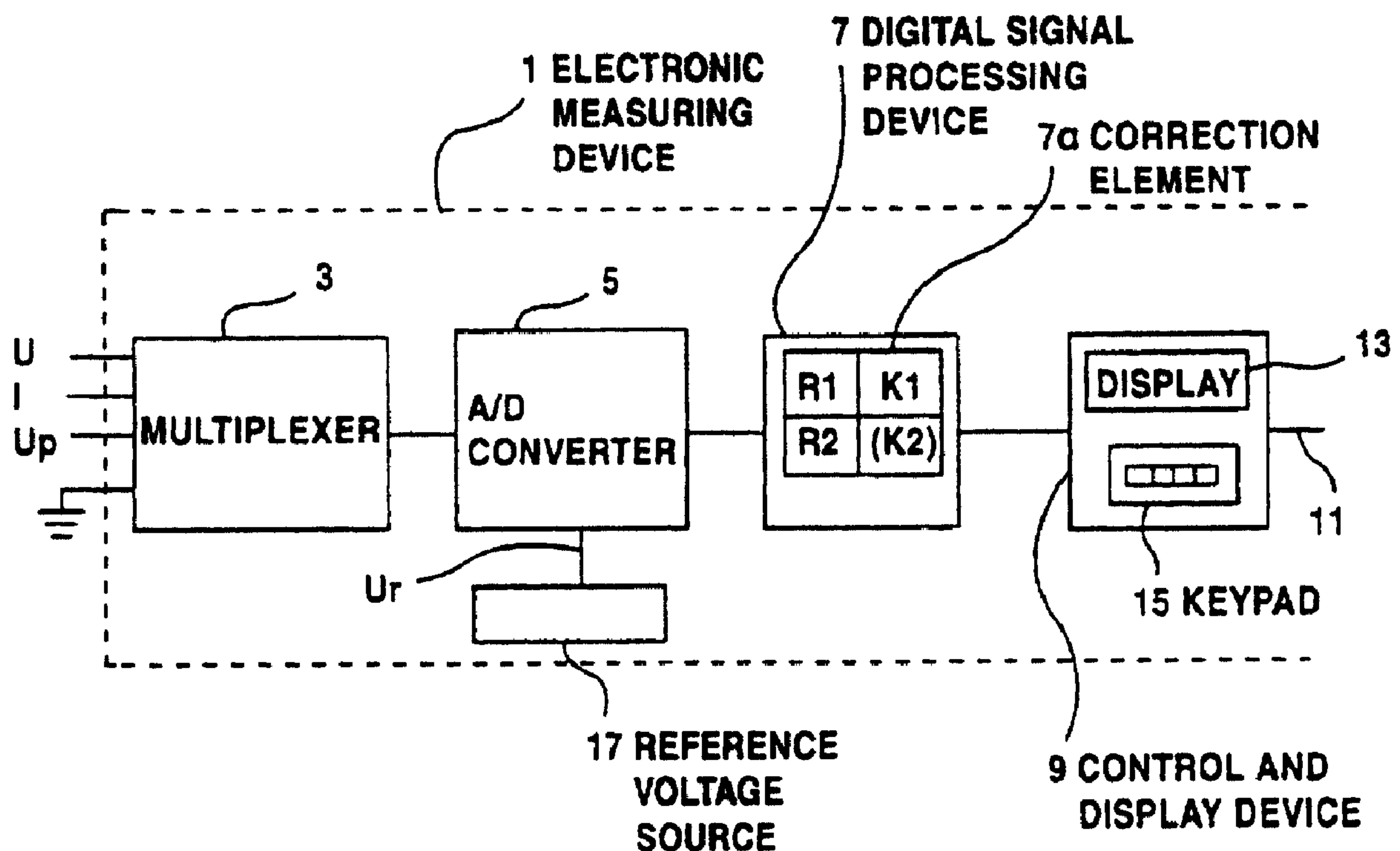




(86) Date de dépôt PCT/PCT Filing Date: 1996/11/20
(87) Date publication PCT/PCT Publication Date: 1997/06/12
(45) Date de délivrance/Issue Date: 2003/02/04
(85) Entrée phase nationale/National Entry: 1998/06/03
(86) N° demande PCT/PCT Application No.: DE 1996/002215
(87) N° publication PCT/PCT Publication No.: 1997/021106
(30) Priorité/Priority: 1995/12/05 (195 45 511.8) DE

(51) Cl.Int.⁶/Int.Cl.⁶ G01R 21/133, G01R 35/04
(72) Inventeurs/Inventors:
WINDSHEIMER, KLAUS, DE;
GRIMM, GEORG, DE
(73) Propriétaire/Owner:
SIEMENS AKTIENGESELLSCHAFT, DE
(74) Agent: FETHERSTONHAUGH & CO.

