P70530 (DC) High Performance Micro-Stepping Drive

Reference Guide
Revision A
10/2007

EN60034-1
EN60034-5

Keep all product manuals as a product component during the life span of the product.
Pass all product manuals to future users/owners of the product.

DANAHER MOTION

Part # M-SD-7DC-01

Record of Manual Revisions

Revision	Date	Description of Revision
1	04/2006	Initial Release
A	10/2007	Added motor selection, changed branding.

Copyright Information

NOTICE:

Safety-alert symbols used in this document are:

WARNING

Alerts users to potential physical danger or harm. Failure to follow warning notices could result in personal injury or death.

CAUTION

Directs attention to general precautions, which if not followed, could result in personal injury and/or equipment damage.

NOTE

Highlights information critical to your understanding or use of the product.

Table of Contents

1. GETTING STARTED

WARNING

Read this reference guide before you apply power to the drive. Mis-wiring of the drive may result in damage to the unit voiding the warranty. Improper grounding of the drive may cause serious injury to the operator.

Only qualified personnel are permitted to transport, assemble, commission, and maintain this equipment. Properly qualified personnel are persons who are familiar with the transport, assembly, installation, commissioning and operation of motors, and who have the appropriate qualifications for their jobs.

Read all available documentation before assembling and using. Incorrect handling of products in this manual can result in injury and damage to persons and machinery. Strictly adhere to the technical information regarding installation requirements.

CAUTION

Keep all covers and cabinet doors shut during operation.

CAUTION

Be aware that during operation, the product has electrically charged components and hot surfaces. Control and power cables can carry a high voltage, even when the motor is not rotating.

CAUTION

Never disconnect or connect the product while the power source is energized.

CAUTION

After removing the power source from the equipment, wait at least 2 minutes before touching or disconnecting sections of the equipment that normally carry electrical charges (e.g., capacitors, contacts, screw connections). To be safe, measure the electrical contact points with a meter before touching the equipment.

1.1 UNPACKING AND INSPECTING

Open the box and remove all the contents. Check to ensure there is no visible damage to any of the equipment.

CAUTION

Use proper procedures when handling electronic components to avoid damage to equipment.

CAUTION

Remove all packing material and equipment from the shipping container. Be aware that some connector kits and other equipment pieces may be quite small and can be accidentally discarded. Do not dispose of shipping materials until the packing list has been checked.

NOTE

Upon receipt of the equipment, inspect components to ensure that no damage has occurred in shipment. If damage is detected, notify the carrier immediately. Check all shipping material for connector kits and documentation.

1.2 PART NUMBER

P7 NN N 0 XX N - NNN

Family
P7 - P7000 Series

Current Rating
03 - 2.5 A_{RMS} continuous, 3.5 A_{RMS} peak (***AC only***)
05 - 5 A_{RMS} continuous, 7.1 A_{RMS} peak (***DC only***)

Voltage
3 - 20 - 75 VDC
6 - 120/240 VAC

Electrical Option
0 - no option

Functionality
SD - Step/Direction only
PN - Step/Direction & Indexing
R4 - Step/Direction & Indexing & RS485 (***AC only)***

Feedback
N - None

Customization
Omitted for standard units

1.3 ACCESSORIES

768-026902-01	26-pin D-Sub connector to terminal block adapter
P7S2-232-9D	RS-232 Serial cable RJ12 to 9 pin D-Sub connector 6 feet

1.4 SPECIFICATIONS

NOTE

Unless otherwise specified, specifications are worse-case limits and apply over the specified operating ambient temperature and over the specified operating line voltage.

1.4.1 DRIVE POWER

Specification	P70530
Max Output Current (0-40° C)	5 A_{RMS}
Max Output Power at 5 A max average	350 W at 72 V 240 W at 48 V 120 W at 24 V
Power Dissipation at 3.5 A	9 W max at 5 A_{RMS}/motor phase 5 W max at 3 A_{RMS}/motor phase 1.8 W typ. at disabled
Motor Inductance Range	2-15 mH nom.
Maximum Motor Cable Length (24 AWG)	20 m
Power Supply 20 - 75 VDC recommended design center isolated unregulated type (or regulated + bus cap)	20 – 75 VDC 5 A average (max)
Cbus cap min scale as ratio of (motor current/5A) scale as ratio of (72 V/supply voltage) for multiple drives on supply scales as (number of drives) locate within 10 ft. of drive (#16 AWG twisted)	6,000 µf at 5 A motor, 72 V
Bus Under Voltage Fault	18 VDC
Bus Over Voltage Fault	91 VDC
Inrush Current & Fusing	
Peak Current	15 A
Inrush Pulse Width	4 ms
Recommended Fusing	10 A Slow Blow
5 VDC Internal Supply	50 mA
Time delay for "reduced idle current" to return to the system's "full current"	< 1 ms (typ)

NOTE

See Appendix A for information on power supply bus capacitance.

1.4.2 I/O SPECIFICATIONS

Step, Direction, & Enable Inputs	
Step/Dir J4-1-J4-6	
Step Input Voltage & Current Range	3 V - 6 V, 16 mA at 5 V (See Note below)
Direction Input Voltage & Current Range	3 V - 6 V, 16 mA at 5 V (See Note below)
Enable Input Voltage & Current Range	3 V - 6 V, 3-6 mA at 5 V (See Note below)
Step Minimum on/off time	800 ns
Step Input Max Frequency	2 MHz
Direction minimum set up Time	50 µs

General Purpose I/O	
DIN1-DIN9 (J4-10-J4-18)	
Input Voltage Range	4 - 6 VDC (See Note below)
Input Current Range (Internally Controlled)	1 mA at 5 VDC
Response Time	<= 250 µs
GPO J4-7, J4-8, J4-21, J4-22	
Maximum Output Voltage	30 VDC
Clamp Voltage	30 VDC
Maximum Output Current	5 mA
On Voltage	0.4 VDC
Response Time	<= 250 µs

NOTE

Higher voltages may also be used if an appropriately sized current limit resistor is installed external to the drive (Reference sections 0, 2.2.1.3, and 2.2.1.4).

1.4.3 ENVIRONMENTAL

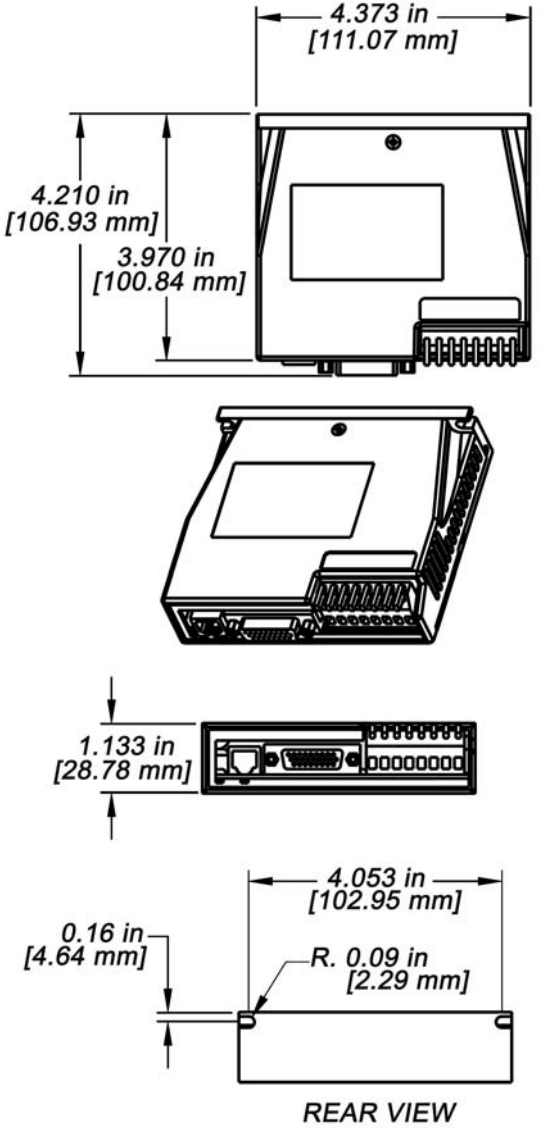
Operating Temperature	0 - 45° C unmounted
Pollution Degree	II
Storage Temperature °C	-20 to + 70° C
Humidity (% non-condensing)	90%
Altitude	<1500 m (5000 ft)

1.5 *DC MOUNTING*

Mount the P70530 to a cold plate using either 8x32 or M4 screws. This drive can be mounted either vertically or horizontally.

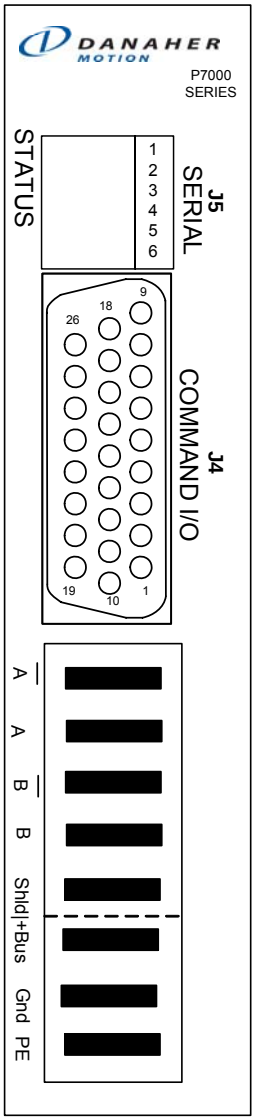
1. For convection cooling allow a minimum of 1 in (25.4 mm) of space around all sides.
2. It the heat sink temperature exceeds 70 °C the drive shuts down due to overheating. Fan cooling or a lower ambient temperature may be required to allow the drive to run properly.

