

AWC

PAK-X Data Acquisition Coprocessor Data Sheet

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Overview

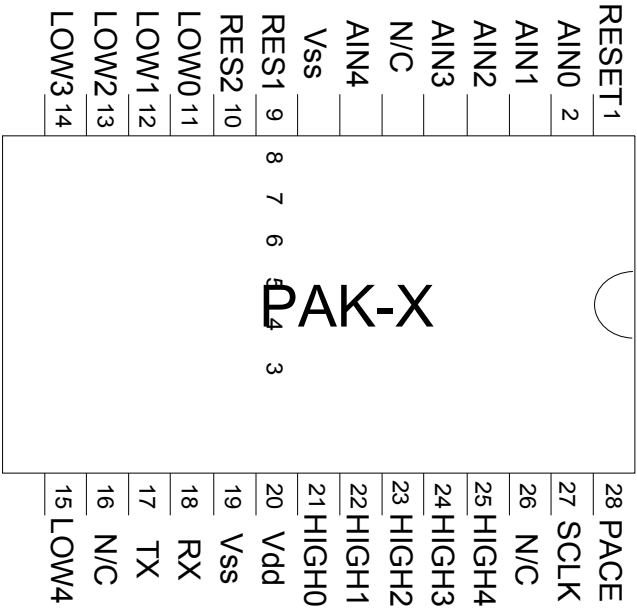
The PAK-X is a 5 channel A/D converter that can offload many common data acquisition tasks from your main processor. It can perform a variety of functions:

- Record the minimum and maximum values for each channel
- Test each channel against a high and low limit, setting an output bit for a high or low condition
- Remember previous high or low conditions
- Apply hysteresis to the high and low limits to prevent chattering
- Average values over a number of samples
- Store setup to EEPROM for instant recall
- Simple RS232 interface
- Easy to use

The PAK-X is a standard 28-pin (.3" wide) IC. In order to operate, it must have a regulated supply of 5V and connection to a clock element. The PAK-X includes a 20MHz ceramic resonator that you can use to clock the chip.

If You Need Help

If you require assistance with your PAK X, 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.



Registering Your PAK-X

Please take a moment to register your e-mail address with AWC. Simply send an e-mail message to pakreg@al-williams.com. AWC will not make your address available to other companies, but we may periodically send you updated technical notes. You'll also receive information about new microcontroller products and specials.

Pin Connections

Pin	Name	Type	Description
1	RESET	Input	A low on this pin resets the PAK; must be high for normal operation
2-5,7	AIN0-AIN4	Analog Input	Input voltages (0 to 5V)
8,19	Vss	Power	Ground pins
9,10	RES1, RES2	Clock	Connect to outer pins of resonator. Can also apply external clock to pin 9
11-15	LOW0-LOW4	Output	Output goes true when channel has dropped to its low limit (or lower)
17	TX	Output	TTL Level RS232 data output (9600, 8 bits, no parity)
18	RX	Input	TTL Level RS232 data input (9600, 8 bits, no parity)
20	Vdd	Power	5V Input
21-25	HIGH0-HIGH4	Output	Output goes true when channel has met or exceeded the high limit
27	SCLK	Output	Optional clock output; changes state before each set of samples acquired
28	PACE	Input	Tie to 5V to enable RS232 pacing; ground for full speed RS232

Theory of Operation

The PAK-X continuously samples 5 channels of analog input. Each input is read with 10 bits of resolution, providing a current value from 0 to 1024, where 0 corresponds to 0V and 1024 corresponds to 5V. If desired, the PAK can average 2, 4, or 8 samples on each channel. Once the channels are read, the PAK compares each value to a programmed high limit and low limit. If either limit is violated, the PAK will assert a digital output to the high state to indicate this. Each channel has a separate high and low output.

Of course, the host CPU can set the limits, read the current value, and also read the current high/low status. In addition, the PAK stores the minimum and maximum value for each channel which the CPU can read. What's more, the CPU can also examine a latch that shows if each channel has hit its high or low limits since the last time you've read the latch.

