

Automated Precision Weighing

WMF - Fast Weight Update Channel



METTLER TOLEDO

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1 Engineering Note Overview

This Engineering Note contains user and developer information about the Fast Weight Update Channel in WMF firmware versions 2.x (2.0 and higher).

The chapter "Description - Fast Weight Update Channel" contains general information to understand the features and benefits from the Fast Weight Update Channel.

The chapter "WMF Firmware Version 2.0 – What is New" explains the changes on the software structure, Standard Automation Interface (SAI) and MT-SICS level and will help software engineers to implement the Fast Weight Update Channel functionality.

The chapter "WMF Update and Integration" guides through the update process for WMF weigh modules with older firmware version and helps to integrate and activate the updated version into the customer's automation environment. The PROFINET implementation is shown in TIA and the EtherNet/IP implementation in Studio 5000.

This document supplements the official Mettler-Toledo WMF user and installation manual which can be downloaded from:

https://www.mt.com/global/en/home/products/Industrial_Weighing_Solutions/AutomPrecision/High_Precision_Weigh_Modules/WMF.tabs.documents.html

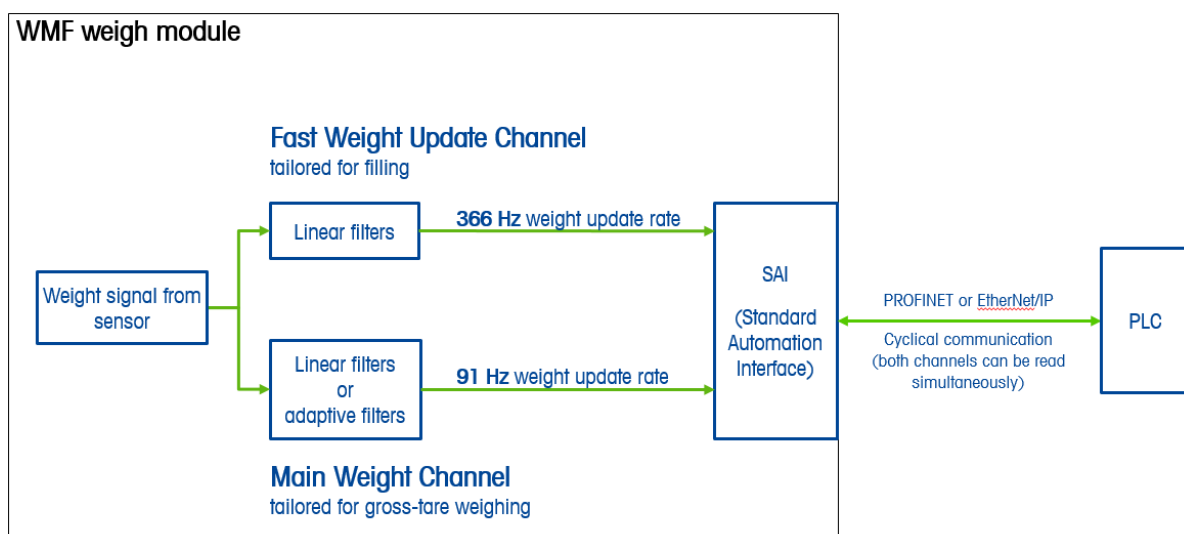
2 Description - Fast Weight Update Channel

WMF modules with firmware versions below version 2.0.0 include a Main Weight Channel for weight values with an update rate of 92 values per second and includes filters optimized for gross-tare weighing.

The WMF firmware versions 2.0.0 and higher (future) include an additional Fast Weight Update Channel with an increased weight update rate of 366 values per second. This Fast Weight Update Channel is tailored to address the needs of filling applications where precision is required.

This increased weight update rate enables the user to make control decisions much more quickly than in previous versions. The two channel concept and an 8-block Standard Automation Interface (SAI) format allows the user to simultaneously observe weight values at 92Hz and at 366Hz. This new firmware allows separate filter settings on the Main Weight Channel (adaptive or linear filter) and the Fast Weight Update Channel (linear filter). With this functionality, the Fast Weight Update Channel is optimized on speed, and the Main Weight Channel can be tuned for more stability.

Adaptive filters (MT-SICS command: M01 = 0) and stability criteria function (MT-SICS command: USTB) are only available on the Main Weight Channel.



3 WMF Firmware Version 2.0 – What is New

3.1 General Information

The implementation of the Fast Weight Update Channel functionality required changes in the Standard Automation Interface (SAI) protocol and on MT-SICS commands.

This chapter explains all changes on the Standard Automation Interface (SAI) protocol and MT-SICS commands in order to ensure easy intergration or PLC program adaption.

3.1.1 PLC performance remark

Note:

To use multiple parallel WMF with the fast weight update rate, sufficient PLC performance must be ensured. The "increased bus connection update rate" (to read the 366 values/s) with the increased data volume (8-block format > 64 Bytes IO) needs more PLC performance than the standard 2-block format with lower WMF internal update rate (to read the 92 Hz values/s)

1 WMF in 2-block format = 19 submodules

1 WMF in 8-block format = 61 submodules

Reference:

12 WMF in *Fast Weight Update Channel* mode on a Siemens S7-1517-3 with 1 ms IO communication cycletime work fine.

The S7-1212-C will not support more than 4 WMF in 8-block format because of the available. The cycletime defines the practical limit. (In TIA portal a project will not compile when the limit is exceeded)

3.2 SAI (Standard Automation Interface)

3.2.1 8-Block SAI Format

To enable higher cyclic data throughput, a new 8-block SAI dataformat is introduced in addition to the existing 2-block SAI dataformat (see chapter 5.2 for a visualization).

