	Requirement Specification 4WCTW Modbus Slave Subsystem				RS
Responsibility:	Date: 2016-07-04	Language: en	Filing system : TFS	Revision: 1.2	Page: 1/16
Issued by: ZuoChen Wang	Approved: -	Released: ABB BUI	Area of validity:		

Title	AquaMaster Modbus Subsystem: Modbus Subsystem Requirements Specification
--------------	---

Distribution	Software Archive
---------------------	------------------

Author	Spring Kunli.Zhou	Date	2012-02-22
---------------	-------------------	-------------	------------

Review	Software Architect	Greg Leach	Date	2012-03-28
---------------	--------------------	------------	-------------	------------

Jax Yang	Date	2013-03-07
----------	-------------	------------

Approved	Software Architect	Date
-----------------	--------------------	-------------

Project Leader	Date
----------------	-------------

Remarks	28-03-2012 Reviewed by Greg Leach 17-01-2013 Modified by Spring Zhou 07-03-2013 Modified by Spring Zhou
----------------	---

© ABB 2013

This document contains information that is confidential. It must only be used for the agreed purpose for which it is provided. The contents of this document must not be reproduced or distributed in whole or in part without the written consent of ABB or its authorised representatives.


ABB	Requirement Specification 4WCTW Modbus Slave Subsystem				RS
Responsibility:	Date: 2016-07-04	Language: en	Filing system : TFS	Revision: 1.2	Page: 2/16
Issued by: ZuoChen Wang	Approved: -	Released: ABB BUI		Area of validity:	

Contents

1	Introduction	4
1.1	Scope	4
1.2	Definitions, acronyms, and abbreviations	4
2	Overview	4
3	Assumptions and dependencies	6
4	Functional requirements	6
4.1	General Requirements	6
4.1.1	Modbus Slave implementation	6
4.1.2	Modbus Slave application layer	7
4.2	Modbus Slave communication requirements	7
4.2.1	Communication Hardware Mode	7
4.2.2	Communication Protocol Mode	7
4.2.3	Baud rate	7
4.2.4	Parity	7
4.2.5	2 or 1 stop bits	7
4.2.6	Start bit	7
4.2.7	Stop bit	8
4.2.8	Inter-character timer	8
4.2.9	Inter-frame timer	8
4.3	Modbus Slave application requirements	8
4.3.1	Modbus Slave register	8
4.3.2	Modbus Slave Register Address	9
4.3.3	Modbus Slave parameter access rule	9
4.3.4	Supported standard Modbus Command	9
5	Non-functional requirements	9
5.1	Command Cycle time	9
6	Design constraints	10
7	References	11
8	Revision History	11
9	Requirement Review	11
9.1	First Review	11
9.1.1	Decision of the Review:	11
9.1.2	Check list:	11
9.1.3	Remarks:	12
9.1.4	Defects	12
9.1.5	Changes are proved:	12
9.2	Second review	12


List of Figures

Figure 1:	4-wire top works Modbus Slave Subsystem Context Diagram	4
Figure 2:	Use Case diagram for Modbus Slave Subsystem	4

	Requirement Specification 4WCTW Modbus Slave Subsystem				RS
Responsibility:	Date: 2016-07-04	Language: en	Filing system : TFS	Revision: 1.2	Page: 3/16
Issued by: ZuoChen Wang	Approved: -	Released: ABB BUI	Area of validity:		

List of Tables

Table 1 Modbus Slave Subsystem Use Case Table 5

	Requirement Specification 4WCTW Modbus Slave Subsystem				RS
Responsibility:	Date: 2016-07-04	Language: en	Filing system : TFS	Revision: 1.2	Page: 4/16
Issued by: ZuoChen Wang	Approved: -	Released: ABB BUI		Area of validity:	

1 Introduction

1.1 Scope

This document defines the requirements for 4-wire top works Modbus Slave subsystem. The subsystem is only designed for both the Enhanced version and MinT version on Front-End board and Mother Board of 4-wire top works depended on the variant devcie. It acts as modbus slave and communicates with PC software through common modbus communication protocol.

1.2 Definitions, acronyms, and abbreviations


Term	Definition
Modbus Subsystem	Modbus Subsystem includes Modbus Interface and Modbus Slave Stack.
Modbus RTU	RTU (Remote Terminal Unit) mode, each 8-bit byte in a message contains two 4-bit hexadecimal characters.

