# SYNCHROTACT® 6

## Operating Instructions

# SYN 6201
# SYN 6202



| | |
|---|---|
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# Content

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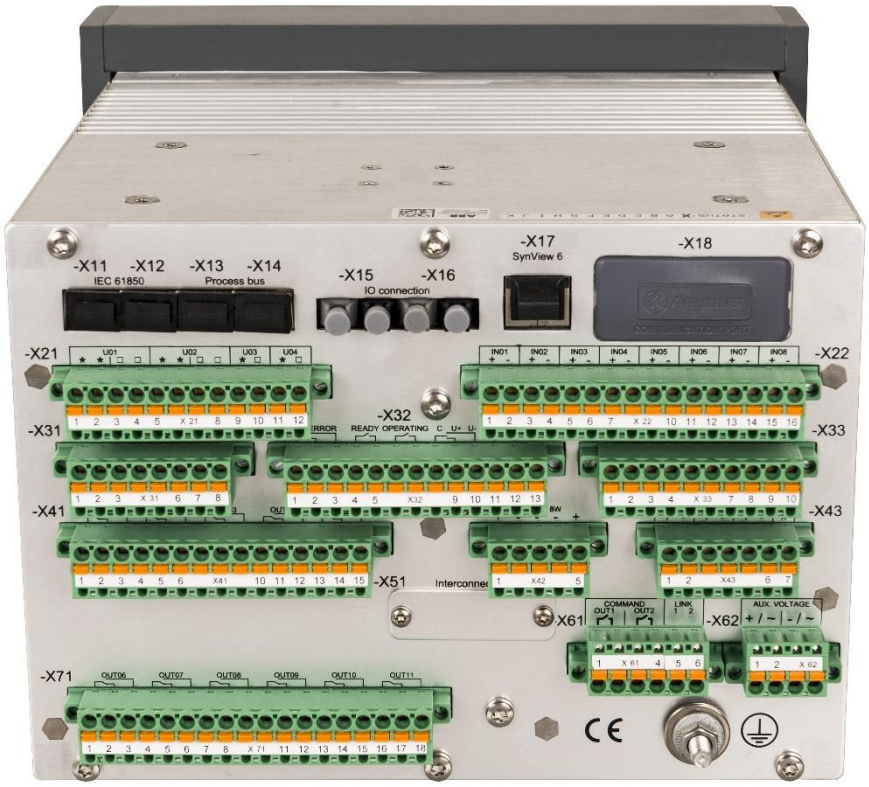


# Terms and Abbreviations

| | |
|---|---|
| AD-converter | Analog to digital converter |
| AIN | Analog INput or measurement input |
| AUTO mode | Operating mode AUTO = automatic Synchronization |
| BCD-Code | Binary Coded Decimal – dual coded decimal (see *Chapter 3.6.6*) |
| BIN | Binary INput – binary input |
| BIST | Built-In-Self-Test – Self test of all RAMs, for fast memory check |
| BLOCKED | SYNCHROTACT 6 is not ready for operation; BLOCKED alone = device out of operation or in test mode; BLOCKED together with EDIT = setting mode (parameter values can be changed); BLOCKED together with ERROR = error in the synchronization system (can also be outside the synchronizing device) |
| BOUT | Binary OUTput – binary output |
| CB | Circuit Breaker |
| CH2 RELEASE<br>CH2 REL | Paralleling command release from channel 2 |
| CHK REL<br>CHK RELEASE | Paralleling command release in channel 1 with generator synchronization or synchronous networks (see *Chapter 3.2.8*) |
| CMD | Paralleling command (either from channel 1 or from the device as a whole) |
| COMMAND | Paralleling command (from the device as a whole) |
| CPU | Central Processing Unit – Also: computer or processor |
| CSL | Control System Logic; possibility to integrate smaller logical nodes in SYNCHROTACT 6 (momentarily not supported) |
| DB<br>Deadbus | Deadbus = voltage-free lines (deadbus is used in general, ie, it does not make a distinction between voltage-free lines and voltage-free busbars) |
| DB REL<br>DB RELEASE | Release by the deadbus function (see *Chapter 3.2.8*) |
| df/dt | Slope of the setpoint ramp of the speed controller (turbine governor); the same expression is also used as a parameter name in SYNCHROTACT 6, to tune the turbine controller. |
| Dual-channel synchronizing device | Two independent and diversified computers (channels) in one casing (eg. SYN 6202); the output contacts operate according to the 2oo2-model (2-out-of-2); ie., the circuit breaker is closed only when both channels give their “consent“;<br>With SYNCHROTACT 6 dual-channel device, the functional security is further improved thanks to additional mutual monitoring of the channels, compared to a conventional dual-channel device. |
| Dual-channel synchronizing system | The synchronization system consists of two independent and diversified computers (channels), consisting either of a dual-channel device (eg. SYN 6202), or two single-channel devices (SYN 6201 and SYN 5100); the output contacts operate according to the 2oo2-model (2-out-of-2); ie., the circuit breaker is closed only when both channels give their “consent”;<br>With SYNCHROTACT 6, the functional safety is further improved thanks to the mutual monitoring of the channels, compared to a conventional dual-channel device, which has been constructed from two single-channel devices. |

| | |
|---|---|
| DR<br>(IEC 61850) | Data Report: DRs are unsolicited data messages sent by the server. The transmission of DRs is triggered by predefined events, eg when the value or the quality of a variable changes in the monitored data set. Data not contained in the report must be polled. More information on the reporting model can be found in the corresponding IEC 61850 PIXIT – documentation. |
| dU/dt | Slope of the setpoint ramp of the voltage regulator; the same expression is also used as a parameter name in SYNCHROTACT 6, to tune the voltage regulator. |
| Dual core CPU | Computer with two cores – Two parallel running computer systems, which together form a fault-tolerant system. |
| ECC | Error Correction Code<br>Internal data corruption can be detected and corrected using an error correction code. |
| EDIT | Setting mode (parameter values can be changed) |
| ERROR | Error in the synchronization system (can also be outside the synchronizing device) |
| Exclusive DB | Exclusive dead bus function: When the Exclusive DB is activated, the circuit breaker can only be closed with the present „Release DB“ signal, if there is actually a dead bus situation.<br>When the Exclusive DB (=factory setting) is switched off, the dead bus signal can be normally synchronized with two existing voltages, even if the release dead bus signal is present. |
| f+, f- | Frequency adjusting commands Raise, Lower |
| f1, f2, s | Frequency values of the measurement voltages and slip (= $\Delta$f in % of f1) |
| FH | Fault Handler = Fault control |
| GOOSE<br>(IEC 61850) | Generic Object Oriented System Events; GOOSE sends messages, eg. about the status change of a switching device, by multicast. |
| GR<br>(IEC 61850) | GOOSE Report: GRs are unsolicited data messages sent by the server (eg. SYNCHROTACT 6) |
| HW | Hardware |
| Lockstep - process | Lockstep process – two equally built, parallel running computer systems (dual core) in lockstep from one defined to the next defined state |
| MAN mode | Operating mode MAN = manual synchronization (SYNCHROTACT 6 functions as synchrocheck) |
| MCP | Maintenance Control Panel = built-in operation panel for maintenance purposes |
| Measuring point | Both voltage measuring circuits of a circuit breaker to be synchronized |
| MPU | Memory Protection Unit – Hardware-side memory protection unit, which supports software memory protection; the memory protection prevents the crash of a program part from affecting the stability of the entire program and also takes care, that data ranges cannot be overwritten with code or vice versa. |
| MSM | Main State Machine = State control in the SW |
| MULTIPLE CMD | Multiple command issue |
| MUX | Multiplexer |
| OPERATING | SYNCHROTACT 6 is synchronizing |
| Operator window | Automatic synchronization with manual release (see *Chapter 3.6.3*) |
| Paralleling point | All relevant current circuits of a circuit breaker to be synchronized:<br>Measuring voltages, u1, u2, adjusting commands, paralleling command, circuit breaker monitoring of the measuring circuits |

| | |
|---|---|
| RAM | Random Access Memory |
| READY | SYNCHROTACT 6 is ready for operation |
| Release DB | Input signal to enable the paralleling of voltage-free lines („dead bus“) |
| SEEK functions | Certain software functions that help to determine system-dependent parameter values (eg paralleling time t on) |
| Sequential Test | Test synchronization, in which all functions are performed individually and consecutively (see *Chapter 3.6.5*) |
| SNTP | Simple Network Time Protocol is a standard for synchronizing clocks in computer systems |
| SW | Software |
| SYN REL<br>SYN RELEASE | Paralleling release for synchronous / quasi-synchronous lines (see *Chapter 3.2.8*) |
| SynView 6 | PC-Tool for commissioning and maintenance, as well as for actual value display during operation |
| TTI | Transformer Tap Indication (see *Chapter 3.6.6*) |
| TVM | Tap changer Voltage Matcher – voltage matching for tap changers (with constant pulse lengths and pause times) |
| U+, U- | Voltage adjusting commands Raise, Lower |
| u1, u2 | Voltage signals (instantaneous values) |
| U1, U2, $\Delta$U | Amplitude values of the measuring voltages and voltage difference |
| UTC | Coordinated Universal Time |
| VT | Voltage Transformer |
| $\varphi$1, $\varphi$2, $\alpha$ | Phase angle of the measuring voltages and phase-angle difference |

# Chapter 1 - General Information

## 1.1. Introduction

This User Manual provides detailed information on the

- safety instructions,
- description of the product,
- installation,
- commissioning and operation,
- maintenance and troubleshooting

of the SYNCHROTACT 6 – synchronizing device, including detailed descriptions of the functions and the hardware. Technical data is included as well.

## 1.2. Intended audience

This User Manual is intended for people who have a basic knowledge of working with electronic equipment, who understand electrical symbols in schematic diagrams, but who know little or nothing about working with SYNCHROTACT 6 equipment.

The User Manual provides the information required in order to engineer, install, commission, maintain, and operate the SYNCHROTACT 6 device of types SYN 6201 and SYN 6202.

## 1.3. Purpose and use of SYN 6201 and SYN 6202

The digital synchronizer can be used for the following applications:

- Automatic synchronization and paralleling of generators.
- Automatic paralleling of synchronous and asynchronous lines, transmission lines and busbars (incl. tap-changer matching and dead bus)
- As a paralleling monitoring device (synchrocheck) to monitor automatic or manual paralleling sequences including dead bus.

## 1.4. Manufacturer's address

If any questions arise, consult the local ABB representative or the manufacturer:

**IMPORTANT!**

When calling ABB, please leave your name, department and phone number. This will allow the responsible ABB representative to call back without delay.

ABB Switzerland Ltd
Synchronizing devices and voltage regulators
CH-5300 Turgi/Switzerland

Phone: +41 58 589 24 86
Fax: +41 58 589 23 33
For general inquiries and product information contact us at:
Email: pes@ch.abb.com
Internet: www.abb.com/synchrotact

24 h - Hotline for urgent Service inquiries: (guaranteed response time only with service contract)
Phone: +41 844 845 845
eMail: SYNCHROTACT.Supportline@ch.abb.com

## 1.5. Cyber security

This chapter provides important information related to cyber security. The relevant SYNCHROTACT 6 cyber security features include:
Secure communication via Ethernet (SFTP / SSH2) and configurable password

- Firewall configuration of server and ports

### 1.5.1. Overview communication interfaces

SYNCHROTACT 6 – devices consist of the following communication interfaces:

| *Desig-nation* | *Interface* | *Comment* |
|---|---|---|
| Front & -X17 | SynView 6 | Both physical Ethernet interfaces are connected in parallel via an internal switch. |
| -X11<br>-X12<br>-X13<br>-X14 | IEC 61850 Operating remote control | 4 physical Ethernet interfaces are internally connected to two ports of the computer |
| -X18 | Operating remote control fieldbus | The fieldbus interface is a third-party component. It is internally decoupled. |

| | | |
|---|---|---|
| -X51 | „Interconnection“ | SYNCHROTACT 6 - internal connection for device selection control; proprietary protocol |
| -X15<br>-X16 | „IP connection” | SYNCHROTACT 6 - internal connection for connection of SYNCHROTACT - peripheral devices; proprietary protocol |
| behind MCP | Programming interface channel 1 | Proprietary protocol; the interface becomes accessible after removing the MCP (see “CAUTION!” below) |
| behind MCP | Ethernet-interface for MCP | SYNCHROTACT 6 - internal connection for connecting the MCP; proprietary protocol; the interface becomes accessible after removing the MCP |
| behind MCP | Programming interface channel 2 | Proprietary protocol; the interface becomes accessible after removing the MCP |

**CAUTION!**

The "programming interface channel 1" currently offers the user a root shell, with which it is possible to change the password directly. Therefore, access by unauthorized persons must be strictly prevented!

**CAUTION!**

If SYNCHROTACT 6 is permanently connected to a networked server during the operating phase, it should be noted that a lack of server protection can also cause safety risks for the operation of SYNCHROTACT 6.

### *1.5.2. Password protection*

The use of SFTP / SSH2 services and a configurable password enables secure communication via the Ethernet interfaces.

The password protection consists of an ex works predefined user name and the associated password. The password has no expiration date.

To change the password, the following rules must be observed:

- at least 10 characters
- at least 1 digit
- at least 1 capital letter
- at least 1 lowercase letter
- at least 1 special character.

**Change password using programming interface channel 1:**
If the password has been forgotten, it can be reset to factory settings using "Channel 1 serial interface". It is not necessary to know the current password.
After opening a serial connection using the terminal program, the VIP_ChangeDefaultPassword function can be used to set the new password:

| *Change password* | |
|---|---|
| **Input arguments:**<br><Password> (string) | **Output arguments:**<br>0 Password changed successfully<br>-1 Gen. Error (PW not changed)<br>-2 password rules not respected |

### *1.5.3. Firewall configuration*

The firewall configuration is set at the factory. There are 4 different services configured and activated (SOAP, PEC scanner, SSH2, SFTP), the other ports are blocked by the firewall

Here is an overview:

| *Port* | *Services* | *Use* |
|---|---|---|
| 21/udp | ftp | File Transfer |
| 23/udp | telnet | Access to remote computers / systems |
| 22/tcp | ssh/sftp | Secure communication with SYNCHROTACT 6 |
| 102/tcp | mms/IEC61850 | (through SynView 6 and Shell Terminal) |
| 8080/tcp | http-proxy, gSOAP soap2.8 | MMS server for IEC61850 |
| 8081/tcp | blackice-icecap, gSOAP soap2.8 | SOAP communication to SYNCHROTACT 6 |
| 123/udp | ntp | SOAP communication to SYNCHROTACT 6 |
| 2757/udp | mms | Network Time Protocol: Time synchronization in the network |
| 5002/udp | rfe/PEC Scanner | MMS server for ABB tools (eg, CB tool) |

Legend for selected fields:

only released in recovery mode

only released during normal operation

**CAUTION!**

The SYNCHROTACT 6 device runs a SOAP service without authentication / encryption. It is therefore strictly forbidden to access SYNCHROTACT 6 via SOAP using a tool other than SynView 6!

# Chapter 2 - Safety Instructions

## 2.1. General

*Chapter 2 - Safety Instructions* includes the safety instructions that must be followed during installation, operation and maintenance of the synchronizing device. Please read all instructions carefully before operating the device and keep this manual for future reference.

## 2.2. Qualifications and Responsibilities

### 2.2.1. Qualifications and Responsibilities

Personnel involved in installation work and commissioning of SYNCHROTACT 6 must be familiar, specially instructed and informed about the residual danger areas according to the regulations currently in force.

The maintenance personnel must be familiar with the accident prevention measures at their workplace and must be instructed in first aid and firefighting.

It is the owner's responsibility to ensure that each person involved in the installation and commissioning of SYNCHROTACT 6 has received the appropriate training or instructions and has thoroughly read and clearly understood the safety instructions in this Chapter.

### 2.2.2. Consequences of Non-Compliance

Failure to comply with the safety instructions increases the risk of electric shock and damage to the equipment. Third parties who approach the installation are also at risk.

## 2.3. Safety Concept

### 2.3.1. General

The safety regulations in this Chapter generally apply when working on the synchronizing system. Additional instructions and warnings related to particular topics or actions can be found throughout the manual where relevant.

The following regulations must be strictly observed:

- The technical specifications and the typical application of the synchronizing system (see *Chapter 3.1)* must be strictly adhered to.
- Modifications without authorization: modifications and constructional changes of the equipment are not allowed.

- Duty of maintenance: The owner must ensure that the synchronizing system is used only under proper conditions and in a fully serviceable state.

### *2.3.2. Safety Rules*

The following safety procedures according to EN 50110-1 must absolutely be followed if any (maintenance) work is carried out on the synchronizing system:

**1** Disconnect synchronizing system completely.

**2** Secure against re-connection.

**3** Verify that the installation is dead.

**4** Carry out grounding and short-circuiting of the system.

**5** Provide protection against live system parts.

### *2.3.3. Residual Danger Areas*

Danger areas that cannot be eliminated by technical measures must be clearly marked with warning labels.

The operating voltages are above 50 V. The nominal value of the auxiliary voltage can be between 24 and 250 VDC or 100 and 230 VAC. The measuring voltage can be 50 to 130 VAC.

The following residual danger areas must be taken into account when working on the synchronizing system:

- Danger from live equipment inside the synchronizing system, if the protective covers are removed.
- Danger from main and auxiliary voltages in switchgear cabinets when the doors are open.

## *2.4. Structure of safety regulations*

| | |
|---|---|
| **Symbol** | **Signal Word!** |
| | Situation - Type of Hazard Statement |
| | Possible consequence - Consequence Statement |
| | Essential safety measure - Avoidance Statement |

The safety instructions always appear at the beginning of each Chapter and/or precede any instruction in the context where a potentially dangerous situation may appear. The safety instructions are divided into five categories and emphasized by the use of the following layout and safety signs:


**DANGER!**

This symbol indicates situations or conditions which can cause a risk of death or serious injury. The text describes the procedure to prevent these risks.

**WARNING!**

This symbol indicates that, when handling the equipment, dangerous voltages occur which can cause death or serious injury. The text describes the procedure to prevent these risks.

**CAUTION!**

The text sections marked with „Caution!“ contain information about situations which can lead to material damage or equipment failure if the instructions are disregarded.

**NOTE!**

The text sections marked with “Note!“ provide additional information. This must be taken into consideration in order to prevent malfunctions.

**IMPORTANT!**

This symbol indicates useful information. Not to be used to indicate dangerous situations.

## 2.5. Instructions for Emergency Situations

### 2.5.1. Firefighting

All personnel must be familiar with the location of fire extinguishers and emergency exits and must be able to operate the fire extinguishers.

Fire extinguishers are carbon dioxide ($CO_2$) or foam-based.

- **$CO_2$ fire extinguishers** are intended for fighting fires in electrical installations and may not be directed at persons.
- **Foam extinguishers** are intended for fighting fires in non-electrical equipment. They may be directed at persons but must not be used for extinguishing fires in electrical equipment.


**DANGER!**

In case of fire,

Be aware of voltage, toxic gases, overheating.

See the instructions below.

1. Shut down the system.

   Operators must be familiar with the emergency shutdown sequence.
2. Put on a protection mask.
3. Use only CO2 to extinguish the fire, no foam, no water.

### *2.5.2. First Aid Measures for Electrical Installations*

In case of an emergency, follow the instructions below:


**DANGER!**

A person is in contact with electricity.

There is a danger of electric shock for the first aider as well.

Do not touch the person until the system is grounded.

4. Shut down the plant.

   Operators must be familiar with the emergency shutdown sequence of the system.


**DANGER!**

Residual voltage of the rotating machine is present immediately after shut-down of the system.

There is a danger of electric shock.

Wait until the system is grounded.

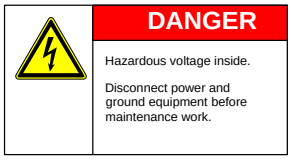
5. Switch off all power supplies and ground the system.
6. Remove the injured person from the dangerous location.
7. Provide first aid for electric shock.
8. Call for emergency assistance.

## 2.6. Danger signs

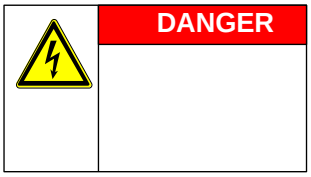
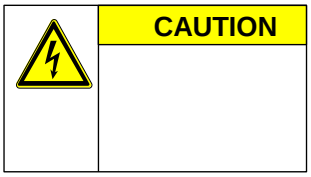
Danger signs are attached to any equipment/location with a potential danger.

The degree and likelihood of such dangers are described by the signal words DANGER, WARNING and CAUTION. The content of the warning sign contains information about the respective situation and the preventive safety measures that must be taken.

Structure of danger signs:

| Sign | Description |
|---|---|
|  | Signal word<br>Situation<br>Essential safety measures |

Meaning of signal words and consequence statement:

| Sign | Description of the signal word |
|---|---|
|  | DANGER, electrical<br>This symbol indicates imminent danger that will result in life-threatening physical injury or death. |
|  | WARNING, electrical<br>This symbol indicates a possible dangerous situation that could result in serious physical injury or death. |
|  | CAUTION, electrical<br>This symbol indicates a possible dangerous situation that could result in moderate physical injury. This signal word can also be used for warnings related to equipment damage. |

# Chapter 3 - Functional Principle

## 3.1. Brief description

The SYNCHROTACT 6 digital synchronizer is used for automatic synchronizing and paralleling of generators with lines, and for the paralleling of lines that are already synchronous. The device is designed for system frequencies of either 50, 60 or 16 $^{2}/_{3}$ Hz.

SYN 6201 is a single-channel synchronizing device whose component choice and software design provides the highest security against incorrect paralleling.

SYN 6202 consists of two independent channels with different hardware and software. This dual-channel property maximizes fault-proof safety.

All parameters required for paralleling are stored in a parameter set. The paralleling conditions and the characteristics of the voltage and frequency matchers are defined in this set. The basic version provides two parameter sets, the maximum version twenty. In this respect, a single device allows to perform parallelings under various conditions, respectively with different matching properties. 13 binary inputs and 11 binary outputs are available for the selection and feedback of a parameter set.

The data which are important for commissioning and control purposes can be read or changed using the PC-Tool **SynView 6** or alternatively, via the keypad on the front panel of the unit.

## 3.2. Paralleling functions

The automatic paralleling process can basically be divided into four function blocks:

1. Measuring
2. Voltage and frequency matching
3. Monitoring of paralleling conditions
4. Paralleling command generation

In the case of the dual channel device SYN 6202, channel 1 contains all the function blocks mentioned, while channel 2 only contains the function blocks measurement and monitoring.

The paralleling command (CMD) of channel 1 and the paralleling command release (CH2 REL) of channel 2 are each sent to a separate safety relay. The output contacts of both relays are connected in series internally.

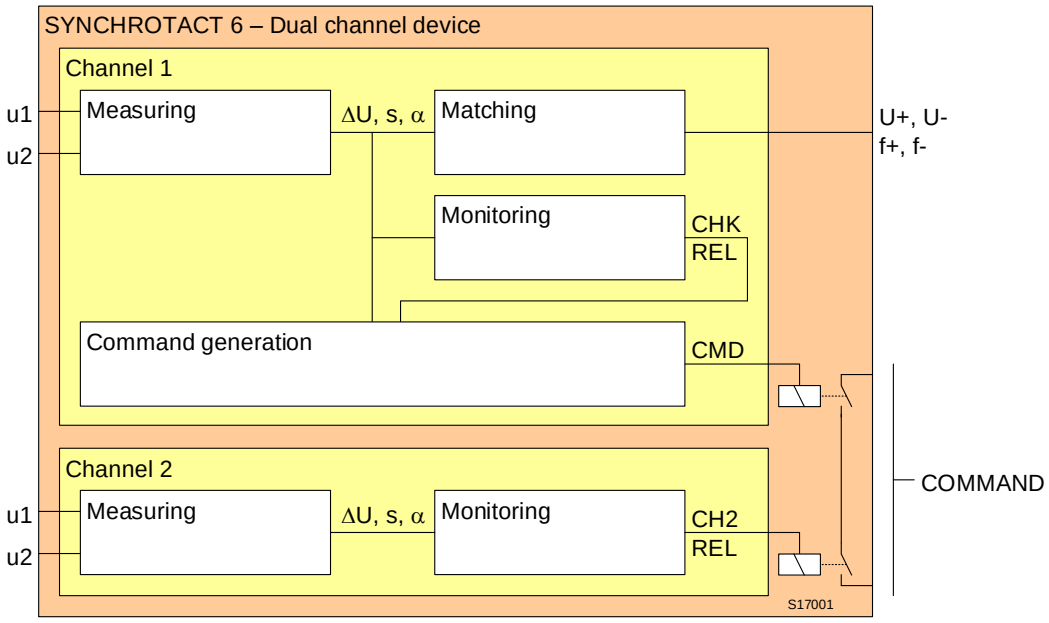



*Figure 3-1 Simplified block diagram SYN 6202*

The following figure illustrates the block circuit diagram of the basic functions of channel 1. The individual functions are described more precisely in the following sections.