The 2-block SAI dataformat remains the standard SAI dataformat to ensure backward compability with existing applications.

The 8-block format must be activated prior to use the Fast Weight Update Channel (see chapter: 4.2).

Remark:

In the 8-block format, only the first 3 SAI blocks are currently in use. Measuring block 3 – 7 are reserved for future usage.

3.2.2 SAI Block 3 – (Measuring Block 2)

The measuring value of Fast Weight Update Channel is situated in SAI Block 3. The structure of Block 3 (as well as all subsequent function blocks) is identical to SAI Block 1, consisting of one floating point measuring value, one status word and a response integer.

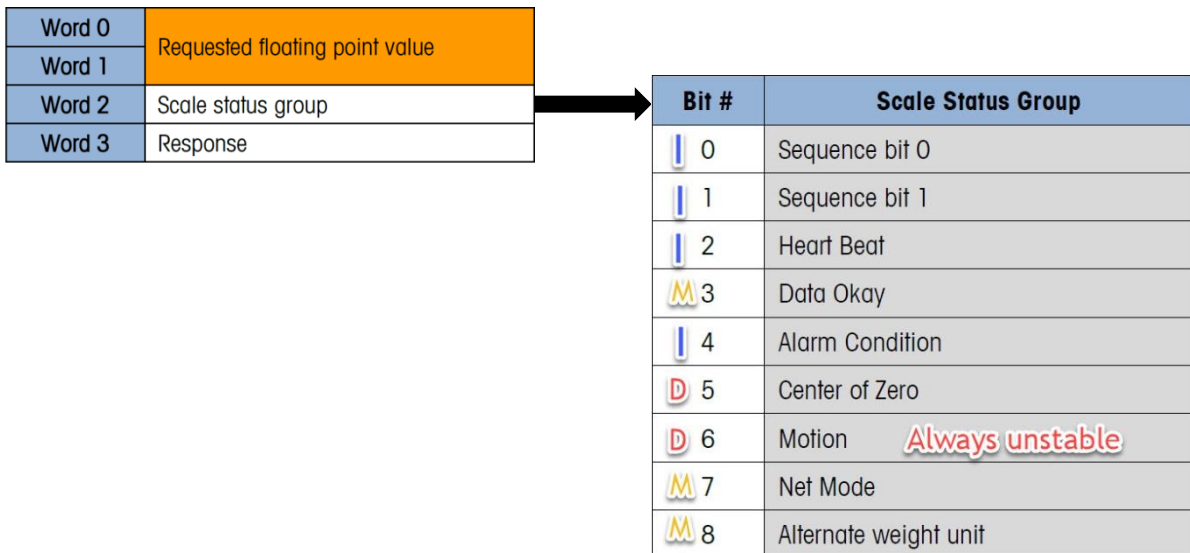
SAI Block 3 supports currently the following commands:

0	Report main path gross weight		
1	Report main path gross weight		
14	Report fast path net weight		

By default, upon powering up the WMF weigh module, the Fast Weight Update Channel (Measuring Block 2) weight value (Word 0 and 1 in drawing below) reports the exact same gross weight as the Main Weight Channel (Measuring Block 1).

To receive the net weight with high update rate through the Fast Weight Update Channel (Measuring Block 2), the PLC must write the decimal value "14" into the Measuring Block 2 Command word. (Word 3 in drawing below)

SAI Block 3 – (Measuring Block 2 Illustration)



Picture explanation:

If the Fast Weight Update Channel is actiated, the scale status group bits have the following functions:

- I** (Status bit 0, 1, 2, 4) These general status bits are independent of the weighing channel (same information in SAI blocks 1 and 3 (MB1 and MB2))
- M** (Status bit 3, 7, 8) These weighing status bits are shared with the Main Weight Channel (same information in SAI block 1 and 3 (MB1 and MB2))
- D** (Status bit 5, 6) These bits are Fast Weight Update Channel specific. (Please note: the Motion Bit in the Fast Weight Update Channel will always be set to 1 = unstable)

3.3 MT-SICS

3.3.1 General Information

This chapter explains MT-SICS commands which are newly implemented in WMF and changes in existing commands.

Refer to the MT-SICS Reference Manual for more detailed information.

3.3.2 M111 – SAI Cyclic Data Format Activation

Description

This command activates a specific SAI cyclic data format on the device.

Standard format is 2-block, extended format used for Fast Weight Update Channel is 8-block format.

Examples

Read parameter from the device.

Command M111

Response M111 A 1

SAI 2 block format is currently activated.

Write parameter to the device. Activate SAI cyclic data 8 block format on the device:

Command M111 31

Response M111 A

3.3.3 FCUT2 – Filter setting Fast Weight Update Channel

Description

This command sets the cut-off frequency for the Fast Weight Update Channel (SAI Block 3). Frequencies higher than the cut-off frequency will be damped by a low pass filter. The behavior is the same as with FCUT in the Main Weight Channel.

