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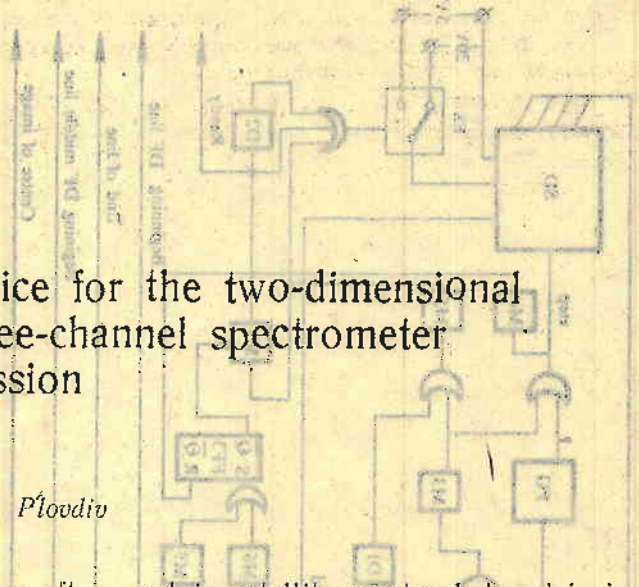


A controllable device for the two-dimensional scanner in the three-channel spectrometer for the VEGA mission

Stoyan I. Sargoichev

Centre of Applied Physics, Plovdiv

Scanning optical systems are often used in satellite spectrophotometric instruments for the study of natural optical emissions. Such a system of Kassegren's type with two-dimensional scanning of the secondary mirror is described in [1]. The angular scanning motion of the secondary mirror is achieved for this system with the aid of an exact small-size scanner, installed behind the mirror [2]. When scanning, the mirror can occupy 105 fixed positions. This corresponds to a sweep containing 7 lines of 15 elements (positions) per line.

The controlling device of the scanning system should interact with a microprocessor system of the instrument and should independently resolve the following problems: 1) performance of the scanner in the linearly-progressive sweep mode — mode A; 2) scanner operation in the linearly-reversive scanning of the middle line — mode B; 3) rapid setting into the initial reference position by a given command; 4) receiving of a command on the modes and signal shaping of completed step; 5) processing — transmission of the sensor system signals for four reference positions of the sweep: beginning of line, end of line, beginning of middle line, sweep centre.

The functional block scheme of the controlling device developed for the purpose is shown in Fig. 1. The following denominations are used: SM — step motor, ST1-ST3 — sensor signals for positioning; STML — sensor signal for middle sweep line; DM1, DM2 — modulating discs, ST — Smith trigger block; M1 ÷ M8 — monovibrators; FF1 — fast/slow rotation trigger of the step driver; FF2 — foreward/backward trigger, PG — pulse generator of the fixed initial phase, SD — servocontrol; ES — electric switch; D1 — retarding "1", D2 — retarding "2".

The circuitry is incorporated as a peripheral device into the microprocessor system of the optical spectrometer. From this system "com step" and "mode A/B" signals are received, and respectively "ready" and the four reference signals of positioning with respect to the sweep are transmitted. When

