Honeywell | CIU 888

Protocol Manual - Modbus Host Guide

Release R210

PREFACE

General

Host systems connecting to the CIU 888, such as the Entis Pro tank inventory system, DCSs (e.g. Experion PKS), PLCs (e.g. MasterLogic, HC900 Control System) and SCADA systems, use the Modbus protocol to communicate with the CIU 888. In this setup, the CIU 888 acts as a Modbus receiver to the Modbus host systems connecting to it. Communication between the CIU 888 and Modbus host systems is established through RS-232 or RS-485 serial lines.

The CIU 888 is the successor to the CIU 880 (Prime and Plus) and can replace one set of CIU Prime and CIU Plus or a single CIU Prime on site. To be compliant with its predecessor, the CIU 888 supports fixed and flexible (i.e. user-defined) CIU Plus compliant Modbus mapping. CIU 888 also supports few new parameters (14 spot temperatures) as part of flexible Modbus map.

Ethernet based hosts systems can connect to CIU 888 using Modbus TCP/IP protocol. In this setup, CIU 888 acts as Modbus TCP/IP server to the Modbus TCP/IP host systems. Modbus TCP/IP communication between the CIU 888 and the host systems is established through FTEA, FTEB and Office LAN ports. CIU 888 exposes the same data (Modbus maps) over the Ethernet host ports as that exposed in the serial host ports.

Purpose of this manual

The purpose of this manual is to provide information about the following:

Modbus protocol and the implementation of the Modbus protocol in the CIU 888.

Target audience of this manual

This manual is primarily intended for service technicians who are responsible for:

- Setting up (commissioning) and configuring the CIU 888
- Troubleshooting issues using the diagnostic features of the CIU 888
- Servicing and maintaining the CIU 888
- Configuring gauges via the CIU 888 using service tools such as Engauge

This page is intentionally left blank

TABLE OF CONTENTS

CHAPTER 1 INTRODUCTION TO THE MODBUS PROTOCOL

1.1 General

The Modbus protocol has been developed by Modicon and is used to establish sender-receiver (client-server) communication between intelligent devices. Modbus is de-facto open standard and the most widely used network protocol in the industrial manufacturing environment.

The Modbus protocol defines the format of the data and the techniques used to control the flow of data. Modbus communication can take place on virtually any communication network: RS-232, RS-485, Ethernet.

Modbus communication can be established between 2 devices as well as 248 devices, also a single sender and up to 247 receivers. In Modbus communication there must always be one sender and at least one receiver. The sender always initiates a communication exchange.

Each receiver on a Modbus network has its own unique address (1...247) so that it can be addressed independently from other receivers. This address is sent by the sender as part of every message. All receivers on the network see the message, but only the receiver with the matching address will respond to the message.

A message sent to a receiver from the sender is called a request, the answer sent back to the sender is called a response. Request and response messages are also called packets or frames.

The sender can issue a Modbus request to receivers in Unicast mode. In Unicast mode, the sender addresses an individual receiver. After receiving and processing the request, the receiver returns a message (response) to the sender.

In serial communication, the term *sender* indicates the device initiating the request and the term *receiver* indicates the device responding to the request. Whereas, in case of ethernet communication, the term *client* indicates the device initiating the request and the term *server* indicates the device responding to the request.

NOTE: Modbus communication on an RS-485 network is limited to a maximum of 32 receivers due to the limitations of this physical layer.

1.2 Supported versions of Modbus

The CIU 888 supports Modbus RTU on serial mode (RS-232 or RS-485) and Modbus TCP/IP on ethernet). When controllers are set up to communicate on a network using Modbus RTU on serial mode, each 8-bit byte in a message contains two 4-bit hexadecimal characters. The main advantage of Modbus RTU on serial mode over that of Modbus ASCII is that its greater character density allows better data throughput for a given baud rate. Each message must be transmitted in a continuous stream. When controllers are set up to communicate on a network using Modbus TCP/IP on Ethernet, the client system connects to the controller using IP address and port number of the controller to get the data.

1.2.1 Modbus RTU message frame

In Modbus RTU on serial mode communication, messages start with a silent interval of at least 3.5 character times. The first field then transmitted is the device address.

The allowable characters transmitted for all fields are $0...9_{HEX}$, $A...F_{HEX}$. Networked devices monitor the network bus continuously, including during the 'silent' intervals. When the first field (the address field) is received, each device decodes it to find out if it is the addressed device.

Following the last transmitted character, a similar interval of at least 3.5 character times marks the end of the message. A new message can begin after this interval.

The entire message frame must be transmitted as a continuous stream. If a silent interval of more than 1.5 character times occurs before completion of the frame, the receiving device flushes the incomplete message and assumes that the next byte will be the address field of a new message.

Similarly, if a new message begins earlier than 1.5 character times following a previous message, the receiving device will consider it a continuation of the previous message. This will set an error, as the value in the final CRC field will not be valid for the combined messages.

A typical Modbus RTU on Serial Mode message frame is shown in FIGURE 1-1.

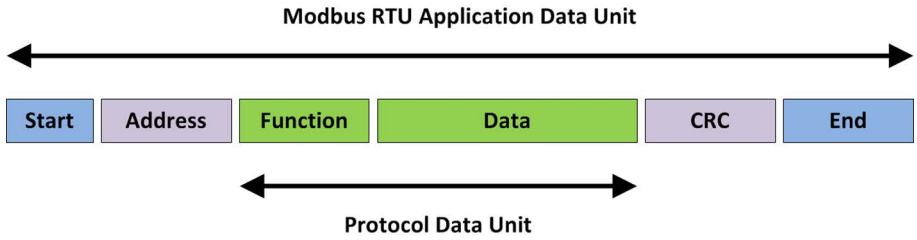


FIGURE 1-1 Modbus RTU on serial mode message frame

TABLE 1-1 gives a description of the fields in the Modbus RTU on serial mode message frame.

TABLE 1-1 Description of the fields in the Modbus RTU on serial mode message frame

Field	Length	Description
Start		Silent interval of at least 3.5 character times.
Address	1 byte	The Address field contains the address of the receiver. • Valid receiver addresses are in the range of 0 up to 247 decimal. • The individual receivers are assigned addresses in the range of 1 up to 247 decimal. • A sender addresses a receiver by placing the receiver address in the Address field of the message. When the receiver sends its response, it places its own address in the Address field of the response to let the sender know which receiver is responding. • Address 0 is used for the broadcast address, which all receivers recognize.
Function Code	1 byte	When a message is sent from the sender to a receiver the Function Code field indicates the receiver what kind of action to perform. When the receiver responds to the sender, it uses the Function Code field to indicate either a normal (error–free) response or that some kind of error occurred (called an exception response). For a normal response, the receiver simply echoes the original function code. For an exception response, the receiver returns a code that is equivalent to the original function code with its most-significant bit set to a logic 1. In addition to its modification of the function code for an exception response, the receiver places a unique code into the Data field of the response. This tells the sender what kind of error occurred, or the reason for the exception.
Data		The Data field is constructed using sets of two hexadecimal bytes, in the range of 00...FF_{HEX}. The Data field contains additional information that the receiver uses to take the action defined by the function code. This can include items like discrete and register addresses, the number of items to be handled, and the count of actual data bytes in the field. If no error occurs, the data field of a response from a receiver to a sender contains the data requested. If an error occurs, the field contains an exception code that the sender application can use to determine the next action to be taken.

Field	Length	Description
CRC Check	2 bytes	The error-check value is the result of Cyclical Redundancy Check (CRC) calculation performed on the message contents. The CRC field checks the contents of the entire message. It is applied regardless of any parity checking method used for the individual characters of the message. The CRC field is appended to the message as the last field in the message. When this is done, the low-order byte of the field is appended first, followed by the high-order byte. The CRC high-order byte is the last byte to be sent in the message. The CRC value is calculated by the sending device, which appends the CRC to the message. The receiving device recalculates a CRC during receipt of the message, and compares the calculated value to the actual value it received in the CRC field. If the two values are not equal, an error results.

REMARK: See section 1.3 and section 1.4 for information about Modbus functions codes. See section 1.5 for information about Modbus exception responses.

1.2.2 Modbus TCP/IP message frame

The MODBUS messaging service provides a Client/Server communication between devices connected on an Ethernet TCP/IP network.

A communicating system over MODBUS TCP/IP may include different types of device:

- A MODBUS TCP/IP Client and Server devices connected to a TCP/IP network
- The Interconnection devices like bridge, router or gateway for interconnection between the TCP/IP network and a serial line sub-network which permit connections of MODBUS Serial line Client and Server end devices.

A typical MODBUS TCP/IP request or response is shown in FIGURE 1-2

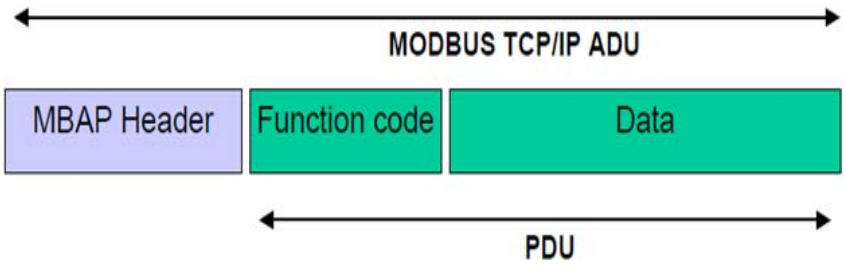


FIGURE 1-2 MODBUS TCP/IP request or response

A dedicated header is used on TCP/IP to identify the MODBUS Application Data Unit. It is called the MBAP header (MODBUS Application Protocol header).

TABLE 1-2 gives a a brief description of the fields in MBAP header.

TABLE 1-2 Description of the fields in MBAP.

Fields	Length	Description	Client	Server
Transaction Identifier	2 Bytes	Identification of a MODBUS Request / Response transaction.	Initialized by the client	Recopied by the server from the received request
Protocol Identifier	2 Bytes	0 = MODBUS protocol	Initialized by the client	Recopied by the server from the received request
Length	2 Bytes	Number of following bytes	Initialized by the client (request)	Initialized by the server (Response)
Unit Identifier	1 Byte	Identification of a remote receiver connected on a serial line or on other buses.	Initialized by the client	Recopied by the server from the received request

The header is seven bytes long with the following fields:

- **Transaction Identifier** - It is used for transaction pairing, the MODBUS server copies in the response the transaction identifier of the request.
- **Protocol Identifier** - It is used for intra-system multiplexing. The MODBUS protocol is identified by the value 0.
- **Length** - The length field is a byte count of the following fields, including the Unit Identifier and data fields.
- **Unit Identifier** - This field is used for intra-system routing purpose. It is typically used to communicate to a MODBUS+ or a MODBUS serial line receiver through a gateway between an Ethernet TCP-IP network and a MODBUS serial line. This field is set by the MODBUS Client in the request and must be returned with the same value in the response by the server.

NOTE: In the subsequent sections, the term sender indicates a serial Modbus sender and Ethernet Modbus client and the term receiver indicates a serial Modbus receiver and Ethernet Modbus TCP/IP server.

1.3 Memory structures

Along with the receiver address, the Modbus function code is another piece of data that is in every request or response. This piece of data specifies an action to be carried out by a Modbus receiver device and the memory range (coils, input registers, etc.) affected.

TABLE 1-3 defines the supported Modbus function codes:

TABLE 1-3 Supported Modbus function codes

Code	Name	Memory Area (Hex)	Description
01	Read Coil Status	0000...FFFF	Reads 1-bit status information
02	Read Input Status	0000...FFFF	Reads 1-bit status information
03	Read Holding Registers	0000...FFFF	Reads 16-bit value information
04	Read Input Registers	0000...FFFF	Reads 16-bit value information
05	Force Single Coil	0000...FFFF	Writes a 1-bit coil
06	Preset Single Register	0000...FFFF	Writes a 16-bit value
08	Diagnostics	0000...FFFF	Perform diagnostic tests
15	Force Multiple Coils	0000...FFFF	Writes multiple 1-bit coils
16	Preset Multiple Registers	0000...FFFF	Writes multiple 16-bit values

In general there are four types of memory images that the Modbus host can request:

- Coils, see section 1.3.1 for more information
- Status inputs, see section 1.3.2 for more information
- Input registers, see section 1.3.3 for more information
- Holding registers, see section 1.3.4 for more information

1.3.1 Coils

All coils are located in the memory range 0000...$FFFF_{HEX}$. The value of coils can be 1 (= ON) or 0 (= OFF). Coils have read/write properties.

The address space of the coils and the discrete inputs are combined in one 1-bit area occupying the addresses 0000...$7FFF_{HEX}$. The data can be read by using Modbus function code 01. Data for tank commands can be written using the Modbus 05 and 15 commands.

1.3.2 Input statuses

Input statuses are located in the memory range 0000...$FFFF_{HEX}$.

The value of input statuses can be 1 (= ON) or 0 (= OFF). Input statuses are considered to be discrete inputs. Input statuses can be used for example to store tank alarm conditions. Input statuses are read-only.

In the CIU 888 the address space of the coils and the discrete inputs are combined in one 1-bit area occupying the addresses 0000...7FFF$_{HEX}$. The data can be read by using Modbus function code 02.

1.3.3 Input registers

Input registers are located in the memory range 0000...FFFF$_{HEX}$. Register values can range from 0000...FFFF$_{HEX}$ since all registers are 16 bits long. Input registers are used for analog inputs or to store values collected from the field and calculated values (level, temperature, volume, etc.). Input registers are read-only.

In the 16-bit registers space both the holding registers and the input registers are combined in one address space occupying the standard area from 0000...270F$_{HEX}$ and the extended memory area from 2710$_{HEX}$ onwards. Data can be retrieved via Modbus function code 04.

1.3.4 Holding registers

Holding registers are located in the memory range 0000...FFFF$_{HEX}$. Register values can range from 0000...FFFF$_{HEX}$ since all registers are 16 bits long. Holding registers are used for analog outputs. Holding registers have read/write properties.

In the 16-bit registers space both the holding registers and the input registers are combined in one address space occupying the standard area from 0000...270F$_{HEX}$ and the extended memory area from 2710$_{HEX}$ onwards. Data can be retrieved via the Modbus function code 03. Via Modbus commands 06 and 16 writing can be done to registers.

1.4 Description of function codes

1.4.1 Function code 01 (01$_{HEX}$): Read coil status

Function code 01 (01$_{HEX}$) is used to read from 1...2000 decimal (0001...07D0$_{HEX}$) continuous status of coils in a remote device. The Request PDU specifies the starting address, i.e. the address of the first coil specified, and the number of coils. In the PDU coils are addressed starting at zero. Therefore, coils numbered 1...16 are addressed as 0...15.

The coils in the response message are packed as one coil per bit of the data field. Status is indicated as 1 = ON and 0 = OFF. The LSB of the first data byte contains the output addressed in the request. The other coils follow toward the high order end of this byte, and from low order to high order in subsequent bytes.

If the returned output quantity is not a multiple of eight, the remaining bits in the final data byte will be padded with zeros (toward the high

order end of the byte). The Byte Count field specifies the quantity of complete bytes of data.

Request

Function code	1 byte	01_{HEX}
Starting address	2 bytes	$0000...FFFF_{HEX}$
Number of coils	2 bytes	$0001...07D0_{HEX}$

Response

Function code	1 byte	01_{HEX}
Byte count	1 byte	**N***
Coil status	n x 1 byte	**n** = **N***

***N** = Number of outputs / 8. If the remainder is not 0, then N = N+1

Error

Function code	1 byte	Function code + 0x80
Exception code	1 byte	01 or 02 or 03 or 04 or 06

Example

Below is an example of a request to read discrete outputs 20...38.

Request		Response	
Field Name	*(Hex)*	*Field Name*	*(Hex)*
Function	01	Function	01
Starting address Hi	00	Byte count	03
Starting address Lo	13	Output status 27-20	CD
Number of outputs Hi	00	Output status 35-28	6B
Number of outputs Lo	13	Output status 38-36	05

The status of outputs 27...20 is shown as the byte value CD_{HEX} (or binary 1100 1101). Output 27 is the MSB of this byte, and output 20 is the LSB.

1.4.2 Function code 02 (02_{HEX}): Read input status

The function code 02 (02_{HEX}) is used to read from 1...2000 ($0001...07D0_{HEX}$) continuous status of discrete inputs in a remote device. The request PDU specifies the starting address, i.e. the address of the first input specified, and the number of inputs. In the PDU discrete Inputs are addressed starting at zero. Therefore, discrete inputs numbered 1...16 are addressed as 0...15.

The discrete inputs in the response message are packed as one input per bit of the data field. Status is indicated as 1 (= ON) or 0 (= OFF). The LSB of the first data byte contains the input addressed in the

request. The other inputs follow toward the high order end of this byte, and from low order to high order in subsequent bytes.

If the returned input quantity is not a multiple of eight, the remaining bits in the final data byte will be padded with zeros (toward the high order end of the byte). The Byte Count field specifies the quantity of complete bytes of data.

Request

Function code	1 byte	02_{HEX}
Starting address	2 bytes	$0000...FFFF_{HEX}$
Number of coils	2 bytes	$0001...07D0_{HEX}$

Response

Function code	1 byte	02_{HEX}
Byte count	1 byte	**N***
Input status	n x 1 byte	**n** = **N***

***N** = Number of inputs / 8. If the remainder is not 0, then N = N+1

Error

Function code	1 byte	Function code + 0x80
Exception code	1 byte	01 or 02 or 03 or 04

Example

Below is an example of a request to read discrete inputs 197...218.

Request		**Response**	
Field Name	*(Hex)*	*Field Name*	*(Hex)*
Function	02	Function	02
Starting address Hi	00	Byte count	03
Starting address Lo	C4	Inputs status 204-197	AC
Number of inputs Hi	00	Inputs status 212-205	DB
Number of inputs Lo	16	Inputs status 218-213	35

The status of discrete inputs 204...197 is shown as the byte value AC_{HEX} (or 1010 1100 binary). Input 204 is the MSB of this byte, and input 197 is the LSB.

The status of discrete inputs 212...205 is shown as the byte value DB_{HEX} (or 1101 1011 binary). Input 212 is the MSB of this byte, and input 205 is the LSB.

The status of discrete inputs 218...213 is shown as the byte value 35_{HEX} (or 0011 0101 binary). Input 218 is the MSB of this byte, and input 213 is the LSB.

1.4.3 Function code 03 (03_{HEX}): Read holding registers

Function code 03 (03_{HEX}) is used to read the contents of a continuous block of holding registers in a receiver device. The request PDU specifies the starting address and the number of holding registers. In the PDU, holding registers are addressed starting at zero. Therefore, holding registers numbered 1...16 are addressed as 0...15.

The holding register data in the response message are packed as two bytes per holding register, with the binary contents right justified within each byte (the byte order is big Endian).

Request

Function code	1 byte	03_{HEX}
Starting address	2 bytes	$0000...FFFF_{HEX}$
Number of registers	2 bytes	$0001...007D_{HEX}$

Response

Function code	1 byte	03_{HEX}
Byte count	1 byte	2 x **N***
Register value	**N*** x 2 bytes	

***N** = Number of registers

Example

Below is an example of a request to read holding registers 108...110.

Request		**Response**	
Field Name	*(Hex)*	*Field Name*	*(Hex)*
Function	03	Function	03
Starting address Hi	00	Byte count	06
Starting address Lo	6B	Register value Hi (108)	02
Number of registers Hi	00	Register value Lo (108)	2B
Number of registers Lo	03	Register value Hi (109)	00
		Register value Lo (109)	00
		Register value Hi (110)	00
		Register value Lo (110)	64

The contents of holding registers 108...110 are shown as the 2 byte value of 02 $2B_{HEX}$ (555 decimal), 00 00_{HEX} (0 decimal) and 00 64_{HEX} (100 decimal) respectively.

1.4.4 Function code 04 (04_{HEX}): Read input registers

The function code 04 (04_{HEX}) is used to read from 1...125 decimal ($0001...007D_{HEX}$) continuous input registers in a receiver device. The

request PDU specifies the starting register address and the number of registers.

In the PDU input registers are addressed starting at zero. Therefore, input registers numbered 1...16 are addressed as...0-15.

The register data in the response message are packed as two bytes per register, with the binary contents right justified within each byte. For each register, the first byte contains the high order bits and the second contains the low order bits.

Request

Function code	1 byte	04_{HEX}
Starting address	2 bytes	$0000...FFFF_{HEX}$
Number of input registers	2 bytes	$0001...007D_{HEX}$

Response

Function code	1 byte	04_{HEX}
Byte count	1 byte	2 x **N***
Input registers	**N*** x 2 bytes	

***N** = Number of input registers

Error

Error code	1 byte	84_{HEX}
Exception code	1 byte	01 or 02 or 03 or 04

Example

Below is an example of a request to read input registers 50...51.

Request		**Response**	
Field Name	*(Hex)*	*Field Name*	*(Hex)*
Function	04	Function	04
Starting address Hi	00	Byte count	04
Starting address Lo	32	Register value Hi (50)	00
Number of registers Hi	00	Register value Lo (50)	40
Number of registers Lo	02	Register value Hi (51)	02
		Register value Lo (51)	1E

1.4.5 Function code 05 (05_{HEX}): Force single coil

Function code 05 (05_{HEX}) is used to force a single coil to either ON or OFF in a receiver device.

The requested ON/OFF state is specified by a constant in the request data field. A value of FF 00_{HEX} requests the coil to be ON. A value of 00

00_{HEX} requests it to be OFF. All other values are illegal and will not affect the output.

The request PDU specifies the address of the coil to be forced. Coils are addressed starting at zero. Therefore, coil numbered 1 is addressed as 0.

When broadcast, the function forces the same coil reference in all attached receivers.

The normal response is an echo of the request, returned after the coil state has been written.

Request

Function code	1 byte	05_{HEX}
Coil address	2 bytes	$0000...FFFF_{HEX}$
Coil value	2 bytes	$0000...FF00_{HEX}$

Response

Function code	2 bytes	05_{HEX}
Coil address	2 bytes	$0000...FFFF_{HEX}$
Coil value	2 bytes	$0000...FF00_{HEX}$

Error

Error code	1 byte	85_{HEX}
Exception code	1 byte	01 or 02 or 03 or 04 or 06

Example

Below is an example of a request to write Coil 173 ON:

Request		Response	
Field Name	*(Hex)*	*Field Name*	*(Hex)*
Function	05	Function	05
Coil address Hi	00	Coil address Hi	00
Coil address Lo	AC	Coil address Lo	AC
Coil value Hi	FF	Coil value Hi	FF
Coil value Lo	00	Coil value Lo	00

1.4.6 Function code 06 (06_{HEX}): Preset single holding register

Function code 06 (06_{HEX}) is used to preset a value into a single holding register in a receiver device. The request PDU specifies the address of the holding register to be written. In the PDU, holding registers are addressed starting at zero. Therefore, holding register numbered 1 is addressed as 0.

When broadcast, the function presets the same register reference in all attached receiver devices.

The normal response is an echo of the request, returned after the holding register contents have been written.

Request

Function code	1 byte	06_{HEX}
Register address	2 bytes	$0000...FFFF_{HEX}$
Register value	2 bytes	$0000...FFFF_{HEX}$

Response

Function code	1 byte	06_{HEX}
Register address	2 bytes	$0000...FFFF_{HEX}$
Register value	2 bytes	$0000...FFFF_{HEX}$

Error

Error code	1 byte	86_{HEX}
Exception code	1 byte	01 or 02 or 03 or 04 or 06

Example

Below is an example of a request to write holding register 2 to 00 03_{HEX}.

Request		Response	
Field Name	*(Hex)*	*Field Name*	*(Hex)*
Function	06	Function	06
Register address Hi	00	Register address Hi	00
Register address Lo	01	Register address Lo	01
Register value Hi	00	Register value Hi	00
Register value Lo	03	Register value Lo	03

1.4.7 Function code 08 (08_{HEX}): Diagnostics

Function code 08 (08_{HEX}) provides a series of tests for checking the communication system between a sender (client) and a receiver (server), or for checking various internal error conditions within a server.

The function uses a 2 byte sub-function code field in the request to define the type of test to be performed. The receiver echoes both the function code and sub-function code in a normal response. Some of the diagnostics cause data to be returned from the remote device in the data field of a normal response.

In general, issuing a diagnostic function to a remote device does not affect the running of the user program in the remote device. User logic,

like discrete and registers, is not accessed by the diagnostics. Certain functions can optionally reset error counters in the remote device.

A receiver can, however, be forced into 'Listen Only Mode' in which it will monitor the messages on the communications system but not respond to them. This can affect the outcome of your application program if it depends upon any further exchange of data with the remote device. Generally, the mode is forced to remove a malfunctioning remote device from the communications system.

The normal response to the Return Query Data request is to loop back the same data. The function code and sub-function codes are also echoed.

REMARK: Broadcast is not supported.

Request

Function code	1 byte	08_{HEX}
Sub-function	2 bytes	
Data	N x 2 bytes	

Response

Function code	1 byte	08_{HEX}
Sub-function	2 bytes	
Data	N x 2 bytes	

Error

Error code	1 byte	88_{HEX}
Exception code	1 byte	01 or 03 or 04

Example

Below is an example of a request to loop-back test.

Request		**Response**	
Field Name	*(Hex)*	*Field Name*	*(Hex)*
Function	08	Function	08
Sub-function Hi	00	Sub-function Hi	00
Sub-function Lo	00	Sub-function Lo	00
Data	01	Data	01
Data	02	Data	02

REMARK: Currently, only loop-back test sub-function (0) is supported. This function is sometimes used to see if the addressee is awake.

1.4.8 Function code 15 ($0F_{HEX}$): Force multiple coils

Function code 15 ($0F_{HEX}$) is used to force each coil in a sequence of coils to either ON or OFF state in a receiver. The request PDU specifies the coil references to be forced. Coils are addressed starting at zero. Therefore, coil numbered 1 is addressed as 0.

The requested ON/OFF states are specified by the contents of the request data field. A logical '1' in a bit position of the field requests the corresponding output to be ON. A logical '0' requests it to be OFF.

The normal response returns the function code, starting address, and quantity of coils forced.

When broadcast, the function forces the same coil references in all attached receiver devices. Any addresses that are not allowed to overwrite generate an error code.

Request

Function code	1 byte	$0F_{HEX}$
Starting address	2 bytes	$0000...FFFF_{HEX}$
Number of coils	2 bytes	$0001...07D0_{HEX}$
Byte count	1 byte	**N***
Coils value	n x 1 byte	n = **N***

REMARK: ***N** = Number of outputs / 8. If the remainder is not 0, then N = N+1

Response

Function code	1 byte	$0F_{HEX}$
Starting address	2 bytes	$0000...FFFF_{HEX}$
Number of coils	2 bytes	$0001...07D0_{HEX}$

Error

Error code	1 byte	$8F_{HEX}$
Exception code	1 byte	01 or 02 or 03 or 04

Example

Here is an example of a request to write a series of 10 coils starting at coil 20.

The request data contents are two bytes: CD 01_{HEX} (1100 1101 0000 0001 binary). The binary bits correspond to the outputs in the following way

Bit:	1	1	0	0	1	1	0	1	0	0	0	0	0	0	0	1
Output:	27	26	25	24	23	22	21	20	-	-	-	-	-	-	29	28

The first byte transmitted (CD_{HEX}) addresses outputs 27...20, with the least significant bit addressing the lowest output (20) in this set.

The next byte transmitted (01_{HEX}) addresses outputs 29...28, with the least significant bit addressing the lowest output (28) in this set. Unused bits in the last data byte should be zero-filled.

Request		Response	
Field Name	*(Hex)*	*Field Name*	*(Hex)*
Function	0F	Function	0F
Starting address Hi	00	Starting address Hi	00
Starting address Lo	13	Starting address Lo	13
Number of coils Hi	00	Number of coils Hi	00
Number of coils Lo	0A	Number of coils Lo	0A
Byte Count	02		
Coils value Hi	CD		
Coils value Lo	01		

1.4.9 Function code 16 (10_{HEX}): Pre set multiple registers

Function code 16 (10_{HEX}) is used to preset values into a sequence of holding registers (1...125 registers) in a remote device. The requested written values are specified in the Request data field. Data is packed as two bytes per register. The normal response returns the function code, starting address, and number of registers written.

When broadcast, the function presets the same register references in all attached receiver devices.

Request

Function code	1 byte	10_{HEX}
Starting address	2 bytes	$0000...FFFF_{HEX}$
Number of registers	2 bytes	$0001...007D_{HEX}$
Byte count	1 byte	2 x **N***
Registers value	**N*** x 2 bytes	Value

***N** = Number of registers

Response

Function code	1 byte	10_{HEX}
Starting address	2 bytes	$0000...FFFF_{HEX}$
Number of registers	2 bytes	$0001...007D_{HEX}$

Error

Error code	1 byte	90_{HEX}
Exception code	1 byte	01 or 02 or 03 or 04

Example

Below is an example of a request to write two registers starting at 2 to 00 $0A_{HEX}$ and 01 02_{HEX}.

Request		Response	
Field Name	*(Hex)*	*Field Name*	*(Hex)*
Function	10	Function	10
Starting address Hi	00	Starting address Hi	00
Starting address Lo	01	Starting address Lo	01
Number of registers Hi	00	Number of registers Hi	00
Number of registers Lo	02	Number of registers Lo	02
Byte count	04		
Registers value Hi	00		
Registers value Lo	0A		
Registers value Hi	01		
Registers value Lo	02		

1.5 Modbus exception responses

When a sender sends a request to a receiver, it expects a normal response. One of four possible events can occur from the sender's request:

- If the receiver receives the request without a communication error, and can handle the request normally, it returns a normal response.
- If the receiver does not receive the request due to a communication error, no response is returned. The sender program will eventually process a time-out condition for the request.
- If the receiver receives the request, but detects a communication error (parity) or data issue (LRC, CRC), no response is returned. The sender program will eventually process a time-out condition for the request.
- If the receiver receives the request without a communication error, but cannot handle it (for example, if the request is to read a non-existent coil or holding register), the receiver will return an exception response informing the sender device of the nature of the error.

The exception response message has two fields that differentiate it from a normal response:

- Function code field, refer to section 1.5.1 for more information
- Data field, refer to section 1.5.2 for more information

1.5.1 Function code field

In a normal response, the receiver echoes the function code of the original request in the Function Code field of the response. All function codes have a most-significant bit (MSB) of 0 (their values are all below 80_{HEX}). In an exception response, the receiver sets the MSB of the function code to 1. This makes the function code value in an exception response exactly 80_{HEX} higher than the value would be for a normal response.

With the MSB of the function code set, the sender's application program can recognize the exception response and can examine the data field for the exception code.

Below is an example of a sender's request and receiver's exception response.

Request		Response	
Field Name	*(Hex)*	*Field Name*	*(Hex)*
Function	01	Function	81
Starting address Hi	04	Exception code	02
Starting address Lo	A1		
Number of coils Hi	00		
Number of coils Lo	01		

In this example, the sender addresses a request to a receiver. The function code (01) is for a Read Coil Status operation. It requests the status of the coil at address 1185 decimal ($04A1_{HEX}$). Note that only one coil is to be read, as specified by the Number of coils field (0001).

If the coil's address is non-existent in the receiver, the receiver will return the exception response with the exception code shown (02). This specifies an illegal data address for the receiver.

1.5.2 Data field

In a normal response, the receiver may return any data or statistics in the data field (any information that was requested in the request). In an exception response, the receiver returns an exception code in the data field. This code defines the receiver's condition that caused the exception.

TABLE 1-4 gives a description of the exception codes.

TABLE 1-4 Description of exception codes

Code	Name	Description
01	Illegal Function	The function code received in the request is not an allowable action for the receiver device. This may be because the function code is only applicable to newer devices, and was not implemented in the selected device. It could also indicate that the receiver device is in the wrong state to process a request of this type, for example because it is not configured and is being asked to return register values.
02	Illegal Data Address	The data address received in the request is not an allowable address for the receiver device. More specifically, the combination of reference number and transfer length is invalid. For a controller with 100 registers, the PDU addresses the first register as 0, and the last one as 99. If a request is submitted with a starting register address of 96 and a quantity of registers of 4, then this request will successfully operate (address-wise at least) on registers 96, 97, 98, 99. If a request is submitted with a starting register address of 96 and a quantity of registers of 5, then this request will fail with Exception Code 0x02 ‘Illegal Data Address’ since it attempts to operate on registers 96, 97, 98, 99 and 100, and there is no register with address 100.
03	Illegal Data Value	A value contained in the request data field is not an allowable value for the receiver device. This indicates a fault in the structure of the remainder of a complex request, e.g. the implied length is incorrect. It specifically does NOT mean that a data item submitted for storage in a register has a value outside the expectation of the application program, since the Modbus protocol is unaware of the significance of any particular value of any particular register.
04	Receiver Device Failure	An unrecoverable error occurred while the receiver device was attempting to perform the requested action.

Code	Name	Description
06	Receiver Device Busy	Specialized use in conjunction with programming commands. The receiver device is engaged in processing a long–duration program command. The sender should retransmit the message later when the receiver device is free. This error code is generated in one of the following cases: • The system is busy. • The system is not able to generate an answer. • The system is not able to reply with the correct data in the required time-out period.

CHAPTER 2 CIU 880 COMPLIANT MODBUS MAPPING

In order to be compliant to the CIU 880, the CIU 888 supports fixed Entis Pro compliant and CIU Plus compliant Modbus maps. it also supports flexible modbus maps similar to CIU 880.

2.1 Port address range details

In the Modbus protocol there are four types of memory images that a Modbus host system can request (see TABLE 2-1):

TABLE 2-1 Memory images in Modbus protocol

	Name	Memory Area (Hex)	Description
Coils	Read Coil Status	0000...FFFF	Reads 1-bit status information
	Force Single Coil	0000...FFFF	Writes a 1-bit coil
	Force Multiple Coils	0000...FFFF	Writes multiple 1-bit coils
Discrete Inputs	Read Input Status	0000...FFFF	Reads 1-bit status information
Input Registers	Read Input Registers	0000...FFFF	Reads 16-bit value information
Holding Registers	Read Holding Registers	0000...FFFF	Reads 16-bit value information
	Preset Single Register	0000...FFFF	Writes a 16-bit value
	Preset Multiple Registers	0000...FFFF	Writes multiple 16-bit values

2.2 Coils (Read/Write)

FIGURE 2-1 displays a graphical overview of the *Coils* area.

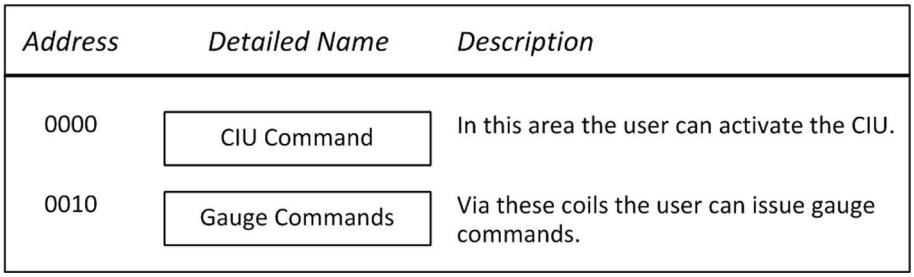


FIGURE 2-1 Graphical overview of *Coils* area

REMARK: These Modbus coil commands are supported through serial host ports and Ethernet host ports of CIU 888.

2.2.1 CIU command area

The user can activate the CIU by issuing the Activate CIU command (see TABLE 2-2).

TABLE 2-2 Activate CIU command

Address	Read/ Write	Function	Description
0001	R/W	Activate CIU	When the value '1' is written the CIU goes active in a Hot Standby situation.

REMARKS:
1. The result of an activate CIU command is after some time visible in the CIU Hot Standby Mode of the related CIU.
2. The CIU command is the same command as entity #501. Refer to APPENDIX C for more information.

2.2.2 Gauge commands

The user can issue gauge commands by forcing Coils to either ON or OFF (Modbus function 05) (see TABLE 2-3). Commands are only accepted when the required command is enabled for the addressed gauge (see section 2.2.2.1). The first Coil address for tank gauge commands is address 000A hexadecimal (0010 decimal).

The sequence in which the tanks are ordered in the Modbus memory map defines the address sequence in which the tank gauge command must be given.

For checking the status of the instrument, the status Discrete Inputs reflects the actual status from the instrument. See section 2.3 for more information about Discrete inputs.

The command Coil itself is seen as a 'push button'. When the Coil is read, its status is always '0'.

TABLE 2-3 Gauge commands

Relative Address	Read/ Write	Function	Description
0	R/W	Unlock command	If the value is '1', then stop all command actions and return to level measuring.
1	R/W	Test gauge command	If the value is '1', then test the level gauge connected to associated tank.
2	R/W	Lock test command	If the value is '1', then lock test the level gauge connected to associated tank.

Relative Address	Read/ Write	Function	Description
3	R/W	Block gauge command	If the value is '1', then block the level gauge.
4	R/W	Density dip command	If the value is '1', then start a density dip action upwards.
5	R/W	Water dip command	If the value is '1', then start a water dip action for the associated tank.
6	R/W	Combined dip command	If the value is '1', then start a combined dip action on the associated tank.

REMARKS:
1. The actual Coil address is (10 + ((x - 1) * 7) + Relative address), where x = tank sequence number in Modbus memory map
2. Multiple commands and commands priority: All commands are treated separately; multiple commands can be given for different tanks; when multiple commands are given to the same Tank, the result can be unpredictable.

2.2.2.1 Enabling Modbus commands for gauges

When configuring a gauge in Ensite Pro, you can specify which Modbus commands are allowed for this gauge (see FIGURE 2-2).

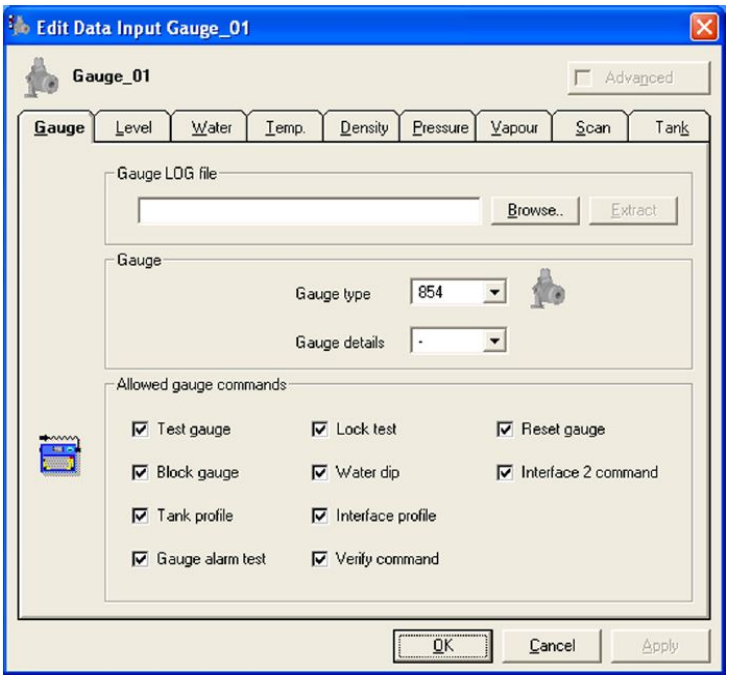


FIGURE 2-2 Ensite Pro: *Edit Data Input Window*

REMARK: Refer to the *Ensite Pro Configuration Tool Instruction Manual* for more information.

NOTE: When configuring a gauge in CIU 888 Service tool, refer to the Configuration Manual CIU 888 (Part No. 4417593) for more information on specifying which Modbus commands are allowed for this gauge.

2.3 Discrete inputs (Read only)

FIGURE 2-3 displays a graphical overview of the *Discrete Inputs* area.

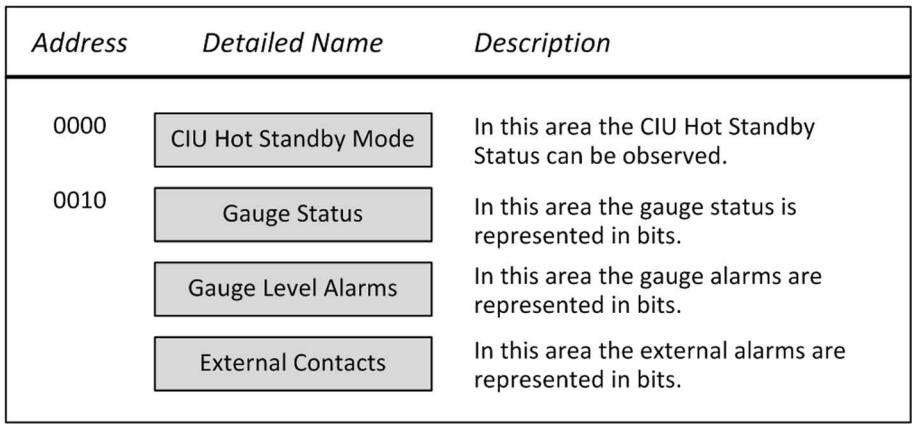


FIGURE 2-3 Graphical overview of *Discrete Input* area

REMARKS:
1. The addresses for Gauge level alarms and External contacts are relative to their previous memory areas i.e. Gauge status and Gauge level alarms respectively. This depends on the number of tanks configured for the corresponding host port.
2. These Modbus discrete inputs are supported through serial host ports and Ethernet host ports of CIU 888.

2.3.1 CIU Hot Standby mode

The CIU Hot Standby mode can be read (see TABLE 2-4).

TABLE 2-4 CIU Hot Standby mode

Address	Read/ Write	Function	Description
0000	R	CIUHotStandbyMode	Value '1' indicates that the CIU is a passive member of a Hot Standby pair.

REMARK: The CIU Hot Standby mode reflects the status of entity #500. Refer to APPENDIX C for more information.

2.3.2 Gauge status

The Gauge status can be read (see TABLE 2-5). The total number of tanks and the sequence how the tanks are ordered in the Modbus memory map defines the address sequence where the status can be read.

TABLE 2-5 Gauge status

Relative Address	R/W	Status	Description
0	R	Measuring level	When the value is '1' the level gauge is measuring level.
1	R	Failure	When the value '1' the level gauge is in failure.

REMARKS:
1. The actual Discrete Input address is 10 + ((x - 1) * 2) + Relative address, where x = Tank sequence number in Modbus memory map.
2. The Discrete Input reflects the status of entity #6. Refer to APPENDIX A for more information.
3. When no Discrete Input is set, the gauge is available but NOT measuring.

2.3.3 Gauge level alarms

The gauge level alarms of the level gauge can be read (see TABLE 2-6). The total number of tanks and the sequence how the tanks are ordered in the Modbus memory map defines the address sequence where the status can be read.

TABLE 2-6 Gauge level alarms

Relative Address	Read/ Write	Function	Description
0	R	Low alarm	If the value is '1', then the low alarm switch of the level gauge is tripped.
1	R	High alarm	If the value is '1', then the high alarm switch of the level gauge is tripped.
2	R	Alarm failure	If the value is '1', then the alarm switches of the level gauge are in failure.

REMARKS:
1. The actual Discrete Input address is 10 + (y * 2) + ((x - 1) * 3) + Relative address, where:
   x = Tank sequence number in Modbus memory map
   y = Total number of tanks in memory map

2. The Discrete Input reflects the status of entity #36. See APPENDIX A for more information.

2.3.3.1 External contacts

The external gauge contacts of the level gauge can be read (see TABLE 2-7). The total number of tanks and the sequence how the tanks are ordered in the Modbus memory map defines the address sequence where the status can be read.

TABLE 2-7 External contacts

Relative Address	Read/ Write	Function	Description
0	R	External 1 contact	When the value is '1' external 1 contact switch of the level gauge is active.
1	R	External 2 contact	When the value is '1' external 2 contact switch of the level gauge is active.
2	R	External contact failure	When the value is '1' the external contact switches of the level gauge are in failure.
3	R	External contact not available	When the value is '1' the external contact switches are not available in the level gauge.

REMARKS:
1. The actual Discrete Input address is 10 + (y *5) + ((x - 1) * 4) + Relative address, where:
   x = Tank sequence number in Modbus memory map
   y = Total number of tanks in memory map
2. The Discrete Input reflects the status of entity #37. See APPENDIX A for more information.

2.4 Input registers and Holding registers

In the 16-bit registers space both the Holding registers and the Input registers are combined in one address space, occupying the standard memory area from 0000...9999 decimal (0000...270F$_{HEX}$) and the extended memory area from 10000 decimal (2710$_{HEX}$) upwards:

- The address occupation is on a 'per port' basis. Each port can be configured inside the restrictions.
- Data can be retrieved via the Modbus commands 03 and 04.
- Writing can be done to some registers via Modbus commands 06 and 16.

FIGURE 2-4 shows a graphical overview of the 16-bit register area.

