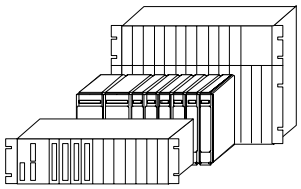
Ax 1703



Firmware Description

DNPMA0

Distributed Network Protocol 3.0 (DNP 3.0) Master
Unblanced Multiple Point Master

HW-Type: 2551 / FW-Type: 1553

This document is applicable to the following product(s):

DNPMA0	Rev. 01 and higher

Version	Revision	Date	Change
A, 1	00	17.01.07	First edition

Document information:

author / editor:	T. Schwarz / E. Josefik
server\service:	\\\VIE001\ENT_TDOK\
directory:	\Ax1703\FW\DNPSA0\
file name(s):	DNPMA0.DOC
file format:	WORD 2003

created		last change		relaesed	
on	by	on	by	on	by
17.01.07	Schwarz Th.			17.01.07	Wranek P.

Table of Contents

1. System overview

1.1. Brief description

The system element DNPMA0 is designed for the communication of Ax/ACP 1703 system components with remote terminal units in accordance with Distributed Network Protocol 3.00. The protocol operates on the principle of Unbalanced Multiple Point Master (multi-point traffic master station). The firmware is able to connect to a maximum of 20 RTU's. For the parameterisation of the data points, presently only a maximum of 3000 data records are available in the receive direction and only a maximum of 2500 data records in the transmit direction.

1.2. Technical data

Modulation:	PCM – byte asynchronous	
Transmission rate:	50 – 64000 Bit/s	
USART Byte frame:	8 Data bits none Parity bit (none parity) 1 Stop bit	
Bit transmission sequence:	LSB (least significant bit is transmitted first)	
Message protection:	HA = 6	
Message formats:	Command direction ->	commands set points General interrogation Counter interrogation Time synchronisation
	Transmit direction ->	binary information time tagged measured values time tagged integrated totals time tagged

This protocol element implements, as an adaptation to non-SAT systems, only a part of the functionality and the data formats of the non-SAT interface. For a concrete case of application, it is therefore to be checked, to what extent the real requirements correspond with the functionality implemented here and to what extent additional expansions or adaptations are required.

1.2.1. Limitations

The Firmware described in this specification only supports the data communication mode Unbalanced Multiple Point Master (multi-point traffic master function). However, the remote terminal unit can also transmit data without a call from the master (unsolicited response).

- Maximum data index = 65535 (16 bit)
- No disturbance record data
- only selected function codes (see chapter 2.2.4.4.)

The Firmware supports all user data objects of the DNP V3.00 "Subset Definitions Level 3", except "pattern control block" and "pattern mask" object types. The detailed description of supported data types and function codes can be found in the device profile document.

1.3. Used interface lines

The following V.24 interface lines are used:

TxD	<103>	Transmission data
RxD	<104>	Reception data
GND	<102>	Signal ground

In addition the following V.24 lines are used, however not in accordance with the V.24 recommendation.

RTS	<105>	serves to switch on the transmit signal level of the transmission facility
DCD	<109>	serves to detect the reception signal level of the transmission facility

1.4. Data communication control

The data communication control functions in accordance with the MASTER/SLAVE principle.

On demand for data by the master, the called remote terminal unit replies with the desired data.

The remote terminal unit is however also able to transmit spontaneous data without interrogation by the master (unsolicited response).

2. DNPMA0 protocol description

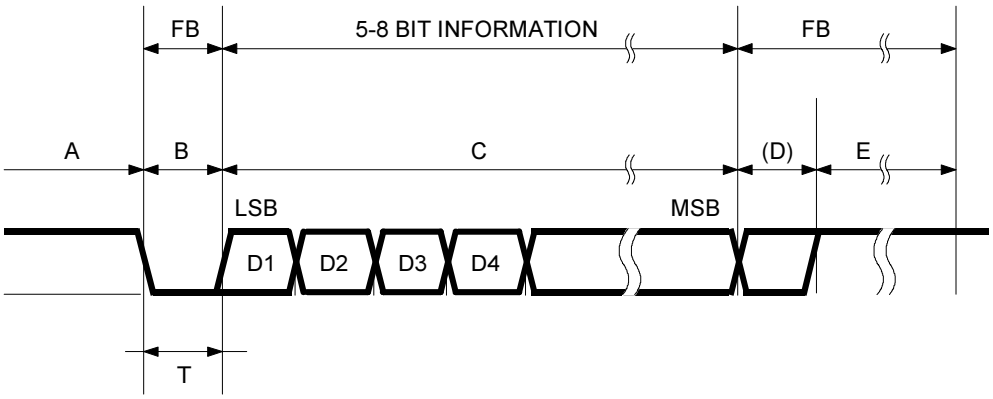
2.1. PCMBA-Modulation method

The data are modulated in groups, each of 8 bit pulse-code and transmitted asynchronously. A USART-module in asynchronous mode thereby provides every byte with a byte frame (BF).

For the DNP protocol, this byte frame contains:

1	Start bit
8	Data bits
1	Parity bit (normally used as no parity)
1	Stop bit

Due to the start- and stop bits of the byte frame, the synchronisation of the receiver takes place anew with every byte.



A: Off-circuit state of the line (binary information "1"), between two messages at least 33 bit (in case of error)
B: Start bit ("0")
C: 5-8 bit data (any frame data or message data), LSB (Least Significant Bit) is transmitted first
D: Parity bit (NO/ODD/EVEN PARITY) (= configurable)
E: 1/1, 5/2 Stop bit(s) ("1") (= configurable)
T: Time for the transmission of a bit (1/transmission rate)
FB: Framing bits of the USART module

2.2. Message description

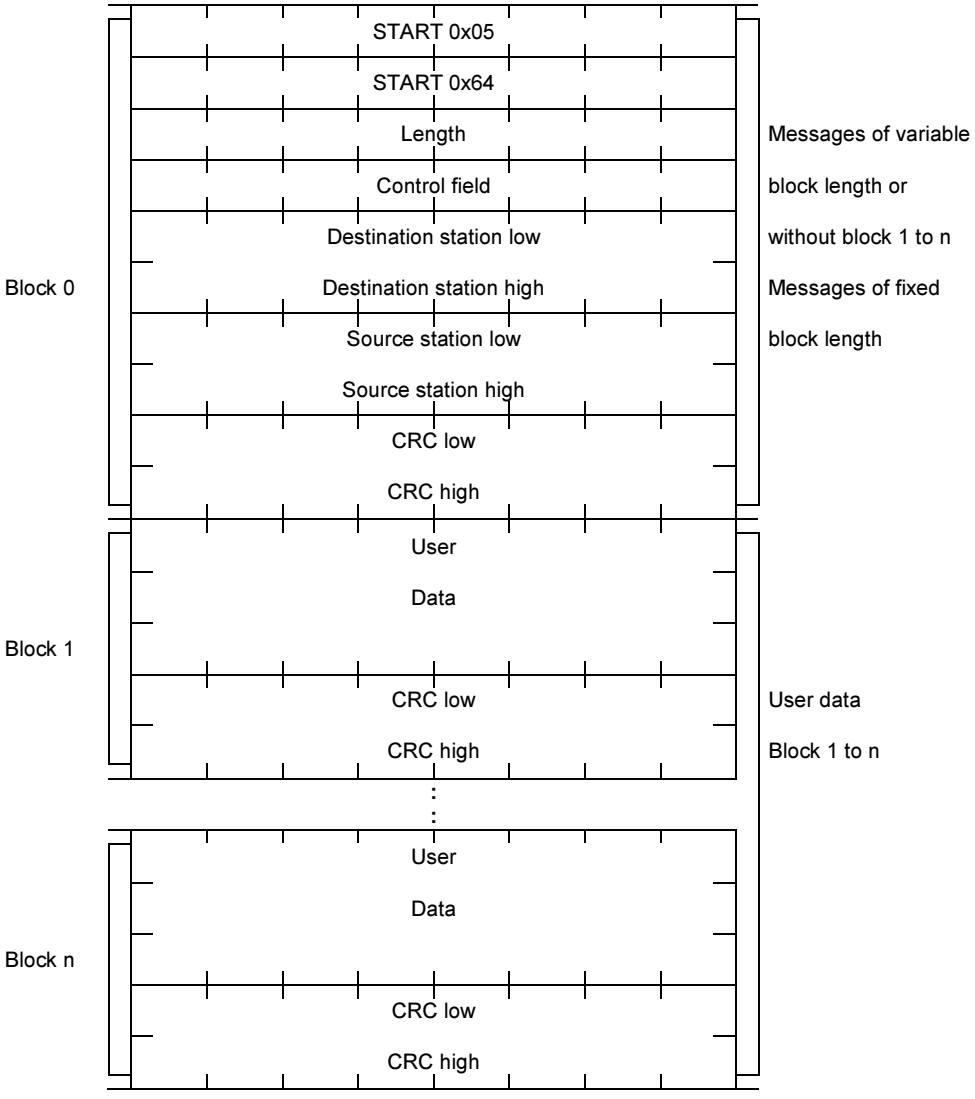
The message structure corresponds to the norms

IEC 870-5-1 "Transmission frame formats"
IEC 870-5-2 "Link transmission procedures"
IEC 870-5-5 "Basic Application Function"

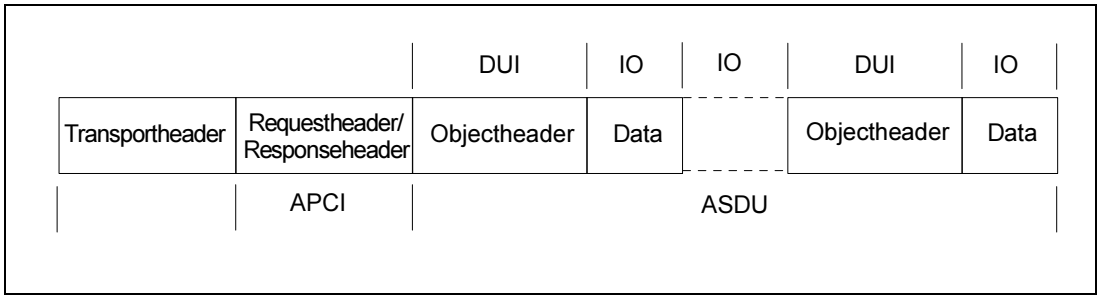
Only message format FT3 is supported.

For a precise message description, please refer to the general protocol documentation DNP.

2.2.1. Message format according to FT3

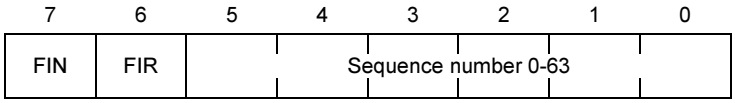


2.2.2. Message structure User Data



2.2.3. Transport header

The transport header is included in every message of a sequence.



FIN: If this bit is set, then this message is the last of a sequence or a fragment.

FIN = 0 More messages are to follow
FIN = 1 Last message of a fragment

FIR: This bit is set for the first message of a sequence or a fragment.

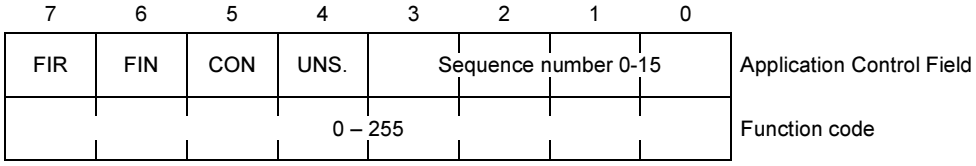
FIR =1 First message of a sequence
FIR =0 Part-message of a sequence

Sequence No.: The sequence number serves to identify the correct message sequence of fragments. It is used in a range of 0 to 63. With each message of a fragment, with the exception of the first message of a fragment, the sequence number is raised by 1. Once the sequence number has reached the value 63, then the next message of a sequence is transmitted with the sequence number 0. With each FIR bit that is set, a new sequence number is adopted.

