

How to...

*... set up Modbus TCP/IP communication between
Altivar Process & M221*

06/2015

GOAL:

Being able to set up communication between a M221 controller and a Altivar Process using Modbus TCP/IP. With this communication you should be able to control the Start / Stop of the Altivar Process and send a speed set point.

BEFORE STARTING

This manual assumes you already have basic knowledge of the SoMachine Basic software, knowing how to add variables, how to make a connection to a PLC and perform a download. If not, please refer to the documentation of the workshop of the M221 Controller.

Setting up communication between an Altivar Process and a M221 controller to control its speed and command, it is important to understand that in perspective of the M221 controller, there will be 2 variables that will be sent and 2 variables that will be received.

RECEIVE / READ	Status of Altivar (in run, fault,...) Frequency feedback (what is the frequency output of the Altivar)
SEND / WRITE	Command to the Altivar (Start / Stop, reset fault,...) Frequency set point (the desired frequency)

Setting up communication between a PLC and the Altivar Process can be done in 2 methods.

Method 1 is directly addressing the registers of the drive. The PLC will read and write the Status Word and Command Word directly with its Modbus address. The big advantage of this method is it requires a minimum of configuration on drive side. The setting up of the communication happens almost completely in the PLC. The disadvantage is that when you want to read or write several registers who are not consecutive, you will need to use multiple reading and writing command and messages which can affect the speed of the communication.

Method 2 is using the Com Scanner of the Altivar Process. The Com Scanner allows you to set up a list of various registers of the drive which the drive will group together. It requires a little bit of configuration on the side of the drive but the big advantage is that you can read or write 32 various registers in 1 command.

This manual will explain both methods.

STEP 1 SET UP COMMUNICATION PARAMETERS

In a Modbus TCP/IP communication, it is important that all devices are located in the same subnet. This means that IP addresses need to be in the same subnet.

Altivar Process

The settings for Modbus TCP/IP communication can be found in the menu 6. Communication and in Embedded Ethernet communication.

IP 192.168.1.12
Subnet Mask 255.255.255.0
Gateway 0.0.0.0

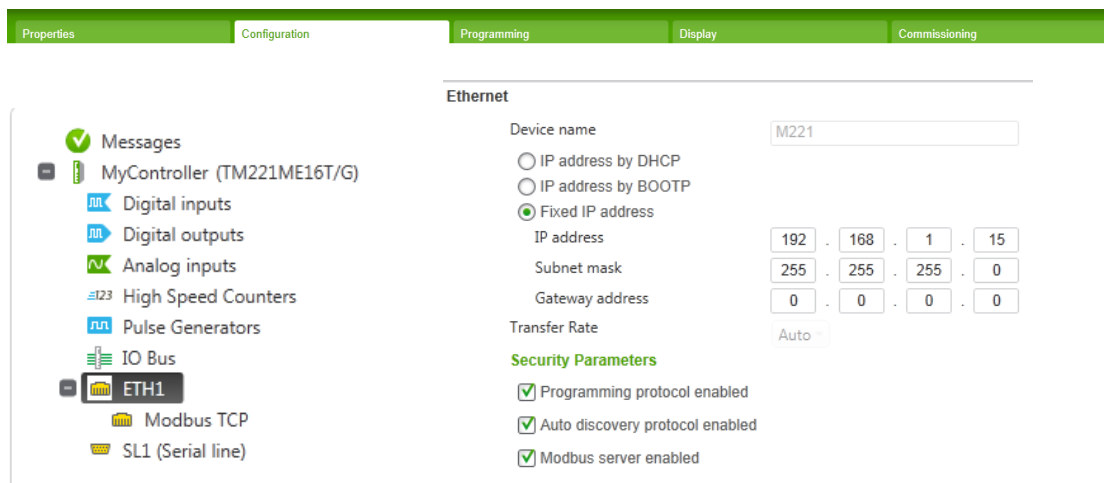
In the Altivar Process we will also have to set up that the Altivar will be controlled by a controller communicating over Modbus TCP/IP.

Therefore go in menu 5.4 Command and Reference and change the setting Ref Freq 1 Config to Embedded Ethernet.

Perform a power cycle to ensure that all settings are taken into account.

M221

The settings for the M221 controller are located in the menu Configuration > ETH1



Properties Configuration Programming Display Commissioning

Messages
MyController (TM221ME16T/G)
Digital inputs
Digital outputs
Analog inputs
High Speed Counters
Pulse Generators
IO Bus
ETH1
Modbus TCP
SL1 (Serial line)

Ethernet

Device name M221

☐ IP address by DHCP
☐ IP address by BOOTP
☒ Fixed IP address

IP address 192 . 168 . 1 . 15
Subnet mask 255 . 255 . 255 . 0
Gateway address 0 . 0 . 0 . 0

Transfer Rate Auto

Security Parameters

☒ Programming protocol enabled
☒ Auto discovery protocol enabled
☒ Modbus server enabled

IP 192.168.1.15
Subnet Mask 255.255.255.0
Gateway 0.0.0.0

We will also have to add the Altivar Process as a client in the network. Go to Configuration > ETH 1 > Modbus TCP and add the IP address of the Altivar Process.



Pay attention to the Unit ID. Depending on which method you are using, the Unit ID will be different. For addressing the registers directly, Unit ID 248 will be used. For using the Com Scanner, Unit ID 255 is required.

Modbus TCP

Client mode: Remote Server table (max 16)

Address: 192 . 168 . 1 . 12 Add

Unit ID: 248

Connection timeout (100 ms): 100

A first connection should be added like this:

Index	Address	Unit ID	Connection timeout (100 ms)
1	192.168.1.12	248	100

IP address 192.168.1.12 has now received the Index number 1.