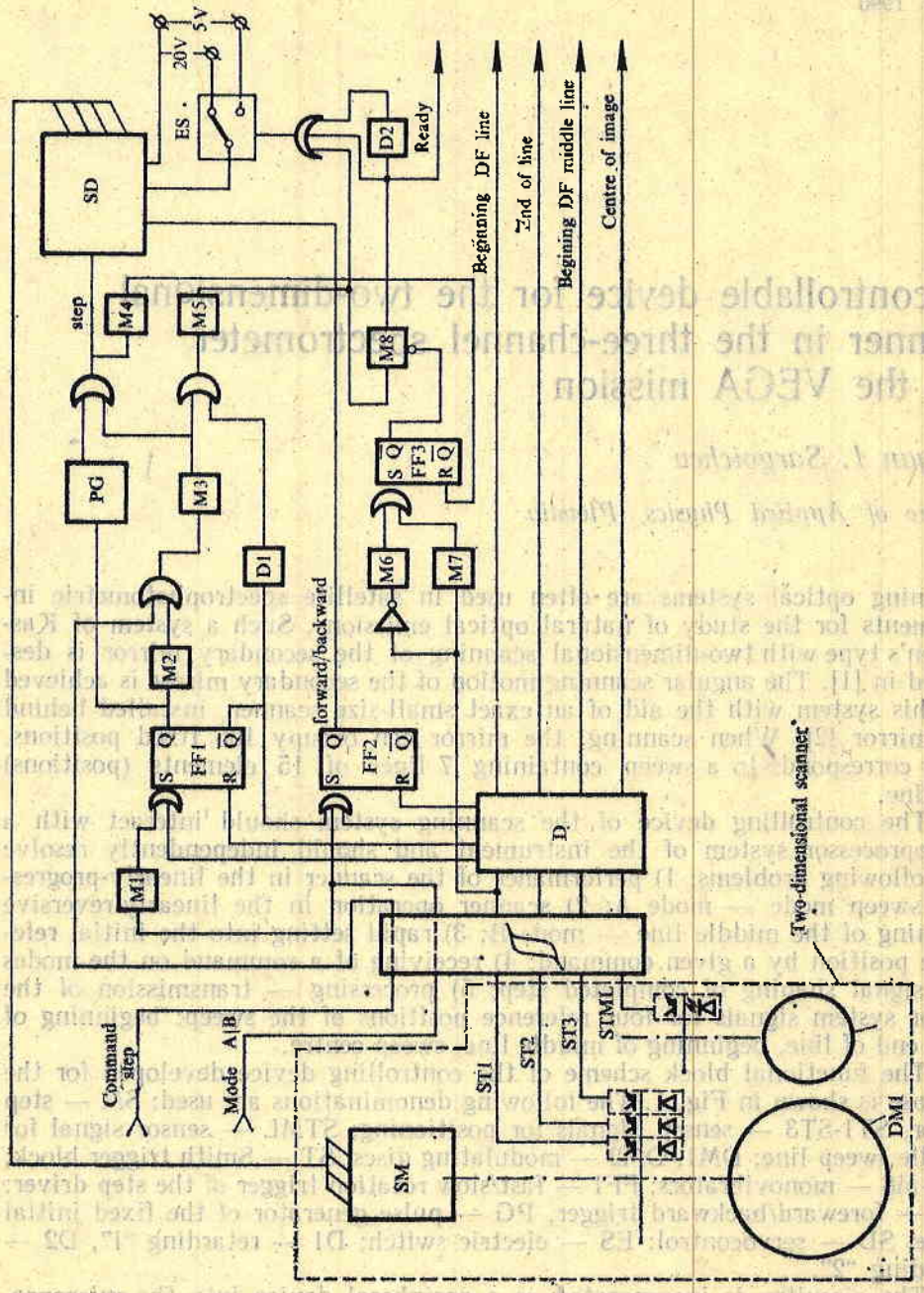

20V
5V
ES
SD
D2
Ready
Beginning DF line
End of line
Begining DF riddle line
Centre of image
step
M4
M5
M8
PG
M3
FF3
D1
M6
M7
forward/backward
M2
FF1
FF2
D
M1
Two-dimensional scanner
Command step
Mode A|B
ST1
ST2
ST3
STML
DM1
SM

Fig. 1

defining the B mode, the controlling device positions automatically the scanner at the beginning of the middle sweep line by fast rotation of the step motor. In A mode, the fast-drive rotation is achieved automatically during the reverse sweep course. The fast-drive rotation pulses are generated by the PG block.

