USER'S MANUAL

for the SMC35 Based

DPD72351

Programmable Preset Indexer

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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. Be sure to look in the TROUBLESHOOTING section located near the back of this manual. If you need assistance beyond what this manual can provide, contact your Local Distributor where you purchased the unit, or contact the factory direct.

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INTRODUCTION

The DPD72351 is a single-axis programmable indexer/ driver/ power supply package based on the SMC35 chip. All the necessary motion parameters can be programmed, including the maximum speed the motor will turn, the minimum or base speed, the acceleration rate, the deceleration rate, as well as many other parameters. Encoder feedback can be used to verify and auto-correct the motor position while under computer control. Eight outputs can be turned on and eight inputs can be read per axis. Several units can be daisychained together to provide up to 32 axes of control.

The DPD72351 can be controlled directly by a computer or can be programmed and then be set up to autostart as a standalone controller (without the computer). These two modes of operation are known as Direct Mode and Stored Program Mode. The DPD72351 can store a program 250 bytes long in its memory. This might not seem like a lot of memory, but it is usually more than enough. Since a program will not be lost after the unit is turned off, the user can write the program and then have the DPD72351 autostart that program on power-up.

This manual is intended to help the user apply the DPD72351 in motion control applications. Familiarity with computers, programmable logic controllers (PLC's), or terminals would be helpful, but is not essential. The user is expected to select the step motor and other machine requirements. Typical users range from programmers to machine designers, and this manual is written intending to be straightforward and yet technical enough for complex designs.

DESCRIPTION
Generally step motor controllers are open-loop systems, meaning that no information is sent back to the controller from the motor to verify the number of steps taken. A step motor is essentially a digital device. If the step motor driver receives 10 clock pulses, the motor will move 10 steps. Sometimes a closed-loop system is needed to verify that the motor indeed moved 10 steps. The DPD72351 will accept encoder inputs to form the closed-loop system. The encoder command can be used in conjunction with a computer to verify the position, and the computer can make any corrections that might be necessary.

The DPD72351 is designed to communicate over a RS232C or RS422 bi-directional serial data bus. The RS422 serial bus is better suited for industrial environment noise problems. RS422 can reliably travel to a distance of 4000 feet. The RS232C line can only be used to a distance of 50 feet in a noise free environment. Almost all computers have, or can be equipped with, an RS232 port. If you need to send your RS232C signal beyond 50 feet, Anaheim Automation offers a RS232C- to - RS422 Bidirectional Data Converter (Model DC1709).

The DPD72351 provides independent programming of acceleration, deceleration, base speed (start up speed), running speed, and the number of steps to be taken in both relative and absolute positioning modes. On absolute positioning moves, the DPD72351 automatically determines the proper direction to go and the number of

steps to take. The relative positioning will move a number of steps in the direction that the user defines. The DPD72351 has a high level command set which includes: looping, conditional statements, time delays, power down motor, encoder feedback, and maskable I/O.

Hard, Soft, and Home Limit Switch inputs are provided for each axis. These features are generally required in most machine control designs. Eight testable Inputs and eight programmable Outputs are provided per axis. These I/O may be used for monitoring and controlling machine operation and/or interaxis coordination. These I/O are accessible independent of the busy state of the axis controls. The 8 inputs are TTL/CMOS compatible. The 8 outputs are current sinking, open collector darlingtons.

The DPD72351 has a built-in programmable reset circuit so that all axes in the daisychain may be reset. The outputs are reset to the off state when the board is reset. Reset is automatic on power-up or with a "break" signal on the RS232 or RS422 input.

SMC35TRM Software for Windows 3.1 or Windows 95 is provided with a purchase of a DPD72351 the unit. This software allows the user to write and change programs that are to be stored in the DPD72351 for autostart use. The software also allows the user to save the programs onto a computer disk, and retrieve them when needed.

ORDERING INFORMATION
The table below lists a variety of products available from Anaheim Automation. These products include those covered by this manual, along with supporting cables and devices. Anaheim Automation is continually adding new products to our line, so please consult your nearest Authorized Anaheim Automation Distributor or Representative for information on the latest releases.

PART NUMBER	DESCRIPTION
PCL351	SINGLE-AXIS, PROGRAMMABLE INDEXER
PCL352	DUAL-AXIS, PROGRAMABLE INDEXER
PCL353	TRIPLE-AXIS, PROGRAMABLE INDEXER
DPD72351	SINGLE-AXIS DRIVER PACK WITH PCL351 SERIES PRO-GRAMMABLE INDEXER AND 300 WATT POWER SUPPLY
DPF72352	DUAL-AXIS DRIVER PACK WITH PCL352 SERIES PRO-GRAMMABLE INDEXER AND 600 WATT POWER SUPPLY

DPFEN353	TRIPLE-AXIS ENHANCED DRIVER PACK WITH PCL353 SERIES PROGRAMMABLE INDEXER AND 500 WATT POWER SUPPLY
AA2680	6 FOOT SERIAL CABLE WITH MALE AND FEMALE CONNECTOR
AA2681	20 PIN RIBBON CABLE CONNECTOR, 24 INCHES
AA2220	20 PIN RIBBON CABLE CONNEOR, 24 INCHES, FLYING LEADS
AA2M20	20 PIN BREAKOUT TERMINAL BOARD
TT1R2-1	HANDHELD TERMINAL

TABLE 1: ORDERING INFORMATION

SPEED CONSIDERATIONS
The SMC35 Integrated Circuit (I.C.) was created to handle speeds from 50 steps per second (sps) to 20,000 sps. When maximum speeds of 10,000 sps or less are anticipated, a few other I.C.'s are available that offer increased smoothness at these speeds (see Table Below). Contact your local distributor for information regarding the appropriate part number.

INTEGRATED CIRCUIT PART NUMBER	SPEED RANGE
SMC35	50 to 20,000 sps
SMC36	35 to 10,000 sps
SMC37	35 to 5,000 sps
SMC38	35 to 2,500 sps

TABLE 2: SMC35 VARIATIONS

SPECIFICATIONS

Power Requirements	105 - 125VAC Standard
	210 - 250VAC X250 Version
	Fuse @ 5 AMP Fast Blow

GENERAL:

Operating Temperature	0 to 60 degree C
Control Inputs	TTL-CMOS Compatible
Pulse Output Range	DPD72351: 50 to 20,000 pps
pps (pulses per second)	DPD72361: 32 to 10,000 pps
	DPD72371: 32 to 5,000 pps
	DPD72381: 32 to 2,500 pps
Inputs (TTL-CMOS)	Logic "0": 0 to 0.8 VDC
	Logic "1": 3.5 to 5.0 VDC

Outputs (CLK, DIR, PWR):   TTL-CMOS compatible
  Logic "0":   0 to 0.32 VDC, 4 mA
  Logic "1":   4.3 to 5.1 VDC, 4 mA

RS422 Input
  Logic "0"   -2 to -10 VDC, 1.5 mA
  Logic "1"   2 to 10 VDC, -2.5 mA
  sensitivity   200 mV

RS422 Output:
  Voltage Output High: 2.5 VDC min, 20 mA
  Voltage Output Low: 0.5 VDC max, 20 mA

RS232 Input
  Logic "0"   2 to 10 VDC, 1.5 mA
  Logic "1"   -2 to -10 VDC, -2.5 mA
  sensitivity   200 mV

RS232 Output
  Logic "0"   0.5 VDC max, 20 mA
  Logic "1"   2.5 VDC min, 20 mA

Encoder   Quadrature only
  Inputs   TTL-CMOS Compatible
  Power   5 VDC @ 100 ma Max.

Baud Rate: 50 to 9600 BAUD
Data Format: Half-Duplex, 1 start bit, 8 data bits, no parity, 1 stop bit

Outputs (8 programmable I/O): Open Collector Type
Maximum voltage: 40 VDC
Current sink: 500 ma (total, all on)
NOTE: For inductive loads, customers must connect the clamp input for fly-back protection.

COMMUNICATION GUIDELINES

COMMUNICATING WITH THE INDEXER

Anaheim Automation programmable indexers communicate by using the RS232C or RS422 standards. Most computers contain at least one RS232 serial port. Some industrial computers have a RS422 serial port. To communicate with the DPD72351, use connector P1 in Figure 1. P1 is used for either RS232 or RS422, and is set by sliding the two switches to the appropriate direction (see below), P1 is a DB9 Female. To communicate with subsequent axes, use P2, the RS422 output port. P2 is a DB9 Male, and is always set for RS422. The switches affect only the Input Port P1. The differences between the two types of communications are discussed below.
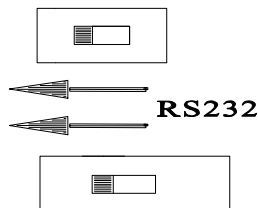
RS232

This serial communication mode is single ended. This means that for each signal there is one wire, and a common ground reference used by all the signals. For the 4 signals, RD, TD, CTS and RTS to be transmitted. RS232C requires 5 wires. The signal line maintains levels of +5VDC to +15VDC (LOW LOGIC INPUT) and -5VDC to -15VDC (HIGH LOGIC INPUT). The receiver for the RS232 looks for a voltage potential of +3 to +25 volts for a logic LOW, and -3 to -25 volts for a logic HIGH. For a valid logic level, the voltage must be +/-3 volts. RS232 works well at 9,600 baud over distances of 50 feet maximum. RS232 is susceptible to electrical noise, and should not be used in noisy areas. Always use the shortest cable connection possible.