The FCUT2 command must be executed in SAI Block 1. (MB1)

Examples

Read parameter from the device.

Command FCUT2

Response FCUT2 A 12

Cut-off frequency is at 12 Hz.

Write parameter to the device. Set cut-off frequency to 3 Hz:

Command FCUT2 3

Response FCUT2 A

3.3.4 M116 – Initial Module Parameterization

Description

Certain industrial ethernet systems (e.g. PROFINET) allow initial module parameterization. If the initial module parameterization is implemented in the device description file, module parameters are sent from the PLC to the device (weigh module) during the connection setup.

Example of initial module parameters: weighing environment, cut-off frequency and timeout settings.

In the Siemens TIA portal (PROFINET system), the initial module parametrization cannot be disabled. Manually configured user settings will therefore be overwritten by the PLC with each connection setup.

With this MT-SICS command, the initial module parameterization feature can be enabled or disabled.

Examples

Read parameter from the device.

Command	M116
Response	M116 A 0

Initial module parametrization is enabled.

Write parameter to the device. Disable initial module parametrization:

Command	M116 1
Response	M116 A

3.3.5 M02 – Environment Condition Main Weight Channel

Description

The filter settings for the environment conditions have been optimized. As a consequence, the weighing value of the Main Weight Channel will react more lively than in previous firmware version (<2.0.0) if the environment setting "very stable" (M02 0) is in use.

This can be overcome by choosing the setting "stable" (M02 1) which is equivalent with the previous "very stable" setting.

M02 0	very stable	new filter behaviour
M02 1	stable	unchanged
M02 2	standard	unchanged
M02 3	unstable	unchanged
M02 4	very unstable	unchanged

Please note: The M02 command is only applicable in combination with normal weighing mode (M01 0).

3.4 Certified Communication Interfaces

The newly integrated 8-block SAI format is certified according to the latest specifications for PROFINET and Ether-Net/IP.

4 WMF Update and Integration

This chapter guides through initial device setup and the selection of the SAI output format. The MT software APW-Link can be used to send the MT-SICS commands.

<https://www.mt.com/ch/de/home/perm-lp/product-organizations/ind/ind-oem/APW-Link-Software.html>

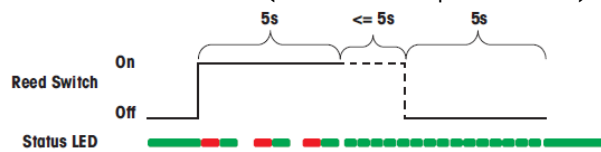
4.1 WMF Firmware Version Verification

- Make sure that the installed firmware version is **1.9.3.20181205** or higher.
- Use MT-SICS command "I3" to verify the current firmware version.
- Update firmware if required. (see chapter 4.1.1)

4.1.1 WMF Firmware Update

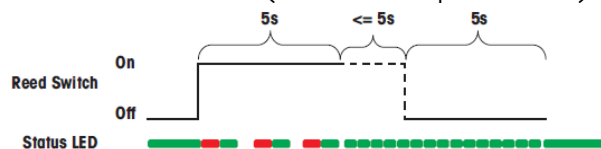
The firmware can be upgraded using the METTLER-TOLEDO e-Loader II software. Please follow the instructions carefully:

1. Preconditions
 - a. Setup network so that the WMF module can be reached through TCP/IP.
 - b. Extract e-Loader II package.
2. Use MT-SICS command "FSET 1" to factory reset the weigh module.
 - a. Note: network settings will be reset to default
 - i. PROFINET default: 192.168.0.55:80
 - ii. EtherNet/IP default: DHCP active
3. Execute a temporary IP reset (this step is only mandatory with EtherNet/IP modules)
 - a. Place a commercial magnet for 5 seconds between the upper and the middle LED and release it
 - b. Wait at least 5 seconds (see Status LED pattern below)



- c. Note: IP address is now set to 192.168.0.55:80

4. Close all TCP/IP connections (APW-Link or other clients)
5. Launch e-Loader II software (ELO2.EXE) and follow the on screen instructions.
 - a. To start firmware download after initial configuration, press button "Start Software Update Procedure..." on the bottom right.
6. Execute a temporary IP reset (this step is only mandatory with EtherNet/IP modules)
 - a. Place a commercial magnet for 5 seconds between the upper and the middle LED and release it
 - b. Wait at least 5 seconds (see Status LED pattern below)



- c. Note: IP address is now set to 192.168.0.55:80

7. Verify firmware version using the MT-SICS command "I3". (see chapter 4.1)
8. Use MT-SICS command "FSET 1" to factory reset the device.
 - a. Note: network settings will be reset to default
 - i. PROFINET default: 192.168.0.55:80
 - ii. EtherNet/IP default: DHCP active

Troubleshooting

If the e-Loader II firmware update procedure did succeed but the new firmware version is not displayed on the device (MT-SICS command "I3"): power cycle the device manually.

