# Joystick Ports

The Be™ system has two joystick ports. (Referred to as A and B) Each port is capable of supporting 4 analog input voltages, and 4 buttons.

Background: The Joystick ports of the ISA community originally supported X & Y digitization, and 2 buttons per joystick. The A/D conversion was performed by counting the time it took for a capacitor to be charged, based on the position of a variable resistor in the base of joystick controller. This was a very low cost way of inputting an analog voltage based on the technology of the day. The trouble with this method was that the joystick response was closely linked to the speed of the machine running the game, and as the speed of processors began to go up, the joystick would "break" because the number of counts between full left and full right would be reduced to the point that the game would become unplayable. Even today some game port cards come with special circuitry to compensate for the speed of the machine.

Along the way some game card makers began making controllers with multiple ports on them, so that 2-joystick games could by created. These multi stick controllers often used the unused pins of the standard 15 pin D connector , and supported 2 Joysticks Via a Y-Cable. Some makers of joysticks have created controllers that could connect to both ports of the came card, and use the additional buttons and even the additional analog channels to control the games. (The "THRUSTMASTER™" joystick is one such device, and yes, that really is its real name.)

Each Joystick port of the Be system will be compatible with the enhanced type of joystick, so that all games for the Be machine may include 2 player 2-joystick modes, where each of the joysticks may be an enhanced type joystick. Note that it is possible to make a 4 player 4 joystick game by using Y-cables off each port.

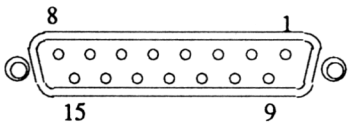


**Fig.1 Joystick Connector (1 of 2)**

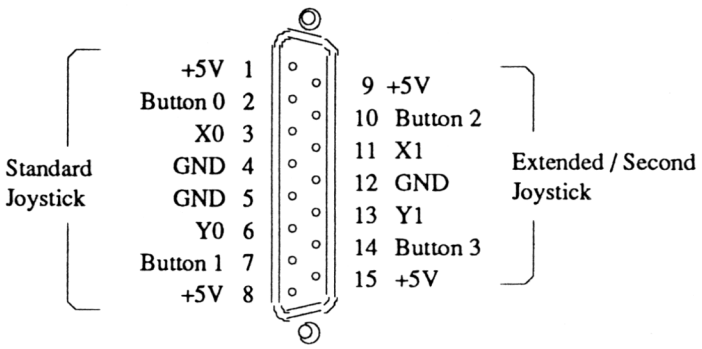


**Fig.2 Joystick Pin Out**

Figure 2 shows the pinout for the Be™ system joystick port. This connector is fully compatible with ISA Joysticks.

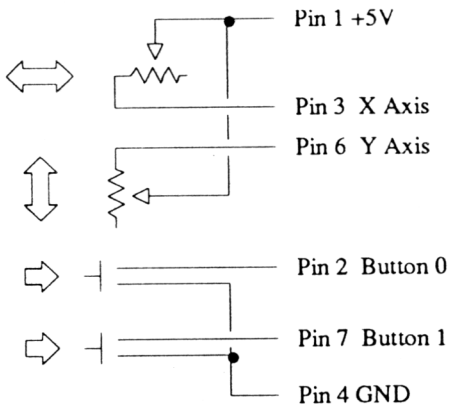


**Fig 3. Typical Simple Joystick**

The standard ISA joystick contains very little circuitry, and because it contains no source of clocks, an individual joystick requires no certification by the FCC. (Joysticks sold as part of a configuration must pass with the computer.)
Enhanced joysticks may contain additional switches or variable resistors, and in the case of the THUSTMASTER, a resistor and switch matrix which allows for 4 position weapon / view select switch to be connected to an analog input.

