

TECHNICAL DESCRIPTION OF SRS - SPIRAL READER SAAB

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Introduction

Until now 4 systems have been delivered from SAAB, Sweden - Stockholm-Copenhagen,
Vienna, Saclay, Serpukhov.

SRS uses the wellknown method invented in 1958 by B. McCormick in Alvarez group
(Berkeley) to scan with a radially oriented slit in a spiral centered on vertex. During
the scan the system stores polar coordinates for hits on the tracks.

The system includes a computer (PDP-9) with magnetic tape units for controlling the mea-
suring procedure and storing data from the event.

SRS is in principal identical to CERN-L.S.D. In the realization of the system some
changes have been done.

Electronically SRS is almost identical to CERN-L.S.D. with AGC 1. Exceptions are: Film-
transport electronics, manual control of X-Y stage, power-supplies and some other power
units.

The mechanical design of SRS is different from other Spiral Readers. In the following
essential data for the different subsystems will be given and a more detailed presen-
tation of some units.

Data for the main subsystems

X-Y system

Linearity: Within 2 microns over 7.5 cm

Perpendicularity: 20 microns over 20 cm

Least count: 2 microns

Platen travel: X, 20 cm. Y, 25 cm.

Max speed: 10 cm/sec

Platen driven by ball-screws directly coupled to printed circuit motors.

Position control: Speed-ball connected to "spill-pulse" circuit.

Cone-Periscope system

Periscope: Vertically driven by ball-screw directly coupled to printed circuit motor.

Max speed: 10 cm/sec

Least count: 8 microns

Periscope travel: 15 cm

PM-tube mounted in the pushrod to the periscope

Cone: Vertically suspended in preloaded ball-bearings.

Rotation speed: 900 rpm

Angular resolution: 10 sec of an arc

Film transport system

Max speed: 100 m/min.

Spool-capacity: 300 m

Transport time: 1 frame 3 sec, 10 frames 5 sec, 25 frames 8 sec.

Position control: Brenner mark detection and capstan pulse detection (resolution 0.24 mm)

System adaptable to 35, 50 and 70 mm films.

Fiducials

Four fiducials measured in one sweep

Slit dimension: 20 x 5000 microns

Optics

The optical system consists of the following elements (Fig. 4):

Projection lamp: Xenon lamp 450 W

Condensor system

Cold mirror

Condensor lens

2 clamping plates: One on each side of the film, 10 mm.

Beamsplitter: 50 % refl., 50 % transmission

Objectiv: Schneider Repro-Claron (303 1:9)

Beamsplitter: 40 % refl., 60 % transmission.

Cone mirror

Pick up slit: 700 x 80 μ

Fiber optic

Plexiglas rod

PM-tube: Philips XP 1110, placed inside the push-rod to the periscope

Above presented elements refers to the measuring channel. For presentation of the event to the operator the system has one objective and 2 mirrors for presentation on the operators table (magnification 10 times) and a hair-cross mirror, objectiv and TV-camera (magnification 200 time) for precise setting.

Film Drive System

The mechanical part of the film drive system consist of two identical but mirrored units on each side of the machine. The film reels are placed in boxes that are slaved to the Y-system by belts from the Y-motor to ball-screws connected to the boxes. Each film have 2 printed circuit motors, a system of rollers for guidance of the film, tachogenerator, forcetransducer and reel diameter sensors to control the servoloop. A brenner mark detection system is used to detect the frames and a capstan with code disc and pulsedetectors is used to control small movements of the film.

Control logic

The control logic consists of:

- Command register with input and output gates connected to the I/o buffer
- 8-bit device selector
- Interrupt and skip logic

Command and status register

Bit		
0	Auto = 1 Manual = 0	} Connected to interrupt line
1	Capstan pulse flag	
2	Brenner mark flag	
3	"Film stopped and clamped"	
4	Capstan pulse interrupt enable	
5	Brenner mark interrupt enable	
6	"Film stopped and clamped" interrupt enable	
7	} Not used	
8		
9		
10		
11		
12		
13	- = 1, + = 0	} Velocity (1's complement)
14	MSB	
15		
16		
17	LSB	

Device selectors

51 Film 1
52 Film 2
53 Film 3

Instructions:

SOUF1	705104	Set Ones	To upper bits (0-8)
SZUF1	705102	Set Zeroes	from AC bits 9-17
SOLF1	705124	Set Ones	To Lower bit (p-17)
SZLF1	705122	Set Zeroes	from AC bits 9-17
RCRF1	705172	Read Command and Status Register	
SKGF1	705101	Skip if no enabled flag on	
SKBF1	705121	Skip if not brenner mark flag	
SKPF1	705141	Skip if not capstan pulse flag	
SKCF1	705161	Skip if not "film stopped and clamped" interrupt enable	

For film 2 and 3 the 1's in the instruction will be replaced by 2 and 3.