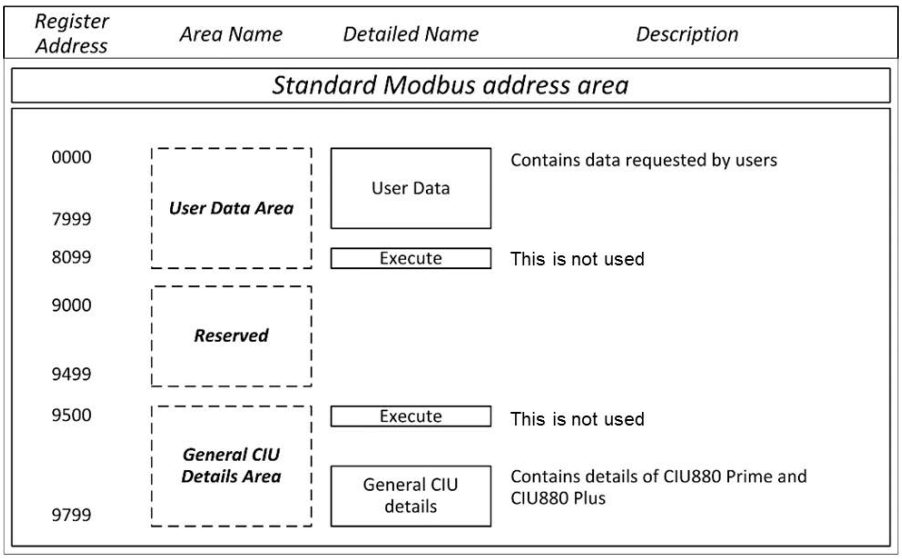


FIGURE 2-4 16-Bit register area

REMARK: These Modbus Holding register and Input register areas are supported through serial host ports and Ethernet host ports of CIU 888.

2.4.1 User data area

The possible configuration options available for the User Data area in the CIU 888 compatible Modbus map are CIU Plus compliant tank record and Entis Pro compliant tank record.

2.4.1.1 CIU Plus compliant tank record

TABLE 2-8 gives an overview of the entities in the CIU Plus compliant tank record (formerly supported by the CIU 880 Prime).

REMARKS:
1. For a description of the entities mentioned in this table, see APPENDIX A
2. For a description of the possible Data Types, see APPENDIX F
3. For a description of the status and validity data entities, see APPENDIX G
4. For a description of the possible Dimension Types, see APPENDIX H

TABLE 2-8 CIU Plus compliant tank record

ID	Name	Register Address		Data Type	Number of Registers	Scaling	Offset	Dimension Type
		Hex	Dec					
106	CIUPrimeTank ID	0000	0	1	1	0	0	160 nodim
77	Verification Signature	0001	1	1	1	0	0	160 nodim
94	TankCRC	0002	2	1	1	0	0	160 nodim

ID	Name	Register Address		Data Type	Number of Registers	Scaling	Offset	Dimension Type
		Hex	Dec					
95	CIUPrimeCRC	0003	3	1	1	0	0	160 nodim
2	TankStatus	0004	4	0	1	0	0	161 bit coded
3	MovingStatus	0005	5	0	1	0	0	162 index
6	GaugeStatus	0006	6	0	1	0	0	162 index
9	HotStandbyStatus	0007	7	0	1	0	0	161 bit coded
10	CommStatus	0008	8	0	1	0	0	161 bit coded
36	GaugeLevelAlarms	0009	9	0	1	0	0	161 bit coded
37	ExternalContacts	000A	10	0	1	0	0	161 bit coded
38	Displacer position	000B	11	51	2	10000	0	0x level
39	DisplacerStatus	000D	13	0	1	0	0	163 status
40	ProductLevel	000E	14	51	2	10000	0	0x level
41	ProductLevelStatus	0010	16	0	1	0	0	163 status
42	WaterLevel	0011	17	51	2	10000	0	0x level
43	WaterLevelStatus	0013	19	0	1	0	0	163 status
44	ProductTemp	0014	20	40	1	100	30000	2x temp
45	ProductTempStatus	0015	21	0	1	0	0	163 status
46	VapRoomTemp	0016	22	40	1	100	30000	2x temp
47	VapRoomTempStatus	0017	23	0	1	0	0	163 status
48	VapRoomPress	0018	24	40	1	10	0	3x pressure
49	VapRoomPressStatus	0019	25	0	1	0	0	163 status
50	DObs	001A	26	51	2	100	0	6xdensity
51	DObsStatus	001C	28	0	1	0	0	163 status
52	ForeGroundTimeStamp	001D	29	3	3	0	0	113 time
53	BackGroundTimeStamp	0020	32	3	3	0	0	113 time
78	ConfigurationStatus	0023	35	0	1	0	0	161 bit coded
88	HydroMeterCorr	0024	36	0	1	0	0	160 nodim
103	Ambient Temperature	0025	37	40	1	100	30000	2x temp
104	Ambient Temperature Status	0026	38	0	1	0	0	163 status
118	Tobs	0027	39	40	1	100	30000	2x temp
119	Tobs Status	0028	40	0	1	0	0	163 status
154	HydroMeterCorrStatus	0029	41	0	1	0	0	163 status

REMARK: The scaling and offset values displayed in TABLE 2-8 are based on the following engineering units: m, C, kPa, m^3, Kg/m^3, m^3/min, kg. In practice, the values may differ depending on the engineering units configured by the customer.

2.4.1.2 Entis Pro compliant tank record

TABLE 2-9 gives an overview of the entities in the Entis Pro compliant tank record (formerly supported by the CIU 880 Plus).

REMARKS:
1. For a description of the entities mentioned in this table, see APPENDIX B
2. For a description of the possible Data Types, see APPENDIX F
3. For a description of the status and validity data entities, see APPENDIX G
4. For a description of the possible Dimension Types, see APPENDIX H

TABLE 2-9 EntisPro compliant tank record

ID	Name	Register Address		Data Type	Number of Registers	Scaling	Offset	Dimension Type
		Hex	Dec					
105	CIUPlus Tank ID	0000	000	1	1	0	0	160 nodim
77	Verification Signature	0001	001	1	1	0	0	160 nodim
21	ProductName	0002	002	15/25	10	0	0	120/121 text
124	CTL	000C	012	51	2	50000	0	170 factor
125	CTLStatus	000E	014	0	1	0	0	163 status
30	Dref	000F	015	51	2	100	0	6x density
31	DrefStatus	0011	017	0	1	0	0	163 status
32	SedAndWater	0012	018	40	1	100	0	140 perc.
33	ProductTC	0013	019	51	2	1000	0	15x temp.c.
34	ProductTCStatus	0015	021	0	1	0	0	163 status
35	LiqVolRatio	0016	022	40	1	10	0	170 factor
38	DisplacerPosition	0017	023	51	2	10000	0	0x level
39	DisplacerPositionStatus	0019	025	0	1	0	0	163 status
40	ProductLevel	0001A	026	51	2	10000	0	0x level
41	ProductLevelStatus	001C	028	0	1	0	0	163 status
42	WaterLevel	001D	029	51	2	10000	0	0x level
43	WaterLevelStatus	001F	031	0	1	0	0	163 status
44	ProductTemp	0020	032	40	1	100	30000	2x temp
45	ProductTempStatus	0021	033	0	1	00	0	163 status
46	VapRoomTemp	0022	034	40	1	100	30000	2x temp
47	VapRoomTempStatus	0023	035	0	1	0	0	163 status
48	VapRoomPress	0024	036	40	1	10	0	3x pressure

ID	Name	Register Address		Data Type	Number of Registers	Scaling	Offset	Dimension Type
		Hex	Dec					
49	VapRoomPressStatus	0025	037	0	1	0	0	163 status
50	DObs	0026	038	51	2	100	0	6x density
51	DObsStatus	0028	040	0	1	0	0	163 status
52	ForeGroundTempStamp	0029	041	3	3	0	0	113 time
53	BackgroundTempStamp	002C	044	3	3	0	0	115 time
54	TOV	002F	047	51	2	1000	0	5x volume
55	TOVStatus	0031	049	0	1	0	0	163 status
56	WaterVol	0032	050	51	2	1000	0	5x volume
57	WaterVolStatus	0034	052	0	1	0	0	163 status
58	GOV	0035	053	51	2	1000	0	5x volume
59	GOVStatus	0037	055	0	1	0	0	163 status
60	GSV	0038	056	51	2	1000	0	5x volume
61	GSVStatus	003A	058	0	1	0	0	163 status
62	NSV	003B	059	51	2	1000	0	5x volume
63	NSVStatus	003D	061	0	1	0	0	163 status
64	LiqInVap	003E	062	51	2	1000	0	5x volume
65	LiqInVapStatus	0040	064	0	1	0	0	163 status
66	TGSV	0041	065	51	2	1000	0	5x volume
67	TGSVStatus	0043	067	0	1	0	0	163 status
68	MassLiq	0044	068	51	2	1	0	10x mass
69	MassLiqStatus	0046	070	0	1	0	0	163 status
70	MassVap	0047	071	51	2	1	0	10x mass
71	MassVapStatus	0049	073	0	1	0	0	163 status
72	TotalMass	004A	074	51	2	1	0	10x mass
73	TotalMassStatus	004C	076	0	1	0	0	163 status
74	FlowTOV	004D	077	51	2	100	0	7x flow
75	AvailableRoom	004F	079	51	2	1000	0	5x volume
76	Available TOV	0051	081	51	2	1000	0	5x volume
79	Molar Weight	0053	083	51	2	10000	0	130 mol.val.
94	TankCRC	0055	085	1	1	0	0	160 nodim
96	CIUPlusCRC	0056	086	1	1	0	0	160 nodim
99	FlowStatus	0057	087	0	1	0	0	163 status
100	AvailableRoomStatus	0058	088	0	1	0	0	163 status
101	Available TOVStatus	0059	089	0	1	0	0	163 status
103	AmbientTemperature	005A	090	40	1	100	30000	2x temp

ID	Name	Register Address		Data Type	Number of Registers	Scaling	Offset	Dimension Type
		Hex	Dec					
104	AmbientTemperature Status	005B	091	0	1	0	0	163 status
107	CTSh	005C	092	51	2	100000	0	170 factor
108	CTShStatus	005E	094	0	1	0	0	163 status
200	Alarms*	005F	095	1	1	0	0	160 nodim
201	DynamicTankStatus*	0060	096	1	1	0	0	160 nodim
204	CombinedVolume Corrections*	0061	097	1	1	0	00	160 nodim
205	Mass&Volume Corrections*	0062	098	1	1	0	0	160 nodim
206	Comm&ConfStatus*	0063	099	1	1	0	0	160 nodim

REMARK: The scaling and offset values displayed in TABLE 2-9 are based on the following engineering units: m, C, kPa, m^3, Kg/m^3, m^3/min, kg. In practice, the values may differ depending on the engineering units configured by the customer.

2.4.2 General CIU details area

Some general entities are available to the user via Modbus registers. These entities are available on fixed Modbus addresses (see TABLE 2-10).

REMARKS:
1. For a description of the entities mentioned in this table, see APPENDIX C
2. For a description of the possible Data Types, see APPENDIX F
3. For a description of the status and validity data entities, see APPENDIX G
4. For a description of the possible Dimension Types, see APPENDIX H

TABLE 2-10 General CIU details

ID	Name	Register Address		Data Type	Number of Registers	Access	Dimension Type
		Hex	Dec				
520	CIUClock	251D	9501	Timestamp	3	R/W	Time
521	CIUYear	2520	9504	40	1	R/W	Time (YYYY)
522	CIUMonth	2521	9505	40	1	R/W	Time (MM)
523	CIUDay	2522	9506	40	1	R/W	Time (DD)
524	CIUHour	2523	9507	40	1	R/W	Time (hh)
525	CIU Minute	2524	9508	40	1	R/W	Time (mm)
526	CIU Seconds	2525	9509	40	1	R/W	Time (ss)

ID	Name	Register Address		Data Type	Number of Registers	Access	Dimension Type
		Hex	Dec				
527	CIUDayLightSaving	2526	9510	40	1	R/W	0 = Off 1 = On
500	CIUHotStandbyMode	2527	9511	0	1	R	Status
501	ActivateCIU	2528	9512	0	1	R/W	Status

2.5 Flexible Modbus maps

The CIU 888 supports flexible (i.e. user-defined) CIU Plus compliant Modbus mapping. Users can enable flexible Modbus mapping for a host port during commissioning/configuration of the CIU 888 using Ensite Pro. Refer to the *Configuration Manual CIU 888* (Part No. 4417593) for more information on configuration of flexible (User specified) Modbus maps for serial and Ethernet host ports. During commissioning/configuration flexible Modbus can be enabled for either a CIU Plus host port (see section 2.5.1) or a CIU Prime host port (see section 2.5.2).

REMARKS:
1. For each configured CIU 888 host port the Modbus mapping must be according to the connected host system.
2. If a CIU 888 host port is used for connecting the Entis Pro system flexible Modbus should not be used since Entis Pro requires its own specific Modbus mapping.

2.5.1 Enabling flexible Modbus for a CIU Plus host port

During commissioning/configuration of the CIU 888 users can enable flexible Modbus mapping for any CIU Plus host port, provided that the host port is not used for connecting the Entis Pro system.

NOTE: Refer to the Configuration Manual CIU 888 (Part No. 4417593) for more information about the mapping of the CIU Plus host ports to the CIU 888 host ports and the mapping for the CIU 888 Ethernet host ports.

Perform the following steps in Ensite Pro to enable flexible Modbus mapping for a CIU Plus host port:

1. Click (**Configure CIU Plus**) in the Ensite Pro toolbar.
   The *Select CIU Plus* window is displayed FIGURE 2-5.

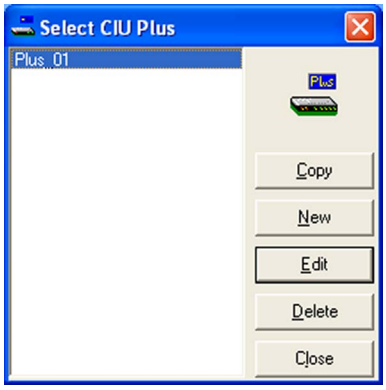


FIGURE 2-5 *Select CIU Plus* window

2. Select the CIU Plus from the list. Next, click **Edit**.
   The *Edit CIU Plus* window is displayed. By default, the *HostPorts* tab is displayed FIGURE 2-6.

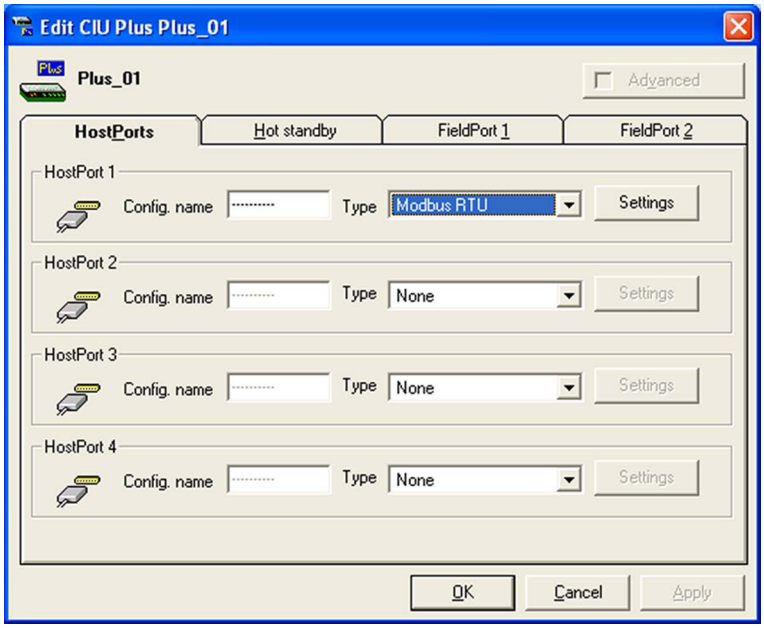


FIGURE 2-6 Ensite Pro: *Edit CIU Plus* window - *HostPorts* tab

3. Check if the type of the host port for which you want to enable flexible Modbus mapping is **Modbus RTU**. If this is not the case, change the type to Modbus RTU and click **Apply**.

4. Click **Settings**.
   The *CIU Plus - HostPort Settings* window is displayed FIGURE 2-7.

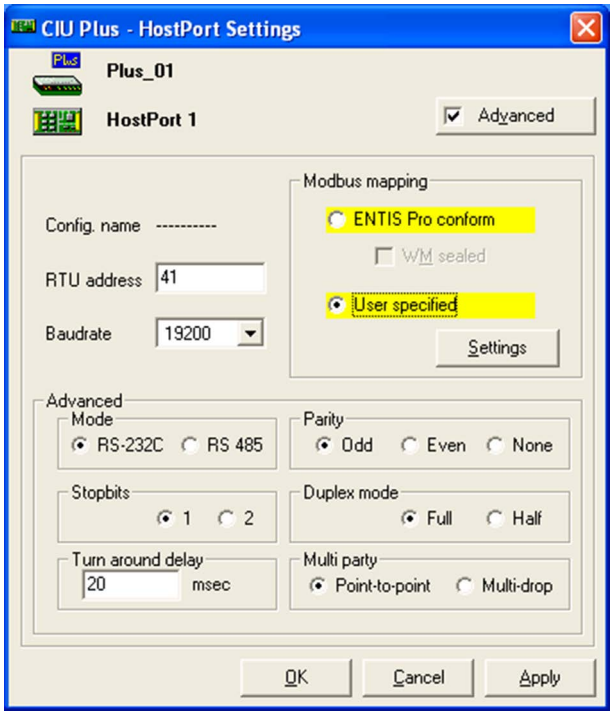


FIGURE 2-7 Ensite Pro: *CIU Plus - HostPort Settings* window

5. Under *Modbus mapping* select the **User specified** radio button. Next, click **Apply**.

6. Click **Settings**.
   The ***Modbus Settings*** window is displayed FIGURE 2-8.

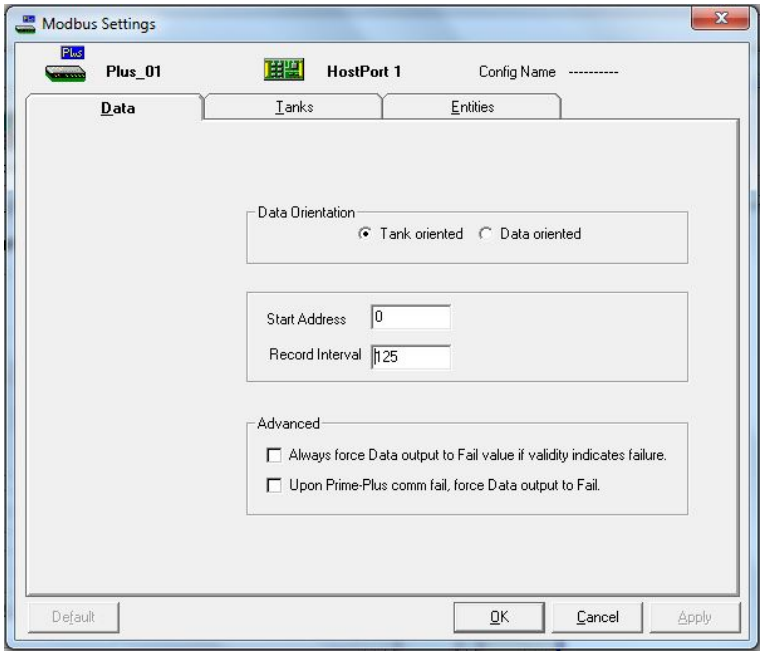


FIGURE 2-8 Ensite Pro: *CIU Plus - Tank Oriented Tab*

7. On the **Data** Tab select either **Tank oriented** or **Data oriented**.
   a) **Tank oriented**: In this option, data in the modbus memory map is mapped to each tank. Both **Start Address** of the memory map as well as the **Record Interval** between the tank records is programmable. Default start address is 0000.
   b) Data oriented: In this option, data in the modbus memory map is mapped to the selected entity. Only the **Start Address** of memory map is programmable. Default start address is 0000**.**

8. Go to the ***Tanks*** *tab (*See FIGURE 2-9*)*. You can arrange the order of tanks using the arrow options. The order can be decided based on the priority on which you want to view the tank details.

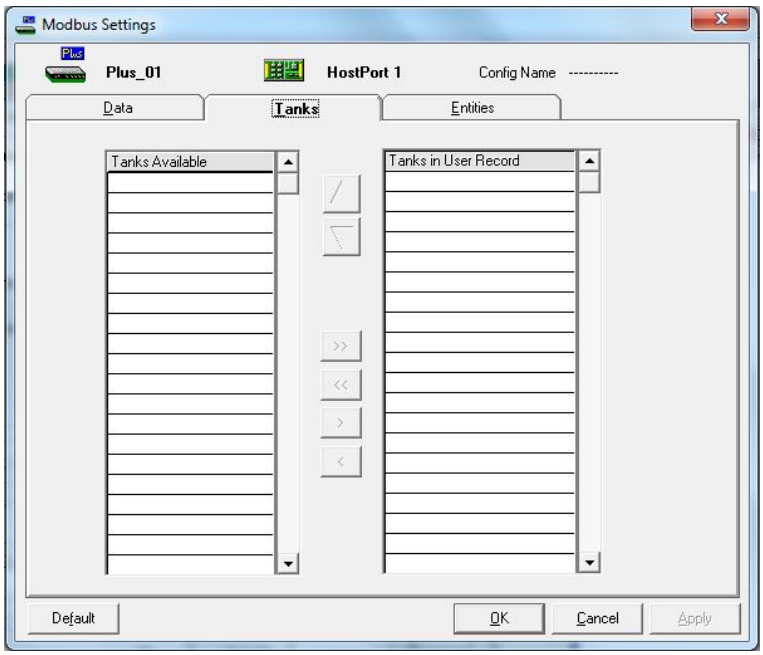


FIGURE 2-9 Ensite Pro: *Modbus Settings* window - *Tanks* tab

9. Go to the *Entities* tab.

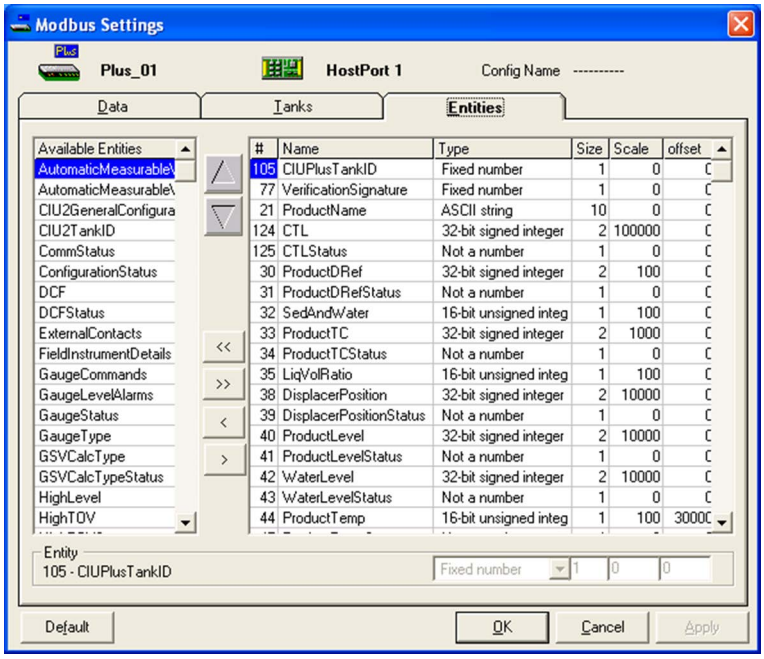


FIGURE 2-10 Ensite Pro: *Modbus Settings* window - *Entities* tab

10. Make the necessary changes to the Modbus entity settings. You can define the order in which the entities should appear.

NOTE: Refer to the Instruction Manual Ensite Pro Configuration Tool version 2.010 (Part No. 4416593) for more information.

11. Click **OK** to save the configuration settings and to close the window. The *CIU Plus - HostPort Settings* window is displayed again.
12. Click **OK** to save the configuration settings and to close the window. The *Edit CIU Plus* window is displayed again.
13. Click **OK** to save the configuration settings and to close the window. The *Select CIU Plus* window is displayed again.
14. Click **Close** to close the window.
15. Click (**Close**) in the *Ensite Pro* toolbar to stop and close Ensite Pro.
16. Upload the new (changed) site configuration to the CIU 888. Refer to the *Configuration Manual CIU 888* (Part No. 4417593) for more information.

2.5.1.1 Available Tank Entities

The table below displays all the entities available to the user.

Name	ID	Dimension
TankName	1	Text (ASCII or Unicode)
TankStatus	2	Bit coded
MovingStatus	3	Index
TankType	4	Bit coded
GaugeType	5	Nodim
GaugeStatus	6	Index
TempElementType	8	Index
HotStandbyStatus	9	Bit coded
CommStatus	10	Bit coded
TankShape	16	Index
ShellCapacity	17	Volume
LowTOV	18	Volume
HighTOV	19	Volume
HighLevel	20	Level
ProductName	21	Text (ASCII or Unicode)
GSVCalcType	22	Index
ProductCode	23	Index
VolumeCorrections	24	Index
MassCalcType	25	Bit coded

Name	ID	Dimension
ProductTRef	26	Temperature
DRef	30	Density
DRefStatus	31	Status
SedAndWater	32	Percentage
ProductTC	33	Temperature coefficient
ProductTCStatus	34	Status
LiqVolRatio	35	Nodim
GaugeLevelAlarms	36	Bit coded
ExternalContacts	37	Bit coded
DisplacerPosition	38	Level
DisplacerPositionStatus	39	Status
ProductLevel	40	Level
ProductLevelStatus	41	Status
WaterLevel	42	Level
WaterLevelStatus	43	Status
ProductTemp	44	Temperature
ProductTempStatus	45	Status
VapRoomTemp	46	Temperature
VapRoomTempStatus	47	Status
VapRoomPress	48	Pressure
VapRoomPressStatus	49	Status
DObs	50	Density
DObsStatus	51	Status
ForegroundTimeStamp	52	Absolute time
BackgroundTimeStamp	53	Absolute time
TOV	54	Volume
TOVStatus	55	Status
WaterVol	56	Volume
WaterVolStatus	57	Status
GOV	58	Volume
GOVStatus	59	Status
GSV	60	Volume
GSVStatus	61	Status
NSV	62	Volume
NSVStatus	63	Status
LiqInVap	64	Volume

Name	ID	Dimension
LiqInVapStatus	65	Status
TGSV	66	Volume
TGSVStatus	67	Status
MassLiq	68	Mass
MassLiqStatus	69	Status
MassVap	70	Mass
MassVapStatus	71	Status
TotalMass	72	Mass
TotalMassStatus	73	Status
FlowTOV	74	Flow
AvailableRoom	75	Volume
AvailableTOV	76	Volume
VerificationSignature	77	Nodim
ConfigurationStatus	78	Bit coded
MolarWeight	79	Molar Weight value
AutomaticMeasurableValues	80	Bit coded
HydroMeterCorr	88	Nodim
TankShellTRef	90	Temperature
TankShellExpansionCoefficient	91	TankShellCoefficient
TankAirDensity	92	Density
VapRoom	93	Volume
TankConfigurationCRC	94	Nodim
CIUPrimeGeneralConfiguratonCRC	95	Nodim
CIUPlusGeneralConfigurationCRC	96	Nodim
LowLevel	97	Level
FlowStatus	99	Status
AvailableRoomStatus	100	Status
AvailableTOVStatus	101	Status
VapRoomStatus	102	Status
AmbientTemperature	103	Temperature
AmbientTemperatureStatus	104	Status
CIUPlusTankID	105	Nodim
CIUPrimeTankID	106	Nodim
CTSh	107	CTSh
CTShStatus	108	Status
InsulationFactor	109	Insulation Factor

Name	ID	Dimension
TObs	118	Temperature
TObsStatus	119	Status
VolumeCorrectionFactor	124	VCF
VolumeCorrectionFactorStatus	125	Status
TemperatureCorrectionFactor	126	TCF
TemperatureCorrectionFactorStatus	127	Status
DensityCorrectionFactor	128	DCF
DensityCorrectionFactorStatus	129	Status
TankStatusStatus	131	Nodim
MovingStatusStatus	132	Nodim
TankTypeStatus	133	Nodim
ShellCapacityStatus	134	Nodim
LowTOVStatus	135	Nodim
HighTOVStatus	136	Nodim
ProductNameStatus	137	Nodim
GSVCalcTypeStatus	138	Nodim
ProductCodeStatus	139	Nodim
VolumeCorrectionStatus	140	Nodim
MassCalcTypeStatus	141	Nodim
ProductTRefStatus	142	Nodim
SedAndWaterStatus	143	Nodim
LiqVolRatioStatus	144	Nodim
MolarWeightStatus	145	Nodim
AutomaticMeasurableValuesStatus	146	Nodim
HydroMeterCorrStatus	154	Nodim
TankTRefStatus	155	Status
TankTCStatus	156	Nodim
AirDensityStatus	157	Status
InsulationFactorStatus	158	Nodim
Alarms* (gauge level alarms) (external contacts)	200 (36) (37)	Nodim (bit coded) (bit coded)
Dynamic tank status* (gauge status) (moving status) (tank status)	201 (6) (3) (2)	Nodim (index) (index) (bit coded)
Static tank definitions* (tank type) (tank shape)	202 (4) (16)	Nodim (bit coded) (index)

Name	ID	Dimension
Field instrument details* (gauge type) (temperature element type)	203 (5) (8)	Nodim (nodim) (index)
Combined volume corrections* (GSV calculation type) (product code)	204 (22) (23)	Nodim (index) (index)
Mass and volume corrections* (volume corrections) (mass calculation type)	205 (24) (25)	Nodim (index) (bit coded)
Comm. and conf. status* (configuration status) (hot standby status) (comm status)	206 (78) (9) (10)	Nodim (bit coded) (bit coded) (bit coded)

*NOTE: * behind the entity name indicates that this is a combined entity. The entities requested with this combined entity are in the above table written between brackets.*

REMARK: For a description of the entities mentioned in this table, see APPENDIX E

2.5.2 Enabling flexible Modbus mapping for a CIU Prime host port

During commissioning/configuration of the CIU 888 users can enable flexible Modbus mapping for CIU Prime host port 2.

REMARK: The CIU Plus/CIU Prime host ports need to be mapped to the CIU 888 host ports in a certain way, whereby CIU Prime host port 1 is linked to the

NOTE: Refer to the Configuration Manual CIU 888 (Part No. 4417593) for more information about the mapping of CIU Prime host port 2 to a CIU 888 host port.

Perform the following steps in Ensite Pro to enable flexible Modbus mapping for a CIU Prime host port:

1. Click  (**Configure Links**) in the Ensite Pro tool bar.
   The *Link* window is displayed FIGURE 2-11.

2. Go to the *CIU Prime* tab.

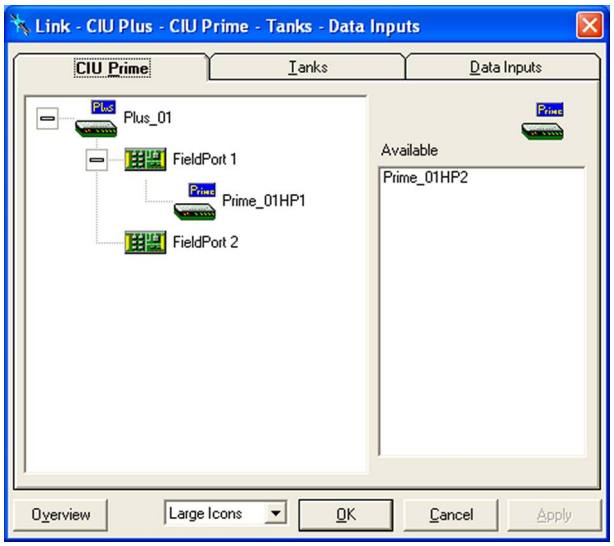


FIGURE 2-11 Ensite Pro: *Link* window - *CIU Prime* tab

3. Make sure that CIU Prime host port 2 is not linked to a CIU Plus.
4. Click **OK** to close the window.
5. Click  (**Configure CIU Prime**) in the Ensite Pro toolbar.
   The *Select CIU Prime* window is displayed FIGURE 2-12.

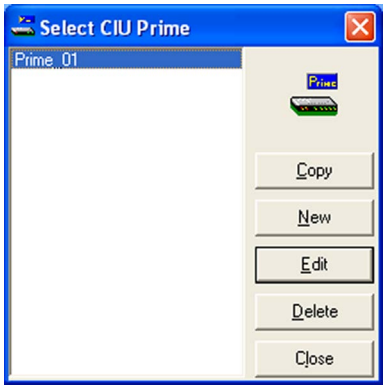


FIGURE 2-12 Ensite Pro: *Select CIU Prime* window

6. Select the CIU Prime from the list. Next, click **Edit**.
   The *Edit CIU Prime* window is displayed FIGURE 2-13. By default, the *HostPort 1* tab is displayed.

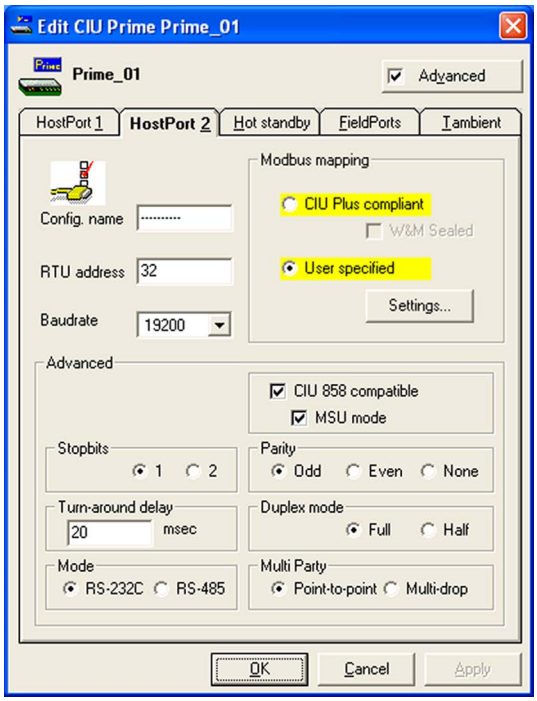


FIGURE 2-13 Ensite Pro: *Edit CIU Prime* window - *HostPort 2* tab

7. Go to the **HostPort 2** tab.
8. Under *Modbus mapping,* select the **User specified** radio button. Next, click **Apply**.

9. Click **Settings...**.
   The *Modbus Settings* window is displayed FIGURE 2-14.

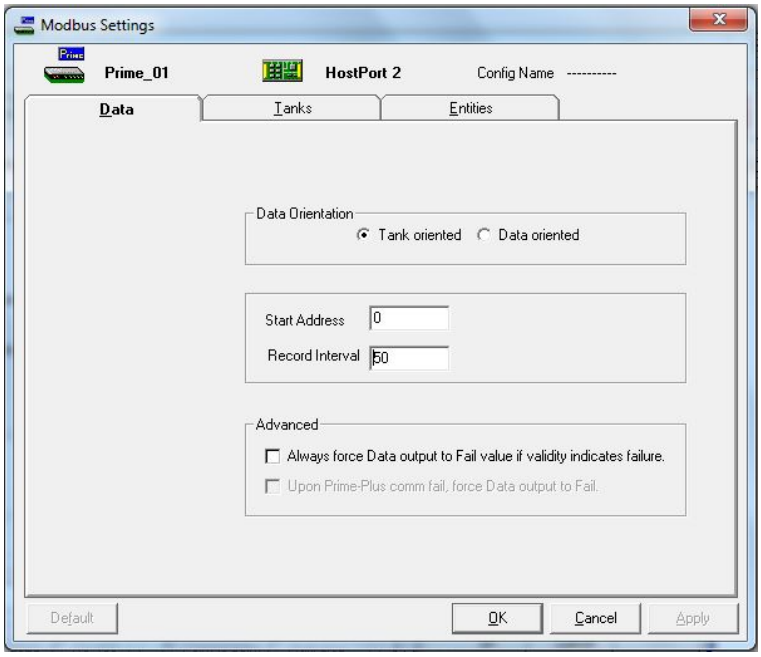


FIGURE 2-14 Ensite Pro: *CIU Prime- Tank Oriented Tab*

10. On the **Data** Tab select either **Tank oriented** or **Data oriented**.
    a) **Tank oriented**: In this option, data in the modbus memory map is mapped to each tank. Both **Start Address** of the memory map as well as the **Record Interval** between the tank records is programmable. Default start address is 0000.
    b) Data oriented: In this option, data in the modbus memory map is mapped to the selected entity. Only the **Start Address** of memory map is programmable. Default start address is 0000**.**

11. Go to the ***Tanks*** *tab (*See FIGURE 2-15*).* You can arrange the order of tanks using the arrow options. The order can be decided based on the priority on which you want to view the tank details.

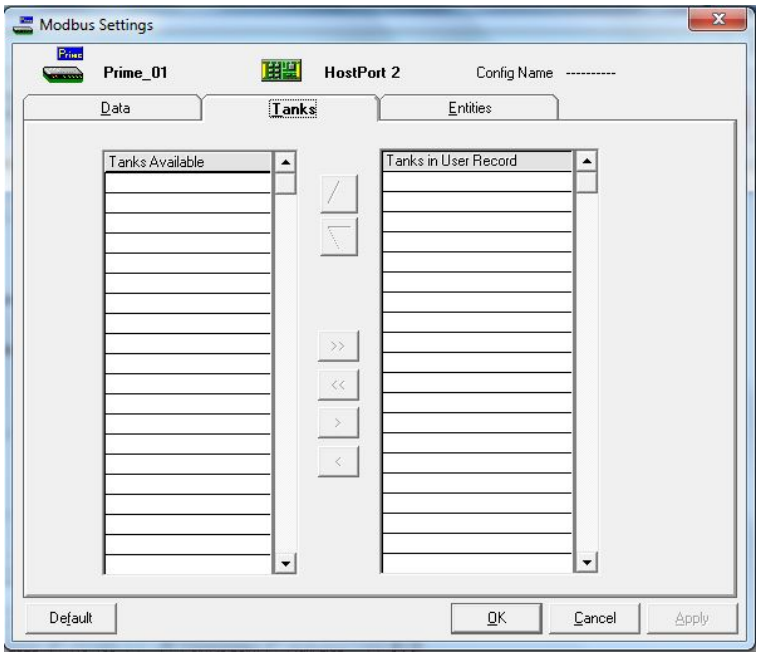


FIGURE 2-15 Ensite Pro: *Modbus Settings* window - *Tanks* tab

12. Go to the ***Entities*** tab.

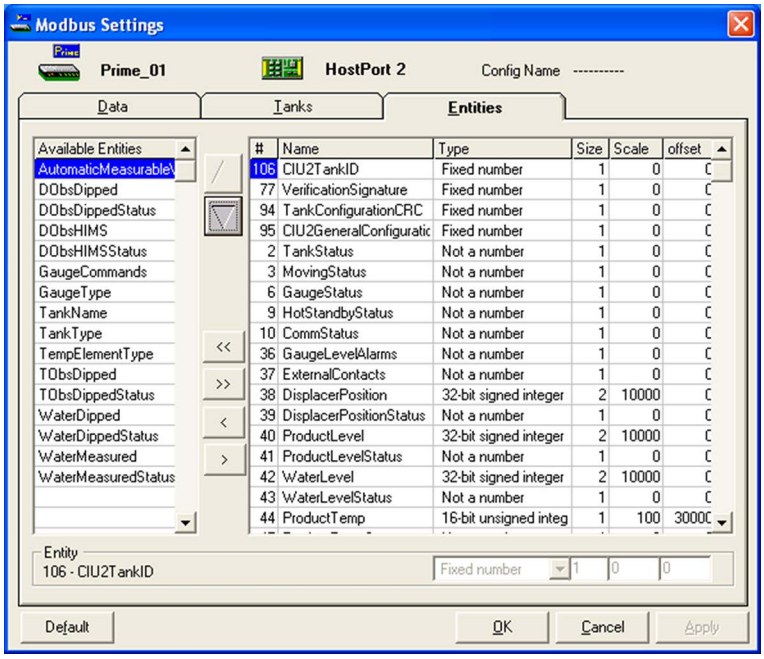


FIGURE 2-16 Ensite Pro: *Modbus Settings* window - *Entities* tab

13. Make the necessary changes to the Modbus entity settings.

NOTE: Refer to the Instruction Manual Ensite Pro Configuration Tool version 2.010 (Part No. 4416593) for more information.

14. Click **OK** to save the configuration settings and to close the window. The *Edit CIU Prime* window is displayed again.
15. Click **OK** to save the configuration settings and to close the window. The *Select CIU Prime* window is displayed again.
16. Click **Close** to close the window.
17. Click (**Close**) in the *Ensite Pro* toolbar to stop and close Ensite Pro.
18. Upload the new (changed) site configuration to the CIU 888. Refer to the *Configuration Manual CIU 888* (Part No. 4417593) for more information.
19. Login into the CIU 888 web interface.
20. Select **CONFIGURE** tab.
21. In the siteelement tree, select the host port siteelement.
22. Select “Enabled” for “Prime compatible Modbus output” and click **Update**.

NOTE: When “Prime compatible Modbus output” option is “Enabled”, then CIU 888’s host port provides data similar to that of CIU Prime. When “Prime compatible Modbus output” option is “Disabled”, then CIU 888’s host port provides data similar to that of CIU Plus (Entities with Modbus data type configured as “Not a Number” would be byte swapped in the Modbus output).

2.5.2.1 Available Tank Entities

The table below displays all entities, available to the user.

Name	ID	Dimension
TankName	1	Text
TankStatus	2	Bit coded
MovingStatus	3	Index
TankType	4	Bit coded
GaugeType	5	Nodim
GaugeStatus	6	Index
GaugeCommands	7	Bit coded
TempElementType	8	Index
HotStandbyStatus	9	Bit coded
CommStatus	10	Bit coded
CIUPrimeAddress	11	
GaugeLevelAlarms	36	Bit coded
ExternalContacts	37	Bit coded

Name	ID	Dimension
DisplacerPosition	38	Level
DisplacerPositionStatus	39	Status
ProductLevel	40	Level
ProductLevelStatus	41	Status
WaterLevel	42	Level
WaterLevelStatus	43	Status
ProductTemp	44	Temperature
ProductTempStatus	45	Status
VapRoomTemp	46	Temperature
VapRoomTempStatus	47	Status
VapRoomPress	48	Pressure
VapRoomPressStatus	49	Status
DObs	50	Density
DObsStatus	51	Status
ForegroundTimeStamp	52	Absolute time
BackgroundTimeStamp	53	Absolute time
VerificationSignature	77	Nodim
ConfigurationStatus	78	Bit coded
AutomaticMeasurableValues	80	Bit coded
HydroMeterCorr	88	Nodim
TObsDipped	89	Temperature
TankConfigurationCRC	94	Nodim
CIUPrimeGeneralConfigurationCRC	95	Nodim
AmbientTemperature	103	Temperature
AmbientTemperatureStatus	104	Status
CIUPrimeTankID	106	Nodim
TObsDippedStatus	111	Status
DObsDipped	112	Density
DObsDippedStatus	113	Status
WaterDipped	114	Level
WaterDippedStatus	115	Status
DObsHIMS	116	Density
DObsHIMSStatus	117	Status
TObs	118	Temperature
TObsStatus	119	Status
WaterMeasured	120	Level

Name	ID	Dimension
WaterMeasuredStatus	121	Status
HydroMeterCorrStatus	154	Status

REMARK: For a description of the entities mentioned in this table, see APPENDIX E

2.6 Write Tank Data

Please refer to section 2-10 for modbus implementation.

2.6.1 Tank Data

Entities can be (over-) written using direct overwrite mechanism.

On the same modbus address as where data is read this data can be overwritten.

The following entities can be overwritten:

Name	ID	Dimension
ProductName	21	Text (ASCII or Unicode)
GSVCalcType	22	Index
ProductCode	23	Index
VolumeCorrections	24	Index
DRef	30	Density
SedAndWater	32	Percentage
ProductTC	33	Temperature Coefficient
LiqVolRatio	35	Nodium
ProductLevel	40	Level
WaterLevel	42	Level
ProductTemp	44	Temperature
VapRoomTemp	46	Temperature
VapRoomPress	48	Pressure
DObs	50	Density
MolarWeight	79	Molar Weight value
HydroMeterCorr	88	Nodim
AmbientTemperature	103	Temperature
TObs	118	Temperature
VolumeCorrectionFactor	124	VCF
TemperatureCorrectionFactor	126	TCF
DensityCorrectionFactor	128	DCF

E.g. in case gas temperature for a tank is read on address 0034. Then the gas temperature for the related tank can be overwritten by a host on address 0034 by using the Pre-set single register command. Provided that the gas temperature is not automatically measured the overwritten value is used for calculations.

2.6.2 CIU data

The internal date and time can be overwritten by writing holding registers.

2.7 Setting up Modbus Host for Redundancy

Modbus Host can be setup either using Modbus serial host or Modbus TCP/IP Host systems.

2.7.1 Serial Modbus Host systems

Given below are the steps to determine the active/passive role of CIU and initiate switch over to partner CIU:

1. Modbus Host (PLC, SCADA, etc.,) detects a communication failure with the connected Primary CIU 888.
2. Modbus Host (PLC, SCADA, etc.,) sends the ActivateCIU command to the Secondary CIU 888 so that it becomes Active. Refer to section 2.7.4 for more details on ActivateCIU command.
3. Modbus Host (PLC, SCADA, etc.) monitors the status of the connected CIU 888 by reading CIUHotStandbyMode. Refer to section 2.7.3 for more details on CIUHotStandbyMode.