4.2 Activate SAI 8-Block Format

- 1. Use MT-SICS command "M111 <space>31" to activate the 8-block communication format.

```
M111 31  
M111 A  
M111  
M111 A 31
```

Figure 1: M111 execution and verification in APW-Link

- 2. Power cycle the WMF for this setting to take effect

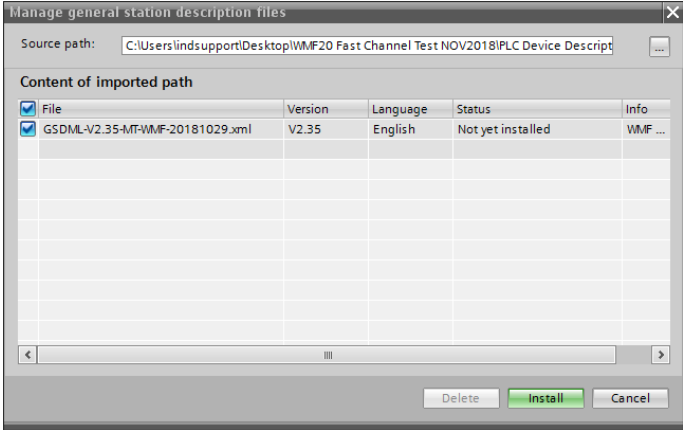
4.3 PROFINET Implementation

4.3.1 General Information

This presentation is based on the Siemens TIA Portal.

4.3.2 GSDML Installation

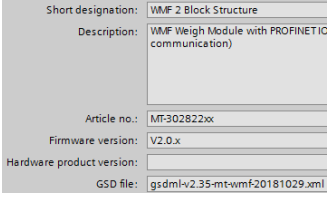
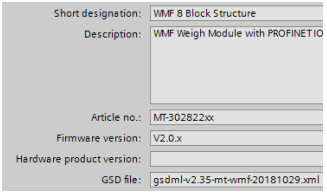
GSDML files with versions V2.35 20181029 and later support 2 and 8-block SAI format.



4.3.3 GSDML Selection

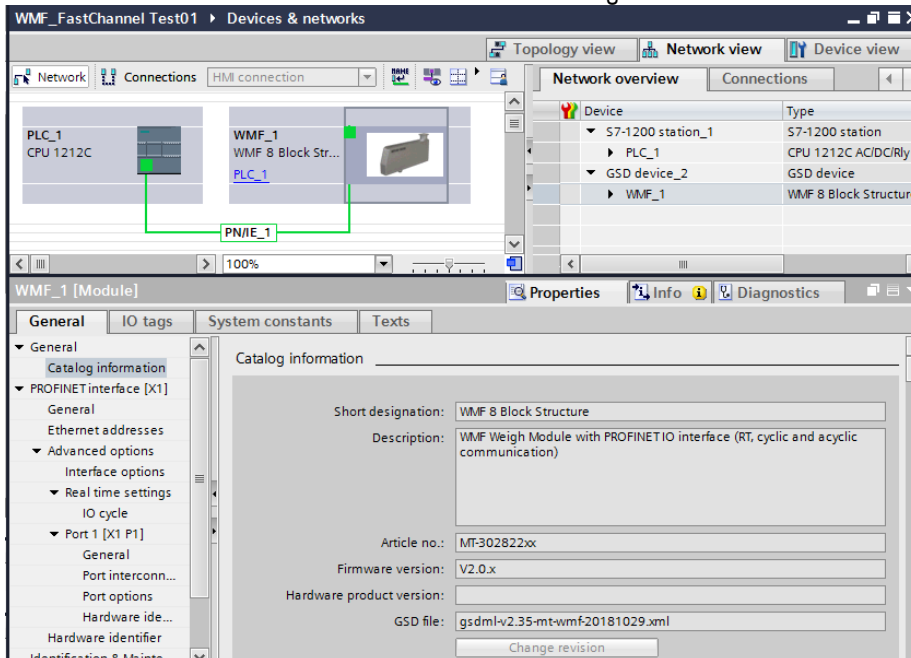
The SAI format must be selected using the MT-SICS command M111. (see chapter 4.2)

The table below is a summary of good and bad combinations of SAI format selection (MT-SICS command M111) and GSDML file versions:

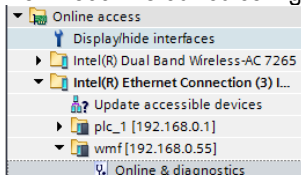
GSDML file used in TIA Portal	M111 Settings	
	1	31
V2.32 / 2-block SAI	Good Combination	PLC Error: Error in lower-level component
V2.35 / 2-block SAI 	Good Combination	PLC Error: Error in lower-level component
V2.35 / 8-block SAI 	PLC Error: Error in lower-level component	Good Combination