2.2.4. Application header

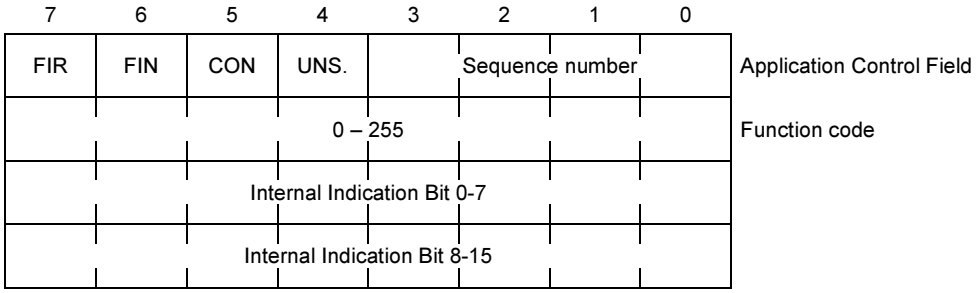
2.2.4.1. Request header

The request header is only included in the first message of a sequence. It comprises the application header and the function code. Only the master transmits a request header.



2.2.4.2. Response header

The response header is only included in the first message of a sequence. It comprises the application header, the function code and the internal indications. Only the slave transmits a response header.



2.2.4.3. Structure Application Control Field

The Application Control Field is used for the identification and utilisation of multifragment-messages.

FIR: If this bit is set, then this sequence is the first of a multifragment.

FIR = 0 More sequences are to follow
FIR = 1 First sequence of a multifragment

FIN: If this bit is set, then this sequence is the last of a multifragment.

FIN = 0 More messages are to follow
FIN = 1 Last sequence of a multifragment

CON: This bit is used for the application acknowledgement of a fragment.

CON = 0 No acknowledgement is expected
CON = 1 an acknowledgement is expected for this fragment

Uns.: This bit is set, when it has to do with an unsolicited response (spontaneous message of the remote terminal unit) or the application acknowledgement for an unsolicited response.

Uns. = 0 No unsolicited response
Uns. = 1 Unsolicited response

Sequence No.: The sequence number is used for identifying the sequence of individual fragments and the sequence of fragments within a multifragment. The sequence number is raised in a range of 0 to 15 with every application header received.
If an application acknowledgement is expected, then this acknowledgement has the same sequence number as the application header of the remote station that demanded this acknowledgement.

2.2.4.4. Application Function Code

2.2.4.4.1. Application Function Code of the Master

CODE	Function	Description	Supported by DNPMA0
General function codes			
0	confirm	Acknowledgement for a fragment at application level	✓
1	read	Interrogation for data	✓
2	write	Write/Save data	✓
Function codes for commands			
3	select	Selection or activation of commands or set point values without command output	✓
4	operate	Output of the selected or activated command or set point values	✓
5	direct operate	direct output of commands or set point values without prior selection	✓
6	direct operate – No Acknowledgement	direct output of commands or set point values without prior selection Do not generate acknowledgement about the status of the output	✓
Function codes for counters			
7	Immediate freeze	Freeze the data	✓
8	immediate freeze –No Acknowledgement	Freeze the data Do not generate acknowledgement about the status of the operation	✓
9	freeze and clear	Freeze and reset the data	✓
10	freeze and clear –No Acknowledgement	Freeze and reset the data Do not generate acknowledgement about the status of the operation	✓
11	freeze with time	Freeze the data at the moment stated	**X[1]**
12	freeze with time –No Acknowledgement	Freeze the data at the moment stated Do not generate acknowledgement about the status of the operation	**X[1]**

X[1] the integrated totals will be frozen at the reception time of the telegram

CODE	FUNCTION	DESCRIPTION	SUPPORTED BY DNPMA0
Application Control Function Codes			
13	cold restart	Carries out a cold restart in the remote terminal unit	X
14	warm restart	Carries out a warm restart in the remote terminal unit	X
15	initialise data to defaults	Initialises the data with the default values	X
16	initialise application	Initialises an application program	X
17	start application	Starts an application program	X
18	stop application	Stops an application program	X
Configuration Function Codes			
19	save configuration	Saves the configuration	X
20	enable unsolicited messages	Enables the transmission of spontaneous messages	✓
21	disable unsolicited messages	Disables the transmission of spontaneous messages	✓
22	assign class	The transmitted data are assigned a class (class 0,1,2 or 3)	✓
Time-synchronisation Function Codes			
23	delay measurement	Calculation of the message transfer time and time delay of the remote terminal unit for the time-synchronisation	✓
Reserved			
24 – 120		Reserved	X
121 – 128		Reserved	X

2.2.4.4.2. Application function codes of the Slave

CODE	Function	Description	Supported by DNPMA0
General function codes			
0	confirm	Acknowledgement for a fragment at application level	✓
129	response	Response to an interrogation for data	✓
130	unsolicited message	Spontaneous message of the remote terminal unit without interrogation from the master	✓

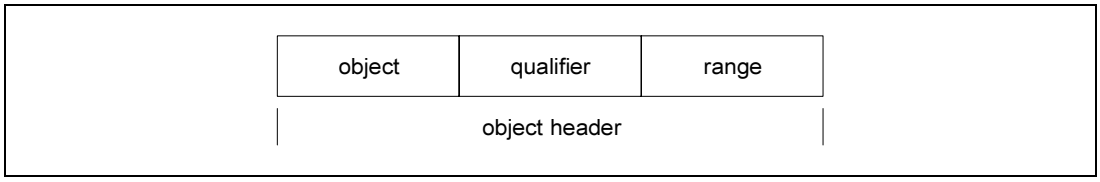
2.2.4.5. Internal Indication

Each message with user data of the remote terminal unit includes the internal indication in the response header. The internal indication comprises 16 bits and contains information and errors of the remote terminal unit.

Bit 0: A message addressed to all remote terminal units has been received.
Bit 1: Data class 1 available
Bit 2: Data class 2 available
Bit 3: Data class 3 available
Bit 4: The remote terminal unit expects a time-synchronisation.
Bit 5: Some or all data points are controlled locally (local/remote switch)
Bit 6: Error in the remote terminal unit
Bit 7: Cold restart of the remote terminal unit
Bit 8: The function code is not supported
Bit 9: The requested data do not exist in the remote terminal unit.
Bit 10: Error in qualifier/index field or in the range field of the object header
Bit 11: Event memory overflow
Bit 12: The received interrogation is being carried out.
Bit 13: Fault or error in the parameters of the remote terminal unit
Bit 14: Reserved
Bit 15: Reserved

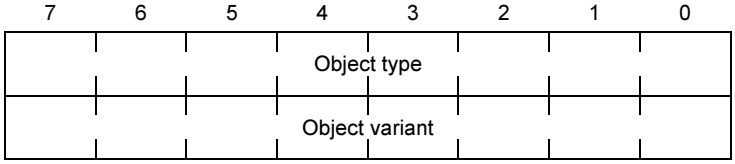
2.2.5. Structure of object header

The object header defines and describes the following data objects for this object header.



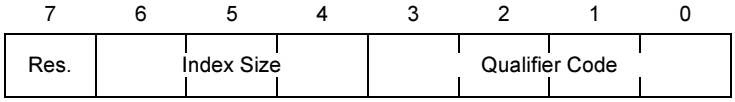
2.2.5.1. Object field of the object header

The object field consists of the object type and the object variant.



2.2.5.2. Qualifier-field of the object header

The qualifier-field determines the number and the structure of the individual data objects for this object header. For precise usage of the qualifier field, please refer to the general description of the DNP protocol.



The qualifier code determines how the data objects are addressed and structured and the index size defines how the index of the data objects is formed.

2.2.5.3. Range-field of the object header

The range-field can be a single index of a data object or a table from a start index and an end index. The size of the index can be maximum 32 bit or 42949671295.

2.2.6. Data objects

For the description of the individual data objects, please refer to the document DNP V3.00 Data Object Library of the DNP Organisation.

3. Message conversion

3.1. General

The conversion of the message formats Ax 1703 ↔ IEC 60870-5-103 and the conversion of the address information is described as message conversion.
The conversion of the address information is carried out with the aid of the OPM (Object-orientated Process-data Manager) protocol - detailed routing.

The following detailed routing types are available in the receive direction:

-Commands for single- or double commands
-Set point values normalised, scaled for set point commands and short floating point

The following detailed routing types are available in the transmit direction:

-Information as process information for single- or double-point information
-Measured values normalised, scaled or floating point
-Integrated totals as counting value signed 31 bit with sequence number

The Ax-address consists of 5 + 1 bytes:

1. Octet of the CAASDU/ region number
2. Octet of the CAASDU/ component number
1. Octet of the IOA/ module number
2. Octet of the IOA/ value number
3. Octet of the IOA/ sub address
Data type (process control addressing)

The non-SAT address consists of:

DNP link address
DNP data index (Address of the data point)
DNP object group

3.2. Message Conversion General Rules

3.2.1. Data Objects with Status Information

3.2.1.1. Status Information for Signals:

7							0
0/1	Res.	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0

Bit 0: Online (Status of the data point)
This status is shown on the IV-Status bit of the Ax-message.
0 = offline, the acquisition of the data point is possibly faulty.
1 = online, the data point was acquired correctly.

Bit 1: Restart (restart of the module that acquires this data point)
This status is not supported by the Firmware.
0 = normal, normal status
1 = restart, restart of the module

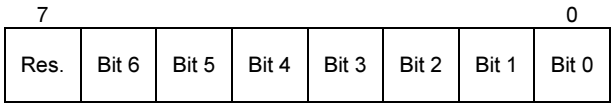
Bit 2: Communication lost (failure of the module that acquires this data point)
This status is shown on the NT-Status bit of the Ax-message.
0 = normal, normal status
1 = lost, communication failed

Bit 3: Remote Forced Data (The change to the data point was caused by a remote command)
This status is used as transmission cause feedback by remote command (11) in the Ax-message.
0 = normal, change without command
1 = remote forced, change due to a remote command

Bit 4: Local Forced Data (The change to the data point was caused by a local command)
This status is used as transmission cause feedback by local command (12) in the Ax-message.
0 = normal, change without command
1 = local forced, change due to a local command

Bit 5: Chatter Filter (The transmission of the data point was prevented as a result of too many changes; bounce suppression)
This status is not supported by the Firmware.
0 = normal, normal status
1 = filter on, bounce suppression

3.2.1.2. Status Information for Measured Values:



Bit 0: Online (Status of the data point)
This status is shown on the IV-Status bit of the Ax-message.
0 = offline, the acquisition of the data point is possibly faulty.
1 = online, the data point was acquired correctly.

Bit 1: Restart (restart of the module that acquires this data point)
This status is not supported by the Firmware.
0 = normal, normal status
1 = restart, restart of the module

Bit 2: Communication lost (failure of the module that acquires this data point)
This status is shown on the NT-Status bit of the Ax-message.
0 = normal, normal status
1 = lost, communication failed

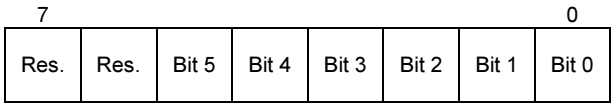
Bit 3: Remote Forced Data (The change to the data point was caused by a remote command)
This status is used as transmission cause feedback by remote command (11) in the Ax-message.
0 = normal, change without command
1 = remote forced, change due to a remote command

Bit 4: Local Forced Data (The change to the data point was caused by a local command)
This status is used as transmission cause feedback by local command (12) in the Ax-message.
0 = normal, change without command
1 = local forced, change due to a local command

Bit 5: Over-range (The acquisition/calculation of the measured value resulted in the measured value range being exceeded)
This status is shown on the OV-Status bit of the Ax-message.
0 = normal, normal status
1 = over-range, measured value range exceeded

Bit 6: Reference Check (Error in the reference voltage for the acquisition of the measured value)
This status is shown on the IV-Status bit of the Ax-message.
0 = normal, normal status
1 = error, error reference voltage

3.2.1.3. Status Information for Counter Values:



Bit 0: Online (Status of the data point)
This status is shown on the IV-Status bit of the Ax-message.
0 = offline, the acquisition of the data point is possibly faulty.
1 = online, the data point was acquired correctly.

