PCL451
Manual Preset Indexer

User's Guide

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Features

- **Internal Index Count Switches**
- **Pulse Rates up to 14,792 Pulses per Second**
- **CW and CCW Home, Hard, and Soft Limit Inputs**
- **Adjustable Motion “Complete” Output**
- **Motion “Busy” Output**
- **Clock Pulses and Step Direction Outputs**
- **CW and CCW Index Inputs**
- **CW and CCW Jog/Run and Fast Jog Inputs**
- **Two “Go to Home Position” Modes**
- **TTL-MOS Compatible**
- **Pulse and Reset Outputs and Coincidence Inputs for Interfacing with a 2 to 6 Decade Thumbwheel, Rotary Switch Assembly or Similar Device**
- **Index On The Fly**

Introduction

The PCL451 contains a manual preset indexer board. Figure 1 shows the general configuration and layout of a preset indexer system. The thumbwheel switch is used to set the index (number of steps or move distance) and the manual switches and/or PLC are used to initiate indexing, homing or jogging.

The manual preset indexer board utilizes the PI45 preset indexer integrated circuit (IC). Available functions include home, hard and soft limit inputs, two homing modes, jog/run, fast jog and switch selectable base speed, maximum speed, and acceleration/deceleration.

This board includes the necessary buffering and other circuitry for the PI45 chip that makes indexing easy. The board can be operated manually or with a programmable logic controller (PLC) to index a set of pulses determined by the internal count switches or an external count module, such as the AA1760-5 or similar device.

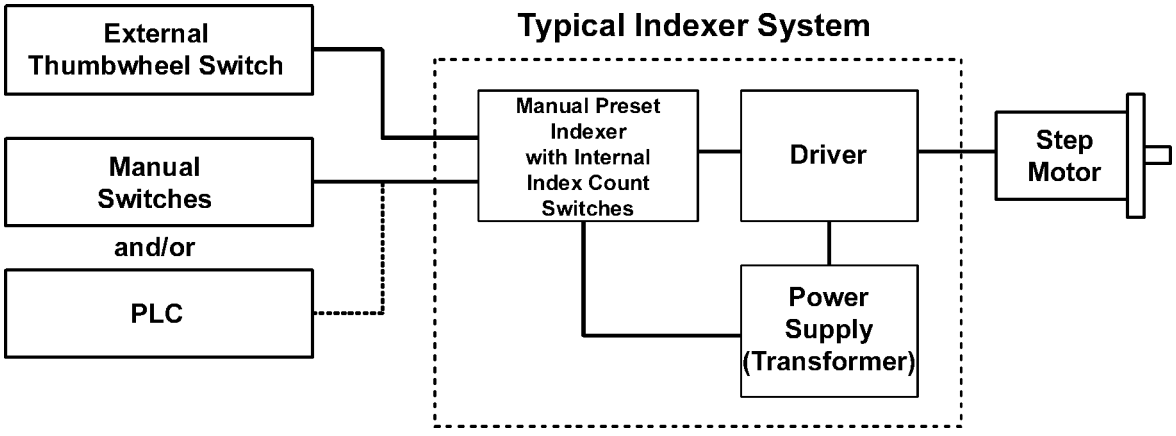


Figure 1: Typical Layout of a Preset Indexer System

The PCL451 Manual Preset Indexer is ideal for applications which are repetitive and require accurate positioning. Some areas where manual preset indexers are commonly used are:

- Robotics
- Machine Control
- Packaging
- Assembly Automation
- Fluid Control and Mixing Systems
- Table Positioning Systems
- Photographic Controls
- Custom Motion Control
- Feed to Position
- Feed to Sensor
- Cut to Length

Using the Manual Preset Indexer

Selecting Motion Parameters

The velocity profile (motion speed and acceleration) is determined by the four green switches; base speed, max speed, acceleration/deceleration, and factor. Figure 2 shows a typical velocity profile of a step motor.

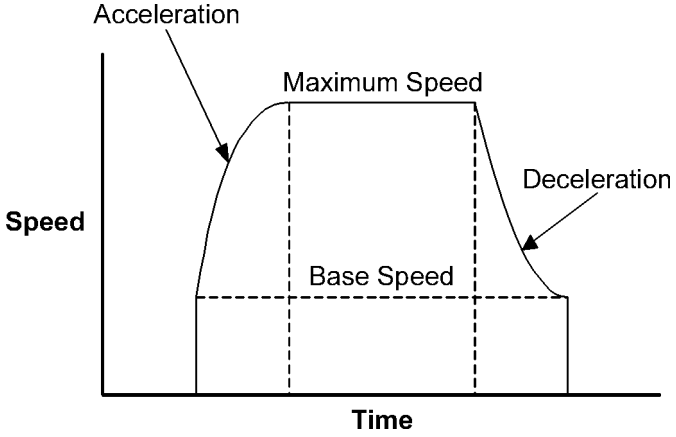


Figure 2: Velocity Profile of a Step Motor

Base Speed

This is the speed at which the motor starts to run. There are 256 choices of base speeds as shown in the Table 3. They range from 2 to 3611 steps/second.

Max Speed

This is the speed at which the motor ramps up to. As shown in Table 2, there are 256 choices available ranging from 163 to 14792 steps/second.

