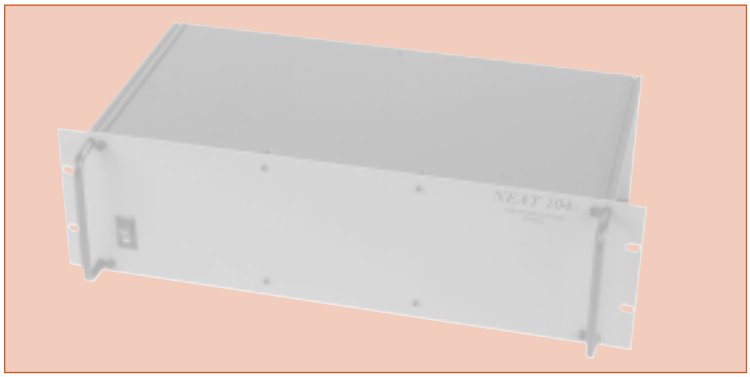
DPS Drives

DPS 100 Series

High Performance Stepping/Microstepping Drives



Danaher Precision Systems

Series 100 Operator's Manual

Overview

Thank you for selecting Danaher Precision Systems as your positioning equipment supplier. We understand that you can choose from a number of competitive suppliers, and are pleased that you have selected DPS.

This manual addresses the DPS 100™ Series High Performance Stepping/Microstepping Drives. As you unpack and begin to use our product, we would like your conclusions as to our products' appearance, quality, precision, and suitability to your ultimate application. By providing us with feedback in these and other areas, you can become an active participant in our on-going program of continuous improvement.

Our Customer Service department can be reached at:

phone: 603.893.0588 (1.800.227.1066 in the US)
fax: 603.893.8711
e-mail: support@NEAT.com

We encourage you to visit our web site at www.NEAT.com. It includes information on new products, along with our existing product catalog, a Motion Control Handbook covering 33 technical topics, and other useful information.

Thank you again for choosing Danaher Precision Systems. We look forward to serving you in the future.

Features

- High speed operation to over 100 revs/second
- One to six axes in convenient, compact enclosures
- Complete midrange resonance suppression (100 H and M)
- Automatic idle current reduction
- Optically isolated inputs

The DPS 100 Drives provide state-of-the-art drive for one to six stepping motors. One and two axis units are housed in a compact 6.5" wide x 5.2" high x 8.7" deep enclosure, while three to six axis models are supplied in a 19.0" wide x 5.2" high x 8.7" deep rack mountable enclosure. Both versions include buffered, opto-isolated step and direction input lines; forced air cooling with a removable air filter; switchable 115 or 230 volt A.C. operation, and locking D-submini motor and remote connectors. The DPS 100 Series is an ideal drive for our PCX line of PC-compatible indexing cards.

The 100M Series of stepping motor drivers provides high speed performance as well as high resolution via its divide by 10 microstepping drive. This sub-divides each full step into 10 microsteps, producing 2,000 steps per revolution from standard 1.8 steppers. These drives exhibit complete freedom from midrange resonance, allow operation at either 28 or 56 volts, and provide automatic or remote current shut-down when idle.

Contents

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Salem, NH 03079

Front Panel Functions

The DPS 100 Drives are intended to function as a remote stepping motor translator, coupled to an intelligent (typically CPU-based) pulse generator such as a printer port, parallel l/0 card, or dedicated motion control plug-in card. Accordingly, the front panel is simple, with no user accessible functions. The series number is screened onto the upper right of the panel. Models with three or more axes are housed in a 19" rack mount enclosure, with standard rack handles and mounting slots.

Rear Panel Functions

The DPS 100 Drive's rear panel includes a number of user-settable functions and interconnects. The A.C. power switch is located in the lower left of the rear panel; depressing the top of the rocker switch applies power to the unit. A.C. power is applied by inserting a modular power cord (supplied with each unit) into the standard l.E.C. Iine voltage receptacle at the lower left of the rear panel. Each NEAT-100 Series driver is shipped with a U.S. standard l.E.C. six foot line cord. Optional line cords are available which allow these units to plug directly into virtually any country's line voltage outlets; contact our Sales Department for details. Directly above the A.C. input is a fuse holder, which accepts 3 AG fuses and provides protection for the incoming A.C. Iine. All models are shipped with a 4 amp, slo-blow fuse; should the fuse blow for any reason, use only 3 AG, 4 amp, slo-blow fuses as replacements.

The forced-air cooling fan is located above the A.C. power fuse; air is exhausted through the protective fan guard, and drawn into the unit via a filter assembly located on the front panel. The air filter is a three-piece design with removable and washable filter elements, and is secured to the side panel with four #6-32 flat head socket screws (5/64" Allen wrench).