4.3.4 TIA Portal Integration

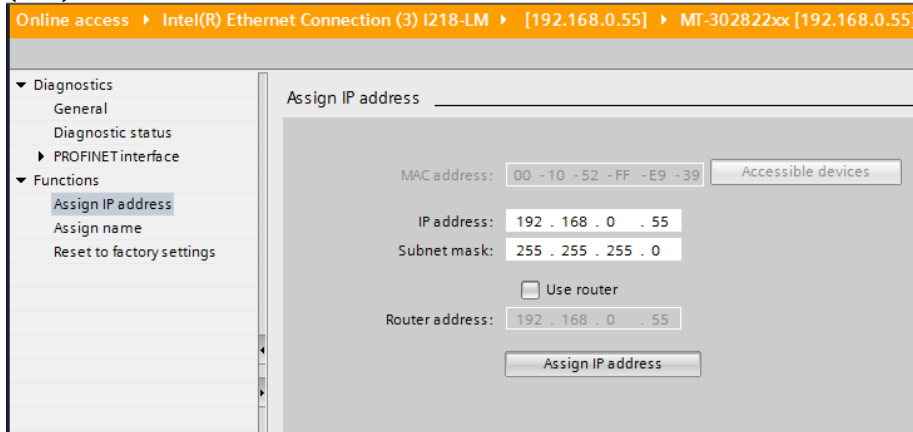
1. Locate the WMF 8 Block Structure in the Hardware Catalog and insert the device into the Profinet Network:



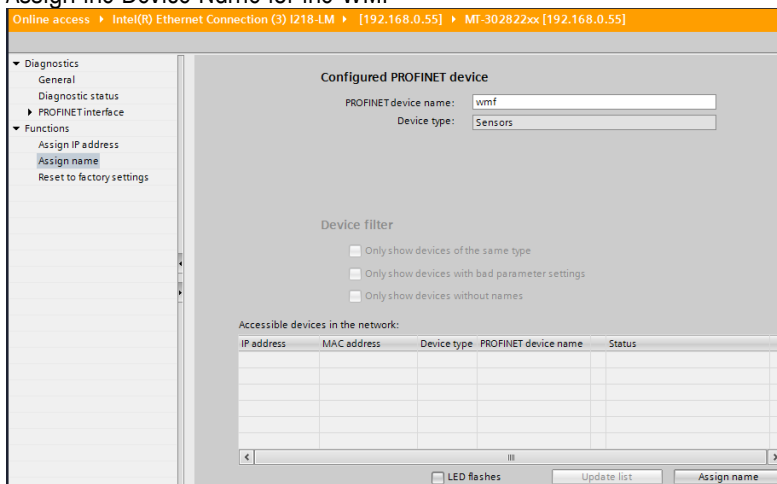
2. Download this device configuration into the PLC under device's Online & diagnostics.



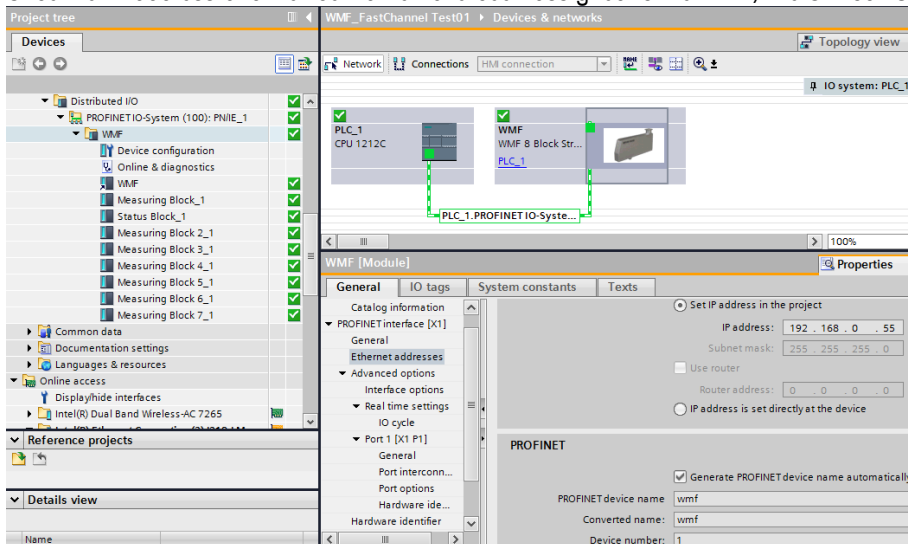
- Assign the required name and IP address for the WMF using Siemens Discovery and Configuration Protocol (DCP)



- Assign the Device Name for the WMF



- Once the IP address and Device Name have been assigned to the WMF, the 8 Block SAI data is available



4.3.5 Weight and Status Information

Under Device Overview, the PLC input and output addresses assigned to different data blocks are shown:

Device overview								
Module	Rack	Slot	I address	Q address	Type	Article no.	Firmware	
WMF	0	0			WMF 8 Block Structure	MF30282xx	V2.0.x	
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			
Measuring Block_2_1	0	3			Measuring Block 2			
Parameter Access Point	0	3.1			Parameter Access Point			
MB2 Command Value	0	3.2		272...275	MB2 Command Value			
MB2 Channel Mask	0	3.3		276...277	MB2 Channel Mask			
MB2 Command	0	3.4		278...279	MB2 Command			
MB2 Measuring Value	0	3.5	272...275		MB2 Measuring Value			
MB2 Device Status	0	3.6	276...277		MB2 Device Status			
MB2 Response	0	3.7	278...279		MB2 Response			

Test the communication between the PLC and WMF using a Watch Table:

WMF_FastChannel Test01 ▶ PLC_1 [CPU 1212C AC/DC/Rly] ▶ Watch and force table				
i	Name	Address	Display format	Monitor value
1	*WeightData_MB1*	%ID256	Floating-point n...	19.943
2	*SequenceBit0_MB1*	%I261.0	Bool	FALSE
3	*SequenceBit1_MB1*	%I261.1	Bool	FALSE
4	*HeartBeat_MB1*	%I261.2	Bool	FALSE
5	*DataOK_MB1*	%I261.3	Bool	TRUE
6	*Alarm_MB1*	%I261.4	Bool	FALSE
7	*CenterOfZero_MB1*	%I261.5	Bool	FALSE
8	*MotionBit_MB1*	%I261.6	Bool	FALSE
9	*NetMode_MB1*	%I261.7	Bool	FALSE
10	*CommandResponse_MB1*	%IW262	DEC+/-	0
11	*CommandValue_MB1*	%QD256	Floating-point n...	0.0
12	*ChannelMask_MB1*	%QW260	Hex	16#0000
13	*Command_MB1*	%QW262	DEC+/-	0
14	*FastWeightData_MB2*	%ID272	Floating-poi...	19.943
15	*SequenceBit0_MB2*	%I277.0	Bool	FALSE
16	*SequenceBit1_MB2*	%I277.1	Bool	FALSE
17	*HeartBeat_MB2*	%I277.2	Bool	FALSE
18	*DataOK_MB2*	%I277.3	Bool	TRUE
19	*Alarm_MB2*	%I277.4	Bool	FALSE
20	*CenterOfZero_MB2*	%I277.5	Bool	FALSE
21	*MotionBit_MB2*	%I277.6	Bool	FALSE
22	*NetMode_MB2*	%I277.7	Bool	FALSE
23	*CommandResponse_MB2*	%IW278	DEC+/-	0
24	*CommandValue_MB2*	%QD272	Floating-point n...	0.0

"WeightData_MB1" (%ID256 in this case) reports the "Main Weight Channel" weight

"FastWeightData_MB2" (%ID272 in this case) reports the "Fast Weight Update Channel" weight

Both weight values (Main Weight Channel and Fast Weight Update Channel) can be read concurrently by the PLC

To check whether a new PLC command has been successfully executed, we have to look into MB2 response (%IW278 in this case).

For instance, if decimal value "14" is returned in MB2 response, it means that the earlier PLC command to report fast channel net weight has been executed successfully.

(see 3.2.2 for more detail on SAI Block 3 (Measuring Block 2))

Other crucial device status bits can be monitored in MB2 Device Status word (in this case %IW277), they are Sequence bits 0 and 1 (bit 0, bit 1), Heart Beat (bit 2), Data OK (bit 3) and Alarm (bit 4).

4.4 EtherNet/IP Implementation

4.4.1 General Information

This presentation is based on Rockwell Automation Studio 5000.

The Rockwell Custom AOP will support WMF V2.0.0 (8-block format) starting Q1 2020. (Before Q1 2020, only 2-block format is supported by the Customer AOP)

EDS files are available for 2-block and 8-block format on mt.com/wmf.

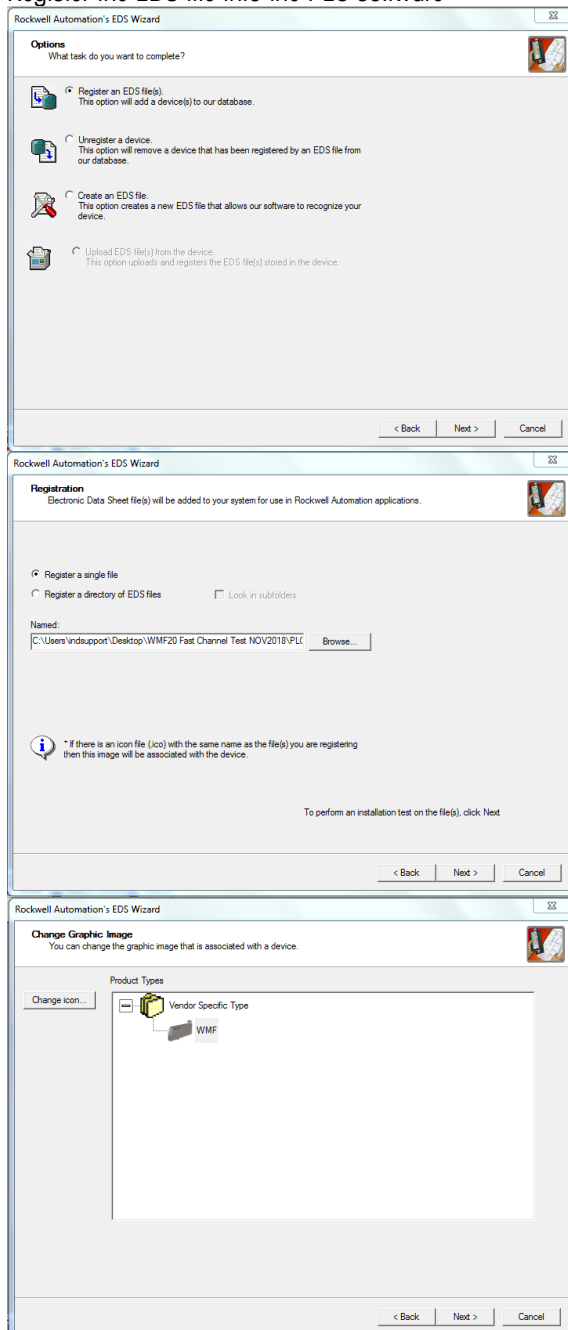
If you have a Rockwell Custom AOP installed which does not support WMF revision 2 (8-block format), the WMF AOP component must be uninstalled before the EDS file can be used.