Acceleration/Deceleration

The step motor starts to accelerate after taking 4 steps at the base speed and continues until it reaches the selected maximum speed taking the number of steps set by A/D at each speed in the internally generated ramp table. A/D=0 is no acceleration (run at base speed only), A/D=1 is the fastest (minimum ramp time), and A/D=F is the slowest (maximum ramp time). The step motor starts to decelerate at the calculated point and continues until it reaches the selected base speed and stops.

Factor
The F switch should be set first because it directly affects the base and max speed. Table 1 lists the maximum obtainable stepping rates for all F switch settings with the maximum speed F.

F	Max (steps/sec)	F	Max	F	Max	F	Max
0	14792	4	4930	8	2548	C	728
1	9264	5	4266	9	1816	D	484
2	7165	6	3759	A	1411	E	366
3	5841	7	3360	B	946	F	246

Table 1: Maximum obtainable stepping rates for all F switch settings with the maximum speed F.

Example:
Assume that the motor is to run at a max speed of 4500 steps/second. It can be seen from the table above that this speed can be obtained with the F switch setting of 0 through 4. Any of these switch settings could provide speeds in excess of 4500 steps/second. The “rule of thumb” is to always choose the highest F switch setting that will provide the desired max speed, and also give the widest range for base speeds. In this example, F with a switch setting of 4 is the best choice.

Setting the M Switch
Now that we have selected the F switch setting, we can find the value for M from Table 2. The factor setting is in the left hand column, and the max speed setting is along the top row. In example 1, for the desired M of 4500 steps/second, we set the F switch at 4. Table 1 lists the maximum speed values for each switch setting of F. Looking at the M values in Table 2 for an F switch setting of 4, the closest speeds are 4495 (M=C) and 4631 (M=D).

For the desired maximum speed of 1200 steps/second (F=A) and M switch setting of A (1207 steps/second) or 9 (1173 steps/second) can be used. A speed of 13000 steps/second (F=0) requires an M switch setting of either A (12737 steps/second) or B (13102 steps/second).

Setting the B Switch
By choosing an F value, we restrict our choice of base speed to 16 possible values (see Table 3). In example 1, from maximum speed of 4500 steps/second (F=4) we can select base speeds ranging from 42 to 1223 steps/second. For the desired maximum speed of 1200 steps/second (F=A), the base speed can be chosen from a range of 11 steps/second to 339 steps/second. If due to the selection of the factor we are limited to a low base speed, it is possible to choose a lower factor and then choose the appropriate base and max settings. Thus, for maximum speed of 1200 steps/second, a Factor of 9 could also be used, giving the range of base speed 15 to 438 steps/second.

M Switch Setting Chart

F	0	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F
F	163	166	170	174	179	183	188	193	199	204	210	217	223	231	238	246
E	242	248	253	259	266	272	279	287	295	303	313	322	332	342	354	366
D	320	327	335	342	351	360	369	380	390	401	412	425	438	452	467	484
C	481	493	504	517	529	543	557	572	588	604	623	641	661	682	705	728
B	626	641	656	672	689	706	725	744	764	786	809	833	859	886	915	946
A	936	957	980	1004	1028	1054	1082	1111	1141	1173	1207	1242	1281	1322	1365	1411
9	1207	1234	1263	1293	1325	1358	1394	1431	1470	1511	1544	1601	1650	1702	1757	1816
8	1699	1737	1777	1820	1864	1911	1959	2011	2066	2123	2184	2248	2316	2388	2466	2548
7	2248	2298	2351	2407	2466	2526	2591	2658	2730	2805	2884	2968	3057	3152	3252	3360
6	2520	2576	2635	2697	2762	2830	2902	2977	3057	3141	3229	3323	3422	3527	3640	3759
5	2866	2930	2997	3067	3141	3218	3299	3384	3474	3568	3669	3774	3886	4005	4132	4266
4	3322	3397	3474	3554	3639	3728	3821	3919	4022	4132	4246	4367	4495	4631	4777	4930
3	3953	4040	4131	4227	4326	4431	4540	4655	4777	4904	5039	5181	5332	5491	5661	5841
2	4878	4985	5095	5211	5332	5459	5592	5732	5879	6033	6196	6368	6551	6743	6948	7165
1	6369	6504	6646	6793	6948	7110	7279	7456	7642	7838	8045	8263	8492	8734	8991	9264
0	9968	10190	10422	10664	10918	11185	11464	11758	12067	12393	12737	13102	13487	13895	14330	14792

Table 2

B Switch Setting Chart

F	0	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F
F	2	5	10	15	19	24	27	32	37	40	44	47	50	53	56	59
E	3	7	14	22	29	36	41	48	54	60	65	71	75	79	83	87
D	4	10	19	28	38	48	54	64	72	79	86	93	99	105	110	115
C	6	14	29	43	57	72	81	97	109	120	130	141	150	159	166	174
B	8	19	37	56	75	94	106	126	141	157	170	183	195	207	216	227
A	11	28	56	84	112	140	159	189	212	234	254	274	292	309	324	339
9	15	37	73	109	145	181	205	244	274	303	329	355	377	399	418	438
8	21	52	103	154	205	256	290	349	387	428	464	501	533	564	590	619
7	28	69	138	206	273	341	386	459	515	569	618	666	707	749	784	821
6	31	78	155	231	307	383	434	516	578	640	694	748	795	841	880	922
5	35	89	177	264	350	438	495	589	659	730	791	853	906	959	1003	1052
4	42	104	206	308	408	510	577	686	768	849	921	993	1054	1116	1167	1223
3	50	124	247	370	489	610	690	821	919	1015	1101	1187	1260	1333	1394	1460
2	62	154	309	460	610	761	860	1021	1143	1264	1368	1474	1565	1655	1730	1812
1	83	206	411	612	809	1009	1141	1352	1513	1671	1809	1947	2066	2181	2281	2389
0	124	310	617	919	1216	1519	1717	2038	2282	2520	2730	2939	3120	2957	3448	3611

