ELECTRONIC SPEED REGULATOR OF ALTERNATING-CURRENT SERVODRIVE

doc.d-r.eng. Pencho Venkov Georgiev - TU-Gabrovo
eng. Stefan Denev Stefanov - TU-Gabrovo

In the report, a block diagram of one alternate solution of electronic speed regulator is suggested. The action principle and the specific features of the electronic protection that has been used are explained.

Also, the schematic diagram of the electronic regulator is given. Its action principle is explained. The indexes that make it applicable to the alternating-current servodrives are specified.

The electronic spead regulator (controller) is the main unit in the automatic control systems of the driving working mechanisms. This regulator has an output quantity U_{out} which controls the independent inverter in such a way, that the desired value of the stator voltage could be obtained, and as a result the necessary rotating speed of the AC-motor. The necessity of a stable shaft speed even with a jumping change of the drag torque M_c in specified limits, as well as the great working speed imposed the development of a new type of quick controller , which is presented in this report, and its principle scheme is shown on the enclosed drawing. The main system contour receives an electrical signal proportional to the speed deviation dW . Except the main functions, the speed regulator needs to fulfill also some check functions, with the aim of increasing the control reliability and the reliability of the scheme dinamic charasteristics. This is realized by IC1, IC2 and IC3 which are controlled by the controller release signal RF and the servocontrol readiness signal Bb, being respec-

tively the output signals of the NC system.

The signal convertion forms, from the input quantities of specified and real values of the shaftspeed, command functions for the power part in such a way, that an optimal control regime for the servodrive could be achieved. The further convertion of the signals takes important control and command functions.

The speed regulator compares the set value and the real value of the shaftspeed and forms a determined current value out of it, which is fed by a limiting connection of the rotor position dependent control of el.current direction. The limiting provides for the accelerating processes, with regard to the power data of the servomotor, an increased peak current which, after about 1 second, decreases to the value of the determined continual current set beforehand. This protects the motor and the aplifier from continual heating. The peak current values and the continual current values are being set constant by the programming module, in accord with the combination amplifier-motor. By means of the same module for the drive dinamic ratio some valid adjustments of the speed regulator are done. In this way all the drive combinations are achieved on optimal adjustment, as a result of which the on-place regulation is not needed.

The speed regulator is provided with three fixed inputs realizing the required connection between the set voltage and the motor shaftspeed. The inputs realizing the connection between the NC-system and the speed regulator are the following :

- addition inputs E3 and E4, which can mainly be assessed by the constant resistors R21 and R22. The selection of these resistors is done depending on the specific features of the servomotor.

- differential inputs E1 and E2.

In case that , regarding the preliminary set value, a constant and uninterrupted enery flow is present from the outside onto the Zero potential of the amplifier modules, then

damages, caused by shifts of constant tacts up to 24 V, can be avoided by using the differential amplifier IC4.

The predetermined voltage must be supplied between the inputs E1 and E2 and should not excede ± 10 V. The applied voltage is transferred in the ratio 1 : 1 to the input voltage of the speed regulator and is commutated by T1. A set value of the shaftspeed, introduced by the differential amplified IC4, is internally switched off by putting off the "RF"-switching-on signal-"controller release".

Despite that the set value is present, the power to the servomotor is stopped before the regulator protection is initiated with a delay of about 200 msec. This is realized by the internal elements of the retarding cirquit C2 and R7.

The nominal shaftspeed of the servomotor are valid at a set voltage of 10 V. In case that the differential input is not to be used (E1/E2), then R16 has to be eliminated , so that the useless drift of IC4 could be avoided.

A decisive importance for the drive shaftspeed has the set current, introduced by the incoming voltage.

In the speed regulator there is an operational amplifier IC6 which is extremely stable with regard to temperature. The Zero drift can be compensated by the potemtiometer RP1. In fact, the ratio Current/RPM reaches 0,33 mkA per a revolution of the servomotor. For a determined voltage U(V) and shaftspeed n(RPM) the resistance of the resistors R31 and R32 is calculated by means of the following empirical formula respectively :

- for 3 and 1,5 V/1000 RPM of the tachogenerator :

$$R\ /KOhm/ = \frac{U \cdot 10^3}{n \cdot k1} - 5 \quad ;$$

$$R\ /KOhm/ = \frac{U \cdot 10^3}{n \cdot k2} - 5 \ .$$

Where : K1 = 0,33 and K2 = 0,165 are dimensional coefficients.

The polarity of the set voltage is preliminarily determined mainly by the polarity of the tachogenerator voltage. A brushless tachogenerator is used for a feedback of the servo motor. This has the possibility, on the basis of internal signal processing, to use the data specified on the connection scheme.