2 Overview

The command process and interpret part of the subsystem is a reuse of modbus common component of ABB BUI. The modbus slave subsystem is responsible for management of hardware layer and communication settings, customized application of modbus protocol, mapping of the object-registers and reuse of the modbus common component.

In this subsystem, the hardware layer use RS485.

The relationships between them are shown in Figure 1.

	Requirement Specification 4WCTW Modbus Slave Subsystem				RS
Responsibility: ZuoChen Wang	Date: 2016-07-04	Language: en	Filing system : TFS	Revision: 1.2	Page: 5/16
Issued by: ZuoChen Wang	Approved: -	Released: ABB BUI		Area of validity:	

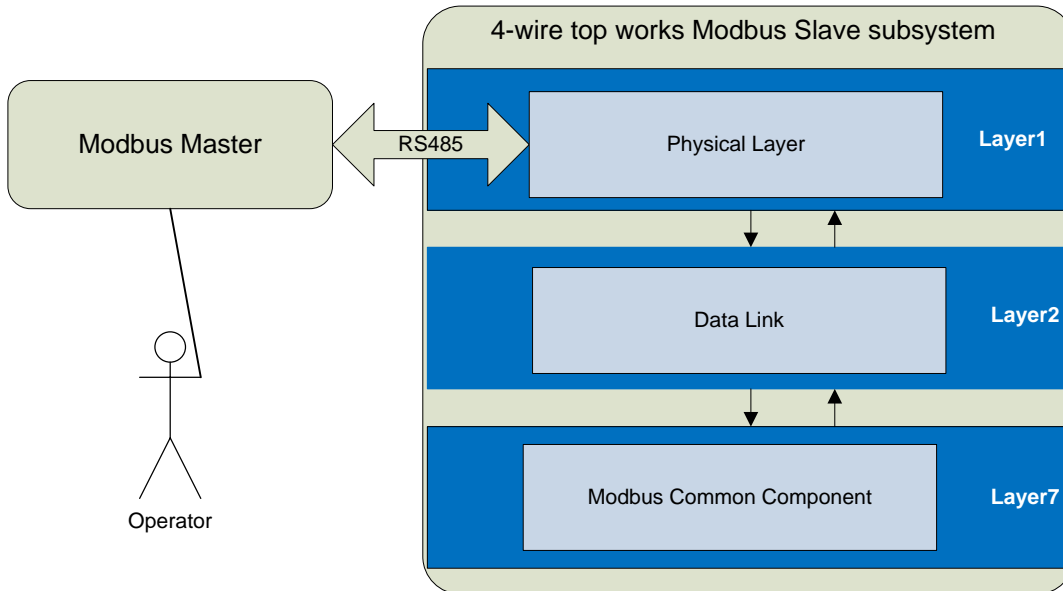


Figure 1: 4-wire top works Modbus Slave Subsystem Context Diagram

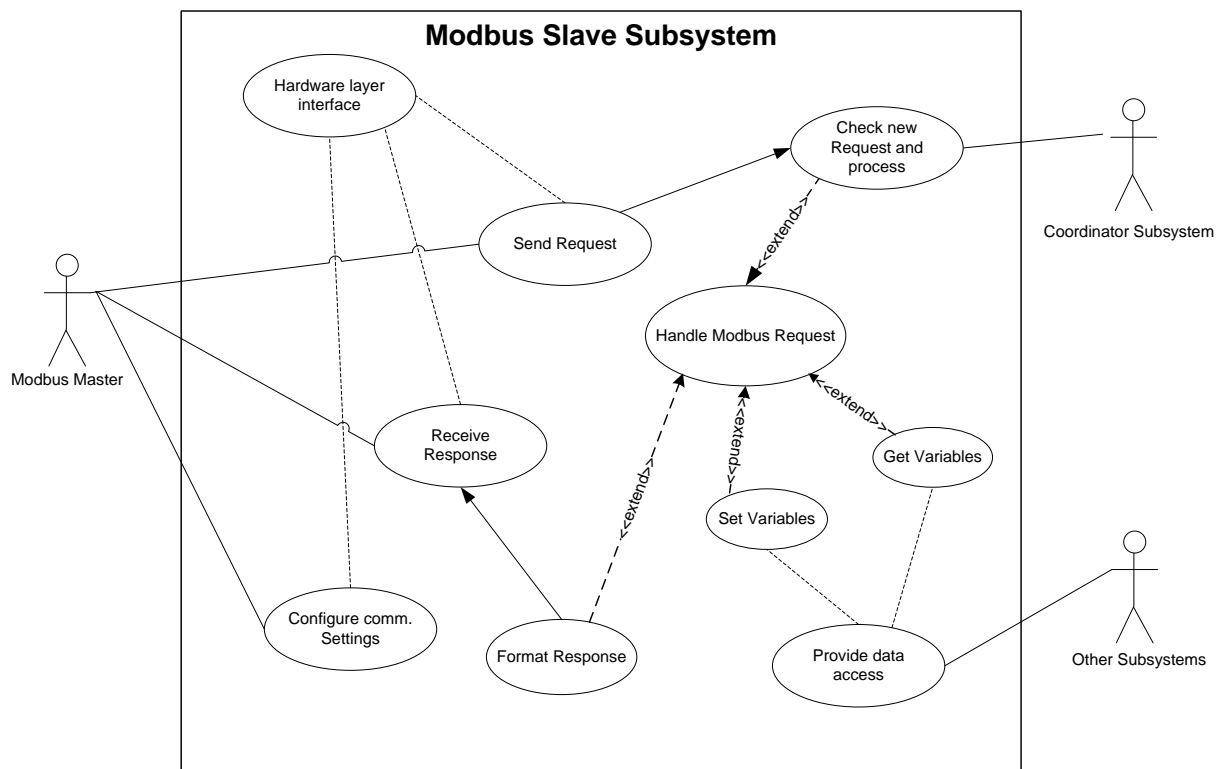



Figure 2: Use Case diagram for Modbus Slave Subsystem

The use case diagram shown in Figure 2 describes the Modbus Slave subsystem behaviors in the scope of the whole system. The external Modbus Master device, as a primary actor, triggers a transaction by sending

	Requirement Specification 4WCTW Modbus Slave Subsystem				RS
Responsibility:	Date: 2016-07-04	Language: en	Filing system : TFS	Revision: 1.2	Page: 6/16
Issued by: ZuoChen Wang	Approved: -	Released:	ABB BUI	Area of validity:	

out a request and receive the response from the Modbus Slave subsystem. The Modbus Master can also configure Modbus Subsystem communication settings, selecting slave address, transmission mode and baud-rate, sets start bits, parity and stop bits. The Modbus Slave subsystem, handles this request and format the response. The hardware interface provides the communication interface for the Modbus Slave subsystem.

No	Use Case ¹	Actors ²	Description