Note: Keep control wiring separated from motor cable/wiring.

PIN #	FUNCTION	RS232 FUNCTION
2	RD	RD (RECEIVE DATA)
3	TD	TD (TRANSMIT DATA)
5	0VDC	SG (SIGNAL GROUND)
7	RTS	RTS (REQ TO SEND)
8	CTS	CTS (CLEAR TO SEND)

TABLE 3: RS232C 9 PIN CONNECTION (COMPUTER OR INDEXER)

PIN #	FUNCTION	RS232 FUNCTION
1	CG	CG (CHASSIS GROUND)
2	TD	TD (TRANSMIT DATA)
3	RD	RD (RECEIVE DATA)
4	RTS	RTS (REQ TO SEND)
5	CTS	CTS (CLEAR TO SEND)
7	0VDC	SG (SIGNAL GROUND)

**TABLE 4: RS232C 25 PIN CONNECTION (COMPUTER PORT)**

> **NOTE:** The Autostart function will not be activated while the switches are set to the RS232C mode. Place the switches to RS422 when autostarting the unit.

RS422

To talk to the DPD72351 in RS422 set the switches to RS422, and use P1. The RS422 serial communication standard is differential. This means that from each signal, there are two wires. For the 4 signals transmitted there needs to be 9 wires including the ground reference. The signal line maintains a voltage level of up to +12 volts on either line. The polarity of the line switches to obtain the logic levels. For example, if RD+ is more positive than RD- then it is a logic HIGH. If RD- is more positive than RD+, then it is a logic LOW. For a valid logic level, the voltage difference between RD+ and RD- needs to be greater than 200 millivolts. RS422 is unsusceptible to noise due to the differential lines. We normally specify a maximum of 9600 Baud at up to 4000 feet.

PIN #	FUNCTION	RS422 FUNCTION
1	SG	SG (SIGNAL GROUND)
2	CTS+	CTS (CLEAR TO SEND)
3	CTS-	CTS
4	TD+	TD (TRANSMIT DATA)
5	TD-	TD
6	RTS+	RTS (REQ TO SEND)
7	RTS-	RTS
8	RD+	RD (RECEIVE DATA)
9	RD-	RD

TABLE 5: RS422 9 PIN CONNECTION

RS422
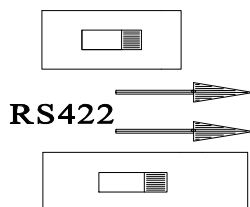
DTE vs DCE
There are two types of devices defined. The first is called DTE (Data Terminal Equipment). Examples of this would be a terminal, or an IBM Compatible Computer. The second type of device is a DCE (Data Communication Equipment). Examples of this would be a modem or an Anaheim Automation Indexer such as the DPD72351. DTE's have input pins of one type corresponding to output pins on the DCE's.

NOTE: THE SIGNAL NAMES ARE FROM THE POINT OF VIEW OF THE DTE (COMPUTER). FOR EXAMPLE: PIN 3 IS CALLED TD (TRANSMIT DATA) BY BOTH SIDES, EVEN THOUGH THE DTE (COMPUTER) SENDS IT AND THE DCE (DPD72351) RECEIVES IT.

With a DB9, a DTE (computer) transmits on pin 3 and receives on pin 2.
With a DB9, a DCE (DPD72351) transmits on pin 2 and receives on pin 3.

HANDSHAKING SIGNALS
There are two "handshaking" signals that we are concerned with; they are RTS and CTS. Some devices use these handshaking signals, and others do not. It is important to know if your device supports certain handshake signals. Anaheim Automation Indexers support both of these signals.

NAME	9 PIN	DIRECTION	FUNCTION
TD	3	DTE TO DCE	TRANSMITTED DATA
RD	2	DCE TO DTE	RECEIVED DATA
RTS	7	DTE TO DCE	REQ TO SEND (DTE READY)
CTS	8	DCE TO DTE	CLEAR TO SEND (DCE READY)

TABLE 6: PIN DESCRIPTION FOR RS232 WITH A DB9

THE COMPUTER IS THE DTE and THE INDEXER IS THE DCE

A MANNER OF SPEAKING
The communication signals supported by Anaheim Automation Indexers are: **RECEIVE, TRANSMIT, CLEAR TO SEND (BUSY), AND REQUEST TO SEND**.

The method in which the Computer and the Indexer communicate is as follows:
When the computer wants to send some information, it looks at the CTS (Clear To Send) line. This will inform the computer if the Indexer is ready to receive information. If a logic LOW is read (meaning it is clear to send), the computer will send information on pin 3, in which the Indexer will receive on pin 3.

When the Indexer receives data that requires some computational time, it will pull the CTS HIGH meaning it is not clear to send data.

When the Indexer is ready to send something to the Computer it looks at the RTS signal which will inform the Indexer if the Computer is busy. If the RTS is low then the Indexer will send information on pin 2, which will be received by the Computer on pin 2 also.

RTS DEFINED
On the DPD72351, there is an option to either enable, or disable the RTS. If RTS is enabled, then the above description applies. If RTS is disabled, then when the DPD72351 wants to send information to the Computer, it will send it without looking at the RTS line. This is used when the computer does not support the RTS line.

CTS DEFINED
The CTS line must always be supported. No information should be sent to any indexer unless the CTS line is low. Otherwise the data sent may be lost, and the indexer could possibly stop communicating.

PIN #	FUNCTION	RS232 FUNCTION
1	CG	CG (CHASSIS GROUND)
2	TD	TD (TRANSMIT DATA)
3	RD	RD (RECEIVE DATA)
4	RTS	RTS (REQ TO SEND)
5	CTS	CTS (CLEAR TO SEND)

TABLE 7: RS232C 25 PIN CONNECTION (COMPUTER PORT)

NOTE: THE SIGNAL NAMES ONLY MAKE SENSE FROM THE POINT OF VIEW OF THE DTE. FOR EXAMPLE: PIN 3 IS CALLED TD (TRANSMIT DATA) BY BOTH SIDES, EVEN THOUGH THE DTE SENDS IT AND THE DCE RECEIVES IT.

HOOKUP INFORMATION

This section applies to all models covered by this manual. The DPD72351 Series Indexer has several connectors that can be used for communication, and several Detachable Terminal Blocks that can be used to integrate switches, sensors, encoders, and other items to the Indexer.

LIST OF CONNECTORS
There are several connectors in which the user must become familiar with. These connectors include communication to the indexer, limit switch terminal block, and encoder terminal block.

FUNCTION	CONN #	TABLE	TYPE
RS422 Input	P1	Table 3	DB-9 female
RS232C Input	P1	Table 1 & 2	DB-9 female
RS422 Output	P2	----------	DB-9 male
Encoder Input	J4	Table 11	4 pin T.B.
Limit Switches	J7	Table 9	20 pin T.B.
Inputs/Outputs	J9	Table 10	20 pin header
Handheld Terminal	J1	---------	RJ11 Socket

TABLE 9: LIST OF CONNECTORS FOR THE INDEXER
Refer to Figure 2 for location of connectors.

JUMPER	JUMPER SETTING	FUNCTION
JP1	1-2	SELECT AXIS ADDRESS NUMBERS G - V
	2-3	SELECT AXIS ADDRESS NUMBERS 0 - F

HANDHELD TERMINAL

The Handheld Terminal is a RS-232 Serial communications device, operating on +5Vdc. To order this unit, use part number TT1R2-1.

PIN #	DESCRIPTION	PIN #	DESCRIPTION
1	+5 VDC input	4	Receive Data
2	Request to Send	5	Transmit Data
3	Clear to Send	6	0 VDC Return (Common)

TABLE 11: Standard pinout for TT1R2-1
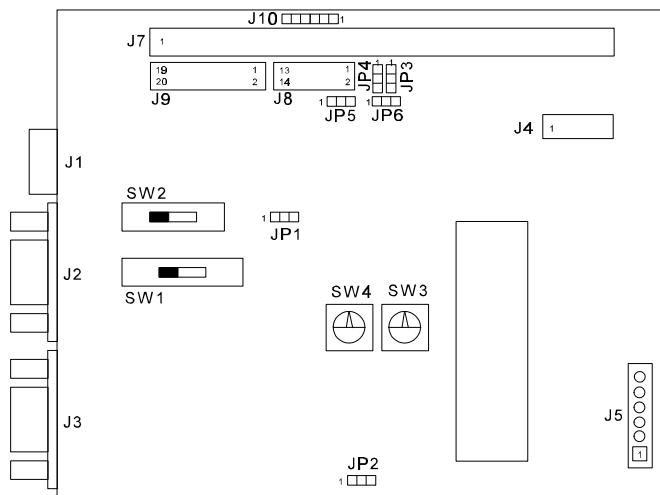
FIGURE 2: DPD72351 SERIES INDEXER PHYSICAL LOCATIONS

AXIS SELECTION

Each DPD72351 can be set to 1 of 32 possible axis numbers. This can be changed by turning the axis rotary switch, SW3 to the appropriate position. For axes greater than "F", internal jumpers, JP11, 15 & 16 must be changed. For axes 0 through "F", the jumper should be across position 2 and 3. For axes "G" through "V", the jumper should be across position 1 and 2. Refer to Figure 1 on page 9 for the placement of the switch and jumper.

