SIEMENS

SICAM RTUs • Ax 1703

Common functions
SIEMENS SINAUT-ST1 GV-S

Protocol Element

DC0-136-2.02

Hint

Please observe Notes and Warnings for your own safety in the Preface.

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Preface

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

- SICAM AK, SICAM TM, SICAM BC, SICAM EMIC, AK 1703 and AMC 1703

Purpose of this manual

This manual describes the function and the manner of working of the SINAUT ST1 (TIM11) slave protocol and essentially contains:

- Functional descriptions

Target Group

The document you are reading right now is addressed to users, who are in charge of the following engineering tasks:

- Conceptual activities, as for example design and configuration
- Creation of the assembly technical documentation using the designated engineering tools
- System parameterization and system diagnostic, using the designated engineering tools
- Technical system maintenance

Hint

The functions described in this manual are illustrated with screenshots from the SICAM TOOLBOX II. These images demonstrate for example the use of the protocol element in SICAM AK. They are however also valid under consideration of the product-specific differences – for the other products.

Notes on Safety

This manual does not constitute a complete catalog of all safety measures required for operating the equipment (module, device) in question because special operating conditions might require additional measures. However, it does contain notes that must be adhered to for your own personal safety and to avoid damage to property. These notes are highlighted with a warning triangle and different keywords indicating different degrees of danger.

Danger

means that death, serious bodily injury or considerable property damage will occur, if the appropriate precautionary measures are not carried out.

Warning

means that death, serious bodily injury or considerable property damage can occur, if the appropriate precautionary measures are not carried out.

Caution

means that minor bodily injury or property damage could occur, if the appropriate precautionary measures are not carried out.

Hint

is important information about the product, the handling of the product or the respective part of the documentation, to which special attention is to be given.

Qualified Personnel

Commissioning and operation of the equipment (module, device) described in this manual must be performed by qualified personnel only. As used in the safety notes contained in this manual, qualified personnel are those persons who are authorized to commission, release, ground, and tag devices, systems, and electrical circuits in accordance with safety standards.

Use as Prescribed

The equipment (device, module) must not be used for any other purposes than those described in the Catalog and the Technical Description. If it is used together with third-party devices and components, these must be recommended or approved by Siemens.

Correct and safe operation of the product requires adequate transportation, storage, installation, and mounting as well as appropriate use and maintenance.

During operation of electrical equipment, it is unavoidable that certain parts of this equipment will carry dangerous voltages. Severe injury or damage to property can occur if the appropriate measures are not taken:

- Before making any connections at all, ground the equipment at the PE terminal.
- Hazardous voltages can be present on all switching components connected to the power supply.
- Even after the supply voltage has been disconnected, hazardous voltages can still be present in the equipment (capacitor storage).
- Equipment with current transformer circuits must not be operated while open.
- The limit values indicated in the manual or the operating instructions must not be exceeded; that also applies to testing and commissioning.

Consider obligatory the safety rules for the accomplishment of works at electrical plants:

1. Switch off electricity all-pole and on all sides!
2. Ensure that electricity cannot be switched on again!
3. Double check that no electrical current is flowing!
4. Discharge, ground, short circuit!
5. Cover or otherwise isolate components that are still electrically active!

Table of Contents

1. Introduction

Contents

1.1. Application

The SIEMENS SINAUT ST1 (TIM11) slave protocol is used in automation units of the systems SICAM AK, SICAM TM, SICAM BC, SICAM EMIC, AK 1703 and AMC 1703. It is deployed in the field of telecontrol and automation.

The protocol is used for the exchange of data - and therefore for the transmission of messages – over a communication interface to other automation units or devices of other manufacturers.

1.1.1. Availability of the Protocol

Protocol	SM-2545	SM-0551, SM-2551	SM-2546 (only CP-5000,14)	SM-2556	SICAM CMIC	SICAM EMIC	SICAM MIC	SICAM BC (local SS) (onlyCP-5000,14)	AMC 1703 (locale SS) (only CP-4000)
SINAUT ST1 (Unbalanced Slave)		■			■	■			
↓	↓	↓	↓			↓	↓	↓	
System									
AK 1703		■							
AMC 1703		■							
SICAM AK		■							
SICAM AK 3		■							
SICAM TM		■							
SICAM CMIC					■				
SICAM EMIC						■			
SICAM MIC									
SICAM BC		■							

Legend: ■ available

1.2. Features and Functions

General Functions

Communication between one central station and one or more remote stations SIEMENS SINAUT ST1 (TIM11)

- Unbalanced Multi-Point (multi-point traffic) according to SIEMENS SINAUT ST1 (TIM11), ST1Sx0 is remote terminal unit (=Secondary Station).
  - Supported functionality according to SIEMENS SINAUT ST1 (TIM11) Protocol definitions (with restrictions)
  - Data acquisition by polling (station interrogation)
  - Acquisition of events (transmission of data ready to be sent)
  - General interrogation, Substation interrogation
  - Command transmission
  - Transmission of integrated totals
- Optimized parameters for selected transmission facilities
- Message conversion
  – IEC 60870-5-101 ⇔ SIEMENS SINAUT ST1 (TIM11)

The operation mode of the interface is set by parameter and optional devices.

Standard Operation Mode	Parameter and Setting		Interface signals on RJ45-plug
Unbalanced interchange circuit V.24/V.28 V.28 asynchronous	asynchronous / isochronous	asynchronous	RXD, TXD, CTS, RTS, DCD, DTR, DSR/+5V, GND

Optional Operation Mode	Parameter and Setting		Interface signals on RJ45-plug
Balanced interchange circuit X.24/X.27 V.11 isochronous	asynchronous / isochronous	Isochronous	
	Bit pulse	internal	RXD, TXD, CTS, TXC, DCD, DTR, DSR/+5V, GND
	Bit pulse	external	RXD, TXD, RTS, RXC, DCD, DTR, DSR/+5V, GND
Balanced interface RS-485 V.11 asynchronous with CM-0829	asynchronous / isochronous	asynchronous	RXD, TXD, CTS, RTS, DCD, DTR, DSR/+5V, GND
Optical interface (multimode fiber optic) with CM--0827	asynchronous / isochronous	asynchronous	RXD, TXD, +5V, GND

Hints

The above mentioned functions are described in detail in the chapter *Protocol Description*.

This protocol element for interfacing 3rd party systems supports only restricted functionality and only a sub set of the possible data formats. For using this protocol element in your project you have to verify if the supported functionality and supported data formats of the protocol element will be compatible to the required functionality and data formats for interfacing a specific 3rd party system.

2. Protocol Description

Contents

2.1. Overview

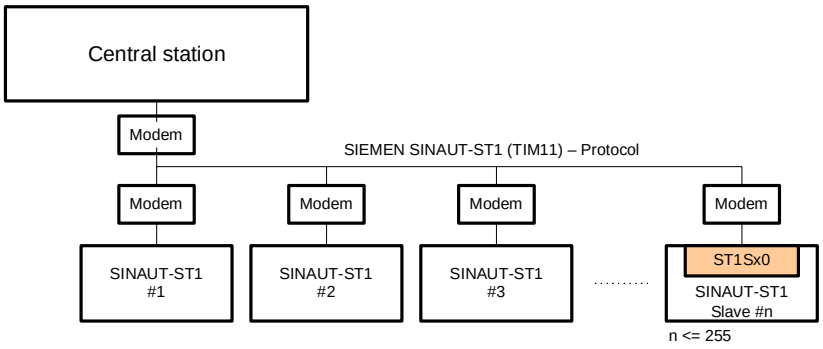
The protocol element is used for coupling SICAM RTUs automation units to telecontrol centers, Frontends and control systems by means of SIEMENS SINAUT ST1 (TIM11) protocol in multi-point traffic .

The master station and the remote terminal units in multi-point traffic work with a communication protocol according to SIEMENS SINAUT ST1 (TIM11). The supported functionality is described in the chapter entitled “Protocol Description”.

Multi-point traffic describes a serial communication protocol, with which a master station is connected with one or multiple remote terminal units over a communication connection in a linear or star configuration. The data traffic is controlled by the central station.

The protocol element ST1Sx0 enables the communication of one SLAVE with one MASTER with up to a maximum of 254 RTUs (SLAVES) on a common line.
Every RTU is assigned an unambiguous station number in the range "0 - 254".
The station number "0" is used for the simultaneous addressing of all stations (= BROADCAST). With this type of addressing no reply (Response Message) is transmitted from the SLAVES to the MASTER.

Data messages or station interrogation messages are sent from the central station. Data from the remote station to the central station can only be transmitted as a reply to a station interrogation.



In multi-point traffic an "unbalanced transmission procedure" is used. That means, that as primary station the master station initiates all message transmissions, while the remote terminal units, which are secondary stations, may only transmit when they are called.

Multi-point traffic requires only a "half-duplex" transmission medium and can be used in a star or linear structure.

2.2. Technical Specifications

Station Addresses	
Slave Addresses	• 0 - 254 • 0 = BROADCAST
Physical Interface	
	• RS232 • RS485 (with CM-0829), 2 wire or 4 wire
Supported Baud Rates	
	• 50, 75, 100, 110, 134.5, 150, 200, 300, 600, 1050, 1200, 1800, 2000, 2400, 4800, 9600, 19200
Byte Frame	
	• 8E1
SIEMENS SINAUT ST1 Protocol	
Data Communication	• Master - Slave (Request Response) • half duplex
Message Protection	
	• Parity + checksum
Supported SINAUT ST1 message formats in receive direction "1703 ← SINAUT ST1" (Command- or Control Direction)	
	• Pulse command • Setpoint Values • Organizational messages - GI-request (ORG = 08) - time synchronization (ORG = 10)
Supported SINAUT ST1 message formats in transmit direction "1703 ← SINAUT ST1" (Signaling- or Monitoring Direction)	
	• Messages (16 Bit, 32 Bit) • measured values (raw value, fixed point format) • integrated total (28 Bit)

supported IEC60870-5-101/104 message formats in receive direction "1703 ← SINAUT ST1" (Command- or Control Direction)	
	• <TI=45> … Single command • <TI=46> … Double command • <TI=47> … regulating step command • <TI=48> … Setpoint command, normalized value • <TI=49> ... Setpoint command, scaled value • <TI=50> ... Setpoint command, short floating point number

supported IEC60870-5-101/104 message formats in transmit direction "1703 ← SINAUT ST1" (Signaling- or Monitoring Direction)	
	• <TI=30> ... Single-point information with time tag CP56Time2a • <TI=31> … Double-point information with time tag CP56Time2a • <TI=34> … Measured value, normalized value with time tag CP56Time2a (15 Bit + VZ) • <TI=35> … Measured value, scaled value with time tag CP56Time2a (15 Bit + VZ) • <TI=36> ... Measured value, short floating point number with time tag CP56Time2a • <TI=37> …Counter values with time tag CP56Time2a (31 Bit + VZ with sequence number)

Redundancy	
	• ---

Parameter setting	
	• System technical parameters with SICAM TOOLBOX II • Process technical parameters with SICAM TOOLBOX II parameter-settable address conversion in transmit and receive direction with OPM

Hint

This protocol element for interfacing 3rd party systems supports only restricted functionality and only a sub set of the possible data formats. For using this protocol element in your project you have to verify if the supported functionality and supported data formats of the protocol element will be compatible to the required functionality and data formats for interfacing a specific 3rd party system.

2.3. Restrictions

- No GI-completeness check
- No emulation for Confirmation / Termination according to IEC 60870-5-101
- No redundancy functions

In SINAUT ST1 there are a variety of organizational messages, which are used for system monitoring as well as additional system concepts (General Interrogation, Diagnostics, Synchronization).
The organizational messages are only limitedly supported!

Hint

As a third party system adaptation this protocol element implements only a part of the functionality and the data formats of the third party interface. Therefore, for a concrete case of application it is to be checked, to what extent the actual requirements correspond with the functionality implemented here and to what extent additional expansions or adaptations are required.

2.4. Communication according to SINAUT ST1

2.4.1. Data Acquisition by Polling (Station Interrogation)

The transmission of data from the RTUs to the master station takes place through station-selective station interrogations (interrogation procedure, Polling), controlled by the master station; i.e., changed data are stored in the RTU and transmitted to the master station when this station is interrogated. The interrogation procedure of the master station ensures, that MODBUS registers from the remote terminal unit will be interrogated sequentially. Remote terminal units may only transmit when they are called.

In every RTU the station-selective address must be set with the parameter `Common settings | own station number`. This address must be unambiguous for every multi-point traffic line.

2.4.2. Acknowledgement Procedure

The acknowledgement of received messages takes place with the single characters (E5H), if there are no user data to send or by means of a long message, if there are user data to be sent.

The protocol element for SINAUT ST1 remote terminal unit in SICAM RTUs acknowledges or answers every command message or call message received without errors.

