

The tuner further comprises detecting means DM which can be part of the mixer oscillator stage (dashed line in figure 1) for receiving a detecting signal D1 from the mixer oscillator stage and for supplying a switching signal S1.

At the input AI the tuner receives signals, for example television signals being in different frequency bands (VHF and UHF). The VHF section and the UHF section select the relevant frequencies. Further the mixer oscillator stage MIOS is programmed to receive the relevant frequency band by switching on the relevant oscillator that is the UHF oscillator (OSU), or the first (OSVL) or second (OSVH) VHF oscillator and a port to supply a relevant voltage or current as is known in the art. When the first (lower) VHF frequency band has to be received the first VHF oscillator is operating and the detecting means receive a detecting signal D1 from the mixer oscillator stage and supply a switching signal S1 (for example negative voltage) to the switching diode's of the tuned circuits in the VHF section.

Below the operation of an example of the tuner according to the invention will be further described with reference to figure 2, 3 and 4.

Figure 2 shows an embodiment of a tuner 1' according to the invention in more detail. Herein the UHF section and VHF section are shown in more detail. Normally both the UHF and the VHF section comprise a tuned input circuit UIC resp. VIC, a (RF) amplifier stage UAM resp. VAM, a primary high frequency band filter UPF resp. VPF and a secondary high frequency band filter USF resp. VSF. Except from the amplifier stage all other parts of the UHF and VHF section contain tuned circuits which normally comprise so called varicaps and inductances, whereby the varicaps receive a tuning voltage (not shown in this figure, see figure 3 for more details).

The parts of the VHF section having tuned circuits also have to change over from the first (lower) VHF frequency band to the second (higher) VHF frequency band or vice versa. This changing over is achieved with switching on the relevant oscillator and port (see figure 4, Q41).

Also in this example the mixer oscillator stage MIOS2 comprises a UHF oscillator OSU2 with a UHF tuned circuit UTC2, and a first and second VHF oscillator OSVL2 and OSVH2 with a first and a second VHF tuned circuit VTCL2, resp. VTCH2.

When operating in the lower VHF frequency band of port of the oscillator OSVH2 is switched off and the first VHF oscillator OSVL2 is operating. The detecting signal D2 indicating that the first VHF oscillator is operating, is supplied to the detecting means DM2, which detecting means provides the switching signal S2 as the negative voltage to switch off the switching diodes of the tuned circuits of the VHF section.

Figure 3 shows an schematic example of a tuner 1'' according to the invention in more detail. Herein the UHF section US3 and the VHF section VS3 are showed in more detail. The input AI3 is coupled to the respective tuned input circuit UIC3 and VIC3. These tuned input circuits comprise a varicap diode D8 resp. D7 and an inductance L8 resp. a seriesarrangement of a inductance L7 and a parallel arrangement of an inductance L12 and a capacitor C10 in series with a switching diode D12. The varicap diode's receive a (not shown) tuning voltage for tuning to the requested frequency.

The switching diode D12 of the tuned input circuit of the VHF section is coupled to the detecting means DM3 for receiving a switching signal S3.

The tuned input circuits UIC3 resp. VIC3 are coupled to the (RF) amplifier stage resp. UAM3 and VAM3. Each amplifier stage is coupled to a primary high frequency band filter UPF3 resp. VPF3, whereby each filter comprises a varicap diode D1 resp. D3 and an inductance L1 resp. an seriesarrangement of an inductance L3 and a

parallelarrangement of an inductance L9 and a capacitor C1 in series with a switching diode D9.

Also this switching diode of the primary high frequency band filter of the VHF section receives a switching signal from the detecting means DM3. The varicap diode's D1 resp. D3 also receive a (not shown) tuning voltage.

Each primary high frequency band filter is coupled to a secondary high frequency band filter USF3 resp. VSF3, whereby each filter comprises a varicap diode D2 resp. D4 and an inductance L2 resp. a seriesarrangement of an inductance L4 and a parallelarrangment of an inductance L10 and a capacitance C2 in series with a switching diode D10. Also the varicap diode's D4 resp. D2 receive a (not shown) tuning voltage.

Also this switching diode D10 of the secondary high frequency band filter of the VHF section receives a switching signal S3 from the detecting means DM3.

Each secondary high frequency filter USF3 resp. VSF3 is coupled to the mixer oscillator stage MIOS3. In the figure the coupling is simplified with capacitances C3 and C4 resp. C5. As is known to the man skilled in the art the practical coupling is more complex but as being not relevant to the invention concerned not further explained here.