2.7.2 Modbus TCP/IP Host systems

Given below are the steps to determine the active/ passive role of CIU and initiate switch over to partner CIU:

1. Modbus Host (PLC, SCADA, etc.,) connects to CIU 888 with Primary CIU's IP addresses.
2. Modbus Host (PLC, SCADA, etc.,) reads the status of the connected CIU 888 by reading CIUHotStandbyMode. Refer to section 2.7.3 for more details on CIUHotStandbyMode.
3. If CIU 888 is passive based on CIUHotStandbyMode, then Modbus Host (PLC, SCADA, etc.,) sends the ActivateCIU command to make the CIU 888 as Active. Refer to section 2.7.4 for more details on ActivateCIU command.

The Modbus TCP/IP host system logic is shown in FIGURE 2-17 below.

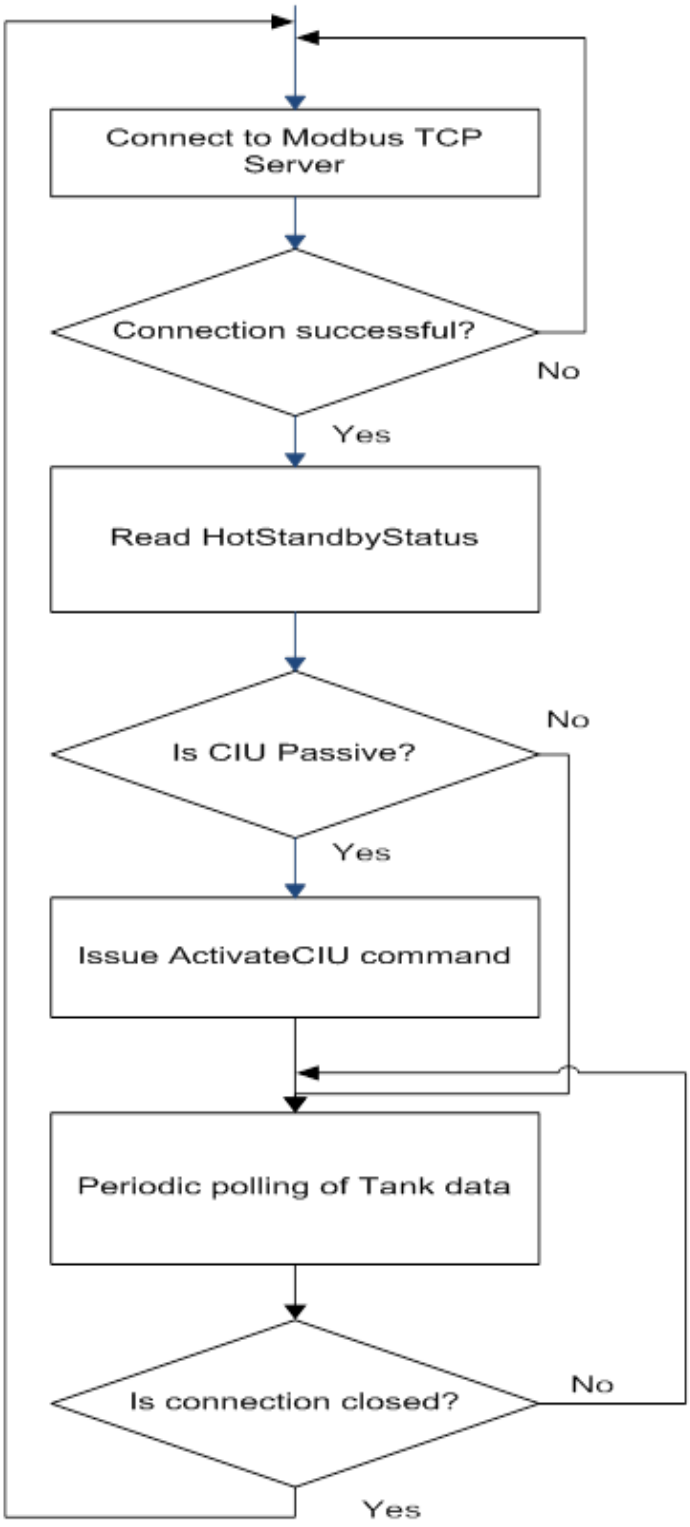


FIGURE 2-17 Modbus TCP/IP host system logic for CIU Switchover.

2.7.3 Active/Passive state of CIU

We can get the Active/Passive state of the CIU by the following mechanisms:

- By reading discrete inputs address 0 (refer to section 2.3.1).

  Or

- By reading CIUHotStandbyMode (Entity 500, refer to APPENDIX C) from General CIU details area (refer to TABLE 2-10).

2.7.4 Initiate Switch Over

The switchover of CIU is achieved by making a CIU active/passive. Use the ActivateCIU (Entity 501) (refer to TABLE 2-9) in the General CIU details area to command a CIU to take active/passive role. This can also be achieved by using a Modbus coil command (refer to section 2.2.1).

CHAPTER 3 ADDITIONAL CIU 888 MODBUS MAPPING

CIU 888 supports new Modbus maps in addition to the CIU 880 compliant Modbus maps. CIU 888 supports ENTIS compliant Modbus map and flexible Modbus maps for temperature and density profiles data.

3.1 Port address range details

In the Modbus protocol there are four types of memory images that a Modbus host system can request (see TABLE 3-1):

TABLE 3-1 Memory images in Modbus protocol

	Name	Memory Area (Hex)	Description
Coils	Read Coil Status	0000...FFFF	Reads 1-bit status information
	Force Single Coil	0000...FFFF	Writes a 1-bit coil
	Force Multiple Coils	0000...FFFF	Writes multiple 1-bit coils
Discrete Inputs	Read Input Status	0000...FFFF	Reads 1-bit status information
Input Registers	Read Input Registers	0000...FFFF	Reads 16-bit value information
Holding Registers	Read Holding Registers	0000...FFFF	Reads 16-bit value information
	Preset Single Register	0000...FFFF	Writes a 16-bit value
	Preset Multiple Registers	0000...FFFF	Writes multiple 16-bit values

3.2 Coils (Read/Write)

FIGURE 3-1 displays a graphical overview of the *Coils* area.

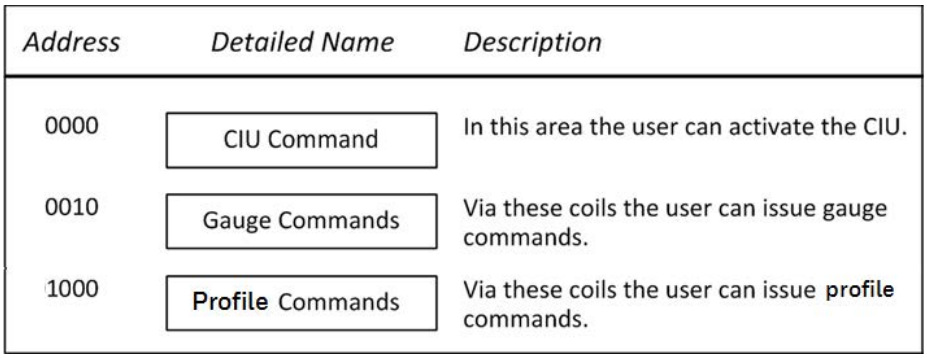


FIGURE 3-1 Graphical overview of *Coils* area

REMARK: These Modbus coil commands are supported through serial host ports and Ethernet host ports of CIU 888.
Refer to sections *REMARK:* and *3.2.1* for CIU command area and Gauge command area respectively.

3.2.1 Profile commands

The user can issue density profile commands by forcing Coils to either ON or OFF (Modbus function 05) (see TABLE 3-2). Commands are only accepted when the required command is enabled for the addressed gauge (see section 3.2.1.1). The first Coil address for density profile commands is address 03E8 hexadecimal (1000 decimal).

The sequence in which the tanks are ordered in the Modbus memory map defines the address sequence in which the tank gauge command must be given.

The command Coil itself is seen as a ‘push button’. When the Coil is read, its status is always ‘0’.

TABLE 3-2 Profile commands

Relative Address	Read/ Write	Function	Description
0	R/W	Upward density profile command	If the value is ‘1’, then start a density profile upwards for the tank, and store the result in the density profile data area.
1	R/W	Downward density profile command	If the value is ‘1’, then start a density profile downwards for the tank, and store the result in the density profile data area.
2	R/W	Upward interface profile command	If the value is ‘1’, then start an interface profile upwards for the tank, and store the result in the density profile data area.
3	R/W	Downward interface profile command	If the value is ‘1’, then start an interface profile downwards for the tank, and store the result in the density profile data area.
4	R/W	Upward combined profile command	If the value is ‘1’, then measure the water interface and start then a density profile upwards for the tank, and store the result in the density profile data area.
5	R/W	Downward combined profile command	If the value is ‘1’, then start a density profile downwards and measure the water interface for the tank, and store the result in the density profile data area.

REMARKS:
1. The actual Coil address is (1000 + ((x - 1) * 10) + Relative address), where x = tank sequence number in Modbus memory map.
2. Multiple commands and commands priority: All commands are treated separately; multiple commands can be given for different tanks; when

multiple commands are given to the same Tank, the result can be unpredictable.

3.2.1.1 Enabling profile commands for gauges

When configuring a gauge in CIU 888 Service tool, you can specify which profile commands are allowed for this gauge (see FIGURE 3-2).

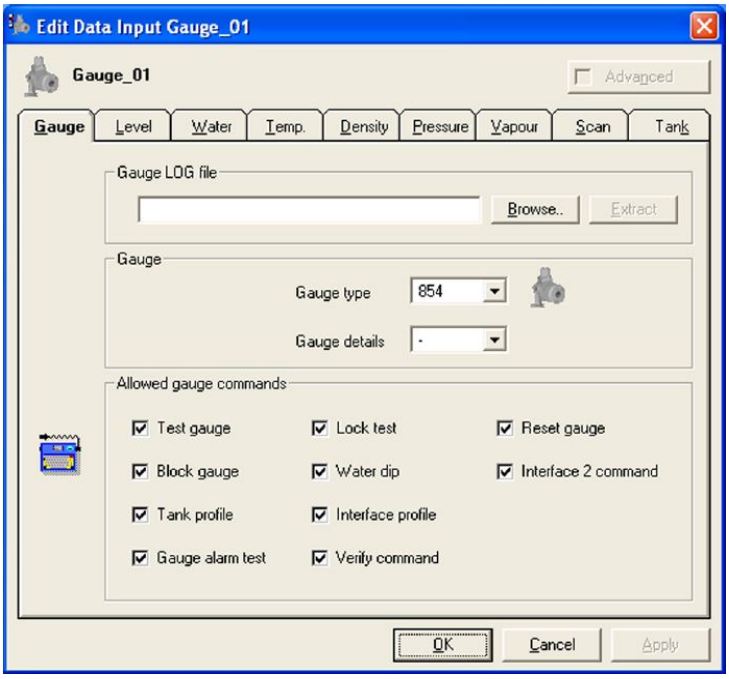


FIGURE 3-2 CIU 888 Service tool: Gauge tab of GPU Data input

REMARK: Refer to the *Configuration Manual CIU 888 (Part No. 4417593)* for more information.

3.3 Discrete inputs (Read only)

Refer to section *2.3* for information on discrete inputs.

3.4 Input registers and Holding registers

In the 16-bit registers space both the Holding registers and the Input registers are combined in one address space, occupying the standard memory area from 0000...9999 decimal (0000...270F$_{HEX}$) and the extended memory area from 10000 decimal (2710$_{HEX}$) upwards:

- The address occupation is on a ‘per port’ basis. Each port can be configured inside the restrictions.
- Data can be retrieved via the Modbus commands 03 and 04.
- Writing can be done to some registers via Modbus commands 06 and 16.

FIGURE 3-3 shows a graphical overview of the 16-bit register area.

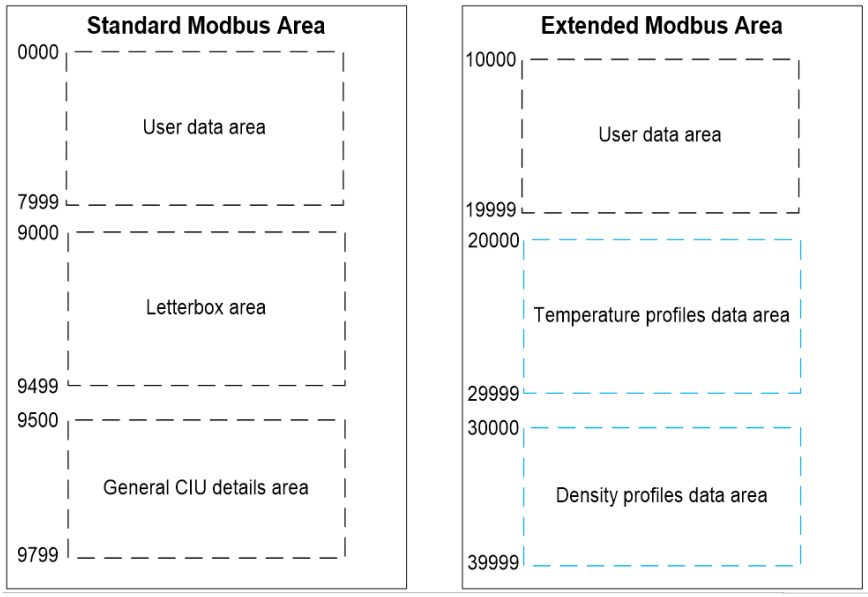


FIGURE 3-3 16-Bit register area

REMARK: These Modbus Holding register and Input register areas are supported through serial host ports and Ethernet host ports of CIU 888.

3.4.1 User data area

The possible configuration options available for the User Data area in the CIU 888 compatible Modbus map are CIU Plus compliant tank record, Entis Pro compliant tank record, ENTIS compliant tank record and User defined record.

NOTE: Refer to section 2.4.1.1 and 2.4.1.2 for more information on CIU Plus compliant tank record and Entis Pro compliant tank record respectively.

3.4.1.1 ENTIS Pro compliant tank record

TABLE 3-3 gives an overview of the entities in the ENTIS compliant tank record.

REMARKS:
1. For a description of the entities mentioned in this table, see APPENDIX B
2. For a description of the possible Data Types, see APPENDIX F
3. For a description of the status and validity data entities, see APPENDIX G
4. For a description of the possible Dimension Types, see APPENDIX H

TABLE 3-3 ENTIS compliant tank record

ID	Name	Register Address		Data Type	Number of Registers	Scaling	Offset	Dimension Type
		Hex	Dec					
105	CIUPlus Tank ID	0000	000	1	1	0	0	160 nodim
77	Verification Signature	0001	001	1	1	0	0	160 nodim
21	ProductName	0002	002	15/25	10	0	0	120/121 text
124	CTL	000C	012	51	2	50000	0	170 factor
125	CTLStatus	000E	014	0	1	0	0	163 status
30	Dref	000F	015	51	2	100	0	6x density
31	DrefStatus	0011	017	0	1	0	0	163 status
32	SedAndWater	0012	018	40	1	100	0	140 perc.
33	ProductTC	0013	019	51	2	1000	0	15x temp.c.
34	ProductTCStatus	0015	021	0	1	0	0	163 status
35	LiqVolRatio	0016	022	40	1	10	0	170 factor
38	DisplacerPosition	0017	023	51	2	10000	0	0x level
39	DisplacerPositionStatus	0019	025	0	1	0	0	163 status
40	ProductLevel	0001A	026	51	2	10000	0	0x level
41	ProductLevelStatus	001C	028	0	1	0	0	163 status
42	WaterLevel	001D	029	51	2	10000	0	0x level
43	WaterLevelStatus	001F	031	0	1	0	0	163 status
44	ProductTemp	0020	032	40	1	100	30000	2x temp
45	ProductTempStatus	0021	033	0	1	00	0	163 status
46	VapRoomTemp	0022	034	40	1	100	30000	2x temp
47	VapRoomTempStatus	0023	035	0	1	0	0	163 status
48	VapRoomPress	0024	036	40	1	10	0	3x pressure
49	VapRoomPressStatus	0025	037	0	1	0	0	163 status
50	DObs	0026	038	51	2	100	0	6x density
51	DObsStatus	0028	040	0	1	0	0	163 status
52	ForeGroundTemp-Stamp	0029	041	3	3	0	0	113 time
53	BackgroundTemp-Stamp	002C	044	3	3	0	0	115 time
54	TOV	002F	047	51	2	1000	0	5x volume
55	TOVStatus	0031	049	0	1	0	0	163 status
56	WaterVol	0032	050	51	2	1000	0	5x volume
57	WaterVolStatus	0034	052	0	1	0	0	163 status

ID	Name	Register Address		Data Type	Number of Registers	Scaling	Offset	Dimension Type
		Hex	Dec					
58	GOV	0035	053	51	2	1000	0	5x volume
59	GOVStatus	0037	055	0	1	0	0	163 status
60	GSV	0038	056	51	2	1000	0	5x volume
61	GSVStatus	003A	058	0	1	0	0	163 status
62	NSV	003B	059	51	2	1000	0	5x volume
63	NSVStatus	003D	061	0	1	0	0	163 status
64	LiqInVap	003E	062	51	2	1000	0	5x volume
65	LiqInVapStatus	0040	064	0	1	0	0	163 status
66	TGSV	0041	065	51	2	1000	0	5x volume
67	TGSVStatus	0043	067	0	1	0	0	163 status
68	MassLiq	0044	068	51	2	1	0	10x mass
69	MassLiqStatus	0046	070	0	1	0	0	163 status
70	MassVap	0047	071	51	2	1	0	10x mass
71	MassVapStatus	0049	073	0	1	0	0	163 status
72	TotalMass	004A	074	51	2	1	0	10x mass
73	TotalMassStatus	004C	076	0	1	0	0	163 status
74	FlowTOV	004D	077	51	2	100	0	7x flow
75	AvailableRoom	004F	079	51	2	1000	0	5x volume
76	Available TOV	0051	081	51	2	1000	0	5x volume
79	Molar Weight	0053	083	51	2	10000	0	130 mol.val.
94	TankCRC	0055	085	1	1	0	0	160 nodim
96	CIUPlusCRC	0056	086	1	1	0	0	160 nodim
99	FlowStatus	0057	087	0	1	0	0	163 status
100	AvailableRoomStatus	0058	088	0	1	0	0	163 status
101	Available TOVStatus	0059	089	0	1	0	0	163 status
103	AmbientTemperature	005A	090	40	1	100	30000	2x temp
104	AmbientTemperature Status	005B	091	0	1	0	0	163 status
107	CTSh	005C	092	51	2	100000	0	170 factor
108	CTShStatus	005E	094	0	1	0	0	163 status
200	Alarms*	005F	095	1	1	0	0	160 nodim
201	DynamicTankStatus*	0060	096	1	1	0	0	160 nodim
204	CombinedVolume Corrections*	0061	097	1	1	0	00	160 nodim

ID	Name	Register Address		Data Type	Number of Registers	Scaling	Offset	Dimension Type
		Hex	Dec					
205	Mass&Volume Corrections*	0062	098	1	1	0	0	160 nodim
206	Comm&ConfStatus*	0063	099	1	1	0	0	160 nodim
88	HydroMeterCorr	0064	100	0	1	0	0	160 nodim
154	HydroMeterCorrStatus	0065	101	0	1	0	0	163 status
93	VapRoom	0066	102	51	2	1000	0	5x volume
102	VapRoomStatus	0068	104	0	1	0	0	163 status
126	TCF	0069	105	51	2	100000	0	170 factor
127	TCFStatus	006B	107	0	1	0	0	163 status
128	DCF	006C	108	51	2	100000	0	170 factor
129	DCFStatus	006E	110	0	1	0	0	163 status
118	TObs	006F	111	40	1	100	30000	2x temp
119	TObsStatus	0070	112	0	1	0	0	163 status
143	SedAndWaterStatus	0071	113	0	1	0	0	163 status
144	LiqVolRatioStatus	0072	114	0	1	0	0	163 status
145	MolarWeigthStatus	0073	115	0	1	0	0	163 status
2600	Gauge2Status	0074	116	0	1	0	0	160 nodim
2603	ProductLevel2	0075	117	51	2	10000	0	0x level
2604	ProductLevel2Status	0077	118	0	1	0	0	163 status

REMARK: The scaling and offset values displayed in TABLE 3-3 are based on the following engineering units: m, C, kPa, m^3, Kg/m^3, m^3/min, kg. In practice, the values may differ depending on the engineering units configured by the customer.

3.4.2 General CIU details area

Refer to section *2.4.2 General CIU details area* for more information.

REMARKS:
1. For a description of the entities mentioned in this table, see APPENDIX B
2. For a description of the possible Data Types, see APPENDIX F
3. For a description of the status and validity data entities, see APPENDIX G
4. For a description of the possible Dimension Types, see APPENDIX H

3.4.3 ENTIS compliant temperature profile record

TABLE 3-4 gives an overview of the temperature profiles entities in the ENTIS compliant Modbus map. Temperature profile absolute start address is 20000 and temperature profiles record interval is 125.

TABLE 3-4 ENTIS compliant temperature profile record

ID	Name	Register Address		Data Type	Number of Registers	Scaling	Offset	Dimension Type
		Hex	Dec					
2535	TemperatureProfilesScanEnable	0000	000	1	1	0	0	160 nodim
10584	TemperatureProfileDataStatus	0001	001	1	1	0	0	160 nodim
10571	TemperatureProfileTimeStamp	0002	002	3	3	0	0	113 time
10585	MultitemperatureNumberOfElements	0005	005	1	1	0	0	160 nodim
466	MultitemperatureSpotRelativeElementPosition0	0006	006	51	2	10000	0	0x level
467	MultitemperatureSpotRelativeElementPosition0Status	0008	008	0	1	0	0	163 status
468	MultitemperatureSpotRelativeElementPosition1	0009	009	51	2	10000	0	0x level
469	MultitemperatureSpotRelativeElementPosition1Status	000B	011	0	1	0	0	163 status
470	MultitemperatureSpotRelativeElementPosition2	000C	012	51	2	10000	0	0x level
471	MultitemperatureSpotRelativeElementPosition2Status	000E	014	0	1	0	0	163 status
472	MultitemperatureSpotRelativeElementPosition3	000F	015	51	2	10000	0	0x level
473	MultitemperatureSpotRelativeElementPosition3Status	0011	017	0	1	0	0	163 status
474	MultitemperatureSpotRelativeElementPosition4	0012	018	51	2	10000	0	0x level
475	MultitemperatureSpotRelativeElementPosition4Status	0014	020	0	1	0	0	163 status
476	MultitemperatureSpotRelativeElementPosition5	0015	021	51	2	10000	0	0x level

ID	Name	Register Address		Data Type	Number of Registers	Scaling	Offset	Dimension Type
		Hex	Dec					
477	MultitemperatureSpotRelativeElementPosition5Status	0017	023	0	1	0	0	163 status
478	MultitemperatureSpotRelativeElementPosition6	0018	024	51	2	10000	0	0x level
479	MultitemperatureSpotRelativeElementPosition6Status	001A	026	0	1	0	0	163 status
480	MultitemperatureSpotRelativeElementPosition7	001B	027	51	2	10000	0	0x level
481	MultitemperatureSpotRelativeElementPosition7Status	001D	029	0	1	0	0	163 status
482	MultitemperatureSpotRelativeElementPosition8	001E	030	51	2	10000	0	0x level
483	MultitemperatureSpotRelativeElementPosition8Status	0020	032	0	1	0	0	163 status
484	MultitemperatureSpotRelativeElementPosition9	0021	033	51	2	10000	0	0x level
485	MultitemperatureSpotRelativeElementPosition9Status	0023	035	0	1	0	0	163 status
486	MultitemperatureSpotRelativeElementPosition10	0024	036	51	2	10000	0	0x level
487	MultitemperatureSpotRelativeElementPosition10Status	0026	038	0	1	0	0	163 status
488	MultitemperatureSpotRelativeElementPosition11	0027	039	51	2	10000	0	0x level
489	MultitemperatureSpotRelativeElementPosition11Status	0029	041	0	1	0	0	163 status
490	MultitemperatureSpotRelativeElementPosition12	002A	042	51	2	10000	0	0x level
491	MultitemperatureSpotRelativeElementPosition12Status	002C	044	0	1	0	0	163 status
492	MultitemperatureSpotRelativeElementPosition13	002D	045	51	2	10000	0	0x level

ID	Name	Register Address		Data Type	Number of Registers	Scaling	Offset	Dimension Type
		Hex	Dec					
493	MultitemperatureSpotRelativeElementPosition13Status	002F	047	0	1	0	0	163 status
494	MultitemperatureSpotRelativeElementPosition14	0030	048	51	2	10000	0	0x level
495	MultitemperatureSpotRelativeElementPosition14Status	0032	050	0	1	0	0	163 status
496	MultitemperatureSpotRelativeElementPosition15	0033	051	51	2	10000	0	0x level
497	MultitemperatureSpotRelativeElementPosition15Status	0035	053	0	1	0	0	163 status
434	MultitemperatureSpotTemperature0	0036	054	40	1	100	30000	2x temp
435	MultitemperatureSpotTemperature0Status	0037	055	0	1	0	0	163 status
436	MultitemperatureSpotTemperature1	0038	056	40	1	100	30000	2x temp
437	MultitemperatureSpotTemperature1Status	0039	057	0	1	0	0	163 status
438	MultitemperatureSpotTemperature2	003A	058	40	1	100	30000	2x temp
439	MultitemperatureSpotTemperature2Status	003B	059	0	1	0	0	163 status
440	MultitemperatureSpotTemperature3	003C	060	40	1	100	30000	2x temp
441	MultitemperatureSpotTemperature3Status	003D	061	0	1	0	0	163 status
442	MultitemperatureSpotTemperature4	003E	062	40	1	100	30000	2x temp
443	MultitemperatureSpotTemperature4Status	003F	063	0	1	0	0	163 status
444	MultitemperatureSpotTemperature5	0040	064	40	1	100	30000	2x temp
445	MultitemperatureSpotTemperature5Status	0041	065	0	1	0	0	163 status
446	MultitemperatureSpotTemperature6	0042	066	40	1	100	30000	2x temp
447	MultitemperatureSpotTemperature6Status	0043	067	0	1	0	0	163 status

ID	Name	Register Address		Data Type	Number of Registers	Scaling	Offset	Dimension Type
		Hex	Dec					
448	MultitemperatureSpotTemperature7	0044	068	40	1	100	30000	2x temp
449	MultitemperatureSpotTemperature7Status	0045	069	0	1	0	0	163 status
450	MultitemperatureSpotTemperature8	0046	070	40	1	100	30000	2x temp
451	MultitemperatureSpotTemperature8Status	0047	071	0	1	0	0	163 status
452	MultitemperatureSpotTemperature9	0048	072	40	1	100	30000	2x temp
453	MultitemperatureSpotTemperature9Status	0049	073	0	1	0	0	163 status
454	MultitemperatureSpotTemperature10	004A	074	40	1	100	30000	2x temp
455	MultitemperatureSpotTemperature10Status	004B	075	0	1	0	0	163 status
456	MultitemperatureSpotTemperature11	004C	076	40	1	100	30000	2x temp
457	MultitemperatureSpotTemperature11Status	004D	077	0	1	0	0	163 status
458	MultitemperatureSpotTemperature12	004E	078	40	1	100	30000	2x temp
459	MultitemperatureSpotTemperature12Status	004F	079	0	1	0	0	163 status
460	MultitemperatureSpotTemperature13	0050	080	40	1	100	30000	2x temp
461	MultitemperatureSpotTemperature13Status	0051	081	0	1	0	0	163 status
462	MultitemperatureSpotTemperature14	0052	082	40	1	100	30000	2x temp
463	MultitemperatureSpotTemperature14Status	0053	083	0	1	0	0	163 status
464	MultitemperatureSpotTemperature15	0054	084	40	1	100	30000	2x temp
465	MultitemperatureSpotTemperature15Status	0055	085	0	1	0	0	163 status
498	MultiTemperatureLevelOffset	0056	086	51	2	10000	0	0x level
499	MultiTemperatureElementType	0058	088	15/25	2	0	0	120/121 text
10572	TemperatureProfilesScanProductLevel	005A	090	51	2	10000	0	0x level

ID	Name	Register Address		Data Type	Number of Registers	Scaling	Offset	Dimension Type
		Hex	Dec					
10573	TemperatureProfilesScanProductLevelStatus	005C	092	0	1	0	0	163 status
10574	TemperatureProfilesScanProductTemperature	005D	093	40	1	100	30000	2x temp
10574	TemperatureProfilesScanProductTemperatureStatus	005E	094	0	1	0	0	163 status
10595	TemperatureProfileScanWaterLevel	005F	095	51	2	10000	0	0x level
10596	TemperatureProfileScanWaterLevelStatus	0061	097	0	1	0	0	163 status
10597	TemperatureProfileScanVapourTemperature	0062	098	40	1	100	30000	2x temp
10598	TemperatureProfileScanVapourTemperatureStatus	0063	099	0	1	0	0	163 status
10599	TemperatureProfileScanVapourPressure	0064	100	40	1	10	0	3x pressure
10600	TemperatureProfileScanVapourPressureStatus	0065	101	0	1	0	0	163 status

REMARK: The scaling and offset values displayed in TABLE 3-4 are based on the following engineering units: m, C, kPa, m^3, Kg/m^3, m^3/min, kg. In practice, the values may differ depending on the engineering units configured by the customer.

3.4.4 ENTIS compliant density profile record

TABLE 3-5 gives an overview of the density profiles entities in the ENTIS compliant Modbus map. Density profile absolute start address is 30000 and temperature profiles record interval is 125.

REMARKS:
1. For a description of the entities mentioned in this table, see APPENDIX B
2. For a description of the possible Data Types, see APPENDIX F
3. For a description of the status and validity data entities, see APPENDIX G
4. For a description of the possible Dimension Types, see APPENDIX H

TABLE 3-5 ENTIS compliant temperature profile record

ID	Name	Register Address		Data Type	Number of Registers	Scaling	Offset	Dimension Type
		Hex	Dec					
10651	DensityProfileDataStatus	0000	000	1	1	0	0	160 nodim

ID	Name	Register Address		Data Type	Number of Registers	Scaling	Offset	Dimension Type
		Hex	Dec					
10652	DensityProfileTimeStamp	0001	001	3	3	0	0	113 time
10655	MultiDensityNumberOfElements	0004	004	1	1	0	0	160 nodim
390	DensityInnageLevel0	0004	004	51	2	10000	0	0x level
391	DensityInnageLevel0Status	0006	006	0	1	0	0	163 status
392	DensityInnageLevel1	0007	007	51	2	10000	0	0x level
393	DensityInnageLevel1Status	000A	009	0	1	0	0	163 status
394	DensityInnageLevel2	000B	010	51	2	10000	0	0x level
395	DensityInnageLevel2Status	000D	012	0	1	0	0	163 status
396	DensityInnageLevel3	000E	013	51	2	10000	0	0x level
397	DensityInnageLevel3Status	0010	015	0	1	0	0	163 status
398	DensityInnageLevel4	0011	016	51	2	10000	0	0x level
399	DensityInnageLevel4Status	0012	018	0	1	0	0	163 status
400	DensityInnageLevel5	0014	019	51	2	10000	0	0x level
401	DensityInnageLevel5Status	0016	021	0	1	0	0	163 status
402	DensityInnageLevel6	0017	022	51	2	10000	0	0x level
403	DensityInnageLevel6Status	0019	024	0	1	0	0	163 status
404	DensityInnageLevel7	001A	025	51	2	10000	0	0x level
405	DensityInnageLevel7Status	001C	027	0	1	0	0	163 status
406	DensityInnageLevel8	001D	028	51	2	10000	0	0x level
407	DensityInnageLevel8Status	001F	030	0	1	0	0	163 status
408	DensityInnageLevel9	0020	031	51	2	10000	0	0x level
409	DensityInnageLevel9Status	0022	033	0	1	0	0	163 status
701	DensityInnageLevel10	0023	035	51	2	10000	0	0x level
702	DensityInnageLevel10Status	0025	037	0	1	0	0	163 status
703	DensityInnageLevel11	0026	038	51	2	10000	0	0x level
704	DensityInnageLevel11Status	0028	040	0	1	0	0	163 status
705	DensityInnageLevel12	0029	041	51	2	10000	0	0x level
706	DensityInnageLevel12Status	002B	043	0	1	0	0	163 status
707	DensityInnageLevel13	002C	044	51	2	10000	0	0x level
708	DensityInnageLevel13Status	002E	046	0	1	0	0	163 status
709	DensityInnageLevel14	002F	047	51	2	10000	0	0x level
710	DensityInnageLevel14Status	0031	049	0	1	0	0	163 status
711	DensityInnageLevel15	0032	50	51	2	10000	0	0x level
712	DensityInnageLevel15Status	0034	052	0	1	0	0	163 status
713	DensityInnageLevel16	0035	053	51	2	10000	0	0x level

ID	Name	Register Address		Data Type	Number of Registers	Scaling	Offset	Dimension Type
		Hex	Dec					
714	DensityInnageLevel16Status	0037	055	0	1	0	0	163 status
715	DensityInnageLevel17	0038	056	51	2	10000	0	0x level
716	DensityInnageLevel17Status	003A	058	0	1	0	0	163 status
717	DensityInnageLevel18	003B	059	51	2	10000	0	0x level
718	DensityInnageLevel18Status	003D	061	0	1	0	0	163 status
719	DensityInnageLevel19	003E	062	51	2	10000	0	0x level
420	DensityInnageLevel19Status	0040	064	0	1	0	0	163 status
721	DensityInnageLevel20	0041	065	51	2	10000	0	0x level
722	DensityInnageLevel20Status	0043	067	0	1	0	0	163 status
723	DensityInnageLevel21	0044	068	51	2	10000	0	0x level
724	DensityInnageLevel21Status	0046	070	0	1	0	0	163 status
725	DensityInnageLevel22	0047	071	51	2	10000	0	0x level
726	DensityInnageLevel22Status	0049	073	0	1	0	0	163 status
727	DensityInnageLevel23	004A	074	51	2	10000	0	0x level
728	DensityInnageLevel23Status	004C	076	0	1	0	0	163 status
729	DensityInnageLevel24	004D	077	51	2	10000	0	0x level
730	DensityInnageLevel24Status	004F	079	0	1	0	0	163 status
731	DensityInnageLevel25	0050	080	51	2	10000	0	0x level
732	DensityInnageLevel25Status	0052	082	0	1	0	0	163 status
733	DensityInnageLevel26	0053	083	51	2	10000	0	0x level
734	DensityInnageLevel26Status	0055	085	0	1	0	0	163 status
735	DensityInnageLevel27	0056	086	51	2	10000	0	0x level
736	DensityInnageLevel27Status	0058	088	0	1	0	0	163 status
737	DensityInnageLevel28	0059	089	51	2	10000	0	0x level
738	DensityInnageLevel28Status	005B	091	0	1	0	0	163 status
739	DensityInnageLevel29	005C	092	51	2	10000	0	0x level
740	DensityInnageLevel29Status	005E	094	0	1	0	0	163 status
741	DensityInnageLevel30	005F	095	51	2	10000	0	0x level
742	DensityInnageLevel30Status	0061	097	0	1	0	0	163 status
743	DensityInnageLevel31	0062	098	51	2	10000	0	0x level
744	DensityInnageLevel31Status	0064	100	0	1	0	0	163 status
745	DensityInnageLevel32	0065	101	51	2	10000	0	0x level
746	DensityInnageLevel32Status	0067	103	0	1	0	0	163 status
747	DensityInnageLevel33	0068	104	51	2	10000	0	0x level
748	DensityInnageLevel33Status	006A	106	0	1	0	0	163 status

ID	Name	Register Address		Data Type	Number of Registers	Scaling	Offset	Dimension Type
		Hex	Dec					
749	DensityInnageLevel34	006B	107	51	2	10000	0	0x level
750	DensityInnageLevel34Status	006D	109	0	1	0	0	163 status
751	DensityInnageLevel35	006E	110	51	2	10000	0	0x level
752	DensityInnageLevel35Status	0070	112	0	1	0	0	163 status
753	DensityInnageLevel36	0071	113	51	2	10000	0	0x level
754	DensityInnageLevel36Status	0073	115	0	1	0	0	163 status
755	DensityInnageLevel37	0074	116	51	2	10000	0	0x level
756	DensityInnageLevel37Status	0076	118	0	1	0	0	163 status
757	DensityInnageLevel38	0077	119	51	2	10000	0	0x level
758	DensityInnageLevel38Status	0079	121	0	1	0	0	163 status
759	DensityInnageLevel39	007A	122	51	2	10000	0	0x level
760	DensityInnageLevel39Status	007C	124	0	1	0	0	163 status
761	DensityInnageLevel40	007D	125	51	2	10000	0	0x level
762	DensityInnageLevel40Status	007F	127	0	1	0	0	163 status
763	DensityInnageLevel41	0080	128	51	2	10000	0	0x level
764	DensityInnageLevel41Status	0082	130	0	1	0	0	163 status
765	DensityInnageLevel42	0083	131	51	2	10000	0	0x level
766	DensityInnageLevel42Status	0085	133	0	1	0	0	163 status
767	DensityInnageLevel43	0086	134	51	2	10000	0	0x level
768	DensityInnageLevel43Status	0088	136	0	1	0	0	163 status
769	DensityInnageLevel44	0089	137	51	2	10000	0	0x level
770	DensityInnageLevel44Status	008B	139	0	1	0	0	163 status
771	DensityInnageLevel45	008C	140	51	2	10000	0	0x level
772	DensityInnageLevel45Status	008E	142	0	1	0	0	163 status
773	DensityInnageLevel46	008F	143	51	2	10000	0	0x level
774	DensityInnageLevel46Status	0091	145	0	1	0	0	163 status
775	DensityInnageLevel47	0092	146	51	2	10000	0	0x level
776	DensityInnageLevel47Status	0094	148	0	1	0	0	163 status
777	DensityInnageLevel48	0095	149	51	2	10000	0	0x level
778	DensityInnageLevel48Status	0097	151	0	1	0	0	163 status
779	DensityInnageLevel49	0098	152	51	2	10000	0	0x level
780	DensityInnageLevel49Status	009A	154	0	1	0	0	163 status
412	MeasuredServoDensity0	009B	155	51	2	100	0	0x level
413	MeasuredServoDensity0Status	009D	157	0	1	0	0	163 status
414	MeasuredServoDensity1	009E	158	51	2	100	0	0x level

ID	Name	Register Address		Data Type	Number of Registers	Scaling	Offset	Dimension Type
		Hex	Dec					
415	MeasuredServoDensity1Status	00A0	160	0	1	0	0	163 status
416	MeasuredServoDensity2	00A1	161	51	2	100	0	0x level
417	MeasuredServoDensity2Status	00A3	163	0	1	0	0	163 status
418	MeasuredServoDensity3	00A4	164	51	2	100	0	0x level
419	MeasuredServoDensity3Status	00A6	166	0	1	0	0	163 status
420	MeasuredServoDensity4	00A7	167	51	2	100	0	0x level
421	MeasuredServoDensity4Status	00A9	169	0	1	0	0	163 status
422	MeasuredServoDensity5	00AA	170	51	2	100	0	0x level
423	MeasuredServoDensity5Status	00AC	172	0	1	0	0	163 status
424	MeasuredServoDensity6	00AD	173	51	2	100	0	0x level
425	MeasuredServoDensity6Status	00AF	175	0	1	0	0	163 status
426	MeasuredServoDensity7	00B0	176	51	2	100	0	0x level
427	MeasuredServoDensity7Status	00B2	178	0	1	0	0	163 status
428	MeasuredServoDensity8	00B3	179	51	2	100	0	0x level
429	MeasuredServoDensity8Status	00B5	181	0	1	0	0	163 status
430	MeasuredServoDensity9	00B6	182	51	2	100	0	0x level
431	MeasuredServoDensity9Status	00B8	184	0	1	0	0	163 status
781	MeasuredServoDensity10	00B9	185	51	2	100	0	0x level
782	MeasuredServoDensity10Status	00BB	187	0	1	0	0	163 status
783	MeasuredServoDensity11	00BC	188	51	2	100	0	0x level
784	MeasuredServoDensity11Status	00BE	190	0	1	0	0	163 status
785	MeasuredServoDensity12	00BF	191	51	2	100	0	0x level
786	MeasuredServoDensity12Status	00C1	193	0	1	0	0	163 status
787	MeasuredServoDensity13	00C2	194	51	2	100	0	0x level
788	MeasuredServoDensity13Status	00C4	196	0	1	0	0	163 status
789	MeasuredServoDensity14	00C5	197	51	2	100	0	0x level
790	MeasuredServoDensity14Status	00C7	199	0	1	0	0	163 status
791	MeasuredServoDensity15	00C8	200	51	2	100	0	0x level
792	MeasuredServoDensity15Status	00CA	202	0	1	0	0	163 status
793	MeasuredServoDensity16	00CB	203	51	2	100	0	0x level

ID	Name	Register Address		Data Type	Number of Registers	Scaling	Offset	Dimension Type
		Hex	Dec					
794	MeasuredServoDensity16Status	00CD	205	0	1	0	0	163 status
795	MeasuredServoDensity17	00CE	206	51	2	100	0	0x level
796	MeasuredServoDensity17Status	00D0	208	0	1	0	0	163 status
797	MeasuredServoDensity18	00D1	209	51	2	100	0	0x level
798	MeasuredServoDensity18Status	00D3	211	0	1	0	0	163 status
799	MeasuredServoDensity19	00D4	212	51	2	100	0	0x level
800	MeasuredServoDensity19Status	00D6	214	0	1	0	0	163 status
801	MeasuredServoDensity20	00D7	215	51	2	100	0	0x level
802	MeasuredServoDensity0Status	00D9	217	0	1	0	0	163 status
803	MeasuredServoDensity21	00DA	218	51	2	100	0	0x level
804	MeasuredServoDensity21Status	00DC	220	0	1	0	0	163 status
805	MeasuredServoDensity22	00DD	221	51	2	100	0	0x level
806	MeasuredServoDensity22Status	00DF	223	0	1	0	0	163 status
807	MeasuredServoDensity23	00E0	224	51	2	100	0	0x level
808	MeasuredServoDensity23Status	00E2	226	0	1	0	0	163 status
809	MeasuredServoDensity24	00E3	227	51	2	100	0	0x level
810	MeasuredServoDensity24Status	00E5	229	0	1	0	0	163 status
811	MeasuredServoDensity25	00E6	230	51	2	100	0	0x level
812	MeasuredServoDensity25Status	00E8	232	0	1	0	0	163 status
813	MeasuredServoDensity26	00E9	233	51	2	100	0	0x level
814	MeasuredServoDensity26Status	00EB	235	0	1	0	0	163 status
815	MeasuredServoDensity27	00EC	236	51	2	100	0	0x level
816	MeasuredServoDensity27Status	00EE	238	0	1	0	0	163 status
817	MeasuredServoDensity28	00EF	239	51	2	100	0	0x level
818	MeasuredServoDensity28Status	00F1	241	0	1	0	0	163 status
819	MeasuredServoDensity29	00F2	242	51	2	100	0	0x level

ID	Name	Register Address		Data Type	Number of Registers	Scaling	Offset	Dimension Type
		Hex	Dec					
820	MeasuredServoDensity29Status	00F4	244	0	1	0	0	163 status
821	MeasuredServoDensity30	00F5	245	51	2	100	0	0x level
822	MeasuredServoDensity30Status	00F7	247	0	1	0	0	163 status
823	MeasuredServoDensity31	00F8	248	51	2	100	0	0x level
824	MeasuredServoDensity31Status	00FA	250	0	1	0	0	163 status
825	MeasuredServoDensity32	00FB	251	51	2	100	0	0x level
826	MeasuredServoDensity32Status	00FD	253	0	1	0	0	163 status
827	MeasuredServoDensity33	00FE	254	51	2	100	0	0x level
828	MeasuredServoDensity33Status	0100	256	0	1	0	0	163 status
829	MeasuredServoDensity34	0101	257	51	2	100	0	0x level
830	MeasuredServoDensity34Status	0103	259	0	1	0	0	163 status
831	MeasuredServoDensity35	0104	260	51	2	100	0	0x level
832	MeasuredServoDensity35Status	0106	262	0	1	0	0	163 status
833	MeasuredServoDensity36	0107	263	51	2	100	0	0x level
834	MeasuredServoDensity36Status	0109	265	0	1	0	0	163 status
835	MeasuredServoDensity37	010A	266	51	2	100	0	0x level
836	MeasuredServoDensity37Status	010C	268	0	1	0	0	163 status
837	MeasuredServoDensity38	010D	269	51	2	100	0	0x level
838	MeasuredServoDensity38Status	010F	271	0	1	0	0	163 status
839	MeasuredServoDensity39	0110	272	51	2	100	0	0x level
840	MeasuredServoDensity39Status	0112	274	0	1	0	0	163 status
841	MeasuredServoDensity40	0113	275	51	2	100	0	0x level
842	MeasuredServoDensity40Status	0115	277	0	1	0	0	163 status
843	MeasuredServoDensity41	0116	278	51	2	100	0	0x level
844	MeasuredServoDensity41Status	0118	280	0	1	0	0	163 status
845	MeasuredServoDensity42	0119	281	51	2	100	0	0x level

ID	Name	Register Address		Data Type	Number of Registers	Scaling	Offset	Dimension Type
		Hex	Dec					
846	MeasuredServoDensity42Status	011B	283	0	1	0	0	163 status
847	MeasuredServoDensity43	011C	284	51	2	100	0	0x level
848	MeasuredServoDensity43Status	011E	286	0	1	0	0	163 status
849	MeasuredServoDensity44	011F	287	51	2	100	0	0x level
850	MeasuredServoDensity44Status	0121	289	0	1	0	0	163 status
851	MeasuredServoDensity45	0122	290	51	2	100	0	0x level
852	MeasuredServoDensity45Status	0124	292	0	1	0	0	163 status
853	MeasuredServoDensity46	0125	293	51	2	100	0	0x level
854	MeasuredServoDensity46Status	0127	295	0	1	0	0	163 status
855	MeasuredServoDensity47	0128	296	51	2	100	0	0x level
856	MeasuredServoDensity47Status	012A	298	0	1	0	0	163 status
857	MeasuredServoDensity48	012B	299	51	2	100	0	0x level
858	MeasuredServoDensity48Status	012D	301	0	1	0	0	163 status
859	MeasuredServoDensity49	012E	302	51	2	100	0	0x level
860	MeasuredServoDensity49Status	0130	304	0	1	0	0	163 status

REMARK: The scaling and offset values displayed in TABLE 3-5 are based on the following engineering units: m, C, kPa, m^3, Kg/m^3, m^3/min, kg. In practice, the values may differ depending on the engineering units configured by the customer.

