Generating Volt Meter

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A new generating volt meter (GVM) was developed to get more accuracy for the terminal voltage measurement and tandem stabilisation, running under GVM control only. This is necessary for experiments like AMS (accelerator mass spectrometry) [1,2,3,4,5,6].

Principle

The GVM consists of two signal plates and a grounded rotating plate (see fig. 1). Alternatively the rotating plate covers and uncovers the signal plates so that, due to the alternating field, a current is induced to the signal plates. This current i follows the equation:

$$i = U_T \frac{dC}{dt}$$

U_T = terminal voltage
C = terminal - signal - plate capacitance

1. Mechanical Layout

The rotating plate covers more than the area of one signal plate, resulting in a capacitance as shown in Fig. 2, C_1 and C_2 respectively. Therefore the readout signal (i_1 and i_2 in Fig. 2) is shaped in that way that its derivative is zero at zero crossing. So the readout electronic can be slow and there is enough time to control the electronic switches. The motor axle is grounded via a massive collector.

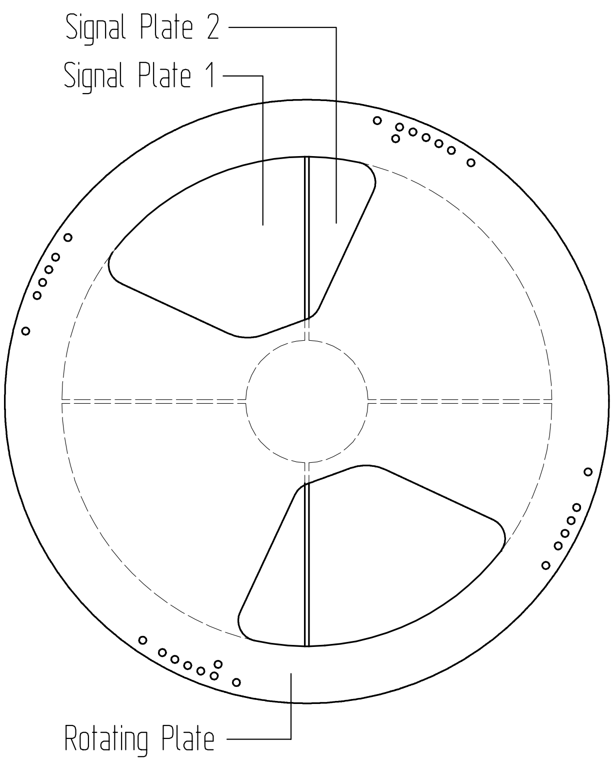

Fig. 1: Top view of the GVM
The grounded rotating plate is on top. Through its windows the signal plates are visible.
Signal plates opposite to each other are electricaly connected. Each pair supplies a signal current (i_1 and i_2 in Fig. 2).

2. Readout Electronic

Position holes in the rotating plate are read out by a photologic sensor to control the complete readout electronic. The positive and negative half cycles of the input signals i_1 and i_2 are integrated in different capacitors and in the next state they are sampled. An output amplifier makes the difference of the sampled voltage. The output voltage, representing the terminal voltage, is independent of the revolution speed. Only the temperature coefficient of the integration capacitors influences the accuracy of measurement.

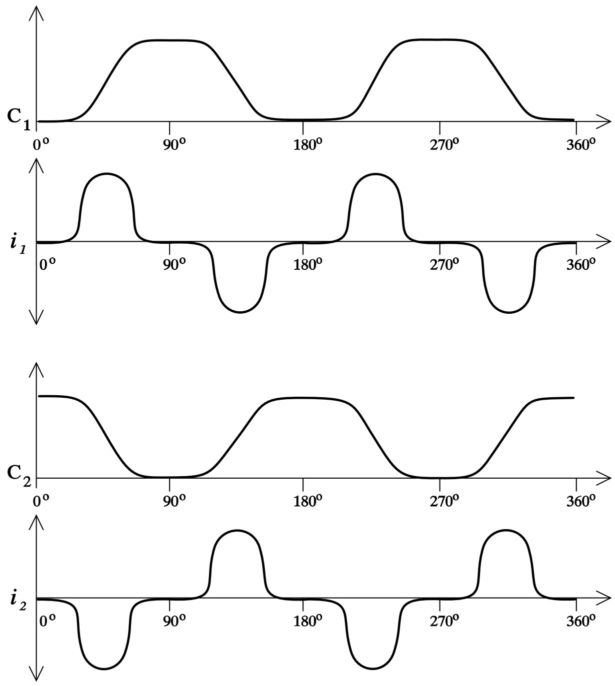

Fig. 2: Wave forms
C_1, C_2: Terminal-signal-plate capacitance as a function of time.
i_1, i_2: Signal currents, fed to the integrators.
90^o correspond to 20 ms (chosen with respect to 50 Hz noise).

3. Results And Outlook

A stability of the tandem voltage better than 1kV is achieved.

To eliminate the effect of the temperature drift of the capacitors it is planned to use the integrators as comparators. Current pulses, representing the nominal value of the terminal voltage, with inverse polarity to the input signals, will be fed to the integrators. At the output we will get the voltage error that controls the voltage stabilizer circuit.

References

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[2] K. Knie *et al.*, this report p.31
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[5] G. Rugel *et al.*, this report p.30
[6] C. Wallner *et al.*, this report p.28