

Application Note

MPiec Controllers Communicating Serially with VFDs





Doc#: AN.MPIEC.06



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Application Overview:

This application note describes how to configure and program an MPiec controller to communicate with multiple VFDs serially. The configuration includes a Moxa MGate MB3170 module which converts Modbus TCP to Modbus RTU. The MPiec controller is a Modbus client in this configuration. The MOXA MB3170 module is configured for RS-485 2-wire.

Application Highlights:

- Yaskawa VFDs support serial communication without adding an option card. The Moxa MGate MB3170 converter converts Modbus TCP messages from the MPiec controller to Modbus RTU messages with a unique Device ID.
- 2. One MB 3170 converter can support RS-485 multidrop communication for up to 31 serial devices.
- 3. All VFD parameters and I/O can be accessed from the MPiec controller using this approach.

Products Used:

Component	Product and Model Number
Controller	MPiec
Software	MotionWorks IEC
VFD	A1000, V1000
Third Party Devices	Moxa MGate MB3170 Modbus TCP to RTU converter





Implementation:

1. Configure the MPiec Controller as a Modbus Client (Master)

Launch the MotionWorks IEC Hardware Configuration. Add a new Modbus Device for each serial connection on the RS-485 network.



Figure 1: Adding a new Modbus slave device

Add the Modbus slave devices in the Hardware Configurator. The IP address field is referring to the address of the Moxa MB3170 converter. Assign a unique status variable and unit identifier for each slave on the network.

Add ModbusTCP Dev	ice 🔰	
Name IP Address	Modbus Slave	IP address of Moxa converter
Status Variable Task	s1 MedTsk	
Update Interval (ms)	50	<u>Unique</u> unit identifier of slave
Comment	[]	
	Add Cancel	





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Figure 3 illustrates the Hardware Configuration with an A1000 with Unit ID 1 and a V1000 with Unit ID 2 which will be accessible via the Moxa MB3170 converter at IP address 192.168.207.244.

Moxa_Test_2013_1210 MyMachine MyMachine Mechatrolink-II Groups TCP/IP Settings FtherNet/IP Modbus/TCP Moxa_V1000 GMoxa_A1000 [Slot_1]	Configure Control	troller as a Modbus Ste Iding Registers Dutput Modbus Inputs nment <u>FastTsk</u> Iler as Modbus Master Devices	3 ve \$	Dutput state when PLC stops:	Specil 60	y Activity Timeout (1s-655 (s)	5356)
	Name	IP Address	Tack	[Indate Interval (ms)	Lloit	Status Variable	Comment
	Mova A1000	192 168 207 244	MedTok	50	OTIK	1 A1000 Stat	Contrient
	Mova_X1000	192 169 207 244	MadTek	50		2 V1000_Stat	
	inond_+rood	102.100.201.244	Modiful	30		2 11000_0101	

Figure 3: Two VFD slaves at ID 1 and 2

The configuration shown below explains how to add two Modbus data blocks (with two registers each) for each slave device. Select the Modbus slave from the device tree and add Modbus data blocks. In Figure 4, a snapshot of two data blocks created for the A1000 is shown. %IB43008 to %IB430011 is the MPiec memory to which 2 modbus registers (number of items = 2) starting at address 1H (starting address = 2) on the A1000 will be read using function code 03. %QB43008 to %QB430011 is the MPiec memory from where data will be written to 2 modbus registers (number of items = 2) starting at address 1H (starting address = 2) on the A1000 using function code 16.

Moxa_Test_2013_1210 MyMachine Mechatrolink-II TCP/IP Settings	Data Blocks				
-n [®] EtherNet/IP	1/O Group Function Code	Starting Address	Local Start Address	Local End Address	Comment
B Modbus/TCP	A Read 03 - Read Holding Regis	e 2	43008	43011	
- Moxa_V1000	A_Write 16 - Write Multiple Regis	e 2	43008	43011	
	Function Code Local Address R Start % End % Number Of Ite	03 - Read Holdi ance B 43008 B 43011 ms 2	ng Registers 🔹		
	Starting Address	2	 Correspon 	ds to address 1	LH on A1

Figure 4: Modbus data blocks for the A1000

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%IB43014 to %IB430017 is the MPiec memory to which 2 modbus registers (number of items = 2) starting at address 1H (starting address = 2) on the V1000 will be read using function code 03. %QB43012 to %QB430015 is the MPiec memory from where data will be written to 2 modbus registers (number of items = 2) starting at address 1H (starting address = 2) on the V1000 using function code 16.