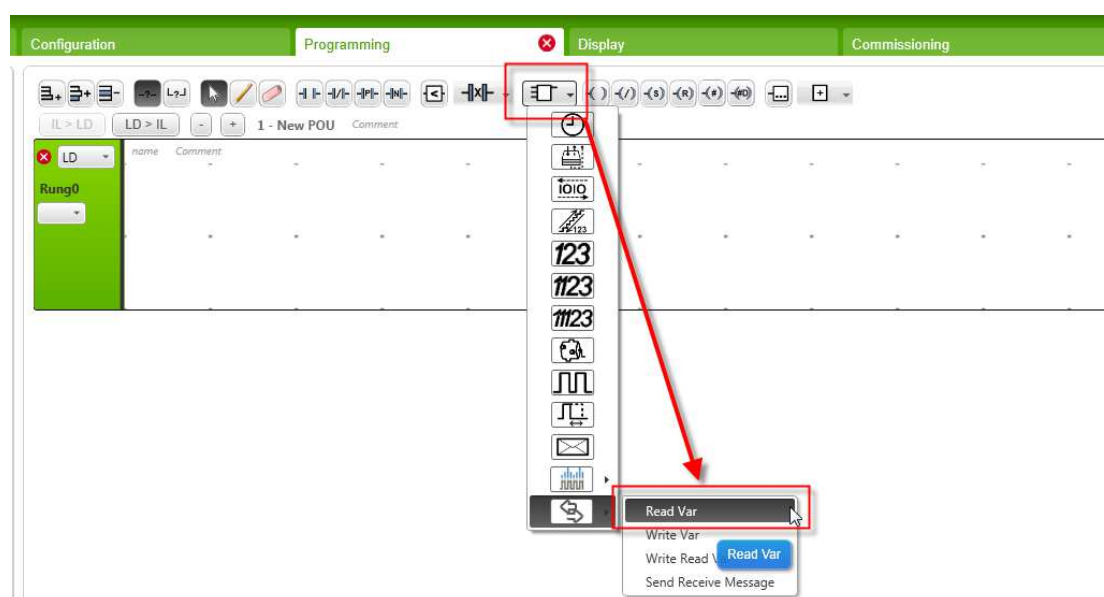


If your computer is connected to the Modbus TCP/IP network, you can test the settings of the IP addresses by pinging both devices.

Go to Start > Run and type "cmd". In the Command Prompt type "ping 192.168.1.12" for the Altivar and type "ping 192.168.1.15" for the M221. You should get a response time.

STEP 2 ADD A READ FUNCTION BLOCK

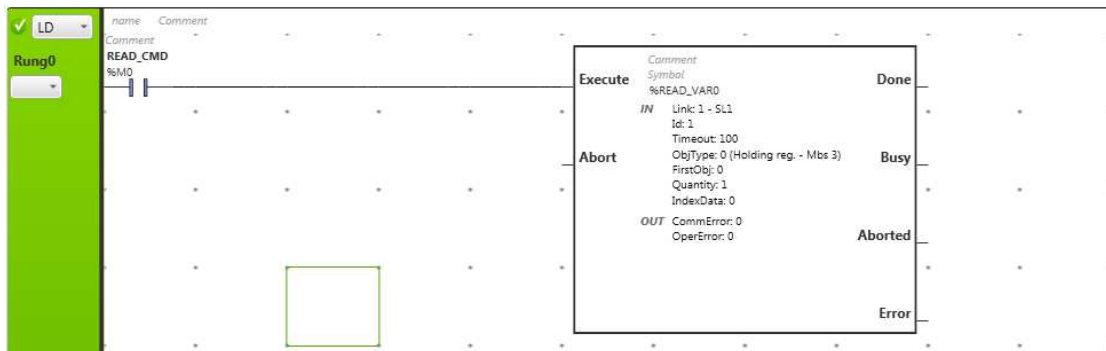
Go to the Programming tab and add a READ_VAR function block in the first POU and the first Rung.



METHOD 1: Directly addressing registers

Add a contact that will trigger the read action. Be aware that the READ_VAR function block will only be executed on a rising edge. This means the contact will have to have a transition from 0 to 1 in order for a read action.

If you like, you can add the symbol "READ_CMD" to the contact like in the example provided.



Double click on the READ_VAR function block to open the configuration screen of the READ_VAR function block. Configure the FB like the example.

Read Var properties											
Used	Address	Symbol	Link	Id	Timeout	ObjType	FirstObj	Quantity	IndexData	Comment	
<input checked="" type="checkbox"/>	%READ_VAR0		3 - ETH1	1	100	0 (Holding reg. - Mbs 3)	3201	2	10		
<input type="checkbox"/>	%READ_VAR1		1 - SL1	1	100	0 (Holding reg. - Mbs 3)	0	1	0		
<input type="checkbox"/>	%READ_VAR2		1 - SL1	1	100	0 (Holding reg. - Mbs 3)	0	1	0		

In this example 2 registers are read, register 3201 (Status Word) and register 3202 (Motor Frequency). The values of the read command are stored in the memory objects %MW10 and %MW11 in the M221 controller (as configured in the IndexData).



To keep the naming of all memory objects clear, you can add clear names as a symbol. To do this, go to Programming > Tools > Memory Words. Add STATUS_WRD to %MW10 and FREQ_PV to %MW11.

STEP 3 PERFORM A FIRST TEST OF YOUR COMMUNICATION

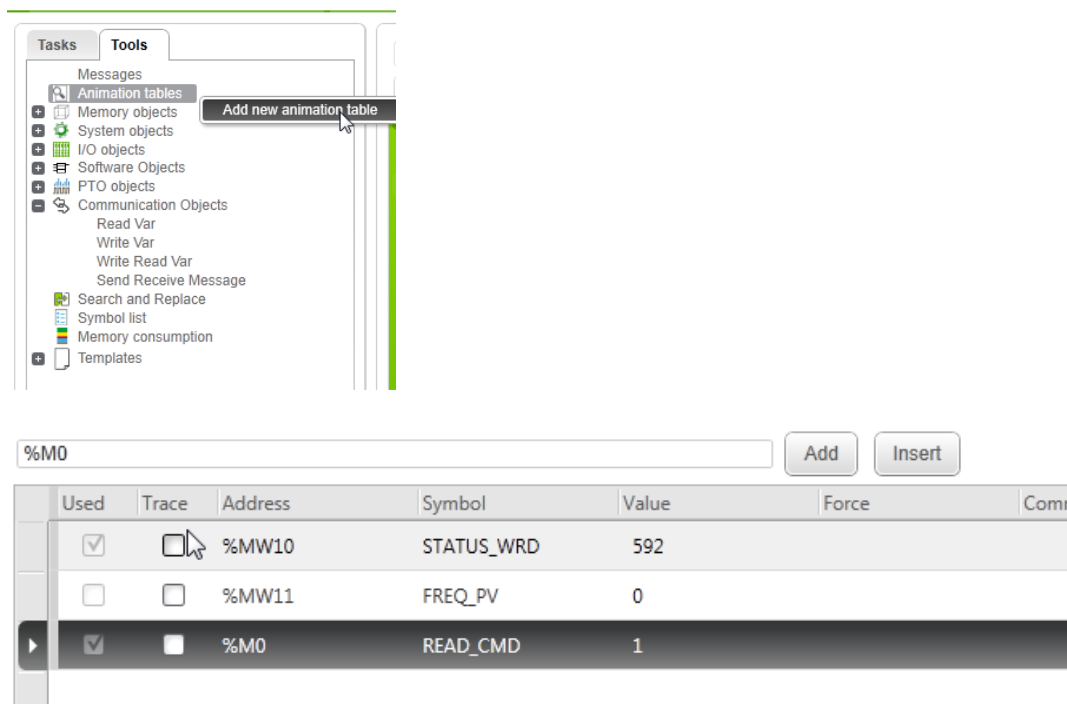


Go in tab Commissioning and login to your M221 Controller. You should get the message that the application of PC and controller are different. Please perform a download.