In this example the mixer oscillator stage MIOS3 comprises the UHF tuning circuit UTC3, a first VHF tuning circuit VTCL3 and a second VHF tuning circuit VTCH3, coupling capacitances C7, C8 resp. C6, C9 and a mixer oscillator integrated circuit MOIC comprising a UHF oscillator OSU3 and a first VHF oscillator OSVL3 and a second VHF oscillator OSVH3. The tuned circuits of the oscillators are normally placed outside the integrated circuit. As mixer oscillator integrated circuit for example a TDA6404 of the applicant can be used. Further the mixer oscillator stage MIOS3 can comprise the detecting means DM3 (dash-point line).

The detecting means is coupled to the mixer oscillator stage MIOS for receiving a detecting signal D3 which detecting signal indicates that the first (lower) VHF oscillator OSVL3 is operating. The detecting means DM3 supply on the basis of the detecting signal a switching signal S3 to the switching diodes of the relevant parts of the VHF section VS3. The mixer oscillator integrated circuit MOIC is coupled to the output MFO3 of the tuner for supplying the MF signal.

Figure 4 shows in more detail part of an example of a mixer oscillator stage. This example shows a first tuning circuit VTCL4 for the first VHF frequency band

(lower) and a second tuning circuit VTCH4 for the second VHF frequency band (higher). The first tuning circuit VTCL4 comprises an inductance L41 and a seriesarrangement of a varicap diode D41 and a capacitance C45. Between the varicap diode and the capacitance a tuning voltage VT is supplied via a resistor R41. This tuning circuit is coupled via capacitances C41 and C42 to the mixer oscillator integrated circuit MOIC4 to a first VHF oscillator OSVL4.

Parallel to the inductance L41 is a detecting means DM4 coupled comprising of a diode D43 operating as a detector and a parallelarrangement of a resistor R44 and a capacitance C47. The cathode of the diode D43 is coupled via a resistor R45 to a transistor Q41 of the mixer oscillator integrated circuit MOIC4. This transistor is the VHFH port that supplies a positive voltage when switched on. When the first VHF oscillator is operating this transistor is switched off. The side of the resistor R45 that is coupled to the transistor is also coupled to a resistor R46 which resistor is coupled with its other side to the (not shown) other tuned circuits of the VHF section VS3 (see figure 3) for supplying a switching signal S4.

The other tuned circuit VTCH4 of the mixer oscillator stage comprises an inductance L42 and a seriesarrangement of a varicap diode D42 and a capacitance C46, whereby a tuning voltage VT is supplied at the connection point of the varicap diode D42 and the capacitance C46. The connection point of the varicap diode and the inductance L42 is coupled via a resistance R42 to ground. The tuned circuit VTCH4 is coupled via capacitances C43 and C44 to a second VHF oscillator OSVH4 of the mixer oscillator integrated circuit MOIC4.

In the above description the idea of the invention has been described on the basis of some examples. The man skilled in the art will be well aware of a lot of different solutions that fall within the scope of the invention concerned.

A tuner according to the invention can be used in a television receiver, a multi media receiver, etc.

The detecting means can be incorporated in the mixer oscillator stage as is indicated in the example of figure 4.

Further is it for example possible to integrate the detector means in the mixer oscillator integrated circuit MOIC.

The invention provides a tuner, a mixer oscillator stage and a receiver

having such a tuner whereby by splitting the VHF oscillator in two separate VHF oscillators (so no switching diodes in the VHF tuned circuits of the oscillator). Further detecting means are used to switch the tuned circuits of the VHF section. This results in an improved performance and lowered costs of the tuner.

CLAIMS

1. Tuner for tuning an input signal, having an input for receiving the input signal, an UHF section coupled to the input for handling UHF signals, an VHF section coupled to the input for handling VHF signals, the UHF section and the VHF section are coupled with outputs to a mixer oscillator stage which mixer oscillator stage comprises UHF oscillation means with an UHF tuning circuit and VHF oscillation means with an VHF tuning circuit, and which mixer oscillator stage is coupled to an output of the tuner,

characterized in that the VHF oscillation means comprises a first and a second VHF oscillator, with a respectively a first and a second VHF tuning circuit for respectively a first and a second VHF frequency range and the tuner comprises detecting means for detecting which VHF oscillator is operating, and the detecting means are arranged to supply a switching signal to the switchable elements of the VHF section.

2. Tuner as claimed in claim 1, characterized in that the VHF section comprises a seriesarrangement of a switchable tuned input circuit, an amplifier stage, a switchable primary high frequency band filter and a switchable secondary high frequency band filter, which are under switching control of the detecting means.

