HAS 500 Ethernet Quick Reference

0991760***-**IP/IM-XXXX-A Ethernet Communications

Modular Dive Systems for AC Motors (Series “A”)

AC890SD (Standalone) Drives - Frames B, C &D with STO SIL3/PLe

ENGINEERING YOUR SUCCESS.

In line with our policy of continuing product improvement, specifications and information contained in this catalog are subject to change.

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Safety

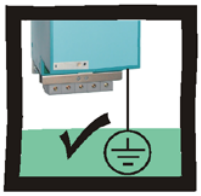
IMPORTANT *Please read this information BEFORE installing the equipment.*

This manual is for anyone installing, operating and servicing this unit.

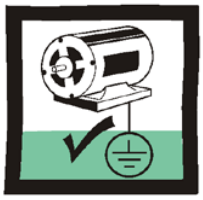
You must be technically competent to install and operate this unit.

Before working on the unit, isolate the main supply from terminals L1, L2 and L3 and wait 3 minutes

Disconnect the unit from circuits when doing high voltage resistance checks.



The unit must be **permanently earthed** due to high earth leakage current



The drive motor must be connected to an appropriate safety earth.

Electrostatic discharge sensitive parts: observe static control precautions.

Copy existing 890 parameters to any replacement 890 unit.

Hazard to Personnel

WARNING!
This equipment can endanger life through rotating machinery and high voltages. Failure to observe the following will constitute an ELECTRICAL SHOCK HAZARD.
Metal parts may reach a temperature of 70 degrees Centigrade in operation.
Before working on the equipment, ensure isolation of the main supply from terminals L1, L2 and L3. The equipment contains high value capacitors which discharge slowly after removal of the main supply. Wait for a least 3 minutes for the dc link terminals (DC+ and DC-terminal voltage with a meter to confirm that the voltage is less than 50V.
do not apply external voltage sources (main supply or otherwise to any of the braking terminals (DBR+, DBR-, DC+, INT or EXT)

Application Risk
The specifications, processes and circuitry described herein are for guidance only and may need to be adapted to user's specific application.

Parker Hannifin Manufacturing Limited does not guarantee the suitability of the equipment described in the manual for individual applications.

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Risk Assessment

Under fault conditions, power loss or other operating conditions not intended, the equipment may not operate as specified. In particular:

- The motor speed may not be controlled
- The direction of rotation of the motor may not be controlled
- The motor may be energized

If the STO feature of the 890 drive is to be used, the user must undertake a risk assessment for the application. The user must then verify that their design, which includes the 890 drive, satisfies the Performance Level (PL) or Safety Integrity Level (SIL) required by the risk assessment.

Under no circumstances must the STO feature be used without first reading and fully understanding chapter 6 (Safe Torque Off) of the Engineering Reference Manual. All safety warnings therein must be observed.

Accessibility

All live power terminals are IP20 rated only, since the equipment is intended to be installed within a normally-closed cubicle or enclosure, which itself requires a tool to open.

Protective Insulation

- All control and signal terminals are SELV, i.e. protected by double insulation. Ensure all wiring is rated for the highest system voltage.

NOTE ***Thermal sensors contained within the motor must be single/basic insulated.***

- All exposed metalwork in the Drive is protected by basic insulation and bonding to a safety earth.

RCDs

Not recommended for use with this product. Where their use is mandatory, use only Type B RCDs (EN61009).

Caution

This is a product of the restricted sales distribution class according to IEC 61800-3. It is designated as “professional equipment” as defined in EN61000-3-2. Permission of the supply authority shall be obtained before connection to the low voltage supply.

HAS 500 Ethernet Quick Reference

Basic Setup instructions

For complete instructions please refer to HAS500 Ethernet Manual HY08-4005-M2

Complete generic drive instructions please refer to AC890 Manual HA468445U004

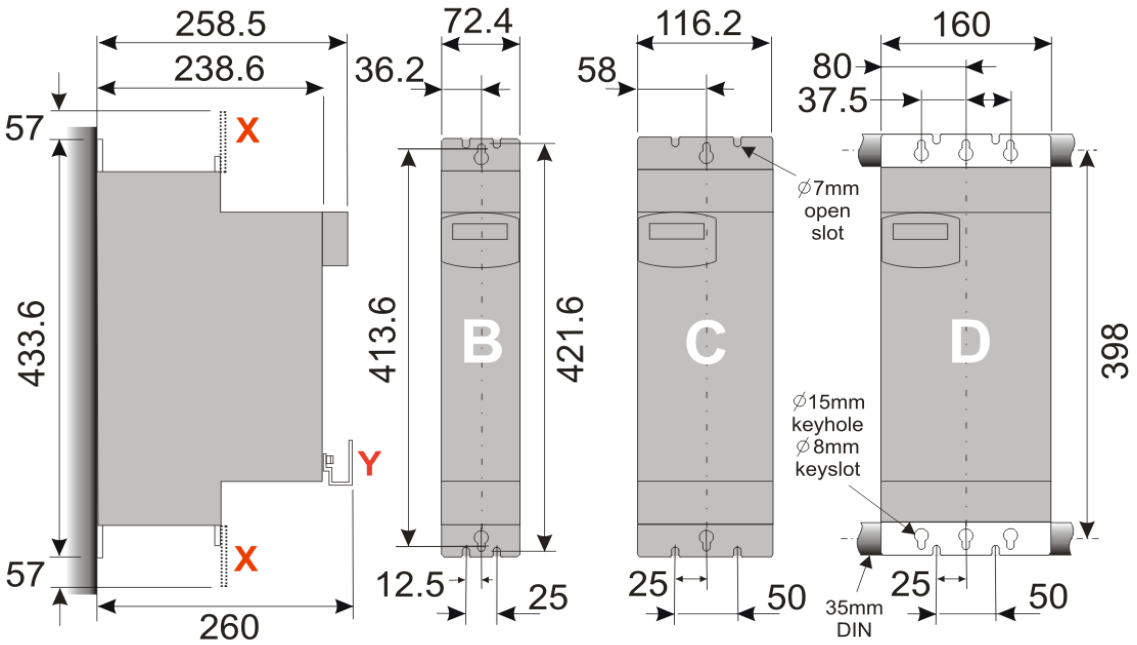
Basic Drive Setup Check List

1. Install drive in suitable enclosure, ensure environmental requires are met. (page 3)
2. Wire per state and local requirements, wiring details found on drawing number: 0991760_-_IP/IM-XXXX-A. (page 4)
3. Set Network IP Address (below)
4. Set Pump Displacement in Drive (page 16)
5. Determine Type of Operation needed
    a. Jog Mode (page 17)
    b. Run Mode (page 19)
    c. Proportional Mode (page 20)

Ethernet Communications Option

IP Address	192.168.1.10
Subnet Mask	255.255.255.0
Bit Order	Little Endian, Low word first

Drive Dimensions



Dimensions are in millimeters (*X: Power Bracket - 890 Installation Kit, Y: Control Bracket*)

The units must be installed in a cubicle. Mount the drive using the keyholes and slots or on a 35mm DIN rail using the 890 Installation Kit supplied.

How to Order Drive Kits

0991760* - XX XX - XXXX-A**

Base Drive

Cable Length
-10 = 10 FT
-15 = 15 FT
-25 = 25 FT
-50 = 50 FT

Communications 00 = Analog / Discrete IP = Ethernet IP
IM = Modbus TCP CT = EtherCat

Motor Configuration A09E = MPP0923D (240VAC) A09F = MPP0923R (460VAC) A10C = MPP1003C (240VAC) A10D = MPP1003R (460VAC) A11E = MPP1154B (240VAC) A11F = MPP1154P (460VAC) A14D = MPP1424R (460VAC) A14G = MPP1428Q (460VAC)

Drive kits include preprogrammed drive, power cable, feedback cable and DB15 breakout module for feedback connection.

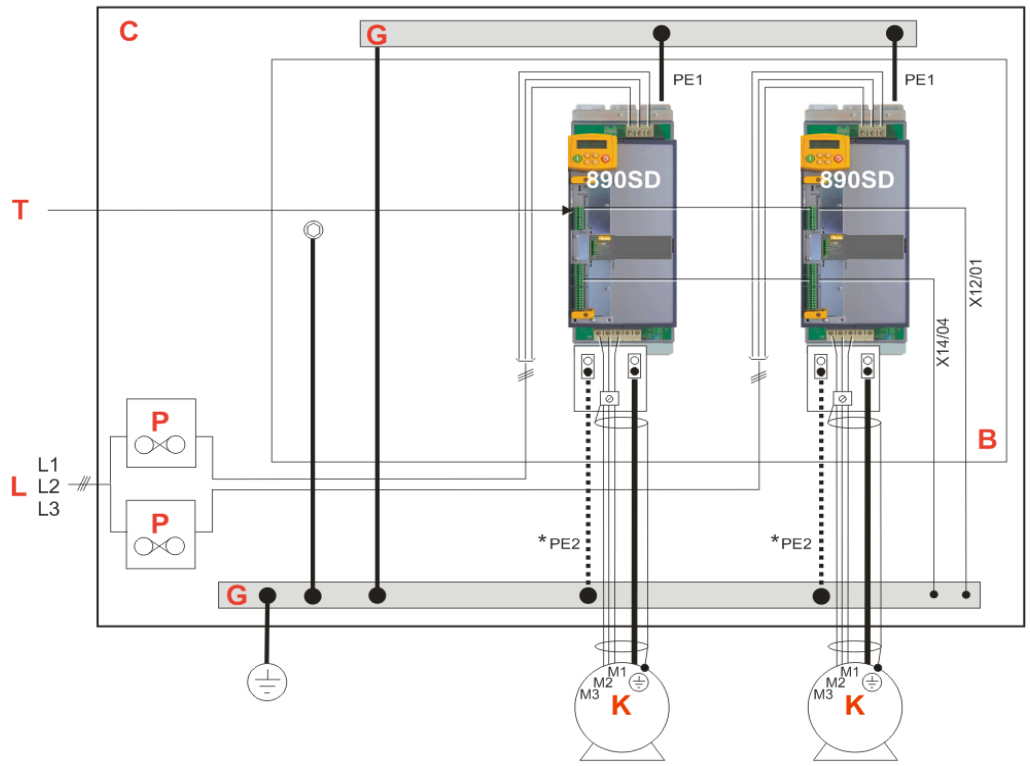
Drive Kit Number	Comon Options		Frame Size	Drive Amps	Voltage	Drive Part No
	Cable	Coms				
0991760101	00 = none	00 = Analog	B	8	230 VAC	890SD/2/0011B/B/00/A/US
0991760111	10 = 10 foot	IP = Ethernet IP	B	12	230 VAC	890SD/2/0016B/B/00/A/US
0991760122	15 = 15 foot	IM = Ethernet TCP	C	24	230 VAC	890SD/2/0024C/B/00/A/US
0991760132	20 = 20 foot		C	30	230 VAC	890SD/2/0030C/B/00/A/US
0991760201	25 = 25 foot		B	4	380-500 VAC	890SD/5/0006B/B/00/A/US
0991760211	50 = 50 foot		B	6	380-500 VAC	890SD/5/0010B/B/00/A/US
0991760221	XX = custom		B	10	380-500 VAC	890SD/5/0016B/B/00/A/US
0991760301			C	20	380-500 VAC	890SD/5/0024C/B/00/A/US
0991760312			C	25	380-500 VAC	890SD/5/0030C/B/00/A/US
0991760322			D	29	380-500 VAC	890SD/5/0039D/B/00/A/US

Installation

A simplified installation is shown below. The installation is not EMC complaint. For European installations and countries with EMC legislation refer to the 890 Engineering Reference Manual Appendix C.

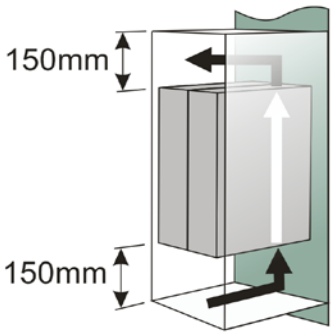
KEY

- **B** Back-plate
- **C** Cubicle
- **G** Supply Protective Earth/Ground
- **K** Motor (M1, M2, M3)
- **L** 3∅ Power Supply Cable (L1, L2, L3)
- **P** Fuse or circuit breaker
- **T** Control Wiring terminals



Ventilation

The drives can be mounted side-by-side with no clearance. A minimum of 150mm (6 inches) free-air space must be allowed at the top and bottom of each drive. If mounting drives above or below other equipment, the top and bottom distances should be added for overall clearance between drives.



Environmental Conditions

Operating ambient	0°C to 45°C (32°F to 113°F)
temperature Enclosure rating	IP20 – UL(cUL) Open type
Atmosphere	Dust free, non flammable, non-corrosive, <85% humidity, non-condensing

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DRAWING NO.
0991760***–**|*–****

OPTIONAL DISCRETE WIRING

HAS ORIENTATIONS:
"A" & "H", CLOCKWISE ROTATION EXTENDS CYLINDER
"B" & "C", COUNTER-CLOCKWISE EXTENDS CYLINDER

0991760*** - ** IP/IM-****-A

DRIVE SIZE
SEE CATALOG FOR
COMPLETE PART NUMBER

CABLE LENTGH

MOTOR VARIABLES

IP = ETHERNET IP
IM = ETHERNET TCP

IP ADDRESS: 192.168.1.10
SUBNET MASK: 255.255.255.0
BIT ORDER: LITTLE ENDIAN

SUGGESTED
SAFE TORQUE OFF
WIRING
SEE SECTION 6 OF MANUAL

+24VDC

460V 3PH POWER

FUSIBLE
DISCONNECT
NOT INCLUDED
IN DRIVE KIT

CB1

A

ENABLE LOGIC | CW CMD | CCW CMD | EXT LIMIT SWITCH | RET LIMIT SWITCH | RESERVOIR OIL LEVEL | CW LIMIT LS OR PSI | CCW LIMIT LS OR PSI | DRIVE FAULTED | SOURCING OUTPUTS

External 24V Pwr

X15-01 DIGITAL IN 1	X15-02 DIGITAL IN 2	X15-03 DIGITAL IN 3	X15-04 DIGITAL IN 4	X15-05 DIGITAL IN 5	X15-06 DIGITAL IN 6	X15-07 DIGITAL IN 7	X15-08 DIGITAL OUT 1	X15-09 DIGITAL OUT 2	X14-01 DIGITAL DOUT3A	X14-02 DIGITAL DOUT3B	X14-03 DIGITAL +24VDC	X14-04 DIGITAL 0 VDC	X13-01 +24VDC INPUT	X13-02 +24VDC INPUT	X13-03 0 VDC INPUT	X13-04 0 VDC INPUT

RJ45 CONNECTOR RESOLVER
FDBK OPTION: 8903/IP/FF
FDBK OPTION: 8903/IM/FF

10/100 Ethernet

– MMI CONN

LOCAL MMI KEYPAD: 6511
(MOUNTED ON DRIVE)
REMOVE WHEN USING REMOTE KEY PAD

X10 M-USB COMS

X11-01 STO A	X11-02 0V	X11-03 STO B	X11-04 0V	X11-05 STO STA TUSC(–)	X11-06 STO STA TUSC(+)	EARTH GND	L1 MAIN SUPPLY	L2 MAIN SUPPLY	L3 MAIN SUPPLY

890 HAS DRIVE

NETWORK COMMUNICATIONS OPTIONS &
SPEED FEEDBACK OPTIONS
REFER TO OPTIONS DWG
HB470916B005

DB15 CONNECTOR RESOLVER
FDBK OPTION: 8902/RE/FF

2 Amp @ 24VDC Rating

REFER TO FRAME B-D PRODUCT MANUAL HA468445U004

0V REF X12-01	AIN1 ANALOG X12-02	AIN2 ANALOG X12-03	AIN3 ANALOG X12-04	AIN4 ANALOG X12-05	AOUT1 ANALOG X12-06	AOUT2 ANALOG X12-07	+REF 10V X12-08	–REF –10V X12-09

X06-01 +24VDC INPUT	X06-02 0 VDC INPUT	X06-03 +24VDC OUTPUT	X06-04 0 VDC OUTPUT	EARTH GND	MOTOR O/P M1/U	MOTOR O/P M2/V	MOTOR O/P M3/W	X16-8 MOTOR THERM	X16-9 MOTOR THERM

WHITE | WHITE | BROWN | GRAY

RESERVOIR THERMISTOR | BLUE

ITEM

Cable Pin	Function Color Code
1	SIN– White/Yellow
2	SIN+ Yellow/Brown
11	COS+ Brown
12	COS– White
14	REF+ Red/Blue
17	REF– Gray/Pink
9	Thermal Gray
13	Thermal Pink