Please refer to Rockwell manuals to uninstall custom AOP from Studio 5000.

4.4.2 EDS Installation

EDS files with versions V1.3 181029 and later support 2 and 8-block SAI format.

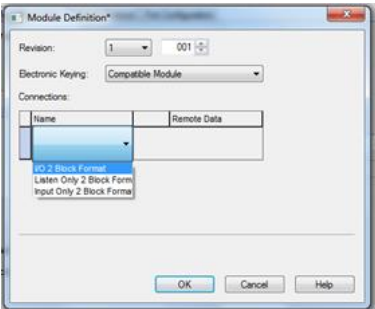
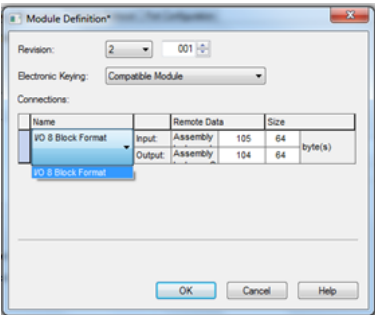
Register the EDS file into the PLC software



4.4.3 EDS Selection

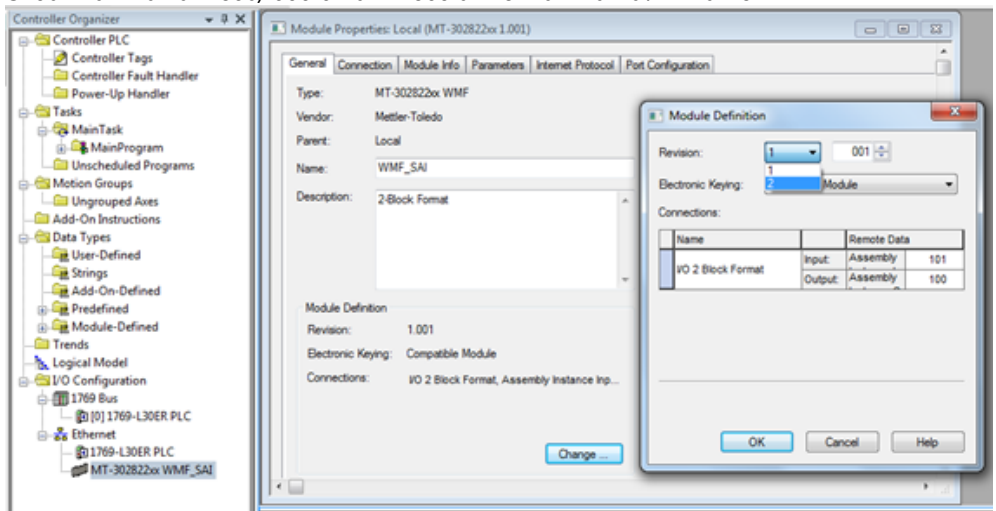
The SAI format must be selected using the MT-SICS command M111. (see chapter: 4.2)

The table below is a summary of good and bad combinations of SAI format selection (MT-SICS command M111) and EDS file versions.

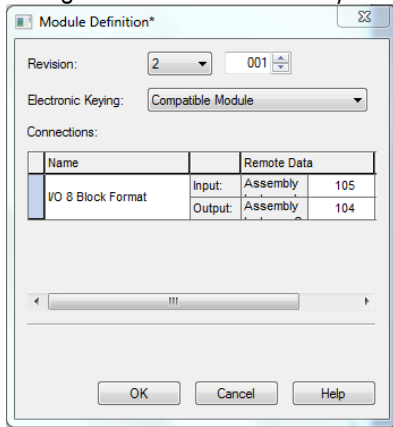
EDS file versions	M111 Settings	
	1	31
<p>V1.0/ Revision 1</p> 	<p>Good Combination</p>	<p>Error: I/O not responding, Module identity mismatch, no input output data communication</p>
<p>V1.3/ Revision 2</p> 	<p>Error: I/O not responding, Module identity mismatch, no input output data communication</p>	<p>Good Combination</p>

4.4.4 Studio 5000 Integration

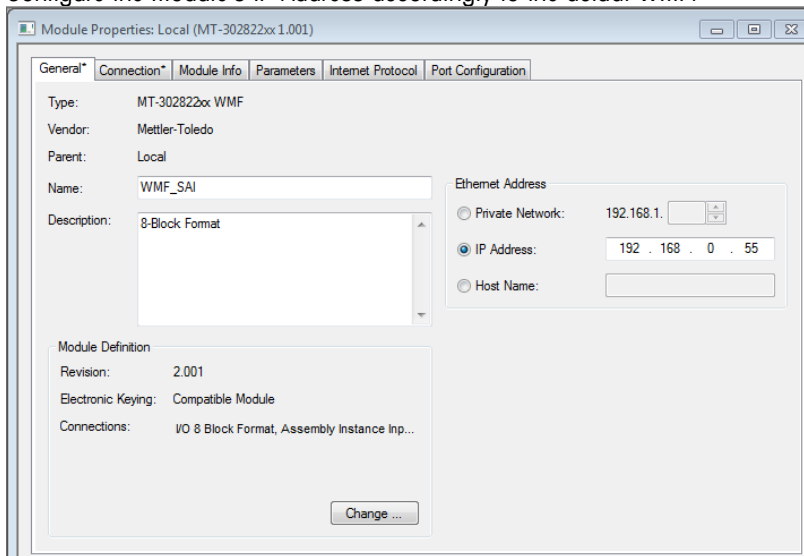
- Under the Ethernet Node, add a new module into the EtherNet/ IP network:



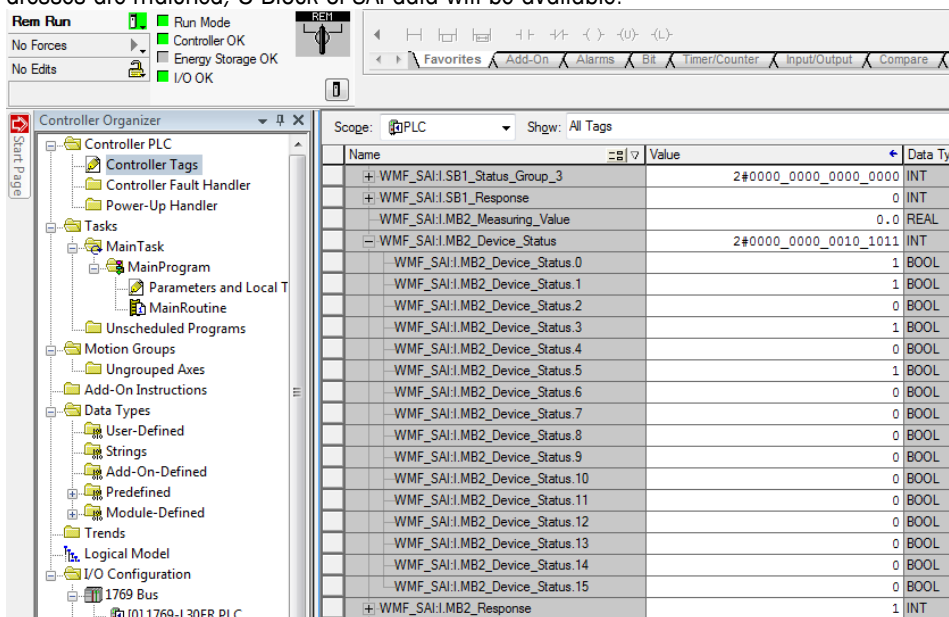
- Change the Module Definition by clicking "Change..." button, choose Revision 2:



- Notice that "I/O 8 Block Format" is automatically assigned after choosing Revision 2. Configure the Module's IP Address accordingly to the actual WMF:



- Download the Module Configuration into the PLC. If the correct EDS file is used and project/ device IP addresses are matched, 8 Block of SAI data will be available:



Refere to chapter 3.2.2 for SAI block information.

5 Migration

5.1 General Information

This section provides information to customer migrating existing applications from a 2-block format to an 8-block format.

5.2 PROFINET Address Space

The IO address number is sequential and the occupied IO space depends on the number of installed devices. Unless manually edited, the SAI input and output addresses are managed by the TIA Portal software according to SAI block size. When switching from the 2-block to the 8-block format, the address space is rearranged because the required address space per device is increased.

PLC tags pointing to the addresses (e.g. to fetch the floating point value) need to be migrated manually.

Example of shift in 2 WMFs' allocated I/O addresses:

PLC I/O byte address	WMF 2-block format	WMF 8-block format
256 – 263	WMF#1, block 1 (MB1)	WMF#1, block 1 (MB1)
264 – 271	WMF#1, block 2 (SB1)	WMF#1, block 2 (SB1)
272 – 279	WMF#2, block 1 (MB1)	WMF#1, block 3 (MB2)
280 – 287	WMF#2, block 2 (SB1)	WMF#1, block 4 (MB3) – reserved for future usage
288 – 295		WMF#1, block 5 (MB4) – reserved for future usage
296 – 303		WMF#1, block 6 (MB5) – reserved for future usage
304 – 311		WMF#1, block 7 (MB6) – reserved for future usage
312 – 319		WMF#1, block 8 (MB7) – reserved for future usage
320 – 327		WMF#2, block 1 (MB1)
328 – 335		WMF#2, block 2 (SB1)
336 – 343		WMF#2, block 3 (MB2)
344 – 351		WMF#2, block 4 (MB3) – reserved for future usage
352 – 359		WMF#2, block 5 (MB4) – reserved for future usage
360 – 367		WMF#2, block 6 (MB5) – reserved for future usage
368 – 375		WMF#2, block 7 (MB6) – reserved for future usage
376 – 383		WMF#2, block 8 (MB7) – reserved for future usage

Note:

- MB is Measuring Block
- SB is Status Block

www.mt.com/WMF

For more information

Mettler-Toledo GmbH

Industrial

CH-8606 Nänikon, Switzerland

Subject to technical changes

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