To test your application and verify if you have Modbus communication with your Altivar Process, you have to create an animation table.

Go to Programming > Tools and right click on Animation tables and add a new animation table. You should have an Animation table in the bottom of your screen where you can add the memory objects of the read command.

METHOD 1: Directly addressing registers



Don't forget that the read command is only executed when the READ_CMD has a rising edge. For a first test, you can also add the system variable %S5 instead of %M0. System variable will generate a pulse every 100ms which automatically generates a rising edge.

If communication is ok, you should get a value in the STATUS_WORD of the Altivar.

STEP 4 ADD A WRITE FUNCTION BLOCK

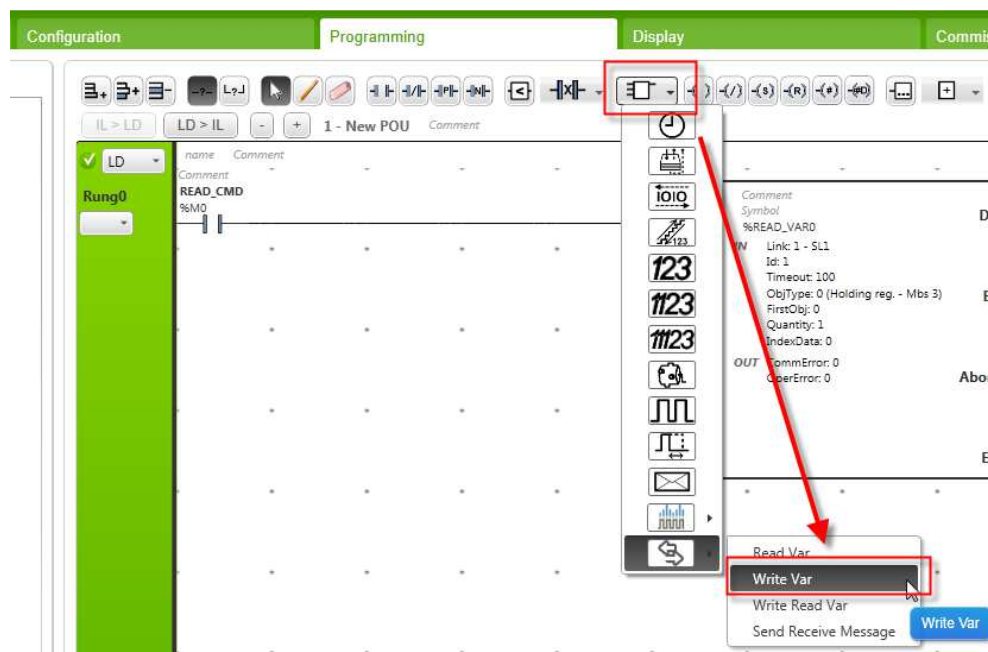
In the same way as the Read FB, we will now add a Write function block. In this way we can write a start / stop command and a speed set point.

Go to the Programming tab and add a second Rung.



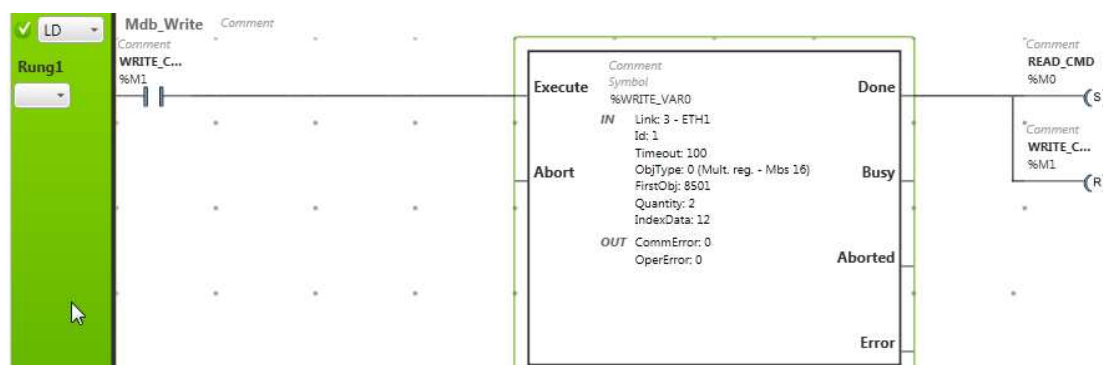
Add WRITE_VAR function block in the first POU and the second Rung.

METHOD 1: Directly addressing registers



Add a contact that will trigger the read action. Be aware that the **WRITE_VAR** function block will only be executed on a rising edge. This means the contact will have to have a transition from 0 to 1 in order for a read action.

If you like, you can add the symbol "WRITE_CMD" to the contact like in the example provided.



Double click on the **WRITE_VAR** function block to open the configuration screen of the **WRITE_VAR** function block. Configure the FB like the example.

Used	Address	Symbol	Link	Id	Timeout	ObjType	FirstObj	Quantity	IndexData	Comment
<input checked="" type="checkbox"/>	%WRITE_VAR0		3 - ETH1	1	100	0 (Mult. reg. - Mbs 16)	8501	2	12	
<input type="checkbox"/>	%WRITE_VAR1		1 - SL1	1	100	0 (Mult. reg. - Mbs 16)	0	1	0	

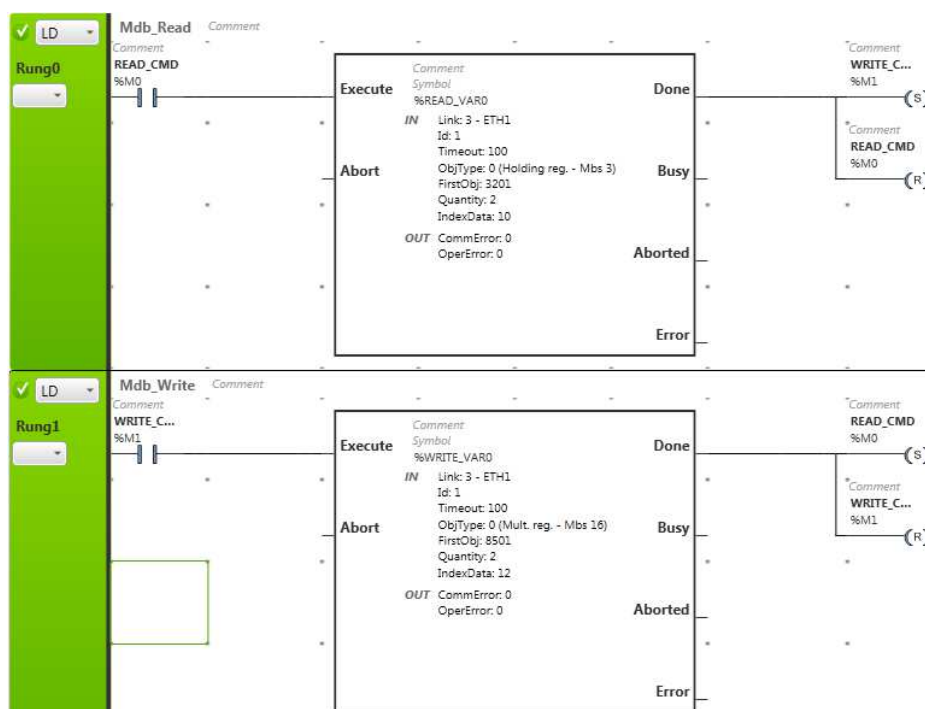
In this example 2 registers are written, register 8501 (Command Word) and register 8502 (Reference Frequency). The values of the write command are coming from the memory objects %MW12 and %MW13 in the M221 controller (as configured in the IndexData).

