

AWC

**PAK-XI PS/2
Coprocessor
Data Sheet**

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Overview

The PAK XI coprocessor allows you to use an ordinary PS/2 mouse with any computing device capable of handling RS232 communications. The PAK XI is the perfect solution for microcontrollers that need precise position and direction information. Mice (and mice electronics) make excellent position encoders and are useful in robotics and CNC applications, in addition to the traditional user interface tasks you normally associate with mice..

Here are some of the PAK XI's major features:

- Serial interface uses TTL level RS232 at 9600
- Uses as few as 1 pin to connect to the host
- Provides information on demand to simplify applications
- Support for right and left mouse buttons
- 16-bit X and Y axis tracking
- Easy to use

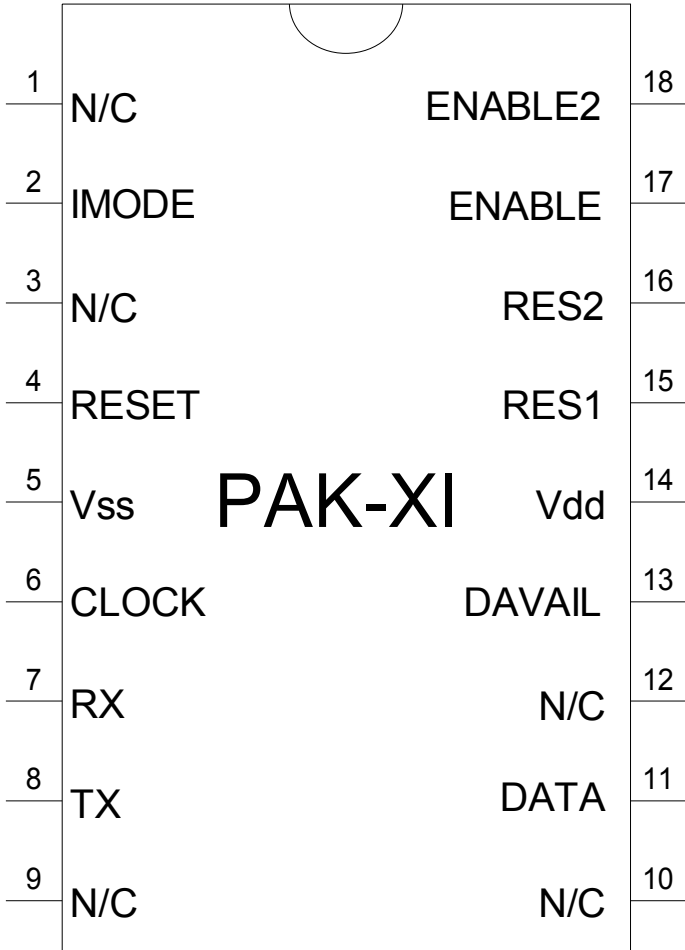
The PAK XI is a standard 18-pin IC. In order to operate it must have a regulated supply of 5V and connection to a clock element. The Stamp PAK XI includes a 20MHz ceramic resonator that you can use to clock the chip.

Other than the power and clock connections, the Pak XI requires at least one wire to connect between your microcontroller (the host) and itself. Depending on the host's capabilities and your application, you may want to use a few additional pins to control the PAK

If You Need Help

If you require assistance with your PAK XI, please feel free to contact us. The best way to get support is via e-mail (stamp@alwilliams.com). However, you may also call between 9AM - 4PM

Central Time at (281) 334-4341. You can also fax to (281) 754-4462. Be sure to check out our Web page for updates at www.alwilliams.com/awce.htm.



WARNING: The PAK XI is a static-sensitive, CMOS device. Observe static precautions when handling. Operating the device without both Vss pins grounded or with RES1 or RES2 disconnected may damage the chip.

Pin Connections

Pin	Name	Type	Description
2	IMODE	Input	Initial mode (ground for raw mode; +5V for normal mode)
7	RX	Input	TTL level RS232 input
8	TX	Output	TTLlevel RS232 output
17	Enable	Input	If this pin is high, the PAK transmits to the host microprocessor; the PAK always responds to commands
18	Enable2	Input	If this pin is low, the PAK to the host microprocessor; the PAK always responds to commands
13	DAvail	Output	High when data is available
4	RESET	Input	Hardware resets the PAK when low. Must be high for normal operation
5	Vss	Power	Ground
14	Vdd	Power	+5V
15	RES1	Clock	Connects to resonator
16	RES2	Clock	Connects to resonator
11	DATA	I/O	PS/2 data line – may require pullup resistor for USB/PS2 mice
6	Clock	I/O	PS/2 clock line – may require pullup resistor for USB/PS2 mice
1,3,9,10,12	N/C	N/C	Not used