The most important unit of the speed regulator is the summing integrator. In it the input voltages of E1/E2 or E3/E4 and the tachosignal are summed. In case of using input resistors with different resistances, the contribution of several input signals to the output signal is inversely propotional to the value of the resistances of the respective resistors. In order to icrease the abilities of the integrator , some additional passive elements are introduces in its feedback connection. In the proportional-integral amplifier the speed of change of the output voltage is proportional to the amplitude of the input voltage.

In this way, with the here offered speed regulator, a fast fitting of the motor to the servocontrol is achieved and the necessity of a precise adjustment is eliminated. This makes it a universal means for mounting and use of the servosystem.

USED MATERIALS

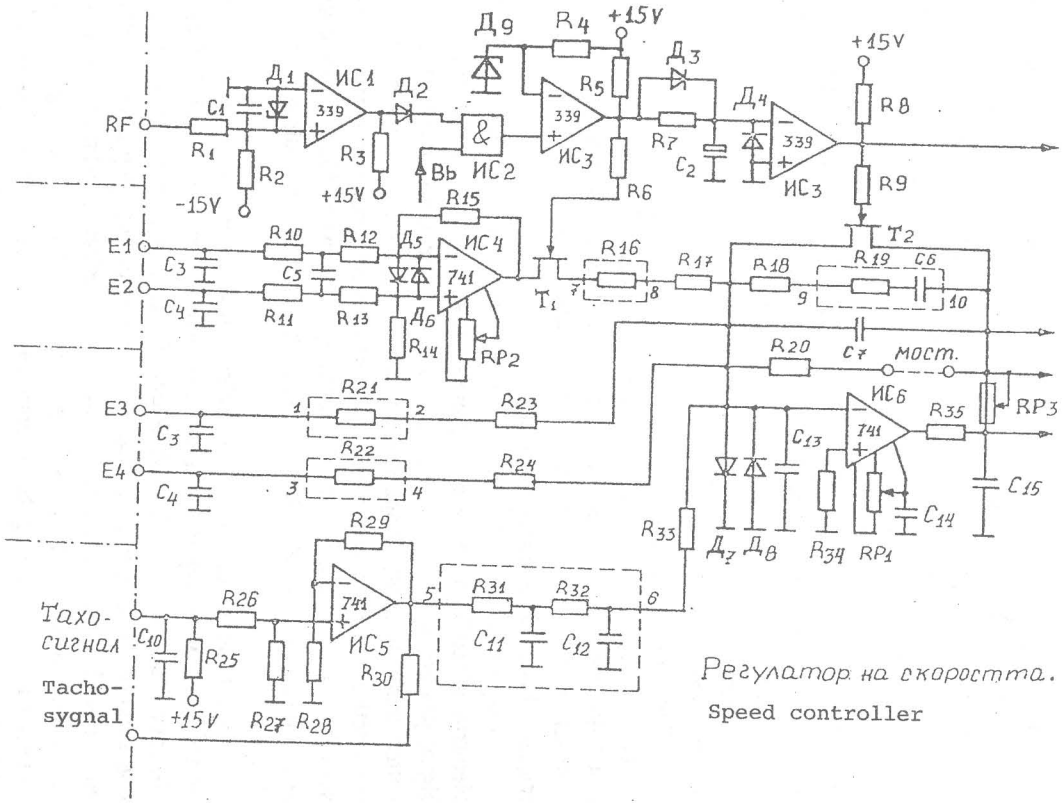
1. Sigeki Kavada, Hirosi Isida and Keilzi Sakamoto (JP) Fudjizu Fanuk Ltd (JP),"Alternatind-Current electrodrive ", 1983.

2. Holiavin A.V.,Konoplev L.N., Pevunov L.G. and Shahov K.N. "Electrodrive on alternating current " 1980.

3. Brodovskij V.N. and Ivanov E.N. " Drives with frequency-current control " 1983.

4. Borisenko I.A.,Kurlov G.K. and Priwanskij D.I. - " Electrodrive with frequency control " 1985.

5. Prospect "INDRAMAT" - three-phase servodrive,1988.


RF
E1
E2
E3
E4
Тахо-сигнал
Tacho-sygnal
-15V
+15V
Вь
ИС1
ИС2
ИС3
ИС4
ИС5
ИС6
339
741
Д1
Д2
Д3
Д4
Д5
Д6
Д7
Д8
Д9
Т1
Т2
мост.
Регулатор на скоростта.
Speed controller