Bit 1: Restart (restart of the module that acquires this data point)
This status is not supported by the Firmware.
0 = normal, normal status
1 = restart, restart of the module

Bit 2: Communication lost (failure of the module that acquires this data point)
This status is shown on the NT-Status bit of the Ax-message.
0 = normal, normal status
1 = lost, communication failed

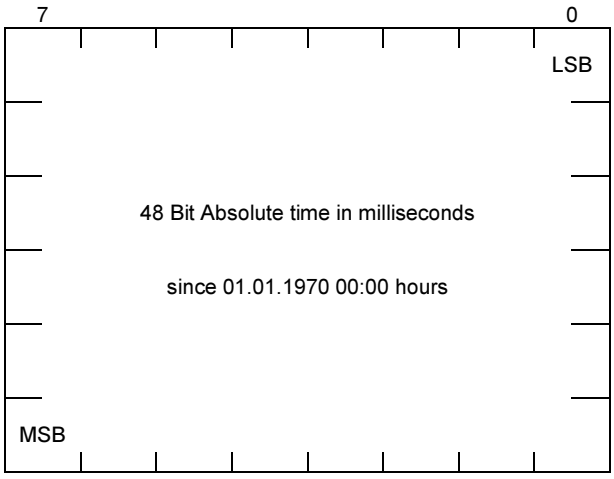
Bit 3: Remote Forced Data (The change to the data point was caused by a remote command)
This status is used as transmission cause feedback by remote command (11) in the Ax-message.
0 = normal, change without command
1 = remote forced, change due to a remote command

Bit 4: Local Forced Data (The change to the data point was caused by a local command)
This status is used as transmission cause feedback by local command (12) in the Ax-message.
0 = normal, change without command
1 = local forced, change due to a local command

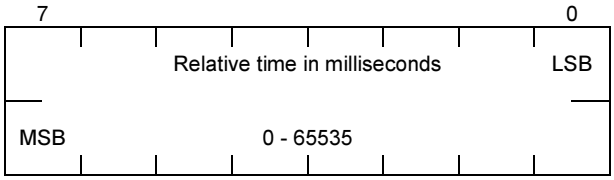
Bit 5: Roll-over (Overflow of the accumulated counter value above the maximum value)
This status serves to calculate the precise counter value or the change in the last transmitted counter value. If with the internal calculation of the counter value an overflow resulted, then the counter overflow bit (CY) in the Ax-message is set to counter value 31 Bit + VZ with sequence number.
0 = normal, normal status
1 = roll-over, counter overflow

3.2.2. Data Objects with Time Information

Time of Occurrence (Absolute Time):



Relative Time (Relative time):



If time tagged events occur and the time is within 59,999 seconds, it is also possible to transmit these data not with absolute time but instead with relative time. This relative time is based to one time object (common time of occurrence → CTO data object 51 variation 01 or 02) sent in prior to the data.

3.2.3. Message Conversion Time-Synchronisation

If time synchronisation is desired, it is possible to send the time synchronisation command to the RTU. The cycle for the request for time synchronisation can be set by system technical parameter. If cycle time is set to 0, the firmware will send out no time synchronisation command.

The time synchronisation runs in 2 steps. The first step is to determine the delay time for transmission and internal processing. The calculated delay time then will be added to the actual time in the time synchronisation object.

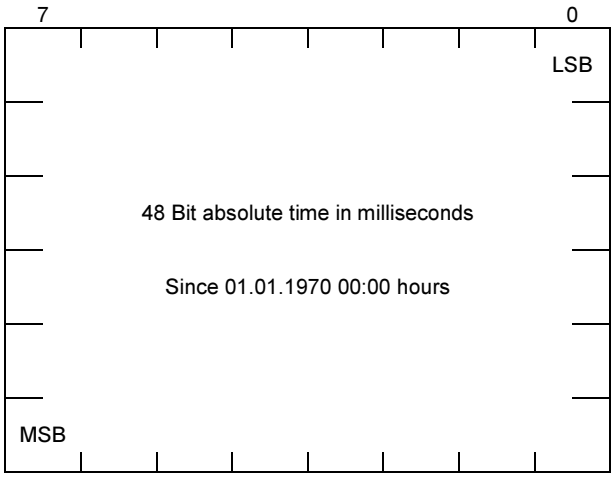
3.2.3.1. Measuring the time delay

An inquiry is transmitted to the remote terminal unit with the function code 23 (Delay Measurement) without data objects. The remote terminal unit replies with the data object Time Delay Fine (Data Object 52 – Variation 2). The content of this data object is the time delay of the remote terminal unit in milliseconds. The time delay is half of the message transfer time and the time delay of the remote terminal unit.

3.2.3.2. Time-setting message

Object format DNP V3.00 Time and Date:

Data Object 50 - Variation 01 Type: Static



The received DNP time format will be converted to internal real time and date format and then used to set the internal time of Ax/ACP system.

3.3. Message conversion in receive direction

DNP V3.00			SAT 1703	
Object type	**Object variation**	**Description**	**Description**	**TI**
1 2	1, 2 1, 2, 3	Binary Input Binary Input Change	Single binary input time tagged double binary input time tagged	30 31
3 4	1, 2 1, 2, 3	Double Binary Input Double Binary Input Change	double binary input time tagged	31
10 11	1, 2 1, 2	Binary Output Binary Cmd. Status	single binary input time tagged	30
30 32 34 40	1, 2, 3, 4,5 1, 2, 3, 4, 5, 7 1, 2, 3 1, 2, 3	Analog Input Analog Change Event Analog Input Deadband Analog Output Status	Measured value signed 15 Bit normalized Measured value signed 15 Bit scaled Measured value short floating point	34 35 36
20 21 22 23	1, 2, 5, 6 1, 2, 5, 6, 9, 10 1, 2, 5, 6 1, 2, 5, 6	Binary Counter Frozen Counter Counter Change Event Frozen Counter Event	Counter value signed 31 Bit with sequence number	37
52	2	Time Delay Fine	Time synchronisation	1)

1) Internal evaluation by firmware only

3.3.1. Message conversion binary information

3.3.1.1. Conversion of Single Binary Input

Object format DNP V3.00 Binary Input:

Object type 1 - variation 01 Type: Static

7							0
7	6	5	4	3	2	1	0
15	14	13	12	11	10	9	8
	↓						
0	0	0	n	n-1	n-2	n-3	n-4

Object format DNP V3.00 Binary Input with Status:

Object type 1 - variation 02 Type: Static

7							0
0/1	Res.	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0

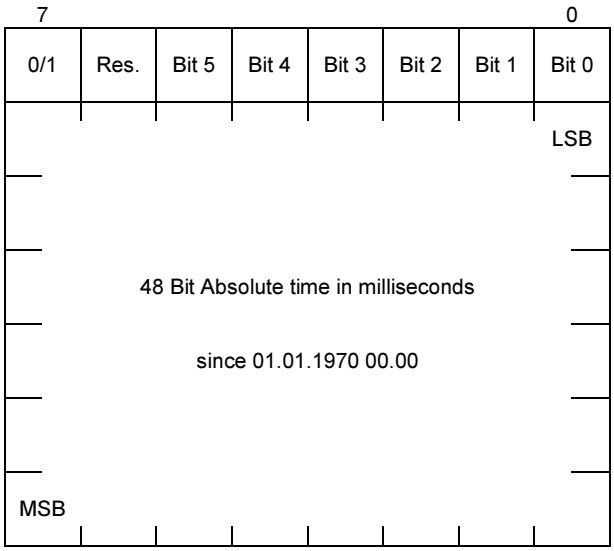
Object format DNP V3.00 Binary Input Change without Time:

Object type 2 - variation 01 Type: Event

7							0
0/1	Res.	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0

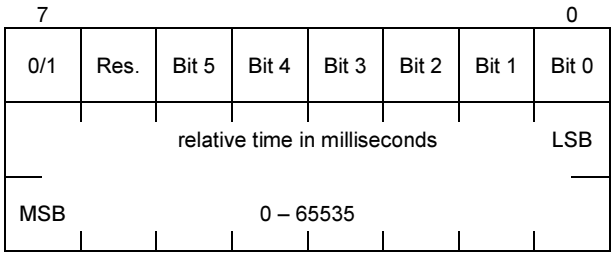
Object format DNP V3.00 Binary Input Change with Time:

Object type 2 - variation 02 Type: Event



Object format DNP V3.00 Binary Input Change without Time:

Object type 2 - variation 03 Type: Event



Address conversion SAT 1703 → DNP V3.00:

The address conversion is parameterised with the help of the OPM (Object-orientated Process-data Manager). For this, in the protocol detailed routing, the detailed routing type "REC_Information" is made available with the following entries.

Supported SAT 1703-message formats:

- 1 Single-point information (TI = 30)
- 1 Double-point information (TI = 31)

SAT 1703-Address:

CASDU1 CASDU2 IOA1 IOA2 IOA3		5-level freely parameterised SAT 1703 destination address possible: 0 – 255

TI: Type identification
possible: 30 = Single-point information
31 = Double-point information

DNP 3.0 Address:

Link address: Link layer station number

DNP Data index: Unambiguous address of this data point
possible: 0-65535

Object group: Assignment of the data to the DNP object types
possible: single binary Input
double Binary Input
binary output

Additional information:

Not used

Conversion information:

Data type bin. information:
- single-point information
- single-point information inverted
- double-point information OFF before ON
- double-point information ON before OFF
- double-point information state OFF
- double-point information state ON

This defines the type and the conversion of the data.

Binary inf. Conversion:
- single-point information
- transient information transfer only ON state
- transient information reproduce OFF state
- double-point information with suppressing of intermediate position
- double-point information without suppressing of intermediate position

This defines the conversion of the binary information.

GI-Behaviour:
- no data transfer from the process image during GI
- transfer data from the process image during GI

This defines whether or not the data should be transferred during GI.
This is used for data that will not be transmitted during GI by the RTU.

3.3.1.2. Conversion of Double Binary Input

Object format DNP V3.00 Binary Input:

Object type 1 - variation 01 Type: Static

7							0
7	6	5	4	3	2	1	0
15	14	13	12	11	10	9	8
	↓						
0	0	0	n	n-1	n-2	n-3	n-4

Object format DNP V3.00 Binary Input with Status:

Object type 1 - variation 02 Type: Static

7							0
ON	OFF	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0

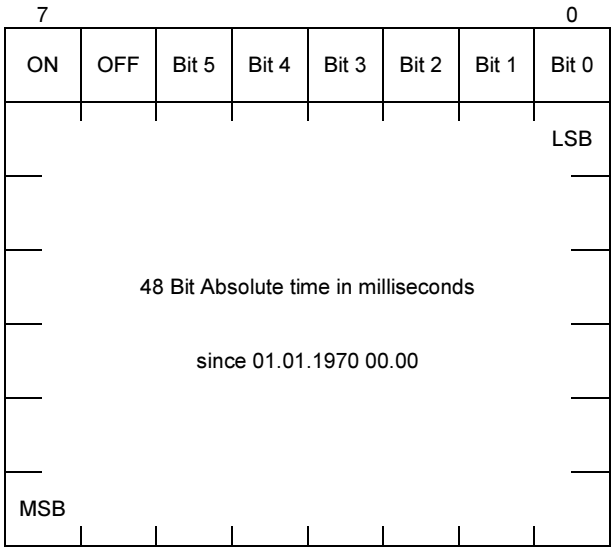
Object format DNP V3.00 Binary Input Change without Time:

Object type 2 - variation 01 Type: Event

7							0
ON	OFF	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0

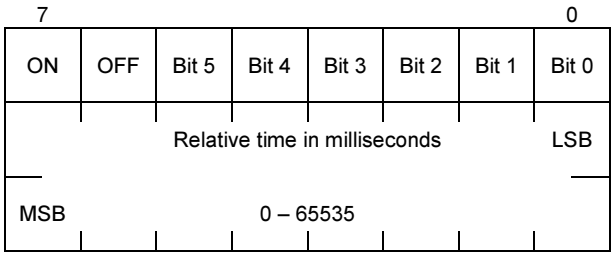
Object format DNP V3.00 Binary Input Change with Time:

Object type 2 - variation 02 Type: Event



Object format DNP V3.00 Binary Input Change without Time:

Object type 2 - variation 03 Type: Event



Address conversion DNP V3.00 → SAT 1703:

The address conversion is parameterised with the help of the OPM (Object-orientated Process-data Manager). For this, in the protocol detailed routing, the detailed routing type "TRA_Information" is made available with the following entries.

