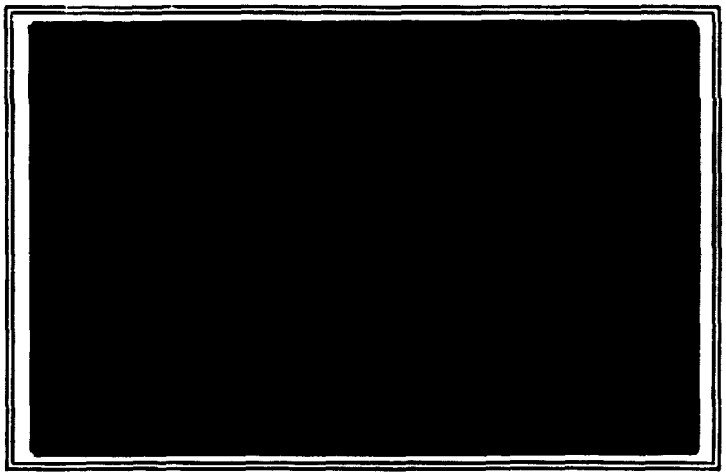

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A COMPACT FOUR CHANNEL SCALER WITH DISPLAY

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Abstract

This note describes the construction of a simple-to-make and inexpensive four channel, four decade scaler with display. The unit is intended for use with standard NIM modules in nuclear counting experiments where counting rates are fairly moderate.

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1. INTRODUCTION

Though the trend in the physics laboratory today is towards automation and computerization, there is often a need for a simple pulse counting device with visual read-out. In our lab., e.g., we are computer controlling an atomic-beam magnetic resonance apparatus for measurements on radioactive nuclei. To calibrate detectors and continuously supervise the experiments we wanted a simple and compact scaler system. With the advent of cheap LSI circuits and miniature seven segment LED displays, we thought it worthwhile to construct the following unit.

2. DESCRIPTION OF THE CIRCUIT

The circuit (see fig. 1.) is based on four AY-5-4007D LSI counters from General Instrument Microelectronics. These circuits were chosen after some investigations because of their capability to drive the LED displays directly, thus simplifying the circuit layout. This LSI chip contains a four decade BCD counter, storage register, multiplexing circuits and seven segment decoder/driver in a 24 lead DIL package. They drive one four digit, seven segment LED strip (Hewlett-Packard 5082-7414) each via the 390 ohm current limiting resistors. The pulses to be counted are input at point 1 in the figure and fed through a SN7407 line driver from which they are gated by the SN7409 to the LSI circuit. The 2 kohm// 47 pF timing network slows down the rise time

of the positive-going edge to ensure proper triggering of the LSI counter. At point 2, a copy of the input is available for further use. The portion of circuitry shown below the broken line is the control logic common to four channels. The leads which cross this line in the figure find their corresponding connections in all four channels. The switch acts as follows. In its left position the counters are enabled, provided control inputs 3 and 4 are left open or in high state. In the middle position the counters are unconditionally disabled and when the switch is to the right a reset to zero occurs in all counters. The reset signal is buffered by a SN74121 monostable giving a single pulse, the duration of which is long enough to let the counters reset correctly. With the switch to the left, a low state at point 3 will inhibit the counting and a low state at point 4 will give a reset. These features can be used when controlling the unit from e.g. an external timer. An overflow (4th decade carry) in any counter will yield a low state at point 5 with the same duration as that of the count input pulse causing the overflow. Thus, point 5 is used to interrupt other equipment, should an overflow indication be desired.

The circuitry was built up on a double-faced printed circuit board. The LSI circuits were placed side by side so that a simple restrapping would connect the scalers in series giving e.g. two channels of eight decades each. For accomodating the LED displays, wire-wrap type 14 pin DIL

sockets were modified to mount edge-on to the PCB. The PCB was installed in a single-width NIM module in such a manner that the displays were visible through a window in the front panel. The panel also holds BNC connectors for input and the switch. A connector for signal outputs and controls (points 2 through 5 in the figure) was placed on the rear panel.

3. PERFORMANCE

We have built a few of these units. When tested, they operated correctly at count pulse periods to well below 1.5 μs, the LSI circuits being rated for 400 kHz. The minimum pulse duration requiredwas found to be less than 0.2 μs, thus making the units compatible with the 0.5 μs pulses generated by standard NIM discriminators. The 1.5 μs period time implies that the unit should be able to handle the pulses from a source of some tens of μCi or more, depending on detector efficiency.

If one desires to extract the information by other means than a visual display, there is a serial output available on the LSI circuit. Other similar circuits provide multiplexed parallel BCD outputs for this task. However, we did not explore these possibilities, since we aimed at a simple gadget for primarily manual operation.