External 24V Pwr

C

HAS UNITS ORDER WITH HEAT EXCHANGER OPTIONS, EQUIPPED WITH SOLENOID

OR

RESERVOIR HEATERS

GRD | 1 | 3 | 2 | Thermal Gray | Thermal Pink

PLEASE NOTE:
MOTOR CONNECTIONS
WIRE NUMBERS
1, 3, 2, FOR U, V, W

FEEDBACK CABLE

DRIVES SHIPPED WITH JUMPER INSTALLED X16-8 & X16-9
FOR MOTOR PROTECTION REMOVE JUMPER AND CONNECT THERMISTER CONNECTION FROM FEEDBACK CABLE AS SHOWN

MOTOR CABLE NO. P-3R1-**

M

HAS PMAC MOTOR

+24VDC
GRAY
GREEN
PINK
YELLOW
WHITE
RED
SHIELD
POSITION FEEDBACK (MTS SHOWN)

+24VDC
1–BROWN
2–WHITE
3–BLUE
4–BLACK
5–GRAY
SHIELD
SCP01–5000P–47–07
PRESSURE TRANSDUCER
HEAD END
CABLE NO: 0975650000

+24VDC
1–BROWN
2–WHITE
3–BLUE
4–BLACK
5–GRAY
SHIELD
SCP01–5000P–47–07
PRESSURE TRANSDUCER
CAP END
CABLE NO: 0975650000

HAS CONFIGURABLE OPTIONS

WIRE ONLY OF ORDERED

AC890

DB15 BREAK OUT
MODULE
DB15 CONNECTOR
VIP–2/SC/D15SUBF

DB15 PIN	Function Color Code	890 DB15
9	SIN– White/Yellow	x30-9
1	SIN+ Yellow/Brown	X30-1
3	COS+ Brown	X30-3
11	COS– White	X30_11
8	REF+ Red/Blue	X30-8
15	REF– Gray/Pink	X30-15
8	Thermal Gray	X16-8
9	Thermal Pink	X16-9

1 2 3 4 5 6 7 8 9 10 11 12 13 14 15

Thermal Gray | Thermal Pink | SIN+ Yellow/Brown | SIN– White/Yellow | COS+ Brown | COS– White | REF– Gray/Pink | REF+ Red/Blue

FEEDBACK CABLE NO. F–9F1–**

TOLERANCES AND FINISHES PER ES–8 (UNLESS OTHERWISE SPECIFIED)

MATERIAL					
HEAT TREATMENT					
SCALE	DATE	DRAWN BY	CHK. BY	APPD. BY	MFG.
NONE	19JUN17	BBESCH			

PARKER HANNIFIN CORPORATION
CYLINDER DIVISION
DES PLAINES, IL 60016

HAS DRIVE KIT WIRING
ETHERNET
0991760***-**-|*-****

PART NO.
0991760***–**|*–****

DRAWING NO.
0991760***–**|*–****

LED Indications

Network Status (NS) and Module Status (MS) LEDs

Note: *A test sequence is performed on these LEDs during start-up.*

Modbus/TCP

Network Status LED (NS)

Colour	LED Indication	Description
 OFF	OFF	No power or no IP Address set
 GREEN	ON	Normal operation
 GREEN	FLASHING	Waiting for connections
 RED	ON	Duplicate IP Address

Figure 7. Modbus/TCP NS LED

Module Status LED (MS)

Colour	LED Indication	Description
 OFF	OFF	No power
 GREEN	ON	Normal operation
 GREEN	FLASHING	Major fault
 RED	ON	Duplicate IP Address
 RED	FLASHING	Minor fault

Figure 8. Modbus/TCP MS LED

Ethernet/IP

Network Status LED (NS)

Colour	LED Indication	Description
 OFF	OFF	No power or no IP Address set
 GREEN	ON	On-line, one of more connections established
 GREEN	FLASHING	On-line, no connections established
 RED	ON	Duplicate IP address
 RED	FLASHING	One or more connections timed out

Figure 9. Ethernet/IP NS LED

Module Status LED (MS)

Colour	LED Indication	Description
 OFF	OFF	No power
 GREEN	ON	Controlled by a Scanner in Run state
 GREEN	FLASHING	Not configured, or Scanner in idle state
 RED	ON	Major fault
 RED	FLASHING	Recoverable fault(s)

Figure 10. Ethernet/IP MS LED

Profinet/I0

Network Status LED (NS)

Colour	LED Indication	Description
 OFF	OFF	No power No connection with IO controller
 GREEN	ON	Connection with IO controller IO Controller in RUN state
 GREEN	FLASHING	Connection with IO controller IO controller in STOP state

Figure 11. Profinet/IO NS LED

Module Status LED (MS)

Colour	LED Indication	Description
 OFF	OFF	No Power Not initialized
 GREEN	ON	Normal operation
 GREEN	1 FLASH	Diagnostic Event
 GREEN	2 FLASHES	Used by engineering tools to identify the node on the network
 RED	ON	Exception error
 RED	1 FLASH	Configuration error
 RED	2 FLASHES	IP address not set
 RED	3 FLASHES	Station name not set
 RED	4 FLASHES	Internal error

Figure 12. Profinet/IO MS LED

LINK/Activity LED

Colour	LED Indication	Description
 OFF	OFF	No link, no activity
 GREEN	ON	Link established
 GREEN	Flickering	Activity

Figure 13. LINK/Activity LED

Modicon Momentum

1. Start a new program and select the PLC processor and chassis type used in your project. Our example uses an M1 980-20 Momentum PLC. Stay offline until you are ready to download the program.
2. Place an MSTR block in the ladder logic. MSTR blocks move data from the PLC data table to the drive or from the drive to the PLC data table. Two MSTR blocks are necessary for a Read and Write operation.
3. Right click over the MSTR block. This will access the Register Editor. Use the Register Editor to configure the block. The MSTR block has two types of operations: Read or Write. The first register defines the type of operation. In our case address 40100 is used for write command and address 40200 is used for read command. A value of 1 in the data column defines a Write operation. A value of 2 in the data column defines a Read operation.

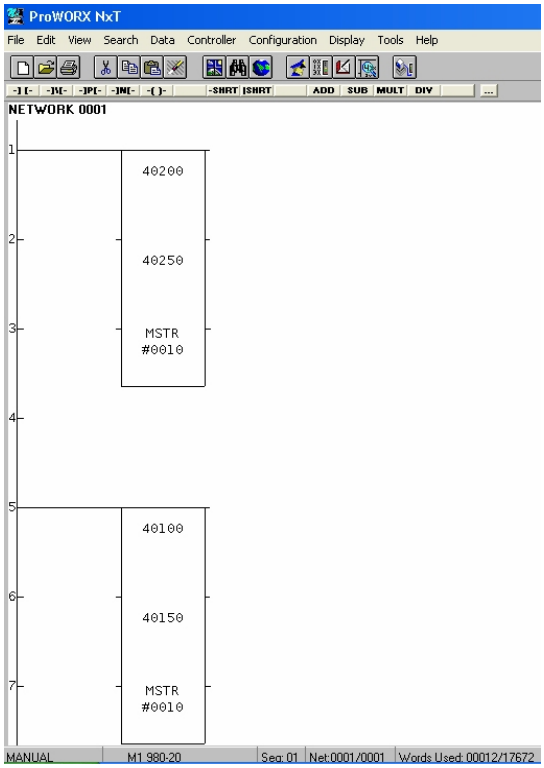
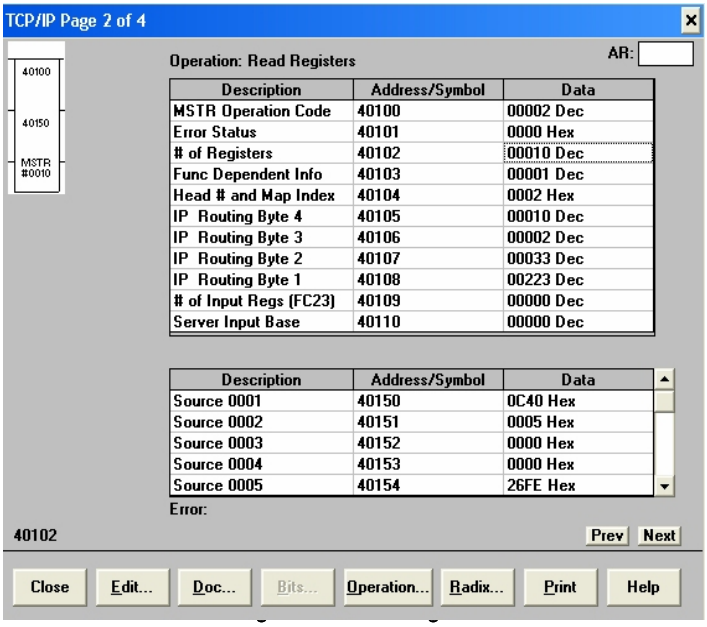


Figure 16. PLC Ladder Logic showing MSTR Blocks



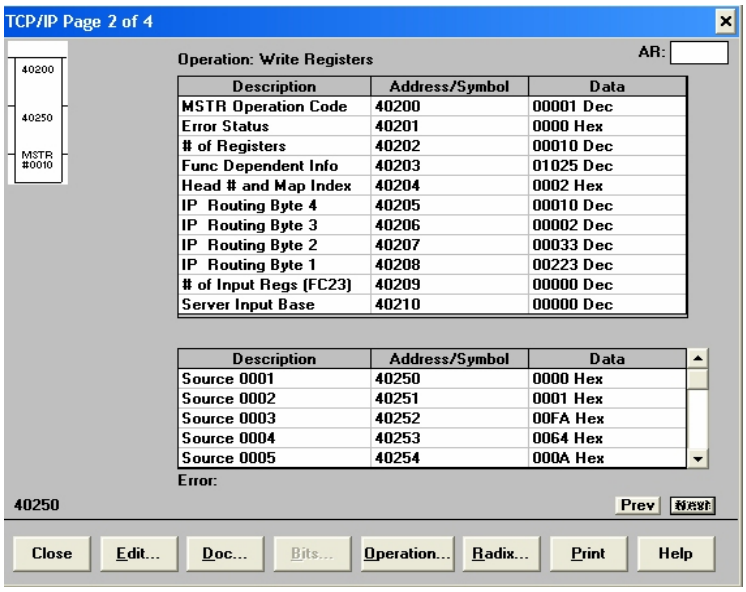


Figure 18 Write Registers

4. The second register contains the error status. Refer to the PLC software help files for a list of error codes.
5. The third register defines the data length (address 40102 or address 40202). The value in the data column depends on which parameter set that has been selected in the drive. The value can be smaller than or equal to the selected parameter set.
6. The fourth register defines the Read and Write locations of the data in the PLC (address 40103 or address 40203). **For a Read function, this value is set to 1, and for a Write function this value is set to 257.**
7. Registers 5, 6, 7 and 8 define the IP address on the Ethernet network (address 40104 or address 40204). Our example shows the data registers starting at locations 40150 and 40250.
8. When using a Modicon PLC, the “32bit Word Order” parameter in the Ethernet function block must be set to “Low Word First”. This applies to Modicon products and most other manufactures using the ModBus/TCP protocol.

Ethernet/IP

Allen Bradley ControlLogix

1. Start a new program and select the PLC processor and chassis type that is used in your project. Our example uses a 1756-L55A processor and 1756-A7/B rack. Remain Offline until you are ready to download the program.
2. Using the I/O Configuration insert the Ethernet interface that will be installed. Right click on the I/O Configuration, select New Module. Our example uses 1756-ENBT/A. Input the desired IP address and slot in the PLC..

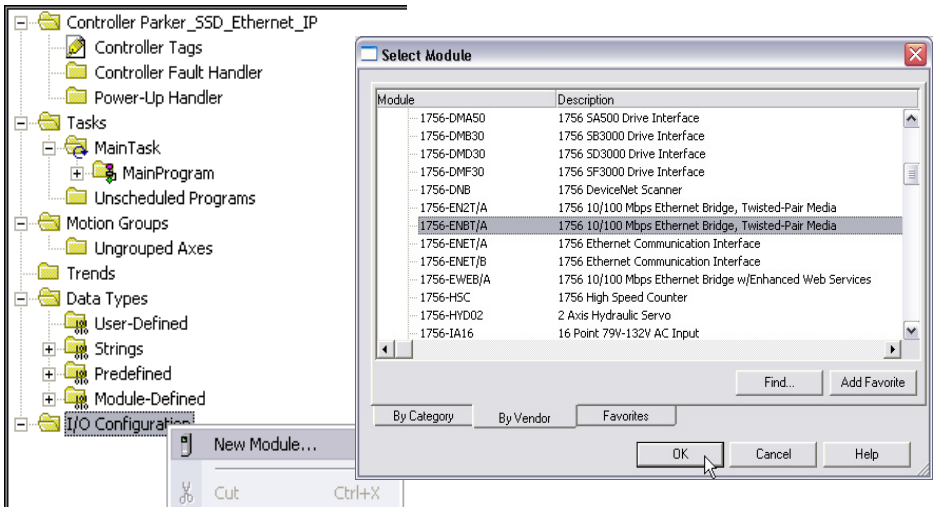


Figure 19. Ethernet Interface Selection

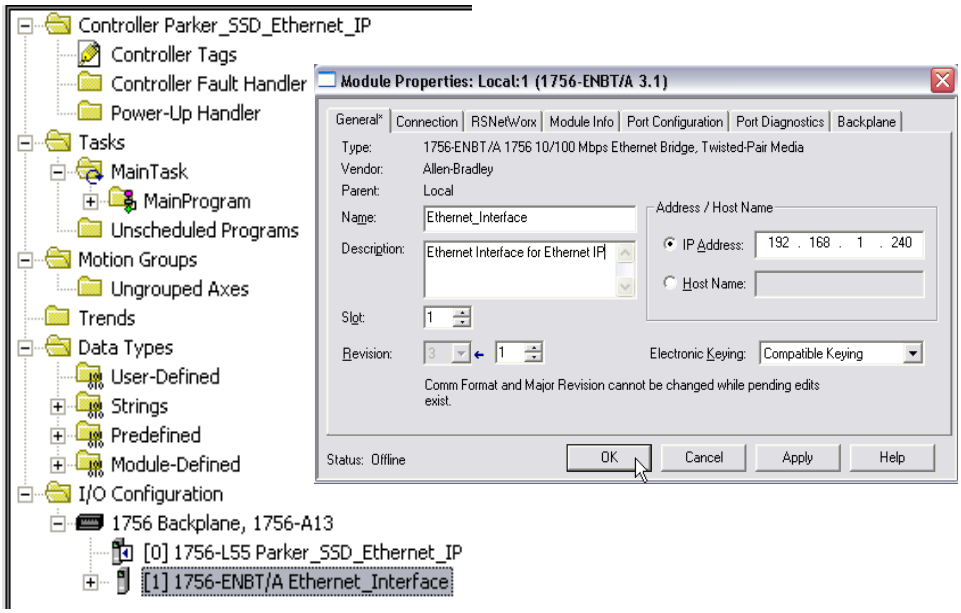


Figure 20. Ethernet Interface Setup

3. Right click on the Ethernet Interface Module, select New Module. This screen will allow the selection of the Generic Ethernet Module. Refer to Figure 21.

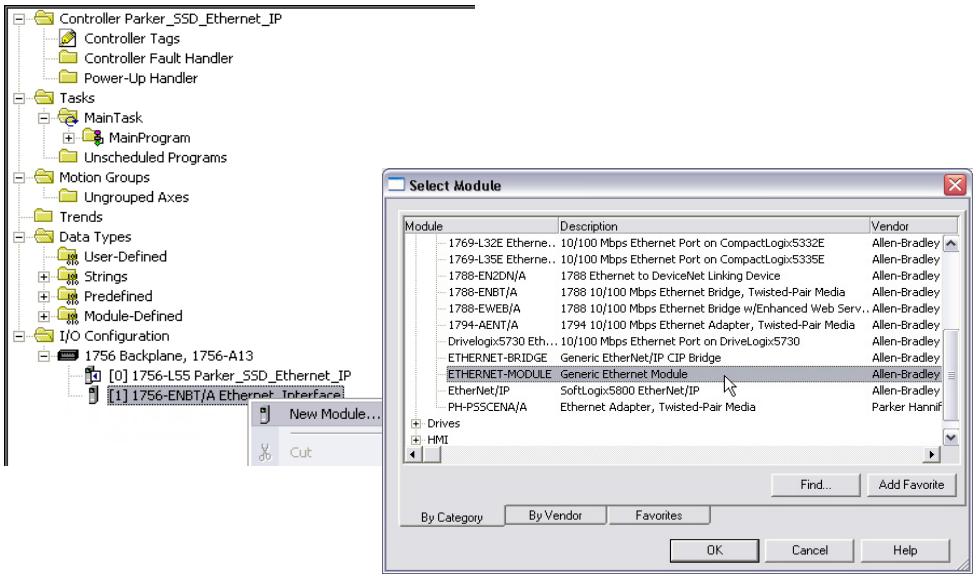


Figure 21. Generic Ethernet Module Select

4. Input the desired module name and IP address. The Comms format will be DATA Int if 16-bit signed integer, or Data-REAL if 32-bit floating point. The Input Assembly Instance is 100 and the Output Assembly Instance is 150. Refer to Figure 22.
5. Click on Next to change the Requested Packet Interval (RPI). The default value of 10ms should be sufficient. If the RPI is set below 5ms unreliable communications may be experienced. Refer to Figure 22.

