MTAP-SER
Jim Chai
Oct. 2018

Programming Guide: ACT350 Precision Profinet with Siemens S7-1200 PLC

- Uses PLC sample program "ACT350_Precision_PNET_ST13_F1"

METTLER TOLEDO

Contents

1 Component Overview

2 ACT350 Precision Web Server Configuration

3 Profinet IO Network Configuration

4 SAI Cyclic Data Structure

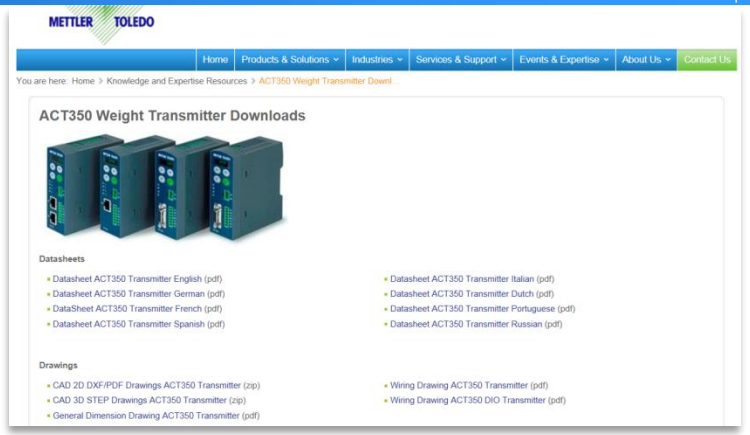
5 Programming – Cyclic Data

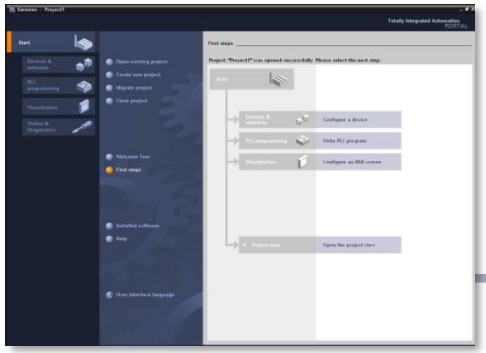
6 Programming – Acyclic Data

7 Programming – Scale Adjustment

Component Overview

Device Description File:
GSDML "GSDML-V2.33-MT-ACT350 2P-20170626"
can be downloaded from **www.mt.com/act350**

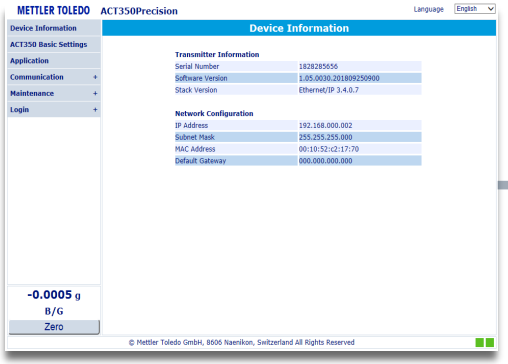




Siemens TIA Portal V13

Siemens CPU S7-1212C

ACT350 Precision DIN PRNT
Firmware: 1.05.0100



Web Browser
ACT350 configuration

WMS Weigh Module

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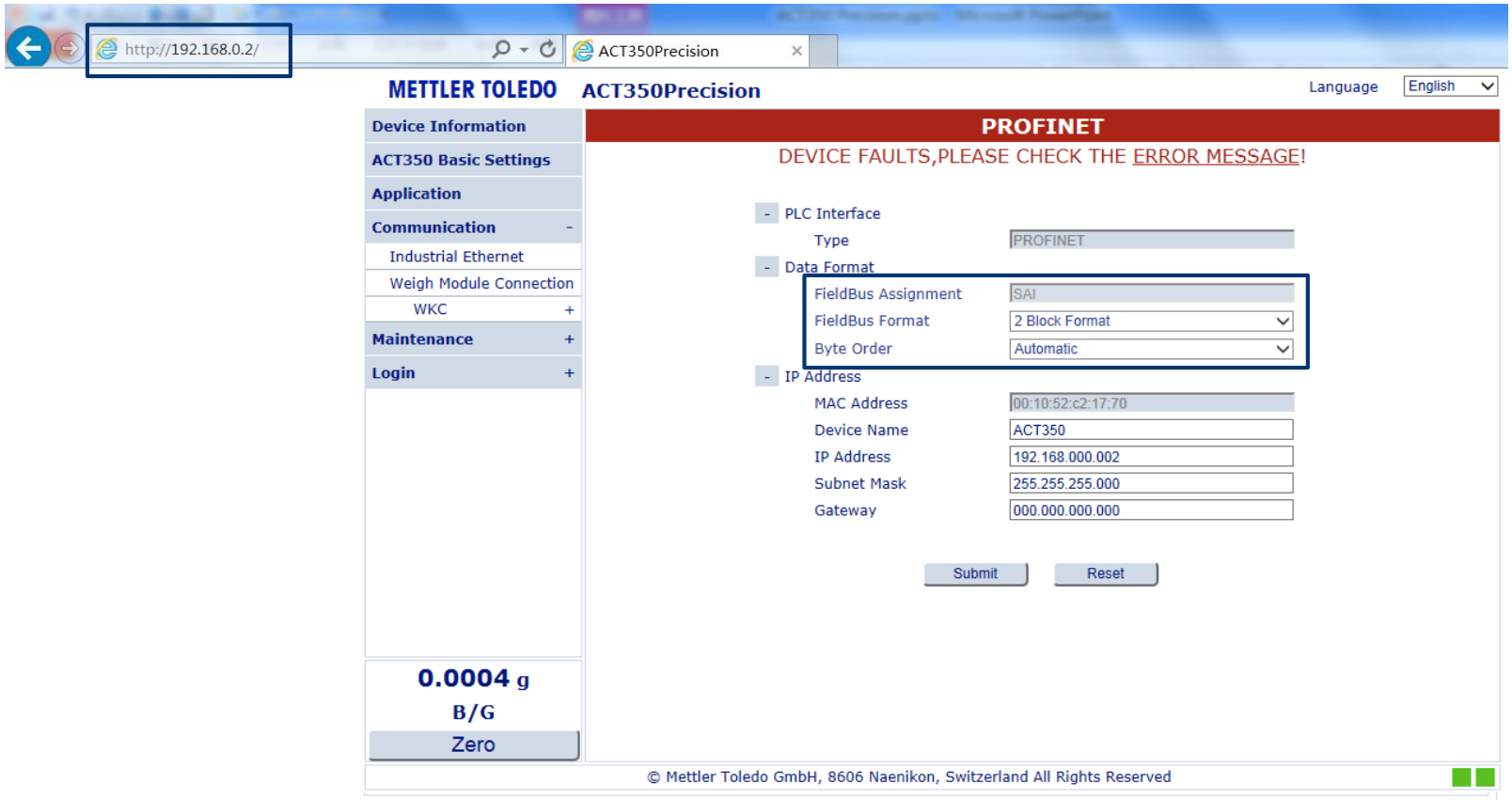
ACT350 Precision Web Server Configuration



1. Connect to ACT350 Precision's IP address with any web browser

2. Choose the required serial interface and connect to weigh module by automatic/ manual Baud rate scan

3. Choose the required SAI format (1 or 2 Block) and set Byte Order to "Automatic"

*1 Block Format is 4 words input/ output while 2 Block is 8 words input/ output

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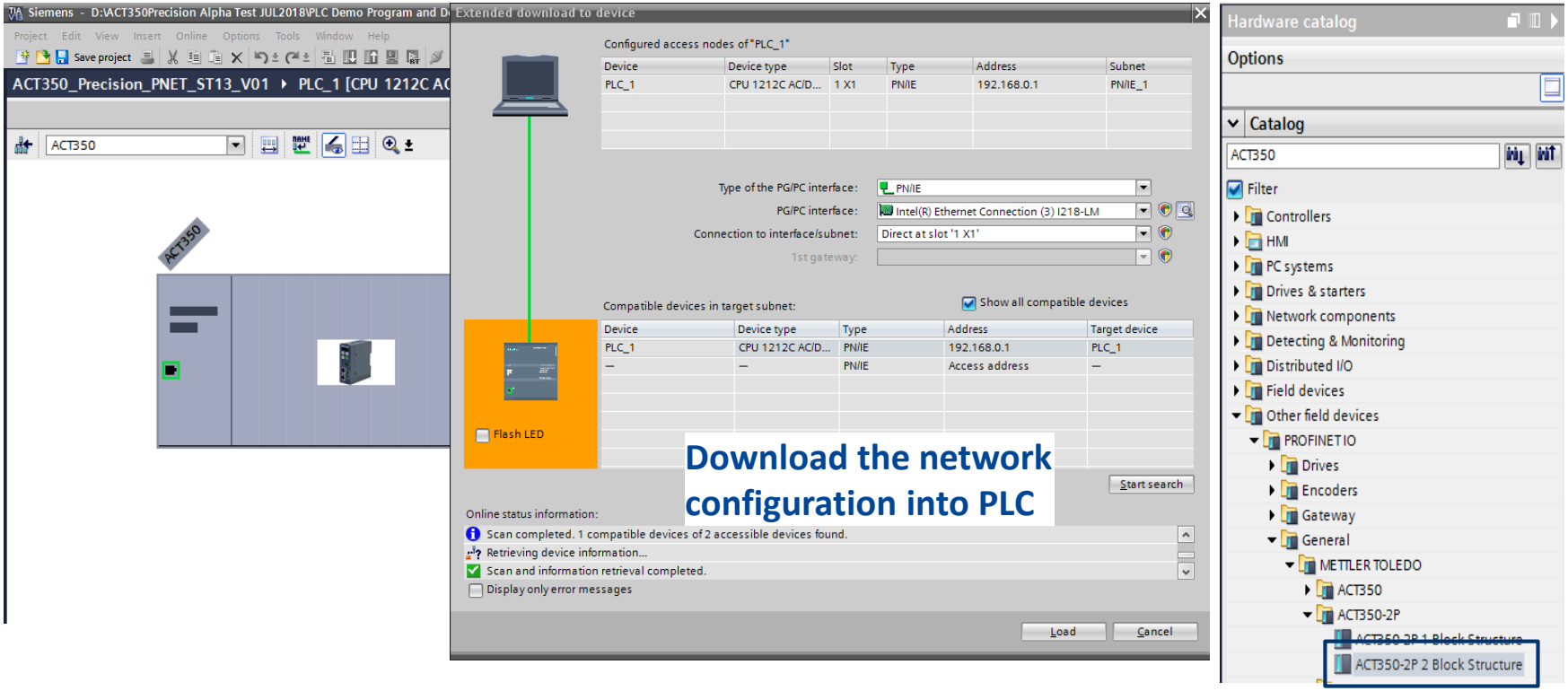
TIA Portal Profinet IO Network Configuration



1. With ACT350 Precision GSDML file already installed, search for ACT350 in Hardware Catalog, insert the ACT350 into TIA Portal project's Devices & Networks. In this sample we use 2-block SAI structure (8 words input and 8 words output)
2. Link the Profinet IO network between PLC and ACT350 Precision. Make sure the Profinet IO controller is assigned to the PLC (as default)
3. Set up ACT350 Precision's IP address and Profinet Device Name. Device Name is equally important in Profinet IO network configuration
4. Under ACT350 Precision Device Overview, all the PLC input (8 words) and output (8 words) addresses are being listed

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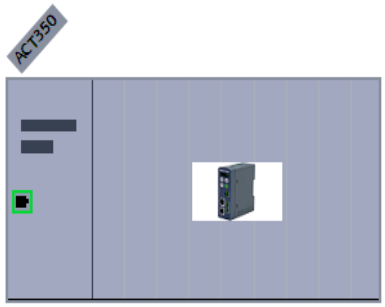
SAI Cyclic Data Structure – PLC Inputs

ACT350_Precision_PNET_ST13_V01 ▸ PLC_1 [CPU 1212C AC/DC/Rly] ▸ Distributed I/O ▸ PROFINET IO-System (100): PN/IE_1 ▸ ACT350

Topology view | Network view | Device view

ACT350

ACT350 Device Overview



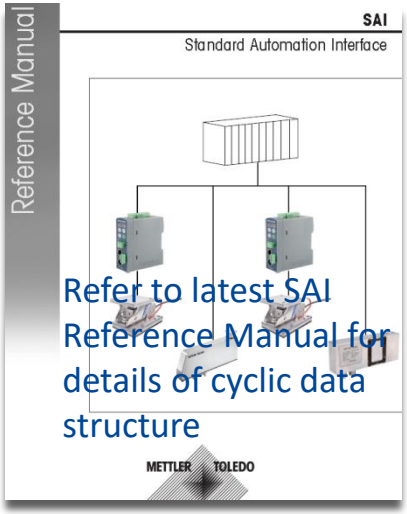
Device overview

Module	Rack	Slot	I address	Q address	Type
ACT350	0	0			ACT350-2P 2 Block...
PROFINET	0	0 X1			ACT350
Measuring Block_1	0	1			Measuring Block
Parameter Access Point	0	1 1			Parameter Access P..
MB Command Value	0	1 2		256...259	MB Command Value
MB Channel Mask	0	1 3		260...261	MB Channel Mask
MB Command	0	1 4		262...263	MB Command
MB Measuring Value	0	1 5	256...259		MB Measuring Value
MB Device Status	0	1 6	260...261		MB Device Status
MB Response	0	1 7	262...263		MB Response
Status Block_1	0	2			Status Block
Parameter Access Point	0	2 1			Parameter Access P..
SB Reserved 1	0	2 2		264...265	SB Reserved 1
SB Reserved 2	0	2 3		266...267	SB Reserved 2
SB Reserved 3	0	2 4		268...269	SB Reserved 3
SB Command	0	2 5		270...271	SB Command
SB Status Group 1	0	2 6	264...265		SB Status Group 1
SB Status Group 2	0	2 7	266...267		SB Status Group 2
SB Status Group 3	0	2 8	268...269		SB Status Group 3
SB Response	0	2 9	270...271		SB Response

Measuring Block (Read)	
Word 0	Floating point value (single precision 32 bit), requested weight value from device
Word 1	
Word 2	16 bit Device status
Word 3	Command Response

Status Block (Read)	
Word 0	Status Group 1
Word 1	Status Group 2
Word 2	Status Group 3
Word 3	Response

Since 2-Block Data Format is chosen, there are 8 words input and 8 words output. 1st Block is Measuring Block; 2nd Block is Status Block.