Motion control

Speed command comes to the system via D/A-converters under computer-control or from speed ball or a potentiometer under manual control. Speed command is compared with information about actual speed and this error-signal is then compensated with information from radius sensors and source transducers. The signal is then fed to one pre-amplifier and power amplifier for each motor. That part have current feed-back to get good linearity between voltage and torque. The power amplifier are controlled by pulse-width modulated current in the same fashion as in the X-Y DC-Servo system.

Brenner-mark detectors

This system have 4 markdetectors and one referensdetector. A logic circuit sets a flag when the conditions for a brenner-mark are fullfilled. The system can be switched to detect brenner-marks on one side of the film or the other or both.

Capstan pulse system

With this system it is possible to detect small movements of the film. The codedisc connected to the capstan gives pulses that sets a flag in the register for a movement of 0.24 mm. This can be used to define the stopdistance after detecting a breunner mark.

Film clamping system

When all films are set to Auto and Zero-speed is commanded the film will be clamped between the two glass-plates. A registerbit "Film stopped and clamped" will be set.

References:

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Figure captions

1 Block diagram
2-3 Mechanical assembly
4 Optical path
5-6 Film transport system

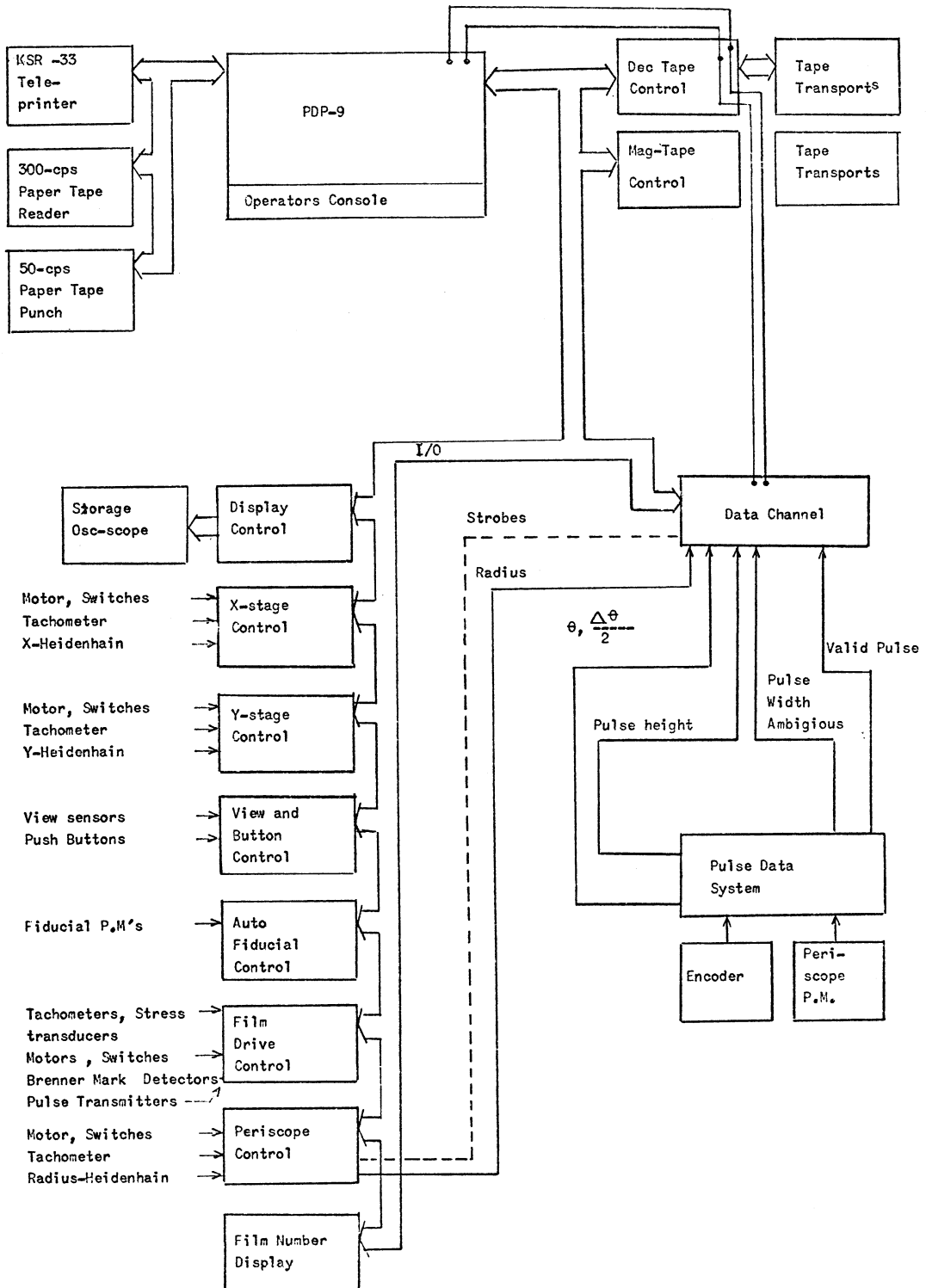


Fig. 1

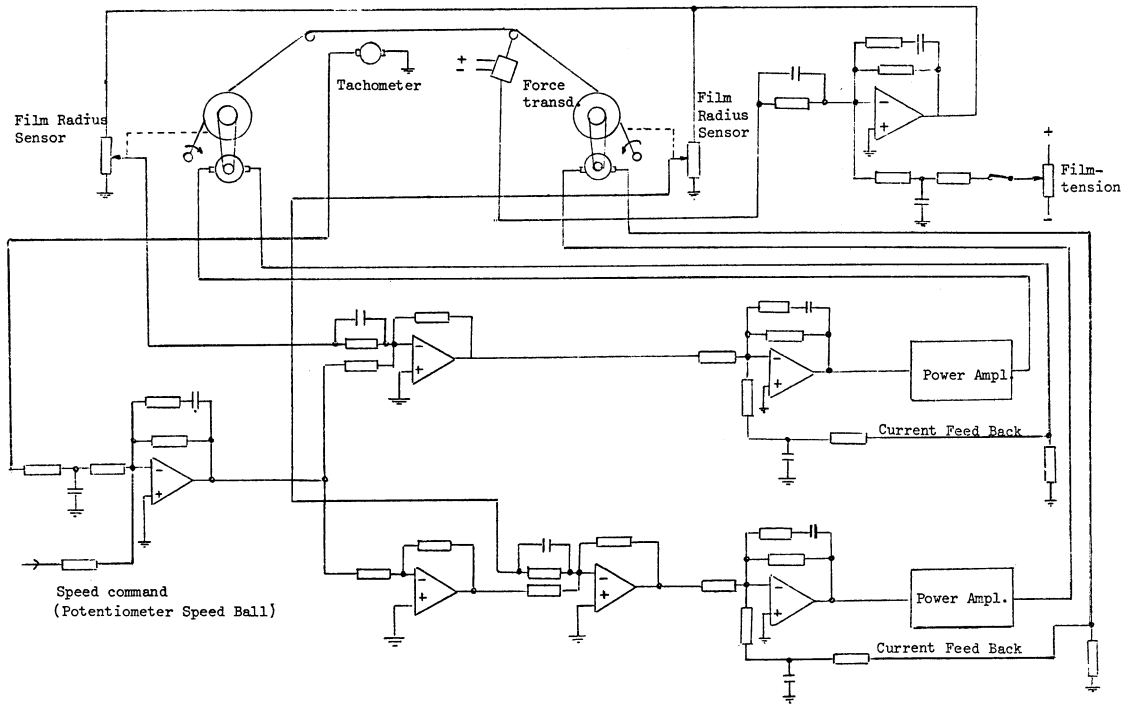


Fig. 5

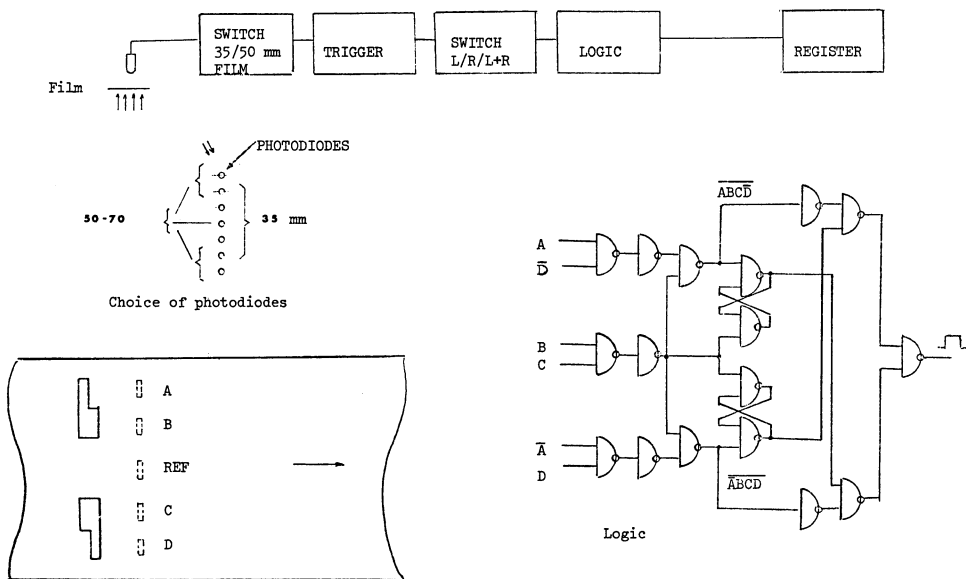


Fig. 6