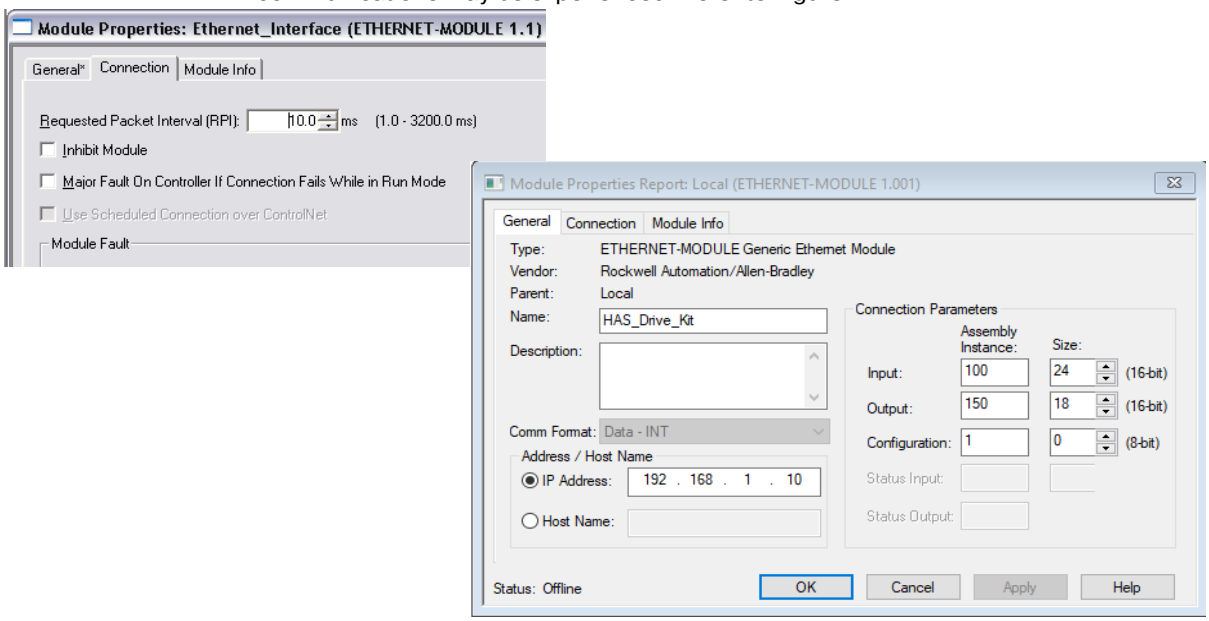


Figure 22 Ethernet Module Setup

6. When completed with the setup of the Generic Ethernet Module it can be downloaded to the PLC. For testing purposes it is not necessary to program Ladder Logic in the PLC. The data can be accessed and monitored via Controller Tags. Refer to table below

Controller Tags - Outputs From HAS Drive

Name	Data Type	Description
SSD_890:C	AB:ETHERNET_MODULE:C:0	
SSD_890:I	AB:ETHERNET_MODULE_INT_48Bytes:I:0	
SSD_890:I.Data	INT[24]	
SSD_890:I.Data[0]	INT	Drive Modbus 400257
SSD_890:I.Data[1]	INT	Drive Modbus 400258
SSD_890:I.Data[2]	INT	Drive Modbus 400259
SSD_890:I.Data[3]	INT	Drive Modbus 400260
SSD_890:I.Data[4]	INT	Drive Modbus 400261
SSD_890:I.Data[5]	INT	Drive Modbus 400262
SSD_890:I.Data[6]	INT	Drive Modbus 400263
SSD_890:I.Data[7]	INT	Drive Modbus 400264
SSD_890:I.Data[8]	INT	Drive Modbus 400265
SSD_890:I.Data[9]	INT	Drive Modbus 400266
SSD_890:I.Data[10]	INT	Drive Modbus 400267
SSD_890:I.Data[11]	INT	Drive Modbus 400268
SSD_890:I.Data[12]	INT	Drive Modbus 400269
SSD_890:I.Data[13]	INT	Drive Modbus 400270
SSD_890:I.Data[14]	INT	Drive Modbus 400271
SSD_890:I.Data[15]	INT	Drive Modbus 400272
SSD_890:I.Data[16]	INT	Drive Modbus 400273
SSD_890:I.Data[17]	INT	Drive Modbus 400274
SSD_890:I.Data[18]	INT	Drive Modbus 400275
SSD_890:I.Data[19]	INT	Drive Modbus 400276
SSD_890:I.Data[20]	INT	Drive Modbus 400277
SSD_890:I.Data[21]	INT	Drive Modbus 400278
SSD_890:I.Data[22]	INT	Drive Modbus 400279
SSD_890:I.Data[23]	INT	Drive Modbus 400280

Controller Tags - Inputs to HAS Drive

Name	Data Type	Description
SSD_890:O	AB:ETHERNET_MODULE_INT_48Bytes:O:0	
SSD_890:O.Data	INT[24]	
SSD_890:O.Data[0]	INT	Drive Modbus 400001
SSD_890:O.Data[1]	INT	Drive Modbus 400002
SSD_890:O.Data[2]	INT	Drive Modbus 400003
SSD_890:O.Data[3]	INT	Drive Modbus 400004
SSD_890:O.Data[4]	INT	Drive Modbus 400005
SSD_890:O.Data[5]	INT	Drive Modbus 400006
SSD_890:O.Data[6]	INT	Drive Modbus 400007
SSD_890:O.Data[7]	INT	Drive Modbus 400008
SSD_890:O.Data[8]	INT	Drive Modbus 400009
SSD_890:O.Data[9]	INT	Drive Modbus 400010
SSD_890:O.Data[10]	INT	Drive Modbus 400011
SSD_890:O.Data[11]	INT	Drive Modbus 400012
SSD_890:O.Data[12]	INT	Drive Modbus 400013
SSD_890:O.Data[13]	INT	Drive Modbus 400014
SSD_890:O.Data[14]	INT	Drive Modbus 400015
SSD_890:O.Data[15]	INT	Drive Modbus 400016
SSD_890:O.Data[16]	INT	Drive Modbus 400017
SSD_890:O.Data[17]	INT	Drive Modbus 400018
SSD_890:O.Data[18]	INT	spare
SSD_890:O.Data[19]	INT	spare
SSD_890:O.Data[20]	INT	spare
SSD_890:O.Data[21]	INT	spare
SSD_890:O.Data[22]	INT	spare
SSD_890:O.Data[23]	INT	spare

Appendix A: Network States

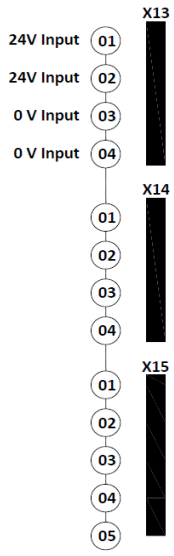
Modbus TCP/IP

State	Description
NOT ACTIVE	Waiting for Modbus TCP/IP requests
ACTIVE	A Modbus TCP/IP request addressed to this node has been received within the specified Connection Timeout time. This time defaults to 0 (disabled) but can be set by writing to Holding Register 0516 (204h). The value is in milliseconds.
IDLE	This state can be entered by writing a non-zero value to Holding Register 0517 (205h)
FAULT	Fatal error. Further Modbus TCP/IP requests will be ignored

Ethernet IP

State	Description
WAIT TO CONNECT	Waiting for a Class 1 connection to be opened
ERROR	• Class 1 connection error • Duplicate IP address detected
RUNNING	Error free Class 1 connection active (RUN-bit set in the 32-bit Run/Idle header of an Exclusive Owner connection).
IDLE	Class 1 connection idle
EXCEPTION	Unexpected error. Major fault.

HAS External 24V Input Wiring



Connection can be made from a suitable, external 24V source. This 24V DC control supply allows for configuration and commissioning of the system without the AC supply being present. The drive will control operate with this supply but will not turn a motor without High Voltage supplied.

Connection is not required when the AC supply is present, but the connection can be safely left connected.

You can connect up to four 890SD units in total when daisy-chaining 24V using these terminals (8A maximum).

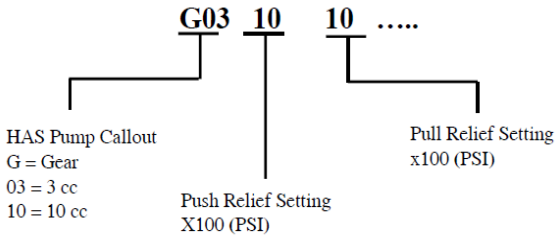
An external power supply is required when HAS units are fitted with Heat Exchangers, Position Feedback and Pressure sensors.

Pump Displacement - Entry

Default Setting: 1

Value of "1" is a None Valid setting resulting in limiting pump speed to a maximum of 1000 RPM.

Obtain Pump Displacement from HAS Model Code



Incorrect values may cause pump cavitation and damage unit, ensure proper selection of displacement

Modbus Register	IP Register	Type	Tag Name	Value
400008	SSD_890:O.Data (7)	UINT16	Pump CC	Value of 2 = 2 cc

Pump Size

The HAS Drive kits are shipped with the pump displacement value of 1. This is a non-applicable displacement, limiting the pump speed to 1000 RPM. It is useful in debugging your machine control. This displacement will provide inaccurate force and pressure values and should only be used to determine direction and verification of control.

To set the proper pump speed, the displacement must be entered at register 400008 (Modbus) O Data 7 (IP). When entered the max pump speed will be scaled to accept an input of 100 %.

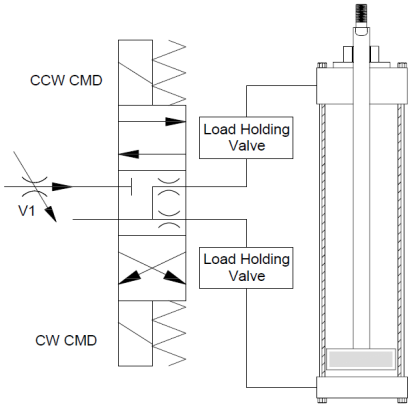
Value is retained in memory and only needs to be sent one time.

The pump size can be determined from the HAS Model code.

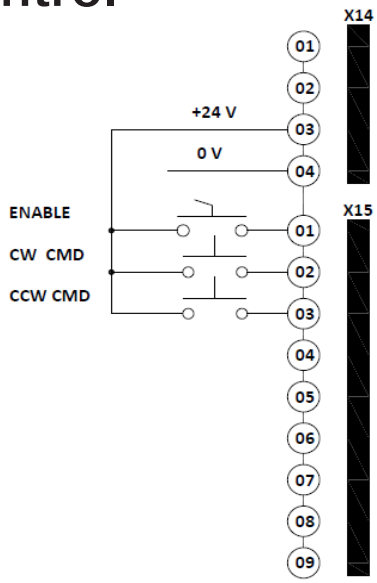
Failure to change setting, drive will function with maximum pump RPM limited to 1000 RPM

Basic Directional Control

Traditional Hydraulic Valve Control equivalent



Jog Mode



Digital Inputs Requirements	
Nominal Rated Voltage	24V DC
Absolute Maximum Input Voltage	-15V to +30 V
Input Threshold	9.0V +/- 2.5V
Sample Rate	1 mS
Input Current	7.3 mA @ 24V

Jog Mode - Hard Wire Inputs

Similar to cylinder operation with standard 4-way directional control valves, this simple operational mode allows direction control of the HAS actuator with simple push, pull discrete inputs. Jog Speed is set by Ethernet Messaging, if Ethernet communications are lost, the drive will hold the last sent value. When power is toggled to the device, or power up without Ethernet communications, Jog Speed is limited to 10% of max pump speed.

Direction is set by Hard Wire inputs X15-02 and X15-03, **or** Network commands listed in above table.

Speed in either direction set by network commands. Entry controls the pump speed at percentage rate of maximum rating of the size pump. This speed is closed loop at the motor, and cylinder speed may vary slightly based upon pump efficiencies at different pressures. The control theory is similar a basic directional valve with a P port proportional flow control.

Enable - Input X15-01

When True (High) drive will react to other discrete inputs. When False (Low) inputs are ignored. Useful for disabling unwanted operation.

CW Jog CMD

When True (High) drive will spin the pump in a clockwise function.

The HAS orientation call out in the model code set the extend and retract direction. Orientations "A" & "H"(reservoir on cylinder cap end) CW rotation Extend Cylinder, "B" & "C" (reservoir on cylinder head end) CCW rotation extends the cylinder.

Direction can be inverted network command entry at 400001.06 (Modbus) or O Data 0.6 (IP).

CCW Jog CMD

When True (High) drive will spin the pump in a counterclockwise function. Same as CW command, cylinder will operate in opposite direction.

Soft-shift Control

When increasing speed setting from stop to Jog Setting- acceleration or Ramp Rate (R1) is used to ramp from stop to Speed setting. When decreasing speed setting, deceleration or Ramp Rate (R2) is used to ramp from current speed to stopped condition. Default Ramp Rates are 300 mS. For Softer starts and Stops Ramp Rates can be increased through network settings.

Basic Directional Control
Jog Mode - Ethernet Messaging

Modbus Register	IP Register	Type	Tag Name	Value
400001.00	SSD_890:O.Data (0.0)	Boolean	Drive Enable	True / False
400001.01	SSD_890:O.Data (0.1)	Boolean	Jog CW	True / False
400001.02	SSD_890:O.Data (0.2)	Boolean	Jog CCW	True / False
400002	SSD_890:O.Data (1)	UINT16	Jog Speed Setpoint	Value of 1 = 0.01%
400001.06	SSD_890:O.Data (0.6)	Boolean	Invert Direction	True / False
400006	SSD_890:O.Data (5)	UINT16	Acceleration Rate	Value of 1 = 0.001 Sec
400007	SSD_890:O.Data (6)	UINT16	Deceleration Rate	Value of 1 = 0.001 Sec
400257.00	SSD_890:I.Data (0.0)	Boolean	Heartbeat	FALSE / TRUE
400257.01	SSD_890:I.Data (0.1)	Boolean	Enabled	FALSE / TRUE
400257.02	SSD_890:I.Data (0.2)	Boolean	Healthy	FALSE / TRUE
400257.03	SSD_890:I.Data (0.3)	Boolean	Running	FALSE / TRUE
400257.04	SSD_890:I.Data (0.4)	Boolean	STO Active	FALSE / TRUE
400258	SSD_890:I.Data (1)	SINT 16	Actual Motor RPM	1=1 RPM
400259	SSD_890:I.Data (2)	SINT 16	Output Torque	1=0.01 nM
400260	SSD_890:I.Data (3)	SINT 16	Motor Amps	1=0.01 amp
400261	SSD_890:I.Data (4)	UINT 16	Energy Used	
400262	SSD_890:I.Data (5)	UINT 16	Reservoir Temp	1= 0.1 F
400263	SSD_890:I.Data (6)	UINT 16	Operation Hours	Value of 1 = 1 hour

Jog Mode - Ethernet

Similar to cylinder operation with standard 4-way directional control valves, this simple operational mode allows direction control of the HAS actuator with simple push, pull discrete inputs.

Speed in either direction set by network commands. Entry controls the pump speed at percentage rate of maximum rating of the size pump. This speed is closed loop at the motor, and cylinder speed may vary slightly based upon pump leakage rates at different pressures. The control theory is similar a basic directional valve with a P port proportional flow control.

Enable - 400001.00 (Modbus) O Data 0.0 (IP)

When True (High) drive will react to other discrete inputs. When False (Low) inputs are ignored. Useful for disabling unwanted operation.

CW Jog CMD - 400001.01 (Modbus) O Data 0.1 (IP)

When True (High) drive will spin the pump in a clockwise function. HAS Speed is 400002 (Modbus) O Data 1 (IP)

The HAS orientation call out in the model code set the extend and retract direction. Orientations "A" & "H"(reservoir on Cap end) CW rotation Extend Cylinder, "B" & "C" (Reservoir on Head end) CCW rotation extends the cylinder. Direction can be inverted network command entry at 400001.06 (Modbus) or O Data 0.6 (IP).

CCW Jog CMD - 400001.02 (Modbus) O Data 0.2 (IP)

When True (High) drive will spin the pump in a counterclockwise function. Same as CW command, cylinder will operate in opposite direction.

Soft-shift Control Acceleration 400006 (Modbus) O.Data 5 (IP)
Soft-shift Control Deceleration 400007 (Modbus) O.Data 6 (IP)

When increasing speed setting from stop to Jog Setting- acceleration or Ramp Rate (R1) is used to ramp from stop to Speed setting. When decreasing speed setting, deceleration or Ramp Rate (R2) is used to ramp from current speed to stopped condition. Default Ramp Rates are 300 mS. For Softer starts and Stops Ramp Rates can be increased through network settings.