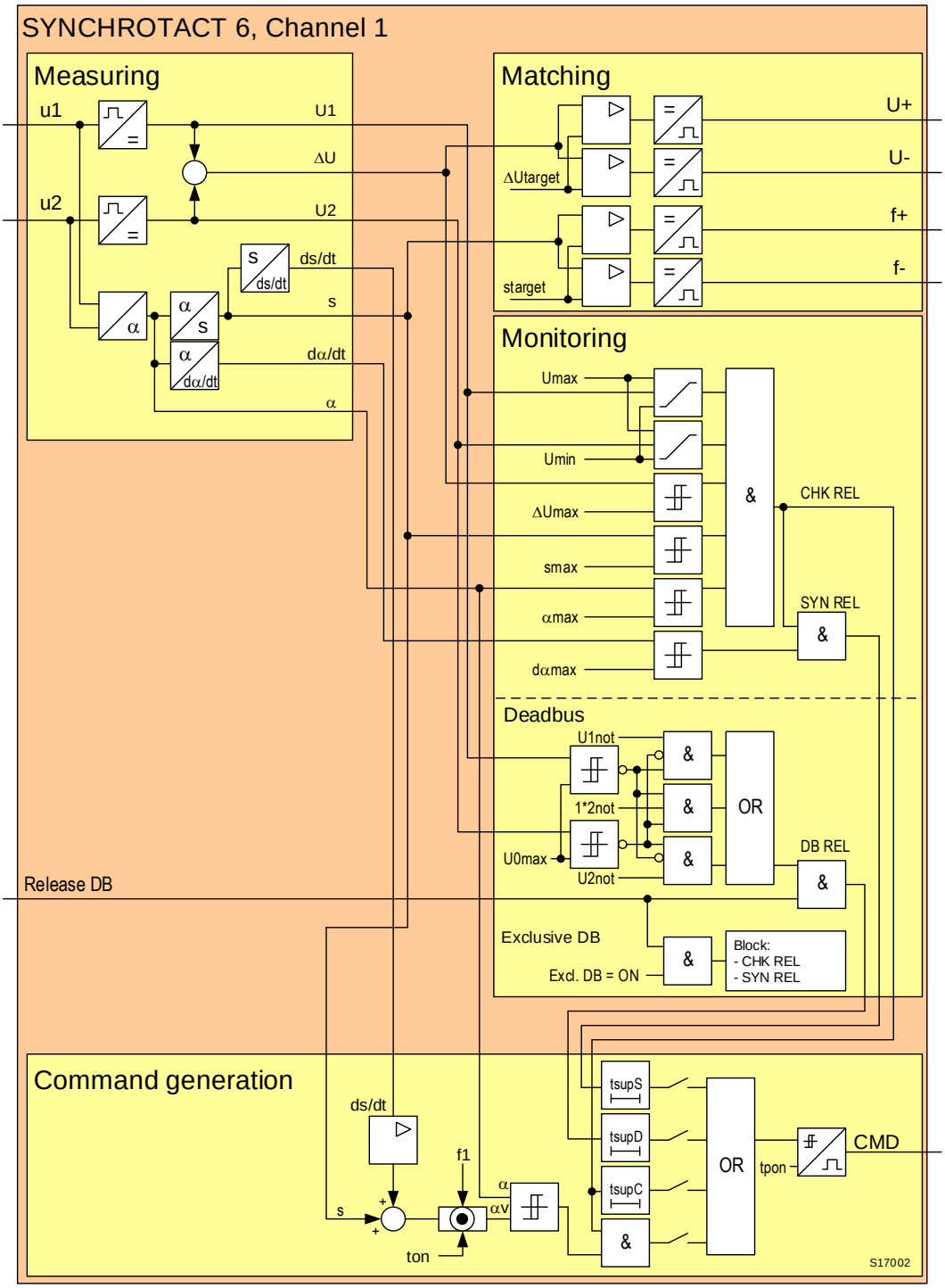



*Figure 3-2 Block circuit diagram of the basic functions of channel 1 or SYN 6201*

The following figure illustrates the block circuit diagram of the basic functions of channel 2. The individual functions are described more in detail in the following sections.

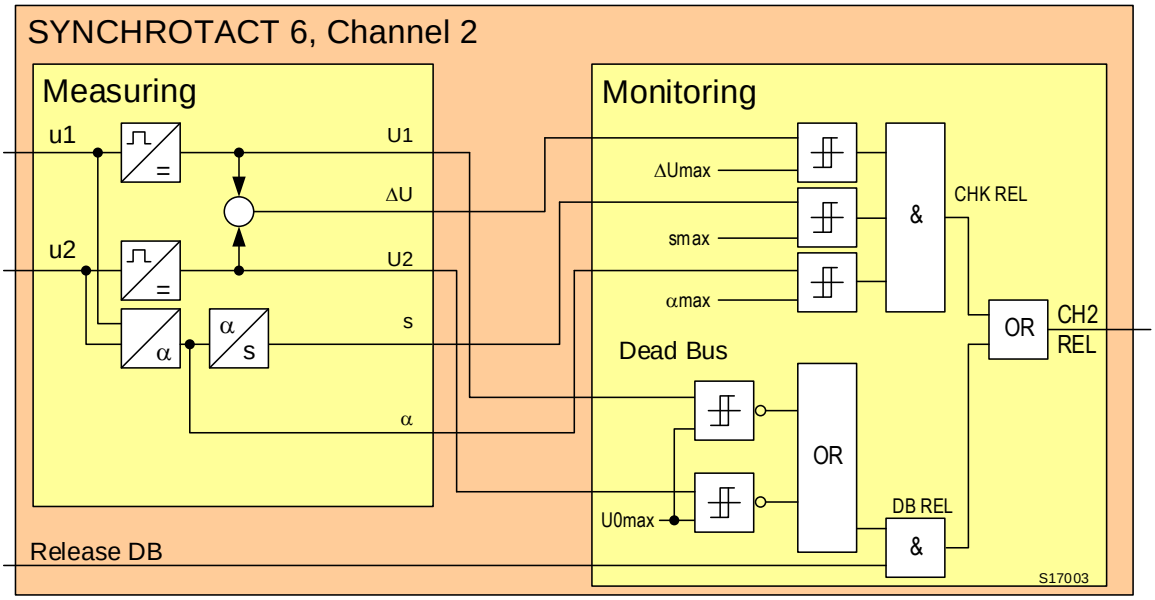



*Figure 3-3 Block circuit diagram of the basic functions of channel 2 (SYN 6202 only)*

### *3.2.1. Measured variable*

The following measured variables are formed from the two single-phase measuring voltages:

**Voltage U1, U2**
U1 is the running voltage, eg, line
U2 is the incoming voltage, eg, generator

**Frequency f1, f2**
f1 is the reference frequency
f2 is the adjustable frequency

**Voltage difference ΔU**
ΔU = IU1I – IU2I
ΔU > 0 Adjustable voltage is lower
ΔU < 0 Adjustable voltage is higher

**Slip s**

$$s = \frac{f1 - f2}{f1} * 100\ \%$$

s > 0 Adjustable frequency is lower (eg, generator is sub-synchronous)
s < 0 Adjustable frequency is higher (eg, generator is over-synchronous)

**Phase-angle difference α**

$$\alpha = \varphi 1 - \varphi 2$$

α > 0 Adjustable measuring voltage is lagging
α < 0 Adjustable measuring voltage is leading

**Acceleration ds/dt**

$$ds/dt = \frac{d\left(\frac{f1 - f2}{f1} * 100\ \%\right)}{dt}$$

ds/dt > 0 Adjustable frequency reduces (eg, generator slows down)
ds/dt < 0 Adjustable frequency increases (eg, generator accelerates)

### *3.2.2. Analog inputs for measurement*

A total of 8 analog measuring inputs (AIN) are available. These can be assigned to the measuring channels according to different connection schemes (see *Chapter 6.6.3 Selection of the connection diagram)*.

Examples:

- Single-phase measurement: in the case of several paralleling points, the measuring points can be electronically selected. This allows to save external selection contacts.
- Multi-phase measurement: two or three AINs are used per measurement U1 and U2, this has the advantage that the phase sequence (clockwise / counterclockwise) and connection errors (rotary field, polarity reversal) and phase failures can also be detected with the single channel device SYN 6201. If sufficient AINs are available, this circuit can be combined with the electronic measuring point selection.

### 3.2.3. Measuring principle

All measuring inputs are each guided over two parallel measuring channels, made of high-resistance input resistors and differential amplifiers.

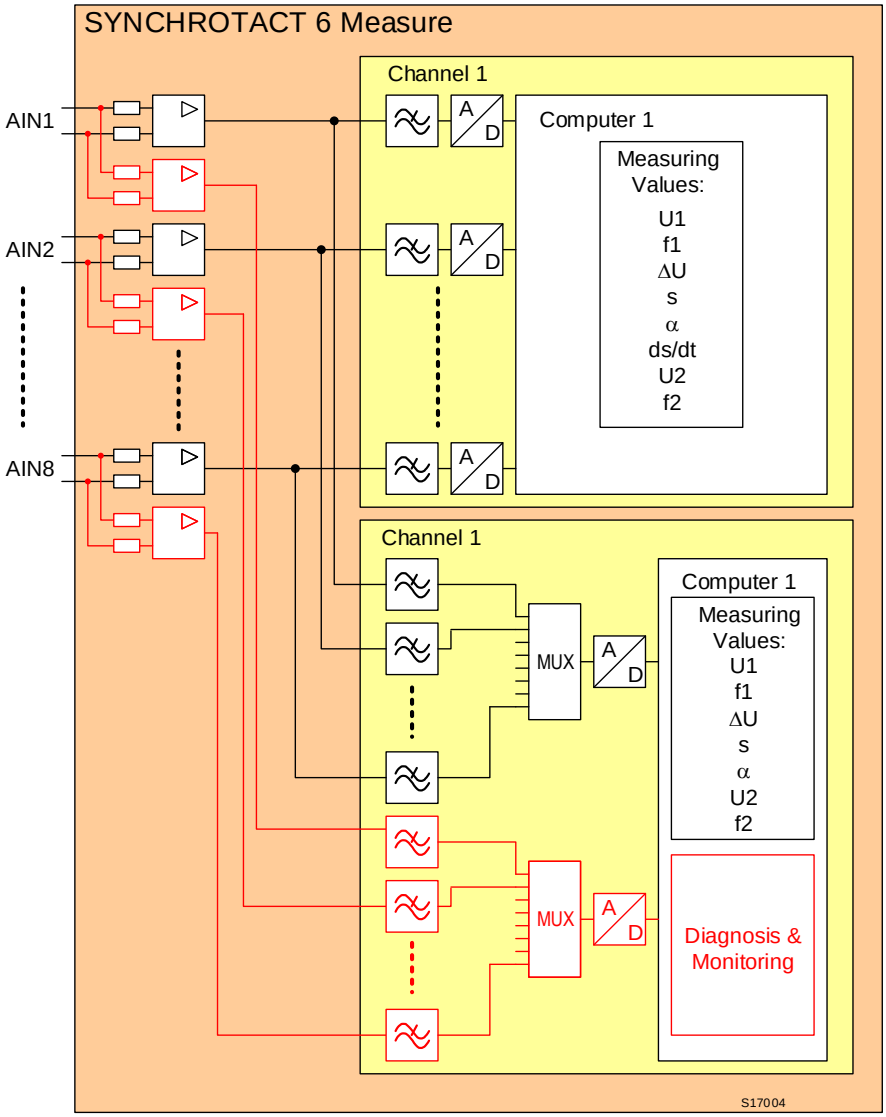



*Figure 3-4 Voltage measurement*

Channel 1 measures at one of these measuring channels respectively. The signals from each of the eight analog inputs are passed to the computer via separate low-pass filters and AD converters. In the converter, the signals of the selected inputs are filtered and measured values are formed.

Channel 2 (SYN 6202 only) uses both measuring channels of an analog input, one of which serves for the generation of measured values and the other for diagnostic and monitoring functions, which are used for functional safety. A low-pass filter is available for each measuring channel. There are only two AD converters. They get the signals from the upstream multiplexer (MUX).

### 3.2.4. Electronic amplitudes and phase-angle compensation

If the secondary voltages U1 and U2 are not equally high in case of a closed circuit breaker, this can be compensated by means of the voltage-matching factor U1/U2, so that ΔU = 0 %. The voltage U2 is thereby adapted to the voltage U1.

If the phase-angle difference is not zero when the circuit breaker is closed, this can be compensated by means of angle adjustment αOffset, so that α = 0 DEG.

Example of amplitude and phase-angle compensation:
The voltage transformer for U1 is only single-phase and measures L1-N.
The voltage transformer for U2 is three-phase and measures L1-L2.
This results in an amplitude difference of √3, as well as a phase-angle difference of +30 DEG.
The actual values are compensated with the parameter settings U1/U2 = 0.577 and αOffs = -30 DEG in both channels.

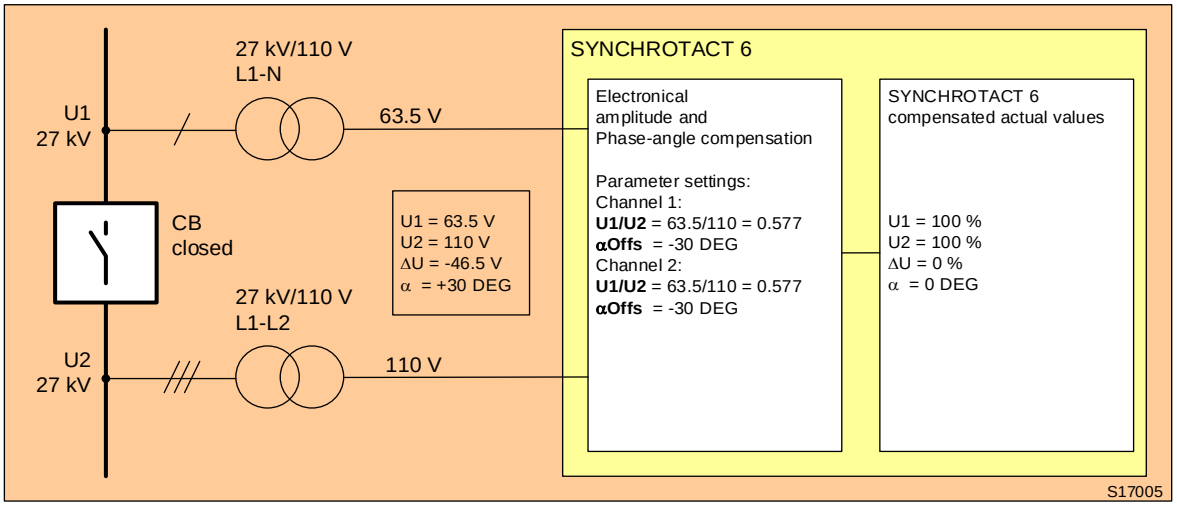



*Figure 3-5 Example of amplitude and phase-angle compensation*

### 3.2.5. Adjustment of the voltage measurement, depending on a coded value

Due to an encoded input value, that for instance represents the active stage of a tap changer, the voltage measurement U1 or U2 (selectable) can be corrected by an adjustable amount. The reading of this input value, resp. the tap changer stage, is effected by the transformer stage detection TTI (Transformer Tap Indication). More details can be found in *Chapter 3.6.6.*

### *3.2.6. Voltage matching*

**Working area of the voltage matcher**
If the voltage U1 is in the range between Umin and Umax and U2 is higher than U0max, the adjusting commands are released. The direction of the adjusting commands depends on the polarity of ΔU.
Adjustment-free range: if ΔU is smaller than 50 % of ΔUmax, no adjusting commands are issued.
As an additional condition, both frequencies must be in the range of ±5 Hz.

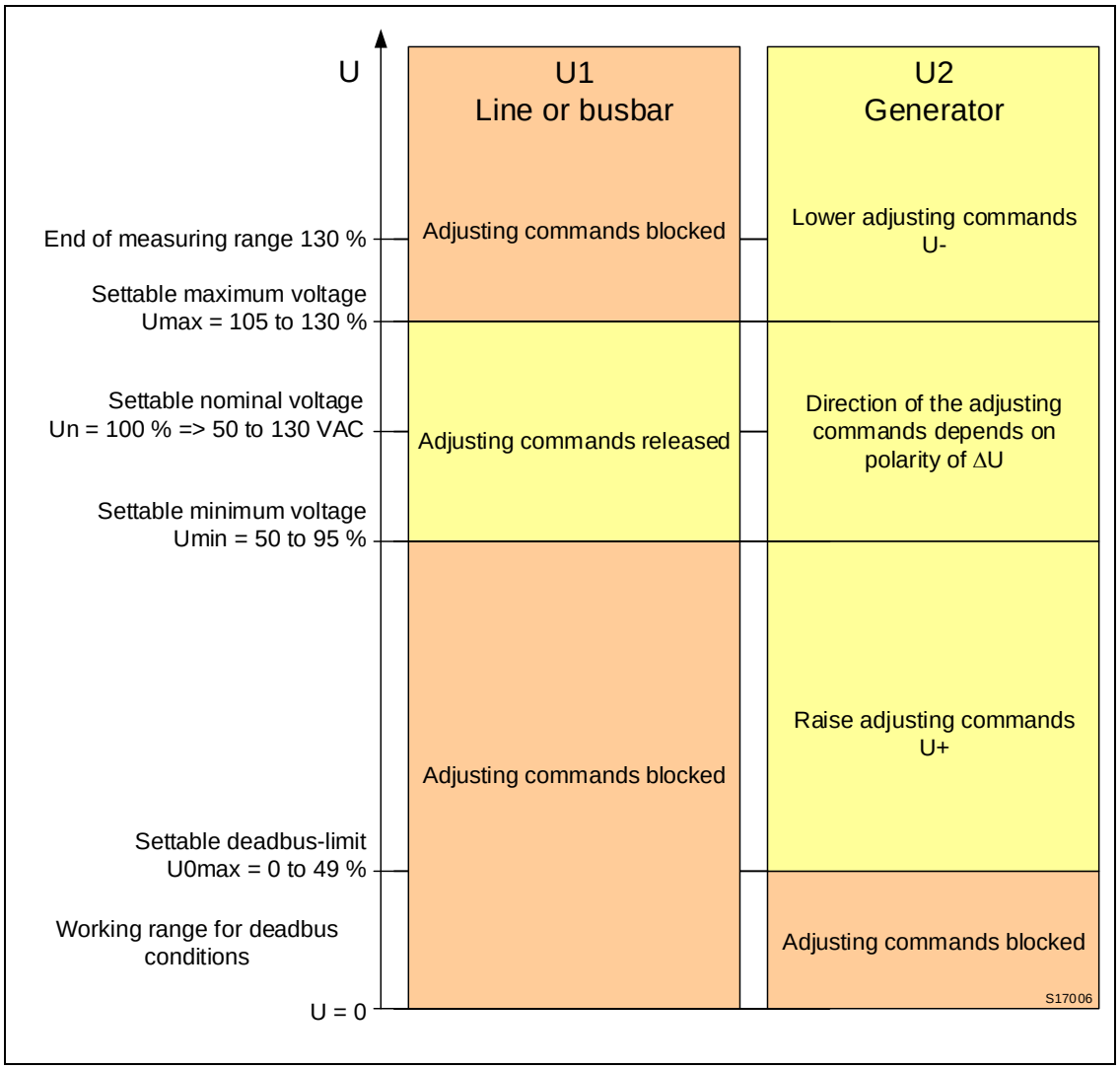



*Figure 3-6 Working area of the voltage matcher*

**Voltage matcher with variable pulse times**
The voltage matcher issues a command, the length of which is proportional to the current voltage difference. The proportionality factor dU/dt can be adapted to the voltage regulator. The voltage matcher aims at a value in the middle of the set tolerance band. The adjusting command length tp U is:

$$tpU = \frac{|\Delta U| - \left( \frac{+\Delta U\,\max - |-\Delta U\,\max|}{2} \right)}{dU/dt}$$

The adjusting pulse is discontinued as soon as the voltage difference passes through the target value. The command length does not fall below an adjustable minimum value. After an adjusting command, the system waits for the set pulse interval ts U so that the actual values can stabilize to the new setpoint.

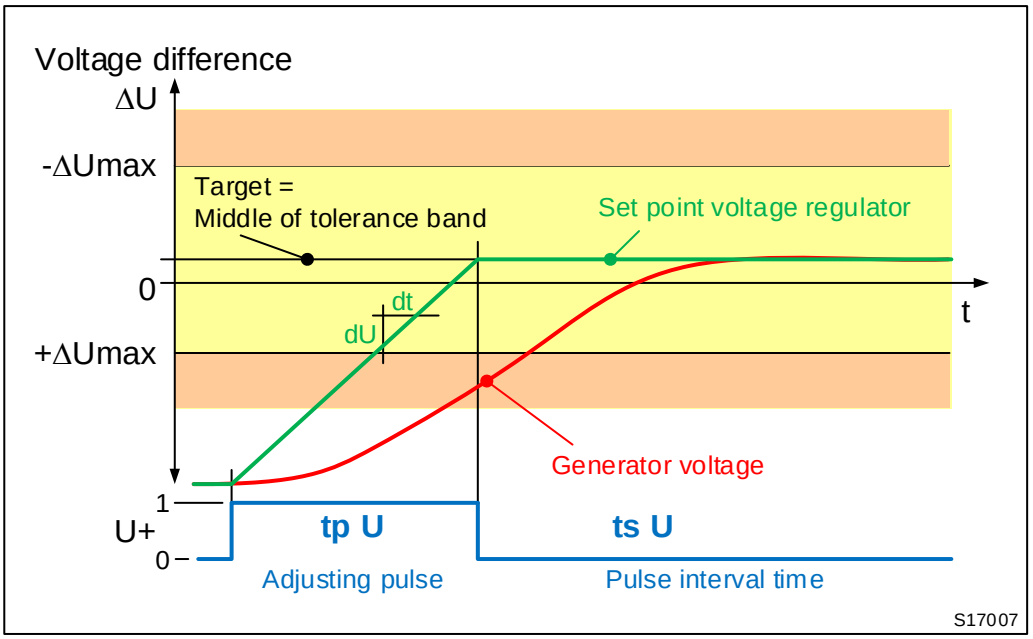



*Figure 3-7 Voltage matcher with variable pulse durations*

**Voltage matching with variable intervals**
In the case of voltage matching with variable intervals, the pulses have always the same length, but the pauses are inversely proportional to the voltage difference.
This function is activated or de-activated using the parameter INVERSE U.
Pulse length: adjustable by means of the parameter tp Umin: tp = tp Umin
Pause interval: adjustable by means of the parameter ts U; depending on ts U and ±ΔUmax:

$$ts = ts\ U * \left\{ 1 - 0{,}325 * \left[ \Delta U - \frac{\left[ (+\Delta U\,\max) + (|-\Delta U\,\max|) \right]}{2} \right] \right\} \geq 0$$

**Voltage matcher for tap changer**
The voltage matcher for tap changers allows constant pulse durations and pulse intervals to be generated, which is necessary for matching by means of the tap changer.
The function is activated or de-activated by means of the parameter TVM (Tap changer Voltage Matcher).
Pulse durations: adjustable by means of parameter tp Umin.
Pulse intervals: adjustable by means of parameter ts U.

## *3.2.7. Frequency matcher*

**Working area of the frequency matcher**
The voltage U1 must be in the range of Umin and Umax, and U2 must be higher than U0max, so that adjusting commands are enabled.
The direction of the adjusting commands depends on the range in which the slip s is located (see *Figure 3-8*).
Adjustable range: between 1/3 and 2/3 of smax there is a range where no adjustment takes place.

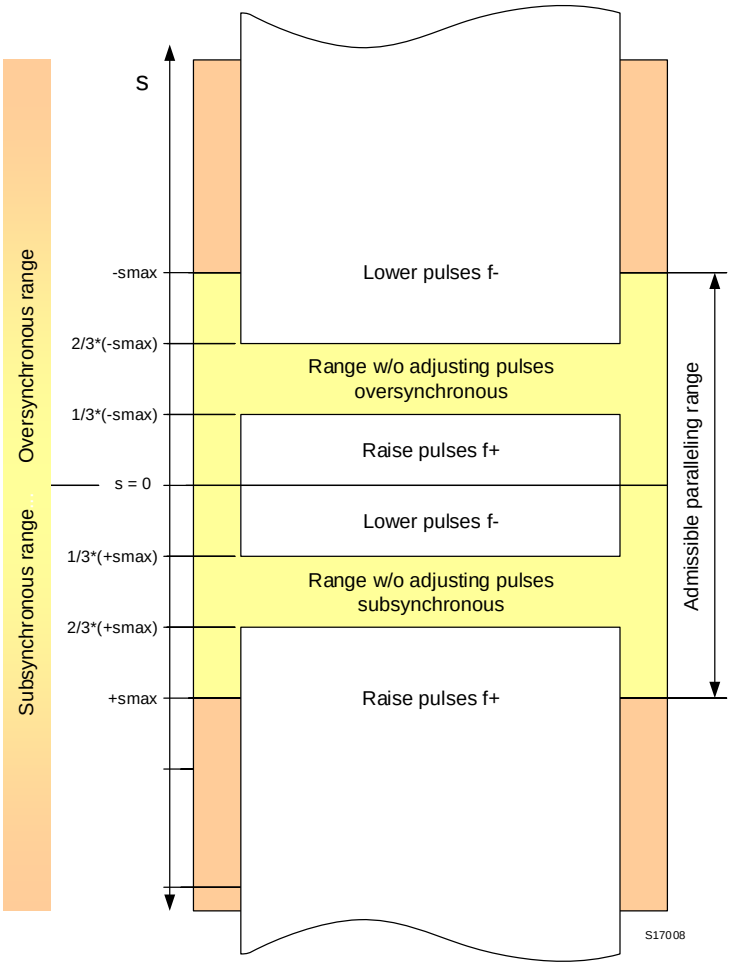



*Figure 3-8 Working area of the frequency matcher*

**Frequency matcher with variable pulse durations**
The frequency matcher issues a command, the length of which is proportional to the current slip. The proportionality factor df/dt can be adapted to the governor. The frequency matcher aims at a value midway between the nearer slip limit and zero. The adjusting command length tpf is:

$$tpf = \frac{|\pm s| - \frac{|\pm s\,\max|}{2}}{df\,/\,dt}$$

The adjusting pulse is discontinued as soon as the slip passes the target value. The command length does not fall below an adjustable minimum value. After an adjusting command the system waits for the set pulse interval ts f so that the actual values can stabilize to the new setpoint.