METHOD 1: Directly addressing registers



To keep the naming of all memory objects clear, you can add clear names as a symbol. To do this, go to Programming > Tools > Memory Words. Add COMMAND_WRD to %MW12 and FREQ_SP to %MW13.

To ensure there is a constant switch between the read and write command, make sure the Read FB sets %M1 and resets %M0 and that the write command sets %M0 and resets %M1.



STEP 5 GO ONLINE AND START ALTIVAR

Add the 2 new memory objects to your existing Animation table. It should look like this:

%M1

Add

Insert

Used	Trace	Address	Symbol	Value	Force	Comment
<input checked="" type="checkbox"/>	<input type="checkbox"/>	%MW10	STATUS_WRD	592		
<input type="checkbox"/>	<input type="checkbox"/>	%MW11	FREQ_PV	0		
<input checked="" type="checkbox"/>	<input type="checkbox"/>	%MW12	COMMAND_WRD	0		
<input type="checkbox"/>	<input type="checkbox"/>	%MW13	FREQ_SP	0		
<input checked="" type="checkbox"/>	<input type="checkbox"/>	%M0	READ_CMD	1		
<input checked="" type="checkbox"/>	<input type="checkbox"/>	%M1	WRITE_CMD	0		

Don't forget to write 1 to %M0 or to %M1 to start the Modbus communication.

METHOD 1: *Directly addressing registers*



If the Altivar Process is in fault because the PLC did not communicate anymore during download (Status Word = 568 or 16#0238) write 128 in the Command Word. This should reset your drive.

If your drive is in Status 592 (16#0250), write 6 in Command Word. This should change the Status Word to 561 (16#0231). Then write 7 in the Command Word and the Status should change to 563 (16#0233). Lastly write 15 and the Status should change to 1591 (16#0637). This is the Status where the drive is now in Run. The only thing missing is a speed reference. Write 100 in `FREQ_SP` to make the drive have output 10Hz. You will be able to see the output frequency of the drive in `FREQ_PV`. To understand these commands see step 6.

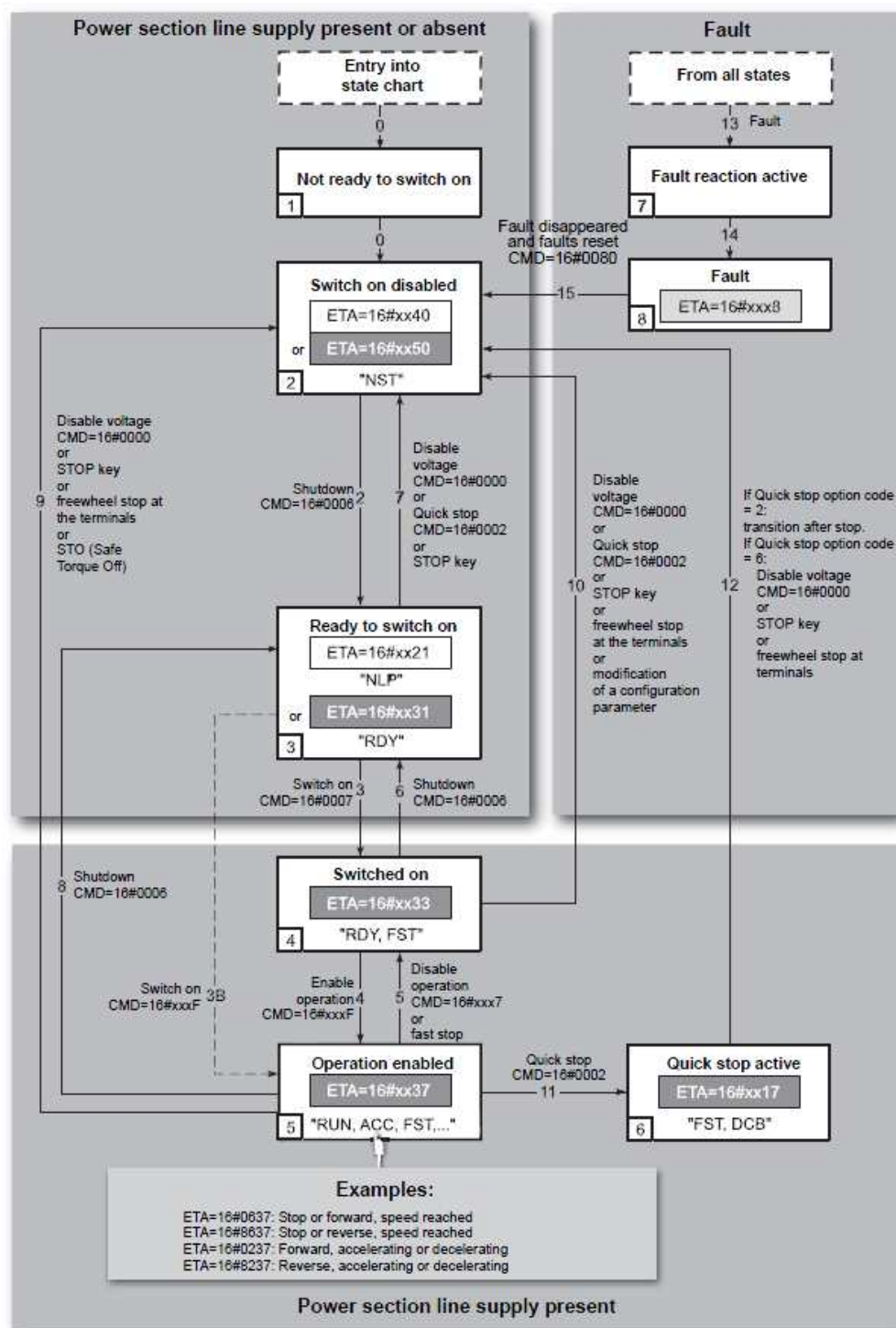
%M1					Add	Insert
Used	Trace	Address	Symbol	Value	Force	Comm
<input checked="" type="checkbox"/>	<input type="checkbox"/>	%MW10	STATUS_WRD	1591		
<input type="checkbox"/>	<input type="checkbox"/>	%MW11	FREQ_PV	100		
<input type="checkbox"/>	<input type="checkbox"/>	%MW12	COMMAND_WRD	15		
<input type="checkbox"/>	<input type="checkbox"/>	%MW13	FREQ_SP	100		
<input checked="" type="checkbox"/>	<input type="checkbox"/>	%M0	READ_CMD	0		
<input checked="" type="checkbox"/>	<input type="checkbox"/>	%M1	WRITE_CMD	1		

Writing 7 again in the Command Word will stop the drive.