(54) Titre : DISPOSITIF DE MESURE ELECTRONIQUE
(54) Title: ELECTRONIC MEASUREMENT DEVICE



(57) Abrégé/Abstract:

In order to achieve an improvement in measurement accuracy for an electronic measuring device (1), whilst at the same time compensating for influences on the measurements, provision is made for a correction factor (K1) to be stored in a correction element (7a) when the measuring device (1) is first set up. During operation, provision is made for a test voltage (Vt) to be connected which is compared with a reference value (R1) stored during setting. If there is a difference between the two values (R1,R2), a new correction factor (K1,K2) is produced which compensates for any measurement signal effect. The measuring device (1) is particularly suitable for electricity meters.



Abstract

Electronic measuring device

In order to achieve an improvement in measurement accuracy for an electronic measuring device (1), whilst at the same time compensating for influences on the measurements, provision is made for a correction factor (K1) to be stored in a correction element (7a) when the measuring device (1) is first set up. During operation, provision is made for a test voltage (Vt) to be connected which is compared with a reference value (R1) stored during setting. If there is a difference between the two values (R1,R2), a new correction factor (K1,K2) is produced which compensates for any measurement signal effect. The measuring device (1) is particularly suitable for electricity meters.

FIG. 1

20365-3872

1

DESCRIPTION

Electronic measuring device

The invention relates to an electronic measuring device, in particular a meter, having an A/D converter and a
5 digital signal processing device.

WO 95/10781 discloses an electronic measuring device in which digitized measurement signals are monitored for a measurement error. If a measurement error occurs, a correction pulse is produced, so that the measurement error
10 is compensated for. This measuring device is preferably used for measuring consumption, in particular for a meter.

If an A/D converter is used for such an electronic measuring device, said converter generally requires a reference voltage source. This is also the case if a sigma-
15 delta modulator (SD modulator) is used. The reference voltage must meet high requirements, since the accuracy of the measuring device is directly dependent on the reference voltage. High measurement accuracy therefore also requires a precise reference voltage, which is very complicated to
20 produce, and it is not necessarily possible to vouch for operational reliability.

The invention is based on the object of specifying a measuring device which exhibits high measurement accuracy whilst at the same time compensating for influences on the
25 measurements.

The invention achieves the object with an electronic measuring device, comprising: at least one A/D converter for receiving measurement signals including a test voltage having a value; a reference voltage source connected
30 to said at least one A/D converter for operation; and a

20365-3872

2

digital signal processing device connected downstream of
said at least one A/D converter; said signal processing
device having a correction element with a first stored
reference value and a resulting first correction factor for
5 compensating for a measurement error in an upstream signal
detection, said correction element producing a new
correction factor when a difference exists between the first
reference value and the value of the test voltage, and the
new correction factor is one of the first correction factor
10 corrected corresponding to the difference, and an additional
correction factor.

In this manner, the entire measurement path for
signal detection is based on the test voltage. This means
that, for example, systematic errors, in particular the
15 temperature response of the A/D converter or an effect of an
upstream multiplexer, are detected and compensated for.
This produces dynamic measurement error compensation, as it
were.

It is advantageous if a first correction factor
20 adapted or corrected on the basis of the difference is used
as the new correction factor. This makes simple dynamic
adaptation of the correction factor possible. If necessary,
the original value can also be saved in a further store as a
precaution.

25 As an alternative to this, an additional
correction factor can be used as the new correction factor.
This enables the original setting and the dynamic or
instantaneous factor to be separated. The separate
correction factor is responsible for dynamic adaptation
30 during operation.

• 20365-3872

2a

Advantageously, means for cyclically checking the difference or producing the new correction factor are provided. This means that the measurement accuracy is continuously checked and adapted in respect of a changed
5 reference voltage or other influences on the measurements. In this case, the cycle times can be prescribed depending on the measurement accuracy desired.

The measurement signals used can be current and voltage signals, the signal processing device comprising
10 means for

-3-

metering electrical power consumption. This constitutes a preferred application of the invention. The measuring device is then used as a meter.

The A/D converter advantageously has a sigma-delta modulator (SD modulator). This produces favorable interaction in terms of precise processing of measured values.

The signal processing device preferably produces an error signal whenever the difference exceeds a prescribed limit value. This provides additional error monitoring.

The invention as well as other advantages and details are described in greater detail below with reference to an exemplary embodiment and to the drawing.

The figure shows an electronic measuring device 1 which is preferably used as a meter for electrical power. In principle, the measuring device can also be used for other applications, e.g. for temperature detection and processing, in which an analog signal is to be processed digitally.

For signal detection and processing, the measuring device 1 comprises a series circuit having a multiplexer 3, an A/D converter 5 connected downstream of the latter and a subsequent digital signal processing device (called device 7 below). The device 7 preferably has a microcomputer and/or a digital signal processor for signal processing. All signal processing is therefore carried out with the aid of programs or program modules which may, if appropriate, also be used twice for different functions.

The device 7 has a control and display device 9 connected to it. This has, for example, display means or a display 13, a keypad 15 and/or an interface 11. This provides a

-4-

comprehensive data input and output facility for the measuring device 1.

Signal detection involves initially feeding measurement signals, in particular a voltage V and a current I , to the measuring device 1, feeding them via the multiplexer 3 to the A/D converter 5 for digitization.

