Lenze
AC Tech

Modbus RTU & Modbus TCP/IP Communication

Communications Interface Reference Guide

About These Instructions

This documentation applies to Modbus RTU and Modbus TCP/IP communications for the PositionServo drive and should be used in conjunction with the PositionServo User Manual (S94P01, S94PM01) that shipped with the drive. These documents should be read in their entirety as they contain important technical data and describe the installation and operation of the drive and the applicable option module.

Contents

Contents

1 Safety Information

1.1 Warnings, Cautions & Notes

General

Some parts of Lenze controllers (frequency inverters, servo inverters, DC controllers) can be live, with the potential to cause attached motors to move or rotate. Some surfaces can be hot.

Non-authorized removal of the required cover, inappropriate use, and incorrect installation or operation creates the risk of severe injury to personnel or damage to equipment.

All operations concerning transport, installation, and commissioning as well as maintenance must be carried out by qualified, skilled personnel (IEC 364 and CENELEC HD 384 or DIN VDE 0100 and IEC report 664 or DIN VDE 0110 and national regulations for the prevention of accidents must be observed).

According to this basic safety information, qualified skilled personnel are persons who are familiar with the installation, assembly, commissioning, and operation of the product and who have the qualifications necessary for their occupation.

Application as directed

Drive controllers are components which are designed for installation in electrical systems or machinery. They are not to be used as appliances. They are intended exclusively for professional and commercial purposes according to EN 61000-3-2. The documentation includes information on compliance with the EN 61000-3-2.

When installing the drive controllers in machines, commissioning (i.e. the starting of operation as directed) is prohibited until it is proven that the machine complies with the regulations of the EC Directive 98/37/EC (Machinery Directive); EN 60204 must be observed.

Commissioning (i.e. starting of operation as directed) is only allowed when there is compliance with the EMC Directive (2004/108/EC).

The drive controllers meet the requirements of the Low Voltage Directive 2006/95/EC. The harmonised standards of the series EN 50178/DIN VDE 0160 apply to the controllers.

The availability of controllers is restricted according to EN 61800-3. These products can cause radio interference in residential areas.

Installation

Ensure proper handling and avoid excessive mechanical stress. Do not bend any components and do not change any insulation distances during transport or handling. Do not touch any electronic components and contacts.

Controllers contain electrostatically sensitive components, which can easily be damaged by inappropriate handling. Do not damage or destroy any electrical components since this might endanger your health!

Electrical connection

When working on live drive controllers, applicable national regulations for the prevention of accidents (e.g. VBG 4) must be observed.

The electrical installation must be carried out according to the appropriate regulations (e.g. cable cross-sections, fuses, PE connection). Additional information can be obtained from the national regulation documentation. In the United States, electrical installation is regulated by the National Electric Code (nec) and NFPA 70 along with state and local regulations.

The documentation contains information about installation in compliance with EMC (shielding, grounding, filters and cables). These notes must also be observed for CE-marked controllers.

The manufacturer of the system or machine is responsible for compliance with the required limit values demanded by EMC legislation.

Operation

Systems including controllers must be equipped with additional monitoring and protection devices according to the corresponding standards (e.g. technical equipment, regulations for prevention of accidents, etc.). You are allowed to adapt the controller to your application as described in the documentation.

DANGER!

- After the controller has been disconnected from the supply voltage, live components and power connection must not be touched immediately, since capacitors could be charged. Wait at least 60 seconds before servicing the drive Observe all corresponding notes on the controller.
- Do not continuously cycle input power to the controller more than once every three minutes.
- Please close all protective covers and doors during operation.

WARNING!

Network control permits automatic operation of the inverter drive. The system design must incorporate adequate protection to prevent personnel from accessing moving equipment while power is applied to the drive system.

Table 1: Pictographs used in These Instructions:

Pictograph	Signal Word	Meaning	Consequence if Ignored
	DANGER!	Warning of Hazardous Electrical Voltage.	Reference to an imminent danger that may result in death or serious personal injury if the corresponding measures are not taken.
	WARNING!	Impending or possible danger to personnel	Death or injury
STOP	**STOP!**	Possible damage to equipment	Damage to drive system or its surroundings
	NOTE	Useful tip: If note is observed, it will make using the drive easier	

1.2 Reference Documents

- Modbus Application Protocol Specification V1.1
  Refer to: http://www.modbus.org/tech.php
- Modbus Over Serial Line Specification & Implementation Guide V1.0.
  Refer to: http://www.modbus.org
- PositionServo Programming Manual: PM94P01, PM94M01(MVOB)
  Refer to: http://www.lenze-actech.com

NOTE:
The complete list of variables can be found in the PositionServo Programming Manual (PM94P01, PM94M01).

2 Introduction

The following information is provided to explain how the PositionServo drive operates on a Modbus network; it is not intended to explain how Modbus itself works. Therefore, a working knowledge of Modbus is assumed, as well as familiarity with the operation of the PositionServo drive.

2.1 Fieldbus Overview

Modbus is an internationally accepted asynchronous serial protocol designed for commercial and industrial automation applications.

The Modbus RTU architecture is based upon a Master-Slave orientation in which the PositionServo drive is always a slave node. While the Modbus RTU protocol does not specify the physical layer, the most commonly used is 2-wire EIA-485 (RS485). The PositionServo requires the use of an EIA-485 option module (E94ZARS41) to be able to connect to such a network and communicate via Modbus RTU.

Modbus TCP/IP uses an Ethernet physical layer and as such peer-to-peer and client-server communication techniques are possible. However, the PositionServo drive is always a server (slave node).

2.2 EIA-485 Module

2.2.1 Specification

- Supported baudrates: 115200bps, 57600bps, 38400bps,19200bps, 9600bps
- Parity modes supported: Even, Odd, None
- Stop bits supported: 2, 1.5, 1
- EIA-485, 2-wire (half duplex)
- Network impedance loading of 1 unit (EIA-485 specification stipulates max of 32 units per network segment)

2.2.2 Module Identification Label

Figure 1 illustrates the labels on the PositionServo EIA-485 (RS485) option module. The PositionServo EIA-485 module is identifiable by:

- One label affixed to the side of the module.
- The TYPE identifier in the center of the label: E94ZARS41
- The port (interface) identifier, P21, on the right hand side of the label.

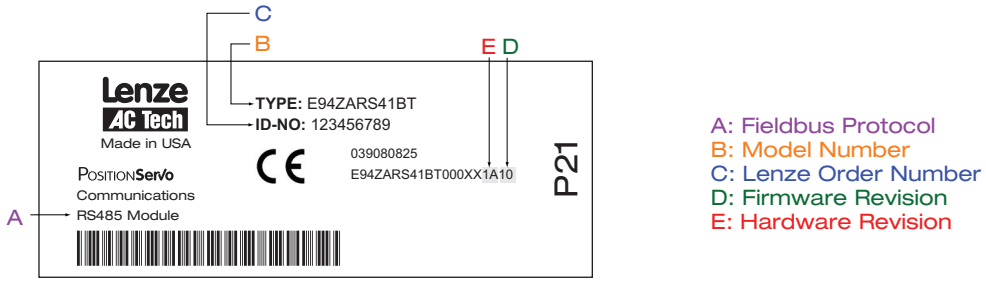


Figure 1: PositionServo EIA-485 (RS485) Module Label

2.3 Ethernet Port

- Supported baudrates: 100Mbps and 10Mbps
- Supports two simultaneous Modbus TCP/IP connections on port 502
- Complies with IEEE 802.3
- Standard screened RJ45 connector with integrated status LEDs
- On open connections with no activity for more then 75 seconds, the PositionServo Drive sends a TCP keep-alive message every 75 seconds to check the connection status.

NOTE:

The PositionServo does **not** support auto negotiation/cross over. Therefore, unless the connecting device supports auto negotiation/cross over, a crossover cable will be required for one-to-one connection.

3 Installation

Section 3.1 is only applicable to Modbus RTU communication with the EIA-485 (RS485) option module, E94ZARS41. Modbus TCP/IP communication uses the P2 Ethernet port on the front of the PositionServo.

3.1 Mechanical Installation

1. Ensure that for reasons of safety, the AC supply, DC supply and +24VDC backup supply have been disconnected before opening the option bay cover.
2. Remove the two COMM module screws that secure Option Bay 1. With a flat head screwdriver, lift the Option Bay 1 cover plate and remove.
3. Fit the 20-pin header into the module before fitting the module into the drive.
4. Install the EIA-485 (RS485) COMM Module (E94ZARS41) in Option Bay 1.
5. Replace the two COMM module screws (max torque: 0.3Nm/3lb-in) to secure Option Bay 1 in place.

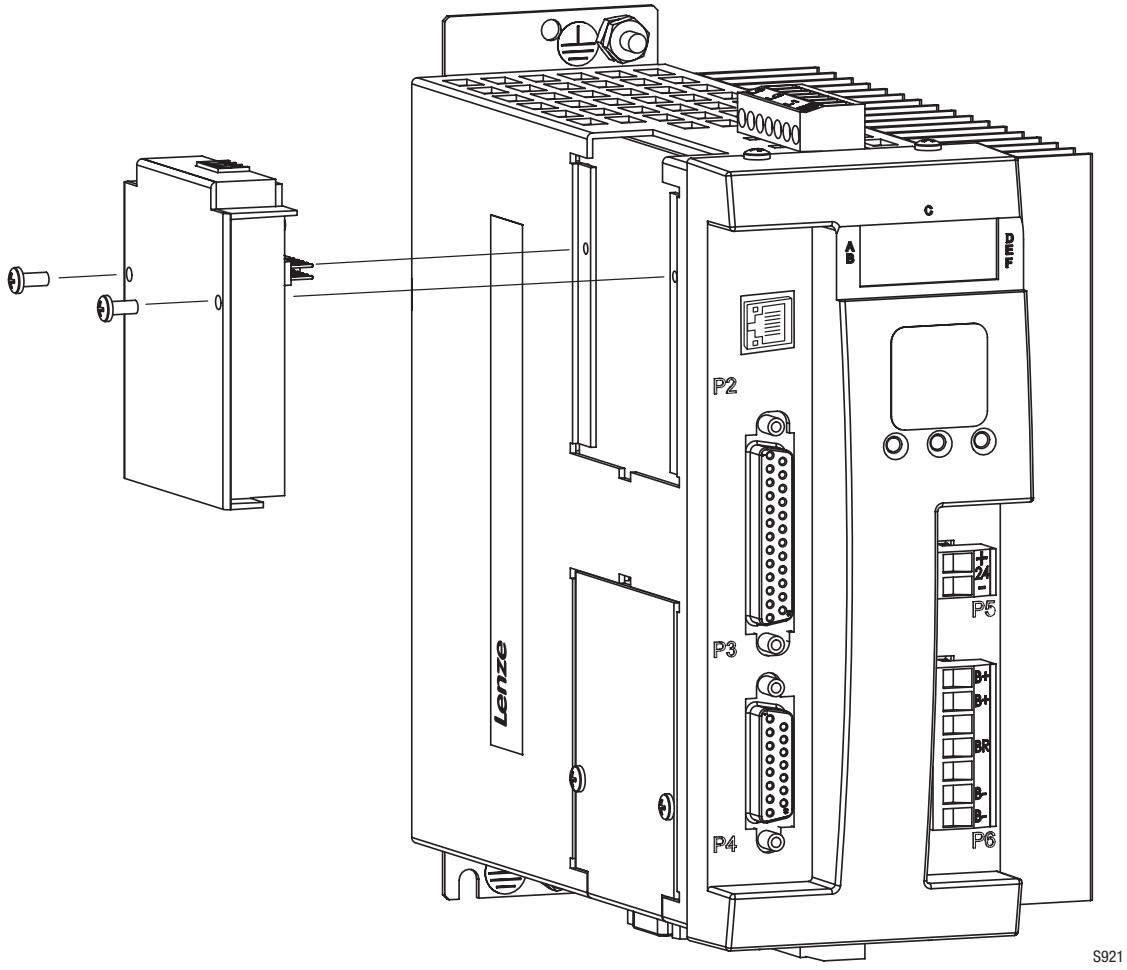


Figure 2: Installation of EIA-485 (RS485) Communications Module

3.2 Connectors

3.2.1 EIA-485 Module

Table 2 and Figure 3 illustrate the pinout of the PositionServo EIA-485 (RS485) Option Module E94ZARS41. The 3-pin connector provides 2-wire plus isolated ground connection to the network.

Table 2: EIA-485 (RS485) Interface Pin Designation

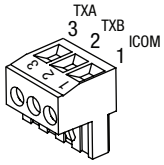
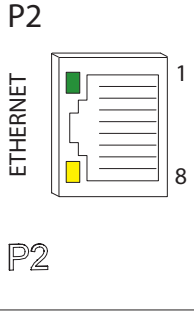
Terminal	Name	Description	Connector
1	ICOM	Isolated Common	
2	TxB (+)	Transmit B (+)	
3	TxA (-)	Transmit A (-)	

Figure 3: EIA-485 (RS485) Interface Pin Designation

3.2.2 Ethernet Port

Port P2 on the front of the PositionServo is an RJ45 Standard Ethernet connector that is used to communicate with a host via Ethernet TCP/IP.

Table 3: P2 Pin Assignments (Communications)

Pin	Name	Function	RJ45 Connector
1	+ TX	Transmit Port (+) Data Terminal	
2	- TX	Transmit Port (-) Data Terminal	
3	+ RX	Receive Port (+) Data Terminal	
4	N.C.		
5	N.C.		
6	- RX	Receive Port (-) Data Terminal	
7	N.C.		
8	N.C.		

