4511 MODBUS RTU

Configuration Manual

Universal I/f converter

No. 4222MCM100(1338)

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CONTENTS

INTRODUCTION

This configuration manual
contains the necessary information for configuring a PR 4222 device which is connected to a PR 4511 Modbus RTU enabler.

Modbus is a "master-slave" system,
where the "master" communicates with one or multiple "slaves".
The master typically is a PLC (Programmable Logic Controller), DCS (Distributed Control System), HMI (Human Machine Interface), RTU (Remote Terminal Unit) or PC.
The three most common Modbus versions used are: MODBUS ASCII, MODBUS RTU and MODBUS/TCP.
In Modbus RTU, data is coded in binary, and requires only one communication byte per data byte. This is ideal for use over multi-drop RS485 networks, at speeds up to 115,200 bps. The most common speeds are 9,600 bps and 19,200 bps.
Modbus RTU is the most widely used industrial protocol and is supported by the 4511.

MODBUS RTU:
To communicate with a slave device, the master sends a message containing:
Device Address - Function Code - Data - Error Check

The Device Address is a number from 0 to 247.
Messages sent to address 0 (broadcast messages) will be accepted by all slaves, but numbers 1-247 are addresses of specific devices. With the exception of broadcast messages, a slave device always responds to a Modbus message so the master knows the message was received.

4511 Supported Modbus Function Codes:

Command	Function code
Read Holding Registers	03
Read Input Registers	04
Write Single Register	06
Diagnostics	08
Write Multiple Registers	16

The Function Code defines the command that the slave device is to execute, such as read data, accept data, report status. Some function codes have sub-function codes.

The Data defines addresses in the device's memory map for read functions, contains data values to be written into the device's memory, or contains other information needed to carry out the function requested.

The Error Check is a 16-bit numeric value representing the Cyclic Redundancy Check (CRC).

Maximum number of registers which can be read or written at once:
For a read command, the limit is 8 registers at a baud rate up to 38,400 bps, 16 registers @ 57,800 bps and 32 registers @ 115,200 bps.
For a write command, the limit is 123 registers at baud rates up to 115,200 bps.

4511 Modbus parameter settings:
Automatic Baudrate Detection:	Yes - can be configured ON or OFF
Supported baudrates:	2400, 4800, 9600, **19.2k**, 38.4k, 57.6k, 115.2k bps
Parity Mode:	**Even**, Odd or None parity
Stop Bits:	**1** or 2 stop bits
Response delay:	0...1000 ms **(0 ms = default)**
Modbus slave addressing range:	1 - 247 **(247 = default address)**
Modbus Parameter Storage:	Saved in non-volatile memory in the 4511 device

(Factory Default Values are marked in **bold**)

Modbus RTU segment line termination:
A 120 Ohm resistor should be installed on both ends of a RS485 Modbus RTU segment loop to prevent signal echoes from corrupting data on the line.