3.4.5 General CIU diagnostics details area

CIU diagnostics are presented in general area at fixed address and are not configurable. The information will be available at fixed general registers. We can read the Current CIU diagnostics only.

TABLE 3-6 CIU diagnostics entities

ID	Name	Register Address		Data Type	Number of Registers	Scaling	Offset	Dimension Type	Units
		Hex	Dec						
10015	CIUSystemStatus	2530	9520	1	1	0	0	160 nodim	-
10081	FieldSerialPortHealth	2531	9521	1	1	0	0	160 nodim	-

ID	Name	Register Address		Data Type	Number of Registers	Scaling	Offset	Dimension Type	Units
		Hex	Dec						
10068	FieldCardType	2532	9522	1	1	0	0	160 nodim	-
3517	FieldPortVersion	2533	9523	15	5	0	0	120 text	-
10089	FieldCardFirmwareVersion	2538	9528	15	7	0	0	120 text	-
10081	FieldSerialPortHealth	253F	9535	1	1	0	0	160 nodim	-
10068	FieldCardType	2540	9536	1	1	0	0	160 nodim	-
3517	FieldPortVersion	2541	9537	15	5	0	0	120 text	-
10089	FieldCardFirmwareVersion	2546	9542	15	7	0	0	120 text	-
10081	FieldSerialPortHealth	254D	9549	1	1	0	0	160 nodim	-
10068	FieldCardType	254E	9550	1	1	0	0	160 nodim	-
3517	FieldPortVersion	254F	9551	15	5	0	0	120 text	-
10089	FieldCardFirmwareVersion	2554	9556	15	7	0	0	120 text	-
10081	FieldSerialPortHealth	255B	9563	1	1	0	0	160 nodim	-
10068	FieldCardType	255C	9564	1	1	0	0	160 nodim	-
3517	FieldPortVersion	255D	9565	15	5	0	0	120 text	-
10089	FieldCardFirmwareVersion	2562	9570	15	7	0	0	120 text	-
10081	FieldSerialPortHealth	2569	9577	1	1	0	0	160 nodim	-
10068	FieldCardType	256A	9578	1	1	0	0	160 nodim	-
3517	FieldPortVersion	256B	9579	15	5	0	0	120 text	-
10089	FieldCardFirmwareVersion	2570	9584	15	7	0	0	120 text	-
10081	FieldSerialPortHealth	2577	9591	1	1	0	0	160 nodim	-
10068	FieldCardType	2578	9592	1	1	0	0	160 nodim	-
3517	FieldPortVersion	2579	9593	15	5	0	0	120 text	-
10089	FieldCardFirmwareVersion	257E	9598	15	7	0	0	120 text	-
10071	SyncLinkConnectionStatus	2585	9605	1	1	0	0	160 nodim	-
10073	ServiceLinkConnectionStatus	2586	9606	1	1	0	0	160 nodim	-
10074	HostEthernetConnectionStatus	2587	9607	1	1	0	0	120 text	-
10112	FTEAActiveClients	2588	9608	1	1	0	0	120 text	-
10113	FTEATXPacketCount	2589	9609	51	2	1	0	170 factor	-
10114	FTEARXPacketCount	258B	9611	51	2	1	0	170 factor	-
10115	FTEAErrorPacketCount	258D	9613	51	2	1	0	170 factor	-
10074	HostEthernetConnectionStatus	258F	9615	1	1	0	0	160 nodim	-
10116	FTEBActiveClients	2590	9616	1	1	0	0	160 nodim	-
10117	FTEBTXPacketCount	2591	9617	51	2	1	0	170 factor	-

ID	Name	Register Address		Data Type	Number of Registers	Scaling	Offset	Dimension Type	Units
		Hex	Dec						
10118	FTEBRXPacketCount	2593	9619	51	2	1	0	170 factor	-
10119	FTEBErrorPacketCount	2595	9621	51	2	1	0	170 factor	-
10074	FieldEthernetConnectionStatus	2597	9623	1	1	0	0	160 nodim	-
10120	LANActiveClients	2598	9624	1	1	0	0	160 nodim	-
10212	LANTXPacketCount	2599	9625	51	2	1	0	170 factor	-
10122	LANRXPacketCount	259B	9627	51	2	1	0	170 factor	-
10123	LANErrorPacketCount	259D	9629	51	2	1	0	170 factor	-
10072	RemoteLinkConnectionStatus	259F	9631	1	1	0	0	160 nodim	-
10111	CompactFlashDiskSpaceHealth	25A0	9632	1	1	0	0	160 nodim	-
10056	CompactFlashSize	25A1	9633	1	1	0	0	160 nodim	MB
10057	CompactFlashFreeSize	25A2	9634	1	1	0	0	160 nodim	MB
10083	RAMUsageHealth	25A3	9635	1	1	0	0	160 nodim	
10055	RAMSize	25A4	9636	1	1	0	0	160 nodim	MB
10063	AverageRAMUsage	25A5	9637	1	1	0	0	160 nodim	%
10076	CarrierBoardTemperatureHealth	25A6	9638	1	1	0	0	160 nodim	-
10050	CarrierBoardTemperature1	25A7	9639	40	1	100/10	30000/4000	140 perc.	°C / °F
10051	CarrierBoardTemperature2	25A8	9640	40	1	100/10	30000/4000	140 perc.	°C / °F
10052	CarrierBoardTemperature3	25A9	9641	40	1	100/10	30000/4000	140 perc.	°C / °F
10053	CarrierBoardTemperature4	25AA	9642	40	1	100/10	30000/4000	140 perc.	°C / °F
10110	CPUCoreTemperatureHealth	25AB	9643	1	1	100/10	30000/4000	160 nodim	-
10054	CPUCoreTemperature	25AC	9644	40	1	100/10	30000/4000	140 perc.	°C / °F
3034	WMKeyStatus	25AD	9645	1	1	0	0	160 nodim	-
3033	WriteProtectKeyStatus	25AE	9646	1	1	0	0	160 nodim	-
10062	AverageCPUUsage	25AF	9647	1	1	0	0	160 nodim	%
532	CIURunHours	25B0	9648	51	2	1	0	170 factor	hours
10500	CIU888Version	25B2	9650	15	10	0	0	120 text	-
1092	CIU888ReleaseNumber	25BC	9660	15	5	0	0	120 text	-
10064	LastPowerUpTime	25C1	9665	3	3	0	0	113 time	-

ID	Name	Register Address		Data Type	Number of Registers	Scaling	Offset	Dimension Type	Units
		Hex	Dec						
10065	LastPowerDownTime	25C4	9668	3	3	0	0	113 time	-
10066	LastPowerDownReason	25C7	9671	1	1	0	0	160 nodim	-
10058	FPGAVersion	25C8	9672	15	5	0	0	120 text	-
10059	BIOSVersion	25CD	9677	15	5	0	0	120 text	-
10060	SecondaryMicrocontrollerVersion	25D2	9682	15	5	0	0	120 text	-
10069	LCDDisplayType	25D7	9687	1	1	0	0	160 nodim	-
10091	CIUSystemStatusDescription	25D8	9688	15	125	0	0	120 text	-

REMARK: For temperature entities, scaling is chosen based on the global engineering units. If Degree C is chosen, then scaling and offset will be 100 and 30000 respectively. If Degree F is chosen, then scaling and offset will be 10 and 4000 respectively.
1. For a description of the entities mentioned in this table, see APPENDIX J
2. For a description of the possible Data Types, see APPENDIX F
3. For a description of the possible Dimension Types, see APPENDIX H

3.5 Flexible Modbus maps

This section covers the flexible (i.e. user defined) Modbus maps supported for tank record, temperature and density profiles data. Refer to the *Configuration Manual CIU 888 (Part No. 4417593)* for more information on configuration of flexible (User specified) Modbus maps for temperature and density profiles data for serial and Ethernet host ports. Refer to (see section 3.5.1) for list of available entities that can be configured in user defined tank record. During commissioning/ configuration flexible Modbus for temperature profiles can be enabled for either a serial host port or a Ethernet host port (see section 3.5.2) and flexible Modbus map for density profiles data can be enabled for either a serial host port or a Ethernet host port (see section 3.5.3).

3.5.1 Enabling flexible Modbus map for tank record data.

During commissioning/configuration of the CIU 888 users can enable flexible Modbus mapping for tank record data for serial host port and or Ethernet host port. Default tank record start address is 0 and default temperature profile record interval is 125.

NOTE: Refer to the Configuration Manual CIU 888 (Part No. 4417593) for more information about the mapping of the tank record data to the CIU 888's serial host port or Ethernet host port.

3.5.1.1 Available tank record Entities

The table below displays all the tank record entities available to the user.

Name	ID	Dimension
TankName	1	Text (ASCII or Unicode)
TankStatus	2	Bit coded
MovingStatus	3	Index
TankType	4	Bit coded
GaugeType	5	Nodim
GaugeStatus	6	Index
GaugeCommands	7	Bit coded
TempElementType	8	Index
HotStandbyStatus	9	Bit coded
CommStatus	10	Bit coded
CIUPrimeAddress	11	Nodim
TankShape	16	Index
ShellCapacity (MaximumTankCapacity)	17	Volume
LowTOV	18	Volume
HighTOV	19	Volume
HighLevel	20	Level
ProductName	21	Text (ASCII or Unicode)
GSVCalcType	22	Index
ProductCode	23	Index
VolumeCorrections	24	Index
MassCalcType	25	Bit coded
ProductTRef	26	Temperature
Dref (ProductDRef)	30	Density
DRefStatus (ProductDRefStatus)	31	Status
SedAndWater	32	Percentage
ProductTC	33	Temperature coef-ficient
ProductTCStatus	34	Status
LiqVolRatio	35	Nodim
GaugeLevelAlarms	36	Bit coded
ExternalContacts	37	Bit coded
DisplacerPosition	38	Level

Name	ID	Dimension
DisplacerStatus (DisplacerPositionStatus)	39	Status
ProductLevel	40	Level
ProductLevelStatus	41	Status
WaterLevel	42	Level
WaterLevelStatus	43	Status
ProductTemp	44	Temperature
ProductTempStatus	45	Status
VapRoomTemp	46	Temperature
VapRoomTempStatus	47	Status
VapRoomPress	48	Pressure
VapRoomPressStatus	49	Status
DObs	50	Density
DObsStatus	51	Status
ForeGroundTimeStamp (ForegroundTimeStamp)	52	Absolute time
BackGroundTimeStamp (BackgroundTimeStamp)	53	Absolute time
TOV	54	Volume
TOVStatus	55	Status
WaterVol	56	Volume
WaterVolStatus	57	Status
GOV	58	Volume
GOVStatus	59	Status
GSV	60	Volume
GSVStatus	61	Status
NSV	63	Volume
NSVStatus	63	Status
LiqInVap	64	Volume
LiqInVapStatus	65	Status
TGSV	66	Volume
TGSVStatus	67	Status
MassLiq (NSM)	68	Mass
MassLiqStatus (NSMStatus)	69	Status
MassVap	70	Mass
MassVapStatus	71	Status
TotalMass (TNSM)	72	Mass
TotalMassStatus (TNSMStatus)	73	Status

Name	ID	Dimension
FlowTOV	74	Flow
AvailableRoom	75	Volume
Available TOV	76	Volume
Verification Signature	77	Nodim
ConfigurationStatus	78	Bit coded
MolarWeight	79	Molar weight value
AutomaticMeasurableValues	80	Bit coded
HydroMeterCorr	88	Nodim
TObsDipped	89	Temperature
TankTRef	90	Temperature
ThermalexpCoeffTankshell	91	TankShellCoeffi-cient
TankAirDensity	92	Density
VapRoom	93	Volume
TankConfigurationCRC	94	Nodim
CIUPrimeGeneralConfigurationCRC (CIU2GeneralConfigurationCRC)	95	Nodim
CIUPrimeGeneral ConfigurationCRCx (CIUPGeneralConfigurationCRC)	96	Nodim
LowLevel	97	Level
FlowStatus	99	Status
AvailableRoomStatus	100	Status
AvailableTOVStatus	101	Status
VapRoomStatus	102	Status
Ambient Temperature	103	Temperature
Ambient Temperature Status	104	Status
CIUPlusTankID	105	Nodim
CIU2TankID	106	Nodim
CTSh	107	CTSh
CTShStatus	108	Status
InsulationFactor	109	Insulation Factor
TObsDippedStatus	111	Status
DObsDipped	112	Density
DObsDippedStatus	113	Status
WaterDipped	114	Level

Name	ID	Dimension
WaterDippedStatus	115	Status
DObsHIMS	116	Density
DObsHIMSStatus	117	Status
Tobs	118	Temperature
Tobs Status	119	Status
WaterMeasured	120	Level
WaterMeasuredStatus	121	Status
VolumeCorrectionFactor (CTL)	124	VCF (= CTL)
VolumeCorrectionFactor Status (CTLStatus)	125	Status
TemperatureCorrectionFactor (TCF)	126	TCF
TemperatureCorrectionFactorStatus (TCFStatus)	127	Status
DensityCorrectionFactor (DCF)	128	DCF
DensityCorrectionFactorStatus (DCFStatus)	129	Status
TankNameStatus	130	Status
TankStatusStatus	131	Status
MovingStatusStatus	132	Status
TankTypeStatus	133	Status
ShellCapacityStatus (MaximumTankCapacityStatus)	134	Status
LowTOVStatus	135	Status
HighTOVStatus	136	Status
ProductNameStatus	137	Status
GSVCalcTypeStatus	138	Status
ProductCodeStatus	139	Status
VolumeCorrectionStatus	140	Status
MassCalcTypeStatus	141	Status
ProductTRefStatus	142	Status
SedAndWaterStatus	143	Status
LiqVolRatioStatus	144	Status
MolarWeightStatus	145	Status
AutomaticMeasurableValuesStatus	146	Status
HydroMeterCorrStatus	154	Status
TankTrefStatus	155	Status
TankTCStatus	156	Status
TankAirDensityStatus	157	Status

Name	ID	Dimension
InsulationFactorStatus	158	Status
FRL1	178	Level
FRL1Status	179	Status
FRL2	180	Level
FRL2Status	181	Status
FRL3	182	Level
FRL3Status	183	Status
FRA	184	Level
FRAStatus	185	Status
RIC	186	Volume
RICStatus	187	Status
cUllage	196	Level
cUllageStatus	197	Status
cInnage	198	Level
cInnageStatus	199	Status
Alarms	200	Nodim
Dynamic tank status (DynamicTankStatus)	201	Nodim
StaticTankDefinitions	202	Nodim
FieldInstrumentDetails	203	Nodim
CombinedVolumeCorrections	204	Nodim
MassAndVolumeCorrections	205	Nodim
CommAndConfStatus	206	Nodim
cGRH	226	Level
cGRHStatus	227	Status
ProductPressure	296	Pressure
ProductPressureStatus	297	Status
TermGRHP	318	Level
TermGRHPStatus	319	Status
DxAver	2174	Level
DxAverStatus	2175	Status
cMassConcentration	2176	percentage
cMassConcentrationStatus	2177	Status
cVolConcentration	2178	Percentage
cVolConcentrationStatus	2179	Status
Gauge2Status	2600	Nodim
ProductLevel2	2603	Level

Name	ID	Dimension
ProductLevel2Status	2604	Status

3.5.2 Enabling flexible Modbus for temperature profiles data

During commissioning/configuration of the CIU 888 users can enable flexible Modbus mapping for any CIU Plus host port, provided that the host port is not used for connecting the Entis Pro system.

NOTE: Refer to the Configuration Manual CIU 888 (Part No. 4417593) for more information about the mapping of the CIU Plus host ports to the CIU 888 host ports and the mapping for the CIU 888 Ethernet host ports.

3.5.2.1 Available Temperature profiles Entities

The table below displays all the temperature profile entities available to the user.

Name	ID	Dimension
TemperatureProfilesScanEnable	2535	Nodim
TemperatureProfileDataStatus	10584	Nodim
TemperatureProfileTimeStamp	10571	Absolute time
MultitemperatureNumberOfElements	10585	Nodim
MultitemperatureSpotRelativeElementPosition0	466	Level
MultitemperatureSpotRelativeElementPosition0Status	467	Status
MultitemperatureSpotRelativeElementPosition1	468	Level
MultitemperatureSpotRelativeElementPosition1Status	469	Status
MultitemperatureSpotRelativeElementPosition2	470	Level
MultitemperatureSpotRelativeElementPosition2Status	471	Status
MultitemperatureSpotRelativeElementPosition3	472	Level
MultitemperatureSpotRelativeElementPosition3Status	473	Status
MultitemperatureSpotRelativeElementPosition4	474	Level
MultitemperatureSpotRelativeElementPosition4Status	475	Status
MultitemperatureSpotRelativeElementPosition5	476	Level
MultitemperatureSpotRelativeElementPosition5Status	477	Status
MultitemperatureSpotRelativeElementPosition6	478	Level
MultitemperatureSpotRelativeElementPosition6Status	479	Status
MultitemperatureSpotRelativeElementPosition7	480	Level

Name	ID	Dimension
MultitemperatureSpotRelativeElementPosition7Status	481	Status
MultitemperatureSpotRelativeElementPosition8	482	Level
MultitemperatureSpotRelativeElementPosition8Status	483	Status
MultitemperatureSpotRelativeElementPosition9	484	Level
MultitemperatureSpotRelativeElementPosition9Status	485	Status
MultitemperatureSpotRelativeElementPosition10	486	Level
MultitemperatureSpotRelativeElementPosition10 Status	487	Status
MultitemperatureSpotRelativeElementPosition11	488	Level
MultitemperatureSpotRelativeElementPosition11 Status	489	Status
MultitemperatureSpotRelativeElementPosition12	490	Level
MultitemperatureSpotRelativeElementPosition12 Status	491	Status
MultitemperatureSpotRelativeElementPosition13	492	Level
MultitemperatureSpotRelativeElementPosition13 Status	493	Status
MultitemperatureSpotRelativeElementPosition14	494	Level
MultitemperatureSpotRelativeElementPosition14 Status	495	Status
MultitemperatureSpotRelativeElementPosition15	496	Level
MultitemperatureSpotRelativeElementPosition15 Status	497	Status
MultitemperatureSpotTemperature0	434	Temperature
MultitemperatureSpotTemperature0Status	435	Status
MultitemperatureSpotTemperature1	436	Temperature
MultitemperatureSpotTemperature1Status	437	Status
MultitemperatureSpotTemperature2	438	Temperature
MultitemperatureSpotTemperature2Status	439	Status
MultitemperatureSpotTemperature3	440	Temperature
MultitemperatureSpotTemperature3Status	441	Status
MultitemperatureSpotTemperature4	442	Temperature
MultitemperatureSpotTemperature4Status	443	Status
MultitemperatureSpotTemperature5	444	Temperature
MultitemperatureSpotTemperature5Status	445	Status
MultitemperatureSpotTemperature6	446	Temperature

Name	ID	Dimension
MultitemperatureSpotTemperature6Status	447	Status
MultitemperatureSpotTemperature7	448	Temperature
MultitemperatureSpotTemperature7Status	449	Status
MultitemperatureSpotTemperature8	450	Temperature
MultitemperatureSpotTemperature8Status	451	Status
MultitemperatureSpotTemperature9	452	Temperature
MultitemperatureSpotTemperature9Status	453	Status
MultitemperatureSpotTemperature10	454	Temperature
MultitemperatureSpotTemperature10Status	455	Status
MultitemperatureSpotTemperature11	456	Temperature
MultitemperatureSpotTemperature11Status	457	Status
MultitemperatureSpotTemperature12	458	Temperature
MultitemperatureSpotTemperature12Status	459	Status
MultitemperatureSpotTemperature13	460	Temperature
MultitemperatureSpotTemperature13Status	461	Status
MultitemperatureSpotTemperature14	462	Temperature
MultitemperatureSpotTemperature14Status	463	Status
MultitemperatureSpotTemperature15	464	Temperature
MultitemperatureSpotTemperature15Status	465	Status
MultiTemperatureLevelOffset	498	Level
MultiTemperatureElementType	499	Text (ASCII or Unicode)
TemperatureProfilesScanProductLevel	10572	Level
TemperatureProfilesScanProductLevelStatus	10573	Status
TemperatureProfilesScanProductTemperature	10574	Temperature
TemperatureProfilesScanProductTemperatureStatus	10574	Status
TemperatureProfileScanWaterLevel	10595	Level
TemperatureProfileScanWaterLevelStatus	10596	Status
TemperatureProfileScanVapourTemperature	10597	Temperature
TemperatureProfileScanVapourTemperatureStatus	10598	Status
TemperatureProfileScanVapourPressure	10599	Pressure
TemperatureProfileScanVapourPressureStatus	10600	Status

REMARK: For a description of the entities mentioned in this table, (see section E).

3.5.3 Enabling flexible Modbus map for density profile data

During commissioning/configuration of the CIU 888 users can enable flexible Modbus mapping for density profiles data for serial host port and or Ethernet host port. Default density profile start address is 30000 and default temperature profile record interval is 320.

NOTE: Refer to the Configuration Manual CIU 888 (Part No. 4417593) for more information about the mapping of the density profiles data to the CIU 888's serial host port or Ethernet host port.

3.5.3.1 Available Density profiles Entities

The table below displays all the density profile entities available to the user.

Name	ID	Dimension
DensityProfileDataStatus	10651	Nodim
DensityProfileTimeStamp	10652	Absolute time
MultiDensityNumberOfElements	10655	Nodim
DensityInnageLevel0	390	Level
DensityInnageLevel0Status	391	Status
DensityInnageLevel1	392	Level
DensityInnageLevel1Status	393	Status
DensityInnageLevel2	394	Level
DensityInnageLevel2Status	395	Status
DensityInnageLevel3	396	Level
DensityInnageLevel3Status	397	Status
DensityInnageLevel4	398	Level
DensityInnageLevel4Status	399	Status
DensityInnageLevel5	400	Level
DensityInnageLevel5Status	401	Status
DensityInnageLevel6	402	Level
DensityInnageLevel6Status	403	Status
DensityInnageLevel7	404	Level
DensityInnageLevel7Status	405	Status
DensityInnageLevel8	406	Level
DensityInnageLevel8Status	407	Status
DensityInnageLevel9	408	Level
DensityInnageLevel9Status	409	Status
DensityInnageLevel10	701	Level
DensityInnageLevel10Status	702	Status
DensityInnageLevel11	703	Level

Name	ID	Dimension
DensityInnageLevel11Status	704	Status
DensityInnageLevel12	705	Level
DensityInnageLevel12Status	706	Status
DensityInnageLevel13	707	Level
DensityInnageLevel13Status	708	Status
DensityInnageLevel14	709	Level
DensityInnageLevel14Status	710	Status
DensityInnageLevel15	711	Level
DensityInnageLevel15Status	712	Status
DensityInnageLevel16	713	Level
DensityInnageLevel16Status	714	Status
DensityInnageLevel17	715	Level
DensityInnageLevel17Status	716	Status
DensityInnageLevel18	717	Level
DensityInnageLevel18Status	718	Status
DensityInnageLevel19	719	Level
DensityInnageLevel19Status	420	Status
DensityInnageLevel20	721	Level
DensityInnageLevel20Status	722	Status
DensityInnageLevel21	723	Level
DensityInnageLevel21Status	724	Status
DensityInnageLevel22	725	Level
DensityInnageLevel22Status	726	Status
DensityInnageLevel23	727	Level
DensityInnageLevel23Status	728	Status
DensityInnageLevel24	729	Level
DensityInnageLevel24Status	730	Status
DensityInnageLevel25	731	Level
DensityInnageLevel25Status	732	Status
DensityInnageLevel26	733	Level
DensityInnageLevel26Status	734	Status
DensityInnageLevel27	735	Level
DensityInnageLevel27Status	736	Status
DensityInnageLevel28	737	Level
DensityInnageLevel28Status	738	Status
DensityInnageLevel29	739	Level

Name	ID	Dimension
DensityInnageLevel29Status	740	Status
DensityInnageLevel30	741	Level
DensityInnageLevel30Status	742	Status
DensityInnageLevel31	743	Level
DensityInnageLevel31Status	744	Status
DensityInnageLevel32	745	Level
DensityInnageLevel32Status	746	Status
DensityInnageLevel33	747	Level
DensityInnageLevel33Status	748	Status
DensityInnageLevel34	749	Level
DensityInnageLevel34Status	750	Status
DensityInnageLevel35	751	Level
DensityInnageLevel35Status	752	Status
DensityInnageLevel36	753	Level
DensityInnageLevel36Status	754	Status
DensityInnageLevel37	755	Level
DensityInnageLevel37Status	756	Status
DensityInnageLevel38	757	Level
DensityInnageLevel38Status	758	Status
DensityInnageLevel39	759	Level
DensityInnageLevel39Status	760	Status
DensityInnageLevel40	761	Level
DensityInnageLevel40Status	762	Status
DensityInnageLevel41	763	Level
DensityInnageLevel41Status	764	Status
DensityInnageLevel42	765	Level
DensityInnageLevel42Status	766	Status
DensityInnageLevel43	767	Level
DensityInnageLevel43Status	768	Status
DensityInnageLevel44	769	Level
DensityInnageLevel44Status	770	Status
DensityInnageLevel45	771	Level
DensityInnageLevel45Status	772	Status
DensityInnageLevel46	773	Level
DensityInnageLevel46Status	774	Status
DensityInnageLevel47	775	Level

Name	ID	Dimension
DensityInnageLevel47Status	776	Status
DensityInnageLevel48	777	Level
DensityInnageLevel48Status	778	Status
DensityInnageLevel49	779	Level
DensityInnageLevel49Status	780	Status
MeasuredServoDensity0	412	Density
MeasuredServoDensity0Status	413	Status
MeasuredServoDensity1	414	Density
MeasuredServoDensity1Status	415	Status
MeasuredServoDensity2	416	Density
MeasuredServoDensity2Status	417	Status
MeasuredServoDensity3	418	Density
MeasuredServoDensity3Status	419	Status
MeasuredServoDensity4	420	Density
MeasuredServoDensity4Status	421	Status
MeasuredServoDensity5	422	Density
MeasuredServoDensity5Status	423	Status
MeasuredServoDensity6	424	Density
MeasuredServoDensity6Status	425	Status
MeasuredServoDensity7	426	Density
MeasuredServoDensity7Status	427	Status
MeasuredServoDensity8	428	Density
MeasuredServoDensity8Status	429	Status
MeasuredServoDensity9	430	Density
MeasuredServoDensity9Status	431	Status
MeasuredServoDensity10	781	Density
MeasuredServoDensity10Status	782	Status
MeasuredServoDensity11	783	Density
MeasuredServoDensity11Status	784	Status
MeasuredServoDensity12	785	Density
MeasuredServoDensity12Status	786	Status
MeasuredServoDensity13	787	Density
MeasuredServoDensity13Status	788	Status
MeasuredServoDensity14	789	Density
MeasuredServoDensity14Status	790	Status
MeasuredServoDensity15	791	Density

Name	ID	Dimension
MeasuredServoDensity15Status	792	Status
MeasuredServoDensity16	793	Density
MeasuredServoDensity16Status	794	Status
MeasuredServoDensity17	795	Density
MeasuredServoDensity17Status	796	Status
MeasuredServoDensity18	797	Density
MeasuredServoDensity18Status	798	Status
MeasuredServoDensity19	799	Density
MeasuredServoDensity19Status	800	Status
MeasuredServoDensity20	801	Density
MeasuredServoDensity0Status	802	Status
MeasuredServoDensity21	803	Density
MeasuredServoDensity21Status	804	Status
MeasuredServoDensity22	805	Density
MeasuredServoDensity22Status	806	Status
MeasuredServoDensity23	807	Density
MeasuredServoDensity23Status	808	Status
MeasuredServoDensity24	809	Density
MeasuredServoDensity24Status	810	Status
MeasuredServoDensity25	811	Density
MeasuredServoDensity25Status	812	Status
MeasuredServoDensity26	813	Density
MeasuredServoDensity26Status	814	Status
MeasuredServoDensity27	815	Density
MeasuredServoDensity27Status	816	Status
MeasuredServoDensity28	817	Density
MeasuredServoDensity28Status	818	Status
MeasuredServoDensity29	819	Density
MeasuredServoDensity29Status	820	Status
MeasuredServoDensity30	821	Density
MeasuredServoDensity30Status	822	Status
MeasuredServoDensity31	823	Density
MeasuredServoDensity31Status	824	Status
MeasuredServoDensity32	825	Density
MeasuredServoDensity32Status	826	Status
MeasuredServoDensity33	827	Density

Name	ID	Dimension
MeasuredServoDensity33Status	828	Status
MeasuredServoDensity34	829	Density
MeasuredServoDensity34Status	830	Status
MeasuredServoDensity35	831	Density
MeasuredServoDensity35Status	832	Status
MeasuredServoDensity36	833	Density
MeasuredServoDensity36Status	834	Status
MeasuredServoDensity37	835	Density
MeasuredServoDensity37Status	836	Status
MeasuredServoDensity38	837	Density
MeasuredServoDensity38Status	838	Status
MeasuredServoDensity39	839	Density
MeasuredServoDensity39Status	840	Status
MeasuredServoDensity40	841	Density
MeasuredServoDensity40Status	842	Status
MeasuredServoDensity41	843	Density
MeasuredServoDensity41Status	844	Status
MeasuredServoDensity42	845	Density
MeasuredServoDensity42Status	846	Status
MeasuredServoDensity43	847	Density
MeasuredServoDensity43Status	848	Status
MeasuredServoDensity44	849	Density
MeasuredServoDensity44Status	850	Status
MeasuredServoDensity45	851	Density
MeasuredServoDensity45Status	852	Status
MeasuredServoDensity46	853	Density
MeasuredServoDensity46Status	854	Status
MeasuredServoDensity47	855	Density
MeasuredServoDensity47Status	856	Status
MeasuredServoDensity48	857	Density
MeasuredServoDensity48Status	858	Status
MeasuredServoDensity49	859	Density
MeasuredServoDensity49Status	860	Status

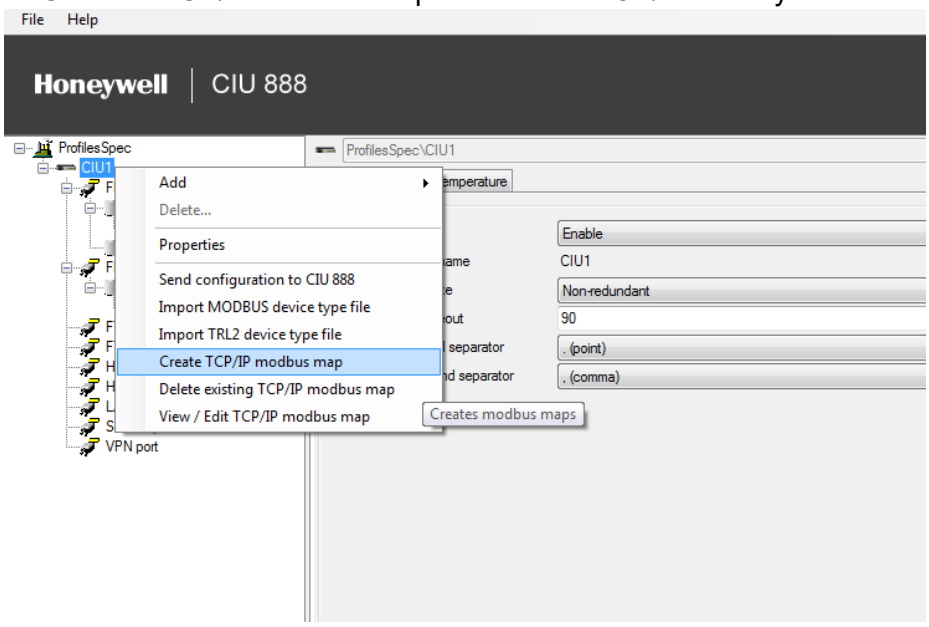
REMARK: For a description of the entities mentioned in this table, (see section E).

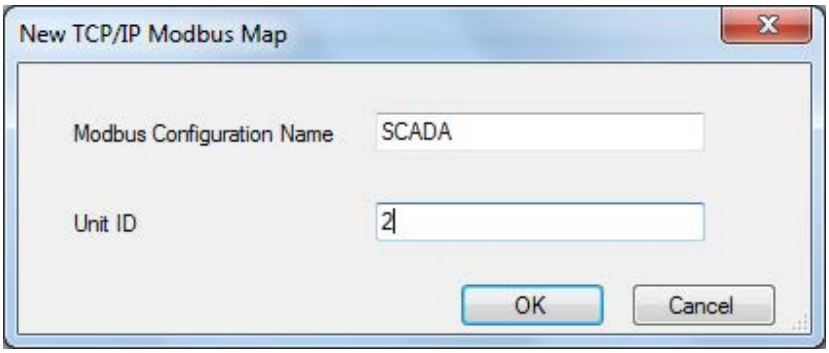
3.6 Profiles data integration to Modbus Host system

This section depicts the interface between Modbus TCP/IP host system/ Modbus RTU host system and CIU w.r.t temperature and density profiles data.

For Modbus TCP/IP host system integration, user shall configure the following in CIU 888.

1. Create a TCP/IP Modbus map for Modbus TCP/IP host system.

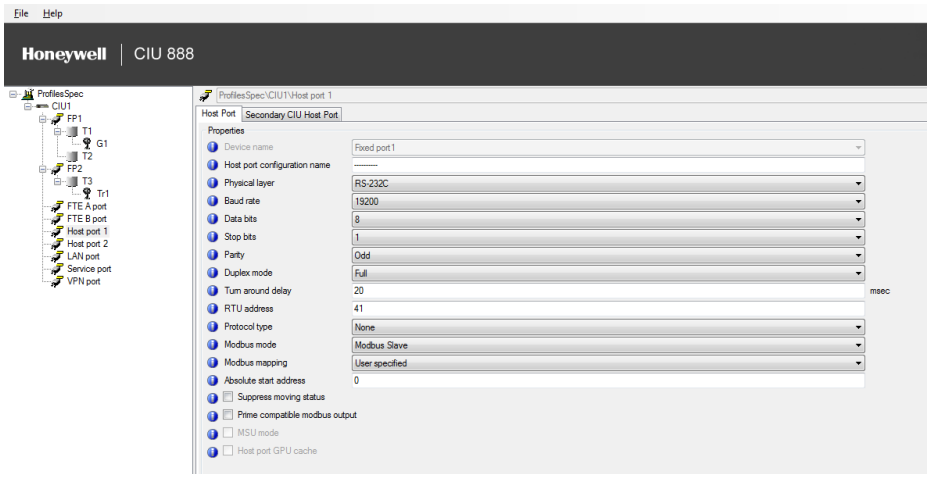




2. Select Modbus mapping as “User specified” and configure the desired temperature profile entities and density profile entities in the user defined Modbus map. Refer to the *Configuration Manual CIU 888 (Part No. 4417593)* for more information.
3. Upload the configuration to CIU 888.

For Modbus RTU host system integration, user shall configure the following in CIU 888.

1. Select Modbus mapping as “User specified” for the desired serial host port.



2. Configure the desired temperature profile entities and density profile entities in the user defined Modbus map. Refer to the *Configuration Manual CIU 888 (Part No. 4417593)* for more information.
3. Upload the configuration to CIU 888.

3.6.1 Temperature profiles data interface

CIU collects temperature profiles data from the gauges periodically based on the configuration and presents the data as configured in the user defined Modbus map in the Modbus TCP/IP output / Modbus RTU output.

3.6.1.1 Temperature profiles data read

Modbus TCP/IP host system / Modbus RTU host system shall issue a Modbus read request (Read Holding register (function code 3) / Read Input register (function code 4)) with desired start address (based on which tank's temperature profile is required) and number of registers to read (based on the configuration).

Modbus Start Address =

Temperature profile absolute start address +
*Tank Sequence Number * Temperature profile record interval*

Where

Temperature profile absolute start address is 20000 (by default) but user configurable.

Tank Sequence Number is from 0 to 79 (since a CIU supports a maximum of 80 tanks).

Temperature profile record interval is 125 (but default) but user configurable.

For example,

We assume user configured temperature profile absolute start address as 20000, temperature profile record interval as 100.

If first tank's temperature profile is required, then

Modbus start address = 20000 + 0 * 100 = 20000

Modbus TCP/IP read request: 00 01 00 00 00 06 01 03 4E 20 00 64

Modbus RTU read request: 29 03 4E 20 00 64 54 EB

If fifth tank's temperature profile is required, then

Modbus start address = 20000 + 4 * 100 = 20400

Modbus TCP/IP read request: 00 01 00 00 00 06 01 03 4F B0 00 64

Modbus RTU read request: 29 03 4F B0 00 64 55 3A

3.6.1.2 Temperature profiles scan enable / disable

Modbus TCP/IP host system / Modbus RTU host system shall enable/ disable temperature profile data scan per tank in CIU 888 by overwriting TemperatureProfilesScanEnable entity in the Modbus map directly.

- To disable temperature profile scan write 0 to TemperatureProfileEnable entity
- To enable temperature profile scan write 1 to TemperatureProfileEnable entity

For example,

We assume user configured temperature profile absolute start address as 20000, temperature profile record interval as 100 and TemperatureProfilesScanEnable entity is the first entity in the Modbus map.

To enable first tank's temperature profile scan:

Modbus TCP/IP read request: 00 01 00 00 00 09 02 10 4E 20 00 01 02 00 01.

Modbus RTU read request: 29 10 4E 20 00 01 02 00 01 30 F5.

To disable fifth tank's temperature profile scan:

Modbus TCP/IP read request: 00 01 00 00 00 09 02 10 4F B0 00 01 02 00 00.

Modbus RTU read request: 29 10 4F B0 00 01 02 00 00 FC A5.

3.6.2 Density profiles data interface

Modbus TCP/IP host system / Modbus RTU host system issues the desired density dip command to CIU 88 via Modbus coil command mechanism (similar to other gauge commands). Refer to section 3.2.1 Profile commands for the various density profile commands supported in CIU 888.

3.6.2.1 Density profiles command

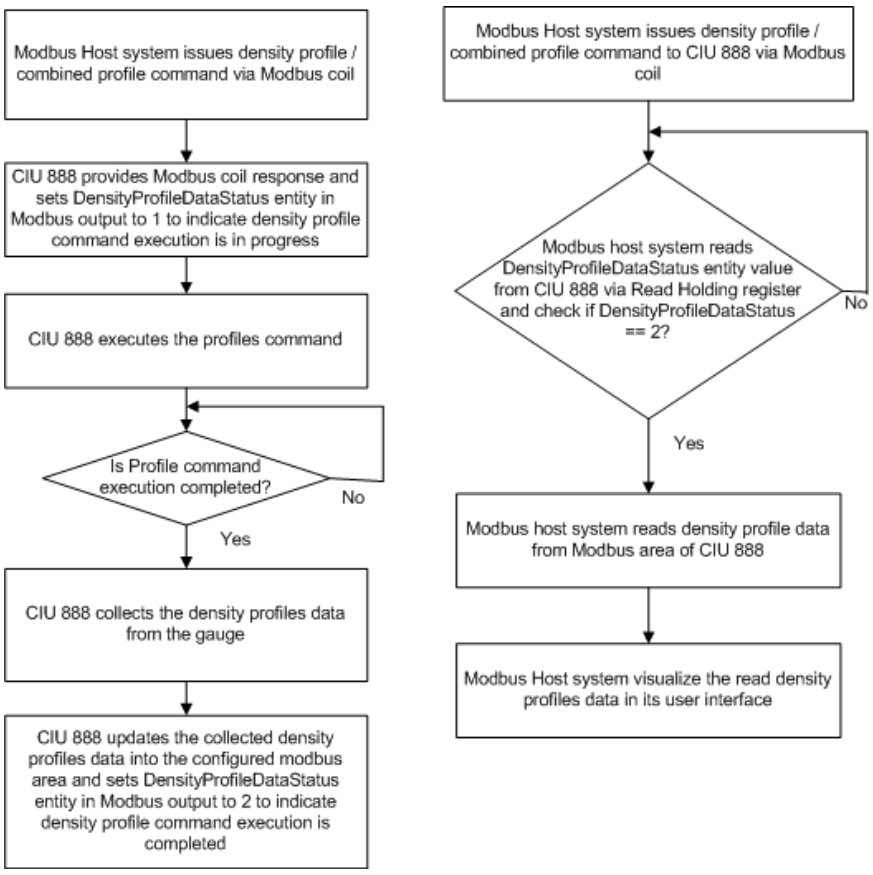


FIGURE 3-4 Density Profiles Command

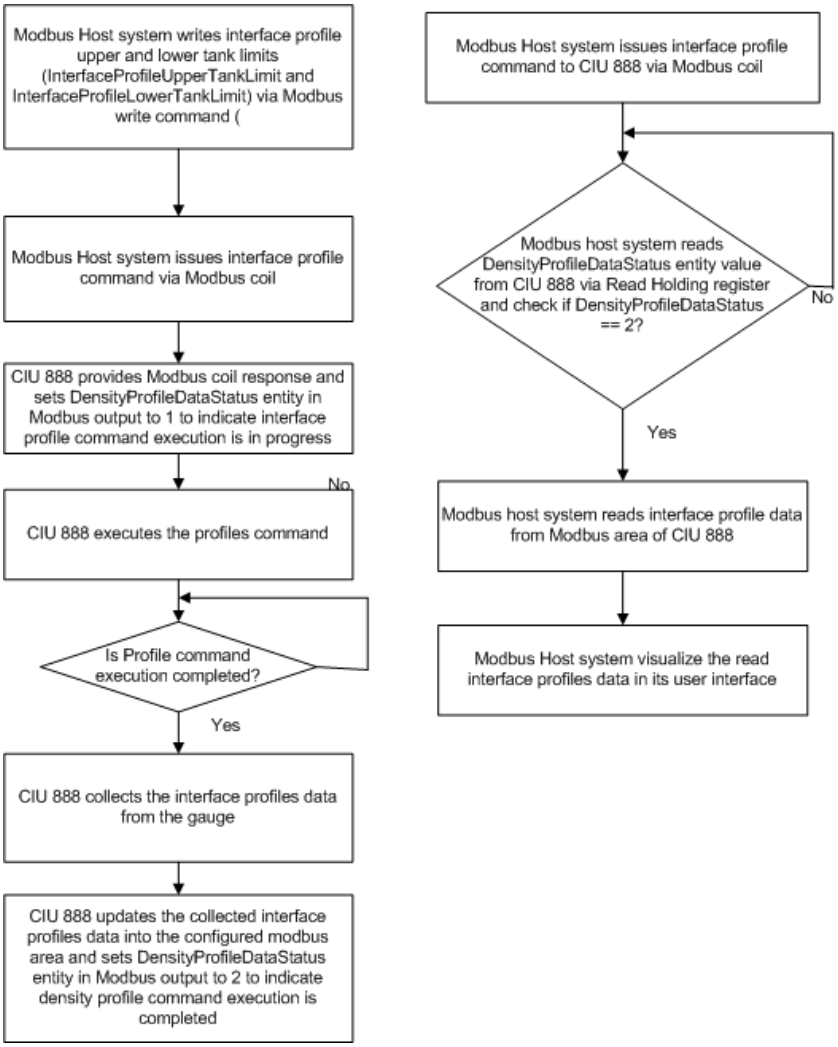
When the density profile command is accepted by CIU, CIU provides a Modbus coil command response and also sets DensityProfileDataStatus entity in Modbus output to 1 to indicate density profile command execution is in progress.

CIU monitors for completion of the command in the gauge, collects the density profiles data from the gauge and presents the data as defined in user defined Modbus map in the Modbus TCP/IP output / Modbus RTU output. CIU sets DensityProfileDataStatus entity in Modbus output to 2 to indicate density profile command execution is completed.