Figure 5: Modbus data blocks for the V1000

Save the Hardware Configuration. The map between the MPiec memory and the Modbus registers on the two slaves under the configuration described above can be seen in the table in figure 6. Cycle power to the MPiec controller to make sure that the configuration takes effect in the MPiec.



MPiec Memory	Function Code	Slave Register
%IB43008 %IB43009	FC 03	1H on A1000
%IB43010 %IB43011	FC 03	2H on A1000
%IB43012 %IB43013	Status of A1000	
%IB43014 %IB43015	FC 03	1H on V1000
%IB43016 %IB43017	FC 03	2H on V1000
%IB43018 %IB43019	Status of V1000	
%QB43008 %QB43009	FC 16	1H on A1000
%QB43010 %QB43011	FC 16	2H on A1000
%QB43012 %QB43013	FC 16	1H on V1000
%QB43014 %QB43015	FC 16	2H on V1000

Figure 6: Memory map on the different devices

The complete Modbus data table for A1000 drives can be accessed from section C9 (of the A1000 technical manual) at the location shown below:

http://www.yaskawa.com/site/dmdrive.nsf/SearchV/86256EC30069E43286257704005947B8?OpenDocume nt&Source=SearchResultPage





The complete Modbus data table for V1000 drives can be accessed from section C10 (of the V1000 technical manual) at the location shown below:

http://www.yaskawa.com/site/dmdrive.nsf/SearchV/86256EC30069E432862574CE0056C4C2?OpenDocum ent&Source=SearchResultPage

A maximum of 16 registers on the VFDs can be read out at a time. The registers also have to be contiguous. Therefore if the user wants to read the status of inputs and write outputs on the A1000 drive, additional read and write data blocks will have to be added to the hardware configuration as shown in figures 7 and 8.

Data Blocks					
I/O Group	Function Code	Starting Address	Local Start Address	Local End Address	Comment
A_Read	03 - Read Holding Registers	2	43008	43011	1
A_Write	16 - Write Multiple Registers	2	43008	43011	1
A_Input	03 - Read Holding Registers	74	43020	43021	1 Read digital inputs
A_Out	16 - Write Multiple Registers	10	43016	43019	9 Write digital output
		Modify Mod	bus Data Block Code Code tatt %IB 43020 r Of Items 1 ddress 74	Holding Registers	Corresponds to address 49H on A1000
		Comment	Read digita	al inputs	

Figure 7: Configuring read data block for digital inputs

ta Blocks							
I/O Group	Function Code		Starting Address	Local Start Address	Local End Address	Comment	
A_Read	03 - Read Hold	ing Registers	2	43008	43011		
A_Write	16 - Write Multi	ple Registers	2	43008	43011		
A_Input	03 - Read Hold	ing Registers	74	43020	43021	Read digital inputs	
A_Out	16 - Write Multi	ple Registers	10	43016	43019	Write digital output	
		I/O Group Function Co Local Addre Start End Number C Starting Add Comment	A.O.Y. 16 - Wrte ss Rance * %QB 43016 %QB 43019 if kems 2 10 Wrte digit	: Multiple Registers	Corres	oonds to addre	ss 9H on A100(

Figure 8: Configuring write data blocks for digital outputs

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2. Configuring the Moxa MB 3170 Converter

The MB 3170 can be accessed using a web browser or Moxa's MGate Manager Configuration software. The various settings on the MB3170 are shown in figures 7 through 11.