In addition to averaging, the PAK-X can employ hysteresis. This allows you to set a margin to prevent the high and low status from rapidly pulsing on and off. For example, suppose you set the high limit to 1000 and the high limit hysteresis to 5. When the input reaches 1000, the channel's high status will be set. However, it won't be reset until the input value drops below 995 ($1000-5$). All channels use the same hysteresis values, but you can set the high and low hysteresis separately.

Command Format

The PAK-X uses a simple command format. Some commands require one byte. Others require two bytes. Here's a list of commands (\$ is used as a prefix for hex numbers; % is used as a prefix for binary numbers):

%00000000 (\$00) – No operation. This is useful when the host CPU may reset in the middle of a PAK operation. When the CPU starts over, the PAK may be waiting for more data from the CPU. By sending two no operation codes and performing a reboot command, you can be sure the PAK is in a known state. Of course, if a CPU reset also resets the PAK, this sequence is unnecessary.

%001CCCBB – This command sets the high limit for the channel specified in CCC (from 000 to 110). You must send a byte that indicates the low 8 bits of the limit. The BB field indicates the top 2 bits. This command resets the high limit latch.

%010CCCBB – This command sets the low limit for the channel specified in CCC (from 000 to 110). You must send a byte that indicates the low 8 bits of the limit. The BB field indicates the top 2 bits. This command resets the low limit latch.

%100CCC00 – This command reads the high limit for the channel specified in CCC (from 000 to 110). The PAK will send two bytes (high byte first) that specifies the limit.

%101CCC00 - This command reads the low limit for the channel specified in CCC (from 000 to 110). The PAK will send two bytes (high byte first) that specifies the limit.

%110000XX – Use this command to set the number of samples the PAK averages on each channel (all channels use the same average setting).

<i>XX</i>	<i>Samples Averaged</i>
0	1
1	2
2	4
3	8

If XX is 0, the PAK reads one sample. If XX is 01 then the PAK averages 2 samples. Values of 10 and 11 average 4 and 8 samples respectively.

%011CCC00 – Read the 10 bit current value from the channel specified by CCC (000 to 110). The PAK will send two bytes specifying the 10 bit result (high byte first). If averaging is in effect, the return value will be averaged.

%011CCC01 – Get the minimum value for the channel specified by CCC (from 000 to 110). The PAK sends two bytes to indicate the value, high byte first.

%011CCC10 – Get the maximum value for the channel specified by CCC (from 000 to 110). The PAK sends two bytes to indicate the value, high byte first.

%011CCC11 – Reset the minimum and maximum values for the specified channel. This command also clears the latched high and low values.

%00000100 (\$04) – Store all operating parameters to EEPROM. When the PAK resets, it reads these parameters. The current input values are not stored.

%00001000 (\$08) – Recalls the operating parameters from EEPROM.

%00001100 (\$0C) – Reads the high and low status of all channels. The first byte sent by the PAK indicates which channels are current over their high limit. For example, if bit 0 is 1 then channel 0 is over its high limit. The second byte indicates which channels are under their low limit.

%00010000 – This command resets the minimum and maximum values for all channels. It also clears the latched high and low values.

%00010100 – Use this command to set the hysteresis value for the low limit. Once a channel has reached its low limit, it must exceed the low limit by the hysteresis value before the low state is reset. Of course, you can set this value to 0 if you don't want hysteresis in effect. Send a single byte with the desired value (between 0 and 255).

%00011000 (\$18) – Use this command to set the hysteresis value for the high limit. Once a channel has reached its high limit, it must drop below the high limit by the hysteresis value before the high state is reset. Of course, you can set this value to 0 if you don't want hysteresis in effect. Send a single byte with the desired value (between 0 and 255).

%00000001 (\$01) – This reads the latched high and low conditions and resets the latch. The first byte shows a 1 in each channel position that has been high since the latch was cleared. The second byte shows a 1 for each channel that has been low since the latch was cleared.

%00000101 (\$05) – This command sends a single byte indicating the current value of the high limit hysteresis value.