1	Configure comm. settings	Modbus Master	The Modbus Master can configure the communication settings of modbus slave, such as baut rate, stop bit , parity bit, etc.
2	Send Request	Modbus Master	An integral request message is sent from Modbus Master
3	Receive Response	Modbus Master	The Modbus Master will receive the response from Modbus Slave subsystem
4	Handle Modbus Request	Modbus Slave	Process the request and give the response
5	Format Response	Modbus Slave	Format suitable response message
6	Check Request	Modbus Slave	Check if the request is OK.
7	Set Variables	Modbus Slave	Some certain variables are updated according to the request
8	Get Variables	Modbus Slave	Some certain variables are read from the system
9	Check new request and process	Coordinator subsystem	Check if there is any new request and process the request.
10	Provide data access	Other subsystems	Provide data access for Modbus slave to set/get variables.

Table 1 Modbus Slave Subsystem Use Case Table

3 Assumptions and dependencies

The Modbus slave subsystem should in accordance with [3], [4].

Non-volatile parameters of the Modbus subsystem will be managed by the Non-Volatile subsystem.

The data process part in data application layer will reuse modbus common component.

4 Functional requirements

4.1 General Requirements³

4.1.1 Modbus Slave implementation


Definition / Motivation	Prio 1	Source
MODBUS Slave shall be implemented at both the Front-End-Board and Mother Board depends on the device variant.It communicates to an external Master like PLC, SPS or PC EDD.take.	Stability C	Development

¹ Use Cases specify what happens when actors interact with the system. They specify the intent, not the action detail.

² Actors in this context are external entities (people or other systems) who interact with the system to achieve a desired goal.