INDEXER TERMINAL BLOCK

The Indexer Terminal Block connector contains three INPUTS (#0-#2), three OUTPUTS (#0-#2), Limit Switch inputs, and Jog inputs. Table 9 shows the pin connections of the Indexer's Detachable Terminal Block.

PIN #	FUNCTION	COMMENTS
1	HOME / (DIRECTION OUTPUT) **	ACTIVE LOW
2	HOME	ACTIVE LOW
3	SOFT / (CLOCK OUTPUT) **	ACTIVE LOW
4	SOFT	ACTIVE LOW
5	HARD +	ACTIVE LOW
6	HARD -	ACTIVE LOW
7	INPUT 2	*HIGH = 4
8	INPUT 1	*HIGH = 2
9	INPUT 0	*HIGH = 1
10	FAST	ACTIVE LOW
11	JOG +	ACTIVE LOW
12	JOG -	ACTIVE LOW
13	OUT 0	*HIGH = 1
14	OUT 1	*HIGH = 2
15	OUT 2	*HIGH = 4
16	O VDC	REFERENCE

TABLE 9: INDEXER TERMINAL BLOCK CONNECTOR
*BINARY WEIGHT
**JUMPER SELECTABLE

DAISYCHAINING

The output of one DPD72351 module can be connected to the input of a subsequent module, making it possible to daisychain up to 32 axes of DPD72351 controllers. The DPD72351 can be manually reset by holding the RTS line at 0Vdc for approximately 0.5 seconds. The RS422 output port, P2 is connected to the subsequent model's RS422 port, P1. A standard 9 pin cable (AA9MFC-9) can be used, and is available from Anaheim Automation. This can also be done by sending a "break" signal to the unit. In many communication programs, this can be done by the HOME key.

LIMIT SWITCH INPUTS

The Limit Switch Inputs are internally pulled up by a resistor making them normally +5 volts. To activate the input, the pin must be grounded to pin 16 (0 VDC) on the terminal block. For an explanation of Home, Soft, and Hard Limit Switches, see the description of the Home command in the Command Dictionary and the Glossary. Figure 5 is a hookup example for a system using Soft \Limit and Home Limit Switches.
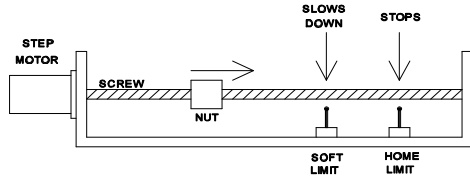

FIGURE 5: HOME TYPE "0" SETUP

HOME TYPE "0" CONFIGURATION

Using Home Type "0" requires two grounding type limit switches called HOME and SOFT. The first limit switch SOFT will decelerate the motor down to base speed. It will continue to run at base speed until it receives a HOME Limit Switch input causing the motor to stop. The HOME Limit Switch only activates after a SOFT Limit is sensed. These switches are not directional, meaning that they will work in either direction. The SOFT Limit Switch will work for any type of motion. The HOME Limit Switch will work only for HOME motions.

NOTE: Whenever a SOFT Limit Switch is activated, the motor will decelerate and run at base speed. Be sure to come back passed the SOFT Limit Switch to set any origins, otherwise the motor will decelerate as it goes passed the Soft Limit Switch.

HOME TYPE "1" CONFIGURATION

This type of homing differs from Home Type "0" in that only one Limit Switch is needed. The HOME Limit Switch in this case causes the motor to ramp down to Base Speed, reverse direction and continue until the Limit Switch is released. This is a good way to compensate for any backlash in the system. It is also useful for minimizing the number of limit switches needed for homing.
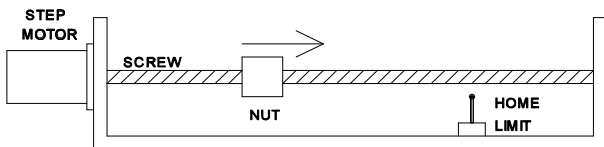

FIGURE 6: HOME TYPE "1" SETUP

PROGRAMMABLE INPUTS AND OUTPUTS

Eight general purpose inputs and outputs are provided per axis. The inputs may be used to initiate a machine cycle, for inter-axis coordination (in stored program mode), for operator intervention, for sensing a machine condition such as out of stock, or to wait for temperature to be reached. Outputs may be used to operate coolant valves, air cylinders, relays, or, with the right interfacing, any electrically controlled device. Pin assignments are listed in Table 10.

PIN #	FUNCTION	PIN #	FUNCTION
1	+5VDC	11	OUTPUT #4
2	CLAMP INPUT	12	INPUT #4
3	OUTPUT #0	13	OUTPUT #5
4	INPUT #0	14	INPUT #5
5	OUTPUT #1	15	OUTPUT #6
6	INPUT #1	16	INPUT #6
7	OUTPUT #2	17	OUTPUT #7
8	INPUT #2	18	INPUT #7
9	OUTPUT #3	19	0VDC REFERENCE
10	INPUT #3	20	0VDC REFERENCE

TABLE 10: INPUT/OUTPUT CONNECTOR

Note: For inductive loads, customers must connect the clamp input in order to provide adequate fly-back protection. *Input wiring should be kept separate from step motor wiring.*
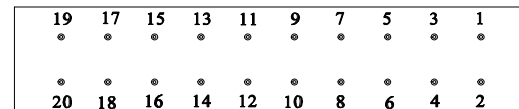

FIGURE 7: I/O HEADER

The 8 inputs and 8 outputs are available on a 20 pin male header type connector (P5). The first 3 inputs and outputs are also brought out to the terminal block (P9, 10 & 11) for easy access, see Table 9. The inputs are TTL compatible. Since the inputs have on-board pull up resistors, all that is required for a signal is a switch closure to ground (0VDC). With zero volts on the input, the pull up resistor source current is approximately 5 mA.

These outputs can drive all types of common peripheral power loads, including lamps, relays, solenoids, LEDs, printer heads, and heaters. For inductive loads, it will be necessary to connect the Clamp input as indicated in Figure 6. The outputs can also be used as drivers for higher power loads requiring discrete power semiconductors. The outputs are current sinking, open collector darlingtons. They are capable of sinking up to 150 mA per output but not more than 500 mA total when all 8 outputs are on, with voltages up to 40 VDC.

ENCODER INPUTS
A Rotary Encoder is a device that measures rotation of a shaft. In the case of a step motor shaft, the encoder may also be mounted on the load for a true position. The encoder sends signals in a format called quadrature to the controller, which will take this data and use it to verify the motor position. The encoder has four wires: Power, Ground, Channel 'A', and Channel 'B'. These lines should be connected to the DPD72351 via Terminal Block P3. The encoder can be used with the DPD72351 to form a closed-loop system when it is used with a computer. The stored program mode does not allow the use of the encoder. See the CP function on page 14 for more information.

PIN	FUNCTION	COMMENTS
1	+5 VDC	ENCODER POWER
2	CHANNEL A INPUT	ACTIVE LOW
3	CHANNEL B INPUT	ACTIVE LOW
4	GROUND (0 VDC)	ENCODER GROUND

TABLE 11: ENCODER TERMINAL BLOCK

JOG INPUTS
Jog is a manual function. The user can select the direction and speed (fast or slow) by grounding the appropriate combinations of inputs on a particular axis. These inputs are located on the Detachable Terminal Block (P4). To jog a motor, it is necessary to ground the Jog input on that axis for the direction (+ or -) desired. For Fast Jog, both the Fast and Jog command for the appropriate direction must be low at the same time. The first closure of Jog causes just one step. In order to get a continuous stream of pulses, the Jog input must be held low. The actual Jog rates can be programmed. Fast Jog is simply the Base rate. The Jog Factor command is used to determine the slow jog rate by dividing the Base speed by the jog factor. The position register will keep track of the number of steps that are taken during jogging.

EXAMPLE: If you have a Base speed of 400 pulses per second and a Jog factor of 5, then the Slow Jog Speed will be:

Jog Speed = 400/5 = 80 pps
Fast Jog = 400 pps

Note: Encoder and Jog input wiring should be kept separate from step motor wiring.

Once a +Jog or -Jog function has been performed, the direction register will retain the last direction of movement; that is, a subsequent Go command will be in the same direction as the last jog command.

HARD LIMITS
When a Hard Limit switch is encountered, the motion will stop. The position counter will also cease counting. Hard Limits are intended as an emergency stop for your system. It should not be used to do any indexing type functions; use the limit switches for this.

BAUD RATE
The Baud Rate is the transfer rate of the serial communications; how fast the ASCII Data is sent over the transfer lines. The number specifies the number of bits that are sent per second. With a baud rate of 9600, 9600 bits of information are sent in one second. For standard communications (like the DPD72351), there is one start bit, one stop bit, and 8 data bits. This means that for every ASCII Character 10 bits are sent, so for the 9600 Baud Rate, 960 ASCII Characters will be sent every second. The Baud Rate is selected by adjusting the Baud Rate Rotary Switch (SW4 in Figure 1). This switch not only determines the baud rate, but also sets the parameter RTS, for communication with your computer. Table 3.8 shows the position of the switch for the corresponding baud rates. If you are not sure if your computer uses RTS, the trial by error method works best, or you can refer to your software manual. Most IBM PC compatibles will work with either RTS ON or OFF.