Refer to latest SAI Reference Manual for details of cyclic data structure

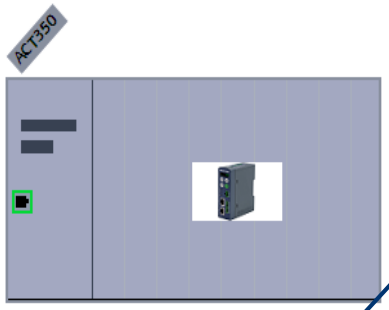
SAI Cyclic Data Structure – PLC Outputs

ACT350_Precision_PNET_ST13_V01 ▸ PLC_1 [CPU 1212C AC/DC/Rly] ▸ Distributed I/O ▸ PROFINET IO-System (100): PN/IE_1 ▸ ACT350

Topology view | Network view | Device view

ACT350

ACT350 Device Overview



Device overview

Module	Rack	Slot	I address	Q address	Type
ACT350	0	0			ACT350-2P 2 Block...
PROFINET	0	0 X1			ACT350
Measuring Block_1	0	1			Measuring Block
Parameter Access Point	0	1 1			Parameter Access P..
MB Command Value	0	1 2		256...259	MB Command Value
MB Channel Mask	0	1 3		260...261	MB Channel Mask
MB Command	0	1 4		262...263	MB Command
MB Measuring Value	0	1 5	256...259		MB Measuring Value
MB Device Status	0	1 6	260...261		MB Device Status
MB Response	0	1 7	262...263		MB Response
Status Block_1	0	2			Status Block
Parameter Access Point	0	2 1			Parameter Access P..
SB Reserved 1	0	2 2		264...265	SB Reserved 1
SB Reserved 2	0	2 3		266...267	SB Reserved 2
SB Reserved 3	0	2 4		268...269	SB Reserved 3
SB Command	0	2 5		270...271	SB Command
SB Status Group 1	0	2 6	264...265		SB Status Group 1
SB Status Group 2	0	2 7	266...267		SB Status Group 2
SB Status Group 3	0	2 8	268...269		SB Status Group 3
SB Response	0	2 9	270...271		SB Response

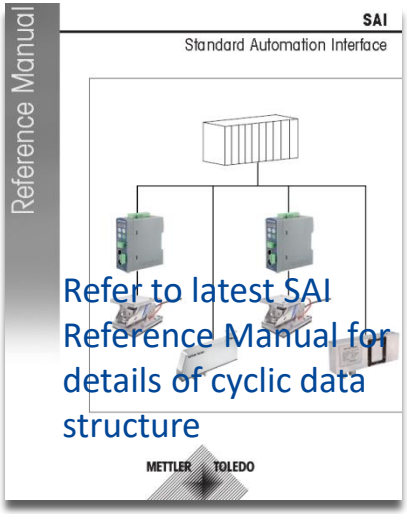
Measuring Block (Write)

Word 0	Floating point command value (single precision 32 bit), used when issuing commands such as preset tare or write filter value
Word 1	
Word 2	Channel Mask*, for addressing different/ multiple channel if more than one channel (load cell) are connected to the device
Word 3	Command

Status Block (Write)

Word 0	Reserved 1
Word 1	Reserved 2
Word 2	Reserved 3
Word 3	Status Block Command

*Measuring Block Write – Word 2 Channel Mask is used only when the SAI device supports multiple channel/ load cell. For single channel device like ACT350 Precision, leave it as zero.



Refer to latest SAI Reference Manual for details of cyclic data structure

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Disclaimer

The PLC Program example shown in this presentation is intended for demonstration purposes only!
It is deemed as "starter kit" to ease integrator during their integration and commissioning process.

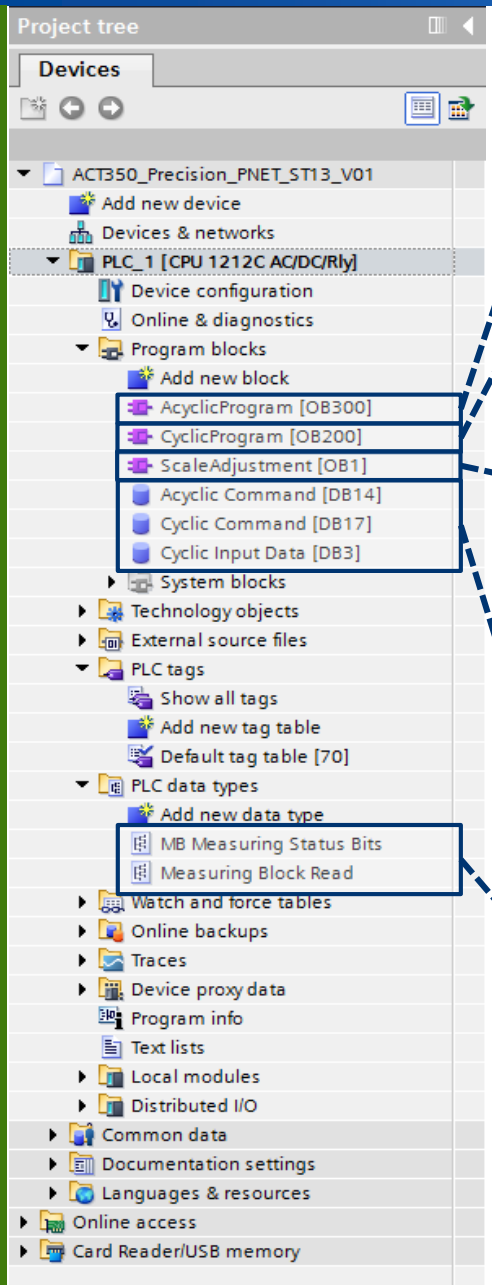
It is the responsibility of the Integrator to determine how any device should be **safely** and **correctly** integrated into their own process.

Mettler Toledo does not accept any responsibility for damage or injuries caused by improper integration of any device.

Press Space Bar When Ready to Continue

Program Overview

Program Descriptions



"AcyclicProgram" demonstrates Acyclic Communication to ACT350 Precision on TCP/IP layer

"CyclicProgram" demonstrates all the usual PLC commands such as reading weight data, tare, clear tare, zero etc.

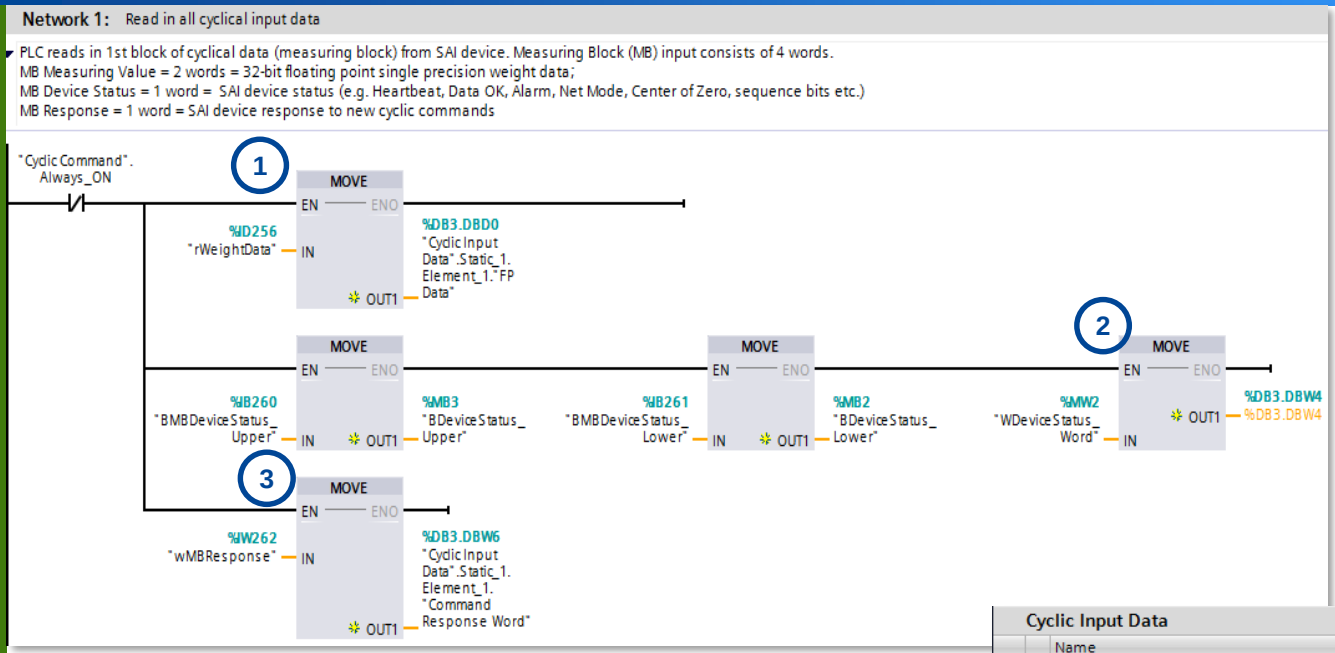
"ScaleAdjustment" program demonstrates PLC adjustment/ test commands to weigh module
***these adjustment/ test can also be carried out in web browser or APW-Link software (if APW is connected to ACT350 Precision)**

Data Blocks:

- **Cyclic Input Data DB3to store/ display cyclical weight data, device status bits and command response**
- **Cyclic Command DB17 contains all PLC commands**
- **Adjustment Command DB14 contains scale adjustment commands such as internal and ecternal adjusments**

PLC data types are created to map all cyclic data into Cyclic Input Data Block DB3

Programming – Cyclic Data



Cyclic Program – Network 1

This network copies the PLC cyclic input addresses into Cyclic Input Data DB3.
The rest of PLC sample program utilizes these variables from DB3.

Device overview

Module	Rack	Slot	I address	Q address	Type
ACT350_1	0	0			ACT350 2P 2 Block Format
PROFINET	0	0 X1			ACT350
Measuring Block_1	0	1			Measuring Block
Parameter Access Point	0	1 1			Parameter Access Point
MB Command Value	0	1 2		256...259	MB Command Value
MB Channel Mask	0	1 3		260...261	MB Channel Mask
MB Command	0	1 4		262...263	MB Command
MB Measuring Value	0	1 5	256...259		MB Measuring Value
MB Device Status	0	1 6	260...261		MB Device Status
MB Response	0	1 7	262...263		MB Response
Status Block_1	0	2			Status Block
Parameter Access Point	0	2 1			Parameter Access Point
SB Reserved 1	0	2 2		264...265	SB Reserved 1
SB Reserved 2	0	2 3		266...267	SB Reserved 2
SB Reserved 3	0	2 4		268...269	SB Reserved 3
SB Command	0	2 5		270...271	SB Command
SB Status Group 1	0	2 6	264...265		SB Status Group 1
SB Status Group 2	0	2 7	266...267		SB Status Group 2
SB Status Group 3	0	2 8	268...269		SB Status Group 3
SB Response	0	2 9	270...271		SB Response

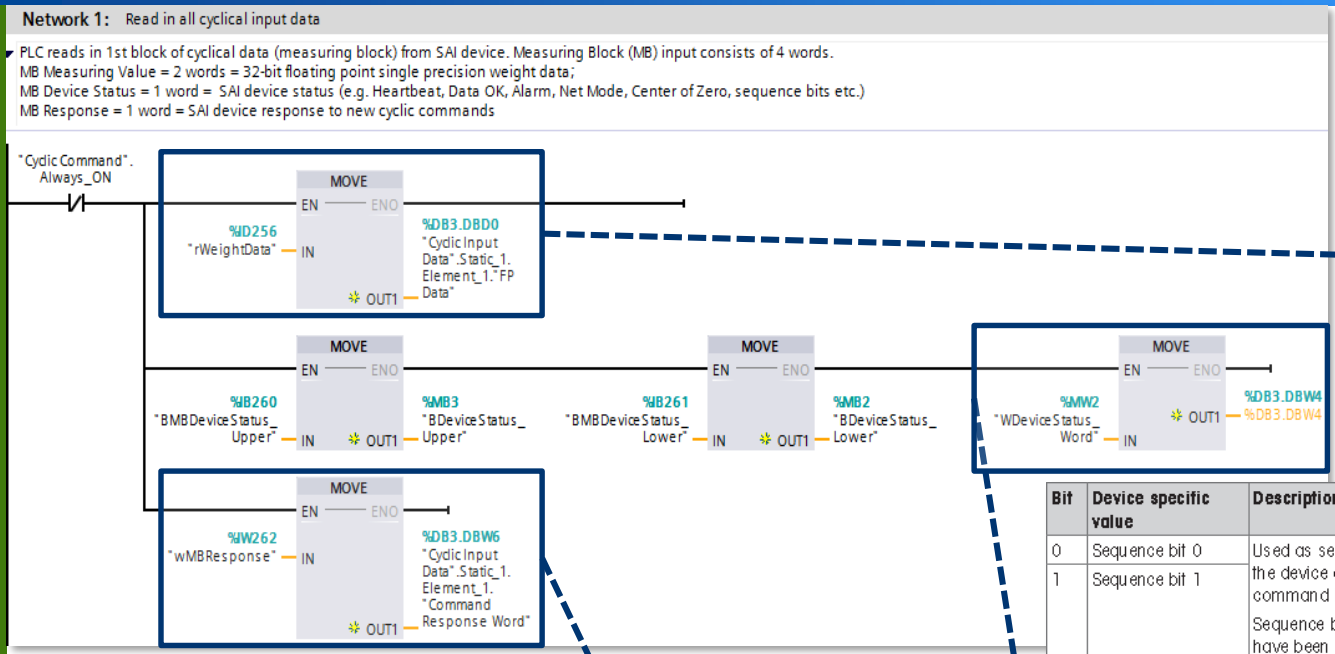
ACT350 Precision Device Overview

Cyclic Input Data

	Name	Data type	Offset	Monitor value
1	Static			
2	Static_1	"Measuring Block Read"	0.0	
3	Element_1	Struct	0.0	
4	FP Data	Real	0.0	-0.0009
5	Measuring Status Read	"MB Measuring Status Bits"	4.0	
6	Element_1	Struct	0.0	
7	Sequence Bit 0	Bool	0.0	FALSE
8	Sequence Bit 1	Bool	0.1	FALSE
9	Heart Bit	Bool	0.2	TRUE
10	Data OK	Bool	0.3	TRUE
11	Alarm	Bool	0.4	FALSE
12	Center of Zero	Bool	0.5	FALSE
13	In Motion	Bool	0.6	FALSE
14	Net Mode	Bool	0.7	FALSE
15	Alternate Weight unit	Bool	1.0	FALSE
16	Device Specific Bit 1	Bool	1.1	FALSE
17	Device Specific Bit 2	Bool	1.2	FALSE
18	Device Specific Bit 3	Bool	1.3	FALSE
19	Device Specific Bit 4	Bool	1.4	FALSE
20	Device Specific Bit 5	Bool	1.5	FALSE
21	Device Specific Bit 6	Bool	1.6	FALSE
22	Device Specific Bit 7	Bool	1.7	FALSE
23	Command Response Word	Word	6.0	16#0000