STEP 6 UNDERSTANDING & ADDING THE DRIVE COM

The Altivar Process is working with the Drive Com principle. This means that the status of the Altivar is always located somewhere in a flowchart and that a certain sequence needs to be followed in order to reset the drive or to start the drive. This means that depending on the state the drive is located; the command needs to be according.

For detailed information, please refer to *Altivar Process - Embedded Ethernet Manual*.



STEP 1 SET UP COMMUNICATION PARAMETERS

In a Modbus TCP/IP communication, it is important that all devices are located in the same subnet. This means that IP addresses need to be in the same subnet.

Altivar Process

The settings for Modbus TCP/IP communication can be found in the menu 6. Communication and in Embedded Ethernet communication.

IP 192.168.1.12
Subnet Mask 255.255.255.0
Gateway 0.0.0.0

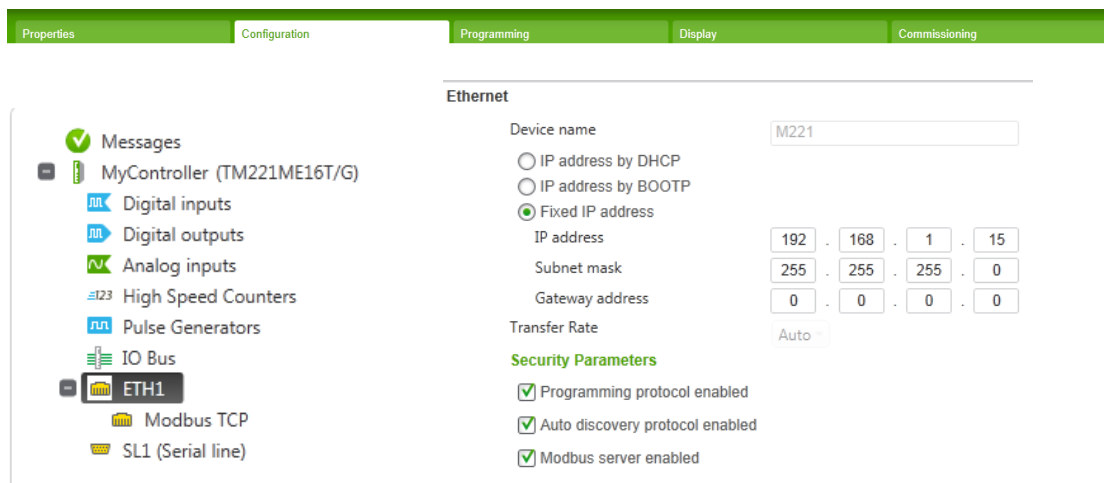
In the Altivar Process we will also have to set up that the Altivar will be controlled by a controller communicating over Modbus TCP/IP.

Therefore go in menu 5.4 Command and Reference and change the setting Ref Freq 1 Config to Embedded Ethernet.

Perform a power cycle to ensure that all settings are taken into account.

M221

The settings for the M221 controller are located in the menu Configuration > ETH1



The screenshot shows the configuration interface for the M221 controller. The 'Configuration' tab is selected, and the 'Ethernet' section is active. On the left, a tree view shows the configuration hierarchy: Messages, MyController (TM221ME16T/G), Digital inputs, Digital outputs, Analog inputs, High Speed Counters, Pulse Generators, IO Bus, ETH1 (selected), Modbus TCP, and SL1 (Serial line). The 'Ethernet' settings are displayed on the right:

- Device name: M221
- IP address by DHCP: ☐
- IP address by BOOTP: ☐
- Fixed IP address: ☒
- IP address: 192 . 168 . 1 . 15
- Subnet mask: 255 . 255 . 255 . 0
- Gateway address: 0 . 0 . 0 . 0
- Transfer Rate: Auto
- Security Parameters:
 - Programming protocol enabled: ☒
 - Auto discovery protocol enabled: ☒
 - Modbus server enabled: ☒

IP 192.168.1.15
Subnet Mask 255.255.255.0
Gateway 0.0.0.0

We will also have to add the Altivar Process as a client in the network. Go to Configuration > ETH 1 > Modbus TCP and add the IP address of the Altivar Process.



Pay attention to the Unit ID. Depending on which method you are using, the Unit ID will be different. For addressing the registers directly, Unit ID 248 will be used. For using the Com Scanner, Unit ID 255 is required.

Modbus TCP

Client mode: Remote Server table (max 16)

Address

192 . 168 . 1 . 12

Add

Unit ID

255

Connection timeout (100 ms)

100

A first connection should be added like this:

Index	Address	Unit ID	Connection timeout (100 n
1	192.168.1.12	255	100

IP address 192.168.1.12 has now received the Index number 1.



If your computer is connected to the Modbus TCP/IP network, you can test the settings of the IP addresses by pinging both devices.

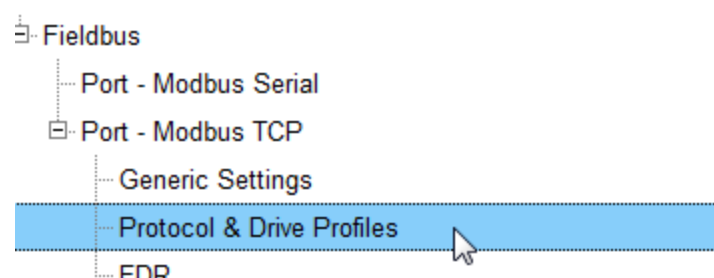
Go to Start > Run and type "cmd". In the Command Prompt type "ping 192.168.1.12" for the Altivar and type "ping 192.168.1.15" for the M221. You should get a response time.

STEP 2 SETTING UP IO SCANNER IN DRIVE

Using the Com Scanner in the drive means you have to configure which registers you want to read and write. This configuration has to be done in the drive. The only way of configuring the Com Scanner is either with the software SoMove or with the webserver of the drive.