Heartbeat:	Confirmation of BUS communications, True/False Pulse signal sent 100 mS on, 100 mS off
Enable:	Confirmation of Enable Bit set
Healthy:	If running and the Invert trips, the Healthy will be True and set FALSE when the run command is removed. The HEALTHY will be True when the Inverter is Not Tripped or when Running.
Running:	Indicates that the Inverter is in the enabled state.
STO Active:	Is the status of the STO (Safe Torque Off) circuit. STO Active prevents HAS from running when True
RPM	Display of actual Pump Speed in RPM, Sign of value confirms direction, (-) value represents
Torque	CCW Motor Torque seen at motor shaft, calculated by amp draw.
Res Temp	With Temp sensor installed, display of reservoir oil temperature
Hours	Display of actual run time hours

Basic Directional Control
Run Mode - Ethernet Messaging

Modbus Register	IP Register	Type	Tag Name	Value
400001.00	SSD_890:O.Data (0.0)	Boolean	Drive Enable	True / False
400001.03	SSD_890:O.Data (0.3)	Boolean	Run CW	True / False
400001.04	SSD_890:O.Data (0.4)	Boolean	Run CCW	True / False
400001.06	SSD_890:O.Data (0.6)	Boolean	Invert Direction	True / False
400003	SSD_890:O.Data (2)	UINT16	Run Speed Setpoint	Value of 1 = 0.01%
400006	SSD_890:O.Data (5)	UINT16	Acceleration Rate	Value of 1 = 0.001 Sec
400007	SSD_890:O.Data (6)	UINT16	Deceleration Rate	Value of 1 = 0.001 Sec
400257.00	SSD_890:I.Data (0.0)	Boolean	Heartbeat	FALSE / TRUE
400257.01	SSD_890:I.Data (0.1)	Boolean	Enabled	FALSE / TRUE
400257.02	SSD_890:I.Data (0.2)	Boolean	Healthy	FALSE / TRUE
400257.03	SSD_890:I.Data (0.3)	Boolean	Running	FALSE / TRUE
400257.04	SSD_890:I.Data (0.4)	Boolean	STO Active	FALSE / TRUE
400258	SSD_890:I.Data (1)	SINT 16	Actual Motor RPM	1=1 RPM
400259	SSD_890:I.Data (2)	SINT 16	Output Torque	1=0.01 nM
400260	SSD_890:I.Data (3)	SINT 16	Motor Amps	1=0.01 amp
400261	SSD_890:I.Data (4)	UINT 16	Energy Used	
400262	SSD_890:I.Data (5)	UINT 16	Reservoir Temp	1= 0.1 F
400263	SSD_890:I.Data (6)	UINT 16	Operation Hours	Value of 1 = 1 hour

Run Mode

Similar to Jog mode, Run Mode allows for a second speed setting for operation. Only applicable with network commands. Enable required for operation.

Enable - Input X15-01 or 400001.00 (Modbus) O Data 0.0 (IP)

When True (High) drive will react to other discrete inputs. When False (Low) inputs are ignored. Useful for disabling unwanted operation.

CW Run CMD - 400001.03 (Modbus) O Data 0.3 (IP)

When True (High) drive will spin the pump in a clockwise function. HAS Speed is 400003 (Modbus) O Data 2 (IP)

The HAS orientation call out in the model code set the extend and retract direction. Orientations "A" & "H"(reservoir on Cap end) CW rotation Extend Cylinder, "B" & "C" (Reservoir on Head end) CCW rotation extends the cylinder. Direction can be inverted network command entry at 400001.06 (Modbus) or O Data 0.6 (IP).

CCW Run CMD 400001.04 (Modbus) O Data 0.4 (IP)

When True (High) drive will spin the pump in a counterclockwise function. Same as CW command, cylinder will operate in opposite direction.

Soft-shift Control

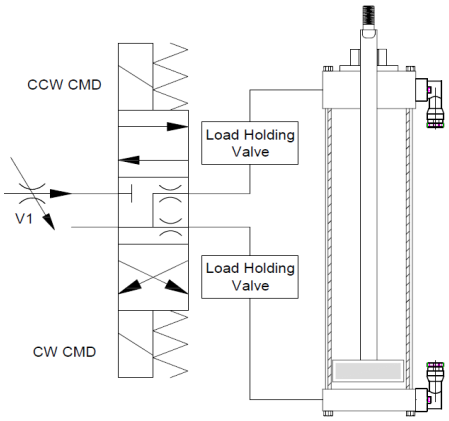
When increasing speed setting from stop to Jog setting- acceleration or Ramp Rate (R1) is used to ramp from stop to Speed setting. When decreasing speed setting, deceleration or Ramp Rate (R2) is used to ramp from current speed to stopped condition. Default Ramp Rates are 300 mS. For Softer starts and Stops Ramp Rates can be increased through network settings.

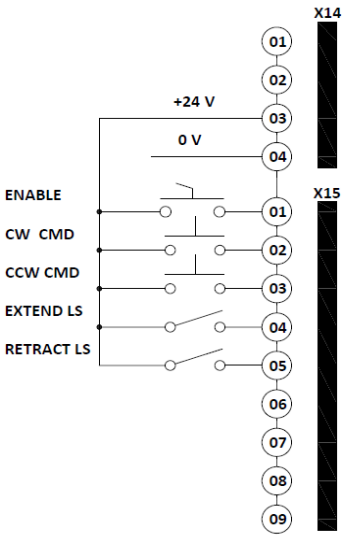
Output Data available from Drive

Heartbeat:	Confirmation of BUS communications, True/False Pulse signal sent 100 mS on, 100 mS off
Enable:	Confirmation of Enable Bit set
Healthy:	If running and the Invert trips, the Healthy will be True and set FALSE when the run command is removed. The HEALTHY will be True when the Inverter is Not Tripped or when Running.
Running:	Indicates that the Inverter is in the enabled state.
STO Active:	Is the status of the STO (Safe Torque Off) circuit. STO Active prevents HAS from running when True
RPM	Display of actual Pump Speed in RPM, Sign of value confirms direction, (-) value represents
Torque	CCW Motor Torque seen at motor shaft, calculated by amp draw.
Res Temp	With Temp sensor installed, display of reservoir oil temperature
Hours	Display of tactual Run time hours

Basic Directional Control with end of stroke limit switch

Traditional Hydraulic Valve Control equivalent





For use with Jog and Run Macros

Digital Inputs Requirements	
Nominal Rated Voltage	24V DC
Absolute Maximum Input Voltage	-15V to +30 V
Input Threshold	9.0V +/- 2.5V
Sample Rate	1 mS
Input Current	7.3 mA @ 24V

Modbus Register	IP Register	Type	Tag Name	Value
400001.07	SSD_890:O.Data (0.7)	Boolean	Invert Limit Switch	True / False
400001.06	SSD_890:O.Data (0.6)	Boolean	Invert Direction	True / False
400257.07	SSD_890:I.Data (0.7)	Boolean	Extend Limit Switch	FALSE / TRUE
400257.08	SSD_890:I.Data (0.8)	Boolean	Retract Limit Switch	FALSE / TRUE

End of Stroke Limits

HAS Motion can be stopped by simply adding end of stroke limit switches either internal or external to the cylinder. Multiple internal switch options are available. See catalog HY08-1132-5NA for details.

Default switch setting is for Normally Open (NO) switch types, motion stopped on true signal. Switch setting can be changed to Normally Closed (NC) by network command: Invert Limit Switch set true 400001.07 (Modbus) O Data 0.7 (IP).

The HAS orientation call out in the model code set the extend and retract direction. Orientations "A" & "H"(reservoir on Cap end) CW rotation Extend Cylinder, "B" & "C" (Reservoir on Head end) CCW rotation extends the cylinder. Direction can be inverted network command entry at 400001.06 (Modbus) or O Data 0.6 (IP). **For proper operation of end of stroke limits, the proper Orientation must be configured.**

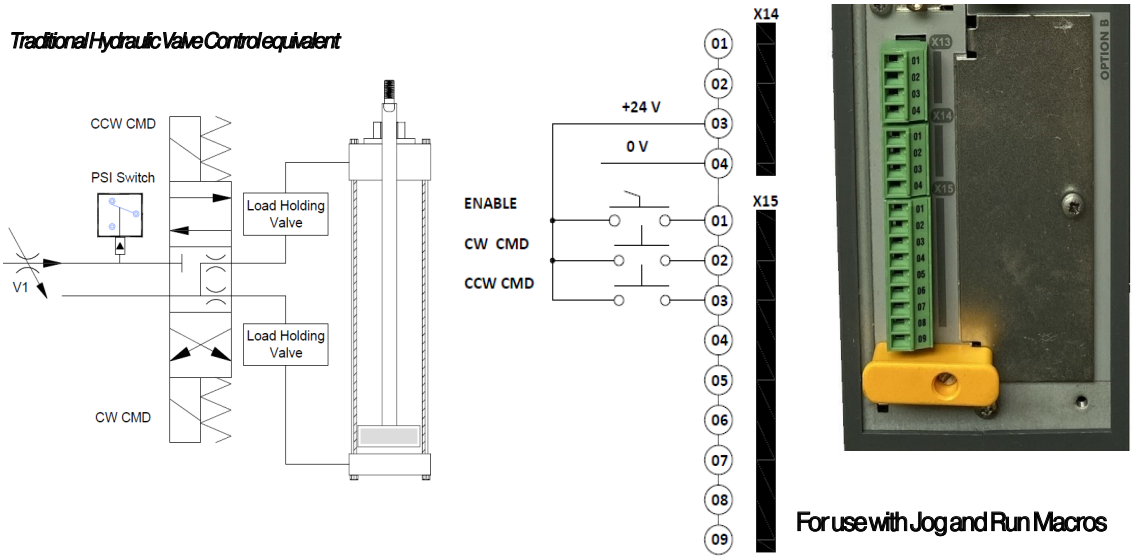
Extend Limit Switch (Input X15-04)

When input X15-04 is transition from its normal state, (either NO, or NC) forward motion command will be ignored, and motion will decelerate at the time value set in R2 (Decell). Valve can be changed by Ethernet Messaging see Basic Control- Ethernet Messaging for details. When activated forward Commands will be ignored. HAS will be allowed to operate in Retract motion. Verification of Switch condition is available on output 400257.07 (Modbus) I data 0.7 (IP)

Retract Limit Switch (Input X15-05)

When input X15-05 is transition from its normal state, (either NO, or NC) retract motion command will be ignored, and motion will decelerate at the time value set in R2 (Decell) Valve can be changed by Ethernet Messaging see Basic Control- Ethernet Messaging for details. When activated retract Commands will be ignored. HAS will be allowed to operate in extend motion. Verification of Switch condition is available on output 400257.08 (Modbus) I data 0.8 (IP)

Basic Directional Control with Stop on PSI



Modbus Register	IP Register	Type	Tag Name	Value
400001.12	SSD_890:O.Data (0.12)	Boolean	Stop on PSI	True / False
400008	SSD_890:O.Data (7)	UINT16	Pump CC	Value of 2 = 2 cc
400012	SSD_890:O.Data (11)	UINT16	Stop On PSI CW (V)	value of 1 = 1 PSI
400013	SSD_890:O.Data (12)	UINT16	Stop on PSI CCW (V)	value of 1 = 1 PSI
400014	SSD_890:O.Data (13)	UINT16	Stop Amps Time CW	value of 1 = 0.1 Sec
400015	SSD_890:O.Data (14)	UINT16	Stop Amps Time CCW	value of 1 = 0.1 Sec

Stop on Theoretical Pressure

Expandable feature for use with Run and Jog mode is the **Stop on PSI Macro** built into the drive.

Stop on PSI is enabled through network commands

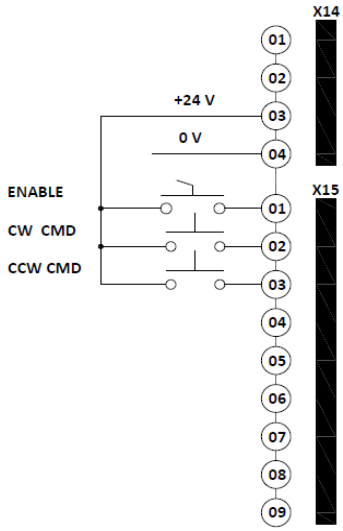
Macro Description:

With proper pump displacement entry, pressure can be approximated without the need of a pressure transducer. Theoretical pump pressure is calculated based upon the motor torque constant, and amp draw of the motor.

Additional network entry required to determine the direction, pressure setting and duration required above setting to activate a stopping motion. Data listed in above table must be sent to drive for proper operation.

If precise pressure is required, please use pressure transducer option on the HAS model code, with an external controller to monitor system pressures.

Basic Directional Control with Stop on Position



For use with Jog and Run Macros

Modbus Register	IP Register	Type	Tag Name	Value
400001.13	SSD_890:O.Data (0.13)	Boolean	Stop On Position	True / False
400011	SSD_890:O.Data (10)	UINT16	Cylinder Stroke	Value of 1 = 0.01"
400016	SSD_890:O.Data (14)	UINT16	Position High Limit	Value of 1 = 0.01%
400017	SSD_890:O.Data (15)	UINT16	Position Low Limit	Value of 1 = 0.01%
400018	SSD_890:O.Data (16)	UINT16	Analog Input Type	Value of 1 = 0 to 10V Value of 2 = 0 to 20 mA Value of 3 = 4 to 20 mA
400266	SSD_890:I.Data (9)	UINT 16	Position	1=0.01"

Stop on Position Value

Expandable feature for use with Run and Jog mode is the Stop on Position macro built into the drive. It requires a Position Feedback device to be ordered with the HAS unit. An external device may also be used.

Stop on Position is enabled through network commands and is available with both Jog and Run modes.

Macro Description:

Macro is enabled from the Stop On Position bit 400001.13 (Modbus) O Data 0.13 (IP)

With proper setup, electronically adjustable window of stroke can be defined. User can define units, typically inch units are used, with a maximum value of 600.00". Resolution of High and Low limit is 0.00 units.

When HAS Unit measured positional value is greater than the High Limit value, the HAS Unit will decelerate and prevent forward motion.

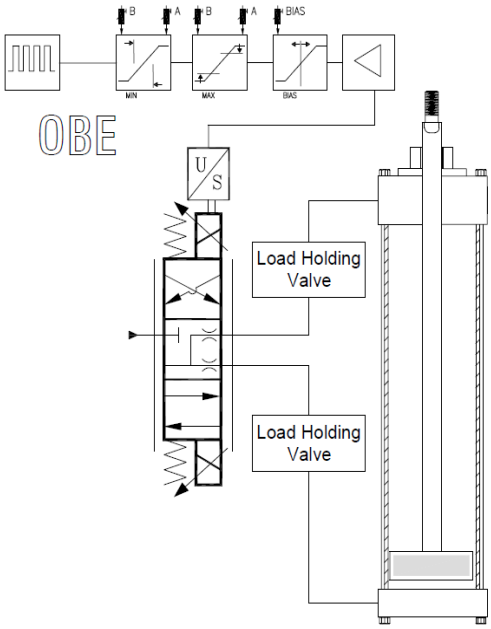
When HAS Unit measured positional value is less than the Low Limit value, the HAS Unit will decelerate and prevent reverse motion.

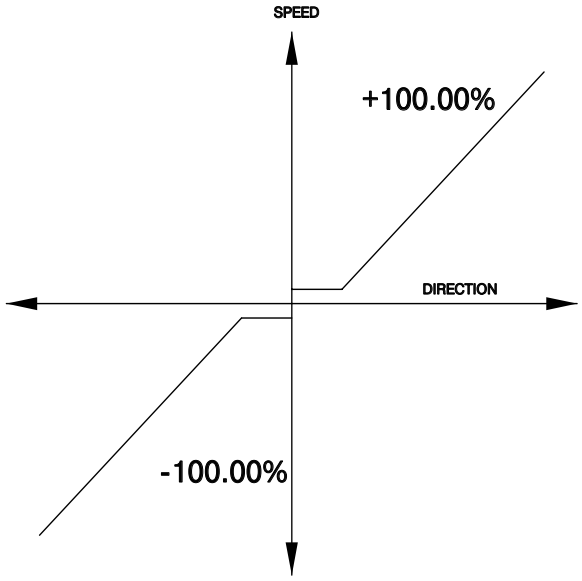
Position Feedback type (voltage or current) can be selected from the Analog Input type register.

Position Feedback can be continuously monitored from the Position output register.