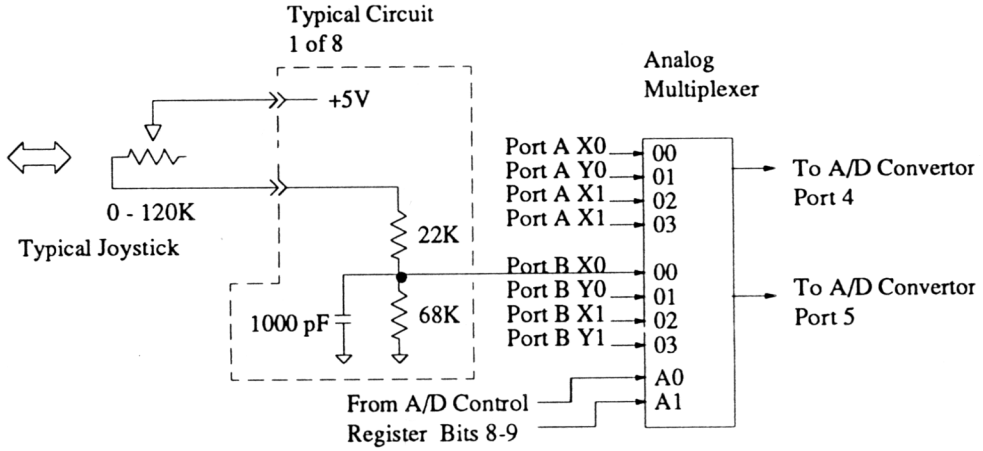


**Fig 4. Be™ System Joystick Circuit**

The Be system does not use the capacitor count system to determine the position of the joystick, it directly digitizes the voltage induced across an internal resistor ladder based on the value of the variable resistor in the joystick.

With a joystick of 120 KΩ, there will be roughly 2200 steps between left and right or top and bottom. The actual step count will vary from joystick to joystick, and from system to system, and even somewhat over temperature.

Because of the circuit used, the Be system is capable of digitizing a wide range of potentiometers, from 10 kΩ (~375 Steps) to 1 MΩ (> 3000 steps).

The circuit also allows the Joystick ports to be used as additional analog inputs, either to measure resistor position or as direct voltage inputs (measured = Vin x .755)

In spite of the high values of the resistors in the system, the Joystick ports are capable of digitizing a signal of over 2000 Hz, well above the speed of human motion.

The analog multiplexer is used to select which input from each port shall be connected to the inputs of the A/D convertor. The A/D control register must be programmed to select the correct port pin via bits 8 and 9, and the SEL bits must be programmed for input 4 and 5 for joystick port A and B, respectively.

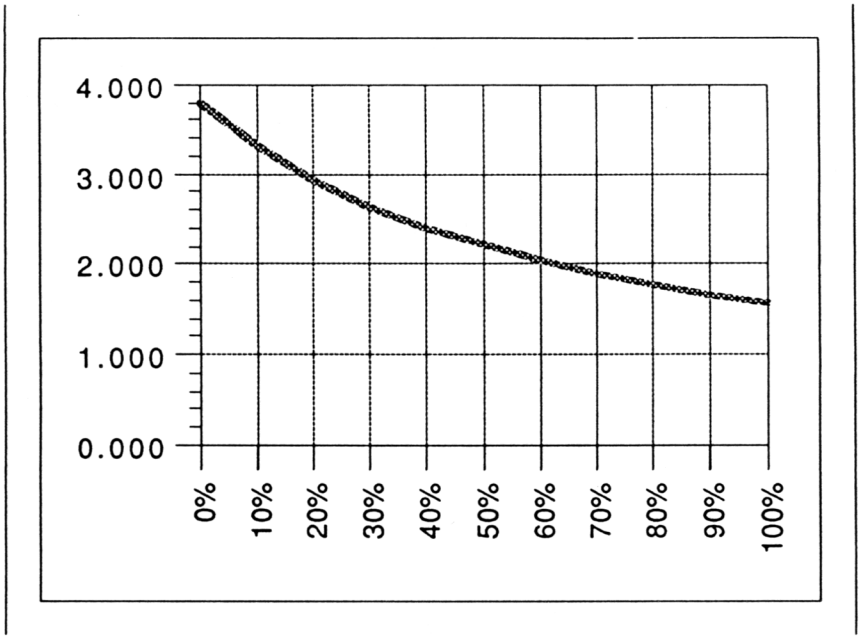


**Fig 5. Voltage Measured / Joystick Position**

The circuit suffers some non-linearity of position to resistor value. Figure 5 graphs the voltage / position relationship for a joystick with a linear 0-120 KΩ resistor. It is not known if any joysticks have used a non-linear resistance profile to attempt to compensate for the effect above, which would be more pronounced with a capacitor timing scheme. In either case it is possible to use a table to correct the curve, or to introduce function to the curve to make the joystick more usable.

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Software note, I suppose that the driver could just return the raw value and let the game (or whatever) use it as they see fit, but a set of standard joystick calls would be cool, (I.E. every game would use the same joystick set up, no user confusion)
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**Measuring Joystick position:**

The GeekPort™ A/D convertor is used to measure the voltage. See the GeekPort™ chapter for register definitions.