Table 3

Homing Modes

There are two homing modes that may be initiated, H0 and H1.

H0 Homing Mode: This mode causes the motor to run at max speed in the direction selected. The motor runs until the nut encounters the soft limit switch, at which time the motor decelerates to the base speed. The nut continues to run at base speed until it hits the home limit switch. This may be illustrated by using a step motor driving a leadscrew as shown below. **Caution**: The two limit switches should be placed such that the nut after hitting the soft limit switch, has enough time to get to base speed before encountering the home limit switch.

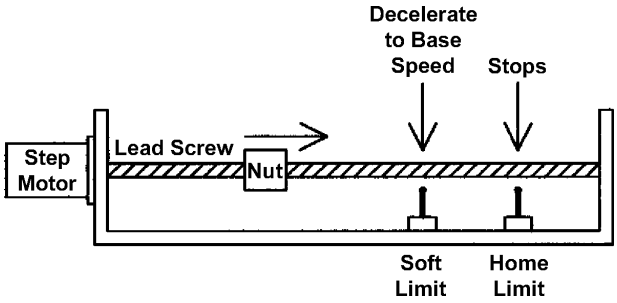


Figure 3

H1 Homing Mode: When this homing mode is selected, the nut seeks home at max speed. It decelerates to base speed when the soft limit switch is encountered. The soft limit switch must remain closed until the motor completely decelerates to base speed, at which time the controller causes the motor to reverse direction and run at base speed until the soft limit switch is no longer closed. This mode is illustrated below. This homing mode uses only one switch, but a flag is required to keep the switch closed during the deceleration cycle. If only a momentary switch closure is made, the motor will decelerate to base speed and stop. This stopping point may not be accurate or repeatable; making the flag is necessary.

1: Max Speed To Home

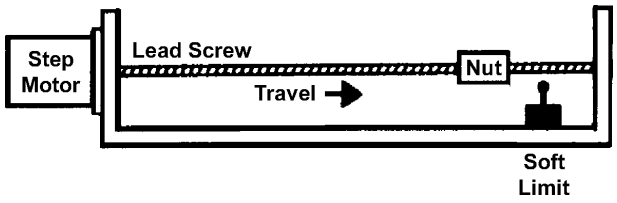


Figure 4

2: Starts To Decelerate to Base Speed

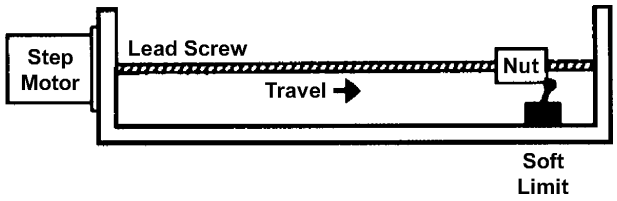


Figure 5

3: Decelerate to Base Speed and Change Direction

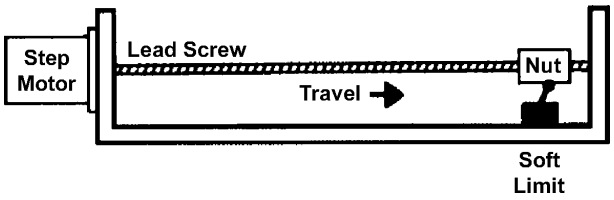


Figure 6

4: Run at Base Speed Until the Soft Limit Switch Is No Longer Closed

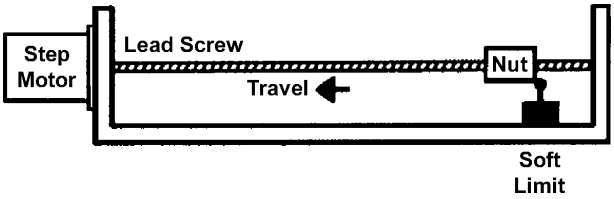


Figure 7

Setting the Move Distance

The index count or move distance for the PCL451 can be accomplished by a number of methods. The easiest way is to use the red switches labeled “Internal Index Number” on the unit. These switches are used by default. External count modules may also be used. These include the Click Pot Module (AA1748), the Thumbwheel Module (AA1760), the BCD Input Module (AA2210), and the Quad Board (AA1754). These modules set the distance of the move, but will allow for different variations in interfacing (see section on Count Index Boards).

Jumpers/Connectors

There are two jumpers on the manual preset indexer board. The first jumper, JP1, is used to set the debounce delay time for the jog, home, and index inputs. When JP1 is in the “1-2” position, the debounce delay is approximately 12.5 milliseconds. When JP1 is in the “2-3” position, the debounce delay is approximately 0.3 milliseconds. The active low signal on these inputs must be wider than the debounce delay time.