All digital inputs are brought in on the REMOTE connector located to the upper right of the fan. This connector is of the standard DB-25 socket type, and mates to a DB-25P pin type (male) connector; panel mounted jackscrews are also present, providing a locking connection for incoming signals. These signals consist of STEP, DIRECTION, and IDLE lines for each axis, together with pins for signal ground and +5 volts. The specific pin-out is provided on page 4, with input signal requirements covered in the "SIGNAL DESCRIPTIONS" section on pages 7 and 8.

In addition to the DB-25S REMOTE connector, the rear panel includes a separate DE-9S (9 pin, D-submini, socket contact) MOTOR connector for each motor axis. In the six axis 106 models, these motor connectors are labeled as X, Y, Z, T, U, and V. Lower axis count models use a subset of these labels; a 103, for example, would label its three motors as X, Y, and Z. Al1 MOTOR connectors inciude a pair of #4-40 jackscrews, allowing a positive, locking interconnection to be made. As described below, the jackscrews must be used to prevent inadvertent disconnection. To avoid high voltage inductive transients from damaging the driver output stage, always make certain that A.C. power is turned off before connecting or disconnecting motor cables. The MOTOR connectors mate with DE-9P (male, or pin contact) connectors, which should include a cable strain relief to assure the highest reliability. Our use of protected socket contacts for the driver output avoids the possibllity of inadvertent shorting through contact with screwdriver, or other metal objects. We recommend that similar socket contacts be used on the far (X-Y stage) end of any cables connected to the 100 series rear panel, to extend protection to the drive. Our standard NEAT motor cables incorporate such a feature, together with metal hoods, jackscrews, and cable strain reliefs.

MOTOR connector pinouts are shown on page 7; note the location of pins 1-9 and the individual pin descriptions. The DPS 100-M drive utllizes bipolar output stages, and hence utilize four of the nine available pins. Note that the pinouts listed in this manual are as viewed facing the rear panel; the pin locations of the mating connector undergo a mirror-image shift. While it is mandatory that pins not be miswired between motor coils, any one error in pin assignation within a single coil (for example, interchanging pins #1 and #6) will simply reverse the directional sense of that motor. The choice of which wires to leave unconnected has significant performance ramifications; refer to the below discussion under the heading "FULL COIL VS HALF COIL."

ALWAYS TURN OFF AC POWER BEFORE CONNECTING OR DISCONNECTING MOTOR CABLES OR CHANGING MOTOR FUSE. PERMANENT DAMAGE TO THE F.E.T. OUTPUTS MAY RESULT IF THIS PROCEDURE IS NOT FOLLOWED.

For every pair of motor connectors, there is a rear panel ACCESS panel which allows access to a variety of axis functions. DPS 101 and 102 units have one access panel, the DPS 103 and 104 units have two, and the Dps 105 and 106 units have three panels. The panels are secured with a pair of #4-40 x 114" button head socket screws, which thread into pem-nut fasteners swaged into the rear panel. The button head socket screws can be removed with a 1/16" Allen wrench. The functions available behind the ACCESS panel include a pair of motor fuses, six-position DIP switches, and current setting resistors.

The functions behind the access panel are grouped into two identicai groups, with the lefthand set corresponding to the left adjacent MOTOR connector, and the right-hand set corresponding to the right adjacent MOTOR connector. To simplify inventory requirements, rear panel PCB's are assembled with a full complement of components. As a result, models with an odd number of axes will appear to have an additional axis. No drive capability will be present, however, on the "extra" axis.

At the top of the access hole are a pair of motor fuses, which fuse the D.C. power supply providing drive current to two motors. These are 2AG, 5 amp fast blow fuses (DPS p/n 2087411). Should the motor lose torque completely, visually inspect the motor fuse to look for a blown element. If no obvious blown condition can be seen, disconnect the REMOTE connector to confirm that the IDLE line has not been pulled low. If the automatic idle current reduction switch (DIP switch 6, described later) is in the disabled state, then having the unit powered on with the motor connected and nothing plugged into the REMOTE connector should result in full motor torque. Should other axes exhibit the no-torque condition, turn off A.C. power, and remove and check the A.C. fuse.

The DPS 100 Drives can be configured to operate on either 115 volts or 230 volts A.C., at either 50 or 60 Hz. The only country which departs from these two voltages and frequencies is Japan, which employs a 100 volt, 50 Hz standard. The 100 series will operate at this voltage, but the D.C. drive voltages will drop from the nominal 27 or 54 volts to 23 or 46. This will have modest consequences for high speed torque, as outlined below. Unless specified differently at time of order, we ship all 100 series drives configured for 115 volt A.C., 50/60 Hz.