2.4.3. Failure Monitoring in the Remote Terminal Unit

In the RTU the monitoring of the interface takes place by monitoring for "cyclic message reception through station interrogation or station-selective data messages".
The monitoring time is to be set in the RTU with the parameter `advanced parameters | Monitoring times | call monitoring time.`
The call monitoring time in the RTU is normally only retriggered by station-selective call messages or station-selective data messages.

The monitoring time in the RTU must be set sufficiently high, so that this does not expire unintentionally with the transmission of larger quantities of data from other RTUs (e.g. during general interrogation).

In the case of a failed interface, data to be sent are stored in the data storage on the basic system element (BSE) of the RTU until they are deleted by the dwell time monitoring or can be transmitted to the master station.

2.4.4. Station Initialization

The SINAUT ST1 protocol does not use any station initialization.

2.4.5. Acquisition of Events (transmission of data ready to be sent)

RTU data ready to be sent are stored in the remote terminal unit until transmission.

Process Image (on protocol element)

The protocol element manages an internal process image, to be able to form the blocked SINAUT ST1 message formats from the 1703 internal IEC message formats. After startup the process image is initialized with the value "0"; for measured values in addition the "F-Bit" (error bit) "=open circuit" is set.

The general interrogation is answered by the protocol element from the internal process image.

After startup of the protocol element a startup delay is used for updating the process image (during this time no calls from the master are accepted).
The duration of the startup delay is set with the parameter `advanced parameters | advanced time settings| Startup delay`.

2.4.5.1. Message from the Remote Terminal Unit to the Master Station

Messages from the RTU to the master station are transmitted with the station interrogation. A Quick-Check procedure to accelerate the transmission of data is not used.

2.4.6. General Interrogation (RTU Interrogation)

The function General Interrogation (RTU interrogation) is used to update the master station after the internal station initialization or after the master station has detected a loss of information.

The general interrogation is answered by the protocol element from the internal process image.

With a general interrogation the data are transmitted by the protocol element in the following order, ascending according to SINAUT ST1 address:

- All binary information
- All measured values
- All integrated totals (optional)

It can be set with the parameter `advanced parameters | GI counter value transfer`, whether integrated totals should also be transmitted for a general interrogation.

2.4.7. Time Synchronization

The time synchronization command is sent to the RTU cyclically from the master station (Default: every 24h) or after a going communication fault.

The protocol element of the RTU performs an automatic adjustment of the time by the message transfer time (as a rule baud rate and fixed message length).

If necessary the RTU protocol element can perform an additional time correction to compensate for the transfer times from transmission facilities. The time correction is to be set with the parameter `advanced parameters | advanced time settings | correction time for clock synchronization command`.

If the time synchronization of the RTU is performed over other interfaces, the time synchronization over the interface with SINAUT ST1 protocol can be deactivated. The function is deactivated with the parameter `advanced parameters | time synchronization`.

The protocol element independently performs a leading summer- / daylight-saving time switchover.

2.4.8. Command Transmission

2.4.8.1. Message from the Master Station selectively to an RTU

Station-selective data messages in command direction are always inserted in the ongoing interrogation procedure (station interrogation) by the master station with high priority after the data transmission in progress has ended.

2.4.9. Transmission of Integrated Totals

The counter interrogation command (=organizational message) is not supported by the RTU protocol element.

Integrated totals are prepared for transmission by the remote terminal unit at certain latching moments (tariff moments). The transmission of the integrated totals then takes place in the interrogation cycle.

Integrated totals can also be transmitted from the RTU for a general interrogation. With the parameter `advanced parameters | GI counter value transfer` it can be set, whether integrated totals should also be transmitted for a general interrogation.

The functionality implemented in the system SICAM RTUs concerning integrated totals is documented in the document "Common Functions Peripheral Elements according to IEC 60870-5-101/104".

2.5. Optimized Parameters for selective Transmission Facilities

The protocol element supports selected transmission facilities – for these the parameters are set fixed – the selection of the transmission facility takes place with the parameter `Common settings | interface modem`. By selecting the "freely definable transmission facility" certain parameters can be set individually.

With TM1703 emic and AMIS DC in addition the physical interface is to be selected with the parameter `Common settings | Interface`.

Transmission facilities support mostly only certain baud rates or combinations of baud rates in transmit/receive direction – these are to be taken from the descriptions for the transmission facility.
The transmission rate (Baud rate) is to be set for transmit/receive direction together with the parameter `Common settings | baud rate` .

Apart from this, a transmission facility that can be freely defined by the user can be selected, for which all available parameters can be set individually. This is then necessary if transmission facilities are to be used that are not predefined or if changed parameters are to be used for predefined transmission facilities. For the selection of the freely definable transmission facility the parameter `Common settings | interface modem` is to be set to "freely definable".
Only this way are all supported parameters displayed and can be parameterized with the required values (see table with default parameters for transmission facilities).

To adapt to different modems or time requirements of third party systems, when using the protocol element on SMx551 the following parameters can be set individually:

- common settings | free definable interface modem | pause time (tp), common settings | free definable interface modem | pause time "time base" (tp)
- common settings | free definable interface modem | set up time (tv), common settings | free definable interface modem | set up time "time base" (tv)
- common settings | free definable interface modem | run out time (tn), common settings | free definable interface modem | run out time "time base" (tn)
- Common settings | free definable interface modem | DCD handling
- Common settings | free defineable interface modem | bounce suppression time (tbounce)
- common settings | free defineable transmission facility | disable time (tdis), common settings | free defineable transmission facility | disable time "time base" (tdis),
- Common settings | free defineable interface modem | stability monitoring time (tstab)
- common settings | free defineable transmission facility | continous level monitoring time (tcl)
- Common settings | free defineable interface modem | Transmission delay if continous level (tcldly)
- common settings | free defineable transmission facility | 5V supply (DSR)
- Common settings | free defineable interface modem | configuration for CM-082x

How effective the individual time settings are for the data transmission is visible on the following page in a timing diagram.

To adapt to different modems or time requirements of third party systems, when using the protocol element in SICAM EMIC or AMIS DC the following parameters can be set individually:

- common settings | free definable interface modem | pause time (tp),
- common settings | free definable interface modem | set up time (tp),
- common settings | free definable interface modem | run out time (tp),
- Common settings | free defineable interface modem | DCD-handling
- Common settings | free defineable interface modem | bounce suppression time (tbounce)
- common settings | free definable interface modem | disable time (tdis),
- Common settings | free defineable interface modem | stability monitoring time (tstab)
- common settings | free defineable transmission facility | continous level monitoring time (tcl)
- Common settings | free defineable interface modem | Transmission delay if continous level (tcldly)
- Common settings | free defineable interface modem | STR-State line as output for

How effective the individual time settings are for the data transmission is visible on the following page in a timing diagram.

Parameter "5V supply (DSR)" [only SM0551, SM2551]

If necessary the voltage supply of the transmission facility (only 5V) – if this is enough – can be supplied over the status line DSR. The enabling of the voltage supply is performed with the parameter `advanced parameters | 5V supply (DSR)`. The voltage supply is only switched to the DSR status line instead of the DSR signal with corresponding parameter setting.

ATTENTION: Required voltage supply and maximum current consumption of the transmission facility must be observed!

Parameter "5V, 10V or external supply (DTR)" [only SICAM EMIC, AMIS DC]

If necessary the voltage supply of the externally connected transmission facility (5V, 10V or external voltage of terminal X2) – if adequate – can take place over the status line DTR. The enabling of the voltage supply is carried out with the parameter `advanced parameters | DTR-Status line as output for`. The voltage supply is only switched to the DTR status line instead of the DTR signal with corresponding parameter setting.

Attention

Required voltage supply and maximum current consumption of the transmission facility must be observed!

Parameter "Configuration for CM082x" [only SM-0551, SM-2551]

If an optical converter of the type CM082x is used as external transmission facility, then when using a patch plug of the type CM2860 the parameter `advanced Parameter | Configuration for CM-082x` must be set.

In addition, for the adaptation of the protocol to the transmission medium used or to the dynamic behavior of the connected remote station, the following parameters are available:

- `advanced parameters | monitoring times | Character monitoring time`, `advanced parameters | monitoring times | Character monitoring time "time base"`
- `advanced parameters | monitoring times | Idle monitoring time`, `advanced parameters | monitoring times | Idle monitoring time "time base"`
- `advanced parameters | monitoring times | expected_ack_time_corr_factor` (see acknowledgment procedure in the central station)

The signal monitoring time and idle monitoring time is used for the message interruption monitoring and message resynchronization in receive direction. A message interruption is detected when the time between 2 bytes of a message is greater than the set signal monitoring time. With message interruption the receive processing in progress is aborted and the message is discarded. After a detected message interruption a new message is only accepted in receive direction after an idle time on the line (idle time).

The protocol element – insofar as the transmission facility (e.g. VFT channel) provides this signal receive-side – can evaluate the interface signal DCD and e.g. utilize it for monitoring functions.

Default parameters for transmission facilities with ST1SA0

Transmission facility	electrical interface	RTS	tp [ms]	tv [ms]	tn□[Bit]	tp_bc [ms]	tdis□[ms]	DCD	Tbounce [ms]	tstab□[ms]	tduration□[sec]	tdelay□[ms]	A_I	T	5V 1)	CM-082x 1)
Modem for "4-wire transmission line" (SAT-VFM,-WT,-WTK,-WTK-S,CE-0700)	RS-232	ON	0	0	3	0	35	YES	5	5	10	200	A	I	NO	NO
Modem for "2-wire transmission line" (SAT-VFM,-WT,-WTK,-WTK-S,CE-0700)	RS-232	↑↓	0	30	3	0	35	YES	5	5	10	200	A	I	NO	NO
SAT-DMS (ring configuration)	RS-232	ON	0	0	5	0	0	NO	0	0	0	0	A	I	NO	NO
SAT-DMS (ring configuration; AE with WT remote)	RS-232	↑↓	0	50	5	0	35	YES	5	5	10	200	A	I	NO	NO
OPTICAL	RS-232	↑↓	0	1	0	0	0	NO	0	0	0	0	A	I	YES	NO
radio digital	RS-232	↑↓	30	100	11	0	50	YES	10	5	0	200	A	I	NO	NO
radio analog	RS-232	↑↓	50	300	50 ms	0	100	YES	10	5	0	200	A	I	NO	NO
Direct connection (RS-485)	RS-485	↑↓	0	1	0	0	0	NO	0	0	0	0	A	I	YES	NO
DLC-Modem (CE-0740, CE-00741)	RS-232	↑↓	0	0	0	0	0	NO	0	0	0	0	A	I	NO	NO
Modem for "4-wire transmission line" (CE-0701)	RS-232	ON	0	0	3	0	0	YES	5	5	10	200	A	I	NO	NO
Modem for "2-wire transmission line" (CE-0701)	RS-232	↑↓	22	30	3	0	0	YES	5	5	10	200	A	I	NO	NO
Modem for "2-wire transmission line" (CE-0701 remote via additional modems)	RS-232	↑↓	0	60	5	0	35	YES	5	5	10	200	A	I	NO	NO
Modem for "2-wire transmission line" (CE-0701 remote via Westermo TD-32 Modem)	RS-232	↑↓	0	1	0	0	0	NO	0	0	0	0	A	I	NO	NO
Modem for "2-wire transmission line" (CE-0701 remote via Westermo GD-01 Modem)	RS-232	↑↓	0	1	0	0	0	NO	0	0	0	0	A	I	NO	NO
Direct connection (RS-232)	RS-232	ON	0	0	0	0	0	NO	0	0	0	0	A	I	NO	NO
SATTELLINE 2ASxE time slot radio	RS-232	↑↓	0	1	0	0	0	NO	0	0	0	0	A	I	NO	NO
free definable																

Legend:
electric interface ..... Parameter "electric interface" [only SM2541]
RTS ..... ↑↓ = RTS is switched (ON / OFF) with every message for the control of the modem carrier switching
tp ..... Parameter "Pause time (t_p)", Parameter "Pause time time base (t_p)"
tv ..... Parameter "Set-up time (t_v)", Parameter "Set-up time time base (t_v)"
tn ..... Parameter "Run-out time (t_n)", Parameter "Run-out time time base (t_n)"
tp_bc ..... Parameter "Pause time after broadcast message (*tp_bc*)", Parameter "Pause time after broadcast message_time base (*tp_bc*)"
tdis ..... Parameter "Disable time (t_{dis})", Parameter "Disable time time base (t_{dis})"
DCD ..... Parameter "DCD-rating"
tprell ..... Parameter "bounce suppression time (t_{prell})"
tstab ..... Parameter "Stability monitoring time (t_{stab})"
tdauer ..... Parameter "Continuous level monitoring time (t_{dauer})"
tverz ..... Parameter "Transmit delay for level (t_{verz})"
A_I ..... Parameter "Asynchronous_Isochronous"
T ..... Parameter "Bit timing (only with Isochronous)" (I=internal, E=external)
Z ..... Parameter "Send time synchronization command station-selective" (s=selective, B=BROADCAST)
1) **CM082x** ..... Parameter "Configuration for CM082x". Configuration of the interface for optical converter CM-082x with Patchplug CM-2860 [only SM0551, SM2551]
1) **5V** ..... Parameter "5V supply (DSR)" [only SM0551, SM2551]