Proportional Mode - Speed and Direction

Traditional Hydraulic Valve Control equivalent





Modbus Register	IP Register	Type	Tag Name	Value
400001.05	SSD_890:O.Data (0.5)	Boolean	Run Speed & Direction	True / False
400004	SSD_890:O.Data (3)	SINT16	Speed & Direction Cmd	Value of 1 = 0.01%
400006	SSD_890:O.Data (5)	UINT16	Acceleration Rate	Value of 1 = 0.001 Sec
400007	SSD_890:O.Data (6)	UINT16	Deceleration Rate	Value of 1 = 0.001 Sec
400019	SSD_890:O.Data (17)	UINT16	Speed & Direction Deadband	Value of 1 = 0.01%
400020	SSD_890:O.Data (18)	UINT16	Speed & Direction Min Pump Speed	Value of 1 = 1 RPM
400257.00	SSD_890:I.Data (0.0)	Boolean	Heartbeat	FALSE / TRUE
400257.01	SSD_890:I.Data (0.1)	Boolean	Enabled	FALSE / TRUE
400257.02	SSD_890:I.Data (0.2)	Boolean	Healthy	FALSE / TRUE
400257.03	SSD_890:I.Data (0.3)	Boolean	Running	FALSE / TRUE
400257.04	SSD_890:I.Data (0.4)	Boolean	STO Active	FALSE / TRUE

Speed and Direction

Through network commands Speed and Direction Mode may be selected. This allows the PLC control both the direction and speed from a single message. This setting can be changed on the fly. Accomplished by setting Run Speed & Direction bit true. The sign of the command dictates the direction and magnitude (value) controls the speed similar to the way a proportional valve control the flow with a bipolar input.

During this mode the drive will scale the speed to the scaled range with adjustment-ability of dead band and minimum speed setting. The drive will ramp in both directions, limited by the acceleration and deceleration register settings.

When controlling a HAS actuator with a closed loop motion controller, an analog drive should be selected as it operates a higher bandwidth.

If used with a PID block, default minimum pump speed and input deadband adjustments available to minimize potential for hunting around null commands, the Drive Enable Control should be used in conjunction with the imposition tolerance of the control scheme. Note: It is possible to use a HAS unit in a closed loop manner, however analog drives update the speed command at higher levels and are preferred choice. Since the control is not force-balance, and load holding valves are used, "servo" precise performance should not be expected.

Drive Warnings

Modbus Register	IP Register	Type	Tag Name	Value
400257.09	SSD_890:I.Data (0.9)	Boolean	High Reservoir Temp	True / False
400257.10	SSD_890:I.Data (0.10)	Boolean	Low Oil Level	True / False
400257.11	SSD_890:I.Data (0.11)	Boolean	Oil Change	True / False
400262	SSD_890:I.Data (5)	UINT 16	Reservoir Temp	1= 0.1 F
400263	SSD_890:I.Data (6)	UINT 16	Operation Hours	Value of 1 = 1 hour

High Reservoir Temperature 400257.09 (Modbus) I data 0.9 (IP)

When True Oil Temp has exceed 165F Warning. Consult Factory for Higher trip values.

Actual Reservoir temperature can be read at 400262 (Modbus) I data 5 (IP).

Low Oil Level in reservoir: 400257.10 (Modbus) I data 0.10 (IP)

Note: Low Level switch must be ordered separately and installed on HAS for low level protection

Oil Change Required: 400257.11 (Modbus) I data 0.11 (IP)

When True HAS unit should be scheduled for service. Actual operational hours can be read at 400263 (Modbus) I data 6 (IP).

Drive Trips

Modbus Register	IP Register	Type	Tag Name	Value
400001.08	SSD_890:O.Data (0.8)	Boolean	Fault Reset	True / False
400001.09	SSD_890:O.Data (0.9)	Boolean	Trip Drive	True / False
400001.10	SSD_890:O.Data (0.10)	Boolean	Trip Temp	True / False
400001.11	SSD_890:O.Data (0.11)	Boolean	Trip Level	True / False
400257.05	SSD_890:I.Data (0.5)	Boolean	Tripped	True / False
400257.06	SSD_890:I.Data (0.6)	Boolean	External Trip Forced	True / False

Recover from Trip condition

Through network commands a fault reset can be issued to the drive. Simply toggle 400001.08 (Modbus) 0.8 (IP).

Force Drive Trip

Through network commands a Trip Drive may be issued to the drive. Simply toggle 400001.09 (Modbus) 0.9 (IP).

Trip Drive on Reservoir Temperature

Default configuration for reservoir Over temperature conditions is to issue a warning on key pad. User may elect to force a drive trip on over temp conditions.

Trip Drive on Low Oil Level in reservoir:

Default configuration for reservoir low level conditions is to issue a warning on key pad. User may elect to force a drive trip on over temp conditions.

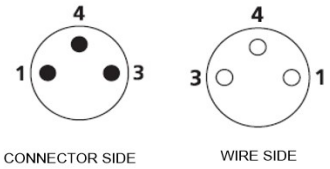
Note: Low Level switch must be ordered separately and installed on HAS for low level protection

HAS Reservoir Temp Sensor Installation

Reservoir Temperature: HAS500 manifolds are equipped with mounting provisions to accept a thermistor. HAS 500 Series drive kits include the thermistor, 5 meter cable and macro in the drive to warn of High Oil Temp with the option to enable shut down HAS operation on over temperature conditions. If sensor is not seen by drive or temperature drops below 14 degrees, an alarm bit sent over the bus at registers listed below.

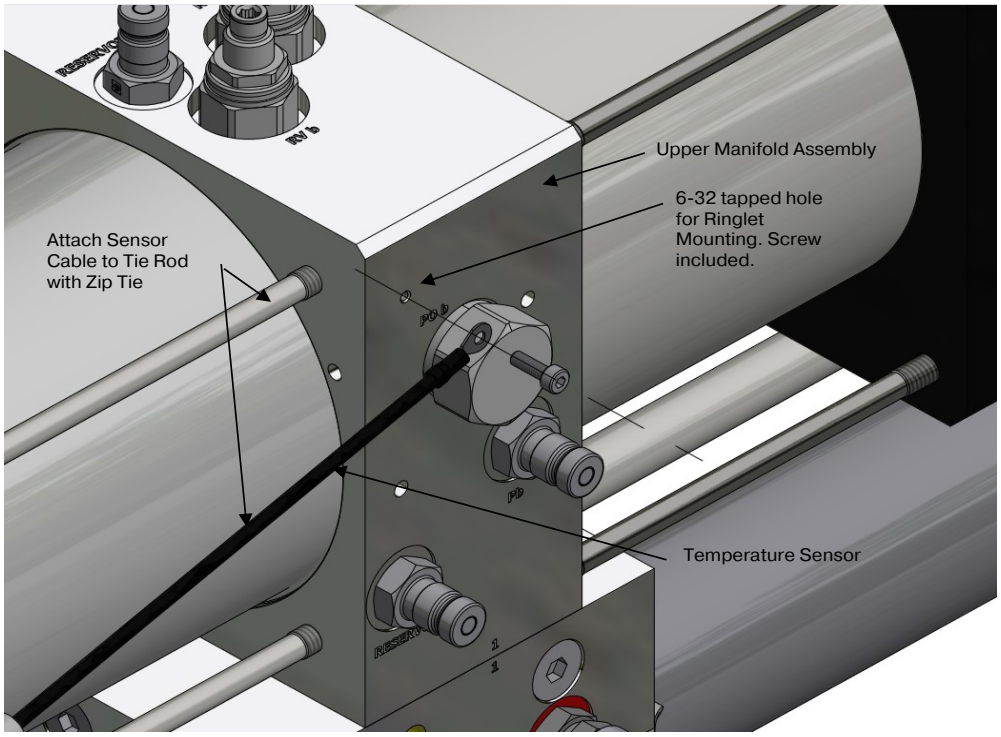
Modbus Register	IP Register	Type	Tag Name	Value
400276-02	SSD_890:I.Data (19.2)	Boolean	Res Temp Sensor Fault	FALSE / TRUE
400262	SSD_890:I.Data (5)	UINT 16	Reservoir Temp	1= 1 F.. 14 to 199 F

Temp Sensor Part No:
0992480000 Mating Cable:
086620T005
IP Rating: IP67
Connector: M8 Nano 3 pin



1 = Brown
4 = Black
3 = Blue

HAS Reservoir Temperature Sensor (Thermistor) Mounting



Inputs to HAS Drive

Modbus Register	IP Register	Type	Tag Name	Value	Hard Wire Input	Range	Description
400001.00	SSD_890:O.Data (0.0)	Boolean	Drive Enable	True / False	X15-01	FALSE / TRUE	This provides a means of electronically inhibiting HAS operation. Setting this parameter to FALSE disables the Inverter operation and causes HAS to stop
400001.01	SSD_890:O.Data (0.1)	Boolean	Jog CW	True / False	X15-02	FALSE / TRUE	Setting this parameter TRUE causes the Inverter to Jog CW at the speed set by JOG SETPOINT.TRUE to FALSE causes the Inverter to ramp to zero at the DECELL Value
400001.02	SSD_890:O.Data (0.2)	Boolean	Jog CCW	True / False	X15-03	FALSE / TRUE	Setting this parameter TRUE causes the HAS to Jog CCW at the speed set by JOG SETPOINT. TRUE to FALSE causes the HAS to ramp to zero at the DECELL Value
400001.03	SSD_890:O.Data (0.3)	Boolean	Run CW	True / False	N/A	FALSE / TRUE	Setting this parameter TRUE causes the HAS to RUN CW at the speed set by RUN SETPOINT. TRUE to FALSE causes the HAS to ramp to zero at the DECELL Value
400001.04	SSD_890:O.Data (0.4)	Boolean	Run CCW	True / False	N/A	FALSE / TRUE	Setting this parameter TRUE causes the HAS to RUN CCW at the speed set by RUN SETPOINT. TRUE to FALSE causes the HAS to ramp to zero at the DECELL Value
400001.05	SSD_890:O.Data (0.5)	Boolean	Run Speed & Direction	True / False	N/A	FALSE / TRUE	Setting this parameter TRUE causes the HAS to RUN based upon the value set in the Speed and Direction register. False statement will ignore value in speed register and allow Jog functions. In the Speed & Direction register (4000005) a (+) Value will drive a CW rotation, speed controlled by value. (-) value will drive a CCW rotation. Acceleration and Deceleration rates are used when ramping. End of Stroke switch, Stop on Amps, or Position Window logic not active, stroke limiting should be implemented and maintained by Master Host controlled when using this function.
400001.06	SSD_890:O.Data (0.6)	Boolean	Invert Direction	True / False	N/A	FALSE / TRUE	Setting this parameter TRUE causes the Inverts the Rotation Direction in all modes
400001.07	SSD_890:O.Data (0.7)	Boolean	Invert Limit Switch	True / False	N/A	FALSE / TRUE	Setting this parameter True (False is Std) changes the input condition expected from end of stroke switch to Open as limit is reached. Value is Retained in memory
400001.08	SSD_890:O.Data (0.8)	Boolean	Fault Reset	True / False	N/A	FALSE / TRUE	On a transition to TRUE, this input clears latched trips (faults)
400001.09	SSD_890:O.Data (0.9)	Boolean	Trip Drive	True / False	N/A	FALSE / TRUE	Setting this parameter TRUE causes the HAS Drive to trip and stop motion
400001.10	SSD_890:O.Data (0.10)	Boolean	Trip Temp	True / False	N/A	FALSE / TRUE	Setting this parameter TRUE will cause the drive to trip on Reservoir Oil Temp exceeding 165F. When False and temp exceeds, Warning bit is activated
400001.11	SSD_890:O.Data (0.11)	Boolean	Trip Level	True / False	N/A	FALSE / TRUE	Setting this parameter TRUE will cause the drive to trip on Low Reservoir Level when input X15-07 is seen, When False and input is seen, Warning bit is activated
400001.12	SSD_890:O.Data (0.12)	Boolean	Stop on PSI	True / False	N/A	FALSE / TRUE	Setting this parameter TRUE will enable the stop on Pressure Feature. Using the Motor's torque constant, pump displacement, and amp draw, HAS PSI generated is calculated. When the HAS unit PSI value is greater than the Stop_PSI Value maintained longer than the Stop_PSI_Time value. HAS will be latched off until opposite direction in commanded
400001.13	SSD_890:O.Data (0.13)	Boolean	Stop On Position	True / False	N/A	FALSE / TRUE	Setting this parameter TRUE will enable the stop on position feature. The feature uses the Position Input Value (X12-05) and defines an operational window of position, based open 0-100% of stroke. Stroke Percentage of stroke is defined by 0-100% of input value. Feature Available with JOG and Run input types. Not available with Speed and Direction Motion control
400001.14	SSD_890:O.Data (0.14)	Boolean	Reset Energy Meter	True / False	N/A	FALSE / TRUE	Setting this parameter TRUE and than FALSE resets the energy used value
400001.15	SSD_890:O.Data (0.15)	Boolean	Reset Hour Meter	True / False	N/A	FALSE / TRUE	Setting this parameter TRUE and than FALSE resets the Hour meter used value
Modbus Register	**IP Register**	**Type**	**Tag Name**	**Value**	**Hard Wire Input**	**Range**	**Description**
400002	SSD_890:O.Data (1)	UINT16	Jog Speed Setpoint	Value of 1 = 0.01%	N/A	0 to 100.00 %	Value will operate HAS unit Velocity when JOG Inputs are seen True either thru Networks coms or Discrete Inputs. Value of 1 represents 0.01% of Pump maximum speed. Maximum speed is determined by Pump Displacement Value (40008).
400003	SSD_890:O.Data (2)	UINT16	Run Speed Setpoint	Value of 1 = 0.01%	N/A	0 to 100.00 %	Value will operate HAS unit Velocity when RUN Inputs are seen True. Value of 1 represents 0.01% of Pump maximum speed. Maximum speed is determined by Pump Displacement Value (40008).
400004	SSD_890:O.Data (3)	SINT16	Speed & Direction Cmd	Value of 1 = 0.01%	N/A	-100.00 to 100.00 %	Value will operate HAS unit Velocity when enabled. Value of 1 represents 0.01% of Pump maximum speed, (+) sign will drive HAS Motor in CW rotation, (-) sign will drive HAS Motor CCW rotation Increasing Value will increase speed limited by Pump Displacement Maximum speed is determined by Pump Displacement Value (40008).

Inputs to HAS Drive

Modbus Register	IP Register	Type	Tag Name	Value	Hard Wire Input	Range	Description
400005	SSD_890:O.Data (4)	UINT16	Torque Limit	Value of 1 = 0.01%	N/A	0 to 300.00 %	Value will Limit the HAS Motor torque based upon RATED torque (Continuous) of the HAS motor. It is limited to 300% of rated Value. Its recommend not to exceed 250% of rated value.
400006	SSD_890:O.Data (5)	UINT16	Acceleration Rate	Value of 1 = 0.001 Sec	N/A	0 to 5.000 secs	Time for HAS unit to ramp the setpoint from 0.00 to100%. Value of 1 = 0.001 secs Resolution for ramp time is rounded to nearest 0.1 seconds.
400007	SSD_890:O.Data (6)	UINT16	Deceleration Rate	Value of 1 = 0.001 Sec	N/A	0 to 5.000 secs	Time for HAS unit to ramp the setpoint from 100 to 0 %. Value of 1 = 0.001 secs Resolution for ramp time is rounded to nearest 0.1 seconds.
400008	SSD_890:O.Data (7)	UINT16	Pump CC	Value of 2 = 2 cc	N/A	2-12	Pump displacement value set speed limits per pump size, see catalog for values. Pump max speed set as 100% speed values. Value of 3= 3 cc Values outside displacement range will limit speed to 1000 RPM Must be sent when drive is NOT enabled
400009	SSD_890:O.Data (8)	UINT16	Push Area	Value of 1 = 0.01 Sq-Icnh	N/A	0 to 655.35 sq-inch	Push Area in square-inch, value of 1 = 0.01 in^2. Value obtained from Sizing Sheet
400010	SSD_890:O.Data (9)	UINT16	Pull Area	Value of 1 = 0.01 Sq-Icnh	N/A	0 to 655.35 sq-inch	Pull Area in square-inch, value of 1 = 0.01 in^2. Value obtained from Sizing Sheet
400011	SSD_890:O.Data (10)	UINT16	Cylinder Stroke	Value of 1 = 0.01"	N/A	0-600.00 inch	Value which is equal for 100% supply at Analog Input X12-05. Used only to pass Cylinder positional data over network coms 10 mS update rate, 12 Bit D-A conversion
Modbus Register	**IP Register**	**Type**	**Tag Name**	**Value**	**Hard Wire Input**	**Range**	**Description**
400012	SSD_890:O.Data (11)	UINT16	Stop On PSI CW (V)	value of 1 = 1 PSI	N/A	1000-3000 PSI	When Stop on PSI feature is enable, PSI value that initiates timer to stop motion when motor is running CW.
400013	SSD_890:O.Data (12)	UINT16	Stop on PSI CCW (V)	value of 1 = 1 PSI	N/A	1000-3000 PSI	When Stop on PSI feature is enable, PSI value that initiates timer to stop motion when motor is running CCW.
400014	SSD_890:O.Data (13)	UINT16	Stop Amps Time CW	value of 1 = 0.001 Sec	N/A	1.0 to 5.0 secs	When Stop on Amps feature is enable, CW Rotation time duration that STOP on AMPS must be greater than. This value should be set to minimize false stops due to acceleration current or other unwanted values. Limit is clamped at 3 second max
400015	SSD_890:O.Data (14)	UINT16	Stop Amps Time CCW	value of 1 = 0.001 Sec	N/A	1.0 to 5.0 secs	When Stop on Amps feature is enable, CCW Rotation time duration that STOP on AMPS must be greater than. This value should be set to minimize false stops due to acceleration current or other unwanted values. Limit is clamped at 3 second max
400016	SSD_890:O.Data (15)	UINT16	Position High Limit	Value of 1 = 0.01	N/A	0-600.00 inch	When Stop on Position feature is enable, The HAS unit must be equipped with a Position Feedback Device Extend motion will be stopped when Position input (X12-05) value is greater than this value. Value is scaled based upon Cylinder Stroke Value (40011). This value mimics the Extend Limit Switch input, and when active Extend LS output is set 400257.07. Invert Direction bit if CW rotation does not create Extending Motion.
400017	SSD_890:O.Data (16)	UINT16	Position Low Limit	Value of 1 = 0.01	N/A	0-600.00 inch	When Stop on Position feature is enable, The HAS unit must be equipped with a Position Feedback Device Retract motion will be stopped when Position input (X12-05) value is less than this value. Value is scaled based upon Cylinder Stroke Value (40011). This value mimics the Retract Limit Switch input, and when active Retract LS output is set 400257.08 Invert Direction bit if CCW rotation does not create Retracting Motion.
400018	SSD_890:O.Data (17)	UINT16	Analog Input Type	Value of 1 = 0 to 10V Value of 2 = 0 to 20 mA Value of 3 = 4 to 20 mA	N/A		By setting this value to either a 1, 2 or 3, configures the Cylinder Position Analog Input type. Any other value listed will be ignored
400019	SSD_890:O.Data (18)	UINT16	Speed & Direction Deadband	Value of 1 = 0.01%	N/A	0.1 -10%	This value determines the deadband on Speed and Direction Input (400004). Speed Values seen at (400004) below this value will not cause motion. Default Value is (10) 0.1%. When value of 10 is read HAS Motor will spin at Minimum Speed and be linear from this value to 100% value. Value is Clamped to range settings.