If a field change in A.C. operating voltage is required, perform the following:

1 . Turn off the DPS 100 drive and disconnect the A.C. power cord.

2. Wait 20 seconds to allow internal voltages to dissipate.

3. Remove the #4-40 button head socket screw at the center rear of the enclosure top plate. This requires a .062" Allen wrench. Slide the top plate off.

4. A voltage selector switch will be visible on each of the power supply boards (there will be one, two, or three of these, depending on the axis count). Its red plastic slider carries two legends: 115 and 230. Only one legend can be seen at a time. If more than one power supply board is present, all must have their switch set to the desired voltage level.

5. Using your fingernail or a convenient tool, slide the switch to select the appropriate legend and voltage setting.

6. Slide back the top plate and replace the button head screw.

7. The unit is now ready for operation; note, however, that a new power cord may be required to interconnect the rear panel universal l.E.C.-320/C.E.C.22 receptacle and the specific A.C. Iine outlet plate. Our sales department can provide A.C. power cords to match the A.C. outlets of most industrialized countries.

Cabling & Interconnects

The DPS 100 drives are capable of being used with a wide variety of pulse sources, and can drive many popular stepping motors or stepper-equipped positioning stages. When used with indexers and motors/stages not supplied by DPS, the pinouts described in this catalog will provide enough information to allow system cables to be made. Note that since pulse generation sources (indexer cards) must both send step and direction information to the DPS 100 drives, as well as accept limit and encoder information from the stage axes, the cabling issue can become complex. A single indexer connector must often route signal lines in two or more directions — to the DPS 100 drives, as well as to the physical stage. Indexer l/O lines for control of peripheral devices may also need to route from the indexer connector to a third destination. Given the tendency of indexer card manufacturers to use a single large connector for all signals, this creates a potential cabling nightmare, with four to ten separate cables expected to converge neatly upon this single connector.

To avoid this problem, DPS offers our DPS PCX™ and Galil-1700™ Breakout Boxes. These are highly effective interconnect boxes which facilitate cabling from multiple sources to the single connector present on our DPS PCX and Galil indexer cards. This single connector.is “fanned out” via the breakout box to as many as eight limit/encoder connectors, two DPS 100 driver connectors, auxiliary I/O lines, etc. All connectors are locking and strain-relieved and mate directly to DPS mechanical staging and drivers; for additional information refer to the data sheet on either breakout box (available from our Sales Department).

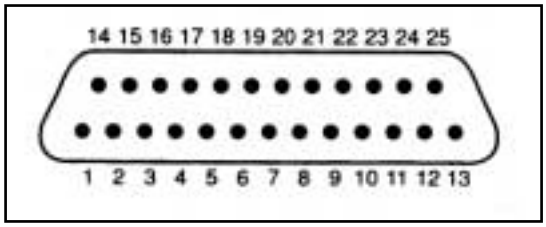
For two and three axis systems without encoders, a potentially simpler cabling system exists. The DPS 100 Drive Remote Input Connector is a DB-25-S, which can accommodate up to six axes (step, direction, and idle lines for each axis, plus +5 volts and grounds).

Remote Connector Pinout

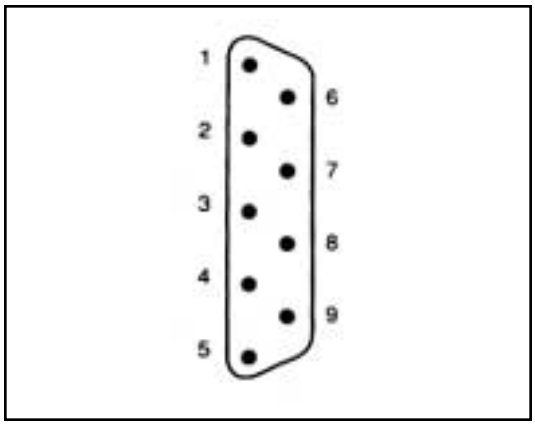
The following page contains the pinout assignments for the DB-25P remote connector. If less than 6 axes are used, then the pins for the unused axes should be left unconnected. The axes are used in the following order: X, Y, Z, T, U, V. For example, if a DPS 103 drive is being wired, the X, Y, and Z axis connections would be used. The pins designated “N.C.” have no internal connection in the unit.

100 Series Remote Connector DB-25P Remote Pin Assignment: DB-25-P (pin, or male). DB-25-S (socket, or female). Pin 1 location: lower left.