1.5.1 DC BASE DRIVE MOUNTING DIMENSIONS



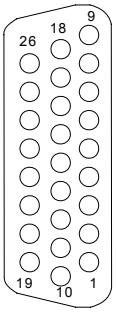
2. WIRING

2.1 *CONNECTOR LOCATIONS*



2.2 *FUNCTIONS BY CONNECTOR*

2.2.1 J4 CONNECTOR – COMMAND I/O



J4 is a 26-Position High Density D subminiature female connector. (Connector is shown as viewed from the front of the drive.

Pin	Description
J4-1	STEP + Opto
J4-2	STEP - - Pulse
J4-3	DIR + Opto
J4-4	DIR - DIR
J4-5	ENABLE + Opto
J4-6	ENABLE - AWO
J4-7	FAULT +
J4-8	FAULT -
J4-9	Gnd
J4-10	DIN1 (MVSEL 1)*
J4-11	DIN2 (MVSEL 2)*
J4-12	DIN3 (MVSEL 3)*
J4-13	DIN4 (MVSEL 4)*

Pin	Description
J4-14	DIN5 (Jog +)*
J4-15	DIN6 (Jog -)*
J4-16	DIN7 (EOT +)*
J4-17	DIN8 (EOT -)*
J4-18	DIN9 (Fault Reset)*
J4-19	+ 5 V I/O Power Source
J4-20	Pull Up/Dn
J4-21	OUT + (Motion Node Active)*
J4-22	OUT – (Motion Node Active)*
J4-23	NC
J4-24	RS-232 RX
J4-25	5 V Return I/O Power Source
J4-26	RS-232 TX

*Default I/O Assignments

NOTE

MVSEL (Move Select) is available in –PNN (Motion Node) units only. The same is true for MOTION NODE ACTIVE outputs.

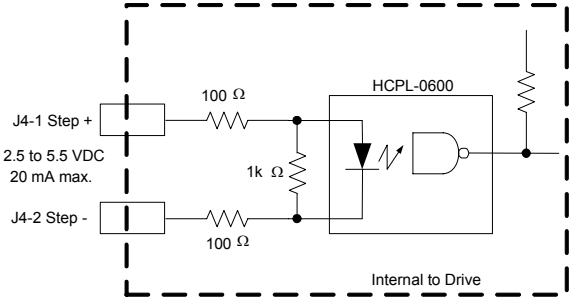
2.2.1.1. Step, Direction, and Enable Inputs

Step Input

J4 1, 2 The P70530 increments its internal step counter on the ON-to-OFF transition of the LED in an opto isolator. Minimum ON and minimum OFF times are both 250 ns. This results in a maximum step input frequency of 2 MHz. Pulses that do not meet minimum times may be ignored by the drive's electronics. ***The input circuitry is suitable for use with 5-volt logic (single ended or***

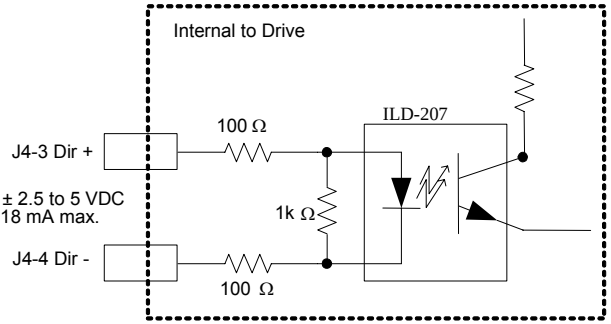
differential). It is best to drive the input to both logic states rather than utilize open collector transistors

The STEP input is sensitive to high frequency noise and should be supplied through shielded cable.



Direction Input

J4 3, 4 The DIRECTION input is similar to the step input except that it employs a slower opto isolator. Allow for a 55 µs setup time from changes at the DIR input prior to transition of the STEP input. Failure to meet setup time can result in the drive misinterpreting the intended direction of a step.



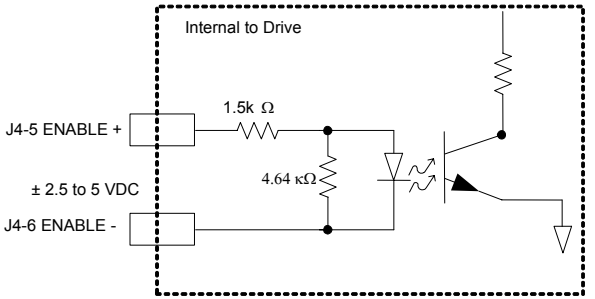
Enable Input

J4 5, 6 The ENABLE input removes current from the motor windings so the axis can be externally moved. The polarity of the ENABLE logic is configurable using P7000Tools. Factory default is ENABLE = ACTIVE OPEN. If the inputs are left open, the drive is enabled.

The input is enabled with 5 mA of current. It is suitable for use with 3 to 5 volt logic. The ENABLE input is digitally filtered and internally de-bounced.

WARNING

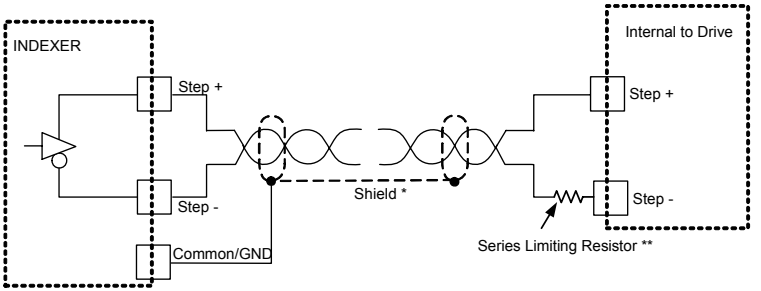
Do not depend on the ENABLE input as a safety or E-STOP mechanism. Internal drive failure could result in motion. When disabled, the winding terminals are not at safe potential. The power output from the drive is electrically safe only when the drive is disconnected from the power source.



For step and direction inputs, refer to Section 1.4.2, I/O Specifications.

NOTE

2.2.1.2. Connection Scheme for Differential Step and Direction Signals



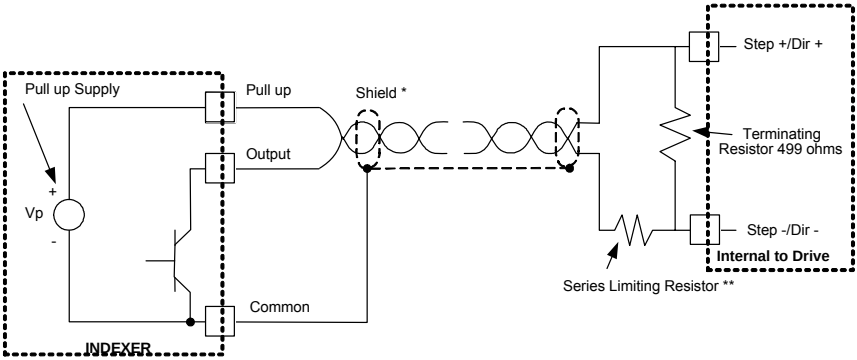
****Always use shielded, twisted pair cable to step and direction signals. Route away from motor leads.***

NOTE

*****Use series limiting resistor for pull-up voltages greater than 5 VDC. Size according to: $R_{CL} = (V_S-5)100$***

NOTE

2.2.1.3. Connection Scheme for Open-Collector Single-Ended Step and Direction Signals



Always use shielded, twisted pair cable to step and direction signals. Route away from motor leads.

NOTE

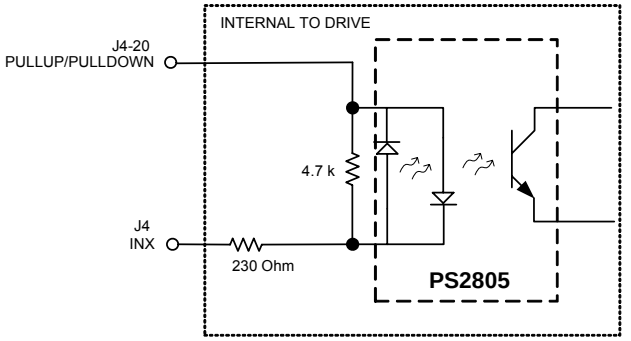
*****Use series limiting resistor for pull-up voltages greater than 5 VDC. Size according to: $R_{CL} = (V_S-5)100$***

NOTE

2.2.1.4. General Purpose Inputs

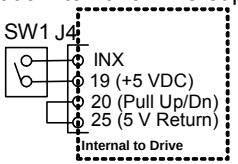
There are nine configurable General Purpose Inputs (GPI's) on the P70530 drive. All the inputs share a common optically isolated bus (Pull Up/Down). The common bus simplifies the wiring allowing a common point to connect either sinking or sourcing input devices.

Typical Input Schematic

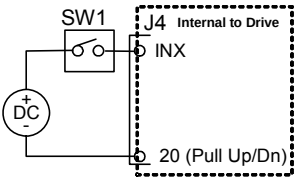


Configuration

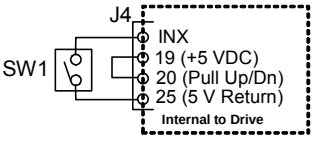
Sourcing input device using P7000 internal 5 VDC supply



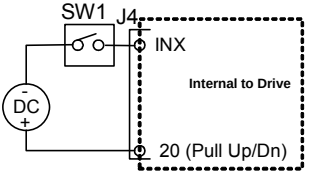
Sourcing input device using external supply (+5 VDC)



Sinking input device using P7000 internal 5 VDC supply



Sinking input device using external supply (+5 VDC)



SW1 Input device is shown as NORMALLY OPEN. It may also be configured via the user interface as NORMALLY CLOSED.