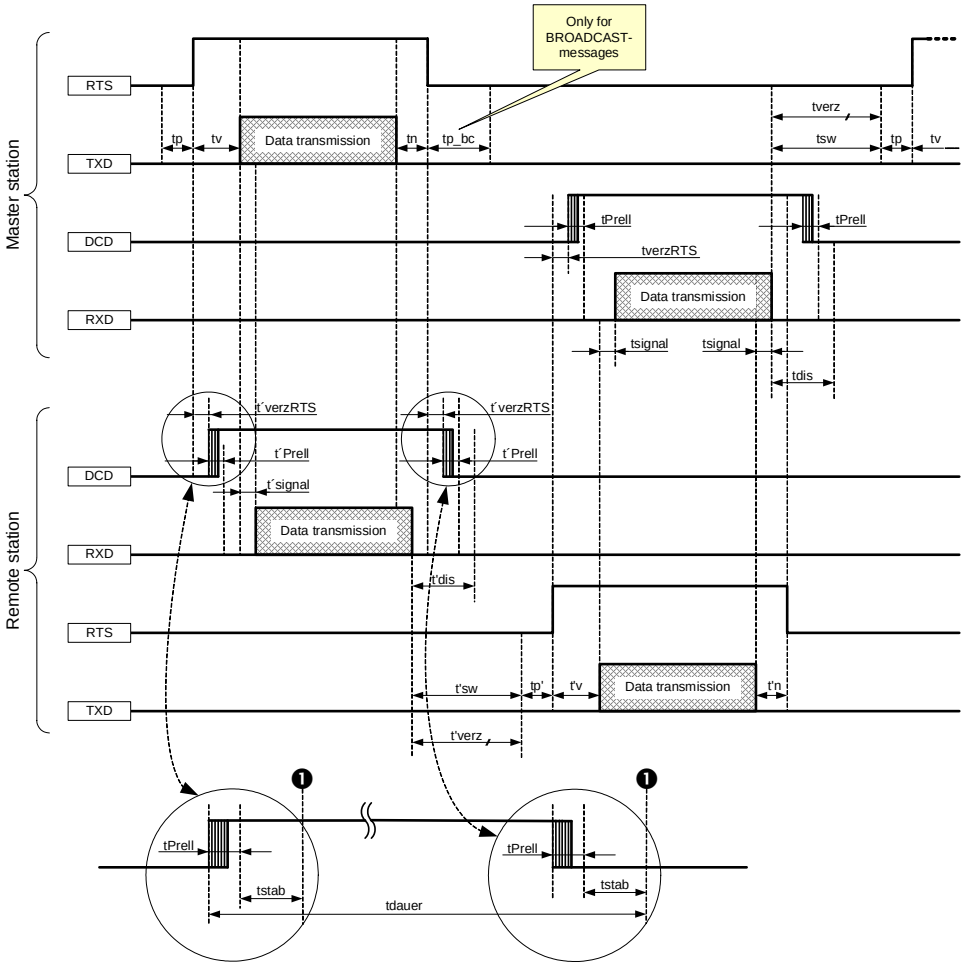
Default parameters for transmission facilities with ST1ST0

Transmission facility	RTS	tp [ms]	tv [ms]	tn [ms]	tdis[ms]	DCD	Tbounce [ms]	tstab [ms]	tduration [sec]	tdelay [ms]	V 1)
Modem for "4-wire transmission line" (SAT-VFM,-WT,-WTK,-WTK-S,CE-0700)	ON	0	0	3	35	YES	5	5	10	200	NO
Modem for "2-wire transmission line" (SAT-VFM,-WT,-WTK,-WTK-S,CE-0700)	↑↓	0	30	3	35	YES	5	5	10	200	NO
SAT-DMS (ring configuration)	ON	0	0	5	0	NO	0	0	0	0	NO
SAT-DMS (ring configuration; AE with WT remote)	↑↓	0	50	5	35	YES	5	5	10	200	NO
OPTICAL	↑↓	0	1	0	0	NO	0	0	0	0	YES
radio digital	↑↓	30	100	11	50	YES	10	5	0	200	NO
radio analog	↑↓	50	300	50	100	YES	10	5	0	200	NO
Direct connection (RS-485)	↑↓	0	1	0	0	NO	0	0	0	0	YES
DLC-Modem (CE-0740, CE-00741)	↑↓	0	0	0	0	NO	0	0	0	0	NO
Modem for "4-wire transmission line" (CE-0701)	ON	0	0	3	0	YES	5	5	10	200	NO
Modem for "2-wire transmission line" (CE-0701)	↑↓	22	30	3	0	YES	5	5	10	200	NO
Modem for "2-wire transmission line" (CE-0701 remote via additional modems)	↑↓	0	60	5	35	YES	5	5	10	200	NO
Modem for "2-wire transmission line" (CE-0701 remote via Westermo TD-32 Modem)	↑↓	0	1	0	0	NO	0	0	0	0	NO
Modem for "2-wire transmission line" (CE-0701 remote via Westermo GD-01 Modem)	↑↓	0	1	0	0	NO	0	0	0	0	NO
Direct connection (RS-232)	ON	0	0	0	0	NO	0	0	0	0	NO
SATTELLINE 2ASxE time slot radio	↑↓	0	1	0	0	NO	0	0	0	0	NO
free definable											

Legend:

RTS ..... ↑↓ = RTS is switched (ON / OFF) with every message for the control of the modem carrier switching
tp ..... Parameter "Pause time (t_p)"
tv ..... Parameter "Set-up time (t_v)"
tn ..... Parameter "Run-out time (t_n)"
tdis ..... Parameter "Disable time (t_{dis})"
DCD ..... Parameter "DCD-rating"
tprell ..... Parameter "bounce suppression time (t_{prell})"
tstab ..... Parameter "Stability monitoring time (t_{stab})"
tdauer ..... Parameter "Continuous level monitoring time (t_{dauer})"
tverz ..... Parameter "Transmit delay for level (t_{verz})"
1) **V** ..... Parameter "DTR status line as output for" voltage supply for external transmission facilities.

The following diagram shows in detail the timing for the data transmission when using transmission facilities with switched carrier.



Legend:

RTS ..... Request to Send
DCD ..... Data Carrier Detect
TXD ..... Transmit Data
RXD ..... Receive Data

$t_{verzRTS}$ ..... Processing time of the transmission system
Time delay/time difference between activation of transmit part (RTS ↑) and receiver ready (DCD ↑)

t_p ..... Break time (delay, before transmit part is activated with RTS)
t_v ..... Setup time (transmission delay, after transmit part was activated with RTS)
t_n ..... Reset time (delayed switch off of the transmit signal level with RTS after message transmission)
t_{p_bc} ..... Break time after BROADCAST-Messages
(some systems require a longer break after the transmission of BROADCAST-messages before the next message can be sent)
t_{sw} ..... Internal processing time
t_{signal} ..... Signal propagation delays (dependent from the used transmission facility/transmission path)

t_{Prell} ..... Protective time after positive/negative DCD-edge (debounce of DCD)
t_{stab} ..... Stability monitoring time – the new DCD-status is only used for message synchronisation after the expiration of the stability monitoring time
t_{dauer} ..... Continuous level monitoring time
t_{verz} ..... Transmission delay – in case of a continuous level a further message transmission will be made at the latest after the transmission delay
t_{dis} ..... Disable time of the receiver after message receiption (to supress faulty signs during level monitoring)

$t`_x$ ..... Corresponding times in the remote stations

❶ ..... DCD valide

2.6. SINAUT ST1 Protocol Description

2.6.1. PCMBA Modulation Method

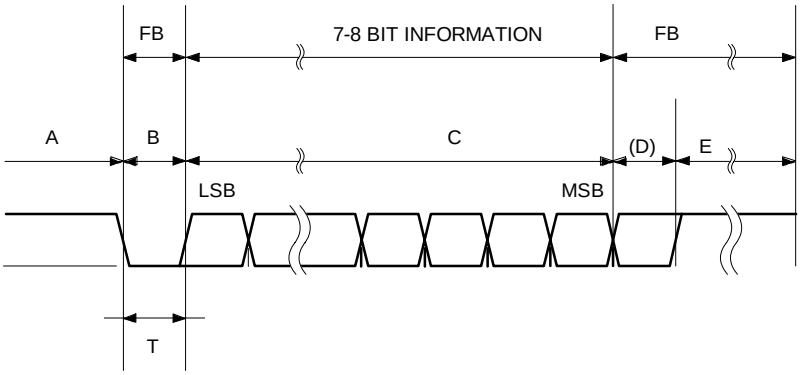
The data are pulse code modulated in groups of 8 Bit and transmitted asynchronous. A USART-module in the asynchronous mode thereby provides each byte with a byte frame (BR).

This byte frame contains:

1 Start bit
8 Data bits
1 Parity bit (even parity)
1 Stop bit

The byte frame can be parameterized (system technical parameter).

Because of start- and stop bits of the byte frame the synchronization of the receiver happens new with each byte.



A: Empty-state of the line (binary information "1"), between two messages at least 3.5 characters
B: Start bit ("0")
C: 7/8 bit data, LSB (Least Significant Bit) is transmitted first
D: Parity bit (NO/ODD/EVEN PARITY) (= configurable)
E: 1/2 stop bit(s) ("1") (= configurable)
T: Time for the transmission of a bit (1/transmission speed)
FB: Framing bits of the USART module

2.7. Interface Signals

Following V.24 interface signals will be used:

TxD	<103>	Transmit data
RxD	<104>	Receive data
GND	<102>	Signal ground

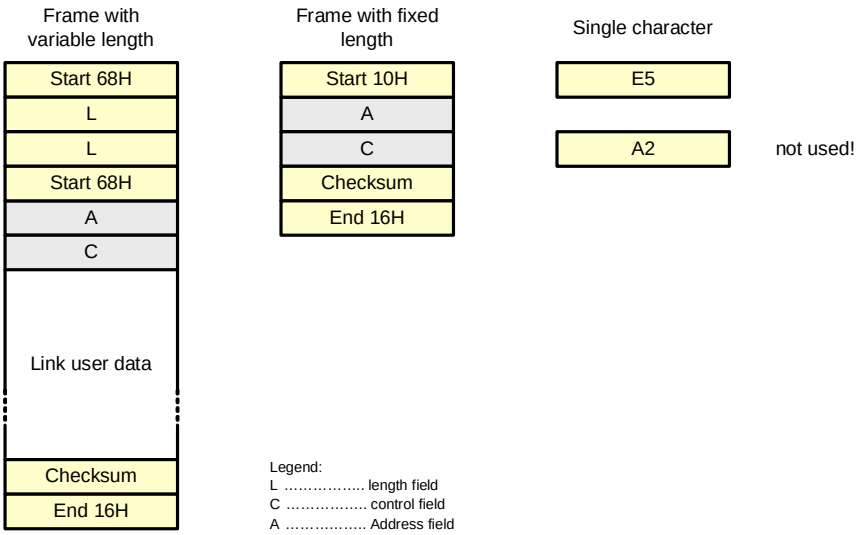
Following V.24 interface signals can be used optional:

RTS	<105>	serves to switch on the signal-level of the transmission facility
DCD	<109>	serves for the recognition of the reception level of the transmission facility

2.8. Message Description

2.8.1. Structure of the Message

The transmission formats and rules of the interface are based on the international standard IEC 60870-5-1 Telecontrol equipment and systems TC 57 Part 5.1, Transmission Frame Formats Format Class FT1.2 with SINAUT ST1 specific deviations regarding the use of the F-field (control field).



The following message formats are used:

Message format IEC 60870-5-1 / FT1.2	Use with SINAUT ST1 (unbalanced)
Messages with fixed block length	Messages for traffic processing (station interrogations)
Messages with variable block length	User data messages
Single character 1	Acknowledgement message (without control field information)
Single character 2	>>> not used <<<

The message formats differ, among other things, through different start characters.

Message format IEC 60870-5-1 / FT1.2	Start character / message frame / stop character
Messages with fixed block length	10H xxH xxH CS 16H
Messages with variable block length	68H LLH LLH 68H xxH xxH ..... CS 16H
Single character 1	E5H
Single character 2	A2H

Legend: CS ..... Checksum (HEX)
xxH .... Data bytes (HEX)
LLH .... Number (=length) of the user data bytes (HEX)

Representation of one byte (LSB shown right-aligned):

2^7	2^6	2^5	2^4	2^3	2^2	2^1	2^0
D8	D7	D6	D5	D4	D3	D2	D1

D1 basically represents the least significant bit (LSB).

