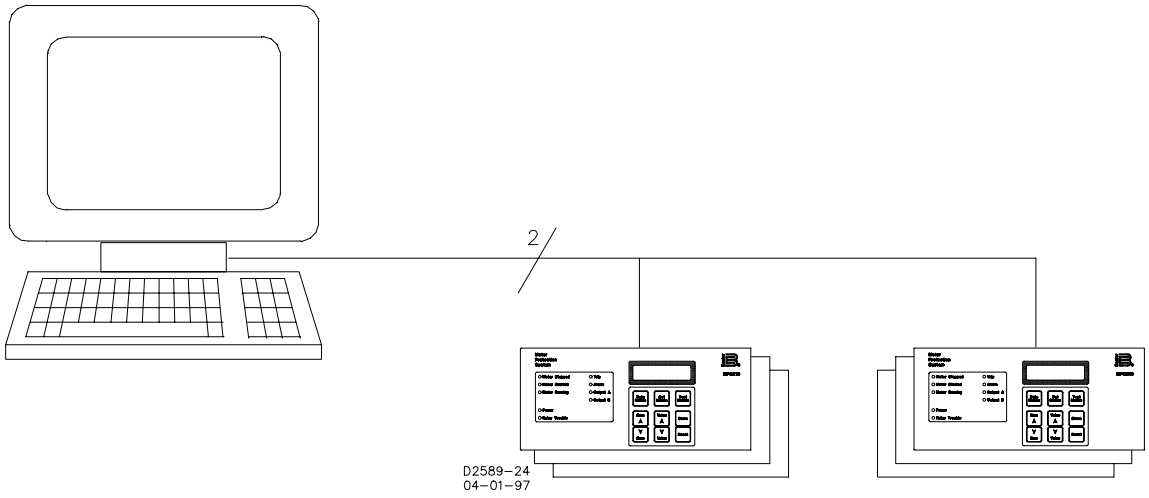
INSTRUCTION MANUAL
for
MPS200 AND MPS210
MOTOR
PROTECTION SYSTEMS

MODBUS PROTOCOL



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INTRODUCTION

This manual provides detailed communications protocol information for MPS200 and MPS210, Motor Protection Systems with the ModBus Protocol.

WARNING

TO AVOID PERSONAL INJURY OR EQUIPMENT DAMAGE, ONLY QUALIFIED PERSONNEL SHOULD PERFORM THE PROCEDURES PRESENTED IN THIS MANUAL.

CAUTION

MEGGERS AND HIGH POTENTIAL TEST EQUIPMENT SHOULD BE USED WITH EXTREME CARE. INCORRECT USE OF SUCH EQUIPMENT COULD DAMAGE COMPONENTS CONTAINED IN THE DEVICE.

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CONTENTS

GENERAL

This publication describes the Modbus communications protocol employed by MPS 200 / 210 Motor Protection System relays, and how to exchange information with MPS 200 / 210 relays over a Modbus network. The MPS 200 / 210 communicates by emulating a subset of the Modicon 984 Programmable Controller.

Warning

It is important to first connect Ground to the MPS 200 / 210 Ground Stud before connecting the serial link wires. Ignoring this warning may result in permanent damage to the Serial Link Hardware and can be dangerous.

INTRODUCTION TO MODBUS PROTOCOL

Modbus communications use a master-slave technique in which only the master can initiate a transaction. This transaction is called a query. When appropriate, a slave (MPS 200 / 210) responds to the query. When a Modbus master communicates with a slave, information is provided or requested by the master.

All supported data can be read as specified in the register table. Abbreviations are used in the *Register Table* to indicate the register type. Register types are:

Read/Write = RW
Read Only = R -

MPS 200 / 210 MODBUS PROTOCOL

When a slave receives a query, the slave responds by either supplying the requested data to the master or performing the requested action. A slave device never initiates communications on the Modbus, and will always generate a response to the query unless certain error conditions occur. The MPS 200 / 210 is designed to communicate on the Modbus only as a slave device.

A master can only query slaves individually. If a query requests actions unable to be performed by the slave, the slave response message contains an exception response code defining the error detected.

MPS 200 / 210 Communication Timing Issues

The MPS 200 / 210 devices will normally respond to a valid request within 40 mS, for a long frame the response could take as long as 200 mS to construct. If the same MPS is queried more than once per second the response may also be delayed. After storing setting parameters the MPS should not be transmitted to again in less than one second to allow the MPS to complete storing parameters within non-volatile memory.

Communication Parameters

The baud rate and device address of the MPS devices can only be set manually and the unit must be powered off and on again for the new values to take affect. The parity is fixed as EVEN, there is one stop bit (fixed) and baudrates may be 1200, 2400, 4800 or 9600 bits per second.

Message Structure

Master initiated queries and MPS 200 / 210 responses share the same message structure. Each message is comprised of four message fields. They are:

- Device Address
- Function Code
- Data Block
- Error Check field

Device Address Field

The device address field contains the unique Modbus address of the slave being queried. The addressed slave repeats the address in the device address field of the response message. This field is 1 byte.

Modbus protocol limits a device address from 1 - 247, the MPS 200 / 210 default value is 248 which is communication OFF condition. Slave address 0, used for broadcast transmissions in Modbus, is not supported in the MPS 200 / 210 Motor Protection System products.

Function Code Field

The function code field in the query message defines the action to be taken by the addressed slave. This field is echoed in the response message, and is altered by setting the most significant bit (MSB) of the field to 1 if the response is an error response. This field is 1 byte.

The MPS 200 / 210 maps all regs into the Modicon 984 holding register address space (4XXXX) and supports the following function codes (MPS use in parenthesis).