Modbus TCP/IP host system / Modbus RTU host system shall poll DensityProfileDataStatus entity in Modbus output to find whether density profile command is in progress or completed. When DensityProfileDataStatus entity value is 2, Modbus host system shall read the density profiles data (individual density points and density values with status & validity) and present it to the user in the intended

graphical format. Modbus TCP/IP host system / Modbus RTU host system shall pick up other values like Product Level, Product temperature, Vapour Temperature, Vapour Pressure, Water Level, Reference density from the configured tank record retrieved from CIU.

3.6.2.2 Interface profiles command



In case of interface profile command, the user has to provide the Upper and lower tank limits within with interface profile needs to be executed. “InterfaceProfileUpperTankLimit” and “InterfaceProfileLowerTankLimit” are exposed as part of the user defined Modbus map. Hence these entities shall be configured as part of the user defined Modbus map.

When interface profiles need to be executed, Modbus TCP/IP host system/Modbus RTU host system shall directly write “InterfaceProfileUpperTankLimit” and “InterfaceProfileLowerTankLimit” entities via Modbus direct write and then issue an appropriate interface profile command via Modbus coil.

CIU monitors for completion of the command in the gauge, collects the density profiles data from the gauge and presents the data as defined in user defined Modbus map in the Modbus TCP/IP output/Modbus RTU output. CIU sets “DensityProfileDataStatus” entity in Modbus output to 2 to indicate density profile command execution is completed.

Modbus TCP/IP host system / Modbus RTU host system shall poll “DensityProfileDataStatus” entity in Modbus output to find whether density profile command is in progress or completed. When “DensityProfileDataStatus” entity value is 2, Modbus host system shall read the density profiles data (individual density points and density values with status & validity) and present it to the user in the intended graphical format. Modbus TCP/IP host system / Modbus RTU host system shall pick up other values like Product Level, Product temperature, Vapour Temperature, Vapour Pressure, Water Level, Reference density from the configured tank record retrieved from CIU.

This page is intentionally left blank

APPENDIX A CIU PLUS COMPLIANT TANK RECORD ENTITIES

TABLE A-1 gives a description of the CIU Plus compliant tank record entities (formerly supported by the CIU 880 Prime).

TABLE A-1 Description of CIU Plus compliant tank record entities

ID	Name	Description	Dimension Type
106	CIUPrimeTank ID	Unique Identifier for a tank: • The range is between 1 to 65535	Nodim
2	TankStatus	The Status of the tank: • Bit 0 = 1 Tank shell is calibrated by W&M (Treated as General Tank calibrated Flag) • Bit 1 = 1 Maintenance (future) • Bit 2 = 1 Tank is disabled • Bit 3 = 1 Tank is not available Note: Default = 6 (bit 2+3). Because of the representation as combined entity the length is fixed to 4 bits.	Bit coded
3	MovingStatus	The level moving status: • 0 = Tank level is stable • 1 = Tank level is moving up • 2 = Tank level is moving down • 3 = No valid movement status can be detected (e.g. manual level)	Index
6	GaugeStatus	The (servo) gauge active status: • 0 = Level gauge is measuring level • 1 = Level gauge is in test • 2 = Level gauge is in lock test • 3 = Level gauge is blocked • 4 = Level gauge is busy with a density profile measurement • 5 = Level gauge is searching water level • 6 = Level gauge end switch reached • 10 = Level gauge has found water level and is measuring it • 255 = Level gauge is in failure	Index
9	HotStandbyStatus	The Hot Standby status: • Bit 0 = 1 Primary CIU Prime is scanning this tank • Bit 1 = 1 Primary CIU Prime is available for this tank • Bit 2 = 1 Secondary CIU Prime is scanning this tank • Bit 3 = 1 Secondary CIU Prime is available for this tank • Bit 4 = 1 CIU Plus is passive member of a Hot Standby pair	Bit coded

ID	Name	Description	Dimension Type
10	CommStatus	The communication status: • Bit 0 = 1 CIU Prime to Gauge comm. OK. (Future) (Bit 0 does not change when bit 1 = 0) • Bit 1 = 1 CIU Plus to (active or passive) CIU Prime comm. OK • Bit 2 = 1 Field port on (active) CIU Prime OK Note: Because of the representation as combined entity, the useful length is fixed to 3 bits.	Bit coded
36	GaugeLevelAlarms	The gauge level alarms: • Bit 0 = 1 Low Level alarm tripped • Bit 1 = 1 High Level alarm tripped • Bit 2 = 1 Alarm failure • Bit 3 = 1 Gauge alarms not available in this instrument	Bit coded
37	ExternalContacts	The external contacts: • Bit 0 = 1 External contact 1 active • Bit 1 = 1 External contact 2 active • Bit 2 = 1 External contact failure • Bit 3 = 1 External contact not available in this instrument	Bit coded
38	DisplacerPosition	The value of the physical servo displacer position.	Level
39	DisplacerStatus	The status of entity ID#38, DisplacerPosition.	Status
40	ProductLevel	The value of the product level.	Level
41	ProductLevelStatus	The status of entity ID#40, ProductLevel.	Status
42	WaterLevel	The value of the water level (copy of entity ID#114, Water-Dipped or entity ID#120, WaterMeasured).	Level
43	WaterLevelStatus	The status of entity ID#42, WaterLevel (copy of entity ID#115, WaterDippedStatus or entity ID#121, WaterMeasuredStatus).	Status
44	ProductTemp	The value of the product temperature	Temperature
45	ProductTempStatus	The status of entity ID#44, ProductTemp	Status
46	VapRoomTemp	The value of the product vapor temperature	Temperature
47	VapRoomTempStatus	The status of entity ID#46, VapRoomTemp.	Status
48	VapRoomPress	The value of the product vapor pressure.	Pressure
49	VapRoomPressStatus	The status of entity ID#48, VapRoomPress.	Status
50	DObs	The value of the product density (copy of entity ID#116, DObsHIMS or entity ID#112, DObsDipped).	Density
51	DObsStatus	The status of entity ID#50, Dobs (copy of entity ID#117, DObsHIMSStatus or entity ID#113, DObsDippedStatus).	Status
52	ForeGroundTimeStamp	The (absolute) time when, in the foreground scan, the most recent item was scanned.	Absolute time
53	BackGroundTimeStamp	The (absolute) time when, in the background scan, the most recent item was scanned.	Absolute time

ID	Name	Description	Dimension Type
77	Verification Signature	Calculated over all entities in the default tank record. The patented calculation algorithm verifies the contents of the transmitted tank records.	Nodim
78	ConfigurationStatus	The CIU and tank configuration status: • Bit 0 = 1 Gauge configuration mismatch (Future) • Bit 1 = 1 CIU Prime general configuration mismatch • Bit 2 = 1 CIU Prime tank configuration mismatch • Bit 3 = 1 CIU Plus general configuration mismatch • Bit 4 = 1 CIU Plus tank configuration mismatch for this tank • Bit 5 = 1 Ensite Pro general configuration mismatch • Bit 6 = 1 Ensite Pro tank configuration mismatch • Bit 7 = 1 CIU Prime record contains invalid verification Note: Because of the representation as combined entity, the length is fixed to 8 bits.	Bit coded
80	AutomaticMeasurableValues	The values that can be automatically measured (this doesn't necessarily mean that they are actually measured). Bit n = 1: value can be measured automatically: • Bit 0 = 1 Level [entity ID#38, entity ID#40] • Bit 1 = 1 Temperature [entity ID#44] • Bit 2 = 1 Water level [entity ID#42] • Bit 3 = 1 Density [entity ID#50] • Bit 4 = 1 Vapor temperature [entity ID#46] • Bit 5 = 1 Vapor pressure [entity ID#48] • Bit 6 = 1 Ambient Temperature [entity ID#103] • Bit 7 = 1 Dummy scan (now used for FDI scan) • Bit 14 ProductTC calc.mode: 0 = manual, 1 = calculated • Bit 15 CTL calc. mode: 0 = manual, 1 = calculated Note: Bits 14 and 15 are for internal use of the CIU Plus. The length is fixed to 16 bits.	Bit coded
88	HydroMeterCorr	'0' is false, '>1' means true.	Nodim
94	TankConfigurationCRC	Checksum, calculated over tank related configuration parameters by the CIU Prime (for W&M purposes).	Nodim
95	CIUPrimeGeneral ConfigurationCRC	Checksum, calculated over general CIU Prime configuration parameters (for W&M purposes).	Nodim
103	Ambient Temperature	The value of the tank's ambient temperature.	Temperature
104	Ambient Temperature Status	The status of entity ID#103, AmbientTemperature.	Status
114	WaterDipped	The value of the dipped water level.	Level
118	Tobs	The value of the observed temperature (copy of entity ID#44, ProductTemp or entity ID#89, TObsDipped).	Temperature
119	Tobs Status	The status of entity ID#118, TObs (copy of entity ID#45, ProductTempStatus or entity ID#111, TObsDippedStatus).	Status
154	HydroMeterCorrStatus	The status of entity ID#88, HydroMeterCorr.	Status

This page is intentionally left blank

APPENDIX B ENTIS PRO COMPLIANT TANK RECORD ENTITIES

TABLE B-1 gives a description of the Entis Pro compliant tank record entities (formerly supported by the CIU 880 Plus).

TABLE B-1 Description of Entis pro compliant tank record entities

ID	Name	Description	Dimension Type
21	ProductName	The name of the product in the tank (20 characters ASCII or 10 characters UNICODE)	Text (ASCII or Unicode)
30	Dref	The reference density for the product in the tank.	Density
31	DRefStatus	The status of entity ID#26, ProductTRef.	Status
32	SedAndWater	The volume of emulsified water in the product. The absolute volume is calculated from the sediment and water percentage (%) and is used when calculating the Net Standard Volume (NSV).	Percentage
33	ProductTC	The product temperature coefficient.	Temperature coefficient
34	ProductTCStatus	The status of entity ID#33, ProductTC.	Status
35	LiqVolRatio	The factor by which a product in gaseous form reduces in volume when converted to a liquid.	Nodim
38	DisplacerPosition	The physical servo displacer position.	Level
39	DisplacerStatus	The status of entity ID#38, DisplacerPosition.	Status
40	ProductLevel	The product level in the tank.	Level
41	ProductLevelStatus	The status of entity ID#40, ProductLevel.	Status
42	WaterLevel	The water level in the tank.	Level
43	WaterLevelStatus	The status of entity ID#42, WaterLevel.	Status
44	ProductTemp	The product temperature.	Temperature
45	ProductTempStatus	The status of entity ID#44, ProductTemp.	Status
46	VapRoomTemp	The product vapor temperature.	Temperature
47	VapRoomTempStatus	The status of entity ID#46, VapRoomTemp.	Status
48	VapRoomPress	The product vapor pressure.	Pressure
49	VapRoomPressStatus	The status of entity ID#48, VapRoomPress.	Status
50	DObs	The product density.	Density
51	DObsStatus	The status of entity ID#50, DObs.	Status
52	ForeGroundTimeStamp	The (absolute) time when, in the foreground scan, the most recent item was scanned.	Absolute time
53	BackgroundTimeStamp	The (absolute) time when, in the background scan, the most recent item was scanned.	Absolute time
54	TOV	The Total Observed Volume (TOV).	Volume
55	TOVStatus	The status of entity ID#54, TOV.	Status

ID	Name	Description	Dimension Type
56	WaterVol	The water volume.	Volume
57	WaterVolStatus	The status of entity ID#56, WaterVol.	Status
58	GOV	The Gross Observed Volume (GOV). The GOV is the total volume of all petroleum liquids and sediment and water, excluding free water, at observed temperature and pressure.	Volume
59	GOVStatus	The status of entity ID#59, GOV	Status
60	GSV	The Gross Standard Volume (GSV). The GSV is the total volume of all petroleum liquids and sediment and water, excluding free water, corrected by the appropriate volume correction factor (VCF = CTL) for the observed temperature and API gravity, relative density, or density to a standard temperature, and also corrected by the applicable pressure correction factor (Cpl) and meter factor.	Volume
61	GSVStatus	The status of entity ID#61, GSV	Status
62	NSV	The Net Standard Volume (NSV). The NSV is the total volume of all petroleum liquids, excluding sediment and water and free water, corrected by the appropriate volume correction factor (VCF = CTL) for the observed temperature and API Gravity, relative density, or density to a standard temperature, and also corrected by the applicable pressure correction factor (Cpl) and meter factor.	Volume
63	NSVStatus	The status of entity ID#63, NSV	Status
64	LiqInVap	The vapor volume in the tank, if it was liquefied.	Volume
65	LiqInVapStatus	The status of entity ID#64, LiqInVap.	Status
66	TGSV	The Total Gross Standard Volume (TGSV).	Volume
67	TGSVStatus	The status of entity ID#66, TGSV.	Status
68	MassLiq	The product volume weight.	Mass
69	MassLiqStatus	The status of entity ID#68, MassLiq.	Status
70	MassVap	The vapor volume weight.	Mass
71	MassVapStatus	The status of entity ID#70, MassVap.	Status
72	TotalMass	The product plus vapor volume weight.	Mass
73	TotalMassStatus	The status of entity ID#72, TotalMass.	Status
74	FlowTOV	The Total Observed Volume (TOV) of the product per time unit.	Flow
75	AvailableRoom	The spare capacity of the tank.	Volume
76	Available TOV	The Total Observed Volume (TOV) of the available product.	Volume
77	VerificationSignature	Calculated over all entities in the default tank record. The patented calculation algorithm verifies the contents of the transmitted tank records.	Nodim
79	Molar Weight	The molar weight of the gas composition.	Molar Weight Value

ID	Name	Description	Dimension Type
94	TankConfigurationCRC	Checksum, calculated over tank related configuration parameters (for W&M purposes).	Bit coded
96	CIUPrimeGeneral ConfigurationCRC	Checksum, calculated over general CIU Prime configuration parameters (for W&M purposes).	Nodim
99	FlowStatus	The status of entity ID#74, FlowTOV.	Status
100	AvailableRoomStatus	The status of entity ID#75, AvailableRoom.	Status
101	Available TOVStatus	The status of entity ID#76, AvailableTOV.	Status
103	AmbientTemperature	The ambient temperature of the tank.	Temperature
104	AmbientTemperature Status	The status of entity ID#103, AmbientTemperature.	Status
105	CIUPlusTankID	Unique Identifier for a tank: • The range is between 1 to 6553	Nodim
107	CTSh	The correction for the expansion of the shell.	CTSh
108	CTShStatus	The status of entity ID#107, CTSh.	Status
124	VolumeCorrectionFactor	The Volume Correction Factor (= Correction for the Temperature of the Liquid).	VCF (= CTL)
125	VolumeCorrectionFactor Status	The status of entity ID#124, VCF.	Status
200	Alarms	Combined entity that represents entity ID#37, ExternalContacts and entity ID#36, GaugeLevel Alarms. High byte: entity ID#37; Indicates (bit coded) the ExternalContacts • Bit 0 = 1: External contact 1 active • Bit 1 = 1: External contact 2 active • Bit 2 = 1: External contact failure • Bit 3 = 1: External contact not available in this instrument Low byte: entity ID#36; Indicates (bit coded) GaugeLeveIAlarms: • Bit 0 = 1: Low Level alarm tripped • Bit 1 = 1: High Level alarm tripped • Bit 2 = 1: Alarm failure • Bit 3 = 1 Gauge alarms not available in this instrument Note: Because of the representation as combined entity the length of each individual entity (#36 and #37) is fixed to 8 bits.	Nodim
201	Dynamic tank status	Combined entity that represents entity ID#6, Gauge Status (Byte 1) and Bit 0-3 of entity ID#3, MovingStatus + Bit 4-7 of entity ID#2, TankStatus (Byte 2). • Byte 1 = Low-order byte (bit 7..0) • Byte 2 = High-order byte (bit 15..8) Remark: The CIU 888 takes this information of the primary level gauge.	Nodim

ID	Name	Description	Dimension Type
204	CombinedVolumeCorrections	Combined entity that represents entity ID#22, GSVCalcType (Byte 1) and entity ID#23, ProductCode (Byte 2). • Byte 1 = Low-order byte (bit 7..0) • Byte 2 = High-order byte (bit 15..8)	Nodim
205	Mass&VolumeCorrections	Combined entity that represents ID#24, VolumeCorrections (Byte 1) and entity ID#25, MassCalcType (Byte 2). • Byte 1 = Low-order byte (bit 7..0) • Byte 2 = High-order byte (bit 15..8)	Nodim
206	CommAndConfStatus	Combined entity that represents entity ID#78, ConfigurationStatus Byte 1) and Bit 0..4 of entity ID#9, HotStandbyStatus + Bit 5..7 of entity ID#10, CommStatus. • Byte 1 = Low-order byte (bit 7..0) • Byte 2 = High-order byte (bit 15..8)SS	Nodim

APPENDIX C ENTIS COMPLIANT MODBUS MAP ENTITIES

TABLE C-1 gives a description of the ENTIS compliant tank record entities.

TABLE C-1 Description of ENTIS compliant tank record entities

ID	Name	Description	Dimension Type
21	ProductName	The name of the product in the tank (20 characters ASCII or 10 characters UNICODE)	Text (ASCII or Unicode)
30	Dref	The reference density for the product in the tank.	Density
31	DRefStatus	The status of entity ID#26, ProductTRef.	Status
32	SedAndWater	The volume of emulsified water in the product. The absolute volume is calculated from the sediment and water percentage (%) and is used when calculating the Net Standard Volume (NSV).	Percentage
33	ProductTC	The product temperature coefficient.	Temperature coefficient
34	ProductTCStatus	The status of entity ID#33, ProductTC.	Status
35	LiqVolRatio	The factor by which a product in gaseous form reduces in volume when converted to a liquid.	Nodim
38	DisplacerPosition	The physical servo displacer position.	Level
39	DisplacerStatus	The status of entity ID#38, DisplacerPosition.	Status
40	ProductLevel	The product level in the tank.	Level
41	ProductLevelStatus	The status of entity ID#40, ProductLevel.	Status
42	WaterLevel	The water level in the tank.	Level
43	WaterLevelStatus	The status of entity ID#42, WaterLevel.	Status
44	ProductTemp	The product temperature.	Temperature
45	ProductTempStatus	The status of entity ID#44, ProductTemp.	Status
46	VapRoomTemp	The product vapor temperature.	Temperature
47	VapRoomTempStatus	The status of entity ID#46, VapRoomTemp.	Status
48	VapRoomPress	The product vapor pressure.	Pressure
49	VapRoomPressStatus	The status of entity ID#48, VapRoomPress.	Status
50	DObs	The product density.	Density
51	DObsStatus	The status of entity ID#50, DObs.	Status
52	ForeGroundTimeStamp	The (absolute) time when, in the foreground scan, the most recent item was scanned.	Absolute time
53	BackgroundTimeStamp	The (absolute) time when, in the background scan, the most recent item was scanned.	Absolute time
54	TOV	The Total Observed Volume (TOV).	Volume
55	TOVStatus	The status of entity ID#54, TOV.	Status

ID	Name	Description	Dimension Type
56	WaterVol	The water volume.	Volume
57	WaterVolStatus	The status of entity ID#56, WaterVol.	Status
58	GOV	The Gross Observed Volume (GOV). The GOV is the total volume of all petroleum liquids and sediment and water, excluding free water, at observed temperature and pressure.	Volume
59	GOVStatus	The status of entity ID#59, GOV	Status
60	GSV	The Gross Standard Volume (GSV). The GSV is the total volume of all petroleum liquids and sediment and water, excluding free water, corrected by the appropriate volume correction factor (VCF = CTL) for the observed temperature and API gravity, relative density, or density to a standard temperature, and also corrected by the applicable pressure correction factor (Cpl) and meter factor.	Volume
61	GSVStatus	The status of entity ID#61, GSV	Status
62	NSV	The Net Standard Volume (NSV). The NSV is the total volume of all petroleum liquids, excluding sediment and water and free water, corrected by the appropriate volume correction factor (VCF = CTL) for the observed temperature and API Gravity, relative density, or density to a standard temperature, and also corrected by the applicable pressure correction fac- tor (Cpl) and meter factor.	Volume
63	NSVStatus	The status of entity ID#63, NSV	Status
64	LiqInVap	The vapor volume in the tank, if it was liquefied.	Volume
65	LiqInVapStatus	The status of entity ID#64, LiqInVap.	Status
66	TGSV	The Total Gross Standard Volume (TGSV).	Volume
67	TGSVStatus	The status of entity ID#66, TGSV.	Status
68	MassLiq	The product volume weight.	Mass
69	MassLiqStatus	The status of entity ID#68, MassLiq.	Status
70	MassVap	The vapor volume weight.	Mass
71	MassVapStatus	The status of entity ID#70, MassVap.	Status
72	TotalMass	The product plus vapor volume weight.	Mass
73	TotalMassStatus	The status of entity ID#72, TotalMass.	Status
74	FlowTOV	The Total Observed Volume (TOV) of the product per time unit.	Flow
75	AvailableRoom	The spare capacity of the tank.	Volume
76	Available TOV	The Total Observed Volume (TOV) of the available product.	Volume
77	VerificationSignature	Calculated over all entities in the default tank record. The patented calculation algorithm verifies the contents of the transmitted tank records.	Nodim
79	Molar Weight	The molar weight of the gas composition.	Molar Weight Value

ID	Name	Description	Dimension Type
94	TankConfigurationCRC	Checksum, calculated over tank related configuration parameters (for W&M purposes).	Bit coded
96	CIUPrimeGeneral ConfigurationCRC	Checksum, calculated over general CIU Prime configuration parameters (for W&M purposes).	Nodim
99	FlowStatus	The status of entity ID#74, FlowTOV.	Status
100	AvailableRoomStatus	The status of entity ID#75, AvailableRoom.	Status
101	Available TOVStatus	The status of entity ID#76, AvailableTOV.	Status
103	AmbientTemperature	The ambient temperature of the tank.	Temperature
104	AmbientTemperature Status	The status of entity ID#103, AmbientTemperature.	Status
105	CIUPlusTankID	Unique Identifier for a tank: The range is between 1 to 6553	Nodim
107	CTSh	The correction for the expansion of the shell.	CTSh
108	CTShStatus	The status of entity ID#107, CTSh.	Status
124	VolumeCorrectionFactor	The Volume Correction Factor (= Correction for the Temperature of the Liquid).	VCF (= CTL)
125	VolumeCorrectionFactor Status	The status of entity ID#124, VCF.	Status
200	Alarms	Combined entity that represents entity ID#37, ExternalContacts and entity ID#36, GaugeLevel Alarms. High byte: entity ID#37; Indicates (bit coded) the ExternalContacts Bit 0 = 1: External contact 1 active Bit 1 = 1: External contact 2 active Bit 2 = 1: External contact failure Bit 3 = 1: External contact not available in this instrument Low byte: entity ID#36; Indicates (bit coded) GaugeLeve- lAlarms: Bit 0 = 1: Low Level alarm tripped Bit 1 = 1: High Level alarm tripped Bit 2 = 1: Alarm failure Bit 3 = 1 Gauge alarms not available in this instrument **Note**: Because of the representation as combined entity the length of each individual entity (#36 and #37) is fixed to 8 bits.	Nodim
201	Dynamic tank status	Combined entity that represents entity ID#6, Gauge Status (Byte 1) and Bit 0-3 of entity ID#3, MovingStatus + Bit 4-7 of entity ID#2, TankStatus (Byte 2). Byte 1 = Low-order byte (bit 7..0) Byte 2 = High-order byte (bit 15..8) Remark: The CIU 888 takes this information of the primary level gauge.	Nodim
204	CombinedVolumeCorrections	Combined entity that represents entity ID#22, GSVCalcType (Byte 1) and entity ID#23, ProductCode (Byte 2). Byte 1 = Low-order byte (bit 7..0) Byte 2 = High-order byte (bit 15..8)	Nodim

ID	Name	Description	Dimension Type
205	Mass&VolumeCorrections	Combined entity that represents ID#24, VolumeCorrections (Byte 1) and entity ID#25, MassCalcType (Byte 2). Byte 1 = Low-order byte (bit 7..0) Byte 2 = High-order byte (bit 15..8)	Nodim
206	CommAndConfStatus	Combined entity that represents entity ID#78, Configura- tion-Status Byte 1) and Bit 0..4 of entity ID#9, HotStandbySta- tus + Bit 5..7 of entity ID#10, CommStatus. Byte 1 = Low-order byte (bit 7..0) Byte 2 = High-order byte (bit 15..8)SS	Nodim
88	HydroMeterCorr	Hydrometer Correction This entity is bit coded. 0 is false, 1 means true.	Nodim
154	HydroMeterCorrStatus	Status and Validity of entity [88] (HydroMeterCorr).	Status
93	VapRoom	Vapour Room. The Vapour Room, not necessarily equal to AvaRoom, is the volume of the empty space above the liquid in the tank (amount of empty gas space in a tank), needed to assess the amount of product vapours in a tank at any specific moment. Typically the VapRoom > [RemCap]. VapRoom = [ShellCapacity] - [TOV] VapRoom, which is normally only used with vapour calcula- tions for pressurized tanks (see VolCorr), is used with the cal- culation of: • [LiqVap] • [MassVap]	Volume
102	VapRoomStatus	Status and Validity of entity [93] (Vapour Room). This 16 bit value contains the Validity (MSB) and Status (LSB) of the calculated value.	Status
126	TCF	Product Temperature Correction Factor (TCF). Normally, VCF is calculated, using the ASTM/API tables. The TCF method provides an alternative for this calculation. The TCF is used to calculate the CTL with Chemical Prod- ucts: CTL = 1 - TCF * (ProdTemp - ReferenceTemp) This entity is configured by the service tool. Can be overwritten. TCF is used with the calculation of: • VCF	TCF
127	TCFStatus	Status and Validity of entity [126] (TCF). This 16 bit value contains the Validity (MSB) and Status (LSB) of the calculated value.	Status

ID	Name	Description	Dimension Type
128	DCF	Product Density Correction Factor (DCF). The DCF is used to calculate [DObs] with Chemical Products: [DObs] = Dref - DCF * (ProdTemp - ReferenceTemp) This entity is configured by the service tool. Can be overwritten. When the DCF calculation method is used (see Prod-CalcType), DCF is used with the calculation of: • [DObs] or ProdDRef	DCF
129	DCFStatus	Status and Validity of entity [128] (DCF). This 16 bit value contains the Validity (MSB) and Status (LSB) of the calculated value.	Status
118	TObs	Observed temperature (A copy of the Product Temperature or [TObs] Dipped). [TObs] is the temperature at which [DObs] was determined. If [DObs] is measured automatically (HIMS or a Density Dip), [TObs] is ProdTemp at the time of the measurement (of [DObs]), otherwise [TObs] is the temperature at which [DObs] was determined in the laboratory. [Tobs] is used with the calculation of: • ProdDRef according to ASTM/API procedures	Temperature
119	TObsStatus	A copy of the appropriate Status and Validity. Along with the value the data acquisition will fetch information about the communication and status of the value presented by the gauge. This information will be used to polulate the Validity and Status of the measured value. These two, both consisting of a byte will be used to populate this 16 bit entity. The Validity will become the MSB and the Status the LSB. In a later stage this entity can be updated by the calculator ot tank operational actions.	Status
143	SedAndWaterStatus	Status and Validity of entity [32] (SedAndWater).	Status
144	LiqVolRatioStatus	Status and Validity of entity [35] (LiqVolRatio).	Status
145	MolarWeigthStatus	Status and Validity of entity [79] (MolarWeight).	Status

ID	Name	Description	Dimension Type
2600	Gauge2Status	Level Gauge Status (servo). 0 = Level gauge is measuring level 1 = Level gauge is in test 2 = Level gauge is in lock test 3 = Level gauge is blocked 4 = Level gauge is busy with a density profile measurement. 5 = Level gauge is searching water level 6 = Level gauge end switch reached 7 = Reserved for future use 8 = Level gauge is in interface mode 2 9 = Level gauge is in interface dip mode 10 = Level gauge has found water level and is measuring it 11 = 253 Future 254 = Uninitialized 255 = Level gauge is in failure	NoDim
2603	ProductLevel2	The product level from secondary gauge in the tank.	Level
2604	ProductLevel2Status	The status of entity ID#2603, ProductLevel2.	Status

TABLE C-2 gives a description of the ENTIS compliant temperature profile record entities.

TABLE C-2 Description of ENTIS compliant tank record entities

ID	Name	Description	Dimension Type
2535	TemperatureProfilesScanEnable	This indicates whether temperature profiles is enabled / disabled for a tank. 0 – Temperature profile data scan disabled 1 – Temperature profile data scan enabled This is a read/write entity. Modbus Host system can write to this entity to enable / disable temperature profile scan for a tank in CIU.	Nodim
10584	TemperatureProfileDataStatus	This indicates the status of the temperature profiles data scan in CIU. 0 – Temperature profiles data not scanned 1 – Temperature profiles data scan in progress 2 – Temperature profiles data scan completed	Nodim
10571	TemperatureProfileTimeStamp	This indicates the timestamp at which temperature profiles data was collected from the field device.	Absolute time
10585	MultitemperatureNumberOfElements	This indicates the configured number of temperature elements in the gauge.	Nodim
466	MultitemperatureSpotRelativeElementPosition0	This indicates multitemperature spot 0 sensor position.	Level
467	MultitemperatureSpotRelativeElementPosition0Status	This indicates multitemperature spot 0 sensor position's status.	Status
468	MultitemperatureSpotRelativeElementPosition1	This indicates multitemperature spot 1 sensor position.	Level
469	MultitemperatureSpotRelativeElementPosition1Status	This indicates multitemperature spot 1 sensor position's status.	Status
470	MultitemperatureSpotRelativeElementPosition2	This indicates multitemperature spot 2 sensor position.	Level
471	MultitemperatureSpotRelativeElementPosition2Status	This indicates multitemperature spot 2 sensor position's status.	Status
472	MultitemperatureSpotRelativeElementPosition3	This indicates multitemperature spot 3 sensor position.	Level
473	MultitemperatureSpotRelativeElementPosition3Status	This indicates multitemperature spot 3 sensor position's status.	Status
474	MultitemperatureSpotRelativeElementPosition4	This indicates multitemperature spot 4 sensor position.	Level
475	MultitemperatureSpotRelativeElementPosition4Status	This indicates multitemperature spot 4 sensor position's status.	Status
476	MultitemperatureSpotRelativeElementPosition5	This indicates multitemperature spot 5 sensor position.	Level

ID	Name	Description	Dimension Type
477	MultitemperatureSpotRelativeElementPosition5Status	This indicates multitemperature spot 5 sensor position's status.	Status
478	MultitemperatureSpotRelativeElementPosition6	This indicates multitemperature spot 6 sensor position.	Level
479	MultitemperatureSpotRelativeElementPosition6Status	This indicates multitemperature spot 6 sensor position's status.	Status
480	MultitemperatureSpotRelativeElementPosition7	This indicates multitemperature spot 7 sensor position.	Level
481	MultitemperatureSpotRelativeElementPosition7Status	This indicates multitemperature spot 7 sensor position's status.	Status
482	MultitemperatureSpotRelativeElementPosition8	This indicates multitemperature spot 8 sensor position.	Level
483	MultitemperatureSpotRelativeElementPosition8Status	This indicates multitemperature spot 8 sensor position's status.	Status
484	MultitemperatureSpotRelativeElementPosition9	This indicates multitemperature spot 9 sensor position.	Level
485	MultitemperatureSpotRelativeElementPosition9Status	This indicates multitemperature spot 9 sensor position's status.	Status
486	MultitemperatureSpotRelativeElementPosition10	This indicates multitemperature spot 10 sensor position.	Level
487	MultitemperatureSpotRelativeElementPosition10Status	This indicates multitemperature spot 10 sensor position's status.	Status
488	MultitemperatureSpotRelativeElementPosition11	This indicates multitemperature spot 11 sensor position.	Level
489	MultitemperatureSpotRelativeElementPosition11Status	This indicates multitemperature spot 11 sensor position's status.	Status
490	MultitemperatureSpotRelativeElementPosition12	This indicates multitemperature spot 12 sensor position.	Level
491	MultitemperatureSpotRelativeElementPosition12Status	This indicates multitemperature spot 12 sensor position's status.	Status
492	MultitemperatureSpotRelativeElementPosition13	This indicates multitemperature spot 13 sensor position.	Level
493	MultitemperatureSpotRelativeElementPosition13Status	This indicates multitemperature spot 13 sensor position's status.	Status
494	MultitemperatureSpotRelativeElementPosition14	This indicates multitemperature spot 14 sensor position.	Level
495	MultitemperatureSpotRelativeElementPosition14Status	This indicates multitemperature spot 14 sensor position's status.	Status
496	MultitemperatureSpotRelativeElementPosition15	This indicates multitemperature spot 15 sensor position.	Level
497	MultitemperatureSpotRelativeElementPosition15Status	This indicates multitemperature spot 15 sensor position's status.	Status

ID	Name	Description	Dimension Type
434	MultitemperatureSpotTemperature0	This indicates multitemperature spot 0 sensor value.	Temperature
435	MultitemperatureSpotTemperature0Status	This indicates multitemperature spot 0 sensor value's status.	Status
436	MultitemperatureSpotTemperature1	This indicates multitemperature spot 1 sensor value.	Temperature
437	MultitemperatureSpotTemperature1Status	This indicates multitemperature spot 1 sensor value's status.	Status
438	MultitemperatureSpotTemperature2	This indicates multitemperature spot 2 sensor value.	Temperature
439	MultitemperatureSpotTemperature2Status	This indicates multitemperature spot 2 sensor value's status.	Status
440	MultitemperatureSpotTemperature3	This indicates multitemperature spot 3 sensor value.	Temperature
441	MultitemperatureSpotTemperature3Status	This indicates multitemperature spot 3 sensor value's status.	Status
442	MultitemperatureSpotTemperature4	This indicates multitemperature spot 4 sensor value.	Temperature
443	MultitemperatureSpotTemperature4Status	This indicates multitemperature spot 4 sensor value's status.	Status
444	MultitemperatureSpotTemperature5	This indicates multitemperature spot 5 sensor value.	Temperature
445	MultitemperatureSpotTemperature5Status	This indicates multitemperature spot 5 sensor value's status.	Status
446	MultitemperatureSpotTemperature6	This indicates multitemperature spot 6 sensor value.	Temperature
447	MultitemperatureSpotTemperature6Status	This indicates multitemperature spot 6 sensor value's status.	Status
448	MultitemperatureSpotTemperature7	This indicates multitemperature spot 7 sensor value.	Temperature
449	MultitemperatureSpotTemperature7Status	This indicates multitemperature spot 7 sensor value's status.	Status
450	MultitemperatureSpotTemperature8	This indicates multitemperature spot 8 sensor value.	Temperature
451	MultitemperatureSpotTemperature8Status	This indicates multitemperature spot 8 sensor value's status.	Status
452	MultitemperatureSpotTemperature9	This indicates multitemperature spot 9 sensor value.	Temperature
453	MultitemperatureSpotTemperature9Status	This indicates multitemperature spot 9 sensor value's status.	Status
454	MultitemperatureSpotTemperature10	This indicates multitemperature spot 10 sensor value.	Temperature

ID	Name	Description	Dimension Type
455	MultitemperatureSpotTemperature10Status	This indicates multitemperature spot 10 sensor value's status.	Status
456	MultitemperatureSpotTemperature11	This indicates multitemperature spot 11 sensor value.	Temperature
457	MultitemperatureSpotTemperature11Status	This indicates multitemperature spot 11 sensor value's status.	Status
458	MultitemperatureSpotTemperature12	This indicates multitemperature spot 12 sensor value.	Temperature
459	MultitemperatureSpotTemperature12Status	This indicates multitemperature spot 12 sensor value's status.	Status
460	MultitemperatureSpotTemperature13	This indicates multitemperature spot 13 sensor value.	Temperature
461	MultitemperatureSpotTemperature13Status	This indicates multitemperature spot 13 sensor value's status.	Status
462	MultitemperatureSpotTemperature14	This indicates multitemperature spot 14 sensor value.	Temperature
463	MultitemperatureSpotTemperature14Status	This indicates multitemperature spot 14 sensor value's status.	Status
464	MultitemperatureSpotTemperature15	This indicates multitemperature spot 15 sensor value.	Temperature
465	MultitemperatureSpotTemperature15Status	This indicates multitemperature spot 15 sensor value's status.	Status
498	MultiTemperatureLevelOffset	This indicates the position of the anchoring-eye in respect with the zero-level of the tank. level = actual_level - M_T_offset (if INNAGE) or level = M_T_offset - Actual_level (if ULLAGE)	Level
499	MultiTemperatureElementType	This item indicates the type of connected multi-temperature element.	Text (ASCII or Unicode)
10572	TemperatureProfilesScanProductLevel	This indicates the product level for a tank when temperature profiles data for that tank was scanned by CIU 888.	Level
10573	TemperatureProfilesScanProductLevelStatus	This indicates the product level status for a tank when temperature profiles data for that tank was scanned by CIU 888.	Status
10574	TemperatureProfilesScanProductTemperature	This indicates the product temperature for a tank when temperature profiles data for that tank was scanned by CIU 888.	Temperature
10574	TemperatureProfilesScanProductTemperatureStatus	This indicates the product temperature for a tank when temperature profiles data for that tank was scanned by CIU 888.	Status
10595	TemperatureProfileScanWaterLevel	This indicates the water level for a tank when temperature profiles data for that tank was scanned by CIU 888.	Level
10596	TemperatureProfileScanWaterLevelStatus	This indicates the water level status for a tank when temperature profiles data for that tank was scanned by CIU 888.	Status
10597	TemperatureProfileScanVapourTemperature	This indicates the vapour temperature for a tank when temperature profiles data for that tank was scanned by CIU 888.	Temperature
10598	TemperatureProfileScanVapourTemperatureStatus	This indicates the vapour temperature status for a tank when temperature profiles data for that tank was scanned by CIU 888.	Status

ID	Name	Description	Dimension Type
10599	TemperatureProfileScan-VapourPressure	This indicates the vapour pressure for a tank when temperature profiles data for that tank was scanned by CIU 888.	Pressure
10600	TemperatureProfileScan-VapourPressureStatus	This indicates the vapour pressure status for a tank when temperature profiles data for that tank was scanned by CIU 888.	Status

TABLE C-3 gives a description of the ENTIS compliant density profile record entities.

TABLE C-3 Description of ENTIS compliant density profile record entities

ID	Name	Description	Dimension Type
10651	DensityProfileDataStatus	This indicates the status of the density profile command execution in CIU. 0 – Density profiles command not executed 1 – Density profiles command execution in progress 2 – Density profiles command execution complete	Nodim
10652	DensityProfileTimeStamp	This indicates the timestamp at which density profiles data was collected from the field device.	Absolute time
10655	MultiDensityNumberOfElements	This indicates the configured number of Density points in the gauge.	Nodim
390	DensityInnageLevel0	This indicates position 0 at which density is measured.	Level
391	DensityInnageLevel0Status	This indicates position 0 status.	Status
392	DensityInnageLevel1	This indicates position 1 at which density is measured.	Level
393	DensityInnageLevel1Status	This indicates position 1 status.	Status
394	DensityInnageLevel2	This indicates position 2 at which density is measured.	Level
395	DensityInnageLevel2Status	This indicates position 2 status.	Status
396	DensityInnageLevel3	This indicates position 3 at which density is measured.	Level
397	DensityInnageLevel3Status	This indicates position 3 status.	Status
398	DensityInnageLevel4	This indicates position 4 at which density is measured.	Level
399	DensityInnageLevel4Status	This indicates position 4 status.	Status
400	DensityInnageLevel5	This indicates position 5 at which density is measured.	Level
401	DensityInnageLevel5Status	This indicates position 5 status.	Status
402	DensityInnageLevel6	This indicates position 6 at which density is measured.	Level
403	DensityInnageLevel6Status	This indicates position 6 status.	Status
404	DensityInnageLevel7	This indicates position 7 at which density is measured.	Level
405	DensityInnageLevel7Status	This indicates position 7 status.	Status
406	DensityInnageLevel8	This indicates position 8 at which density is measured.	Level
407	DensityInnageLevel8Status	This indicates position 8 status.	Status
408	DensityInnageLevel9	This indicates position 9 at which density is measured.	Level

ID	Name	Description	Dimension Type
409	DensityInnageLevel9Status	This indicates position 9 status.	Status
701	DensityInnageLevel10	This indicates position 10 at which density is measured.	Level
702	DensityInnageLevel10Status	This indicates position 10 status.	Status
703	DensityInnageLevel11	This indicates position 11 at which density is measured.	Level
704	DensityInnageLevel11Status	This indicates position 11 status.	Status
705	DensityInnageLevel12	This indicates position 12 at which density is measured.	Level
706	DensityInnageLevel12Status	This indicates position 12 status.	Status
707	DensityInnageLevel13	This indicates position 13 at which density is measured.	Level
708	DensityInnageLevel13Status	This indicates position 13 status.	Status
709	DensityInnageLevel14	This indicates position 14 at which density is measured.	Level
710	DensityInnageLevel14Status	This indicates position 14 status.	Status
711	DensityInnageLevel15	This indicates position 15 at which density is measured.	Level
712	DensityInnageLevel15Status	This indicates position 15 status.	Status
713	DensityInnageLevel16	This indicates position 16 at which density is measured.	Level
714	DensityInnageLevel16Status	This indicates position 16 status.	Status
715	DensityInnageLevel17	This indicates position 17 at which density is measured.	Level
716	DensityInnageLevel17Status	This indicates position 17 status.	Status
717	DensityInnageLevel18	This indicates position 18 at which density is measured.	Level
718	DensityInnageLevel18Status	This indicates position 18 status.	Status
719	DensityInnageLevel19	This indicates position 19 at which density is measured.	Level
720	DensityInnageLevel19Status	This indicates position 19 status.	Status
721	DensityInnageLevel20	This indicates position 20 at which density is measured.	Level
722	DensityInnageLevel20Status	This indicates position 20 status.	Status
723	DensityInnageLevel21	This indicates position 21 at which density is measured.	Level
724	DensityInnageLevel21Status	This indicates position 21 status.	Status
725	DensityInnageLevel22	This indicates position 22 at which density is measured.	Level
726	DensityInnageLevel22Status	This indicates position 22 status.	Status
727	DensityInnageLevel23	This indicates position 23 at which density is measured.	Level
728	DensityInnageLevel23Status	This indicates position 23 status.	Status
729	DensityInnageLevel24	This indicates position 24 at which density is measured.	Level
730	DensityInnageLevel24Status	This indicates position 24 status.	Status
731	DensityInnageLevel25	This indicates position 25 at which density is measured.	Level
732	DensityInnageLevel25Status	This indicates position 25 status.	Status
733	DensityInnageLevel26	This indicates position 26 at which density is measured.	Level
734	DensityInnageLevel26Status	This indicates position 26 status.	Status
735	DensityInnageLevel27	This indicates position 27 at which density is measured.	Level

ID	Name	Description	Dimension Type
736	DensityInnageLevel27Status	This indicates position 27 status.	Status
737	DensityInnageLevel28	This indicates position 28 at which density is measured.	Level
738	DensityInnageLevel28Status	This indicates position 28 status.	Status
739	DensityInnageLevel29	This indicates position 29 at which density is measured.	Level
740	DensityInnageLevel29Status	This indicates position 29 status.	Status
741	DensityInnageLevel30	This indicates position 30 at which density is measured.	Level
742	DensityInnageLevel30Status	This indicates position 30 status.	Status
743	DensityInnageLevel31	This indicates position 31 at which density is measured.	Level
744	DensityInnageLevel31Status	This indicates position 31 status.	Status
745	DensityInnageLevel32	This indicates position 32 at which density is measured.	Level
746	DensityInnageLevel32Status	This indicates position 32 status.	Status
747	DensityInnageLevel33	This indicates position 33 at which density is measured.	Level
748	DensityInnageLevel33Status	This indicates position 33 status.	Status
749	DensityInnageLevel34	This indicates position 34 at which density is measured.	Level
750	DensityInnageLevel34Status	This indicates position 34 status.	Status
751	DensityInnageLevel35	This indicates position 35 at which density is measured.	Level
752	DensityInnageLevel35Status	This indicates position 35 status.	Status
753	DensityInnageLevel36	This indicates position 36 at which density is measured.	Level
754	DensityInnageLevel36Status	This indicates position 36 status.	Status
755	DensityInnageLevel37	This indicates position 37 at which density is measured.	Level
756	DensityInnageLevel37Status	This indicates position 37 status.	Status
757	DensityInnageLevel38	This indicates position 38 at which density is measured.	Level
758	DensityInnageLevel38Status	This indicates position 38 status.	Status
759	DensityInnageLevel39	This indicates position 39 at which density is measured.	Level
760	DensityInnageLevel39Status	This indicates position 39 status.	Status
761	DensityInnageLevel40	This indicates position 40 at which density is measured.	Level
762	DensityInnageLevel40Status	This indicates position 40 status.	Status
763	DensityInnageLevel41	This indicates position 41 at which density is measured.	Level
764	DensityInnageLevel41Status	This indicates position 41 status.	Status
765	DensityInnageLevel42	This indicates position 42 at which density is measured.	Level
766	DensityInnageLevel42Status	This indicates position 42 status.	Status
767	DensityInnageLevel43	This indicates position 43 at which density is measured.	Level
768	DensityInnageLevel43Status	This indicates position 43 status.	Status
769	DensityInnageLevel44	This indicates position 44 at which density is measured.	Level
770	DensityInnageLevel44Status	This indicates position 44 status.	Status
771	DensityInnageLevel45	This indicates position 45 at which density is measured.	Level