4222 Modbus Configuration Parameter List

Category	Parameter Name	No.	Register Address	Register Size	Read/Write	Type	Description	Values
GENERAL	DEVICE NUMBER	0	0	1	RO	UNSIGNED INTEGER	Defines the actual device type	4222 = 16930 (0x4222)
GENERAL	DEVICE VERSION	1	1	1	RO	UNSIGNED INTEGER	Product version	0
GENERAL	PASSWORD	2	2	1	R/W	UNSIGNED INTEGER	Password for entering configuration menu	Range: 0...9999
INPUT	INPUT TYPE	3	3	1	R/W	UNSIGNED INTEGER	Selected input type (Voltage, Current, Resistance, Potentiometer, Temperature)	TEMP = 0 POTM = 1 LINR = 2 CURR = 3 VOLT = 4
INPUT	INPUT VOLTAGE RANGE	4	4	1	R/W	UNSIGNED INTEGER	Fixed input range for voltage measurements	0...1 V = 0 0.2...1 V = 1 0...2.5 V = 2 0.5...2.5 V = 3 0...5 V = 4 1...5 V = 5 0...10 V = 6 2...10 V = 7
INPUT	INPUT CURRENT RANGE	5	5	1	R/W	UNSIGNED INTEGER	Fixed input range for current measurements	0...20 mA = 0 4...20 mA = 1
INPUT	CONNECTION TYPE	6	6	1	R/W	UNSIGNED INTEGER	Sensor connection type for RTD / resistance measurements	2-wire = 0 3-wire = 1 4-wire = 2
INPUT	LIN RES LOW	7	7	1	R/W	UNSIGNED INTEGER	Input range low for Linear resistance measurements	Range: 0...9998
INPUT	LIN RES HIGH	8	8	1	R/W	UNSIGNED INTEGER	Input range high for Linear resistance measurements.	Range: 1...9999
INPUT	TEMP UNIT	9	9	1	R/W	UNSIGNED INTEGER	Temperature units	°C = 0 °F = 1
INPUT	TEMP SENSOR TYPE	10	10	1	R/W	UNSIGNED INTEGER	Temperature sensor type	TC = 0 Ni = 1 Pt = 2
INPUT	PT TYPE	11	11	1	R/W	UNSIGNED INTEGER	Pt value (Pt10, Pt20, Pt50...)	Pt10 = 0 Pt20 = 1 Pt50 = 2 Pt100 = 3 Pt200 = 4 Pt250 = 5 Pt300 = 6 Pt400 = 7 Pt500 = 8 Pt1000 = 9
INPUT	NI TYPE	12	12	1	R/W	UNSIGNED INTEGER	Ni value (Ni50, Ni100...)	Ni50 = 0 Ni100 = 1 Ni120 = 2 Ni1000 = 3
INPUT	TC TYPE	13	13	1	R/W	UNSIGNED INTEGER	Thermocouple type (TCB, TCK...)	TC type B = 0 TC type E = 1 TC type J = 2 TC type K = 3 TC type L = 4 TC type N = 5 TC type R = 6 TC type S = 7 TC type T = 8 TC type U = 9 TC type W3 = 10 TC type W5 = 11 TC type Lr = 12
DISPLAY	DISPLAY UNIT	14	14	1	R/W	UNSIGNED INTEGER	Units shown as display units for non-temperature input types	acc. to table 1
DISPLAY	DECIMAL POINT	15	15	1	R/W	UNSIGNED INTEGER	Decimal point place for display reading of non-temperature input types	XXXX = 0 X.XXX = 1 XX.XX = 2 XXX.X = 3
DISPLAY	DISPLAY LOW	16	16	1	R/W	INTEGER	Low display range for display reading of non-temperature input types.	Range: -1999...9999
DISPLAY	DISPLAY HIGH	17	17	1	R/W	INTEGER	High display range for display reading of non-temperature input types	Range: -1999...9999
OUTPUT	OUTPUT TYPE	18	18	1	R/W	UNSIGNED INTEGER	**Output type:** Programmable pulse is available for: Frequency < 500 Hz Pulses < 30,000 p/m < 1,800,000 p/hour < 43,200,000 p/day	DC 50% = 0 Prog Pulse = 1
OUTPUT	OUTPUT UNIT	19	19	1	R/W	UNSIGNED INTEGER	Output unit	Hz = 0 p/min = 1 p/hour = 2 p/day = 3