BAUD RATE	SWITCH POSITION	
	RTS ON	RTS OFF
75	0	8
150	1	9
300	2	A
600	3	B
1200	4	C
2400	5	D
4800	6	E
9600	7	F

TABLE 12: BAUD RATE SWITCH

SMC35 Programmable Indexer Disks

Included with the DPD72351 is the SMC35 Programmable Indexers Disks. These disks contain all of the software needed to run the indexer via a PC. Also included in the disks are examples programs that can be downloaded into the indexer. This software requires a minimum system of a 486/66MHz processor with 8Mbytes of RAM and Windows 3.1. Running the Setup.exe from disk 1 of the SMC35 Programmable Indexer Disks will install the software into the directory of choice. After running the setup.exe the following files should be found in the directory of installation:

smc35trm.exe
config.ldb and .mdb
temp.ldb and .mdb
sample1.ldb and .mdb
b_sample.ldb and .mdb
vb_smple.ldb and .mdb

SMC35TRM Software - DPD72351 STORED PROGRAM GENERATOR
The easiest way to program the indexer is to use the smc35trm.exe software provided. The SMC35TRM software allows three different modes of communication between the Indexer and the PC.

Motion Tab

Under this heading, the user is allowed to directly send motor parameters and commands. Motor parameters are simply entered in the appropriate space and then sent to the indexer by clicking the corresponding button. The parameters can then be verified by clicking the Verify Parameters button.
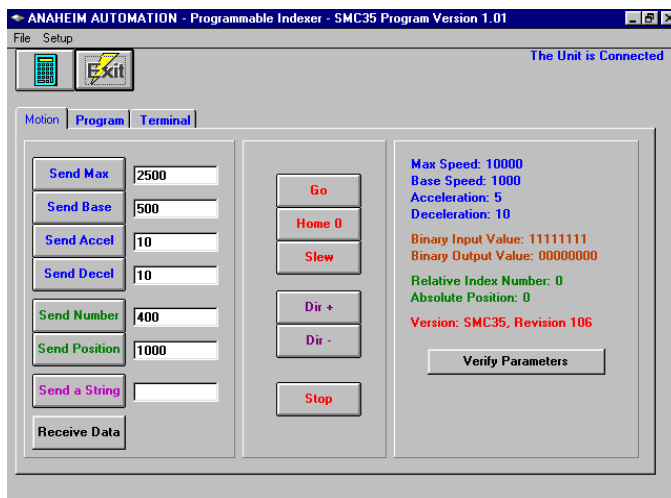

Figure 8. Motion Tab

Program Tab

In the Program tab (see Figure 7), programs can be composed, sent to the indexer, and then verified. Existing program in the indexers memory can also be read, saved, edited, and re-written to the indexer.
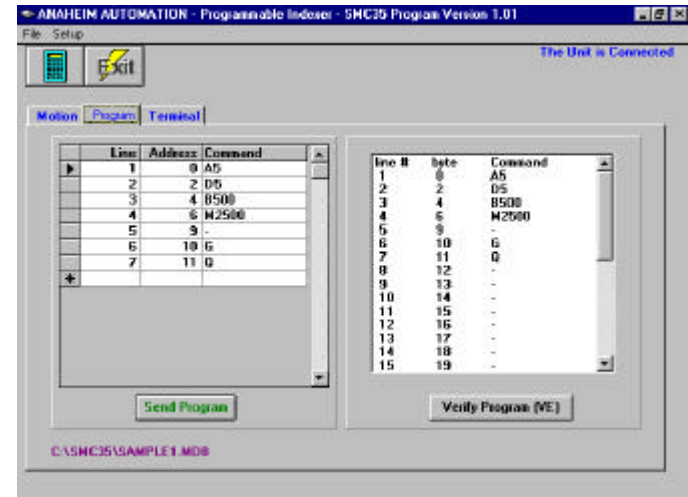

Figure 9. Program Tab

Terminal Tab
The Terminal tab allows the PC to act like a handheld terminal. Here commands can be sent to the indexer directly.
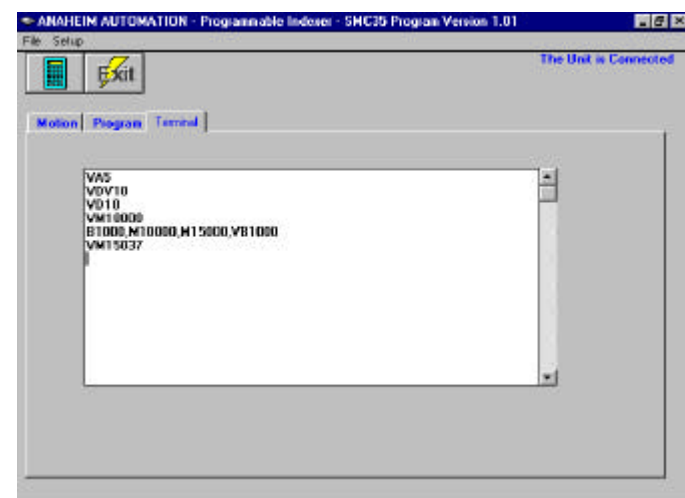

Figure 10. Terminal Tab

PROGRAMMING

COMMANDS
Commands are sent to the DPD72351 by a computer, dumb terminal, or handheld terminal. These commands must be sent in ASCII by a RS232 or RS422 communications format. RS232 is used most commonly by computers. Commands are made up of one or two letters, possibly followed by one or more numbers. All letters are upper case 8-bit ASCII characters with the most significant bit ignored. All numbers are ASCII sent with the most significant digit first. Spaces can be imbedded with no effect. A comma, carriage return or line feed are accepted as terminators for a previous command.

INTERNALLY STORED PROGRAMS
A stored program is a sequence of commands stored in an external EEPROM of the DPD72351. The EEPROM can hold 250 bytes of code. More than one program can be stored by entering the first program byte in a buffer location following the last byte of the preceding program. Each program may be run independently by sending the Run command with that program's first byte buffer location. To stop the execution of an internal program the Period (.) command is used.

The Enter command itself uses no program buffer locations. All programs are terminated by a Quit (Q) command which uses one location. Terminators (comma, carriage return, and line feed), spaces, and illegal commands do take up any buffer location. See page 20 for a listing of the number of bytes used for each command. One buffer location is one byte.

It should be noted that any parameters stored directly will be used by a program without the need to reenter that parameter within the program. Any parameter can be changed within the program. A parameter will have the value last specified whether specified directly or by a statement executed within a program.

PROGRAMMABLE RESET
The DPD72351 units have a built-in programmable reset circuit so that all axes in the daisychain may be reset. The outputs are reset to the off state when the board is reset. Reset is automatic on power-up.

From most communications programs, this reset can be sent by pressing the Home key. This reset holds the DPD72351's receive (Rx) line low, and will reset the board for a time which is determined by the baud rate setting. The amount of time required can be calculated by the following formula.

$$T(reset) = 64/baud\ rate\ (seconds)$$

COMMAND	CODE	MODE	DESCRIPTION
Acceleration	Axx	Both	set acceleration
Base Speed	Bdddd	Both	set base speed
Holding Current	CHxx	Direct	set time motor is on after index
Set Autostart	CSzz	Direct	set autostart flag at address zz
Encoder Position	CPrrrrr	Direct	set encoder position
Deceleration	Dxx	Both	set deceleration
Enter Program	Ezz	Direct	enter program at address zz
Finish Move	F	Direct	finish index then continue
Go	G	Both	begin motion
Home	Hx	Both	find home position
Inputs	Ixx,yy,zz	Stored	if inputs, as defined by mask xx are equal to yy then goto zz
Jog	Jxx	Both	set jog rate factor
Loop	Lyy,zz	Stored	loop back yy times to location zz
Maximum Speed	Mdddd	Both	set maximum speed
Number of Steps	Nrrrrr	Both	set number of steps to move
Outputs	Oxx,zz	Both	output zz as defined by mask xx
Motor Position	Prrrrr	Both	set next absolute position
Quit	Q	Both	quit entering program or stop motion
Run	Rzz	Both	run stored program at address zz
Slew	S	Direct	slew motor
Trace	T	Direct	single step through the program
Until	Uxx,yy,zz	Stored	if inputs, as defined by mask xx are not equal to yy then goto address zz

Verify	V	Direct	verify specified data
Wait	Wxx	Both	wait for a period of time in (.01 sec increments)
Continue	X	Direct	continue internal program
Zero	Zrrrrr	Both	set position register
Select Axis	@c	Direct	select axis or axes
Clockwise	+	Both	select CW direction
Counterclockwis	-	Both	select CCW direction
Messages	%	Direct	pole axis for message
Identify Version	?	Direct	return revision and type
Stop All Motion	.	Direct	stop motion and stored program

TABLE 13: COMMAND SUMMARY

-Direct means the command is used only with a computer, or terminal.

-Stored means the command is used only in the stored program.
-Both means either the Direct or the Stored mode.

c	character	Character = 1 byte
x	0 byte	0 or 1 (HOME only) = 0 byte
xx	1 byte	0 - 255 = 1 byte
yy	1 byte	256 - 65,535 = 2 bytes
zz	1 byte	65,536 - 16,777,215 = 3 bytes
dddd	up to 2 bytes	
rrrrr	up to 3 bytes	

When using the DPD72351 in the stored program mode, the user must keep track of how many bytes each command uses and the addresses of each command. When using the Anaheim Automation SMC35TRM software that comes with the unit, byte counting is done automatically. The chart below can be used to determine the byte count for each

Number Range	Byte Count
1 - 255	1
256 - 65,535	2
65536 - 16777215	3
ASCII character	1

TABLE 14: ASCII BYTE COUNT

command.