ID	Name	Description	Dimension Type
772	DensityInnageLevel45Status	This indicates position 45 status.	Status
773	DensityInnageLevel46	This indicates position 46 at which density is measured.	Level
774	DensityInnageLevel46Status	This indicates position 46 status.	Status
775	DensityInnageLevel47	This indicates position 47 at which density is measured.	Level
776	DensityInnageLevel47Status	This indicates position 47 status.	Status
777	DensityInnageLevel48	This indicates position 48 at which density is measured.	Level
778	DensityInnageLevel48Status	This indicates position 48 status.	Status
779	DensityInnageLevel49	This indicates position 49 at which density is measured.	Level
780	DensityInnageLevel49Status	This indicates position 49 status.	Status
412	MeasuredServoDensity0	This indicates density measured at position 0.	Density
413	MeasuredServoDensity0Status	This indicates density status measured at position 0.	Status
414	MeasuredServoDensity1	This indicates density measured at position 1.	Density
415	MeasuredServoDensity1Status	This indicates density status measured at position 1.	Status
416	MeasuredServoDensity2	This indicates density measured at position 2.	Density
417	MeasuredServoDensity2Status	This indicates density status measured at position 2.	Status
418	MeasuredServoDensity3	This indicates density measured at position 3.	Density
419	MeasuredServoDensity3Status	This indicates density status measured at position 3.	Status
420	MeasuredServoDensity4	This indicates density measured at position 4.	Density
421	MeasuredServoDensity4Status	This indicates density status measured at position 4.	Status
422	MeasuredServoDensity5	This indicates density measured at position 5.	Density
423	MeasuredServoDensity5Status	This indicates density status measured at position 5.	Status
424	MeasuredServoDensity6	This indicates density measured at position 6.	Density
425	MeasuredServoDensity6Status	This indicates density status measured at position 6.	Status
426	MeasuredServoDensity7	This indicates density measured at position 7.	Density
427	MeasuredServoDensity7Status	This indicates density status measured at position 7.	Status
428	MeasuredServoDensity8	This indicates density measured at position 8.	Density
429	MeasuredServoDensity8Status	This indicates density status measured at position 8.	Status
430	MeasuredServoDensity9	This indicates density measured at position 9.	Density
431	MeasuredServoDensity9Status	This indicates density status measured at position 9.	Status
781	MeasuredServoDensity10	This indicates density measured at position 10.	Density
782	MeasuredServoDensity10Sta-tus	This indicates density status measured at position 10.	Status
783	MeasuredServoDensity11	This indicates density measured at position 11.	Density
784	MeasuredServoDensity11Status	This indicates density status measured at position 11.	Status
785	MeasuredServoDensity12	This indicates density measured at position 12.	Density

ID	Name	Description	Dimension Type
786	MeasuredServoDensity12Status	This indicates density status measured at position 12.	Status
787	MeasuredServoDensity13	This indicates density measured at position 13.	Density
788	MeasuredServoDensity13Status	This indicates density status measured at position 13.	Status
789	MeasuredServoDensity14	This indicates density measured at position 14.	Density
790	MeasuredServoDensity14Status	This indicates density status measured at position 14.	Status
791	MeasuredServoDensity15	This indicates density measured at position 15.	Density
792	MeasuredServoDensity15Status	This indicates density status measured at position 15.	Status
793	MeasuredServoDensity16	This indicates density measured at position 16.	Density
794	MeasuredServoDensity16Status	This indicates density status measured at position 16.	Status
795	MeasuredServoDensity17	This indicates density measured at position 17.	Density
796	MeasuredServoDensity17Status	This indicates density status measured at position 17.	Status
797	MeasuredServoDensity18	This indicates density measured at position 18.	Density
798	MeasuredServoDensity18Status	This indicates density status measured at position 18.	Status
799	MeasuredServoDensity19	This indicates density measured at position 19.	Density
800	MeasuredServoDensity19Status	This indicates density status measured at position 19.	Status
801	MeasuredServoDensity20	This indicates density measured at position 20.	Density
802	MeasuredServoDensity0Status	This indicates density status measured at position 20.	Status
803	MeasuredServoDensity21	This indicates density measured at position 21.	Density
804	MeasuredServoDensity21Status	This indicates density status measured at position 21.	Status
805	MeasuredServoDensity22	This indicates density measured at position 22.	Density
806	MeasuredServoDensity22Status	This indicates density status measured at position 22.	Status
807	MeasuredServoDensity23	This indicates density measured at position 23.	Density
808	MeasuredServoDensity23Status	This indicates density status measured at position 23.	Status
809	MeasuredServoDensity24	This indicates density measured at position 24.	Density
810	MeasuredServoDensity24Status	This indicates density status measured at position 24.	Status
811	MeasuredServoDensity25	This indicates density measured at position 25.	Density
812	MeasuredServoDensity25Status	This indicates density status measured at position 25.	Status

ID	Name	Description	Dimension Type
813	MeasuredServoDensity26	This indicates density measured at position 26.	Density
814	MeasuredServoDensity26Status	This indicates density status measured at position 26.	Status
815	MeasuredServoDensity27	This indicates density measured at position 27.	Density
816	MeasuredServoDensity27Status	This indicates density status measured at position 27.	Status
817	MeasuredServoDensity28	This indicates density measured at position 28.	Density
818	MeasuredServoDensity28Status	This indicates density status measured at position 28.	Status
819	MeasuredServoDensity29	This indicates density measured at position 29.	Density
820	MeasuredServoDensity29Status	This indicates density status measured at position 29.	Status
821	MeasuredServoDensity30	This indicates density measured at position 30.	Density
822	MeasuredServoDensity30Status	This indicates density status measured at position 30.	Status
823	MeasuredServoDensity31	This indicates density measured at position 31.	Density
824	MeasuredServoDensity31Status	This indicates density status measured at position 31.	Status
825	MeasuredServoDensity32	This indicates density measured at position 32.	Density
826	MeasuredServoDensity32Status	This indicates density status measured at position 32.	Status
827	MeasuredServoDensity33	This indicates density measured at position 33.	Density
828	MeasuredServoDensity33Status	This indicates density status measured at position 33.	Status
829	MeasuredServoDensity34	This indicates density measured at position 34.	Density
830	MeasuredServoDensity34Status	This indicates density status measured at position 34.	Status
831	MeasuredServoDensity35	This indicates density measured at position 35.	Density
832	MeasuredServoDensity35Status	This indicates density status measured at position 35.	Status
833	MeasuredServoDensity36	This indicates density measured at position 36.	Density
834	MeasuredServoDensity36Status	This indicates density status measured at position 36.	Status
835	MeasuredServoDensity37	This indicates density measured at position 37.	Density
836	MeasuredServoDensity37Status	This indicates density status measured at position 37.	Status
837	MeasuredServoDensity38	This indicates density measured at position 38.	Density
838	MeasuredServoDensity38Status	This indicates density status measured at position 38.	Status
839	MeasuredServoDensity39	This indicates density measured at position 39.	Density

ID	Name	Description	Dimension Type
840	MeasuredServoDensity39Status	This indicates density status measured at position 39.	Status
841	MeasuredServoDensity40	This indicates density measured at position 40.	Density
842	MeasuredServoDensity40Status	This indicates density status measured at position 40.	Status
843	MeasuredServoDensity41	This indicates density measured at position 41.	Density
844	MeasuredServoDensity41Status	This indicates density status measured at position 41.	Status
845	MeasuredServoDensity42	This indicates density measured at position 42.	Density
846	MeasuredServoDensity42Status	This indicates density status measured at position 42.	Status
847	MeasuredServoDensity43	This indicates density measured at position 43.	Density
848	MeasuredServoDensity43Status	This indicates density status measured at position 43.	Status
849	MeasuredServoDensity44	This indicates density measured at position 44.	Density
850	MeasuredServoDensity44Status	This indicates density status measured at position 44.	Status
851	MeasuredServoDensity45	This indicates density measured at position 45.	Density
852	MeasuredServoDensity45Status	This indicates density status measured at position 5.	Status
853	MeasuredServoDensity46	This indicates density measured at position 46.	Density
854	MeasuredServoDensity46Status	This indicates density status measured at position 46.	Status
855	MeasuredServoDensity47	This indicates density measured at position 47.	Density
856	MeasuredServoDensity47Status	This indicates density status measured at position 47.	Status
857	MeasuredServoDensity48	This indicates density measured at position 48.	Density
858	MeasuredServoDensity48Status	This indicates density status measured at position 48.	Status
859	MeasuredServoDensity49	This indicates density measured at position 49.	Density
860	MeasuredServoDensity49Status	This indicates density status measured at position 49.	Status

This page is intentionally left blank

APPENDIX D GENERAL CIU DETAILS AREA

TABLE D-1 gives a description of the general entities available to the user via Modbus registers.

TABLE D-1 Description of General CIU details Area

ID	Name	Description	Dimension Type
500	CIUHotStandbyMode	• Bit 0 = 1 CIU has a Hot Standby counterpart • Bit 1 = 1 CIU is secondary member of a Hot-Standby pair • Bit 2 = 1 CIU is passive member of a Hot-Standby pair (calculated by CIU) (In case of CIU Plus, this bit is set	Status
501	ActivateCIU	Bit 0 =1 Make this CIU active in a Hot-Standby pair	Nodim
520	CIUClock	The Real -Time clock	Time
521	CIUYear	Year (Real -Time clock)	Time
522	CIUMonth	Month (Real -Time clock)	Time
523	CIUDay	Day of the month (Real -Time clock)	Time
524	CIUHour	Hour in military time (Real -Time clock)	Time
525	CIUMinute	Minute (Real -Time clock)	Time
526	CIUSeconds	Seconds (Real -Time clock)	Time
527	CIUDaylightSaving	• 1 = Daylight saving active (Real -Time clock) • 0 = DST off	Time

This page is intentionally left blank

APPENDIX E FLEXIBLE MODBUS MAPPING ENTITIES

TABLE E-1 gives a description of the Flexible Modbus Mapping entities.

TABLE E-1 Description of Flexible Modbus Mapping entities

ID	Name	Description	Dimension Type
1	TankName	Tank name: • The Tank Name as being entered in the commission by one of the service tools.	Text (ASCII or Unicode)
2	TankStatus	The Status of the tank: • Bit 0 = 1 Tank shell is calibrated by W&M (Treated as General Tank calibrated Flag) • Bit 1 = 1 Maintenance (future) • Bit 2 = 1 Tank is disabled • Bit 3 = 1 Tank is not available Note: Default = 6 (bit 2+3). Because of the representation as combined entity the length is fixed to 4 bits.	Bit coded
3	MovingStatus	The level moving status: • 0 = Tank level is stable • 1 = Tank level is moving up • 2 = Tank level is moving down • 3 = No valid movement status can be detected (e.g. manual level)	Index

ID	Name	Description	Dimension Type
4	TankType	Tank type: • Bit 0 = 1 Level measurement is Ullage if bit is set : the Level value decreases when product is pumped into the tank, level 0 is at or near the top of the tank [Innage (0): level increases] In CIU-2 Needed for level calculations. • Bit 1 = 1 WAP tank (Water Above Product) (future) • Bit 2 = 1 MassLiq must be calculated in Air (0: MassLiq in vacuum) • Bit 3 = 1 MassVap must be calculated in Air (0: MassVap in vacuum) • Bit 4 = 1 HIMS calculation not allowed. If bit is set MassLiq is not calculated from [Dobs] x GOV • Bit 5 = 1 HTG measurement. If this bit is set the Liquid Mass will be calibrated even if [Dobs] and/or GOV is not calibrated. Measurement of [Dobs] is a HIMS/HTG measurement: MassLiq, calculated from [Dobs] x GOV, is calibrated if the Tank Shell is calibrated (see above), even when the volume, from which MassLiq is calculated (GOV), is not calibrated • Bit 6 Future • Bit 7 Tank Shell is not calibrated. Therefore, calculated TOV and WaterVol are also not calibrated. If the Tank Shell is calibrated, TOV and WaterVol can still be not calibrated because other input, e.g. [ProductLevel], or Free Water Level, is not calibrated.	Bit coded
5	GaugeType	Type of level measuring instrument. To get the instrument type number add 800 (decimal) to the Gauge Type value.	Nodim
6	GaugeStatus	The (servo) gauge active status: • 0 = Level gauge is measuring level • 1 = Level gauge is in test • 2 = Level gauge is in lock test • 3 = Level gauge is blocked • 4 = Level gauge is busy with a density profile measurement • 5 = Level gauge is searching water level • 6 = Level gauge end switch reached • 10 = Level gauge has found water level and is measuring it • 255 = Level gauge is in failure	Index

ID	Name	Description	Dimension Type
7	GaugeCommands	Allowed Gauge Commands: • Bit 0 = 1 Test not allowed • Bit 1 = 1 Lock test not allowed • Bit 2 = 1 Block not allowed • Bit 3 = 1 Calibration not allowed • Bit 4 = 1 Alarm test not allowed • Bit 5 = 1 Tank profile not allowed • Bit 6 = 1 Interface profile not allowed • Bit 7 = 1 Water dip not allowed • Bit 8 = 1 Reset Gauge not allowed • Bit 9 = 1 Interface 2 command not allowed • Bit 10..15 Future	Bit coded
8	TempElementType	Type of temperature element: • 0 = No element available • 1 = MRT • 2 = MRT with bottom spot • 3 = MRT with bottom and top spot • 4 = One Spot element • 5 = Two spot elements • 6 = Future • 7 = Future • 8 = MTT	Index
9	HotStandbyStatus	The Hot Standby status: • Bit 0 = 1 Primary CIU Prime is scanning this tank • Bit 1 = 1 Primary CIU Prime is available for this tank • Bit 2 = 1 Secondary CIU Prime is scanning this tank • Bit 3 = 1 Secondary CIU Prime is available for this tank • Bit 4 = 1 CIU Plus is passive member of a Hot Standby pair	Bit coded
10	CommStatus	The communication status: • Bit 0 = 1 CIU Prime to Gauge comm. OK. (Future) (Bit 0 does not change when bit 1 = 0) • Bit 1 = 1 CIU Plus to (active or passive) CIU Prime comm. OK • Bit 2 = 1 Field port on (active) CIU Prime OK Note: Because of the representation as combined entity, the useful length is fixed to 3 bits.	Bit coded
11	CIUPrimeAddress	Host Port Address of the CIU prime where the most recent data of this tank is measured.	Nodim

ID	Name	Description	Dimension Type
16	TankShape	Tank shape: • 0 = No shape defined • 1 = Cylindrical fixed roof • 2 = Cylindrical with floating roof • 3 = Cylindrical with internal floater • 4 = Spherical tank • 5 = Bullet • 6 = Underground bullet • 7 = Irregular cavern • 8..99 Reserved (future) • 100..255 Free configurable by the user These values are used to display a picture of the tank by ENTIS Pro or Scada systems	Index
17	ShellCapacity (MaximumTankCapacity)	Tank Shell Capacity: The Tank Shell Capacity is the total volume of the Tank (Used for Gas calculations).	Volume
18	LowTOV	Low Total Observed Volume: This value, which is not necessarily the volume of the lowest strap (see TCT) or 0.0 in case of a true cylindrical or spherical tank, is the TOV to which the tank safely can be emptied, without the risk of pumping water or vapour instead of product.	Volume
19	HighTOV	High Total Observed Volume: This entity contains the Total Observed Volume (TOV) to which the tank safely can be filled, without the risk of overflow of the product. HighTOV, is not necessarily the volume of the highest strap (see TCT) or the maximum volume of the true cylindrical or spherical tank.	Volume
20	HighLevel	Level corresponds to HighTOV This level is only used for graphical display purposes.	Level
21	ProductName	The name of the product in the tank (20 characters ASCII or 10 characters UNICODE)	Text (ASCII or Unicode)

ID	Name	Description	Dimension Type
22	GSVCalcType	GSVCalcType (Product Calculation Type): This entity indicates how ProdDRef and CTL must be calculated: • 0 = No GSV calculation • 1 = CTL Calculation according to ASTM D1250 (1980) table 6, Dref according to ASTM D1250 (1980) table 5 • 2 = CTL Calculation according to ASTM D1250 (1980) table 24, Dref according to ASTM D1250 (1980) table 23 • 3 = CTL Calculation according to ASTM D1250 (1980) table 54, Dref according to ASTM D1250 (1980) table 53 • 4 = DCF calculation • 5 = TCF calculation • 6 = CTL Calculation according to ASTM D4311 (1990) table 1 • 7 = CTL Calculation according to ASTM D4311 (1990) table 2 • 8 = M - manual entry of CTL • 9 = CTL Calculation according to ASTM D4311 (1996) table 1 (implemented using formula) • 100..255 GSV calculation according defined chemical formulas (future implementation)	Index
23	ProductCode	ProductCode: • 0 = Not applicable • 1 = Product Code A (use subsection A of the table specified in [GSVCalcType]) • 2 = Product Code B (use subsection B of the table specified in [GSVCalcType]) • 3 = Product Code C (use subsection C of the table specified in [GSVCalcType]) • 4 = Product Code D (use subsection D of the table specified in [GSVCalcType]) • 5 = Product Code E (use subsection E of the table specified in [GSVCalcType]) • Bit 7= 1 Range checking disabled	Index

ID	Name	Description	Dimension Type
24	VolumeCorrections	VolumeCorrections This entity is used to indicate which correction must be applied to the calculated volume: • 0 = NONE. a) • 1 = S&W correction applied. a) • 2 = LiqVap calculations according Liq/Vol Ratio ISO DP 4267/1 1982 (ISO/TC28/SC 3 N 411). c) • 3 = LiqVap calculations according Molar method according to ISO DP 4267/1 1982 (ISO/TC28/SC 3 N 411). c) • 4 = LiqVap calculations according Molar method according to API research project 44. c) • 5 = LiqVap calculations according Molar method according to ISO 6578. c) • 6..255 Other vapour calculations (reserved, future). C)	Index
25	MassCalcType	Mass calculation type: • Bit 0 = 1 Liquid mass directly calculated from G.O.V. * Observed Density • Bit 1 = 1 Liquid mass calculated from NSV • Bit 2 = 1 Liquid mass calculated in air. • Bit 3 = 1 Vapour mass calculated in air. • Bit 4 = 1 HTG measurement (Liquid Mass always calibrated)	Bit coded
26	ProductTRef	Product Reference Temperature: The volume of the product in a tank varies with changes of ProdTemp. This causes changes in the product level which result in incorrect volume calculations. ProdTRef is used to get calculation results (volumes, mass) which are independent of the temperature of the product in the tank at the time of the measure-ment. The base temperature of a metric system is 15 OC. The base temperature of an imperial system is 60 OF. Normally ProdTRef is equal to the base temperature.	Temperature
30	Dref (ProductDRef)	The reference density for the product in the tank.	Density
31	DRefStatus (ProductDRefStatus)	The status of entity ID#26, ProductTRef.	Status
32	SedAndWater	The volume of emulsified water in the product. The absolute volume is calculated from the sediment and water percentage (%) and is used when calculating the Net Standard Volume (NSV).	Percentage
33	ProductTC	The product temperature coefficient.	Temperature coefficient
34	ProductTCStatus	The status of entity ID#33, ProductTC.	Status
35	LiqVolRatio	The factor by which a product in gaseous form reduces in volume when converted to a liquid.	Nodim

ID	Name	Description	Dimension Type
36	GaugeLevelAlarms	The gauge level alarms: • Bit 0 = 1 Low Level alarm tripped • Bit 1 = 1 High Level alarm tripped • Bit 2 = 1 Alarm failure • Bit 3 = 1 Gauge alarms not available in this instrument	Bit coded
37	ExternalContacts	The external contacts: • Bit 0 = 1 External contact 1 active • Bit 1 = 1 External contact 2 active • Bit 2 = 1 External contact failure • Bit 3 = 1 External contact not available in this instrument	Bit coded
38	DisplacerPosition	The value of the physical servo displacer position.	Level
39	DisplacerStatus (DisplacerPositionStatus)	The status of entity ID#38, DisplacerPosition.	Status
40	ProductLevel	The value of the product level.	Level
41	ProductLevelStatus	The status of entity ID#40, ProductLevel.	Status
42	WaterLevel	The value of the water level (copy of entity ID#114, WaterDipped or entity ID#120, WaterMeasured).	Level
43	WaterLevelStatus	The status of entity ID#42, WaterLevel (copy of entity ID#115, WaterDippedStatus or entity ID#121, Water-MeasuredStatus).	Status
44	ProductTemp	The value of the product temperature	Temperature
45	ProductTempStatus	The status of entity ID#44, ProductTemp	Status
46	VapRoomTemp	The value of the product vapor temperature	Temperature
47	VapRoomTempStatus	The status of entity ID#46, VapRoomTemp.	Status
48	VapRoomPress	The value of the product vapor pressure.	Pressure
49	VapRoomPressStatus	The status of entity ID#48, VapRoomPress.	Status
50	DObs	The value of the product density (copy of entity ID#116, DObsHIMS or entity ID#112, DObsDipped).	Density
51	DObsStatus	The status of entity ID#50, Dobs (copy of entity ID#117, DObsHIMSStatus or entity ID#113, DObsDip-pedStatus).	Status
52	ForeGroundTimeStamp (ForegroundTimeStamp)	The (absolute) time when, in the foreground scan, the most recent item was scanned.	Absolute time
53	BackGroundTimeStamp (BackgroundTimeStamp)	The (absolute) time when, in the background scan, the most recent item was scanned.	Absolute time
54	TOV	The Total Observed Volume (TOV).	Volume
55	TOVStatus	The status of entity ID#54, TOV.	Status
56	WaterVol	The water volume.	Volume
57	WaterVolStatus	The status of entity ID#56, WaterVol.	Status

ID	Name	Description	Dimension Type
58	GOV	The Gross Observed Volume (GOV). The GOV is the total volume of all petroleum liquids and sediment and water, excluding free water, at observed temperature and pressure.	Volume
59	GOVStatus	The status of entity ID#59, GOV	Status
60	GSV	The Gross Standard Volume (GSV). The GSV is the total volume of all petroleum liquids and sediment and water, excluding free water, corrected by the appropriate volume correction factor (VCF = CTL) for the observed temperature and API gravity, relative density, or density to a standard temperature, and also corrected by the applicable pressure correction factor (Cpl) and meter factor.	Volume
61	GSVStatus	The status of entity ID#61, GSV	Status
62	NSV	The Net Standard Volume (NSV). The NSV is the total volume of all petroleum liquids, excluding sediment and water and free water, corrected by the appropriate volume correction factor (VCF = CTL) for the observed temperature and API Gravity, relative density, or density to a standard temperature, and also corrected by the applicable pressure correction factor (Cpl) and meter factor.	Volume
63	NSVStatus	The status of entity ID#63, NSV	Status
64	LiqInVap	The vapor volume in the tank, if it was liquefied.	Volume
65	LiqInVapStatus	The status of entity ID#64, LiqInVap.	Status
66	TGSV	The Total Gross Standard Volume (TGSV).	Volume
67	TGSVStatus	The status of entity ID#66, TGSV.	Status
68	MassLiq (NSM)	The product volume weight.	Mass
69	MassLiqStatus (NSMStatus)	The status of entity ID#68, MassLiq.	Status
70	MassVap	The vapor volume weight.	Mass
71	MassVapStatus	The status of entity ID#70, MassVap.	Status
72	TotalMass (TNSM)	The product plus vapor volume weight.	Mass
73	TNSMStatus(TNSMStatus)	The status of entity ID#72, TotalMass.	Status
74	FlowTOV	The Total Observed Volume (TOV) of the product per time unit.	Flow
75	AvailableRoom	The spare capacity of the tank.	Volume
76	Available TOV	The Total Observed Volume (TOV) of the available product.	Volume
77	Verification Signature	Calculated over all entities in the default tank record. The patented calculation algorithm verifies the contents of the transmitted tank records.	Nodim

ID	Name	Description	Dimension Type
78	ConfigurationStatus	The CIU and tank configuration status: • Bit 0 = 1 Gauge configuration mismatch (Future) • Bit 1 = 1 CIU Prime general configuration mismatch • Bit 2 = 1 CIU Prime tank configuration mismatch • Bit 3 = 1 CIU Plus general configuration mismatch • Bit 4 = 1 CIU Plus tank configuration mismatch for this tank • Bit 5 = 1 Ensite Pro general configuration mismatch • Bit 6 = 1 Ensite Pro tank configuration mismatch • Bit 7 = 1 CIU Prime record contains invalid verification Note: Because of the representation as combined entity, the length is fixed to 8 bits.	Bit coded
79	MolarWeight	Molar weight of the gas composition: In some tanks (pressurized) the room above the product is filled with vapour which, in condensed form and it would take a certain amount of product (volume). This volume can be calculated.	Molar weight value
80	AutomaticMeasurableValues	The values that can be automatically measured (this doesn't necessarily mean that they are actually measured). Bit n = 1: value can be measured automatically: • Bit 0 = 1 Level [entity ID#38, entity ID#40] • Bit 1 = 1 Temperature [entity ID#44] • Bit 2 = 1 Water level [entity ID#42] • Bit 3 = 1 Density [entity ID#50] • Bit 4 = 1 Vapor temperature [entity ID#46] • Bit 5 = 1 Vapor pressure [entity ID#48] • Bit 6 = 1 Ambient Temperature [entity ID#103] • Bit 7 = 1 Dummy scan (now used for FDI scan) • Bit 14 ProductTC calc.mode: 0 = manual, 1 = calculated • Bit 15 CTL calc. mode: 0 = manual, 1 = calculated Note: Bits 14 and 15 are for internal use of the CIU Plus. The length is fixed to 16 bits.	Bit coded
88	HydroMeterCorr	'0' is false, '>1' means true.	Nodim
89	TObsDipped	Temperature of the dipped density.	Temperature
90	TankTRef	Tank Shell Reference Temperature: Tanks undergo expansion and contraction, due to variations in AmbientTemp and ProdTemp. This results in incorrect level readings, which makes it necessary to correct the calculated volumes.	Temperature

ID	Name	Description	Dimension Type
91	ThermalexpCoeffTankshell	Tank shell expansion coefficient (TankTC): Tanks undergo expansion and contraction, due to variations in AmbientTemp and ProdTemp. This results in incorrect level readings, which makes it necessary to correct the calculated volumes. TankTC is the expansion coefficient of the Tank Shell material.	TankShell-Coefficient
92	TankAirDensity	Air density: The Air Density is always in kg/m3, regardless of the units in which the system is configured. At creation of the tank this entity gets populated with the actual value of entity AirDensity] [3027]	Density
93	VapRoom	Vapour Room: The Vapour Room, not necessarily equal to AvaRoom, is the volume of the empty space above the liquid in the tank (amount of empty gas space in a tank), needed to assess the amount of product vapours in a tank at any specific moment.	Volume
94	TankConfigurationCRC	Checksum, calculated over tank related configuration parameters by the CIU Prime (for W&M purposes).	Nodim
95	CIUPrimeGeneralConfigurationCRC (CIU2GeneralConfigurationCRC)	Checksum, calculated over general CIU Prime configuration parameters (for W&M purposes).	Nodim
96	CIUPrimeGeneralConfigurationCRC (CIUPGeneralConfigurationCRC)	Checksum, calculated over general CIU Prime configuration parameters (for W&M purposes).	Nodim
97	LowLevel	Level corresponds to Low TOV.	Level
99	FlowStatus	The status of entity ID#74, FlowTOV.	Status
100	AvailableRoomStatus	The status of entity ID#75, AvailableRoom.	Status
101	AvailableTOVStatus	Status and Validity of entity [76] (Available TOV).	Status
102	VapRoomStatus	Status and Validity of entity [93] (Vapour Room).	Status
103	Ambient Temperature	The value of the tank’s ambient temperature.	Temperature
104	Ambient Temperature Status	The status of entity ID#103, AmbientTemperature.	Status
105	CIUPlusTankID	Unique Identifier for a tank: • The range is between 1 to 6553	Nodim
106	CIU2TankID	Ensite Pro's elementID. A unique number between 0 and 65535.	Nodim
107	CTSh	The correction for the expansion of the shell.	CTSh
108	CTShStatus	The status of entity ID#107, CTSh.	Status
109	InsulationFactor	Tank Shell Insulation Factor. The Insulation Factor (0 < Insulation <= 1.0) indicates how well the tank shell is insulated from the environmental temperature (AmbientTemp) outside the tank. For a fully insulated tank (TankShellTemp = ProdTemp), Insulation = 1.0.	Insulation Factor
111	TObsDippedStatus	Status and Validity of entity [89] (observed temperature of the dipped density).	Status

ID	Name	Description	Dimension Type
112	DObsDipped	Observed (dipped) Density. The Dipped Density is acuired by CIU 888 through GPU record ZSC.	Density
113	DObsDippedStatus	Status and Validity of entity [112] (Dipped Density).	Status
114	WaterDipped	The value of the dipped water level.	Level
115	WaterDippedStatus	Status and Validity of entity [114] (Water dipped).	Status
116	DObsHIMS	Observed (HIMS) Density. Density input from ATG (such as HIMS, HTG or Servo).	Density
117	DObsHIMSStatus	Status and Validity of entity [116] (Observed Hims Density).	Status
118	Tobs	The value of the observed temperature (copy of entity ID#44, ProductTemp or entity ID#89, TObsDipped).	Temperature
119	Tobs Status	The status of entity ID#118, TObs (copy of entity ID#45, ProductTempStatus or entity ID#111, TObsDippedStatus).	Status
120	WaterMeasured	The continuous water level directly measured by a Water Scout.	Level
121	WaterMeasuredStatus	Status and Validity of entity [120] (Measured Water)	Status
124	VolumeCorrectionFactor (CTL)	The Volume Correction Factor (= Correction for the Temperature of the Liquid).	VCF (= CTL)
125	VolumeCorrectionFactorStatus (CTLStatus)	The status of entity ID#124, VCF.	Status
126	TemperatureCorrectionFactor (TCF)	Product Temperature Correction Factor (TCF).	TCF
127	TemperatureCorrectionFactorStatus (TCFStatus)	Status and Validity of entity [126] (TCF).	Status
128	DensityCorrectionFactor (DCF)	Product Density Correction Factor (DCF).	DCF
129	DensityCorrectionFactorStatus (DCFStatus)	Status and Validity of entity [128] (DCF).	Status
130	TankNameStatus	Status and Validity of entity [1] (TankName).	Status
131	TankStatusStatus	Status and Validity of entity [2] (TankStatus).	Status
132	MovingStatusStatus	Status and Validity of entity [3]]MovingStatus].	Status
133	TankTypeStatus	Status and Validity of entity [4] [TankType].	Status
134	ShellCapacityStatus (MaximumTankCapactityStatus)	Status and Validity of entity [17] (ShellCapacity).	Status
135	LowTOVStatus	Status and Validity of entity [18] (LowTOV).	Status
136	HighTOVStatus	Status and Validity of entity [19] (HighTOV).	Status
137	ProductNameStatus	Status and Validity of entity [21] (ProductName).	Status
138	GSVCalcTypeStatus	Status and Validity of entity [22] (GSVCalcType).	Status
139	ProductCodeStatus	Status and Validity of entity [23] (ProductCode).	Status

ID	Name	Description	Dimension Type
140	VolumeCorrectionStatus	Status and Validity of entity [24] (VolumeCorrection).	Status
141	MassCalcTypeStatus	Status and Validity of entity [25] (MassCalcType).	Status
142	ProductTRefStatus	Status and Validity of entity [26] (ProductTRef).	Status
143	SedAndWaterStatus	Status and Validity of entity [32] (SedAndWater).	Status
144	LiqVolRatioStatus	Status and Validity of entity [35] (LiqVolRatio).	Status
145	MolarWeightStatus	Status and Validity of entity [79] (MolarWeight).	Status
146	AutomaticMeasurableValuesStatus	Status and Validity of entity [80] (AutomaticMeasurableValues).	Status
154	HydroMeterCorrStatus	The status of entity ID#88, HydroMeterCorr.	Status
155	TankTrefStatus	Status and Validity of entity [90] (TankTref).	Status
156	TankTCStatus	Status and Validity of entity [91] (TankTC).	Status
157	TankAirDensityStatus	Status and Validity of entity [92] [AirDensity].	Status
158	InsulationFactorStatus	Status and Validity of entity [109] (InsulationFactor).	Status
178	FRL1	Floating Roof Level 1 FRL is needed for Floating Roof Immersion compensation, but it can also be used for floating roof alarming. FRI is assumed to be an accurate immersion measurement done with for example magnetostrictive, capacitive or guided wave radar probes. Preferable 3 are used, but it should also be possible with 2 or even only 1 probe. Manual overwrite is not useful for operational purpose but might be needed for verification of the compensation. FRL1 is used with the calculation of: • RIC.	Level
179	FRL1Status	Status and Validity of entity [178] (FRL1).	Status
180	FRL2	Floating Roof Level 2 FRL is needed for Floating Roof Immersion compensation, but it can also be used for floating roof alarming. FRI is assumed to be an accurate immersion measurement done with for example magnetostrictive, capacitive or guided wave radar probes. Preferable 3 are used, but it should also be possible with 2 or even only 1 probe.Manual overwrite is not useful for operational purpose but might be needed for verification of the compensation. FRL2 is used with the calculation of: • RIC	Level
181	FRL2Status	Status and Validity of entity [180] (FRL2).	Status

ID	Name	Description	Dimension Type
182	FRL3	Floating Roof Level 3 FRL is needed for Floating Roof Immersion compensation, but it can also be used for floating roof alarming. FRI is assumed to be an accurate immersion measurement done with for example magnetostrictive, capacitive or guided wave radar probes. Preferable 3 are used, but it should also be possible with 2 or even only 1 probe. Manual overwrite is not useful for operational purpose but might be needed for verification of the compensation. FRL3 is used with the calculation of: • RIC	Level
183	FRL3Status	Status and Validity of entity [182] (FRL3).	Status
184	FRA	Floating Roof Adjustment Correction of volume and weight of by floating roof displaced liquid.Based on equation, some TCT's have a already correction in for static density only. Note: some tanks need add. Correction for roof ladder. FRA is not used with other calculations.	Level
185	FRAStatus	Status and Validity of entity [184] (FRA).	Status
186	RIC	Correction where the actual immersion of the FR is measured with 1, 2 or 3 sensors to correct for variable roof loading (i.e. caused by rain, snow, wind and friction). RIC is not used with other calculations.	Volume
187	RICStatus	Status and Validity of entity [186] (RIC).	Status
196	cUllage	Corrected Ullage. Ullage corrected for thermal expansion or contraction of servo measuring wire. See also [cSWire]. Note This is thermal correction of measuring wire. Thermal correction of tank wall and/or stilling well is assumed to be done in cGRH. Ullage is used with the calculation of: • [TOV]	Level
197	cUllageStatus	Status and Validity of entity [196] [cUllage]	Status
198	cInnage	cInnage is used with the calculation of: • [TOV]	Level
199	cInnageStatus	Status and Validity of entity [198] [cInnage]	Status

ID	Name	Description	Dimension Type
200	Alarms	Combined entity that represents entity ID#37, ExternalContacts and entity ID#36, GaugeLevel Alarms. High byte: entity ID#37; Indicates (bit coded) the ExternalContacts Bit 0 = 1: External contact 1 active Bit 1 = 1: External contact 2 active Bit 2 = 1: External contact failure Bit 3 = 1: External contact not available in this instrument Low byte: entity ID#36; Indicates (bit coded) GaugeLevelAlarms: Bit 0 = 1: Low Level alarm tripped Bit 1 = 1: High Level alarm tripped Bit 2 = 1: Alarm failure Bit 3 = 1 Gauge alarms not available in this instrument Note: Because of the representation as combined entity the length of each individual entity (#36 and #37) is fixed to 8 bits.	Nodim
201	Dynamic tank status (DynamicTankStatus)	Combined entity that represents entity ID#6, Gauge Status (Byte 1) and Bit 0-3 of entity ID#3, MovingStatus + Bit 4-7 of entity ID#2, TankStatus (Byte 2). Byte 1 = Low-order byte (bit 7..0) Byte 2 = High-order byte (bit 15..8) Remark: The CIU 888 takes this information of the primary level gauge.	Nodim
202	StaticTankDefinitions	Tank definitions This entity combines data of other entities. The main reaon for having combined entities is to publish data in Modbus efficiently: • Byte 1 Entity [4] [TankType] • Byte 2 Entity [16] [TankShape] • Byte 1 = Low-order byte (bit 7..0) • Byte 2 = High-order byte (bit 15..8)	Nodim
203	FieldInstrumentDetails	Field instruments details. This entity combines data of other entities. The main reaon for having combined entities is to publish data in Modbus efficiently: • Byte 1 Entity [5] [GaugeType] • Byte 2 Entity [8] [TempElementType] • Byte 1 = Low-order byte (bit 7..0) • Byte 2 = High-order byte (bit 15..8)	Nodim

ID	Name	Description	Dimension Type
204	CombinedVolumeCorrections	Volume corrections. This entity combines data of other entities. The main reaon for having combined entities is to publish data in Modbus efficiently. In case of CIU 880: • Byte 1 Entity [22] [GSVCalcType] • Byte 2 Entity [23] [ProductCode] Note that the CIU 888 maintains entity [8122] and [8123]. For compliancy this CIU will constuct this entity based on the format of [22] and [23] • Byte 1 = Low-order byte (bit 7..0) • Byte 2 = High-order byte (bit 15..8)	Nodim
205	MassAndVolumeCorrections	Mass- and volume corrections. This entity combines data of other entities. The main reaon for having combined entities is to publish data in Modbus efficiently: • Byte 1 Entity [24] [VolumeCorrections] • Byte 2 Entity [25] [MassCalcType] • Byte 1 = Low-order byte (bit 7..0) • Byte 2 = High-order byte (bit 15..8)	Nodim
206	CommAndConfStatus	Communications- and configuration status. This entity combines data of other entities. The main reaon for having combined entities is to publish data in Modbus efficiently: • Byte 1 Entity [78] [ConfigurationStatus] • Byte 2: Bit 0..4 Entity [9] [HotStandbyStatus] Bit 5..7 Entity [10] [CommStatus] • Byte 1 = Low-order byte (bit 7..0) • Byte 2 = High-order byte (bit 15..8)	Nodim
226	cGRH	Corrected GRH GRH corrected for tank shell/stilling well temperature. Calculation method depends on tank type and gauge installation details. [GRH] is used with the calculation of: • TOV	Level
227	cGRHStatus	Status and Validity of entity [226] [cGRH]	Status
296	ProductPressure	Value of the product pressure.	Pressure
297	ProductPressureStatus	Status of entity ID#296	Status
318	TermGRHP	Correction of the Gauge Reference Height by influence of pressure	Level
319	TermGRHPStatus	Status and Validity of entity [318] (TermGRHP).	Status
2174	DxAver	Roof immersion relative to reference level (FRLn - LRefn) Δxaver = (Δx1+Δx2+Δx3) / 3	Level

ID	Name	Description	Dimension Type
2175	DxAverStatus	Status and Validity of entity [2174] (DxAver).	Status
2176	cMassConcentration	Calculated concentration of Mass	percentage
2177	cMassConcentrationStatus	Status and Validity of entity [2176] (cMassConcentration).	Status
2178	cVolConcentration	Calculated concentration of Volume	percentage
2179	cVolConcentrationStatus	Status and Validity of entity [2178] (cVolConcentration).	Status
2600	Gauge2Status	Level Gauge Status (servo). 0 = Level gauge is measuring level 1 = Level gauge is in test 2 = Level gauge is in lock test 3 = Level gauge is blocked 4 = Level gauge is busy with a density profile measurement. 5 = Level gauge is searching water level 6 = Level gauge end switch reached 7 = Reserved for future use 8 = Level gauge is in interface mode 2 9 = Level gauge is in interface dip mode 10 = Level gauge has found water level and is measuring it 11 = 253 Future 254 = Uninitialized 255 = Level gauge is in failure	NoDim
2603	ProductLevel2	The product level from secondary gauge in the tank.	Level
2604	ProductLevel2Status	The status of entity ID#2603, ProductLevel2.	Status
2535	TemperatureProfilesScanEnable	This indicates whether temperature profiles is enabled / disabled for a tank. 0 – Temperature profile data scan disabled 1 – Temperature profile data scan enabled This is a read/write entity. Modbus Host system can write to this entity to enable / disable temperature profile scan for a tank in CIU.	Nodim
10584	TemperatureProfileDataStatus	This indicates the status of the temperature profiles data scan in CIU. 0 – Temperature profiles data not scanned 1 – Temperature profiles data scan in progress 2 – Temperature profiles data scan completed	Nodim
10571	TemperatureProfileTimeStamp	This indicates the timestamp at which temperature profiles data was collected from the field device.	Absolute time
10585	MultitemperatureNumberOfElements	This indicates the configured number of temperature elements in the gauge.	Nodim
466	MultitemperatureSpotRelativeElementPosition0	This indicates multitemperature spot 0 sensor position.	Level
467	MultitemperatureSpotRelativeElementPosition0Status	This indicates multitemperature spot 0 sensor position's status.	Status

ID	Name	Description	Dimension Type
468	MultitemperatureSpotRelativeElementPosition1	This indicates multitemperature spot 1 sensor position.	Level
469	MultitemperatureSpotRelativeElementPosition1Status	This indicates multitemperature spot 1 sensor position's status.	Status
470	MultitemperatureSpotRelativeElementPosition2	This indicates multitemperature spot 2 sensor position.	Level
471	MultitemperatureSpotRelativeElementPosition2Status	This indicates multitemperature spot 2 sensor position's status.	Status
472	MultitemperatureSpotRelativeElementPosition3	This indicates multitemperature spot 3 sensor position.	Level
473	MultitemperatureSpotRelativeElementPosition3Status	This indicates multitemperature spot 3 sensor position's status.	Status
474	MultitemperatureSpotRelativeElementPosition4	This indicates multitemperature spot 4 sensor position.	Level
475	MultitemperatureSpotRelativeElementPosition4Status	This indicates multitemperature spot 4 sensor position's status.	Status
476	MultitemperatureSpotRelativeElementPosition5	This indicates multitemperature spot 5 sensor position.	Level
477	MultitemperatureSpotRelativeElementPosition5Status	This indicates multitemperature spot 5 sensor position's status.	Status
478	MultitemperatureSpotRelativeElementPosition6	This indicates multitemperature spot 6 sensor position.	Level
479	MultitemperatureSpotRelativeElementPosition6Status	This indicates multitemperature spot 6 sensor position's status.	Status
480	MultitemperatureSpotRelativeElementPosition7	This indicates multitemperature spot 7 sensor position.	Level
481	MultitemperatureSpotRelativeElementPosition7Status	This indicates multitemperature spot 7 sensor position's status.	Status
482	MultitemperatureSpotRelativeElementPosition8	This indicates multitemperature spot 8 sensor position.	Level
483	MultitemperatureSpotRelativeElementPosition8Status	This indicates multitemperature spot 8 sensor position's status.	Status
484	MultitemperatureSpotRelativeElementPosition9	This indicates multitemperature spot 9 sensor position.	Level
485	MultitemperatureSpotRelativeElementPosition9Status	This indicates multitemperature spot 9 sensor position's status.	Status
486	MultitemperatureSpotRelativeElementPosition10	This indicates multitemperature spot 10 sensor position.	Level
487	MultitemperatureSpotRelativeElementPosition10Status	This indicates multitemperature spot 10 sensor position's status.	Status
488	MultitemperatureSpotRelativeElementPosition11	This indicates multitemperature spot 11 sensor position.	Level