3. Tuner as claimed in claim 2, characterized in that the detecting means comprise a diode detector coupled to the first VHF tuning circuit and the detecting means being part of the mixer oscillator stage.

4. Mixer oscillator stage for use in a tuner as claimed in claim 1.

5. Receiver comprising a tuner as claimed in claim 1.

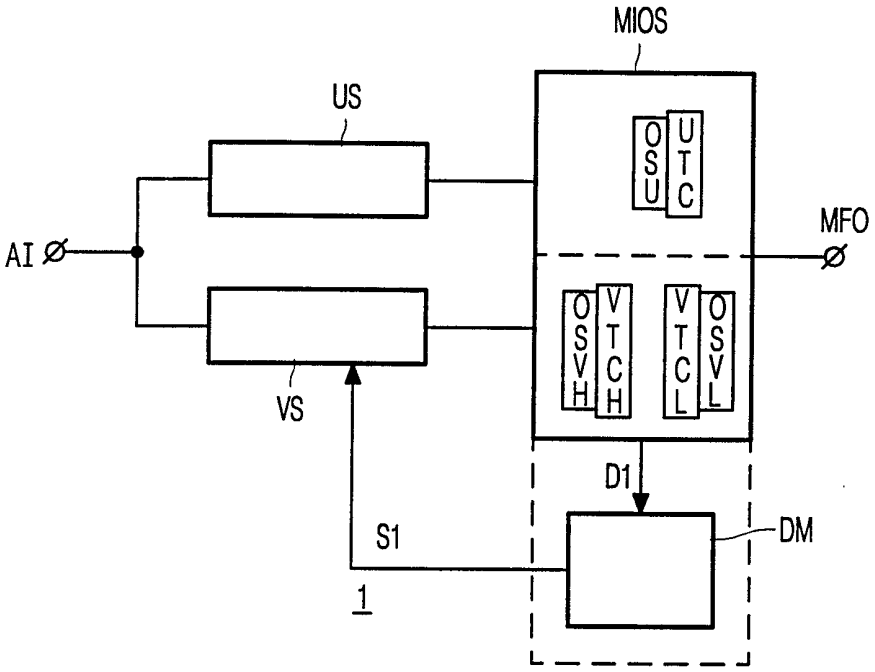
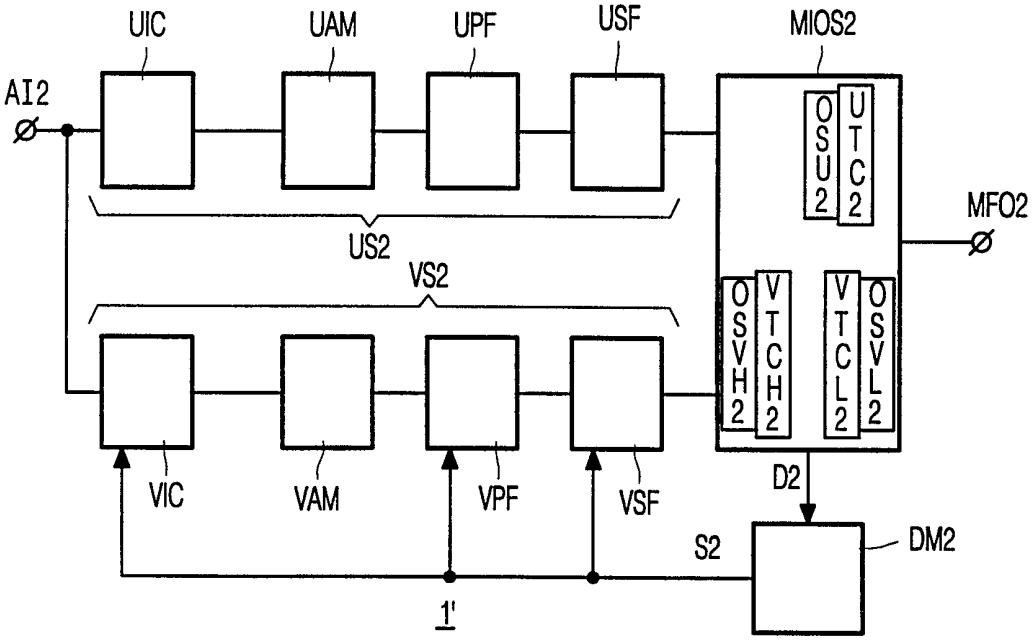