NOTE: A comma is not considered as a character therefore it has 0 byte.

Examples:
A5   requires 2 bytes, 1 byte for A, 1byte for 5
M10000   requires 3 bytes, 1 byte for M, 2 bytes for 10000
G   requires 1 byte
H1   requires 1 byte

Example Stored Program:
The procedure to enter a stored program from a terminal is as follows:

.@0,E0,A10,D10,B500,M2000,N400,+G,W10,R0,Q,[ENTER]CS0,

.@0,E0,   = selects axis 0 and starts program at byte 0
A10,D10,B500,M2000,   = sets up the speed parameter
N400,+G,   = set index to 400, + direction, start motion
W10,R0,Q,   = wait 100ms, goto byte 0, end of program
[ENTER]CS0,   = exit enter mode, autostart the program at location 0

Note: Upper Case characters must be used

Now whenever the unit is turned on the program will automatically start at bit location 0.

COMMAND DICTIONARY

A (2 to 127) The **ACCELERATION** command controls the time that the motor will take to move from base speed to maximum speed. The higher the value, the slower the motor will accelerate. The default value is 5.

B (50 to 3500) The **BASE SPEED** is the speed at which motion starts and stops. It is entered directly as the number of steps per second. This is also the stepping rate in the Fast Jog Mode. Not all base speeds will be possible.   On the computer, if you enter "B2455", and then "VB", the DPD72351 would return a speed of 2466. A verify of this parameter will return the actual base speed obtainable by the unit. The closest base speed possible is always chosen. The default value is 1000.

CH (0 to 127) The **HOLDING CURRENT ON/OFF** command sets the time that the motor will be supplied holding current after a move. The number entered is in 0.01 second increments. If the value of CH is 0 then the power is left on indefinitely. If you enter "N1000,CH115,+G" the motor will go 1000 steps, stop, and remain energized for 1.15 seconds. The default value is zero.

Note: A sufficient value for CH is needed to allow the mechanical system to stabilize - if the value is too small, errors might occur.

CP (0 to 16,777,215) The **ENCODER POSITION** command sets the encoder position to a designated value. If you enter "CP100000," the encoder position will be set to 100,000. A 400-line, quadrature encoder will count 1600 steps for every revolution the motor takes. If you then move 400 steps clockwise (one full revolution half-stepping in the clockwise direction) then enter "VCP" the new encoder position will be 101600. The Encoder Position cannot be used in the stored program mode, but can effectively be used when interfaced with a computer.

$$\text{\# of encoder counts per step} = \frac{\text{encoder lines per rev} * 4}{\text{400 half steps per rev}}$$

SAMPLE BASIC PROGRAM   REMARKS

10 OPEN "COM1:9600,N,8,1,CS65535,DS,CD" AS #1

     (Using a 400 line quadrature encoder)

20 PRINT #1, "CP1000000,"   set encoder position to 1,000,000
30 PRINT #1, "N2000,-GF,"   move motor clockwise 2000 steps, wait until
             themove is finished before continuing
40 PRINT #1, "VCP,"   verify encoder position
50 INPUT #1, A$: PRINT A$ print encoder position to screen (the number
             992,000 will be on the screen)

CS (0 to 249) The **SET AUTOSTART** command is used to set the Autostart flag to a specified address. To Autostart a program enter the first line of the program after CS. "CS10" will autostart the program starting at line 10, and save the current contents of the program in the EEPROM.
NOTE: To autostart the program be sure that the communi- cation switch is on **RS422**.
   It is advisable to include a wait command of 100 milliseconds (W10) at the start of the Autostart program to allow everything to power up properly.
NOTE: To turn off the autostart flag, send "CS250," and the autostart flag will be inactive.

D (2 to 127) The **DECELERATION** command determines the time it takes to go from Maximum speed to Base speed. The higher the value, the slower the motor will decelerate. The default value on power up is 10.

E (0-249) The **ENTER** command allows you to enter a program to be saved in the DPD72351's memory. This command sets the stored program pointer to the specified address byte, and puts the controller in the mode to enter a program. The information you type in will overwrite any previous information stored there. Typing E0 will allow you to begin entering the program at address 0. More than one program can be stored in the memory - be sure to separate the programs by the Q command. Each axis you may be using must be independently programmed. Two or more axes can communicate with each other through the 8 inputs and 8 outputs associated with each axis. The **ENTER** command can be used to edit an existing stored program by simply specifying the byte where you wish to start editing. You can exit the Enter - program mode at any time with a carriage return.

F (no value) When using a computer, the **FINISH** command is used directly after a Go command. With this command, the DPD72351 will send a busy signal to the host computer until the move is complete before accepting any further inputs. The **FINISH** command is used in the direct mode only. Unless the F command is used, the computer will keep on sending data, even thought the DPD72351 is not ready to receive it. This data will be ignored by the DPD72351, so the program will not work as expected.

SAMPLE BASIC PROGRAM

02 OPEN "COM ....
05 PRINT #1, "A10,D10,B500,"
10 PRINT #1, "M1000,N4000,+G**F**,W100"
20 PRINT #1, "M20000,N4000,-G,Q

In this program the motor indexes 4000 steps in the positive direction with a maximum speed of 1000, waits 1 second, and then indexes 4000 steps in the negative direction with a maximum speed of 20000. If the user did not include the F command after the +G, the computer would have kept sending the data while the motor was indexing. This causes a loss of index commands only.

G (no value) The **GO** command causes the motion to start in the direction last specified. This command will move the motor the number of steps given by the N command or to the absolute position given by the P command. This is one of three ways to start motion; the other two are the H command and the S command.

H (0 or 1) The **HOME** command starts the controller searching for Home in the direction last set. Motion will start immediately after a terminator "," is supplied. There are two homing modes. The proper syntax is H0 or H1. The default value on power up is H0. H0 or H1 counts only as one byte.   See Figure 4.

H0 causes the motor to run to the maximum speed in the last direction programmed. The motor will run until a Soft limit switch is encountered at which time the driver will decelerate to the base speed and continue to run in the same direction until a Home limit is encountered. Proper spacing is required between Soft and Home limit switches as the Home limit switch will not respond until Base speed is reached.

H1 causes the motor to run to the maximum speed until a Home limit switch is encountered. It will then decelerate to the base speed, stop, reverse direction and continue in the opposite direction until it is off the Home limit switch. Since the inputs are edge triggered, they need not be held closed until the deceleration and reversal are complete.

When a hard limit switch is encountered, all motion ends. Absolute positioning information is lost because the controller then assumes it is no longer valid.

Ixx,yy,zz (0-255,0-255,0-249) The **INPUT** command reads, "If the input pins, as defined by the mask xx, are equal to yy, then go to program location zz". The first data entered, xx, specifies the binary-weighted value of the input pins to be tested. The second data entered, yy, is the binary-weighted pattern that these selected inputs are to match. If the data and selected pins match, the program will execute the next command given by the address location specified by zz. If not equal the program will just continue on. Since the inputs are pulled up internally, they will read "high" if no signal is applied.

The mask is defined as follows:

BINARY WEIGHT	1	2	4	8	16	32	64	128
INPUT	I0	I1	I2	I3	I4	I5	I6	I7

The mask defines which inputs out of the eight bits that will be tested. For instance, the following numbers will only test these inputs.

255 = 1 + 2 + 4 + 8 + 16 + 32 + 64 + 128
233 = 1 + 8 + 32 + 64 + 128
 98 = 2 + 32 + 64

 34 = 2 + 32

255 masks	I0	I1	I2	I3	I4	I5	I6	I7
233 masks	I0			I3		I5	I6	I7
98 masks		I1				I5	I6	
34 masks		I1				I5		

SAMPLE STORED PROGRAM

Address	Command	Remarks
0	A10	set the acceleration to 10
2	D15	set the deceleration to 15
4	N440	set the number of steps to 440
8	M10000	set the maximum speed to 10000
12	I98,34,2	loop to address 2 if the mask given by 98 is equal to 34 mask 98 = I1, I5, and I6
		34 binary value: I1 = high, I5 = high, I6 = low if mask 98 is <u>not</u> equal to 34, continue
16	H0	home type 0
18	Q	quit

J (0 - 255) The **JOG FACTOR** sets the slow jog rate. The slow jog rate is the base speed divided by the jog factor. The default value on power up is 20.

Lxx,yy (0 to 255,0 to 249) The **LOOP** instruction reads "loop xx times to address yy" If x is equal to zero then the loop is endless. No nesting of loops is allowed (i.e. a loop cannot have another loop).

SAMPLE STORED PROGRAM

Address	Command	Remarks
0	A10	set acceleration to 10
2	D18	set deceleration to 18
4	B500	set base speed to 500
7	M5000	set maximum speed to 5000
10	N1000	set number of step to 1000
13	+G	set the direction to CW, then index
15	W100	wait 1 second before continuing
17	L5,10	**LOOP** 5 times to address 10
20	H0	home type 0
21	Q	quit

M (50 to 20,000) The **MAXIMUM SPEED** is the top speed the user wants the motor to run at. The default value on power up is 10,000 pulses per second. The

Maximum Speed can never be set below the Base Speed.

N (1 to 16,777,215) This specifies the **NUMBER OF STEPS** to be moved for the Go command. The default value on power up is 0.