To use an external count module, the INT/EXT input (pin 13) must be pulled low to a logic “0”. The on-board switches will be ignored. External count modules plug into either connector labeled “External Count Module Connector” (P1 or P2). When only using one module for both forward and reverse indexes, jumper JP2 must be in the “1-2” position.

When using external count modules, it is possible to use one module for forward indexing and another module for reverse indexing. The connector P1 is for the forward count; the connector P2 is for the reverse count. When using two modules for different forward and reverse indexes, jumper JP2 must be in the “2-3” position.

Jumper Location/Function

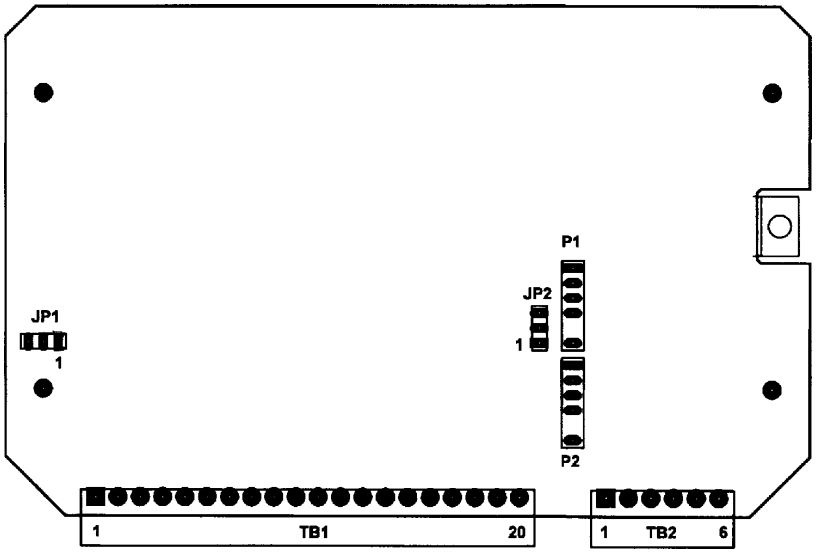


Figure 8: Jumper Locations

JP1	Debounce Input Delay
1-2	12.5 ms
2-3	0.3 ms

Table 4

JP2	External Count Modules
1-2	One Module (Same Forward and Reverse)
2-3	Seperate Modules for Forward and Reverse

Table 5

Terminal Pin Descriptions (P1)

Pin	Function	Description
1	-HARD LIMIT	When active low, this signal instructs the step motor to halt all motion in CCW direction.
2	+HARD LIMIT	Same as -HARD LIMIT except in CW direction.
3	-SOFT LIMIT	When active low, this signal instructs the step motor to ramp down to base speed and complete the move in the CCW direction. Input active during a -INDEX or -HOME function.
4	+SOFT LIMIT	Same as -SOFT LIMIT except in CW direction.
5	-HOME LIMIT	Used in H0 Homing Mode in conjunction with -SOFT LIMIT. Giving -HOME command (active low) causes motor to ramp to high speed in the CCW direction until -SOFT LIMIT is contacted. At contact, motor will decelerate to base speed and run until the -HOME LIMIT is contacted, at which time the motor will stop.
6	+HOME LIMIT	Same as -HOME LIMIT except in CW direction.
7	-JOG/RUN	A low level on this line causes the step motor to take one step in the CCW direction. Normally, the JOG/RUN inputs are manipulated by external push button switches. A single depression of the switch causes a "jog" operation, while holding the switch down for 0.5 seconds causes a "slow run" condition. This command may be used with FAST to perform a fast run at the base speed rate.

Pin	Function	Description
8	+JOG/RUN	Same as -JOG/RUN except in CW direction.
9	-HOME	A low level on this line instructs the step motor to move to the home position via the CCW direction. (See HOME SELECT)
10	+HOME	Same as -HOME except in CW direction.
11	-INDEX	When low, this signal causes the PI45 chip to read the current motion parameters and number of steps from the thumbwheel switches and command the motor to step the indicated distance in the CCW direction. (See -SOFT LIMIT). Note: If -SOFT LIMIT is encountered during an index, the motor will decelerate to base speed and complete the index.
12	+INDEX	Same as -INDEX, except in CW direction.
13	#INT/EXT	This input determines which set of switches will be used for counting. A logic "1" or open selects the Internal Index Count Number. A logic "0" selects the count of an external counter module.
14	HOME SELECT	This input selects the type of "Home" operation to perform: When active low, H0 Homing Mode is selected. It is a standard deceleration and stop on switch operation. In essence, type H0 is a combination of the HOME and SOFT LIMIT commands. When active high, H1 Homing Mode is selected. H1 is used for anti-backlash protection. It performs a decelerate, reverse, return off switch operation. Note: The switch must remain closed during deceleration, reverse, and return in H1 Mode.
15	FAST	When active low, it is used in conjunction with JOG/RUN to cause a fast run (base speed) operation in the specified direction.
16	BUSY	This open collector switch output is ON when the motor is moving. This output can sink 0.5A and stand off 40VDC maximum.
17	CLOCK	This output is an open collector output, 15 microseconds wide, (minimum) that is the clock input for the motor driver. It is buffered to assure adequate drive for an LS-TTL input.
18	0VDC	Ground (0VDC)
19	DIRECTION	This output is an open collector output. Clockwise (CW) motion causes this output to be active high, i.e. logic "1". Counterclockwise (CCW) motion causes this output to be active low, i.e. logic "0". This output tells the motor driver which direction to run.
20	COMPLETE	This open collector switch output turns on after the indexing cycle is executed. The pulse width (time that this output is on) is adjustable from about 12ms to 120ms (see table). This output can sink 0.5A and stand off 40VDC maximum.