NOTE

For voltages greater than 5 VDC (24 VDC max), install a current limiting resistor in series with the input.

Size according to: $R_{CL} = (V_S\text{-}5)\ 100$

2.2.1.5. Fault Output (J4-7, 8)

This output is from an optoisolator able to support no more than 5 mA before increasing VCE_{SAT}.

NOTE

Dedicated Fault Output indicates that the drive has sustained a latched condition. Whenever the fault output is asserted, the front panel LED blinks a Fault Code repeatedly. FAULT+ and FAULT- are the isolated (collector-emitter) terminals of an optocoupler. They must be attached to a pull-up and signal common of the machine control system. The output pair is normally conducting and becomes and open circuit during a fault.

Faults are cleared in three ways:

1. Power cycle – Power must remain disconnected for approximately 10 seconds to effect reset.
2. Software reset – Use the Reset button on the toolbar.
3. I/O pin – Any of the nine I/O pins may be configured as a Fault Reset. (See schematic in section 2.2.1.6)

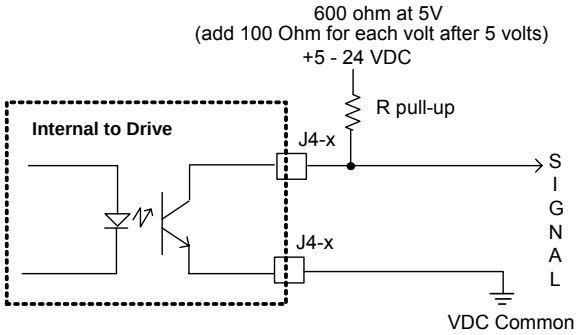
2.2.1.6. General Purpose Output (J4-21, 22)

This output is from an optoisolator able to support no more than 5 mA before increasing VCE_{SAT}.

NOTE

The P70530 includes one optically isolated output that can be configured to indicate:
— EOT latched
— Motor Moving
— Motion Node Active
— No Function
— Stalled

The input may be powered by the on-board 5 VDC logic supply (J4-19) or from a remote supply ranging from 5 - 24 VDC.



2.2.2 J5 SERIAL CONNECTOR (RS-232)

RJ12/RJ11 Phone Style
Standard RJ12/RJ11 Plug

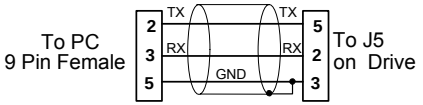
RJ12/RJ11 Phone Style	
Pin	**Description**
J5-1	No Connection
J5-2	RX232
J5-3	I/O RTN
J5-4	No Connection
J5-5	TX232
J5-6	No Connection

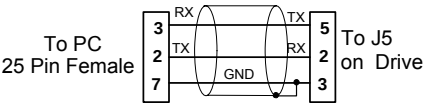
Parameter	Specification
Baud rate	19,200
Electrical interface	RS-232, Full duplex
Transfer format	UART, 1 start bit (mark), 8 data bits, even parity bit and 1 stop bit (space), no flow control.

Cable wiring diagrams for connecting to either 9 or 25 pin serial ports of most computers are also shown below.

NOTE

Pinouts vary among computer manufacturers. Check the hardware reference manual for your machine before wiring.





P7000 Stepper drives are MODbus RTU compatible. Please refer to the P7000 MODbus Application note.

NOTE

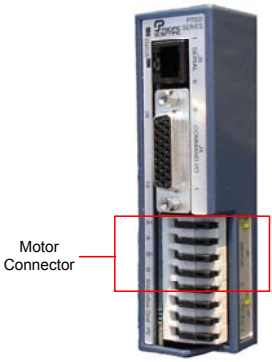
Warning:

The P7000 products automatically update non-volatile memory when a variable is changed. Designing a system that changes one or more variables on a repetitive basis could exceed the storage device's life expectancy of 1,000,000 writes. Exceeding the specification will cause a drive failure - requiring repair. Please see P7000 MODbus Application note for details

2.2.3 J6 MOTOR

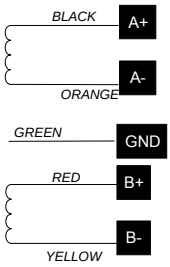
2.2.3.1. Connecting A Motor

Danaher Motion offers a number of standard stepper motors designed to provide optimum performance when matched with the P70530. The motors are offered with a 4-flying lead configuration. If your motor has 6 or 8 leads, you should consult your distributor or the factory for assistance.



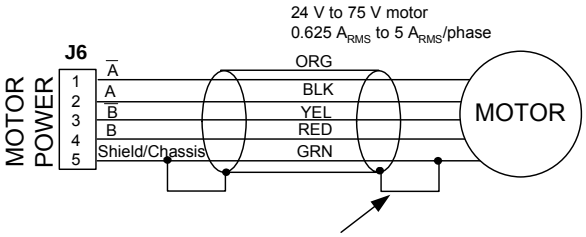
Danaher Motion's Pacific Scientific Flying Lead Motor Wiring

For T2x, N3x, K3x, N4x, and K4x Series Motors.



CAUTION

Do not hot-plug the motor connector.
Avoid "whiskers" from stranded phase leads protruding from the motor plug.



To avoid electrical shock, motor ground must be connected to protective earth.

Typical Danaher Motion stepper wire color code:

$\overline{A}$	Orange	Motor Phase A (twisted pair)
A	Black	
$\overline{B}$	Yellow	Motor Phase B (twisted pair)
B	Red	
PE	Green/Yellow Stripe	Cable Shield/Motor Case (J6-5 connects to J7-3 inside drive)

To reverse direction of motor rotation:

Switch $\overline{A}$ with A

OR

Switch $\overline{B}$ with B

OR

Switch $\overline{A}$, A with $\overline{B}$, B

OR

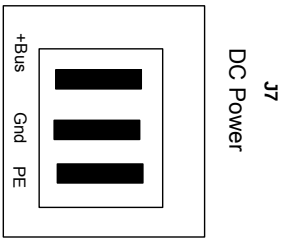
Switch rotation polarity in the user interface

NOTE

NOTE

Danaher Motion recommends the use of insulated wire ferrels to prevent shorting and add strain relief.

2.2.4 J7 DC POWER



(Connector view from front of drive)

Pin	Description	
J7-1	Plus power supply terminal	20 V – 75 V 5 A av max isolated, unregulated (or regulated) power supply
J7-2	Negative power supply terminal Negative power supply terminal/ Bus Gnd is normally earthed *Note: Maximum allowable voltage between Bus Gnd (J7-2) and Chassis (J7-3) is 100 V peak.*	
J7-3	Connect to PE (Protective Earth) (J7-3) connects to J6-5 inside drive	

NOTE

Danaher Motion recommends the use of insulated wire ferrels to prevent shorting and add strain relief.

3. CONFIGURE THE DRIVE WITH SWITCHES

NOTE

The drive is configured by either using P7000Tools or the switches on the top of the drive. The instructions that follow detail how to configure the drive using the switches.

3.1 *MOTOR SELECTION*

Configure the drive for a motor type via switch settings on the top of the drive. Valid settings are:

MOTOR	S1	S2-1
GUI Select	0	OFF
T2H…H (parallel)	1	OFF
T21H…H (parallel)	2	OFF
T22…G (parallel)	3	OFF
T23…H (parallel)	4	OFF
CTP20…17	5	OFF
CTP20…27	6	OFF
CTP21…39	7	OFF
CTM21…39	8	OFF
CTP22…50	9	OFF
CTM22…50	A	OFF
CTP31…45	B	OFF
CTM31…45	C	OFF
CTP32...73	D	OFF
CTM32…73	E	OFF
CTP33…47	F	OFF

MOTOR	S1	S2-1
CTM33…47	0	ON
N31…J (parallel)	1	ON
N32…J (parallel)	2	ON
N33…J (parallel)	3	ON
N34…J (parallel)	4	ON
K31…J (parallel)	5	ON
K32…J (parallel)	6	ON
K33…J (parallel)	7	ON
K34…J (parallel)	8	ON
N41…J (parallel)	9	ON
N42…K (parallel)	A	ON
K41…J (parallel)	B	ON
K41…K (parallel)	C	ON
CTP10…10*	D	ON
CTP11...11*	E	ON
CTP12…10	F	ON

NOTE

For non-system motors, configure the drive with the P7000Tools GUI Wizard. The motor inductance range is 2 – 15 mH.

Motor type zero is used for other motors.

Using incorrect settings results in zero current (motor will not operate).

If you change the motor type, you MUST cycle power to the drive for the changes to take effect.

3.2 *STEP RESOLUTION*

Step Resolution			
Resolution	**S2-2**	**S2-3**	**S2-4**
200	ON	ON	ON
400	OFF	ON	ON
5,000	ON	OFF	ON
10,000	OFF	OFF	ON
18,000	ON	ON	OFF
25,000	OFF	OFF	OFF
25,400	OFF	ON	OFF
50,000	ON	OFF	OFF

3.3 *LOAD INERTIA*

The P7000 eliminates resonance, typical of step motors, with high-speed, digital processing of motor electrical activity. To use this feature, you must set three switches based on the load-to-rotor inertia ratio. These switches select the gain parameter for the drive to use to stabilize the motor.