Oxx,yy (0 to 255,0 to 255) The **OUTPUT** command reads "set the outputs defined by mask xx to the binary-weighted number specified by yy". (See INPUT command for explanation of the mask and binary-weighted numbers) Keep in mind that the inputs are active low while the outputs are active high.

EXAMPLE:
     O127,7 would read as: look at output 0 to 6, turn on output 0, 1 and 2 and turn off output 3, 4, 5 and 6.

P (0 to 16,777,215) The **POSITION** command specifies the next absolute position to go to when the GO command is given. The DPD72351 automatically sets the direction and number of steps needed to go to that position. The default value on power up is 0.

SAMPLE BASIC PROGRAM
```
5       Open "COM .......
10      PRINT #1, "@0,A10,D10,B500,M5000,VI" * INITIAL PARAMETERS
15      INPUT #1, A$
20      IF A$="254" THEN PRINT #1, "P500,GF," * GOTO POSITION 500
```

Q (no value) The **QUIT** command, used within a stored program, stops execution of the program. In the direct mode, the QUIT command will cause the motor to ramp down and then stop.

R (0 - 249) The **RUN** command starts a stored program execution at the address specified. This allows multiple programs to be stored in the EEPROM so that any one of them can be started individually. Each program must be terminated with the Q command. The RUN command is also used as an unconditional branch in the internal program.
   If the sample stored program below is already in the DPD72351's EEPROM, the program can be started by typing "R20". The R20 at address 31 is an unconditional branch.

SAMPLE STORED PROGRAM

Address	Command	Remarks
20	A5	Set acceleration to 5
22	B100	Set base speed to 100
24	M5000	Set Maximum Speed to 5000
27	I1,1,33	If INPUT #0 is high then go to address 33
31	R20	Goto to address 20
33	N3320	Set number of steps to 3320
36	G	Start Indexing
37	Q	End program

S (no value) The **SLEW** command will accelerate the motor up to maximum speed and continue to run at that speed until reaching a hard limit switch or receiving a quit (Q) command.

SAMPLE BASIC PROGRAM
```
5       OPEN "COM .....
10      PRINT #1, "@0,A10,D10,B500,M5000,S": REM SLEW MOTOR TO
5000                                              MAX UNTIL Q
20      FOR T=1 TO 10000: NEXT T
30      PRINT #1, "Q"
```

T (no value) The **TRACE** command will allow you to single-step through the stored program one step at a time. Each time a `T' is entered, the next command of the program will be executed. In order to specify the initial program address location, the program pointer can be set with the Enter (E) command, followed immediately by a carriage return.

Uxx,yy,zz (0 - 255,0 - 255,0 - 249) The **UNTIL** command reads "Until the input pins represented by the mask xx are equal the value yy, branch to location zz." This command is opposite of the Input command (see p. 16).

SAMPLE STORED PROGRAM

Address	Command	Remarks
0	B500	set base speed to 500
3	M20000	set maximum speed to 20000
6	N2300	set number of steps to 2300
9	G	index 2300 steps in the last direction used
10	W210	wait 2.10 seconds
12	U254,49,9	loop to address 9 until the input mask 254 equals 49
16	H1	home type 1
17	Q	quit

V (appropriate code) VERIFY causes the DPD72351 to send data back to whatever it is communicating with. The data is sent as an ASCII decimal string followed by a carriage return and a line feed. If a verify Enter command (VE) is sent the   DPD72351 returns the entire internal stored program. No more than one axis at a time can be addressed with this command, or they would contend for the bus. The permissible verify commands are shown below.

SAMPLE BASIC PROGRAM

```
10    OPEN "COM1:9600,N,8,1,CS65535,DS,CD" AS #1
20    PRINT #1, "@0,B500,M5000,-H1F,Z,P4000,GF,"
25    PRINT #1, "VI,"
30    INPUT #1, A$: PRINT A$
40    IF A$ = "254" GOTO 50 ELSE 40
50    PRINT #1, "P5000,GF,"
60    GOTO 20
70    END
```

VA	Acceleration
VB	Base Speed
VCP	Encoder Position
VD	Deceleration
VE	Internal Program
VG	Step remaining in current move
VH	Hold Time
VI	Input Terminals
VJ	Slow Jog Divisor
VM	Maximum Speed
VN	Number of Steps to Index
VO	Output Terminals
VP	Position
VR	Internal Program Pointer
VW	Ticks remaining in Wait counter

TABLE 14: VERIFY COMMANDS

W (0 - 255) In the stored program mode, the **WAIT** command pauses the program for the specified number of 0.01 seconds.

SAMPLE INTERNAL STORED PROGRAM

Address	Command	Remarks
0	N4000	set number of steps to 4000
3	+G	set the direction to clockwise, and index
5	W150	WAIT for 1.5 seconds before continuing
7	-G	set the direction to counterclockwise, and index
9	Q	quit

X (no value) The CONTINUE command will continue the stored program from the address where the stored program was stopped.

Z (0 to 16,777,215) The **ZERO POSITION** command sets the position register to a designated value. The number following the (Z) will be the new absolute position of the motor. The default value is 0.

SAMPLE BASIC PROGRAM
```
10 OPEN "COM1:9600,N,8,1,CS65535,DS,CD" AS #1
20 PRINT#1,"@0,A10,D10,B500,M5000,-H1F,Z1000,P4000,GF,"
```

@ (0 to 9 and A to V) The **SELECT AXIS** command will designate an axis or axes. Any or all devices can be addressed simultaneously to receive commands from the DPD72351. However, only the most recently selected controller will send data to the host (such as during a Verify). This is necessary to prevent contention on the bus. The list of characters must be terminated by a comma. If just the @ command is sent with no axes addresses, then all axes are deselected. The axes 0 to 9, and A to V represent 32 possible axes that can be selected all at one time or any combination of them.

SAMPLE BASIC PROGRAM

```
10    OPEN "COM1:9600,N,8,1,CS65535,DS,CD" AS #1
20    PRINT#1,"@0,A10,D10,B500,M5000,-H1F,Z1000,P4000,"
30    PRINT#1,"@1,A10,D10,B500,M5000,-H1F,Z1000,P4000,"
40    PRINT #1,"@01,+GF,"
```

+ (no value) Set motor direction to clockwise (CW).

- (no value) Set motor direction to counterclockwise (CCW).

% (no value) POLL the device for any waiting messages such as errors or end

of move. The responses are defined in Table 15. As in the Verify command, only one axis at a time may be addressed with this command. The POLL command is especially useful in debugging a program.

#	DESCRIPTION
0	Normal
1	Command error, illegal command sent
2	Range error, an out of range number was sent
3	Command invalid while moving
4	Command only valid in stored program
5	End of move notice, previous Go command complete
6	End of wait notice, a previous Wait command is
7	Hard limit stop, move was stopped by hard limit
8	End of program notice, internal program completed
G	Motor is moving and no other notice pending

TABLE 15: RESPONSES TO POLL COMMAND (ERRORS AND MESSAGES)

? (no value) This command returns two numbers. The first number is the part identifier which is always 35 (for the DPD72351 controller IC). The second number is the revision number. A quick test to see if you are communicating with the DPD72351 is to use this command.

. (no value) If a period is received, the motor will stop, the timer will be cleared and the internal program will stop. It is possible for this command to stop execution of the internal program in the middle of an instruction, causing the parameter for that instruction to be read incorrectly. For this reason, the period command is only intended as a debugging tool.

SAMPLE PROGRAMS

Sample SMC35TRM Program

Given in Figure 11. is a program that could be entered in the program tab. This program first sets the motor parameters: B500 = Base Speed of 500 steps/sec, M1000 = Max Speed of 1000 steps/sec, and N400 = Motor index number of 400 step/index. Next a Go command in the plus direction is given, followed by a one second wait delay: +G, W100. Then a Go command in the minus direction is given, again followed by a one second delay. Last a Run program at address 0 is given, thus looping the program to the begining. For more information on SMC35 commands see the COMMAND DICTIONARY section.
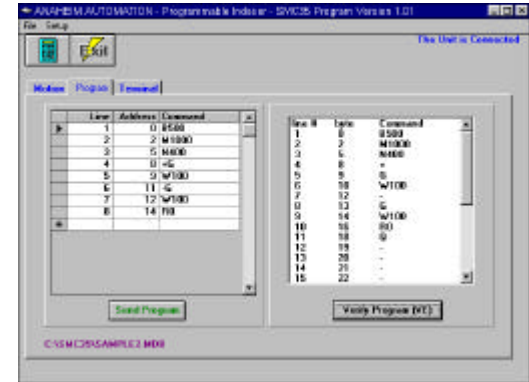
Figure 11. Sample Program

Sample Basic Program

Given in Figure 12 is a listing of the sample basic program (b_sample.bas) provided with the installation of the software. The first line opens COM port 2 for communication with the indexer, at 9600 baud (consistent with the switch setting on the indexer). The following print statements send parameters to the indexer. After a label (TOP:) the program gives a GO command with a Wait-for-motion-to-stop command. Then, after a delay (W100), the same is done in the other direction. The program finally waits for a keyboard input before it continues to loop back to TOP:.

```
OPEN
"COM2:9600,N,8,1,CS65535,DS,CD"
FOR RANDOM AS #1
PRINT #1, "B500,"
PRINT #1, "M5000,"
PRINT #1, "A1000,"
PRINT #1, "D10000,"
PRINT #1, "N400,"
TOP:
PRINT #1, "-GF,"
PRINT #1, "W100,"
PRINT #1, "+GF,"
INPUT BREAK
GOTO TOP
```

Figure 12. Sample Basic Program

C Programming and the DPD72351

Programming the DPD72351 using C language usually requires a third party software to handle the serial-handshaking communication. For information on this software contact the factory.