Representation of one byte "Bit sequence on the line": (example for single character 1)

Bit sequence on the line	1	2	3	4	5	6	7	8	9	10	11
Data bits	STA	D1	D2	D3	D4	D5	D6	D7	D8	P	STP
	0	1	0	1	0	0	1	1	1	1	1

Legend: STA ... Start-Bit (is transmitted as 1st Bit on the line)
STP ... Stop-Bit
P ..... Parity-Bit (even)

With the specified transmission rules and character definitions, all message formats (except the single characters) are protected with d = 4 against faulty information as well as block displacements (synchronization errors).

2.8.1.1. Message Format with fixed Block Length

This data record is used in call direction as call message to request data.

Formats with fixed block length consist of one start character, one fixed number L of user data bytes, one checksum and one stop character.

	2^7	2^6	2^5	2^4	2^3	2^2	2^1	2^0	
Start character	0	0	0	1	0	0	0	0	10H
Address field	A-field (0..254)								Station address
Control field	F-field								
Checksum	CS								
Stop sign	0	0	0	1	0	1	1	0	16H

For the transmission protocol according to SINAUT ST1 based on IEC60870-5-2 the number of bytes for the A-field and F-field for the "Format with fixed block length" is 2 Bytes (control field and address field).

A-Field: SINAUT ST1 — The A-Field contains the participant address (in the case of application SINAUT ST1 station number or communication address)
Value range 0 ... 254,
The station number 0 is used for calls to all stations

Transmission rules for message formats with fixed block length

R1 Idle state on the line represents 1-Signal
R2 Every USART character has one Start Bit (0-Signal), 8 Information-Bits, one Parity-Bit (even) and a Stop Bit (1-Signal)
R3 No idle states are permitted between the USART characters of a message
R4 With a loss of synchronization a minimum number of 33 Bits idle state are required between the formats (block).
R5 The user data are monitored with a checksum. The checksum is the arithmetic sum of all user data bytes (without Start and Stop characters) without consideration of the carry overs.
R6 The receiver checks for each USART character: Start-Bit, Stop-Bit and Parity-Bit (even Parity).

Special checks in receive direction for message format with variable block length:

- the determined start character at the beginning and at the end of the header (10H)
- the number of received user data bytes (2 USART characters)
- the checksum
- the stop character (16H)

Error handling:
After an error is detected the data received are discarded and to resynchronize the receiver the receive data line is monitored for a pause of at least 33 Bit.

Comment to R4:
This time is generated by the transmitter, in normal operation after the detection of a missing acknowledgement and always before sending the next message.

2.8.1.2. Message Format with variable Block Length

This data record is used to transmit multiple user data bytes. Its use is independent of the data content and the transmission direction.

These formats consist of one first Start character, two identical characters in which the number L of user data bytes is transmitted, one second Start character, the user data L are basically in the range 0 to 255. (For the SINAUT ST1 protocol, L is used in the range "1 < = L < = 255".)

	2^7	2^6	2^5	2^4	2^3	2^2	2^1	2^0	
Start character	0	1	1	0	1	0	0	0	68H
	Length (0..126)								Number of user data bytes
	Length (0..126)								Number of user data bytes
Start character	0	1	1	0	1	0	0	0	68H
Address field	A-field (0..254)								User data byte (n + 0)
Control field	F-field								User data byte (n + 1)
	TA			Additional identifier					User data byte (n + 2)
	ST1 message address								
	Object (1)								Address field expansion (optional)
	Index (1)								Address field expansion (optional)
	Information part								
									User data byte (n + m)
Checksum	CS								
Stop sign	0	0	0	1	0	1	1	0	16H

(1) only available with AE = 1 (address field expansion)

For the transmission protocol according to SINAUT ST1 based on IEC60870-5-2 the number of bytes for the A-field and F-field for the "Format with variable block length" is 2 Bytes.

Transmission rules for messages formats with variable block length

The transmission rules R1 to R6 and the error handling are valid as for "Message format with fixed block length".

Special checks in receive direction for message format with variable block length:

- - the determined start character at the beginning and at the end of the header (68H xx xx 68H)
- - the identity of the two length bytes (68H xx xx 68H)
  The L-Field specifies the number (0 ... 126) of user data bytes and thus determines the message length
- - that the number of characters received equals L+6
- - the checksum
  The checksum is the arithmetic sum of all user data bytes, without consideration of the carry overs (= modulo 256 Addition)
- - the stop character (16H)

2.8.1.3. Single Characters (Short Message)

According to the standard the single characters can be used for special information, to enable efficient data communication control.

Single character-1: ($E5_H$)

With the SINAUT ST1 protocol (multi-point traffic) the single character-1 ($E5_H$) is used as follows:

- SLAVE ⇨ MASTER:
  acknowledgment message "ACK"

	2^7	2^6	2^5	2^4	2^3	2^2	2^1	2^0	
Single sign 1	1	1	1	0	0	1	0	1	E5H

Single character-2: ($A2_H$)

With the SINAUT ST1 protocol (multi-point traffic) the single character-2 ($A2_H$) is not used!

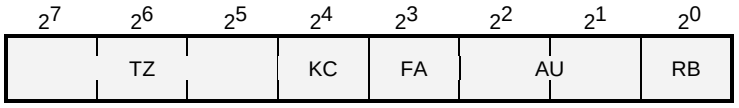
	2^7	2^6	2^5	2^4	2^3	2^2	2^1	2^0	
Single sign 2	1	0	1	0	0	0	1	0	A2H

Transmission rules for single characters

The transmission rules R1 to R4 and R6 and the error handling are valid as for "Message format with fixed block length".

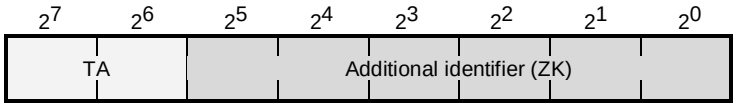
2.8.2. SINAUT ST1 Function Fields

2.8.2.1. Function Field (F-Field)



Elements of the function field (F-Field)	
RB … Direction bit	RB=0: message from SLAVE → MASTER (=reply direction) RB=1: message from MASTER → SLAVE (=call direction)
AE … Address field expansion	AE=0: SINAUT ST1 "without address field expansion" = DEFAULT AE=1: SINAUT ST1 "with address field expansion" (address field expansion for "Object" and "Index") AE=2: not supported! AE=3: not supported!
FA … Function selection	FA=0: call control code for the TIM FA=1: call control code for the basic device … is only used in data messages, when call message is FA=0
KC … Control code	Call direction: (MASTER→ SLAVE) KC=0: normal message KC=1: message after call Reply direction: (SLAVE → MASTER) KC=0: nth message KC=1: last message
TZ … Message counter	TZ=0: startup identifier TZ=1..7: 1st to 7th message

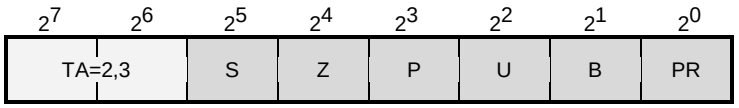
2.8.2.2. Message Type (TA), Additional Identifier



Elements of the field for TA and additional identifier	
TA … Message type	TA=0: Organizational message (e.g. GI-request) TA=0: Free TA=2: Data message TA=3: Interrogated data message (not in control direction) Message from MASTER → SLAVE (=call direction)
ZK … Additional identifier for message type	For organizational messages (TA=0) the individual messages are differentiated based on the additional identifier. TA=0, ZK= 8: General Interrogation TA=0, ZK=10: Time synchronization

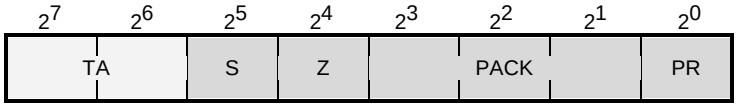
The additional identifier is used differently depending on the address expansion (AE).

Additional identifier for data messages (TA = 2 or 3) with "AE=0"



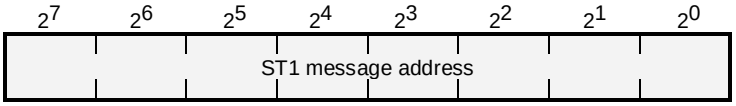
Elements of the field for TA and additional identifier	
S ... enable/disable	S=0: message enable S=1: message disable
t ... time tag	Z=0: Message without time tag Z=1: Message with time tag
P	P=1: message is to be transmitted permanently (cyclically)
U	U=1: Transmit message spontaneously without fail
B	B=1: Transmit message conditionally spontaneously
PR ... Principle of the message transmission	PR=0: Image memory principle PR=1: Transmit buffer principle

Additional identifier for data messages with "AE=1"



Elements of the field for TA and additional identifier	
S ... enable/disable	S=0: message enable S=1: message disable
t ... time tag	Z=0: Message without time tag Z=1: Message with time tag
PACK ... Number of user data bits per object	Bit number = 4×2^{PACK} PACK=0: 4 Bits user data per object PACK=1: 8 Bits user data per object PACK=2: 16 Bits user data per object PACK=3: 32 Bits user data per object Note: "PACK" is not used in control direction Example: If the RTU sends a binary information message with 32 Bit (= 4 Bytes) and PACK=0 (4 Bits/Object), then the master generates 8 objects with ascending object number from the received message.
PR ... Principle of the message transmission	PR=0: Image memory principle PR=1: Transmit buffer principle

2.8.2.3. SINAUT ST1 Message Address



ST1 message address	
ST1 message address	possible: 0 .. 255 (used: 2.. 250) In standard mode (without address field expansion) the message address is always assigned unambiguously. Addressed per message address are: - 16 or 32 Bit binary information - 2 or 4 analog values - 1 integrated total - 1 setpoint value - one group of 8 commands

2.8.2.4. SINAUT ST1 Object / Index (only with address field expansion AE=1)

The "Object Number" is used together with the "Index" for the address field expansion.
The object number is always only parameterized as "Start-Object" in the RTU. With the help of "PACK" the number of objects is then derived in the master station.
"Object" and "Index" are always only parameterized per ST1 message (e.g. 32 bit binary information, 4 analog values).

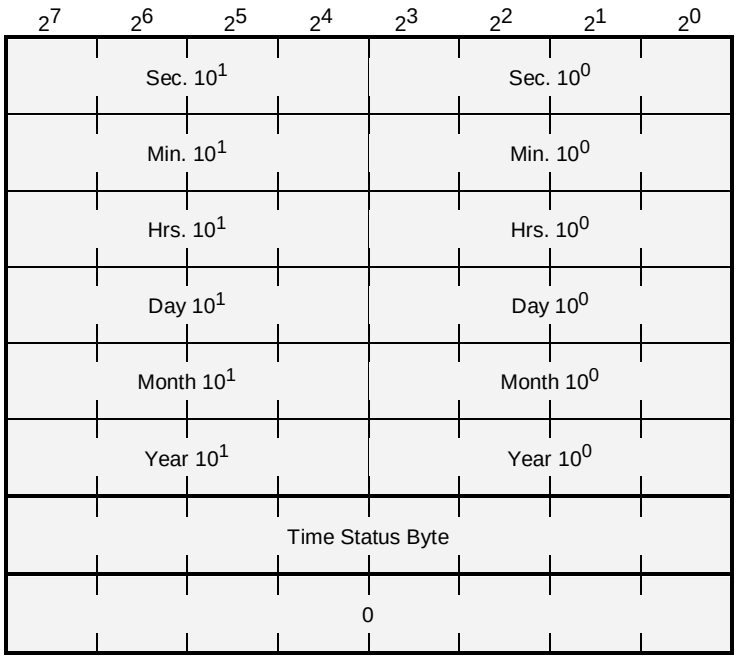
The index is used to differentiate the data types.

Index:
2 … Commands
3 … Binary information
4 … Measured values
5 … Integrated totals
6 … Setpoint values

2.8.2.5. SINAUT ST1 Time Tag

If the time identifier "Z" is set in the additional identifier, then after the user data information follows an 8 Byte long time tag.

Sinaut ST1 time tag:



Assignment of the time status byte:	
Bit 0:	1 = clock unclear, TIM-clock has not yet been converted after a startup
Bit 1:	1 = clock set by AG per control instruction
Bit 2:	1 = clock set via ORG message
Bit 3:	1 = clock synchronization not taken place within the last 24 hours
Bit 4:	0 = daylight-saving time 1 = normal time
Bit 5:	… presently not used
Bit 6:	1 = SYN-display; the bit changes the valency with every SYN-procedure
Bit 7:	1 = STEL-display; the bit changes the valency with every STEL-procedure

2.9. Message Conversion

Data in control direction are transferred from the basic system element to the protocol element in the SICAM RTUs internal IEC 60870-5-101/104 format. These are converted by the protocol element to the SIEMENS SINAUT ST1 (TIM11) message format on the line and transmitted according to the transmission procedure of the protocol.