The status LEDs integrated in the RJ45 connector indicate link activity and baudrate. The green LED indicates baudrate and blinks steadily when the drive is running at the network speed (10/100Mbps). The yellow LED indicates link activity and flashes when the drive is communicating (transmitting/receiving) with the network.

3.3 Electrical Installation

3.3.1 Cable Types

Due to the high data rates used on Modbus networks it is paramount that correctly specified quality cable is used. The use of low quality cable will result in excess signal attenuation and data loss.

For EIA-485 it is recommended to use a good quality shielded twisted pair cable with characteristic impedance of 120Ω.

For Ethernet it is recommended that a minimum specification of CAT5e UTP cable (unscreened) is used. However, for environments that high levels of electrical noise STP (screened) cable is recommended.

3.3.2 Network Limitations: EIA-485

There are several limiting factors that must be taken into consideration when designing a Modbus RTU network, however, here is a simple checklist:

- Modbus RTU networks are limited to a maximum of 247 nodes.
- Only 32 nodes (based on each node having a load impedance of 1 unit) may be connected on a single network segment. Certain Modbus EIA-485 masters may only be able to support a fewer number of nodes (i.e., 8, 16). Refer to the documentation for the Modbus master in use.
- A network may be built up from one or more segments with the use of network repeaters.
- Maximum network segment length is 1200 meters for baudrates up to and including 19200bps. Certain Modbus masters may be limited to shorter runs. Refer to the documentation for the Modbus master in use.
- Minimum of 1 meter of cable between nodes.
- Use fiber optic segments to:
  - Extend networks beyond normal cable limitations.
  - Overcome different ground potential problems.
  - Overcome very high electromagnetic interference.
- EIA-485 is a linear daisy chain topology. Both ends of the network segment must be terminated by a 120Ω ±1% resistor.

3.3.3 Network Limitations: Ethernet

There are several limiting factors that must be taken into consideration when designing a Modbus TCP/IP network, however, here is a simple checklist:

- Modbus TCP/IP networks are limited to a maximum of 255 nodes per subnet (based on a Class C addressing system).
- Hubs are not recommended for general use as they contribute in creating network data collisions (ports on a hub do not route data direct to other ports but instead all ports are open to receive data from every port) and as such will cause additional delays in transmissions while the re-attempts are carried out.
- Switches are the recommended solution for connecting a multi-node network as they route network data direct from port to port (collisions may occur during network start-up or when a device is connected and the correct port routing is established) and therefore reduce the possibility of collisions.
- “Office grade” Ethernet equipment does not generally offer the same level of noise immunity or robustness as “industrial grade” Ethernet equipment.

- Maximum cable length for UTP/STP CAT5e cable is typically 100m. For other categories consult the cable data sheet.
- Use fiber optic segments to:
  - Extend networks beyond normal cable limitations.
  - Overcome different ground potential problems.
  - Overcome very high electromagnetic interference.
- Spurs or T connections are not permitted on an Ethernet cable. To create additional connections an Ethernet switch must be used.
- The use of wireless networking products for industrial applications is becoming more acceptable, but extreme care must be taken during the design phase and consultation with an industrial wireless provider is strongly recommended.

3.3.4 Connections and Shielding: EIA-485

To ensure good system noise immunity all network cables should be correctly grounded:

- Minimum recommendation of grounding is that the network cable is grounded once in every cubical.
- Ideally the network cable should be grounded on or as near to each drive as possible.
- For wiring of cable to the connector plug the unscreened cable cores should be kept as short as possible; recommended maximum of 20mm.

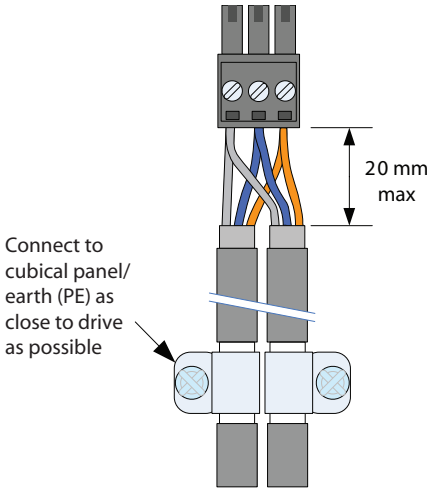


Figure 4: EIA-485 Connection

3.3.5 Connections and Shielding: Ethernet

The use of pre-fabricated cables is recommended as this reduces the chances of connections mistakes and poor quality connections.

If cable connections are assembled on site then it is strongly recommended that these cables are tested with a suitable Ethernet cable tester

STP cables are the preferred solution as they provide a screen/shield surrounding the inner cores and have an integrated screened surround on the RJ45 connector for quick and easy connection.

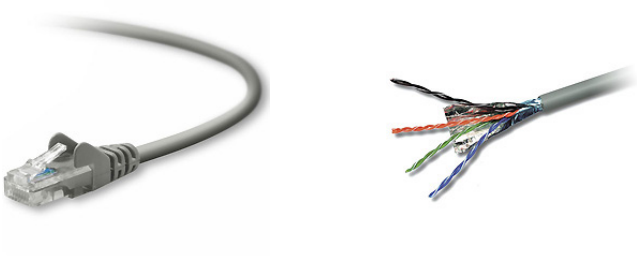


Figure 5: CAT5e STP Cable

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3.3.6 Network Termination: EIA-485

In high speed (EIA-485) networks (typically 19.2kbps or higher) it is essential to install the specified termination resistors, i.e. one at both ends of a network segment. Failure to do so will result in signals being reflected back along the cable which will cause data corruption. A 120Ω 1% ¼W resistor should be fitted to both ends of a network segment across the TxA and TxB lines.

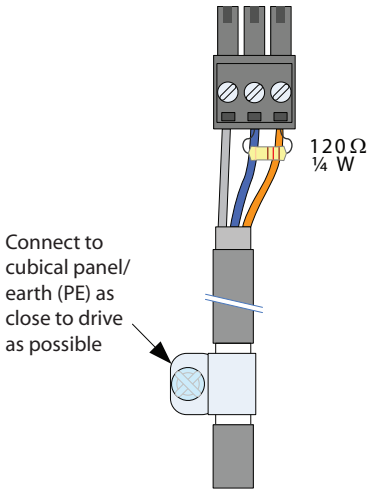

Figure 6: EIA-485 (RS485) Network Termination

3.3.7 Network Termination: Ethernet

Ethernet network cable termination is not required as it is integrated into the circuitry of each device's RJ45 port.

3.3.8 Network Schematic: EIA-485

Figure 7 illustrates the connection of the cables for a PositionServo drive in a Modbus master/slave network.

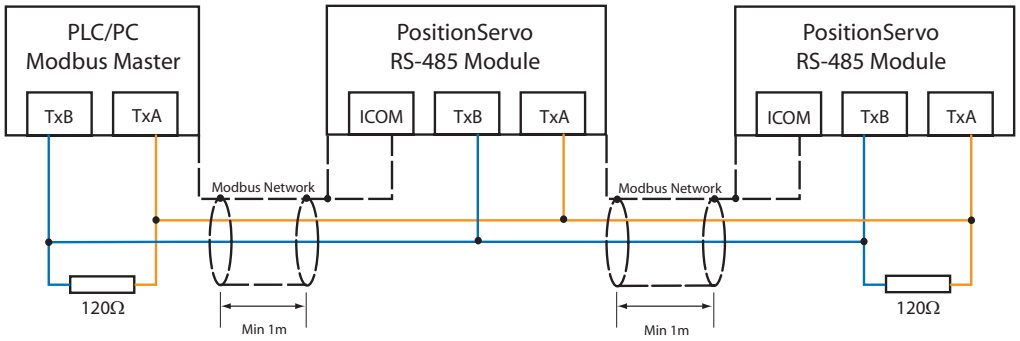

Figure 7: 120Ω (1%) Termination in EIA-485 (RS485) Network

3.3.9 Network Schematic: Ethernet

Figure 8 illustrates a one-to-one ethernet connection. Figure 9 illustrates a multi node ethernet connection.

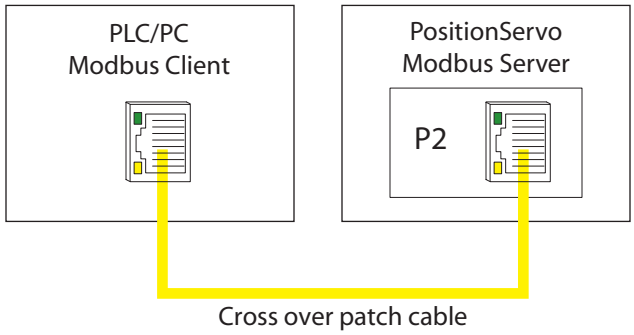

Figure 8: One-to-One Connection

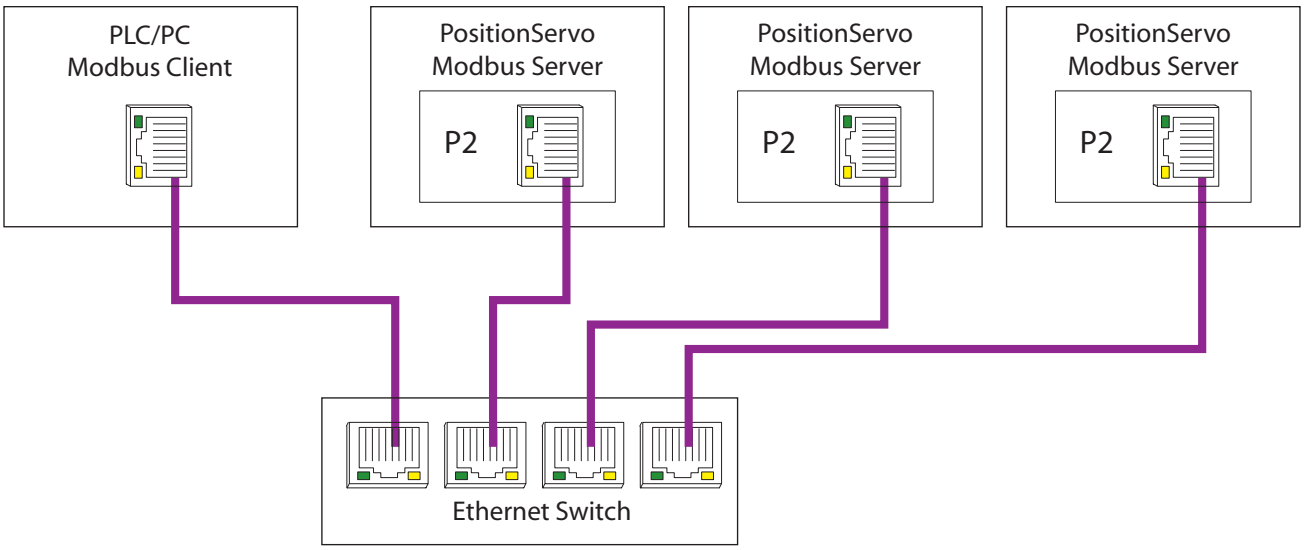

Figure 9: Multi Node Connection

4 Commissioning

4.1 Overview

It is assumed that the user has familiarised themselves with how to set parameters using MotionView software. Refer to the PositionServo with MVOB User Manual (S94PM01) for more details. The details that follow provide a step-by-step guide to quickly and easily set-up a PositionServo drive to communicate on a Modbus network

4.2 Configuring the Network Master/Client

The method for configuring master/client devices differs greatly between manufacturers. Provided herein is a very basic, generic guide to setting up a network master/client. Consult the master/client manufacturer for configuration assistance if required.

1. Launch the Master/client configuration software.
2. Setup the Master/client Modbus port as required. Refer to Table 4.

Table 4: Modbus RTU and Modbus TCP/IP Settings

Modbus RTU Master settings	Modbus TCP Client settings
Node address	IP Address or DHCP enabled
Baud rate	Subnet mask set as required, i.e. 255.255.255.0
Data bits = 8 (for Modbus RTU)	Gateway set as required
Parity	Service port = 502
Stop bits	Baud rate set as required, i.e. 100Mbps
Flow control	

3. Add generic Modbus slave/server node to the master/client
4. Set the slave/server node address.
5. Assign the Modbus slave/service registers as required.

NOTE:

In true Modbus, 3X and 4X Registers are numbered starting at 1. This is known as ‘one based’ addressing. However, when transmitted to a slave over the serial link, the actual address transmitted is one less.

Some Modbus masters will allow for the first register number to be 0. This is known as ‘zero based’ addressing. If this is the case, the Modbus register numbers listed in this manual must be offset by -1 to properly program a master using ‘zero-based’ addressing.

Refer to Section 6 for a list of the PositionServo Modbus registers.