FIGURE CAPTION

Fig. 1: Schematic of four decade scaler. The circuitry below the broken line is common to four channels, only one of which is shown here. The encircled numbers refer to the text. All resistors are $\frac{1}{4}$ W.

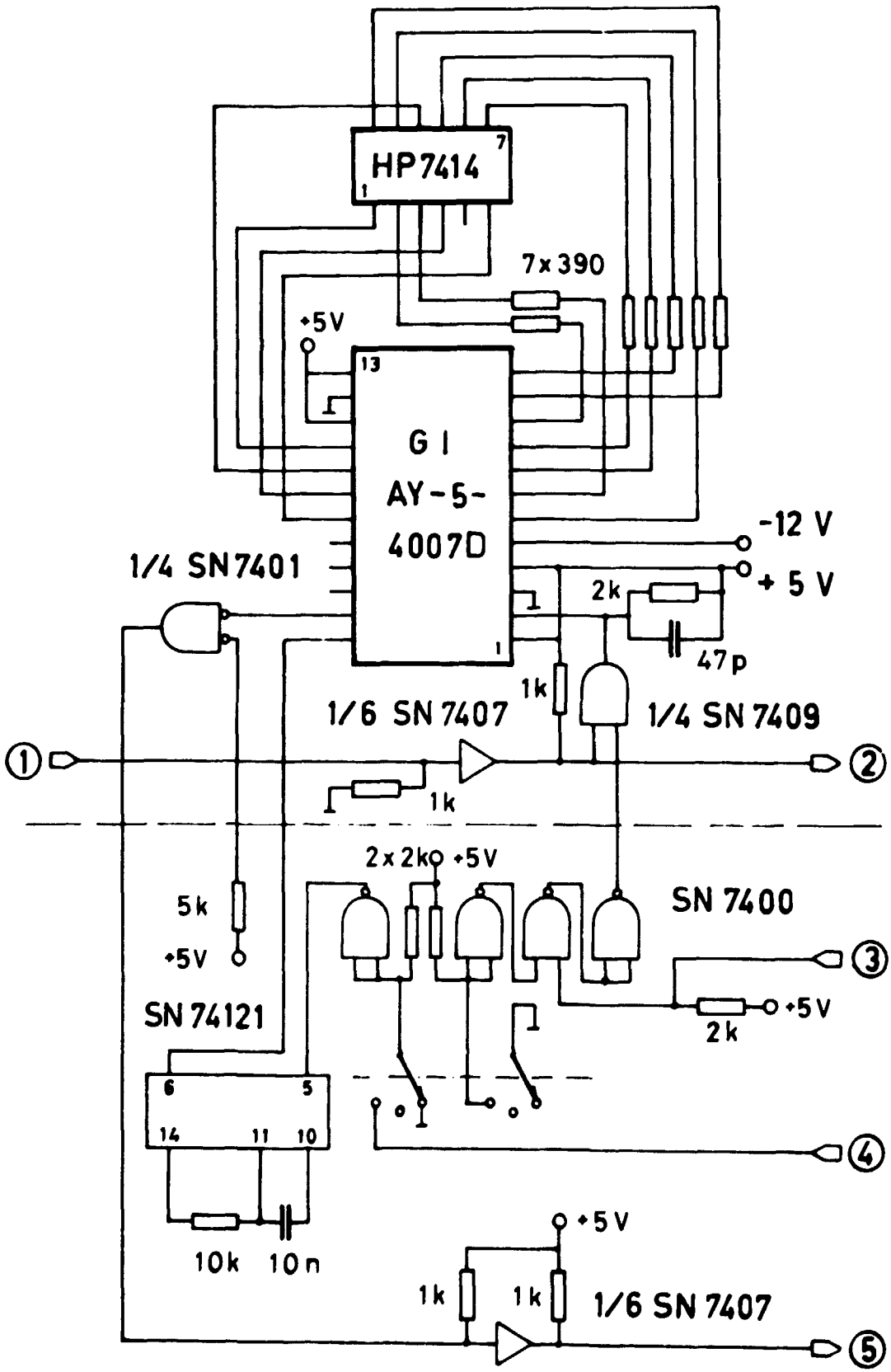
HP7414
7
1
7x390
+5V
13
G I
AY-5-
4007D
-12 V
+ 5 V
1/4 SN7401
2k
47p
1k
1/6 SN 7407
1/4 SN 7409
①
②
1k
2x2k
+5V
5k
+5V
SN 74121
SN 7400
③
+5V
2k
6
5
14
11
10
④
10k
10n
+5V
1k
1k
1/6 SN 7407
⑤

Fig. 1