Data in receive direction are converted by the protocol element from the message format on the transmission line to a SICAM RTUs internal IEC 60870-5-101/104 format and transferred to the basic system element.

The conversion of the message formats SICAM RTUs ↔ SIEMENS SINAUT ST1 (TIM11) and the conversion of the address information is called message conversion.

The parameterization for the conversion of the address information from IEC 60870-5-101/104 ⇔ SIEMENS SINAUT ST1 (TIM11) is to be done with TOOLBOX II (OPM) using "SIP Message Address Conversion".

Master – Categories for SIP Message Address Conversion:

Data	Direction	Category	ST1SA0	ST1ST0
Command	Receive Direction	*firmware /*`Rec_command`	✓	✓
Setpoint	Receive Direction	*firmware /*`Rec_setpoint_command`	✓	✓
Indication	Transmit Direction	*firmware /*`Transmit detailed routing`	✓	✓
Measurand	Transmit Direction	*firmware /* `Transmit detailed routing`	✓	✓
Counter	Transmit Direction	*firmware /* `Transmit detailed routing`	✓	✓

Following parameters valid for all parameter categories:

Parameter	
Lk_Reg	**Link Region Number** … data point assigned to automation unit (AU) with selected region number.
Lk_Comp	**Link Component Number** … data point assigned to automation unit (AU) with selected component number.
Lk_BSE	**Link BSE** … data point assigned to BSE (basic system element) in selected automation unit (AU).
Lk_SSE	**Link SSE** … data point assigned to selected SSE of selected BSE in selected automation unit (AU).
Lk_DS	**Link Destination Station Number** … data point assigned to selected destination station (DS) of selected SSE of selected BSE in selected automation unit (AU).
Lk_Cat	**Link Category**
Lk_Prep	Link Prepared: Data point: - prepared … Signal will not be converted/loaded into destination system - activated … Signal is activated and will be converted/loaded into destination system.

2.10. Message Conversion in Monitor Direction

Message conversion in transmit direction: IEC60870-5-101/104 → SINAUT ST1

IEC 60870-5-101/104 ⇨		SINAUT ST1		
Type ID	**Designation**	**TA**	**ZK**	**Designation**
<TI=30>	single-point information with time tag CP56Time2a	2, 3	0	binary information 16 Bit without time binary information 32 Bit without time
<TI=30>	single-point information with time tag CP56Time2a	2, 3	1	binary information 16 Bit with time binary information 32 Bit with time
<TI=31>	Double-point information with time tag CP56Time2a	2, 3	0	binary information 16 Bit without time binary information 32 Bit without time
<TI=31>	Double-point information with time tag CP56Time2a	2, 3	1	binary information 16 Bit with time binary information 32 Bit with time
<TI=34>	Measured value, normalized value with time tag CP56Time2a (15 Bit + VZ)	2, 3	0	Analog value 1 MW Analog value 2 MW Analog value 4 MW
<TI=35>	Measured value, scaled value with time tag CP56Time2a (15 Bit + VZ)	2, 3	0	Analog value 1 MW Analog value 2 MW Analog value 4 MW
<TI=36>	Measured value, short floating point number with time tag CP56Time2a	2, 3	0	Analog value 1 MW Analog value 2 MW Analog value 4 MW
<TI=37>	Integrated totals with time tag CP56Time2a (31 Bit + VZ)	0	10	Integrated total 1 ZW

TA … SINAUT ST1 message type
ZK … SINAUT ST1 additional identifier

2.10.1. Binary Information

Binary information transmission with SINAUT ST1:

- 16 or 32 Bit per SINAUT ST1 message
- Without time or with time
- Spontaneous or with general interrogation

ST1 message format for binary information (AE=0)

2^7	2^6	2^5	2^4	2^3	2^2	2^1	2^0	
TA		S = 0	Z = 0	P = 0	U = 1	B = 0	PR = 1	
message number = 2 to 255								
Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0	Data byte 1
Bit 15	Bit 14	Bit 13	Bit 12	Bit 11	Bit 10	Bit 9	Bit 8	Data byte 2
Bit 23	Bit 22	Bit 21	Bit 20	Bit 19	Bit 18	Bit 17	Bit 16	Data byte 3 (only at 32 Bit)
Bit 31	Bit 30	Bit 29	Bit 28	Bit 27	Bit 26	Bit 25	Bit 24	Data byte 4 (only at 32 Bit)

TA = 2 … spontaneous message
TA = 3 … requested message (general interrogation)

ST1 message format for binary information (AE=1)

2^7	2^6	2^5	2^4	2^3	2^2	2^1	2^0	
TA		S = 0	Z = 0		PACK		PR = 1	
Message address								
Object								
Index = 3								
Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0	Data byte 1
Bit 15	Bit 14	Bit 13	Bit 12	Bit 11	Bit 10	Bit 9	Bit 8	Data byte 2
Bit 23	Bit 22	Bit 21	Bit 20	Bit 19	Bit 18	Bit 17	Bit 16	Data byte 3 (only at 32 Bit)
Bit 31	Bit 30	Bit 29	Bit 28	Bit 27	Bit 26	Bit 25	Bit 24	Data byte 4 (only at 32 Bit)

TA = 2 … spontaneous message
TA = 3 … requested message (general interrogation)

PACK … 0: 4 Bit per object → 8 objects each 4 Bit
1: 8 Bit per object → 4 objects each 8 Bit
2:16 Bit per object → 2 objects each 16 Bit

Address conversion SINAUT ST1 → SICAM RTUs

The parameterization of the address and message conversion for indications in transmit direction is to be done with TOOLBOX II / OPM with the parameter category *firmware /* Transmit detailed routing.

Parameter Category:
*firmware /*Transmit detailed routing

Parameter	Value
Lk_Reg	222
Lk_Comp	35
Lk_BSE	020 CP-2010(M)/MC25
Lk_SSE	128 SM-2551/ST1SA0
Lk_DS	Protocols
Lk_Cat	ST1SA0/Transmit detailed routing
Lk_Prep	Activated
CASDU1	222
CASDU2	35
IOA1	0
IOA2	0
IOA3	0
TI	Single pt. information (TI 30)
ST1_tel_type_(ST1Sxx)	binary information - 32 bit
pack_(ST1Sxx)	16
telegram_with_timetag_(ST1Sxx)	no
ST1_format_(ST1Sxx)	single point information
X_0%	0
X_100%	0
Y_0%	0
Y_100%	0
ST1_tel_no_(ST1Sxx)	20
ST1_index_(ST1Sxx)	3
ST1_object_(ST1Sxx)	0
ST1_data_index_(ST1Sxx)	0

SICAM RTU address

CASDU1
CASDU2
IOA1
IOA2
IOA3

5-stage freely parameter-settable SICAM RTU address
possible: 0 - 255

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

SINAUT ST1 Address

ST1-Message address possible: 2 – 255

ST1-Object: used together with the "ST1 Index" for the address field expansion
possible: 0 – 255 (0 = no address field expansion)

ST1-Index: used to differentiate the data types
possible: 0 – 255 (0 = no address field expansion)

ST1-Data element bit position for binary information or value numbers for measured values
possible: 0 – 31

ST1-Message type possible:
- binary information 16 Bit
- binary information 32 Bit
- analog value 1 MW
- analog value 2 MW
- analog value 4 MW
- integrated total 1 ZW

PACK: number of bits per object
possible:
- 4
- 8
- 16
- unused/automatic

Time tag: send message with or without time
possible: yes/no

ST1-Format: possible:
- single-point information
- double-point information E/A
- double-point information A/E
- measured value 12 Bit left-aligned
- measured value 15 Bit + VZ
- integrated total + 28 Bit binary

X_0%: Value adaptation
Lower limit of the value range used in the external (protocol-specific) format. The corresponding internal value is parameterized at Y_0%.
Possible: - 32768 … + 32767

X_100%: Value adaptation
Upper limit of the value range used in the external (protocol-specific) format. The corresponding internal value is parameterized at Y_100%.
Possible: - 32768 … + 32767

Y_0%: Value adaptation
Lower limit of the value range used in the selected internal format. The internal format is defined by the TI (Type Identification). The corresponding external value is parameterized at X_0%.
Possible: TI = 34: - 1 … + 1
TI = 35: - 32768 … + 32767
TI = 36: no check

Y_100%: Value adaptation
Upper limit of the value range used in the selected internal format. The internal format is defined by the TI (Type Identification). The corresponding external value is parameterized at X_100%.
Possible: TI = 34: - 1 … + 1
TI = 35: - 32768 … + 32767
TI = 36: no check

Note: The parameters X_0%, X_100%, Y_0% and Y_100% must be left at their default value/is checked by the firmware.

Spontaneous Message Forwarding

The table describes the data point quality descriptor and the cause of transmission according to IEC 60870-5-101/104.

Elements of the message	
TI .. Type Identification	TI 30 single-point information with time tag CP56Time2a TI 31 double-point information with time tag CP56Time2a
CASDU, IOA .. Message address	can be set by parameter
SPI .. single point information	0 .. OFF 1 .. ON
DPI .. double point information	double-point information ON/OFF double-point information OFF/ON
QDS .. Quality descriptor	
BL .. blocked	not supported
SB .. substituted	not supported
NT .. not topical	not supported
IV .. invalid	not supported
cause of transmission	
02 .. background scan	not supported
03 .. spontaneous	upon change of information state or quality descriptor
05 .. requested	not supported
11 .. return information, caused by a remote command	not supported
12 .. return information, caused by a local command	not supported
20 .. interrogated by general interrogation	On reception of a GI request
21 -36 interrogated by group 1-16 interrogation	not supported
T .. Test	not supported

2.10.2. Measured Values (Analog Values)

Transmission of measured values with SINAUT ST1:

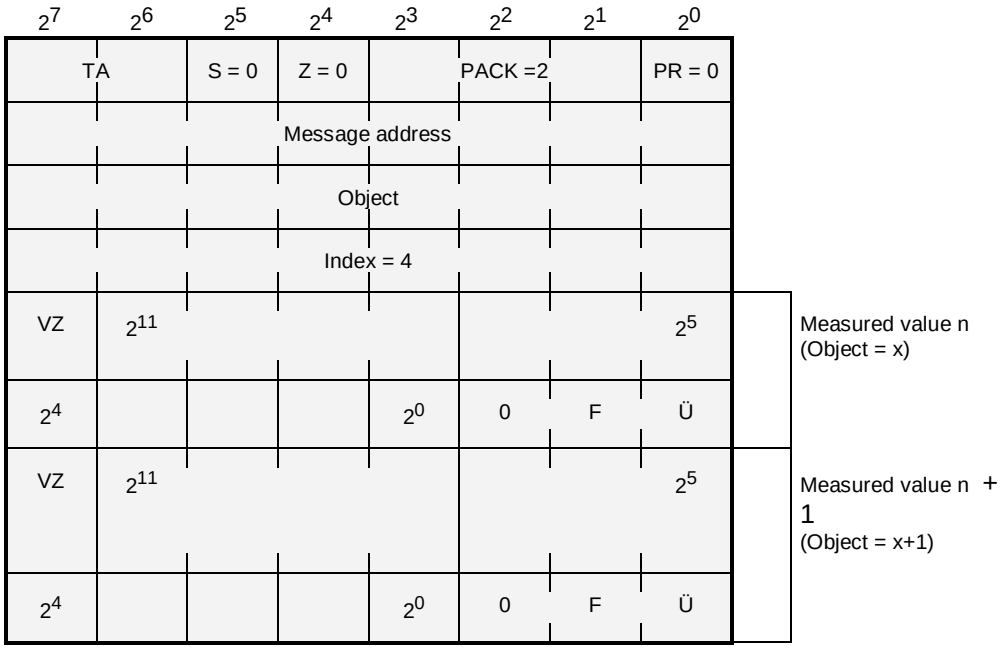
- 2 or 4 measured values per SINAUT ST1 message
- Without time or with time
- Spontaneous or with general interrogation
- Coding as non-linearized value or fixed point formats

ST1 message format for measured values (AE=0)

2^7	2^6	2^5	2^4	2^3	2^2	2^1	2^0	
TA = 00b		S = 0	Z = 0	P = 0	U = 1	B = 0	PR = 0	
Message number								
VZ	2^{11}						2^5	Measured value n
2^4				2^0	0	F	Ü	
VZ	2^{11}						2^5	Measured value n + 1
2^4				2^0	0	F	Ü	

Ü … Overflow
F … Open circuit, is set when SICAM RTUs NT=1 or IV=1
TA = 2 … Spontaneous message
TA = 3 … Interrogated message (general interrogation)

ST1 message format for measured values (AE=1)



Ü … Overflow
F … Open circuit, is set when SICAM RTUs NT=1 or IV=1

TA = 2 … spontaneous message
TA = 3 … requested message (general interrogation)

Measured value coding

- Non-linearized values: -2048 Bit … 0 … +2048 Bit (= -100% … 0 … +100%)
  Example:

Name	Range	Non-linearized value	Value on control system
Pressure ND-container	0 – 40 mbar	0x2F00	29.4
Content ND-container	0 – 150000 cbm	0x1500	49365

- Fixed point format
  The measured value is represented as scaled value in the range -32768 … +32767

Name	Range	Non-linearized value	Value on control system
BHKW4 flow temperature	0 – 99	0x001F	31
Total electrical output	-5500 … +5500	0xFFDB	-37

Address Conversion SINAUT ST1 → SICAM RTUs

The parameterization of the address and message conversion for measurands (analogue values) in transmit direction is to be done with TOOLBOX II / OPM with the parameter category *firmware /* Transmit detailed routing.

