Atari 8 Channel ADC

Although the Atari computers seem to be mainly thought of as games machines, they probably have more potential for user add-ons than most Atari users realise. The joystick ports of the Atari 400 and 800 computers provide what is effectively two 8 bit input/output ports with each line individually programmable to act as an input or an output. The 600XL and 800XL are rather more limited in that they only have two joystick ports, and therefore one 8 bit input/output.

The joystick ports have two analogue to digital converters per port, but these are resistance operated converters and not the more useful voltage sensitive type. However, it is quite easy to interface a high quality analogue to digital converter to the digital inputs of the joystick ports, and a suitable 8 channel design based on the CMOS 7581 device is shown here. Apart from the normal +5 volt supply a −10 volt reference source is required for this device. The 7581 also needs an external clock supplying a frequency of about 1 to 1.6MHz. In this case IC2a is used as a simple relaxation oscillator operating at typically just over 1MHz, and IC2b provides a buffered output for the clock input of the 7581 (IC1). The clock signal is applied to a series of four more buffers, and each of these drives a rectifier circuit that gives a negative output. The four rectified outputs are effectively connected in series, smoothed by C6, and then limited to −10 volts by zener diode D9. This gives the required reference voltage to pin 10 of IC1. This potential sets the full scale input sensitivity of each channel at 10 volts.

The 7581 has a quite complex internal circuit, but it is basically a successive approximation converter, 8 by 8 RAM, and eight input analogue multiplexer. The action of the device is to convert each channel in turn and store the result in the appropriate 8 bit RAM location. By reading one of the RAM locations the latest value for the corresponding channel is obtained (each channel is updated approximately every 500uS, or 2000 times per second). D0 to D7 carry the 8 bit output from the selected channel, while A0 to A3 are inputs which are used to select the required channel. A connection diagram for the four joystick ports is included here, and note that five lines are left unused and are therefore free to act as outputs if the converter is used in a control application. Connection to the joystick ports is via 9 way D sockets.

The converter can be read at address 54016 using the PEEK function (e.g. PRINT PEEK (54016) would print the returned value on screen). However, first the three address outputs must be set up as outputs and used to select the desired channel. The following commands achieve this:-

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POKE 54019,56
POKE 54017,255
POKE 54019,60
POKE 54017,X
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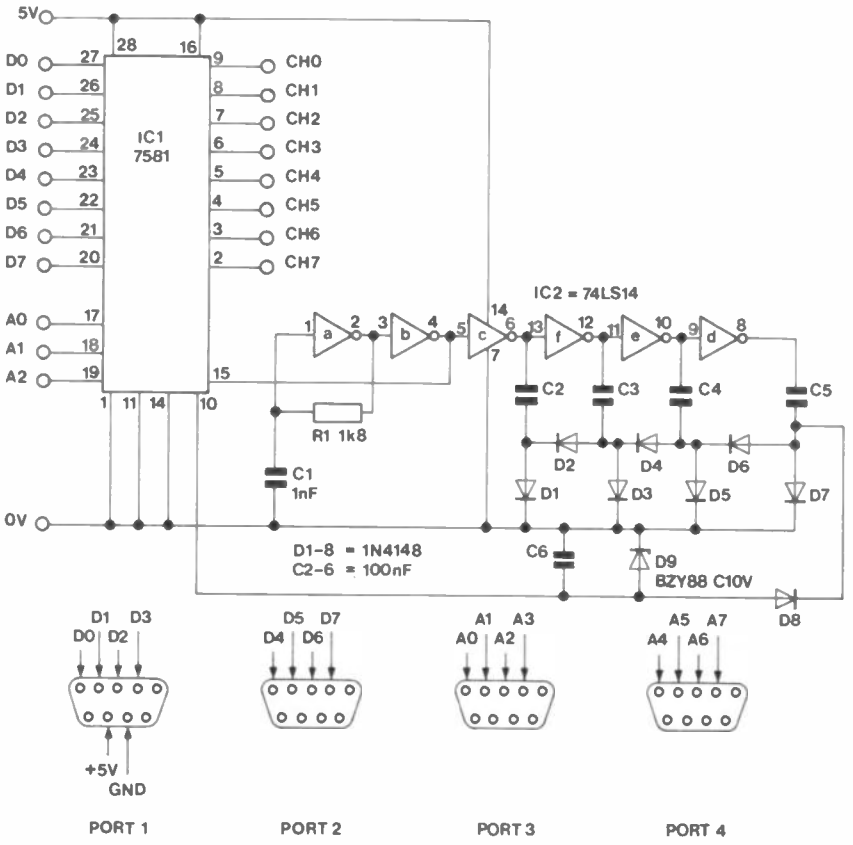


