

The invention relates to a phase control circuit, in which the output of a first phase comparator, in which the actual frequency is compared with the reference frequency, is connected to the input of a first controller, the output of which is connected to the input of a follow-up oscillator.

In the book by U. Tietze and Ch. Schenk, "Halbleiter-Schaltungstechnik", 4 th. Edition, "Springer-Verlag", 1978, a phase control circuit, a so-called phase-locked-loop, is described on pages 683 to 684.

Phase control circuits, often shortened as PLL, serve e.g. in CD-players to obtain from the EFM-signal, which is the data signal encoded according to the eight-to-fourteen-code and optically read from the CD-disc, the synchronisation signal for the control of the rotational speed of the disc drive. One example of such a control is described in the document GB-A-2 128 780. The control of the rotational speed is necessary to secure a constant bit-rate in the data-flow.

A first drawback now exists in that during the production of a CD-player the follow-up oscillator of the phase control circuit must be manually adjusted to the reference frequency, because adjustments by hand are always time-consuming and expensive.

A second drawback appears only during the operation of a CD-player, when due to temperature drift or aging of the components of the PLL in the passage of time the parameters of the separate components change and cause an at first barely perceptible deterioration of the audio reproduction.

It is therefore an object of the invention to avoid in a phase control circuit the disadvantageous adjustment by hand and to achieve a trouble-free operation, as much as possible independent of aging of components and of temperature drift.

The invention defined in claim 1 solves this object in that the output of a second controller is connected to the input of the follow-up oscillator, that the output of the follow-up oscillator is connected to the first input of a second phase comparator, to the second input of which is fed the reference frequency and the output of which is connected to the input of the second controller, that for the automatic adjustment of the phase control circuit the first controller is separated from the follow-up oscillator, that the second controller varies the value at its output for that length of time, until the frequency at the output of the follow-up oscillator coincides with the reference frequency, that after the adjustment the second controller maintains this value independent of the value at the output of the second phase controller and the first controller is again connected to the input of the follow-up oscillator.

There are shown in:

Figure 1 a first embodiment

Figure 2 a second embodiment

Figure 3 a third embodiment

Figure 4 a fourth embodiment of the invention.

Using the embodiment shown in Figure 1 the invention will now be first described and subsequently explained.

In Figure 1 the EFM-signal is supplied to the first

input of a phase comparator P1, the output of which is connected to the input of a first controller R. The output of a quartz oscillator OZ, which generates the reference frequency BF, is connected to the second input of the phase comparator P1 and a further phase comparator P2, the first input of which is connected to the output of a follow-up oscillator VCO. The input of the follow-up oscillator VCO, e.g. a voltage controlled oscillator, is connected to the first input A1 of a micro-processor MP provided as second controller and via a controllable switch S to the output of the first controller R. The input E of the microprocessor MP is connected to the output of the phase comparator P2. The control input of the controllable switch S is connected to the second output A2 of the microprocessor MP.

For the adjustment of the phase control circuit the microprocessor MP opens the controllable switch S, such that the output of the first controller (R) is separated from the input of the follow-up oscillator OZ, and now changes the voltage at its output A1 for that length of time, until the frequency at the output of the voltage controlled oscillator VCO coincides with the reference frequency BF of the quartz oscillator OZ. Subsequently the microprocessor MP maintains this voltage at its output A1 and closes the controllable switch S. The phase control circuit is now adjusted and ready for operation.

The automatic adjustment of the phase control circuit can according to dependent claim 5 be initiated each time the CD-player is switched on. It is also possible, as stated in the dependent claims 6 and 7, to undertake this procedure each time before playing a new CD-disc or when no data are reproduced, for instance in

a pause between two music pieces. Even if the scanning device of the CD-player is in a stand-by position, because the user e.g. is inputting a program into the CD-player, the adjustment can take place. In two further embodiments the adjustment happens when the error rate in the data signal exceeds a pre-selectable threshold value or when the CD-player fails completely. The adjustment can be undertaken also at track jumping.

In a further embodiment if the adjustment is undertaken with an already-running disc drive, e.g. between two music pieces, for the duration of the adjustment there is maintained the rotational speed of the disc drive set immediately before the adjustment. This measure has the advantage in a system that operates with a constant track speed - so-called constant linear velocity system - that the rotational speed of the disc drive after the adjustment lies adjacent to the devised value.