Software Commands

Code	Name	Description
\$01	NOAUTO	Turns auto mode off (default)
\$02	AUTO	Turns on auto mode – PAK will send a five byte packets while any mouse button is pressed
\$03	PURGE	Sets X and Y to 0, clears status latch,
\$04	FLUSH	Clears any pending packets and executes a PURGE
\$05	REPORT	Sends 5 byte report
\$07	CLRREPORT	Sends 5 byte report then clears X and Y (and status latch)
\$09	NORMAL	Sets normal mode (PAK only reports in response to queries; default when IMODE=0)
\$0A	RAW	Sends all data from mouse directly to host (does not track X, Y, or buttons; default when IMODE=1)
\$0B	ESCAPE	Sends next byte directly to mouse
\$0D	INIT	Reinitialize mouse (done automatically on power up when IMODE=0)
\$0F	BLATCH	Send latched status and clear latch
\$FF	RESET	Warm reset PAK and reset keyboard

Note: Codes are hex, not ASCII. So to send a REPORT, send a byte with value 5, not an ASCII character "5". All codes are one byte in length (although ESCAPE requires you to send another byte which is sent to the mouse).

Operating Modes

When the PAK-XI starts, it resets the mouse and begins reading packets from the mouse. It accumulates a 16-bit X and a 16-bit Y counter that starts at zero. By sending a REPORT (or similar command) the PAK will respond with 5 bytes. The first two bytes are the current X count (two's compliment, high byte first). The next two bytes are the Y count in the same format. The final byte is a status byte directly from the mouse.

The byte has the following format:

Bit 7 – Y overflow (should always be 0 as this reflects the mouse overflowing, not the PAK)

- Bit 6 – X overflow (should always be 0 as this reflects the mouse overflowing, not the PAK)
- Bit 5 – Sign bit for Y (1 is negative)
- Bit 4 – Sign bit for X (1 is negative)
- Bit 3 – 1 if any mouse packets have been read
- Bit 2 – 1 if middle button down (note: your mouse may require a command to enable its middle button)
- Bit 1 – 1 if right button down
- Bit 0 – 1 if left button down

Each time the mouse sends this status to the PAK, the PAK updates the BLATCH so that any 1 that occurs is remembered until you read and clear the latch. In this way, you can detect button presses that occurred when you were not sampling the mouse.

Normally, the PAK tracks the mouse silently, and only sends data when asked. However, if you set auto mode, the PAK will send a 5 byte report every time it detects a button push and if the mouse moves while a button is pressed. However, this can generate a rapid flurry of events. Processors like the Basic Stamp will have problems reading the packets fast enough since the PAK only buffers 6 packets.

Typical Circuits and Software

Connecting the PAK to its external components is simple. Supply 5V to Vdd and ground the Vss pins. Connect the two outer pins of the ceramic resonator to the RES1 and RES2 pins (the order does not matter). Ground the center pin of the resonator. Connect the RESET pin to 5V. For the simplest mode of operation leave ENABLE tied to +5V and jumper ENABLE2 to ground. Of course, you'll also need to connect the RX and TX pin to the host microprocessor. If the host uses true RS232, you'll need a line driver (like the Maxim 232 chip). For connection to a TTL inverted device (like the Basic Stamp) you can directly connect the pins.

If you are not planning to send the PAK any commands, you can omit the RX line. If you'd like an indication of when the PAK has data available, you can monitor the DAVAIL pin which is high when data is available.

If you are using the Basic Stamp you'll have no problems using the SEROUT command to send codes to the PAK. Many Basic Stamp-compatible compilers have these commands too.