1	Z IDLE	Z axis idle current
2	Y IDLE	Y axis idle current
3	X IDLE	X axis idle current
4	GND	Signal ground
5	N.C.	
6	Z DIR	Z axis direction select
7	Y DIR	Y axis direction select



8	X DIR	X axis direction select
9	V DIR	V axis direction select
10	U DIR	U axis direction select
11	T DIR	T axis direction select
12	N.C.	
13	N.C.	
14	V IDLE	V axis idle current
15	U IDLE	U axis idle current
16	+5 VOLTS	Logic power output
17	T IDLE	T axis idle current
18	Z STEP	Z axis step command input
19	Y STEP	Y axis step command input
20	X STEP	X axis step command input
21	V STEP	V axis step command input
22	U STEP	U axis step command input
23	T STEP	T axis step command input
24	N.C.	
25	N.C.	



100 Series Remote Connector DE-9S Pin assignment: DB-9-S (socket, or female). Mate DB-9-P (pin or mail). Pin 1 location: upper left.

1	PHASE 1	Phase 1 output
2	PHASE 3	Phase 3 output
3	N.C.	
4	PHASE 2	Phase 2 output
5	PHASE 4	Phase 4 output
6	PHASE 1,3 C.T.	Phase 1 & 3 center tap
7	N.C.	
8	N.C.	
9	PHASE 2,4 C.T.	Phase 2 & 4 center tap

Note: a discussion of motor coil connections to these outputs is given on the following page.

DPS 100 Drive DIP-Switch Designations

Switch 1 and **switch 2** determine whether the motor will step on rising edges or falling edges. Set switch 1 ON and switch 2 OFF to step on the rising edge of the step input; set switch 1 OFF and switch 2 ON to step on the falling edge. The unit should not be operated with both switches 1 and 2 on or off together.

Switch 3 and **switch 4** determine the direction of motor rotation for a given level of the direction line. A low on the direction line corresponds to CW rotation (as viewed facing the motor drive shaft) when switch 3 is OFF and switch 4 is ON. This convention is reversed (a low on the direction line corresponds to CCW rotation) if switch 3 is ON and switch 4 is OFF. Do not operate the unit with both switches 3 and 4 to an on or off state. Note that these motor directions are for NEAT wired motors and for motors wired in the “standard’, configuration—changing motor wiring can reverse the direction of rotation. This is discussed further in the SIGNAL DESCRIPTIONS: Direction Lines” section.

Switch 5 has no effect on 1OO-M series microsteppers.

Switch 6 enables automatic idle current reduction when set to ON. This will lower motor current (and torque) to the idle setting when the motor is not moving—when no motion pulses have been seen for 50 milliseconds on the ‘step’ input line, the current is lowered. Details on the main and idle current settings may be found in the CURRENT SETTING RESISTORS section. When switch 6 is set to the OFF position, motor current is maintained at the full torque setting. This idle current function is the same one which may be manually activated by the remote connector idle current lines, described later in the SIGNALS section. Note that for applications with larger torque requirements, the automatic idle current reduction may not restore full current fast enough (when a move begins) to achieve the desired accelerations. In these cases, the automatic idle current reduction should be disabled (switch 6 set to OFF), and then remote connector idle line may be used and switched externally to lower the current when the motor is not moving, and restore it a short time before each move begin

Full Coil versus Half Coil

Since most stepping motors are six lead devices, and the 100-M series has four output leads, two leads must be left unconnected. The choice of which two leads to leave unconnected has distinct performance impacts, as described below. No such quandary exists with the unipolar 1 00L series, which requires that all six motor leads be wired. This section does not apply to the 100L series. Stepping motors are normally wired as two center-tapped coils (six leads total). Motor connector pins #1 and #6 (and similarly #4 and #9) can be wired across the full coil, leaving the center tap disconnected, or across a coit end and the center tap, leaving the other coil end disconnected. These two possibilities are referred to as Ufull coil" and "half coil", respectively.

Operation in full coil mode doubles the number of winding turns and quadruples the winding inductance (compared to half coil operation). Accordingly, the current setting resistor (see below) should be set to one-half the rated (nameplate) motor current value for Ufull coil" operation. (Six-lead motor nameplate values assume unipolar, half coil operation.) Heating of the drive and motor will be half that experienced in half coil mode. Power supply current requirements are also cut in half. On the downside, motor torque wili fall off faster at higher speeds. The graph of motor torque vs. frequency can be broken into two regions: a low speed region within which torque is constant, and a high speed region within which torque is inversely proportional to frequency. The onset of the ~break" between the two regions will be halved in full coil mode, and the torque at any given high speed will be half that available in half coil mode. The following chart summarizes the differences between full and half coil modes:

In the above chart, 'I' is the motors rated (namepiate) current; ~L' is the rated inductance; 'R' is the rated resistance; 'V' is the drive supply voltage; 'f' is the step frequency; ~T' is the holding torque, and 'k' is a motor-specific constant of proportionality. Since high speed torque is proportional to the D.C. supply voltage, full coil operation at 54 volts will result in the identical performance as half coil operation at 27 volts; concomitantly, half coil high speed torque at 54 volts will be four times that of full coil operation at 27 volts.