Load Inertia Ratio			
Load-Rotor	**S2-5**	**S2-6**	**S2-7**
0-1	OFF	OFF	OFF
1-1.5	ON	OFF	OFF
1.5-2.5	OFF	ON	OFF
2.5-5.0	ON	ON	OFF
5.0-7.0	OFF	OFF	ON
7.0-12.0	ON	OFF	ON
12.0-20.0	OFF	ON	ON
20.0-32.0	ON	ON	ON

3.4 *DYNAMIC SMOOTHING™*

Dynamic smoothing is a temporal filter (2nd- Order, Low-pass) applied to the command sequence to reduce jerk. It helps reduce overshoot and lessens the excitation of mechanical resonance in the system. It filters from slightly below the resonant frequency up to well above resonance to remove spectral content would be misrepresented in the motor output and may also excite other parts of the machine.

Dynamic Smoothing		
Smoothing	S2-8	S2-9
Minimal	OFF	OFF
Moderate	ON	OFF
Heavy	OFF	ON
Aggressive	ON	ON

3.5 *CURRENT REDUCTION*

Reduces drive and motor heating by invoking standby current reduction via Switch S2-10. When enabled, the reduction mode cuts motor current to 75% of its commanded value 100 ms after receipt of the last step pulse or the end of a stored move. The reduction proportion and the delay can be set to other values using P7000Tools.

Current Reduction	S2-10	ON=Disabled

3.6 *MULTI-STEPPING™*

Multi-Stepping™ is similar to dynamic smoothing™ except that it is a much more aggressive use of the filter. Typically, it results in a filter that begins to roll off a couple octaves below the resonant frequency. This is intended for use with course resolution (full/half step input pulses) to smooth out the big steps into a continuous train of microsteps.

Multi-Stepping	S2-11	ON=Enabled

3.7 *ENCODERLESS STALL DETECTION™*

The P70530 drive is uniquely designed to sense the motor shaft position at all times. The drive monitors the commanded position and compares it to the actual position. As with any two-phase step motor, when the shaft position and commanded position are greater than two full steps apart a stall will be detected and the drive will fault.

Stall Detection	S2-12	ON=Enabled

Encoderless stall detection uses an internal motor model for stall detection. Motors in the *P7000 Data Publication* work well. Other motors may not work as well as the algorithm is subject to constraints. No guarantees of reliability of this feature are made when using other motors.

4. USING P7000TOOLS

4.1 *INSTALLING P7000TOOLS*

When you install P7000Tools, the Installation Wizard will check to see if you have a previous version of P7000Tools on your system. If found, it will uninstall it. After this, you will need to run the installation again to install the new version on your system.

If you do not have a previous version of P7000Tools on your system, you only need to run the installation once.

4.2 *SET-UP WIZARD*

Start **P7000Tools.** Follow the **Setup Wizard.** You will go through a series of screens to set up the motor, drive I/O, command structure and mechanical configuration.

When you successfully finish this set up, the front panel **LED** indicator is **Solid Green**. The motor has holding torque.

4.3 TOOLBARS

Utilities Toolbar

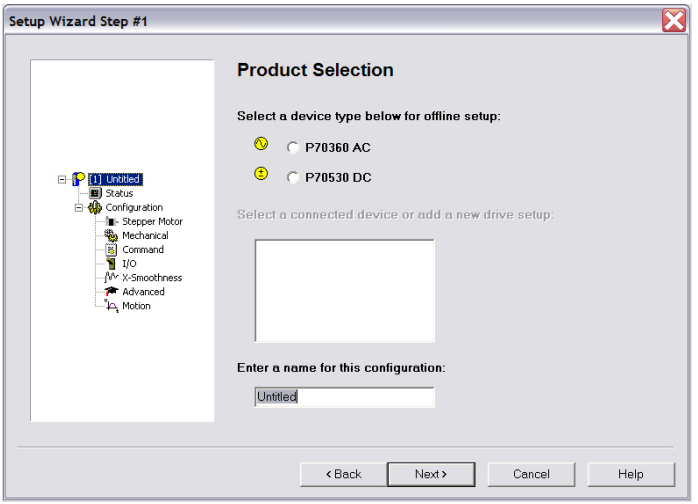
	New Project	Creates a new project file in P7000 Tools
	Open Project	Opens an existing project file in P7000 Tools
	Save Project	Saves the current project to a file
	Print Configuration	Prints the selected drive configuration (active only when the Configuration view is selected)
	Send All	Sends the entire configuration to the currently connected drive
	Retrieve All	Retrieves the entire configuration from the currently connected drive*
	Reset Drive	Performs a soft drive reset equivalent to a power cycle (used for clearing fault conditions)
	Soft Disable Amplifier	Disables amplifier
	Scan for Connected	Scans the selected serial port for connected drives

Motion Toolbar

	Jog Motor Negative	Jogs the motor in the negative direction at the selected velocity
	Jog Velocity Toggle	Selects the active jog velocity for the Jog arrow buttons (L designates Low Speed, H designates High speed)
	Jog Motor Positive	Jogs the motor in the positive direction at the selected velocity
	Stop Motion	Stops all Motion Node generated motion and breaks any active move sequence

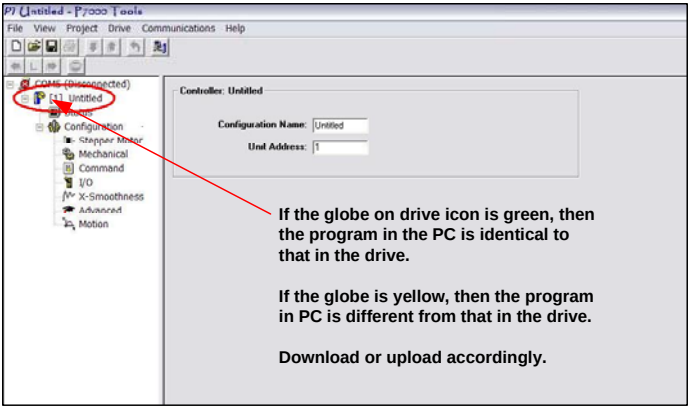
*Drive automatically uploads Parameter File when using “Scan For Connected Units” in toolbar or Setup Wizard.

4.4 PRODUCT SELECTION

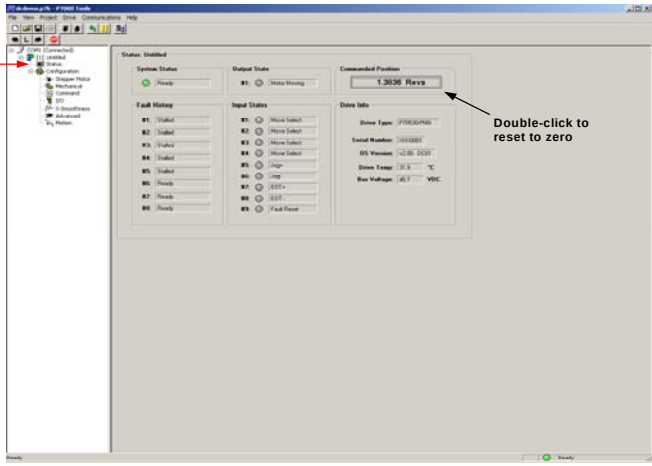


- Select either P70360 AC or P70530 DC unit.
- Add New Drive
  Add additional units.
- Enter a Name for this configuration
  This is the name for the unit or axis.

4.5 CONFIGURATION AND UNIT ADDRESS



4.5.1 STATUS SCREEN



System Status

Disconnected	Not online with the drive. Indicator off.
Disabled	Drive blinking green indicates online, but not enabled.
Ready	Drive online and enabled. Solid green indicator.

Output State

Offline	Not connected to a drive. Indicator gray.
Online	Indicator is green when programmed output condition is met.

Fault History List of the last nine drive faults. #1 being the most recent, #8 is the oldest.

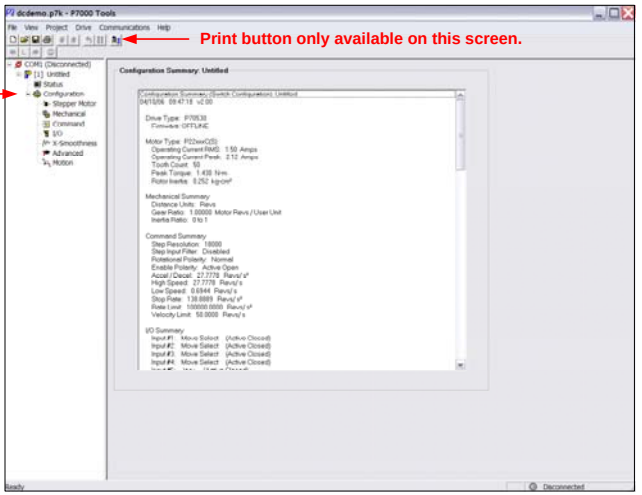
Input States Indicator is green if the input is true, gray if false.

Commanded Position Actual motor position in user units (double-click in box to reset to zero).