ID	Name	Description	Dimension Type
489	MultitemperatureSpotRelativeElementPosition11Status	This indicates multitemperature spot 11 sensor position's status.	Status
490	MultitemperatureSpotRelativeElementPosition12	This indicates multitemperature spot 12 sensor position.	Level
491	MultitemperatureSpotRelativeElementPosition12Status	This indicates multitemperature spot 12 sensor position's status.	Status
492	MultitemperatureSpotRelativeElementPosition13	This indicates multitemperature spot 13 sensor position.	Level
493	MultitemperatureSpotRelativeElementPosition13Status	This indicates multitemperature spot 13 sensor position's status.	Status
494	MultitemperatureSpotRelativeElementPosition14	This indicates multitemperature spot 14 sensor position.	Level
495	MultitemperatureSpotRelativeElementPosition14Status	This indicates multitemperature spot 14 sensor position's status.	Status
496	MultitemperatureSpotRelativeElementPosition15	This indicates multitemperature spot 15 sensor position.	Level
497	MultitemperatureSpotRelativeElementPosition15Status	This indicates multitemperature spot 15 sensor position's status.	Status
434	MultitemperatureSpotTemperature0	This indicates multitemperature spot 0 sensor value.	Temperature
435	MultitemperatureSpotTemperature0Status	This indicates multitemperature spot 0 sensor value's status.	Status
436	MultitemperatureSpotTemperature1	This indicates multitemperature spot 1 sensor value.	Temperature
437	MultitemperatureSpotTemperature1Status	This indicates multitemperature spot 1 sensor value's status.	Status
438	MultitemperatureSpotTemperature2	This indicates multitemperature spot 2 sensor value.	Temperature
439	MultitemperatureSpotTemperature2Status	This indicates multitemperature spot 2 sensor value's status.	Status
440	MultitemperatureSpotTemperature3	This indicates multitemperature spot 3 sensor value.	Temperature
441	MultitemperatureSpotTemperature3Status	This indicates multitemperature spot 3 sensor value's status.	Status
442	MultitemperatureSpotTemperature4	This indicates multitemperature spot 4 sensor value.	Temperature
443	MultitemperatureSpotTemperature4Status	This indicates multitemperature spot 4 sensor value's status.	Status
444	MultitemperatureSpotTemperature5	This indicates multitemperature spot 5 sensor value.	Temperature
445	MultitemperatureSpotTemperature5Status	This indicates multitemperature spot 5 sensor value's status.	Status
446	MultitemperatureSpotTemperature6	This indicates multitemperature spot 6 sensor value.	Temperature
447	MultitemperatureSpotTemperature6Status	This indicates multitemperature spot 6 sensor value's status.	Status
448	MultitemperatureSpotTemperature7	This indicates multitemperature spot 7 sensor value.	Temperature
449	MultitemperatureSpotTemperature7Status	This indicates multitemperature spot 7 sensor value's status.	Status

ID	Name	Description	Dimension Type
450	MultitemperatureSpotTemperature8	This indicates multitemperature spot 8 sensor value.	Temperature
451	MultitemperatureSpotTemperature8Status	This indicates multitemperature spot 8 sensor value's status.	Status
452	MultitemperatureSpotTemperature9	This indicates multitemperature spot 9 sensor value.	Temperature
453	MultitemperatureSpotTemperature9Status	This indicates multitemperature spot 9 sensor value's status.	Status
454	MultitemperatureSpotTemperature10	This indicates multitemperature spot 10 sensor value.	Temperature
455	MultitemperatureSpotTemperature10Status	This indicates multitemperature spot 10 sensor value's status.	Status
456	MultitemperatureSpotTemperature11	This indicates multitemperature spot 11 sensor value.	Temperature
457	MultitemperatureSpotTemperature11Status	This indicates multitemperature spot 11 sensor value's status.	Status
458	MultitemperatureSpotTemperature12	This indicates multitemperature spot 12 sensor value.	Temperature
459	MultitemperatureSpotTemperature12Status	This indicates multitemperature spot 12 sensor value's status.	Status
460	MultitemperatureSpotTemperature13	This indicates multitemperature spot 13 sensor value.	Temperature
461	MultitemperatureSpotTemperature13Status	This indicates multitemperature spot 13 sensor value's status.	Status
462	MultitemperatureSpotTemperature14	This indicates multitemperature spot 14 sensor value.	Temperature
463	MultitemperatureSpotTemperature14Status	This indicates multitemperature spot 14 sensor value's status.	Status
464	MultitemperatureSpotTemperature15	This indicates multitemperature spot 15 sensor value.	Temperature
465	MultitemperatureSpotTemperature15Status	This indicates multitemperature spot 15 sensor value's status.	Status
498	MultiTemperatureLevelOffset	This indicates the position of the anchoring-eye in respect with the zero-level of the tank. level = actual_level - M_T_offset (if INNAGE) or level = M_T_offset - Actual_level (if ULLAGE)	Level
499	MultiTemperatureElementType	This item indicates the type of connected multi-temperature element.	Text (ASCII or Unicode)
10572	TemperatureProfilesScanProductLevel	This indicates the product level for a tank when temperature profiles data for that tank was scanned by CIU 888.	Level
10573	TemperatureProfilesScanProductLevelStatus	This indicates the product level status for a tank when temperature profiles data for that tank was scanned by CIU 888.	Status

ID	Name	Description	Dimension Type
10574	TemperatureProfilesScanProduct-Temperature	This indicates the product temperature for a tank when temperature profiles data for that tank was scanned by CIU 888.	Temperature
10574	TemperatureProfilesScanProduct-TemperatureStatus	This indicates the product temperature for a tank when temperature profiles data for that tank was scanned by CIU 888.	Status
10595	TemperatureProfileScanWaterLevel	This indicates the water level for a tank when temperature profiles data for that tank was scanned by CIU 888.	Level
10596	TemperatureProfileScanWaterLevel-Status	This indicates the water level status for a tank when temperature profiles data for that tank was scanned by CIU 888.	Status
10597	TemperatureProfileScanVapour-Temperature	This indicates the vapour temperature for a tank when temperature profiles data for that tank was scanned by CIU 888.	Temperature
10598	TemperatureProfileScanVapour-TemperatureStatus	This indicates the vapour temperature status for a tank when temperature profiles data for that tank was scanned by CIU 888.	Status
10599	TemperatureProfileScanVapour-Pressure	This indicates the vapour pressure for a tank when temperature profiles data for that tank was scanned by CIU 888.	Pressure
10600	TemperatureProfileScanVapour-PressureStatus	This indicates the vapour pressure status for a tank when temperature profiles data for that tank was scanned by CIU 888.	Status
10651	DensityProfileDataStatus	This indicates the status of the density profile command execution in CIU. 0 – Density profiles command not executed 1 – Density profiles command execution in progress 2 – Density profiles command execution complete	Nodim
10652	DensityProfileTimeStamp	This indicates the timestamp at which density profiles data was collected from the field device.	Absolute time
10655	MultiDensityNumberOfElements	This indicates the configured number of Density points in the gauge.	Nodim
390	DensityInnageLevel0	This indicates position 0 at which density is measured.	Level
391	DensityInnageLevel0Status	This indicates position 0 status.	Status
392	DensityInnageLevel1	This indicates position 1 at which density is measured.	Level
393	DensityInnageLevel1Status	This indicates position 1 status.	Status
394	DensityInnageLevel2	This indicates position 2 at which density is measured.	Level
395	DensityInnageLevel2Status	This indicates position 2 status.	Status
396	DensityInnageLevel3	This indicates position 3 at which density is measured.	Level
397	DensityInnageLevel3Status	This indicates position 3 status.	Status
398	DensityInnageLevel4	This indicates position 4 at which density is measured.	Level
399	DensityInnageLevel4Status	This indicates position 4 status.	Status

ID	Name	Description	Dimension Type
400	DensityInnageLevel5	This indicates position 5 at which density is measured.	Level
401	DensityInnageLevel5Status	This indicates position 5 status.	Status
402	DensityInnageLevel6	This indicates position 6 at which density is measured.	Level
403	DensityInnageLevel6Status	This indicates position 6 status.	Status
404	DensityInnageLevel7	This indicates position 7 at which density is measured.	Level
405	DensityInnageLevel7Status	This indicates position 7 status.	Status
406	DensityInnageLevel8	This indicates position 8 at which density is measured.	Level
407	DensityInnageLevel8Status	This indicates position 8 status.	Status
408	DensityInnageLevel9	This indicates position 9 at which density is measured.	Level
409	DensityInnageLevel9Status	This indicates position 9 status.	Status
701	DensityInnageLevel10	This indicates position 10 at which density is measured.	Level
702	DensityInnageLevel10Status	This indicates position 10 status.	Status
703	DensityInnageLevel11	This indicates position 11 at which density is measured.	Level
704	DensityInnageLevel11Status	This indicates position 11 status.	Status
705	DensityInnageLevel12	This indicates position 12 at which density is measured.	Level
706	DensityInnageLevel12Status	This indicates position 12 status.	Status
707	DensityInnageLevel13	This indicates position 13 at which density is measured.	Level
708	DensityInnageLevel13Status	This indicates position 13 status.	Status
709	DensityInnageLevel14	This indicates position 14 at which density is measured.	Level
710	DensityInnageLevel14Status	This indicates position 14 status.	Status
711	DensityInnageLevel15	This indicates position 15 at which density is measured.	Level
712	DensityInnageLevel15Status	This indicates position 15 status.	Status
713	DensityInnageLevel16	This indicates position 16 at which density is measured.	Level
714	DensityInnageLevel16Status	This indicates position 16 status.	Status
715	DensityInnageLevel17	This indicates position 17 at which density is measured.	Level
716	DensityInnageLevel17Status	This indicates position 17 status.	Status
717	DensityInnageLevel18	This indicates position 18 at which density is measured.	Level
718	DensityInnageLevel18Status	This indicates position 18 status.	Status
719	DensityInnageLevel19	This indicates position 19 at which density is measured.	Level

ID	Name	Description	Dimension Type
720	DensityInnageLevel19Status	This indicates position 19 status.	Status
721	DensityInnageLevel20	This indicates position 20 at which density is measured.	Level
722	DensityInnageLevel20Status	This indicates position 20 status.	Status
723	DensityInnageLevel21	This indicates position 21 at which density is measured.	Level
724	DensityInnageLevel21Status	This indicates position 21 status.	Status
725	DensityInnageLevel22	This indicates position 22 at which density is measured.	Level
726	DensityInnageLevel22Status	This indicates position 22 status.	Status
727	DensityInnageLevel23	This indicates position 23 at which density is measured.	Level
728	DensityInnageLevel23Status	This indicates position 23 status.	Status
729	DensityInnageLevel24	This indicates position 24 at which density is measured.	Level
730	DensityInnageLevel24Status	This indicates position 24 status.	Status
731	DensityInnageLevel25	This indicates position 25 at which density is measured.	Level
732	DensityInnageLevel25Status	This indicates position 25 status.	Status
733	DensityInnageLevel26	This indicates position 26 at which density is measured.	Level
734	DensityInnageLevel26Status	This indicates position 26 status.	Status
735	DensityInnageLevel27	This indicates position 27 at which density is measured.	Level
736	DensityInnageLevel27Status	This indicates position 27 status.	Status
737	DensityInnageLevel28	This indicates position 28 at which density is measured.	Level
738	DensityInnageLevel28Status	This indicates position 28 status.	Status
739	DensityInnageLevel29	This indicates position 29 at which density is measured.	Level
740	DensityInnageLevel29Status	This indicates position 29 status.	Status
741	DensityInnageLevel30	This indicates position 30 at which density is measured.	Level
742	DensityInnageLevel30Status	This indicates position 30 status.	Status
743	DensityInnageLevel31	This indicates position 31 at which density is measured.	Level
744	DensityInnageLevel31Status	This indicates position 31 status.	Status
745	DensityInnageLevel32	This indicates position 32 at which density is measured.	Level
746	DensityInnageLevel32Status	This indicates position 32 status.	Status

ID	Name	Description	Dimension Type
747	DensityInnageLevel33	This indicates position 33 at which density is measured.	Level
748	DensityInnageLevel33Status	This indicates position 33 status.	Status
749	DensityInnageLevel34	This indicates position 34 at which density is measured.	Level
750	DensityInnageLevel34Status	This indicates position 34 status.	Status
751	DensityInnageLevel35	This indicates position 35 at which density is measured.	Level
752	DensityInnageLevel35Status	This indicates position 35 status.	Status
753	DensityInnageLevel36	This indicates position 36 at which density is measured.	Level
754	DensityInnageLevel36Status	This indicates position 36 status.	Status
755	DensityInnageLevel37	This indicates position 37 at which density is measured.	Level
756	DensityInnageLevel37Status	This indicates position 37 status.	Status
757	DensityInnageLevel38	This indicates position 38 at which density is measured.	Level
758	DensityInnageLevel38Status	This indicates position 38 status.	Status
759	DensityInnageLevel39	This indicates position 39 at which density is measured.	Level
760	DensityInnageLevel39Status	This indicates position 39 status.	Status
761	DensityInnageLevel40	This indicates position 40 at which density is measured.	Level
762	DensityInnageLevel40Status	This indicates position 40 status.	Status
763	DensityInnageLevel41	This indicates position 41 at which density is measured.	Level
764	DensityInnageLevel41Status	This indicates position 41 status.	Status
765	DensityInnageLevel42	This indicates position 42 at which density is measured.	Level
766	DensityInnageLevel42Status	This indicates position 42 status.	Status
767	DensityInnageLevel43	This indicates position 43 at which density is measured.	Level
768	DensityInnageLevel43Status	This indicates position 43 status.	Status
769	DensityInnageLevel44	This indicates position 44 at which density is measured.	Level
770	DensityInnageLevel44Status	This indicates position 44 status.	Status
771	DensityInnageLevel45	This indicates position 45 at which density is measured.	Level
772	DensityInnageLevel45Status	This indicates position 45 status.	Status

ID	Name	Description	Dimension Type
773	DensityInnageLevel46	This indicates position 46 at which density is measured.	Level
774	DensityInnageLevel46Status	This indicates position 46 status.	Status
775	DensityInnageLevel47	This indicates position 47 at which density is measured.	Level
776	DensityInnageLevel47Status	This indicates position 47 status.	Status
777	DensityInnageLevel48	This indicates position 48 at which density is measured.	Level
778	DensityInnageLevel48Status	This indicates position 48 status.	Status
779	DensityInnageLevel49	This indicates position 49 at which density is measured.	Level
780	DensityInnageLevel49Status	This indicates position 49 status.	Status
412	MeasuredServoDensity0	This indicates density measured at position 0.	Density
413	MeasuredServoDensity0Status	This indicates density status measured at position 0.	Status
414	MeasuredServoDensity1	This indicates density measured at position 1.	Density
415	MeasuredServoDensity1Status	This indicates density status measured at position 1.	Status
416	MeasuredServoDensity2	This indicates density measured at position 2.	Density
417	MeasuredServoDensity2Status	This indicates density status measured at position 2.	Status
418	MeasuredServoDensity3	This indicates density measured at position 3.	Density
419	MeasuredServoDensity3Status	This indicates density status measured at position 3.	Status
420	MeasuredServoDensity4	This indicates density measured at position 4.	Density
421	MeasuredServoDensity4Status	This indicates density status measured at position 4.	Status
422	MeasuredServoDensity5	This indicates density measured at position 5.	Density
423	MeasuredServoDensity5Status	This indicates density status measured at position 5.	Status
424	MeasuredServoDensity6	This indicates density measured at position 6.	Density
425	MeasuredServoDensity6Status	This indicates density status measured at position 6.	Status
426	MeasuredServoDensity7	This indicates density measured at position 7.	Density
427	MeasuredServoDensity7Status	This indicates density status measured at position 7.	Status
428	MeasuredServoDensity8	This indicates density measured at position 8.	Density
429	MeasuredServoDensity8Status	This indicates density status measured at position 8.	Status
430	MeasuredServoDensity9	This indicates density measured at position 9.	Density
431	MeasuredServoDensity9Status	This indicates density status measured at position 9.	Status
781	MeasuredServoDensity10	This indicates density measured at position 10.	Density
782	MeasuredServoDensity10Status	This indicates density status measured at position 10.	Status
783	MeasuredServoDensity11	This indicates density measured at position 11.	Density
784	MeasuredServoDensity11Status	This indicates density status measured at position 11.	Status
785	MeasuredServoDensity12	This indicates density measured at position 12.	Density

ID	Name	Description	Dimension Type
786	MeasuredServoDensity12Status	This indicates density status measured at position 12.	Status
787	MeasuredServoDensity13	This indicates density measured at position 13.	Density
788	MeasuredServoDensity13Status	This indicates density status measured at position 13.	Status
789	MeasuredServoDensity14	This indicates density measured at position 14.	Density
790	MeasuredServoDensity14Status	This indicates density status measured at position 14.	Status
791	MeasuredServoDensity15	This indicates density measured at position 15.	Density
792	MeasuredServoDensity15Status	This indicates density status measured at position 15.	Status
793	MeasuredServoDensity16	This indicates density measured at position 16.	Density
794	MeasuredServoDensity16Status	This indicates density status measured at position 16.	Status
795	MeasuredServoDensity17	This indicates density measured at position 17.	Density
796	MeasuredServoDensity17Status	This indicates density status measured at position 17.	Status
797	MeasuredServoDensity18	This indicates density measured at position 18.	Density
798	MeasuredServoDensity18Status	This indicates density status measured at position 18.	Status
799	MeasuredServoDensity19	This indicates density measured at position 19.	Density
800	MeasuredServoDensity19Status	This indicates density status measured at position 19.	Status
801	MeasuredServoDensity20	This indicates density measured at position 20.	Density
802	MeasuredServoDensity0Status	This indicates density status measured at position 20.	Status
803	MeasuredServoDensity21	This indicates density measured at position 21.	Density
804	MeasuredServoDensity21Status	This indicates density status measured at position 21.	Status
805	MeasuredServoDensity22	This indicates density measured at position 22.	Density
806	MeasuredServoDensity22Status	This indicates density status measured at position 22.	Status
807	MeasuredServoDensity23	This indicates density measured at position 23.	Density
808	MeasuredServoDensity23Status	This indicates density status measured at position 23.	Status
809	MeasuredServoDensity24	This indicates density measured at position 24.	Density
810	MeasuredServoDensity24Status	This indicates density status measured at position 24.	Status
811	MeasuredServoDensity25	This indicates density measured at position 25.	Density
812	MeasuredServoDensity25Status	This indicates density status measured at position 25.	Status
813	MeasuredServoDensity26	This indicates density measured at position 26.	Density
814	MeasuredServoDensity26Status	This indicates density status measured at position 26.	Status
815	MeasuredServoDensity27	This indicates density measured at position 27.	Density
816	MeasuredServoDensity27Status	This indicates density status measured at position 27.	Status
817	MeasuredServoDensity28	This indicates density measured at position 28.	Density
818	MeasuredServoDensity28Status	This indicates density status measured at position 28.	Status
819	MeasuredServoDensity29	This indicates density measured at position 29.	Density
820	MeasuredServoDensity29Status	This indicates density status measured at position 29.	Status
821	MeasuredServoDensity30	This indicates density measured at position 30.	Density

ID	Name	Description	Dimension Type
822	MeasuredServoDensity30Status	This indicates density status measured at position 30.	Status
823	MeasuredServoDensity31	This indicates density measured at position 31.	Density
824	MeasuredServoDensity31Status	This indicates density status measured at position 31.	Status
825	MeasuredServoDensity32	This indicates density measured at position 32.	Density
826	MeasuredServoDensity32Status	This indicates density status measured at position 32.	Status
827	MeasuredServoDensity33	This indicates density measured at position 33.	Density
828	MeasuredServoDensity33Status	This indicates density status measured at position 33.	Status
829	MeasuredServoDensity34	This indicates density measured at position 34.	Density
830	MeasuredServoDensity34Status	This indicates density status measured at position 34.	Status
831	MeasuredServoDensity35	This indicates density measured at position 35.	Density
832	MeasuredServoDensity35Status	This indicates density status measured at position 35.	Status
833	MeasuredServoDensity36	This indicates density measured at position 36.	Density
834	MeasuredServoDensity36Status	This indicates density status measured at position 36.	Status
835	MeasuredServoDensity37	This indicates density measured at position 37.	Density
836	MeasuredServoDensity37Status	This indicates density status measured at position 37.	Status
837	MeasuredServoDensity38	This indicates density measured at position 38.	Density
838	MeasuredServoDensity38Status	This indicates density status measured at position 38.	Status
839	MeasuredServoDensity39	This indicates density measured at position 39.	Density
840	MeasuredServoDensity39Status	This indicates density status measured at position 39.	Status
841	MeasuredServoDensity40	This indicates density measured at position 40.	Density
842	MeasuredServoDensity40Status	This indicates density status measured at position 40.	Status
843	MeasuredServoDensity41	This indicates density measured at position 41.	Density
844	MeasuredServoDensity41Status	This indicates density status measured at position 41.	Status
845	MeasuredServoDensity42	This indicates density measured at position 42.	Density
846	MeasuredServoDensity42Status	This indicates density status measured at position 42.	Status
847	MeasuredServoDensity43	This indicates density measured at position 43.	Density
848	MeasuredServoDensity43Status	This indicates density status measured at position 43.	Status
849	MeasuredServoDensity44	This indicates density measured at position 44.	Density
850	MeasuredServoDensity44Status	This indicates density status measured at position 44.	Status
851	MeasuredServoDensity45	This indicates density measured at position 45.	Density
852	MeasuredServoDensity45Status	This indicates density status measured at position 5.	Status
853	MeasuredServoDensity46	This indicates density measured at position 46.	Density
854	MeasuredServoDensity46Status	This indicates density status measured at position 46.	Status
855	MeasuredServoDensity47	This indicates density measured at position 47.	Density
856	MeasuredServoDensity47Status	This indicates density status measured at position 47.	Status
857	MeasuredServoDensity48	This indicates density measured at position 48.	Density

ID	Name	Description	Dimension Type
858	MeasuredServoDensity48Status	This indicates density status measured at position 48.	Status
859	MeasuredServoDensity49	This indicates density measured at position 49.	Density
860	MeasuredServoDensity49Status	This indicates density status measured at position 49.	Status

This page is intentionally left blank

APPENDIX F MODBUS NUMBER PRESENTATION

F.1 General

Numerical data has the following properties:

- Type of representation (see section F.2). Depending on the type of representation, the number of registers is also defined
- Applied scaling and offset (see section F.3)

F.2 Data types

Data can be transmitted in the following types (see TABLE F-1):

TABLE F-1 Modbus data types

Data type (No.)	Description	Number of registers	Range	Failure
0	Not a number	1		
1	Fixed number	1		
3	Time stamp	3		
15	ASCII string	10		
25	Unicode string	10		
40	16 bit unsigned integer	1	0...65534	FFFF $_{HEX}$
41	16 bit signed integer	1	-32768...+32766	7FFF $_{HEX}$
42	16 bit decimal float	1	-1023*E7...+1023*E7	7BFF $_{HEX}$
43	12 bit signed	1	-4095...+4095	EFFF $_{HEX}$
50	Unsigned double integer	2	0...65535.9999	FFFF FFFF $_{HEX}$
51	32 bit signed integer	2	-2147483647...+2147483646	7FFF FFFF $_{HEX}$
52	32 bit floating point	2	-3.402823*E-38... +3.402823*E38	7FBF FFFF $_{HEX}$
60	32 bit unsigned integer/fraction1	2	0...65535.5	FFFF FFFF $_{HEX}$
61	32 bit unsigned integer/fraction10	2	0...65535.95	FFFF FFFF $_{HEX}$
62	32 bit unsigned integer/fraction100	2	0...65535.995	FFFF FFFF $_{HEX}$
63	32 bit unsigned integer/fraction1000	2	0...65535.9995	FFFF FFFF $_{HEX}$
64	32 bit unsigned integer/fraction10000	2	0...65535.99995	FFFF FFFF $_{HEX}$

Type 0 (Not a number)

This data represents bit-coded information (8 bits/16 bits). The meaning depends on the entity it represents. All the status and validity entities fall under this data type.

Example

Value (Hex)	Represented Entity (Entity Number)	Meaning
8140	Product Level Status (41)	Status (40) - No data available Validity (81) - No data available
4	Tank status (2)	Tank is disabled

Type 1 (Fixed number)

This data represents a 16 bit fixed number. The meaning depends on the entity it represents.

Example

Value (Hex)	Represented Entity (Entity No.)	Meaning
4	TankShape (16)	Tank shape is ‘Spherical’.
3	Product Code (23)	Product code is ‘C’.

Type 3 (Timestamp)

The data represents absolute date and time information, and consists of three 16-bit registers.

Register No.	Definition		Range
Register 1	Bit 15	- Daylight Saving Time (DST)	0 - DST OFF 1 - DST ON
	Bit 14	- Clock uninitialized	0 - Clock initialized 1 - Clock uninitialized
	Bit 13...Bit 0	- Year	0...9999
Register 2	Bit 15...Bit 14	- Not used	-
	Bit 13...Bit 10	- Month	1...12
	Bit 9...Bit 5	- Day of Month	1...31
	Bit...to 0	- Hour (24 hour format)	0...23
Register 3	Bit 15...Bit 8	- Minutes	0...59
	Bit 7...Bit 0	- Seconds	0...59

The two 16-bit registers give the date/time information.

Example

Register No.	Value (Hex)	Meaning
Register 1	87DE	DST - ON Clock initialized Year - 2014
Register 2	14E5	Month - 5 Day of Month - 7 Hour - 5
Register 3	170B	Minutes - 23 Seconds - 11

Type 15 (ASCII string)

The data represents a string of two ASCII characters per register. Empty registers contain 0.

Type 25 (Unicode string)

The data represents a string of one Unicode character per register. Empty registers contain 0.

Type 40 (16-Bit Unsigned Integer)

Data is transmitted as contents of the register. The value $FFFF_{HEX}$ (65535 decimal) is seen as failure.

Type 41 (16-Bit Signed Integer) (represented in twos complement)

The 16-bit register is used as follows:

Bits :	15	14..0
Meaning	sign	Data

Some examples

Hex Value	Meaning
0000	0
0001	1
7FFF	Failure
8000	-32768
FFFF	-1

Type 42 (16-Bit Decimal Float)

This value is mostly used for Scaling and Offset. The 16-bit register is used as follows:

Bits :	15	14..11	10..0
Meaning	sign	Exponent power of 10	Mantissa

Exponent bias = 7

Calculation:

$$x = -1^{Sign} * mantissa * 10^{(Exponent-7)}$$

NOTE: When using this data type the rule is to normalise the values, in other words to keep the mantissa as small a possible. E.g. $100*10^1$ is incorrect and should be $1*10^2$.

Some examples

Binary Value	Hex Value	Meaning
0000 0000 0000 0000	0000	0
0100 0000 0000 0001	4001	1
0100 1000 0000 0001	4801	100
0111 0011 1110 1000	73E8	1*1010
1100 0000 0000 0001	9001	-1
0101 0000 0000 0001	5001	1000
0010 0000 0000 0001	2001	0.001
0101 1010 0001 0110	5A16	5340000
0111 0111 1111 1111	77FF	1023 E7
1000 0000 0000 0001	8001	-1 E-7
0111 1011 1111 1111	7BFF	Failure

How to decode:

If you want to decode 5430000 go as follows:

5430000	=	$543 * 10^4$		
Sign	=	positive	Bit 15	= 0
Mantissa	=	543	Bit 0..10	= 010 0001 0110
Exponent	=	4 (add 7)	Bit 14..11	= 1011

Type 43 (12-Bit Signed)

The 16-bit register is used as follows:

Bits	Description
15..13	If not 000 see definition below
12	Sign: 0 = Positive 1 = Negative
11..00	Analog value (12-bit), Resolution: 0,025% / digit Range: 0 - 4000 dec (0...100%) Overflow range: 4001 - 4095 dec (up to 102,4%) If the sign is negative, the analog value is shown in twos complement.

Some possible values

Bit definitions					
15	14	13	12	11 to 0	Description
0	0	0	X	X	Analog value O.K.
1	1	1	0	FFF	Error
0	1	1	0	FFF	Time-Out

Type 50 (Unsigned Double Integer)

The two 16-bit registers are used as follows:

- First register (Lower address register) contains the Integer value.
- Second register (Higher address register) contains the Fraction.
- The value FFFF $FFFF_{HEX}$ is seen as failure.

Type 51 (32-bit Signed Integer)

Binary data is a 32-bit signed integer.

Covering the data range between: +2147483648 to -2147483647 (Data value between +2,147,483.648 to -2,147,483.647)

Examples (in hexadecimal):

1	=	00	00	00	01
0	=	00	00	00	00
-1	=	FF	FF	FF	FF
invalid	=	7F	FF	FF	FF

Type 52 (32-bit Floating point)

32-bit IEEE floating point in two registers. All floating point data is coded into 4-bytes Floating point. This format allows a representation of finite numbers from negative to positive 3.402823*E38.

first byte	:	sign (0 = positive; 1 = negative) + 7-bit exponent
second byte	:	8th bit of exponent + 7-bit mantissa (implied 1)
third byte	:	8-bit of mantissa
fourth byte	:	rest of mantissa

Examples:

the number 4 in Hex	:	40 80 00 00
the number 5 in hex	:	40 A0 00 00
invalid	:	7F 80 00 00

Type 60 (32-bit unsigned integer/fraction1)

Most significant 16 bits represent integer data and least significant 16 bits is 0.

Examples (in hexadecimal):

	1	00	01	00	01
	4567	11	D7	00	00
	0	00	00	00	00
invalid		FF	FF	FF	FF

Type 61 (32-bit unsigned integer/fraction10)

Most significant 16 bits represent integer data and least significant 16 bits represents 1 fraction digit.

Examples (in hexadecimal):

	1	00	01	00	00
	4567,4	11	D7	00	04
	0	00	00	00	00
invalid		FF	FF	FF	FF

Type 62 (32-bit unsigned integer/fraction100)

Most significant 16 bits represent integer data and least significant 16 bits represents 2 fraction digits.

Examples (in hexadecimal):

	1	00	01	00	00
	4567,56	11	D7	00	38
	0	00	00	00	00
invalid		FF	FF	FF	FF

Type 63 (32-bit unsigned integer/fraction1000)

Most significant 16 bits represent integer data and least significant 16 bits represents 3 fraction digits.

Examples (in hexadecimal):

	1	00	01	00	00
	4567,673	11	D7	02	A1
	0	00	00	00	00
invalid		FF	FF	FF	FF

Type 64 (32-bit unsigned integer/fraction10000)

Most significant 16 bits represent integer data and least significant 16 bits represents 4 fraction digits.

Examples (in hexadecimal):

	1	00	01	00	00
	4567,9453	11	D7	24	ED
	0	00	00	00	00
invalid		FF	FF	FF	FF

F.3 Scaling and offset

The scaling and offset are defined as follows:

- Use for the scaling the value as entered in the scaling register. (Scaling is entered as a 32-bit float)
- Use for the offset the offset register value (Offset is entered as a 32-bit signed integer)
- The original data measured or calculated by the CIU is available in the dimension and resolution as defined by the dimension table (see section H).

- The value of the data that will be available for the user is calculated as follows:
  Register value = (Data * Scaling) + Offset
- This data is represented in the requested representation in the output registers.

Some examples:

A	Level = 22316.2 mm Level Dimension = mm Scaling = 0.01 Offset = 0 Data type = 51 (32 bit signed integer) Calculation (22316.2 * 0.01) + 0 = 223.162 rounded to 223 Data in register 1 : 0 Data in register 2 : 223
B	Temperature = -8.23 ºC Dimension = ºC Scaling = 10 Offset = 100 Data type = 40 (Unsigned integer) Data in register: (-8.23 * 10) + 100 = -82.3 + 100 = 17.6 rounded to 18
C	Level = 12 11 07 (Feet, Inches, Sixteenth) Dimension = Fis Scaling = 1 Offset = 0 Data type = 41 (16 bit signed integer) Data in register: (121107 * 1) + 0 = 121107 => Too big, therefore result is FFFF (Fail)
D	Level = 12 11 07 (Feet, Inches, Sixteenth) Dimension = 1/16" Scaling = 1 Offset = 0 Data type = 41 (16 bit signed integer) Data in register: ([{(12 * 12) + 11}*16 +7] * 1) + 0 = 2487

APPENDIX G STATUS AND VALIDITY OF DATA

Measured and calculated data is accompanied by validity and status information. Each measured and each calculated entity in the CIU 888 contains a 16 bits status register:

- The high byte (validity byte) is used to indicate if the data of this entity is available (valid) and, if not valid, to indicate why the data is not available (invalid).
- The low byte is used to indicate the status of the data.

G.1 Validity byte

The data validity byte is a hexadecimal number. If the validity byte is $\geq 80_{HEX}$, the related data is invalid. If the data of an entity is invalid, all derived data shows the same code in its data validity byte and the status indicates how the data field should be displayed (FFFF, blanks, etc.). If the validity byte is $< 80_{HEX}$, the related data is valid. In this case, additional information is given.

Some examples are listed in TABLE G-1.

TABLE G-1 Description of validity bytes

Validity Byte (HEX)	Description	Additional Details
0...56	Reserved for future use	
57	Zone not calibrated	
58	Zone data is manual	The zone and therefore the calculated TOV (zone is used for volume correction), or GOV (zone is used for floating roof weight correction) and further derived data are not approved
59	Water level is past one or more zones	The correction values of these zones (volume correction only) are applied completely to the calculated Water Volume.Therefore the Water Volume can be different from what one might have expected,
5A	Product level is past one or more zones	The correction values of these zones are applied completely to the calculated TOV (zones used for volume correction) or GOV (zones used for roof weight correction) Therefore the volume can be different from what one might have expected,
5B	Water level under range	The manually entered WVolUnderRange, if available, is used in further calculations.
5C	Reserved for future use	
5D	Reserved for future use	
5E	Water level not approved	The water level and therefore the entities which are calculated using WaterLevel are not approved.
5F	Product level not approved	The product level and therefore the entities which are calculated using ProdLevel are not approved.

Validity Byte (HEX)	Description	Additional Details
60	Product temperature not approved	The Product Temperature and therefore the entities which are calculated using ProdTemp are not approved.
61	Ambient temperature not approved	The Ambient Temperature and therefore the entities which are calculated using AmbientTemp are not approved.
62	Vapor pressure not approved	The Vapor Pressure and therefore the entities which are calculated using VapPress are not approved.
63	Vapor temperature not approved	The Vapor Temperature and therefore the entities which are calculated using VapTemp are not approved.
64	Product observed density not approved	The Product Observed Density and therefore the entities which are calculated using ProdDObs are not approved.
65	Temperature of product observed density not approved	The Temperature of the Product Observed Density and therefore the entities which are calculated using ProdTObs are not approved.
66	Reserved for future use	
67	Tank Shell not calibrated	The Tank Shell and therefore the calculated volumes (TOV, Water Volume) and derived data is not approved.
68	No HIMS calculation because of status of observed density	If, with HIMS calculations, the status of ProdDObs or ProdTObs is manual or stored, MassLiq is calculated from ProdDRef and GSV (not from Prod DObs and GOV),
69	Mass type not complete because of volume correction	Mass Type could not be calculated completely because Vol Corr is invalid. This makes it impossible to check if Mass Liq must be calculated from NSV. The appropriate bit is set to zero.
6A	Mass type not complete because of Tank Type	MassType could not be calculated completely because TankType is invalid. The bits which normally would have been copied from TankType are set to zero.
6B	Mass type not complete because of product calculation type	MassType could not be calculated completely because ProdCalcType is invalid. This makes it impossible to check if the DCF calculation method is used, in which case MassLiq must be calculated from GOV. The appropriate bit is set to zero.
6C	Water measurement not supported on this tank	Water measurement is not supported on this tank. Only manual data entry of water level or Water Volume is possible.
6D	Reduced accuracy due to resolution mismatch	This validity occurs with data conversions.
6E	Water level is within a zone or Product level is within one or two zones	On Water level The (interpolated) correction value of this zone (volume correction only) is applied to the calculated WaterVolume. Therefore the volume can be different from what one might have expected. Note that zones which have already been passed are also involved in the correction.
6F	Reduced accuracy in ambient temperature	
70	Stored because of water dip	Whenever a WaterDip is executed the last known Product Level and Product Temperature (only with MRT) and Vapour Temperature (only with MRT) will be used with Volume Calculations. To indicate this, the Status is set to Stored.

Validity Byte (HEX)	Description	Additional Details
71	Stored because of density dip	
72	Contamination detected by Instrument	
73	Reduced accuracy detected by level gauge	
74	Stored because of test command	
75	Product level below lowest temperature element	The measured temperature is the temperature of the vapor in the tank. This results in a product temperature with reduced accuracy.
76	Limit switch hit	
77	Water dip aborted	
78	Manual value used by Instrument	
79	Last valid value used by Instrument	
7A	Stored because of dipped product level	
7B	Warning from radar gauge	
7C	Reduced accuracy in product temperature	
7D	Alternative temperature element selected	
7E	Low supply in level gauge	
7F	Reduced accuracy in vapor temperature	
80	Illegal use of 0xFF	The host used value 0xFF, which is reserved for special purposes, to set the validity and/or the status of an entity. The DLL replaces the validity of this entity with 0x80 and the status to 0x00.
81	No data available (not required)	No data available because the entity is not required for the calculations, e.g. if CTSh calculation is not required, the Insulation Factor is also not required. This validity is also indicated in the Data Status.
82	Data is not scanned	No data available because (the scan for) the primary (measured) item has been killed (disabled). Data will be available again as soon as the scan is resumed again or when the data is entered manually. This validity is also indicated in the Data Status.
83	Required data is not initialized yet	The data is required to properly perform all calculations, however: The instrument has not yet been scanned for this entity, e.g. Product Level or A required manual value has not yet been entered, e.g. Product Reference Temperature.
84	Product reference temperature not supported	A not standard ProdTRef is only supported for ASTM tables 53/54. This is due to the lack of the calculation description with other tables.

Validity Byte (HEX)	Description	Additional Details
85	Product calculation type does not exist	
86	Product code does not exist or is not supported	
87	Volume correction does not exist	
88	Manual input not allowed	An attempt was made to manually enter data for an entity which does not allow this, e.g. Product Level whilst the scan is not killed for this tank, or ProdDRef where ProdDRef can be calculated from ProdDObs and ProdTObs (ASTM).
89	Molar weight out of range	
8A	Flow interval out of range	
8B	Reserved for future use	
8C	Level measuring type unknown	
8D	Reserved for future use	
8E	The Water Level is within a zone and interpolation is not allowed	
8F	The Product Level is within a zone and interpolation is not allowed.	
90	Reserved for future use	
91	Tank radius out of range	Can only occur with a mathematically calculated tank.
92	Tank height out of range	Can only occur with a mathematically calculated cylindrical tank.
93	Volume out of range	For most volumes, a dedicated validity is available to indicate that the volume is out of range. This validity is applied if one of the following, manually entered volumes, is less than zero: WaterVol, HighTOV, LowTOV or ShellCapacity.
94	Liquid volume ratio out of range	The Liquid/Volume ratio must be chosen from a table, which is not implemented in this DLL. The only check which is done here is if the value is positive.
95	CTL out of range	This validity can only occur with manual data entry of CTL (see ProdCalcType).
96	Tank Shell temperature coefficient out of range	
97	Local gravity out of range	
98	S&W percentage out of range	
99	Flow rate calculation multiplication factor out of range	

Validity Byte (HEX)	Description	Additional Details
9A	Reserved for future use	
9B	Zone correction resulted in volume < 0.0	A zone is used for volume correction (TOV, or WaterVol). The corrected volume is negative.
9C	Temperature correction factor out of range	
9D	Density correction factor out of range	
9E	Insulation factor out of range	
9F	Tank shell reference temperature out of range	
A0	Return code indicates: not successful	The internally used return code indicates that some error was detected. Mostly, a dedicated validity is available to indicate the cause of the error.
A1	Error in strapping data	The levels of straps must be incremental (innage) or decremental (ullage), this will be checked by the DLL and the appropriate bit in TankType is (re)set. Volumes must always be incremental and >= 0.0. One or more irregularities were detected and because of this TOV and WaterVol (GOV in case of WAP) will not be calculated. The usError field in the strap data contains the number of the strap where the error was detected, which is not necessarily the erroneous strap itself.
A2	Error in zone data	The begin and end levels of a zone must be incremental (innage) or decremental (ullage) and zones of the same type may not overlap.
A3	Product reference density equals air density	This would result in a Divide by Zero error.
A4	General data conversion failure	The DLL tried to convert numerical data to other units, but the units of the input or output data could not be found. For most data conversions, a dedicated validity is available to indicate the failure. This error, as well as the dedicated ones, should never occur.
A5	Error in conversion of displacer value to tank units	
A6	Error in conversion of product level to tank units	
A7	Error in conversion of dipped water level to tank units	
A8	Error in conversion of air density to kg/m3	
A9	Error in conversion of density to kg/m3	The conversion from Tank units, e.g. API, to kg/m3 is used with the calculation of: RoofCorr, LiqVap, MassLiq, MassVap or CTL.
AA	Error in conversion of product temperature to tank units	
AB	Error in conversion of reference temperature to Kelvin	This conversion is used with Gas calculations.

Validity Byte (HEX)	Description	Additional Details
AC	Error in conversion of vapor temperature to tank units	
AD	Error in conversion of vapor temperature to Kelvin	This conversion is used with Gas calculations.
AE	Error in conversion of vapor pressure to tank units	
AF	Error in conversion of vapor pressure to kPa	This conversion is used with Gas calculations.
B0	Error in conversion of HIMS density (ZQQ) to tank units	
B1	Error in conversion of dipped density (ZSC) to tank units	
B2	Error in conversion of volume to tank units	This conversion is used when a mathematically (cylinder, sphere) calculated volume is converted to e.g. bbls.
B3	Error in conversion of volume to m3	With mass calculations, the volume, e.g. bbls, is converted to m3.
B4	Error in conversion of mass to kg	The conversion Tank units to kg is used with the calculation of: RoofCorr or LiqVap according to ISO,
B5	Error in conversion of ambient temperature to tank units	
B6	Error in conversion of water level to tank units	
B7	Error in conversion of reference density	This conversion is used whenever e.g. tank units are metric and ASTM table 5/6 is used.
B8	Error in conversion of product reference temperature	This conversion is used whenever e.g. tank units are metric and ASTM table 5/6 is used.
B9	Error in conversion of observed product density	This conversion is used to convert the measured value to tank units and whenever e.g. tank units are metric and ASTM table 5/6 is used.
BA	Error in conversion of temperature of observed density	This conversion is used to convert the measured value to tank units and whenever e.g. tank units are metric and ASTM table 5/6 is used.
BB	Divide by zero error	
BC	Reserved for use by a host	
BD	Reserved for use by a host	
BE	Reserved for use by a host	
BF	Reserved for use by a host	
C0	Water level out of range	When water level is measured automatically, the error is in the TCT or, if the tank is calculated according to the mathematical formula, in the Tank Height (cylinder), or Radius (sphere).