4

OUTPUT	FREQUENCY LOW / PULSE LOW	20	20	2	R/W	UNSIGNED INTEGER	Frequency output low value in mHz or 1/1000nds of pulses per min./hour/day	Range with frequency selected: 0...25000000 Range with p/min. selected: 60...30000000 Range with p/hour selected: 3600...30000000 Range with p/day selected: 86400...30000000
OUTPUT	FREQUENCY HIGH / PULSE HIGH	21	22	2	R/W	UNSIGNED INTEGER	Frequency output high value in mHz or 1/1000nds of pulses per min./hour/day	Range with frequency selected: 0...25000000 Range with p/min. selected: 60...30000000 Range with p/hour selected: 3600...30000000 Range with p/day selected: 86400...30000000
OUTPUT	CUTOFF FREQUENCY / PULSE	22	24	2	R/W	UNSIGNED INTEGER	Cutoff frequency in mHz or 1/1000nds of pulses per min./hour/day	Range with frequency selected: 0...25000000 Range with p/min. selected: 60...30000000 Range with p/hour selected: 3600...30000000 Range with p/day selected: 86400...30000000
OUTPUT	PULSE TIME	23	26	1	R/W	UNSIGNED INTEGER	Pulse length in ms, must be set less than 0.9 x (1 / Fmax)	Range: 1...1000
OUTPUT	INDICATE ERROR	24	27	1	R/W	UNSIGNED INTEGER	Use a specific frequency to indicate errors	NO = 0 YES = 1
OUTPUT	ERROR FREQUENCY	25	28	2	R/W	UNSIGNED INTEGER	Frequency to indicate an error in mHz or 1/1000nds of pulses per min./hour/day	Range with frequency selected: 0...26250000 Range with pulse selected: 0...31500000
OUTPUT	RESPONE TIME	26	30	1	R/W	UNSIGNED INTEGER	Response time in 1/10 s	Range for non-temperature inputs: 4...600 (0.4...60 s) Range for temperature inputs: 10...600 (1...60 s)
OUTPUT	OUTPUT LOW	27	31	2	R/W	INTEGER	Specific output value low. Dependant of selected input. For temperature types value is 1/10°.	Range equals the measurement range for the selected sensor type and must be lower than OUTPUT HIGH
OUTPUT	OUTPUT HIGH	28	33	2	R/W	INTEGER	Specific output value high. Dependant of selected input. For temperature types value is 1/10°.	Range equals the measurement range for the selected sensor type and must be higher than OUTPUT LOW
DISPLAY	DISPLAY CONTRAST	29	35	1	R/W	UNSIGNED INTEGER	Contrast in the LCD display	Range: 0...9
DISPLAY	DISPLAY BACKLIGHT	30	36	1	R/W	UNSIGNED INTEGER	Backlight intensity in LCD	Range: 0...9
DISPLAY	TAG TEXT	31	37	3	R/W	ASCII CHAR	Tag of the device (6 characters)	Range: ASCII values from 32 to 90 (' ' to 'Z').
DISPLAY	LINE 3 FUNCTION	32	40	1	R/W	UNSIGNED INTEGER	Information shown in line 3 of display in monitor mode (normal mode). Choose between the output frequency value or the configured tag.	Output value = 0 TAG = 1
INPUT	USE CALIB	33	41	1	R/W	UNSIGNED INTEGER	Use the applied calibration values	NO = 0 YES = 1
GENERAL	ENABLE PASSWORD	34	42	1	R/W	UNSIGNED INTEGER	Password protect entry to configuration menu	NO = 0 YES = 1
INPUT	CALIB RANGE LOW	35	43	2	R/W	FLOAT	Actual process value for low calibration point in either display values or 1/10 °C	For non-temperature input types range is DISPLAY LOW...DISPLAY HIGH For temperature input types the range equals the measurement range for the selected sensor type
INPUT	CALIB RANGE HIGH	36	45	2	R/W	FLOAT	Actual process value for high calibration point in either display values or 1/10 °C	As CALIB RANGE LOW
INPUT	CALIB POINT LOW	37	47	2	R/W	FLOAT	Measured process value for low calibration point in either display values or 1/10 °C. (Must be copied from PROCESS DATA)	As CALIB RANGE LOW
INPUT	CALIB POINT HIGH	38	49	2	R/W	FLOAT	Measured process value for high calibration point in either display values or 1/10 °C (Must be copied from PROCESS DATA)	As CALIB RANGE LOW
GENERAL	HELP TEXT LANGUAGE	39	53	1	R/W	UNSIGNED INTEGER	Language for the help texts shown in display	UK = 0 DK = 1 DE = 2 FR = 3 SE = 4 IT = 5 ES = 6
GENERAL	CHECKSUM	100	100	1	RO	UNSIGNED INTEGER	CRC16 checksum of the configuration	Range 0...65536
GENERAL	Configuration counter	101	101	1	R0	UNSIGNED INTEGER	This counter will count the number of times the configuration has been changed. The counter is reset on power-up	Range 0...65536

Table 1: Display units

0	°C	10	mils	20	in/s	30	kHz	40	MPa	50	GW	60	mV	70	gal/h
1	°F	11	yd	21	ips	31	Hz	41	kPa	51	MW	61	Ω	71	t/h
2	K	12	m^3	22	ft/s	32	p/min	42	hPa	52	kW	62	S	72	mol
3	%	13	L	23	in/min	33	p/h	43	bar	53	hp	63	µS	73	pH
4	m	14	s	24	ft/min	34	p/day	44	mbar	54	A	64	m^3/min	74	[blank]
5	cm	15	min	25	in/h	35	t	45	kJ	55	kA	65	m^3/h		
6	mm	16	m/s	26	ft/h	36	kg	46	Wh	56	mA	66	l/s		
7	µm	17	mm/s	27	m/s^2	37	g	47	MWh	57	µA	67	l/min		
8	Ft	18	m/min	28	mm/s^2	38	N	48	kWh	58	V	68	l/h		
9	in	19	m/h	29	rpm	39	Pa	49	W	59	kV	69	gal/min		