The basic conclusion is that for high speed performance, half coil mode should be employed. If low to moderate speeds are adequate, and especially if heating or supply current are of concern, full coil operation is preferable. The pair of leads which remain unconnected should be insulated to avoid shorts or shocks; under some circumstances voltages of up to 120 volts can appear on these leads. There is no specific rule as to the order of the four remaining leads and motor connector pins #1, #4, #6, and #9 (excepting, of course, that pins #1 and #6 must nun to a motor coil and not to the ends of two separate motor coils). Reversing any two of the four motor leads will result in a direction reversal relative to the state of the direction line. Accordingly, if your system "runs the wrong way", reversing any pair of motor leads (after carefully powering down the D.C. supply) will reverse the system direction sense. It is easier, however, to leave the motor leads as-is and reverse the direction line sense via the access panel DlP-switches.

	Full Coil	Half Coil
Drive Current Setting	0.5 I	I
D.C. Supply Current	0.33 I	0.66 I
Drive Heating (low speed region)	0.15 I^2	0.6 I^2
Drive Heating (high speed region)	0.03 I^2	0.1 I^2
Coil Inductance	4L	L
Coil Resistance	2R	R
Speed/Torque Break Point	0.5f break	f break
Low Speed Torque	T	T

Full/Half Step Mode

This function is determined by the state of switch #5 on the ACCESS panel DlP-switch. Switch #5 shouid be left in the OFF state on the microstepping 100M series, for which this section is irrelevant. On the 1 00L and 1 00H series, this pin selects either full or half step operation. Half step mode doubles the resolution, providing 400 steps per revolution from standard 1.8 degree stepping motors. The default state (as shipped) of this switch is OFF, which selects full step; if the switch is set to ON, then the motor will operate in half step mode.

The principal benefits of half-stepping are the doubling of resolution and increased smoothness during low speed operation. The step rate for any given motor shaft speed will be twice as high as that required for full step operation. The primary resonance of stepping motors, which occurs between 1/2 and 2 revolutions per second, results in noisy operation and the potential for lost steps near these speeds. Half step operation is very effective in reducing the effect of this resonance. Our microstepping 100M series provides even higher suppression of the primary resonance, and smoother low speed operation.

Signal Descriptions DB-25-P Remote Connector

The stepping motor for a given axis will rotate one step (full, half or microstep, depending on model and mode of operation) for each “active” edge received on its corresponding step line. The ~active,, edge is defined as the signal’s high-to-low or low-to-high transition, depending on the setting of DlP-switches 1 & 2 described previously. The direction of rotation will depend on the level on the direction line and the motor wiring, as discussed in the preceding section. Each step line is tied internally through a 2.2K ohm pull-up resistor to +5 volts; when not connected, it will be in the high state.

Direction lines: X-DIR, Y-DIR, Z-DIR, T-DIR, U-DIR, V-DIR

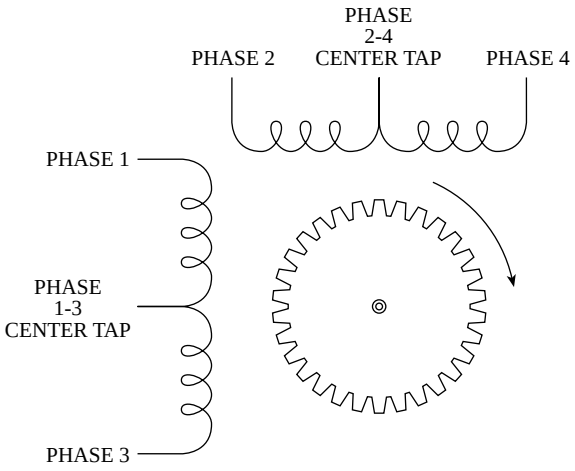
Each of these input pins sets the direction of motor rotation for subsequent step pulses. The level on a direction pin must be established at least 100 microseconds prior to issuing step pulses. The correlation between the level at the direction pin and the direction of motor rotation varies with the coil connections to the motor connector, and may be reversed with DlP-switches 3 and 4 corresponding to the given axis. If these DlP-switches are in their factory default positions (switch 3 OFF and switch 4 ON), then the specific equivalence for Rapidsyn and Superior motors is as follows: if pins #1, #6, #4, and #9 are wired to motor lead colors red, black, green, and white respectively, then a low level applied to the direction pin will result in clockwise rotation, as viewed facing the stepping motor drive shaft. For other motor manufacturers refer to the chart below, or wire the motor and check—as described above, simply reversing any pair of motor leads (after carefully shutting off D.C. power) will reverse the direction sense. Each direction line is tied internally through a 2.2K ohm pull-up resistor to +5 volts; when not connected, it will be in the high state.

