



Method of determining a position in a cassette recorder

The invention is based on a method in accordance with the first part of claim 1. The method is applicable in particular, for magnetic tape equipment for analogue and/or digital recording of video and/or audio data as well as for data recorders which have position switches available. This is the case for example when identifying cassettes or when getting feedback as to the position of the loading mechanism.

In the case of a tape loading mechanism in a magnetic tape recorder having a rotating head drum, the tape is pulled out of the cassette by means of the mechanism and wrapped around the head drum over an angle of approximately 180°. The tape is guided back towards the cassette during the unloading process. Various systems are known for the mechanism, such as the M-loading process in the case of VHS and the C-loading process in the case of Video 2000 for example. Differing positions are needed in both systems for the various operational states such as reproduction, pause, rewind, cassette ejection etc. Each single position represents a switching state that serves as feedback for the controlling electronics. Switch indexing plates are used predominantly thereby, as also are code switches or individual switches. The number of feedback lines amounts to approximately 3 to 4 in conventional equipment in dependence on the complexity of the mechanism.

It has been shown in practice that the differences between the voltage values associated with the individual positions are very small so that uncertainty arises during the evaluation process. A greater degree of certainty can be achieved using close tolerance resistors and by having a stabilised voltage on the resistance network and the reference input of the A/D convertor that serves for the purposes of evaluation. However, the costs of the circuit are thereby considerably increased. The object of the invention is to ensure a reliable evaluation despite the tiny differences between the individually determined voltage values without needing to use close tolerance resistors and a stabilised voltage for the resistance network and the A/D



convertor. This object is achieved by the invention defined in claim 1. Advantageous developments of the invention are specified in the appendant claims.

In the method in accordance with the invention, close tolerance resistors or stabilised voltages are thus replaced by an intentionally introduced calibration process. Due to this calibration process, practically all of the deviations in the resistor values or the operating voltage are taken into account and neutralised, in that the voltage values measured for the respective positions during the calibration operation are stored and used as reference values during normal operation. Thus, for the comparison in the evaluating electronic circuitry, it is not the theoretically correct reference values that are used, but rather, it is the values which were actually occurring in practice at the individual positions and which were determined and stored during a calibration process that are used. The resistance network can then be implemented using conventional cheap resistors of higher tolerance while a highly stable voltage is not required for the operating voltage for the network and the A/D convertor.

The invention will be explained hereinafter with the help of the drawing. Therein

Fig. 1 shows a simplified basic circuit diagram for the determination of a position,

Fig. 2 a resistance network together with the evaluating electronic circuitry and

Fig. 3 a numerical example for the voltage values determined at the individual positions.

In Fig. 1, the wiper A is driven over the position indicator B, which comprises three contact tracks 1, 2, 3 as well as an earthed contact track 4, by the motor M via the active coupling WV. Due to the wiper A, the contact tracks 1, 2, 4 are connected to the contact track 4 in dependence on its location. Due to the

wiring of the contact tracks 1, 2, 3 through a respective resistor to the supply voltage, switching signals can be tapped off the leads a, b, c when there is a connection to the earthed contact track 4, the signals then being supplied to the evaluating electronic circuitry AE. The resistance network is formed from the equally large resistors R1, R2, R3 each of 22 kohm and it is connected to an operating voltage of +5 volts. One advantageous simplification is the reduction of the leads to just one whereby differing dc voltages are formed via one resistance network for the different switching states. The evaluating electronic circuitry AE includes an A/D convertor which converts the analogue voltages delivered over the leads a, b, c into digitally distinguishable values.

A resistance network of this type having resistors R1, R2, R3, R4 and R5 is illustrated in Fig. 2 wherein the resistors have the following values:

R1 = 27 kohm
R2 = 47 kohm
R3 = 100 kohm
R4 = 220 kohm
R5 = 39 kohm.

The common output e of the resistor matrix R1 to R6 is connected to the input of the A/D convertor W within the evaluating electronic circuitry AE.

Fig. 3 shows the respective resulting dc voltage for the individually possible switching states in numerical and graphical form. Once it is known to the evaluating electronic circuitry AE which voltage values are actually occurring, then the limiting values for the identification of each individual voltage value can be exactly defined. During a test phase, e.g. when setting up the equipment or in the event of it being serviced, a calibration run of the A/D convertor W is carried out using the connected network. The values measured thereby are stored and used as reference values during each loading/unloading process.