Drive Information

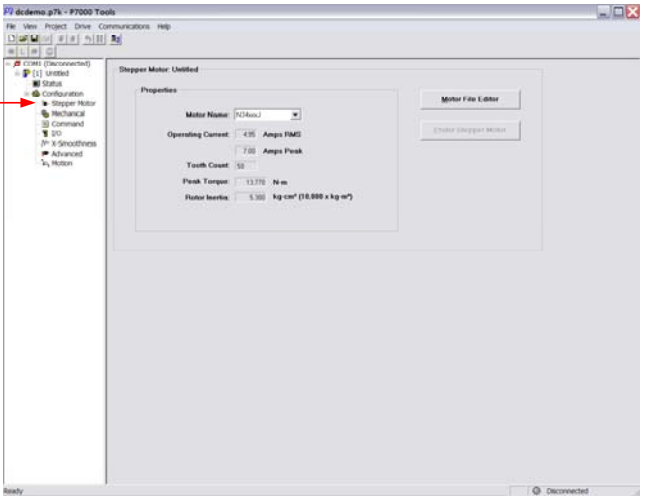
Drive Type	Model number for this drive.
Serial Number	Serial number for this drive.
OS Version	Current firmware revision level.
Drive Temp	Drive temperature in degrees Celsius.
Bus Voltage	DC Bus voltage

4.5.2 CONFIGURATION SUMMARY



The configuration summary is displayed.

4.5.3 STEPPER MOTOR SCREEN



Motor Name Select from the list or create a custom file using Motor File Editor (see section 4.5.3.1 for details).

Operating Current

A_{RMS} Continuous current rating for the selected motor.

A_{PEAK} Peak current rating for the selected motor. (Calculated by GUI based on continuous current rating.

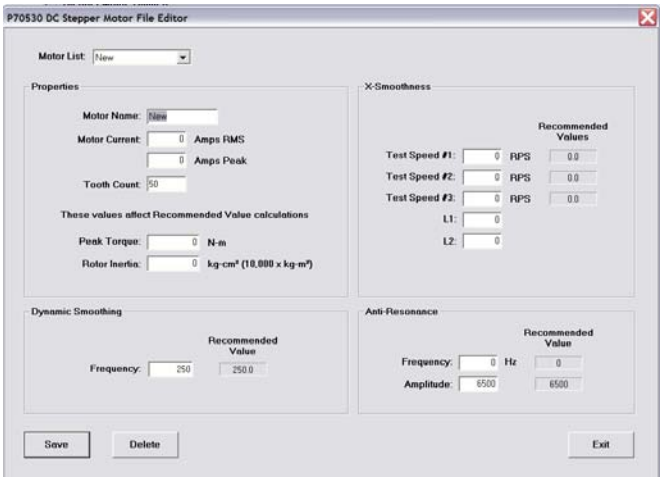
Tooth Count Number of magnetic poles on the stator.

Peak Torque Peak torque capability of the motor N-m.

Rotor Inertia Rotor inertia of the motor kg-cm^2.

Probe Stepper Motor When a new motor is selected, you are prompted to allow a PROBE. This is similar to what an inductance meter does to measure inductance. The P7000 uses a more powerful test signal, which makes an audible tone in the motor. The probe action takes 10 to 20 seconds, during which time, the drive is gathering information needed to operate state observers. It may be desirable to manually start a probe using the PROBE STEPPER MOTOR button. This would be done if a motor were replaced by a unit of the same type.

4.5.3.1. Motor File Editor



Motor List List box that contains all of the motor file configurations available in the database on this PC. Select a motor from this list to edit or select NEW to configure a new motor.

Properties:
This screen is where you will enter custom motor parameters. The steps to define a custom motor are:

The Properties box must be populated with values from a motor data sheet. All other values are calculated by the GUI software.

NOTE

Motor Name Enter an appropriate motor name.

Motor Current: Continuous current rating of the motor (A_{RMS}). A_{PEAK} is automatically calculated by the GUI software.

Tooth Count Total number of magnetic poles on the motor stator. The default is 50.

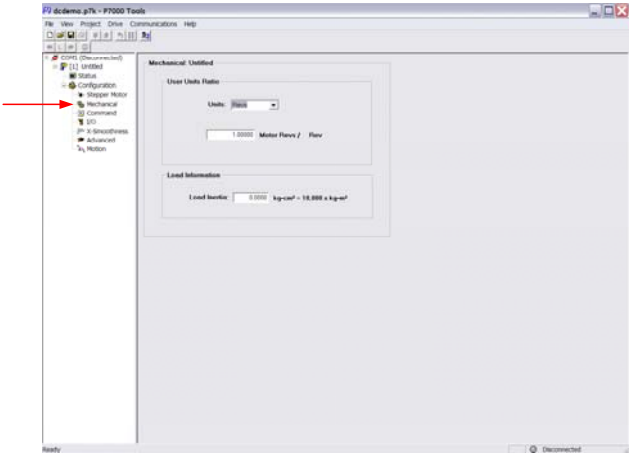
Peak Torque Peak output torque of motor in N-m.
Rotor Inertia Inertia of motor rotor in kg cm^2.

Frequency equations illustrated later use rotor inertia in units of kg m^2

NOTE

The other screens in the Stepper Motor File Editor are referenced in the following sections: Dynamic Smoothing 4.5.8.3; X-Smoothness 4.5.7; Anit-Resonance 4.5.8.1

4.5.4 MECHANICAL



4.5.4.1. User Units Ratio

These values are used as parameters by the Move Profile Editor.

NOTE

Units Can be set to one of the following:
Steps
Revolutions
Millimeters
Inches

Motor revs/rev This is a scaling function used in the Motion Node to accommodate a gearbox.
Example:
— 2:1 Gearbox
— Enter 2 motor revs/rev
— Enter a Distance of 1 rev in a given motion profile

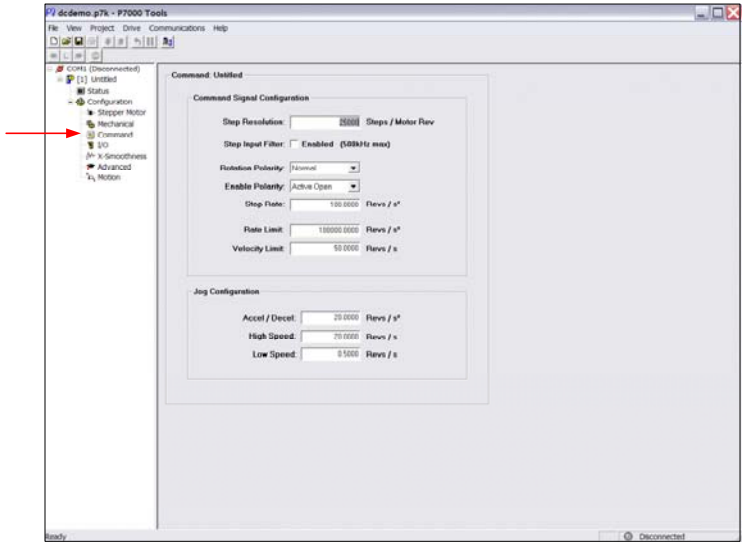
Result:
The motor advances 2 revolutions to obtain 1 revolution of the gearbox.

4.5.4.2. Load Information

The anti-resonance, stall detect, and dynamic smoothing features require the adjustment of various parameters, depending upon the ratio of Load-to-Rotor inertia. If the ratio is unknown, use an educated guess. The drive easily tolerates a 30% - 40% error.

If the selection is set unrealistically high, the anti-resonance damping may be ineffective. If set too low, dynamic performance may be somewhat reduced.

4.5.5 COMMAND CONFIGURATION



Command Signal Configuration

Here you can check the Step Resolution, Rotation Polarity, Enable Polarity, Stop Rate, Rate Limit, and Velocity Limit.

Step Resolution 200 to 50,000 steps per motor revolution.

NOTE

When using a controller, set the drive resolution equal to the controller resolution. This is particularly important if there is position feedback to the controller.

Step Input Filter Check to enable low pass cutoff filter at 500 kHz to reduce response to high frequency noise.

Rotation Polarity Changes direction of motor rotation for a given input command.

Enable Polarity

Active Open	Drive is enabled upon power up or external switch must ***OPEN*** to ENABLE drive.
Active Closed	External switch must ***CLOSE*** to ENABLE drive.
Stop Rate	Used by Motion Profile Generator to terminate a programmed move.
Rate Limit	Global limit on ACCEL/DECEL in programmed moves.
Velocity Limit	Global limit on the velocity of programmed moves and jog speeds.

Jog Configuration

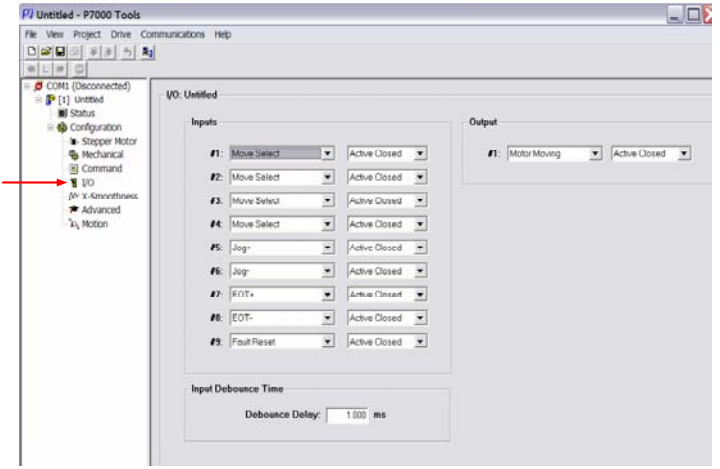
Here you can set the Acceleration/Deceleration, High and Low speeds.

NOTE

These parameters control ACCEL/DECEL and jog speeds that are generated by jog commands from within the user interface or the I/O.

ACCEL/DECEL	Global limit on jog acceleration/deceleration.
High Speed	High jog.
Low Speed	Low jog.

4.5.6 I/O CONFIGURATION



4.5.6.1. INPUTS

These nine configurable inputs can be configured as a group as either sinking or sourcing. Individually, they can be configured as either Active Closed or Active Open. All inputs, regardless of function, are subjected to digital debouncing and Debounce Delay is applied globally. Debounce logic requires an input state to persist for the programmed time before being recognized.