Note: Do not bundle the Step and Direction signals within the same cable as the motor leads; this may result in signal noise and erratic operation. Use separate cables, and employ a shield around the motor leads; this shield should be connected to the chassis case.

These input lines are used to affect the current with which their corresponding motors are driven. Each idle line is tied internally through a 2.2K ohm pull-up resistor to +5 volts; when not connected, it will be in the high state, which is the “non-idle” mode (detailed below). Behind the ACCESS panels on the rear of the chassis are pairs of spring sockets, designed to hold 1/4 watt resistors. Two resistor positions are used for each motor axis, with one designated (MAIN) and the other designated (IDLE). In the 100H and 100M series, resistors are used to determine how much current is delivered to the motor when it is moving (MAIN) and when it is stationary (IDLE).

In the 1OO-L series, the current to the motor may only be switched on or off — no resistors are present in the spring sockets. The MAIN socket is left open, and the IDLE socket contains a shorting jumper. (100L series units will be factory-configured in this manner.) In the 100L series, when the idle line for a given axis is pulled low (to logic ground), the corresponding motor will be given no current by the unit. When the idle line is not connected or driven high, the corresponding motor will be given its full current.This current will be 1.0 amp per phase or 1.5 amps per phase, depending on the version of the 1OO-L series purchased.

For the 1OO-M series, the pair of resistors -for each axis may be used to variably set the amount of output current sent to a motor. The value chosen for the (MAIN) current setting resistor is a function of the motors rated (nameplate) phase current and the coil drive mode (full coil or half coil). The value chosen for the IDLE current setting resistor is a function of the percentage of torque desired when the motor is stationary. The following section details the resistors needed for various settings.



Manufacturer	Phase 1	Phase 1-3 C.T.	Phase 3	Phase 2	Phase 2-4 C.T.	Phase 4
Rapidsyn	Red	Black	Red/White	Green	White	Green/White
Superior	Red	Black	Red/White	Green	White	Green/White
Oriental	Black	Yellow	Green	Red	White	Blue
Sigma (Pac-Sci)	Black	Black/Orange/White	Orange	Red	Red/Yellow/White	Yellow
Bodine	Brown	White/Brown	Orange	Red	White/Red	Yellow

Current Setting Resistors

For 100H and 100M series units, the relationship between motor rated current, drive mode, and resistor value is as follows:

Current Set Resistor Table

Full Coil	*Half Coil*	*Coil Resistor*
1 .5A	0.75A	1.2K
2.0A	1 .00A	1.5K
2.5A	1 .25A	27K
3.0A	1 .50A	33K
3.5A	1 .75A	47K
4.0A	2.00A	68K
4.5A	2.25A	82K
5.0A	2.50A	1/20K
5.5A	2.75A	1/80K
6.0A	3.00A	270K
6.5A	3.25A	560K
7.0A	3.5A	3.3M

When an idle line is activated (pulled low), the corresponding (IDLE) current setting resistor is onnected in parallel with (MAIN) resistor, creating an equivalent resistance according to the following formula:

IdleR = 1 / (1/MAIN + 1/lDLE)

The (IdleR), resistance may be looked up in the preceding table to determine what the motor current will be when its idle line is activated. Total motor current shutoff when the idle line is active may be achieved by putting a shorting jumper in place of the (IDLE) resistor.

As an example, a popular 100 oz-in motor is rated at 1.8 amps per phase. Operation in half coil mode will require a 47K ohm resistor, while fuil coil operation will require a 12K or 15K ohm resistor. To make the half coil mode idle current 0.75 amps, a 1.6K (IDLE) resistor would be used:

12K = 1 / (1/47K + 1/16K)

The highest motor phase current operable with the 100-M series drives will be 7.0 amps per phase, although motors of this current rating could only be run in full coil mode. To preserve the highest possible microstep uniformity, do not vary the resistor value from that indicated in the table. If you happen to be using a 4 lead motor, the rated (nameplate) current rating will correspond to the half-coil column resistor value. Note that while the resistor sets the motor operating current (and hence torque) at standstill and throughout the low speed region, high speed torque is inductively limited and hence less dependent of the specific resistor setting. (See the FULL COIL VS HALF COIL section for a discussion of the speed regions.)