Supported SAT 1703-message formats:

- 1 Double-point information (TI = 31)

SAT 1703-Address:

CASDU1 CASDU2 IOA1 IOA2 IOA3		5-level freely parameterised SAT 1703 destination address possible: 0 – 255

TI: Type identification
possible: 31 = Double-point information

DNP 3.0 Address:

Link address: Link layer station number

DNP Data index: Unambiguous address of this data point
possible: 0-65535

Object group: Assignment of the data to the DNP object types
possible: double Binary Input

Additional information:

Not used

Conversion information:

Data type bin. information:
- single-point information
- single-point information inverted
- double-point information OFF before ON
- double-point information ON before OFF
- double-point information state OFF
- double-point information state ON

This defines the type and the conversion of the data.

Binary inf. Conversion:
- single-point information
- transient information transfer only ON state
- transient information reproduce OFF state
- double-point information with suppressing of intermediate position
- double-point information without suppressing of intermediate position

This defines the conversion of the binary information.

GI-Behaviour:
- no data transfer from the process image during GI
- transfer data from the process image during GI

This defines whether or not the data should be transferred during GI. This is used for data that will not be transmitted during GI by the RTU.

3.3.1.3. Conversion of Binary Output

Object format DNP V3.00 Binary Output:

Object type 10 - variation 01 Type: Static

7							0
7	6	5	4	3	2	1	0
15	14	13	12	11	10	9	8
	↓						
0	0	0	n	n-1	n-2	n-3	n-4

Object format DNP V3.00 Binary Output with Status:

Object type 10 - variation 02 Type: Static

7							0
0/1	Res.	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0

Address conversion SAT 1703 → DNP V3.00:

The address conversion is parameterised with the help of the OPM (Object-orientated Process-data Manager). For this, in the protocol detailed routing, the detailed routing type "REC_Information" is made available with the following entries.

Supported SAT 1703-message formats:

- 1 Single-point information (TI = 30)

SAT 1703-Address:

CASDU1 CASDU2 IOA1 IOA2 IOA3		5-level freely parameterised SAT 1703 destination address possible: 0 – 255

TI: Type identification
possible: 30 = Single-point information

DNP 3.0 Address:

Link address: Link layer station number

DNP Data index: Unambiguous address of this data point
possible: 0-65535

Object group: Assignment of the data to the DNP object types
possible: binary output

Additional information:

Not used

Conversion information:

Data type bin. information:
- single-point information
- single-point information inverted
- double-point information OFF before ON
- double-point information ON before OFF
- double-point information state OFF
- double-point information state ON

This defines the type and the conversion of the data.

Binary inf. Conversion:
- single-point information
- transient information transfer only ON state
- transient information reproduce OFF state
- double-point information with suppressing of intermediate position
- double-point information without suppressing of intermediate position

This defines the conversion of the binary information.

GI-Behaviour:
- no data transfer from the process image during GI
- transfer data from the process image during GI

This defines whether or not the data should be transferred during GI.
This is used for data that will not be transmitted during GI by the RTU.

3.3.2. Message Conversion Measured Values

Object format DNP V3.00 32 Bit Analog Input:

Object type 30 - variation 01 Type: Static

Object format DNP V3.00 32 Bit Frozen Analog Input:

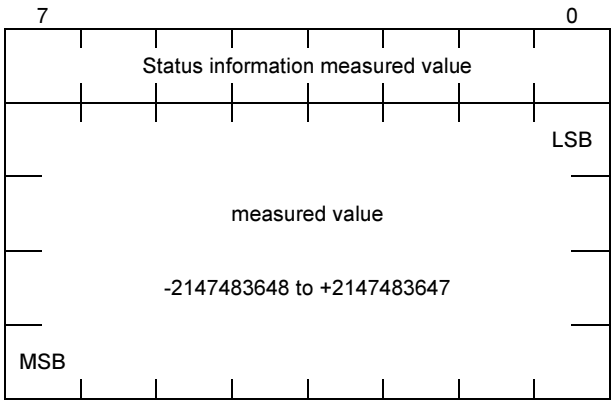
Object type 31 - variation 01 Type: Static

Object format DNP V3.00 32 Bit Analog Change Event without Time:

Object type 32 - variation 01 Type: Event

Object format DNP V3.00 32 Bit Frozen Analog Event without Time:

Object type 33 - variation 01 Type: Event

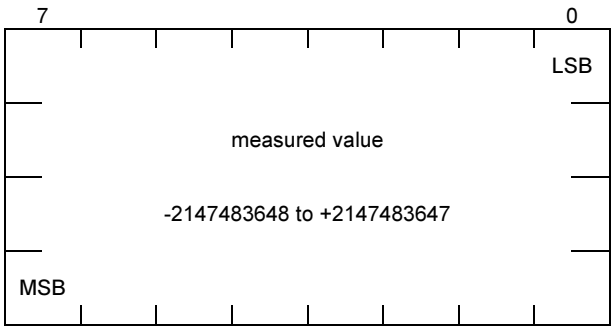


Object format DNP V3.00 32 Bit Analog Input without Flag:

Object type 30 - variation 03 Type: Static

Object format DNP V3.00 32 Bit Frozen Analog Input without Flag:

Object type 31 - variation 05 Type: Static



Object format DNP V3.00 32 Bit Frozen Analog Input with Time of Freeze:

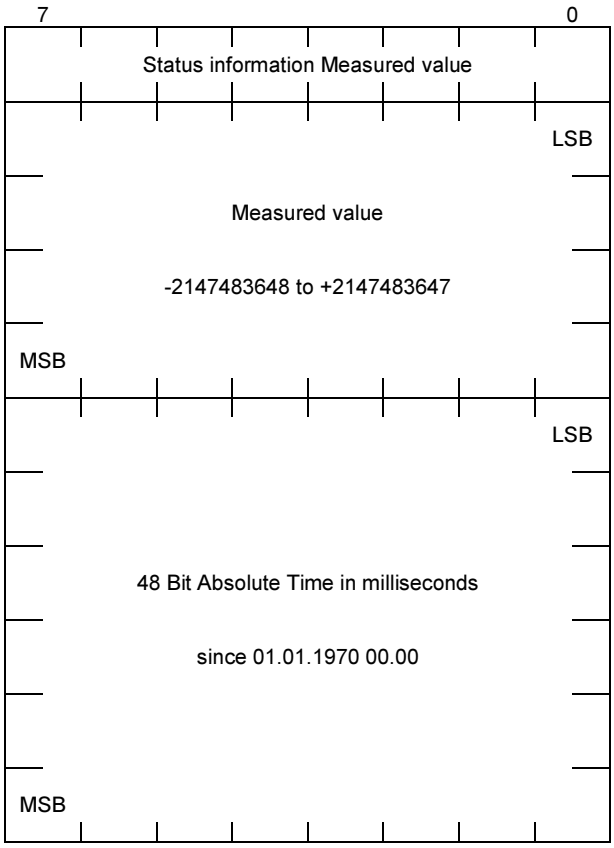
Object type 31 - variation 03 Type: Static

Object format DNP V3.00 32 Bit Analog Change Event with Time:

Object type 32 - variation 03 Type: Event

Object format DNP V3.00 32 Bit Frozen Analog Event with Time:

Object type 33 - variation 03 Type: Event



Object format DNP V3.00 16 Bit Analog Input:

Object type 30 - variation 02 Type: Static

Object format DNP V3.00 16 Bit Frozen Analog Input:

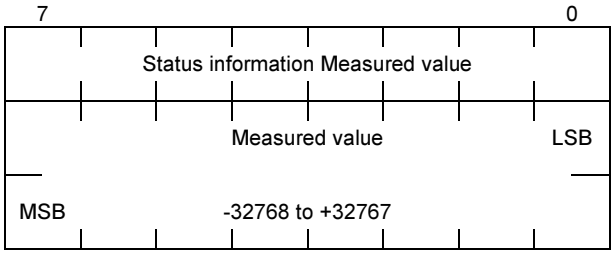
Object type 31 - variation 02 Type: Static

Object format DNP V3.00 16 Bit Analog Change Event without Time:

Object type 32 - variation 02 Type: Event

Object format DNP V3.00 16 Bit Frozen Analog Event without Time:

Object type 33 - variation 02 Type: Event

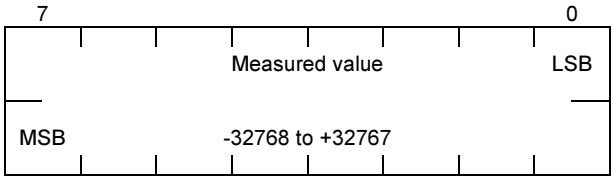


Object format DNP V3.00 16 Bit Analog Input without Flag:

Object type 30 - variation 04 Type: Static

Object format DNP V3.00 15 Bit Frozen Analog Input without Flag:

Object type 31 - variation 06 Type: Static



Object format DNP V3.00 16 Bit Frozen Analog Input with Time of Freeze:

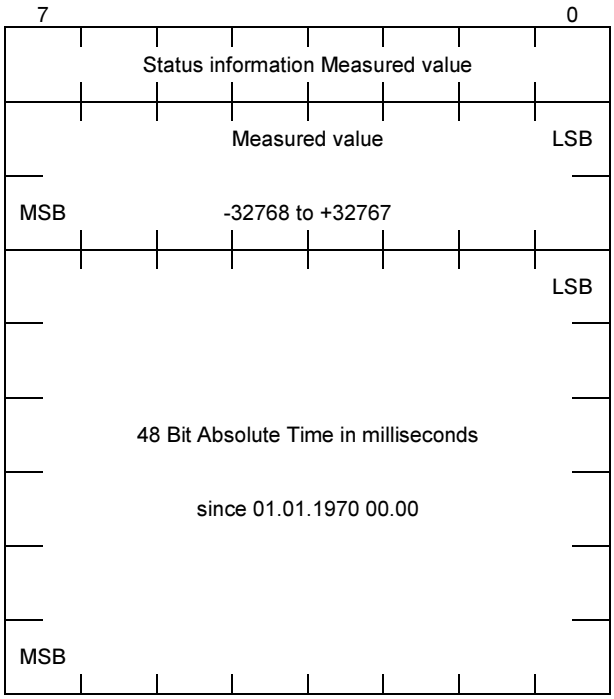
Object type 31 - variation 04 Type: Static

Object format DNP V3.00 16 Bit Analog Change Event with Time:

Object type 32 - variation 04 Type: Event

Object format DNP V3.00 16 Bit Frozen Analog Event with Time:

Object type 33 - variation 04 Type: Event



Object format DNP V3.00 short floating point Analog Input:

Object type 30 - variation 05 Type: Static

Object format DNP V3.00 short floating point Frozen Analog Input:

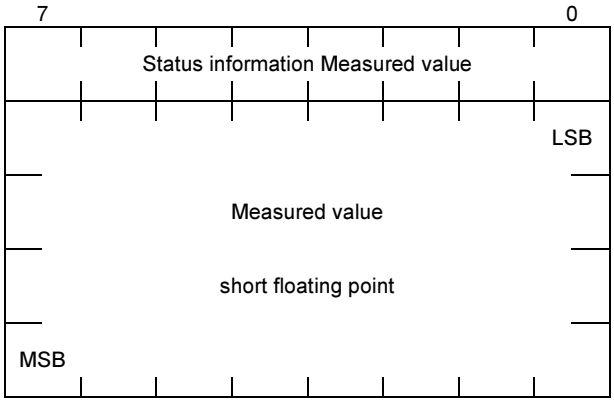
Object type 31 - variation 07 Type: Static

Object format DNP V3.00 short floating point Analog Change Event without Time:

Object type 32 - variation 05 Type: Event

Object format DNP V3.00 short floating point Frozen Analog Event without Time:

Object type 33 - variation 05 Type: Event

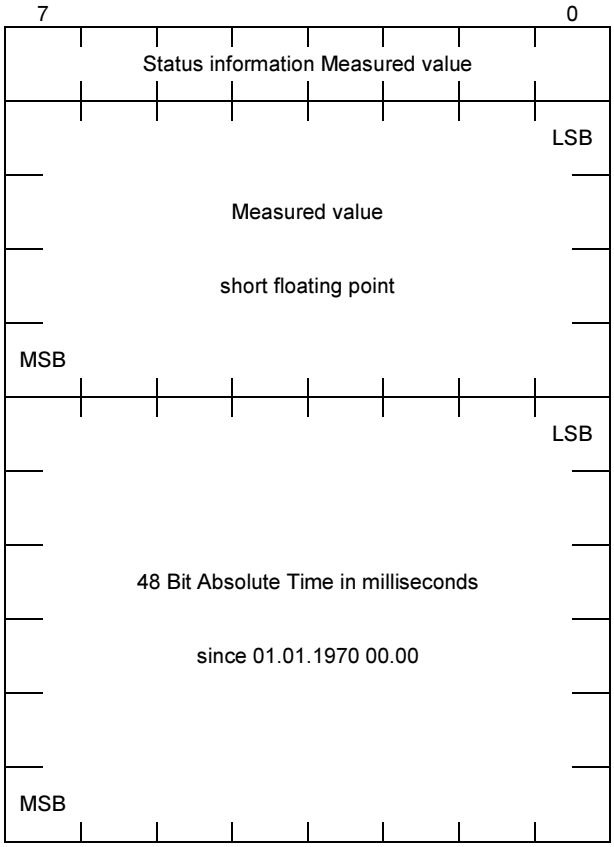


Object format DNP V3.00 short floating point Analog Change Event with Time:

Object type 32 - variation 07 Type: Event

Object format DNP V3.00 short floating point Frozen Analog Event with Time:

Object type 33 - variation 04 Type: Event



Address conversion DNP V3.00 → SAT 1703:

The address conversion is parameterised with the help of the OPM (Object-orientated Process-data Manager). For this, in the protocol detailed routing, the detailed routing type "REC_Measured_value" is made available with the following entries.

Supported SAT 1703-message formats:

- measured value signed 15 bit normalised (TI = 34)
- measured value signed 15 bit scaled (TI = 35)
- measured value short floating point (TI = 36)

SAT 1703-Address:

CASDU1 CASDU2 IOA1 IOA2 IOA3	5-level freely parameterised SAT 1703 destination address possible: 0 – 255

TI: Type identification
possible: 34 = measured value signed 15 bit normalised
35 = measured value signed 15 bit scaled
36 = measured value short floating point

DNP 3.0 Address:

Link address: Link layer station number

DNP Data index: Unambiguous address of this data point
possible: 0-65535

Object group: Assignment of the data to the DNP object types
possible: analog input
analog input deadband
analog output

Additional information:

Not used

Conversion information:

Additional information for set point values/measured values:

Adaption X0:	This is the minimum value of the SAT internal analog value (source)
Adaption X100:	This is the maximum value of the SAT internal analog value (source)
Adaption Y0:	This is the minimum value of the DNP external analog value (destination)
Adaption Y100:	This is the maximum value of the DNP external analog value (destination)
Measured value threshold:	Change monitoring of analog values (large threshold) If the deviation from the most recent transmitted value is greater or equal to the large threshold, the new value will be transmitted immediately.
Measured value threshold:	Change monitoring of analog values (additive threshold) Otherwise, the deviations from the most recent transmitted value are added each time the value was received taking polarity signs into account. Only when this sum surpasses the adjusted limit value (additive threshold) will a transmission with the current (new) value be triggered.

3.3.3. Message Conversion Integrated Totals

Object format DNP V3.00 32 Bit Binary Counter:

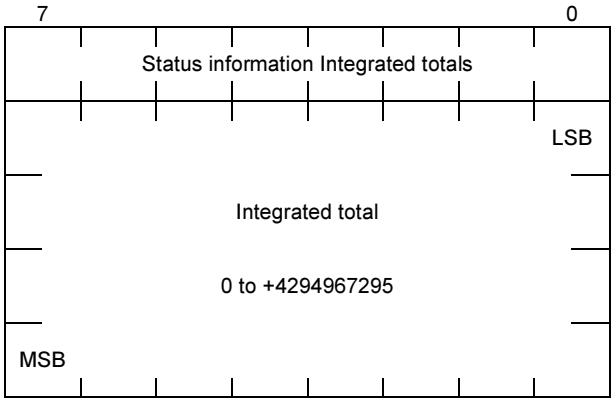
Object type 20 - variation 01 Type: Static

Object format DNP V3.00 32 Bit Frozen Binary Counter:

Object type 21 - variation 01 Type: Static

Object format DNP V3.00 32 Bit Binary Frozen Counter Change Event without Time:

Object type 23 - variation 01 Type: Event

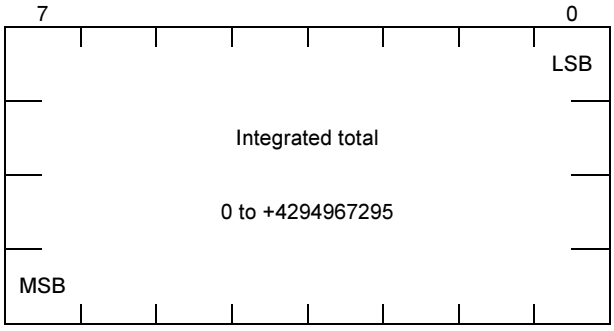


Object format DNP V3.00 32 Bit Binary Counter without Flag:

Object type 20 - variation 05 Type: Static

Object format DNP V3.00 32 Bit Binary Frozen Counter without Flag:

Object type 21 - variation 09 Type: Static



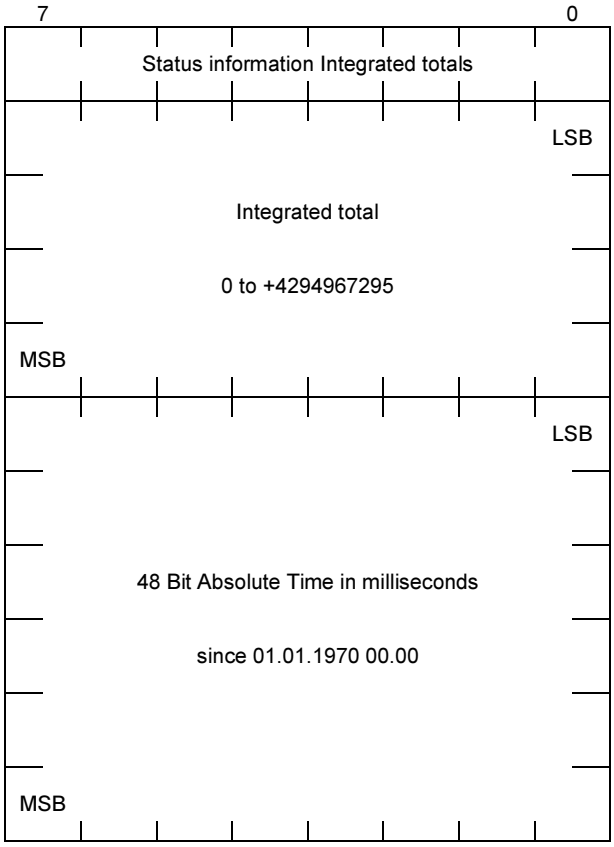
Object format DNP V3.00 32 Bit Binary Frozen Counter with Time of Freeze:

Object type 21 - variation 05 Type: Static

Object format DNP V3.00 32 Bit Binary Frozen Delta Counter with Time of Freeze:

Object format DNP V3.00 32 Bit Binary Frozen Counter Change Event with Time:

Object type 23 - variation 05 Type: Event



Object format DNP V3.00 16 Bit Binary Counter:

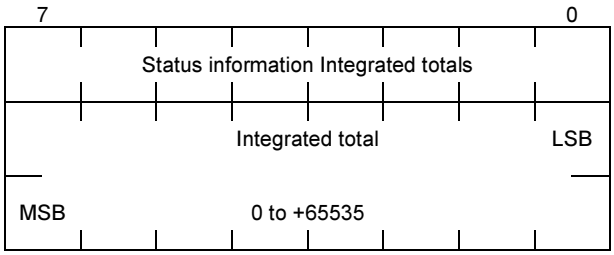
Object type 20 - variation 02 Type: Static

Object format DNP V3.00 32 Bit Frozen Binary Counter:

Object type 21 - variation 02 Type: Static

Object format DNP V3.00 32 Bit Binary Frozen Counter Change Event without Time:

Object type 23 - variation 02 Type: Event

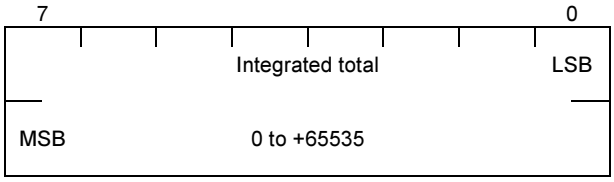


Object format DNP V3.00 32 Bit Binary Counter without Flag:

Object type 20 - variation 05 Type: Static

Object format DNP V3.00 32 Bit Binary Frozen Counter without Flag:

Object type 21 - variation 09 Type: Static



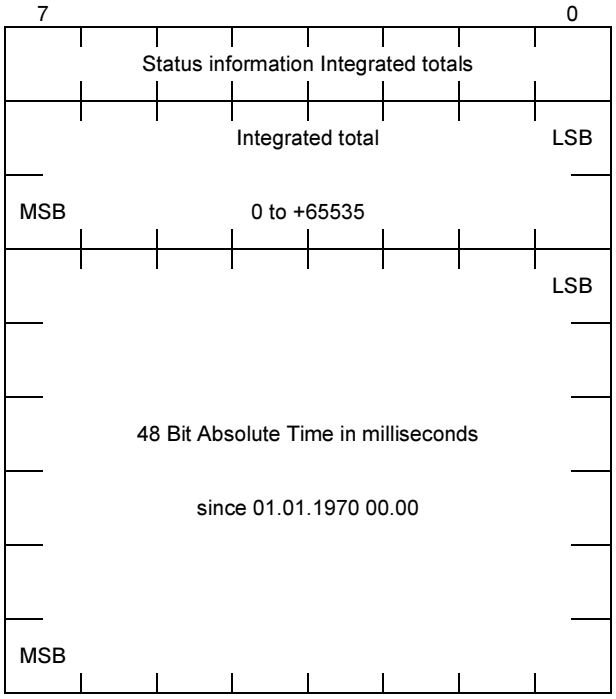
Object format DNP V3.00 32 Bit Binary Frozen Counter with Time of Freeze:

Object type 21 - variation 05 Type: Static

Object format DNP V3.00 32 Bit Binary Frozen Delta Counter with Time of Freeze:

Object format DNP V3.00 32 Bit Binary Frozen Counter Change Event with Time:

Object type 23 - variation 05 Type: Event



Address conversion DNP V3.00 → SAT 1703:

The address conversion is parameterised with the help of the OPM (Object-orientated Process-data Manager). For this, in the protocol detailed routing, the detailed routing type "REC_Integrated_totals" is made available with the following entries.