Setting	Pulse Width	Setting	Pulse Width
1	12 ms	6	79.5 ms
2	25.5 ms	7	93 ms
3	39 ms	8	106.5 ms
4	52.5 ms	9	120 ms
5	66 ms	--	--

Table 6

Terminal Pin Descriptions (P2)

Pin	Function	Description
1	+5VDC	+5VDC Regulated Voltage Supply (Output/Input)
2	+12VDC Unreg	+12VDC Unregulated Voltage Supply (Output/Input)
3	0VDC	Ground (0VDC)
4	0VDC	Ground (0VDC)
5	9-12VAC IN	9-12VAC Voltage Supply Input
6	9-12VAC IN	9-12VAC Voltage Supply Input

Note: Refer to specifications section for power requirements.

PCL451 Dimensions

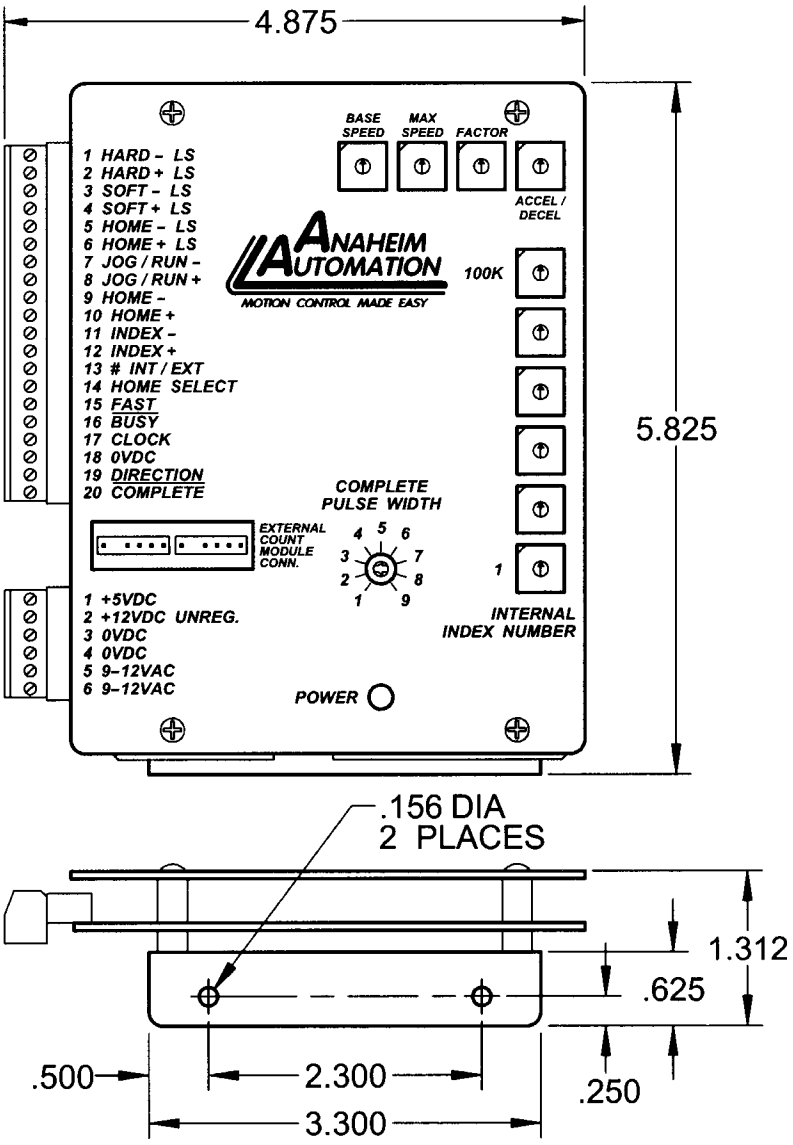


Figure 8: PCL451 Dimensions Drawing

Wiring Diagram

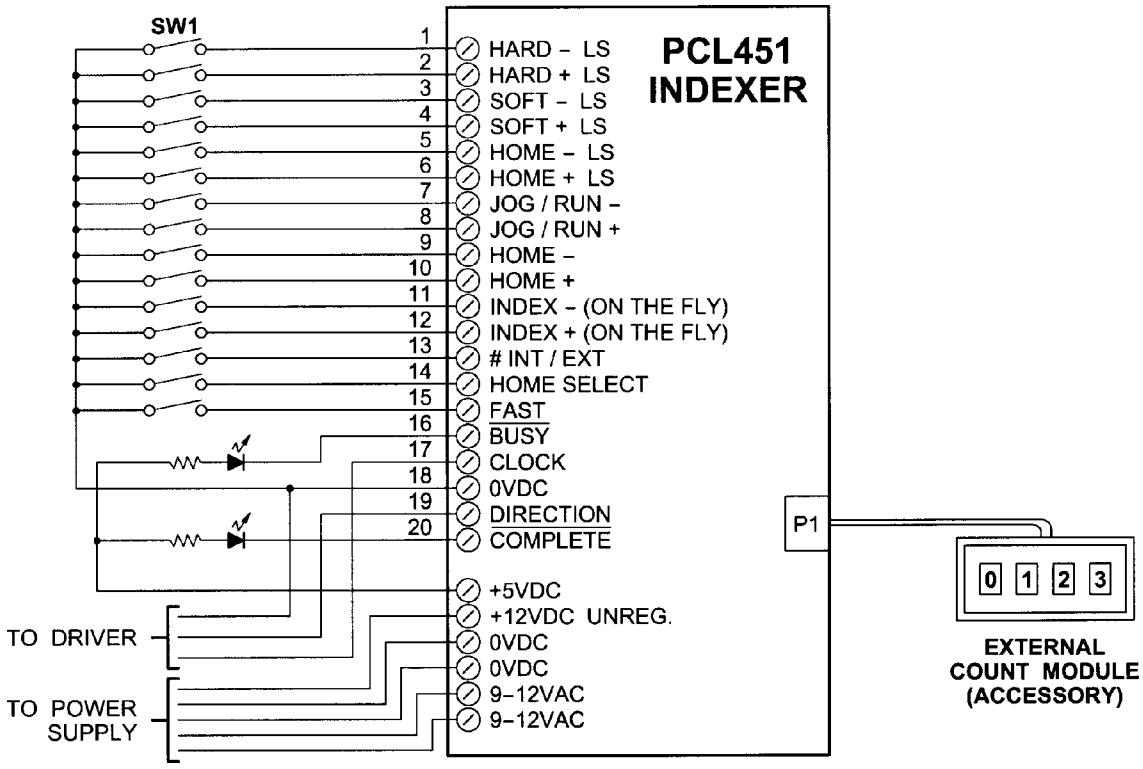


Figure 9: PCL451 Wiring Diagram

Specifications

Power Requirements:
The PCL451 can be powered three different ways. The most common is with 9-12VAC (TB2, pins 5 & 6). The second way to power the PCL451 is using voltages of +5VDC (TB2, pin 1) or +9VDC to +15VDC (TB2, pin 2). If the AC inputs are used then the +5VDC and +12VDC unregulated can be used as outputs. If the +9VDC to +15VDC is used then only the +5VDC can be used as an output. If +5VDC is used to power the board, then no output voltages are available. The +5VDC output can deliver up to 250mA and the +12VDC output can deliver up to 500mA. However the total current drawn from both pin 1 and pin 2 must not exceed 500mA.