MIOS
US
OSU
UTC
AI
MFO
OSVH
VTCH
VTCL
OSVL
VS
D1
DM
S1
1

FIG. 1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UAM
UPF
USF
MIOS2
AI2
OSU2
UTC2
MFO2
US2
VS2
OSVH2
VTCH2
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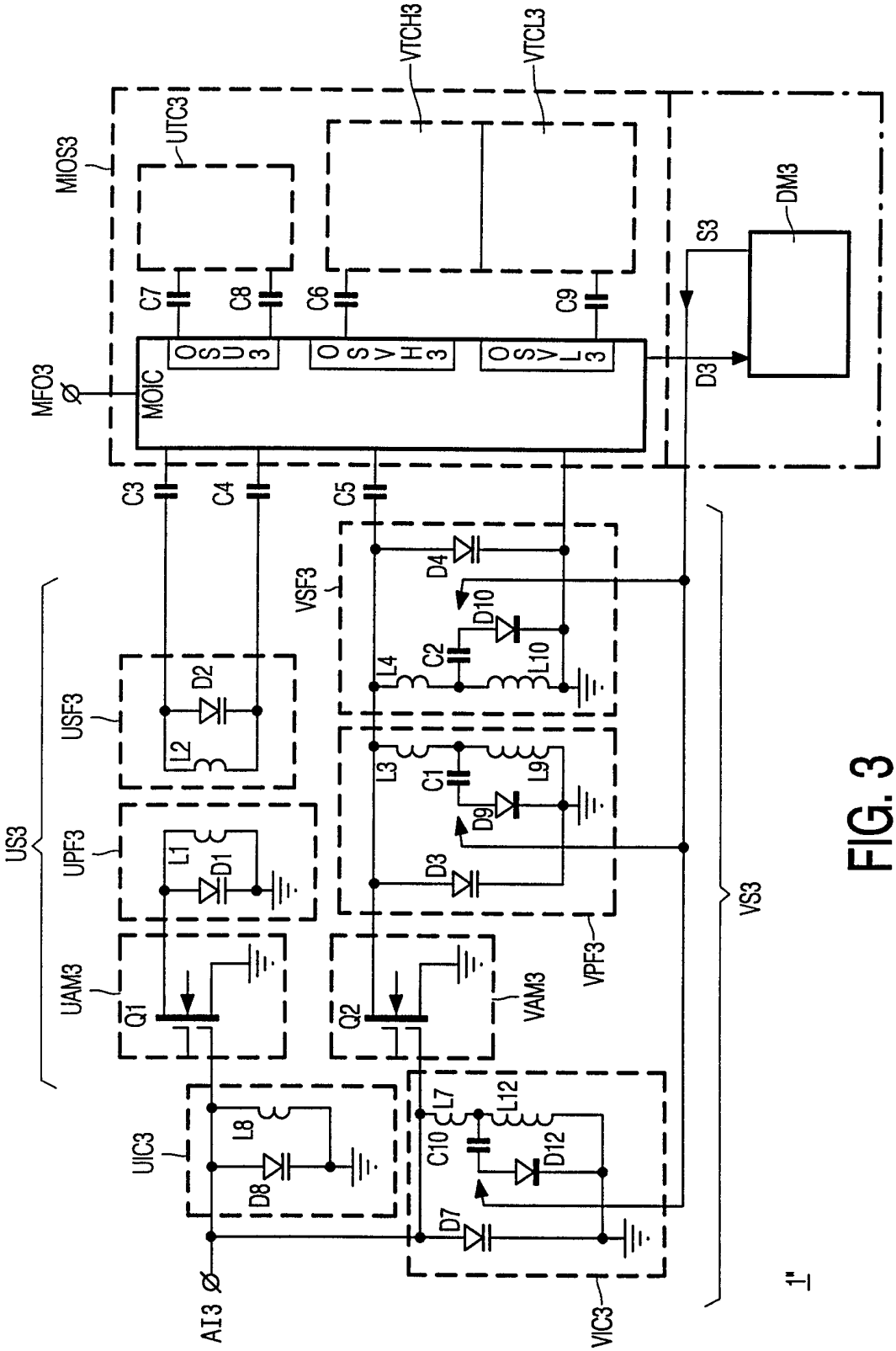
OSVL2
VIC
VAM
VPF
VSF
D2
S2
DM2
1'