There are some assumptions about the use of these inputs when using them for Move Select that must be understood. Only the first six inputs may be configured as Move Select Inputs with DINP1 being the LSB (Least Significant Bit).

Input Funtion	Description
EOT+	Stops motion in a positive direction when transitioned from inactive to active.
EOT-	Stops motion in a negative direction when transitioned from inactive to active.
Home	A home input is used by the internal move engine during a Home maneuver.
Jog+	Jogs the motor in a positive direction.
Jog-	Jogs the motor in a negative direction
Jog Speed	Selects high or low jog speed.
Fault Reset	Clears latched fault condition and resets the position counter.
Move Select	Functions as one bit of a binary number (up to 6 bits) for selecting pre-programmed moves. The combination of states on the assigned Move Select inputs serves to define a SELECTED MOVE. (See section 4.5.9)
Start Move	Transition to active triggers the move engine to begin the selected move. If a Start Move input has not been assigned, moves are triggered by the appearance of a non-zero value at the Move Select inputs.
Start/Stop Move	Similar to Start Move except that this type of input automatically becomes a Stop input once motion is begun.
Stop Move	Transition to active causes the move engine to decelerate to a controlled stop.
Stop Move on Edge	Move stops on leading edge of input transition.
No Function	Input has no effect.

4.5.6.2. Input Debounce Time

Requires an input state to persist for the programmed time before being recognized.

4.5.6.3. Output

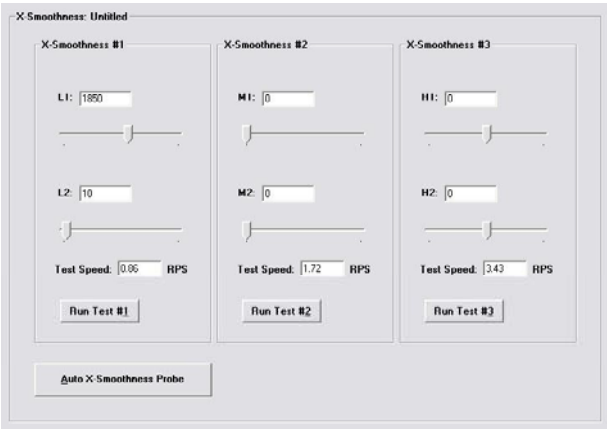
This output can be configured as Active Closed or Active Open.

Output Function	Description
EOT Latched	Indicates that an EOT has been encountered and the motor has not been moved back off the sensor.
Motor Moving	Motor is rotating.
Motion Node Active	Motion Node is still processing a move, including any programmed time delay.
Stalled	Indicates that the drive has detected a stall.
No Function	Output will not be asserted.

The GPO+ and GPO- are the isolated (collector – emitter) terminals of an optocoupler. They must be attached to a pull-up and signal common of the machine control system (see General Purpose Output (J4-21, 22) – section 2.2.1.6).

4.5.7 X-SMOOTHNESS

Adjusting your Motor for Maximum Smoothness with the X-Smoothness Feature



The X-Smoothness feature helps eliminate undesirable motor vibration effects due to the 3 major resonance frequency responses: Fundamental, 2nd Harmonic and 4th Harmonic. The X-Smoothness settings allow you to enter compensation values, which cancel these resonance responses.

X-Smoothness #1:

- **L1** Amplitude adjustment for 4th harmonic
- **L2** Phase adjustment for 4th harmonic

NOTE

All Danaher Motion's standard motors, which have been characterized for use with the P7000 drive, have nominal values for L1 & L2 stored in the motor files. Variances in the materials and magnets of two-step motors of the same type can affect comparable motor performance by as much as ±10%. Due to these variances, the nominal settings may not be the best possible settings for a given motor.

X-Smoothness #2:

- **M1** Amplitude adjustment for 2nd harmonic
- **M2** Phase adjustment for 2nd harmonic

X-Smoothness #3

- **H1** DC offset adjustment for phase A
- **H2** DC offset adjustment for phase B

Procedure for Achieving Optimum Performance

Step 1: Run the Auto X-Smoothness Probe **on the unloaded motor**. The X-Smoothness Probe typically comes within 95% of the best adjustment values and finds the exact test speeds for the given motor.

Step 2: Run each X-Smoothness group at the given test speed and verify the motor smoothness. You may find a better smoothing value by slightly moving the slider bars back and forth.

It is very important to make the X-Smoothness adjustments at the proper test speeds with an unloaded motor. Running at an incorrect test speed will not excite the motor at its peak resonance, making it more difficult to find proper adjustment values. Running the tests with a loaded motor moves the resonance frequency and the calculated tests speeds no longer apply.

Test Speed #1 Test speed which generates the excitation frequency for the X-Smoothness #1 compensation adjustment

$$\text{Test Speed \#1} = \sqrt{\frac{T_{\text{max N·M}}}{16 \bullet \text{Toothcount} \bullet J_{\text{Rotor kg·m}^2}}}$$

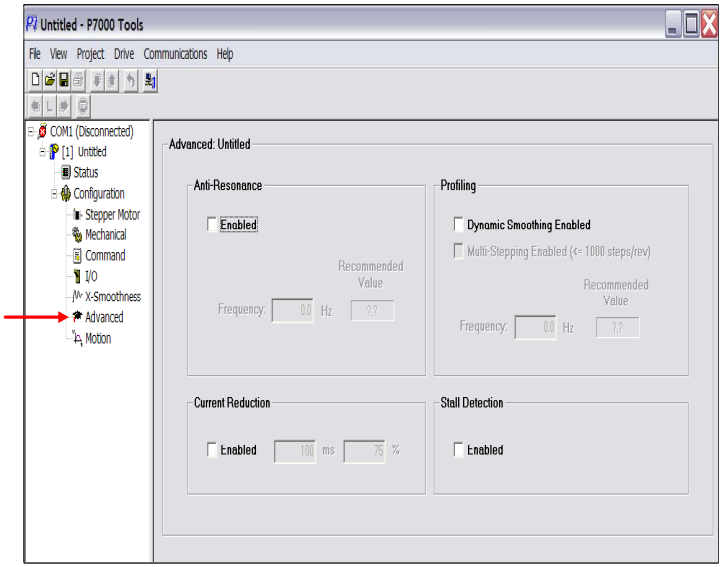
Test Speed #2 Test speed which generates the excitation frequency for the X-Smoothness #2 compensation adjustment

$$\text{Test Speed \#2} = \sqrt{\frac{T_{\text{max N·M}}}{4 \bullet \text{Toothcount} \bullet J_{\text{Rotor kg·m}^2}}}$$

Test Speed #3 Test speed which generates the excitation frequency for the X-Smoothness #3 compensation adjustment

$$\text{Test Speed \#3} = \sqrt{\frac{T_{\text{max N·M}}}{\text{Toothcount} \bullet J_{\text{Rotor kg·m}^2}}}$$

4.5.8 ADVANCED SETUP



4.5.8.1. Anti-Resonance

Step motors are highly resonant, which results in vibration and ringing. The ringing utilizes a large fraction of the motor's available torque – thereby wasting performance. Furthermore, at mid-range velocities, the resonance can become so severe that the motor looses synchronization and stalls. The P7000 drives provide robust anti-resonance control to stop the vibrations and maintain equilibrium. This feature requires that the drive be configured with respect to the total inertia in the system. The rotor inertia and the Load-to-Rotor inertia ratio are set in the Mechanical screen. If set improperly, the effectiveness of the feature may be diminished.

The anti-resonance check box is used to invoke or disable the feature. It should be enabled unless the system configuration either does not need it or cannot tolerate it. A system with loose couplings or viscous loading generally does not need this feature. If a system has compliant (springy) coupling and is absent appreciably viscosity, it may not respond well to the active, anti-resonant loop in the drive. The anti-resonant feature is not designed to damp such a 4th order system. If the application of anti-resonance results in degradation or instability, it should be disabled (unchecked).

Frequency Break frequency of anti-resonance tuning filter. Typically set to 1/10 the resonant frequency of the motor.

$$\text{ARes Frequency} = \sqrt{\frac{\text{ToothCount} \bullet T_{\text{max N·M}}}{100 \bullet J_{\text{Rotor kg·m}^2}}}$$

Amplitude Set to 6500 nominal. Do not alter this value unless advised by technical support.

4.5.8.2. Current Reduction

Unlike a servo system, the step motor is left energized – even at rest. This leaves full torque available to oppose external disturbing influences and hold position precisely. However, many applications encounter vanishingly small load effects at rest and may benefit from the reduction of current when not moving. The reduced level is programmed as a percent of full current and the time delay is entered in milliseconds (ms). The drive will gently reduce the current to the programmed value after the motor has been at rest for a specified time. If the box is left unchecked, the numeric entries have no effect and full current is maintained at rest.

Motor heating is proportional to the square of the current. Thus, a reduction of 70% current represents a reduction to 50% power. Current reduction has little effect as long as the resting motor is not opposing a continuous torque as in lifting applications. If a disturbing torque is present, the current reduction will result in a small amount of movement. The current vector is restored to full value the instant an incoming step is received or the move engine begins a move.