MOX	∧° т	Total Solution for Industrial Device Networking				
Model Name	- MGate MB3170 - MG-MB3170_3714			IP Serial NO.	- 192.168.207.244 - 3714	
- Main Menu Overview - Basic Settings	:- Me	odbus Opera	ation Mode			
Mode	Port		Mode			
Network		1	RTU Slave	-		
Serial	ProCOM		Enable			
Advanced Settings		2	RTU Slave	-		
Modbus		3	RTU Slave	~		
- Priority Control		4	RTU Slave	~		
Accessible IP List		5	RTU Slave	~		
SNMP						
Miscellaneous					Activate	
- Maintenance Settings						
Firmware Upgrade						

Figure 7: Modbus Operation Mode

- Main Menu		
Overview	Network Parameters	
- Basic Settings		
Mode	Network Settings	
Network	Name	MG-MB3170_3714
Serial	IP configuration	Static 👻
Slave ID	IP address	192 168 207 244
- Advanced Settings	Network S	132.100.207.244
Modbus	Netmask	255.255.255.0
- Priority Control	Gateway	192.168.207.253
Accessible IP List	DNS1	0.0.0.0
SNMP	DNS2	0.0.0
Miscellaneous		
- Maintenance Settings		Activate
Firmware Upgrade		_

Figure 8: Network Parameters

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Overview	Serial P	Serial Parameters								
- Basic Settings										
Mode	Port	Baud rate	Parity	Data bit	Stop bit	Flow control	FIFO	Interface	RTS on delay	RTS off delay
Network	1	9600 👻	None 👻	8 -	1 -	None -	Disable -	RS-485 2-wire -	0	0
Serial										
Slave ID										
- Advanced Settings										

Figure 9: Serial Parameters

Main Manu					
- Main Menu	S	ave ID Map			
Overview					
- Basic Settings					
Mode		Slave ID Table			
Network		Channel No	Type	Definition	Slave ID Range (Virtual<->Real)
Serial		01	Modbus Serial	PORT1	001 - 002 <-> 001 - 002
Slave ID		01	Modbus Gena	PORT	001-002 <> 001-002
- Advanced Settings				Remove Modify	
- Maintenance Settings		Add New TCD Class			
Firmware Upgrade		Add New TCP Slave			
Configuration Import		Remote IP address			
Configuration Export		TCP Port		502 (Default: 502)	
Load Factory Default		Slave ID Start			
Change Password		Slave ID End			
Restart		Slave ID Offset			
				Add	

Figure 10: Slave ID map

- Main Menu	Modbuo Paramotoro	
Overview	Moubus Parameters	
- Basic Settings		
Mode	Modbusd Settings	
Network	Initial Delay	0 (0.30000ma Dafault: 0ma)
Serial	Madhur TCD Everyfian	
Slave ID	Modulus TCP Exception	M Enable
- Advanced Settings	Response Time-out	
Modbus		Response Time-out (10-120000ms, Default:1000ms)
- Priority Control	Port1	3000
Accessible IP List	TCP/ProCOM	1000
SNMP	Interval Time out	
Miscellaneous	interval Time-out	
- Maintenance Settings		Inter-character Time-out (10-500ms, Default: 0ms)
Firmware Upgrade	Port1	0
Configuration Import		Inter-frame Delay (10-500ms, Default: 0ms)
Configuration Export	Port1	0
Load Factory Default		
Change Password		Activate
Restart		

Figure 11: Modbus Parameters



3. Configuring the VFDs

Ensure that the VFDs are wired correctly for RS-485 communication. Follow guidelines from the A1000 / V1000 user's manual for correct wiring.

RS-485 Interface



Figure 12: RS-485 connections for 2-wire communication



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To configure the VFDs to accept frequency reference and run commands via Modbus communication, set VFD parameter b1-01 and b1-02 to a value of 2.

The other parameters that must be set to configure the VFD to respond to Modbus messages are:

- H5-01: Slave ID (Set for 1 for A1000 and 2 for V1000 in our example)
- H5-02: Communication speed selection (set to 3 representing 9600 bps)
- H5-03: Communication parity selection (set to 0 for no parity)
- H5-07: RTS control selection (set to 1 to enable multidrop communication)

	_					
Parameter Groups A1000 A Initialization		Oveniew	Export E-Mail			
B:Application C:Tuning D:Instructions E:Motor Parameter		Click Preview to review p	Phint Edit Parameter			
F:Option		L .		Parameter Groups		
H:Terminal Function Selection L:Protection Function Selection N:Special Adjustment O:Operator Relation		Parameter Groups	s A1000			
		No.	Parameter	Working Value	Info (Working Value)	Default
		b1-01	Reference selection	2	Memobus communication	1
Q:DWEZ Parameter		b1-02	Operation method selection	2	Memobus communication	1
KConnection Juta Modified Parameters Monitors A1000		H2-01	Terminal M1/M2 Selection	000F	Not used	0000
		H2-02	Terminal M3/M4 Selection	000F	Not used	0001
		H2-03	Terminal M5/M6 Selection	000F	Not used	0002
		H5-01	Station address	01		1F
		H5-04	Serial fault selection	1	Coast to Stop	3
		H5-05	CE Detection Selection	0	Disabled	1