BLD72 DRIVER

SPECIFICATIONS

Control Inputs (All) : (Terminals 5, 6, 8, 9)
TTL-compatible
Logic "0" - 0 to 0.8 V
Logic "1" - 3.5 to 5.0 V

Fault Reset: (Terminal 4)
Pulled up to +5Vdc through a 10kÙ
Logic "1" (open) - Driver enabled and Fault detection enabled
Logic "0" - Resets a Fault condition (driver is disabled when this input is low).
This input must be held low for at least 100ms.

Clock Inputs : (Terminals 6) Internally connected to indexer.

Direction Control: (Terminal 5) Internally connected to indexer.

Excitation Mode Select: (Terminal 8)
Pulled up to +5Vdc through a 10kÙ
Logic "1" (open) - Half-step
Logic "0" - 2 ö Full-step

Power ON/OFF: (Terminal 9) Internally connected to indexer.

Output Current Rating: (Terminals 1, 2, 3, 11, 12, and 13)
10 Amps/phase maximum operating current, 7.0 Amps/phase maximum standstill current, over the operating voltage and temperature range. Motor phase ratings of 1.0 Amp minimum are required to meet the minimum kick level.

Power Requirement: 105 - 125VAC Standard
210 - 250VAC Optional. Order with X250 suffix.

Operating Temperature: 0 to 60 degrees C

Fusing: 5 Amp (5 X 20mm) Fast Blow Fuse located in drawer below line cord input connector.

JUMPER FUNCTIONS/LOCATIONS

FUNCTION	JP1	JP2	JP3
NEGATIVE GOING CLOCKS	1-2	X	X
POSITIVE GOING CLOCKS	2-3	X	X
TERMINAL 5 = CCW	X	1-2	X
TERMINAL 5 = DIRECTION	X	2-3	X
GROUND FAULT DETECTION ENABLED	X	X	2-3
GROUND FAULT DETECTION DISABLED	X	X	1-2
STANDARD PRODUCT	1 - 2	2 - 3	2 - 3

TABLE 4: JUMPERS SETTINGS
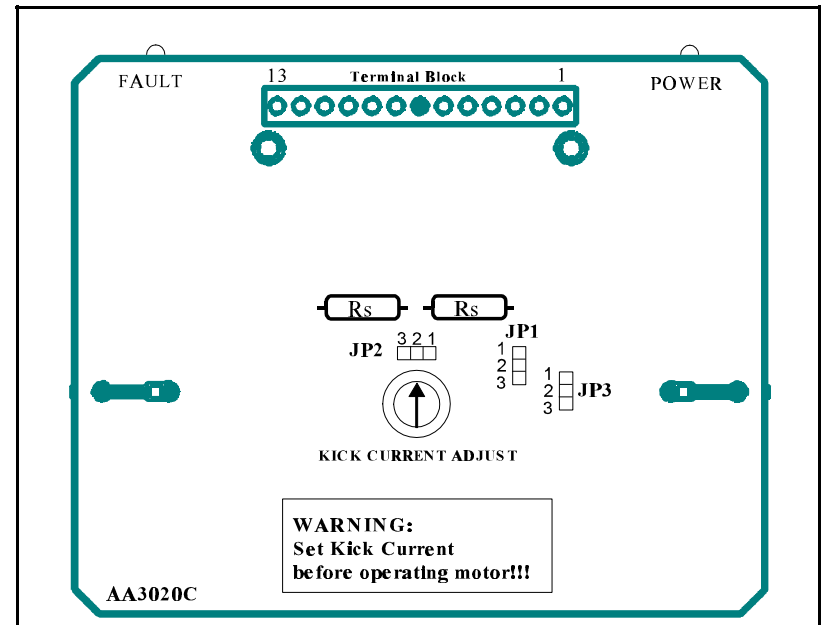
FIGURE 13: JUMPER LOCATIONS.

MOTOR POWER ON/OFF INPUT
The Motor On/Off input allows de-energizing a motor without disturbing the positioning logic. After re-energizing the motor, a routine can continue. This reduces motor heating and conserves power, especially in applications where motors are stopped for long periods and no holding torque is required. Use the "CH" (see Command Dictionary) command to de-energize the motor after a move.

FAULT PROTECTION
There are 3 types of fault detection incorporated in the BLD72 driver. When a fault is detected, the driver turns off the motor current and the red Fault LED indicates the type of fault detected. See the Troubleshooting section for more information.

1	LED - Slow Blink	shorted wire in the motor or cable
2	LED - Fast Blink	open wire in the motor or cable
3	LED - ON Steady	ground fault (voltage shorted to 0V)

TABLE16: FAULT LED

If the driver goes into a fault condition, the fault may be reset by turning the power OFF for at least 15 seconds or by pulling the RESET FAULT input (terminal 4) to a logic "0" for at least 100ms.

ADJUSTING KICK CURRENT
By following the silkscreen instructions on the cover, use a small screwdriver to adjust the potentiometer. Line up arrow to the number corresponding to the motors rated current (amps/phase). Example 1: 23D104 Motor - set Kick Current to 2 Amps
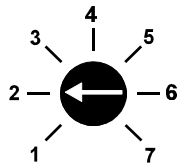
Example 2: 34D314 Motor - set Kick Current to 7 Amps
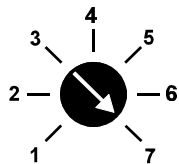
MOTOR CONNECTIONS

Figure 14 is a hookup diagram for typical BLD72 driver applications. *Wiring connected to inputs must be separated from motor connections and all other possible sources of interference.*

IMPORTANT NOTE: When the wiring from the driver to the step motor extends beyond 25 feet, consult the factory.

WIRING DIAGRAM
The wiring diagram in Figure 14 shows the BLD72 with the AA2791 Transformer.
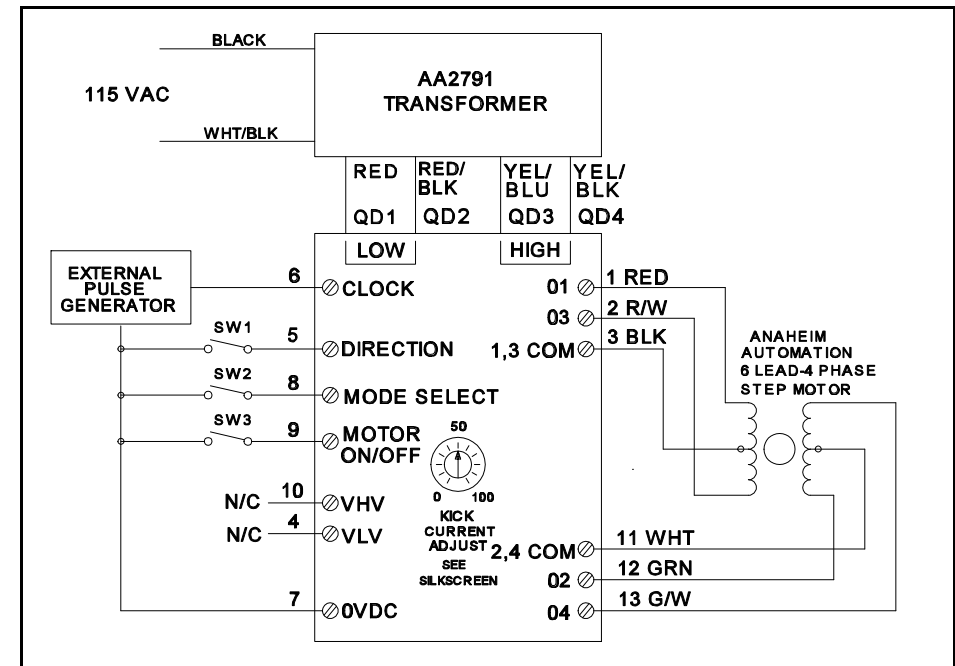
FIGURE 14: TYPICAL WIRING FOR CLOCKWISE AND DIRECTION OPTION AND MOTOR WIRING

TROUBLESHOOTING BLD72 DRIVER PROBLEMS

If a Fault occurs, reset the Fault by applying a logic "0" to the Reset Fault Input (terminal 4) for at least 100ms (or by cycling power OFF for at least 15 seconds). After resetting, try to run the motor again. If the driver faults again then check the conditions listed below.

Is the LED blinking Slowly?
This indicates that the motor has a phase shorted or there is a short in the motor cable or wiring. Check the motor and the wiring for shorts. If the driver continues to sense "shorts" after the motor and wiring are determined to be good, then the output transistors should be checked (see below).

Is the LED blinking Quickly?
This indicates that there is an open connection in one of the motor wires. Check the motor and the wiring for opens. Another condition that may cause this type of fault is when a large motor is ramped down too quickly so that it loses it's positioning.

Is the LED on Steadily?
This indicates that there is a ground fault - a voltage shorted to 0V. This detection is useful in detecting a short-to-case in a motor when the motor's case AND the driver's 0V are both connected to earth ground. Excessive noise on the 0V line may also cause the driver to sense this type of fault. This type of fault sensing may be disabled by placing jumper JP3 in position "1-2". NOTE: IF THE GROUND FAULT DETECTION IS DISABLED, DO NOT CONNECT THE DRIVER'S 0V TO EARTH GROUND!