SoMove software

In the software go to Parameter List > Fieldbus > Protocol & Drives Profile

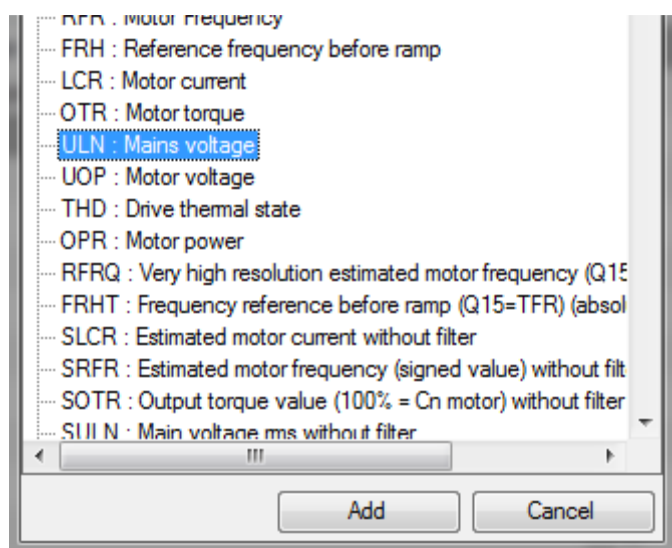
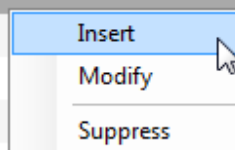


METHOD 2: Using Com Scanner of drive

In the menu Drive I/O Profile there are 2 lists available. One list are the inputs, registers the PLC is reading from the drive. The second list are the outputs, registers the PLC is writing to the drive.

In this screen you can now add registers / variables to the Com Scanner with a right-click and select the register you wish to read.

Inputs (Drive to Controller)			
Channel	Code	Description	Logical address
1	ETA	CIA402 State Register	3201
2	RFRD	DRIVECOM : Actual speed value	8604
3			
4			
5			
6			
7			

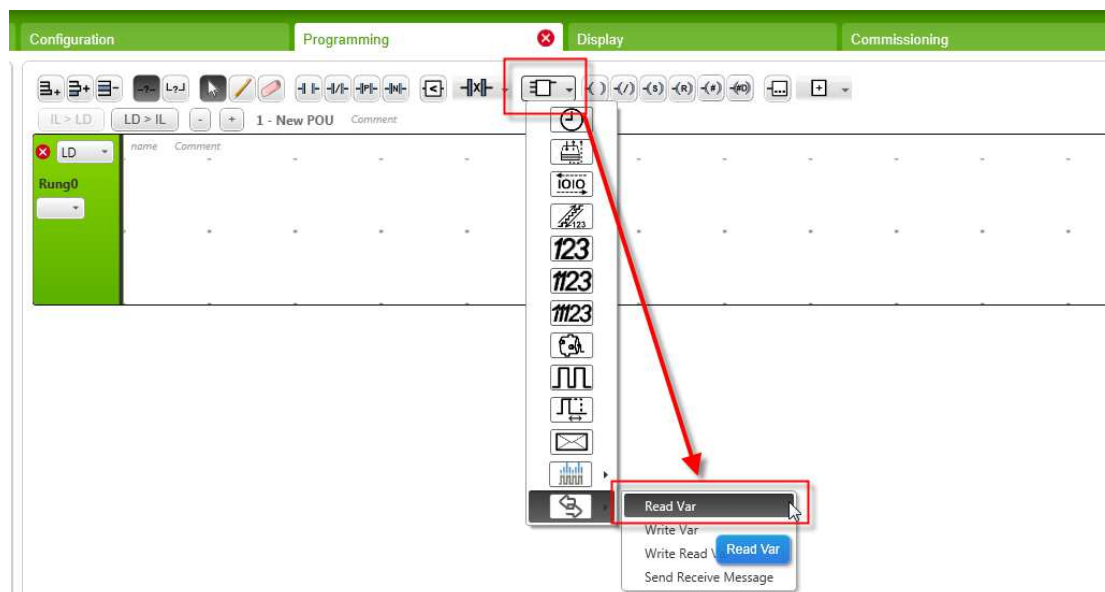


Do not forget to validate with the “Apply changes” button.

And send the changes to drive.

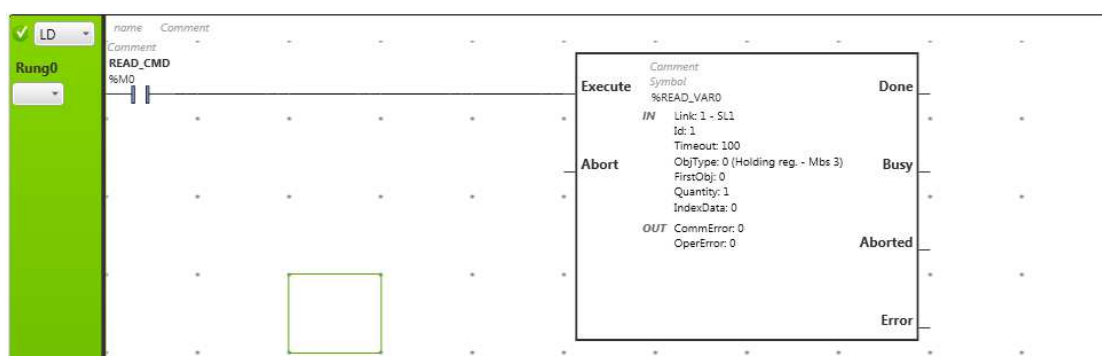
STEP 3 ADD A READ FUNCTION BLOCK

Go to the Programming tab and add a READ_VAR function block in the first POU and the first Rung.



Add a contact that will trigger the read action. Be aware that the READ_VAR function block will only be executed on a rising edge. This means the contact will have to have a transition from 0 to 1 in order for a read action.

If you like, you can add the symbol "READ_CMD" to the contact like in the example provided.



Double click on the READ_VAR function block to open the configuration screen of the READ_VAR function block. Configure the FB like the example.

Read Var properties										
Used	Address	Symbol	Link	Id	Timeout	ObjType	FirstObj	Quantity	IndexData	Comment
<input checked="" type="checkbox"/>	%READ_VAR0		3 - ETH1	1	100	0 (Holding reg. - Mbs 3)	0	32	0	
<input type="checkbox"/>	%READ_VAR1		1 - SL1	1	100	0 (Holding reg. - Mbs 3)	0	1	0	
<input type="checkbox"/>	%READ_VAR2		1 - SL1	1	100	0 (Holding reg. - Mbs 3)	0	1	0	

METHOD 2: Using Com Scanner of drive

In this example 32 registers are read starting from register 0 (first register of the Com Scanner). These values of the read command are stored in the memory objects, starting from %MW0 (as configured in the IndexData). For this example %MW0 will be Status Word and %MW1 will be Speed Feedback.



To keep the naming of all memory objects clear, you can add clear names as a symbol. To do this, go to Programming > Tools > Memory Words. Add STATUS_WRD to %MW0 and FREQ_PV to %MW11.