Ambient Temperature:
0 to 50 degrees C

Control Inputs:
All Input Terminals are pulled up to +5VDC through 1k ohm resistors.

TTL-MOS Compatible
Logic “0”: 0VDC to 0.8VDC
Logic “1”: 3.5VDC to 5.0VDC

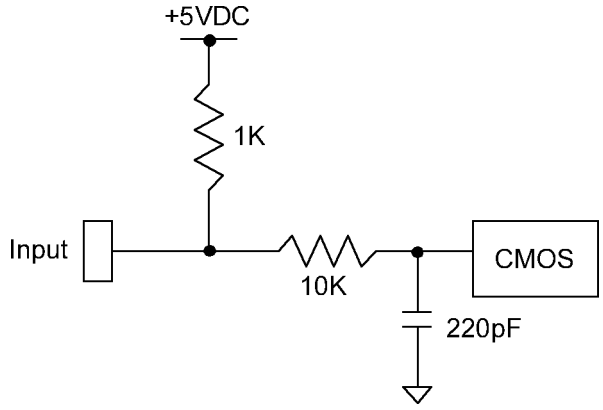


Figure 10

Busy and Complete Outputs:
These are open collector outputs that can sink 500mA and stand-off 40VDC maximum (no sourcing). Pull-up resistors may be added to these outputs to produce TTL level signals.

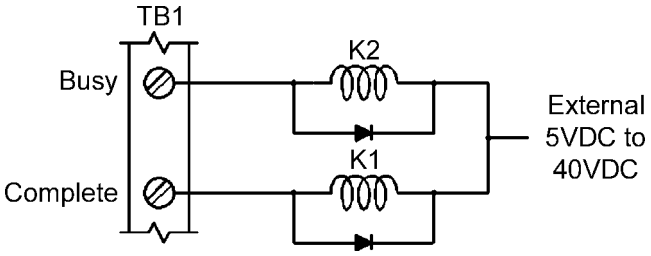


Figure 11: Busy and Complete Outputs

For typical applications, relays are used on the outputs Busy and Complete.
K1 will energize immediately after completion of an index cycle and remain energized for approximately an amount of time set by the “Complete Pulse Width” pot. K2 will be energized throughout an index cycle.

Index On The Fly

Index on the fly is a new feature on the PI45 that uses the existing Homing and Index inputs located on the DPD72451. Index on the fly allows the user to index an accurate preset distance after an input becomes active.