The calibration operation is started at a predetermined starting point. This "zero" position is gone to initially when the calibration function is called for, it is referred to hereinafter as phase A. There are various ways to this end. In the present case, the zero position is the unloading end position:

1. The unloading sequence is to be continued until the zero position is reached in all circumstances. A time criterion is efficacious in the case of this sequence.
2. The sequence is to be executed until there is a significant increase in the loading motor current. Here, one is concerned with interrogating the current.
3. The sequence is to be continued until a higher placed switching position is reached e.g. the position "cassette ejected". Here, one is concerned with interrogating the switches.

The step then ensuing, namely the phase B, is the actual calibration operation in which the loading mechanism is driven towards the tape loading end position at low speed in clocked manner i.e. two pulses "off" and one pulse "on". Any change of voltage on the test lead above a threshold value leads to the loading mechanism being stopped; the count of the position counter being increased and to a multiple interrogation of the dc voltage value concerned. The calculation of an average value occurs thereafter and this value is assigned a loading position number. One continues with these steps until all of the positions envisaged in the construction have been measured.

An ensuing step is executed in a further phase C although this is not absolutely necessary. Hereby, the loading mechanism is driven at low speed towards the tape unloading end position and one proceeds, in principle, as for the preceding case. Merely the count of the position counter is decreased for each change.



Upon reaching the condition 1. (time) or 2. (current) or 3. (switch), the position counter has again reached the starting value. Any difference points to a flawed measurement and the process (phase (A, B, C)) is executed once more. The insertion mechanism is now in the starting position so that a cassette can be immediately inserted for executing further tests. The measured and assigned values are placed in a non-volatile store e.g. an EEPROM and are read out therefrom following each activation process. Since the calibration operation is preferably executed without a tape in order to avoid for example superfluous things such as e.g. tape tensioning or the activation of the head drum, warning signals such as "no cassette, end of tape, start of tape, torn tape" for example, have to be consciously ignored.

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Claims

1. Method of determining a position in a cassette recorder including a mechanism for threading a tape in and for threading a tape out together with position switches, wherein the output signals of the switches are coupled via a resistance network whose output is connected to the input of an A/D convertor (W), characterised in that, during a calibration operation, the voltage value at the output of the network associated with a respective individual position is measured, entered into a store and used as a reference value during normal operation.
2. Method in accordance with Claim 1, characterised in that, the calibration operation ends automatically when a certain number of changes in position have been run through.
3. Method in accordance with Claim 1, characterised in that, the calibration operation is subdivided into two phases which differ from one another by virtue of the direction of movement of the mechanism and the counting direction of a position counter.
4. Method in accordance with Claim 1, characterised in that, the instantaneous voltage value is compared on each occasion with the preceding voltage value in a comparator.
5. Method in accordance with Claim 4, characterised in that, the movement of the mechanism is stopped on each occasion that a deviation of the instantaneous voltage value from the preceding voltage value is registered, a predetermined number of voltage measurements is effected and the counting state of a position counter is changed.
6. Method in accordance with Claim 4, characterised in that, the average value is formed from the predetermined number of measurements.
7. Method in accordance with Claim 2 and 6, characterised in that, a new overall average is calculated from the average values measured during the different phases.





8. Method in accordance with Claim 1, characterised in that, the calibration operation is effected at a speed of the mechanism which is lower than the speed of the mechanism during normal operation.

9. Method in accordance with Claim 8, characterised in that, the reduction of the speed of the mechanism is effected by altering the period for which the motor driving the mechanism is switched on.

10. Method in accordance with Claim 1, characterised in that, the starting point for the calibration operation is determined by interrogating the switches.

11. Method in accordance with Claim 1, characterised in that, the starting point for the calibration operation is effected by measuring the current delivered by the resistance network.

12. Method in accordance with Claim 1, characterised in that, the starting point for the calibration operation is determined in time controlled manner.

13. Method in accordance with Claim 1, characterised in that, the initiation of the calibration operation is effected during a test mode.

14. Method in accordance with Claim 3, 4, 6, 8 and 9, characterised in that, the interrogation of the resistance network lead, the position counting, the comparison, the forming of the average value, the controlling of the motor driving the mechanism and the storing of the determined voltage values are effected by a microprocessor.