FIG. 2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VTCL3
MIOS3
UTC3
DM3
S3
C7
C8
C6
C9
OSU3
OSVH3
OSVL3
MFO3
MOIC
D3
C3
C4
C5
D4
VSF3
D10
L4
C2
L10
USF3
D2
L2
L3
C1
L9
D9
US3
UPF3
L1
D1
D3
UAM3
Q1
Q2
VAM3
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D8
C10
L7
L12
D12
D7
AI3
VIC3
1"

FIG. 3

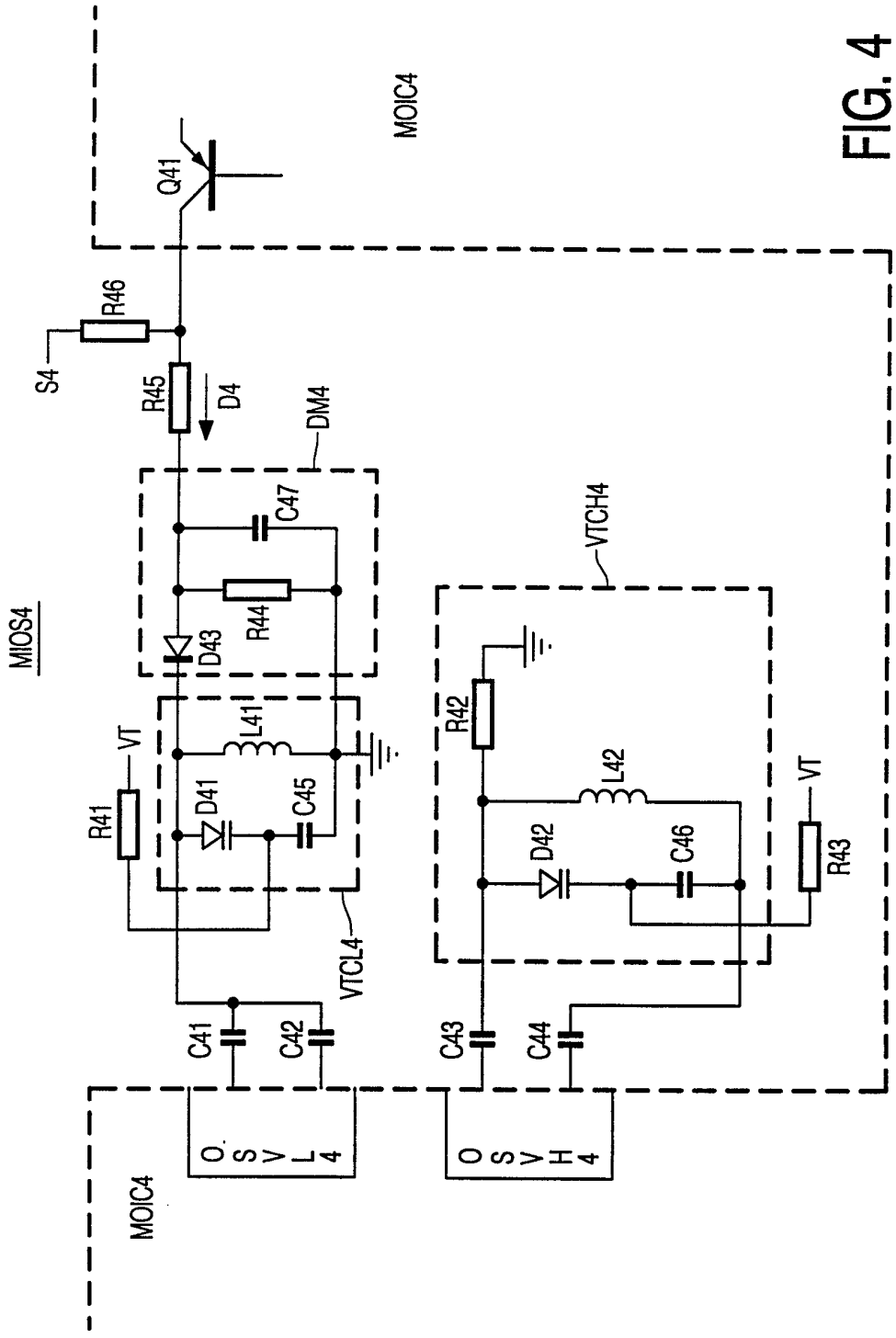
MOIC4
Q41
R46
S4
R45
D4
DM4
C47
R44
D43
MIOS4
VT
L41
R41
D41
C45
VTCL4
VTCH4
R42
L42
D42
C46
VT
R43
C41
C42
C43
C44
OSVL4
OSVH4
MOIC4

FIG. 4