Validity Byte (HEX)	Description	Additional Details
C1	Measured product temperature out of range	Note: when product temperature is outside ASTM ranges, this is indicated in a dedicated validity.
C2	Vapor pressure out of range	This error can occur with the: Density as obtained from the field instrument, manual entry of ProdDRef, calculation of RoofCorr (ProdDRef - DAir) or calculation of LiqVap (ProdDRef or ProdDRef - DAir).
C3	Density out of range	
C4	Ambient temperature out of range	
C5	Product level out of range	When product level is measured automatically, the error is in the TCT or, if the tank is calculated according to the mathematical formula, in the Tank Height (cylinder), or Radius (sphere).
C6	Vapor temperature out of range	When VapTemp is used to calculate LiqVap or MassVap (according to API44), it is converted to Kelvin. To prevent dividing by zero, the result of this conversion may not be zero. When VapTemp is used with the calculation of MassVap (according to ISO), the calculation formula may not give a zero result, again to prevent dividing by zero.
C7	Tank shell temperature correction factor out of range	The calculated CTSh is less than, or equal to, zero.
C8	Gross observed volume out of range	
C9	Time out received from instrument	Action: Monitor field communication (e.g. Instrument address).
CA	Total observed volume exceeds HighTOV	The calculated TOV exceeds the high safety limit: possibly overflow of the tank. Action: Check HighTOV against TankShellCapacity.
CB	Total observed volume exceeds tank shell capacity	The calculated TOV does not fit in the tank, according to the Shell Capacity.
CC	Water volume exceeds LowTOV	Low TOV is the volume to which product can safely be pumped out of the tank. If WaterVol exceeds this value, water will be pumped i.s.o. product.
CD	Water volume exceeds TOV	It is very unlikely that this error ever will occur. However, with manual data entry of Product and/or Water Level (or WaterVol), there is a possibility that the entered values are not correct, which may give unpredictable results.
CE	Port access error	The field scan encountered a problem with the I/O port.
CF	Max total observed volume exceeds tank shell capacity	
D0	None volatile RAM failure	
D1	Code flash failure	
D2	Configuration failure	
D3	IP Module failure	
D4	External RAM failure	
D5	Clock failure	
D6	CRC error detected	

Validity Byte (HEX)	Description	Additional Details
D7	Error in conversion of product temperature coefficient	
D8	Error in conversion of air density	
D9	Reserved for future use	
DA	Water dip aborted internally	A new command was received by the instrument.
DB	Density dip aborted internally	A new command was received by the instrument.
DC	Limit switch hit	If during normal Level measurement the upper or lower Limit Switch is hit, this is indicated in the Validity. If a Limit Switch is hit during a Water Bottom measurement (dip), this will be indicated in the Status.
DD	Floating roof correction volume exceeds coarse GOV	RoofCorr will be subtracted from CoarseGOV, which is TOV WaterVol, evt. corrected with CTSh, to obtain GOV, which must be >= 0.0.
DE	Available gross observed volume out of range	The calculated AvaGOV is <= 0.0,
DF	Reply from instrument contains error code	
E0	TOR, as received from instrument, not supported	The instrument returned an unknown Type Of Record.
E1	Reserved for future use	
E2	Error in received displacer status	
E3	Error in received HIMS density (ZQQ) status	
E4	Error in received product level status	811, 813, 854, 873 etc. ---------- Check the Level status (LS) Bit Error (STIC central) ---------- 7 (parity) 6 1 5 (not used) 4 Temp. out of range (no level correction) 3 Product level out of range 2 Contamination 1 No good data 0 Bad connection

Validity Byte (HEX)	Description	Additional Details
E5	Error in received (scanned, not dipped) water level status	Water Scout --- Bit Error (STIC central) --- 7 (parity) 6 1 5 (not used) 4 (not used) 3 (not used) 2 No Water found 1 No good data 0 Bad connection
E6	Error in product temperature status	811, 813, 854, 873 etc. --- Check the Temperature status (TS) Bit Error (STIC central) --- 7 (parity) 6 1 5 (not used) 4 (not used) 3 (not used) 2 Temperature out of range 1 No good data 0 Bad connection
E7	Error in received vapor temperature status	TS1 Bit Error --- 7 0 6 1 5 One or more temp. elements defective 4 Level exceeds highest temp. element 3 Level exceeds lowest temp. element 2 Failure in average gas temp. reading 1 Failure in average product reading 0 Failure in Temp. reading TS2 Bit Error --- 7 0 6 1 5 Temperature out of specified range 4 MTC: specified differential temp. exceeded 3 MTC: device not calibrated 2 Level timeout 1 Manual level used 0 Last valid level used

Validity Byte (HEX)	Description	Additional Details
E8	Reserved for future use	
E9	Reserved for future use	
EA	Error in received vapor pressure status	PS0 Bit Error ------ ---------- 7 0 6 1 5 Level timeout (HIMS only) 4 HiHi alarm 3 High alarm 2 LoLo alarm 1 Low alarm 0 General F/H/OPU failure PS1 Bit Error ------ ---------- 7 0 6 1 5 Exceeding range P3 4 Exceeding range P2 3 Exceeding range P1 2 P3 exceeds min. or max. trip value 1 P2 exceeds min. or max. trip value 0 P1 exceeds min. or max. trip value PS2 Bit Error ------ ---------- 7 0 6 1 5 Manual level used (HIMS only) 4 Last valid P3 used 3 Manual P3 used 2 P3 failure 1 P2 failure 0 P1 failure
EB	Error in conversion of volume from m3 to tank units	Used with the calculations of RoofCorr and LiqVap.
EC	Error in conversion of mathematically calculated volume to tank units	This conversion is used with mathematically (cylinder, sphere) calculated volumes, whilst the tank units are e.g. bbls.
ED	Error in received ambient temperature status	

Validity Byte (HEX)	Description	Additional Details
EE	Error in received dipped density status (ZSC, ZR0...ZR9)	Bit Error ------ ---------- 7 0 6 1 5 Conversion underflow 4 Conversion overflow 3 No measuring point or out of range 2 0: Tank profile; 1: Interface profile 1 Measurement not complete 0 General fail / Default setting
EF	Error in received density profile level status (ZD0...ZD9)	Status 0 Bit Error -------- ---------- 7 0 6 1 5 0 4 0 3 Level/Trajectory exceeds [ML] level 2 Level/Trajectory exceeds [MH] level 1 No valid [Y4] level 0 General fail / default setting Status 1 Bit Error -------- ---------- 7 0 6 1 5 0 4 0 3 0 2 No or invalid [DK] and/or [DN] level(s) (TP only) 1 Density trajectory stops below [DZ] or [EZ] level (TP only) 0 Trajectory exceeds [Y4] level, [DB] level too small (TP only)
F0	Reserved for future use	
F1	Error in received dipped water level status (811, 854, etc.)	
F2	Error in conversion of density (kg/m3) to tank units	The conversion from kg/m3 to Tank units is used by the What If calculator with the calculation of MassLiq.
F3	Error in conversion of mass (kg) to tank units	MassLiq and MassVap are always calculated in kg and will, after they have been calculated, be converted to Tank units.
F4	Input string too long	This validity is used by DLL functions, which receive an input string, when the number of input characters exceeds the length of an internally used buffer.It is used by e.g. ENRAF_ConvertNumber, when the number of input characters exceeds 4 (hex input), or 5 (decimal input).

Validity Byte (HEX)	Description	Additional Details
F5	ASTM no solution	NBR15639_2016 ---------- 789.24 <= DRef <= 998.2 (Dref as input) 793.51 <= Dobs <= 999.09 (Dobs as an input)"
F6	ASTM supercritical fluid	
F7	ASTM no reference fluids	
F8	Local gravity missing	Local gravity is used with pressure conversions and is not in the tank record.
F9	Product temperature coefficient out of range	p ASTM D1250-1980 Table 6 - ---------- C 2700 <= ProdTC <= 9300 p ASTM D1250-1980 Table 24 - ---------- C 2700 <= ProdTC <= 9300 p ASTM D1250-1980 Table 54 - ---------- C 4860 <= ProdTC <= 16740

Validity Byte (HEX)	Description	Additional Details
FA	Product temperature out of range	ASTM D4311-1983: Table 1 --- 0.0 <= Temp <= 500.0 ASTM D4311-1983: Table 2 --- -25.0 <= Temp <= 275.0 ASTM D4311-1996: Table 1 --- -25.0 <= Temp <= 275.0 p ASTM D1250-1980: Table 6 - --- A 0.0 <= APIRef <= 40.0 0.0 <= Temp <= 300.0 40.1 <= APIRef <= 50.0 0.0 <= Temp <= 250.0 50.1 <= APIRef <= 85.0 0.0 <= Temp <= 200.0 B 0.0 <= APIRef <= 40.0 0.0 <= Temp <= 300.0 40.1 <= APIRef <= 50.0 0.0 <= Temp <= 250.0 50.1 <= APIRef <= 85.0 0.0 <= Temp <= 200.0 C 2700 <= ProdTC <= 5100 0.0 <= Temp <= 300.0 5101 <= ProdTC <= 5300 0.0 <= Temp <= 250.0 5301 <= ProdTC <= 9300 0.0 <= Temp <= 200.0 D -10.0 <= APIRef <= 45.0 0.0 <= Temp <= 300.0 p ASTM D1250-1980: Table 24 - --- A 0.6110 <= DRef60/60 <= 0.7990 0.0 <= Temp <= 200.0 0.7995 <= DRef60/60 <= 0.8250 0.0 <= Temp <= 250.0 0.8255 <= DRef60/60 <= 1.0760 0.0 <= Temp <= 300.0 B 0.6535 <= DRef60/60 <= 0.7790 0.0 <= Temp <= 200.0 0.7995 <= DRef60/60 <= 0.8250 0.0 <= Temp <= 250.0 0.8255 <= DRef60/60 <= 1.0760 0.0 <= Temp <= 300.0 C 2700 <= ProdTC <= 5100 0.0 <= Temp <= 300.0 5101 <= ProdTC <= 5300 0.0 <= Temp <= 250.0 5301 <= ProdTC <= 9300 0.0 <= Temp <= 200.0 D (n.a.) (n.a.)

Validity Byte (HEX)	Description	Additional Details
		p ASTM D1250-1980: Table 54 - ---------- A 610.5 <= DRef <= 778.5 -18.0 <= Temp <= 95.0 779.0 <= DRef <= 824.0 -18.0 <= Temp <= 125.0 824.5 <= DRef <= 1075.0 -18.0 <= Temp <= 150.0 B 653.0 <= DRef <= 778.5 -18.0 <= Temp <= 95.0 779.0 <= DRef <= 824.0 -18.0 <= Temp <= 125.0 824.5 <= DRef <= 1075.0 -18.0 <= Temp <= 150.0 C 4860 <= ProdTC <= 9180 -18.0 <= Temp <= 95.0 9180 <= ProdTC <= 9540 -18.0 <= Temp <= 125.0 9540 <= ProdTC <= 16740 -18.0 <= Temp <= 150.0 D 800.0 <= DRef <= 1164.0 -20.0 <= Temp <= 150.0 E 0.500 <= DRef <= 0.595 -46.0 <= Temp <= 60.0 0.600 <= DRef <= 0.835 -25.0 <= Temp <= 75.0 0.840 <= DRef <= 0.865 -25.0 <= Temp <= 100.0 0.870 <= DRef <= 0.955 -25.0 <= Temp <= 125.0 0.960 <= DRef <= 1.100 -25.0 <= Temp <= 150.0 ASTM D4311M-2015 (@ 15ºC) ---------- -25.0 <= Temp <= 275.0 ASTM D4311-2015 ºAPI (@ 60 º F) ---------- 0.0 <= Temp <= 500.0 Aromatic HC — ASTM D1555M-2016 kg/m3 (@ 15 ºC) ---------- BE (Benzene) 5.0 <= Temp <= 60.0 CU (Cumene) -15.0 <= Temp <= 60.0 CY (Cyclohexane) 6.0 <= Temp <= 60.0 ET (Ethylbenzene) -15.0 <= Temp <= 60.0 ST (Styrene) -9.0 <= Temp <= 60.0 TO (Toluene) -20.0 <= Temp <= 60.0 MI (Mixed Xylenes) -15.0 <= Temp <= 60.0 MX (m-Xylene) -15.0 <= Temp <= 60.0 OX (o-Xylene) -15.0 <= Temp <= 60.0 PX (p-Xylene) 13.0 <= Temp <= 65.0 (300-350°F) Arom.HC -15.0 <= Temp <= 60.0 (350-400°F) Arom.HC -15.0 <= Temp <= 60.0

Validity Byte (HEX)	Description	Additional Details
		Aromatic HC — ASTM D1555-2016 ºAPI (@ 60 º F) BE (Benzene) 43.0 <= Temp <= 140.0 CU (Cumene) 5.0 <= Temp <= 140.0 CY (Cyclohexane) 44.0 <= Temp <= 140.0 ET (Ethylbenzene) 5.0 <= Temp <= 140.0 ST (Styrene) 15.0 <= Temp <= 140.0 TO (Toluene) -5.0 <= Temp <= 140.0 MI (Mixed Xylenes) 5.0 <= Temp <= 140.0 MX (m-Xylene) 5.0 <= Temp <= 140.0 OX (o-Xylene) 5.0 <= Temp <= 140.0 PX (p-Xylene) 56.0 <= Temp <= 150.0 (300-350°F)Arom. HC 5.0 <= Temp <= 140.0 (350-400°F)Arom. HC 5.0 <= Temp <= 140.0 SGS-2021 -35.0 <= Temp <= 30.0 NBR15639_2016 -20.0 <= Temp <= 50.0 EN15940_2019 -20.0 <= Temp <= 50.0
FB	Too many iterations	ASTM functions allow only a maximum number of iterations in order to calculate the Reference density.
FC	Observed density (or API) out of range	p ASTM D1250-1980 Table 5 A 0.0 <= API <= 100.0 B 0.0 <= API <= 85.0 D -10.0 <= API <= 45.0 p ASTM D1250-1980 Table 23 A 0.6110 <= DObs60/60 <= 1.0760 B 0.6535 <= DObs60/60 <= 1.0760 D (n.a.) p ASTM D1250-1980 Table 53 A 610.5 <= DObs <= 1075.0 B 653.0 <= DObs <= 1075.0 D 800.0 <= DObs <= 1164.0 EN15940_2019(Dobs/Tobs as an Input) 670.8 >= Dobs >= 851.6
FD	Reference density (or API) out of range	ASTM D4311-1983 Table 1 APIRef <= 34.9

Validity Byte (HEX)	Description	Additional Details
		ASTM D4311-1983 Table 2 ---------- 850.0 <= Dref ASTM D4311-1996 Table 1 ---------- 850.0 <= DRef p ASTM D1250-1980 Table 5 (see note) - ---------- A 610.627 <= DRef <= 1074.982 B 652.934 <= DRef <= 1074.982 D 800.0 <= DRef <= 1164.0 p ASTM D1250-1980 Table 23 (see note) - ---------- A 610.627 <= DRef <= 1074.982 B 652.934 <= DRef <= 1074.982 D (n.a.) p ASTM D1260-1980 Table 53 (see note) - ---------- A 610.627 <= DRef <= 1074.982 B 652.934 <= DRef <= 1074.982 D 800.0 <= DRef <= 1164.0 p ASTM D1250-1980 Table 6 - ---------- A 0.0 <= APIRef <= 100.0 B 0.0 <= APIRef <= 85.0 D -10.0 <= APIRef <= 45.0 E (n.a) p ASTM D1250-1980 Table 23 (see note) - ---------- A 610.627 <= DRef <= 1074.982 B 652.934 <= DRef <= 1074.982 D (n.a.) p ASTM D1260-1980 Table 53 (see note) - ---------- A 610.627 <= DRef <= 1074.982 B 652.934 <= DRef <= 1074.982 D 800.0 <= DRef <= 1164.0 Note: API is internally converted to Dref ASTM D4311M-2015 kg/m3 @ 15ºC ---------- 850.0 <= DRef

Validity Byte (HEX)	Description	Additional Details
		D4311-15 ºAPI (@60ºF) --- Dref <= 34.9 EN15940_2019 --- 700 >= Dref >= 830
FE	Temperature of observed density out of range	p ASTM D1250-1980: Table 5 - --- A 0.0 <= APIObs <= 40.0 0.0 <= TObs <= 300.0 40.1 <= APIObs <= 50.0 0.0 <= TObs <= 250.0 50.1 <= APIObs <= 85.0 0.0 <= TObs <= 200.0 B 0.0 <= APIObs <= 40.0 0.0 <= TObs <= 300.0 40.1 <= APIObs <= 50.0 0.0 <= TObs <= 250.0 50.1 <= APIObs <= 85.0 0.0 <= TObs <= 200.0 D -10.0 <= APIObs <= 45.0 0.0 <= TObs <= 300.0 p ASTM D1250-1980: Table 23 - --- A 0.6110 <= DObs60/60 <= 0.7990 0.0 <= TObs <= 200.0 0.7995 <= DObs60/60 <= 0.8250 0.0 <= TObs <= 250.0 0.8255 <= DObs60/60 <= 1.0760 0.0 <= TObs <= 300.0 B 0.6535 <= DObs60/60 <= 0.7790 0.0 <= TObs <= 200.0 0.7995 <= DObs60/60 <= 0.8250 0.0 <= TObs <= 250.0 0.8255 <= DObs60/60 <= 1.0760 0.0 <= TObs <= 300.0 D (n.a.) (n.a.) p ASTM D1250-1980: Table 53 - --- A 610.5 <= DObs <= 778.5 -18.0 <= TObs <= 95.0 779.0 <= DObs <= 824.0 -18.0 <= TObs <= 125.0 824.5 <= DObs <= 1075.0 -18.0 <= TObs <= 150.0 B 653.0 <= DObs <= 778.5 -18.0 <= TObs <= 95.0 779.0 <= DObs <= 824.0 -18.0 <= TObs <= 125.0 824.5 <= DObs <= 1075.0 -18.0 <= TObs <= 150.0 D 800.0 <= DObs <= 1164.0 -20.0 <= TObs <= 150.0 SGS-2021(Dobs, Tobs as an input) --- -35 <= Tobs <= 30 EN15940_2019(Dobs/Tobs as an Input) --- -20 <= Tobs <= 50

Validity Byte (HEX)	Description	Additional Details
FF	Reserved (may not be used to indicate invalid data)	Reserved (may not be used to indicate invalid data)

G.2 Status byte

The data status byte is bit coded. The meaning of the bits depends on the validity byte ($< 80_{HEX}$ or $\geq 80_{HEX}$). TABLE G-2 describes the possible status bytes.

TABLE G-2 Description of status bytes

Status Byte (bit)	Validity $< 80_{HEX}$ Description (bit set)	Validity $\geq 80_{HEX}$ Description (bit set)
7	Uncalibrated	Generate Alarm
6	Manual	No Data Available
5		Killed
4		Over Range
3		Under Range
2		Uninitialized
1	Stored	
0	Reduced Accuracy	

REMARKS:

1. Validity $< 80_{HEX}$ represents valid data. Suggested characters to display depending on the contents of the status byte:
   - uncalibrated = '#'
   - manual = '&'
   - stored = 'S'
   - reduced accuracy = '?'

   The data status basically exists of two parts which should be displayed in tabular data in two separate columns:
   - bit 7, which indicates whether the data is calibrated or not
   - bit 6...0, which (in decreasing priority) tell something about the physical status of the data
2. Validity $\geq 80_{HEX}$ represents invalid data. Suggested characters to display: 'FFFF' or 'blanks'.

APPENDIX H ENGINEERING UNITS

ID	Name	Type	Units	Range	Reso-lution	Default Offset	Default Scaling	Details
1	Meters	5	m	-999.999 9...+999.999 9	-4	0	10000	SI unit
2	Millimeters	5	mm	-999 999.9...+999 999.9	-1	0	10	1 mm = 0.001 m
3	Feet	5	ft	-999.999 9...+999.999 9	-4	0	10000	1 ft = 12 inch
4	Inches	5	in	-9 999.999...+9 999.999	-3	0	1000	1 inch = 0.0254 m
5	Sixteenth	5	in/16	-999 999.9...+999.999 9	-1	0	10	1 inch/16 = 1/16 inch
6	Fractions	5	fis	-999’11”15...+999’11”15	0	0	1	Feet, inches, inches/16 ID06 in its pure form are used for CIU Prime field communication and Entis Pro display only. Anywhere else in the CIU's, it is represented as a straight inch/16 integer.
7	FII256	5	fii/256	-99’11”255...+99’11”255	0	0	1	Feet, inches, inches/256 ID07 in its pure form are used for CIU Prime field communication only. Anywhere else in the CIU's, it is represented as a straight inch/256 integer.
8	TwoFiveSixth	5	in256	- 9 999 999...+9 999 999	0	0	1	For internal use only
20	Celsius	12	°C	-300.00...+300.00	-2	30000	100	Derived SI unit
21	Fahrenheit	12	°F	-400...+572.0	-1	4000	10	x °F = (x - 32.0) * 5/9 °C
22	Kelvin	12	K	0...573.15	-2	0	100	x K = x - 273.15 °C
23	Kelvin (rounded)	12	K273	0...573.00	-2	0	100	x K = x - 273.00 °C
30	Kgf cm sq	17	kgf/cm^2	0...65.535	-3	0	1000	1 kgf/cm² = (10 * 9,80665) kPa
31	Pascal	17	Pa	0...6 553 500	2	0	0.01	SI unit
32	Kilo Pascal	17	kPa	0...6 553.5	-1	0	10	1 kPa = 1000 Pa
33	PSI	17	psi	0...655.35	-2	0	100	1 psi = 0.45359237 * 10* (9,80665) / (2.54)² kPa. (psi is an abbreviation for 1 lbs/in2)
34	Atm	17	atm	0...65.535	-3	0	1000	1 atm = 101.325 kPa

ID	Name	Type	Units	Range	Reso-lution	Default Offset	Default Scaling	Details
35	Bar	17	bar	0...65.535	-3	0	1000	1 bar = 100 kPa
37	ATM relative	17	atm(rel)	-1.000...+64.535	-3	1	1000	x at(rel) = x + atmospheric pressure
39	PSIG	17	psig	-15.00...+630.35	-2	15	100	x psig = x + atmospheric pressure
41	PSI range 100	17	psi r100	0...99.99999	0	0	0	psi hundred range (item_PI=I) for field communication only Note: ENSITE is capable of configuring this number, but not communicating in it.
42	PSI range 1000	17	psi r1000	0...999.9999	0	0	0	psi thousand range (item_PI=S) for field communication only Note: ENSITE is capable of configuring this number, but not communicating in it.
50	Liter	11	L	0...999 999 999	0	0	1	1 liter = 1/1000 m3
51	Cubic meter	11	m^3	0...999 999.999	-3	0	1000	SI unit
52	US gallon	11	US gal	0...99 999 999.9	-1	0	10	1 US gallon = 231 cubic inches = 231*(0.0254)^3 m^3
53	Barrel	11	bbls	0...9 999 999.99	-2	0	100	1 bbls = 42 US gal
54	UK gallon	11	UK gal	0...99 999 999.9	-1	0	10	1 UK gallon = 4.546092 liter (ref. API MPMS Chapter 15, page 10)
55	Cubic centimeters	11	cm^3	0...999 999.99	-2	0	100	1000 cm^3 = 1 liter
56	Cubic decimeters		dm^3	0...999 999 990	0	0	0	1 dm^3 = 1 liter
60	Kilogra cubic meters	14	kg/m^3	0...9 999.99	-2	5000	100	SI unit
61	Degrees API	14	API	-50.00...+600.00	-2	5000	100	x °API = (141,5 / Spec. gravity 60/60) - 131,5 = {141,5 / (D60'F/999.012)} - 131.5 = {141,5*999.012/D60'F} - 131.5 = 141360.198 / (D60'F)-131.5 in which: D60'F is density in kg/m3 by 60'F
62	Pounds cubic feet	14	lbs/ft^3	0...999.999	-3	0	1000	= 0.45359237 / 0.3048^3 kg/m^3
63	DENS_60_60	14	RD60	0...9.999 99	-5	0	100000	= (Density in kg/m3) / 999.012 Also called Gravity 60/60
64	Lbs US gallon	14	lbs/ US gal	0...99.999 9	-4	0	10000	= x * 0.45359237/(231*0.0254^3) [kg/ m^3] (see dimensions 103 and 52)

ID	Name	Type	Units	Range	Reso-lution	Default Offset	Default Scaling	Details
65	Kilogram liters	14	kg/l	0...9.999 99	-5	0	10000	1 kg/l = 1000 kg/m^3 For internal use only
70	Cubic meter minute	18	m^3/min	-9 999.99...+9 999.99	-2	0	100	
71	Cubic meter hour	18	m^3/h	-99 999.9...+99 999.9	-1	0	10	
72	Liter minute	18	l/min	-999 999...+999 999	0	0	1	
73	Liter hour	18	l/hr	-999 999...+999 999	0	0	1	
74	Barrel minute	18	bbls/min	-9 999.99...+9 999.999	-2	0	100	
75	Barrel hour	18	bbls/hr	-99 999.9...+99 999.9	-1	0	10	
76	US gallon minute	18	US gal/ min	-999 999...+999 999	0	0	1	
77	US gallon hour	18	Us gal/hr	-999 999...+999 999	0	0	1	
78	UK gallon minute	18	UK gal/ min	-999 999...+999 999	0	0	1	
90	Meter second sq	20	m/s^2	0...99.999 9	-5	0	100000	SI unit
100	Kilogram	10	kg	0...999 999 999	0	0	1	SI unit
101	Metric ton	10	ton	0...999 999.999	-3	0	1000	x (metric) ton = 1000x kg
102	Short ton	10	US ton	0...999 999.999	-3	0	1000	x UStON = 2000 x lbs
103	Lbs	10	lbs	0...999 999 999	0	0	1	x lbs = 0.45359237x kg
104	Long ton	10	long ton	0...999 999.999	-3	0	1000	x Long ton = 2240x lbs
105	Gram	10	gram		0			
106	Pound	10	lbs		0	0		
110	Second	9	sec	0...59	0	0	1	seconds
11	Minute	9	min	0...59	0	0	1	minutes
112	Hour	9	hr	0...23	0	0	1	hours

ID	Name	Type	Units	Range	Reso-lution	Default Offset	Default Scaling	Details
113	Abs time	9	AbsTime	0	0	0	1	Reg. 1: Bit 15 Daylight Saving Bit 14 Un-initialized Bit 0..13 Year Reg. 2: Bit 14..15 Reserved Bit 10..13 Month Bit 5..9 Day Bit 0..4 Hour Reg. 3: Bit 8..15 Minutes Bit 0..7 Seconds
114	Day	9	dd	1...31	0	0	1	Day in the month
115	Month	9	MM	1...12	0	0	1	Month
116	Year	9	YYYY	0...65535	0	0	1	Year
117	Daylight Saving	9		0...1	0	0	1	Daylight saving active
120	ASCII	7	ASCII		0	0	1	1 char = 1 byte
121	Unicode	7	Unicode		0	0	1	1 char = 2 bytes
130	Mola value	19	kg/kmol	0...99.999 9	-4	0	10000	Molar value
140	Percentage	15	%	0...100.00	-2	0	100	Resolution depends on entity
150	Temp coeff celsius	16	10E-7/°C	0...99 999.999	-3	0	1000	
151	Temp coeff fahrenheit	16	10E-7/°F	0...99 999.999	-3	0	1000	
152	Temp coeff celsius	45	10E-5/°C	0...99 999.999	-3	0	1000	

ID	Name	Type	Units	Range	Reso-lution	Default Offset	Default Scaling	Details
153	Temp coeff fahrenheit	45	10E-5/°F	0...99 999.999	-3	0	1000	
160	Nodim	6	Nodim	0...2#bits	0	0	0	No dimension, unsigned value
161	Bit coded	1	Bit coded	0...2#bits	0	0	0	Separate bits
162	Index	4	Index	0...2#bits	0	0	0	Index refers to row number in a table
163	Status	8	Status	0...65535	0	0	0	See "entity Status Description Doc.nr 43"
170	Factor	13	Factor	0.00000...9.999 99	-5	0	100000	No dimension, unsigned value
171	Factor (Entis Pro only)	49	Factor 100	0.00000...9 999.99	-2	0	100	No dimension, unsigned value
172	Factor_1000	48	Factor 1000	0.00000...999.999	-3	0	1000	No dimension, unsigned value
180	Air density	47	kg/m^3 (air)	0...9.999	-3	0	1000	Air density unit (fixed to kg/m3; no conversion to any other unit allowed)
200	Kilogram	10	kg	-999 999 999... +999 999 999	0	0	1	SI unit
201	Metric ton	10	metric ton	-999 999 999... +999 999.999	-3	0	1000	x (metric) ton = 1000 x kg
202	US ton	10	US ton	-999 999 999... +999 999.999	-3	0	1000	x US ton = 2000 x lbs
203	Lbs	10	lbs	-999 999 999... +999 999 999	0	0	1	x lbs = 0.45359237 x kg
204	Long ton	10	long ton	-999 999 999... +999 999.999	-3	0	1000	x Long ton = 2240 x lbs
210	Liter	11	Liters	-999 999 999... +999 999 999	0	0	1	1 liter = 1/1000 m^3
211	Cubic meter	11	m^3	-999 999 999... +999 999.999	-3	0	1000	SI unit
212	US gallon	11	US gal	-99 999 999.9... +99 999 999.9	-1	0	10	1 US gallon = 231 cubic inches = 231*(0.0254)^3 m^3
213	Barrel	11	bbls	-9 999 999.99... +9 999 999.99	-2	0	100	1 bbls = 42 US gallon

ID	Name	Type	Units	Range	Reso-lution	Default Offset	Default Scaling	Details
214	UK gallon	11	UK gal	-99 999 999.9... +99 999 999.9	-1	0	10	1 UK gallon = 4.546092 liter (ref. API MPMS Chapter 15, page 10)
250	Acc. tot. liter	11	L	N/A	0	0	1	1 liter = 1/1000 m^3
251	Acc. tot. cubic meter	11	m^3	N/A	0	0	1000	SI unit
252	Acc. tot. centimeters	11	cm^3	N/A	0	0	100	1000 cm^3 = 1 liter
253	Acc. tot. decimeters	11	dm^3	N/A	0	0	0	1 dm^3 = 1 liter
254	Acc. tot. US gallon	11	US gal	N/A	0	0	10	1 US gallon = 231 cubic inches = 231*(0.0254)^3 m^3
255	Acc. tot. UK gallon	11	UK gal	N/A	0	0	10	1 UK gallon = 4.546092 liter (ref. API MPMS Chapter 15, page 10)
256	Acc. tot. barrel	11	bbls	N/A	0	0	100	1 bbls = 42 US gal
257	Millimeter	11	mm	N/A	0	0	100	
258	Cubic centimeter	11	cc	N/A	0	0	100	
259	Parts per million	15	ppm	N/A	0	0	0	
260	Milliliter per minute	56	ml/min	N/A	0	0		
261	Cubic centimeter per minute	56	cc/min	N/A	0	0		
262	UK Gallons per minute	18	UK gal/ min	N/A	0	0		
263	Cubic centimeter per minute	18	cm^3/min	N/A	0	0		
264	Cubic decimeter per minute	18	dm^3/min	N/A	0	0		
265	Liter	58	L	N/A	0	0		
266	Cubic meter	58	m^3	N/A	0	0		
267	Cubic centimeter	58	cm^3	N/A	0	0		
268	Cubic decimeter	58	dm^3	N/A	0	0		
269	US Gallons	58	US gal	N/A	0	0		
270	UK Gallons	58	UK gal	N/A	0	0		

ID	Name	Type	Units	Range	Reso-lution	Default Offset	Default Scaling	Details
271	Barrel	58	bbl	N/A	0	0		
272	Litre	59	L	N/A	0	0		
273	Cubic meter	59	m^3	N/A	0	0		
274	Cubic centimeter	59	cm^3	N/A	0	0		
275	Cubic decimeter	59	dm^3	N/A	0	0		
276	US Gallons	59	US gal	N/A	0	0		
277	UK Gallons	59	gal	N/A	0	0		
278	Barrel	59	bbl	N/A	0	0		
279	Liter	60	L	N/A	0	0		
280	Cubic meter	60	m^3	N/A	0	0		
281	Cubic centimeter	60	cm^3	N/A	0	0		
282	Cubic decimeter	60	dm^3	N/A	0	0		
283	US Gallons	60	US gal	N/A	0	0		
284	UK Gallons	60	UK gal	N/A	0	0		
285	Barrel	60	bbl	N/A	0	0		
286	Milliliter	61	ml	N/A	0	0		
287	Cubic centimeter	61	cc	N/A	0	0		
288	Kilogram per min	62	kg/min	N/A	0	0		
289	Metric ton per min	62	metric ton/min	N/A	0	0		
290	Pounds per min	62	Lb/min	N/A	0	0		
291	long ton per min UK	62	UK Long tn/min	N/A	0	0		
292	Short ton per min US	62	US short ton/min	N/A	0	0		
293	Pulses per Liter	63	Pulses/L	N/A	0	0	1	
294	Pulses per cubic meter	63	Pulses/m^3	N/A			1000	

ID	Name	Type	Units	Range	Reso-lution	Default Offset	Default Scaling	Details
295	Pulses per US Gal	63	Pulses/ gal	N/A	0	0	10	
296	Pulses per Barrel	63	Pulses/ bbl	N/A	0	0	100	
297	Pulses per UK Gal	63	Pulses/ Ugal	N/A	0	0	10	
298	Pulses per cubic centimeters	63	Pulses/ cm^3	N/A	0	0	100	
299	Pulses per cubic decimeters	63	Pulses/ dm^3	N/A	0	0	0	
300	Pulses per Kilogram	64	Pulses/kg	N/A	0	0	1	
301	Pulses per metric ton	64	Pulses/ ton	N/A	0	0	1000	
302	Pulses per Short ton	64	Pulses/ US ton	N/A	0	0	1000	
303	Pulses per lbs	64	Pulses/lb	N/A	0	0	1	
304	Pulses per long ton	64	Pulses/ long ton	N/A	0	0	1000	
305	CTPL(VCF)	65		0.00000	1.99999	0	0	

APPENDIX I LIST OF ABBREVIATIONS

Abbreviation	Description
ASCII	American Standard Code for Information Interchange
CIU	Communication Interface Unit
CRC	Cyclic Redundancy Check
CTL	Correction for Temperature Liquid
DCS	Distributed Control System
GOV	Gross Observed Volume
GSV	Gross Standard Volume
HEX	Hexadecimal
LRC	Longitudinal Redundancy Check
LSB	Least Significant Bit
MSB	Most Significant Bit
NSV	Net Standard Volume
PDU	Protocol Data Unit
PLC	Programmable Logic Controller
RTU	Remote Terminal Unit
SCADA	Supervisory Control and Data Acquisition
TGSV	Total Gross Standard Volume
TOV	Total Observed Volume
VCL	Volume Correction Factor
W&M	Weights and Measures

This page is intentionally left blank

APPENDIX J GENERAL CIU DIAGNOSTICS DETAILS AREA

TABLE J-1 gives a description of diagnostics entities available to the user via Modbus registers.

TABLE J-1 Description of diagnostics entities available to the user via Modbus registers

ID	Name	Description	Units	Dimension Type
10015	CIUSystemStatus	This parameter indicates the overall CIU 888 system status. • 0 = Unknown • 1 = Normal (Green LED) • 2 = Warning (Orange LED) • 3 = Fail (Red LED) Note : This is a CIU diagnostics entity	-	Nodim
10081	FieldSerialPortHealth	This health parameter indicates the health of field serial communication. If any of the field serial cables are disconnected but are configured to be used, then the health of this parameter is reduced. • 1 = Normal (Green LED) • 2 = Warning (Orange LED) • 3 = Fail (Red LED) • 4 = Not configured (Grey LED)	-	Nodim
10068	FieldCardType	Type of field card installed on the device. This is an indexed entity. • 0 = No field card • 1 = BPM field card • 2 = TRL2 field card • 3 = Serial field card • 4 = Unknown field card	-	Nodim
3517	FieldPortVersion	Version information of the CIU 888 field card. This is of the format x. For example, the version is 2.	-	text (ASCII)
10089	FieldCardFirmwareVersion	Firmware version of the installed field card. This is an indexed entity. "This is of the format x.y.z For example, the version is 1.0.4"	-	text (ASCII)
10081	FieldSerialPortHealth	This health parameter indicates the health of field serial communication. If any of the field serial cables are disconnected but are configured to be used, then the health of this parameter is reduced • 1 = Normal (Green LED) • 2 = Warning (Orange LED) • 3 = Fail (Red LED) • 4 = Not configured (Grey LED)	-	Nodim

ID	Name	Description	Units	Dimension Type
10068	FieldCardType	Type of field card installed on the device. This is an indexed entity. • 0 = No field card • 1 = BPM field card • 2 = TRL2 field card • 3 = Serial field card • 4 = Unknown field card	-	Nodim
3517	FieldPortVersion	Version information of the CIU 888 field card. This is of the format x. For example, the version is 2.	-	text (ASCII)
10089	FieldCardFirm-wareVersion	Firmware version of the installed field card. This is an indexed entity. "This is of the format x.y.z For example, the version is 1.0.4"	-	text (ASCII)
10081	FieldSerialPortH-ealth	This health parameter indicates the health of field serial communication. If any of the field serial cables are disconnected but are configured to be used, then the health of this parameter is reduced • 1 = Normal (Green LED) • 2 = Warning (Orange LED) • 3 = Fail (Red LED) • 4 = Not configured (Grey LED)	-	Nodim
10068	FieldCardType	Type of field card installed on the device. This is an indexed entity. • 0 = No field card • 1 = BPM field card • 2 = TRL2 field card • 3 = Serial field card • 4 = Unknown field card	-	Nodim
3517	FieldPortVersion	Version information of the CIU 888 field card. This is of the format x. For example, the version is 2.	-	text (ASCII)
10089	FieldCardFirm-wareVersion	Firmware version of the installed field card. This is an indexed entity. "This is of the format x.y.z For example, the version is 1.0.4"	-	text (ASCII)
10081	FieldSerialPortH-ealth	This health parameter indicates the health of field serial communication. If any of the field serial cables are disconnected but are configured to be used, then the health of this parameter is reduced • 1 = Normal (Green LED) • 2 = Warning (Orange LED) • 3 = Fail (Red LED) • 4 = Not configured (Grey LED)	-	Nodim

ID	Name	Description	Units	Dimension Type
10068	FieldCardType	Type of field card installed on the device. This is an indexed entity. • 0 = No field card • 1 = BPM field card • 2 = TRL2 field card • 3 = Serial field card • 4 = Unknown field card	-	Nodim
3517	FieldPortVersion	Version information of the CIU 888 field card. This is of the format x. For example, the version is 2.	-	text (ASCII)
10089	FieldCardFirmwareVersion	Firmware version of the installed field card. This is an indexed entity. "This is of the format x.y.z For example, the version is 1.0.4"	-	text (ASCII)
10081	FieldSerialPortHealth	This health parameter indicates the health of field serial communication. If any of the field serial cables are disconnected but are configured to be used, then the health of this parameter is reduced • 1 = Normal (Green LED) • 2 = Warning (Orange LED) • 3 = Fail (Red LED) • 4 = Not configured (Grey LED)	-	Nodim
10068	FieldCardType	Type of field card installed on the device. This is an indexed entity. • 0 = No field card • 1 = BPM field card • 2 = TRL2 field card • 3 = Serial field card • 4 = Unknown field card	-	Nodim
3517	FieldPortVersion	Version information of the CIU 888 field card. This is of the format x. For example, the version is 2.	-	text (ASCII)
10089	FieldCardFirmwareVersion	Firmware version of the installed field card. This is an indexed entity. "This is of the format x.y.z For example, the version is 1.0.4"	-	text (ASCII)
10071	SyncLinkConnectionStatus	Devices in a redundant setup will sync their data over a sync link. For several software modules it is important to know the status of the sync link. • 1 = Disconnected • 2 = Connected	-	Nodim
10073	ServiceLinkConnectionStatus	Connection Status of the Service link ethernet cable. Different values for this entity are : • 1 = Disconnected • 2 = Connected	-	Nodim
10074	HostEthernetConnectionStatus	Connection Status of the ethernet cable connected to the host ports. It is an indexed parameter. Different values for this entity are : • 1 = Disconnected • 2 = Connected	-	Nodim

ID	Name	Description	Units	Dimension Type
10112	FTEAActiveClients	This indicates number of active Modbus clients over FTEA interface of CIU 888. possible values of 0 to 15.	-	Nodim
10113	FTEATXPacket-Count	This indicates number of Modbus tx packets over FTEA interface of CIU 888. Possbile values of 0 to 2147483647	-	Packet Count
10114	FTEARXPacket-Count	This indicates number of Modbus Rx packets over FTEA interface of CIU 888. Possbile values of 0 to 2147483647	-	Packet Count
10115	FTEAErrorPacket-Count	This indicates number of Modbus error packets over FTEA interface of CIU 888. Possbile values of 0 to 2147483647	-	Packet Count
10074	HostEthernetCon-nectionStatus	Connection Status of the ethernet cable connected to the host ports. It is an indexed parameter. Different values for this entity are : • 1 = Disconnected • 2 = Connected	-	Nodim
10116	FTEBActiveClients	This indicates number of active Modbus clients over FTEB interface of CIU 888. possible values of 0 to 15.	-	Nodim
10117	FTEBTXPacket-Count	This indicates number of Modbus tx packets over FTEB interface of CIU 888. Possbile values of 0 to 2147483647	-	Packet Count
10118	FTEBRXPacket-Count	This indicates number of Modbus Rx packets over FTEB interface of CIU 888. Possbile values of 0 to 2147483647	-	Packet Count
10119	FTEBErrorPacket-Count	This indicates number of Modbus error packets over FTEB interface of CIU 888. Possbile values of 0 to 2147483647	-	Packet Count
10074	FieldEthernetCon-nectionStatus	Connection Status of the ethernet cable connected to the host ports. It is an indexed parameter. Different values for this entity are : • 1 = Disconnected • 2 = Connected	-	Nodim
10120	LANActiveClients	This indicates number of active Modbus clients over LAN interface of CIU 888. possible values of 0 to 15.	-	Nodim
10212	LANTXPacket-Count	This indicates number of Modbus tx packets over LAN interface of CIU 888. Possbile values of 0 to 2147483647	-	Packet Count
10122	LANRXPacket-Count	This indicates number of Modbus Rx packets over LAN interface of CIU 888. Possbile values of 0 to 2147483647	-	Packet Count
10123	LANErrorPacket-Count	This indicates number of Modbus error packets over LAN interface of CIU 888. Possbile values of 0 to 2147483647	-	Packet Count
10072	RemoteLinkCon-nectionStatus	Connection Status of the ethernet cable connected to the host ports. It is an indexed parameter. Different values for this entity are : • 1 = Disconnected • 2 = Connected	-	Nodim
10111	CompactFlash-DiskSpaceHealth	This parameter indicates the overall compact disk space health "0 - Unknown • 1 = Normal (Green LED) • 2 = Warning (Orange LED) • 3 = Fail (Red LED)	-	Nodim

ID	Name	Description	Units	Dimension Type
10056	CompactFlash-Size	Total size of compact flash card in mega bytes installed on this device. Possible values are 0 to 4096	-	Nodim
10057	CompactFlash-FreeSize	Total size of compact flash card in mega bytes installed on this device. Possible values are 0 to 4096	MB	Nodim
10083	RAMUsageHealth	This parameter indicates the health of RAM. • 0 = Unknown • 1 = Normal (Green LED) • 2 = Warning (Orange LED) • 3 = Fail (Red LED)	MB	Nodim
10055	RAMSize	Total size of RAM in mega bytes installed on this device. Possbile values are 0 to 4096	MB	Nodim
10063	AverageRA-MUsage	Average RAM used in percentage by the device. Possbile values are 0 to 100	%	Nodim
10076	CarrierBoardTem-peratureHealth	Health of Carrier board temperature. This health parameter will be affected by any or all of the carrier board temperature values. • 0 = Unknown • 1 = Normal (Green LED) • 2 = Warning (Orange LED) • 3 = Fail (Red LED)	-	Nodim
10050	CarrierBoardTem-perature1	Carrier board temperature for sensor 1 on the device. Possible values are -300 degree C to 300 degree C (or) -400 degree F to 572 degree F"	degree C / degree F	Tempera-ture
10051	CarrierBoardTem-perature2	Carrier board temperature for sensor 2 on the device. Possible values are -300 degree -400 degree F to 572 degree F"	degree C / degree F	Tempera-ture
10052	CarrierBoardTem-perature3	Carrier board temperature for sensor 3 on the device. Possible values are -300 degree C to 300 degree C (or) -400 degree F to 572 degree F"	degree C / degree F	Tempera-ture
10053	CarrierBoardTem-perature4	Carrier board temperature for sensor 4 on the device. Possible values are -300 degree C to 300 degree C (or) -400 degree F to 572 degree F"	degree C / degree F	Tempera-ture
10110	CPUCoreTem-peratureHealth	This parameter indicates the overall CPU core temperature health • 0 = Unknown • 1 = Normal (Green LED) • 2 = Warning (Orange LED) • 3 = Fail (Red LED)	-	Nodim
10054	CPUCoreTem-perature	Temperature of the CPU core of the device Possible values are -300 degree C to 300 degree C (or) -400 degree F to 572 degree F"	degree C / degree F	Tempera-ture

ID	Name	Description	Units	Dimension Type
3034	WMKeyStatus	Shows the status of WM Key • 0 = Unlocked • 1 = Locked	-	Tempera-ture
3033	WriteProtectKey-Status	Shows the status of configuration Key • 0 = Unlocked • 1 = Locked	-	Nodim
10062	Aver-ageCPUUsage	Average CPU in percentage used by the device. Possible values are 0 to 100	%	Nodim
532	CIURunHours	Total hours on power on since last default reset. Possbile val-ues are 0 to 2147483647	hours	hours
10500	CIU888Version	Version of this process in the format xxx.xxx.xxxx.x e.g. 1.0.5021.0	-	text (ASCII)
1092	CIU888Re-leaseNumber	CIU 888 release number in the format Rabc.d e.g. R140.1	-	text (ASCII)
10064	LastPowerUpTime	Last time when the device was powered up.	-	Absolute time
10065	LastPowerDown-Time	Last time when the device was powered down.	-	Absolute time
10066	LastPowerDown-Reason	Reason for the last power down. possbile values are 0 - Power cycled (1) • 0 = Power cycled (1) • 1 = Power cycled (2) • 2 = Power cycled (3) • 3 = Power cycled (4) • 4 = Power cycled (5) • 5 = Power cycled (6) • 6 = Internal FPGA failure • 7 = Overheated core processor • 8 = Restart by watchdog due to COMe issue • 9 = Restart by watchdog due to secondary controller issue • 10 = User initiated shutdown/restart • 11 = Unknown	-	Nodim
10058	FPGAVersion	Version of FPGA installed on this device "Format is abc e.g. 3d8"	-	text (ASCII)
10059	BIOSVersion	Version of BIOS installed on this device. "Format is abcdef e.g. 080015"	-	text (ASCII)
10060	SecondaryMicro-controllerVersion	Version of secondary microcontroller installed on this device "Format is x.y.z e.g. 2.1.2"	-	text (ASCII)
10069	LCDDisplayType	Type of LCD installed on the device. Different values for this entity are : • 0 = NewHaven • 1 = NewHaven1 • 2 = Unknown	-	Nodim

ID	Name	Description	Units	Dimension Type
10091	CIUSystemStatus-Description	This parameter indicated the reason for CIU system status in case CIU System status indicates Warning / Fail. Text limited to 250 characters	-	text (ASCII)

This page is intentionally left blank

For service-related questions, contact:

Technical Assistance Centre

Phone:

+1 800 423 9883 or

+1 215 641 3610

E-mail:

HFS-TAC-SUPPORT@honeywell.com

For More Information

To learn more about Honeywell Enraf's solutions, contact your Honeywell Enraf account manager or visit www.honeywellenraf.com.

Americas

Honeywell Enraf Americas, Inc.
1250 West Sam Houston Pkwy S.
Houston, TX 77042
USA
Phone: +1 (480) 293-2042
Email: enraf-us@honeywell.com

Europe, Middle East and Africa

Honeywell Enraf
Delftechpark 39
2628 XJ Delft the Netherlands
Phone: +31 (0)15 2701 100
Email: enraf-nl@honeywell.com

Asia Pacific

Honeywell Pte Ltd.
17 Changi Business Park Central 1
Singapore 486073
Phone: +65 6355 2828
Email: enraf-sg@honeywell.com

Honeywell

4417588_Rev16
December 2022