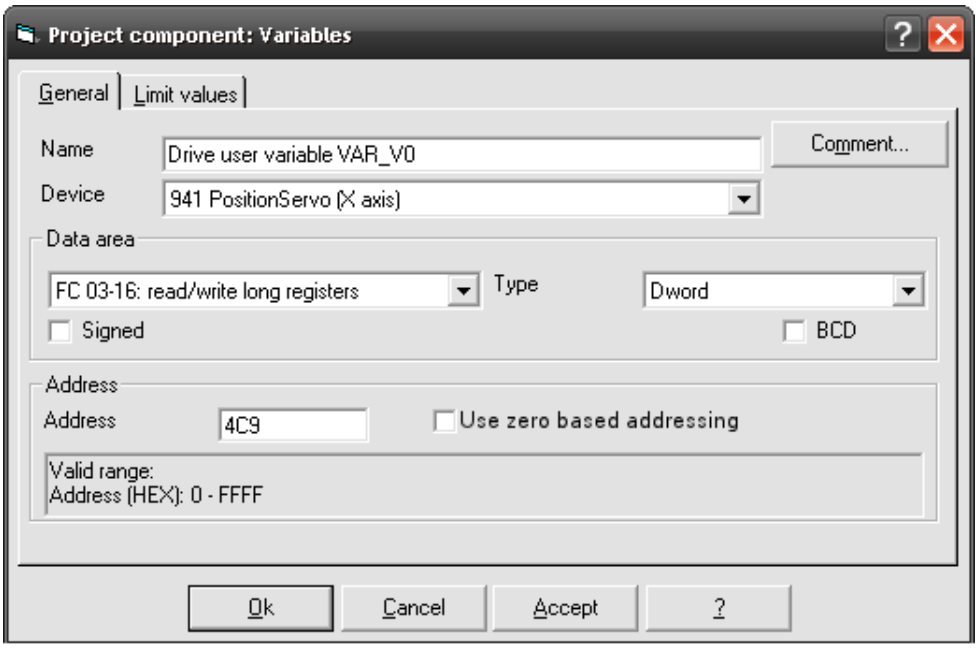

Figure 10: Example Modbus Register Assignment

6. Repeat steps 3 to 5 for each required slave/server node

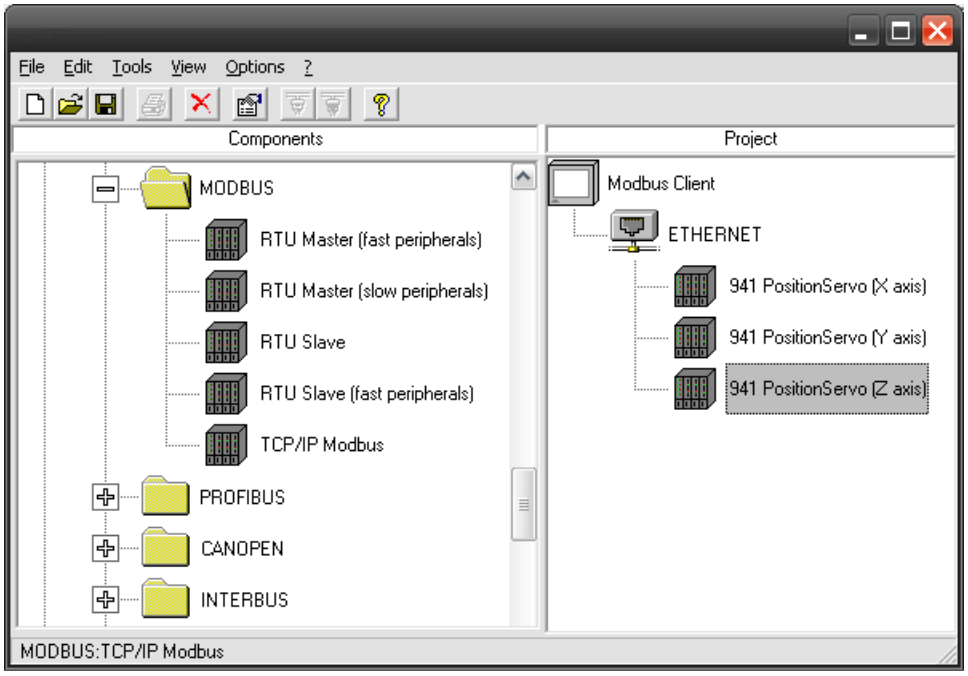

Figure 11: Example Modbus Master/Client Configuration

7. Save the configuration and download to the master/client

4.3 Configuring the PositionServo Slave/Server

4.3.1 Connecting

With the drive power disconnected, install the EIA-485 (RS485) module and connect the network cable as instructed in the preceeding sections. Ensure the drive Run/Enable terminal is disabled then apply the correct voltage to the drive (refer to drive's user manual for voltage supply details).

4.3.2 Connect to the Drive with MotionView OnBoard

Refer to the PositionServo User Manual, section 6.2 for full details on configuring and connecting a drive via MotionView OnBoard (MVOB) software. Contained herein is a brief description of launching MVOB and communicating with the drive.

1. Open the PC's web browser. Enter the drive's default IP address [192.168.124.120] in the browser's Address window.
2. The authentication screen may be displayed if the PC does not have Java RTE version 1.4 or higher. If so, to remedy this situation, download the latest Java RTE from http://www.java.com.
3. When MotionView has finished installing, a Java icon entitled [MotionView OnBoard] will appear on your desktop and the MVOB splash screen is displayed. Click [Run] to enter the MotionView program.
4. Once MotionView has launched, verify motor is safe to operate, click [YES, I have] then select [Connect] from the Main toolbar (top left). The Connection dialog box will appear.
5. Select [Discover] to find the drive(s) on the network available for connection.

   [Discover] may fail to find the drive's IP address on a computer with both a wireless network card and a wired network card (or a PC with more than one network connection). If this happens, try one of the following remedies:

   Disable the wireless network card and then use [Discover].
   Type in the drive's IP address manually at the box [IP Address].

   Then click [Connect]
6. Highlight the drive (or drives) to be connected and click [Connect] in the dialog box.

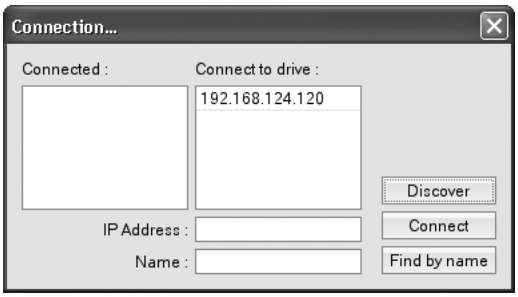

Figure 12: Connection Box with Discovered Drive

In the lower left of the MotionView display, the Message WIndow will contain the connection status message. The message "Successfully connected to drive B04402200450_192.168.124.120" indicates that the drive B04402200450 with IP address 192.168.124.120 is connected.

4.3.3 Modbus RTU Slave Node Settings

If using the EIA-485 (RS485) module, open MotionView and click on the [Communication] folder. Then select the [RS485] folder to set/change the RS485 parameters: Configuration, Baud Rate, Parity, Stop Bits and Address.

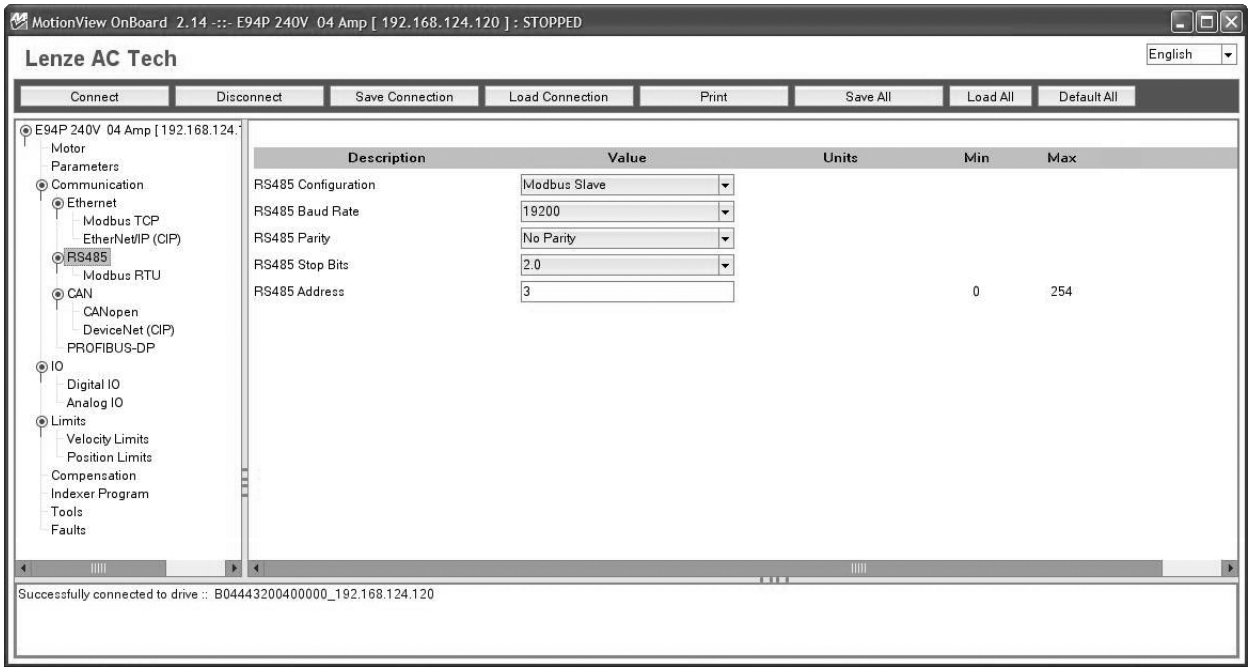

Figure 14: RS-485 Folder

Configuration: 'Modbus slave' = the modbus slave protocol is enabled on the RS485 port.
UPPP = the RS485 uses UPPP (Point-to-Point Protocol).

Baud Rate: 115200bps, 57600bps, 38400bps, 19200bps, 9600bps

Parity: Even, Odd, None

Stop Bits: 2, 1.5, 1

Address: 1-247

Each slave device in the Modbus network must have its own unique network address. The 'Addr' submenu on the drive display and the front panel buttons can be used to set the Modbus network address.

The RS485 default configuration is: UPPP, 19200bps, No Parity, 2 Stop Bits and Address = 1.

TIP - Avoid using address 1. Most Modbus devices ship with a default address of 1. As duplicate addressing on a Modbus network is not allowed, this can lead to conflicts when replacing and commissioning nodes. To avoid this it is recommended that you do not set the slave address to 1.

Modbus RTU Folder - Modbus Reply Delay

Modbus Reply Delay is the delay introduced after receiving a Modbus request and before sending a reply. Note that this delay will always be >= 3.5 characters as required by the Modbus specification. Some Modbus master devices are slower to respond than others and an increase of the 'Modbus reply delay' value may be required to successfully work with these devices.

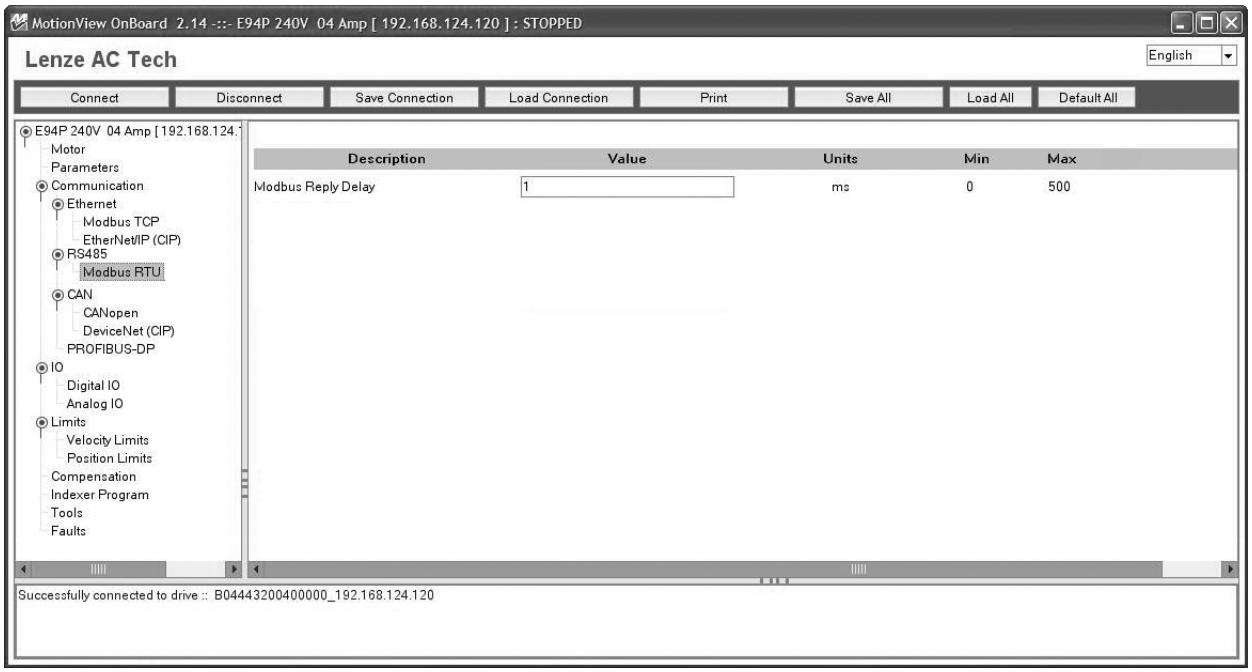

Figure 15: Modbus RTU Folder

4.3.4 Modbus TCP/IP Server Node Settings

The IP address of the PositionServo drive is composed of four sub-octets that are separated by three dots. Each sub-octet can be configured with a number between 1 and 254. As shipped from the factory the default IP address of a drive is:

192.168.124.120.

There are two methods of changing the current IP address. An address can be assigned to the drive automatically (dynamic IP address) when the drive is connected to a DHCP (Dynamic Host Configuration Protocol) enabled server, or the drive can have an IP address assigned to it manually be the user (static IP address).