4.5.8.3. Profiling

Multi-stepping refers to the process of altering the acceleration in the command sequence to reduce Jerk. Acceleration transients jar the application and may cause unwanted vibrations. When Dynamic Smoothing is enabled, the moment-to-moment move profile is passed through digital filters to smooth out the acceleration/deceleration transients. If the feature is enabled, a value is recommended for the frequency of the filters. This recommendation is based on the moment of inertia of the motor, the load-to-rotor inertia ratio, and torque production specified in the configuration. That recommendation should be accepted, unless it is desired to filter more aggressively. If the application uses course resolution such as 200 or 400 steps/rev, it may be quite helpful to invoke Multistepping (checkbox). This is a very aggressive use of the smoothing filter, which will make full stepping appear almost as smooth as microstepping.

Heavy filtering is accompanied by a small delay of the command sequence. All causal low-pass filters have group delay, which is inversely proportional to the bandwidth. In this case, the delay is 0.22/BW. Multistepping cuts the bandwidth to 1/10 the value shown in the frequency box.

Dynamic Smoothing is the process whereby the incoming pulse train or move profile is filtered in such a way as to sharply reduce Jerk. This results in a more quiet system and reduces the excitation of mechanical resonances.

The more heavily the filtering is applied, the smoother the commanded motion becomes. Heavy filtering is necessarily accompanied by group delay.

The drive uses information about load-to-rotor inertia ratio to predict the resonant frequency fr of the system. The various levels of filtering introduce a second-order, low-pass filter into the command sequence, according to the following table.

Dynamic Smoothing:

Frequency: Break frequency of a second order command input filter. Typically set to 1/3 the natural frequency of the motor.

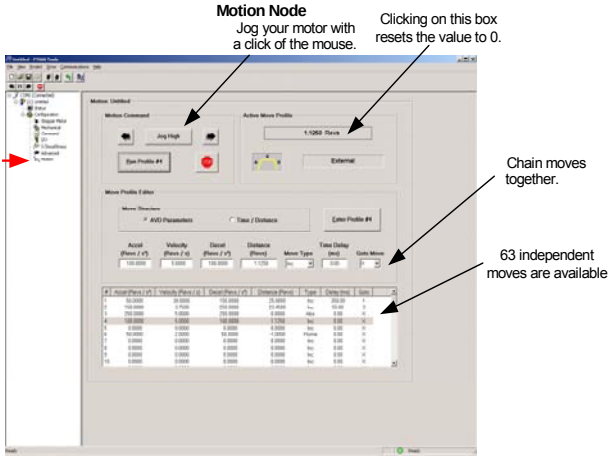
$$\text{Smoothing Frequency} = \sqrt{\frac{\text{ToothCount} \bullet T_{\text{max N·M}}}{9 \bullet J_{\text{Rotor kg·m}^2}}}$$

4.5.8.4. Stall Detection

Stall Detection is enabled and disabled using the check box. Stall detection should be disabled if it failed to operate correctly and rendered nuisance stall indications. This may occur with non-standard motors from other vendors. If an application is suspected of causing nuisance stall indications, try disabling the feature and running the move sequence. If the system makes the move without losing synchronism, then it is likely that nuisance trips have occurred.

4.5.9 MOTION PROFILE GENERATOR

Once the system is configured you can select Motion Generator by double clicking on the motion folder.



The Motion Profile Generator selects the Move Structure (Acceleration-Velocity-Distance [AVD] or Time-Distance [T/D]), and enters the parameters for a stored move. Once a move has been composed, it must be entered using the Enter Profile button.

Moves may be entered in any order and edited at will. A move profile is brought to the edit line by clicking on it in the move list. To enter a new move, click on it in the list and select a structure (AVD or T/D). Enter the various parameters represented in user unites as defined in the Mechanical screen.

NOTE

If the Enter Profile button is not clicked, the move is not stored and is lost. Once a move is stored, its parameters appear in the move list.

The most popular move structure is AVD. The programmer must specify both acceleration and deceleration rates along with velocity, distance, move type, time delay, and GoTo index, if needed.

For convenience, a move may be copied, pasted, or deleted by right-clicking on the target in the move list. Moves are anchored to the index at which they are entered. Deleting a move does not cause the others to shift up to fill the gap. The only way to relocate a move is to copy, paste, and then delete from the original position.

It is impossible to enter a set of move parameters that are inconsistent. For instance, it may be impossible to reach the target velocity using the specified acceleration in the programmed distance. If the programmed parameters do not define an attainable trapezoidal move, the Generator offers to collapse the move into a triangular profile by adjusting the velocity. The move engine cannot execute moves that have inconsistent parameters.

Individual Motion Profiles are executed in the following manner:

Up to six of the digital inputs may be programmed as Move Select. These inputs now function as binary coded decimal bits. Inputs must be programmed for this function, starting with the LSB-Input #1 and proceeding sequentially until the desired number of inputs are programmed for Move Select.

Input	Binary	Decimal
1	2^0	1
2	2^1	2
3	2^2	4
4	2^3	8
5	2^4	16
6	2^5	32

Initiating a programmed move from a controller works by one of the following methods:

METHOD 1:

1. Assert a logic signal on the appropriate MOVE SELECT inputs. For example, to execute Move #3, assert a logic signal on MOVE SELECT inputs 1 and 2.
2. Assert a logic signal on START MOVE. The drive scans the MOVE SELECT inputs and executes the selected move. This input is edge triggered.
3. MOVE SELECT input signals may now be terminated along with the START MOVE input.

METHOD 2: You may initiate a move without using START MOVE. You are limited to the following moves: 1, 2, 4, 8, 16, 32. To do this, configure as many MOVE SELECT inputs as required and ***DO NOT*** configure an input as START MOVE. Triggering the appropriate MOVE SELECT input initiates the selected move.

NOTE

Method 1 requires that one input be programmed as Start Move. Method 2 does not.

NOTE

You need not configure more inputs for Move Select than you actually need. For example, if you have only four programmed moves, configure only Inputs 1, 2, and 3 for Move Select.

NOTE

Move Select inputs must be consecutive. It is suggested to start with input 1 and work down.

5. TROUBLESHOOTING

5.1 *COMMON PROBLEMS*

Problems	Possible Fixes
Motor spins in wrong direction	Reverse wires on one phase. Change direction polarity using P7000Tools
Motion Profiles in table will not execute	The P7000 Drive is the SDN version not the PNN version,
Drive Overheats	Lower ambient temperature. Provide fan cooling. Reduce system throughput.

5.2 *STATUS DISPLAY*

There are 7 faults that may occur with the P7000 drive. The fault output latches when they occur. Determine the type of fault by viewing the front panel or through the serial port. The front panel LED turns red and blinks according to the table below.

LED Color	Blinks	Description	Cause	Solution
Green	Solid	System OK	NA	NA
Green	1	Amplifier is disabled	The enable input (J4-5 & J4-6) is not asserted if ENABLE is configured ACTIVE CLOSED or the enable input is asserted if ENABLE is configured ACTIVE OPEN.	De-assert the enable input or disable the soft shutdown from P7000Tools.
Red	Solid	FLASH memory fault	A FLASH memory checksum validation has failed indicating corruption of the operating system. This typically occurs during firmware download.	Without attempting to connect to the drive, download the most current firmware file from the P7000Tools menu option Drive->Update Operating System…. If the FLASH download utility fails, contact technical support.
Red	1	Stall Fault	The Encoderless Stall Detection feature has detected that the motor has slipped or stalled.	Reduce move profile acceleration, velocity, deceleration or load inertia. Power cycle or reset drive via Fault Reset input or P7000Tools.
Red	2	Over-current Fault	An event has occurred which caused the amplifier output current to exceed 5.6 amps.	Check motor wiring for shorts. Power cycle or reset drive via Fault Reset input or P7000Tools.
Red	3	Over-voltage Fault	A regenerative event has occurred which forced the bus voltage above 91 VDC. Incoming AC line voltage too high.	Reduce deceleration, load inertia, or reduce deceleration duty cycle to allow enough time for the power dump circuit to recover. Power cycle or reset drive via Fault Reset input or P7000Tools.
Red	4	Drive Over-temp Fault	The temperature of the heatsink has exceeded 70° C.	Reduce ambient temperature or system duty cycle. Power cycle or reset drive via Fault Reset input or P7000Tools.

LED Color	Blinks	Description	Cause	Solution
Red	5	System Fault	An error occurred while attempting to converge on a solution while running the Motor Probe or Auto X-Smoothness Probe.	Power cycle or reset drive via Fault Reset input or P7000Tools.
Red	6	Under-voltage Fault	Attempting to operate the unit at a bus voltage below 10 VDC. Incoming Power Supply voltage too low.	Power cycle or reset drive via Fault Reset input or P7000Tools.
Red	7	EEPROM Checksum Fault	User non-volatile memory checksum validation has failed indicating user setup corruption.	Restore default configuration from the P7000Tools menu option Drive->Restore Default Configuration…
Red	8	Open Phase Fault	A motor phase is open	Check continuity of motor cable and motor windings.
Red	Constant Blinking	Processor Fault	Illegal Address	Contact technical support.
Alternating Red & Amber	Multi	Processor Fault	Internal system error.	Contact technical support.
Alternating Red & Green	Fast	Motor being probed	Part of setup process.	
Alternating Red & Green	Slow	End of Travel	An End of Travel input has been activated	Determine cause of activation.

The blinking continues until the drive is reset by one of the following methods:

- Power Cycle
- GUI Control
- Fault Reset (Configurable General Purpose Input)

5.3 *SAFETY*

As the user or person applying this unit, you are responsible for determining the suitability of this product for the application. In no event will Danaher Motion be responsible or liable for indirect or consequential damage resulting from the misuse of this product.

Read this manual completely to effectively and safely operate the P7000.

Comply with the applicable European standards and Directives.