Inputs to HAS Drive

Modbus Register	IP Register	Type	Tag Name	Value	Hard Wire Input	Range	Description
400020	SSD_890:O.Data (19)	UINT16	Speed & Direction Min Pump Speed	Value of 1 = 1 RPM	N/A	100-1000 rpm	This value determines minimum pump speed on Speed and Direction Input (400004) and Speed and Direction Deadband. Speed Values seen at (400004) when equal to deadband (400019) pump speed will start at this RPM and be linear to max pump speed. Default value 100 RPM, this is intended to be used with Closed Loop PID control, Pump operation below 500 RPM is not recommended, such step creates havoc with closed loop control, default setting allow traditional PID loops to ramp control to null. When using Closed Loop control, it is recommended to disable drive when "in position" to prevent Integral Gain from winding up causing undesired motion. Macro monitors motor RPM and if below 500 rpm for a period of 30 seconds, drive command set to zero, active once speed demand request is greater than 500 RPM.
400021	SSD_890:O.Data (20)	UINT16	Heater/Heat Exchanger Mod	Value of 0 = Not Used Value of 1 = ON when CW Value of 2 = ON when CCW Value of 3 = ON Both Dir Value of 4 = Always On Value of 5 = Heater Mode	N/A	0-4	This value determines when a relay contact is closed for operating the Fan or Water valve when HAS units are fitted for Heat Exchangers. Operator may configure heat exchanger to be on when pump is spinning CW, CCW both or always on, by setting the appropriate value in this field. Values not listed: Relay will be closed when operating in Both Direction, similar to a Value of 3 issued.
400022	SSD_890:O.Data (21)	UINT16	Heat Exchanger on Temp	Value of 1 = 1 degree F	N/A	50-140F	This value determines when a relay contact is closed for operating the Fan or Water valve when HAS units are fitted for Heat Exchangers. When the reservoir temperature exceed this value, in conjunction with above Heat Exchanger Mode, the cooling loop is activated. When Reservoir temperature falls 10 degrees below this setting the cooling relay contact will be disabled.
400023	SSD_890:O.Data (22.0)	Boolean	Reserved				
	SSD_890:O.Data (22.1)	Boolean	Reserved				
	SSD_890:O.Data (22.2)	Boolean	Reserved				

Outputs from HAS Drive

Modbus Register	IP Register	Type	Tag Name	Range	Description
400257.00	SSD_890:I.Data (0.0)	Boolean	Heartbeat	FALSE / TRUE	Confirmation of BUS communications, Pulse signal sent 100 mS on, 100 mS off
400257.01	SSD_890:I.Data (0.1)	Boolean	Enabled	FALSE / TRUE	Confirmation of Enable Bit set
400257.02	SSD_890:I.Data (0.2)	Boolean	Healthy	FALSE / TRUE	If running and the Invert trips, the Healthy will be True and set FALSE when the run command is removed. The HEALTHY will be True when the Inverter is Not Tripped or when Running.
400257.03	SSD_890:I.Data (0.3)	Boolean	Running	FALSE / TRUE	Indicates that that the Inverter is in the enabled state.
400257.04	SSD_890:I.Data (0.4)	Boolean	STO Active	FALSE / TRUE	Is the status of the STO (Safe Torque Off) circuit. STO Active prevents HAS from running when True
400257.05	SSD_890:I.Data (0.5)	Boolean	Tripped	FALSE / TRUE	Indicates a latched Trip is present
400257.06	SSD_890:I.Data (0.6)	Boolean	External Trip Forced	FALSE / TRUE	Confirmation External Trip sent over network coms
400257.07	SSD_890:I.Data (0.7)	Boolean	Extend Limit Switch	FALSE / TRUE	Value of True indicates HAS unit has reached End of Stroke condition. Inverting Limit switch state does not change State.
400257.08	SSD_890:I.Data (0.8)	Boolean	Retract Limit Switch	FALSE / TRUE	Value of True indicates HAS unit has reached End of Stroke condition. Inverting Limit switch state does not change State.
400257.09	SSD_890:I.Data (0.9)	Boolean	High Reservoir Temp	FALSE / TRUE	When True Oil Temp has exceed 165F Warning
400257.10	SSD_890:I.Data (0.10)	Boolean	Low Oil Level	FALSE / TRUE	When True Oil level has reached low value, Warning
400257.11	SSD_890:I.Data (0.11)	Boolean	Oil Change	FALSE / TRUE	When True, the HAS units should be removed from service for Maintenance
400257.12	SSD_890:I.Data (0.12)	Boolean	Limit Switch Inverted	FALSE / TRUE	When False Limit switch is Normally Open, activated Closed When True, switch is Normally Closed, Activated Open HAS motion is topped on activated state
400257.13	SSD_890:I.Data (0.13)	Boolean	Motor Rotation Inverted	FALSE / TRUE	Motor Rotation set inverted, all CW and + setpoint values, cause a CCW Rotation Direction.
400257.14	SSD_890:I.Data (0.14)	Boolean	Stopped on PSI CW	FALSE / TRUE	When True, HAS unit stopped when calculated pressure has passed desired limit Limit Switch Inverted must be set to False for proper operation.
400257.15	SSD_890:I.Data (0.15)	Boolean	Stopped on PSI CCW	FALSE / TRUE	When True, HAS unit stopped when calculated pressure has passed desired limit Limit Switch Inverted must be set to False for proper operation.
Modbus Register	**IP Register**	**Type**	**Tag Name**	**Range**	**Description**
400258	SSD_890:I.Data (1)	SINT 16	Actual Motor RPM	1=1 RPM	Motor RPM
400259	SSD_890:I.Data (2)	SINT 16	Output Torque	1=0.01 nM	nM meter torque output
400260	SSD_890:I.Data (3)	SINT 16	Motor Amps	1=0.01 amp	Motor Amps
400261	SSD_890:I.Data (4)	UINT 16	Energy Used		Total Energy Consumed by the load in Kilowatt hours.
400262	SSD_890:I.Data (5)	UINT 16	Reservoir Temp	1= 1 F.. 14 to 199 F	Reservoir Temp in F : Valid range of temp is 14 F to 199.4F
400263	SSD_890:I.Data (6)	UINT 16	Operation Hours	Value of 1 = 1 hour	Operation is retained in memory, minimum of 3 seconds of operation required to start time increment.
400264	SSD_890:I.Data (7)	UINT 16	Push Force	Based upon Push Area entry	HAS
400265	SSD_890:I.Data (8)	UINT 16	Pull Force	Based upon Push Area entry	HAS Unit equipped with Industrial Pressure Transducer, feature allow passing cylinder force generated by HAS Unit. Value in register is HAS Pull Force Note HAS is Hydrostatic, for Force measurement, it is recommended to subtract Pull Force from Push force value for force generated. Push CYL Area < 13 , Value 1 = 1 lbs. Push CYL Area > 13, < 130 , Value 1 = 10 lbs.
400266	SSD_890:I.Data (9)	UINT 16	Position	1=0.01"	Cylinder Position Value set buy max cylinder stroke value, assuming 0-10V supplied cylinder feedback device.

Outputs from HAS Drive

Modbus Register	IP Register	Type	Tag Name	Range	Description
400267	SSD_890:I.Data (10)	UINT 16	Pressure	1=1 PSI	Calculated Pump PSI
400268	SSD_890:I.Data (11)	SINT 16	Torque %	1= 0.01%	Torque % based upon Motor's continuous rating
400269	SSD_890:I.Data (12)		Reserved		
400270	SSD_890:I.Data (13)		Reserved		
400271	SSD_890:I.Data (14)		Reserved		
400272	SSD_890:I.Data (15)		Reserved		
400273	SSD_890:I.Data (16)		Reserved		
400274	SSD_890:I.Data (17)		Reserved		
400275	SSD_890:I.Data (18)		Reserved		
400276.00	SSD_890:I.Data (19.0)	Boolean	Low RPM Time Out	FALSE / TRUE	When True, during Mode 4, RPM Low RPM Time out expired.
400276.01	SSD_890:I.Data (19.1)	Boolean	Cooling Loop Active	FALSE / TRUE	When True, Relay Contact Closed to operate Cooling Loop . This time out protects the pump from operating below minimum RPM. To re-engage speed loop, issue speed command above min threshold.
400276-02	SSD_890:I.Data (19.2)	Boolean	Res Temp Sensor Fault	FALSE / TRUE	When True, no signal from temp sensor or ambient temperatures has dropped below 14 F.
400276-03		Boolean	Reserved		
400276-04		Boolean	Reserved		
400276-05		Boolean	Reserved		
400276-06		Boolean	Reserved		
400276-07		Boolean	Reserved		
400276-08		Boolean	Reserved		
400276-09		Boolean	Reserved		
400276-10		Boolean	Reserved		
400276-11		Boolean	Reserved		
400276-12		Boolean	Reserved		
400276-13		Boolean	Reserved		
400276-14		Boolean	Reserved		
400276-15		Boolean	Reserved		
400277	SSD_890:I.Data (20)	Boolean	Trip Status Word 1		Trip Table 1
400277-00		Boolean	Over Voltage		The drive internal dc link voltage is too high
400277-01		Boolean	Under Voltage		The drive internal dc link voltage is too low
400277-02		Boolean	Over Current		The motor current being drawn from the drive is too high
400277-03		Boolean	Heat Sink		The drive heatsink temperature is too high
400277-04		Boolean	External Trip		n/a
400277-05		Boolean	input 1 break		n/a
400277-06		Boolean	input 2 break		n/a
400277-07		Boolean	Motor Stalled		The motor has stalled (not rotating)
400277-08		Boolean	Inverse Time		The inverse time current limit is active: motor loading is too great; fixed or autoboost levels are too high (Drive Full Load Current = 150% for 60 seconds)
400277-09		Boolean	Brake Resistor		n/a
400277-10		Boolean	Brake Switch		Internal dynamic braking switch has been overloaded
400277-11		Boolean	Op Station		Keypad has been disconnected from drive whilst drive is running in local control
400277-12		Boolean	Coms Break		Not used
400277-13		Boolean	Contactor FBK		Not used
400277-14		Boolean	Speed Feedback Error		SPEED ERROR > 50.00% for 10 seconds
400277-15		Boolean	Ambient Temp (Drive)		The temperature in the drive is too high
Modbus Register	**IP Register**	**Type**	**Tag Name**	**Range**	**Description**
400278	SSD_890:I.Data (21)	Boolean	Trip Status Word 2		Trip Table 2
400278-00		Boolean	Motor Over Temp		The motor temperature is too high
400278-01		Boolean	Current Limit		Not used

Outputs from HAS Drive

Modbus Register	IP Register	Type	Tag Name	Range	Description
400278-02		Boolean	Reserved		
400278-03		Boolean	24V Failure		The 24V customer output has fallen below 17V
400278-04		Boolean	Low Speed over I		The motor is drawing too much current (>100%) at zero output frequency
400278-05		Boolean	Phase Fail		One or more input phases not present
400278-06		Boolean	Encoder Fault		
400278-07		Boolean	DESAT		Instantaneous overcurrent. Refer to OVERCURRENT in this table
400278-08		Boolean	VDC Ripple		The dc link ripple voltage is too high. Check for a missing input phase.
400278-09		Boolean	Brake Short Circuit		Brake resistor overcurrent
400278-10		Boolean	Overspeed		Speed feedback > 150% for 0.1 seconds
400278-11		Boolean	Analog Input Error		4-20mA analog input current > 22mA could damage the input circuit
400278-12		Boolean	INT DB Resistor		Braking mode set to INTERNAL. Set to EXTERNAL and connect an External Braking Resistor if braking is required.
400278-13		Boolean	Reserved		
400278-14		Boolean	Unknown		
400278-15		Boolean	Other		
400279	SSD_890:I.Data (22)	Boolean	Trip Status Word 4		Trip Table 4
400279-00		Boolean	reserved		
400279-01		Boolean	App Halted		The application has been halted by the DSE Configuration Tool
400279-02		Boolean	App Error		The application has ceased execution due to an error
400279-03		Boolean	Firmware Error		The firmware in the drive has stopped executing
400279-04		Boolean	Reserved		
400279-05		Boolean	Reserved		
400279-06		Boolean	Reserved		
400279-07		Boolean	Reserved		
400279-08		Boolean	Resolver Error		
400279-09		Boolean	I2T Motor Trip		Motor is undersized
400279-10		Boolean	Reserved		
400279-11		Boolean	Safe Torque Off		The safe torque off feature has been activated
400279-12		Boolean	Ref Encoder Cal		Endat The drive has failed to set absolute position
400279-13		Boolean	Ref Encoder Fail		
400279-14		Boolean	Drive Config Error		The configuration defined in DRIVE CONFIG doesn't match the actual drive configuration
400279-15		Boolean	Reserved		
400280	SSD_890:I.Data (23)	Boolean	Trip Status Word 5		Trip Table 5
400280-04		Boolean	reserved		
400280-05		Boolean	reserved		
400280-06		Boolean	reserved		
400280-07		Boolean	Current Balance		A CD Module hardware fault
400280-08		Boolean	System Volts		Supply overloaded, fan shorted or low voltage supply wiring fault
400280-09		Boolean	Left Fan Failure		Fan not rotating
400280-10		Boolean	Right Fan Failure		Fan not rotating
400280-11		Boolean	CS Phase Loss		Complete 3 phase power supply loss, or loss of a single phase
400280-12		Boolean	CS Temperature		Warning that the CS Module is running too hot
400280-13		Boolean	CS Bridge		The current being drawn from the CS Module is too high
400280-14		Boolean	Earth Fault		Currents do not sum to zero. One phase may have a short to earth
400280-15		Boolean	Stack Mismatch		Check U, V & W CD Modules are the same voltage/power rating

Safety Guide for Selecting and Using Hydraulic, Pneumatic Cylinders and Their Accessories

WARNING: ⚠ FAILURE OF THE CYLINDER, ITS PARTS, ITS MOUNTING, ITS CONNECTIONS TO OTHER OBJECTS, OR ITS CONTROLS CAN RESULT IN:

- **Unanticipated or uncontrolled movement of the cylinder or objects connected to it.**
- **Falling of the cylinder or objects held up by it.**
- **Fluid escaping from the cylinder, potentially at high velocity.**

THESE EVENTS COULD CAUSE DEATH OR PERSONAL INJURY BY, FOR EXAMPLE, PERSONS FALLING FROM HIGH LOCATIONS, BEING CRUSHED OR STRUCK BY HEAVY OR FAST MOVING OBJECTS, BEING PUSHED INTO DANGEROUS EQUIPMENT OR SITUATIONS, OR SLIPPING ON ESCAPED FLUID.