- Function 01 - Read Coil Status (Read Discrete Command status)
- Function 02 - Read Input Status (Read Discrete Input status)
- Function 03 - Read Holding Registers (Read Setting Parameters)
- Function 04 - Read Input Registers (Read Actual Data)
- Function 05 - Force Single Coil (Force One Discrete Command)
- Function 06 - Preset Single Register (Write One Setting Parameter)
- Function 08, subfunction 00 - diagnostics: return query data (Loopback Diagnostics)
- Function 15 - Force Multiple Coils (Force Discrete Command)
- Function 16 - Preset Multiple Registers (Write Setting Parameters, non-broadcast)

Data Block Field

The query data block contains additional information needed by the slave to perform the requested function. The response data block contains data collected by the slave for the queried function. An error response will substitute an exception response code for the data block. The length of this field varies with each query. See the paragraphs on *Register Definitions* in this manual for interpretation of reg data.

Error Check Field

The error check field provides a method for the slave to validate the integrity of the query message contents and allows the master to confirm the validity of response message contents. This field is 2 bytes.

Serial Transmission Details

A standard Modbus network offers two transmission modes for communication: ASCII or remote terminal unit (RTU). The MPS 200 / 210 supports only the RTU mode.

Each 8-bit byte in a message contains two 4-bit hexadecimal characters. The message is transmitted in a continuous stream with the LSB of each byte of data transmitted first. Transmission of each 8-bit data byte occurs with one start bit and one stop bit. Parity checking is performed, when enabled, and can be either odd or even. The transmission baud rate is user-selectable, and can be set at installation and altered during real-time operation. The MPS 200 / 210 supported baud rates are 1200, 2400, 4800, and 9600. The factory set baud rate is 9600. MPS 200 / 210 supports an RS-485 compatible serial interface.

Message Framing And Timing Considerations

When receiving a message, the MPS 200 / 210 requires an inter-byte latency of 3.5 character times before considering the message complete. Table 1 provides the response message transmission time (in seconds) and 3.5 character times (in milliseconds) for various message lengths and baud rates.

Table 1. Timing Considerations

Baud Rate	3.5 Character Time (mSec)	Message Tx Time (Sec.)	
		128 Bytes	256 Bytes
300	128.3	4.69	9.39
600	64.2	2.35	4.69
1200	32.1	1.17	2.35
2400	16.04	0.59	1.17
4800	8.021	0.29	0.59
9600	4.0104	0.15	0.29
19200	2.0052	0.07	0.15

Error Handling And Exception Responses

Any query received that contains a non-existent device address, a framing error, or CRC error is ignored. No response is transmitted. Queries addressed to a MPS 200 / 210 with an unsupported function code, unsupported register references, or illegal values in the data block result in an error response message with an exception response code. The exception response codes supported by the MPS 200 / 210 are provided in Table 2.

Table 2. Supported Exception Response Codes

Code	Name	Meaning
01	Illegal Function	The query Function/Subfunction Code is unsupported.
02	Illegal Data Address	Data Address is not allowable.
03	Illegal Data Value	One or more data values out of range.
06	MPS Busy	Trying to Preset Multiple Registers while motor is not stopped (Function 16).

COMMUNICATIONS HARDWARE REQUIREMENTS

The MPS 200 / 210 RS-485 physical interface is three positions of a terminal strip with locations for Data +, Data - and shield. Refer to the MPS 200 / 210 Owner's Manual for further details.

DETAILED MESSAGE QUERY AND RESPONSE

A detailed description of MPS 200 / 210 supported message queries and responses is provided in the following paragraphs.

Read Input Registers

Query

This query message requests a register or block of registers to be read. The data block contains the starting register address and the quantity of registers to be read. A register address of N will read holding register N+1.

Device Address
Function Code 04 (hex)
Starting Address Hi
Starting Address Lo
No. of Registers Hi
No. of Registers Lo
CRC error check

The number of registers cannot exceed 120 without causing an error response with the exception code for an illegal function.

Example: Read Actual Parameters 1...3 (I1, I2 & I3 Currents) of MPS #18. Actual registers requested are addressed as 0 ...2, data length = 3, 1 register per phase.

Frame sent to slave address 18, (12h)

Serial Link #	Function Read Input Register	Holding Register Hi	Holding Register Lo	Number of Registers Hi	Number of Registers Lo	CRC H i	CRC Lo
12h	04h	00h	00h	00	03h	xxh	xxh

Response

The response message contains the data queried. The data block contains the block length in bytes followed by the data for each requested reg. For each requested reg, there is one Data Hi and one Data Lo. Attempting to read an unused register or a register which does not support a read results in an error response with the exception code for an illegal data address.

Device Address
Function Code 04 (hex)
Byte Count
Data Hi (For each requested reg, there is one Data Hi and one Data Lo.)
Data Lo
.
.
.
Data Hi
Data Lo
CRC error check

Example: Assuming that currents are 400, 402 and 398 Amps, respectively.

Slave Response Frame Sent Back to Master

Serial Link #	Function Read Input Register	Byte Count	Data High	Data Low	Data High	Data Low	Data High	Data Low	CRC H i	CRC Lo
12h	04h	06h	01h	90h	01h	92h	01h	8Eh	xxh	xxh

Return Query Data

This query contains data to be returned (looped back) in the response. The response and query messages should be identical.