In Germany, these include:

- DIN VDE 0100 (instructions for setting up power installations with rated voltages below 1000 V).
- DIN - EN 60204 - Part 1, (VDE 0113, part 1) instructions relative to electric equipment in machines for industrial use.
- DIN EN 50178, (VDE 0160) instructions relative to electronic equipment for use in power installations.

Insure that the motor's case is connected to PE ground. The fifth wire in the motor cable connecting J6,5 to the motor case accomplishes this.

Motor case grounding

CAUTION

If the motor is not properly grounded, dangerous voltages can be present on the motor case due to capacitive coupling between the motor windings and case.

Requirements for Safe Operation of the Drive

It is the machine builder's responsibility to insure that the complete machine complies with the Machine Directive (EN60204). The following requirements relate directly to the stepper controller:

Emergency Stop

CAUTION

If personal injury can result from motor motion, the user must provide an external hardwired emergency stop circuit outside the drive. This circuit must simultaneously remove power from the drive's motor power terminal J6-$\overline{A}$, J6-A, J6-$\overline{B}$, and J6-B.

Note: The motor will coast under this condition with no braking torque.

Note: The drive must be disabled at least 1 ms prior to interrupting motor conductors

Avoiding Unexpected Motion

CAUTION

Always remove power from J7 and wait 2 minutes before working on the machine or working anywhere where injury can occur due to machine motion.

Avoiding Electrical Shock

CAUTION

Never power the stepper drive with the cover removed or with anything attached to circuitry inside the cover.

If the drive must be removed from the cabinet, wait at least five minutes after turning off power before removing any cables from the drive or removing the drive from the mounting panel. To be safe, measure the electrical contact points with a meter before touching the equipment.

Never connect or disconnect any wiring to the drive while power is applied. Always power down and wait two minutes before connecting or disconnecting any wires to the terminals.

Avoiding Burns

The temperature of the drive's heat sink and housing may exceed 70°C. Therefore, there is a danger of severe burns if these regions are touched.

CAUTION

Preventing Damage to the Drive

Follow these guidelines to prevent damage to the stepper drive during operation:

- Never plug or unplug connectors with power applied.
- Never connect or disconnect any wires to terminals with power applied
- If the drive indicates a fault condition, find the cause of the fault and fix it prior to resetting the fault or power-cycling the drive.

5.4 *FIRMWARE UPGRADE PROCEDURES*

1. Note the current operating system version is the Status screen.
2. Check Danaher Motion's website to see if a new version is available.
3. Download the new version (if appropriate) and move it into the P7000 directory.
4. Perform the following steps in P7000Tools:

Save your current drive configuration file and rename it or it will be erased during this process

NOTE

a. Establish communication between the PC and the drive.
b. Select DRIVE.
c. Select DRIVE OPERATING SYSTEM.
d. Review and answer YES to the first prompt if you wish to proceed.
e. Review and answer YES to the second prompt is you wish to proceed.
f. Select the version of firmware you wish to load. If your current version is vXXXpilt.dcv, select the newer version of the vXXXpilt.dcv. If your current version is vXXXB_A1.dcv, select the newer version vXXXB_A1.dcv.
g. The loader will now execute the download to the drive.

APPENDIX A

A.1 POWER SUPPLY SELECTION

The power supply MUST have an output capacitor that meets the drive minimum requirements. In an unregulated supply the Cbus min requirements are normally met by the output filter capacitor built into the power supply. If a regulated power supply is used, Cbus min should be added across the output of the supply.

The DC P7000 drive has a small internal bus capacitor of 200 µf. This absorbs most of the high frequency PWM ripple current, but it is not large enough to handle the peak power demands of the motor during rapid acceleration and deceleration.

WARNING

➔Do not skimp on Bus Capacitance.

Drives are difficult loads for supplies. Drives can have high peak power flows in and out as the load accelerates and decelerates. The DC P7000 does not have any internal means to dissipate regenerated motor energy. Energy regenerated back to the supply must be absorbed capacitively with a limited increase in bus voltage.

For a single drive load related energy flows in the bus are approximately proportional to motor current and bus voltage, so the minimum bus capacitor is selected so that capacitive energy storage scales with motor current and bus voltage. Capacitance rises as bus voltage drops to compensate for the fact that energy storage in a capacitor goes down as the square of voltage.

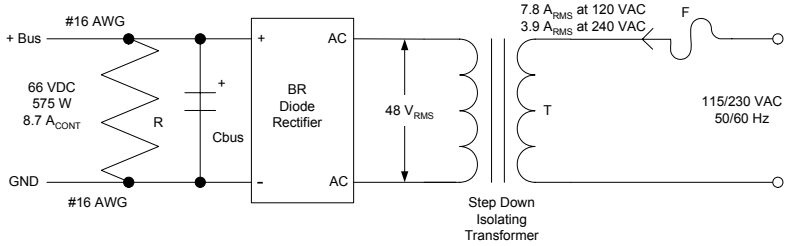
A.2 CBUS MIN

Motor Current (rms per phase)	Bus Voltage		
	24 V nom	48 V nom	75 V nom
5 A	18,000 µf	9,000 µf	6,000 µf
3 A	10,800 µf	5,4000 µf	3,600 µf
1.5 A	5,400 µf	2,700 µf	1,800 µf

Capacitor type is a general purpose, 85C, aluminum electrolytic, screw terminal, can. For 75 V bus select a 100 V rated capacitor; for a 48 V bus select a 63 V or 75 V rated capacitor; for a 24 V bus select a 35 V or 40 V rated capacitor. For example, Cornell Dubilier DCMC, 85C, High Capacitance, Computer Grade, Aluminum.

6,000 µf, 100 V DCMC602U100EA2B 1.75 in dia x 2.125 in

Example of a Simple, Unregulated, Isolated Offline DC Power



Vbus Spec

79 VDC at 0 W load, 264/132 VAC line

69 VDC at 0 W load, 230/115 VAC line

66 VDC at 575 W load, 230/115 VAC line

56 VDC at 489 W load, 195/98 VAC line

Materials

T — 115/230 VAC to 24/48 VAC step down transformer, 900 VA, 4,000 V Isolation
5.25 x 5.2 x 4.8, ht 20 lb, Signal MPI-900-48

BR — 25 A, 200 V, single phase bridge rectifier, 1.14 x 1.14
General Semiconductor GBPC2502

Cbus — 20,000 µf, 100 V aluminum capacitor, computer grade, 85C, 2 dia x 4.125 ht
Cornell Dubilier DCMC203U100BC2B

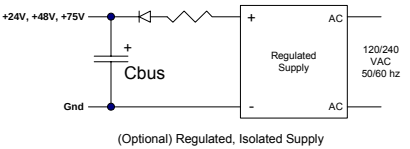
F — 250 VAC, Type 3AB, slo-blo fuse, 1.25 x 0.25
115 VAC line: 15 A rated, Littlefuse 326015
230 VAC line: 7 A rated, Littlefuse 326007

R — 1 k, 10 W, wirewound, aluminum housed chassis mount resistor, 1.42 x 0.62
Huntington Electric TMC-10-1-0K

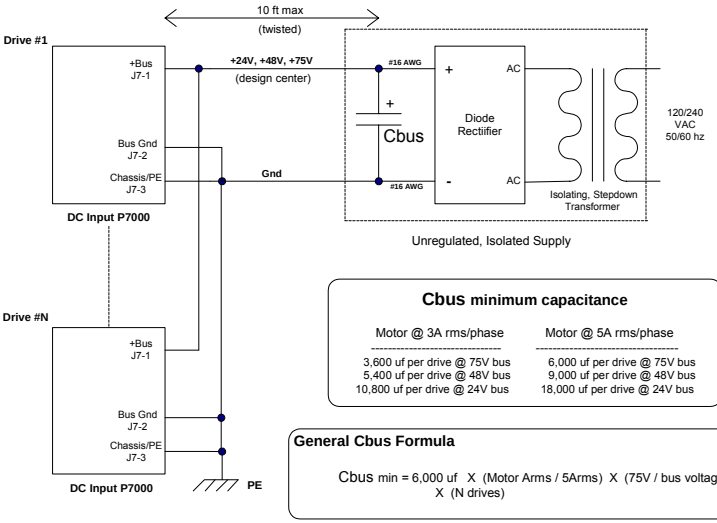
For multiple drives on the same supply a conservative rule is to scale up the capacitance by the number of drives on the supply. For a large number of drives on the same supply with moves that are uncorrelated it may be adequate to increase the minimum capacitance by the square root of the number of drives.

$$C_{bus\ min} = 6{,}000\ \mu f\ X\ (motor\ A_{RMS}/5A_{RMS})\ X\ (75\ V/bus\ voltage)\ X\ (\#\ of\ Drives)$$

The recommended minimum capacitance will handle matched inertias with most motors, but if the application has high regenerated energy, then more bus capacitor than the minimum may be needed.



(Optional) Regulated, Isolated Supply



Unregulated, Isolated Supply

Cbus minimum capacitance

Motor @ 3A rms/phase	Motor @ 5A rms/phase
3,600 uf per drive @ 75V bus	6,000 uf per drive @ 75V bus
5,400 uf per drive @ 48V bus	9,000 uf per drive @ 48V bus
10,800 uf per drive @ 24V bus	18,000 uf per drive @ 24V bus

General Cbus Formula

Cbus min = 6,000 uf X (Motor Arms / 5Arms) X (75V / bus voltage) X (N drives)

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Sales and Service

Danaher Motion is committed to quality customer service. Our products are available world-wide through an extensive authorized distributor network. To serve in the most effective way, please contact your local sales representative for assistance. If you are unaware of your local sales representative, please contact us.

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