Cyclic input Data DataBlock DB3

Programming – Cyclic Data



Cyclic Program – Network 1

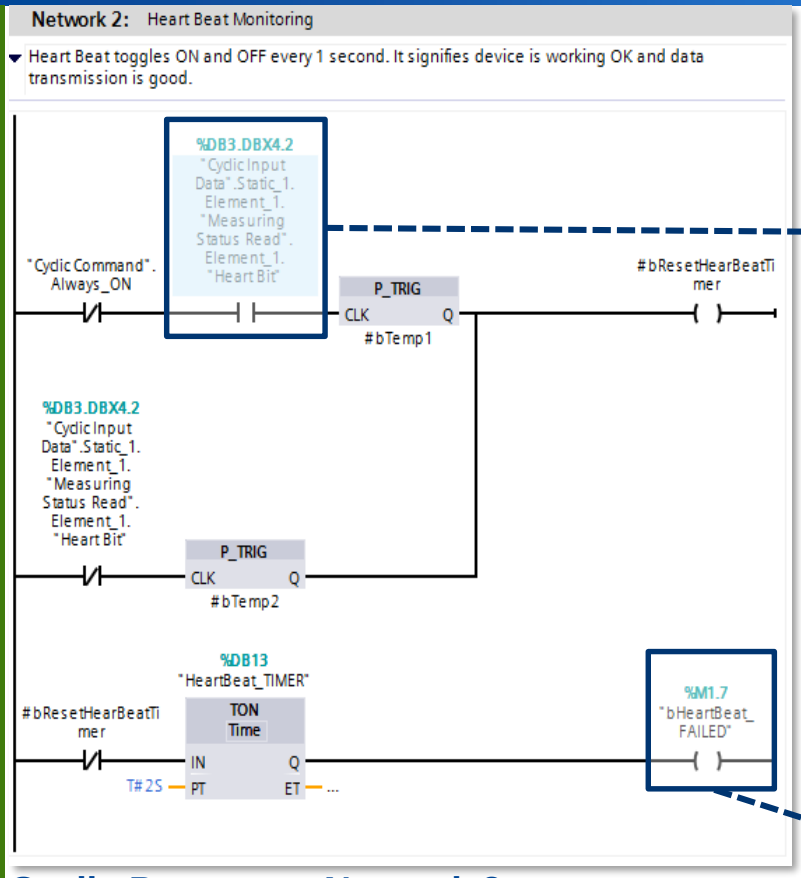
"rWeightData" is a 32-bit single precision floating point weight value read into PLC input words 0 and 1.
This data is by default gross weight, it can also be net weight, tare weight and others depending on which PLC command is sent.

"wMBResponse" is read into PLC input word 3. It provides feedback to PLC on the state of last command issued. Status can be failed, succeeded or timeout.
If the last command is succeeded, the command will be copied to this response word.

Bit	Device specific value	Description
0	Sequence bit 0	Used as sequence toggle bits. When commands are sent by the control system, the device changes the value of the sequence bits as an indication that the command has been seen and acted on. Sequence bits are used during a sequence of commands to ensure that there have been no sequencing errors in the request and the response of data. They are updated on every new command.
1	Sequence bit 1	
2	Heart beat	Toggles between 0 and 1 (1 sec.) to ensure that the device is operational and updating data in Words 0, 1 and 2.
3	Data OK	Indicates that the data being reported is OK. 0 = Device is still operational but has a critical error and the value being reported can not be guaranteed to be valid (e.g. over capacity).
4	Alarm condition	The alarm condition indicates a system error. The nature of the error can be determined using a field value command. 1 = Application fault; predictive diagnostics alarm or command received cannot be executed as requested.
5	Center of zero	1 = Gross weight value is at a value of zero +/- one quarter of a weight and measures verification interval denoted as "e".
6	Motion	1 = Weight is unstable.
7	Net Mode	1 = Net weight instead of gross weight is reported.
8	Alternate weight unit	1 = An alternate weight unit, other than the primary unit is in use.
9	Device specific bit 1	These bits are used to provide device specific status information e.g. I/O or application status.
10	Device specific bit 2	
11	Device specific bit 3	
12	Device specific bit 4	
13	Device specific bit 5	
14	Device specific bit 6	
15	Device specific bit 7	

See SAI Reference Manual – MB Device Status (PLC input word 2)

Programming – Cyclic Data



Cyclic Program – Network 2

Bit	Device specific value	Description
0	Sequence bit 0	Used as sequence toggle bits. When commands are sent by the control system, the device changes the value of the sequence bits as an indication that the command has been seen and acted on. Sequence bits are used during a sequence of commands to ensure that there have been no sequencing errors in the request and the response of data. They are updated on every new command.
1	Sequence bit 1	
2	Heart beat	Toggles between 0 and 1 (1 sec.) to ensure that the device is operational and updating data in Words 0, 1 and 2.
3	Data OK	Indicates that the data being reported is OK. 0 = Device is still operational but has a critical error and the value being reported can not be guaranteed to be valid (e.g. over capacity).
4	Alarm condition	The alarm condition indicates a system error. The nature of the error can be determined using a field value command. 1 = Application fault; predictive diagnostics alarm or command received cannot be executed as requested.
5	Center of zero	1 = Gross weight value is at a value of zero +/- one quarter of a weight and measures verification interval denoted as "e".
6	Motion	1 = Weight is unstable.
7	Net Mode	1 = Net weight instead of gross weight is reported.
8	Alternate weight unit	1 = An alternate weight unit, other than the primary unit is in use.
9	Device specific bit 1	These bits are used to provide device specific status information e.g. I/O or application status.
10	Device specific bit 2	
11	Device specific bit 3	
12	Device specific bit 4	
13	Device specific bit 5	
14	Device specific bit 6	
15	Device specific bit 7	

See SAI Reference Manual – MB Device Status (PLC input word 2)

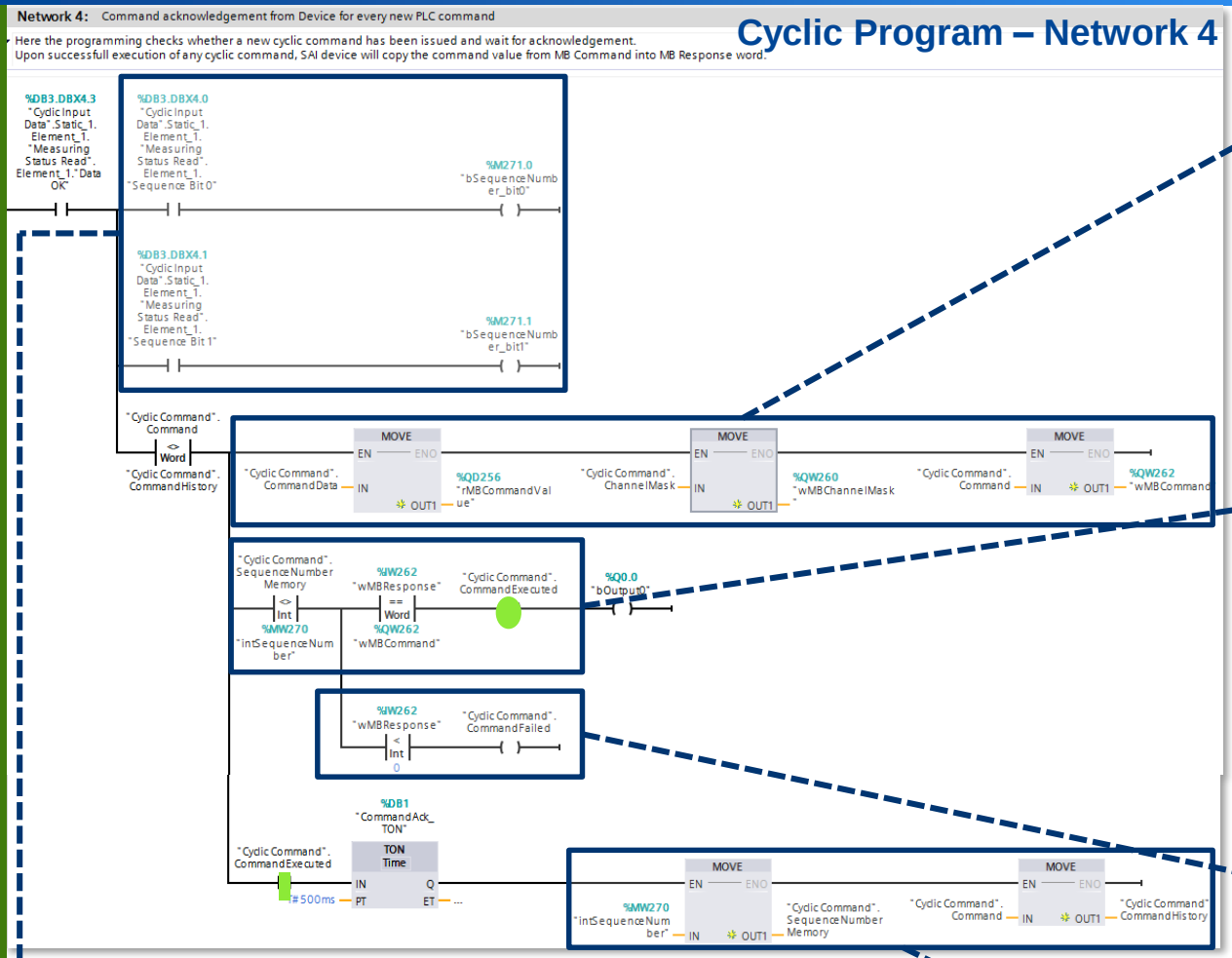
This is a crucial bit for PLC to monitor communication with ACT350 . Heart beat failed flag will be turned ON if Heartbeat bit stops toggling for more than 2 seconds

Heart Beat bit is also the first bit to check after downloaded the new network configuration to make sure Profinet communication has been set up and working properly.

Programming – Cyclic Data

3. New Command Acknowledgement

Cyclic Program – Network 4



Bit	Device specific value	Description
0	Sequence bit 0	Used as sequence toggle bits. When commands are sent by the control system, the device changes the value of the sequence bits as an indication that the command has been seen and acted on. Sequence bits are used during a sequence of commands to ensure that there have been no sequencing errors in the request and the response of data. They are updated on every new command.
1	Sequence bit 1	

See SAI Reference Manual – MB Device Status (PLC input word 2)

PLC will issue a new command to ACT350 after detecting a different command than previously executed. Command data (pre-tare weight, comparator setpoints, filter settings etc.) will also be sent to ACT350 if available

If new command has been received and acted on by ACT350, sequence bits 0 and 1 will be incremented (intSequenceNumber goes 0-1-2-3).

If the new command has been successfully executed, the command itself will be displayed in wMBResponse

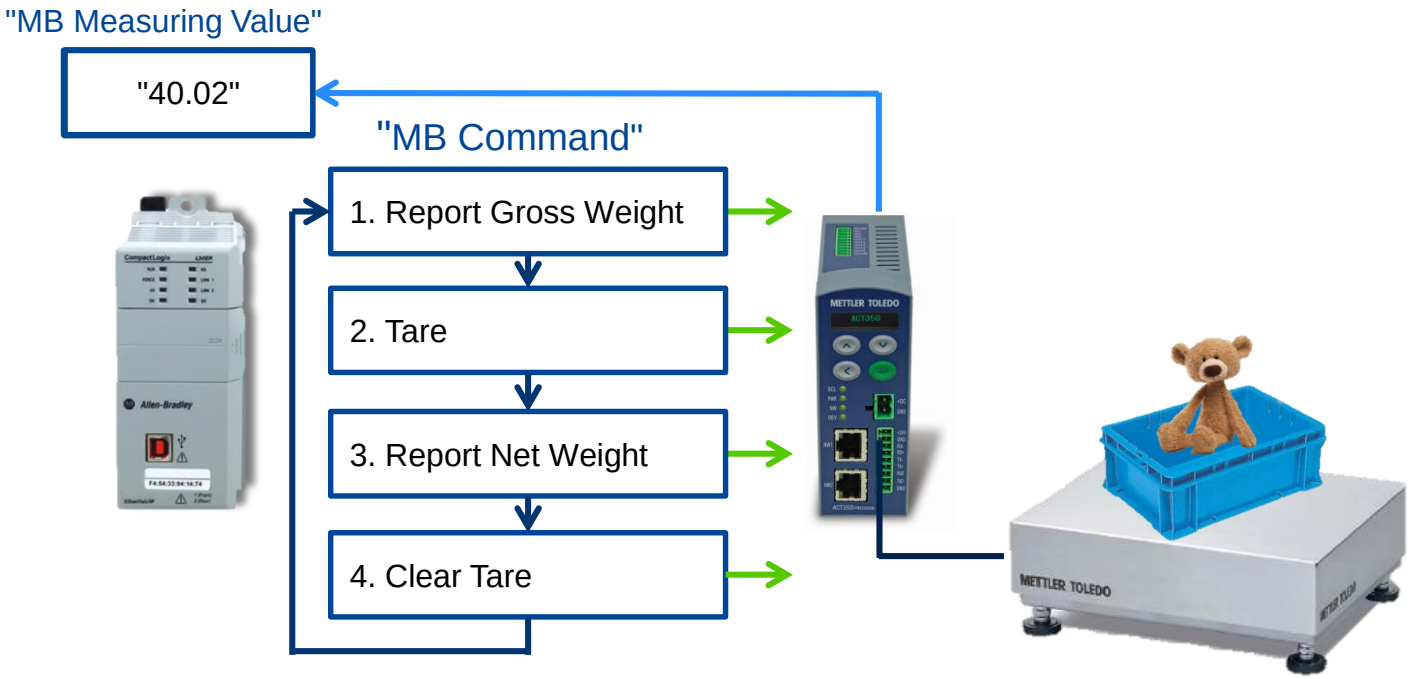
The above 2 conditions will then toggle CommandExecuted bit

However, if the new command cannot be executed successfully, wMBResponse word will be showing error responses such as "-32767" and then CommandFailed bit will be triggered

After CommandExecuted bit is set, PLC records the latest command in CommandHistory and Sequence Bits pattern in SequenceNumberMemory for next cycle of command checking