4.3.4.1 Obtaining the PositionServo's Current Ethernet Settings

The current Ethernet setting and IP address of the PositionServo drive can be obtained from the drive display and keypad. Press the recessed 'mode' button (↵) on the display and use the "UP" and "DOWN" buttons (▲ ▼) to access parameters IP_1, IP_2, IP_3 and IP_4. Each of these parameters contain one sub-octet of the full IP address, for example in the case of the drive default (factory set) address parameters:

IP_1 = 192

IP_2 = 168

IP_3 = 124

IP_4 = 120

By accessing these four parameters the full IP address on the drive can be obtained.

If parameters IP_1, IP_2, IP_3 and IP_4 all contain '----' rather than a numerical values it means that the drive has DHCP enabled and the DHCP server is yet to assign the drive its dynamic IP address. As soon as an IP address is assigned by the server the address assigned will be display by the drive in the above parameters. See section on obtaining IP addresses through DHCP.

4.3.4.2 Configuring the IP Address Manually (Static Address)

When connecting directly from PositionServo drive to the PC without a DHCP server or when connecting to a private network (where all devices have static IP addresses) the IP address of the PositionServo drive will need to be assigned manually.

To assign the address manually, the drive must have its DHCP mode disabled. This can be done using the drive keypad and display. Press the recessed 'mode' button (↵) on the display and use the "UP" and "DOWN" buttons (▲ ▼) to access parameter 'DHCP'. Check this parameter is set to a value of '0'. If the DHCP parameter is set to '1' then use the 'mode' (↵) and down (▼) arrows to set to '0' and then cycle power to the drive in order for this change to take effect. When DHCP is disabled and power cycled to the drive, it will revert back to its previous static IP address.

It is most common for the PositionServo drive IP address to be left at its default value (192.168.124.120) and to configure the PC Ethernet port to communicate on this subnet. If more than one drive needs to be connected to the PC at any one time then the IP_4 parameter can be accessed via the keypad and changed to provide a unique IP address on the network for each drive. Note that IP_4 is the only octet that can be changed (IP_1, IP2, and IP_3 are read-only) and that power must be cycled to the drive for any changes to take effect.

If the PositionServo drive(s) needs to be configured for a specific subnet with different values to default (for IP_1, IP_2, and IP_3, and IP_4) then this needs to be performed with the MotionView configuration tool. First establish communications using the default drive address or with an address that was established by changing IP_4 parameters via the drive keypad. Follow the rest of these instructions in order to establish communications and launch MotionView using this address. Once within the MotionView software a full IP address can be assigned.

From the Node tree within MotionView select the [Communications] folder and then the [Ethernet] sub-folder as shown in Figure 16. The settings reflect those that will appear in the software parameter view window.

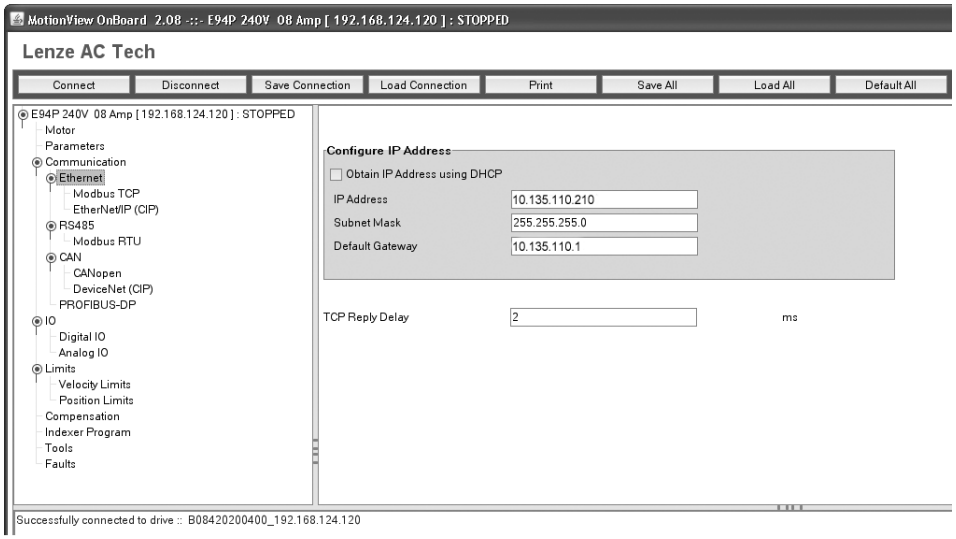

Figure 16: Ethernet Folder

The IP address, subnet mask, and default gateway address can all be edited in this screen. If the text in any of these boxes turns red once it has been entered then this means that the values or format used is invalid and the values will not be applied.

To enable DHCP, click the box adjacent to [Obtain IP Address using DHCP] to place a check mark in this box ☑.

To disable DHCP, click the box again. Power must be cycled for any changes to [Configure IP Address] to take effect. On changing any ethernet parameter value, the dialog box in Figure 17 will appear. Click [Ok] and cycle power for changes to take effect.

4.3.4.3 Configuring the IP Address Automatically (Dynamic Address)

When connecting a PositionServo drive onto a network domain with a DHCP enabled server (where all devices have dynamic IP addresses assigned by the server) the IP address of the PositionServo drive can also be assigned automatically by the server.

To have the address assigned automatically the drive must have its DHCP mode enabled. This can be done by using the drive keypad and display. Press the 'mode' button on the display and use the "UP" and "DOWN" buttons to access parameter 'DHCP'. Check this parameter is set to a value of '1'. If the DHCP parameter is set to '0' then use the 'mode' and up arrow to set to '1' and then cycle power to the drive in order for this change to take effect.

When the PositionServo drive is waiting for an IP address to be assigned to it by the server it will display '----' in each of the four octet parameters (IP_1, IP_2, IP_3, and IP_4) on its display. Once the address is assigned by the server it will appear in these parameters. If this parameters continue to display '----' then it is likely that a connection between the drive and server has not been established, or the server is not DHCP enabled.

DHCP can be enabled through the MotionView software for convenience should the operator wish to configure the drive using a manual (static) IP address and switch over to an automatic (dynamic) address once configuration is complete.

4.3.5 Re-Initializing

To activate any changes made the drive has to be reinitialized. Hence the warning within MotionView

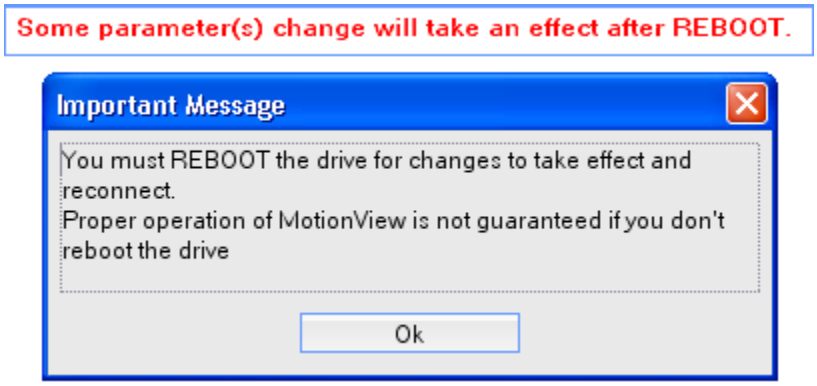

Figure 17: REBOOT Message

This can be done by cycling the power to the drive.

4.3.6 Non-Communication Based Parameter Settings

In addition to configuring the Modbus settings and depending upon the application there may be several drive based parameters that will need to be set using MotionView or an Indexer program or via the Modbus parameter access channel. Such as:

- PID34 – Drive Mode (VAR_DRIVEMODE)
- PID37 – Reference (VAR_REFERENCE)
- PID29 – Enable switch funtion (VAR_ENABLE_SWITCH_TYPE)

4.4 Drive Monitoring

The master/client can read the drive parameters as long as Modbus communications are enabled.

NOTE:
The complete list of variables can be found in the PositionServo Programming Manual (PM94P01, PM94M01).

4.5 Controlling the Drive

Controlling the drive over Modbus is essentially identical to controlling the drive from the User's program. The list of variables and their functionality is identical for both User's program and Modbus control. Refer to the variable list in the PositionServo Programming Manual for the functionality of the drive's variables.

4.6 Changing Drive Parameters

To change drive parameters, simply write to the appropriate register as listed in the PositionServo Programming Manual (PM94P01 or PM94M01).

4.7 EIA-485 (RS485) Parameters

Drive variables #172-176 are EIA-485 (RS485) communication programming parameters specifically for configuration of the EIA-485 interface.

Table 5: EIA-485 (RS485) Variables - Excerpted from PS Variable List

PID	Variable Name	Type	Format	EPM	Access	Description	Units
172	VAR_SERIAL_ADDRESS		W	Y	R/W	RS485 drive ID. Range: 0 - 254	
173	VAR_MODBUS_BAUDRATE		W	Y	R/W	Baud rate for Modbus operations: 2 - 9600 3 - 19200 4 - 38400 5 - 57600 6 - 115200	
174	VAR_MODBUS_DELAY		W	Y	R/W	Modbus reply delay in mS Range: 0 - 1000	mS
175	VAR_RS485_CONFIG		W	Y	R/W	RS485 configuration: 0 - normal IP over PPP 1 - ModBus	
176	VAR_PPP_BAUDRATE NOTE: Does NOT apply to MVOB.		W	Y	R/W	RS232/485 (normal mode) baud rate: 2 - 9600 3 - 19200 4 - 38400 5 - 57600 6 - 115200	

4.8 Ethernet Parameters

Drive variables #67-70 are Ethernet communication programming parameters specifically for configuration of the ethernet interface.

Table 6: Ethernet Variables - Excerpted from PS Variable List

PID	Variable Name	Type	Format	EPM	Access	Description	Units
67	VAR_IP_ADDRESS		W	Y	R/W	Ethernet IP address. IP address changes at next boot up. 32 bit value	
68	VAR_IP_MASK		W	Y	R/W	Ethernet IP NetMask. Mask changes at next boot up. 32 bit value	
69	VAR_IP_GATEWAY		W	Y	R/W	Ethernet Gateway IP address. Address changes at next boot up. 32 bit value	
70	VAR_IP_DHCP		W	Y	R/W	Use DHCP: 0, 1 0 - manual; 1 - use DHCP service	

4.9 Negative Number Transmission

Drive variables 51, 60, 79, 81 and 90 are signed integer values and could be negative. These registers are sent over the modbus communications in signed internal units.

Table 7: Signed Integer Variables - Excerpted from PS Variable List

PID	Variable Name	Type	Format	EPM	Access	Description	Units
51	VAR_VREG_WINDOW	vel	W	Y	R/W	Gains scaling coefficient Range: -16 to +4	
60	VAR_VLIMIT_ATSPEED		F	Y	R/W	Target Velocity for At Speed window Range: -10000 - +10000	Rpm
79	VAR_M2SRATIO_MASTER		W	Y	R/W	Master to system ratio. Master counts range: -32767 - +32767 Value will be applied upon write to PID #80. Write to this PID followed by writing to PID#80 to apply new ratio pair	
81	VAR_S2PRATIO_SECOND		W	Y	R/W	Secondary encoder to prime encoder ratio. Second counts range: -32767 - +32767 Value will be applied upon write to PID #82. Write to this PID followed by writing to PID#82 to apply new ratio pair	
90	VAR_AIN1_OFFSET			Y	R/W	Analog input #1 offset. Applied when used as current/velocity reference Range: -10,000 to +10,000	mV

5 Modbus Implementation

5.1 Supported Function Codes

The Modbus function codes supported by the PositionServo drive are:

03 – Read Holding Register
16 – Preset (write) Multiple Registers

5.2 Data Format, Size and Memory Area

Modbus registers are limited by protocol definition to a length of 16-bits per register. The user must use two consecutive 16-bit registers to read/write one 32-bit register.

All PositionServo drive parameters are 32-bit in size but can be accessed in 3 different formats:

- IEEE Floating Point (FLOAT or REAL)
- 32-bit integer (DWORD or DINT)
- 16-bit integer (WORD or INT) where by the true 32-bit value consumes two consecutive 16-bit registers

Furthermore, PositionServo parameters exist in each of the 3 formats in both RAM (volatile) and EPM (non-volatile) areas. Therefore the memory addresses are divided into six ranges according to their format and memory type as shown in Table 8.

Table 8: Memory Address Ranges

Memory Area Offset	0	512	1024	1556	2068	2304
Type	RAM	RAM	EPM	EPM	RAM	EPM
Format	32-bit INT	Float	32-bit INT	Float	16-bit INT	16-bit INT

The Modbus register address of a drive parameter can be calculated as follows:

$$Modbus_{Register} = (2 \times PID_{Number}) + Memory_{Offset} + Modbus_{Offset}$$

Where:

PIDNumber = PositionServo **P**arameter **Ind**ex Number. Refer to section xxxx for a full list.