It is self-evident that a combination of all features disclosed in the dependent claims 4 to 8 is possible.

If a CD-player is equipped with the phase control circuit according to the invention, not only the burdensome adjustment by hand in production is avoided, but also due to the frequent new adjustment a constant good audio reproduction is ensured, because changes of the parameters of individual components due to aging or due to temperature variations are compensated at each new adjustment.

As shown in Figure 2, the controllable switch S can be provided before the first input of the phase comparator P1 or, as shown in Figure 3, between the phase comparator P1 and the controller R. With a closed

comparator P1 and the controller R. With a closed switch S the output of the controller R is of low resistance, but with an opened switch S of high resistance. Therefore the controller R is only active in the first case; in the second case on the other hand it is switched inactive.

In Figure 4 the first input of the phase comparator P1 is connected with reference potential via the collector-emitter-path of a transistor T; the base of which is connected to the output A2 of the microprocessor MP. During the adjustment of the phase control circuit the input of the phase comparator P2 is being pulled to reference potential by the transistor T. Because the output of the controller R becomes of high resistance by this, the controller R no longer influences the PLL. It is switched inactive. With a blocked transistor T the controller R is on the other hand active, because its output is in this case of low resistance.



Claims

1. A phase control circuit, in which the output of a first phase comparator (P1), in which the actual frequency (IF) is compared with the reference frequency (BF), is connected to the input of a first controller (R), the output of which is connected to the input of a follow-up oscillator (VCO), characterised in that the output (A1) of a second controller (MP) is connected to the input of the follow-up oscillator (VCO), that the output of the follow-up oscillator (VCO) is connected to the first input of a second phase comparator (P2), to the second input of which the reference frequency (BF) is fed and the output of which is connected to the input (E) of the second controller (MP), that for the automatic adjustment of the phase control circuit the first controller (R) is separated from the follow-up oscillator (VCO), that the second controller (MP) varies the value at its output (A1) for that length of time, until the frequency at the output of the follow-up oscillator (VCO) coincides with the reference frequency (BF), that after the adjustment the second controller (MP) maintains this value independent of the value at the output of the second phase comparator (P2) and the first controller (R) is again connected to the input of the follow-up oscillator (VCO).

2. A phase control circuit according to claim 1, characterised in that the output of a quartz oscillator (OZ), which generates the reference frequency (BF), is connected to the second input of the first and the second phase comparator (P1, P2), that the first output (A1) of the second controller (MP) is connected to the input of the follow-up oscillator (VCO) and the second output (A2) of the second controller (MP) to the control input of a controllable switch (S), which switches the first controller (R) inactive.



3. A phase control circuit according to claim 2, characterised in that the controllable switch (S) is arranged either in front of the first input of the first phase comparator (P1) or between the first phase comparator (P1) and the first controller (R) or between the first controller (R) and the follow-up oscillator (VCO), that the second controller (MP) for adjustment of the phase control circuit opens the controllable switch (S) and closes it again after the adjustment.

4. A phase control circuit according to claim 1,2 or 3, characterised in that the phase control circuit in a CD-player generates from the EFM-signal, which is fed to the first input of the first phase comparator (P1), the synchronizing signal for the control of the record drive.

5. A phase control circuit according to claim 4, characterised in that the adjustment takes place each time after starting of the CD-player.

6. A phase control circuit according to claim 4 or 5, characterised in that the adjustment takes place each time before a new CD-disc is played.

7. A phase control circuit according to claim 4,5 or 6, characterised in that the adjustment takes place when no data signals are reproduced.

8. A phase control circuit according to claim 4,5,6 or 7, characterised in that the adjustment takes place when the error rate of the data signal exceeds a pre-selectable threshold value.



9. A phase control circuit according to claim 4,5,6,7 or 8, characterised in that the adjustment takes place upon failure of the data reproduction.

10. A phase control circuit according to claim 4,5,6,7,8 or 9, characterised in that the adjustment takes place during the track jumping.

11. A phase control circuit according to claim 4,5,6,7,8,9 or 10, characterised in that the adjustment takes place in the pause between two music pieces.

12. A phase control circuit according to claim 4,5,6,7,8,9,10 or 11, characterised in that for the duration of the adjustment there is maintained the rotational speed of the disc drive set immediately before the adjustment.