This signal detection can, of course, also be designed to be multichannel, e.g. for detecting multiphase voltages and currents or for detecting current and voltage separately. In such a case, a number of multiplexers and/or A/D converters might then be connected to the device 7 as appropriate.

In order for it to operate, the A/D converter 5 requires a reference voltage V_r , which is a DC voltage. This is supplied to the A/D converter from a reference voltage source 17. If the device 1 is designed as a module or semiconductor component, it is possible, for example, to produce the reference voltage input of the A/D converter 5 and the output of the reference voltage source 17 separately and, if appropriate, connect them to one another externally using a bridge. This makes checking operations possible, wherein a voltage from an external voltage source can then also be supplied to the A/D converter 5. The reference voltage source 17 is preferably a constituent part of the device 1.

The device 7 has a correction element 7a. A first correction factor K_1 , which corresponds to a first stored reference value R_1 , is saved in a store for the correction element 7a. In addition, the correction factor K_1 may already contain further multiplication factors or other factors for the purpose of (computational) simplification.

In order to set or save the reference value R_1 for the first time, as when it is set or adjusted in the factory for the

-5-

first time, one input of the multiplexer 3 is initially connected, for example, to ground (shown as the ground symbol in the figure) and the resulting digitized voltage value is initially stored. This value corresponds to the DC component from signal detection. The input used for this purpose may be a special input or an input which is used for current or voltage.

In addition, a highly accurate test signal V_t (a test voltage used as a new reference or a new base) is applied to another input of the multiplexer 3. The resulting difference value between the voltage value of the DC component and the measured value of the test signal V_t corresponds to the actual value of the test signal V_t . This value is stored as the first reference value R_1 , thereby producing the resulting correction factor K_1 for all other digitized measured values.

During operation of the measuring device 1, a further comparison with a test signal V_t is preferably carried out at cyclic intervals (which can be prescribed manually or automatically). This can be produced by the same voltage transmitter or, for example, by a voltage transmitter installed at the location where the device 1 is installed. The time intervals of the cycles can be prescribed as per requirements. The corresponding digitized value is stored as the second new reference value R_2 . After this, a comparison is made between the first reference value R_1 and the second reference value R_2 . If they are different, a new correction factor is determined.

This can be done such that, for example, the first correction factor K_1 is formed again or is overwritten, or that a completely new and separate correction factor K_2 is placed in a further store which is then used for operation at that time. This makes it possible to identify changes in the detected measured values, so that the measurement accuracy can be

-6-

continuously adapted and maintained. For the first basic setting, the correction factor K_2 can be equal to K_1 , or may have a default value, for example 1.

Should the difference between the values R_1 and R_2 exceed a prescribed limit value, it is possible that the device 7 will produce an error signal which will then be signalled via the control and display device 9 or via the interface 11 to a superordinate central control station. The error signal is then an indication that there is a significant measurement error.

The measuring device 1 is particularly suitable for use as a precision meter for class 0.5 or 0.2. In this instance, the test signal V_t fed to the measuring device 1 must be highly accurate and satisfy the appropriate calibration or standardization requirements.

The measuring device shown has the advantage that the entire signal detection process or the measuring system is based on the external test signal, in particular its reference voltage. This obviates systematic errors, such as the effect of temperature on the multiplexer 5 or on the switch resistance when a sigma-delta modulator is used.

Of course, if the measuring device is used as a meter, the relevant regulations with regard to standardization etc. have to be taken into account. A particular application is conceivable, for example, for detecting consumption without any bearing on billing, e.g. in a company. The test signal V_t can be connected to an input permanently, for example. The test signal source necessary for this can be incorporated in the measuring device 1 or be connected externally. Alternatively, it is also possible to make temporary connections or connections which are repeated at specifiable intervals.

• 20365-3872

-7-

CLAIMS:

1. An electronic measuring device, comprising:

 at least one A/D converter for receiving
measurement signals including a test voltage having a value;

5 a reference voltage source connected to said at
least one A/D converter for operation; and

 a digital signal processing device connected
downstream of said at least one A/D converter;

 said signal processing device having a correction
10 element with a first stored reference value and a resulting
first correction factor for compensating for a measurement
error in an upstream signal detection, said correction
element producing a new correction factor when a difference
exists between the first reference value and the value of
15 the test voltage, and the new correction factor is one of
the first correction factor corrected corresponding to the
difference, and an additional correction factor.
2. The electronic measuring device according to claim
1, including a device for cyclically checking the
20 difference.
3. The electronic measuring device according to claim
1, wherein said at least one A/D converter receives current
and voltage signals as the measurement signals, and said
signal processing device includes a device for metering
25 electrical power consumption.
4. The electronic measuring device according to claim
1, wherein said at least one A/D converter includes a sigma-

• 20365-3872

-8-

delta modulator.

5. The electronic measuring device according to claim
1, wherein said signal processing device presents an error
signal whenever the difference exceeds a prescribed limit
5 value.

FETHERSTONHAUGH & CO.

OTTAWA, CANADA

PATENT AGENTS

FIG.1