To implement “Index on the Fly” simply set a distance on either the internal or external switches and activate the homing input. While the PI45 is homing, pull the index input low and the motors will step the distance set on the switches.

Application Example:

Given an automated assembly line controlled by the PI45, packages come in at a set rate. Assume the required function is to stamp a set distance from the edge of the box.

Step A
Sensor #1 detects the leading edge of the box and is connected to the index input of the PI45. Homing the PI45 causes the assembly line to begin moving in the direction indicated below. As soon as sensor 1 detects the edge of the box, activating the index input, the PI45 will step the amount indicated on its counter switches and then stop.

Step B
A second axis receives a motion complete signal from the PI45.

Step C
The second axis triggers the stamp onto the box.

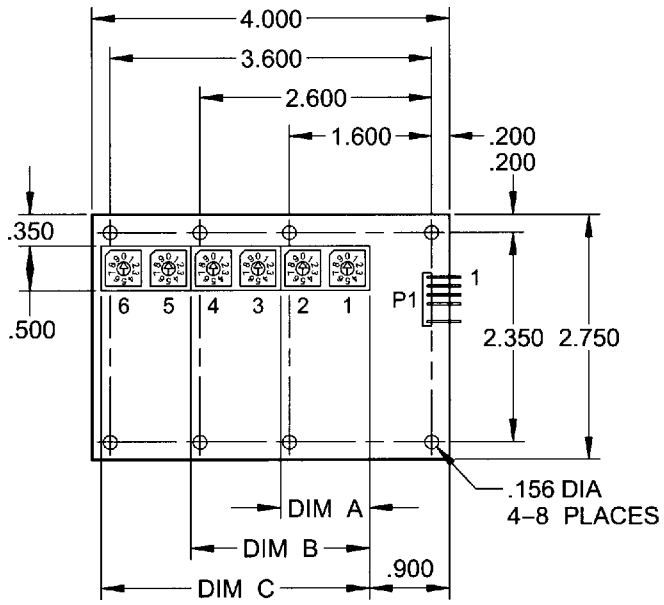
Step D
Sensor #2 detects completion of the stamping. Upon completion the homing input is again activated, repeating the process.

Count Input Boards

All of the count input boards or modules set the number of steps the motor will move when an index is initiated, but each module allows for a different variation in interfacing.

AA1748 - Click Pot Module

A ‘click pot’ module consists of 10 position (0 - 9) digital pots mounted on a printed circuit board. One pot is used per each decade (digit). These units are available in 2, 4, or 6 decades. The user dials in the step count on the pots. Any time the motor is indexed, it will move the number of steps set on the pots. One module is required per axis. The module is connected to the manual preset indexer via a 5 lead cable (supplied).



PANEL CUTOUT DIMENSIONS

MODEL NO.	DIM A	DIM B	DIM C
AA1748 – 2	1.000	X	X
AA1748 – 4	X	2.000	X
AA1748 – 6	X	X	3.000

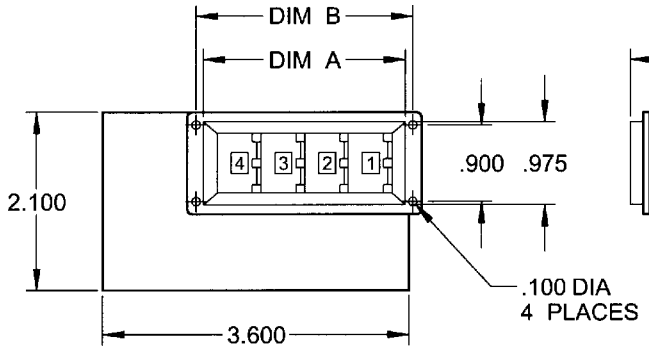
MAX. PCB LENGTH	
AA1748 – 2	2.000
AA1748 – 4	3.000
AA1748 – 6	4.000

NOTE:
IF UNIT IS TO BE MOUNTED TO THE BACK SIDE OF A PANEL WITH A CUTOUT FOR SWITCH ACCESS, USE A MINIMUM .375" SPACER FROM FRONT SIDE OF PCB.

Figure 12: AA1748 Click Pot Module Dimensions Drawing

AA1760 - Thumbwheel Switch Module

These thumbwheel switches provide an attractive way to input a step count. The user dials in the desired count on the thumbwheels, which can be mounted on an enclosure face. The module is available in 3, 4, 5, or 6 decades. The module is connected via a 5-lead cable (supplied).



PANEL CUTOUT DIMENSIONS

MODEL NO.	DIM A	DIM B
AA1760 – 2	1.420	1.590
AA1760 – 3	1.920	2.090
AA1760 – 4	2.420	2.590
AA1760 – 5	2.920	3.090
AA1760 – 6	3.420	3.590

Figure 13: AA1760 Thumbwheel Switch Module Dimensions Drawing

AA2210 BCD Counter Module

The AA2210 BCD counter interface module enables the user to select any move length from 0 to 999,999 steps using a standard PLC (programmable logic controller). Selecting the proper inputs creates a count value in steps, resulting in a move distance. The module is connected to the indexer via a 5-lead cable (supplied).