³ Priority: 1 = mandatory, 2 = desirable, 3 = future

Stability: Committed, Not yet agreed, Likely to change

	Requirement Specification 4WCTW Modbus Slave Subsystem				RS
Responsibility:	Date: 2016-07-04	Language: en	Filing system : TFS	Revision: 1.2	Page: 7/16
Issued by: ZuoChen Wang	Approved: -	Released: ABB BUI	Area of validity:		

4.1.2 Modbus Slave application layer

Definition / Motivation	Prio 1	Source
Modbus Slave subsystem application layer should reuse the Modbus common component.	Stability C	Development

4.2 Modbus Slave communication requirements

4.2.1 Communication Hardware Mode

Definition / Motivation	Prio 1	Source
Modbus Slave use RS485 as hardware layer to communicate with external Master, asynchronous half duplex communication.	Stability C	Development

4.2.2 Communication Protocol Mode

Definition / Motivation	Prio 1	Source
Modbus Slave use RTU communication Mode.	Stability C	4-Wire TRS

4.2.3 Baud rate

Definition / Motivation	Prio 1	Source
<p>The following baud-rates should be supported by the Modbus Slave subsystem. 2400, 4800, 9600, 19200, 38400, 56000, 57600 and 115200bps.</p> <p>The baud rate setting should be stored in non-volatile memory by the Modbus Slave subsystem.</p> <p>The default baud rate is 9600bps.</p>	Stability C	Development


4.2.4 Parity

Definition / Motivation	Prio 1	Source
<p>The following parity settings should be supported by the Modbus subsystem. None, odd and even.</p> <p>The parity setting should be stored in non-volatile memory by the Modbus Slave subsystem.</p> <p>The default parity bit is Even.</p> <p>If no parity bit, there should be 2 stop bits</p> <p>If 1 parity bit, there should be 1 stop bit.</p>	Stability C	Development

Notes: The Modbus byte encoding format should be 11 bytes, that is 1 start bit, 8 data bits, 0 or 1 parity bit, 2 or 1 stop bits.

4.2.5 Start bit

Definition / Motivation	Prio 1	Source
--------------------------------	---------------	---------------

	Requirement Specification 4WCTW Modbus Slave Subsystem				RS
Responsibility:	Date: 2016-07-04	Language: en	Filing system : TFS	Revision: 1.2	Page: 8/16
Issued by: ZuoChen Wang	Approved: -	Released: ABB BUI		Area of validity:	

Only 1 start bit is supported by the Modbus subsystem.
It's not selectable.

Stability C

Development

4.2.6 Stop bit

Definition / Motivation	Prio 1	Source
The following stop bit settings should be supported by the Modbus subsystem: 1 bit and 2 bits. The stop bit settings should be stored in non-volatile memory by the Modbus subsystem. The default stop bit is 1 bit. If 1 stop bit, parity should be even or odd If 2 stop bit, parity should be no parity.	Stability C	Development

4.2.7 Inter-character timer

Definition / Motivation	Prio 1	Source
The inter-character timer is not compulsory, it will be ensured by the modbus master.	Stability C	Development


4.2.8 Inter-frame timer

Definition / Motivation	Prio 1	Source
The inter-frame timer should be 3.5 characters time. If the baud rate is higher than 38400bps, then the inter frame timer should fix at 1.75ms.	Stability C	Development

4.3 Modbus Slave application requirements

4.3.1 Modbus Slave register

Definition / Motivation	Prio 1	Source															
The Modbus slave subsystem register table should be arranged to allow standard commands to access all of the indexed parameters. Below table shows the structure at the uppermost level which has the same device address definition with micro motion. <table border="1" data-bbox="177 1675 895 1868"> <thead> <tr> <th>Device Address</th><th>Custom Command Address</th><th>Description</th></tr> </thead> <tbody> <tr> <td>1 .. 10000</td><td>0 .. 9999</td><td>Coils (outputs)</td></tr> <tr> <td>10001..20000</td><td>10000 .. 19999</td><td>Input coils</td></tr> <tr> <td>30001..40000</td><td>30000 .. 39999</td><td>Input registers</td></tr> <tr> <td>40001..50000</td><td>40000 .. 49999</td><td>Holding registers</td></tr> </tbody> </table>	Device Address	Custom Command Address	Description	1 .. 10000	0 .. 9999	Coils (outputs)	10001..20000	10000 .. 19999	Input coils	30001..40000	30000 .. 39999	Input registers	40001..50000	40000 .. 49999	Holding registers	Stability C	Development
Device Address	Custom Command Address	Description															
1 .. 10000	0 .. 9999	Coils (outputs)															
10001..20000	10000 .. 19999	Input coils															
30001..40000	30000 .. 39999	Input registers															
40001..50000	40000 .. 49999	Holding registers															