Here X is simply the number of the channel that you wish to read. The above routine sets A3 to A7 as outputs incidentally, and these can be controlled by POKEing the appropriate value to address 54017 (remembering to also set A0 to A2 to the right states when the converter is to be read).

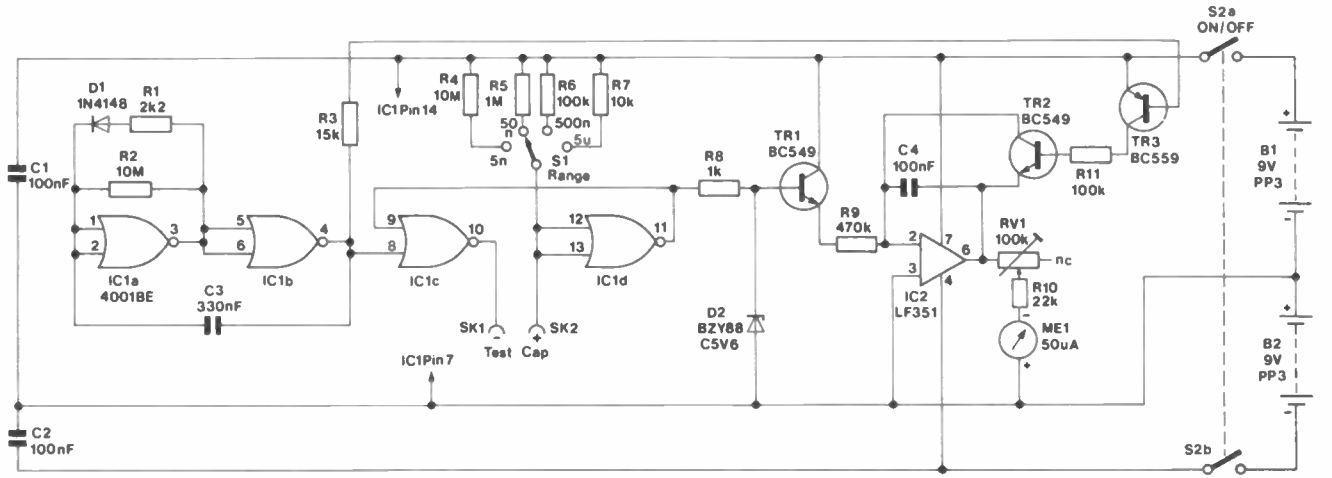
The unit could be used with a 600XL or an 800XL, but only as a single channel converter since joystick ports 2 and 3 are not fitted to these machines, and no means of selecting the desired channel is available. A0 to A2 would therefore be earthed, and only channel 0 would be used. Another problem if the unit is used with a 600XL or 800XL is that there would be no spare lines to act as outputs if the equipment is needed for a control application.

Capacitance Meter

This capacitance meter has four ranges with full scale values of 5nF, 50nF, 500nF and 5μF, enabling it to be used for checking most capacitors. It cannot be used to test high value electrolytic capacitors, but as these can be checked satisfactorily using an ordinary multimeter this is not a serious flaw. Although the unit has a quite simple circuit it is capable of excellent accuracy provided it is calibrated properly. No special equipment (apart from one close tolerance capacitor) is needed in order to calibrate the meter.