Supported SAT 1703-message formats:

- binary counter signed 31 bit with sequence number (TI = 37)

SAT 1703-Address:

CASDU1 CASDU2 IOA1 IOA2 IOA3		5-level freely parameterised SAT 1703 destination address possible: 0 – 255

TI: Type identification
possible: 37 = binary counter signed 31 Bit with sequence number

DNP 3.0 Address:

Link address: Link layer station number

DNP Data index: Unambiguous address of this data point
possible: 0-65535

Object group: Assignment of the data to the DNP object types
possible: binary counter
frozen binary counter

Additional information:

IEC-Group: This determines the IEC counter group which the Ax-System telegram is related to.
possible: group 1
group 2
group 3
group 4

Transmission: This parameter defines how the binary counter internal gets frozen and transmitted. The binary counter can be requested by the master (counter interrogation) or it can be frozen by the selected interval of time. If an event class is defined, the frozen binary counter will be transmitted as an event.
possible: counter interrogation
1 minute
2 minutes
3 minutes
5 minutes
10 minutes
15 minutes
30 minutes
60 minutes
spontaneous

Conversion information:

Raw value type: This defines how the received value will or has to be converted
possible: absolute value → absolute value
absolute value → relative value
relative value → absolute value
relative value → relative value

Overflow: how the overflow of the integrated total has to be calculated
possible: 31 bit integer
24 bit integer
2 decades of BCD (99)
3 decades of BCD (999)
4 decades of BCD (9999)
5 decades of BCD (99999)
6 decades of BCD (999999)
7 decades of BCD (9999999)
8 decades of BCD (99999999)
9 decades of BCD (999999999)
16 bit integer

3.4. Message conversion in transmit direction

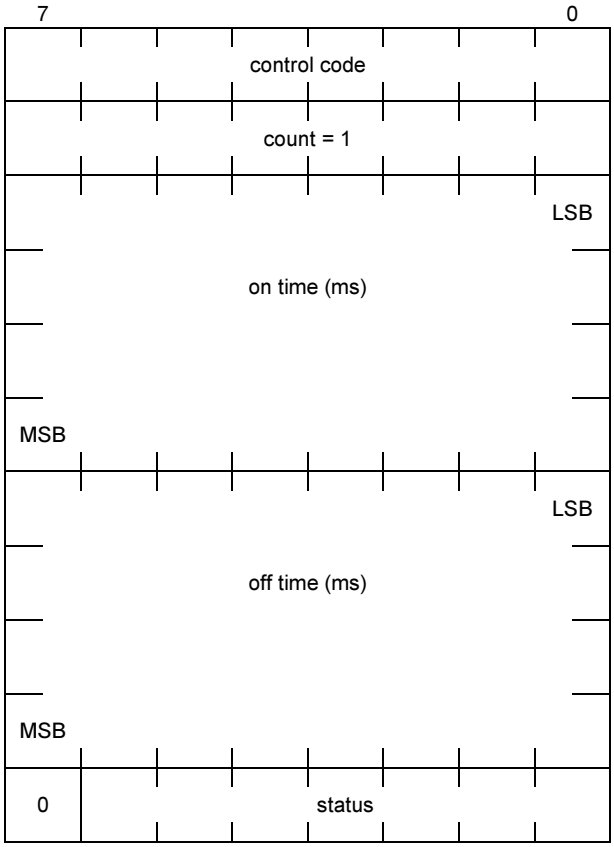
SAT Ax/ACP 1703		DNP V3.00			
TI	**Description**	**Description**	**Object type**	**Object variation**	
45 46	Single command Double command	Control Relay Output Block	12	1	
30	single binary input time tagged	Binary Output	10	1	
48 49 50	Set point value signed 15 Bit normalized Set point value signed 15 Bit scaled Set point value short floating point	32 Bit Analog Output Block 16 Bit Analog Output Block short floating point Analog Output Bl.	41	1 2 3	
34 35 36	Measured value signed 15 Bit normalized Measured value signed 15 Bit scaled Measured value short floating point	Analog Input Deadband	34	1, 2, 3	
	Cyclic requests	Enable/Disable unsolicited messages for data Class 1 , 2 or 3	60	2, 3, 4	1)
		Assign Class Assign the related data to the specified class 1, 2 or 3.			1)
		Delay Measurement			1)
	Time synchronisation	Time and Date	50	1	1)

1) Internal generation by firmware only

3.4.1. Message conversion for commands

Object format DNP V3.00 Control Relay Output Block:

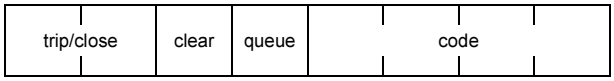
Object type 12 - variation 01 Type: Static



Every command that is transmitted by the master will be responded by the RTU, additionally the RTU will put its own diagnostic information about the success or failure of the command procedure, in to the response. These information can be evaluated by the firmware DNPMA0. The RTU will not respond if the function code "direct operation no acknowledgement" is used.

Count: counter for the number of command outputs
only count = 1 is supported by the firmware

Control code:



Code: 0 = NUL operation, no operation specified (not evaluated by the firmware)
1 = Pulse ON, the point is turned on (specified on time) then turned off (specified off time) and left in the off state
the firmware does interpret this as a latch on command
2 = Pulse OFF, the point is turned off (specified off time) then turned on (specified on time) and left in the on state
the firmware does interpret this as a latch off command
3 = Latch ON, this latches the point on
4 = Latch OFF, this latches the point off
5 – 15 Reserve

Queue: place operation at the back of the control queue when complete
(not supported by the firmware)

Clear: cancel currently running operation remove queued operations on affected points immediately before activating this new operation (if not NUL)
(not supported by the firmware)

Trip/Close: This field determines which control relay to activate in a system where a trip and close relay pair is used to energize and de-energize the field points.
(only applicable to double point commands)

Status:
0 = SUCCESS, request accepted, initiated or queued
1 = TIMEOUT, request not accepted because no previous matching select request exists. (An operate message was sent to activate an output that was not previously armed with a matching select message)
2 = NO SELECT, request not accepted because no previous matching select request exists. (An operate message was sent to activate an output that was not previously armed with a matching select message)
3 = FORMAT ERROR, request not accepted because there where formatting errors in the control request.
4 = NOT SUPPORTED, request not accepted because a control operation is not supported fort his point.
5 = ALREADY ACTIVE, request not accepted because the control queue is full ort he point is already active
6 = HARDWARE ERROR, request not accepted because of control hardware problems.
7 = LOCAL, request not accepted because local/remote switch is in local position.
8 = TOO MANY OPS, request not accepted because too many operations requested.
9 = NOT AUTHORIZED, request not accepts because of insufficient authorization.
10 – 127 Reserved for future use

Address conversion SAT 1703 → DNP V3.00:

The address conversion is parameterised with the help of the OPM (Object-orientated Process-data Manager). For this, in the protocol detailed routing, the detailed routing type "TRA_commands" is made available with the following entries.

Supported SAT 1703-message formats:

- single point command (TI = 45)
- double point command (TI = 46)
- regulating step command (TI = 47)

DNP 3.0 Address:

Link address: Link layer station number

DNP Data index: Unambiguous address of this data point
possible: 0-65535

Object group: Assignment of the data to the DNP object types
possible: binary command (CROB)

Additional information:

Command ON time: This parameter defines the desired command time for the ON command.

Command OFF time: This parameter defines the desired command time for the OFF command.

Function code: This parameter defines what kind of function code should be send. And how the SELECT/EXECUTE procedure should be performed.
possible: select & execute
direct operation (only EXECUTE will be used)
direct operation no ack (only EXECUTE will be used)

Data conversion information:

Control code: This parameter defines what kind of control operation this point can perform.
possible: command as LATCH ON/OFF
command as PULSE ON
command as PULSE ON with TRIP
command as PULSE ON with CLOSE
command as PULSE ON TRIP and CLOSE

Command point: This parameter defines the usage of the specified command point and it determines if this DNP command point can perform the ON and the OFF command or only one of them.
possible: data point used as ON/CLOSE and OFF/TRIP
data point only ON/CLOSE
data point only OFF/TRIP

SAT 1703-Address:

CASDU1 CASDU2 IOA1 IOA2 IOA3	5-level freely parameterised SAT 1703 destination address possible: 0 – 255

TI: Type identification
possible: 45 = single binary command
46 = double binary command
47 = regulating step command

3.4.2. Message conversion for binary outputs

Object format DNP V3.00 Binary Output:

Object type 10 - Variation 01 Type: Static

7							0
7	6	5	4	3	2	1	0
15	14	13	12	11	10	9	8
	↓						
0	0	0	n	n-1	n-2	n-3	n-4

The firmware does only support the transmission of 1 binary output per message.

The address conversion is parameterised with the help of the OPM (Object-orientated Process-data Manager). For this, in the protocol detailed routing, the detailed routing type "TRA_commands" is made available with the following entries.

Supported SAT 1703-message formats:

- single binary information (TI = 30)

DNP 3.0 Address:

Link address: Link layer station number

DNP Data index: Unambiguous address of this data point
possible: 0-65535

Object group: Assignment of the data to the DNP object types
possible: binary output

Additional information:

Command ON time: not used

Command OFF time: not used

Function code: This parameter defines what kind of function code should be send. And how the SELECT/EXECUTE procedure should be performed.
possible: write

Data conversion information:

Control code: not used

Command point: not used

SAT 1703-Address:

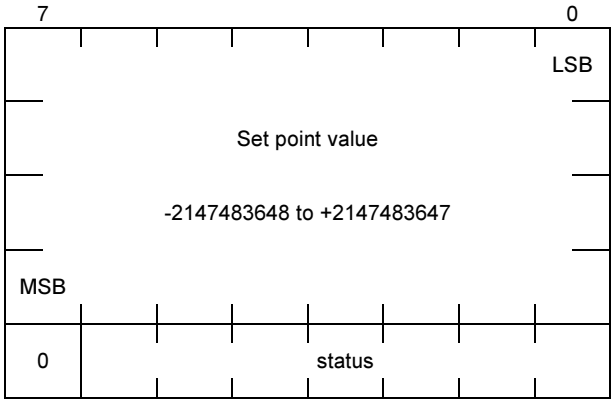
CASDU1 CASDU2 IOA1 IOA2 IOA3		5-level freely parameterised SAT 1703 destination address possible: 0 – 255

TI: Type identification
possible: 30 = single binary information

3.4.3. Message conversion set point values

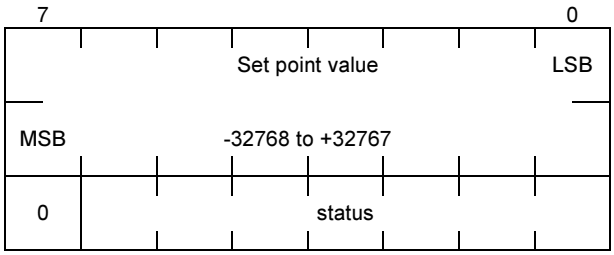
Object format DNP V3.00 32 Bit Analog Output Block:

Object type 41 - variation 01 Type: Static



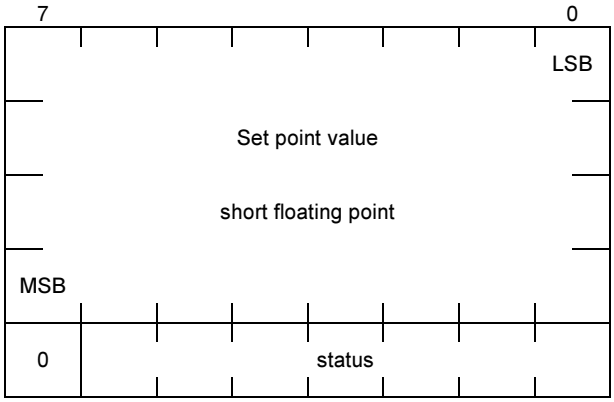
Object format DNP V3.00 16 Bit Analog Output Block:

Object type 41 - variation 02 Type: Static



Object format DNP V3.00 Short Floating Point Analog Output Block:

Object type 41 - variation 03 Type: Static



Status:
- 0 = SUCCESS, request accepted, initiated or queued
- 1 = TIMEOUT, request not accepted because no previous matching select request exists. (An operate message was sent to activate an output that was not previously armed with a matching select message)
- 2 = NO SELECT, request not accepted because no previous matching select request exists. (An operate message was sent to activate an output that was not previously armed with a matching select message)
- 3 = FORMAT ERROR, request not accepted because there where formatting errors in the control request.
- 4 = NOT SUPPORTED, request not accepted because a control operation is not supported fort his point.
- 5 = ALREADY ACTIVE, request not accepted because the control queue is full ort he point is already active
- 6 = HARDWARE ERROR, request not accepted because of control hardware problems.
- 7 = LOCAL, request not accepted because local/remote switch is in local position.
- 8 = TOO MANY OPS, request not accepted because too many operations requested.
- 9 = NOT AUTHORIZED, request not accepted because of insufficient authorization.
- 10 – 127 Reserved for future use

Every command that is transmitted by the master will be responded by the RTU, additionally the RTU will put its own diagnostic information about the success or failure of the command procedure, in to the response. These information can be evaluated by the firmware DNPMA0. The RTU will not respond if the function code "direct operation no acknowledgement" is used.