Programming – Cyclic Data

Example: typical PLC commands to Weighing transmitter



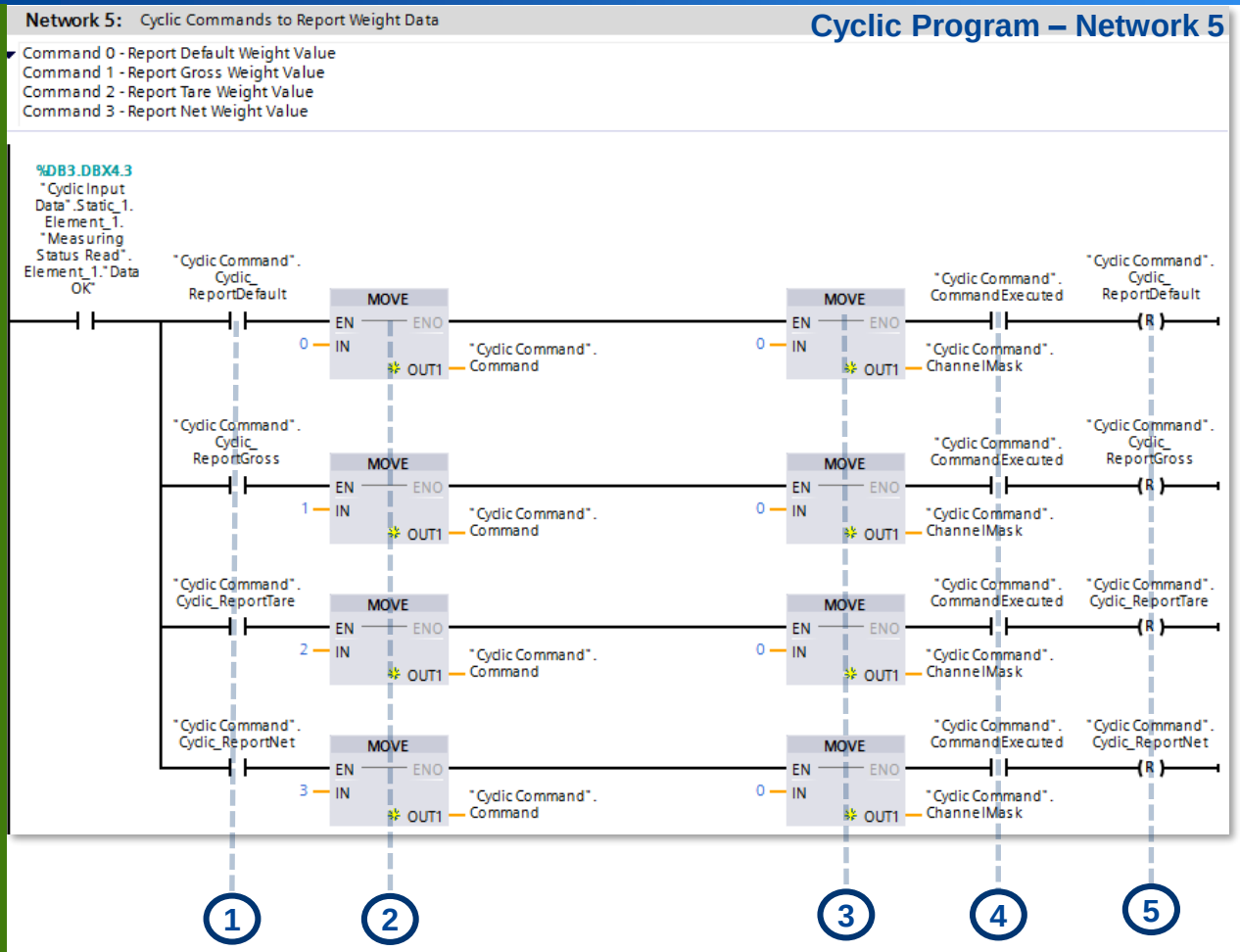
1. Initially upon successful integration of ACT350 onto Ethernet IP network, ACT350 is already sending cyclic default (gross) weight value to the PLC. Or if some other command had been executed earlier, a "Report Gross Weight" command has to be sent to the ACT350 in order to receive continuous stream of gross weight values.
2. After a "Tare" command is sent, ACT350 will execute the Tare command (switch to Net mode) but stop updating/ reporting its gross weight values.
3. In order to measure the product net weight, a "Report Net Weight" command has to be issued to the ACT350.
4. Lastly, after a "Clear Tare" command has been sent to ACT350, it will switch into gross mode and stop updating its net weight values.

Note:
MB is Measuring Block

Programming – Cyclic Data

5. Reporting Weight Data to PLC

Cyclic Program – Network 5



1. Trigger bit to read in floating point format weight data

2. Place the respective command value into PLC command word (PLC output word 3)

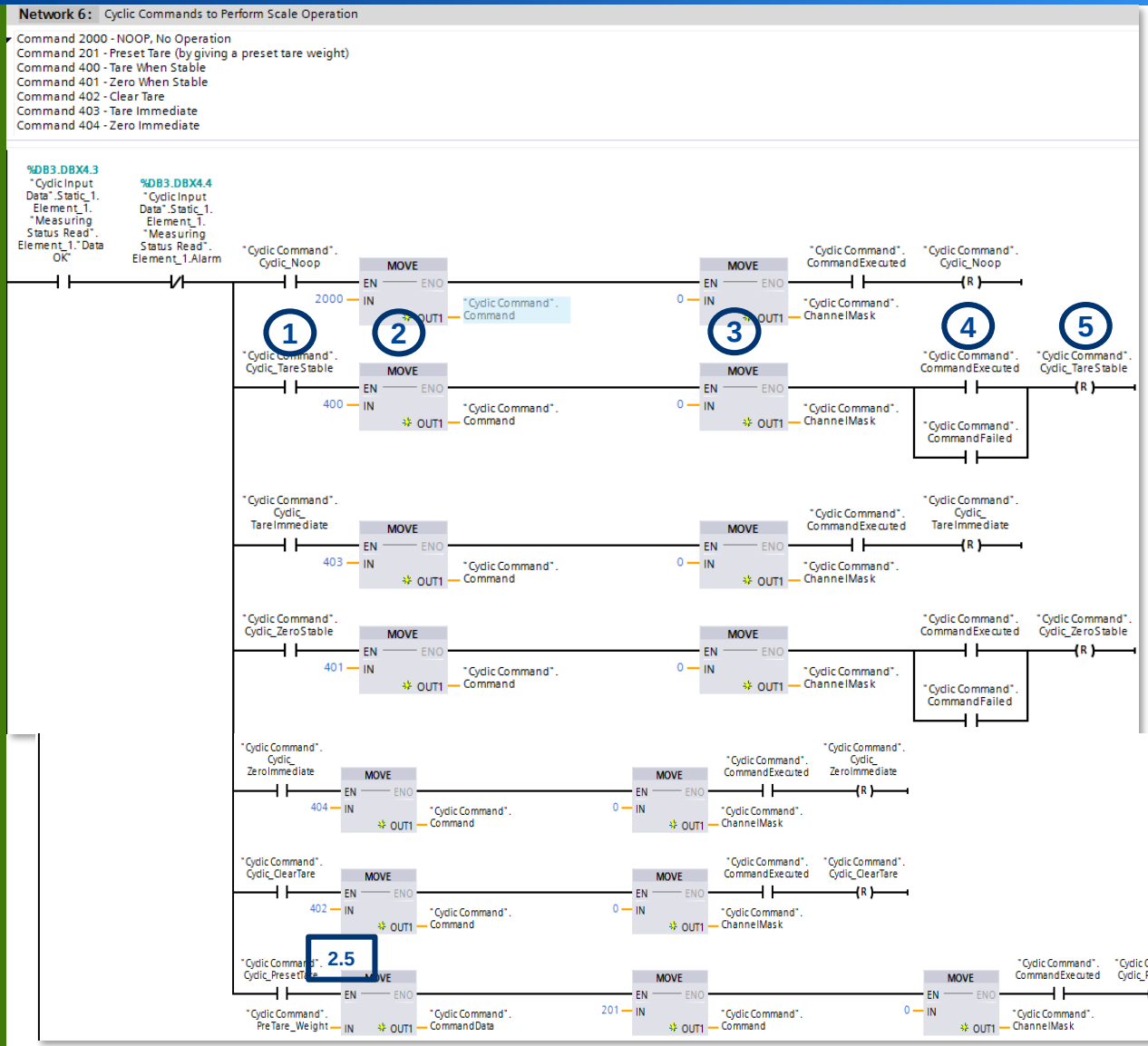
Command	Description
0 (default)	Gross weight - rounded
1	Gross weight - rounded
2	Tare weight - rounded
3	Net weight - rounded
5	Gross weight - internal resolution
6	Tare weight - internal resolution
7	Net weight - internal resolution

3. ChannelMask is "0" as there is only single scale channel on ACT350 Precision

4. Waiting for CommandExecuted bit, which is triggered in Network 4 (see slide 17). This bit confirms that command has been executed successfully

5. Reset the command triggering bit

Programming – Cyclic Data



Cyclic Program – Network 6

1. Trigger bit to send scale command to ACT350 Precision

2. Place the respective command value into PLC command word (PLC output word 3)

Command	Description
400	Tare when stable
401	Zero when stable
402	Clear tare
403	Tare immediately
404	Zero immediately
201	Preset tare (display unit)

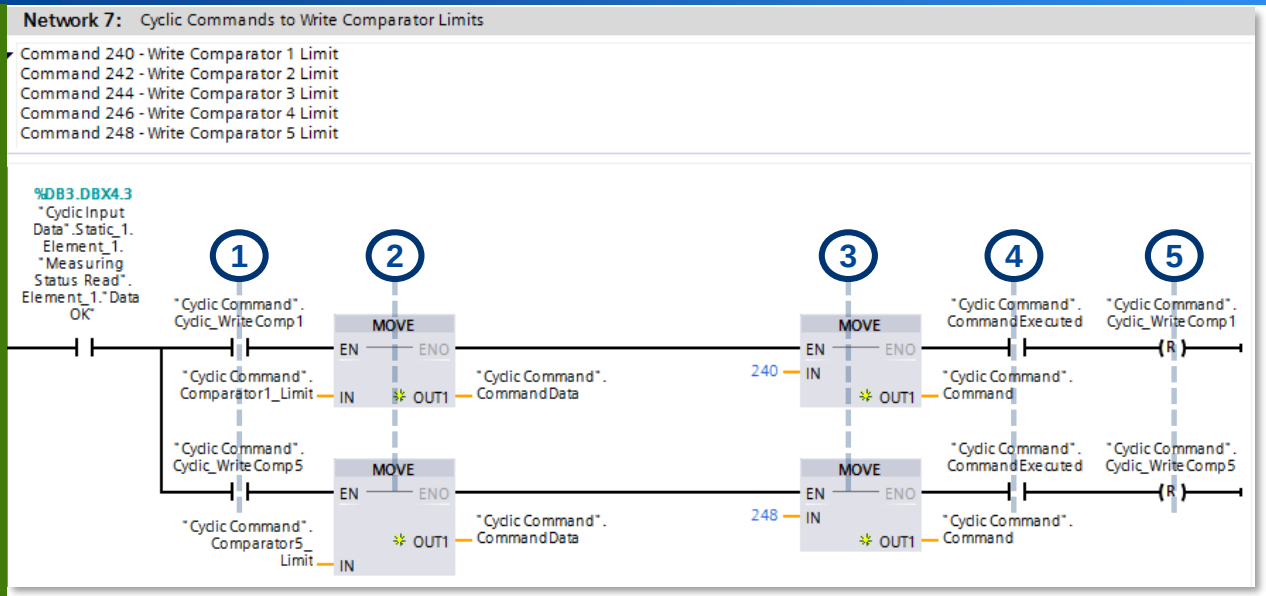
2.5. If Scale command requires a floating point command data (pretare value, comparator setpoints etc.) , move the data into CommandData (PLC output word 0 and 1).

3. ChannelMask is "0" as there is only single scale channel on ACT350 Precision

4. Waiting for CommandExecuted or CommandFailed bit, which is triggered in Network 4 (see slide 17). CommandExecuted bit confirms that command has been executed successfully

5. Reset the command triggering bit

Programming – Cyclic Data



Cyclic Program – Network 7

***Make sure comparator function is enabled in ACT350 Precision before issuing PLC write/ read comparator commands.**

1. Trigger bit to send write comparator limit command to ACT350 Precision

2. Place floating point comparator limit into CommandData (PLC output word 0 and 1)

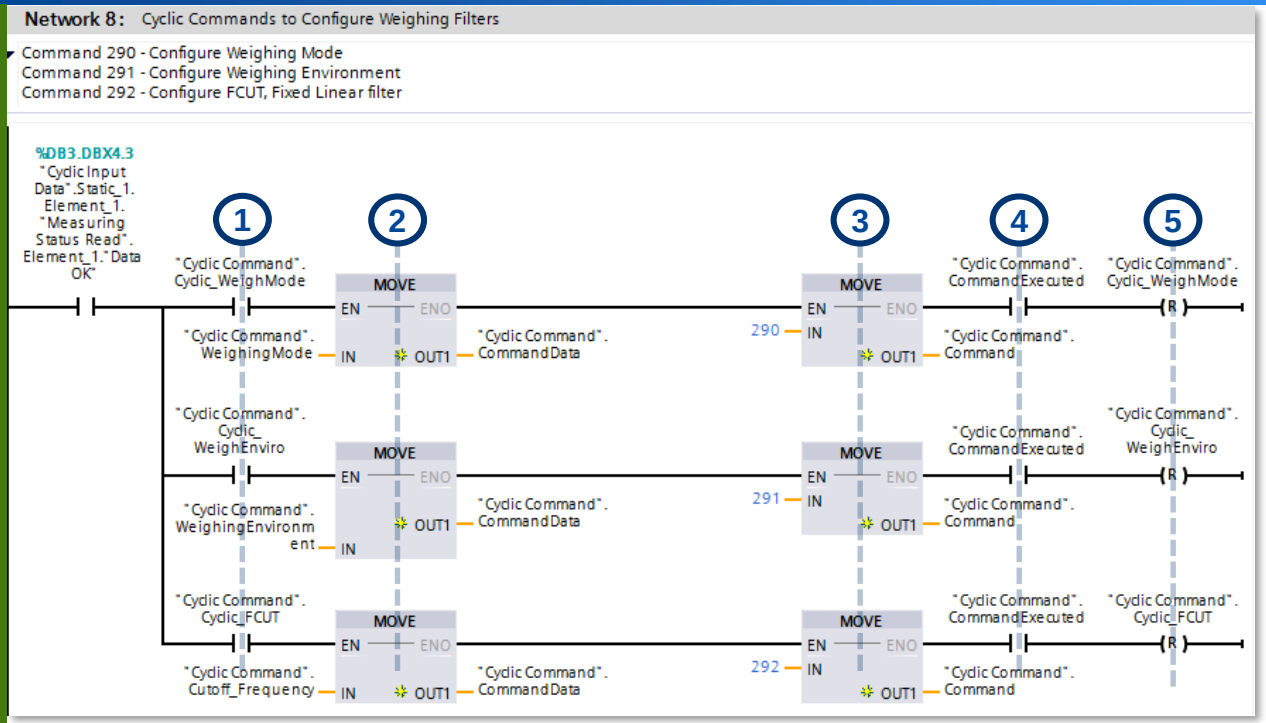
3. Place the respective command value into PLC command word (PLC output word 3)

Write Comparator 1 Limit	**240**
Write Comparator 2 Limit	**242**
Write Comparator 3 Limit	**244**
Write Comparator 4 Limit	**246**
Write Comparator 5 Limit	**248**

4. Waiting for CommandExecuted bit, which is triggered in Network 4 (see slide 17). This bit confirms that command has been executed successfully

5. Reset the command triggering bit

Programming – Cyclic Data



Cyclic Program – Network 8

***These filter settings can also be configured via web server and APW-Link (if APW is connected to ACT350 Precision)**

***Environment and Linear Filter FCUT settings will only take effect when Weighing Mode is set to "2.00" – Sensor/ Fixed Filter mode**