Checking Output Transistors

1. Remove the side plate.
2. Set the multimeter to Diode Test.
3. Place the RED meter lead on (between) the Sense Resistors (labeled Rs in Figure 5).
4. Touch the BLACK meter lead to each phase (terminals 1, 2, 12, and 13).
5. This should give readings between 0.450V and 0.550V.
6. If any readings are significantly less than 0.450V, then the unit has been damaged. To send the unit in for repair, contact the factory for an RMA#.

**STANDARD MOTOR TORQUE/SPEED CURVES**

23D102

23D204

23D209

23D306

23D309

34D106

34D109

34D207

34D209
23D104

34D213

34D307

34D311


34D314

42D112

42D212
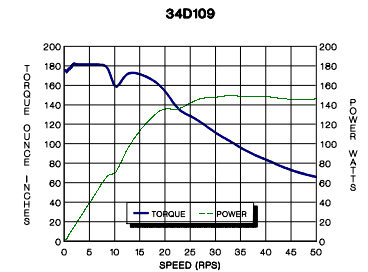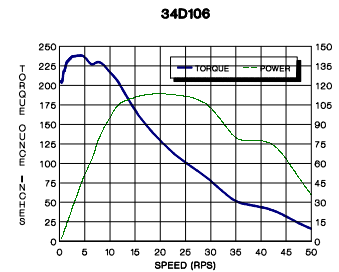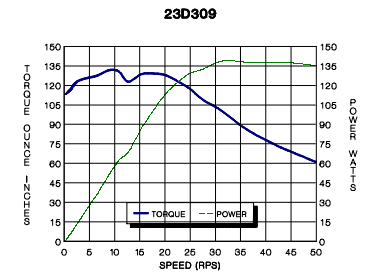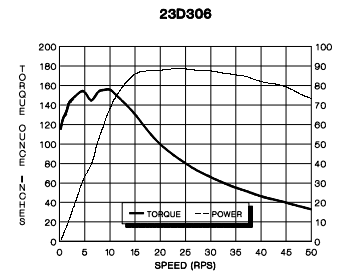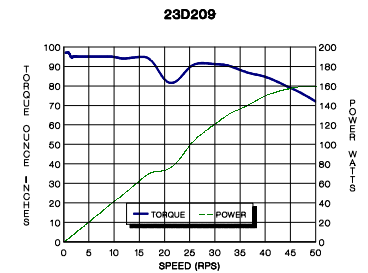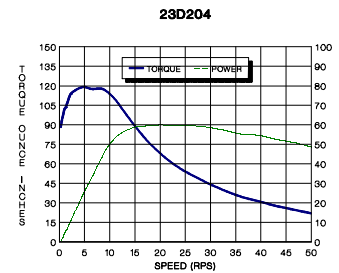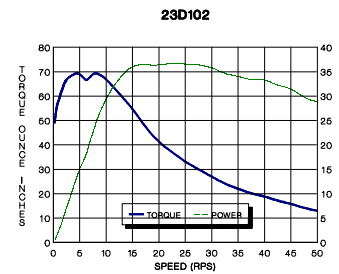
TROUBLESHOOTING

My computer won't talk to the DPD72351.

To use a computer to communicate to the DPD72351, you must use a communications program such as Crosstalk, or a programming language such as BASIC, or C language. The communication parameters must be set up correctly for 8 Data Bits, No Parity Bits, and 1 Stop Bit. The Baud Rate can be set up for rates between 75 Hz to 9600 (75, 150, 300, 600, 1200, 2400, 4800, 9600). Check the Baud Rate setting on the yellow and black rotary switch on the side of the unit. This setting must match to the baud rate you specified (see Table 12). The Request To Send (RTS) signal is supported by some software and not others. Refer to the software manual to see what you need, or just use trial and error - it will not damage anything. Generally use RTS on, or the first 8 positions of the dip switch. Once the communications are set up you finally need to talk to the DPD72351. This is done by selecting the axis you want to talk to. Position the Axis Select for the desired axis number for your unit. If you chose axis 0 for example, the rotary dip switch would be pointing to 0. To communicate to this axis, type a period, the @ sign, the axis number, a comma, and a question mark. (.@0,?) The DPD72351 should then return two numbers to your screen - first the number 35, and then the revision number of the chip. Now you are communicating.

The unit will not Autostart.

Be sure the that the communication switch is set to RS422.
NOTE: Axis F will not autostart.
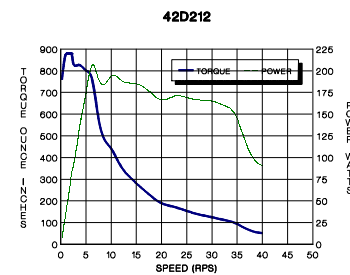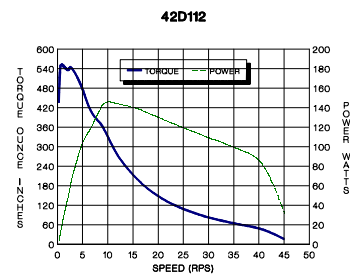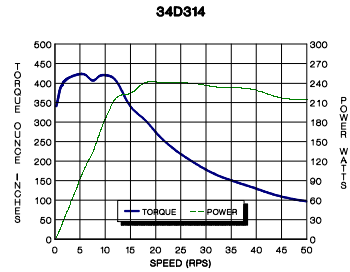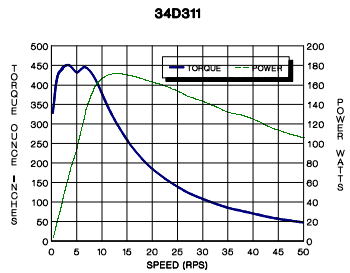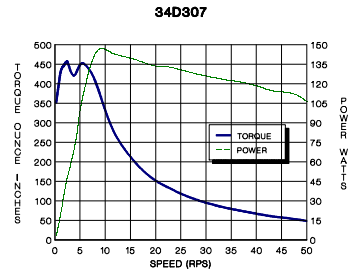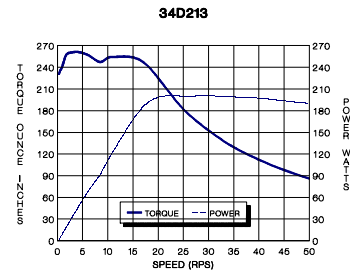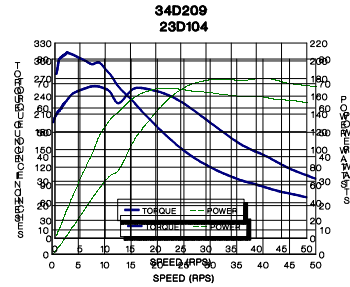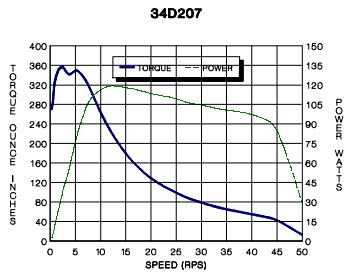
GLOSSARY

Absolute Mode A positioning coordinate reference wherein all positions are specified relative to some reference, or "home" position. This is different from relative, or incremental programming, where distances are specified relative to the current position.

Baud Rate A term used frequently in serial data communications but often is misunderstood. A 'baud' is defined as the reciprocal of the shortest pulse duration in a data word (signal), including start, stop, and parity bits. This is often taken to mean the same as "bits per second", a term that expresses only the number of 'data' bits per second. Very often, the parity bit is included as an information or data bit.

Break Signal A break is often used to signal a remote computer to stop trans- mission. Typically a Break Signal is produced by holding the data terminal equipment (DTE) transmit data (TXD) low for some time significantly longer than the time it takes to send a word.

Daisychain A term used to describe the linking of several RS422/RS232C devices in a sequence such that a single data stream flows through one device and on to the next. Daisy-chained devices usually are distinguished by device addresses, which serve to indicate the desired destination for data in the stream.

Debug A term used to define refinements to a system or program that remove undesirable effects.

EEPROM Electrically Erasable Programmable Read-Only Memory. A memory device frequently used with microprocessors, that can be erased and reprogrammed with- out removing it from the circuit. This creates non-volatile memory; i.e. memory that won't be lost if the power is turned off.

Hard Limit Switch A switch (i.e. photo, Hall-effect or mechanical) that defines the absolute limit of motion in a particular direction. It may be used to prevent collisions or out-of-bounds conditions.

Home A reference position in a motion control system, usually derived from a mechanical datum. Often designated as the "zero" position.

Home Limit Switch The switch used to establish the reference position designated "home".

Program Counter The Program Counter is used by the processor to point to the address of the next instruction to be executed by the processor in the stored program mode.

Mask A binary-weighted number that conceals some or all of the bits in an associated memory address or register.

Relative Mode A coordinate system where positions or distances are specified relative to the current position.

Stack A register or buffer in memory that uses Last-In-First-Out (LIFO) entry and retrieval of data.

Soft Limit Switch This switch is used exclusively in Homing Mode 0 (zero). If positioned properly for the appropriate parameters, it causes the motor to ramp down to the Base Speed before encountering the Home Limit Switch. This ensures that the motor speed is within the start-stop region.

Start-Stop Region That range of speeds in which a step motor can start, stop, or reverse direction in synchronism with the external pulse signal.