Address conversion SAT 1703 → DNP V3.00:

The address conversion is parameterised with the help of the OPM (Object-orientated Process-data Manager). For this, in the protocol detailed routing, the detailed routing type "TRA_setpoint_values" is made available with the following entries.

Supported SAT 1703-message formats:

- set point value signed 15 bit normalized (TI = 48)
- set point value signed 15 bit scaled (TI = 49)
- set point value short floating point (TI = 50)

DNP 3.0 Address:

Link address: Link layer station number

DNP Data index: Unambiguous address of this data point
possible: 0-65535

Object group: Assignment of the data to the DNP object types
possible: - analog output block

Additional information:

Function code: This parameter defines what kind of function code should be send. And how the SELECT/EXECUTE procedure should be performed.
possible: - select & execute
- direct operation (only EXECUTE will be used)
- direct operation no ack (only EXECUTE will be used)

Data conversion information:

Object_variation: This Parameter defines the format and the data type of the related DNP command.
possible: - 32 bit analog value
- 16 bit analog value
- short floating point value

Additional information for set point values/measured values:

Adaption X0: This is the minimum value of the SAT internal analog value (source)

Adaption X100: This is the maximum value of the SAT internal analog value (source)

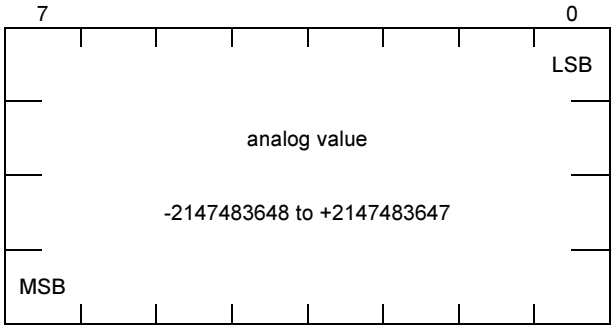
Adaption Y0: This is the minimum value of the DNP external analog value (destination)

Adaption Y100: This is the maximum value of the DNP external analog value (destination)

3.4.4. Message conversion analog input deadband

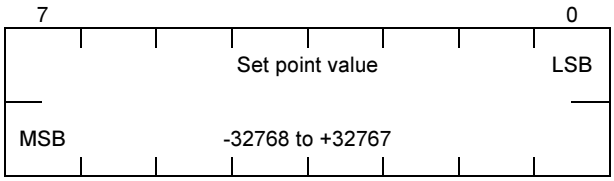
Object format DNP V3.00 32 Bit Analog Input Deadband:

Object type 34 - variation 02 Type: Static



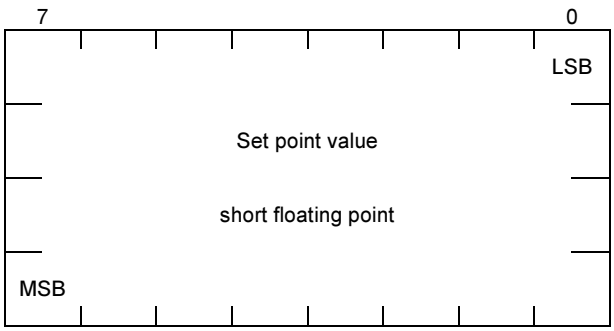
Object format DNP V3.00 16 Bit Analog Input Deadband:

Object type 34 - variation 01 Type: Static



Object format DNP V3.00 Short Floating Point Analog Input Deadband:

Object type 34 - variation 03 Type: Static



Address conversion SAT 1703 → DNP V3.00:

The address conversion is parameterised with the help of the OPM (Object-orientated Process-data Manager). For this, in the protocol detailed routing, the detailed routing type "TRA_setpoint_values" is made available with the following entries.

Supported SAT 1703-message formats:

- analog value signed 15 bit normalized (TI = 34)
- analog value signed 15 bit scaled (TI = 35)
- analog value short floating point (TI = 36)

DNP 3.0 Address:

Link address: Link layer station number

DNP Data index: Unambiguous address of this data point
possible: 0-65535

Object group: Assignment of the data to the DNP object types
possible: analog input deadband

Additional information:

Function code: This parameter defines what kind of function code should be send. And how the SELECT/EXECUTE procedure should be performed.
possible: - write

Data conversion information:

Object_variation: This Parameter defines the format and the data type of the related DNP command.
possible: - 32 bit analog value
- 16 bit analog value
- short floating point value

Additional information for set point values/measured values:

Adaption X0: This is the minimum value of the SAT internal analog value (source)

Adaption X100: This is the maximum value of the SAT internal analog value (source)

Adaption Y0: This is the minimum value of the DNP external analog value (destination)

Adaption Y100: This is the maximum value of the DNP external analog value (destination)

4. General Protocol Functions

4.1. Failure concept

The protocol element DNPMA0 detects a failure of the remote station by the absence of acknowledgement messages or reply messages to the interrogation of data points.

4.2. Acknowledgement behaviour

Protocol DNP knows 2 different acknowledgement variants. These are the normal acknowledgement at link layer level and the application acknowledgement at application layer level. For all messages that the master transmits, the acknowledgement that the master expects from the remote terminal unit can be set.

The acknowledgement at link layer level consists of a message of fixed block length with the contents ACK or NACK.

The acknowledgement at application layer level consists of a message of variable block length with the data bytes for transport header, application header and the function code 0.

4.3. Retry behaviour

If the acknowledgement for a message or fragment with a non-faulty line is absent, then this message or fragment is repeated n-times (n = configurable number).

The retry detection takes place exclusively via the sequence numbers of the transport header and the application header.

4.4. General interrogation

The DNP Protocol does not support any general interrogation message. The remote terminal unit can only transmit that data that is inquired by the master.

4.5. Redundancy

With the help of Ax-Redundancy, it is possible to put the Firmware in Standby-mode. In Standby-mode, all services running on SIP are aborted and all messages that are on SIP or arrive new are acknowledged positively for BSE. All messages received are transferred to the SAT 1703 System.

4.6. Fragments and Multifragments

If all the data of an object is interrogated, then the reply to this interrogation can contain more data than can be transmitted with one message (max. 249 user data bytes). For this reason, a reply to this interrogation consists of several single messages (frames). Several of these single messages form a fragment. The size of a fragment is dependent on the maximum application buffer size (maximum application fragment size). Several of these fragments form a Multifragment.

4.7. Unsolicited Response

The remote terminal unit is able to transmit spontaneous changes to the data immediately. These messages are called unsolicited response and can be transmitted without interrogation by the master.

After every firmware restart or after every concluded initialisation of the link layer, depending on the parameterisation, the messages for Disable and Enable Unsolicited Messages are transmitted (only if parameterised).

A. Appendix: Diagnostic

A.1.1. Class Internal - Record 0 : Internal error in the operating system

Bit	Description
00	RAM error
01	STACK error The laid down stack range has been exceeded; Replace system element or notify SAT.
02	Firmware shut down Diagnosis: - Read out system diagnostics ring (command ID R) in ST emulation (maybe store to file)
03	Not enough free space There is not enough free RAM memory for the dynamic memory management; Diagnosis: - Change parameterization of size definitions (e.g. realtime rings, pool size) - Notify SAT.
08	CPU 80386 error Occurs when there is an internal software error.

A.1.2. Class Internal - Record 1 : Internal error in the base system

Bit	Description
00	Check sum error in the parameter area The check sum for the parameters is not correct. --> Reload parameters.

A.1.3. Class Internal - Record 2 : Parameter error - ZSE

Bit	Description
00	Parameter error detected by ZSE
01	Parameter error of the LOCAL parameter block No. 06 Diagnosis: - TI 38-40 and 136-143 requires parameter setting with time - TI 160 requires parameter setting without time - transmission of the objects on GI with/without time; value > 3 - Octett count cause of transmission (COT) <> 2 - Octett count common address of ASDU (CAASDU) <> 2 - Octett count information object address (IOA) <> 3 - Octett count time stamp <> 7
02	Parameter error ZSE general

Bit	Description
03	Configured LINK address is wrong. Reason: The same LINK address was assigned several times to various stations.
04	Configured station number is wrong. Reason: station number is already being used.
05	Parameter setting for IEC870 link layer invalid
06	Parameter setting for IEC870 application layer invalid
07	Parameter error - redundancy
08	Parameter error - detailed transmission routing
09	Parameter error - detailed reception routing
10	Parameter error - general
12	Parameter error Adaption for measured values
15	Parameter error - time zones

A.1.4. Class Internal - Record 3 : ZSE Format Conversion Errors

Bit	Description
00	Format conversion error in transmit direction Read out erroneous message in the ST emul with "id r"
02	Format conversion error in receive direction Read out erroneous message in ST emul with "id r"
15	Error detected in the conversion of an PST control message Diagnosis: - Read out system diagnostics ring (command ID R) in ST emulation (possibly save in file)

A.1.5. Class Internal - Record 4 : Parameter Errors of Protocol-Specific Application Layer

Bit	Description
00	Error in routing information conditioning

A.2. Class Communication

A.2.1. Class Communication - Record 2 : Communication errors to station nos. 0 - 15

Bit	Description
00	Communication error to station no. 0
01	Communication error to station no. 1
02	Communication error to station no. 2
03	Communication error to station no. 3

Bit	Description
04	Communication error to station no. 4
05	Communication error to station no. 5
06	Communication error to station no. 6
07	Communication error to station no. 7
08	Communication error to station no. 8
09	Communication error to station no. 9
10	Communication error to station no. 10
11	Communication error to station no. 11
12	Communication error to station no. 12
13	Communication error to station no. 13
14	Communication error to station no. 14
15	Communication error to station no. 15

A.2.2. Class Communication - Record 3 : Communication error to station nos. 16 - 31

Bit	Description
00	Communication error to station no. 16
01	Communication error to station no. 17
02	Communication error to station no. 18
03	Communication error to station no. 19
04	Communication error to station no. 20
05	Communication error to station no. 21
06	Communication error to station no. 22
07	Communication error to station no. 23
08	Communication error to station no. 24
09	Communication error to station no. 25
10	Communication error to station no. 26
11	Communication error to station no. 27
12	Communication error to station no. 28
13	Communication error to station no. 29
14	Communication error to station no. 30
15	Communication error to station no. 31

A.2.3. Class Communication - Record 4 : Communication error to station nos. 32 - 47

Bit	Description
00	Communication error to station no. 32
01	Communication error to station no. 33
02	Communication error to station no. 34
03	Communication error to station no. 35
04	Communication error to station no. 36
05	Communication error to station no. 37
06	Communication error to station no. 38
07	Communication error to station no. 39
08	Communication error to station no. 40
09	Communication error to station no. 41
10	Communication error to station no. 42
11	Communication error to station no. 43
12	Communication error to station no. 44
13	Communication error to station no. 45
14	Communication error to station no. 46
15	Communication error to station no. 47

A.2.4. Class Communication - Record 5 : Communication error to station nos. 48 -63

Bit	Description
00	Communication error to station no. 48
01	Communication error to station no. 49
02	Communication error to station no. 50
03	Communication error to station no. 51
04	Communication error to station no. 52
05	Communication error to station no. 53
06	Communication error to station no. 54
07	Communication error to station no. 55
08	Communication error to station no. 56
09	Communication error to station no. 57
10	Communication error to station no. 58
11	Communication error to station no. 59
12	Communication error to station no. 60

Bit	Description
13	Communication error to station no. 61
14	Communication error to station no. 62
15	Communication error to station no. 63

A.2.5. Class Communication - Record 6 : Communication error to station nos. 64 -79

Bit	Description
00	Communication error to station no. 64
01	Communication error to station no. 65
02	Communication error to station no. 66
03	Communication error to station no. 67
04	Communication error to station no. 68
05	Communication error to station no. 69
06	Communication error to station no. 70
07	Communication error to station no. 71
08	Communication error to station no. 72
09	Communication error to station no. 73
10	Communication error to station no. 74
11	Communication error to station no. 75
12	Communication error to station no. 76
13	Communication error to station no. 77
14	Communication error to station no. 78
15	Communication error to station no. 79