1. Trigger bit to send write filter setting command to ACT350 Precision

2. Place floating point filter settings into CommandData (PLC output word 0, 1)

Weighing Mode: 0-Universal; 2-Sensor Mode/ Fixed Filter
Weighing Environment: 0-Very Stable; 1-Stable; 2-Standard; 3-Unstable; 4-Very Unstable
FCUT (Cut-off Frequency): 0.001 ~ 20.0Hz

3. Place the respective command value into PLC command word (PLC output word 3)

Command	Description
290	Write weighing mode
90	Report weighing mode
291	Write weighing environment
91	Report weighing environment
292	Write filter cut-off frequency
92	Report filter cut-off frequency
290	Write weighing mode

4. Waiting for CommandExecuted bit, which is triggered in Network 4 (see slide 17). This bit confirms that command has been executed successfully

5. Reset the command triggering bit

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Programming – Acyclic Data

Acyclic Communication

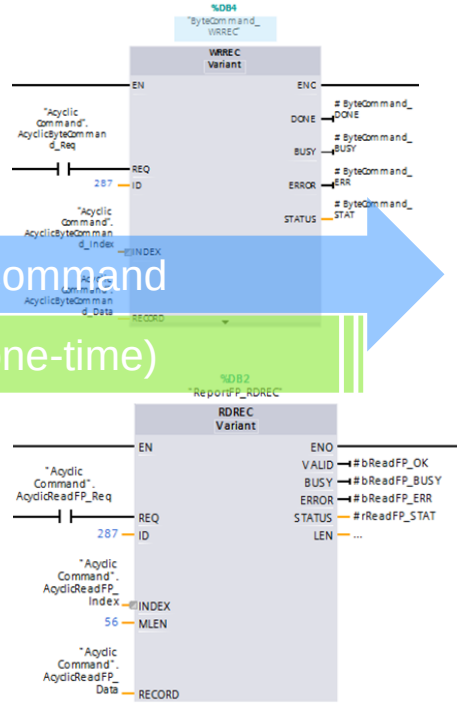
- "on demand" / "one-time-off" data request/ command by the PLC
- TCP/IP Messaging, not real time, only a snapshot of data and no automatic update of most current data
- Usually used for setup data and calibration or test during no operation. Or special device information required not frequently.

Index table given by SAI manual..

PROFINET IO RT			Description
Slot	Sub slot	Index	
0	1	0x2010	Tare when stable
0	1	0x2013	Zero when stable
0	1	0x2012	Clear tare
0	1	0x2011	Tare immediately
0	1	0x2014	Zero immediately
0	1	0x2020	Preset tare (display unit

PROFINET IO RT			Description
Slot	Sub slot	Index	
0	1	0x2000	Gross weight - rounded
0	1	0x2001	Gross weight - rounded
0	1	0x2002	Tare weight - rounded
0	1	0x2003	Net weight - rounded
0	1	0x2004	Gross weight - internal resolution
0	1	0x2005	Tare weight - internal resolution
0	1	0x2006	Net weight - internal resolution

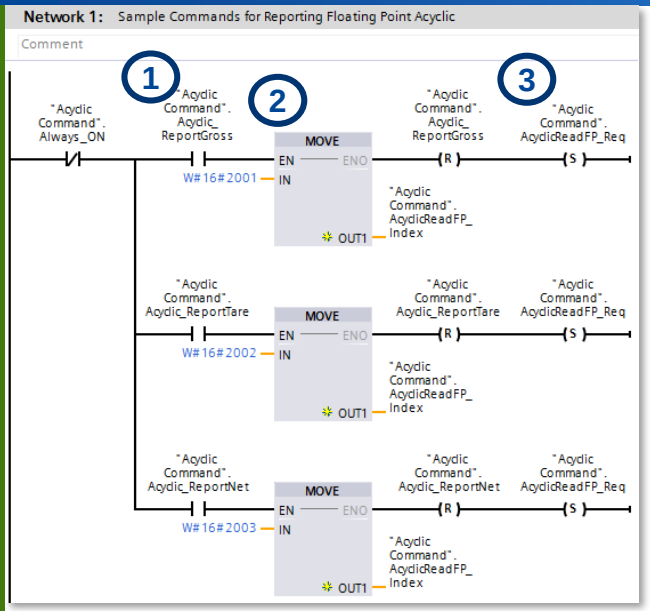
TIA Portal RDREC, WRREC function configuration



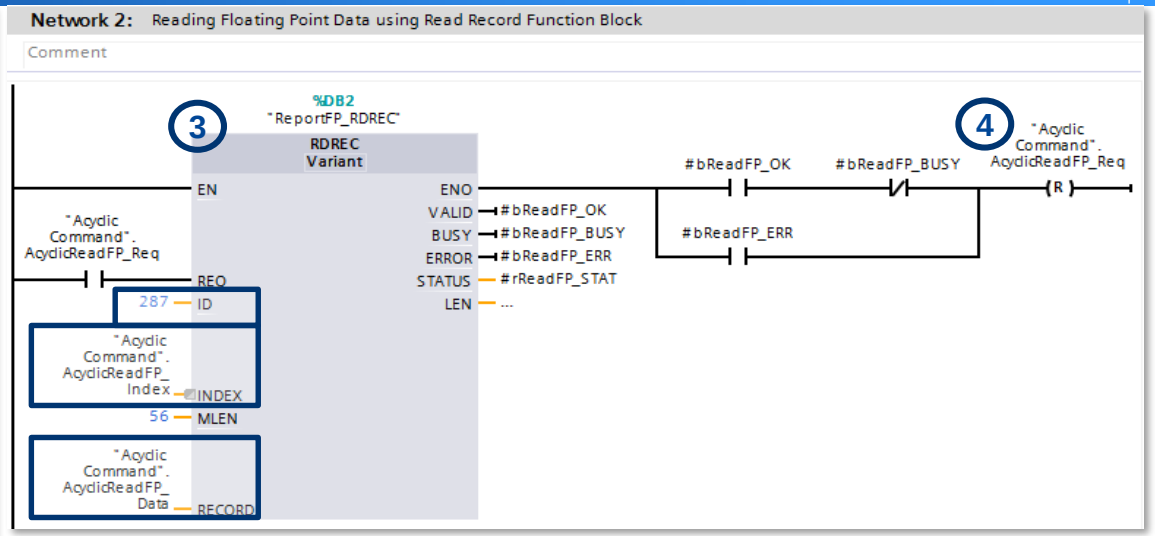
Command

Read (one-time)

Programming – Acyclic Data



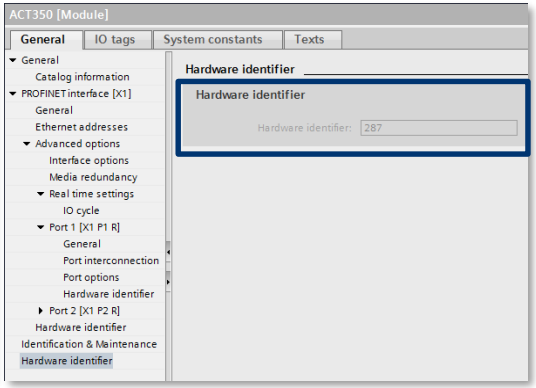
Acyclic Program – Network 1



Acyclic Program – Network 2

PROFINET IO RT			Data Type	Description
Slot	Sub slot	Index	Type bits	
0	1	0x2000	Float 32	Gross weight - rounded
0	1	0x2001	Float 32	Gross weight - rounded
0	1	0x2002	Float 32	Tare weight - rounded
0	1	0x2003	Float 32	Net weight - rounded
0	1	0x2004	Float 32	Gross weight - internal resolution
0	1	0x2005	Float 32	Tare weight - internal resolution
0	1	0x2006	Float 32	Net weight - internal resolution

See SAI Reference Manual – 11. SAI Measuring Block Command List



Hardware Identifier as found in ACT350 Precision Module Parameter

Trigger acyclic command bit to request for floating point weight data

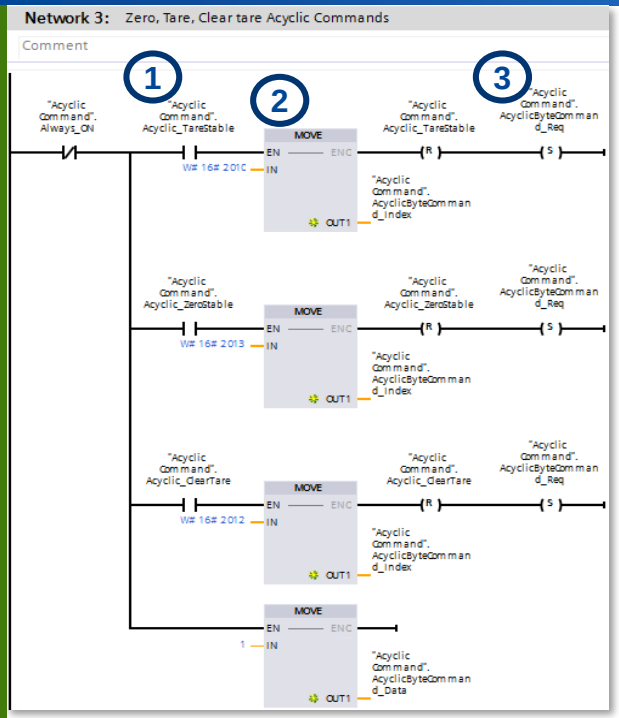
Command indexes can be found in SAI manual

Trigger RDREC (Read Data Record) function by providing:
- ID: Hardware identifier
- INDEX: Acyclic command index

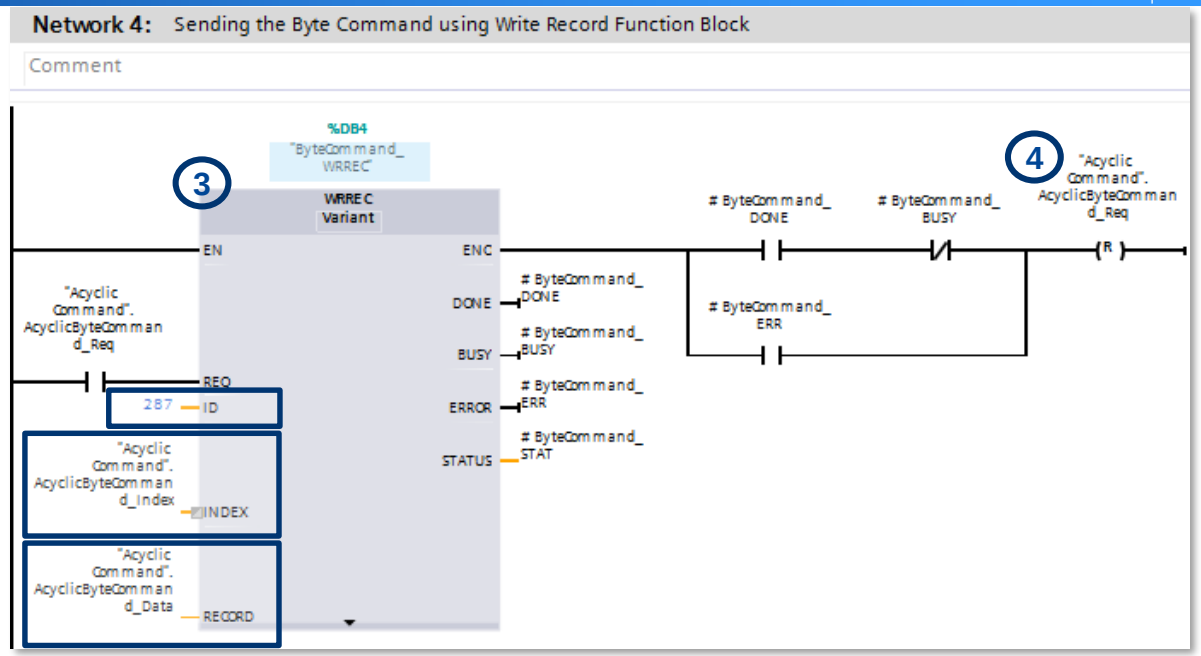
Reported weight data will be copied to "AcyclicReadFP_Data" variable

Acyclic command bit will tuned off

Programming – Acyclic Data



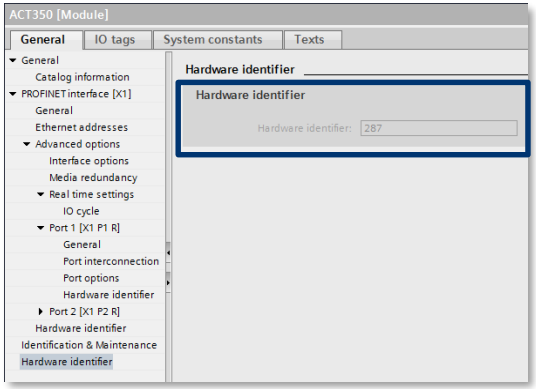
Acyclic Program – Network 3



Acyclic Program – Network 4

PROFINET IO RT			Data Type	Description
Slot	Sub slot	Index	Type bits	
0	1	0x2010	UInt 8	Tare when stable
0	1	0x2013	UInt 8	Zero when stable
0	1	0x2012	UInt 8	Clear tare
0	1	0x2011	UInt 8	Tare immediately
0	1	0x2014	UInt 8	Zero immediately
0	1	0x2020	Float 32	Preset tare (display unit

See SAI Reference Manual – 11. SAI Measuring Block Command List



Hardware Identifier as found in ACT350 Precision Module Parameter

Trigger acyclic command bit to perform scale operations

Command indexes can be found in SAI manual

Trigger WRREC (Write Data Record) function by providing:

- ID: Hardware identifier
- INDEX: Acyclic command index
- RECORD: "AcyclicByteCommand_Data" is a 1-byte data with decimal "1"