Parameter Category:
*firmware /*Transmit detailed routing

Parameter	Value
Lk_Reg	222
Lk_Comp	35
Lk_BSE	020 CP-2010(M)/MC25
Lk_SSE	128 SM-2551/ST1SA0
Lk_DS	Protocols
Lk_Cat	ST1SA0/Transmit detailed routing
Lk_Prep	Activated
CASDU1	222
CASDU2	35
IOA1	0
IOA2	1
IOA3	0
TI	Measured val. 15 bit + sign scaled (TI 35)
ST1_tel_type_(ST1Sxx)	analoge value - 4 MV
pack_(ST1Sxx)	unused/automatic
telegram_with_timetag_(ST1Sxx)	yes
ST1_format_(ST1Sxx)	measured value 15 bit + sign
X_0%	0
X_100%	0
Y_0%	0
Y_100%	0
ST1_tel_no_(ST1Sxx)	20
ST1_index_(ST1Sxx)	4
ST1_object_(ST1Sxx)	0
ST1_data_index_(ST1Sxx)	0

SICAM RTU Address

CASDU1
CASDU2
IOA1
IOA2
IOA3

5-stage freely parameter-settable SICAM RTU address
possible: 0 - 255

TI: Type identification: possible: Measured value 15 Bit + VZ normalized (TI = 34)
Measured value 15 Bit + VZ scaled (TI = 35)
Measured value short floating point (TI = 36)

SINAUT ST1 Address

ST1-message address — possible: 2 – 255

ST1-Object: — used together with the "ST1 Index" for the address field expansion
possible: 0 – 255 (0 = no address field expansion)

ST1-Index: — used to differentiate the data types
possible: 0 – 255 (0 = no address field expansion)

ST1-Data element — bit position for binary information or value numbers for measured values
possible: 0 – 31

ST1-message type — possible:
- binary information 16 Bit
- binary information 32 Bit
- analog value 1MW
- analog value 2 MW
- analog value 4 MW
- integrated total 1 ZW

PACK: — number of bits per object
possible:
- 4
- 8
- 16
- unused/automatic

Time tag: — send message with or without time
possible: yes/no

ST1-Format: — possible:
- single-point information
- double-point information E/A
- double-point information A/E
- measured value 12 Bit left-aligned
- measured value 15 Bit + VZ
- integrated total + 28 Bit binary

X_0%: Value adaptation
Lower limit of the value range used in the external (protocol-specific) format. The corresponding internal value is parameterized at Y_0%.
Possible: - 32768 … + 32767

X_100%: Value adaptation
Upper limit of the value range used in the external (protocol-specific) format. The corresponding internal value is parameterized at Y_100%.
Possible: - 32768 … + 32767

Y_0%: Value adaptation
Lower limit of the value range used in the selected internal format. The internal format is defined by the TI (Type Identification). The corresponding external value is parameterized at X_0%.
Possible: TI = 34: - 1 … + 1
TI = 35: - 32768 … + 32767
TI = 36: no check

Y_100%: Value adaptation
Upper limit of the value range used in the selected internal format. The internal format is defined by the TI (Type Identification). The corresponding external value is parameterized at X_100%.
Possible: TI = 34: - 1 … + 1
TI = 35: - 32768 … + 32767
TI = 36: no check

Spontaneous Message Transfer

This table describes the data point quality descriptor and the cause of transmission according to IEC 60870-5-101/104.

Elements of the message	
TI .. Type Identification	TI 34 .. Measured value, normalized value with time tag CP56Time2a□TI 35 .. Measured value, scaled value with time tag CP56Time2a□TI 36 .. Measured value, short floating point number with time tag CP56Time2a
CASDU, IOA .. Message address	can be set by parameter
QDS .. Quality descriptor	
BL .. blocked	not supported
SB .. substituted	not supported
NT .. not topical	F … open-circuit = 1, if SICAM RTUs NT = 1
IV .. invalid	F … open-circuit = 1, if SICAM RTUs NT = 1
OV .. overflow	Non-linearized value outside the parameterized measuring range (X_0, X_{100}) or conditioned value outside the range (Y_0, Y_{100}). The conditioned value is limited to Y_0 or Y_{100}.
cause of transmission	
03 .. spontaneous	
20 .. interrogated	

2.10.2.1. Measured Value Conversion in Transmit Direction

ST1Sx0 supports the following measured value formats:

- Measured value 12 Bit + VZ left-aligned -2048 … 0 … +2048
- Measured value 15 Bit + VZ -32768 … 0 … +32767

The ST1 measured value format can be converted to 3 Ax 1703 type identifications:

- Measured value – normalized (TI = 34): Value range: - 1 … + 1
- Measured value – scaled (TI = 35): Value range: - 32768 … + 32767
- Measured value – short float (TI = 36): Value range: $- 3{,}4.10^{38}$ … $+ 3{,}4.10^{38}$

For each measured value a linear adaptation can be parameterized. The linear adaptation is determined by the following parameters:

X_0% Value adaptation:
Lower limit of the value range used in the external (protocol-specific) format. The corresponding internal value is parameterized at Y_0%.

X_100% Value adaptation:
Upper limit of the value range used in the external (protocol-specific) format. The corresponding internal value is parameterized at Y_100%.

Y_0% Value adaptation:
Lower limit of the value range used in the selected internal format. The internal format is defined by the TI (Type Identification). The corresponding external value is parameterized at X_0%.

Y_100% Value adaptation:
Upper limit of the value range used in the selected internal format. The internal format is defined by the TI (Type Identification). The corresponding external value is parameterized at X_100%.

Since the protocol firmware defined only two measured value formats, for the parameters X_0% and X_100% the following value range is produced:

Measured value 12 Bit + VZ left-aligned -2048 … 0 … +2048
Measured value 15 Bit + VZ -32768 … 0 … +32767

Also valid: X_100% > X_0%

The parameters Y_0% and Y_100% are determined by the Ax 1703 internal type identification used.

Measured value - normalized: - 1 … + 1
Measured value - scaled: - 32768 … + 32767
Measured value - short floating point:
no check

The linear adaptation is activated when X_0% or X_100% are parameterized unequal "0".

2.10.2.2. Conversion without Linear Adaptation

- Measured value - normalized (TI=34)

  – Measured value - 11 Bit:
  Value $_{Ax\ 1703}$ = Value $_{ST1}$ / 2048
  Value $_{ST1}$ < -2048 => Value $_{Ax\ 1703}$ = -1, OV=1
  Value $_{ST1}$ > 2048 => Value $_{Ax\ 1703}$ = 1, OV=1

  – Measured value – 15 Bit:
  Value $_{Ax\ 1703}$ = Value $_{ST1}$ / 32767
  Value $_{ST1}$ < -32768 => Value $_{Ax\ 1703}$ = -1, OV=1
  Value $_{ST1}$ > 32767 => Value $_{Ax\ 1703}$ = 1, OV=1

- Measured value – scaled (TI=35)
  Value $_{Ax\ 1703}$ = Value $_{ST1}$

- Measured value – short float (TI=36)
  Value $_{Ax\ 1703}$ = Value $_{ST1}$
  The received binary value is converted to a "Real"-number.

2.10.2.3. Conversion with Linear Adaptation

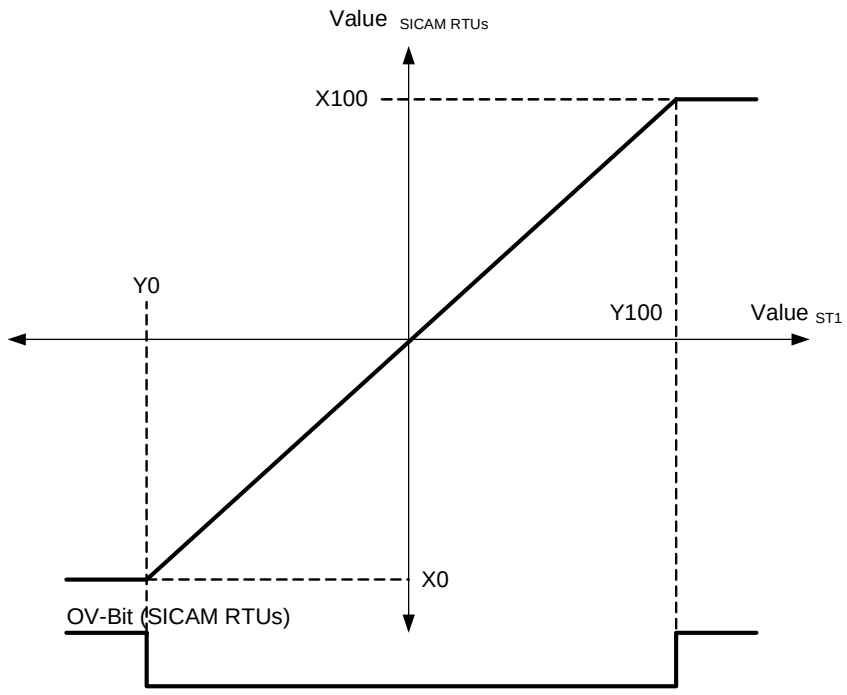
The adaptation is activated when "X0" or "X100" are parameterized unequal "0".

Value $_{Ax\ 1703}$ = k * Value $_{ST1}$ + d

whereby k = (Y100 – Y0) / (X100 – X0)
d = Y0 – k * X0

Note: Value $_{ST1}$ < X0 => Value $_{Ax\ 1703}$ = Y0, OV=1
Value $_{ST1}$ > X100 => Value $_{Ax\ 1703}$ = Y100, OV=1

Example: Bipolar measured values



X0, X100 Value $_{ST1}$ (e.g.: X0 = -2048, X100 = 2048)
Y0, Y100 Value $_{Ax\ 1703}$ (e.g.: short floating point, Y0 = -100, Y100 = +100)
For unipolar measured values "X0" and "Y0" must be parameterized to "0".

2.10.3. Integrated Totals

Transmission:

- 1 integrated total per SINAUT ST1 message
- with time
- transmission every minute derived from the time in the RTU
- also with general interrogation !!!! (last value incl. time from process image)
- Coding: 28 Bit + 2 additional bits

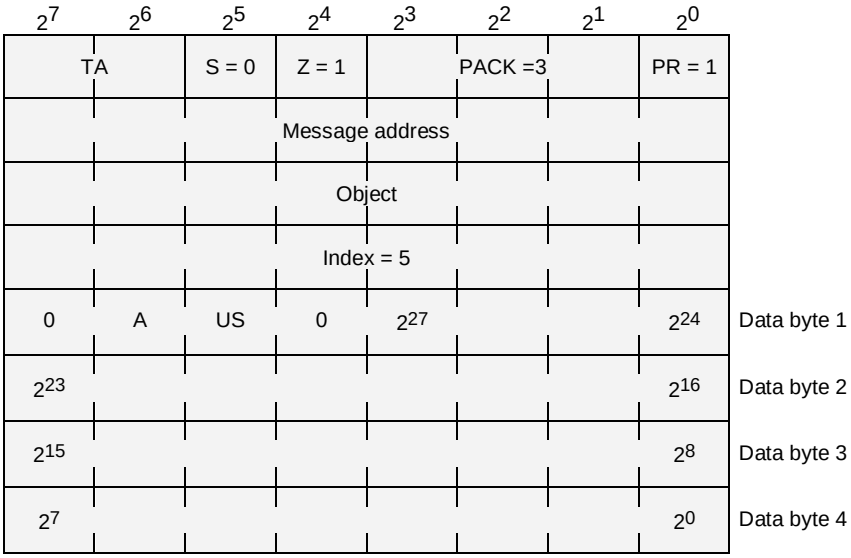
ST1 message format for integrated totals (AE=0)
(representation without time tag)

2^7	2^6	2^5	2^4	2^3	2^2	2^1	2^0	
TA		S = 0	Z = 1	P = 0	U = 1	B = 0	PR = 1	
message number = 2 to 255								
0	A	US	0	2^{27}			2^{24}	Data byte 1
2^{23}							2^{16}	Data byte 2
2^{15}							2^8	Data byte 3
2^7							2^0	Data byte 4

US … latching identifier, changes with every transmission initiation
(not with general interrogation)
A … topicality bit (1st integrated total after restart: A= 0)

TA = 2 … spontaneous message
TA = 3 … requested message (general interrogation)

ST1 message format for integrated totals (AE=1)
(representation without time tag)



US … latching identifier, changes with every transmission initiation
(not with general interrogation)
A … topicality bit (1st integrated total after restart: A= 0)

TA = 2 … spontaneous message
TA = 3 … requested message (general interrogation)

Address conversion SINAUT ST1 → SICAM RTUs

The parameterization of the address and message conversion for counters (integrated totals) in transmit direction is to be done with TOOLBOX II / OPM with the parameter category *firmware /* Transmit detailed routing.