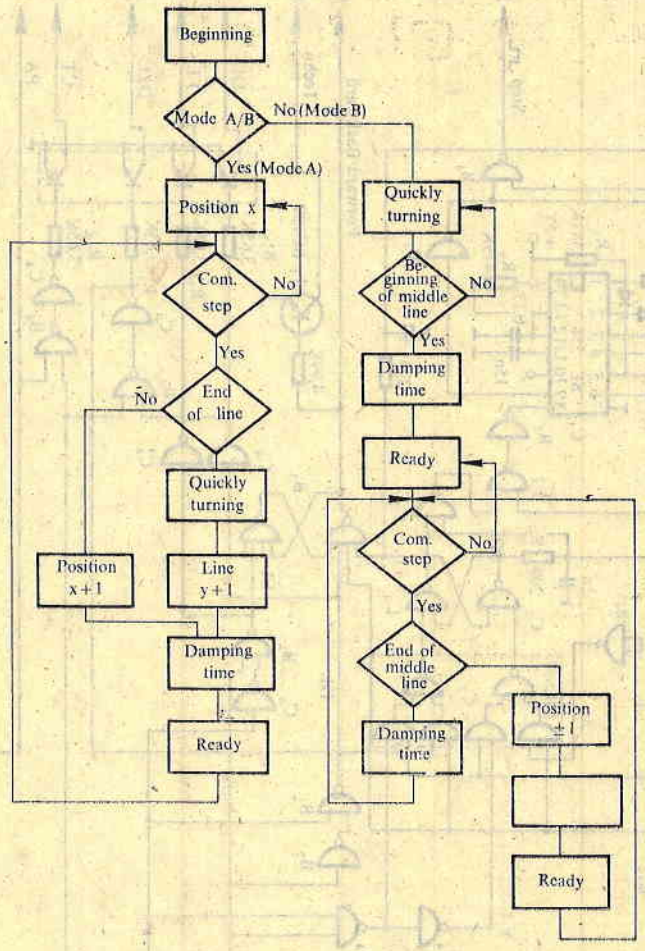


Fig. 2

With the aid of the non-contact key ES the supply voltage is reswitched, and hence the total current via the driver during rotation and in a fixed position, thus reducing the average power consumption. The output signals for the scanner position with regard to the sweep are shaped by its sensor system signal decoding. The DM1 modulator disc contains three tracks, optically connected with three optocouples — light-diode phototransistor with diaphragms. The DM2 disc contains an aperture for angular reference. When the information from the outer and middle DM1 tracks is decoded, we obtain the output signals "beginning of line" and "end of line", as well as the inner signals for the direct and reverse sweep course via the ST1 and ST2 sensors. The signals are