Acyclic command bit will tuned off

Contents

1 Component Overview

2 ACT350 Precision Web Server Configuration

3 Profinet IO Network Configuration

4 SAI Cyclic Data Structure

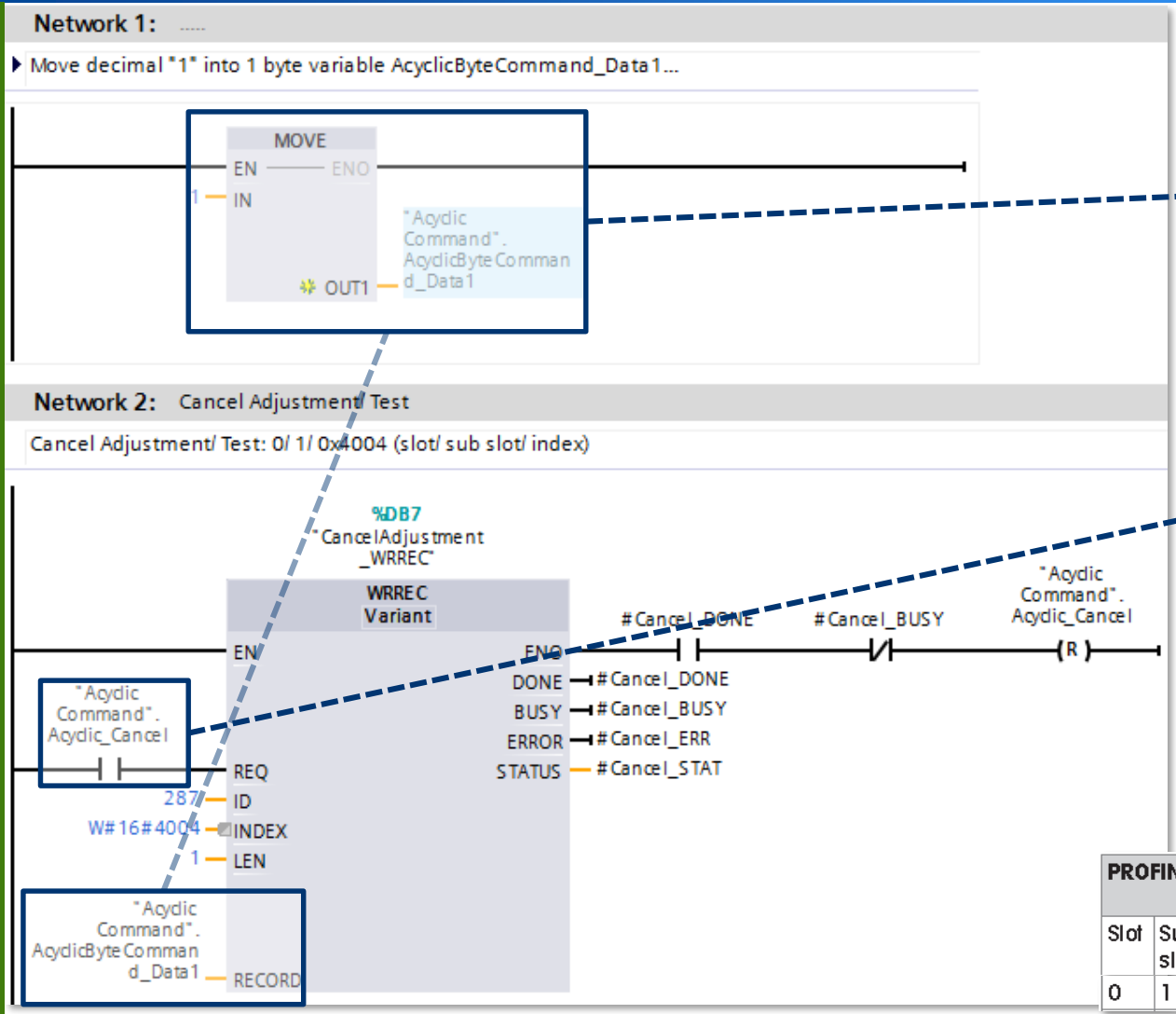
5 Programming – Cyclic Data

6 Programming – Acyclic Data

7 Programming – Scale Adjustment

Scale Adjustment: Cancel Adjustment/ Test

Cancel Adjustment Process



Since adjustment commands are byte messages, decimal "1" is loaded into "AcyclicByteCommand_Data1" short integer variable.
This "AcyclicByteCommand_Data1 " short integer will then be sent to ACT350 Precision along with explicit messaging commands.

When there is a need to cancel any adjustment process at any time, user can trigger this "Acyclic_Cancel" command to end process.
This is ACT350 Precision direct access variable 0/1/16#4004 (slot/ subslot/ index).

Scale Adjustment Program – Network 1, 2

PROFINET IO RT			Data Type	Description
Slot	Sub slot	Index	Type bits	
0	1	0x4004	UInt 8	Cancel adjustment / test

SAI Reference Manual - 11. SAI Measuring Block Command List

Scale Adjustment: Internal Adjustment

Acyclic Messages involved in Internal Adjustment Procedure:

*only applicable to weigh module which supports internal adjustment function

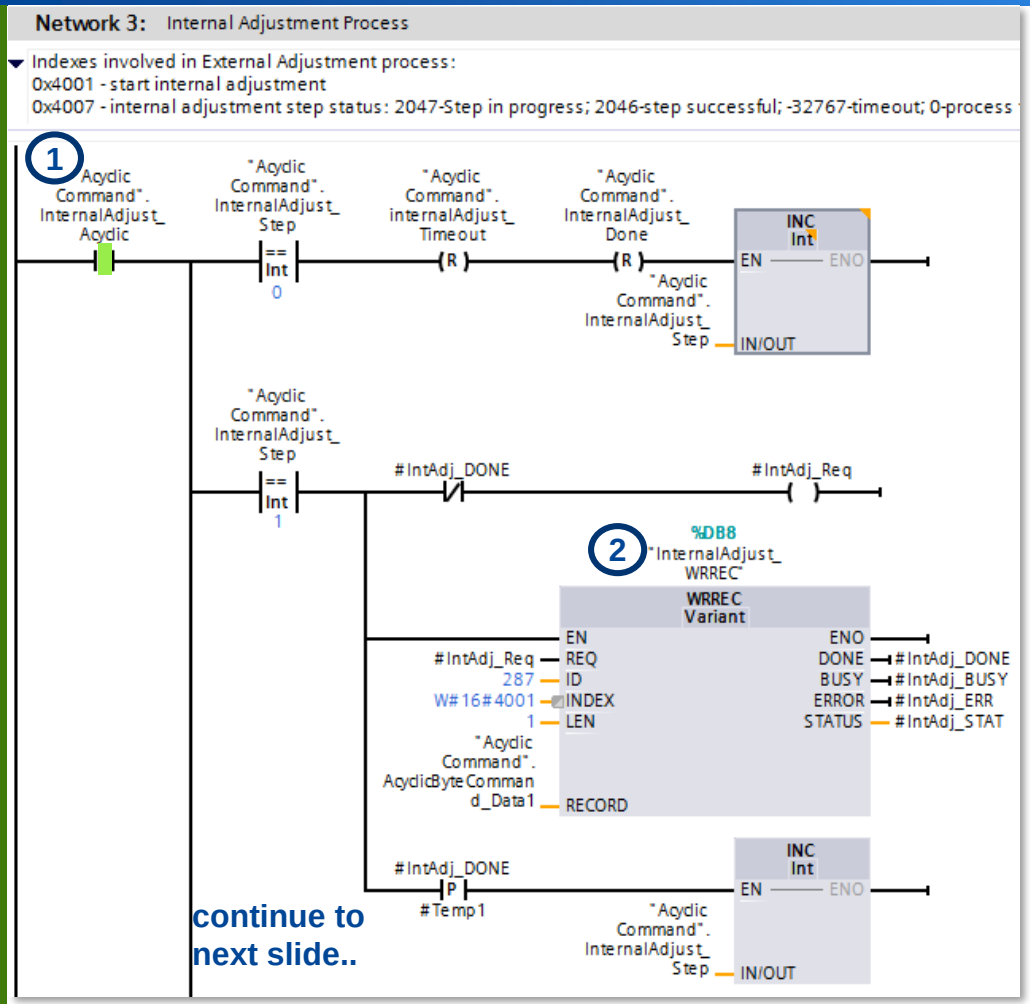
PROFINET IO RT			EtherNet/IP			PROFIBUS DP		Data Type	Description
Slot	Sub slot	Index	Class	Instance	Attribute	Slot	Index	Type bits	
0	1	0x4001	0x410	0x01	0x01	1	0x80	UInt 8	Start adjustment with internal weight

PROFINET IO RT			EtherNet/IP			PROFIBUS DP		Data Type	Description
Slot	Sub slot	Index	Class	Instance	Attribute	Slot	Index	Type bits	
0	1	0x4007	0x410	0x01	0x07	1	0x86	UInt 16	Adjustment and test status Information

Step	Description	Acyclic Slot/ Subslot/ Index	PLC Read/ Write
1	Trigger start internal adjustment (send a byte of decimal "1" via explicit messaging)	0/ 1/ 16#4001	Write
2	Read adjustment status (2046 – step successful; 2047 – executing step; -32752 – timeout error/ failed; 0 – done)	0/ 1/ 16#4007	Read

Scale Adjustment: Internal Adjustment

1. Internal Adjustment (1/2)



Scale Adjustment Program – Network 3 part 1/2

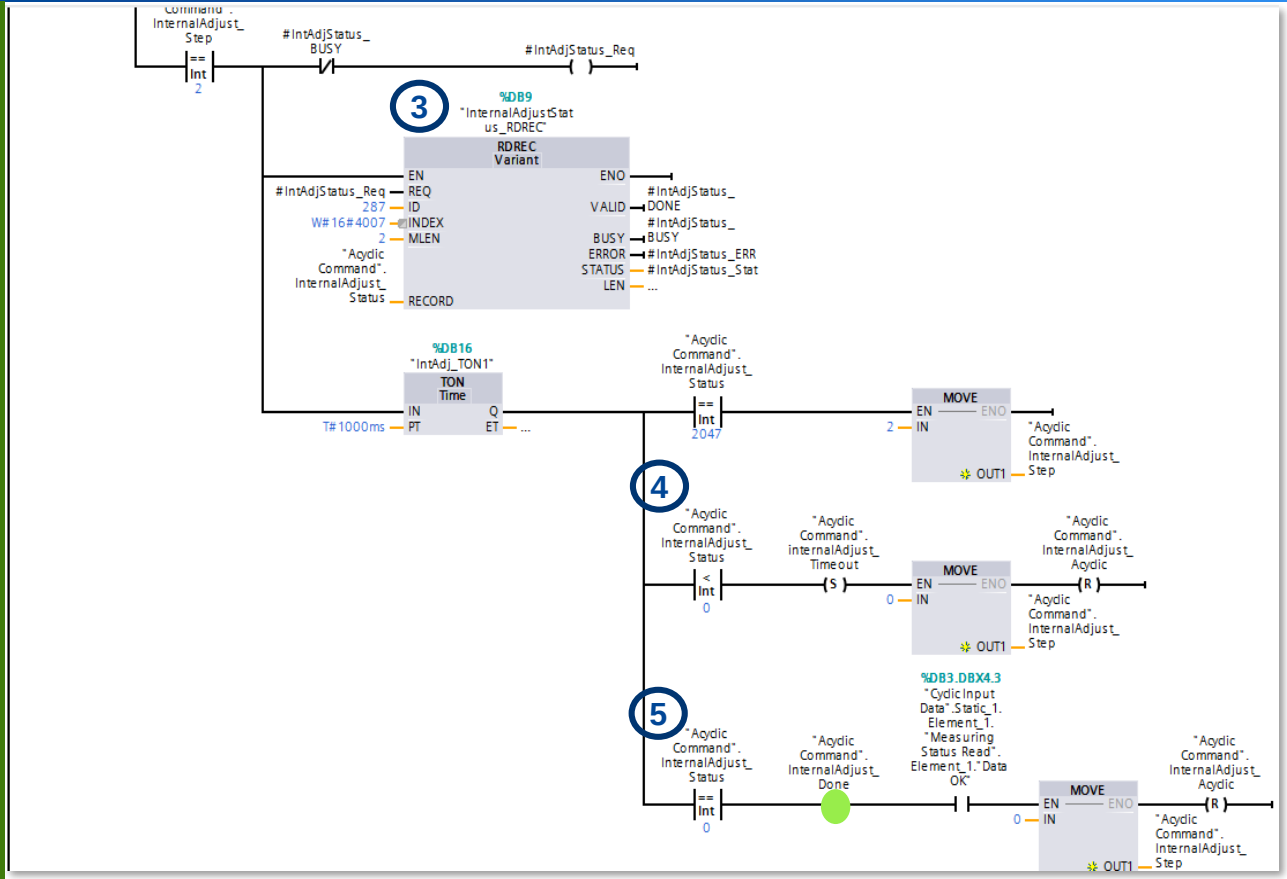
1. User trigger "InternalAdjust_Acyclic" bit

2. PLC sends an acyclic message to ACT350 Precision direct access variable 0/1/16#4001 (slot/ subslot/ index) to start Internal Adjustment process.

41		----------Internal Adjust ----------	Bool	false
42		InternalAdjust_Acyclic	Bool	
43		InternalAdjust_Step	Int	1
44		InternalAdjust_Status	Int	0
45		InternalAdjust_Done	Bool	false
46		internalAdjust_Timeout	Bool	false

Acyclic Command Data Block DB14

Scale Adjustment: Internal Adjustment



Scale Adjustment Program – Network 3 part 2/2

3. After adjustment process has been started, PLC reads direct access variable 0/1/16#4001 for adjustment status:
   - "2047" -> step in progress
   - "2046" -> step successful
   - "0" -> process completed
   - "-32752" -> error or timeout

4. If the adjustment process is taking too much time and eventually timed-out, "InternalAdjust_Timeout" bit will be turned ON.

5. Status "0" means adjustment process has been completed, Data_Okay bit will be turned back ON, PLC resets the " InternalAdjust_Acyclic " bit and turns ON "InternalAdjust_Done" bit.