STEP 4 PERFORM A FIRST TEST OF YOUR COMMUNICATION



Go in tab Commissioning and login to your M221 Controller. You should get the message that the application of PC and controller are different. Please perform a download.

To test your application and verify if you have Modbus communication with your Altivar Process, you have to create an animation table.

Go to Programming > Tools and right click on Animation tables and add a new animation table. You should have an Animation table in the bottom of your screen where you can add the memory objects of the read command.

Used	Trace	Address	Symbol	Value	Force	Com
<input type="checkbox"/>	<input type="checkbox"/>	%MW0	STATUS_WRD	592		
<input type="checkbox"/>	<input type="checkbox"/>	%MW1	FREQ_PV	0		
<input checked="" type="checkbox"/>	<input type="checkbox"/>	%M0	READ_CMD	1		

Don't forget that the read command is only executed when the READ_CMD has a rising edge. For a first test, you can also add the system variable %S5 instead of %M0. System variable will generate a pulse every 100ms which automatically generates a rising edge.

If communication is ok, you should get a value in the STATUS_WORD of the Altivar.

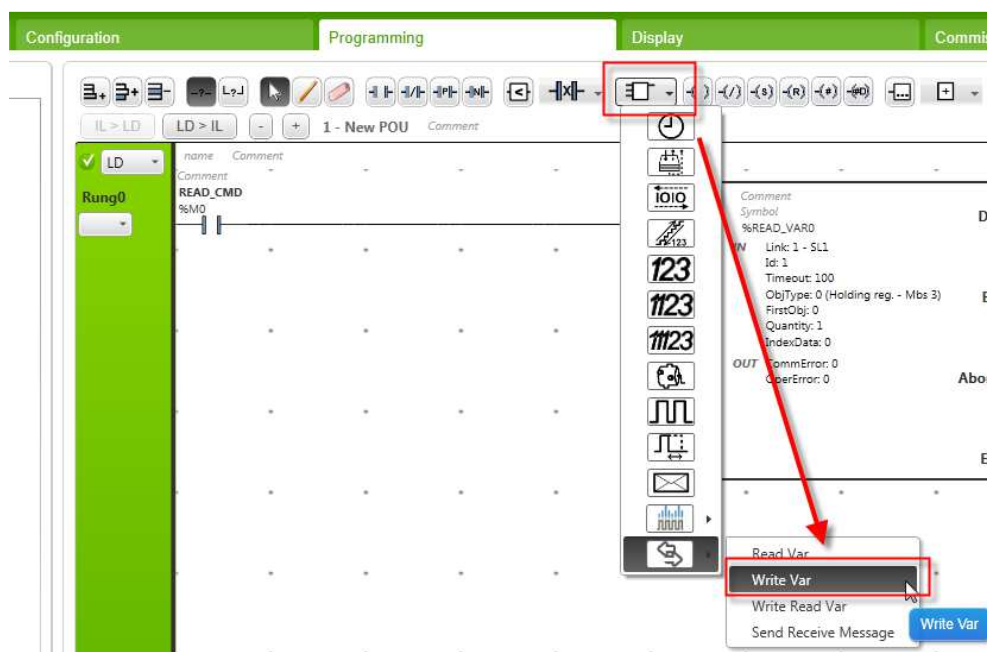
STEP 5 ADD A WRITE FUNCTION BLOCK

In the same way as the Read FB, we will now add a Write function block. In this way we can write a start / stop command and a speed set point.

Go to the Programming tab and add a second Rung.

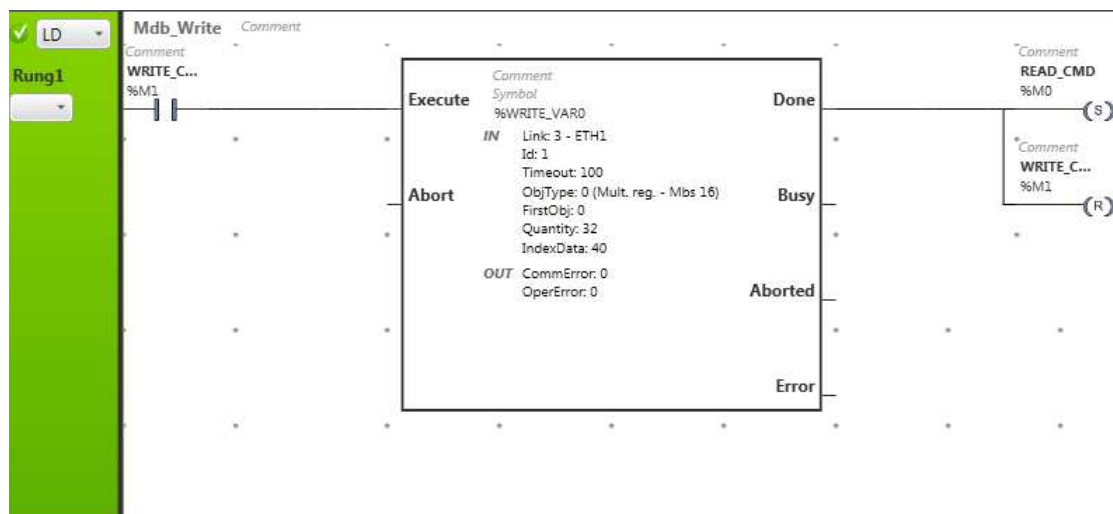


Add WRITE_VAR function block in the first POU and the second Rung.



Add a contact that will trigger the read action. Be aware that the WRITE_VAR function block will only be executed on a rising edge. This means the contact will have to have a transition from 0 to 1 in order for a read action.

If you like, you can add the symbol "WRITE_CMD" to the contact like in the example provided.



Double click on the WRITE_VAR function block to open the configuration screen of the WRITE_VAR function block. Configure the FB like the example.