The circuit is based on a monostable multivibrator which is built around two CMOS 2 input NOR gates (IC1c and IC1d) and utilizes a standard configuration. The capacitor under test is the timing capacitor in the monostable, and the timing resistor is one of four switched components (R4 to R7) which gives the unit its four ranges. The monostable's output pulse duration is proportional to the value of the test capacitor, and some means of converting the pulse length into a corresponding meter reading is required. This is achieved by feeding the output pulse to the input of a Miller Integrator. The latter is a conventional operational amplifier type which is built around IC2. The basic action of the circuit is to give an output voltage that goes negative at a linear rate while the input pulse is present. In other words it gives the required pulse length to voltage conversion, and RV1 can be set up so that the unit provides direct readings in capacitance. R8 and D2 effectively stabilise the output pulse voltage of the monostable so that variations in supply voltage do not significantly affect the calibration of the unit. The output pulse length of the monostable does not seem to be supply dependent, and it is not necessary to use a stabilised supply for this section of the circuit.

IC1a and IC1b form a low frequency astable circuit which provides a brief negative output pulse about once per second. R1 and steering diode D1 are used to give the astable circuit the required non-symmetrical output waveform. The trailing edge of this signal is used to trigger the monostable and automatically take new readings at about one



second intervals. C4 must be discharged before a new reading is taken, and this is accomplished by TR2 and TR3 which are biased into conduction during each of the brief negative output pulses from the astable circuit.

In order to calibrate the unit a close tolerance capacitor having a value which is something approaching the full scale value of one of the ranges is required. For example, a 47nF capacitor has a value that is close to the maximum reading on the 50nF range, and could be used to calibrate the unit while it is switched to this range. It is simply a matter of connecting the calibration component to SK1 and SK2 and then carefully adjusting RV1 to obtain precisely the correct reading. Provided R4 to R7 are 1% tolerance resistors the unit will give good accuracy on all four ranges.

The unit can be used to check electrolytic capacitors provided they are connected with the polarity indicated on the circuit diagram, and they are of reasonable quality. Components having high leakage levels may not give a reading, but would obviously be of doubtful worth anyway. There should be no need to recalibrate the meter as its 0 to 50 scale is quite convenient for all four ranges.

ATARI 8-CHANNEL ADC PARTS LIST

RESISTORS – All 0.4W 1% Metal Film			
R1	1k8	1	(M1K8)
CAPACITORS			
C1	1nF Carbonate	1	(WW22Y)
C2-6	100nF Polyester	5	(BX76H)
SEMICONDUCTORS			
IC1	7581	1	(QY56L)
IC2	74LS14	1	(YF12N)
D1-8	1N4148	8	(QL80B)
D9	BZY88C10V	1	(QH14Q)
MISCELLANEOUS			
	DIL Socket 28-pin	1	(BL21X)
	D Socket 9-way	3	(RK61R)

CAPACITANCE METER PARTS LIST

RESISTORS – All 0.4W 1% Metal Film			
R1	2k2	1	(M2K2)
R2,4	10M	2	(M10M)
R3	15k	1	(M15K)
R5	1M	1	(M1M)
R6,11	100k	2	(M100K)
R7	10k	1	(M10K)
R8	1k	1	(M1K)
R9	470k	1	(M470K)
R10	22k	1	(M22K)
RV1	100k S-Min Hor Preset	1	(WR61R)
CAPACITORS			
C1,2,4	100nF Polyester	3	(BX76H)
C3	330nF Polyester	1	(BX79L)
SEMICONDUCTORS			
IC1	4001BE	1	(QX01B)
IC2	LF351	1	(WQ30H)
TR1,2	BC549	2	(QQ15R)
TR3	BC559	1	(QQ18U)
D1	1N4148	1	(QL80B)
D2	BZY88C5V6	1	(QH08J)
MISCELLANEOUS			
S1	Rotary Sw 3-pole 4-way	1	(FH44X)
S2	DPST Rotary	1	(FH57M)
ME1	50μA Panel Meter	1	(RW91Y)
SK1	1mm Socket Black	1	(WL59P)
SK2	1mm Socket Red	1	(WL60Q)
B1,2	Battery 9V PP3	2	(FK62S)
	Battery Connector	2	(HF28F)
	DIL Socket 14-pin	1	(BL18U)