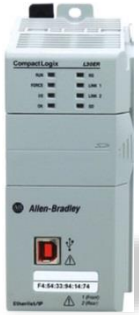
41		----------Internal Adjust ----------	Bool	false
42		InternalAdjust_Acyclic	Bool	false
43		InternalAdjust_Step	Int	2
44		InternalAdjust_Status	Int	0
45		InternalAdjust_Done	Bool	
46		internalAdjust_Timeout	Bool	false

Acyclic Command Data Block DB14

Scale Adjustment: External Adjustment

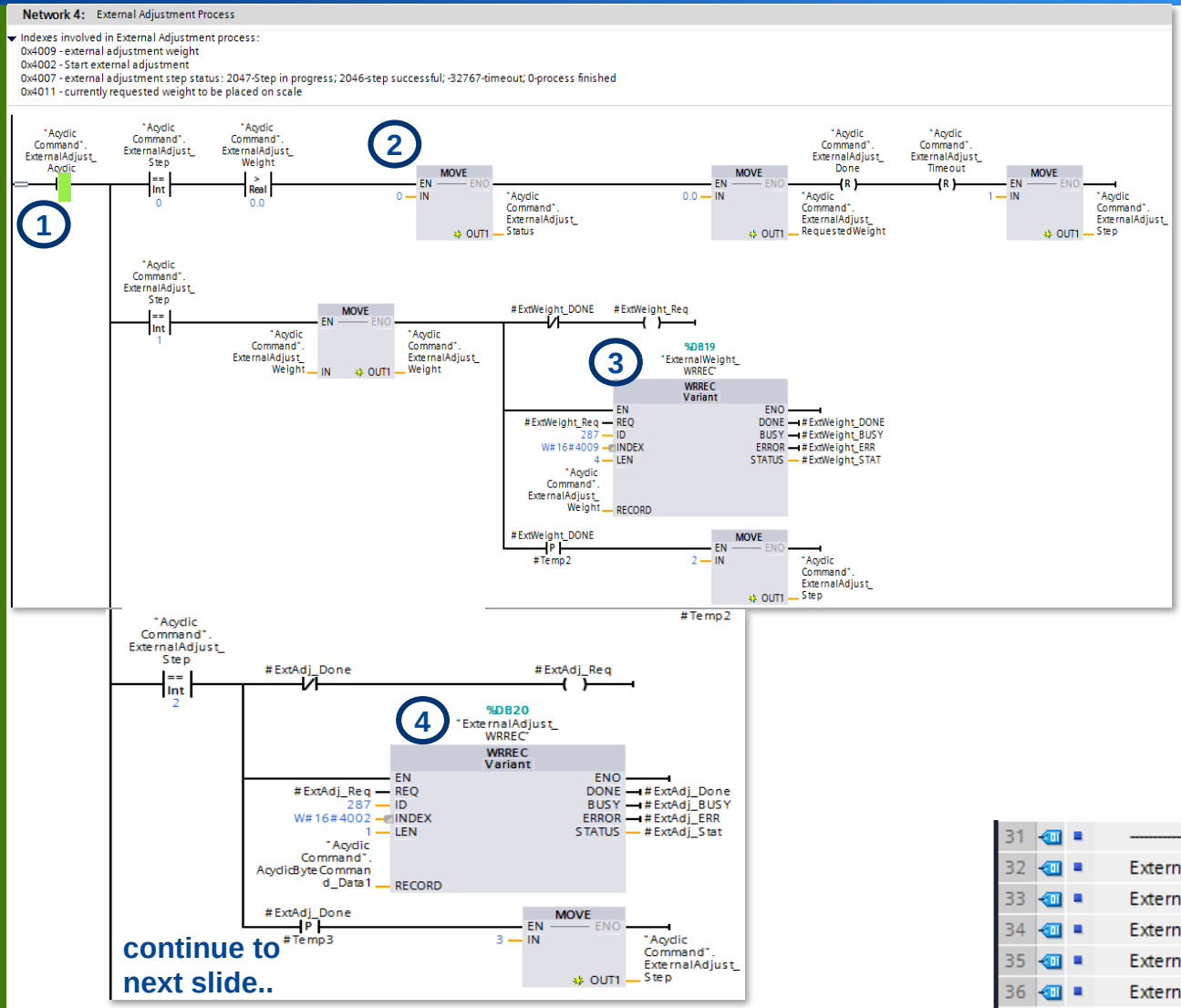
PROFINET IO RT			EtherNet/IP			PROFIBUS DP		Data Type	Description
Slot	Sub slot	Index	Class	Instance	Attribute	Slot	Index		
0	1	0x4007	0x410	0x01	0x07	1	0x80	UInt 16	Adjustment / calibration status
0	1	0x4011	0x410	0x01	0x11	1	0x91	Float 32	Currently requested weight to be placed externally
0	1	0x4002	0x410	0x01	0x02	1	0x81	UInt 8	External adjustment
0	1	0x4009	0x410	0x01	0x09	1	0x88	Float 32	External adjustment weight
0	1	0x4004	0x410	0x01	0x04	1	0x83	UInt 8	Cancel adjustment

External Adjustment Procedure (acyclic messages):



Step	Description	Acyclic slot/ subslot/ index	PLC Read/ Write
1	Configure external adjustment weight (span weight)	0/ 1/ 16#4009	Write
2	Trigger start external adjustment (send a byte of decimal "1" via acyclic messaging)	0/ 1/ 16#4002	Write
3	Cyclic data – Data Okay bit will be turned OFF	(cyclic)	Read
4	Read currently requested weight to be placed on weighing pan, **0.0000 kg**	0/ 1/ 16#4011	Read
5	Read adjustment status (**2046** – step successful; 2047 – executing step; -32752 – error; 0 – done)	0/ 1/ 16#4007	Read
6	Read currently requested weight to be placed on weighing pan, for example **200.0000 kg**	0/ 1/ 16#4011	Read
7	Read adjustment status (**2046** – step successful; 2047 – executing step; -32752 – error; 0 – done)	0/ 1/ 16#4007	Read
8	Read currently requested weight to be placed on weighing pan, **0.0000 kg**	0/ 1/ 16#4011	Read
9	Read adjustment status (2046 – step successful; 2047 – executing step; -32752 – error; **0** – done)	0/ 1/ 16#4007	Read
10	Cyclic data – Data Okay bit will be turned back ON	(cyclic)	Read

Scale Adjustment: External Adjustment



Scale Adjustment Program – Network 4 part 1/4

1. User trigger "ExternalAdjust_Acyclic" bit

2. PLC initializes adjustment status, current requested weight, and turns off adjustment done and timeout bits

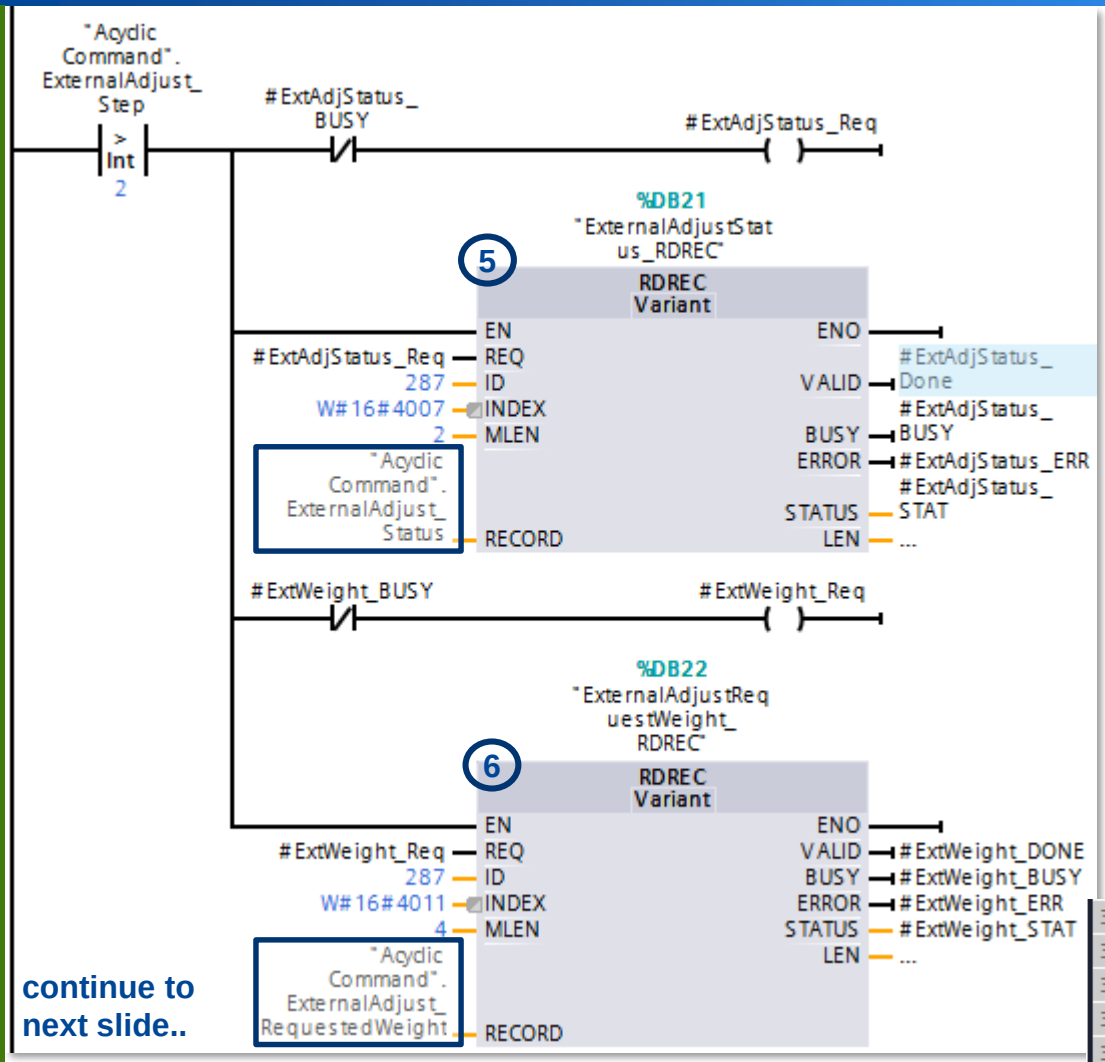
3. PLC sends an acyclic message to ACT350 Precision direct access variable 0/ 1/ 16#4009 (slot/ subslot/ index) to define external weight used for this adjustment (span weight)

4. PLC sends an acyclic message to ACT350 Precision direct access variable 0/ 1/ 16#4002 (slot/ subslot/ index) to start the external adjustment process

31	----------External Adjust ----------	Bool	false
32	ExternalAdjust_Acyclic	Bool	
33	ExternalAdjust_Step	Int	2
34	ExternalAdjust_Weight	Real	200
35	ExternalAdjust_Status	Int	0
36	ExternalAdjust_RequestedWeight	Real	0.0
37	ExternalAdjust_PleaseUnloadWeight	Bool	false
38	ExternalAdjust_PleaseLoadWeight	Bool	false
39	ExternalAdjust_Done	Bool	false
40	ExternalAdjust_Timeout	Bool	false

Controller Tags for External Adjustment control

Scale Adjustment: External Adjustment



Scale Adjustment Program – Network 4 part 2/4

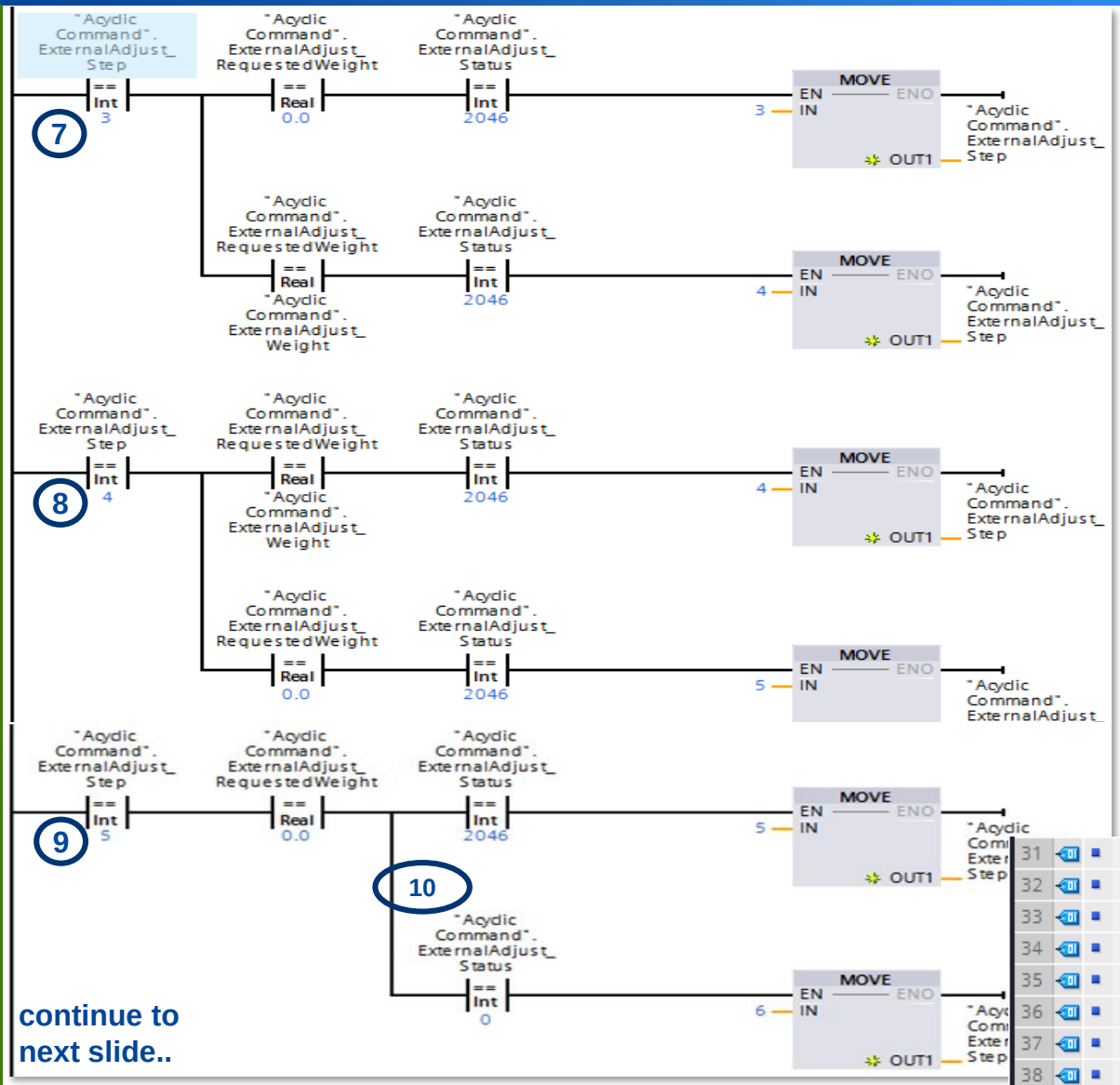
5. After adjustment process has been started, PLC reads direct access variable 0/ 1/ 16#4007 for adjustment status:
   - "2047" -> step in progress
   - "2046" -> step successful
   - "0" -> process completed
   - "-32752" -> error or timeout

6. Similarly, when adjustment process in on going, PLC reads direct access variable 0/ 1/ 16#4011 for current requested weight and updates the value to "ExternalAdjust_RequestedWeight"

31	----------External Adjust ----------	Bool	false
32	ExternalAdjust_Acyclic	Bool	
33	ExternalAdjust_Step	Int	2 - 6
34	ExternalAdjust_Weight	Real	200
35	ExternalAdjust_Status	Int	2046
36	ExternalAdjust_RequestedWeight	Real	200.0
37	ExternalAdjust_PleaseUnloadWeight	Bool	false
38	ExternalAdjust_PleaseLoadWeight	Bool	false
39	ExternalAdjust_Done	Bool	false
40	ExternalAdjust_Timeout	Bool	false

Controller Tags for External Adjustment control

Scale Adjustment: External Adjustment



Scale Adjustment Program – Network 4 part 3/4

7. Initially, ACT350 Precision requests the scale to be cleared, hence showing "0.00" in "ExternalAdjust_RequestedWeight". PLC will only move to next step when ACT350 Precision request for external weight to be loaded.