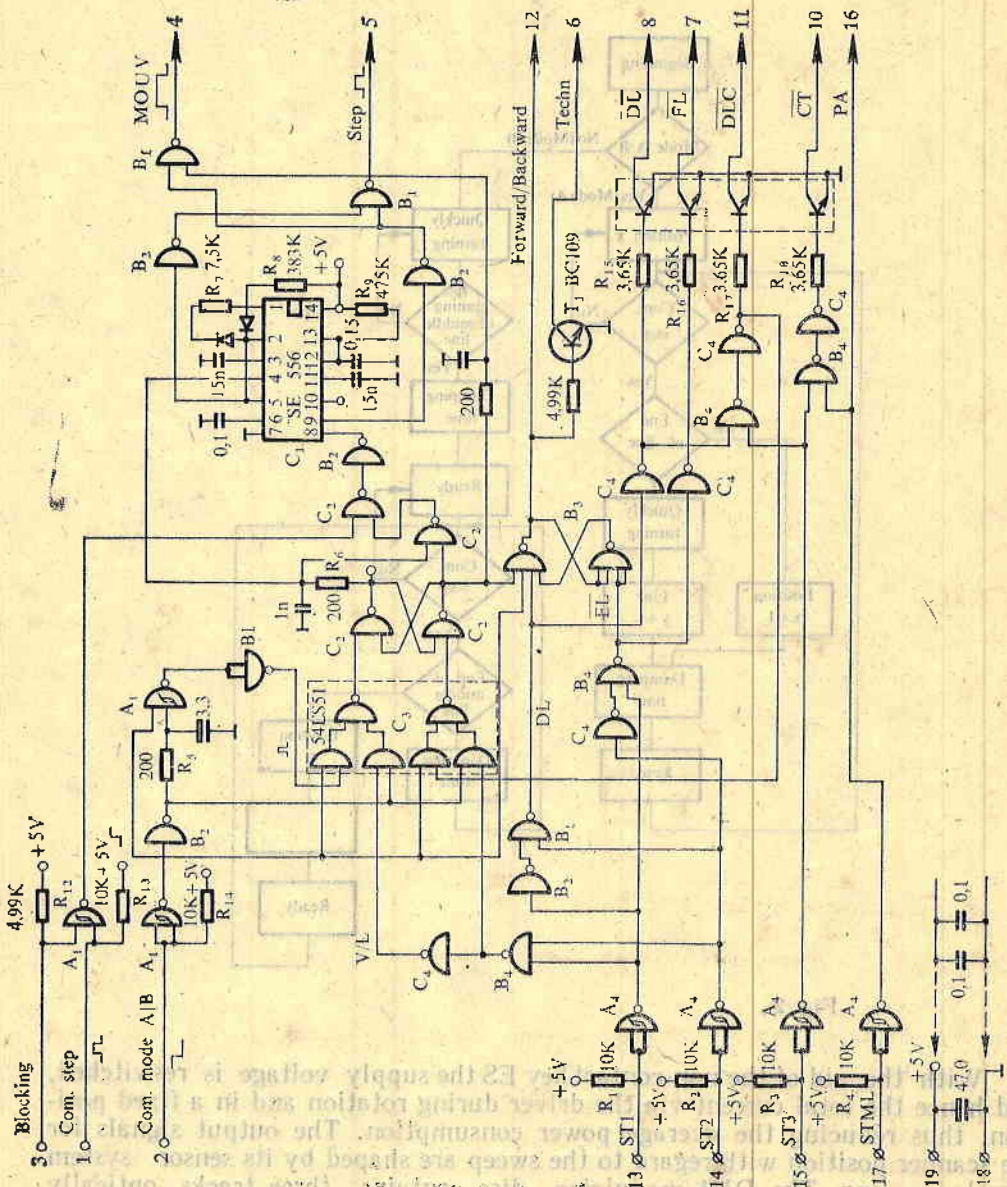
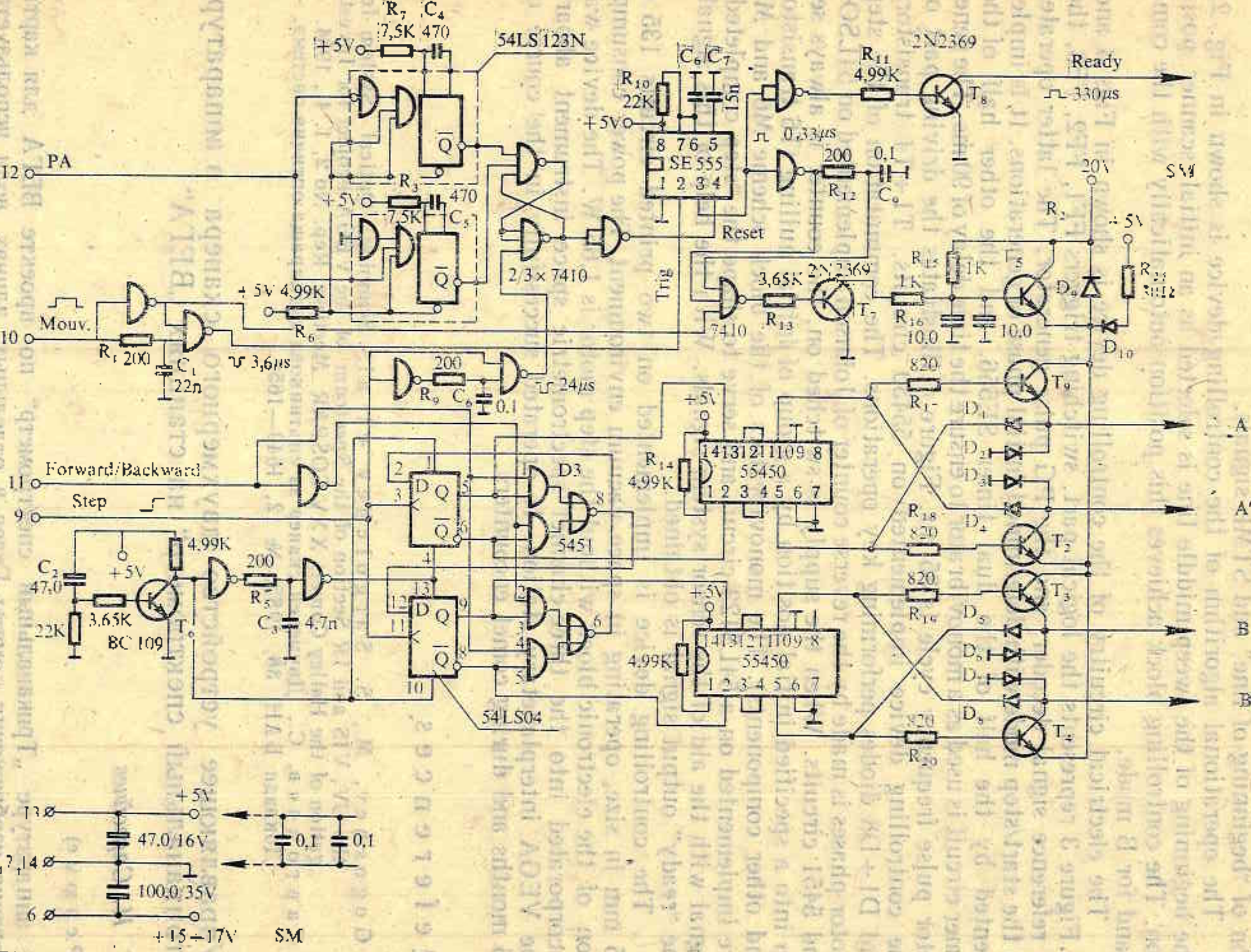