4222 Input Types and Ranges

Input type	Min. value	Max. value	Standard
mA	0 mA	20 mA	-
V	0 V	10 V	-
Pt10...Pt1000	-200°C	+850°C	IEC 60751
Ni50...Ni1000	-200°C	+250°C	DIN 43760
Lin. R	0 Ω	10000 Ω	-
Potentiometer	10 Ω	100 kΩ	-
TC B	0°C	+1820°C	IEC 60584-1
TC E	-100°C	+1000°C	IEC 60584-1
TC J	-100°C	+1200°C	IEC 60584-1
TC K	-180°C	+1372°C	IEC 60584-1
TC L	-200°C	+900°C	DIN 43710
TC N	-180°C	+1300°C	IEC 60584-1
TC R	-50°C	+1760°C	IEC 60584-1
TC S	-50°C	+1760°C	IEC 60584-1
TC T	-200°C	+400°C	IEC 60584-1
TC U	-200°C	+600°C	DIN 43710
TC W3	0°C	+2300°C	ASTM E988-90
TC W5	0°C	+2300°C	ASTM E988-90
TC LR	-200°C	+800°C	GOST 3044-84

4222 Modbus Process Parameter List

Parameter Name	No.	Register Address	Register Size	Read/ Write	Type	Description	Values
DISPLAY VALUE	0	1000	2	RO	INTEGER	The measured value in 1/10 of °C/°F for temperature Input types, or the scaled display value for non-temperature input types (INTEGER version of PRIMARY VALUE)	**Range for non-temperature input types:** DISPLAY LOW...DISPLAY HIGH **Range for temperature input types:** equals the measurement range for the selected sensor type
PERCENT PV	1	1002	1	RO	INTEGER	The relative input value as 1/100 of % calculated from PRIMARY VALUE. For temperature input types 0...100% corresponds the selected temperature range (OUTPUT LOW...OUTPUT HIGH) For non-temperature input types 0...100% corresponds the selected fixed range (e.g. 4...20 mA)	Range: 0...9999 (e.g. 7898 = 78.98%)
MEASURE STATUS	2	1003	1	RO	INTEGER	The actual measurement status	OUTPUT UNDERRANGE: bit 0=1 OUTPUT OVERRANGE: bit 1= 1 OUTPUT LOW LINITED: bit 2= 1 OUTPUT HIGH LIMITED: bit 3= 1 INPUT UNDERRANGE: bit 4= 1 INPUT OVERRANGE: bit 5= 1 SENSOR SHORTED: bit 6= 1 SENSOR BROKEN: bit 7= 1
ERROR STATUS	3	1004	1	RO	INTEGER	The actual error status (Device errors)	AD COMM. ERROR bit 0= 1 CJC ERROR bit 1= 1 RAM ERROR bit 2= 1 EEP ERROR bit 3= 1 FLASH ERROR bit 4= 1 NOT CALIBRATED bit 5= 1 BAD OUTPUT bit 6= 1 NO OUTPUT bit 7= 1 OUTPUT SUPPLY ERROR bit 8= 1 INPUT SUPPLY ERROR bit 9= 1
PRIMARY RAW VALUE	5	1005	2	RO	FLOAT	The measured value in 1/10 of °C/°F for temperature Input types, or the scaled display value for non-temperature input types, NOT PROCESS CALIBRATED.	Range for non-temperature input types: DISPLAY LOW...DISPLAY HIGH Range for temperature input types equals the measurement range for the selected sensor type
PRIMARY VALUE	6	1007	2	R/W	FLOAT	The measured value in 1/10 of °C/°F for temperature Input types, or the scaled display value for non-temperature input types	Range for non-temperature input types: DISPLAY LOW...DISPLAY HIGH Range for temperature input types equals the measurement range for the selected sensor type
RELATIVE PV	7	1009	2	RO	FLOAT	The relative input value calculated from PRIMARY VALUE. For temperature input types relative to selected temperature range (OUTPUT LOW...OUTPUT HIGH) For non-temperarure input types relative to selected fixed range (e.g. 4...20 mA)	Range: 0.0...1.0
OUTPUT FREQUENCY	8	1011	2	R/W	FLOAT	Calculated output value in mHz or 1/1000nds of pulses per min./hour/day	**Range with frequency selected:** 0...25000000 (0...25000 Hz) **Range with pulse selected:** 0...30000000
MEASURE CONTROL	9	1013	1	R/W	INTEGER	Measurement control. By disabling update of certain READ/WRITE parameters PRIMARY VALUE, OUTPUT VALUE or RELAY STATUS, these can be simulated by writing values. All bits are cleared when TIMEOUT COUNTER reaches 0	RESTART SCAN bit 0 = 1 RESTART WITH NEW CONFIGURATION bit 1 = 1 DISABLE PRIMARY VALUE UPDATE bit 2 = 1 DISABLE OUTPUT VALUE UPDATE bit 3 = 1 NOT USED bit 4 = 1 DISABLE CONFIGURATION CHECK bit 5 = 1 GET NEW CONFIGURATION bit 6 = 1
TIMEOUT COUNTER	10	1014	1	R/W	INTEGER	Time out counter, decrements every 0.075 second. When reaching 0 (if not refreshed) all bits in MEASURE CONTROL will be cleared.	Range: 0...255
INTERNAL TEMPERATURE	11	1015	1	RO	INTEGER	Internal measured or connector temperature in 1/10 of °C/°F	Range: -200...800 (-20.0...80.0 °C) or -40...1760 (-4.0...176.0 °F)