8. This step waits for user to load the external weight onto the scale.

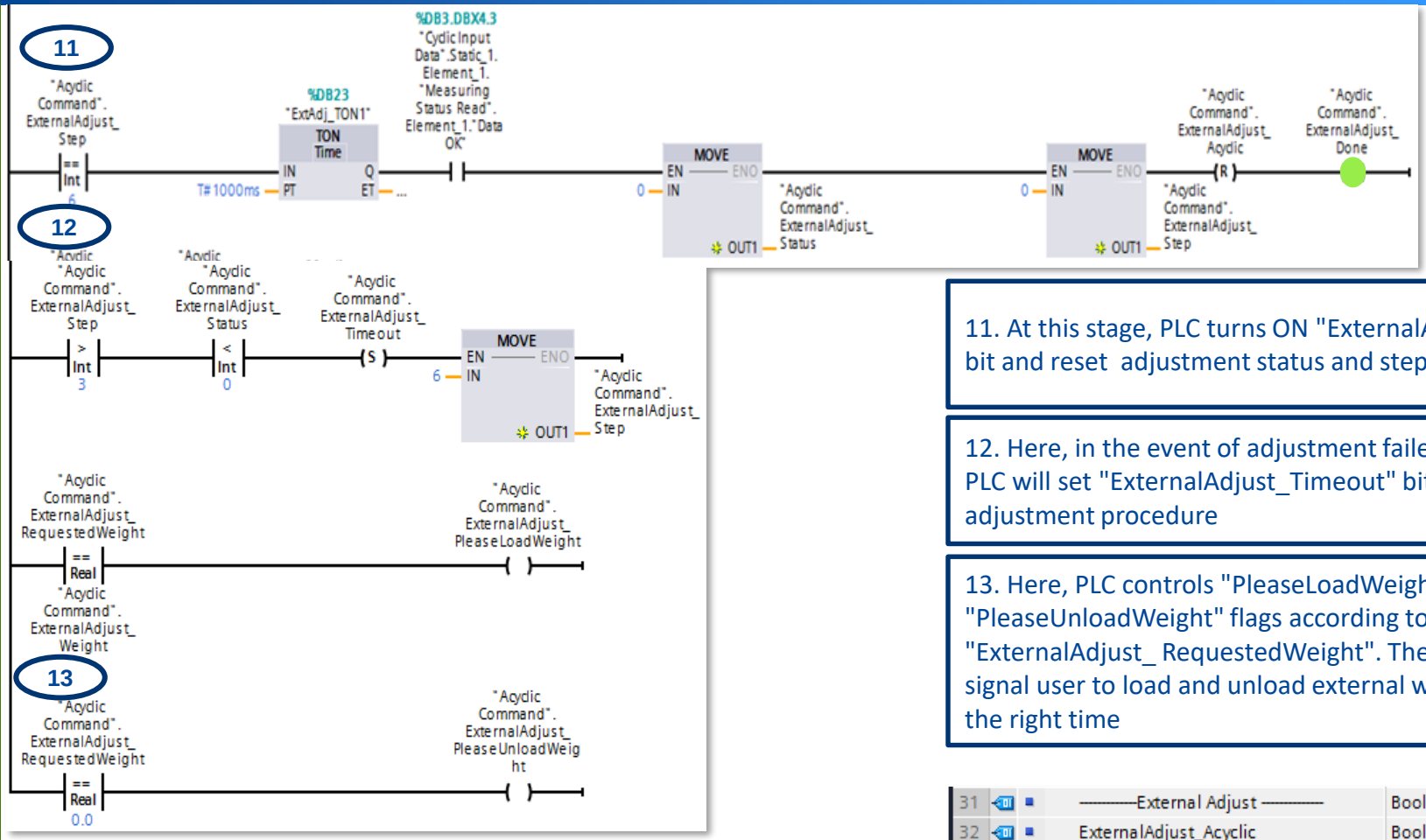
9. This step waits for user to unload the external weight from the scale.

10. After external weight has been unloaded, and "ExternalAdjust_Status" returns "0", the external adjustment process is complete

31	----------External Adjust ----------	Bool	false
32	ExternalAdjust_Acyclic	Bool	
33	ExternalAdjust_Step	Int	5
34	ExternalAdjust_Weight	Real	200
35	ExternalAdjust_Status	Int	2046
36	ExternalAdjust_RequestedWeight	Real	0.00
37	ExternalAdjust_PleaseUnloadWeight	Bool	
38	ExternalAdjust_PleaseLoadWeight	Bool	
39	ExternalAdjust_Done	Bool	false
40	ExternalAdjust_Timeout	Bool	false

Controller Tags for **External** Adjustment control

Scale Adjustment: External Adjustment



Scale Adjustment Program – Network 4 part 4/4

11. At this stage, PLC turns ON "ExternalAdjust_Done" bit and reset adjustment status and step

12. Here, in the event of adjustment failed/ timeout PLC will set "ExternalAdjust_Timeout" bit and exit the adjustment procedure

13. Here, PLC controls "PleaseLoadWeight" and "PleaseUnloadWeight" flags according to "ExternalAdjust_ RequestedWeight". These two flags signal user to load and unload external weight during the right time

31	----------External Adjust ----------	Bool	false
32	ExternalAdjust_Acyclic	Bool	false
33	ExternalAdjust_Step	Int	0
34	ExternalAdjust_Weight	Real	0.0
35	ExternalAdjust_Status	Int	0
36	ExternalAdjust_RequestedWeight	Real	0.0
37	ExternalAdjust_PleaseUnloadWeight	Bool	false
38	ExternalAdjust_PleaseLoadWeight	Bool	false
39	ExternalAdjust_Done	Bool	
40	ExternalAdjust_Timeout	Bool	

Controller Tags for External Adjustment control

Internal Test

Explicit Messages involved in Internal Test Procedure:

*only applicable to weigh module which supports internal adjustment/ test function

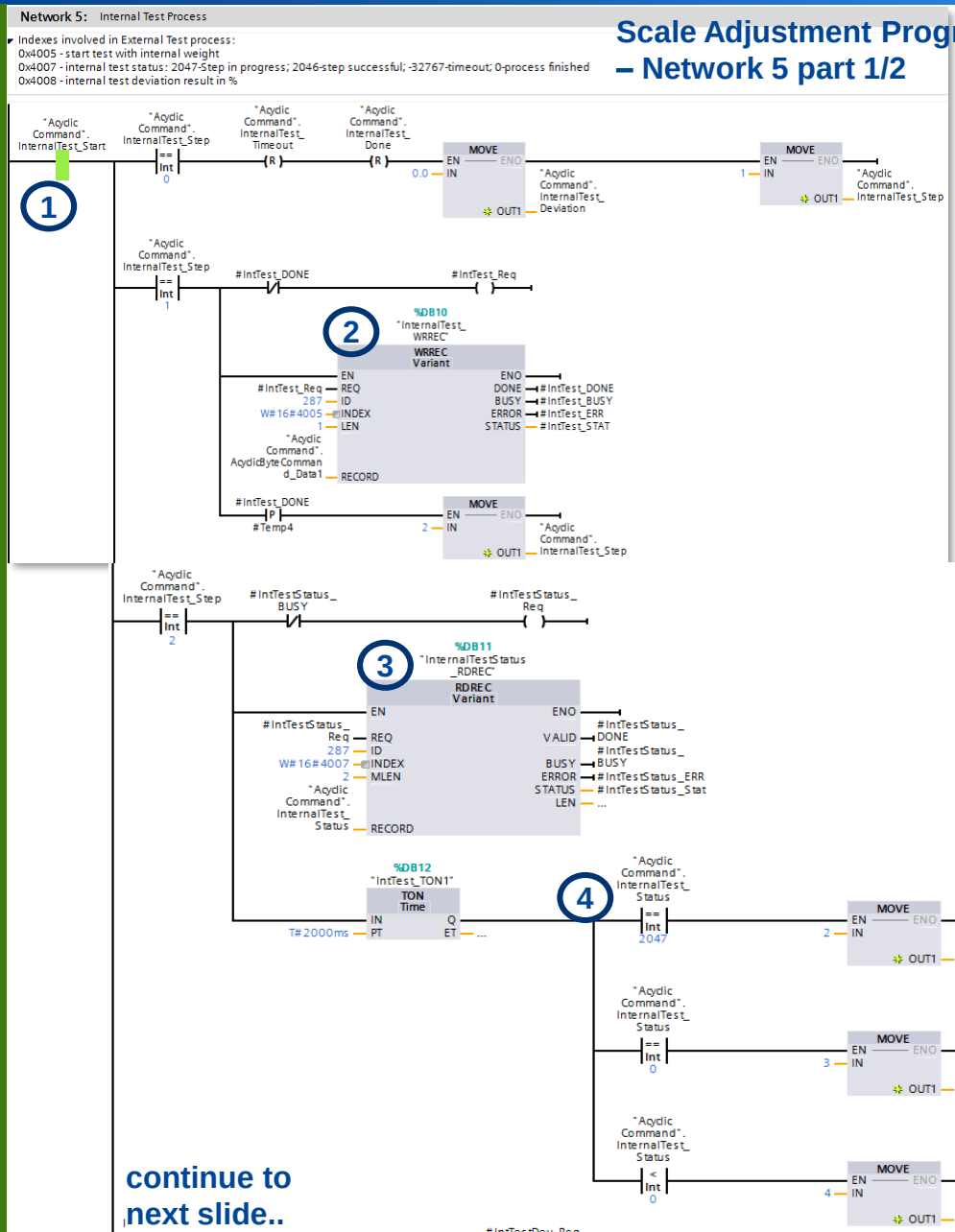
PROFINET IO RT			ETHERNET/ IP			Description
Slot	Sub slot	Index	Class	Instance	Attribute	
0	1	0x4005	0x410	0x01	0x05	Start test with internal weight
0	1	0x4007	0x410	0x01	0x07	Adjustment and test status information
0	1	0x4008	0x410	0x01	0x08	Test deviation in %

Step	Description	PROFINET IO INDEX	PLC Read/ Write
1	Trigger start internal test procedure (send a byte of decimal "1" via acyclic messaging)	0/ 1/ 0x4005	Write
2	Read test status (2046 – step successful; 2047 – executing step; -32767 – error; **0** – done)	0/ 1/ 0x4007	Read
3	Read test deviation in %	0/ 1/ 0x4008	Read

Internal Test

3. Internal Test (1/2)

Scale Adjustment Program – Network 5 part 1/2



1. User trigger "InternalTest_Start" bit

2. PLC sends an acyclic message to ACT350 Precision direct access variable 0/1/0x4005 (slot/ subslot/ index) to start the Internal Test process

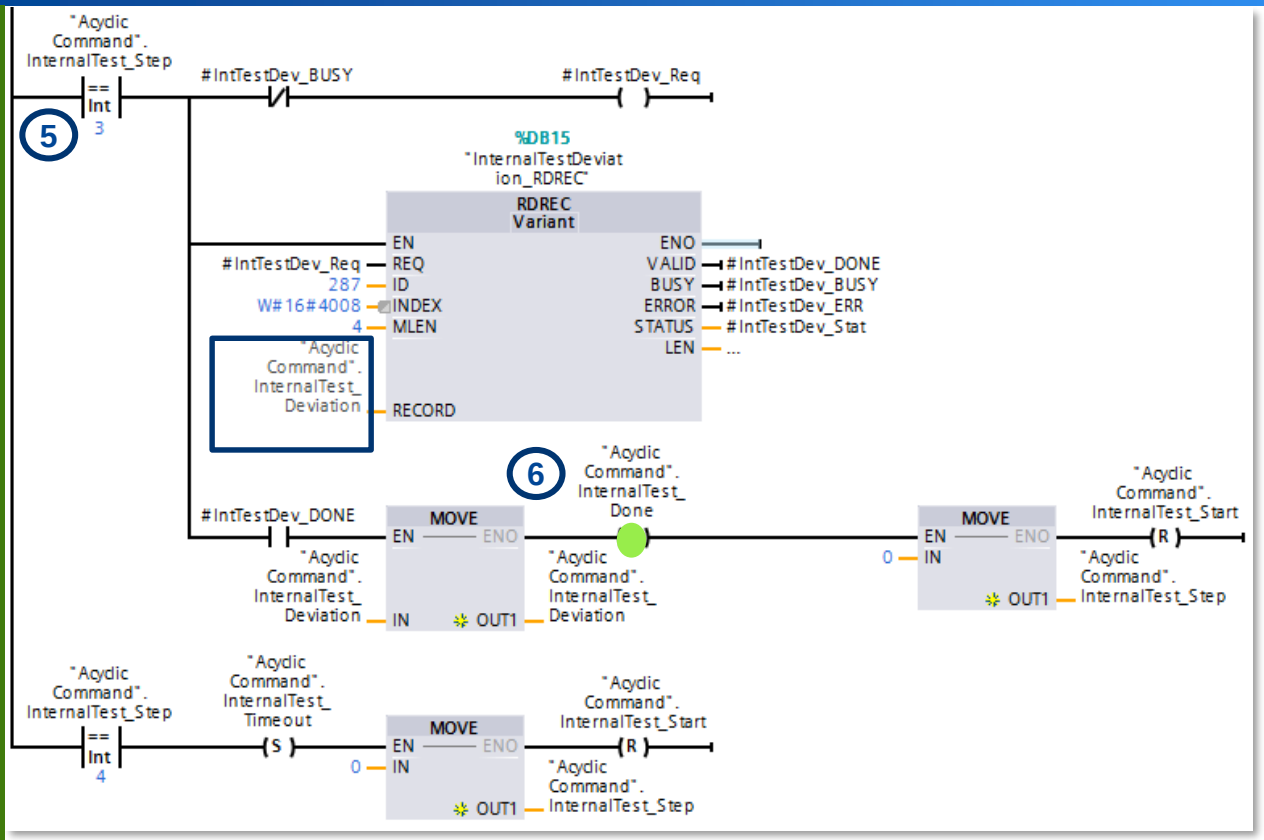
3. After test process has been started, PLC reads direct access variable 0/1/0x4007 for test status:
- "2047" -> step in progress
- "0" -> process completed
- "-32767" -> error or timeout

4. Status "0" means test process has been completed, while "-32767" means timeout error. Here, PLC jumps to steps 3 and 4 accordingly

48		InternalTest_Start	Bool	FALSE
49		InternalTest_Step	Int	0
50		InternalTest_Status	Int	-32767
51		InternalTest_Done	Bool	FALSE
52		InternalTest_Timeout	Bool	TRUE
53		InternalTest_Deviation	Real	0.0

Acyclic Command Data Block DB14

Internal Test



Scale Adjustment Program – Network 5 part 2/2

5. After completed internal test, last step is to read out the internal test deviation. Test result in % is moved into variable "InternalTest_ Deviation".

6. Lastly PLC sets "InternalTest_Done" flag and resets "InternalTest_Start" bit.

47		----------Internal Test----------	Bool	FALSE
48		InternalTest_Start	Bool	FALSE
49		InternalTest_Step	Int	0
50		InternalTest_Status	Int	0
51		InternalTest_Done	Bool	TRUE
52		InternalTest_Timeout	Bool	FALSE
53		InternalTest_Deviation	Real	0.0268

Acyclic Command Data Block DB14

End of slides