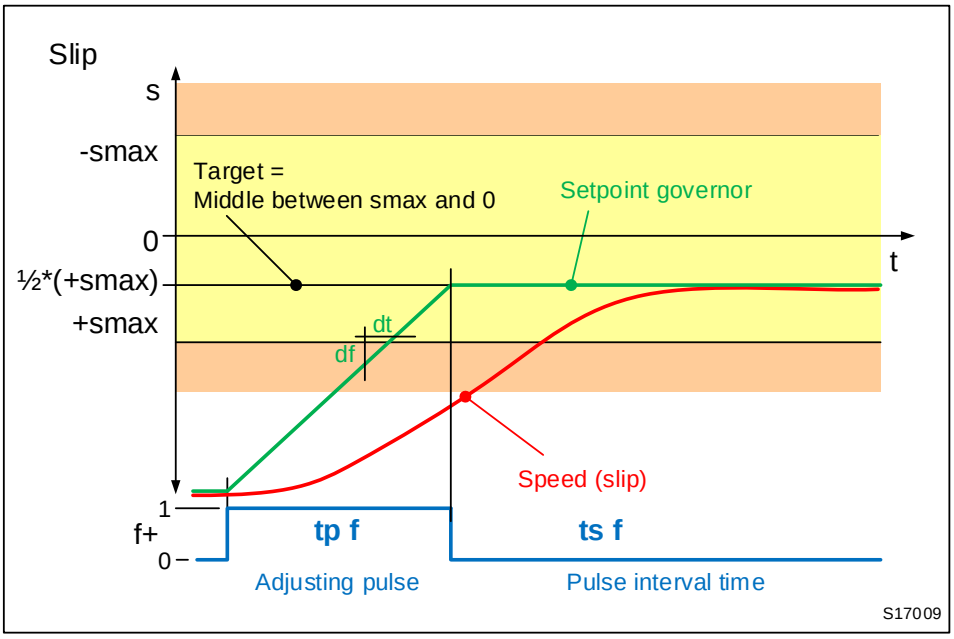



*Figure 3-9 Frequency matcher with variable pulse times*

**Frequency matcher with variable pulse durations**

The pulses of the frequency matcher with variable pulse durations always have the same length, but the pause intervals are inversely proportional to the slip.
The function is activated or de-activated by means of the parameter INVERSE f.
Pulse duration: adjustable by means of parameter tp fmin: tp = tp fmin
Pause duration: calculated according to the following formula (not adjustable, ie, parameter ts f is ineffective with this function):

$$ts = \frac{1}{f1 - f2} = \frac{1}{f1 * |s|} \leq 30 \ [s]$$

### *3.2.8. Monitoring of paralleling conditions channel 1*

The monitoring of the paralleling conditions in channel 1 can be divided into the following functions:

- CHK RELEASE (generator synchronization, or synchronous lines)
- SYN RELEASE (synchronous or asynchronous lines)
- DB RELEASE (voltage-free lines (dead bus))

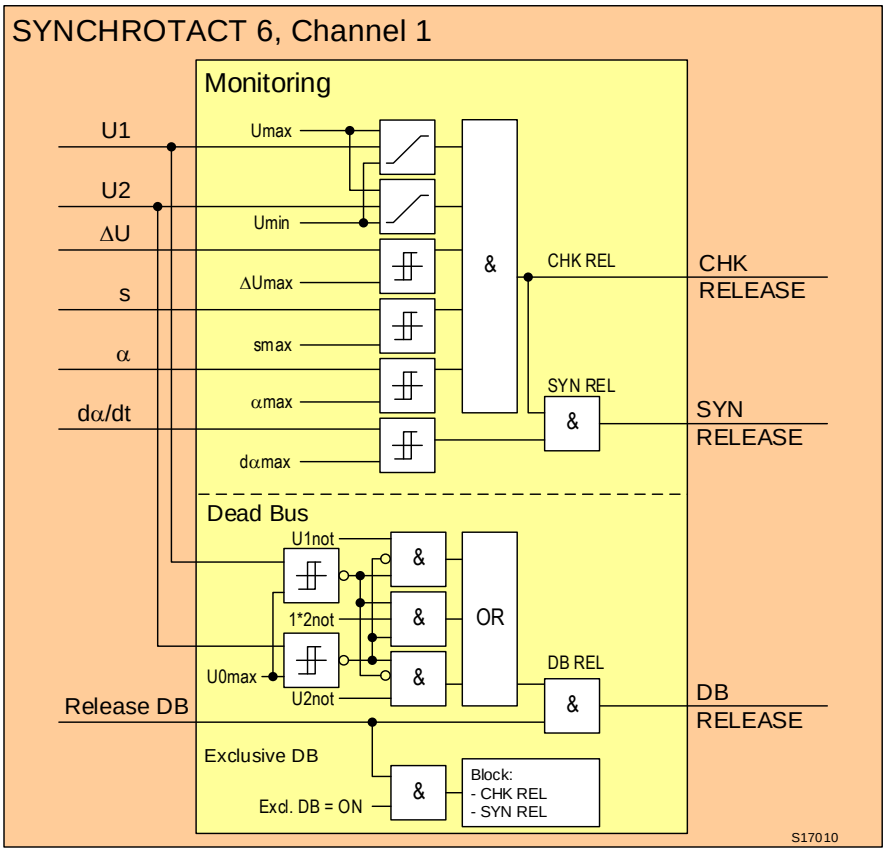



*Figure 3-10 Monitoring channel 1*

**CHK RELEASE**

The monitoring of the paralleling conditions enables a paralleling command (CHK RELEASE), if the following conditions are fulfilled simultaneously:

- The phase-angle difference is within the tolerance band αmax
- The slip is within the tolerance band smax
- The voltage difference is within the tolerance band ΔUmax
- The voltage does not fall below the minimum voltage Umin
- The maximum voltage Umax is not exceeded
- The device is in operating status (OPERATING)
- Nominal frequency deviation ≤ 5 Hz

The signal is used in various applications:

- Generator synchronization: the command generation uses the signal as a condition for issuing a paralleling command
- Synchrocheck: when the command generation is switched off, the output is sent directly to the command relay as a release signal

- Paralleling of synchronous and asynchronous lines: the signal CHK RELEASE is used by the SYN RELEASE – function, or by the command generation.

**SYN RELEASE**
The function SYN RELEASE is an AND-operation of CHK RELEASE and the synchronization detection dα/dtmax. The synchronization detection distinguishes between quasi-synchronous lines with very slowly running phase-angle differences (dα/dt < dα/dtmax) und asynchronous lines (dα/dt > dα/dtmax).

In the quasi-synchronous state, it may take a very long time for the phase-angle difference, which is already in the permitted angle window, to have a zero crossing. For this reason, switching is already done after the adjustable monitoring time t supS. If the frequency difference is greater, it is worthwhile to wait for the phase match. In this case, the asynchronous branch of the command generation will issue the command.

**DB RELEASE**
A special case for the monitoring is the paralleling of voltage-free lines. A paralleling command is only issued if the external release command is present and at the same time the release is enabled by the measurement logic. The measurement logic issues the release when both voltages are in one of the permissible ranges. The dead bus area can be defined as permissible by the parameters U1not, U2not and 1*2not for one, the other or both measuring voltages.

The monitoring of the paralleling conditions releases the paralleling command (CHK RELEASE), if the following conditions are fulfilled simultaneously:
- The release signal for dead bus (binary input „Release DB“) is issued
- The zero voltage(s) do(es) not exceed the set threshold U0max
- The present voltage does not fall below the minimum voltage
- The present voltage does not exceed the maximum voltage
- The present zero voltage situation corresponds to a configuration permitted by means of U1not, U2not, 1*2not
- The device is in operating status (OPERATING)

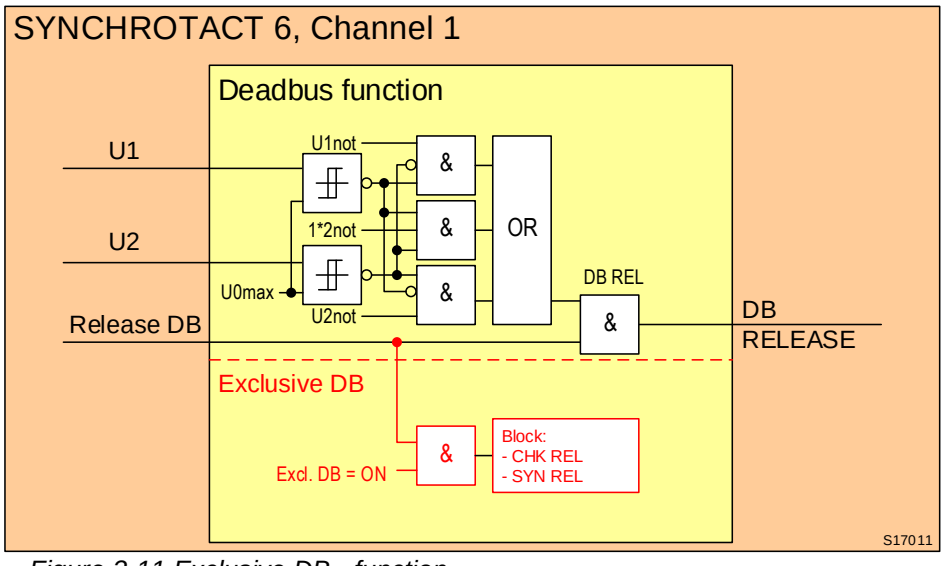



*Figure 3-11 Exclusive DB - function*

The *Exclusive dead bus* – function „Exclusive DB“ (marked in red in the figure above) can be activated or deactivated. When the Exclusive DB is switched on, the circuit breaker can only be closed, when a Release dead bus signal is present, and if a dead bus state is actually present. Exclusive DB blocks the signals CHK REL and SYN REL, while DB REL remains unchanged.

When Exclusive DB is switched off (= factory setting), synchronization can be performed with two available voltages even if the Release dead bus signal is present.

The previous SYNCHROTACT – products behaved as Exclusive DB = OFF.

### *3.2.9. Monitoring of the paralleling conditions channel 2 (only SYN 6202)*

The monitoring of the paralleling conditions can be divided into the following sub-functions:

- Monitoring of live power sources
- Monitoring of voltage-free lines (dead bus)

Their output signals CHK REL and DB REL lead in parallel to the channel 2 command enable relay, ie the output signal CH2 RELEASE is active, when either CHK REL or DB REL is active.

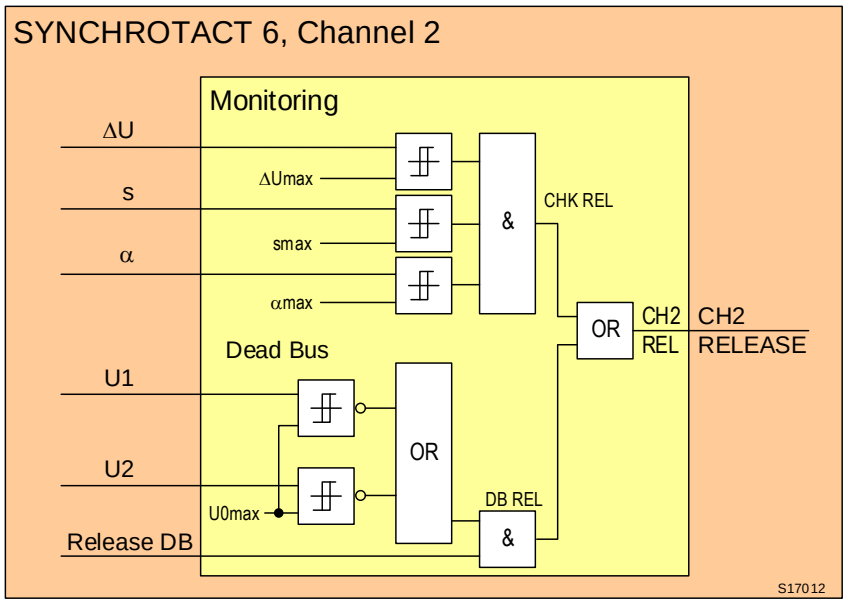



*Figure 3-12 Monitoring channel 2*

**CHK REL**

The monitoring of live power sources enables the paralleling command (CHK REL), if the following conditions are fulfilled simultaneously:

- The phase-angle difference is within the tolerance band αmax
- The slip is within the tolerance band smax
- The voltage difference is within the tolerance band ΔUmax
- The device is in operating status (OPERATING)

**DB REL**
As with channel 1, the signal „Release DB“ is used by channel 2 for the monitoring of the paralleling of voltage-free lines.
Release conditions for DB REL in channel 2:

- Release dead bus („Release DB“-input, common with channel 1) is pending
- At least one of the two measuring voltages does not exceed the threshold U0max set in channel 2
- The device is in operating status (OPERATING)

### *3.2.10. Command generation*

The command generation generates the paralleling command CMD on the basis of the relevant actual values, setting parameters and states of the monitoring functions:

- Actual values α, f1, s, ds/dt (asynchronous sources)
- Parameter t on, tp on, CMDGen
- Monitoring function CHK RELEASE
- Monitoring function SYN RELEASE
- Monitoring function DB RELEASE

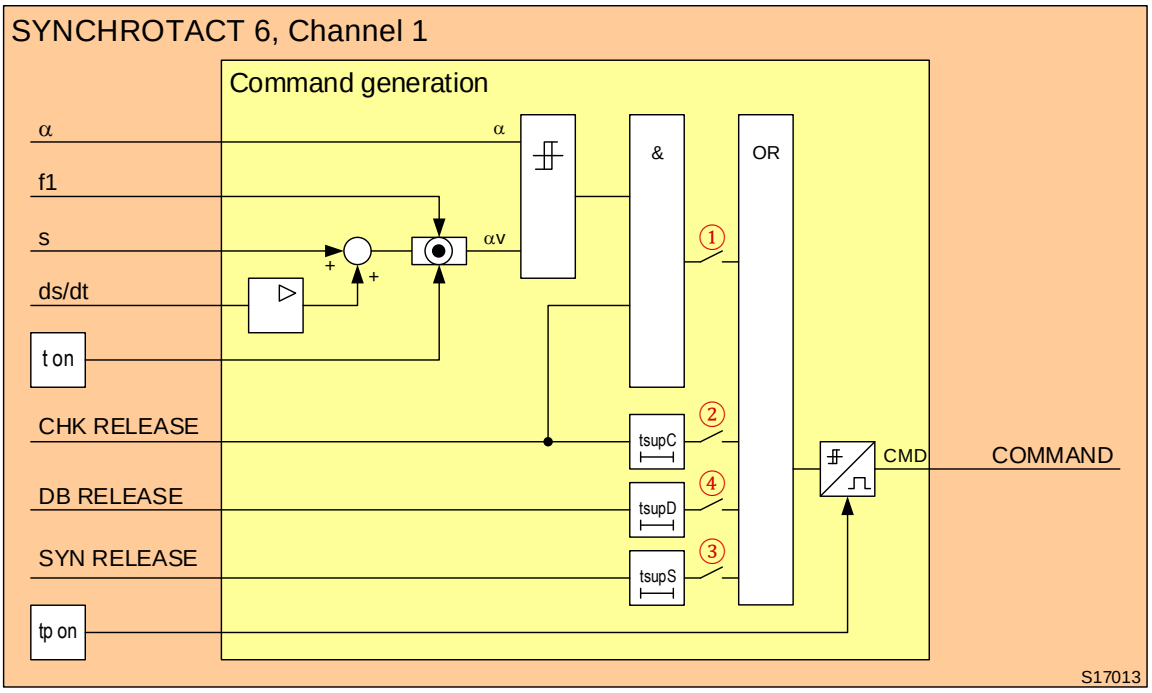



*Figure 3-13 Command Generation*

From this, four parallel branches are generated, which can lead to the command output. The branch whose conditions are first fulfilled, generates the paralleling command. Each branch can be switched off individually.

| | ***Branch*** | ***Application*** | ***Used Values*** | ***Can be disengaged by*** |
|---|---|---|---|---|
| ① | Asynchronous | Generator synchronization | Actual values, setpoint t on and CHK RELEASE | t on = OFF |
| ② | Synchronous | Paralleling of synchronous lines | CHK RELEASE and monitoring time t supC | t supC = OFF |
| ③ | Synchronous + angle drift | Paralleling of synchronous and asynchronous lines | SYN RELEASE and monitoring time t supS | t supS = OFF |
| ④ | Voltage-free | Connection of voltage-free lines (dead bus) | DB RELEASE and monitoring time t supD | t supD = OFF |

The command generation can also be switched off as a whole, by means of the setting parameter CMDGen = OFF, ie the device is then operated as synchrocheck.

**Asynchronous sources**
Asynchronous sources are the case if both paralleling lines (resp. generator and lines) are asynchronous before the circuit breaker is closed.

From the slip s, the acceleration ds/dt, the line frequency f1 and the set paralleling time t on, the command generation calculates the necessary lead angle $\alpha v$ by which the paralleling command is shifted forward in time so that the main contacts close exactly on phase coincidence

$$\alpha v = \left[ 3{,}6 * f1 * \left| s + \frac{ds/dt * t\ on}{2} \right| * t\ on \right]$$

If the measured phase-angle difference $\alpha$ corresponds to the lead angle $\alpha$v and if all paralleling conditions are simultaneously fulfilled (CHK RELEASE), a command is generated (COMMAND).

The command length always corresponds to the set paralleling command length tp on.

**NOTE!**

If the command generation is switched off (parameter CMDGen = OFF), the device acts as a synchrocheck. In channel 1, the signals CHK RELEASE, SYN RELEASE and DB RELEASE are sent directly to the output relay and without the monitoring times. As soon as no more release signals are pending, the contacts are re-opened.

**Synchronous sources and quasi-synchronous lines**
The situation, when both lines to be paralleled are synchronous before the circuit breaker is closed, is called synchronous sources

If the paralleling conditions (CHK RELEASE) are fulfilled during the monitoring time t supC, a command is generated immediately after the timeout of t supC. That means that a phase balance is not necessary. The monitoring time t supC is exclusively used for the CHK RELEASE function.

If two lines are quasi-synchronous, there is only an extremely slight frequency difference, resp. angle drift. Depending on the size of this angle drift, it is possible that the next phase match needs to be waited for to close the circuit breaker or, if all conditions are met, it is switched beforehand, as it would take a long time to reach the phase match. In this application, the monitoring function SYN RELEASE is used (see *Chapter 3.2.8*)

If the paralleling conditions (SYN RELEASE) are fulfilled during the monitoring time t supS, a command is generated immediately after the expiration of t supS. That is, the phase balance is not waited for. The monitoring time t supS is exclusively used for the function SYN RELEASE.

**Voltage-free lines (Dead Bus)**
If the dead bus conditions (DB RELEASE) are fulfilled during the monitoring time t supD, a command is generated immediately after the timeout of t supD. The monitoring time t supD is exclusively used for the dead bus function.

**Multiple commands**
A further function of the command generation are the multiple commands (MULTIPLE CMD). In a synchronization process, it allows either multiple commands (whenever the conditions are fulfilled) to be issued or it blocks command generation after the first command of a running synchronization process was issued, regardless of whether the circuit breaker is closed or not.

## *3.3. Selection of paralleling points and parameter sets*

### *3.3.1. SYN 6201 and channel 1 of SYN 6202*

All measuring, signal and command circuits that are necessary for the synchronization of a circuit breaker, are assigned to a **paralleling point**. These include:

- Measuring circuits of both voltages U1 and U2 (= measuring point)
- Adjusting commands to the voltage regulator
- Adjusting commands to the turbine governor
- Closing command to the circuit breaker

If no synchronization process is active (ie, in READY state), the current circuits of a paralleling point are normally separated from the synchronizing device. As soon as someone wants to synchronize, they are connected to the synchronizing device, eg by means of relay contacts. The paralleling point is thus selected.

In order to synchronize a paralleling point, certain settings in the synchronizing device are necessary. The adjusting parameters which are available for this purpose, form a **parameter set**.

The parameter set must be selected to synchronize. If no synchronizing process is active (ie, in READY state), then no parameter set is selected.

**IMPORTANT!**

In BLOCKED state (eg during commissioning), paralleling point and parameter set selection are executed.

If only one circuit breaker is synchronized with a synchronizing device, both selections can be permanently executed. If, on the other hand, several circuit breakers will be synchronized, the paralleling point and parameter set must be selected at or immediately before the START of the synchronizing process. SYNCHROTACT 6 reads the selections once after receipt of the START command and activates the corresponding parameter set and the paralleling point. A selection change is only possible by previous STOP and renewed START.

Normally the allocation is made with the same ordinal numbers (paralleling point 1 to parameter set 1, paralleling point 2 to parameter set 2, etc.). A signal (eg, at a binary input) is for that reason sufficient to select both the paralleling point and the parameter set.

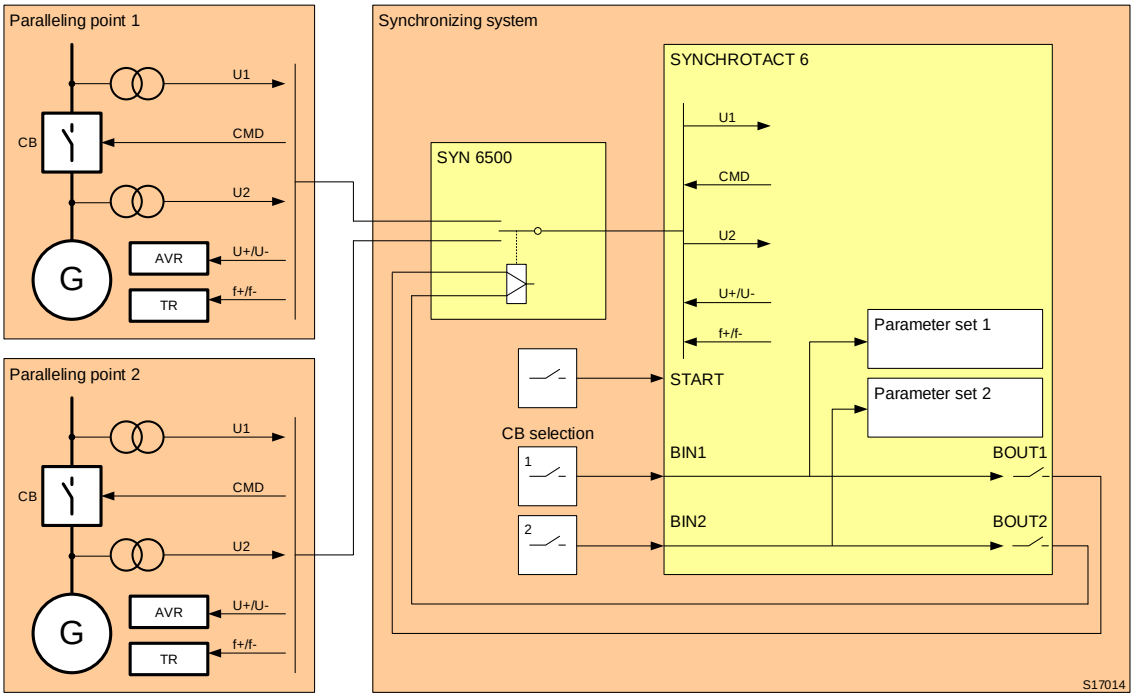



*Figure 3-14 Example of a selection of parameter set and paralleling point*

However, there are also applications in which the ordinal numbers are different, eg 2 parameter sets for the same paralleling point or 1 parameter set for several paralleling points (see *Chapter 6.3*)

With SYNCHROTACT 6 the signal for the selection of paralleling point and parameter set can come from different sources:

- Binary input
- Communication interface
- With only one parameter set / paralleling point: electronic, permanent selection.

The selection is only executed if SYNCHROTACT 6 is in the OPERATING state or BLOCKED state (without errors).

The paralleling point selection can be executed in different ways:

- SYNCHROTACT 6 Relay output contact (to external contact multiplier, eg SYN 6500)
- Electronically via communication interface

For the electronic execution of the paralleling point selection, the following must be observed:

- Measuring circuits: SYNCHROTACT 6 provides 8 analog inputs which can be electronically selected
- Adjustment command circuits: Raise and Lower commands can be sent to the voltage regulator or the turbine governor via a communication interface (eg. IEC 61850)
- Paralleling command circuits: can be sent to the circuit breaker via a communication interface (eg IEC 61850).

**CAUTION!**

The electronic execution of the paralleling point selection, or parts thereof, carries certain dangers. Therefore, the rules according to *Chapter 6.4* must be observed at all times during configuration!

### *3.3.2. Channel 2 of SYN 6202*

**Channel 2 – Parameter set selection by means of hardware inputs**
Maximum 6 parameter sets are available in channel 2 of the SYN 6202 dual channel device. Normally, channel 2 accepts the parameter set selection of binary inputs BIN01 to BIN06.
In this operating mode, diagnostic functions compare first whether the selection in channel 1 matches the one in channel 2 (BIN1 to BIN6) and second whether the outputs for paralleling point selection (BOUT1 to BOUT6) agree with the selection.
As a result, the inputs BIN01 to BIN06 and the outputs BOUT01 to BOUT06 can no longer be configured, or must be used with the factory setting.
This restriction does not apply to the following two variants.

**Use of only one parameter set in channel 2**
If more than 6 paralleling points are used, channel 2 can only be operated with parameter set 1.