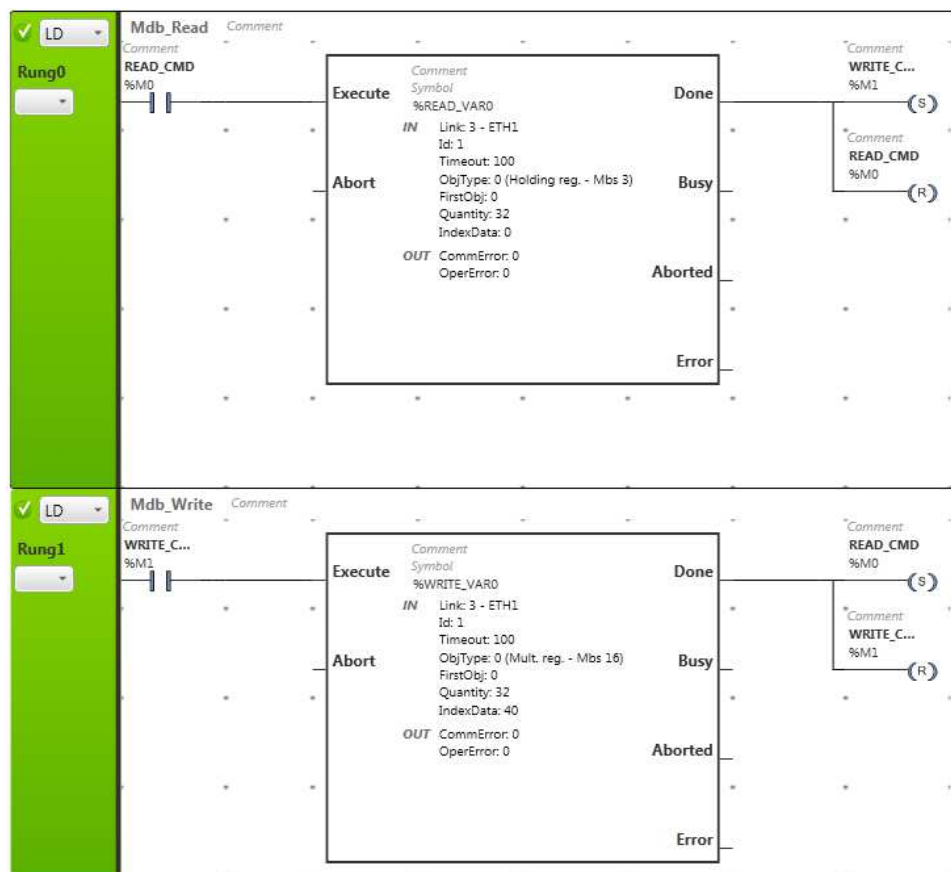
Write Var properties										
Used	Address	Symbol	Link	Id	Timeout	ObjType	FirstObj	Quantity	IndexData	Cor
<input checked="" type="checkbox"/>	%WRITE_VAR0		3 - ETH1	1	100	0 (Mult. reg. - Mbs 16)	0	32	40	
<input type="checkbox"/>	%WRITE_VAR1		1 - SL1	1	100	0 (Mult. reg. - Mbs 16)	0	1	0	
<input type="checkbox"/>	%WRITE_VAR2		1 - SL1	1	100	0 (Mult. reg. - Mbs 16)	0	1	0	

In this example 32 registers are written, starting with register 0. Following the configuration of our Com Scanner register 0 will be the COMMAND_WORD and register 1 will be FREQ_SP. The values of the write command are coming from the memory objects starting at %MW40 in the M221 controller (as configured in the IndexData).



To keep the naming of all memory objects clear, you can add clear names as a symbol. To do this, go to Programming > Tools > Memory Words. Add COMMAND_WRD to %MW40 and FREQ_SP to %MW41.

To ensure there is a constant switch between the read and write command, make sure the Read FB sets %M1 and resets %M0 and that the write command sets %M0 and resets %M1.



STEP 6 GO ONLINE AND START ALTIVAR

Add the 2 new memory objects to your existing Animation table. It should look like this:

%M1					Add	Insert
Used	Trace	Address	Symbol	Value	Force	Comment
<input type="checkbox"/>	<input type="checkbox"/>	%MW0	STATUS_WRD	592		
<input type="checkbox"/>	<input type="checkbox"/>	%MW1	FREQ_PV	0		
<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	%MW40	COMMAND_WRD	0		
<input type="checkbox"/>	<input type="checkbox"/>	%MW41	FREQ_SP	0		
<input checked="" type="checkbox"/>	<input type="checkbox"/>	%M0	READ_CMD	1		
<input checked="" type="checkbox"/>	<input type="checkbox"/>	%M1	WRITE_CMD	0		

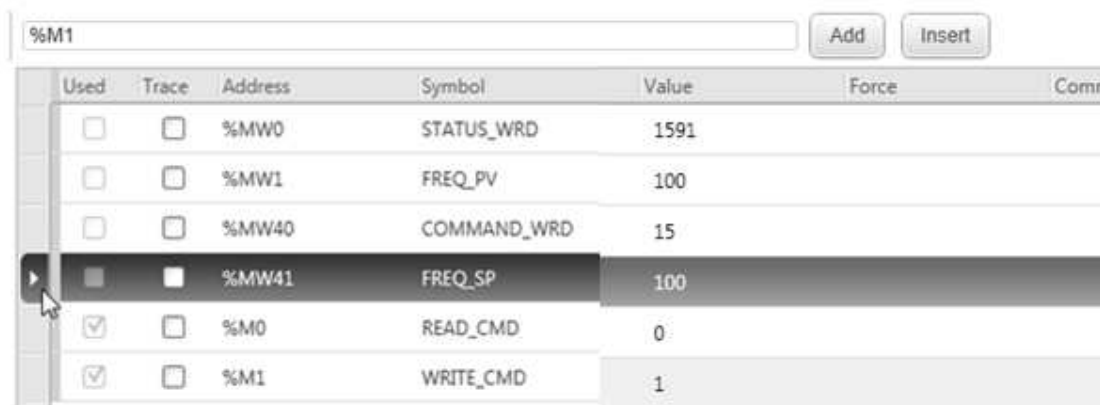
Don't forget to write 1 to %M0 or to %M1 to start the Modbus communication.



If the Altivar Process is in fault because the PLC did not communicate anymore during download (Status Word = 568 or 16#0238) write 128 in the Command Word. This should reset your drive.

METHOD 2: Using Com Scanner of drive

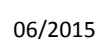
If your drive is in Status 592 (16#0250), write 6 in Command Word. This should change the Status Word to 561 (16#0231). Then write 7 in the Command Word and the Status should change to 563 (16#0233). Lastly write 15 and the Status should change to 1591 (16#0637). This is the Status where the drive is now in Run. The only thing missing is a speed reference. Write 100 in `FREQ_SP` to make the drive have output 10Hz. You will be able to see the output frequency of the drive in `FREQ_PV`. To understand this commands see step6.



Used	Trace	Address	Symbol	Value	Force	Command
<input type="checkbox"/>	<input type="checkbox"/>	%MW0	STATUS_WRD	1591		
<input type="checkbox"/>	<input type="checkbox"/>	%MW1	FREQ_PV	100		
<input type="checkbox"/>	<input type="checkbox"/>	%MW40	COMMAND_WRD	15		
<input checked="" type="checkbox"/>	<input type="checkbox"/>	%MW41	FREQ_SP	100		
<input checked="" type="checkbox"/>	<input type="checkbox"/>	%M0	READ_CMD	0		
<input checked="" type="checkbox"/>	<input type="checkbox"/>	%M1	WRITE_CMD	1		

Writing 7 again in the Command Word will stop the drive.

For detailed information, please refer to *Altivar Process - Embedded Ethernet Manual*.



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