In applications where full acceleration torque is required, enabling full current 10-20 milliseconds before initiating a move will improve performance. If the 100-M series units are shipped with DPS positioning tables, then the current setting resistors will be factory pre-set to match the tables. Otherwise, they are shipped with a 1.5K ohm 'MAIN' resistor installed, corresponding to a 1.0 amp/phase motor in half coil mode, or a 2.0 amp/phase motor in full coil mode; and with a 68K ohm 'IDLE' resistor installed, resulting in an idle current of 0.75 amps in half coil mode or 1.5 amps in full coil mode. Do not operate a 100-M series unit without a current setting resistor. If the resistor is omitted, the drive current defaults to 3.5 amp/phase (half coil). This could overheat and damage any motor not rated for this current value. If a 100-L series unit is operated with both resistor sockets open, it will function normally except that the idle line function will be disabled. Specific current settings will be set to match any accompanying DPS stages; if purchasing the drive separately, specify the desired motor current when ordering.

DC Supply Voltage Selection

The DPS 100-M stepping motor drives is designed to operate at a D.C. supply voltage of +28 or +56 volts. The decision as to which supply voltage to employ is a trade-off between high speed performance and motor heating. High speed torque is essentially doubled at the higher voltage, which will permit motors to operate without stalling at much higher speeds. Iron losses in the motor laminations due to the PWM (pulse-width-modulated) nature of the motor excitation cause motor heating to rise as the supply voltage is increased. In applications with low inductance motors, high supply voltage, and high duty cycle, motor heating can easily exceed winding ratings and damage the motor. A switch to the 28 volt supply setting will greatly decrease motor heating, albeit with a concomitant decrease in high speed performance. The technique for changing D.C. supply voltage is identical to the A.C. voltage change procedure, except that the voltage selector switch is black, and that a jumper must be moved to apply the correct voitage to the fan. To switch from the factory-default 56 volts to the lower 28 volt setting, slide the switch towards the board legend 28V, which is movement away from the previously described red A.C. selector switch. In addition, a 1" shorting jumper must be installed on the two pin header on the 28 volt side of the switch - this jumper is necessary to maintain proper fan speed and cooling. This jumper must be removed if the D.C. voltage selector switch is returned to the 56 volt position.

Microstepping

The 100M series implements microstepping at the divide by 10 level; that is, it electronically subdivides each full step into 10 microsteps. This provides two distinct benefits: the system resolution is increased tenfold, and the noise and vibration associated with step rates at or below the fundamental resonance is greatly reduced. In leadscrew based systems, microstepping aliows fine resolutions to be achieved with relatively coarse leadscrews; this permits high linear velocities which would be unattainable with fine pitch leadscrews in full or half step systems. The benefits of microstepping are best realized at low to moderate division ratios—popular systems which divide full steps into as many as 256 microsteps often provide "empty resolution," with limited practical advantages. The step rates required to operate such systems at high shaft rotation rates are usuaily beyond the capability of typical pulse sources. The divide by 10 level of microstepping has been chosen as optimal for most real world applications. For applications that truly require higher microstepping division ratios, an "HR" (High Resolution) series option is available which allows any or all 100 series axes to provide microstepping at many popular ratios, ranging from 4 to 100 microstep divisions. Contact our sales department for details.

Midrange Resonance

Midrange resonance is a parasitic oscillation of the stepping motor rotor from its intended position, which occurs while the motor is rotating. It generally sets in at shaft rotation rates between 5 and 15 revs/sec. (1000 to 3000 full steps/sec. for standard 1.8 degree steppers). Depending on the frictional and inertial aspects of the load, midrange resonance may or may not occur in any given application. When viewed across a broad range of applications, midrange resonance can constitute a serious problem for stepping motor based systems. In many examples where the system is incapable of exceeding 5-15 revolutions per second, the actual cause is stalling due to midrange resonance. The effect usually manifests itself as a 50-150 Hz vibration which builds in amplitude over 1/2 to 2 seconds, terminating in a stalled motor and loss of position.