Device Address	
Function Code	08 (hex)
Subfunction Hi	00 (hex)
Subfunction Lo	00 (hex)
Data Hi	
Data Lo	
CRC error check	

Example: Loopback Message

Frame Sent To Slave Address 125 , (7dh)

Serial Link #	Function Loopback	Diagnostic Code Hi	Diagnostic Code Lo	Data Hi	Data Lo	CRC H i	CRC Lo
7dh	08h	00	00	a5h	5ah	10h	9ch

Frame Returned To Master

Serial Link #	Function Loopback	Diagnostic Code Hi	Diagnostic Code Lo	Data Hi	Data Lo	CRC H i	CRC Lo
7dh	08h	00	00	a5h	5ah	10h	9ch

Preset Multiple Registers

A preset multiple registers query could address multiple registers in one slave or multiple slaves.

Query

A query message requests a register or block of registers to be written. The data block contains the starting address and the quantity of registers to be written, followed by the Data Block byte count and data. The MPS 200 / 210 will perform the write when the device address is the same as the MPS 200 / 210s remote address or when the device address is 0. A device address is 0 for a broadcast query.

A register address of N will write Holding Register N+1.

No data will be written if any of the following exceptions occur.

- Queries to write to Read Only or unsupported registers result in an error response with Exception Code of Illegal Data Address.
- Queries attempting to write more than 100 registers cause an error response with Exception Code Illegal Function.
- An incorrect Byte Count will result in an error response with Exception Code of “Illegal Data Value.

- A query to write which is not preceded by a valid Password Clearance query results in an error response with Exception Code of “Illegal Function.
- There are several instances of registers that are grouped together to collectively represent a single numerical (vs. ASCII string) MPS 200 / 210 reg value (DP, FP, TP). A query to write a subset of such a register group will result in an error response with Exception Code “Illegal Data Address.
- A query to write an unallowed value (out of range) to a register results in an error response with Exception Code of “Illegal Data Value.

Device Address	
Function Code	10 (hex)
Starting Address Hi	
Starting Address Lo	
No. of Registers Hi	
No. of Registers Lo	
Byte Count	
Data Hi	
Data Lo	
.	
.	
.	
Data Hi	
Data Lo	
CRC Error Check	

Response

The response message echoes the starting address and the number of registers. There is no response message when the query is broadcast.

Device Address	
Function Code	10 (hex)
Starting Address Hi	
Starting Address Lo	
No. of Registers Hi	
No. of Registers Lo	
CRC Error Check	

CRC Error Check

This field contains a two-byte CRC value for transmission error detection. The master first calculates the CRC and appends it to the query message. The MPS 200 / 210 recalculates the CRC value for the received query and performs a comparison to the query CRC value to determine if a transmission error has occurred. If so, no response message is generated. If no transmission error has occurred, the slave calculates a new CRC value for the response message and appends it to the message for transmission.

The CRC calculation is performed using all bytes of the device address, function code and data block fields. A 16-bit CRC-register is initialized to all 1's. Then each eight-bit byte of the message is used in the following algorithm:

First, exclusive-OR the message byte with the low-order byte of the CRC-register. The result, stored in the CRC-register, will then be right-shifted eight times. The CRC-register MSB is zero-filled with each shift. After each shift, the CRC-register LSB is examined. If the LSB IS a 1, the CRC-register is then exclusive-ORed with the fixed polynomial value A001 (hex) prior to the next shift. Once all bytes of the message have undergone the above algorithm, the CRC-register will contain the message CRC value to be placed in the error check field.

MAPPING MPS MEMORY INTO MODICON ADDRESS SPACE

Conventions

The MPS 200 and 210 memory is organized according to the common Modbus addresses as follows:

Modbus Memory Type	MPS Use	Number of Parameters
3X Registers	Actual Data	144 Registers, 1 ... 144
4X Registers	Setting Parameters	159 Registers, 1 ... 159
1X Registers	Hardwired Control Inputs	32 Inputs, 1 ... 32
0X Registers	Discrete Serial Commands	16 Coils, 1 ... 16

Register Tables

The following tables list the parameters based upon memory type. Included in the tables are ranges and defaults values if available. As noted, some registers (especially the Setting Parameters - 4X references) may take on one of two ranges of variables depending upon the type of starter. The second range is selected only for two speed motors and is in parenthesis.

NOTE

Query address n will access the holding register n+1.

Actual Data (3X References)

Actual Data includes measured values such as Voltages, Currents and Power. It also includes Calculated, Logic and Statistical information. All parameters are word (two byte) parameters. The protocol supports Read Only operations on these parameters.

Parameter #s are "1-based." The actual address is one lower than the Modbus register #. For example the address of Actual Data #1 is 0 (30000).

Modbus Register	Parameter	Read/Write Supported	Range	Notes
0001	IA, Phase A Line Current	R -	Amp.	
0002	IB, Phase B Line Current	R -	Amp.	
0003	IC, Phase C Line Current	R -	Amp.	
0004	IG, Ground Current	R -	Amp.	
0005	VA, Phase A Voltage	R -	Volt	
0006	VB, Phase B Voltage	R -	Volt	
0007	VC, Phase C Voltage	R -	Volt	
0008	VLAB, Phase A to B line voltage	R -	Volt	
0009	VLBC, Phase B to C line voltage	R -	Volt	
0010	VLCA, Phase C to A line voltage	R -	Volt	
0011	Drive Status	R -	0-Avail, 1-Running, 2-Not Avail	
0012	Trips	R -	OR of all trips, bit mapped d0: momentary, d1: latched	
0013	Alarms	R -	OR of all Alarms, bit mapped d0: momentary, d1: latched	
0014	Time_To_Trip, Estimated time to trip	R -	Sec., 64000: No Trip Expected	
0015	Time_To_Start, Estimated time to start	R -	Sec.	
0016	Average_RMS_Current, 3 lines Ave.	R -	Amp.	
0017	Motor_Load, Average current	R -	% of FLC	
0018	Unbalance, unbalance current	R -		
0019	Alarm_Fault_Number, alarm cause	R -	(See Fault List Starting at Register #58)	
0020	Frequency_10, 10 * frequency	R -	(Hz * 10)	
0021	Ph_Seq, Phase Sequence	R -	1 - correct, <>1 - wrong seq.	
0022	Temp 1, temperature	R -	Tenth degree C	
0023	Temp 2, temperature	R -	Tenth degree C	
0024	Temp 3, temperature	R -	Tenth degree C	
0025	Temp 4, temperature	R -	Tenth degree C	
0026	Temp 5, temperature	R -	Tenth degree C	
0027	Temp 6, temperature	R -	Tenth degree C	
0028	Temp 7, temperature	R -	Tenth degree C	
0029	Temp 8, temperature	R -	Tenth degree C	
0030	Temp 9, temperature	R -	Tenth degree C	
0031	Temp 10, temperature	R -	Tenth degree C	
0032	Reserved	R -		

