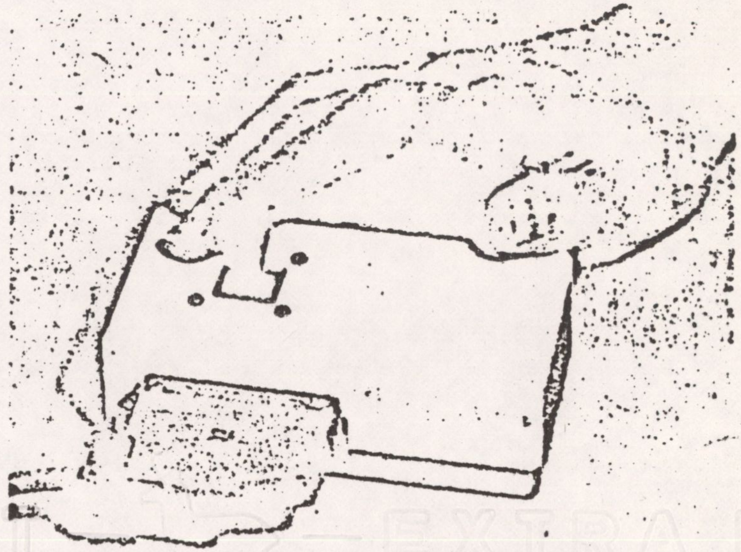

FIG 13c – 8 CHANNEL ADC IN USE WITH A JOYSTICK

HOW IT WORKS

The heart of the circuit is the analogue to digital converter chip (IC2). Its objective is to accept a voltage at its Vin input and convert it to an 8 bit digital output. To do this it requires several signals from the PIO chip plus a clock. The clock is similar to the Z80A clock in your Spectrum, but operates at a lower frequency. On each clock pulse the chip performs the next bit of the conversion. The frequency of the clock is about 500 kHz, and it is turned on and off by PA0. Each analogue to digital conversion therefore takes about 20 uS. The conversion is initiated by PA2 operating the start of conversion pin and PA0 switching on the clock. IC1 together with its associated resistors and capacitor forms the clock circuit. When the conversion is complete, IC2 sends an end of conversion signal to PA3. This indicates that the output data byte can then be read. PA1 operates the output enable pin. Port B of the PIO can then be used to read in the 8 bit data byte from the ADC.

In the sample BASIC drawing program, PA0, PA1, and PA2 are all operated simultaneously. The end of conversion signal will be finished in the time it takes BASIC to complete the coordinate read routine. If machine code were to be used then it would be necessary to use the end of conversion signal. This is because machine code operates so much faster than BASIC. The ADC may not have completed the conversion, and therefore it must be checked.

The ADC chip is fairly expensive, so if we wish to measure analogue voltages from more than one source, it is better if we can arrange this with only one ADC

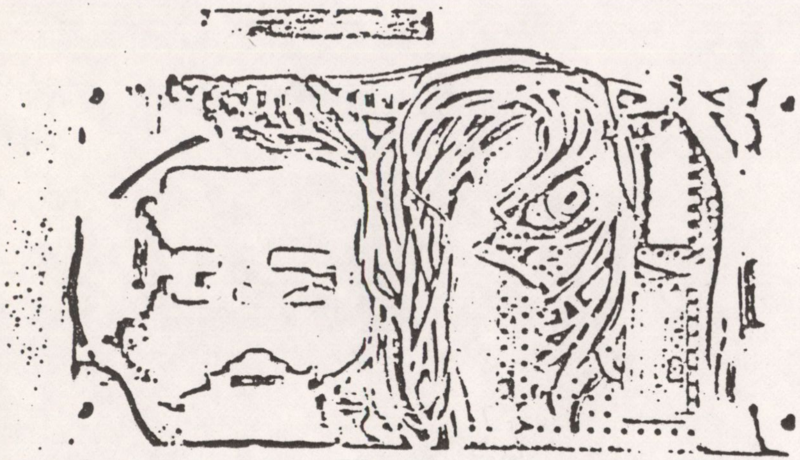

FIG 13d – 8 CHANNEL ADC INTERNAL LAYOUT

chip. This is where IC3 comes in useful. This is a 1 to 8 line analogue multiplexer chip. An address from 0 to 7 can be applied to it via PA4, PA5 and PA6. This enables any one of the 8 inputs to be connected via the multiplexer to the common output. If we select address 0 for example, the input voltage applied at C0 will appear at the I/O common pin. The chip is conceptually similar to an 8 way 1 pole switch. Changing the address to the chip is like changing the position of the switch.

The BASIC drawing program will operate with the X and Y axes of the joystick connected channel to 0 and channel 1 respectively. Lines 10 to 90 set up the PIO port so that port B is all input and port A is all output except for PA3. Consider lines 140 to 170, which read in the X coordinate. First of all, port A outputs are set to zero. This stops the clock, selects multiplexer channel 0, and disables the ADC chip. Then in line 160, the clock is started simultaneously with the start of conversion signal to the ADC chip. By the time that line 170 reads in the X coordinate from port B, the conversion is complete.

The BASIC drawing program itself is very easy to use. There are two modes, 'D' and 'S', each entered by pressing the appropriate key on the Spectrum keyboard. In 'S' mode a small flashing dot can be moved around the screen with the joystick, but it doesn't leave any mark. If 'D' is pressed then the moving dot leaves a line behind it. You can draw pictures in this way. Typing 'S' again stops the drawing until you press 'D'. To start a new drawing press 'N'.