MemoryOffset = Memory offset as per table 4 above

ModbusOffset = 0 for zero based addressing
1 for traditional Modbus addressing

NOTE: All values in decimal notation

To access the <variable index> as a RAM-integer, use the following formula to calculate this register address (maximum address allowed is 511):

<register address> = 0 + 2 * <variable index> + 1;

To access the <variable index> as a RAM-float, use the following formula to calculate this register address (maximum address allowed is 1023):

<register address> = 512 + 2 * <variable index> + 1;

To access the<variable index> as a EPM-integer, use the following formula to calculate this register address (maximum address allowed is 1535):

<register address> = 1024 + 2 * <variable index> + 1;

To access the <variable index> as EPM-float, use the following formula to calculate this register address (maximum address allowed is 2047):

<register address> = 1536 + 2 * <variable index> + 1;

Two special methods are created for those terminals that can ony handle 16-bit registers:

To access the <variable index> as a RAM- 16 bit integer register (the RAM copy of a variable that is represented as a 16 bit integer) use the following formula to calculate this register address (maximum address allowed is 2303):

<register address> = 2048 + <variable index> + 1;

For these terminals the values are represented only as integers. The variable index is not multiplied by 2 because one variable is mapped to one register only. If the variable, which is represented as a 32 bit value internally, is out of range (lower than minimum or higher than maximum value for 16 bit integers), then the return value is truncated to the closest value supported by the 16 bit signed number. The access to a variable using this register address range will only read/write the RAM copy of a variable.

To access the <variable index> as an EPM -16 bit signed integer register (the EPM copy of a variable that is represented as a 16 bit integer) use the following formula to calculate this register address (maximum address allowed is 2560):

<register address> = 2304 + <variable index> + 1;

For these terminals the values are represented only as integers. The variable index is not multiplied by 2 because one variable is mapped to one register only. If the variable, which is represented as a 32 bit value internally, is out of range (lower than minimum or higher than maximum value for 16 bit integers), then the return value is truncated to the closest value supported by the 16 bit register. The access to a variable using this register address range will read only the RAM copy of a variable and write both the RAM and EPM copies of a variable.

Refer to section 6 for a complete list of Modbus registers for each variable.

5.3 Register Numbering

Modbus registers start at 1 which historically coincided with many older slave devices that often have parameters starting at address 1. However, the true data addressed within a Modbus telegram starts at address 0. This means that registers are offset by 1 compared to the true data address transmitted on the network, e.g.

Holding register 40001 is actually accessed as 0000 in the message telegram address field

The conversion from Modbus register number to the Modbus data address field is performed automatically by the Modbus Master/Client. The PositionServo adheres to the Modbus Standard in that its registers start at 1.

NOTE:

Some Modbus masters will allow for the first register number to be 0. This is known as ‘zero based’ addressing. If this is the case, the Modbus register numbers listed in this manual must be offset by -1 to properly program a master using ‘zero-based’ addressing.

- Using a master that supports traditional register addressing to access PositionServo parameter 100 (user variable VAR_V0) as a 16-bit value would use Modbus register 42405
- Using a master that has zero based addressing enabled would use Modbus register 42404

5.4 Endian Format

Modbus uses “big-endian” representation of the register data. This means that when a numerical value that is larger than a single byte is transmitted, the MOST significant byte (MSB) is sent first, e.g.

- 16-bit integer value 0x1234 = 2 bytes of 0x12 and 0x34
- 32-bit integer value 0x12345678 = 4 bytes of 0x12, 0x34, 0x56 and 0x78

5.5 Registers Access

- Care should be taken when accessing registers from multiple sources such as multiple clients or the drive Indexer program as data could be over written or out of sequence
- Writing to the EPM area of memory simultaneously writes to the RAM area too
- Writing to the EPM area of memory should be done conservatively as the EEPROM (EPM) has a typical life expectancy of 1 million writes

5.5.1 Register Reading

Use the function code “03 (0x03) Read 4X Holding Registers” to read an adjoining block of holding registers in a remote device.

NOTE:

Do NOT attempt to read any write-only variables. Attempting to read a write-only variable can result in erroneous data.

5.5.2 Register Writing

No discrete coil access (function code 1) is provided for PositionServo Drive. Use the “16 (0x10) Write Multiple Registers” function to write binary values. This requires the user programming to pack bits into user registers.

The function code “16 (0x10) Write Multiple Registers” is used to write a block of adjoining registers (1-123, Master device dependent) in a remote device.

NOTE:

Do NOT attempt to write to any read-only variables. Attempting to write to a read-only variable can result in drive fault (F41).

5.6 No Response Conditions

The PositionServo Drive will not respond to any message that:

- contains one or more parity errors
- has an invalid CRC value
- was not directed to the drive’s network address
- is not at least 8 bytes long (minimum required for the supported functions)
- is more than 18 bytes long (maximum allowed before input buffer overflow occurs)

5.7 Exception Responses

If an invalid message is received, the drive will respond with a Modbus Exception as per the “Modbus application Protocol specification V1.1”, i.e. the exception function code = the request function code + 0x80 (an exception code is provided to indicate the reason of the error).

Table 9: Exception Codes

Code	V1.1 Specification	Description
0x01	Illegal Function	function not supported by PositionServo
0x02	Illegal data address	requested address is not a valid register address
0x03	Illegal Data Value	set value not valid for specific variable

5.8 Modbus Message Frame

The Modbus protocol defines a simple protocol data unit (PDU) independent of the underlying communication layers. There are additional application data unit (ADU) fields introduced by the network layer.

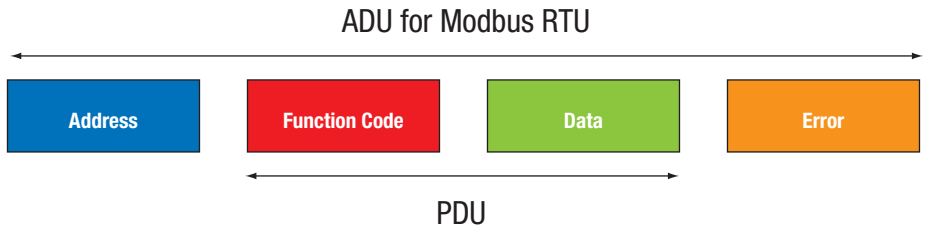

Figure 18: Modbus RTU Frame EIA-485

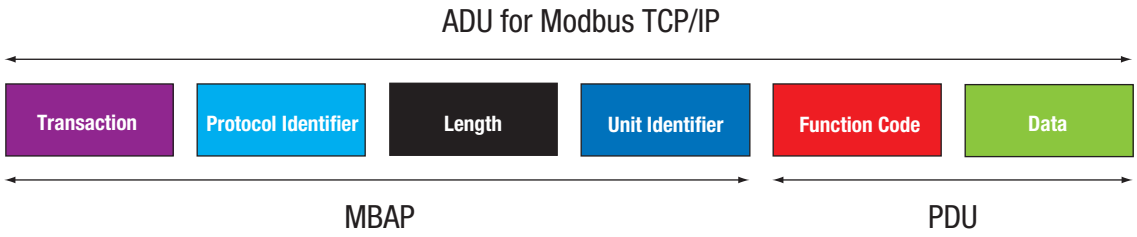

Figure 19: Modbus TCP/IP Request/Response

5.8.1 PDU Function Code

- Size = 1 byte
- The function code indicates what kind of action to perform.
- The function code (depending upon the function) is normally followed by a data field that contains request and response parameters.

5.8.2 PDU Data

The data field of messages sent from a master/client to slave/server device contains additional information that the slave/server uses to take the action defined by the function code. This can include items like discrete and register addresses, the quantity of the items to be handled, and the count of the actual data bytes in the field.

The data field may be nonexistent (of zero length) in certain kinds of requests. In this case the slave/server does not require any additional information. The function code alone specifies the action.

If no error occurs related to the Modbus function requested in a properly received Modbus ADU, the data field of a response from a slave/server to a master/client contains the data requested. If an error related to the Modbus function requested occurs, the field contains an exception code that the server application can use to determine the next action to be taken.

5.8.3 ADU for Modbus RTU

The ADU for Modbus RTU consists of the Address field, Error Check and the common Modbus PDU.

Address Field

As described in the previous section the valid slave nodes addresses are in the range of 0 – 247 decimal. The individual slave devices are assigned addresses in the range of 1 to 247. A master addresses a slave by placing the slave address in the address field of the message. When the slave returns its response, it places its own address in the response address field to let the master know which slave is responding.

Error Check Field

Error checking field is the result of a Cyclical Redundancy Checking (CRC) calculation that is performed on the message contents.

The CRC field checks the contents of the entire message. It is applied regardless of any parity checking method used for the individual characters of the message.

The CRC field contains a 16–bit value implemented as two 8–bit bytes.

The CRC field is appended to the message as the last field in the message. When this is done, the low–order byte of the field is appended first, followed by the high–order byte. The CRC high–order byte is the last byte to be sent in the message.

The CRC value is calculated by the sending device, which appends the CRC to the message. The receiving device recalculates a CRC during receipt of the message, and compares the calculated value to the actual value it received in the CRC field. If the two values are not equal then it results in an error.

5.8.4 ADU for Modbus TCP

The ADU for Modbus TCP consists of the MBAP Header and the common Modbus PDU.

The MBAP header is 7 bytes long.

The actual IP addressing and message error checking are performed by the Ethernet physical layer, refer to the ISO 7-layer model and the Modbus-IDA website for further details.

Table 10: MBAP Header

Field	Length (Bytes)	Description	Client	Server
Transaction Identifier	2	Identification of a Modbus Request/Response transaction	Initialized by the client	Recopied by server from received request
Protocol Identifier	2	0 = Modbus protocol	Initialized by the client	Recopied by server from received request
Length	2	Number of following bytes	Initialized by the client (request)	Initialized by the server (response)
Unit Identifier	1	Identification of a remote slave connected on a serial line or on other buses.	Initialized by the client	Recopied by server from received request

6 Reference

6.1 PID List with Modbus Values

This is a condensed PID List to show the corresponding Modbus 4X Registers for PIDs 1-256. Modbus RTU can not access beyond PID256. For the complete variable list refer to the PositionServo Programming Manual (PM94P01 or PM94M01).

These variables can be accessed from the user's program or any supported communications interface protocol. From the user program, any variable can be accessed by either its variable name or by its index value (using the syntax: @<VARINDEX> , where <VARINDEX> is the variable index from the PID List. From the communications interface any variable can be accessed by its index value.

The column "**Type**" indicates the type of variable:

mtr Motor: denotes a motor value
mtn Motion: writing to an "mtn" variable could cause the start of motion ⚠
vel Velocity: denotes a velocity or velocity scaling value

The column "**Format**" provides the native format of the variable:

W 32 bit integer
F float (real)

When setting a variable via an external device the value can be addressed as floating or integer. The value will automatically adjusted to fit it's given form.

The column "**EPM**" shows if a variable has a non-volatile storage space in the EPM memory:

Y Variable has non-volatile storage Space in EPM
N Variable does not exist in EPM memory

The user's program uses a RAM (volatile) 'copy' of the variables stored on the EPM. At power up all RAM copies of the variables are initialized with the EPM values. The EPM's values are not affected by changing the variables in the user's program. When the user's program reads a variable it always reads from the RAM (volatile) copy of the variable. Communications Interface functions can change both the volatile and non-volatile copy of the variable. If the host interface requests a change to the EPM (non-volatile) value, this change is done both in the user program's RAM memory as well as in the EPM. Interface functions have the choice of reading from the RAM (volatile) or from the EPM (non-volatile) copy of the variable.

The column "**Access**" lists the user's access rights to a variable:

R read only
W write only
R/W read/write

Writing to an R (read-only) variable or reading from a W (write-only) variable will not work.

The column "**Units**" shows units of the variable. Units unique to this manual that are used for motion are:
UU user units
EC encoder counts
S seconds
PPS pulses per sample. Sample time is 512μs - servo loop rate
PPSS pulses per sample per sample. Sample time is 512μs - servo loop rate

NOTE:

In true Modbus, 3X and 4X Registers are numbered starting at 1. This is known as 'one based' addressing. However, when transmitted to a slave over the serial link, the actual address transmitted is one less.

Some Modbus masters will allow for the first register number to be 0. This is known as 'zero based' addressing. If this is the case, the Modbus register numbers listed in this manual must be offset by -1 to properly program a master using 'zero-based' addressing.