Actual Data (Cont'd)

Modbus Register	Parameter	Read/Write Supported	Range	Notes
0033	Control_In_1, Control Input Byte 1	R -		d15...d8: Reserved d7: Conatctor A NC Contact (0=closed) d6: Conatctor A NO Contact (1=open) d5: Contactor B NC Contact (0=closed) d4: Contactor B NO Contact (1=open) d3: Isolator NC Contact (0=closed) d2: Isolator NO Contact (1=open) d1: Ext. fault 2 contact (1=fault) d0: Ext. fault 3 contact (1=fault)
0034	Control_In_2, Control Input Byte 2	R -		d15...d8: Reserved d7: Start A. (0=start) d6: Start B. (0=start) d5: Stop. (1=stop) d4: Local (=1) / Remote (=0) d3: PLC (=1) / Serial Port (=0) d2: Remote Reset (0=Reset) d1: PLC A control (0=Start, 1=Stop) d0: PLC B control (0=Start, 1=Stop)
0035	Control_In_3, Control Input Byte 3	R -		d15...d8: Reserved d7: Low Speed. (0=Low Speed) d6: Interlock. (1=Locked) d5: Authorized Key. (0=Authorized) d4: Emergency Stop. (1=E. Stop) d3 ... d0: Reserved
0036	Hardwire_Message	R -		1=Hardwire Start, 2=Hardwire Stop
0037	Reserved	R -		
0038	Reserved	R -		
0039	Reserved	R -		
0040	Reserved	R -		
0041	Total_Run_Time	R -		Total Hours of Running Motor
0042	Total_Starts	R -		Total Number of Starts
0043	Total_Trips	R -		Total Number of Fault Trips
0044	Thermal_Capacity	R -		% of thermal capacity used
0045	Trip_Fault_Number, trip cause	R -		(See Fault List Starting at Register # 58)
0046	Logic_Status	R -		Logic Status of MPS. 1 Indicates: d15 ... d8: Reserved d7: Trip d6: Alarm d5: Protection Only d4: Drive Available d3: PLC/Serial port input = PLC d2: Local/Remote input = Local d1: Contactor A is energized d0: Conatctor B is energized

Actual Data (Cont'd)