A.2.6. Class Communication - Record 7 : Communication error to station nos. 80 -95

Bit	Description
00	Communication error to station no. 80
01	Communication error to station no. 81
02	Communication error to station no. 82
03	Communication error to station no. 83
04	Communication error to station no. 84
05	Communication error to station no. 85
06	Communication error to station no. 86
07	Communication error to station no. 87
08	Communication error to station no. 88

Bit	Description
09	Communication error to station no. 89
10	Communication error to station no. 90
11	Communication error to station no. 91
12	Communication error to station no. 92
13	Communication error to station no. 93
14	Communication error to station no. 94
15	Communication error to station no. 95

A.2.7. Class Communication - Record 8 : Communication error to station nos. 96 -99

Bit	Description
00	Communication error to station no. 96
01	Communication error to station no. 97
02	Communication error to station no. 98
03	Communication error to station no. 99

A.3. Class Test

A.3.1. Class Test - Record 0 : Test Mode of Operating and Base Systems

Bit	Description
00	Memory test disabled

B. Appendix: Parameterdokumentation

Parameter	Description	Values/Ranges
baud rate receiver	baud rate in receive direction	[50] 50 [Bd] [75] 75 [Bd] [100] 100 [Bd] [110] 110 [Bd] [134] 134,5 [Bd] [150] 150 [Bd] [200] 200 [Bd] [300] 300 [Bd] [600] 600 [Bd] [1050] 1050 [Bd] [1200] 1200 [Bd] [1800] 1800 [Bd] [2000] 2000 [Bd] [2400] 2400 [Bd] [4800] 4800 [Bd] [9600] 9600 [Bd] [19200] 19200 [Bd]
baud rate transmitter	baud rate in transmit direction	[50] 50 [Bd] [75] 75 [Bd] [100] 100 [Bd] [110] 110 [Bd] [134] 134,5 [Bd] [150] 150 [Bd] [200] 200 [Bd] [300] 300 [Bd] [600] 600 [Bd] [1050] 1050 [Bd] [1200] 1200 [Bd] [1800] 1800 [Bd] [2000] 2000 [Bd] [2400] 2400 [Bd] [4800] 4800 [Bd] [9600] 9600 [Bd] [19200] 19200 [Bd]
interface modem	Selection of the interface modem. Most of the parameters for the predefined interface modems are standardized and not changeable.	[0] free defineable [1] SAT Modem "4-wire circuit transmission line" (SAT-VFM,-WT,-WTK,-WTK-S,-CE0700) [2] SAT Modem "2-wire circuit transmission line" (SAT-VFM,-WT,-WTK,-WTK-S,-CE0700) [5] OPTICAL [8] NULL-Modem interface (RS-485)

B.1. Common settings | byte frame

byte frame

Parameter	Description	Values/Ranges
Parity		[0] no parity [1] even parity [2] odd parity
data bits	Number of data bits	[0] 5 bit [1] 6 bit [2] 7 bit [3] 8 bit
stop bits		[0] 1 bit [1] 1,5 bit [2] 2 bit

B.2. Common settings | free defineable transmission facility

free defineable transmission facility

Parameter	Description	Values/Ranges
DCD handling	DCD signal handling. DCD can be used for message synchronization in receive direction.	[0] disabled [1] enabled
Transmission delay if countinous level (tcldly)	If continous level is detected on the line, the next message will be sent after transmission delay.	Float [####.#] 0.1 to 6553.5 [s] 0 [s]
asynchron/isochron	asynchronous (V.24/V.28, 16 x receive-/transmit clock) or isochron (X.24/X.27 1 x receive-/transmit clock)	[0] asynchronous "V.24/V.28" (16 x bit clock) [1] Isochron "X.24/X.27" (1x bit clock)
bounce suppression time (tbounce)	State of DCD signal will be used after bounce suppression time (tbounce).	Integer [#####] 0 to 65535 [ms]
continuous level monitoring time (tcl)	continuous level monitoring time (tcl)	Float [####.#] 0.1 to 6553.5 [s] 0 [s]
disable time "time base" (tdis)	Parametrized times in bits depend on the the baudrate!	[0] Bit [1] ms
disable time (tdis)	disable time of the receiver after a received message. Note: Used for suppressing of bad characters during carrier switching.	Integer [#####] 0 to 32767 [ms / Bit]
electrical interface	electrical interface	[0] RS232 (V.24/V.28) [1] RS422 (V.11) [2] RS485 (V.11)
pause time "time base" (tp)	Parametrized times in bits depend on the the baudrate!	[0] Bit [1] ms
pause time (tp)	Before a message transmission the set pause time is waited before switching on the transmit carrier (RTS).	Integer [#####] 0 to 32767 [ms / Bit]
run-out time "time base" (tn)	Parametrized times in bits depend on the the baudrate!	[0] Bit [1] ms

Parameter	Description	Values/Ranges
run-out time (tn)	After message transmission, the transmit carrier (RTS) is switched off after run-out time.	Integer [#####] 0 to 32767 [ms / Bit]
set up time "time base" (tv)	Parametrized times in bits depend on the the baudrate!	[0] Bit [1] ms
set up time (tv)	After switching the carrier to ON (RTS) the message transmission is started after set up time. Note: If "tv=0" no carrier switching is used (RTS=OFF)!	Integer [#####] 0 to 32767 [ms / Bit]
source for receive-/transmit clock (only for "Isochronous")	Source for receive-/transmit clock (only for "Isochronous"). Either external (from RXC-input) or intern (at TXC-output)	[0] extern (bit clock from RXC input) [1] internal (bit clock at the TXC-output)
stability monitoring time (tstab)	stability monitoring time (tstab). The "new" DCD state is utilized after stability monitoring time (DCD can be used for message synchronization).	Integer [#####] 0 to 65535 [ms]

B.3. Message retries

Parameter	Description	Values/Ranges
Retries for INIT-messages SEND/CONFIRM (station selective)	Number of max. message retrys	Integer [###] 0 to 255
Retries for data message SEND/CONFIRM (station selective)	Number of max. message retrys	Integer [###] 0 to 255
Retries for data message SEND/NO REPLY (broadcast)	Number of max. message retrys	Integer [###] 0 to 255

B.4. Redundancy

Parameter	Description	Values/Ranges
Delay time passive=>active	delay time in case of switch over from PASSIVE=>ACTIVE (0 = without delay)	Integer [####] 0 to 2000 [s]
listening_mode (failure monitoring time)	failure monitoring time in listening mode (0 = no monitoring)	Float [####.] 0 to 60000 [s]
operation if passive	operation if passive	[0] transmitter "tristate", listening mode [1] transmitter "active", listening mode [3] transmitter "active", normal operation

B.5. advanced parameters

Parameter	Description	Values/Ranges
DTR is permanent HIGH		[0] NO [255] YES
Enable ACTCON		[0] NO [255] YES
Enabling 1 out of n commands		[0] NO [255] YES
RTS is permanent HIGH		[0] NO [255] YES
initialization in transmitt direction		[0] no Init (link is instantly ready) [254] only reset remote link [255] request status and reset remote link

B.6. advanced parameters | DNP time settings

DNP time settings

Parameter	Description	Values/Ranges
timeout application confirmation		Float [####.#] 0.1 to 6553.5 [s] 0 [s]
timeout transmit delay		Float [###.##] 0.01 to 655.35 [s] 0 [s]

B.7. advanced parameters | Software test points

Software test points

Parameter	Description	Values/Ranges
Handshake RTS,GPB (ASCII-Mode)	The change of this parameter required profoundness communication knowledge. A specialist should be contacted before.	[0] NO [1] YES
Handshake RTS,GPB (HEX-Mode)	The change of this parameter required profoundness communication knowledge. A specialist should be contacted before.	[0] NO [1] YES
Init-end processing	The change of this parameter required profoundness communication knowledge. A specialist should be contacted before.	[0] NO [1] YES
PRE-control message		[0] NO [1] YES
User-Softwaretestpoint 1		[0] NO [1] YES

Parameter	Description	Values/Ranges
User-Softwaretestpoint 2		[0] NO [1] YES
User-Softwaretestpoint 3		[0] NO [1] YES
User-Softwaretestpoint 4		[0] NO [1] YES
User-Softwaretestpoint 5		[0] NO [1] YES
User-Softwaretestpoint 6		[0] NO [1] YES
User-Softwaretestpoint 7		[0] NO [1] YES
User-Softwaretestpoint 8		[0] NO [1] YES
data and acknowledgement between BSE	The change of this parameter required profoundness communication knowledge. A specialist should be contacted before.	[0] NO [1] YES
level locking station locking	The change of this parameter required profoundness communication knowledge. A specialist should be contacted before.	[0] NO [1] YES
mask for blocking data pick-up	The change of this parameter required profoundness communication knowledge. A specialist should be contacted before.	[0] NO [1] YES
master-standby switchover	The change of this parameter required profoundness communication knowledge. A specialist should be contacted before.	[0] NO [1] YES
stop_serialtest_after_comm_error	The change of this parameter required profoundness communication knowledge. A specialist should be contacted before.	[0] NO [1] YES

B.8. advanced parameters | binary information

binary information

Parameter	Description	Values/Ranges
faulty position suppression time	Faulty position suppression time (s)	Integer [##] 0 to 60 [s]
intermediate position suppression time	Intermediate position suppression time (s)	Integer [##] 0 to 60 [s]

B.9. advanced parameters | common DNP settings

common DNP settings

Parameter	Description	Values/Ranges
Unsolicited messages data class 1		[0] send disable messages [1] no send [2] send enable messages
Unsolicited messages data class 2		[0] send disable messages [1] no send [2] send enable messages
Unsolicited messages data class 3		[0] send disable messages [1] no send [2] send enable messages
data link layer confirmation		[0] no acknowledgement [1] only for multi fragments [2] always expect acknowledgement
own station number	own station number must be parametrized always	Integer [#####] 0 to 65500

B.10. advanced parameters | monitoring times

monitoring times

Parameter	Description	Values/Ranges
Character monitoring time	Maximum possible gap between sequential bytes of a message in receive direction. If a gap is detected, the message is ignored and the idle monitoring time will be started.	Integer [#####] 0 to 32767 [ms / Bit]
Character monitoring time "time base"	Parametrized times in bits depend on the the baudrate!	[0] Bit [1] ms
Timeout Confirmation		Integer [###] 0 to 255 [s]
expected_ack_time_corr_factor	The expected acknowledgement time is calculated automatically. Signal transfer times and other delays must be parametrized in the "expected acknowledgement time correction factor."	Float [###.##] 0 to 655.35 [s]
idle monitoring time	After communication errors,the line is monitored for quiescent state. After expiry of this monitoring time, the resynchronisation of the receiver takes place. By using the DCD input, faster resynchronisation can be achieved.	Integer [#####] 0 to 32767 [ms / Bit]
idle monitoring time "time base"	Parametrized times in bits depend on the the baudrate!	[0] Bit [1] ms
timeout termination - long		Integer [###] 0 to 255 [s]
timeout termination - short		Integer [###] 0 to 255 [s]

B.11. advanced parameters | settings for receive direction

settings for receive direction

Parameter	Description	Values/Ranges
maximum application fragment size		Integer [####] 100 to 2048
maximum link fragem size		Integer [###] 20 to 296

B.12. advanced parameters | settings for send direction

settings for send direction

Parameter	Description	Values/Ranges
maximum application fragment size		Integer [####] 100 to 2048
maximum link fragem size		Integer [###] 20 to 296

B.13. advanced parameters | settings time management

settings time management

Parameter	Description	Values/Ranges
correction time for clock synchronization command	The time of the clock synchronization command will be adjusted with the transmission delay and the correction time.	Float [###.###] -60.000 to 60.000 [ms]
cycle time for sending clock synchronization command	0=no cyclic time setting	Integer [#####] 0 to 65535 [s]
support daylight saving time		[0] NO [255] YES
time offset daylight saving time		Integer [####] -120 to 120 [min]