Warranty and Terms

Terms and Conditions

Danaher Precision Systems (DPS) warrants to original equipment manufacturers, distributors and industrial and commercial users of its products that each new product manufactured or supplied by DPS shall be free from defects in materials and workmanship. DPS's sole obligation under this warranty is limited to furnishing without additional charge a replacement for, or at its option, repairing or issuing credit for any product which shall within one year from the date of sale by DPS be returned freight prepaid to the plant designated by DPS and which upon inspection is determined by DPS to be defective in materials or workmanship. Complete information as to operating conditions must accompany any product returned for inspection. The provisions of this warranty shall not apply to any DPS product which has been subjected to misuse, improper operating conditions or which has been repaired or altered. Seller makes no warranty that its products are fit for the use or purpose to which they may be put by the buyer, whether or not such use or purpose has been disclosed to seller in specifications or drawings previously or subsequently provided seller, and whether or not seller's products are specifically designed and/or manufactured for this purpose. THIS WARRANTY IS IN LIEU OF ALL OTHER WARRANTIES, EXPRESSED OR IMPLIED, INCLUDING ANY IMPLIED WARRANTY OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE. DPS's sole liability on any such claim of any kind, whether in contract, tort or otherwise, for any loss or damage arising out of, connected with, or resulting from the manufacture, sale, delivery or use of the products sold thereunder shall in no case exceed the cost of replacement or repair as provided herein. IN NO EVENT SHALL DPS BE LIABLE FOR ANY SPECIAL, INCIDENTAL OR CONSEQUENTIAL DAMAGES. There are no other warranties, expressed or implied, made by DPS except the warranty against defects in materials and workmanship set forth above and neither assumes nor authorizes any other person or firm to assume for it any other obligations or liability in connection with its products.

Custom design work performed by DPS will be subject to engineering charges. Payments are due upon acceptance of the custom design work. DPS will retain all copyright and other proprietary rights to the product and any additional custom work. The Purchaser shall respect the proprietary rights of DPS and shall take measures to prevent unauthorized disclosure of information relating to the product and any additional custom design work. DPS shall retain all proprietary rights and shall have the right and authority to use, sell, market, research, and utilize for any other purpose at it sole discretion said product and custom design work without notification or any liability whatsoever, including but not limited to monetary remuneration, to the Purchaser.

Prices in this quotation do not include any taxes or charges of any nature imposed by any governmental authority which shall become payable by reason of sale, purchase, delivery, storage, processing, use, consumption, or shipment of equipment hereunder. All such taxes or charges shall be the obligation of the buyer and may be either billed to the buyer separately, or added to the price of the equipment shipped.

Returning Goods Procedure

Claims for incorrect or defective materials must be received in writing within thirty (30) days from delivery at buyer's place of business. No units or systems may be returned, in or out of warranty, without first issuing a purchase order and obtaining a return authorization number from the seller, and no claim will be allowed nor credit given for units or systems returned without such approval. Buyer will not be allowed to debit accounts. All credits must be issued by seller. Units which have been exposed to hazardous or toxic materials must be decontaminated at the expense of the Purchaser before being returned. Equipment that has not been decontaminated and certified will not be accepted for repair. After approval from DPS, the defective unit or system is to be returned to the factory with a written statement of the problem and transportation prepaid. (No C.O.D. or collect freight shipments will be accepted). After DPS's in-plant examination, warranty or out-of-warranty status will be determined. If upon examination of such unit or system, warranted defects exist, then the unit or system will be repaired at no charge and shipped prepaid back to the buyer, via common carrier. If an out-of-warranty situation exists, the buyer shall be notified of the repair cost immediately. At such time, the buyer must issue a purchase order to cover the cost of the repair or authorize the unit or system to be shipped back as is, at the buyer's cost. Warranty work will be suspended when owner/user is in default of financial obligation to seller.

Shipping/Risk of Loss

Unless express shipping instructions are furnished by buyer, seller will use its discretion. All shipments are F.O.B. seller's plant. Upon delivery to a common carrier, title and all risk of loss or damage in transit shall pass to buyer.

Field Service Policy

If the system or unit cannot be made functional by no-charge telephone assistance or purchased replacement parts, and cannot be returned to the DPS factory for repair, then the following field service policy will apply: DPS will provide an on-site field service representative in a reasonable amount of time, provided that the customer issues a bonafide purchase order to DPS covering all transportation and subsistence costs and the prevailing cost per hour (eight hour minimum) including travel time necessary to complete the repair, regardless of warranty determination. If the DPS field service representative determines during his on-site repair that the system or unit's problem is not warranty-related, then the prevailing service charge per hour (eight-hour minimum) shall be assessed against the issued purchase order.

Order Cancellation Policy

Cancellation of orders consisting of standard products, for any reason, is subject to a minimum fifteen (15) percent cancellation charge. All standard, non-standard products, custom products, or systems are subject to a cancellation charge to be determined by DPS.

Blanket Order Policy

Any order placed with DPS that has more than one delivery date for the same line item shall be termed a Blanket Order, and is is subject to the following conditions:

- Specific ship dates must be given for the entire quantity of each item when an order is placed. DPS must receive written confirmation of a purchase order verifying these dates.
- The entire quantity of each item on an order must be shipped within 12 months of receipt of order.
- DPS reserves the right to refuse any rescheduling of delivery dates.
- Quantity increases to items on existing orders may not be subject to the same quantity discount as given on the original order.

Prices and specifications are subject to change without notice.