By setting parameter 3127 CH2 AlwaysPs1 = ON, parameter set 1 is permanently selected in channel 2 and the hardware selection (binary inputs BIN01 to BIN06) is ignored.

**Channel 2 – Parameter set selection controlled via channel 1**
A further possibility of the parameter set selection in channel 2 is to accept the selection of channel 1. This can be programmed by setting parameter 3128 CH2Ctrl by CH1 = ON. Channel 2 then ignores the hardware selection (binary inputs BIN01 to BIN06) and instead adopts the **paralleling point selection of channel 1**, which can be done for instance via the communication interface. The binary inputs are available for other functions.

**IMPORTANT!**

The transfer of the parameter set selection of channel 1 is not SIL-compatible, since two diagnostic functions cannot be used:

- Diagnostic function for checking the correspondence of selection to the binary inputs and selection of the output relay for the paralleling point selection is deactivated.
- Diagnostic function for checking the correctness of the selections in channel 1 and in channel 2 is not possible.

## 3.4. SEEK-Functions

Three SEEK-functions are provided for the SYNCHROTACT 6 to be matched to the system, which can be used to determine system-specific setting values for the parameters.

1. SEEK ton: Determination of the paralleling time t on.
2. SEEK dUdt: Adjust the voltage matcher to the voltage regulator (parameter dU/dt)
3. SEEK dfdt: Adjust the frequency matcher to the turbine governor (parameter df/dt)

The operating mode of the respective SEEK function is described below:

### 3.4.1. SEEK ton function

The SEEK ton-function closes the circuit breaker. As a starting condition the device selector switch on the device front must be set to the position „ENABLE SEEK ton“, there must be voltage on one side of the circuit breaker (>Umin) and no voltage on the other side (<U0max). After closing, SYNCHROTACT 6 measures how long it takes until voltage is applied to both measuring inputs.

### 3.4.2. SEEK dUdt function

The SEEK dUdt-function runs as follows:

1. Adjusting the generator voltage until it is ≤98% of the line voltage, then the adjusting pulse is canceled. If the generator voltage is already in this range, this first step is omitted.
2. The initial generator voltage $U2_0$ is measured ten seconds after the first adjusting pulse. Then a Raise command U+ is issued, until the generator voltage reaches 99%, then the adjusting command is interrupted and the adjusting command length $tpU_1$ is measured.
3. Ten seconds after the pulse end, the final generator voltage $U2_1$ is measured and $dU/dt_1$ is calculated according to the following formula:

$$dU/dt_1 = \frac{U2_1 - U2_0}{tpU_1}$$

4. With this $dU/dt_1$-value, a Lower command $tpU_2$ is issued with the target value of 96 % of the generator nominal voltage.
5. Ten seconds after the end of the adjusting command, the generator voltage $U2_2$ is measured and $dU/dt_2$ is calculated according to the following formula:

$$dU/dt_2 = \frac{U2_1 - U2_2}{tpU_2}$$

6. Based on $dU/dt_2$, a Raise command $tpU_3$ with the target value of 100% of the generator nominal voltage is now issued.
7. Ten seconds after the end of the adjusting command, the generator voltage $U2_3$ is measured and $dU/dt_3$ is calculated according to the following formula:

$$dU/dt_3 = \frac{U2_3 - U2_2}{tpU_3}$$

8. The average value from $dU/dt_2$ and $dU/dt_3$ is now displayed as a result. If there is a deviation of more than 10 %, the message „Calculation may be inaccurate!“ is displayed.

### *3.4.3. SEEK dfdt function*

The SEEK dfdt-function runs as follows:

1. Adjusting the generator frequency until it is ≤98% of the mains frequency, then the adjustment pulse is canceled. If the generator frequency is already in this range, this first step is omitted.
2. The initial generator frequency is $f2_0$ is measured ten seconds after the first adjusting impulse. Then a Higher command f+ is issued, until the generator frequency reaches 99 %, then the adjusting command is interrupted and the adjusting command length is measured.
3. Ten seconds after the pulse end, the final generator frequency $f2_1$ is measured and $df/dt_1$ is calculated according to the following formula:

$$df/dt_1 = \frac{f2_1 - f2_0}{tpf_1}$$

4. With this $df/dt_1$ value, a Lower command $tpf_2$ is issued with the target value of 98 % of the generator nominal voltage.

5. Ten seconds after the end of the adjusting command, the generator voltage $f2_2$ is measured and $df/dt_2$ is calculated according to the following formula:

$$df / dt_2 = \frac{f2_1 - f2_2}{tpf_2}$$

6. Based on $df/dt_2$, a higher Raise command $tpf_3$ is now issued with the target value of 100 % of the generator nominal frequency.
7. Ten seconds after the end of the adjusting command, the generator frequency $f2_3$ is measured and $df/dt_3$ is calculated according to the following formula:

$$df / dt_3 = \frac{f2_3 - f2_2}{tpf_3}$$

8. The average value from $df/dt_2$ and $df/dt_3$ is now displayed as a result. If there is a deviation of more than 10% between $df/dt_2$ and $df/dt_3$, the message „Calculation may be inaccurate!“ is displayed.

## 3.5. Operating modes

| *No.* | *State* | *LED* | *Remark* |
|---|---|---|---|
| **1** | Blocked with error | **BLOCKED** & **ERROR** | An error is present, the device is blocked |
| **2** | Blocked without error | **BLOCKED** | The device is out of service, or in test mode, ie in a safe state for commissioning and maintenance.<br>Parameter values cannot be written.<br>Test operation:<br>• Operating mode TEST (configurable by means of binary in- and outputs). Test run of the synchronization, in which adjusting commands are normally synchronized, but instead of the command relay, the paralleling command is issued to a configurable relay.<br>• SEEK ton: Paralleling command is deliberately issued<br>• SEEK dUdt: Voltage adjusting commands are deliberately issued<br>• SEEK dfdt: Frequency adjusting commands are deliberately issued. |
| **3** | Blocked in setting mode | **BLOCKED & EDIT** | Setting mode: parameter values can only be changed in this state. When in state 2, state 3 can be attained with the MCP by pressing the Hand-button (the hand is in state 2 (red) or 3 (green)) |
| **4** | READY | **READY** | Operational readiness |
| **5** | Operating | **OPERATING** | Synchronizing process is running |

**IMPORTANT!**

On initial power supply, the device is in the BLOCKED state after the auxiliary voltage has been applied. The device can be set to READY state by means of the PC-Tool SynView 6, or by means of a control unit MCP (see *Chapter 3.10*). For the following supplies, the device will go directly to READY.

The start-up time from switching on the auxiliary voltage until reaching the operating state is just under one minute.

## 3.6. Operating modes of the synchronization process

The following operating modes can be distinguished:

| *Operating mode* | *Remark* |
|---|---|
| Automatic synchronization | Normal operating mode, in which SYNCHROTACT 6, after receiving the synchronization requirement (START), performs fully automatically all functions, including the closure of the circuit breaker |
| Manual synchronization | In this operating mode, SYNCHROTACT 6 is operated as synchrocheck, for monitoring purposes. The closing command is given manually or by another external device. |
| Automatic synchronization with manual release („Operator window“) | The operator must manually release the automatic paralleling command of SYNCHROTACT 6 immediately before the expected time. |
| Operating mode TEST | Is executed the same way as the “automatic synchronization”, but the paralleling command is sent to a configurable relay instead of to the command relay. |
| Sequential test | The automatic synchronization process is divided into individual functions (voltage matchers, frequency matchers etc.). These functions are executable, triggered individually and manually. This allows for example a final check of the individual functions before the first sharp synchronization. |
| Synchronization by means of a tap changer | Voltage matching by means of a tap changer and / or adaptation of the measured voltage as a function of the tap changer stage. |

### 3.6.1. Automatic synchronization

**Auxiliary voltage**
The auxiliary voltage must be permanently applied to the commissioned device.

**Selection of paralleling points and parameter sets**
The selection must be present at the device no later than 1 second after receiving START. The selection is executed immediately after receiving START (OPERATING). No selection will be executed in the READY state, regardless of the selection signal.

**Selection of synchronization (START)**
The synchronization process is started by selecting synchronization in the Ready state (READY). The device changes to the OPERATING state and begins to synchronize.

**Discarding the synchronization (STOP)**
The “STOP” command stops the running synchronization process. Normally the signal “feedback circuit breaker closed” is used as STOP signal. It is recommended to use a manual STOP signal parallel to this, which will for instance be used with a started but not succeeded paralleling condition.

### *3.6.2. Manual synchronization*

SYN 6201 and SYN 6202 can be operated as a synchrocheck by using a parameter set in which a command generation, command and frequency matcher are switched off.

The sequence with paralleling point / parameter set selection, START and STOP is then identically performed with the automatic synchronizing process, only, in this case, no voltage and frequency adjusting commands are generated. Instead of the paralleling command, a paralleling command release occurs.

If one and the same circuit breaker is alternatively closed once automatically and once manually with synchrocheck and the same synchronizer is to be used in both cases, this can be achieved by configuring the inputs and outputs. This is an example of using multiple parameter sets for the same paralleling point (see *Chapter 5.3*).

Optionally, the synchrocheck can be operated with interlock, so that the synchrocheck-release only occurs if the operator has not given the manual paralleling command. This ensures that the operator does not give the command independently of the paralleling conditions and the synchrocheck triggers the closing of the circuit breaker with its release. For this function, a free, configurable binary input (BIN01 to BIN13), which is programmed with code +46, is required. In addition to the actual paralleling command contact, the manual paralleling switch requires a second contact, which is wired to the binary input.

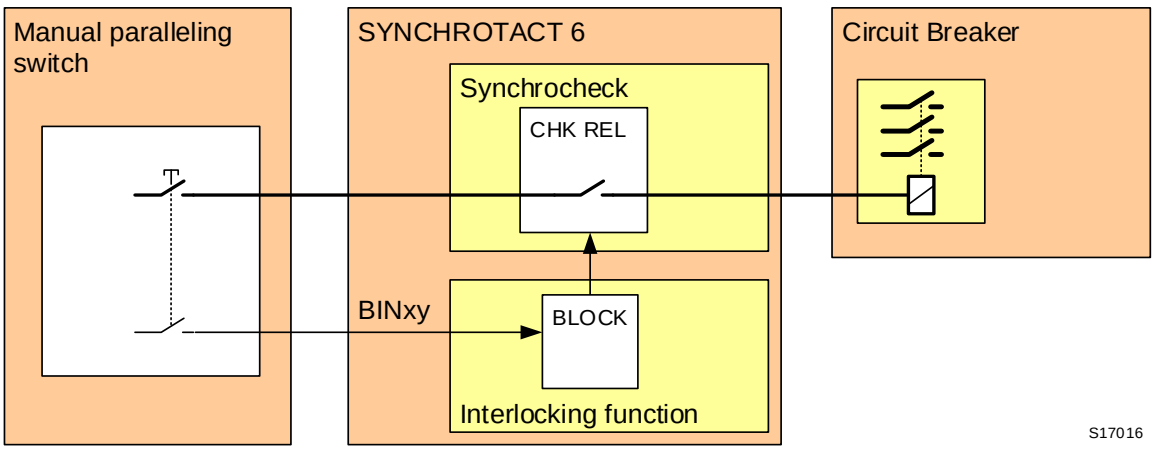



*Figure 3-15 Manual synchronization and synchrocheck with interlocking function*

### 3.6.3. Automatic synchronization with manual release („Operator window“)

With this type of synchronization, the operator („Operator“) issues a manual release of the paralleling command of SYNCHROTACT 6.

This manual release (CMD REL) must not take place before an adjustable angle window (αmax) and not later than the intended start of the paralleling command (αv). In addition, the validity of the release is limited in time (tOpWin). When the angle window is reached, either the corresponding LED on the front panel or the contact of a configurable relay output is used.

If the release is made outside of the permitted angle window (αmax < CMD REL <αv), the paralleling command is blocked. A new release can only take place if the signal of the manual release is removed.

The external manual release must have two contact pairs, one of which is connected in series with the command circuit and feeds the other to the binary input used for the manual release.

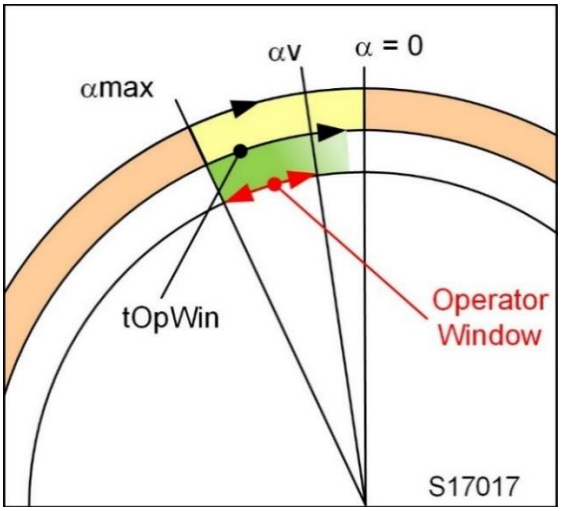



*Figure 3-16 Operator window*

### 3.6.4. Operating mode TEST

The TEST operating mode can be used to check the operability of the synchronizer by means of configurable in-/outputs. After the corresponding selection and the start signal, SYNCHROTACT 6 goes into the BLOCKED state and adjusts at the same time the generator voltage and frequency by means of adjusting commands. The paralleling command is not issued via the command relay, but via a configurable signal relay.

### 3.6.5. Sequential test

The sequential test is performed eg at the end of the commissioning works, before the first sharp synchronization is performed.

The device is already in READY state. The sequential test can now be started using SynView 6. Different test steps can be carried out successively by manual triggering. If a test step is not to be executed, this can be skipped. This enables an easier assessment of the operability of the voltage and frequency matcher, and the correct timing of the paralleling command issuing can be verified.

Overview of the individual test steps:

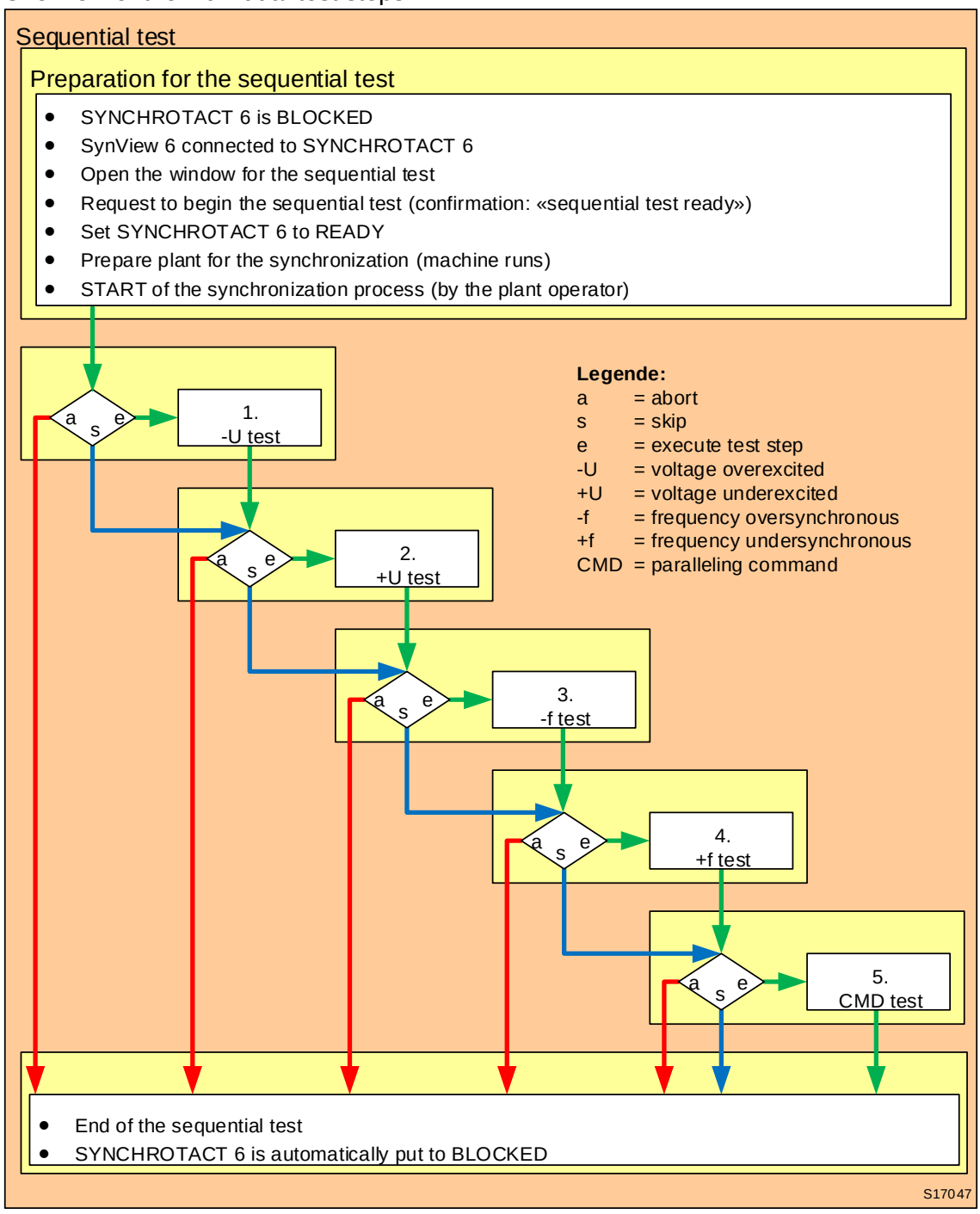



*Figure 3-17 Sequence of the sequential test*

**This is how the test steps are carried out in detail:**

**1. –U-test: voltage matcher underexcited**

The voltage matcher adjusts the generator voltage U2 to a lower value than the line voltage U1. The target value is: U2 = 2 x +ΔUmax (underexcited), but minimum +3 % and maximum +10 %. The adjustment command length required for this is calculated on the basis of the set dU/dt.

After the waiting time of ts U, the generator voltage is brought to the new target value „center of the set tolerance band“ by means of the voltage adjustment command U+.

**2. + U-test: voltage matcher overexcited**

The voltage matcher adjusts the generator voltage U2 to a higher level than the line voltage U1. The target value is: U2 = 2 x -ΔUmax (overexcited), but minimum -3 % and maximum -10 %. The adjustment command length required for this is calculated on the basis of the set dU/dt.

After the waiting time of ts U, the generator voltage is brought to the new target value „center of the set tolerance band“ by means of the voltage adjustment command U-.

**3. –f-test: frequency matcher undersynchronous**

The frequency matcher adjusts the generator frequency f2 to a lower value than the line frequency f1. The target value is: f2 = 2 x +smax (undersynchronous), but minimum +0.4 % and maximum +1 %. The adjustment command length required for this is calculated on the basis of the set df/dt.

After the waiting time of ts f, the generator frequency is brought to the new target value "center between the slip limit +smax and zero" by means of the frequency adjustment command f+.

**4. +f-test: frequency matcher oversynchronous**

The frequency matcher adjusts the generator frequency f2 to a higher value than the line frequency f1. The target value is: f2 = 2 x -smax (oversynchronous), but minimum -0.4 % and maximum -1 %. The adjustment command length required for this is calculated on the basis of the set df/dt.

After the waiting time of ts f, the generator frequency is brought to the new target value "center between the slip limit -smax and zero" by means of the frequency adjustment command f-.

**5. CMD-test: Paralleling command issue**

After confirmation of this test step, a paralleling command is output.
The paralleling conditions must be fulfilled for that purpose. This is the case if the previous test steps were carried out successfully. The result is recorded in the transient recorder and can be checked there.

### *3.6.6. Synchronizing with tap changer*

The tap changer control consists of two sub-functions:

1. Voltage matching for tap changers TVM (Tap changer Voltage Matcher). See also *Chapter 3.2.6.*

2. Transformer tap indication for the adaptation of the voltage measurement TTI (Transformer Tap Indication). See below and also *Chapter 3.2.5 Adjustment of the voltage measurement, depending on a coded value*.

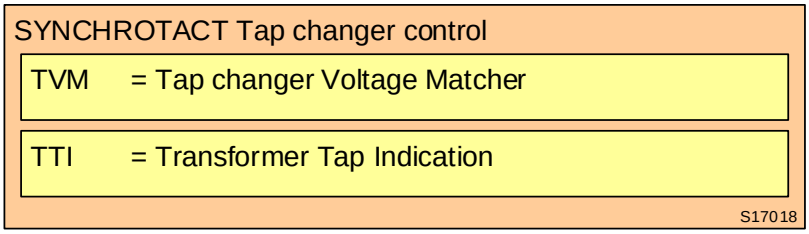



*Figure 3-18 Tap changer control*

Depending on the application, one of both, or both sub-functions are used.

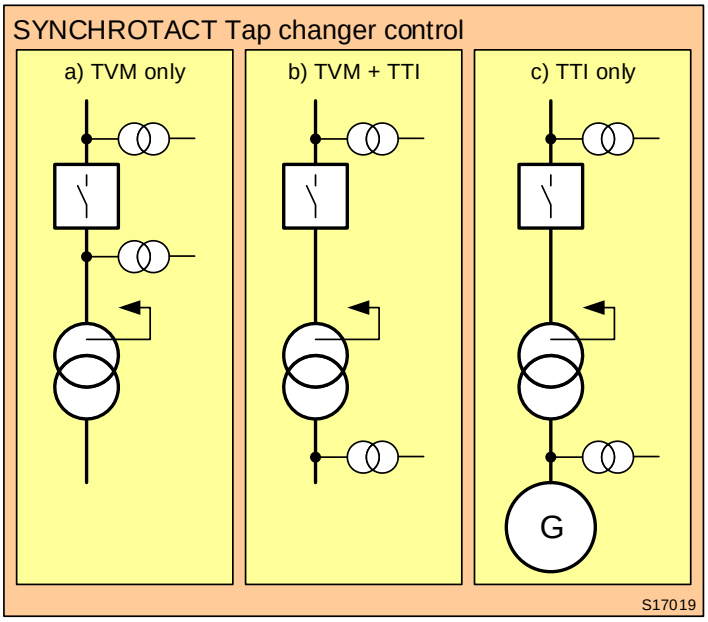



*Figure 3-19 Tap changer control: Use of sub-functions*

a) The voltage transformers measure directly at the circuit breaker, therefore the measuring voltage does not have to be adjusted (= no TTI required). Since however two lines must be synchronized, the TVM function is used for voltage matching.

b) A tap changer is located between the circuit breaker and the voltage transformer. The TTI function is used to adjust the voltage measurement. The TVM function is again used for voltage matching.

c) As with b), the TTI function must be used to adjust the voltage measurement. Normal adjusting commands are sent to the generator voltage regulator for voltage matching.

**Transformer Tap Indication (TTI)**

The transformer tap indication TTI reads and decodes the active tap of a tap changer and allows the voltage measurement to be adjusted on the basis of this value.

TTI can be divided into the following function blocks:

1. Switch on TTI
2. Read and decode the tap
3. Adjust the measuring voltage, depending on the active tap

4. Calculate and display the tap number

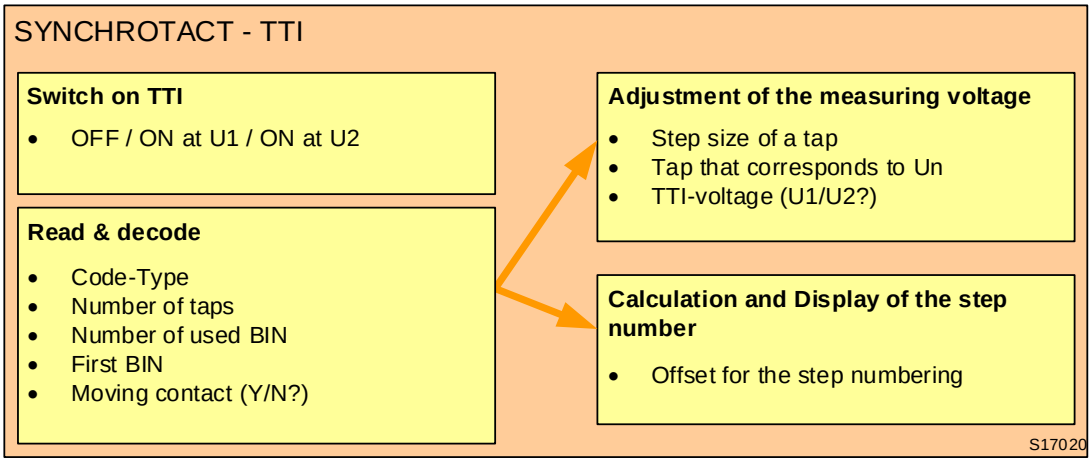



*Figure 3-20 TTI-function blocks*

**Switch on TTI:**
In order to be able to use the TTI function, it must first be switched on and secondly it must be determined on which of the two measuring voltages (U1 or U2) it should act.

**Read and decode:**
For decoding, a selection between different types of code is possible:

1. Natural BCD code “Natural BCD”
   Each digit of a decimal number is represented by a 4-bit binary code according to the following table:

| Decimal | Binary |
|---|---|
| 0 | 0000 |
| 1 | 0001 |
| 2 | 0010 |
| 3 | 0011 |
| 4 | 0100 |
| 5 | 0101 |
| 6 | 0110 |
| 7 | 0111 |
| 8 | 1000 |
| 9 | 1001 |

Example:
38 = 0011.1000

**NOTE!**

The value "0", that is, all the binary inputs without signal that are used for decoding, cannot be used.

As long as the decimal number does not exceed the value 9, the BCD code corresponds to the binary code.