Index	Name	Type	Format	EPM	Access	Description	Range	Unit	RAM Registers 32bit Integer Access 4X Register #	RAM Register 32bit Float Access 4X Register #	EPM Reg Copy 32bit Integer Access 4X Register #	EPM Reg Copy 32bit Float Access 4X Register #	RAM Register 16bit Signed Integer 4X Register #	EPM INT16 4X Register #
1	VAR_IDSTRING			N	R	Drive's identification string			3	515	1027	1539	2050	2306
2	VAR_NAME			Y	R/W	Drive's symbolic name			5	517	1029	1541	2051	2307
3	VAR_SERIAL_NUMBER				R	Drive's serial number			7	519	1031	1543	2052	2308
4	VAR_MEM_INDEX				R/W	Position in RAM file	(0 - 32767)		9	521	1033	1545	2053	2309
5	VAR_MEM_VALUE				R/W	Value to be read or written to the RAM file			11	523	1035	1547	2054	2310
6	VAR_MEM_INDEX_ INCREMENT				R/W	Holds value the MEM_INDEX will modify once the R/W operation is complete			13	525	1037	1549	2055	2311
7	VAR_VELOCITY_ACTUAL				R	Actual measured motor velocity **NOTE:** Only applicable to MVOB drives with Firmware 4.00 and higher.			15	527	1039	1551	2056	2312
8	VAR_RSVD_2								17	529	1041	1553	2057	2313
9	VAR_DFAULT				R	Drive Default Settings			19	531	1043	1555	2058	2314
10	VAR_M_ID	mtr		Y	R/W*	Motor ID			21	533	1045	1557	2059	2315
11	VAR_M_MODEL	mtr		Y	R/W*	Motor model			23	535	1047	1559	2060	2316
12	VAR_M_VENDOR	mtr		Y	R/W*	Motor vendor			25	537	1049	1561	2061	2317
13	VAR_M_ESET	mtr		Y	R/W*	Motor Feedback Resolver: 'Positive for CW' 0 - none 1 - Positive for CW	0 - 1		27	539	1051	1563	2062	2318
14	VAR_M_HALLCODE	mtr		Y	R/W*	Hallcode index	0 - 5		29	541	1053	1565	2063	2319
15	VAR_M_HOFFSET	mtr		Y	R/W*	Reserved			31	543	1055	1567	2064	2320
16	VAR_M_ZOFFSET	mtr		Y	R/W*	Resolver Offset	0 - 360		33	545	1057	1569	2065	2321
17	VAR_M_ICTRL	mtr		Y	R/W*	Reserved			35	547	1059	1571	2066	2322
18	VAR_M_JM	mtr		Y	R/W*	Motor moment of inertia Jm	0 - 0.1	Kgm2	37	549	1061	1573	2067	2323
19	VAR_M_KE	mtr		Y	R/W*	Motor voltage or back EMF constant Ke	1 - 500	V/Krpm	39	551	1063	1575	2068	2324
20	VAR_M_KT	mtr		Y	R/W*	Motor torque or force constant Kt	0.01 - 10	Nm/A	41	553	1065	1577	2069	2325
21	VAR_M_LS	mtr		Y	R/W*	Motor phase-to-phase inductance Lm	0.1 - 500	mH	43	555	1067	1579	2070	2326
22	VAR_M_RS	mtr		Y	R/W*	Motor phase-to-phase resistance Rm	0.01 - 500	[Ohm]	45	557	1069	1581	2071	2327
23	VAR_M_MAXCURRENT	mtr		Y	R/W*	Motor's max current(RMS)	0.5 - 50	[A]mp	47	559	1071	1583	2072	2328
24	VAR_M_MAXVELOCITY	mtr		Y	R/W*	Motor's max velocity	500 - 20000	RPM	49	561	1073	1585	2073	2329
25	VAR_M_NPOLES	mtr		Y	R/W*	Motor's poles number	2 - 200		51	563	1075	1587	2074	2330
26	VAR_M_ENCODER	mtr		Y	R/W*	Encoder resolution	256 - 65536 * 12/Npoles	PPR	53	565	1077	1589	2075	2331
27	VAR_M_TERMVOLTAGE	mtr		Y	R/W*	Nominal Motor's terminal voltage	50 - 800	[V]olt	55	567	1079	1591	2076	2332
28	VAR_M_FEEDBACK	mtr		Y	R/W*	Feedback type 1 - Encoder; 2 - Resolver	1 - 2		57	569	1081	1593	2077	2333
29	VAR_ENABLE_SWITCH_ TYPE		W	Y	R/W	Enable switch function 0 - inhibit only; 1 - Run	0 - 1	Bit	59	571	1083	1595	2078	2334
30	VAR_CURRENTLIMIT		F	Y	R/W	Current limit		[A]mp	61	573	1085	1597	2079	2335
31	VAR_ PEAKCURRENTLIMIT16		F	Y	R/W	Peak current limit for 16kHz operation		[A]mp	63	575	1087	1599	2080	2336
32	VAR_PEAKCURRENTLIMIT		F	Y	R/W	Peak current limit for 8kHz operation		[A]mp	65	577	1089	1601	2081	2337
33	VAR_PWMFREQUENCY		W	Y	R/W	PWM frequency selection 0 - 16kHz; 1 - 8kHz	0 - 1		67	579	1091	1603	2082	2338

* These are all R/W variables but they only become active after variable 247 is set.

Index	Name	Type	Format	EPM	Access	Description	Range	Unit	RAM Registers 32bit Integer Access 4X Register #	RAM Register 32bit Float Access 4X Register #	EPM Reg Copy 32bit Integer Access 4X Register #	EPM Reg Copy 32bit Float Access 4X Register #	RAM Register 16bit Signed Integer 4X Register #	EPM INT16 4X Register #
34	VAR_DRIVEMODE		W	Y	R/W	Drive mode 0 - torque; 1 - velocity ; 2 - position	0 - 2		69	581	1093	1605	2083	2339
35	VAR_CURRENT_SCALE		F	Y	R/W	Analog input #1 current reference scale	Model Dependent	A/V	71	583	1095	1607	2084	2340
36	VAR_VELOCITY_SCALE	vel	F	Y	R/W	Analog input #1 velocity reference scale	-10000 to +10000	RPM/V	73	585	1097	1609	2085	2341
37	VAR_REFERENCE		W	Y	R/W	Reference selection 1 - internal source; 0 - external	1 - 0		75	587	1099	1611	2086	2342
38	VAR_STEPINPUTTYPE		W	Y	R/W	Selects how position reference inputs operating 0 - Quadrature inputs (A/B) 1 - Step & Direction	0 - 1		77	589	1101	1613	2087	2343
39	VAR_ MOTORTHERMALPROTECT		W	Y	R/W	Motor thermal protection function 0 - disabled; 1 - enabled	0 - 1		79	591	1103	1615	2088	2344
40	VAR_ MOTORPTCRESISTANCE		F	Y	R/W	Motor thermal protection PTC cut-off resistance		[Ohm]	81	593	1105	1617	2089	2345
41	VAR_SECONDENCODER		W	Y	R/W	Second encoder 0 - disabled; 1 - enabled	0 - 1		83	595	1107	1619	2090	2346
42	VAR_REGENDUTY		W	Y	R/W	Regen circuit PWM duty cycle in %	1-100%	%	85	597	1109	1621	2091	2347
43	VAR_ENCODERREPEATSRC		W	Y	R/W	Selects source for repeat buffers 0 - Model 940 - Encoder Port P4 Model 941 - 2nd Encoder Option Bay 1 - Model 940 - 2nd Encoder Option Bay Model 941 - Resolver Port P4	0 - 1		87	599	1111	1623	2092	2348
44	VAR_VP_GAIN	vel	W	Y	R/W	Velocity loop Proportional gain	0 - 32767		89	601	1113	1625	2093	2349
45	VAR_VI_GAIN	vel	W	Y	R/W	Velocity loop Integral gain	0 - 32767		91	603	1115	1627	2094	2350
46	VAR_PP_GAIN		W	Y	R/W	Position loop Proportional gain	0 - 32767		93	605	1117	1629	2095	2351
47	VAR_PI_GAIN		W	Y	R/W	Position loop Integral gain	0 - 16383		95	607	1119	1631	2096	2352
48	VAR_PD_GAIN		W	Y	R/W	Position loop Differential gain	0 - 32767		97	609	1121	1633	2097	2353
49	VAR_PI_LIMIT		W	Y	R/W	Position loop integral gain limit	0 - 20000		99	611	1123	1635	2098	2354
50	VAR_SEI_GAIN					Not Used			101	613	1125	1637	2099	2355
51	VAR_VREG_WINDOW	vel	W	Y	R/W	Gains scaling coefficient	-16 to +4		103	615	1127	1639	2100	2356
52	VAR_ENABLE		W	N	W	Software Enable/Disable 0 - disable; 1 - enable	0 - 1		105	617	1129	1641	2101	2357
53	VAR_RESET		W	N	W	Drive's reset (Disables drive, Stops running program if any, reset active fault) 0 - no action; 1 - reset drive	0 - 1		107	619	1131	1643	2102	2358
54	VAR_STATUS		W	N	R	Drive's status register			109	621	1133	1645	2103	2359
55	VAR_BCF_SIZE		W	Y	R	User's program Byte-code size		Bytes	111	623	1135	1647	2104	2360
56	VAR_AUTOBOOT		W	Y	R/W	User's program autostart flag 0 - program started manually (MV or interface); 1 - program started automatically after drive booted	0 - 1		113	625	1137	1649	2105	2361
57	VAR_GROUPID		W	Y	R/W	Network group ID	1 - 32767		115	627	1139	1651	2106	2362
58	VAR_VLIMIT_ZEROSPEED		F	Y	R/W	Zero Speed window	0 - 100	Rpm	117	629	1141	1653	2107	2363
59	VAR_VLIMIT_SPEEDWND		F	Y	R/W	At Speed window	10 - 10000	Rpm	119	631	1143	1655	2108	2364
60	VAR_VLIMIT_ATSPEED		F	Y	R/W	Target Velocity for At Speed window	-10000 - +10000	Rpm	121	633	1145	1657	2109	2365
61	VAR_PLIMIT_POSERROR		W	Y	R/W	Position error	1 - 32767	EC	123	635	1147	1659	2110	2366
62	VAR_PLIMIT_ERRORTIME		F	Y	R/W	Position error time (time which position error has to remain to set-off position error fault)	0.25 - 8000	mS	125	637	1149	1661	2111	2367
63	VAR_PLIMIT_SEPOSERROR		W	Y	R/W	Second encoder Position error	1 - 32767	EC	127	639	1151	1663	2112	2368
64	VAR_PLIMIT_ SEERRORTIME		F	Y	R/W	Second encoder Position error time (time which position error has to remain to set-off position error fault)	0.25 - 8000	mS	129	641	1153	1665	2113	2369
65	VAR_INPUTS		W	N	R	Digital inputs states. A1 occupies Bit 0, A2-Bit 1 … C4 - bit 11.			131	643	1155	1667	2114	2370

Index	Name	Type	Format	EPM	Access	Description	Range	Unit	RAM Registers 32bit Integer Access 4X Register #	RAM Register 32bit Float Access 4X Register #	EPM Reg Copy 32bit Integer Access 4X Register #	EPM Reg Copy 32bit Float Access 4X Register #	RAM Register 16bit Signed Integer 4X Register #	EPM INT16 4X Register #
66	VAR_OUTPUT		W	N	R/W	Digital outputs states. Writing to this variables sets/resets digital outputs except outputs which have been assigned special function. Output 1 Bit 0 Output 2 Bit 1 Output 3 Bit 2 Output 4 Bit 3	Output 1 - Output 4		133	645	1157	1669	2115	2371
67	VAR_IP_ADDRESS		W	Y	R/W	Ethernet IP address. IP address changes at next boot up. 32 bit value			135	647	1159	1671	2116	2372
68	VAR_IP_MASK		W	Y	R/W	Ethernet IP NetMask. Mask changes at next boot up. 32 bit value			137	649	1161	1673	2117	2373
69	VAR_IP_GATEWAY		W	Y	R/W	Ethernet Gateway IP address. Address changes at next boot up. 32 bit value			139	651	1163	1675	2118	2374
70	VAR_IP_DHCP		W	Y	R/W	Use DHCP 0 - manual; 1 - use DHCP service	0 - 1		141	653	1165	1677	2119	2375
71	VAR_AIN1		F	N	R	Analog Input AIN1 current value		[V]olt	143	655	1167	1679	2120	2376
72	VAR_AIN2		F	N	R	Analog Input AIN2 current value		[V]olt	145	657	1169	1681	2121	2377
73	VAR_BUSVOLTAGE		F	N	R	Bus voltage		[V]olt	147	659	1171	1683	2122	2378
74	VAR_HTEMP		F	N	R	Heatsink temperature 0 - for temperatures < 40C and actual heat sink temperature for temperatures >40 C	0 - actual heat sink temperature	[c]	149	661	1173	1685	2123	2379
75	VAR_ENABLE_ ACCELDECEL	vel		Y	R/W	Enable Accel/Decel function for velocity mode 0 - disable; 1 - enable	0 - 1		151	663	1175	1687	2124	2380
76	VAR_ACCEL_LIMIT	vel	F	Y	R/W	Accel value for velocity mode	0.1 - 5000000	Rpm*Sec	153	665	1177	1689	2125	2381
77	VAR_DECEL_LIMIT	vel	F	Y	R/W	Decel value for velocity mode	0.1 - 5000000	Rpm*Sec	155	667	1179	1691	2126	2382
78	VAR_FAULT_RESET		W	Y	R/W	Reset fault configuration 0 - on activation of Enable/Inhibit input (A3) 1 - on deactivation of Enable/Inhibit input (A3)	0 - 1		157	669	1181	1693	2127	2383
79	VAR_M2SRATIO_MASTER		W	Y	R/W	Master to system ratio Master counts range: -32767 - +32767	-32767 - +32767		159	671	1183	1695	2128	2384
80	VAR_M2SRATIO_SYSTEM		W	Y	R/W	Master to system ratio System counts range: 1 - 32767	1 - 32767		161	673	1185	1697	2129	2385
81	VAR_S2PRATIO_SECOND		W	Y	R/W	Secondary encoder to prime encoder ratio Second counts range: -32767 - +32767	-32767 - +32767		163	675	1187	1699	2130	2386
82	VAR_S2PRATIO_PRIME		W	Y	R/W	Secondary encoder to prime encoder ratio Prime counts range: 1 - 32767	1 - 32767		165	677	1189	1701	2131	2387
83	VAR_EXSTATUS		W	N	R	Extended status. Lower word copy of DSP status flags.			167	679	1191	1703	2132	2388
84	VAR_HLS_MODE		W	Y	R/W	Hardware limit switches 0 - not used; 1 - stop and fault; 2 - fault	0 - 2		169	681	1193	1705	2133	2389
85	VAR_AOUT_FUNCTION		W	Y	R/W	Analog output function range: 0 - 8 0 - Not assigned 1 - Phase Current (RMS) 2 - Phase Current (Peak Value) 3 - Motor Velocity 4 - Phase Current R 5 - Phase Current S 6 - Phase Current T 7 - Iq current 8 - Id current	0 - 8		171	683	1195	1707	2134	2390
86	VAR_AOUT_VELSCALE		F	Y	R/W	Analog output scale for velocity quantities.	0 - 10	mV/Rpm	173	685	1197	1709	2135	2391
87	VAR_AOUT_CURSCALE		F	Y	R/W	Analog output scale for current related quantities.	0 - 10	V/A	175	687	1199	1711	2136	2392
88	VAR_AOUT		F	N	W	Analog output value.(Used if VAR #85 is set to 0)	0 - 10	V	177	689	1201	1713	2137	2393
89	VAR_AIN1_DEADBAND		F	Y	R/W	Analog input #1 dead-band. Applied when used as current or velocity reference.	0 - 100	mV	179	691	1203	1715	2138	2394
90	VAR_AIN1_OFFSET			Y	R/W	Analog input #1 offset. Applied when used as current/velocity reference	-10,000 to +10,000	mV	181	693	1205	1717	2139	2395

