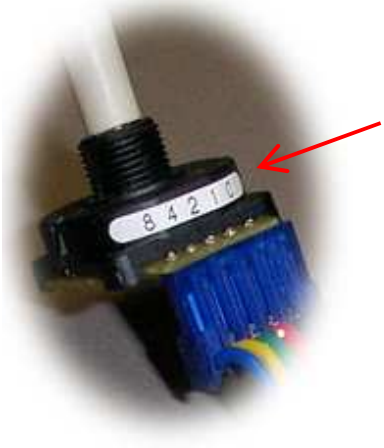
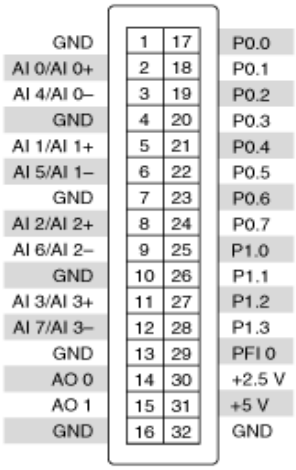
Hardware Example: Mechanical Encoder Digital Input

The images here show a Grayhill mechanical encoder connected to the digital I/O lines of an NI USB-6008 multifunction DAQ device. (Also shown are a number of LED's connected to the device, which will be used in subsequent exercises). The common pin labeled "C" is connected to a ground pin of the DAQ device, while the remaining pins labeled 1, 2, 4, and 8 (according to their bit significance) are connected to the first four lines of digital port 0 (see figures below).



Bit #0: $2^0 = 1$, connect to P0.0
Bit #1: $2^1 = 2$, connect to P0.1
Bit #2: $2^2 = 4$, connect to P0.2
Bit #3: $2^3 = 8$, connect to P0.3
C: "common," connect to GND

"Pinouts" for DAQ device



GND	1	17	P0.0
AI 0/AI 0+	2	18	P0.1
AI 4/AI 0–	3	19	P0.2
GND	4	20	P0.3
AI 1/AI 1+	5	21	P0.4
AI 5/AI 1–	6	22	P0.5
GND	7	23	P0.6
AI 2/AI 2+	8	24	P0.7
AI 6/AI 2–	9	25	P1.0
GND	10	26	P1.1
AI 3/AI 3+	11	27	P1.2
AI 7/AI 3–	12	28	P1.3
GND	13	29	PFI 0
AO 0	14	30	+2.5 V
AO 1	15	31	+5 V
GND	16	32	GND

As the post of the encoder is turned (usually connected to a knob), the internal construction switches the four output pins on and off in a pre-determined sequence. If the numeric values of the individual bits are added together when on, then a unique integer position number can be assigned to each position of the post. With four bits, a total of $2^4 = 16$ unique positions result, numbered from 0 to 15. Note that the encoder therefore acts as a sort of analog to digital converter, with the analog value being the angular position of the post, and the digital output being the sequence of bits. Also note that the resolution of the encoder is therefore $360° \div 16 = 22.5°$. Using the DAQ Assistant in LabVIEW, create a virtual instrument to display the on/off state of each bit with an array of LED's, and display the corresponding position number as well.