Parameter Category:
*firmware /*Transmit detailed routing

Parameter	Value
Lk_Reg	222
Lk_Comp	35
Lk_BSE	020 CP-2010(M)/MC25
Lk_SSE	128 SM-2551/ST1SA0
Lk_DS	Protocols
Lk_Cat	ST1SA0/Transmit detailed routing
Lk_Prep	Activated
CASDU1	222
CASDU2	35
IOA1	0
IOA2	2
IOA3	0
TI	Count 31 bit + sign (TI 37)
ST1_tel_type_(ST1Sxx)	integrated total - 1 CV
pack_(ST1Sxx)	unused/automatic
telegram_with_timetag_(ST1Sxx)	no
ST1_format_(ST1Sxx)	integrated total 28 bit binary
X_0%	0
X_100%	0
Y_0%	0
Y_100%	0
ST1_tel_no_(ST1Sxx)	21
ST1_index_(ST1Sxx)	3
ST1_object_(ST1Sxx)	0
ST1_data_index_(ST1Sxx)	0

SICAM RTUs-Address

CASDU1
CASDU2
IOA1
IOA2
IOA3

5-stage, free parameter settable SICAM RTUs source address possible: 0 - 255

TI: Type identification: possible: Integrated total 31 Bit + VZ (TI = 37)

SINAUT ST1 Address

ST1-Message address — possible: 2 – 255

ST1-Object: — used together with the "ST1 Index" for the address field expansion
possible: 0 – 255 (0 = no address field expansion)

ST1-Index: — used to differentiate the data types
possible: 0 – 255 (0 = no address field expansion)

ST1-Data element — bit position for binary information or value numbers for measured values
possible: 0 – 31

ST1-Message type — possible:
- binary information 16 Bit
- binary information 32 Bit
- analog value 1MW
- analog value 2 MW
- analog value 4 MW
- integrated total 1 ZW

PACK: — number of bits per object
possible:
- 4
- 8
- 16
- unused/automatic

Time tag: — send message with or without time
possible: yes/no

ST1-Format: — possible:
- single-point information
- double-point information E/A
- double-point information A/E
- measured value 12 Bit left-aligned
- measured value 15 Bit + VZ
- integrated total + 28 Bit binary

X_0%: Value adaptation
Lower limit of the value range used in the external (protocol-specific) format. The corresponding internal value is parameterized at Y_0%.
Possible: - 32768 ... + 32767

X_100%: Value adaptation
Upper limit of the value range used in the external (protocol-specific) format. The corresponding internal value is parameterized at Y_100%.
Possible: - 32768 ... + 32767

Y_0%: Value adaptation
Lower limit of the value range used in the selected internal format. The internal format is defined by the TI (Type Identification). The corresponding external value is parameterized at X_0%.
Possible: TI = 34: - 1 ... + 1
TI = 35: - 32768 ... + 32767
TI = 36: no check

Y_100%: Value adaptation
Upper limit of the value range used in the selected internal format. The internal format is defined by the TI (Type Identification). The corresponding external value is parameterized at X_100%.
Possible: TI = 34: - 1 ... + 1
TI = 35: - 32768 ... + 32767
TI = 36: no check

Note: The parameters X_0%, X_100%, Y_0% and Y_100% must be left at their default value/is checked by the firmware.

2.11. Message Conversion in Control Direction

Message Conversion in receive direction: IEC60870-5-101/104 ← SINAUT ST1

IEC 60870-5-101/104		⇦		SINAUT ST1
Type ID	**Designation**	**TA**	**ZK**	**Designation**
<TI=45>	Single command	2	0	Command
<TI=46>	Double command	2	0	Command
<TI=47>	Regulating step command	2	0	Command
<TI=48>	Set point command, normalized value	2	0	Setpoint value
<TI=49>	Set point command, scaled value	2	0	Setpoint value
<TI=50>	Set point command, short floating point number	2	0	Setpoint value

TA … SINAUT ST1 message type
ZK … SINAUT ST1 additional identifier

2.11.1. Commands

Transmission of commands with SINAUT ST1:

- Spontaneous
- 8 commands per SINAUT ST1 message ("1 of 8")

ST1 message format for commands (AE=0)

2^7	2^6	2^5	2^4	2^3	2^2	2^1	2^0	
TA = 2		S	Z	P	U	B	PR	
message number = 2 to 255								
B7	B6	B5	B4	B3	B2	B1	B0	command = 0 - 7
B7	B6	B5	B4	B3	B2	B1	B0	command = 0 – 7 (copy)

additional identifier = 0

ST1 message format for commands (AE=1)

2^7	2^6	2^5	2^4	2^3	2^2	2^1	2^0	
TA		S = 0	Z = 0	PACK =0			PR = 0	
Message address								
Object								
Index = 2								
B7	B6	B5	B4	B3	B2	B1	B0	command = 0 - 7
B7	B6	B5	B4	B3	B2	B1	B0	command = 0 – 7 (copy)

Address conversion SINAUT ST1 → SICAM RTUs

The parameterization of the address and message conversion for commands in receive direction is to be done with TOOLBOX II / OPM with the parameter category *firmware /* Rec_command.

Parameter Category:
*firmware /*Rec_command

Parameter	Value
Lk_Reg	222
Lk_Comp	20
Lk_BSE	020 CP-2000(M)/MC00
Lk_SSE	128 SM-2551/ST1SA0
Lk_DS	Protocols
Lk_Cat	ST1SA0/Rec_command
Lk_Prep	Activated
ST1_tel_no_(ST1Sxx)	40
ST1_index_(ST1Sxx)	2
ST1_object_(ST1Sxx)	1
ST1_command_bit_(ST1Sxx)	0
IEC-command_state	NOT USED
IEC-qualifier_of_command	no definition
CASDU1	222
CASDU2	0
IOA1	40
IOA2	0
IOA3	0
TI	Single command (TI 45)

SICAM RTU Address

CASDU1 CASDU2 IOA1 IOA2 IOA3	5-stage, freely parameter-settable SICAM RTUs source address possible: 0 - 255

TI: Type identification: possible: single command (TI = 45)
double command (TI = 46)
step-by-step adjusting command (TI = 47)

SINAUT ST1 Address

ST1-message address	possible: 2 – 255
ST1-Object:	used together with the "ST1 Index" for the address field expansion possible: 0 – 255 (0 = no address field expansion)
ST1-Index:	used to differentiate the data types possible: 0 – 255 (0 = no address field expansion)
ST1-command bit	bit position for commands possible: 0 – 7
IEC-command state	assignment between IEC command state and ST1 command bit possible: - NOT USED - ON - OFF
IEC-qualifier of command	command output time to be added possible: - none - short - long

2.11.2. Setpoint Values

Transmission:

- Spontaneous
- 1 setpoint value per SINAUT ST1 message (non-linearized values, 100% = 2048 Bit)

ST1 message format for setpoint values (AE=0)

2^7	2^6	2^5	2^4	2^3	2^2	2^1	2^0
TA = 2		S = 0	Z = 0	P	U	B	PR
message number = 2 to 255							
VZ	2^{11}						2^5
2^4				2^0	0	0	0

additional identifier = 0 !!!

ST1 message format for setpoint values (AE=1)

2^7	2^6	2^5	2^4	2^3	2^2	2^1	2^0
TA		S = 0	Z = 0	PACK =0			PR = 0
Message address							
Object							
Index = 6							
VZ	2^{11}						2^5
2^4				2^0	0	0	0

Representation of non-linearized value:

Setpoint input from control system:
Setpoint value = 25000 (100% = 65000) => non-linearized value = 0x1898 (=787DEZ)
Setpoint value = 18000 (100% = 65000) => non-linearized value = 0x11B8 (567DEZ)

Address conversion SINAUT ST1 → SICAM RTUs

The parameterization of the address and message conversion for setpoints in receive direction is to be done with TOOLBOX II / OPM with the parameter category *firmware /* Rec_command.

Parameter Category:
*firmware /*Rec_command

Parameter	Value
Lk_Neg	222
Lk_Comp	20
Lk_BSE	020 CP-2000(M)/MC00
Lk_SSE	128 SM-2551/ST1SA0
Lk_DS	Protocols
Lk_Cat	ST1SA0/Rec_setpoint_command
Lk_Prep	Activated
ST1_tel_no_(ST1Sxx)	255
ST1_index_(ST1Sxx)	0
ST1_object_(ST1Sxx)	0
ST1_format_sv_(ST1Sxx)	setpoint value 12 bit + sign left-aligned
X_0%	0
X_100%	0
Y_0%	0
Y_100%	0
CASDU1	222
CASDU2	0
IOA1	50
IOA2	0
IOA3	0
TI	Setpoint val. positioning comm. stand. (TI 48

SICAM RTUs-Address

CASDU1
CASDU2
IOA1
IOA2
IOA3

5-stage, free parameter settable SICAM RTUs source address possible: 0 - 255

TI: Type identification: possible: Setpoint value 15 Bit + VZ normalized (TI=48)
Setpoint value 15 Bit + VZ scaled (TI=48)
Setpoint value short floating point (TI=50)

SINAUT ST1 Address

ST1-Message address possible: 2 – 255

ST1-Object: used together with the "ST1 Index" for the address field expansion
possible: 0 – 255 (0 = no address field expansion)

ST1-Index: used to differentiate the data types
possible: 0 – 255 (0 = no address field expansion)

ST1-Format possible: - setpoint value 12 Bit + VZ left-aligned

X_0%: Value adaptation
Lower limit of the value range used in the external (protocol-specific) format. The corresponding internal value is parameterized at Y_0%.
possible: - 2048 … + 2047

X_100%: Value adaptation
Upper limit of the value range used in the external (protocol-specific) format. The corresponding internal value is parameterized at Y_100%.
Possible: - 2048 … + 2047

Y_0%: Value adaptation
Lower limit of the value range used in the selected internal format. The internal format is defined by the TI (Type Identification). The corresponding external value is parameterized at X_0%.
Possible: TI = 34: - 1 … + 1
TI = 35: - 32768 … + 32767
TI = 36: no check

Y_100%: Value adaptation
Upper limit of the value range used in the selected internal format. The internal format is defined by the TI (Type Identification). The corresponding external value is parameterized at X_100%.
Possible: TI = 34: - 1 … + 1
TI = 35: - 32768 … + 32767
TI = 36: no check

2.11.2.1. Setpoint Value Conversion

Value range: - 2048 … 2048

The following Ax 1703 type identifications can be converted to ST1 setpoint value format:

- setpoint command – normalized (TI = 48): Value range: - 1 … + 1
- setpoint command – scaled (TI = 49): Value range: - 32768 … + 32767
- setpoint command – short float (TI = 50): Value range: $- 3{,}4.10^{38}$ … $+ 3{,}4.10^{38}$

A linear adaptation can be parameterized for each setpoint value. The linear adaptation is determined by the following parameters:

X_0% Value adaptation:
Lower limit of the value range used in the external (protocol-specific) format. The corresponding internal value is parameterized at Y_0%.

X_100% Value adaptation:
Upper limit of the value range used in the external (protocol-specific) format. The corresponding internal value is parameterized at Y_100%.

Y_0% Value adaptation:
Lower limit of the value range used in the selected internal format. The internal format is defined by the TI (Type Identification). The corresponding external value is parameterized at X_0%.

Y_100% Value adaptation:
Upper limit of the value range used in the selected internal format. The internal format is defined by the TI (Type Identification). The corresponding external value is parameterized at X_100%.

Since in the ST1 protocol only one setpoint value format is defined, the parameters X_0% and X_100% produce the following value range:

X_0%, X_100% = - 32768 … + 32767

Also valid: X_100% > X_0%

The parameters Y_0% and Y_100% are determined by the Ax 1703 internal type identification used.

Setpoint value - normalized: - 1 … + 1
Setpoint value - scaled: - 2048 … + 2048
Setpoint value - short floating point:
no check

The linear adaptation is activated, when Y_0% or Y_100% is parameterized unequal "0".

2.11.2.2. Conversion without Linear Adaptation

- setpoint command normalized (TI = 48)

  - Ax 1703 – value range: -1… +1

    Value $_{ST1}$ = Value $_{Ax\ 1703}$ * 2048

- setpoint command - scaled (TI = 49)

  - Ax 1703 - value range: -32768… +32767

  Value $_{ST1}$ = Value $_{Ax\ 1703}$

- setpoint command – short float (TI = 50)

  - Ax 1703 - value range: $-3{,}4.10^{38}$… $3{,}4.10^{38}$

  Value $_{ST1}$ = Value $_{Ax\ 1703}$

  A conversion from "Real" - format to a binary value takes place. If the Ax 1703 – value is greater than 2048 or less than -2048, then the setpoint value is discarded with the error message "Error format conversion in transmit direction".