Index	Name	Type	Format	EPM	Access	Description	Range	Unit	RAM Registers 32bit Integer Access 4X Register #	RAM Register 32bit Float Access 4X Register #	EPM Reg Copy 32bit Integer Access 4X Register #	EPM Reg Copy 32bit Float Access 4X Register #	RAM Register 16bit Signed Integer 4X Register #	EPM INT16 4X Register #
91	VAR_SUSPEND_MOTION		W	N	R/W	Suspend motion. Suspends motion produced by trajectory generator. Current move will be completed before motion is suspended. 0 - motion suspended; 1 - motion resumed	0 - 1		183	695	1207	1719	2140	2396
92	VAR_MOVEP	⚠ mtn	W	N	W	Target position for absolute move. Writing value executes Move to position as per MOVEP statement using current values of acceleration, deceleration and max velocity.			185	697	1209	1721	2141	2397
93	VAR_MOVED	⚠ mtn	W	N	W	Incremental position. Writing value <0> executes Incremental move as per MOVED statement using current values of acceleration, deceleration and max velocity			187	699	1211	1723	2142	2398
94	VAR_MDV_DISTANCE		F	N	W	Distance for MDV move			189	701	1213	1725	2143	2399
95	VAR_MDV_VELOCITY	⚠ mtn	F	N	W	Velocity for MDV move. Writing to this variable executes MDV move with Distance value last written to variable #94			191	703	1215	1727	2144	2400
96	VAR_MOVE_PWI1	⚠ mtn	W	N	W	Writing value executes Move in positive direction while input true (active). Value specifies input # 0 - 3 : A1 -A4 4 - 7 : B1 - B4 8 - 11 : C1 - C4	0 - 11		193	705	1217	1729	2145	2401
97	VAR_MOVE_PWI0	⚠ mtn	W	N	W	Writing value executes Move in positive direction while input false (not active). Value specifies input # 0 - 3 : A1 -A4 4 - 7 : B1 - B4 8 - 11 : C1 - C4	0 - 11		195	707	1219	1731	2146	2402
98	VAR_MOVE_NWI1	⚠ mtn	F	N	W	Writing value executes Move negative direction while input true (active). Value specifies input # 0 - 3 : A1 -A4 4 - 7 : B1 - B4 8 - 11 : C1 - C4	0 - 11		197	709	1221	1733	2147	2403
99	VAR_MOVE_NWI0	⚠ mtn	F	N	W	Writing value executes Move negative direction while input false (not active). Value specifies input # 0 - 3 : A1 -A4 4 - 7 : B1 - B4 8 - 11 : C1 - C4	0 - 11		199	711	1223	1735	2148	2404
100	VAR_V0		F	Y	R/W	User variable			201	713	1225	1737	2149	2405
101	VAR_V1		F	Y	R/W	User variable			203	715	1227	1739	2150	2406
102	VAR_V2		F	Y	R/W	User variable			205	717	1229	1741	2151	2407
103	VAR_V3		F	Y	R/W	User variable			207	719	1231	1743	2152	2408
104	VAR_V4		F	Y	R/W	User variable			209	721	1233	1745	2153	2409
105	VAR_V5		F	Y	R/W	User variable			211	723	1235	1747	2154	2410
106	VAR_V6		F	Y	R/W	User variable			213	725	1237	1749	2155	2411
107	VAR_V7		F	Y	R/W	User variable			215	727	1239	1751	2156	2412
108	VAR_V8		F	Y	R/W	User variable			217	729	1241	1753	2157	2413
109	VAR_V9		F	Y	R/W	User variable			219	731	1243	1755	2158	2414
110	VAR_V10		F	Y	R/W	User variable			221	733	1245	1757	2159	2415
111	VAR_V11		F	Y	R/W	User variable			223	735	1247	1759	2160	2416
112	VAR_V12		F	Y	R/W	User variable			225	737	1249	1761	2161	2417
113	VAR_V13		F	Y	R/W	User variable			227	739	1251	1763	2162	2418
114	VAR_V14		F	Y	R/W	User variable			229	741	1253	1765	2163	2419
115	VAR_V15		F	Y	R/W	User variable			231	743	1255	1767	2164	2420
116	VAR_V16		F	Y	R/W	User variable			233	745	1257	1769	2165	2421
117	VAR_V17		F	Y	R/W	User variable			235	747	1259	1771	2166	2422
118	VAR_V18		F	Y	R/W	User variable			237	749	1261	1773	2167	2423
119	VAR_V19		F	Y	R/W	User variable			239	751	1263	1775	2168	2424
120	VAR_V20		F	Y	R/W	User variable			241	753	1265	1777	2169	2425

Index	Name	Type	Format	EPM	Access	Description	Range	Unit	RAM Registers 32bit Integer Access 4X Register #	RAM Register 32bit Float Access 4X Register #	EPM Reg Copy 32bit Integer Access 4X Register #	EPM Reg Copy 32bit Float Access 4X Register #	RAM Register 16bit Signed Integer 4X Register #	EPM INT16 4X Register #
121	VAR_V21		F	Y	R/W	User variable			243	755	1267	1779	2170	2426
122	VAR_V22		F	Y	R/W	User variable			245	757	1269	1781	2171	2427
123	VAR_V23		F	Y	R/W	User variable			247	759	1271	1783	2172	2428
124	VAR_V24		F	Y	R/W	User variable			249	761	1273	1785	2173	2429
125	VAR_V25		F	Y	R/W	User variable			251	763	1275	1787	2174	2430
126	VAR_V26		F	Y	R/W	User variable			253	765	1277	1789	2175	2431
127	VAR_V27		F	Y	R/W	User variable			255	767	1279	1791	2176	2432
128	VAR_V28		F	Y	R/W	User variable			257	769	1281	1793	2177	2433
129	VAR_V29		F	Y	R/W	User variable			259	771	1283	1795	2178	2434
130	VAR_V30		F	Y	R/W	User variable			261	773	1285	1797	2179	2435
131	VAR_V31		F	Y	R/W	User variable			263	775	1287	1799	2180	2436
132	VAR_MOVEDR_DISTANCE		F	N	W	Registered move distance. Incremental motion as per MOVEDR statement		UU	265	777	1289	1801	2181	2437
133	VAR_MOVEDR_ DISPLACEMENT	⚠ mtn	F	N	W	Registered move displacement. Writing to this variable executes the move MOVEDR using value set by #132		UU	267	779	1291	1803	2182	2438
134	VAR_MOVEPR_DISTANCE		F	N	W	Registered move distance. Absolute motion as per MOVEPR statement		UU	269	781	1293	1805	2183	2439
135	VAR_MOVEPR_ DISPLACEMENT	⚠ mtn	F	N	W	Registered move displacement. Writing to this variable makes the move MOVEPR using value set by #134		UU	271	783	1295	1807	2184	2440
136	VAR_STOP_MOTION		W	N	W	Stops motion 0 - no action; 1 - stops motion	0 - 1		273	785	1297	1809	2185	2441
137	VAR_START_PROGRAM		W	N	W	Starts user program 0 - no action; 1 - starts program	0 - 1		275	787	1299	1811	2186	2442
138	VAR_VEL_MODE_ON		W	N	W	Turns on Profile Velocity for Internal Position Mode 0 - normal operation; 1 - velocity mode on	0 - 1		277	789	1301	1813	2187	2443
139	VAR_IREF		F	N	W	Reference: Internal Torque or Velocity Mode		RPS Amps	279	791	1303	1815	2188	2444
140	VAR_NV0		F	N	R/W	User defined Network variable			281	793	1305	1817	2189	2445
141	VAR_NV1		F	N	R/W	User defined Network variable			283	795	1307	1819	2190	2446
142	VAR_NV2		F	N	R/W	User defined Network variable			285	797	1309	1821	2191	2447
143	VAR_NV3		F	N	R/W	User defined Network variable			287	799	1311	1823	2192	2448
144	VAR_NV4		F	N	R/W	User defined Network variable			289	801	1313	1825	2193	2449
145	VAR_NV5		F	N	R/W	User defined Network variable			291	803	1315	1827	2194	2450
146	VAR_NV6		F	N	R/W	User defined Network variable			293	805	1317	1829	2195	2451
147	VAR_NV7		F	N	R/W	User defined Network variable			295	807	1319	1831	2196	2452
148	VAR_NV8		F	N	R/W	User defined Network variable			297	809	1321	1833	2197	2453
149	VAR_NV9		F	N	R/W	User defined Network variable			299	811	1323	1835	2198	2454
150	VAR_NV10		F	N	R/W	User defined Network variable			301	813	1325	1837	2199	2455
151	VAR_NV11		F	N	R/W	User defined Network variable			303	815	1327	1839	2200	2456
152	VAR_NV12		F	N	R/W	User defined Network variable			305	817	1329	1841	2201	2457
153	VAR_NV13		F	N	R/W	User defined Network variable			307	819	1331	1843	2202	2458
154	VAR_NV14		F	N	R/W	User defined Network variable			309	821	1333	1845	2203	2459
155	VAR_NV15		F	N	R/W	User defined Network variable			311	823	1335	1847	2204	2460
156	VAR_NV16		F	N	R/W	User defined Network variable			313	825	1337	1849	2205	2461
157	VAR_NV17		F	N	R/W	User defined Network variable			315	827	1339	1851	2206	2462
158	VAR_NV18		F	N	R/W	User defined Network variable			317	829	1341	1853	2207	2463
159	VAR_NV19		F	N	R/W	User defined Network variable			319	831	1343	1855	2208	2464
160	VAR_NV20		F	N	R/W	User defined Network variable			321	833	1345	1857	2209	2465
161	VAR_NV21		F	N	R/W	User defined Network variable			323	835	1347	1859	2210	2466