	Requirement Specification 4WCTW Modbus Slave Subsystem				RS
Responsibility:	Date: 2016-07-04	Language: en	Filing system : TFS	Revision: 1.2	Page: 9/16
Issued by: ZuoChen Wang	Approved: -	Released: ABB BUI		Area of validity:	

4.3.2 Modbus Slave Register Address

Definition / Motivation	Prio 1	Source
The Modbus slave shall use the same register-object addresses as micro motion.	Stability N	Development

4.3.3 Modbus Slave parameter access rule

Definition / Motivation	Prio 1	Source
All parameters which are access able by customer over HMI shall also be access able over MODBUS slave.	Stability C	Development
Definition / Motivation	Prio 1	Source
Parameters accessible at Service level will be prohibited for both MinT and Enhanced.	Stability C	Development


4.3.4 Supported standard Modbus Command

Definition / Motivation	Prio1	Source																						
The standard command supported are shown in table below.	StabilityC	Development																						
<table><tr><th>Command ID (Hex)</th><th>Description</th></tr><tr><td>0x1</td><td>Read coils</td></tr><tr><td>0x2</td><td>Read discrete inputs</td></tr><tr><td>0x3</td><td>Read holding registers</td></tr><tr><td>0x4</td><td>Read input registers</td></tr><tr><td>0x5</td><td>Write single coil</td></tr><tr><td>0x6</td><td>Write single register</td></tr><tr><td>0x8</td><td>Diagnostics</td></tr><tr><td>0xF</td><td>Write multiple coils</td></tr><tr><td>0x10</td><td>Write multiple registers</td></tr><tr><td>0x11</td><td>Report slave id</td></tr></table>			Command ID (Hex)	Description	0x1	Read coils	0x2	Read discrete inputs	0x3	Read holding registers	0x4	Read input registers	0x5	Write single coil	0x6	Write single register	0x8	Diagnostics	0xF	Write multiple coils	0x10	Write multiple registers	0x11	Report slave id
Command ID (Hex)	Description																							
0x1	Read coils																							
0x2	Read discrete inputs																							
0x3	Read holding registers																							
0x4	Read input registers																							
0x5	Write single coil																							
0x6	Write single register																							
0x8	Diagnostics																							
0xF	Write multiple coils																							
0x10	Write multiple registers																							
0x11	Report slave id																							


5 Non-functional requirements

5.1 Command Cycle time

Definition / Motivation	Prio 1	Source
The Modbus subsystem should be able to complete a command request within 125ms.	Stability C	Development

	Requirement Specification 4WCTW Modbus Slave Subsystem				RS
Responsibility:	Date: 2016-07-04	Language: en	Filing system : TFS	Revision: 1.2	Page: 10/16
Issued by: ZuoChen Wang	Approved: -	Released: ABB BUI		Area of validity:	

6 Design constraints

	Requirement Specification 4WCTW Modbus Slave Subsystem				RS
Responsibility: ZuoChen Wang	Date: 2016-07-04	Language: en	Filing system : TFS	Revision: 1.2	Page: 11/16
Issued by: ZuoChen Wang	Approved: -	Released: ABB BUI	Area of validity:		

7 References

Ref.	Document
[1]	Technical requirement specification 4-wire platform_2011-09-09.pdf
[2]	4WCTW Software Requirements Specification_2011-08-26SN.doc
[3]	Modbus_Application_Protocol_V1_1b.pdf
[4]	Modbus Over Serial Line V1.02.pdf

8 Revision History

Rev.	Description of Version/Changes	Primary Author(s)	Date
0.1	Initial revision	Spring Kunli.Zhou	2012/02/24
0.2	Reviewed by Greg Leach Confirmed by Simon and Herald by email	Spring Kunli.Zhou	2012/03/28
1.0	Modified by Spring The hardware layer will not use Comport subsystem interface	Spring Kunli.Zhou	2013/01/17
1.1	Modified by Spring After review by Jax Yang	Spring Kunli.Zhou	2013/03/07
1.2	Adapted according the review comments.	Zuochen Wang	2016/07/04