Modbus Register	Parameter	Read/Write Supported	Range	Notes
0047	Pre_Trip_IA	R -	Phase A Current Value just before trip	
0048	Pre_Trip_IB	R -	Phase B Current Value just before trip	
0049	Pre_Trip_IC	R -	Phase C Current Value just before trip	
0050	Pre_Trip_IG	R -	Ground Current Value just before trip	
0051	Pre_Trip_VA	R -	Phase A Voltage Value just before trip	
0052	Pre_Trip_VB	R -	Phase A Voltage Value just before trip	
0053	Pre_Trip_VC	R -	Phase A Voltage Value just before trip	
0054	Last_Start_Period	R -	Last start time duration - Tenth Sec.	
0055	Last_Start_Peak_I	R -	Last start peak RMS current	
0056	Reserved	R -		
0057	Reserved	R -		
0058	Max_Start_Time	R -	d0: Momentary, d1: Latched (0=no, 1=fault)	**Fault 1**
0059	Too_Many_Starts	R -	d0: Momentary, d1: Latched (0=no, 1=fault)	**Fault 2**
0060	U/C_Level_1	R -	d0: Momentary, d1: Latched (0=no, 1=fault)	**Fault 3**
0061	U/C_Level_2	R -	d0: Momentary, d1: Latched (0=no, 1=fault)	**Fault 4**
0062	Load_Increased	R -	d0: Momentary, d1: Latched (0=no, 1=fault)	**Fault 5**
0063	O/C_Level_1	R -	d0: Momentary, d1: Latched (0=no, 1=fault)	**Fault 6**
0064	O/C_Level_2	R -	d0: Momentary, d1: Latched (0=no, 1=fault)	**Fault 7**
0065	Thermal_Level_1	R -	d0: Momentary, d1: Latched (0=no, 1=fault)	**Fault 8**
0066	Thermal_Level_2	R -	d0: Momentary, d1: Latched (0=no, 1=fault)	**Fault 9**
0067	Unbalance_Level_1	R -	d0: Momentary, d1: Latched (0=no, 1=fault)	**Fault 10**
0068	Unbalance_Level_2	R -	d0: Momentary, d1: Latched (0=no, 1=fault)	**Fault 11**
0069	Undervoltage	R -	d0: Momentary, d1: Latched (0=no, 1=fault)	**Fault 12**
0070	O/V_Level_1	R -	d0: Momentary, d1: Latched (0=no, 1=fault)	**Fault 13**
0071	O/V_Level_2	R -	d0: Momentary, d1: Latched (0=no, 1=fault)	**Fault 14**
0072	Phase_Loss	R -	d0: Momentary, d1: Latched (0=no, 1=fault)	**Fault 15**
0073	Phase_Sequence	R -	d0: Momentary, d1: Latched (0=no, 1=fault)	**Fault 16**
0074	Gnd_Fault_Level_1	R -	d0: Momentary, d1: Latched (0=no, 1=fault)	**Fault 17**
0075	Gnd_Fault_Level_2	R -	d0: Momentary, d1: Latched (0=no, 1=fault)	**Fault 18**
0076	Comm_Port_Failed	R -	d0: Momentary, d1: Latched (0=no, 1=fault)	**Fault 19**
0077	Internal_Failure	R -	d0: Momentary, d1: Latched (0=no, 1=fault)	**Fault 20**
0078	Control_Circuit_Open	R -	d0: Momentary, d1: Latched (0=no, 1=fault)	**Fault 21**
0079	Welded_Contactor	R -	d0: Momentary, d1: Latched (0=no, 1=fault)	**Fault 22**
0080	External_Fault_1	R -	d0: Momentary, d1: Latched (0=no, 1=fault)	**Fault 23**
0081	External_Fault_2	R -	d0: Momentary, d1: Latched (0=no, 1=fault)	**Fault 24**
0082	External_Fault_3	R -	d0: Momentary, d1: Latched (0=no, 1=fault)	**Fault 25**
0083	RTD_1_Level_1	R -	d0: Momentary, d1: Latched (0=no, 1=fault)	**Fault 26**
0084	RTD_1_Level_2	R -	d0: Momentary, d1: Latched (0=no, 1=fault)	**Fault 27**
0085	RTD_2_Level_1	R -	d0: Momentary, d1: Latched (0=no, 1=fault)	**Fault 28**
0086	RTD_2_Level_2	R -	d0: Momentary, d1: Latched (0=no, 1=fault)	**Fault 29**
0087	RTD_3_Level_1	R -	d0: Momentary, d1: Latched (0=no, 1=fault)	**Fault 30**
0088	RTD_3_Level_2	R -	d0: Momentary, d1: Latched (0=no, 1=fault)	**Fault 31**
0089	RTD_4_Level_1	R -	d0: Momentary, d1: Latched (0=no, 1=fault)	**Fault 32**
0090	RTD_4_Level_2	R -	d0: Momentary, d1: Latched (0=no, 1=fault)	**Fault 33**
0091	RTD_5_Level_1	R -	d0: Momentary, d1: Latched (0=no, 1=fault)	**Fault 34**
0092	RTD_5_Level_2	R -	d0: Momentary, d1: Latched (0=no, 1=fault)	**Fault 35**
0093	RTD_6_Level_1	R -	d0: Momentary, d1: Latched (0=no, 1=fault)	**Fault 36**
0094	RTD_6_Level_2	R -	d0: Momentary, d1: Latched (0=no, 1=fault)	**Fault 37**

Actual Data (Cont'd)

Modbus Register	Parameter	Read/Write Supported	Range	Notes
0095	RTD_7_Level_1	R -	d0: Momentary, d1: Latched (0=no, 1=fault)	**Fault 38**
0096	RTD_7_Level_2	R -	d0: Momentary, d1: Latched (0=no, 1=fault)	**Fault 39**
0097	RTD_8_Level_1	R -	d0: Momentary, d1: Latched (0=no, 1=fault)	**Fault 40**
0098	RTD_8_Level_2	R -	d0: Momentary, d1: Latched (0=no, 1=fault)	**Fault 41**
0099	RTD_9_Level_1	R -	d0: Momentary, d1: Latched (0=no, 1=fault)	**Fault 42**
0100	RTD_9_Level_2	R -	d0: Momentary, d1: Latched (0=no, 1=fault)	**Fault 43**
0101	RTD_10_Level_1	R -	d0: Momentary, d1: Latched (0=no, 1=fault)	**Fault 44**
0102	RTD_10_Level_2	R -	d0: Momentary, d1: Latched (0=no, 1=fault)	**Fault 45**
0103	Under_Power_Level_1	R -	d0: Momentary, d1: Latched (0=no, 1=fault)	**Fault 46**
0104	Under_Power_Level_2	R -	d0: Momentary, d1: Latched (0=no, 1=fault)	**Fault 47**
0105	Low_Power_Factor	R -	d0: Momentary, d1: Latched (0=no, 1=fault)	**Fault 48**
0106	Reserved	R -		
.				
.				
.				
0120	Reserved	R -		
0121	Power	R -	KW	
0122	Reactive_Power	R -	KVAR	
0123	Power_Multiplier	R -	1 = KW, KVAR; 10 = (1/10) KW, KVAR	
0124	Power_Factor	R -	Power factor * 1000 (Integer parameter, + >> I lagging)	
0125	Reserved	R -		
0126	Reserved	R -		
0127	Reserved	R -		
0128	Enhanced_Low_Speed	R -	1 - Low Speed, 0 - High Speed	
0129	Reserved	R -		
.				
.				
.				
0144	Reserved	R -		

Setting Parameters (4X Registers)

Setting Parameters include all registers which can be set manually. These parameters determine the modes of operation of the MPS. They also set protection levels. All parameters are word (two byte) in length. The protocol supports reading and writing of (most of) these registers.

NOTE

Any of these registers must be set with care. Harmful results can occur to the motor by inadequate settings of some parameters.