2.11.2.3. Conversion with Linear Adaptation

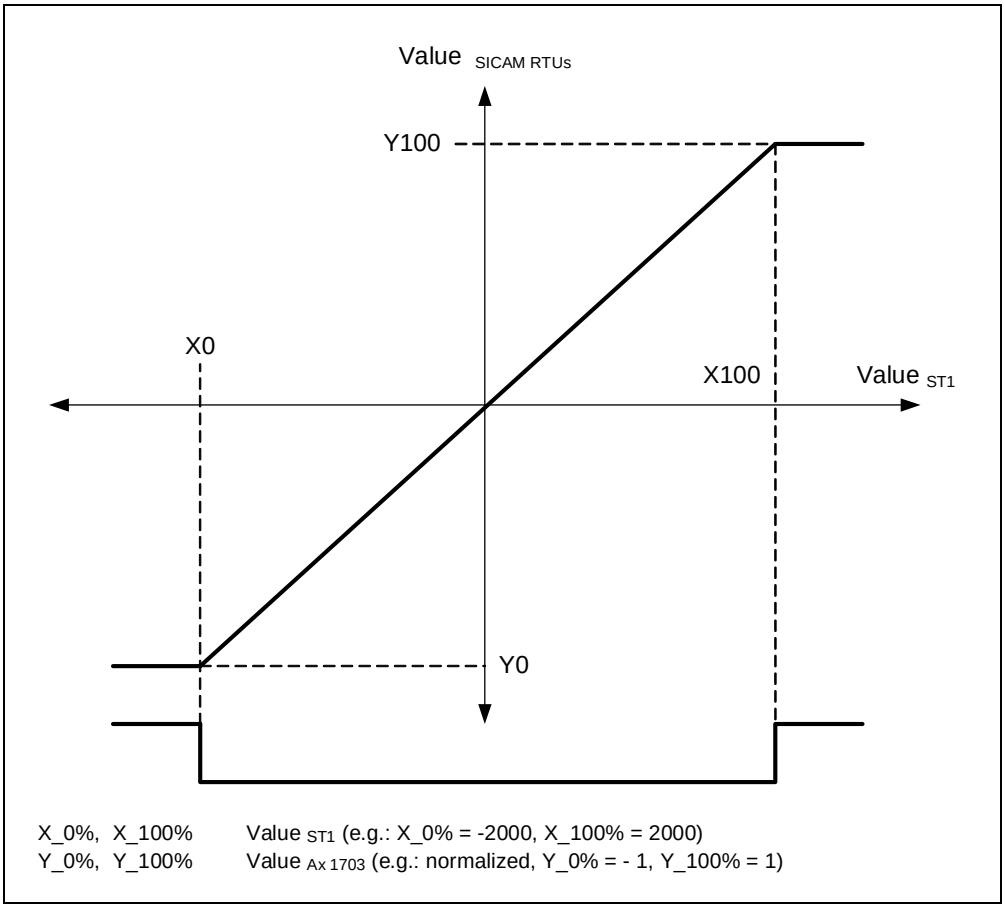
The adaptation is activated when "Y_0%" or "Y_100%" is parameterized unequal "0".

Value $_{Ax\ 1703}$ = k * Value $_{ST1}$ + d

whereby k = (X100 – X0) / (Y100 – Y0)
d = X0 – k * Y0

If the setpoint value cannot be adapted (setpoint value < Y_0% or setpoint value > Y_100%), then the setpoint value is discarded with the error message "Error format conversion in transmit direction".

Bipolar setpoint values



For unipolar setpoint values X_0% and Y_0% must be parameterized to "0".

2.12. Organizational Messages (= System Messages)

In SINAUT ST1 there are a variety of organizational messages, which are used for system monitoring as well as additional system concepts (general interrogation, diagnostics, time synchronization).

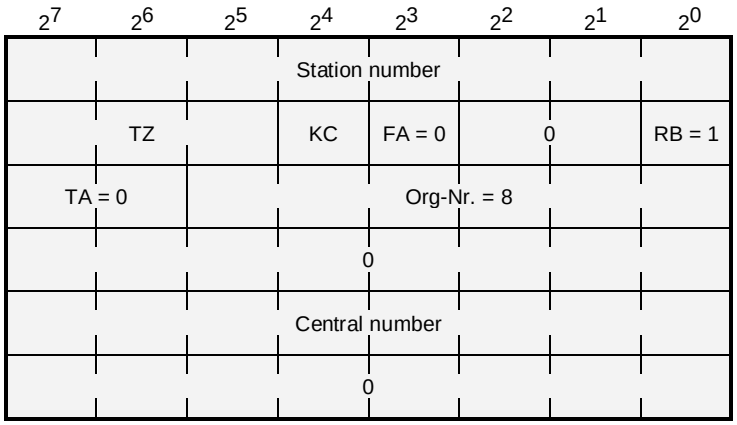
The following organizational messages are presently supported:

- General interrogation (ORG = 08)
- Time synchronization (ORG = 10)

All other messages are indeed acknowledged at "Protocol Level", but are not evaluated.

2.12.1. General Interrogation (Master Station → RTU)

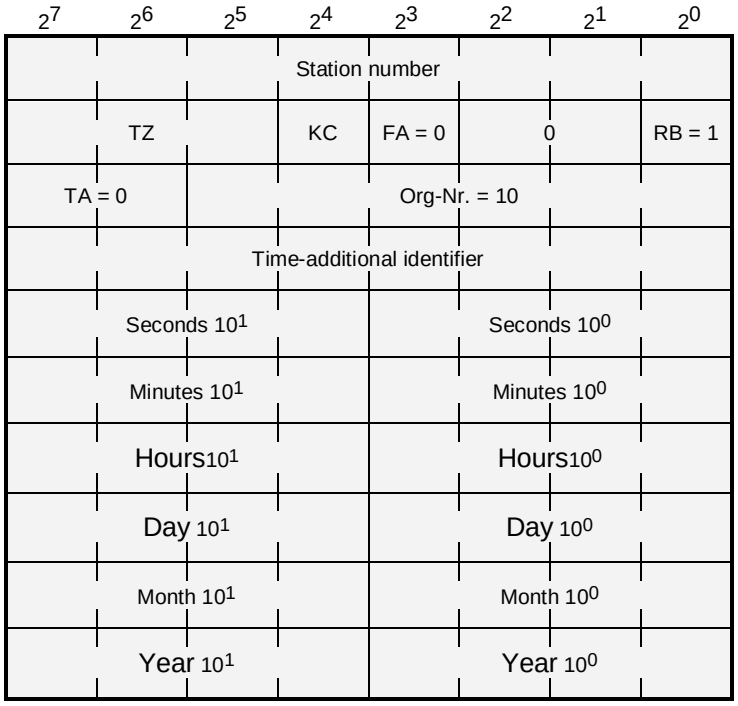
Message structure:



If the SICAM RTUs receive an organizational messages with ORG = 8, then the firmware sends its entire process image as follows:

- All binary information (ascending according to ST1 address)
- All measured values (ascending according to ST1 address)
- All integrated totals (ascending according to ST1 address)
  The transmission of the integrated totals is settable; the last 1-minute value is transmitted, the latching identifier and time are not redetermined.

2.12.1.1. Time Synchronization



of the voltage transformer inputs

Bit 4 = 0: Daylight saving time
1: Normal time

Bit 6 = 1: SYN-Bit; TIM-clock is synchronized

Bit 7 = 1: STEL-Bit; TIM-clock is set

The SINAUT ST1 master station sends this command periodically in a settable time frame (Default: 24h).
In addition this is always sent to the corresponding station after a going communication fault.
With the help of the protocol analysis it can be established, that the "Time Synchronization" is sent twice (interval: 1-2 seconds, SYN-Bit changes).
The SICAM RTUs must adjust the time received by the message transfer time!!

Note: No "milliseconds" in the time message!!

2.13. Control and Return Information of Protocol Elements

This function is used for the user-specific influencing of the functions of the protocol elements.

This function contains two separate independent parts:

- Protocol element control
- Protocol element return information

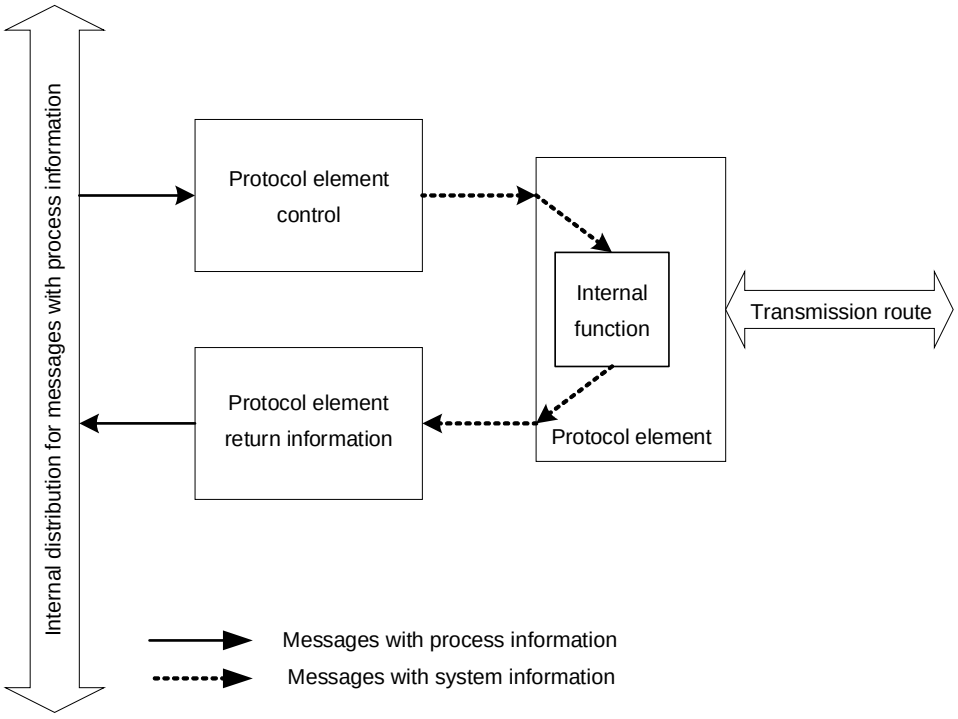
The **Protocol Element Control** enables:

- Applicational control of the station interrogation
- Set control location
- Testing the reachability of stations
- the suppression of errors with intentionally switched-off stations (Station Service)

The **Protocol Element Return Information** enables:

- States of certain state lines to be used as process information
- Information to be obtained about the station state/failure

Block Diagram



2.13.1. Protocol Element Control

The protocol element control is not supported by the protocol element for SIEMENS SINAUT ST1 "TIM11" Slave (=RTU function)!

2.13.2. Protocol Element Return Information

The protocol element return information on the basic system element generates *messages with process information in monitor direction* and thereby enables states of the protocol elements to be displayed or processed.

There are three different categories of return information:

- Status of the state lines
- Status of the stations
- Protocol-specific return information (dependent on the protocol element used)

The assignment of the *messages with process information* to the return information is carried out on the basic system element with the help of process-technical parameters of the ACP 1703 system data *protocol element return information*.

From which source the parameterized return information are to be generated, is set with the parameters "Supplementary system element" and "Station number".

Messages for protocol element return information are transmitted spontaneously from the protocol element to the basic system element with change or as reply to a general interrogation command.

Possible master station return information:

	Parameter	
Return information function_(PRE)	**Station**	**Note**
Status DTR (1 = state line active)	255	(1)
Status DSR (1 = state line active)	255	(1)
Station state	0 – 99	1 = Station enabled for call cycle
Station failure	0 – 99	1 = Station failed

(1) States of the state lines are transmitted spontaneously from the protocol element to the basic system element with change or as reply to a general interrogation command.
The spontaneous transmission of the current states takes place internally in a 100ms grid.
⇨ State line changes shorter than 100ms are not guaranteed to be transmitted!

Legend: Station .....Station number
0 - 99..... Station 0-99 of the selected protocol element
255..... Station number not used!

Literature

SICAM RTUs Common Functions System and Basic System Elements	DC0-015-2
ACP 1703 Platforms Configuration Automation Units and Automation Networks	DC0-021-2
SICAM RTUs • Ax 1703 ST1SA0 - SIEMENS SINAUT ST1 "TIM11" (SLAVE) Protocol element	DC0-087-1
SICAM EMIC Protocol Elements System Element Manual	DC6-049-2
AMIS DC Protocol Elements System Element Manual	D23-048-1

Documents on Interoperability

International Standards