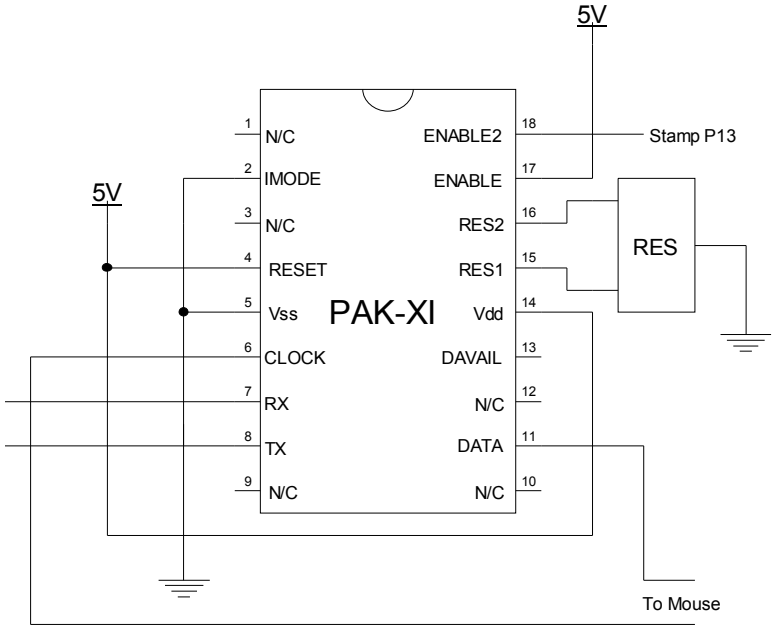
Important Note

Not all mice are the same. The PAK-XI is made to work with common PS/2 mice. However, it will not utilize special features your mouse may have (although you can set some features using escape commands). If you need full control of the mouse, you can place the unit in raw mode. In raw mode, every byte the mouse sends is sent to the host. You still must escape commands you want to send to the mouse. You also must correctly read acknowledge bytes and responses from the mouse. In raw mode, the PAK simply acts as a protocol converter and does not other processing.

Changing between raw and normal modes resets the X and Y counters and clears any pending data waiting for transmission to the host microcontroller.

Many mice will not activate special features (such as the middle button, scroll wheels, etc.) until you send special sequences to activate them. In addition, the number of counts per inch can vary. Common mice have 400 dots per inch or 800 dots per inch at their maximum resolution. Since the PAK-XI records up to 32767 counts (positive and negative) the total range will be just under 41 inches for an 800 DPI mouse and almost 82 inches for a 400 DPI mouse. Of course, you can use raw mode to initialize the mouse to other DPI settings. It is also possible to read and reset the counters, accumulating the total in the host processor. In this case, the limit

represents the maximum motion between samples, not the total limit (which would depend on the program in the host computer).



An Example Circuit

Note: Pin 7 goes to SEROUT pin; pin 8 goes to SERIN pin

Mouse Commands

Most mice allow you to send a variety of commands:

\$FF - Reset mouse

\$F6 – Set default values

\$F5 – Disable data reporting

\$F4 – Enable data reporting

\$F3 – Set sample rate (send another byte via escape)

\$F0 – Set remote mode

\$EB – Read data

\$EA – Set stream mode (default for PAK)

\$E8 – Set resolution (send another byte via escape

\$E7 – Set 2:1 scaling

\$E6 – Set 1:1 scaling

Programming the mouse is beyond the scope of this manual. Do not attempt to send mouse commands unless the PAK is in raw mode. You must send an ESCAPE code before sending data directly to the mouse. If you want to send multiple bytes to the keyboard, you must prefix each byte with escape.

For most commands, you'll need to disable data reporting first, and then reenabled it after you are done. Also, expect to delay a bit after issuing a command to allow the mouse to execute and acknowledge it. In addition, most commands return an acknowledge byte (\$FA) and other data which you must read.

Hints

PS/2 mice require 4 wires: two for power and ground and two for clock and data. For prototyping, you may find it handy to acquire a PS/2 connector designed to connect PS/2 keyboards to PC motherboards (you can find these at any place that sells PC components for a few dollars). These PS/2 connectors terminate in a .1" single inline pin socket. You can either cut the wires to connect to the PAK, or use some .1" single inline pins to make the connection.

Frequently Asked Questions

Q: Can I run the PAK XI from a different clock source?

A: You may be able to use a lower clock speed, but it isn't recommended. The serial communications depend on specific timing.

Q: Is there a second source for the PAK XI?

A: No. However, if you have a high-volume application and you are concerned about availability, contact AWC about obtaining a license to produce your own PAKs or obtain them from third parties.

Q: What is the state of the PAK at startup?

A: If IMODE is grounded on reset, the PAK resets the mouse, forces stream mode (which should be the default), turns the mouse to high resolution, and the PAK is not in auto mode.

Q: How do I connect the resonator?

A: The center pin is ground and the outer pins are interchangeable.

Further Information

To learn more about programming PC mice in raw mode, you can refer to several resources on the World Wide Web:

- www.al-williams.com/awce/pak6mou.htm
- www.repairfaq.org/REPAIR/F_Pinouts2.html

Specifications

Absolute Maximum Ratings

Ambient temperature under bias	-40°C to +125°C
Storage temperature	-65°C to +150°C
Voltage on VDD with respect to VSS	-0.3V to +6.5V
Maximum current out of VSS pin	300 mA
Maximum current into VDD pin	250 mA
Maximum output current sunk by any I/O pin	25 mA
Maximum output current sourced by any I/O pin	25 mA

DC Characteristics

Parameter	Minimum	Typical	Maximum
Supply voltage	4.5V	5V	5.5V
Vdd rise time on power up	.05V/ms	-	-
Supply current @ 5V	-	4mA	7mA