Modbus Register	Parameter	Read/Write Supported	Range	Default
0001	Motor Number	R W	0 ... 320	0
0002	Baud Rate	R -	12/24/48/96 (*100)	96 = 9600 baud
0003	Address_Number	R -	1 ... 247 and 248 (off)	248 (to lock out)
0004	Future_Enhance_1	R W	0 ... 1	0 (not used)
0005	Future_Enhance_2	R W	0 ... 1	0 (not used)
0006	Future_Enhance_3	R W	0 ... 1	0 (not used)
0007	Reserved			
0008	Reserved			
0009	Line_Volts (Vn)	R W	100 ... 22000	480 (Volt)
0010	Line_Frequency	R W	50 / 60 Hz	60 Hz
0011	VT_Primary	R W	90 and 100 ... 22000	90 (not used)
0012	VT_Secondary	R W	90 and 100 ... 660	90 (not used)
0013	Motor_FLC	R W	1 ... 2000	100 (Amp)
0014	CT_Primary	R W	1 ... 2000	100 (Amp)
0015	Gnd_CT_Primary	R W	1 ... 2000	100 (Amp)
0016	Gnd_Fault_Level_1	R W	1 ... 100	5 (% of FLC)
0017	G/F_Level_1_Delay	R W	1 ... 60	10 (Sec)
0018	Gnd_Fault_Level_2	R W	1 ... 100	10 (% of FLC)
0019	G/F_Level_2_Delay	R W	1 ... 20 (0 - 2 Sec)	5 (0.5 Sec)
0020	Current_Inhibit	R W	40 ... 100, 250 (@10%)	250 (Off)
0021	Start_Stop_Signal	R W	0 - Mom., 1 - Maint.	0 (Momentary)
0022	Starting_Method	R W	0 - Direct On Line 1 - Star / Delta 2 - Reversing 3 - 2 Speed (A=hi, B=lo) 4 - Valve control	0 (DOL)
0023	Max_Time_In_Star (Low_Spd_Motor_FLC)	R W	1 ... 60 Sec. (1 ... 2000)	10 (Sec.) no default
0024	Transition_Time (Low_Spd_t6x_Time)	R W	5 ... 200 (* 0.01 Sec.) 1 ... 240 (* 0.5 Sec.)	20 (200 mSec) no default
0025	Star_To_Delta_At	R W	70 ... 200 % of FLC	150 % of FLC
0026	Config_Output_C	R W	0 - Alarm 1 - Contactor A 2 - Contactor B 3 - Start / Run	0 - alarm relay
0027	Output_C_Delay	R W	0 ... 120 Sec.	0 (no delay)

Setting Parameters (Cont'd)

Modbus Register	Parameter	Read/Write Supported	Range	Notes
0028	Config_Output_D	R W	0 - Trip 1 - Trip Fail Safe 2 - Contactor A 3 - Contactor B	0 - trip relay
0029	Output_D_Delay	R W	0 ... 120 Sec.	0 (no delay)
0030	Protection_Only	R W	0 ... 1 (No / Yes)	1 (Yes)
0031	Reserved			
0032	Reserved			
0033	U/V_Level	R W	50 ... 95 % of Rated	80 (% Rated)
0034	U/V_Delay	R W	2 ... 100 (* 0.1 Sec.)	50 (5 Sec)
0035	U/V_Start_Prevent	R W	50 ... 95 % of Rated	50 (% Rated)
0036	U/V_Auto_Restart	R W	0 / 1 (Disable / Enable)	0 (Disable)
0037	U/V_Restart_Delay	R W	2 ... 1200 (* 0.1 Sec)	40 (4 Sec)
0038	O/V_Level_1	R W	100 ... 120 (% of Rated)	115 (% Rated)
0039	O/V_Level_2	R W	100 ... 120 (% of Rated)	120 (% Rated)
0040	O/V_Level_2_Delay	R W	1 ... 100 Sec.	1 (Sec.)
0041	Max_Start_Time	R W	1 ... 250 Sec.	10 (Sec.)
0042	Number_Of_Starts	R W	1 ... 10	10
0043	Starts_Period	R W	1 ... 30 min.	30 (min.)
0044	Start_Inhibit	R W	1 ... 60 min.	15 (min.)
0045	U/C_Level_1	R W	10 ... 90 % of FLC	50 (% of FLC)
0046	U/C_Level_1_Delay	R W	1 ... 60 Sec.	2 (Sec.)
0047	U/C_Level_2	R W	10 ... 90 % of FLC	40 (% of FLC)
0048	U/C_Level_2_Delay	R W	1 ... 60 Sec.	5 (Sec.)
0049	Load_Increase	R W	60 ... 150 % of FLC	120 (% of FLC)
0050	O/C_Level_1	R W	10 ... 50 (* 10% FLC)	40 (4 FLC)
0051	O/C_Level_1_Delay	R W	5 ... 100 (* o.1 Sec.)	20 (2 Sec.)
0052	O/C_Level_2	R W	40 ... 120 (* 10% FLC)	80 (8 FLC)
0053	O/C_Level_2_Delay	R W	0 ... 40 (* o.1 Sec.)	5 (0.5 Sec.)
0054	Overload_Pickup	R W	60 ... 130 % of FLC	105 (% FLC)
0055	Thermal_Level_1	R W	50 ... 99 % thermal cap.	80 (% capacity)
0056	t6x_Time	R W	1 ...240 (* 0.5 Sec.)	20 (10 Sec.)
0057	Hot_Cold_Ratio	R W	20 ... 100 %	50 (%)
0058	Cool_Time_Factor	R W	1 ... 10	5
0059	Stall_Time_Factor	R W	20 ... 100 %	50 (%)
0060	Reserved			
0061	Reserved			
0062	Unbalanced_Level_2	R W	10 ... 40	15 (%)
0063	Unbal_Lev_2_Max_T	R W	20 ... 120 Sec.	30 (Sec.)