Index	Name	Type	Format	EPM	Access	Description	Range	Unit	RAM Registers 32bit Integer Access 4X Register #	RAM Register 32bit Float Access 4X Register #	EPM Reg Copy 32bit Integer Access 4X Register #	EPM Reg Copy 32bit Float Access 4X Register #	RAM Register 16bit Signed Integer 4X Register #	EPM INT16 4X Register #
162	VAR_NV22		F	N	R/W	User defined Network variable			325	837	1349	1861	2211	2467
163	VAR_NV23		F	N	R/W	User defined Network variable			327	839	1351	1863	2212	2468
164	VAR_NV24		F	N	R/W	User defined Network variable			329	841	1353	1865	2213	2469
165	VAR_NV25		F	N	R/W	User defined Network variable			331	843	1355	1867	2214	2470
166	VAR_NV26		F	N	R/W	User defined Network variable			333	845	1357	1869	2215	2471
167	VAR_NV27		F	N	R/W	User defined Network variable			335	847	1359	1871	2216	2472
168	VAR_NV28		F	N	R/W	User defined Network variable			337	849	1361	1873	2217	2473
169	VAR_NV29		F	N	R/W	User defined Network variable			339	851	1363	1875	2218	2474
170	VAR_NV30		F	N	R/W	User defined Network variable			341	853	1365	1877	2219	2475
171	VAR_NV31		F	N	R/W	User defined Network variable			343	855	1367	1879	2220	2476
172	VAR_SERIAL_ADDRESS		W	Y	R/W	RS485 drive ID	0 - 254		345	857	1369	1881	2221	2477
173	VAR_MODBUS_BAUDRATE		W	Y	R/W	Baud rate for ModBus operations 2 - 9600; 3 - 19200 4 - 38400; 5 - 57600; 6 - 115200	2 - 6		347	859	1371	1883	2222	2478
174	VAR_MODBUS_DELAY		W	Y	R/W	ModBus reply delay in mS	0 - 1000		349	861	1373	1885	2223	2479
175	VAR_RS485_CONFIG		W	Y	R/W	Rs485 configuration 0 - normal IP over PPP; 1 - ModBus1 19200	0 - 1		351	863	1375	1887	2224	2480
176	VAR_PPP_BAUDRATE		W	Y	R/W	RS232/485 (normal mode) baud rate 2 - 9600; 3 - 19200 4 - 38400; 5 - 57600; 6 - 115200	2 - 6		353	865	1377	1889	2225	2481
177	VAR_MOVEPS		F	N	W	Same as variable #92 but using S-curve acceleration/deceleration			355	867	1379	1891	2226	2482
178	VAR_MOVEDS		F	N	W	Same as variable #93 but using S-curve acceleration/deceleration			357	869	1381	1893	2227	2483
179	VAR_MDVS_VELOCITY	⚠ mtn		N	W	Velocity for MDV move using S-curve accel/deceleration. Writing to this variable executes MDV move with Distance value last written to variable #94 (unless motion is suspended by #91).			359	871	1383	1895	2228	2484
180	VAR_MAXVEL		F	N	R/W	Max velocity for motion profile			361	873	1385	1897	2229	2485
181	VAR_ACCEL		F	N	R/W	Accel value for indexing		UU/S2	363	875	1387	1899	2230	2486
182	VAR_DECEL		F	N	R/W	Decel value for indexing		UU/S2	365	877	1389	1901	2231	2487
183	VAR_QDECEL		F	N	R/W	Quick decel value		UU/S2	367	879	1391	1903	2232	2488
184	VAR_INPOSLIM		W	N	R/W	Sets window for “In Position” Limits		UU	369	881	1393	1905	2233	2489
185	VAR_VEL		F	N	R/W	Velocity reference for “Profiled” velocity		UU/S	371	883	1395	1907	2234	2490
186	VAR_UNITS		F	Y	R/W	User units			373	885	1397	1909	2235	2491
187	VAR_MECOUNTER		W	N	R/W	A/B inputs reference counter value		Count	375	887	1399	1911	2236	2492
188	VAR_PHCUR		F	N	R	Phase current		A	377	889	1401	1913	2237	2493
189	VAR_POS_PULSES		W	N	R/W	Target position in encoder pulses		EC	379	891	1403	1915	2238	2494
190	VAR_APOS_PULSES		W	N	R/W	Actual position in encoder pulses		EC	381	893	1405	1917	2239	2495
191	VAR_POSERROR_PULSES		W	N	R	Position error in encoder pulses		EC	383	895	1407	1919	2240	2496
192	VAR_CURRENT_VEL_PPS		F	N	R	Set-point (target) velocity in PPS		PPS	385	897	1409	1921	2241	2497
193	VAR_CURRENT_ACCEL_ PPSS		F	N	R	Set-point (target) acceleration (demanded value)		PPSS	387	899	1411	1923	2242	2498
194	VAR_IN0_DEBOUNCE		W	Y	R/W	Input A1 de-bounce time in mS	0 - 1000	mS	389	901	1413	1925	2243	2499
195	VAR_IN1_DEBOUNCE		W	Y	R/W	Input A2 de-bounce time in mS	0 - 1000	mS	391	903	1415	1927	2244	2500
196	VAR_IN2_DEBOUNCE		W	Y	R/W	Input A3 de-bounce time in mS	0 - 1000	mS	393	905	1417	1929	2245	2501
197	VAR_IN3_DEBOUNCE		W	Y	R/W	Input A4 de-bounce time in mS	0 - 1000	mS	395	907	1419	1931	2246	2502
198	VAR_IN4_DEBOUNCE		W	Y	R/W	Input B1 de-bounce time in mS	0 - 1000	mS	397	909	1421	1933	2247	2503
199	VAR_IN5_DEBOUNCE		W	Y	R/W	Input B2 de-bounce time in mS	0 - 1000	mS	399	911	1423	1935	2248	2504
200	VAR_IN6_DEBOUNCE		W	Y	R/W	Input B3 de-bounce time in mS	0 - 1000	mS	401	913	1425	1937	2249	2505
201	VAR_IN7_DEBOUNCE		W	Y	R/W	Input B4 de-bounce time in mS	0 - 1000	mS	403	915	1427	1939	2250	2506
202	VAR_IN8_DEBOUNCE		W	Y	R/W	Input C1 de-bounce time in mS	0 - 1000	mS	405	917	1429	1941	2251	2507

Index	Name	Type	Format	EPM	Access	Description	Range	Unit	RAM Registers 32bit Integer Access 4X Register #	RAM Register 32bit Float Access 4X Register #	EPM Reg Copy 32bit Integer Access 4X Register #	EPM Reg Copy 32bit Float Access 4X Register #	RAM Register 16bit Signed Integer 4X Register #	EPM INT16 4X Register #
203	VAR_IN9_DEBOUNCE		W	Y	R/W	Input C2 de-bounce time in mS	0 - 1000	mS	407	919	1431	1943	2252	2508
204	VAR_IN10_DEBOUNCE		W	Y	R/W	Input C3 de-bounce time in mS	0 - 1000	mS	409	921	1433	1945	2253	2509
205	VAR_IN11_DEBOUNCE		W	Y	R/W	Input C4 de-bounce time in mS	0 - 1000	mS	411	923	1435	1947	2254	2510
206	VAR_OUT1_FUNCTION		W	Y	R/W	Programmable Output 1 Function 0 - Not Assigned 1 - Zero Speed 2 - In Speed Window 3 - Current Limit 4 - Run time fault 5 - Ready 6 - Brake 7 - In position	0 - 7		413	925	1437	1949	2255	2511
207	VAR_OUT2_FUNCTION		W	Y	R/W	Programmable Output 2 Function	0 - 7		415	927	1439	1951	2256	2512
208	VAR_OUT3_FUNCTION		W	Y	R/W	Programmable Output 3 Function	0 - 7		417	929	1441	1953	2257	2513
209	VAR_OUT4_FUNCTION		W	Y	R/W	Programmable Output 4 Function	0 - 7		419	931	1443	1955	2258	2514
210	VAR_HALLCODE		W	N	R	Current hall code Bit 0 - Hall 1 Bit 1 - Hall 2 Bit 2 - Hall 3			421	933	1445	1957	2259	2515
211	VAR_ENCODER		W	N	R	Primary encoder current value		EC	423	935	1447	1959	2260	2516
212	VAR_RPOS_PULSES		W	N	R	Registration position		EC	425	937	1449	1961	2261	2517
213	VAR_RPOS		F	N	R	Registration position		UU	427	939	1451	1963	2262	2518
214	VAR_POS		F	N	R/W	Target position		UU	429	941	1453	1965	2263	2519
215	VAR_APOS		F	N	R/W	Actual position		UU	431	943	1455	1967	2264	2520
216	VAR_POSERROR		W	N	R	Position error		EC	433	945	1457	1969	2265	2521
217	VAR_CURRENT_VEL		F	N	R	Set-point (target) velocity (demanded value)		UU/S	435	947	1459	1971	2266	2522
218	VAR_CURRENT_ACCEL		F	N	R	Set-point (target) acceleration (demanded value)		UU/S2	437	949	1461	1973	2267	2523
219	VAR_TPOS_ADVANCE		W	N	W	Target position advance. Every write to this variable adds value to the Target position summing point. Value gets added once per write. This variable useful when loop is driven by Master encoder signals and trying to correct phase. Value is in encoder counts		EC	439	951	1463	1975	2268	2524
220	VAR_IOINDEX		W	N	R/W	Same as INDEX variable in user's program.			441	953	1465	1977	2269	2525
221	VAR_PSLIMIT_PULSES		W	Y	R/W	Positive Software limit switch value in Encoder counts		EC	443	955	1467	1979	2270	2526
222	VAR_NSLIMIT_PULSES		W	Y	R/W	Negative Software limit switch value in Encoder counts		EC	445	957	1469	1981	2271	2527
223	VAR_ SLS_MODE		W	Y	R/W	Soft limit switch action code: 0 - no action 1- Fault 2- Stop and fault (When loop is driven by trajectory generator only. With all other sources same action as 1)"	0 - 2		447	959	1471	1983	2272	2528
224	VAR_PSLIMIT		F	Y	R/W	Same as var 221 but value in User Units		UU	449	961	1473	1985	2273	2529
225	VAR_NSLIMIT		F	Y	R/W	Same as var 222 but value in User Units		UU	451	963	1475	1987	2274	2530
226	VAR_SE_APOS_PULSES		W	N	R	2nd encoder actual position in encoder counts		EC	453	965	1477	1989	2275	2531
227	VAR_SE_POSERROR_ PULSES		W	N	R	2nd encoder position error in encoder counts		EC	455	967	1479	1991	2276	2532
228	VAR_MODBUS_PARITY		W	Y	R/W	Parity for Modbus Control: 0 - No Parity; 1 - Odd Parity; 2 - Even Parity	0 - 2		457	969	1481	1993	2277	2533
229	VAR_MODBUS_STOPBITS		W	Y	R/W	Number of Stopbits for Modbus Control 0 - 1.0; 1 - 1.5; 2 - 2.0	0 - 2		459	971	1483	1995	2278	2534
230	VAR_M_NOMINALVEL		F	Y	R/W	Induction Motor Nominal Velocity	500 - 20000	RPM	461	973	1485	1997	2279	2535
231	VAR_M_COSPHI		F	Y	R/W	Induction Motor Cosine Phi	0 - 1.0		463	975	1487	1999	2280	2536
232	VAR_M_BASEFREQUENCY		F	Y	R/W	Induction Motor Base Frequency	0 - 400Hz	Hz	465	977	1489	2001	2281	2537
233	VAR_M_SERIES					Induction Motor Series			467	979	1491	2003	2282	2538

Index	Name	Type	Format	EPM	Access	Description	Range	Unit	RAM Registers 32bit Integer Access 4X Register #	RAM Register 32bit Float Access 4X Register #	EPM Reg Copy 32bit Integer Access 4X Register #	EPM Reg Copy 32bit Float Access 4X Register #	RAM Register 16bit Signed Integer 4X Register #	EPM INT16 4X Register #
234	VAR_CAN_BAUD_EPM		W	Y	R/W	CAN Bus Parameter: Baud Rate: 1 - 8 1 - 10k; 2 - 20k; 3 - 50k; 4 - 125k 5 - 250k; 6 - 500k; 7 - 800k; 8 - 1000k	1 - 8		469	981	1493	2005	2283	2539
235	VAR_CAN_ADDR_EPM		W	Y	R/W	CAN Bus Parameter: Address	1-127		471	983	1495	2007	2284	2540
236	VAR_CAN_OPERMODE_ EPM		W	Y	R/W	CAN Bus Parameter: Boot-up Mode (Operational State Control) 0 - enters into pre-operational state 1 - enters into operational state 2 - pseudo NMT: sends NMT Start Node command after delay (set by variable 237)	0 - 2		473	985	1497	2009	2285	2541
237	VAR_CAN_OPERDELAY_ EPM		W	Y	R/W	CAN Bus Parameter: pseudo NMT mode delay time in seconds	Refer to variable 236	sec	475	987	1499	2011	2286	2542
238	VAR_CAN_ENABLE_EPM		W	Y	R/W	CAN Bus Parameter: Mode Control 0 - Disable CAN interface 1 - Enable CAN interface in DS301 mode 2 - Enable CAN interface in DS402 mode 3 - Enable DeviceNet 4 - Enable PROFIBUS DP	0 - 4		477	989	1501	2013	2287	2543
239	VAR_HOME_ACCEL		F	Y	R/W	Homing Mode: ACCEL rate	0 - 10000000.0	UU/sec2	479	991	1503	2015	2288	2544
240	VAR_HOME_OFFSET		F	Y	R/W	Homing Mode: Home Position Offset	-32767 to +32767	UU	481	993	1505	2017	2289	2545
241	VAR_HOME_OFFSET_ PULSES		W	Y	R/W	Homing Mode: Home Position Offset in encoder counts	+/- 2147418112	EC	483	995	1507	2019	2290	2546
242	VAR_HOME_FAST_VEL		F	Y	R/W	Homing Mode: Fast Velocity	-10000 to +10000	UU/sec	485	997	1509	2021	2291	2547
243	VAR_HOME_SLOW_VEL		F	Y	R/W	Homing Mode: Slow Velocity	-10000 to +10000	UU/sec	487	999	1511	2023	2292	2548
244	VAR_HOME_METHOD		W	Y	R/W	Homing Mode: Homing Method	1 - 35		489	1001	1513	2025	2293	2549
245	VAR_START_HOMING		W	N	W	Homing Mode: Start Homing 0 - No action; 1 - Start Homing	0 - 1		491	1003	1515	2027	2294	2550
246	VAR_HOME_SWITCH_ INPUT		W	Y	R/W	Homing Mode: Switch Input Assignment: 0-3: A1-A4 4-7: B1-B4 8-11: C1-C4	0-11		493	1005	1517	2029	2295	2551
247	VAR_M_VALIDATE_ MOTOR		W	N	W	Makes Drive accept Motor's parameters 0 - No action 1 - Validate Motor Data	0 -1		495	1007	1519	2031	2296	2552
248	VAR_M_I2T		F	Y	R/W	Motor			497	1009	1521	2033	2297	2553
249	VAR_M_EABSOLUTE		F	Y	R/W	Motor			499	1011	1523	2035	2298	2554
250	VAR_M_ABSWAP		F	Y	R/W	Motor Encoder Feedback: B leads A 0 - No Action 1 - B leads A for forward checked (active)	0 - 1		501	1013	1525	2037	2299	2555
251	VAR_M_HALLS_INVERTED		F	Y	R/W	Motor Encoder Feedback: Halls 0 - No Action 1 - Inverted Halls Box checked (active)	0 - 1		503	1015	1527	2039	2300	2556
252	RESERVED					Do NOT use			505	1017	1529	2041	2301	2557
253	RESERVED					Do NOT use			507	1019	1531	2043	2302	2558
254	RESERVED					Do NOT use			509	1021	1533	2045	2303	2559
255	RESERVED					Do NOT use			511	1023	1535	2047	2304	2560
256	RESERVED					Do NOT use			513	1025	1537	2049	2305	2561

This is a condensed PID List to show the corresponding Modbus 4X Registers for PIDs 1-256. Modbus RTU can not access beyond PID256. For the complete variable list refer to the PositionServo Programming Manual (PM94P01 or PM94M01).

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