



the joystick. We can summarise the actions of the joystick's switches on the contents of the joystick memory location as follows:

Joystick	Decimal	Binary
Central	127	01111111
Up	126	01111110
Down	125	01111101
Left	123	01111011
Right	119	01110111
Fire	111	01101111

You may also have noticed that moving the joystick diagonally can cause two switches to close simultaneously. Although we do not require detection of diagonal movement to control our vehicle, the results of such movements on the joystick memory location are as follows:

Joystick	Decimal	Binary
Up and left	122	01111010
Up and right	118	01110110
Down and left	121	01111001
Down and right	117	01110101

The following program uses a joystick to control the movements of the twin motor vehicle. The vehicle should be connected to the output box in the same way as on page 586 and the joystick should be plugged into games port 2, located on the right-hand side of the Commodore 64.

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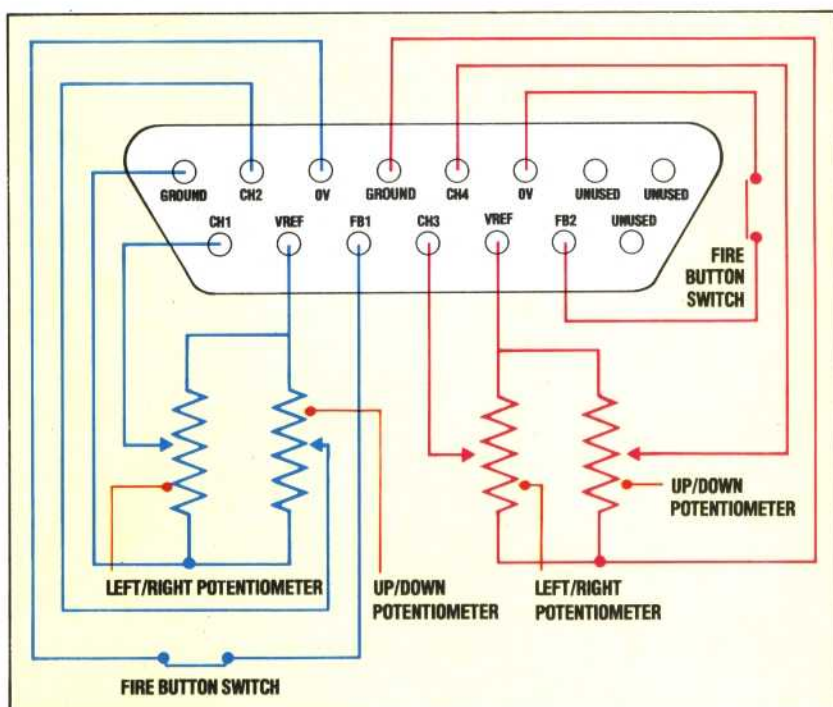
10 REM CBM 64 JOYSTICK
20 DDR=56579:DATREG=56577
30 POKEDDR,255:REM ALL OUTPUT
40 JOY=PEEK(56320):REM JOY PORT 2
50 GOSUB1000:REM TEST JOYSTICK
60 POKEDATREG,0:GOTO40
90 :
1000 REM TEST JOYSTICK S/R
1005 IF JOY=127 THEN POKEDATREG,0
1010 IF JOY=126 THEN POKEDATREG,5
1020 IF JOY=125 THEN POKEDATREG,10
1030 IF JOY=123 THEN POKEDATREG,6
1040 IF JOY=119 THEN POKEDATREG,9
1050 IF JOY=111 THEN POKEDATREG,0:END
1060 RETURN

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BBC MICRO

The BBC joystick is an analogue device relying on two potentiometers to provide information about the up/down and left/right movements made. The essential difference between a digital joystick and the analogue type used by the BBC Micro is that the latter gives information about 'position' within given limits, whereas the former gives information about direction of travel only. The joystick potentiometers work in the following manner.

A potentiometer is essentially a resistance across which a voltage is applied. A third connector to the potentiometer can move along the resistance taking a fraction of the supply voltage. This fraction depends on the position of the moving connection. On a linear type of potentiometer, if the moving connection were positioned halfway across the resistance, then the voltages tapped off would be half the supply voltage. Thus, by moving the central connection, any voltage between zero and the supply voltage



can be obtained. Turning the volume control on a radio or record player is essentially moving the middle connection across the resistance of the volume control potentiometer. In an analogue joystick the movement of the middle connection is made by moving the joystick handle.

BBC Micro joysticks are generally supplied in pairs. The BBC Micro's analogue port connections for joysticks 1 and 2 are shown in the above diagram.

A reference voltage is provided by the micro across each potentiometer and the middle connection's tap-off voltage is input through two channel inputs. Channel 1 is used for the input from the left/right potentiometer and channel 2 is used to accept input from the up/down potentiometer. The fire button is a simple make or break switch.

Once the potentiometer inputs have been accepted they must be converted from analogue to digital form by an internal converter. This conversion is done by comparing the input voltage with the reference voltage and conversion time is around 10 milliseconds for each channel read. Once the joystick input is in digital form we can use the values to control our vehicle.

Input to the analogue port can be read from BASIC using the BBC BASIC command ADVAL. The value returned by ADVAL is in the range 0 to 65520, the upper limit corresponding to an input equal to the reference voltage. Reduced input voltages will produce correspondingly smaller numbers until an input voltage of zero volts will produce a value of zero returned by ADVAL. For our simple application we are only really interested in the two limiting values. The channel read by ADVAL is determined by the number in a bracket after the keyword. Thus ADVAL (1) will read channel 1 and return a value in the range 0 to 65520.

Analogue Reflections

BBC Micro joysticks are usually supplied in pairs, going into a single connector. The analogue port pin-outs as seen from outside the machine show that joystick 2 is connected in an exactly similar way to joystick 1. Single joysticks may be connected in the place of either