Before selecting or using Parker Hannifin Corporation (the Company) cylinders or related accessories, it is important that you read, understand and follow the following safety information. Training is advised before selecting and using the Company's products.

1.0 General Instructions

1.1 Scope – This safety guide provides instructions for selecting and using (including assembling, installing, and maintaining) cylinder products. This safety guide is a supplement to and is to be used with the specific Company publications for the specific cylinder products that are being considered for use.

1.2 Fail Safe – Cylinder products can and do fail without warning for many reasons. All systems and equipment should be designed in a fail-safe mode so that if the failure of a cylinder product occurs people and property won't be endangered.

1.3 Distribution – Provide a free copy of this safety guide to each person responsible for selecting or using cylinder products. Do not select or use the Company's cylinders without thoroughly reading and understanding this safety guide as well as the specific Company publications for the products considered or selected.

1.4 User Responsibility – Due to very wide variety of cylinder applications and cylinder operating conditions, the Company does not warrant that any particular cylinder is suitable for any specific application. This safety guide does not analyze all technical parameters that must be considered in selecting a product. The hydraulic and pneumatic cylinders outlined in this catalog are designed to the Company's design guidelines and do not necessarily meet the design guideline of other agencies such as American Bureau of Shipping, ASME Pressure Vessel Code etc. The user, through its own
analysis and testing, is solely responsible for:

- Making the final selection of the cylinders and related accessories.
- Determining if the cylinders are required to meet specific design requirements as required by the Agency(s) or industry standards covering the design of the user's equipment.
- Assuring that the user's requirements are met, OSHA requirements are met, and safety guidelines from the applicable agencies such as but not limited to ANSI are followed and that the use presents no health or safety hazards.
- Providing all appropriate health and safety warnings on the equipment on which the cylinders are used.

1.5 Additional Questions – Call the appropriate Company technical service department if you have any questions or require any additional information. See the Company publication for the product being considered or used, or call 1-847-298-2400, or go to www.parker.com, for telephone numbers of the appropriate technical service department.

2.0 Cylinder and Accessories Selection

2.1 Seals – Part of the process of selecting a cylinder is the selection of seal compounds. Before making this selection, consult the "seal information page(s)" of the publication for the series of cylinders of interest.

The application of cylinders may allow fluids such as cutting fluids, wash down fluids etc. to come in contact with the external area of the cylinder. These fluids may attack the piston rod wiper and or the primary seal and must be taken into account when selecting and specifying seal compounds.

Dynamic seals will wear. The rate of wear will depend on many operating factors. Wear can be rapid if a cylinder is mis-aligned or if the cylinder has been improperly serviced. The user must take seal wear into consideration in the application of cylinders.

2.2 Piston Rods – Possible consequences of piston rod failure or separation of the piston rod from the piston include, but are not limited to are:

- Piston rod and or attached load thrown off at high speed.
- High velocity fluid discharge.
- Piston rod extending when pressure is applied in the piston retract mode.

Piston rods or machine members attached to the piston rod may move suddenly and without warning as a consequence of other conditions occurring to the machine such as, but not limited to:

- Unexpected detachment of the machine member from the piston rod.
- Failure of the pressurized fluid delivery system (hoses, fittings, valves, pumps, compressors) which maintain cylinder position.
- Catastrophic cylinder seal failure leading to sudden loss of pressurized fluid.
- Failure of the machine control system.

Follow the recommendations of the "Piston Rod Selection Chart and Data" in the publication for the series of cylinders of interest. The suggested piston rod diameter in these charts must be followed in order to avoid piston rod buckling.

Piston rods are not normally designed to absorb bending moments or loads which are perpendicular to the axis of piston rod motion. These additional loads can cause the piston rod to fail. If these types of additional loads are expected to be imposed on the piston rod, their magnitude should be made known to our engineering department.

The cylinder user should always make sure that the piston rod is securely attached to the machine member.

On occasion cylinders are ordered with double rods (a piston rod extended from both ends of the cylinder). In some cases a stop is threaded on to one of the piston rods and used as an external stroke adjuster. On occasions spacers are attached to the machine member connected to the piston rod and also used as a stroke adjuster. In both cases the stops will create a pinch point and the user should consider appropriate use of guards. If these
external stops are not perpendicular to the mating contact surface, or if debris is trapped between the contact surfaces, a bending moment will be placed on the piston rod, which can lead to piston rod failure. An external stop will also negate the effect of cushioning and will subject the piston rod to impact loading. Those two (2) conditions can cause piston rod failure. Internal stroke adjusters are available with and without cushions. The use of external stroke adjusters should be reviewed with our engineering department.

The piston rod to piston and the stud to piston rod threaded connections are secured with an anaerobic adhesive. The strength of the adhesive decreases with increasing temperature. Cylinders which can be exposed to temperatures above +250°F (+121°C) are to be ordered with a non studded piston rod and a pinned piston to rod joint.

2.3 Cushions – Cushions should be considered for cylinder applications when the piston velocity is expected to be over 4 inches/second.

Cylinder cushions are normally designed to absorb the energy of a linear applied load. A rotating mass has considerably more energy than the same mass moving in a linear mode. Cushioning for a rotating mass application should be reviewed by our engineering department.

2.4 Cylinder Mountings – Some cylinder mounting configurations may have certain limitations such as but not limited to minimum stroke for side or foot mounting cylinders or pressure de-ratings for certain mounts. Carefully review the catalog for these types of restrictions.

Always mount cylinders using the largest possible high tensile alloy steel socket head cap screws that can fit in the cylinder mounting holes and torque them to the manufacturer's recommendations for their size.

2.5 Port Fittings – Hydraulic cylinders applied with meter out or deceleration circuits are subject to intensified pressure at piston rod end.

The rod end pressure is approximately equal to:

$$\frac{\text{operating pressure x effective cap end area}}{\text{effective rod end piston area}}$$

Contact your connector supplier for the pressure rating of individual connectors.

3.0 Cylinder and Accessories Installation and Mounting

3.1 Installation

3.1.1 – Cleanliness is an important consideration, and cylinders are shipped with the ports plugged to protect them from contaminants entering the ports. These plugs should not be removed until the piping is to be installed. Before making the connection to the cylinder ports, piping should be thoroughly cleaned to remove all chips or burrs which might have resulted from threading or flaring operations.

3.1.2 – Cylinders operating in an environment where air drying materials are present such as fast-drying chemicals, paint, or weld splatter, or other hazardous conditions such as excessive heat, should have shields installed to prevent damage to the piston rod and piston rod seals.

3.1.3 – Proper alignment of the cylinder piston rod and its mating component on the machine should be checked in both the extended and retracted positions. Improper alignment will result in excessive rod gland and/or cylinder bore wear. On fixed mounting cylinders attaching the piston rod while the rod is retracted will help in achieving proper alignment.

3.1.4 – Sometimes it may be necessary to rotate the piston rod in order to thread the piston rod into the machine member. This operation must always be done with zero pressure being applied to either side of the piston. Failure to follow this procedure may result in loosening the piston to rod-threaded connection. In some rare cases the turning of the piston rod may rotate a threaded piston rod gland and loosen it from the
cylinder head. Confirm that this condition is not occurring. If it does, re-tighten the piston rod gland firmly against the cylinder head.

For double rod cylinders it is also important that when attaching or detaching the piston rod from the machine member that the torque be applied to the piston rod end of the cylinder that is directly attaching to the machine member with the opposite end unrestrained. If the design of the machine is such that only the rod end of the cylinder opposite to where the rod attaches to the machine member can be rotated, consult the factory for further instructions.

3.2 Mounting Recommendations

3.2.1 – Always mount cylinders using the largest possible high tensile alloy steel socket head screws that can fit in the cylinder mounting holes and torque them to the manufacturer's recommendations for their size.

3.2.2 – Side-Mounted Cylinders – In addition to the mounting bolts, cylinders of this type should be equipped with thrust keys or dowel pins located so as to resist the major load.

3.2.3 – Tie Rod Mounting – Cylinders with tie rod mountings are recommended for applications where mounting space is limited. The standard tie rod extension is shown as BB in dimension tables. Longer or shorter extensions can be supplied. Nuts used for this mounting style should be torqued to the same value as the tie rods for that bore size.

3.2.4 – Flange Mount Cylinders – The controlled diameter of the rod gland extension on head end flange mount cylinders can be used as a pilot to locate the cylinders in relation to the machine. After alignment has been obtained, the flanges may be drilled for pins or dowels to prevent shifting.

3.2.5 – Trunnion Mountings – Cylinders require lubricated bearing blocks with minimum bearing clearances. Bearing blocks should be carefully aligned and rigidly mounted so the trunnions will not be subjected to bending moments. The rod end should also be pivoted with the pivot pin in line and parallel to axis of the trunnion pins.

3.2.6 – Clevis Mountings – Cylinders should be pivoted at both ends with centerline of pins parallel to each other. After cylinder is mounted, be sure to check to assure that the cylinder is free to swing through its working arc without interference from other machine parts.

4.0 Cylinder and Accessories Maintenance, Troubleshooting and Replacement

4.1 Storage – At times cylinders are delivered before a customer is ready to install them and must be stored for a period of time. When storage is required the following procedures are recommended.

4.1.1 – Store the cylinders in an indoor area which has a dry, clean and noncorrosive atmosphere. Take care to protect the cylinder from both internal corrosion and external damage.

4.1.2 – Whenever possible cylinders should be stored in a vertical position (piston rod up). This will minimize corrosion due to possible condensation which could occur inside the cylinder. This will also minimize seal damage.

4.1.3 – Port protector plugs should be left in the cylinder until the time of installation.

4.1.4 – If a cylinder is stored full of hydraulic fluid, expansion of the fluid due to temperature changes must be considered. Installing a check valve with free flow out of the cylinder is one method.

4.1.5 – When cylinders are mounted on equipment that is stored outside for extended periods, exposed unpainted surfaces, e.g. piston rod, must be coated with a rust-inhibiting compound to prevent corrosion.

4.2 Cylinder Trouble Shooting

4.2.1 – **External Leakage**

4.2.1.1 – Rod seal leakage can generally be traced to worn or damaged seals. Examine the piston rod for dents, gouges or score marks, and replace piston rod if surface is rough.

Rod seal leakage could also be traced to gland wear. If clearance is excessive, replace rod bushing and seal. Rod seal leakage can also be traced to seal deterioration. If seals are soft or gummy or brittle, check compatibility of seal material with lubricant used if air cylinder, or operating fluid if hydraulic cylinder. Replace with seal material, which is compatible with these fluids. If the seals are hard or have lost elasticity, it is usually due to exposure to temperatures in excess of 165°F. (+74°C). Shield the cylinder from the heat source to limit temperature to 350°F. (+177°C.) and replace with fluorocarbon seals.

4.2.1.2 – Cylinder body seal leak can generally be traced to loose tie rods. Torque the tie rods to manufacturer's recommendation for that bore size.

Excessive pressure can also result in cylinder body seal leak. Determine maximum pressure to rated limits. Replace seals and retorque tie rods as in paragraph above. Excessive pressure can also result in cylinder body seal leak. Determine if the pressure rating of the cylinder has been exceeded. If so, bring the operating pressure down to the rating of the cylinder and have the tie rods replaced.

Pinched or extruded cylinder body seal will also result in a leak. Replace cylinder body seal and retorque as in paragraph above.

Cylinder body seal leakage due to loss of radial squeeze which shows up in the form of flat spots or due to wear on the O.D. or I.D. – Either of these are symptoms of normal wear due to high cycle rate or length of service. Replace seals as per paragraph above.

4.2.2 – **Internal Leakage**

4.2.2.1 – Piston seal leak (by-pass) 1 to 3 cubic inches per minute leakage is considered normal for piston ring construction. Virtually no static leak with lipseal type seals on piston should be expected. Piston seal wear is a usual cause of piston seal leakage. Replace seals as required.

4.2.2.2 – With lipseal type piston seals excessive back pressure due to over-adjustment of speed control valves could be a direct cause of rapid seal wear. Contamination in a hydraulic system can result in a scored cylinder bore, resulting in rapid seal wear. In either case, replace piston seals as required.

4.2.2.3 – What appears to be piston seal leak, evidenced by the fact that the cylinder drifts, is not always traceable to the piston. To make sure, it is suggested that one side of the cylinder piston be pressurized and the fluid line at the opposite port be disconnected. Observe leakage. If none is evident, seek the cause of cylinder drift in other component parts in the circuit.

4.2.3 – **Cylinder Fails to Move the Load**

4.2.3.1 – Pneumatic or hydraulic pressure is too low. Check the pressure at the cylinder to make sure it is to circuit requirements.

4.2.3.2 – Piston Seal Leak – Operate the valve to cycle the cylinder and observe fluid flow at valve exhaust ports at end of cylinder stroke. Replace piston seals if flow is excessive.

4.2.3.3 – Cylinder is undersized for the load – Replace cylinder with one of a larger bore size.

4.3 Erratic or Chatter Operation

4.3.1 – Excessive friction at rod gland or piston bearing due to load misalignment – Correct cylinder-to-load alignment.

4.3.2 – Cylinder sized too close to load requirements – Reduce load or install larger cylinder.

4.3.3 – Erratic operation could be traced to the difference between static and kinetic friction. Install speed control valves to provide a back pressure to control the stroke.

4.4 Cylinder Modifications, Repairs, or Failed Component – Cylinders as shipped from the factory are not to be disassembled and or modified. If cylinders require modifications, these modifications must be done at company locations or by the Company's certified facilities. The Cylinder Division Engineering Department must be notified in the event of a mechanical fracture or permanent deformation of any cylinder component (excluding seals). This includes a broken piston rod, tie rod, mounting accessory or any other cylinder component. The notification should include all operation and application details. This information will be used to provide an engineered repair that will prevent recurrence of the failure.

It is allowed to disassemble cylinders for the purpose of replacing seals or seal assemblies. However, this work must be done by strictly following all the instructions provided with the seal kits.

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2. Price; Payment. The Products set forth in the Quote are offered for sale at the prices indicated in the Quote. Unless otherwise specifically stated in the Quote, prices are valid for thirty (30) days and do not include any sales, use, or other taxes or duties. Seller reserves the right to modify prices at any time to adjust for any raw material price fluctuations. Unless otherwise specified by Seller, all prices are F.C.A. Seller's facility (INCOTERMS 2020). All sales are contingent upon credit approval and full payment for all purchases is due thirty (30) days from the date of invoice (or such date as may be specified in the Quote). Unpaid invoices beyond the specified payment date incur interest at the rate of 1.5% per month or the maximum allowable rate under applicable law.

3. Shipment; Delivery; Title and Risk of Loss. All delivery dates are approximate, and Seller is not responsible for damages resulting from any delay. Regardless of the manner of shipment, delivery occurs and title and risk of loss or damage pass to Buyer, upon placement of the Products with the carrier at Seller's facility. Unless otherwise agreed prior to shipment and for domestic delivery locations only, Seller will select and arrange, at Buyer's sole expense, the carrier and means of delivery. When Seller selects and arranges the carrier and means of delivery, freight and insurance costs for shipment to the designated delivery location will be prepaid by Seller and added as a separate line item to the invoice. Buyer shall be responsible for any additional shipping charges incurred by Seller due to Buyer's acts or omissions. Buyer shall not return or repackage any Products without the prior written authorization from Seller, and any return shall be at the sole cost and expense of Buyer.

4. Warranty. The warranty for the Products is as follows: (i) Goods are warranted against defects in material or workmanship for a period of eighteen (18) months from the date of delivery or 2,000 hours of use, whichever occurs first; (ii) Services shall be performed in accordance with generally accepted practices and using the degree of care and skill that is ordinarily exercised and customary in the field to which the Services pertain and are warranted for a period of six (6) months from the date of completion of the Services; and (iii) Software is only warranted to perform in accordance with applicable specifications provided by Seller to Buyer for ninety (90) days from the date of delivery or, when downloaded by a Buyer or end-user, from the date of the initial download. All prices are based upon the exclusive limited warranty stated above, and upon the following disclaimer: EXEMPTION CLAUSE; DISCLAIMER OF WARRANTY, CONDITIONS, REPRESENTATIONS: THIS WARRANTY IS THE SOLE AND ENTIRE WARRANTY, CONDITION, AND REPRESENTATION, PERTAINING TO PRODUCTS. SELLER DISCLAIMS ALL OTHER WARRANTIES, CONDITIONS, AND REPRESENTATIONS, WHETHER STATUTORY, EXPRESS OR IMPLIED, INCLUDING BUT NOT LIMITED TO THOSE RELATING TO DESIGN, NONINFRINGEMENT, MERCHANTABILITY, AND FITNESS FOR A PARTICULAR PURPOSE. SELLER DOES NOT WARRANT THAT THE SOFTWARE IS ERROR-FREE OR FAULT-TOLERANT, OR THAT BUYER'S USE THEREOF WILL BE SECURE OR UNINTERRUPTED. UNLESS OTHERWISE AUTHORIZED IN WRITING BY SELLER, THE SOFTWARE SHALL NOT BE USED IN CONNECTION WITH HAZARDOUS OR HIGH RISK ACTIVITIES OR ENVIRONMENTS. EXCEPT AS EXPRESSLY STATED HEREIN, ALL PRODUCTS ARE PROVIDED "AS IS".