Setting Parameters (Cont'd)

Modbus Register	Parameter	Read/Write Supported	Range	Default
0064	Reserved			
0065	Rated_Pwr_Factor_at_FLC	R W	50 ... 99 (* 0.01)88 (0.88)	
0066	Under_Power_Level_1	R W	5 ... 99	45 (%)
0067	Under_Power_Level_1_Delay	R W	1 ... 120 Sec.	30 (Sec.)
0068	Under_Power_Level_2	R W	5 ... 99	25 (%)
0069	Under_Power_Level_2_Delay	R W	1 ... 120 Sec.	30 (Sec.)
0070	Low_Power_Factor	R W	20 ... 98 (PF * 100)	80 (0.8)
0071	Low_Power_Factor_Delay	R W	1 ... 120 Sec.	30 (Sec.)
0072	Reserved			
0073	Reserved			
0074	Reserved			
0075	Reserved			
0076	RTD_type	R W	0: Copper., 1: Pt100, 2:Ni120	1 (Pt100)
0077	RTD_1_Level_1	R W	0 ... 200 deg. C	120 deg. C
0078	RTD_1_Level_2	R W	0 ... 200 deg. C	140 deg. C
0079	RTD_2_Level_1	R W	0 ... 200 deg. C	120 deg. C
0080	RTD_2_Level_2	R W	0 ... 200 deg. C	140 deg. C
0081	RTD_3_Level_1	R W	0 ... 200 deg. C	120 deg. C
0082	RTD_3_Level_2	R W	0 ... 200 deg. C	140 deg. C
0083	RTD_4_Level_1	R W	0 ... 200 deg. C	120 deg. C
0084	RTD_4_Level_2	R W	0 ... 200 deg. C	140 deg. C
0085	RTD_5_Level_1	R W	0 ... 200 deg. C	120 deg. C
0086	RTD_5_Level_2	R W	0 ... 200 deg. C	140 deg. C
0087	RTD_6_Level_1	R W	0 ... 200 deg. C	120 deg. C
0088	RTD_6_Level_2	R W	0 ... 200 deg. C	140 deg. C
0089	RTD_7_Level_1	R W	0 ... 200 deg. C	80 deg. C
0090	RTD_7_Level_2	R W	0 ... 200 deg. C	100 deg. C
0091	RTD_8_Level_1	R W	0 ... 200 deg. C	80 deg. C
0092	RTD_8_Level_2	R W	0 ... 200 deg. C	100 deg. C
0093	RTD_9_Level_1	R W	0 ... 200 deg. C	80 deg. C
0094	RTD_9_Level_2	R W	0 ... 200 deg. C	100 deg. C
0095	RTD_10_Level_1	R W	0 ... 200 deg. C	80 deg. C
0096	RTD_10_Level_2	R W	0 ... 200 deg. C	100 deg. C

Setting Parameters (Cont'd)

For each of the following Setup parameters, every bit has a special function:

- d15 ... d8: Reserved
- d7: Trip
- d6: Alarm
- d5: Auto Reset
- d4: Panel Reset
- d3: Remote Reset
- d2 ... d0: Reserved

For each bit: 0 = Disabled, 1 = Enabled

Modbus Register	Parameter	Read/Write Supported	Range	Default
0097	Max_Start_Time_Setup	R W		58h
0098	Too_Many_Starts_Setup	R W		18h
0099	U/C_Level_1_Setup	R W		58h
0100	U/C_Level_2_Setup	R W		18h
0101	Load_Increased_Setup	R W		58h
0102	O/C_Level_1_Setup	R W		D8h
0103	O/C_Level_2_Setup	R W		D8h
0104	Thermal_Level_1_Setup	R W		58h
0105	Thermal_Level_2_Setup	R W		D8h
0106	Unbalance_Level_1_Setup	R W		58h
0107	Unbalance_Level_2_Setup	R W		D8h
0108	Undervoltage_Setup	R W		58h
0109	O/V_Level_1_Setup	R W		58h
0110	O/V_Level_2_Setup	R W		D8h
0111	Phase_Loss_Setup	R W		D8h
0112	Phase_Sequence_Setup	R W		F8h
0113	Gnd_Fault_Level_1_Setup	R W		58h
0114	Gnd_Fault_Level_2_Setup	R W		C0h
0115	Comm_Port_Failed_Setup	R W		38h
0116	Internal_Failure_Setup	R W		40h
0117	Control_Circuit_Open_Setup	R W		18h
0118	Welded _Cotactor_Setup	R W		18h
0119	External_Fault_1_Setup	R W		18h
0120	External_Fault_2_Setup	R W		18h
0121	External_Fault_3_Setup	R W		18h
0122	RTD_1_Level_1_Setup	R W		18h
0123	RTD_1_Level_2_Setup	R W		18h
0124	RTD_2_Level_1_Setup	R W		18h
0125	RTD_2_Level_2_Setup	R W		18h
0126	RTD_3_Level_1_Setup	R W		18h
0127	RTD_3_Level_2_Setup	R W		18h
0128	RTD_4_Level_1_Setup	R W		18h
0129	RTD_4_Level_2_Setup	R W		18h
0130	RTD_5_Level_1_Setup	R W		18h
0131	RTD_5_Level_2_Setup	R W		18h
0132	RTD_6_Level_1_Setup	R W		18h
0133	RTD_6_Level_2_Setup	R W		18h

Setting Parameters (cont'd)