2. “Binary” code
   The binary code corresponds to the translation of a decimal number into its binary value. The quantity of numbers that can be represented with this is $2^{bit}$:

| Decimal | Binary |
|---|---|
| 1 | 1 |
| 2 | 10 |
| 3 | 11 |
| 4 | 100 |
| 5 | 101 |
| 6 | 110 |
| 7 | 111 |
| 8 | 1000 |
| 9 | 1001 |
| 10 | 1010 |
| 11 | 1011 |
| 12 | 1100 |
| 13 | 1101 |
| 14 | 1110 |
| 15 | 1111 |
| 16 | 10000 |
| … | … |

3. 1-of-n
   Every decimal number is represented by an active bit (“one-hot-bit”). The quantity of decimal numbers that can be represented is equal to the number of bits:

| Decimal | Binary |
|---|---|
| 1 | 00000001 |
| 2 | 00000010 |
| 3 | 00000100 |
| 4 | 00001000 |
| 5 | 00010000 |
| 6 | 00100000 |
| 7 | 01000000 |
| 8 | 10000000 |

4. Individual coding „Custom“

   On request, further individual coding is possible. However, such solutions require additional configuration effort.

   The binary inputs that are used for decoding must be consecutive (eg, BIN04, BIN05 and BIN06). The required number depends on the number of taps and the selected code type.

   In order for the selected voltage to be adapted correctly due to the tap, the step size between two taps and which tap corresponds to the nominal voltage must be indicated.

In practice, for the tap numbering of the transformer tap, often not “1” for the smallest and “n” for the largest tap is used, but “-n/2” for the smallest tap, “0” for the nominal value and “+n/2” for the largest tap. The tap indication can therefore be set with param. 77 “Offset”.

If a moving contact is used to indicate the reaching of a new tap, an additional binary input is required. The moving contact is a normally closed contact, which remains closed until it is confirmed by opening a new tap. From then on, SYNCHROTACT 6 takes the values of the new tap.

**Example of a TTI programming:**
A tap changer with 7 taps is installed between the circuit breaker and the voltage measurement U2. The tap in the middle represents the nominal voltage and must be called Tap „0“. The tap indication of the tap changer is made in the natural BCD code. There is no moving contact.
On the SYNCHROTACT 6 – device, the free binary inputs starting from BIN08 should be used.

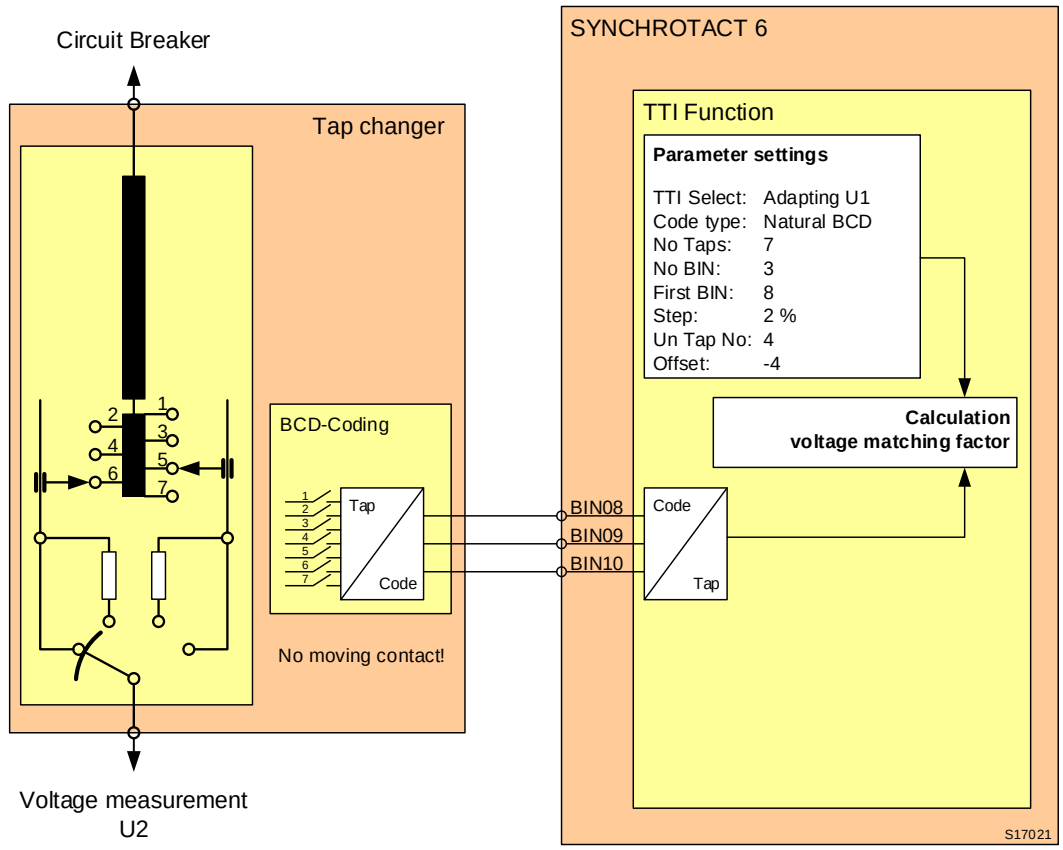



*Figure 3-21 Example of TTI-Programming*

## 3.7. Monitoring and Diagnosis of the synchronizer

SYNCHROTACT 6 includes extensive monitoring and diagnostic functions:

**Auxiliary voltage**: The internally stabilized (reference) voltages are monitored. In the case of impermissible deviations, the device is immediately blocked with a corresponding fault indication. A failure of the auxiliary voltage is reported via a quiescent contact (ERROR).

The **program sequence** is interrupted and reset by an internal watchdog when an error occurs. After the reset, the system automatically restarts.

**Paralleling command circuits**: Contact monitoring permanently compares the position of the command contacts with their control signals (CMD and CH2 REL). If a discrepancy is detected, contact monitoring activates and sets the device to the "ERROR" state with the corresponding error message. By appropriately configuring the binary outputs, this signal is available externally so that the control circuit can be blocked. This function is also used to monitor the internal circuits for short circuits.

The internal fault and event memory records when each relay has been opened and closed.

A **monitoring of external workflows** provides information and indications of the possible cause if the synchronization is not successful. As a criterion, when synchronization was not successful, the following options are available:

- An adjustable time after START of the synchronization process (parameter t tot = 1 to 15 minutes)
- An adjustable time after a paralleling command (parameter t stop = 1 to 30 seconds)
- Both of the above criteria

As required, each of the two criteria can be individually switched off, or both together. In the latter case, this monitoring is out of operation.

By means of a third parameter „EffectSel“, it is possible to set how the device should behave when one of the above-mentioned criteria is fulfilled, either:

- Abort of the synchronization process with display of relevant events (ERROR), eg non-fulfilled conditions of the external control or the measuring signals. The device is blocked in such a state. It can only be used again after a reset for further synchronization attempts. The reset can be remote-controlled via a binary input or via the communication interface.
- Abort of the synchronization process (STOP), without any further indication of the cause of the problem. The device is ready for another attempt.

The **dual-channel device SYN 6202** guarantees a fault-proof safety which complies with the requirements of SIL2 according to IEC61508. The diverse structure, with different computer types in the individual channels with different software and separate command relays, forms a fault-tolerant system and minimizes the spread of systematic errors.

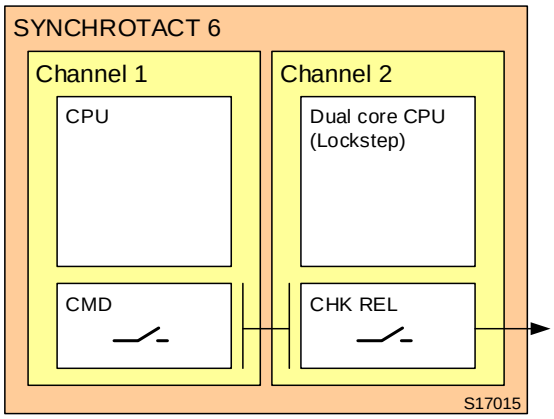



*Figure 3-22 Dual channel safety concept*

Channel 2 is already a fault-tolerant system in itself, through the use of a dual core CPU, which operates in the lockstep process.

This concept is supported by comprehensive diagnostic functions:

- Self-monitoring of processor and memory (BIST)
- Hardware support of the memory protection by a memory protection unit (MPU)
- Detect and correct corrupt programs and data by using error correction code (ECC) in all memories. The evaluation is carried out in the processor.
- Diagnostic function for checking the match of the selection at the binary inputs BIN01 to BIN06 and selecting the corresponding output relay BOUT01 to BOUT06 for the paralleling point selection.
- Diagnostic function for checking the match of the selections in channel 1 and in channel 2.

## 3.8. Saved Data

The parameter values are permanently stored in the non-volatile memory, free of influences caused by aging or failure of the auxiliary voltage. The parameter settings can only be changed by means of write commands.

The event memory and transient recorder data are lost after a certain time if the auxiliary voltage fails. While the data is kept for several years in the device new state, this time is shortened during the life of 20 to 25 years and by the influence of temperature only insignificantly.

The internal real-time clock (RTC) can hold the time and date in new condition for approx. 30 days. Typically, a minimum storage period of 20 days can be assumed.

## 3.9. Time synchronization

The clock in the SYNCHROTACT 6 device is used for the date and time stamp of the event memory and the transient recorder.

There are two ways to synchronize with an external clock:

- Relative synchronization with pulses (pulse synchronization): With SynView 6, the time can be transferred once to the device. Either the system time of the connected PC, or a manual time can be selected. The relative synchronization prevents the time drifting by means of periodic pulses. A free binary input BIN01 to BIN13 can be used as the pulse input.

- Absolute synchronization SNTP using the IEC 61850-interface (option).
  This time synchronizing method must be enabled using SynView 6 ("Enable").

**NOTE!**

The SNTP time synchronization can also be operated without an IEC 61850 network. However, a communication module (electrical or optical) which is available as an accessory, is necessary for connection.

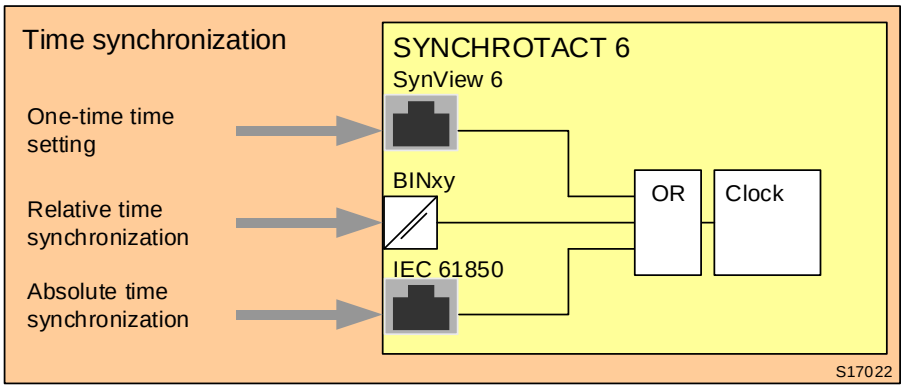
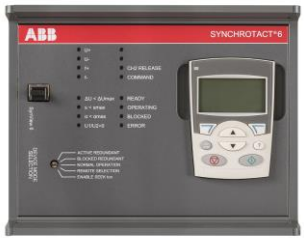



*Figure 3-23 Time synchronization*

## 3.10. Control options

SYNCHROTACT 6 distinguishes between service and operation:

**Maintenance control** for commissioning and maintenance:
1. Control on the device using the MCP (Maintenance Control Panel):

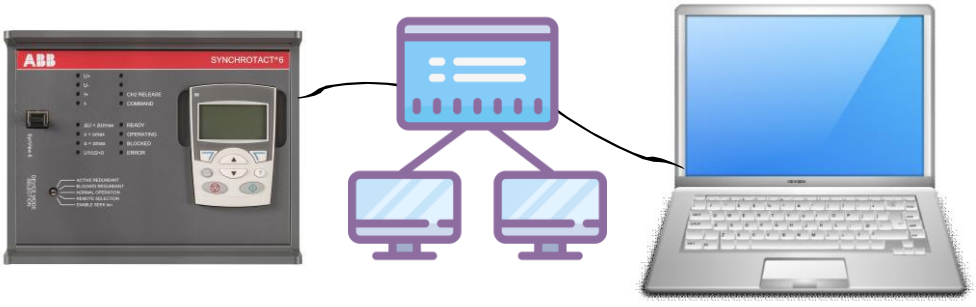



S17023

2. Control via PC (SynView 6) on site: direct connection SYNCHROTACT – PC


S17024

3. Remote control by means of PC (SynView 6): via the network and IEC 61850-interface. If the IEC 61850 option is not used, an optional communication module is required.




S17025

**Operation control** for the normal synchronization mode:
1. Conventional operation by means of wired control circuits (standard)
2. Remote control by means of PC: via network and optional operating interface (IEC 61850, Modbus, or Profibus)
3. Remote display of synchronizing instruments via SynView 6 Actual value module (communication module required if IEC 61850 - option is not selected)

## 3.11. Transmitted signals via communication interfaces

### 3.11.1. Maintenance interface

The maintenance interface is operated using SynView 6. The transmitted information is therefore identical to the SynView 6-functions. These are essentially:

- Parameter setting values (read and write)
- Prepare and block device, acknowledge errors
- Read out actual values
- Read and display disturbance recorder data (transient recorder)
- Read and display trending data
- Read event memory and diagnostic data

### 3.11.2. Fieldbus operating interface

The data relevant for normal operation are transmitted using the operating interface:

- Writing to binary inputs (START, STOP, Release DB, selection of parameter sets and paralleling point, all configured input signals)
- Reading of the binary outputs (ERROR, READY, OPERATING, U+, U-, f+, f-, feedback of paralleling point selection, all configured output signals)
- Reading of the status indications ($\Delta U < \Delta Umax$, $s < smax$, $\alpha < \alpha max$, U1/U2=0, COMMAND, CHK RELEASE, BLOCKED)
- Reading of the actual values ($\Delta U$, $\alpha$, s, U1, U2, f1, f2, ds/dt, selected parameter set, software version, command counter)

### 3.11.3. IEC 61850 - Operating interface

To the above functions of the operating interface, the following possibilities are added to the IEC 61850 interface:

- Reading of the disturbance recorder data (transient recorder) in the COMTRADE-Format
- Time signal for SNTP time synchronization (also possible without IEC 61850 option)

# Chapter 4 - Hardware construction

## 4.1. Type code for devices

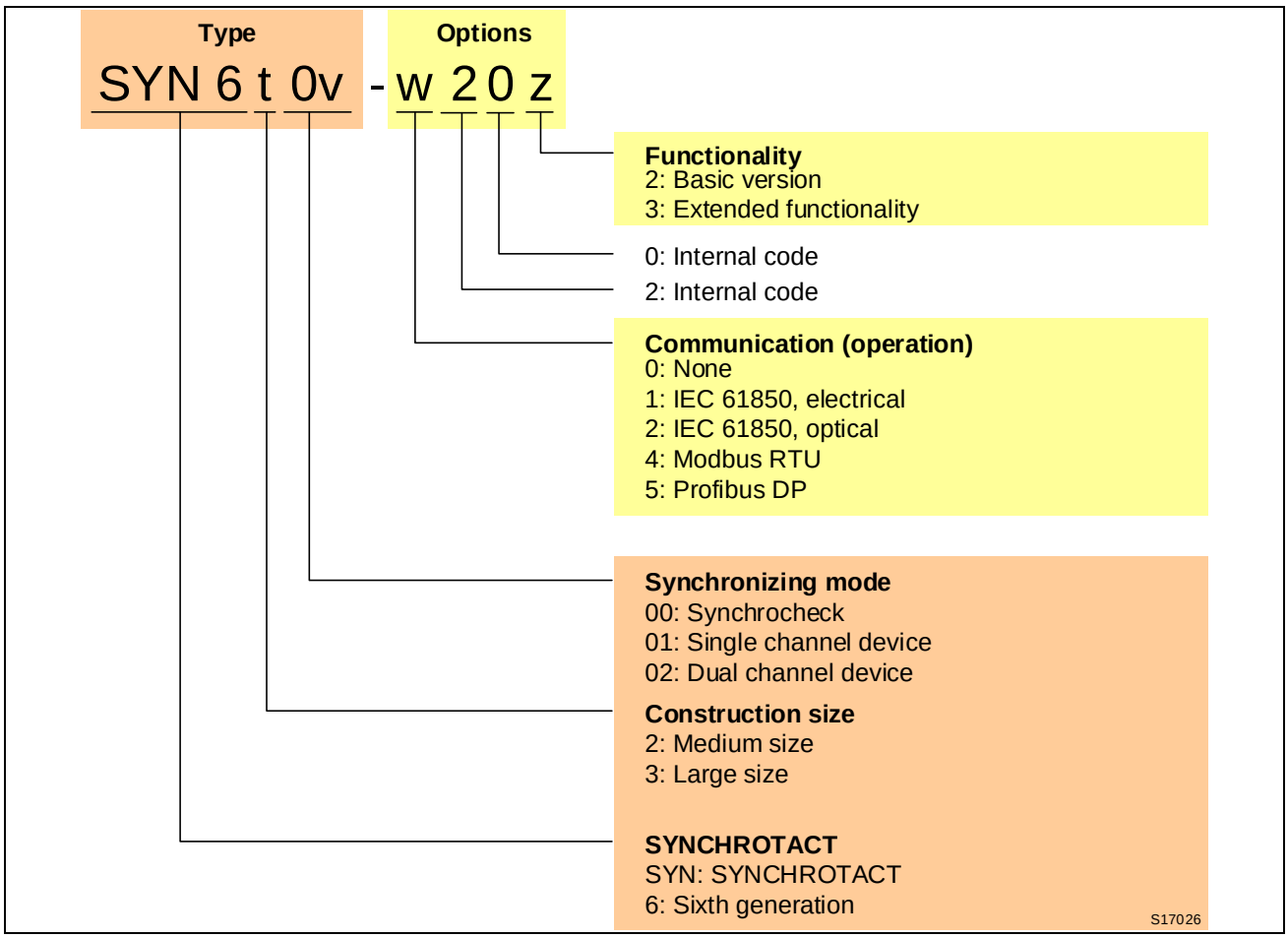



*Figure 4-1 Type code for devices*

## 4.2. Device front

The front side of the device SYN 6201 or SYN 6202 features the LED status display, the maintenance control MCP, the device mode selector switch and the SynView 6 interface.


*Figure 4-2 Device front SYN 6201 or SYN 6202*

### 4.2.1. LED Status display

The LED Status display consists of 4 blocks that display the following factory default states:

| LED | Symbol | Function |
|---|---|---|
| 01 | U+ | Display of the output of Raise and Lower commands for voltage and frequency. |
| 02 | U- | |
| 03 | f+ | |
| 04 | f- | |

| | | |
|---|---|---|
| 05 | $\Delta U < \Delta U max$ | Display of $\Delta U$, s and $\alpha$ in the tolerance band, or at least one measuring voltage is missing |
| 06 | s < smax | |
| 07 | $\alpha < \alpha max$ | |
| 08 | U1/U2 = 0 | |

| | | |
|---|---|---|
| 09 | | Factory setting: no function assignment for LED09 and LED10 |
| 10 | | |
| 11 | CH2 RELEASE | Paralleling command release channel 2 (only for SYN 6202) |
| 12 | COMMAND | Paralleling command release channel 1 |
| | | |
| xx | READY | Display ready for operation (LED not configurable) |
| xx | OPERATING | Display synchronization process running (LED not configurable) |
| 13 | BLOCKED | Display device blocked, eg during commissioning |
| xx | ERROR | Display fault in device or externally (LED not configurable) |

The functions of LEDs 01 to 13 can be changed individually. For labeling, self-adhesive labels 70 x 29.7 mm are recommended (e.g., Herma 4456 or Zweckform 3489). The Documentation Memory Stick features a template that facilitates printing.

### *4.2.2. Built-in control for maintenance purposes MCP*

Using MCP, all manipulations such as viewing/changing parameters, viewing actual values can be performed. It consists of the following parts:

- MCP Status LED
- Display
- Keyboard


*Figure 4-3 MCP*

**MCP Status LED**
The MCP status LED differentiates between normal operation (green), alarm or error states (flashing green or red) of the SYNCHROTACT 6 – device.

**Display**
A liquid crystal display (LCD) is used as a display for parameter values, actual values and events. This consists of 3 zones:

- Header: Displays the editing mode and information for navigating the menu.
- Main field: Main information, such as actual values, parameter values and events
- Footer: actual function of the menu keys

Example of the LCD display:


*Figure 4-4 LCD-Display*

**Keyboard**
The keyboard consists of 8 keys and is protected by a code (key combination) against unintended access (decommissioning). Reading is possible any time.

Basic functions:

| *Key* | | *Function* |
|---|---|---|
| Move up,<br>Move down |  | Move in the menu and increase/decrease values. |
| Menu buttons |  | Selection of functions, parameters etc.;<br>Display of the actual function in the LCD footer. |
| REM/LOC |  | No function with SYNCHROTACT 6 |
| ? |  | Display of the software version of the MCP |
| Confirmation buttons |  | To confirm setting values, states etc.. |

**IMPORTANT!**

As an alternative to the MCP, all commissioning and maintenance work can be carried out conveniently with a PC and the SYNCHROTACT 6-PC-Tool SynView 6. The connection is done via Ethernet interface. The description of SynView 6 can be found in C*hapter 8.2*, or more detailed in document 3BHS840044 D80.

### *4.2.3. Device mode selector switch*

The device selector switch is operated by means of a screwdriver and fulfills two functions:

- Selection of the operating mode in the redundant system (only SYN 6302)
- Preselection of the execution of the SEEK ton function during commissioning

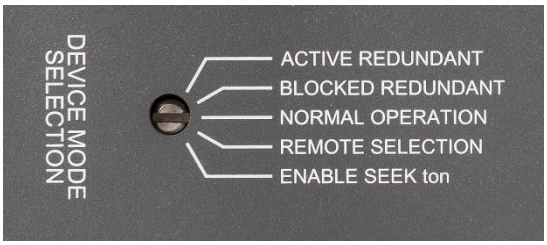



*Figure 4-5 Device selector switch*

**NOTE!**

For the devices SYN 6201 and SYN 6202 that are described in this document, the device mode selector switch must always be in the position „NORMAL OPERATION“ except for the execution of „SEEK ton“ during commissioning.

### 4.2.4. SynView 6 interface

An Ethernet interface (RJ45 connector) is provided on the front for the connection of SynView 6.

It is connected in parallel via an internal switch with the SynView 6 interface on the rear panel. Depending whether the work takes place in the area in front or behind the device, the one or the other interface will be preferred.

Both interfaces have the same fixed TCP-IP address and can therefore be operated in parallel. A parallel operation is however only possible without problems as long as the device is not set to the setting mode (State 3 according to *Chapter 3.5*). In the setting mode with several connection sources, conflicts can occur.

## 4.3. Device back panel

The electrical connections are attached at the rear with screw-in connections and spring-loaded terminals.

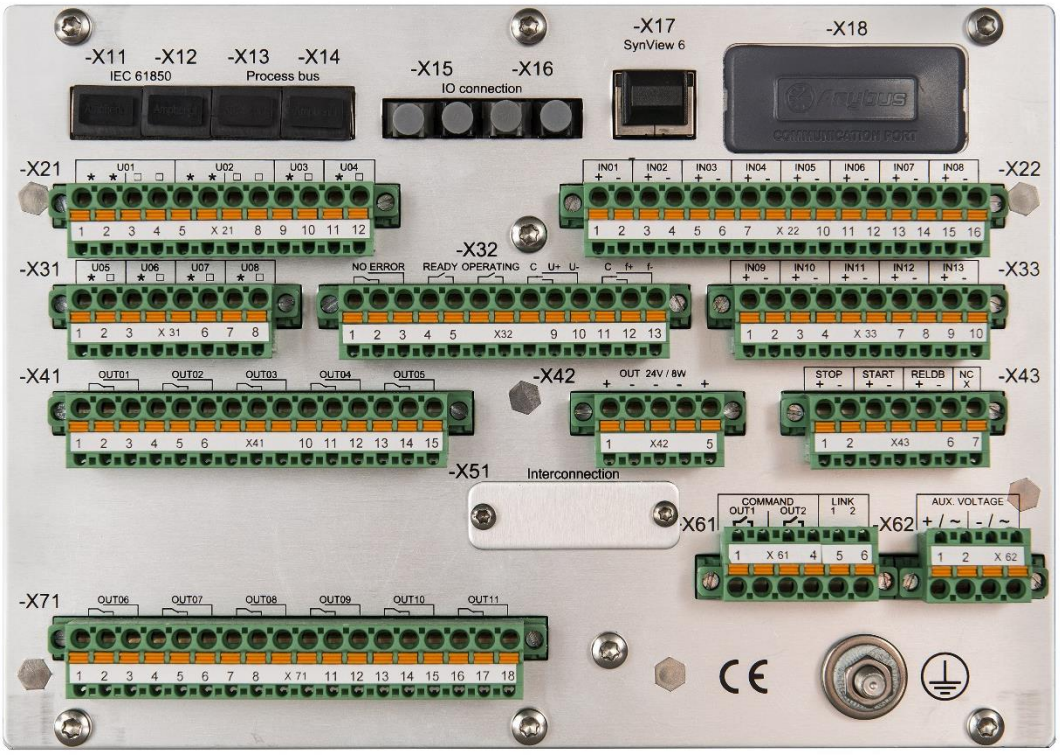



*Figure 4-6 Device back panel*

### 4.3.1. Measurement inputs –X21 and –X31

A total of 8 analog hardware measurement inputs are available. By parameter setting, these can be assigned to the software inputs in the parameter sets. This also applies to the second channel of dual channel devices SYN 6202.