Figure 13: Modified Parameters on the A1000 when successfully communicating with an MPiec controller

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Default
1
1
as a pass-through mode.) 000E
as a pass-through mode.) 0000
as a pass-through mode.) 0002
1F
3
1
e it e it

Figure 14: Modified Parameters on the V1000 when successfully communicating with an MPiec controller



4. Programming in MotionWorks IEC

After configuring the MPiec controller, the Moxa converter and the VFDs, the user will have to populate the MotionWorks IEC editor with Modbus variables. All variables that will be used in the project will have to be added in the global variables table. The Modbus groups will be ready for the user to populate. Data type and variable address are fields that the user should take care in entering correctly.

		-					
_ ⊟ <moxa_a1000> 'iA_Read</moxa_a1000>	l' Address Range: %l	B43008 - %IB4301	1 (* Do Not Modify Group Name or Status Variable. *)				
A1000_RunStatus	BOOL	VAR_GLOB		%IX43008.0			
A1000_FreqMonitor	WORD	VAR_GLOB		%IW43010			
A1000_Stat	WORD	VAR_GLOB	(* Do Not Modify. *) Modbus Slave Status Variable	%IW43012			
🖂 <moxa_a1000> 'oA_Writ</moxa_a1000>	S < Moxa_A1000> 'oA_Write' Address Range: %QB43008 - %QB43011 (* Do Not Modify Group Name or Status Variable. *)						
A1000_RunCommand	BOOL	VAR_GLOB	Run FWD (1H bit 0)	%QX43008.0			
A1000_FreqCommand	WORD	VAR_GLOB	2H	%QW43010			
🖂 <moxa_v1000> 'iV_Read</moxa_v1000>	l' Address Range: %l	B43014 - %IB4301	7 (* Do Not Modify Group Name or Status Variable. *)				
V1000_RunStatus	BOOL	VAR_GLOB		%IX43014.0			
V1000_FreqMonitor	WORD	VAR_GLOB		%IW43016			
V1000_Stat	WORD	VAR_GLOB	(* Do Not Modify. *) Modbus Slave Status Variable	%IW43018			
□ <moxa_v1000> 'oV_Writ</moxa_v1000>	te' Address Range: %	6QB43012 - %QB43	3015 (* Do Not Modify Group Name or Status Variable. *)				
V1000_RunCommand	BOOL	VAR_GLOB		%QX43012.0			
V1000_FreqCommand	WORD	VAR_GLOB		%QW43014			
🗆 User Variables							
🖂 <moxa_a1000> 'iA_Input</moxa_a1000>	t' Address Range: %I	B43020 - %IB4302	1 (* Do Not Modify Group Name or Status Variable. *)				
Input0	BOOL	VAR_GLOB		%IX43020.0			
Input1	BOOL	VAR_GLOB		%IX43020.1			
Input2	BOOL	VAR_GLOB		%IX43020.2			
Input3	BOOL	VAR_GLOB		%IX43020.3			
Input4	BOOL	VAR_GLOB		%IX43020.4			
Input5	BOOL	VAR_GLOB		%IX43020.5			
Input6	BOOL	VAR_GLOB		%IX43020.6			
Input7	BOOL	VAR_GLOB		%IX43020.7			
Moxa_A1000> 'oA_Out'	Address Range: %Q	B43016 - %QB430	19 (* Do Not Modify Group Name or Status Variable. *)				
Output0	BOOL	VAR_GLOB		%QX43016.0			
Output1	BOOL	VAR_GLOB		%QX43016.1			
Output2	BOOL	VAR_GLOB		%QX43016.2			

Figure 15: Global variables table in MotionWorks IEC

Once variables are added, the user can start coding in POUs. An example of setting up frequency command and run command are shown in figure 16.

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Figure 16: Programming example