Modbus Register	Parameter	Read/Write Supported	Range	Default
0134	RTD_7_Level_1_Setup	R W		18h
0135	RTD_7_Level_2_Setup	R W		18h
0136	RTD_8_Level_1_Setup	R W		18h
0137	RTD_8_Level_2_Setup	R W		18h
0138	RTD_9_Level_1_Setup	R W		18h
0139	RTD_9_Level_2_Setup	R W		18h
0140	RTD_10_Level_1_Setup	R W		18h
0141	RTD_10_Level_2_Setup	R W		18h
0142	Under_Pwr_Level_1_Setup	R W		18h
0143	Under_Pwr_Level_2_Setup	R W		18h
0144	Low_Power_Factor_Setup	R W		18h
0145	Reserved			
.				
.				
.				
0159	Reserved			

Notes:

1. Parameter # is "1-based." The address is one lower that the parameter #. For example, address of parameter #1 is 0 (40000).

2. For all Setpoints, it is important to use values within the listed limits.
   Care must be taken when Preset Single / Multiple Register Functions (06 / 16) are used to adjust one or more setting parameters. harmful results may occur by setting one or more parameters incorrectly or out of the specified range.

3. Preset of one setting parameter (using Function 06) can be done at any time.
   Preset of one or more setting parameters (using Function 16) can be performed only when the motor is stopped. Exception response (06 = Busy) is returned by the MPS if an attempt to write setting parameters is done while the motor is running (not stopped).

4. After storing setting parameters (using Function 16), it is prohibited to transmit again to the same MPS in less than one second.

5. Communication parameters 2 & 3 can only be read through the serial link. They can be preset only manually.

6. When internal DIP switch #2, located on the microcontroller board, is set the MPS is locked to protection only. In this case, parameter #29 (Protection_Only) is locked to "Yes" and cannot be changed through the serial link nor manually.

7. It is the user's responsibility to read and check all changed setting parameters after presetting.

8. It is never allowed to read more than 120 Setting Parameters together in one request.

Discrete Commands (Coils, 0x Registers)

The MPS incorporates 16 "Coils" (bit parameters) from which only four (4) are operative. The other 12 are reserved and are incorporated to enable using word (16 bit) type parameters. Coil number is "1 based." The actual address is one lower than the coil #. For example, coil #1 is addressed as 0 (00000). The coils have the following 0x references.

Modbus Register	Parameter	Read/Write Supported	Range	Default
0001	Coil 1, Stop	R W	Write "1" (ON) to Stop.	
0002	Coil 2, Start A	R W	Write "1" (ON) for Start A	
0003	Coil 3, Start B	R W	Write "1" (ON) for Start B	
0004	Reserved	R W		
0005	Reserved	R W		
0006	Reserved	R W		
0007	Reserved	R W		
0008	Coil 8, Reset		Write "1" (ON) to Reset	
0009	Reserved	R W		
0010	Reserved	R W		
0011	Reserved	R W		
0012	Reserved	R W		
0013	Reserved	R W		
0014	Reserved	R W		
0015	Reserved	R W		
0016	Reserved	R W		

Discrete Hardwired Inputs (1x Registers)

The MPS incorporates 32 Discrete Inputs (bit parameters) of which only 20 are operative. The other 12 are reserved and were included to enable using two word (16 bit) parameters. The input number is "1 based." The actual address is one lower than the input #. For example, input #1 is addressed as 0 (10000). Note that Input # 1 ... 20 are equal to the MPS Terminal (1 ... 20) status respectively. The inputs have the following 1x references.

Modbus Input	Parameter	Read/Write Supported	Range	Comment
0001	Input_1, Start A	R		Local Start A ("1" = start)
0002	Input_2, Start B	R		Local Start B ("1" = start)
0003	Input_3, Stop	R		("0" = stop)
0004	Input_4, Local/Remote	R		("0" = Local, "1" = Remote)
0005	Input_5, PLC/S.port	R		("0" = PLC, "1" = S.port)
0006	Input_6, PLC Reset	R		("1" = Reset)
0007	Input_7, PLC Strt/ Stp A	R		("0" = Stop, "1" = Start)
0008	Input_8, PLC Strt/ Stp B	R		("0" = Stop, "1" = Start)
0009	Input_9, Speed Sensor	R		("0" = High spd., "1" = Low spd.)
0010	Input_10, Interlock	R		("0" = Locked, "1" = Run enable)
0011	Input_11, Key	R		("0" = Locked, "1" = Unlocked)
0012	Input_12, Ext. Fault 1	R		("0" = Fault, "1" = Run enable)
0013	Input_13, Contactor A NC	R		("0" = Open, "1" = Closed)
0014	Input_14, Contactor A NO	R		("0" = Open, "1" = Closed)
0015	Input_15, Contactor B NC	R		("0" = Open, "1" = Closed)
0016	Input_16, Contactor B NO	R		("0" = Open, "1" = Closed)
0017	Input_17, Isolator NC	R		("0" = Open, "1" = Closed)
0018	Input_18, Isolator NO	R		("0" = Open, "1" = Closed)
0019	Input_19, Ext. Fault 2	R		("0" = Fault, "1" = Run enable)
0020	Input_20, Ext. Fault 3	R		("0" = Fault, "1" = Run enable)
0021	Reserved	R		
.				
.				
.				
0032	Reserved	R		

Notes:

1. In the Modbus Input list above, Closed input reads "1," open input reads "0."
2. Hardwired Inputs 1 ... 20 discussed here can also be analyzed from Actual Parameters #25, 26 and 27 (Control_In_1, Control_In_2 and Control_In_3). Note, however, that for the Contro_In_x parameters "0" indicated closed contact while here in this section "1" indicates closed contacts.