### 4.3.2. Paralleling command output –X61

The command output is actuated by one safety relay per channel with forcibly guided contacts. The relay contacts of SYN 6202 channels 1 and 2 are internally wired in series and are passed to one connector.

### 4.3.3. Binary inputs and outputs

All inputs and outputs are potential-isolated from one another and from the electronics.

### 4.3.4. SynView 6 interface –X17

An Ethernet interface (RJ45 connector) is provided on the back for the connection of SynView 6.

It is connected in parallel via an internal switch with the SynView 6 interface on the front panel. Depending whether the work takes place in the area in front or behind the device, the one or the other interface will be preferred.

Both interfaces have the same TCP-IP address and can therefore be operated in parallel. A parallel operation is however only possible without problems as long as the device is not set to the setting mode (State 3 according to *Chapter 3.5*) In the setting mode with several connection sources, conflicts can occur.

### 4.3.5. Terminals for the device selector controls „Interconnection“–X51

This terminal is not used with the device types SYN 6201 and SYN 6202.

### 4.3.6. Optical communication connections „IO connection“–X15 and –X16

Serves the connection of external peripheral devices, eg analog outputs.

### 4.3.7. Communication terminals of the operating remote control –X11…-X14, -X18

The slots, top left and right, can be equipped with optional communication modules. On the left there are 4 slots –X11 to –X14 for the IEC 61850 interfaces. The slot –X18 on the right hand side can be equipped with Modbus RTU or Profibus DP communication modules (for information on available connector types, see *Chapter 11.3.3*).

# Chapter 5 - Parameters, actual values, events

## 5.1. Overview

### 5.1.1. Menu structure of the local operation MCP

The menu is divided into three main levels:

- Parameters (adjusting parameters and actual values) „PARAMETERS“
- Event memory „EVENT LOGGER“
- SEEK-functions (in order to determine project-specific adjusting parameters) „SEEK“

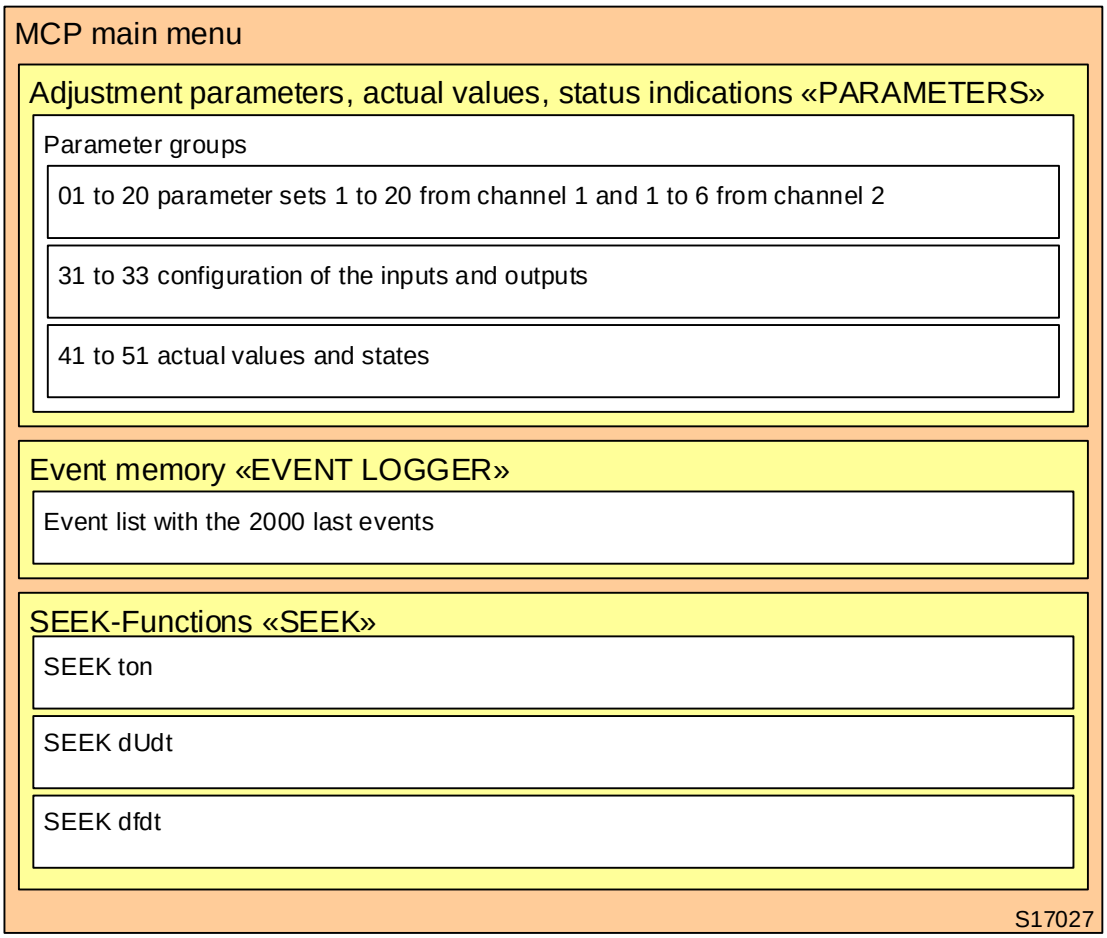



*Figure 5-1 MCP menu structure*

### *5.1.2. Parameter grouping and numbering*

The parameters (setting parameters and actual values, respectively status displays) are numbered in groups on two different levels.
A setting parameter is clearly displayed in the MCP with 4 digits (a, b, c and d) and a nickname (“MCP parameter name”). The numbers have the following meaning:

| ***Digit*** | ***ab*** | ***c*** | ***d*** |
|---|---|---|---|
| ***Meaning*** | Group of level 1 | Group of level 2 | Parameter number within the group |

**Example: 0101 Un**

| | | | |
|---|---|---|---|
| 01 | 0 | 1 | Un |
| Parameter set 1 | Channel 1 measurement | First parameter | MCP parameter name |

**IMPORTANT!**

**Group name of level 1:**
In SynView 6, the group names are displayed in the selected language; in the MCP, they are displayed language-independent (English-based). The following table lists both names, with the non-verbal characters enclosed in quotation marks.

**Group name of level 2:**
The names appear only in the PC-Tool SynView 6. The MCP shows only the group number.

**Table of the parameter groups:**

| ***Level 1: Group number and name*** | | ***Parameter type*** |
|---|---|---|
| | ***Level 2: Group number and name*** | |
| **01…20 parameter sets 1 to 20 „parameter set 1“ to „parameter set 20“** | | **Setting parameter** |
| | 0 Channel 1 measurement | |
| | 1 Command generation | |
| | 2 Channel 1 paralleling conditions | |
| | 3 Channel 1 dead bus-conditions | |
| | 4 Voltage matchers | |
| | 5 Frequency matchers | |
| | 6 Time indications | |
| | 7 Channel 1 TTI-parameters (Transformer tap) | |
| | 8 Channel 2 measurement | |
| | 9 Channel 2 paralleling conditions | |
| **31 Configuration binary inputs „Config of BIN“** | | |
| **32 Configuration binary outputs „Config of BOUT“** | | |
| **33 Configuration operational interface (only SynView 6)** | | |
| **41 Selection of paralleling point/parameter set „Selection“** | | **Actual values and status displays** |
| **42 Measuring value „Actual values“** | | |
| **43 Program counter „Command counters“** | | |
| **44 Status displays and operational elements in SynView 6** | | |
| **45 Status of the SEEK- and TEST-functions „SEEK“** | | |
| **46 Status displays and operational elements in SynView 6** | | |
| **47 Configuration disturbance recorder (only SynView 6)** | | |
| **48 Display of IP address** | | |
| **51 Transformer tap display „TTI“** | | |

### 5.1.3. Parameter sets 1...20

In the basic version, there are 2 parameter sets in channel 1; 20 parameter sets are available as an option. For channel 2, there are 6 parameter sets available.
The parameters of channel 1 and channel 2 are accommodated in the same parameter set. That is, the parameters of channels 1 and 2 are contained in the parameter sets 1 to 6, whereas in parameter sets 7 to 20 only the parameters of channel 1 are contained. In the factory settings, parameter sets 11 to 20 differ from parameter sets 1 to 10 because they are prepared for synchrocheck.
Each parameter is preceded by:

- Indication to which parameter set the parameter belongs, eg „ParSet1“
- Indication to which channel the parameter belongs. eg „CH1“

***01…20 Parameter sets 1...20 „Parameter set 1…Parameter set 20“***

**0 Channel 1 Measurement**

| MCP Parameter name | Parameter name | Symbol | Range / Step size | Unit | Factory setting all parameter sets |
|---|---|---|---|---|---|
| 01 Un | Nominal voltage | Un | 50...130 | VAC | 110 |
| 02 UnPrimary | Primary nominal voltage | UnPrim | 0.3…1000.0 | kV | 10 |
| 03 fnSel | Nominal frequency | fn | 16.7 / 50 / 60 | Hz | 50 |
| 04 U1/U2 | Voltage ratio | U1/U2 | 0.20…5.00 | [1] | 1.00 |
| 05 alphaOffset | Angle tuning | αOffset | ±180 | DEG | 0 |
| 06 AINSelU1 | Channel 1 selection analog input for U1 | AINSelU1 | 1…8 | - | 1 |
| 07 AINSelU2 | Channel 1 selection analog input for U2 | AINSelU2 | 1…8 | - | 2 |
| 08 NoPh | Number of used analog inputs | NoAIN | 1. 2. 3 | - | 1 |

**1 Command generation**

| MCP Parameter name | Parameter name | Symbol | Range / Step size | Unit | Factory setting all parameter sets | |
|---|---|---|---|---|---|---|
| | | | | | **1…10** | **11…20** |
| 10 CmdGen_On | Command generation ON/OFF | CMDGen | OFF / ON | - | ON | OFF |
| 11 tOn | Paralleling time | t on | OFF, 1...999 | ms | 100 | 100 |
| 12 tpOn | Paralleling command duration | tp on | 50...999 | ms | 999 | 999 |
| 13 tSupC | Monitoring time synchronous | t supC | OFF, 0...99 | s | OFF | OFF |
| 14 tSupD | Monitoring time no voltage | t supD | OFF, 0...99 | s | 10 | 10 |
| 15 tSupS | Mon. time synchr. + angle drift | t supS | OFF, 0...99 | s | OFF | OFF |
| 16 MultCmd_On | Multiple commands | MULTIPLE CMD | OFF / ON | - | OFF | OFF |
| 17 tOpWin | Expiration time for „Operator Window“ | tOpWin | OFF 0.1 …6.2 | s | OFF | OFF |

**2 Channel 1 paralleling conditions**

| MCP Parameter name | Parameter name | Symbol | Range / Step size | Unit | Factory setting all parameter sets | |
|---|---|---|---|---|---|---|
| | | | | | **1..10** | **11…20** |
| 20 –sMax | Slip limit over-synchronous | -smax | 0.000...6.000 | % | 0.4 | 0.2 |
| 21 +sMax | Slip limit under-synchronous | +smax | 0.000...6.000 | % | 0.4 | 0.2 |
| 22 –alphaMax | Angle limit negative | -αmax | 0.0...99.9 | DEG | 10 | 10 |
| 23 +alphaMax | Angle limit positive | +αmax | 0.0...99.9 | DEG | 10 | 10 |
| 24 –DUmax | Max. voltage difference over-excited | -ΔUmax | 0.0...40.0 | % | 3 | 3 |
| 25 +DUmax | Max. voltage difference under-excited | +ΔUmax | 0.0...40.0 | % | 3 | 3 |
| 26 UMax | Maximum voltage | Umax | 105...130 | % | 120 | 120 |
| 27 UMin | Minimum voltage | Umin | 50...95 | % | 80 | 80 |
| 28 dalpha/dt_Max | Synchronous detection limit | dα/dtmax | 1.0…5.0 | DEG/s | 1.8 | 1.8 |

**3 Channel 1 dead bus-conditions**

| MCP Parameter name | Parameter name | Symbol | Range / Step size | Unit | Factory setting all parameter sets |
|---|---|---|---|---|---|
| 30 U0Max | Maximum zero voltage | CH1 U0max | 0...49 | % | 5 |
| 31 U1not_Rel | Release U1 = voltage-free | U1not | OFF/ON | - | OFF |
| 32 U2not_Rel | Release U2 = voltage-free | U2not | OFF/ON | - | OFF |
| 33 U1*U2not_Rel | Release U1 und U2 = voltage-free | U1*U2not | OFF/ON | - | OFF |
| 34 ExclDB_On | „Exclusive dead bus“ - function | ExclDB | OFF/ON | - | OFF |

## 4 Voltage matchers

| MCP Parameter name | Parameter name | Symbol | Range / Step size | Unit | Factory setting parameter sets **1…10** | **11…20** |
|---|---|---|---|---|---|---|
| 40 dU/dt | Voltage adjustment characteristic | dU/dt | OFF. 0.01...5.00 | %/s | 0.33 | OFF |
| 41 tsU | Pulse interval | ts U | 1...20 | s | 2 | 2 |
| 42 tpUmin | Minimum pulse time | tp Umin | 0.05...10.00 | s | 0.05 | 0.05 |
| 43 InvU_On | Switchover to variable pauses | INVERSE U | OFF/ON | - | OFF | OFF |
| 44 TapCh_On | Switchover to tap changer matcher | TVM | OFF/ON | - | OFF | OFF |

## 5 Frequency matchers

| MCP Parameter name | Parameter name | Symbol | Range / Step size | Unit | Factory setting parameter sets **1…10** | **11…20** |
|---|---|---|---|---|---|---|
| 50 df/dt | Frequency adjustment characteristic | df/dt | OFF. 0.01...5.00 | %/s | 0.20 | OFF |
| 51 tsf | Pulse interval | ts f | 1...120 | s | 20 | 20 |
| 52 tpfmin | Minimum pulse time | tp fmin | 0.05...10.00 | s | 0.05 | 0.05 |
| 53 Invf_On | Switchover to variable intervals | INVERSE f | OFF/ON | - | OFF | OFF |

## 6 Time indications

| MCP Parameter name | Parameter name | Symbol | Range / Step size | Unit | Factory setting all parameter sets |
|---|---|---|---|---|---|
| 60 tBlock | Lockout period after START | t block | 1...10 | s | 2 |
| 61 tTot | Abort after START | t tot | OFF. 1...15 | min | 5 |
| 62 tStop | Abort after CMD | t stop | OFF. 1...30 s | s | OFF |
| 63 EffectSel | Effect of abortion | EffectSel | STOP. ERROR | - | ERROR |

## 7 Channel 1 TTI-Parameters (tap changer)

| MCP Parameter name | Parameter name | Symbol | Range / Step size | Unit | Factory setting all parameter sets |
|---|---|---|---|---|---|
| 70 TTISel | TTI-function ON / OFF | CH1 TTI Select | OFF<br>Adapting U1<br>Adapting U2 | - | OFF |
| 71 TTI_codeType | Code type | Code type | Natural BCD<br>Binary<br>1-of-n<br>Custom | - | Natural BCD |
| 72 TTI_NoOfTaps | Number of taps | No Taps | 1…63 | - | 1 |
| 73 TTI_NoOfBINSel | Number of used BIN | No BIN | 1…13 | - | 1 |
| 74 TTI_FirstBINSel | 1. used BIN for decoding | First BIN | 1…13 | - | 1 |
| 75 TTI_Step | Step size between two taps | Step | 0.1…10.0 | % | 1 |
| 76 TTI_UnTapNr | Level that corresponds to the nominal value | Un Tap No | 0…63 | - | 0 |
| 77 TTI_IndOffset | Offset for the tap numbering | Offset | -63…+63 | - | 0 |

## 8 Channel 2 Measurement (only SYN 6202)

| MCP Parameter name | Parameter name | Symbol | Range / Step size | Unit | Factory setting parameter sets **1..6** |
|---|---|---|---|---|---|
| 80 CH2_Un | Nominal voltage | Un | 50...130 | VAC | 110 |
| 81 CH2_fnSel | Nominal frequency | fn | 16.7 / 50 / 60 | Hz | 50 |
| 82 CH2_U1U2 | Voltage ratio | U1/U2 | 0.20…5.00 | [1] | 1 |
| 83 CH2_alphaOffset | Angle tuning | αOffset | ±180 | DEG | 0 |
| 84 CH2_AINSelU1 | Channel 2 selection analog input for U1 | AINSelU1 | 1…8 | - | 1 |
| 85 CH2_AINSelU2 | Channel 2 selection analog input for U2 | AINSelU2 | 1…8 | - | 2 |

## 9 Channel 2 Paralleling conditions (only SYN 6202)

| MCP Parameter name | Parameter name | Symbol | Range / Step size | Unit | Factory setting parameter sets **1..6** |
|---|---|---|---|---|---|
| 90 CH2_sMax | Channel 2 slip limit | smax | 0.000...6.000 | % | 0.45 |
| 91 CH2_alphaMax | Channel 2 angle limit | αmax | 0.0...99.9 | DEG | 15 |
| 92 CH2_DUMax | Channel 2 max. voltage difference | ΔUmax | 0.0...40.0 | % | 4 |
| 95 CH2_U0Max | Channel 2 maximum zero voltage | CH2 U0max | 0…49 | % | 5 |
| 98 CH2_TTISel | Channel 2 TTI-function ON / OFF | CH2 TTI Select | OFF<br>Adapting U1<br>Adapting U2 | - | OFF |

### *5.1.4. Configuration of the binary inputs*

This allows the attribution of a certain function to the binary inputs on the one hand and on the other hand allows defining its operating mode (also refer to *Chapter 5.3*).

| ***31 Configuration binary inputs "Config of BIN"*** | | | | | |
|---|---|---|---|---|---|
| **Function configuration** | | | | | |
| MCP Parameter name | Parameter name | Symbol | Setting range | Unit | Factory setting |
| 01 ConfigSelBIN1 | Function binary input BIN01 | BIN01 Fct | 0…±60 | - | +1 |
| 02 ConfigSelBIN2 | Function binary input BIN02 | BIN02 Fct | 0…±60 | - | +2 |
| 03 ConfigSelBIN3 | Function binary input BIN03 | BIN03 Fct | 0…±60 | - | +3 |
| 04 ConfigSelBIN4 | Function binary input BIN04 | BIN04 Fct | 0…±60 | - | +4 |
| 05 ConfigSelBIN5 | Function binary input BIN05 | BIN05 Fct | 0…±60 | - | +5 |
| 06 ConfigSelBIN6 | Function binary input BIN06 | BIN06 Fct | 0…±60 | - | +6 |
| 07 ConfigSelBIN7 | Function binary input BIN07 | BIN07 Fct | 0…±60 | - | +7 |
| 08 ConfigSelBIN8 | Function binary input BIN08 | BIN08 Fct | 0…±60 | - | +8 |
| 09 ConfigSelBIN9 | Function binary input BIN09 | BIN09 Fct | 0…±60 | - | +9 |
| 10 ConfigSelBIN10 | Function binary input BIN10 | BIN10 Fct | 0…±60 | - | +10 |
| 11 ConfigSelBIN11 | Function binary input BIN11 | BIN11 Fct | 0…±60 | - | +31 (parameter set 11) |
| 12 ConfigSelBIN12 | Function binary input BIN12 | BIN12 Fct | 0…±60 | - | +44 (RESET) |
| 13 ConfigSelBIN13 | Function binary input BIN13 | BIN13 Fct | 0…±60 | - | +45 (BLK REM) |
| **Selection operating mode** | | | | | |
| MCP Parameter name | Parameter name | Symbol | Setting range | Unit | Factory setting |
| 14 ModeSelBIN1 | Operating mode binary input BIN01 | BIN01 Mode | Normal [0]<br>Always ON [1]<br>Always OFF [2]<br>Inverted [3] | - | Normal |
| 15 ModeSelBIN2 | Operating mode binary input BIN02 | BIN02 Mode | | - | Normal |
| 16 ModeSelBIN3 | Operating mode binary input BIN03 | BIN03 Mode | | - | Normal |
| 17 ModeSelBIN4 | Operating mode binary input BIN04 | BIN04 Mode | | - | Normal |
| 18 ModeSelBIN5 | Operating mode binary input BIN05 | BIN05 Mode | | - | Normal |
| 19 ModeSelBIN6 | Operating mode binary input BIN06 | BIN06 Mode | | - | Normal |
| 20 ModeSelBIN7 | Operating mode binary input BIN07 | BIN07 Mode | | - | Normal |
| 21 ModeSelBIN8 | Operating mode binary input BIN08 | BIN08 Mode | | - | Normal |
| 22 ModeSelBIN9 | Operating mode binary input BIN09 | BIN09 Mode | | - | Normal |
| 23 ModeSelBIN10 | Operating mode binary input BIN10 | BIN10 Mode | | - | Normal |
| 24 ModeSelBIN11 | Operating mode binary input BIN11 | BIN11 Mode | | - | Normal |
| 25 ModeSelBIN12 | Operating mode binary input BIN12 | BIN12 Mode | | - | Normal |
| 26 ModeSelBIN13 | Operating mode binary input BIN13 | BIN13 Mode | | - | Normal |
| 27 CH2_AlwaysPSet1 | Channel 2 always parameter set 1 | CH2 AlwaysPs1 | OFF / ON | - | OFF |
| 28 CH2_RemCtrl_On | Channel 2 control by channel 1 | CH2Ctrl by CH1 | OFF / ON | - | OFF |

### 5.1.5. Configuration of the binary outputs

This allows attributing several functions to the relay outputs, as well as to the LEDs and events of the event memory (also refer to *Chapter 5.4*).

| ***32 Configuration binary outputs "Config of BOUT"*** | | | | | |
|---|---|---|---|---|---|
| **Configuration relay outputs** | | | | | |
| MCP Parameter name | Parameter name | Symbol | Setting range | Unit | Factory settings |
| 01 ConfigSelBOUT1 | Function binary output BOUT01 | BOUT01 Fct | 0…76, 101…116 | - | 1 |
| 02 ConfigSelBOUT2 | Function binary output BOUT02 | BOUT02 Fct | | - | 2 |
| 03 ConfigSelBOUT3 | Function binary output BOUT03 | BOUT03 Fct | | - | 3 |
| 04 ConfigSelBOUT4 | Function binary output BOUT04 | BOUT04 Fct | | - | 4 |
| 05 ConfigSelBOUT5 | Function binary output BOUT05 | BOUT05 Fct | | - | 5 |
| 06 ConfigSelBOUT6 | Function binary output BOUT06 | BOUT06 Fct | | - | 6 |
| 07 ConfigSelBOUT7 | Function binary output BOUT07 | BOUT07 Fct | | - | 7 |
| 08 ConfigSelBOUT8 | Function binary output BOUT08 | BOUT08 Fct | | - | 8 |
| 09 ConfigSelBOUT9 | Function binary output BOUT09 | BOUT09 Fct | | - | 9 |
| 10 ConfigSelBOUT10 | Function binary output BOUT10 | BOUT10 Fct | | - | 10 |
| 11 ConfigSelBOUT11 | Function binary output BOUT11 | BOUT11 Fct | | - | 41 |
| **Configuration LEDs** | | | | | |
| MCP Parameter name | Parameter name | Symbol | Setting range | Unit | Factory settings |
| 12 ConfigSelLED1 | Function LED01 (U+) | LED01 Fct | 0…76, 101…116 | - | 66 |
| 13 ConfigSelLED2 | Function LED02 (U-) | LED02 Fct | | - | 67 |
| 14 ConfigSelLED3 | Function LED03 (f+) | LED03 Fct | | - | 68 |
| 15 ConfigSelLED4 | Function LED04 (f-) | LED04 Fct | | - | 69 |
| 16 ConfigSelLED5 | Function LED05 (ΔU<ΔUmax) | LED05 Fct | | - | 46 |
| 17 ConfigSelLED6 | Function LED06 (s<smax) | LED06 Fct | | - | 45 |
| 18 ConfigSelLED7 | Function LED07 (α<αmax) | LED07 Fct | | - | 44 |
| 19 ConfigSelLED8 | Function LED08 (U1/U2=0) | LED08 Fct | | - | 58 |
| 20 ConfigSelLED9 | Function LED09 (-) | LED09 Fct | | - | 0 |
| 21 ConfigSelLED10 | Function LED10 (-) | LED10 Fct | | - | 0 |
| 22 ConfigSelLED11 | Function LED11 (CH2 REL) | LED11 Fct | | - | 62 |
| 23 ConfigSelLED12 | Function LED12 (COMMAND) | LED12 Fct | | - | 61 |
| 24 ConfigSelLED13 | Function LED13 (BLOCKED) | LED13 Fct | | - | 74 |
| **Configuration Events (only SynView 6)** | | | | | |
| | Parameter name | Symbol | Setting range | Unit | Factory settings |
| 25 | Function Event 01 | Event01 Fct | 0…76, 101…116 | - | 0 |
| 26 | Function Event 02 | Event02 Fct | | - | 0 |
| 27 | Function Event 03 | Event03 Fct | | - | 0 |
| 28 | Function Event 04 | Event04 Fct | | - | 0 |
| 29 | Function Event 05 | Event05 Fct | | - | 0 |
| 30 | Function Event 06 | Event06 Fct | | - | 0 |
| 31 | Function Event 07 | Event07 Fct | | - | 0 |
| 32 | Function Event 08 | Event08 Fct | | - | 0 |
| 33 | Function Event 09 | Event09 Fct | | - | 0 |
| 34 | Function Event 10 | Event10 Fct | | - | 0 |
| 35 | Function Event 11 | Event11 Fct | | - | 0 |
| 36 | Function Event 12 | Event12 Fct | | - | 0 |
| 37 | Function Event 13 | Event13 Fct | | - | 0 |
| 38 | Function Event 14 | Event14 Fct | | - | 0 |
| 39 | Function Event 15 | Event15 Fct | | - | 0 |
| 40 | Function Event 16 | Event16 Fct | | - | 0 |