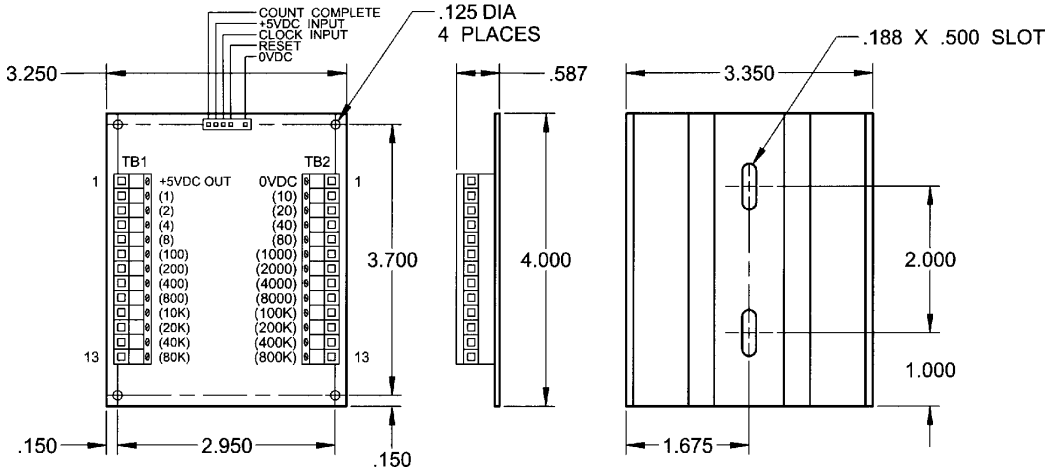


Figure 15: AA2210 BCD Counter Module DImensions Drawing

Note: All inputs are active low (0-0.8Vdc). All unused inputs may be ignored since they are pulled up.

Example: For a move distance of 1234 steps the following inputs should be pulled low.

1's Decade: Bit 4 (TB1, pin 4)
10's Decade: Bit 1 and 2 (TB2, pin 2 and 3)
100's Decade: Bit 2 (TB1, pin 7)
1000's Decade: Bit 1 (TB2, pin 6)

All other inputs must be open or high (3.5-5VDC).

AA1754 - Quad Board Counter

The quad board module is a 4-bank version of the click pot module with each bank having 6 decades. The user can "dial in" four different move lengths and then select any one of them as desired. The module is connected to the indexer via a 5-lead cable (supplied).

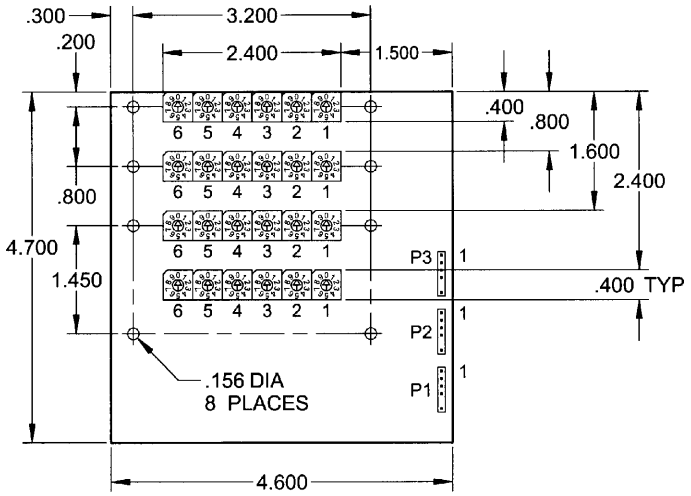


Figure 14: AA1754 Quad Board Counter Dimensions Drawing

Connector	Pin 1	Pin 2	Pin 3	Pin 4	Pin 5	Pin 6
P1 (To Indexer)	Common	+5VDC	Clock	Reset	Key	0VDC
P2 (Expansion)	Common	+5VDC	Clock	Reset	Key	0VDC
P3 (Select Inputs)	Select #1	Select #2	Select #4	Key	+5VDC	0VDC

Table 7

The selection of the switch banks is done by switching select lines 1 and 2 on connector P3. The select lines are “low true” meaning that if a select line is pulled low (to 0VDC), it is recognized as being “on” or “true”. When a select line is not pulled low it is internally “pulled up” to +5VDC and is “off” or “false”. The bank select lines must be set at least 1 millisecond before the index command is given. The select lines must remain in the set state until the index is complete. Once the move is finished, the select lines may be changed as needed.

0=LOW (0-0.8VDC), 1=HIGH (3.5-5VDC)

Bank Select	Select Line	
	#1	#2
Switch Bank #1	0	0
Switch Bank #2	1	0
Switch Bank #3	0	1
Switch Bank #4	1	1

Table 8

Select line #4 is only used if additional count input devices are “daisy chained” to the expansion connector (P2). If select line #4 is low, that quad board is ignored and the count input device connected to the P2 expansion connector is read. This allows multiple quad boards to be used together. The “daisy chained” count input device does not have to be a quad board, it could be a thumbwheel switch or click pot module.

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TECHNICAL SUPPORT

If you should require technical support or if you have problems using any of the equipment covered by this manual, please read the manual completely to see if it will answer the questions you have. If you need assistance beyond what this manual can provide, contact your Local Distributor where you purchased the unit, or contact the factory direct.