5. Claims; Commencement of Actions. Buyer shall promptly inspect all Products upon receipt. No claims for shortages will be allowed unless reported to Seller within ten (10) days of delivery. Buyer shall notify Seller of any alleged breach of warranty within thirty (30) days after the date the non-conformance is or should have been discovered by Buyer. Any claim or action against Seller based upon breach of contract or any other theory, including tort, negligence, or otherwise must be commenced within twelve (12) months from the date of the alleged breach or other alleged event, without regard to the date of discovery.

6. LIMITATION OF LIABILITY. IN THE EVENT OF A BREACH OF WARRANTY, SELLER WILL, AT ITS OPTION, REPAIR OR REPLACE THE NON-CONFORMING PRODUCT, RE-PERFORM THE SERVICES, OR REFUND THE PURCHASE PRICE PAID WITHIN A REASONABLE PERIOD OF TIME. IN NO EVENT IS SELLER LIABLE FOR ANY SPECIAL, INDIRECT, INCIDENTAL OR CONSEQUENTIAL DAMAGES INCLUDING ANY LOSS OF REVENUE OR PROFITS, WHETHER BASED IN CONTRACT, TORT OR OTHER LEGAL THEORY. IN NO EVENT SHALL SELLER'S LIABILITY UNDER ANY CLAIM MADE BY BUYER EXCEED THE PURCHASE PRICE PAID FOR THE PRODUCTS.

7. Confidential Information. Buyer acknowledges and agrees that any technical, commercial, or other confidential information of Seller, including, without limitation, pricing, technical drawings or prints and/or part lists, which has been or will be disclosed, delivered or made available, whether directly or indirectly, to Buyer ("Confidential Information"), has been and will be received in confidence and will remain the property of Seller. Buyer further agrees that it will not use Seller's Confidential Information for any purpose other than for the benefit of Seller.

8. Loss to Buyer's Property. Any tools, patterns, materials, equipment or information furnished by Buyer or which are or become Buyer's property ("Buyer's Property"), will be considered obsolete and may be destroyed by Seller after two (2) consecutive years have elapsed without Buyer ordering the Products manufactured using Buyer's Property. Furthermore, Seller shall not be responsible for any loss or damage to Buyer's Property while it is in Seller's possession or control.

9. Special Tooling. "Special Tooling" includes but is not limited to tools, jigs, fixtures and associated manufacturing equipment acquired or necessary to manufacture Goods. Seller may impose a tooling charge for any Special Tooling. Such Special Tooling shall be and remain Seller's property notwithstanding payment of any charges by Buyer. In no event will Buyer acquire any interest in the Special Tooling, even if such Special Tooling has been specially converted or adapted for manufacture of Goods for Buyer and notwithstanding any charges paid by Buyer. Unless otherwise agreed, Seller has the right to alter, discard or otherwise dispose of any Special Tooling or other property owned by Seller in its sole discretion at any time.

10. Security Interest. To secure payment of all sums due from Buyer, Seller retains a security interest in all Products delivered to Buyer and, Buyer's acceptance of these Terms is deemed to be a Security Agreement under the Uniform Commercial Code. Buyer authorizes Seller as its attorney to execute and file on Buyer's behalf all documents Seller deems necessary to perfect Seller's security interest.

11. User Responsibility. Buyer, through its own analysis and testing, is solely responsible for making the final selection of the Products and assuring that all performance, endurance, maintenance, safety and warning requirements of the application of the Products are met. Buyer must analyze all aspects of the application and follow applicable industry standards, specifications, and any technical information provided with the Quote or the Products, such as Seller's instructions, guides and specifications. If Seller provides options of or for Products based upon data or specifications provided by Buyer, Buyer is responsible for determining that such data and specifications are suitable and sufficient for all applications and reasonably foreseeable uses of the Products. In the event Buyer is not the end-user of the Products, Buyer will ensure such end-user complies with this paragraph.

12. Use of Products, Indemnity by Buyer. Buyer shall comply with all instructions, guides and specifications provided by Seller with the Quote or the Products. Unauthorized Uses. If Buyer uses or resells the Products in any way prohibited by Seller's instructions, guides or specifications, or Buyer otherwise fails to comply with Seller's instructions, guides and specifications, Buyer acknowledges that any such use, resale, or non-compliance is at Buyer's sole risk. Further, Buyer shall indemnify, defend, and hold Seller harmless from any losses, claims, liabilities, damages, lawsuits, judgments and costs (including attorney fees and defense costs), whether for personal injury, property damage, intellectual property infringement or any other claim, arising out of or in connection with: (a) improper selection, design, specification, application, or any misuse of Products; (b) any act or omission, negligent or otherwise, of Buyer; (c) Seller's use of patterns, tools, equipment, plans, drawings, designs, specifications or other information or things furnished by Buyer; (d) damage to the Products from an external cause, repair or attempted repair by anyone other than Seller, failure to follow instructions, guides and specifications provided by Seller, use with goods not provided by Seller, or opening, modifying, deconstructing, tampering with or repackaging the Products; or (e) Buyer's failure to comply with these Terms. Seller shall not indemnify Buyer under any circumstance except as otherwise provided in these Terms.

13. Cancellations and Changes. Buyer may not cancel or modify, including but not limited to movement of delivery dates for the Products, any order for any reason except with Seller's written consent and upon terms that will indemnify, defend and hold Seller harmless against all direct, incidental and consequential loss or damage and any additional expense. Seller, at any time, may change features, specifications, designs and availability of Products.

14. Limitation on Assignment. Buyer may not assign its rights or obligations without the prior written consent of Seller.

15. Force Majeure. Seller is not liable for delay or failure to perform any of its obligations by reason of events or circumstances beyond its reasonable control. Such circumstances include without limitation: accidents, labor disputes or stoppages, government acts or orders, acts of nature, pandemics, epidemics, other widespread illness, or public health emergency, delays or failures in delivery from carriers or suppliers, shortages of materials, war (whether declared or not) or the serious threat of same, riots, rebellions, acts of terrorism, fire or any reason whether similar to the foregoing or otherwise. Seller will resume performance as soon as practicable after the event of force majeure has been removed. All delivery dates affected by force majeure shall be tolled for the duration of such force majeure and rescheduled for mutually agreed dates as soon as practicable after the force majeure condition ceases to exist. Force majeure shall not include financial distress, insolvency, bankruptcy, or other similar conditions affecting one of the parties, affiliates and/or sub-contractors.

16. Waiver and Severability. Failure to enforce any provision of these Terms will not invalidate that provision; nor will any such failure prejudice either party's right to enforce that provision in the future. Invalidation of any provision of these Terms shall not invalidate any other provision herein and, the remaining provisions will remain in full force and effect.

17. Termination. Seller may terminate any agreement governed by or arising from these Terms for any reason and at any time by giving Buyer thirty (30) days prior written notice. Seller may immediately terminate, in writing, if Buyer: (a) breaches any provision of these Terms, (b) becomes or is deemed insolvent, (c) appoints or has appointed a trustee, receiver or custodian for all or any part of Buyer's property, (d) files a petition for relief in bankruptcy on its own behalf, or one is filed against Buyer by a third party, (e) makes an assignment for the benefit of creditors; or (f) dissolves its business or liquidates all or a majority of its assets.

18. Ownership of Software. Seller retains ownership of all Software supplied to Buyer hereunder. In no event shall Buyer obtain any greater right in and to the Software than a right in the nature of a license limited to the use thereof and subject to compliance with any other terms provided with the Software.

19. Indemnity for Infringement of Intellectual Property Rights. Seller is not liable for infringement of any patents, trademarks, copyrights, trade dress, trade secrets or similar rights ("Intellectual Property Rights") except as provided in this Section. Seller will defend at its expense and will pay the cost of any settlement or damages awarded in an action brought against Buyer based on a third party claim that one or more of the Products sold hereunder infringes the Intellectual Property Rights of a third party in the country of delivery of the Products by Seller to Buyer. Seller's obligation to defend and indemnify Buyer is contingent on Buyer notifying Seller within ten (10) days after Buyer becomes aware of any such claim, and Seller having sole control over the defense of the claim including all negotiations for settlement or compromise. If one or more Products sold hereunder is subject to such a claim, Seller may, at its sole expense and option, procure for Buyer the right to continue using the Products, replace or modify the Products so as to render them non-infringing, or offer to accept return of the Products and refund the purchase price less a reasonable allowance for depreciation. Seller has no obligation or liability for any claim of infringement: (i) arising from information provided by Buyer; or (ii) directed to any Products provided hereunder for which the designs are specified in whole or part by Buyer; or (iii) resulting from the modification, combination or use in a system of any Products provided hereunder. The foregoing provisions of this Section constitute Seller's sole and exclusive liability and Buyer's sole and exclusive remedy for claims of infringement of Intellectual Property Rights.

20. Governing Law. These Terms and the sale and delivery of all Products are deemed to have taken place in, and shall be governed and construed in accordance with, the laws of the State of Ohio, as applicable to contracts executed and wholly performed therein and without regard to conflicts of laws principles. Buyer irrevocably agrees and consents to the exclusive jurisdiction and venue of the courts of Cuyahoga County, Ohio with respect to any dispute, controversy or claim arising out of or relating to the sale and delivery of the Products.

21. Entire Agreement. These Terms, along with the terms set forth in the main body of any Quote, forms the entire agreement between the Buyer and Seller and constitutes the final, complete and exclusive expression of the terms of sale and purchase. In the event of a conflict between any term set forth in the main body of a Quote and these Terms, the terms set forth in the main body of the Quote shall prevail. All prior or contemporaneous written or oral agreements or negotiations with respect to the subject matter shall have no effect. These Terms may not be modified unless in writing and signed by an authorized representative of Seller.

22. Compliance with Laws. Buyer agrees to comply with all applicable laws, regulations, and industry and professional standards, including those of the United States of America, and the country or countries in which Buyer may operate, including without limitation the U.S. Foreign Corrupt Practices Act ("FCPA"), the U.S. Anti-Kickback Act ("Anti-Kickback Act"), U.S. and E.U. export control and sanctions laws ("Export Laws"), the U.S. Food Drug and Cosmetic Act ("FDCA"), and the rules and regulations promulgated by the U.S. Food and Drug Administration ("FDA"), each as currently amended. Buyer agrees to indemnify, defend, and hold harmless Seller from the consequences of any violation of such laws, regulations and standards by Buyer, its employees or agents. Buyer acknowledges that it is familiar with all applicable provisions of the FCPA, the Anti-Kickback Act, Export Laws, the FDCA and the FDA and certifies that Buyer will adhere to the requirements thereof and not take any action that would make Seller violate such requirements. Buyer represents and agrees that Buyer will not make any payment or give anything of value, directly or indirectly, to any governmental official, foreign political party or official thereof, candidate for foreign political office, or commercial entity or person, for any improper purpose, including the purpose of influencing such person to purchase Products or otherwise benefit the business of Seller. Buyer further represents and agrees that it will not receive, use, service, transfer or ship any Products from Seller in a manner or for a purpose that violates Export Laws or would cause Seller to be in violation of Export Laws. Buyer agrees to promptly and reliably provide Seller all requested information or documents, including end-user statements and other written assurances, concerning Buyer's ongoing compliance with Export Laws. 8/20

Parker's Motion & Control Technologies

At Parker, we're guided by a relentless drive to help our customers become more productive and achieve higher levels of profitability by engineering the best systems for their requirements. It means looking at customer applications from many angles to find new ways to create value. Whatever the motion and control technology need, Parker has the experience, breadth of product and global reach to consistently deliver. No company knows more about motion and control technology than Parker. For further info call 1 800 C-Parker (1 800 272 7537)

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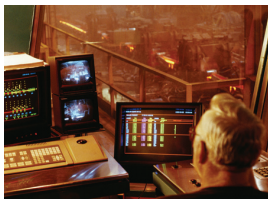
Industrial machinery
Life sciences
Oil & gas
Precision cooling
Process
Refrigeration
Transportation

Key Products

Accumulators
Advanced actuators
CO_2 controls
Electronic controllers
Filter driers
Hand shut-off valves
Heat exchangers
Hose & fittings
Pressure regulating valves
Refrigerant distributors
Safety relief valves
Smart pumps
Solenoid valves
Thermostatic expansion valves



Electromechanical

Key Markets

Aerospace
Factory automation
Life science & medical
Machine tools
Packaging machinery
Paper machinery
Plastics machinery & converting
Primary metals
Semiconductor & electronics
Textile
Wire & cable

Key Products

AC/DC drives & systems
Electric actuators, gantry robots & slides
Electrohydrostatic actuation systems
Electromechanical actuation systems
Human machine interface
Linear motors
Stepper motors, servo motors, drives & controls
Structural extrusions

Filtration

Key Markets

Aerospace
Food & beverage
Industrial plant & equipment
Life sciences
Marine
Mobile equipment
Oil & gas
Power generation & renewable energy
Process
Transportation
Water Purification

Key Products

Analytical gas generators
Compressed air filters & dryers
Engine air, coolant, fuel & oil filtration systems
Fluid condition monitoring systems
Hydraulic & lubrication filters
Hydrogen, nitrogen & zero air generators
Instrumentation filters
Membrane & fiber filters
Microfiltration
Sterile air filtration
Water desalination & purification filters & systems

Fluid & Gas Handling

Key Markets

Aerial lift
Agriculture
Bulk chemical handling
Construction machinery
Food & beverage
Fuel & gas delivery
Industrial machinery
Life sciences
Marine
Mining
Mobile
Oil & gas
Renewable energy
Transportation

Key Products

Check valves
Connectors for low pressure fluid conveyance
Deep sea umbilicals
Diagnostic equipment
Hose couplings
Industrial hose
Mooring systems & power cables
PTFE hose & tubing
Quick couplings
Rubber & thermoplastic hose
Tube fittings & adapters
Tubing & plastic fittings

Hydraulics

Key Markets

Aerial lift
Agriculture
Alternative energy
Construction machinery
Forestry
Industrial machinery
Machine tools
Marine
Material handling
Mining
Oil & gas
Power generation
Refuse vehicles
Renewable energy
Truck hydraulics
Turf equipment

Key Products

Accumulators
Cartridge valves
Electrohydraulic actuators
Human machine interfaces
Hybrid drives
Hydraulic cylinders
Hydraulic motors & pumps
Hydraulic systems
Hydraulic valves & controls
Hydrostatic steering
Integrated hydraulic circuits
Power take-offs
Power units
Rotary actuators
Sensors

Pneumatics

Key Markets

Aerospace
Conveyor & material handling
Factory automation
Life science & medical
Machine tools
Packaging machinery
Transportation & automotive

Key Products

Air preparation
Brass fittings & valves
Manifolds
Pneumatic accessories
Pneumatic actuators & grippers
Pneumatic valves & controls
Quick disconnects
Rotary actuators
Rubber & thermoplastic hose & couplings
Structural extrusions
Thermoplastic tubing & fittings
Vacuum generators, cups & sensors

Process Control

Key Markets

Alternative fuels
Biopharmaceuticals
Chemical & refining
Food & beverage
Marine & shipbuilding
Medical & dental
Microelectronics
Nuclear Power
Offshore oil exploration
Oil & gas
Pharmaceuticals
Power generation
Pulp & paper
Steel
Water/wastewater

Key Products

Analytical Instruments
Analytical sample conditioning products & systems
Chemical injection fittings & valves
Fluoropolymer chemical delivery fittings, valves & pumps
High purity gas delivery fittings, valves, regulators & digital flow controllers
Industrial mass flow meters/ controllers
Permanent no-weld tube fittings
Precision industrial regulators & flow controllers
Process control double block & bleeds
Process control fittings, valves, regulators & manifold valves

Sealing & Shielding

Key Markets

Aerospace
Chemical processing
Consumer
Fluid power
General industrial
Information technology
Life sciences
Microelectronics
Military
Oil & gas
Power generation
Renewable energy
Telecommunications
Transportation

Key Products

Dynamic seals
Elastomeric o-rings
Electro-medical instrument design & assembly
EMI shielding
Extruded & precision-cut, fabricated elastomeric seals
High temperature metal seals
Homogeneous & inserted elastomeric shapes
Medical device fabrication & assembly
Metal & plastic retained composite seals
Shielded optical windows
Silicone tubing & extrusions
Thermal management
Vibration dampening

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