%00001001 (\$09) – This command sends a single byte indicating the current value of the low limit hysteresis value.

%00000011 (\$03) – Completely reboot the PAK X, starting with the initial conditions from EEPROM. This clears all registers to their initial states.

%00000111 (\$07) – Turns on the PAK X's clock output. The clock output varies depending on the number of channels selected and the average count.

%00001011 (\$0B) – Turns off the PAK X's clock output (the pin becomes a high impedance pin).

%000CCC10 – Sets the maximum channel number the PAK-X will include when scanning. With all channels set and no averaging, the PAK-X scans about 1000 times per second. Reducing the number of channels in the scan will increase the speed. Averaging, of course, reduces the speed.

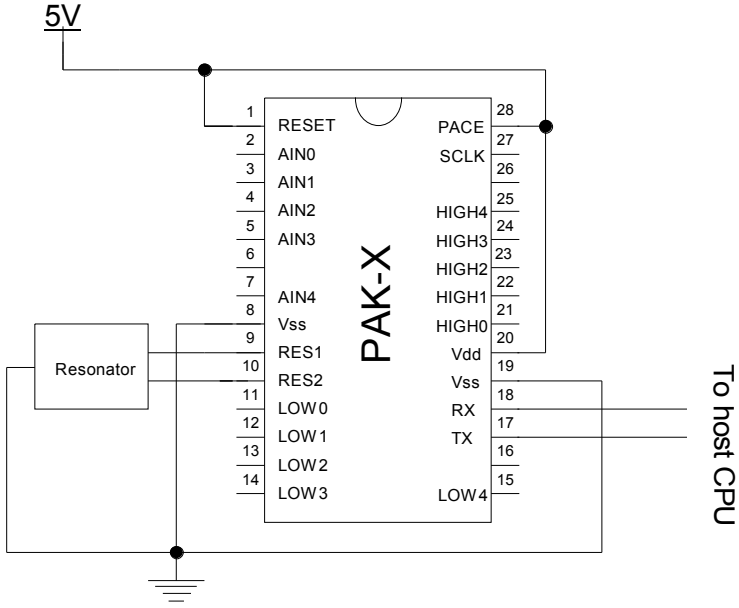
Software

If you are using the Basic Stamp II, IISX, or IIP, you can use the simple library included on the companion disk to work with the PAK-VIII. You'll need to change the pin and baud rate assignments to match your particular setup.

Here are the available subroutine calls:

Call	Arguments	Description
sendcmd	cmd, chan	Send specified command with optional channel
sendcmd0	cmd	Send command (automatically called by sendcmd when necessary)
sendvalcmd	cmd, chan, value	Send command that requires 10 bit value
sendvalcmd1	cmd, chan, value	Send command that requires byte value
readbyte	Returns in value	Read a single byte
readword	Returns in value	Read a word

Example Circuit



Frequently Asked Questions

Q: Can I use a different clock?

A: Yes, you can use a different ceramic resonator or crystal to change the speed of the PAK-X. Reducing the speed will reduce the power required, and also reduce the scan rate and the baud rate.

Q: How do I connect the resonator?

A: The middle pin is ground. The outer pins are interchangeable.

Q: Can I connect the PAK-X to a PC?

A: Yes, if you use an RS232 line driver/receiver such as the MAX232. Our RS-I kit will provide the required level conversions. You can also use a GPMPU28 PC board, although some trace cutting is required.

Specifications

Absolute Maximum Ratings

Ambient temperature under bias	-55°C to +125°C
Storage temperature	-65°C to +150°C
Voltage on VDD with respect to VSS	-0.3V to Vdd + 0.3V
Maximum current out of VSS pin	300mA
Maximum current into VDD pin	250mA
Maximum current to/from output pin	25mA
Maximum current to/from LOWn pins	200mA combined
Maximum current to/from HIGHn pins	200mA combined

DC Characteristics

Parameter	Minimum	Typical	Maximum
Supply voltage	4V	5V	5.5V
Vdd rise time on power up	.05V/ms	-	-
Supply current @ 5V/20MHz	-	7mA	15mA