4511 Modbus Configuration Parameter List

Parameter Name	No.	Register Address	Register Size	Read/ Write	Type	Description	Values	
ENABLE MODBUS	1	3000	1	R/W	INTEGER	Enable Modbus communication. If disabled, 4511 ignores all frames sent from the Modbus master and the only way to re-enable Modbus communication is by using the 4511 menu.	NO YES	= 0 = 1
BAUDRATE	2	3001	1	R/W	INTEGER	The baud value used for Modbus communication	2400 BAUD 4800 BAUD 9600 BAUD 19200 BAUD 38400 BAUD 57600 BAUD 115200 BAUD	= 0 = 1 = 2 = 3 = 4 = 5 = 6
ENABLE AUTOBAUD	3	3002	1	R/W	INTEGER	Enable automatic baudrate detection. If enabled, 4511 determines the baudrate automatically by listening to frames sent on the Modbus line.	NO YES	= 0 = 1
PARITY	4	3003	1	R/W	INTEGER	Configures parity check on Modbus frames	NONE EVEN PARITY ODD PARITY	= 0 = 1 = 2
STOPBITS	5	3004	1	R/W	INTEGER	Configures the number of stopbits in Modbus frames	ONE STOPBIT TWO STOPBITS	= 1 = 2
ADDRESS	6	3005	1	R/W	INTEGER	Configures the Modbus address of the 4511 (Address 0 is broadcast address)	Range: 1...247	
RESPONSE DELAY	7	3006	1	R/W	INTEGER	Configures minimum delay for Modbus response in ms	Range: 0...1000	

4511 Modbus Status Parameter List

Parameter Name	No.	Register Address	Register Size	Read/ Write	Type	Description	Values	
AUTOBAUD STATUS	1	4000	1	RO	INTEGER	Actual state of automatic baudrate detection	2400 BAUD 4800 BAUD 9600 BAUD 19200 BAUD 38400 BAUD 57600 BAUD 115200 BAUD SEARCHING ERROR	= 0 = 1 = 2 = 3 = 4 = 5 = 6 = 7 = 8
IDENTIFY DEVICE	2	4001	1	R/W	INTEGER	Enables the device to flash the LCD background with appr. 4 Hz. **Value will automatically return to NO if not written within 10 seconds!**	NO YES	= 0 = 1
MAXIMUM READ REGISTERS	3	4002	1	RO	INTEGER	Maximum allowed number of registers that can be read in one command, with the given/detected baudrate	Range:	8...32

4511 Modbus Front Programming Parameter Menu

Scrolling HELP TEXTS:

[1]   Set correct password
[2]   Enter advanced setup menu
[3]   Perform memory operations
       Enter display setup
       Perform process calibration
       Enter simulation setup
       Enter password setup
       Enter language setup
       Enter rail setup (System 9000)
       Enter Modbus setup
[4]   Check automatic baudrate detection status
       Enable Modbus communication
       Disable Modbus communication
[5]   Reset Modbus to default
[6]   Select Modbus slave address
[7]   Select parity for Modbus
[8]   Select number of stop bits
[9]   Select response delay in ms
[10]   Enable automatic baudrate detection
[11]   Searching for Modbus baudrate
       Modbus baudrate detected
       Modbus baudrate not detected
[12]   Select baudrate in bps

Please note:
If no keys are activated for 1 minute, the 4511 display will return to the "Monitor" view without saving.
The display will aslo return to "Monitor" upon successful Modbus write command!

The grayed-out menus and texts are only shown for guidance and are not a part of the 4511 specific submenu.
The Modbus submenu is located in the Advanced Setting menu structure of any host device using the 4511.
The actual placement is defined for each particular device.

* 1) Only if automatic baudrate detection is enabled