Blocking
Com. step
Com. mode A/B
4,99K
+5V
10K
MOUV
Step
Forward/Backward
Techn
DL
V/L
EL
DE
FL
DLC
CT
PA
ST1
ST2
ST3
STM1
SE 556
54LS51
BC109
3,65K
383K
475K
7,5K
47,0
0,1

Fig. 3



PA
Mouv.
Forward/Backward
Step
Ready
330μs
54LS123N
SE 555
Reset
Trig
2/3× 7410
7410
2N2369
BC 109
55450
5451
54LS04
D3
SM
+15÷17V
47,0/16V
100,0/35V
A
A'
B
B'

Fig. 4

transmitted to the M1, FF1 and FF2 blocks. The "ready" signal is obtained from the inner track through appropriate electron processing in blocks M6, M7, FF3 and M8. In addition, the combination with STML signal provides the „centre of image" signal. The "beginning of middle line" signal is obtained by the combination of "beginning of line" and STML signals.

The operational algorithm of the controlling device is shown in Fig. 2. The beginning of the sweep middle line is selected as an initial scanner position. The controlling block achieves this position automatically with the command for B mode.

The electrical circuitry of the controlling device is shown in Figs 3 and 4. Figure 3 represents the logical part, switching triggers FF1, FF2, FF3, the D reference signal decoder, and the PG pulse generator. The latter operates in the start/stop mode with determined initial phase of generations. It is implemented by the half of the dual timer SE556, and the other half of the timer circuit is used as a monovibrator to ensure the time delay of 90 ms. The generator pulse frequency cycle is 35 ms. Figure 4 illustrates the driving part of the controlling device implemented on 55450 circuits, T1÷T4 transistors and D1÷D8 diodes performing key operations. The commutation of the step motor phases is made by the reverse counter of Johnson implemented on 54LSO4 and 5451 circuits. When the supply is switched on, the counter is always set up into a specified initial position by a group of initial nulling (T6 transistor and other components). The monovibrators of the block scheme M6 and M7 are implemented on a 54LS123 circuit and serve to shape the "step completed" signal with the aid of the sensor system signals. With the help of this signal, the "ready" output signal is obtained.

The controlling device is implemented on two printed circuits 135×75 mm in size, operating in space vacuum environment. The power consumption of the electronic block without the step motor is 1,65 W. The device was incorporated into the three-channel spectrometric space instrument aboard the VEGA interplanetary station. It operated successfully in the course of 15 months and during comet encounters.

References

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2. Саргойчев, С., Двумерен сканер за спътникова сканираща оптична система. — Доклади БАН, 38, 1985, № 12, 1649—1652.

Управляющее устройство двухмерного сканера в аппаратуре „триканальный спектрометр" на станциях „ВЕГА"

С. И. Саргойчев

(Резюме)

В аппаратуре „Триканальный спектрометр" по проекте ВЕГА для картирования изображения кометы Галея в отдельных длинах волн используется телескопическая система с механическим двухмерным сканированием изображения. Объектом рассмотрения в настоящей работе является управляющее устройство для механического сканера. Представлены функциональная блок-схема, алгоритм управления и принципиальные схемы этого устройства.