9 Requirement Review


9.1 First Review

9.1.1 Decision of the Review:

<i>Decision</i>	<i>next steps</i>
Inspection passed without restrictions	Phase finished
X Inspection passed with restrictions	some changes must be done
Inspection not passed	Inspection must be repeated

9.1.2 Check list:

		yes	no	N.A.
1.	Does the specification explain the currently known requirements that the product finally has to perform?	Y		
2.	Are complex subjects explained?	Y		
3.	Are all used abbreviations and technical expressions explained?	Y		
4.	Are all referenced documents in the reference list?	Y		
5.	Contains the document a rough overview of the product's main functionality?	Y		
6.	Are all requirements referenced?	Y		
7.	Are all requirements testable?	Y		
8.	Is the typical environment of the product described?	Y		

		Requirement Specification 4WCTW Modbus Slave Subsystem			RS
Responsibility:	Date:	Language:	Filing system :	Revision:	Page:
	2016-07-04	en	TFS	1.2	12/16
Issued by:	Approved:	Released:		Area of validity:	
ZuoChen Wang	-	ABB BUI			

9.	Is defined which components already exist, will be bought or self-written?			N.A
10.	Are safety requirements (e.g error-detection, error-handling) specified?			N.A
11.	Are service/update requirements described?			N.A
12.	Are all dependencies to other requirement documents considered?	Y		
13.	Are templates used in a correct manner?	Y		
14.	Are all open issues transferred to the defects table?	Y		

9.1.3 Remarks:

9.1.4 Defects

No.	Checkpoint	Description	Major Defect	done Date
1	4.3.1	The device address definition is in accordance with micro motion.	N	2012-3-28
2	4.3.2	The Modbus slave shall use the same register-object addresses as micro motion. It's difficult to do, TBD		
3	4.2.3,4.2.4	Change the default baudrate to 19200, default parity to even parity	N	2012-3-28
4		Delete the inter-character timer requirement which will be assured by modbus master.	N	2012-3-28
5		Delete the customized command requirement, the PC will only use common command to get all register data.	N	2012-3-28
6	4.3.3	Add: "for MinT version, parameters accessible at Service level will be prohibited". Calibration will only be done as a full system with CB.	N	2012-3-28

9.1.5 Changes are proved:

The Reviewer confirms that all changes are done:


Proved Rev:	Updated to Rev:	Date:	Reviewer:
Greg Leach	0.2	2012-4-12	Greg Leach

9.2 Second review

Project:	4WCTW
Document under Review:	4WCTW_Modbus Slave Subsystem Requirement Specification V1.0.doc
Revision:	0.1
Review Date:	6/3/2013

Review-Participant:

Dept.	Name

		Requirement Specification 4WCTW Modbus Slave Subsystem			RS
Responsibility:	Date:	Language:	Filing system :	Revision:	Page:
	2016-07-04	en	TFS	1.2	13/16
Issued by:	Approved:	Released:		Area of validity:	
ZuoChen Wang	-	ABB BUI			

PAMP	Jax Yang	
PAMP		

Decision of the Review:

<i>Decision</i>	<i>next steps</i>
Inspection passed without restrictions	Phase finished
X Inspection passed with restrictions	some changes must be done
Inspection not passed	Inspection must be repeated

Changes are proved:


The Reviewer confirms that all changes are done:

proved Rev:	Date:	Reviewer:

Check list:

		yes	no	N.A.
1.	Does the specification explain the currently known requirements that the product finally has to perform?	Y		
2.	Are complex subjects explained?	Y		
3.	Are all used abbreviations and technical expressions explained?	Y		
4.	Are all referenced documents in the reference list?	Y		
5.	Contains the document a rough overview of the product's main functionality?	Y		
6.	Are all requirements referenced?	Y		
7.	Are all requirements testable?	Y		
8.	Is the typical environment of the product described?	Y		
9.	Is defined which components already exist, will be bought or self-written?			N.A
10.	Are safety requirements (e.g error-detection, error-handling) specified?			N.A
11.	Are service/update requirements described?			N.A
12.	Are all dependencies to other requirement documents considered?	Y		
13.	Are templates used in a correct manner?	Y		
14.	Are all open issues transferred to the defects table?	Y		