### 5.1.6. Configuration of the operating interface

Selection and configuration of the desired protocol for the operating interface

| 33 Configuration operating interface (only SynView 6) | | | | | |
|---|---|---|---|---|---|
| MCP Parametername | Parameter name | Symbol | Setting range | Unit | Factory settings |
| 01 FieldbusSel | Selection Protocol | ProtocolSelect | 0…3* | - | 0 |
| 02 ModB_SlAddr | Slave Address for Modbus | MB SlaveAddr | 1…247* | - | 1 |
| 03 BaudRate | Baud rate for Modbus | MB BaudRate | 0…8* | - | 4 |
| 04 Parity | Parity for Modbus | MB Parity | 0…2* | - | 0 |
| 05 ProfiB_SlAddr | Slave Address for Profibus | PB SlaveAddr | 1…125* | - | 1 |

*See *Chapter 5.5*

### 5.1.7. Actual values and status displays

The following tables show actual values and status displays:

| 41 Selection paralleling point/parameter set „Selection“ | | | | |
|---|---|---|---|---|
| MCP Parameter name | Parameter name | Symbol | Range | Unit |
| 01 parPointNo | Selected paralleling point | Ppoint selected | 1…20 | - |
| 02 parSetNo | Selected parameter set in channel 1 | CH1 Pset selected | 1…20 | - |
| 03 CH2_parSetNo | Selected parameter set in channel 2 | CH2 Pset selected | 1…6 | - |

| 42 Measuring values „Actual values“ | | | | |
|---|---|---|---|---|
| MCP Parameter name | Parameter name | Symbol | Range | Unit |
| 01 U1 | Voltage U1 | U1 | 0…130 | % |
| 02 U2 | Voltage U2 | U2 | 0…130 | % |
| 03 DU | Voltage difference | ΔU | 0…130 | % |
| 04 f1 | Frequency f1 | f1 | 10…100 | Hz |
| 05 f2 | Frequency f2 | f2 | 10…100 | Hz |
| 06 s | Slip | s | 0…±100 | % |
| 07 ds/dt | Acceleration | ds/dt | 0…10 | %/s |
| 08 alpha | Phase-angle difference | α | -180…+180 | DEG |
| 09 dalpha/dt | Angle drift | dα/dt | 0…18‘000 | DEG/s |
| 10 RotDir1 | Rotational direction of U1 (Phase sequence) | RotDirU1 | Not detected [0]<br>Clockwise [1]<br>Counterclockwise [2]<br>Not applicable (one-phase measurement) [3] | - |
| 11 RotDir2 | Rotational direction of U2 (Phase sequence) | RotDirU2 | Not detected [0]<br>Clockwise [1]<br>Counterclockwise [2]<br>Not applicable (one-phase measurement) [3] | - |
| 12 CA_version | Application Software Version (only MCP) | FW | 0…65535 | - |

| 43 Command counter „Command counters“ | | | | |
|---|---|---|---|---|
| MCP Parameter name | Parameter name | Symbol | Range / resolution | Unit |
| 01 CMD_Ctr_ParSet1 | Command counter parameter set 01 | CMD Count 01 | 0…65535 | - |
| 02 CMD_Ctr_ParSet2 | Command counter parameter set 02 | CMD Count 02 | 0…65535 | - |
| 03 CMD_Ctr_ParSet3 | Command counter parameter set 03 | CMD Count 03 | 0…65535 | - |
| 04 CMD_Ctr_ParSet4 | Command counter parameter set 04 | CMD Count 04 | 0…65535 | - |
| 05 CMD_Ctr_ParSet5 | Command counter parameter set 05 | CMD Count 05 | 0…65535 | - |
| 06 CMD_Ctr_ParSet6 | Command counter parameter set 06 | CMD Count 06 | 0…65535 | - |
| 07 CMD_Ctr_ParSet7 | Command counter parameter set 07 | CMD Count 07 | 0…65535 | - |
| 08 CMD_Ctr_ParSet8 | Command counter parameter set 08 | CMD Count 08 | 0…65535 | - |
| 09 CMD_Ctr_ParSet9 | Command counter parameter set 09 | CMD Count 09 | 0…65535 | - |

| | | | | |
|---|---|---|---|---|
| 10 CMD_Ctr_ParSet10 | Command counter parameter set 10 | CMD Count 10 | 0…65535 | - |
| 11 CMD_Ctr_ParSet11 | Command counter parameter set 11 | CMD Count 11 | 0…65535 | - |
| 12 CMD_Ctr_ParSet12 | Command counter parameter set 12 | CMD Count 12 | 0…65535 | - |
| 13 CMD_Ctr_ParSet13 | Command counter parameter set 13 | CMD Count 13 | 0…65535 | - |
| 14 CMD_Ctr_ParSet14 | Command counter parameter set 14 | CMD Count 14 | 0…65535 | - |
| 15 CMD_Ctr_ParSet15 | Command counter parameter set 15 | CMD Count 15 | 0…65535 | - |
| 16 CMD_Ctr_ParSet16 | Command counter parameter set 16 | CMD Count 16 | 0…65535 | - |
| 17 CMD_Ctr_ParSet17 | Command counter parameter set 17 | CMD Count 17 | 0…65535 | - |
| 18 CMD_Ctr_ParSet18 | Command counter parameter set 18 | CMD Count 18 | 0…65535 | - |
| 19 CMD_Ctr_ParSet19 | Command counter parameter set 19 | CMD Count 19 | 0…65535 | - |
| 20 CMD_Ctr_ParSet20 | Command counter parameter set 20 | CMD Count 20 | 0…65535 | - |

## *45 Statuses of the SEEK functions „SEEK“*

### 0 SEEK control

| MCP Parameter name | Parameter name | Symbol | Range / resolution | Unit |
|---|---|---|---|---|
| 01 SEEK_ReqSel | Preselected SEEK-function | | | |
| 02 SEEK_RelCode | Password for the SEEK-release | | | |
| 03 SEEK_Cancel_On | Abortion of the SEEK-function | | | |

### 3 SEEK Status

| MCP Parameter name | Parameter name | Symbol | Range / resolution | Unit |
|---|---|---|---|---|
| 31 SEEK_state | Status of the SEEK-function | SEEK State | 0, 10…13, 20…23, 30..33 | - |

### 5 SEEK ton

| MCP Parameter name | Parameter name | Symbol | Range / resolution | Unit |
|---|---|---|---|---|
| 51 SEEK_tOn_Result | SEEK ton: actual result<br>(at timeout: result = 1000 ms) | | 0…1000 | ms |
| 52 SEEK_tOn_parSet | SEEK ton: used parameter set | | | |

### 6 SEEK dUdt

| MCP Parameter name | Parameter name | Symbol | Range / resolution | Unit |
|---|---|---|---|---|
| 61 SEEK_dUdt_Res | SEEK dUdt: actual result | SEEK dUdt Result | -100…100 | %/s |
| 62 SEEK_dUdt_Inacc | SEEK dUdt-result inaccurate | SEEK dUdt Inaccurate | No / Yes | - |
| 63 SEEK_dUdt_Compl | SEEK dUdt-result available | SEEK dUdt Completed | No / Yes | - |
| 64 SEEK_dUdt_parSet | SEEK dUdt: used parameter set | SEEK dUdt Pset | 1…20 | - |

### 7 SEEK dfdt

| MCP Parameter name | Parameter name | Symbol | Range / resolution | Unit |
|---|---|---|---|---|
| 71 SEEK_dfdt_Result | SEEK dfdt: actual result | SEEK dfdt Result | -100…100 | %/s |
| 72 SEEK_dfdt_Inacc | SEEK dfdt-result inaccurate | SEEK dfdt Inaccurate | No / Yes | - |
| 73 SEEK_dfdt_Compl | SEEK dfdt-result available | SEEK dfdt Completed | No / Yes | - |
| 74 SEEK_dfdt_parSet | SEEK dfdt: used parameter set | SEEK dfdt Pset | 1…20 | - |

## *48 IP address “IP address”*

| MCP Parameter name | Parameter name | Symbol | Range | Factory setting |
|---|---|---|---|---|
| 01 IP_byte1 | IP address Block 1 | IP byte1 | 0…255 | 172 |
| 02 IP_byte2 | IP address Block 2 | IP byte2 | 0…255 | 16 |
| 03 IP_byte3 | IP address Block 3 | IP byte3 | 0…255 | 0 |
| 04 IP_byte4 | IP address Block 4 | IP byte4 | 0…255 | 211 |
| 05 SubnetM_byte1 | Subnet mask Block 1 | NetMask byte 1 | 0…255 | 255 |
| 06 SubnetM_byte2 | Subnet mask Block 2 | NetMask byte 2 | 0…255 | 255 |
| 07 SubnetM_byte3 | Subnet mask Block 3 | NetMask byte 3 | 0…255 | 0 |
| 08 SubnetM_byte4 | Subnet mask Block 4 | NetMask byte 4 | 0…255 | 0 |

## *51 Transformer Tap Indication „TTI“*

| MCP Parameter name | Parameter name | Symbol | Range / resolution | Unit |
|---|---|---|---|---|
| 01 TTI_TapInd | Transformer Tap Indication | TapNo | 0…±63 | - |

### 5.1.8. Event memory

The events are displayed with a code, short text and time stamp in the event memory (meaning of the codes: also refer to *Chapter 10 - Maintenance and Troubleshooting*):

### 5.1.9. SEEK-Functions

In this menu part, the following SEEK functions can be executed using MCP:

- SEEK ton: determine the system-dependent parameter value t on
- SEEK dUdt: determine the system-dependent parameter value dU/dt
- SEEK dfdt: determine the system-dependent parameter value df/dt

**NOTE!**

The SEEK-functions can be carried out using the MCP, but it is not recommended for security reasons. The execution of the SEEK function using SynView 6 is recommended.

## 5.2. Parameter sets 1 to 20

### 5.2.1. Group 0: Channel 1 Measurement

**01 Nominal voltage "*Un*"**
The nominal secondary voltage is set in volts. The nominal voltage is plant-dependent. It is typically 58 (100/$\sqrt{3}$); 64 (110/$\sqrt{3}$); 100; 110 V ac, but can also have a different value.

**02 Primary nominal voltage *"UnPrim"***
For information purposes, the primary nominal voltage can be displayed instead of the percentage display. The set value kV corresponds to the primary voltage at 100%.

**03 Nominal frequency "*fn*"**
The nominal frequency can have the following values:
[1] = 16.7 Hz
[2] = 50 Hz
[3] = 60 Hz.

**04 Voltage ratio "*U1/U2*"**
The value $\Delta$U can be adjusted as follows:

- In connected state, read actual values U1 and U2 in %
- Divide U1 by U2 and adjust and save the resulting factor in the parameter U1/U2
- Check whether $\Delta$U is now 0 %.

Approximately, the factor can be calculated by dividing the secondary voltage U1n [V] by U2n [V]:

$$U1/U2 = \frac{U1n}{U2n}$$

In any case however, the result must be verified by measurement in connected state. Also refer to the example in *Chapter 3.2.4.*

**05 Angle tuning „*αOffset*“**
Phase shifts caused by measuring inaccuracy or by the switching group of a step-up transformer between the circuit breaker and the measuring, can be compensated with this parameter. Also refer to the example in Chapter *3.2.4*.
If other components are connected to the same voltage transformer (VT), without the possibility of compensation, then external compensation VTs must be used for this. In these cases, we recommend to connect the SYNCHROTACT 6-device to the externally compensated voltage (also refer to *Chapter 6.6.5*).

**CAUTION!**

An incorrectly calculated factor can lead to damage to the plant! Before paralleling is carried out for the first time, it is essential to ensure that the setting is correct.

**NOTE!**

It must not be forgotten to carry out this adjustment at channel 2 of the dual channel device SYN 6202 as well (see description of adjusting parameter 82)

**06, 07 Selection of the analog input that is used for *“U1”, “U2 AINSelU1”, “AINSelU2”***
Selection of the analog inputs that are used for the measuring voltages U1 and U2 from channel 1 (see description adjusting parameter 84 and 85)

Eight analog inputs are available for synchronizing devices SYNCHROTACT 6. They can be used either to connect single-phase measuring devices, eg different paralleling points, or to connect multi-phase measuring voltages.

The setting values must be determined by the responsible project engineer and checked for correctness during commissioning (also refer to *Chapter 6.6 Connection of the measuring voltages*).

**08 Number of used analog inputs “*NoAIN*”**
Number of analog inputs used for a measured value (eg U1 of channel 1).
Setting range: 1, 2, or 3.
If several analog inputs are used, the first is defined by the parameter setting 06 AINSelU1 resp. 07 AINSelU2. For the other inputs of the same measurement, subsequent inputs must then be used.

**CAUTION!**

No overlapping (multiple use) may be set. If NoAIN is set to 2 and AINSelU1 to 1, AINSelU2 cannot be set to 2, but must be set to at least 3. Analog for NoAIN = 3 and AINSelU1 = 1 => AINSelU2 must be set to 4, 5, or 6.

Example: Setting: AINSelU1 = 1; AINSelU2 = 4 and NoAIN = 3. This means that the inputs AIN1, AIN2, AIN3 are used for the measurement U1 and AIN4, AIN5, AIN6 are used for the measurement U2.

The setting values must be defined by the responsible project engineer and checked for correctness during commissioning (see also *Chapter 6.6 Connection of the measuring voltages*).

### *5.2.2. Group 1: Command generation*

**10 Command generation ON/OFF "*CMDGen*"**
With this setting parameter, the command generation can be switched on or off. When the command generation is switched off, the device functions as a synchrocheck: as soon as the release has been carried out by the monitoring, the contacts close, when the release is omitted, they re-open.

If, therefore, a certain parameter set is to be used for automatic synchronization, the command generation must be activated. In this case, SYNCHROTACT 6 outputs a paralleling command.

If a particular parameter set is to be used only as a monitoring of a paralleling (synchrocheck-operation), the command generation must be switched off. In this case, SYNCHROTACT 6 only provides a release. The paralleling command is given by another element (eg another automatic synchronizing device or manual paralleling switch).

**11 Paralleling time "*t on*"**
The time is required for the compensation of the breaker closing time. The closing time of the circuit breaker, including all intermediate circuits, is measured using the function SEEK ton (see *Chapter 8.2.6)*. If the closing time of the circuit breaker is known, it can be set and stored directly.

The aim is to determine the running time of the paralleling command, from the SYNCHROTACT 6 – device to the circuit breaker and the closing time of the circuit breaker itself, so that the paralleling command can be given at this defined time before the zero-crossing of the phase-angle difference.

**NOTE!**

The execution of the SEEK-function using SynView 6 is recommended. It is indeed possible to perform the SEEK function using the MCP, but it is not recommended for safety reasons.

**CAUTION!**

If the paralleling time is unknown and the SEEK-function cannot be carried out, the value must be empirically determined. Procedure:

1. Presettings:
   - Adjust t on to approximately 100 ms
   - Reduce parameter 20/21 ±smax temporarily to 0.1 ... 0.2 %
2. All other commissioning work must be completed (especially calibration of the measuring voltages)
3. Connect external recorder with the following measured values:
   - Channel 1: Beat wave voltage u1 – u2
   - Channel 2: Paralleling command
   - Channel 3: Generator power $P_G$ or current $I_G$
   - Time: 20...50 ms/DIV
   - Trigger on paralleling command
4. Set SYNCHROTACT 6 to READY
5. Machine must be in operation; voltage exists on both sides of the circuit breaker
6. First carry out some blind synchronizations and check whether the paralleling takes place at the correct time.
7. Synchronize live
   - Start SYNCHROTACT 6
   - Observe the synchronization process using the SynView 6 actual values Tool or observe synchronizing instruments.
8. Wait until the end of the synchronization process
9. Read SynView 6 transient recorder or external recorder
10. The envelope of the beat wave voltage should be at the minimum when the main contacts (P or IG) are closed. If the closing is too late, t on must be increased, if it is too early, t on must be reduced.

Repeat the points 7 to 10 until the circuit breaker closes at the correct time, ie, P or IG are minimal after synchronizing. Reset parameter 20/21 ±smax to the desired value.

**CAUTION!**

Carefully correct the value!

**NOTE!**

The command generation for asynchronous sources can be switched off using 11 t on = OFF (see *Chapter 3.2.10)*

**12 Paralleling command duration "*tp on*"**
In order to avoid damage to the contact that closes the circuit breaker, the paralleling command duration must be long enough to ensure that the closing coil of the circuit breaker is safely decoupled before the paralleling contacts are opened.

A little reserve should be provided, but the command length should not be so long that the paralleling command is active beyond the set angle window.
Recommended setting: tp on = 2 x t on.

**13 Monitoring time synchronous *"t supC"***
The monitoring time t supC plays a role with synchronous or quasi-synchronous sources (paralleling of lines). This function is not required for generator synchronization.

The command is issued if all conditions (CHK RELEASE) are permanently maintained during this time.

As soon as at least one condition is no longer fulfilled, t supC is stopped and set to zero.

**CAUTION!**

In the case of generator synchronization (asynchronous sources), a command output can occur after the termination of t supC, while maintaining the predetermined angle window, but with a phase-angle difference ≠ zero.

Therefore, t supC should be set to OFF, or at least not <10 s.

In the case of synchrocheck operation, ie deactivated command generation (10 CMDGen = OFF), t supC has no influence. The command is released immediately if all conditions are fulfilled.

**14 Monitoring time voltage-free "*t supD*"**
The monitoring time t supD plays a role when connecting voltage-free lines (dead bus).

The command is issued when all dead bus conditions (DB RELEASE) are permanently maintained during this time.

As soon as at least one condition is no longer met, t supD is stopped and set to zero.

In the case of synchrocheck operation, ie deactivated command generation (10 CMDGen = OFF), t supD has no influence. The command is released immediately if all conditions are fulfilled.

**15 Monitoring time synchronous + angle drift *"t supS"***
The monitoring time t supS, similar to 13 t supC plays a role in synchronous or quasi-synchronous sources (paralleling of lines). This function is not needed for the generator synchronization.

The command is issued if all conditions (SYN RELEASE) are permanently maintained during this time.

**NOTE!**

In contrast to the branch with t supC, angle drift is additionally taken into account here. It can therefore be decided with very small slip values that it is sufficient to meet all conditions and that it is not necessary to wait for the next phase match (see *Chapter 3.2.8* and *3.2.10*).

As soon as at least one condition is no longer fulfilled, t supS is stopped and set to zero.

In the case of synchrocheck operation, ie deactivated command generation (10 CMDGen = OFF), t supS has no influence. The command is released immediately if all conditions are fulfilled.

**16 Multiple commands *„MULTIPLE CMD"***
This setting can be used to determine whether the synchronizing device should issue only one command or whenever all conditions are fulfilled. In the case of synchrocheck operation, ie deactivated command generation (10 CMDGen = OFF), MULTIPLE CMD has no influence. The contacts close at each release.

**17 Timeout time for „Operator window" *„tOpWin"***
With this setting parameter, the function „Manual release of the paralleling command" („Operator window") can either be switched off (tOpWin = 0.0 s), or the timeout time of the manual release can be set.

Recommended setting:

$$tOpWin = \frac{\propto max}{3{,}6}$$

**NOTE!**

The „Operator window“ – function includes a corresponding setting of αmax (see *Chapter 5.2.3,* Parameter description 22, 23, section c)), (*see Chapter 6.9 Manual release of the paralleling command („Operator window“)*) and a relay output set with code 44 to indicate when the phase-angle difference is within the tolerance band.

### *5.2.3. Group 2: Channel 1 Paralleling conditions*

**20, 21 Slip limit oversynchronous „*–smax“*, undersynchronous „*+smax“***
Depending on the application, the setting value depends on different criteria:
a) Normal synchronization
b) Coarse synchronization (synchronizing during coast down)
c) Paralleling of synchronous lines
d) Paralleling of asynchronous lines
e) Paralleling of asynchronous sources with manual release („*Operator window*“):

a) Normal synchronization
The slip limit values set in practice are far from placing a serious load on the machine, even on large machines.
Usual setting values: 0.1…0.5 %; default setting: 0.4 %
The following are a number of points which can influence the setting value:

- Smaller slip limits should be chosen for large and modern generators.
- Gas turbines are more sensitive than hydro generators (= smaller tolerance band).
- Lower values should be selected if fine synchronization has priority and higher values if fast synchronization is to take place.
- Lower slip values are usually selected where settings are made for synchrocheck operation to monitor manual synchronization.
- If one wishes to prevent the tripping of the reverse power relay, the sub-synchronous limit +smax is reduced or set to zero.

b) Coarse synchronization (synchronizing during coast down)
With coarse synchronization, ie synchronization without frequency adjusting commands (eg. during coast down), in order to carry out paralleling with 100% reliability, the slip limits must be set in such a way that at least one phase zero passage occurs within the permissible range.

$$|s\max| \geq 10 * \sqrt{\frac{2 * ds/dt}{fn}} \; [\%]$$

Key:
fn = nominal frequency [Hz]
ds/dt = acceleration [%/s] (known or read actual value from SYNCHROTACT 6).

If the determined value appears inadmissibly high, a lower value can be set. However, in this case it is not guaranteed that paralleling can be achieved with only one attempt of synchronization.

c) Paralleling of synchronous lines:
If only synchronous sources are paralleled, the slip limits do not need to be set.

d) Paralleling of asynchronous lines:
If two lines do not form a ring connection, ie asynchronous, the slip limits are restricted by the limit current permitted after paralleling. If the flow of power in a particular direction is to be avoided, the corresponding slip limit must be set to zero.

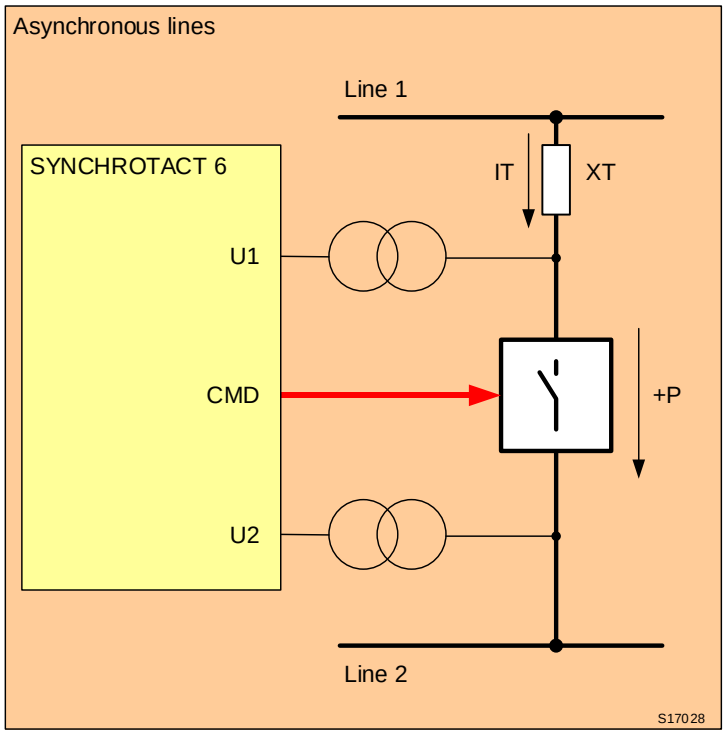



*Figure 5-2 Paralleling of asynchronous lines*

e) Paralleling of asynchronous sources with manual release („Operator window“):
For this application it is recommended to work with small slip values, ie. adjusting smax = 0.1 %, or maximum 0.2 %. The setting has an influence on the angle window setting (see there: parameter 22, 23, section c)).

**22, 23 Angle limit negative “-$\alpha$max” and positive “+$\alpha$max”**
The permissible angle limit is based on different criteria, depending on the application:
a) Paralleling of asynchronous sources.
b) Paralleling of synchronous sources.
c) Paralleling of asynchronous sources with manual release („Operator window“)

a) Paralleling of asynchronous sources:
The maximum permissible angle limit ±αmax should generally be set symmetrically and to 10 DEG.

If 3.6*fn*smax*t on+3 > 10 DEG, the value should be rounded up to whole degrees. Setting values above 15 DEG are not usual. If the calculation produces such a result, it should be checked whether the maximum slip can be reduced.

b) Paralleling of synchronous sources:
The coupling reactance $x_K$ in ring mains lines and the balancing current flowing through these cause a phase shift between the two voltages U1 and U2.