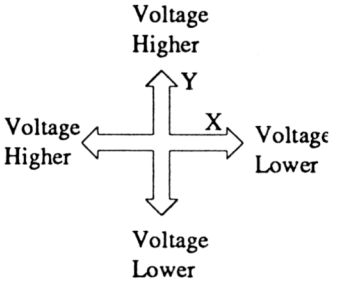


**Figure 6 Joystick Polarity**

Figure 6 shows the relationship between the position of the joystick controller and the voltages read from the X and Y pins.
Joysticks with additional analog features must be explored on a case by case basis

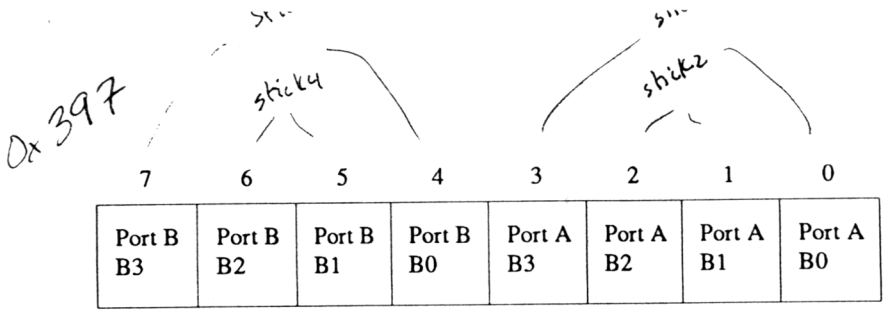


**Fig 7. Joystick button register.**

### Joystick Button Inputs

Buttons from both ports appear in one byte mapped into ISA address space.
The bits are normally high, switch closure will cause the bit to go low. No hardware debounceing is provided, debounce routines must be implemented in software. (User studies have shown that a if a button is held for more than 20 mS the user believes that they had pushed it, if a button is held for less than 20 mS, the user was not surprised if the equipment does not respond. (I think this is an old Bell Labs study done for touch tone phones)

### Joystick Button Register.

Contains instantaneous data from switch inputs

| From | Type | Address |
|---|---|---|
| CPU | Memory | 8000 XXXX |
| PCI | Memory | XXXX XXXX |
| ISA | I/O Port | ____ XXXX |

Access: Read Only

| Bit | Name | Description | |
|---|---|---|---|
| 0 | Port A Button 0 | From Port A, Pin 2, | Low = Button Depressed |
| 1 | Port A Button 1 | From Port A, Pin 7, | Low = Button Depressed |
| 2 | Port A Button 2 | From Port A, Pin 10, | Low = Button Depressed |
| 3 | Port A Button 3 | From Port A, Pin 14, | Low = Button Depressed |
| 4 | Port B Button 0 | From Port B, Pin 2, | Low = Button Depressed |
| 5 | Port B Button 1 | From Port B, Pin 7, | Low = Button Depressed |
| 6 | Port B Button 2 | From Port B, Pin 10, | Low = Button Depressed |
| 7 | Port B Button 3 | From Port B, Pin 14, | Low = Button Depressed |

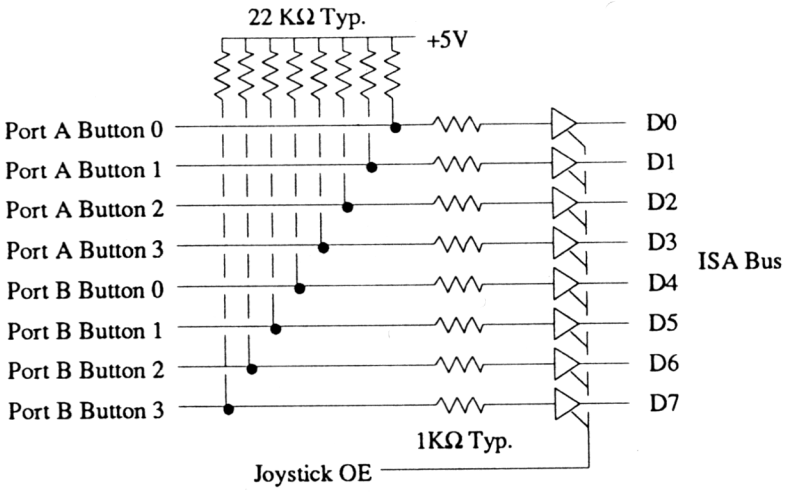


**Fig 8 Joystick Button Input Circuit**

The button input circuit is a 20 KΩ pull up with a 1 K series input protection resistor for each of the data bits. Note that the button inputs may be used as general purpose inputs.