Remarks:

	<div>Requirement Specification</div> <div>4WCTW Modbus Slave Subsystem</div>				<div>RS</div>
Responsibility:	Date:	Language:	Filing system :	Revision:	Page:
	2016-07-04	en	TFS	1.2	14/16
Issued by:	Approved:	Released:			Area of validity:
ZuoChen Wang	-	ABB BUI			

Defects

No.	Checkpoint	Description	Major Defect	done Date
1		HMI and other subsystem use cases may need to be added in Figure 2	N	2013.3.7
2		4.2.4 and 4.2.6 should describe the stop bit and parity bit in details: If no parity bit, there should be 2 stop bits If 1 parity bit, there should be 1 stop bit.	N	2013.3.7
3		It would be better that if the byte encoding format(11bits) is described in details. E.g. 1 start bit 8 data bits 0 or 1 parity bit 2 or 1 stop bits	N	2013.3.7
4		Spell errors: 1) 4.2 4.3 "requirments" should be "requirements" 2) 4.2.8 "baut rate " should be baud rate 3) "Prio" > Priority would be better 4) "hardwarelayer" need a blank space 5) "standared" should be "standad"	N	2013.3.7
5		It need to speicify that the slave response should meet Modbus specification	N	2013.3.7

9.3 Third review


Project:	Cor_IF + 4-wire
Document under Review:	4WCTW_Modbus Slave Subsystem Requirement Specification V1.1.doc
Revision:	1.1
Review Date:	15.06.2016

Review-Participant:

Dept.	Name	
R&D	Georg Horst	

Decision of the Review:

<i>Decision</i>	<i>next steps</i>
x Inspection passed without restrictions	Phase finished
Inspection passed with restrictions	some changes must be done
Inspection not passed	Inspection must be repeated

	Requirement Specification 4WCTW Modbus Slave Subsystem				RS
Responsibility:	Date: 2016-07-04	Language: en	Filing system : TFS	Revision: 1.2	Page: 15/16
Issued by: ZuoChen Wang	Approved: -	Released: ABB BUI		Area of validity:	

Changes are proved:


The Reviewer confirms that all changes are done:

proved Rev:	Date:	Reviewer:
1.2	26.07.2016	G. Horst

Check list:

		yes	no	N.A.
1.	Does the specification explain the currently known requirements that the product finally has to perform?		x	
2.	Are complex subjects explained?	x		
3.	Are all used abbreviations and technical expressions explained?	x		
4.	Are all referenced documents in the reference list?	x		
5.	Contains the document a rough overview of the product's main functionality?	x		
6.	Are all requirements referenced?	x		
7.	Are all requirements testable?	x		
8.	Is the typical environment of the product described?	x		
9.	Is defined which components already exist, will be bought or self-written?			x
10.	Are safety requirements (e.g error-detection, error-handling) specified?			x
11.	Are service/update requirements described?			x
12.	Are all dependencies to other requirement documents considered?		x	
13.	Are templates used in a correct manner?	x		
14.	Are all open issues transferred to the defects table?	x		

Remarks:

	Requirement Specification 4WCTW Modbus Slave Subsystem				RS
Responsibility:	Date: 2016-07-04	Language: en	Filing system : TFS	Revision: 1.2	Page: 16/16
Issued by: ZuoChen Wang	Approved: -	Released: ABB BUI		Area of validity:	

Defects

No.	Checkpoint	Description	Major Defect	done Date
1	1	1.1 Scope (site 3): Subsystem is also designed for the Enhanced version, not only for MINT	N	2016.07.04
2	1	Req. 4.1.1: Modbus Slave will be also implemented at Motherboard. Depends on the device variant	N	2016.07.04
3	12	Req. 4.2.2: The Source for this Requirements is the 4-wire TRS	N	2016.07.04
4	12	Req. 4.2.3: Default of Modbus Baudrate is 9600 and not 19200. Further the Source for this Requirements is the 4-wire TRS	N	2016.07.04
5	1	Req. 4.3.3: Parameters behind the Service level are not accessible for MinT and Enhanced	N	2016.07.04