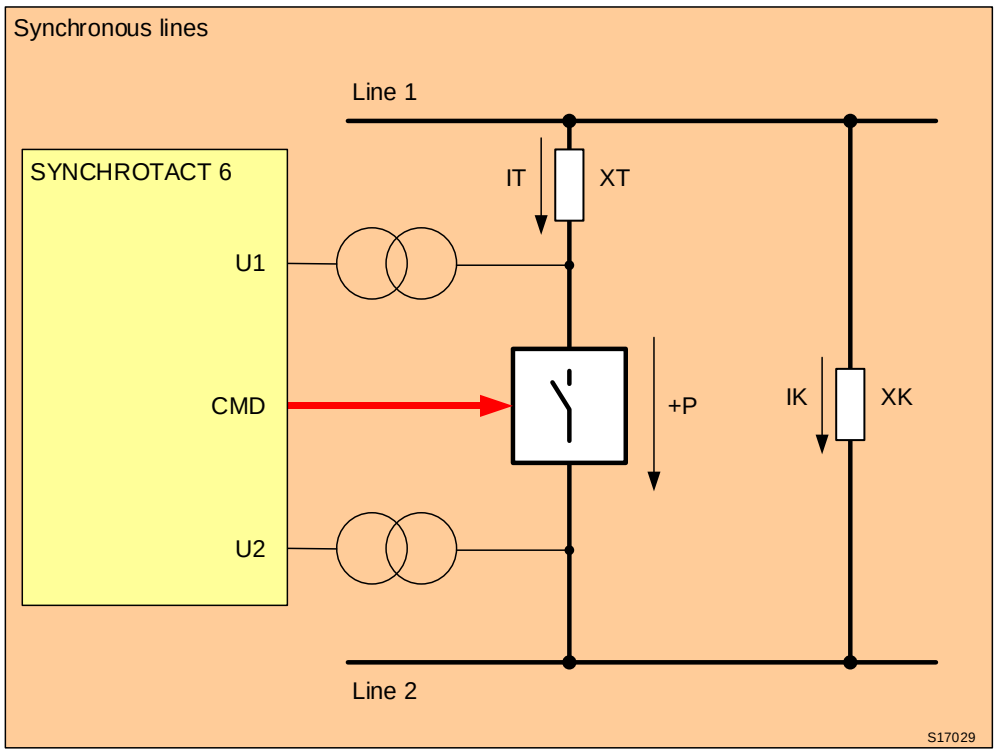



*Figure 5-3 Paralleling of synchronous lines*

The maximum phase shift ±αmax permitted for paralleling is calculated from the greatest phase shift which occurs, plus a reserve. ±αmax is limited by the current $i_T = f(U1, U2, x_T)$ flowing after paralleling and if the flow of power in a particular direction is to be avoided. In the latter case, the corresponding parameter (-αmax or +αmax) is set to zero.

c) Paralleling of asynchronous sources with manual release („Operator window“):
The criterion for the earliest possible manual release is determined by the parameter ±αmax. The set angle is not directly related to the command output in the SYNCHROTACT 6-device. As soon as the angle limit αmax is reached, this is indicated to the operator by means of an LED or a configurable relay output. The operator must now issue the hand release until the time immediately before the command output time.

It is recommended to adjust the angle window as follows: about 200 to 260 times bigger than smax.
Example: smax = 0.1 % => αmax = 250 * 0.1 = 25 DEG.
In the case of the dual channel device SYN 6202, the angle window in channel 2 can be set smaller than for channel 1 (see description parameter 91).

**24, 25 Maximum voltage difference, overexcited "*-ΔUmax*", underexcited "*+ΔUmax*"**
Maximum permitted amplitude difference between the two voltages.

- Usual values for generators: 1 to 5 %
- Usual values for synchronous lines 3 to 10 %

Recommended setting: default setting

**26 Maximum voltage "*Umax*"**
No paralleling takes place above this voltage. The default setting of 120 % can be changed if necessary.

**27 Minimum voltage "*Umin*"**
No paralleling takes place below this voltage. The default setting of 80 % can be changed if necessary.

**28 Synchronous detection limit "*dα/dtmax*"**
This parameter must only be set for the paralleling of synchronous and asynchronous lines. It is used together with the parameter 15 t supS.

In order to shorten the paralleling time, quasi-synchronous lines (dα/dt < dα/dtmax) can be treated as synchronous lines, ie if the paralleling conditions are fulfilled, it is not absolutely necessary to wait for a phase coincidence.

A typical limit value is 5 mHz, which corresponds to 1.8 DEG/s. If all paralleling conditions are fulfilled and dα/dt < dα/dtmax, then t supS is started and the command output is issued after expiration.

### *5.2.4. Group 3: Channel 1 dead bus-conditions*

**30 Maximum zero voltage "*CH1 U0max*"**
Maximum voltage at which the SYNCHROTACT 6 can still recognize the measuring voltages as voltage-free. Setting of another value only as required.

**31…33 Release of voltage-free lines "*U1not*", "*U2not*", "*U1*U2not*"**
These parameters must only be set in the case of paralleling voltage-free lines. The synchronization of two existing voltages is not affected by the programming. The following relationships apply:

| *U1not* | *U2not* | *U1*U2not* | *Conditions* |
|---|---|---|---|
| OFF | OFF | OFF | Both U1 and U2 must be present (default) |
| ON | OFF | OFF | Only the voltage U1 can be missing, U2 must be present. |
| OFF | ON | OFF | Only the voltage U2 can be missing, U1 must be present. |
| ON | ON | OFF | One of the two voltages can be missing, the other must be present. |
| OFF | OFF | ON | Both voltages can be missing (simultaneously) |
| ON | OFF | ON | The voltage U1 or both voltages can be missing |
| OFF | ON | ON | The voltage U2 or both voltages can be missing |
| ON | ON | ON | One of the two voltages or both voltages can be missing. |

**CAUTION!**

A misinterpretation of the measurement can lead to serious damage to the plant. If no-voltage lines are detected, it is essential to make sure that the measuring circuits (voltage transformers, fuses and input cables) are functioning 100 % correctly. Only then should the release signal Release DB be given. In dual channel synchronizing systems, two different transformer circuits for the two channels should be connected whenever possible in order to avoid a risk in the event of loss of phase. If, instead of the star point, one of the phases is earthed on the secondary side, this does not affect normal synchronizing operation, however, a failure of the earthed phase cannot be detected by the synchronizing device.

**34 „*Exclusive dead bus*“ – function “*ExclDB*”**
This parameter is normally set to OFF, ie. the *Exclusive dead bus* – function is off. In this state, SYNCHROTACT 6 behaves like all SYNCHROTACT-predecessors: with a given release dead bus signal („Release DB“), paralleling is also possible if both voltages are present and the corresponding conditions are met.

If it is requested, that the dead bus function (no normal synchronization) is exclusively active with the release dead bus signal („Release DB“), then this parameter must be set to ON (see *Figure 3-11 Exclusive DB - function*).

### *5.2.5. Group 4: Voltage matcher*

**40 Voltage adjusting characteristic “*dU/dt*”**
Factor for the command length formed in proportion to the voltage difference.
Set the SYNCHROTACT 6 voltage matcher to the desired value ramp of the voltage regulator (AVR), so that a single voltage adjusting command brings the voltage difference ΔU approximately to the center of the set tolerance band ±ΔUmax (parameter 24, 25).

The setting value can be determined in the following ways:

- automatically, through SEEK dUdt (see *Chapter 8.2.6*)
- computed by the voltage regulator data
- empirically, through targeted tests in the plant

Typical setting values: 0.3…0.7%/s. Adjusting pulses are suppressed if dU/dt is set to OFF.

**NOTE!**

The execution of the SEEK-function using SynView 6 is recommended. It is possible to perform the SEEK-function using the MCP, but it is not recommended for safety reasons.

Example for the computational determination of dU/dt, using the standard setpoint ramp of an ABB UNITROL excitation system:
UNITROL 6000 setpoint data:

- Minimum setpoint: 90 % Un
- Maximum setpoint: 110 % Un
- Runtime from minimum to maximum setpoint: 60 s

$$dU/dt = \frac{\Delta U}{\Delta t} = \frac{20\ \%}{60\ s} = 0{,}33\ \%/s$$

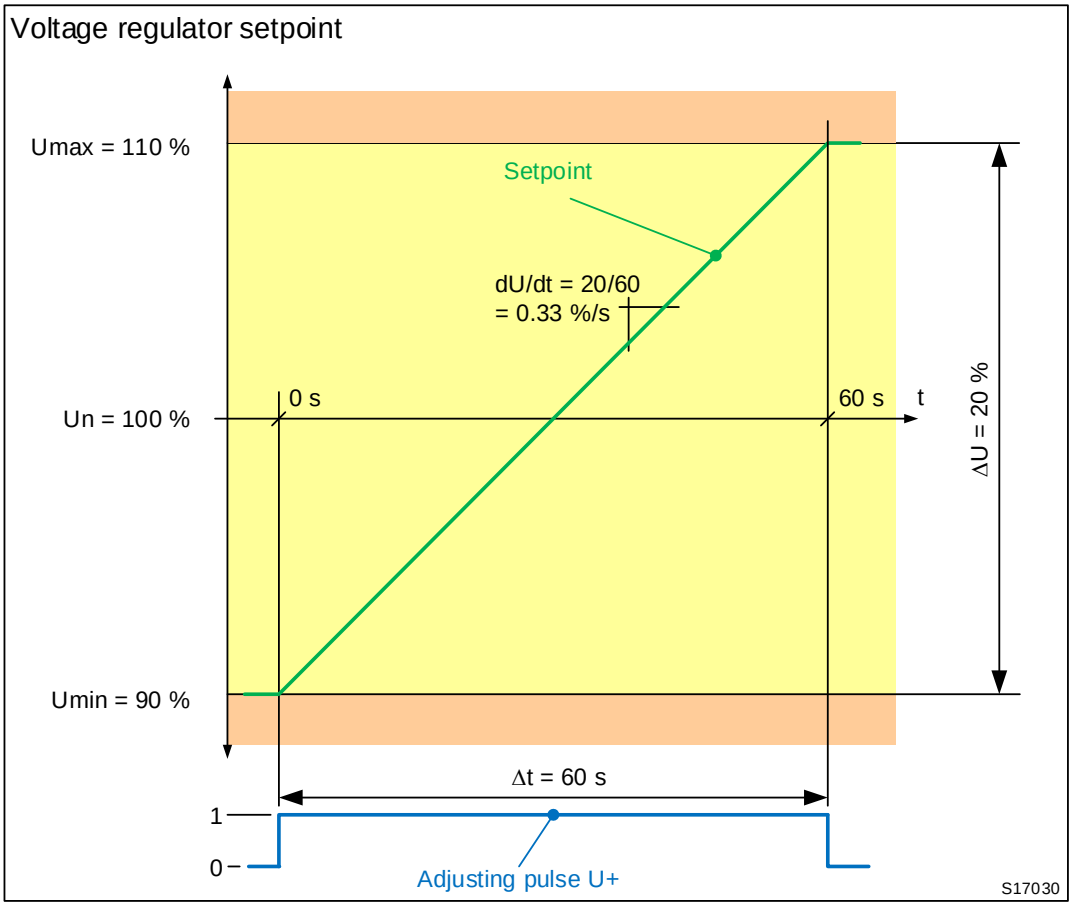



*Figure 5-4 UN 6000 setpoint ramp*

Empirical determination of the setting value:
To do this, the voltage matcher must adjust the machine by means of voltage adjusting commands. The operator checks the command length and corrects it if necessary until the matcher is functioning satisfactorily.

Procedure:

1. Prevent the circuit breaker from closing while work is being carried out (circuit breaker in test position, unplug connector -X61 for the paralleling command on the SYNCHROTACT 6)
2. Temporarily switch off frequency matcher: set 50 df/dt = OFF and write into the random access memory.
3. In order to better judge the effect of the adjusting pulse: temporarily set pulse interval 41 ts U to maximum
4. Set SYNCHROTACT 6 to READY
5. The machine must be in operation: voltages present on both sides of the circuit breaker; voltage difference outside of the set tolerance window.
6. Read the initial voltage difference ΔU0
7. Start synchronizing process
8. Wait for the end of the voltage adjusting command (LED), then wait until the voltage difference display shows stable values (5...10 s) and read the final voltage difference ΔU1
9. Stop SYNCHROTACT 6
10. Calculate value according to the following formula:

$$dU/dt = dU/dt0 * \frac{(\Delta U0 - \Delta U1)}{\Delta U0}$$

Key:

| | |
|---|---|
| dU/dt | = newly calculated value |
| dU/dt0 | = setting value prior to test |
| ΔU0 | = initial voltage difference |
| ΔU1 | = final voltage difference |

11. Block SYNCHROTACT 6, set calculated value and set to READY again
12. Bring voltage difference outside of the tolerance band
13. Start synchronizing process
14. Following the first voltage adjusting command, the voltage difference must lie approximately in the middle of the tolerance band.
15. If the pulse was too long: increase the setting value; if the pulse was too short: lower the setting value.
16. Repeat points 11 to 15 until the adjusting pulse length is correct and the matcher is functioning satisfactorily.
17. Activate the frequency matcher again: set df/dt to previous value and save.
18. Set pulse interval ts U back to previous value and save.

**41 Pulse interval "*ts U*"**
The pulse interval defines the time between two voltage adjusting pulses. The default setting can normally be left as it is. If problems arise with the voltage matching, tests can be carried out with higher or lower values.

**42 Minimum pulse time "*tp Umin*"**
The minimum voltage adjusting pulse should be set as short as possible taking into account the manufacturer's specifications for the final control element. Usual setting value: tp Umin = 0.05 s.

Where the function 43 INVERSE U is used or tap changer matching, this parameter corresponds to the pulse duration.

**43 Switchover to variable intervals "*INVERSE U*"**
If this parameter is set to ON, the following applies:
- fixed pulse duration
- variable interval dependent on 41 ts U

Settings recommendation for 42 tp Umin if INVERSE U = ON: as high as possible, but so that the matcher does not overshoot (also see *Chapter 3.2.6*).

**44 Switchover to Tap changer "*TVM*"**
If the voltage matcher controls a tap changer, the parameter TVM should be set to ON. The matcher then issues fixed pulse durations (42 tp Umin) and fixed pulse intervals (41 ts U). The settings are based on the tap changer manufacturer's specifications.

### *5.2.6. Group 5: Frequency matcher*

**50 Frequency adjusting characteristic "*df/dt*"**
Factor for the command length which is formed proportionally to the slip.
Aim: The setting of the SYNCHROTACT 6 frequency adjuster is to be adjusted to the setpoint ramp of the turbine controller, so that a single frequency adjusting command brings the slip to the vicinity of half the maximum slip smax.
The setting value can be determined in the following ways:
- automatic, using SEEK dfdt (see *Chapter 8.2.6*)
- calculated, using the turbine controller data
- empirically, through targeted tests in the plant

Typical setting values: 0.1…0.5 %/s. The adjustment pulses are suppressed, when df/dt is set to OFF.

**NOTE!**

The execution of the SEEK function using SynView 6 is recommended. It is possible to perform the SEEK function using the MCP, but it is not recommended for safety reasons.

Example for the computational determination of df/dt, based on the setpoint data of a turbine controller:

- Rated speed: 3000 $min^{-1}$ = 100 %
- Minimum setpoint: 2970 $min^{-1}$ = 99 %
- Maximum setpoint: 3030 $min^{-1}$ = 101 %
- Running time from minimum to maximum setpoint: 10 s

$$df/dt = \frac{\Delta f}{\Delta t} = \frac{2\ \%}{10\ s} = 0{,}2\ \%/s$$

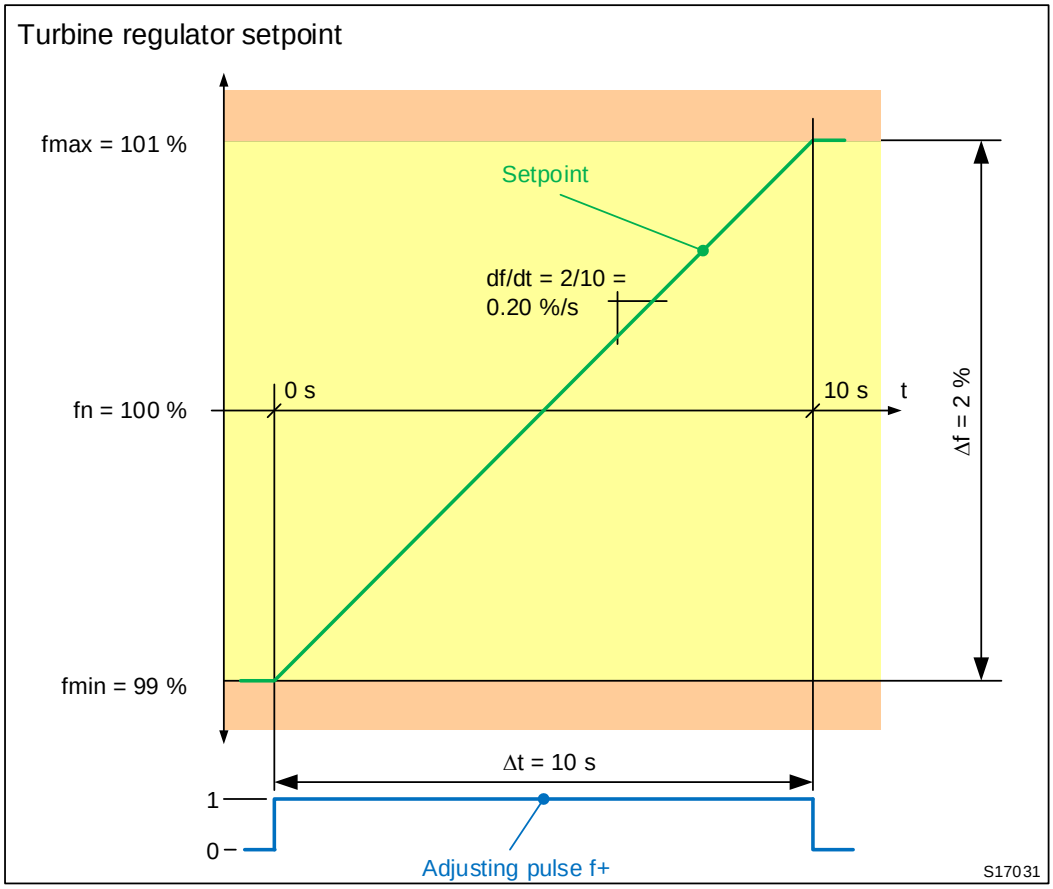



*Figure 5-5 Turbine controller setpoint ramp*

Empirical determination of the setting value:
To do this, the frequency matcher must adjust the machine by means of frequency adjusting commands. The operator checks the command length and corrects it if necessary until the matcher is functioning satisfactorily.

Procedure:

1. Prevent the circuit breaker from closing while work is being carried out (circuit breaker in test position, unplug connecter –X61 for the paralleling command on the SYNCHROTACT 6)
2. Temporarily switch off voltage matcher: set 40 dU/dt = OFF and write to the random access memory.
3. In order that the effect of the adjusting pulse can be judged in a better way: temporarily set pulse interval 51 ts f to maximum.

4. Set SYNCHROTACT 6 to READY
5. The machine must be in operation: voltages present on both sides of the circuit breaker; slip outside of the set tolerance window.
6. Read the initial slip s0
7. Start synchronizing process
8. Wait for the end of the frequency adjusting command (LED), then wait until the slip display shows stable values (10...20 s) and then read the final slip s1
9. Stop SYNCHROTACT 6
10. Calculate value according to the following formula:

$$df/dt = df/dt0 * \frac{|s0 - s1|}{|s0| - \left|\frac{smax}{2}\right|}$$

Key:

| | |
|---|---|
| df/dt | = newly calculated value |
| df/dt0 | = setting value prior to test |
| s0 | = initial slip |
| s1 | = final slip |
| smax | = set slip limit |

11. Block SYNCHROTACT 6, set calculated value and set to READY again
12. Bring slip outside of the tolerance band
13. Start synchronizing process
14. After the first frequency adjusting command, the slip must lie approximately half-way between smax and zero
15. If the pulse was too long: increase the setting value, if the pulse was too short: lower the setting value
16. Repeat points 11 to 15 until the adjusting pulse length is correct and the matcher is functioning satisfactorily
17. Reactivate voltage matcher: set dU/dt = to previous value and save
18. Reset pulse interval ts f to previous value and save

**51 Pulse interval "*ts f*"**
The pulse interval defines the time between two frequency adjusting pulses. The default setting of 20 s can normally be left as it is. If problems arise with the frequency matching, tests should be carried out with higher or lower values.

**52 Minimum pulse time "*tp fmin*"**
The minimum frequency adjusting pulse should be set as short as possible taking into account the manufacturer's specifications for the final control element. Usual setting value: tp fmin =0.05 s.
Where the function 53 INVERSE f is used, this parameter corresponds to the pulse duration.

**53 Switchover to variable intervals "*INVERSE f*"**
If this parameter is set to ON, the following applies:

- fixed pulse duration
- variable interval depending on the actual value, according to the formula:

$$tsf = \frac{1}{(f1 - f2)}$$

Settings recommendation for 52 tp fmin if INVERSE f = ON: as high as possible, but so that the matcher does not overshoot (see *Chapter 3.2.7*)

### *5.2.7. Group 6: Time specifications*

**60 Lockout period after *START "t block"***
The adjustable parameter t block prevents a command being given between START and selection of the measuring voltages. The time t block does not expire if the parameter set has not been selected or if another criterion for synchronization is not fulfilled. If the parameter set is selected subsequently, t block is then started. The default setting for t block is 2 Seconds.

**CAUTION!**

If t block is set too short, it is possible that the measuring voltages will not yet be stably connected when the device is already „live". This is indicated with a single flash of the LED "U1/U2=0" after the start. In this case, the setting of t block has to be increased until this flash does not occur anymore.

**61 Abort after *START "t tot"***
As soon as the start signal is activated, the monitoring of t tot starts to run. If this time is exceeded before the stop signal is activated, either a STOP is automatically generated, or an error indication (ERROR) and an entry of the conditions not met at time t tot are stored in the event memory.

If the device is used as a synchrocheck for manual synchronization, the setting t tot is based on the maximum expected manual synchronization time.

Usual setting value: 5 min. If the device shall be set to continuous operation or if these messages are not desired, t tot must be set to OFF.

**62 Abort after *CMD "t stop"***
Alternatively to 61 t tot, this second abort criterion t stop can be used. t stop starts to run after issuing a paralleling command. If this time is exceeded, either a STOP is automatically generated, or an error indication (ERROR) and an entry of the conditions not met at time t stop are stored in the event memory.

If the device is used as a synchrocheck for manual synchronization, this function cannot be used, since SYNCHROTACT 6 will not issue a paralleling command.

Common setting value: OFF, or 5 s. If this function is not desired, t stop must be set to OFF.

**63 Impact of abort "*EffectSel*"**
With this parameter, it is possible to commonly determine the effect of the abort for both above-mentioned abort criteria 61 t tot and 62 t stop. The possibilities are ERROR or STOP.

Default setting: ERROR

### *5.2.8. Group 7: Channel 1 TTI-parameters (Tap changer)*

**70 TTI-function ON/OFF "*CH1 TTI Select*"**
Switch the TTI function ON/OFF and assign to which measuring voltage the function should act.

| *TTI Select-setting* | *Meaning* |
|---|---|
| [0] = OFF | TTI = switched off |
| [1] = Adapting U1 | TTI = switched on and acts on U1 |
| [2] = Adapting U2 | TTI = switched on and acts on U 2 |

Setting according to the engineering specifications (see *Chapter 6.10 Use of the Transformer Tap Indication* TTI).

**71 Codetype "*Codetype*"**
Selection of the coding, either predefined code (eg, BCD, binary or 1-of-n), or individual coding according to a table.
Adjustment options:
[1] = Natural BCD
[2] = Binary code „Binary"
[3] = 1-of-n-Code „1-of-n"
[4] = Individual coding „Custom"
Setting according to the engineering specifications (see *Chapter 6.10 Use of the Transformer Tap Indication* TTI)

**72 Number of Taps "*No Taps*"**
Adjustment of the number of taps of the tap changer
Setting range: 1 to 63
Setting according to the specifications of engineering (see *Chapter 6.10 Use of the Transformer Tap Indication* TTI).

**73 Number of utilized binary inputs "*NoBIN*"**
Number of binary inputs used for decoding. The setting depends on the coding and the number of taps.
Setting according to the specifications of engineering (see *Chapter 6.10 Use of the Transformer Tap Indication* TTI).

**NOTE!**

The binary inputs used by the TTI-function for decoding must be set manually to code „0“ (ConfigSelBINxy = 0)! Otherwise the programmed function will be executed in parallel.

**74 First binary input used for decoding “*First BIN*”**
This specifies which is the first binary input used for coding. The remaining binary inputs used for coding must follow the first.
Setting according to the specifications of engineering (see *Chapter 6.10 Use of the Transformer Tap Indication* TTI).

**75 Step size between two taps *“Step”***
Percentage difference in voltage amplitude between two taps.
Adjusting range: 0.1 to 10 %
Setting according to the specifications of engineering (see *Chapter 6.10 Use of the Transformer Tap Indication* TTI).

**76 Tap that corresponds to the nominal value “*Un Tap No*”**
UnTapNo is used to determine which tap corresponds to the set nominal voltage. Setting according to the specifications of engineering (see *Chapter 6.10 Use of the Transformer Tap Indication* TTI).

**77 Offset for the step numbering “*Offset*”**
Offset for the step numbering, so that the displayed step is counted with the nominal value „0“ and upwards +1, +2, +3 etc and downwards -1, -2, -3 etc.
Setting according to the specifications of engineering (*Chapter 6.10 Use of the Transformer Tap Indication* TTI).

### *5.2.9. Group 8: Channel 2 Measurement (only SYN 6202)*

**80 Nominal voltage “*Un*”**
Nominal voltage of the plant. Setting as in channel 1 of the assigned parameter set, unless a different voltage is connected, eg. Ph-N instead of Ph-Ph.

**81 Nominal frequency “*fn*”**
Nominal frequency of the system. Setting as in channel 1 of the assigned parameter set.

**82 Voltage adjustment factor “*U1/U2*”**
Same setting as for 04 U1/U2 in channel 1 of the assigned parameter set, if the connection scheme for both channels is the same.

**83 Angle adjustment “*αOffset*”**
Same setting as 05 αOffset in channel 1 of the assigned parameter set, if the connection scheme for both channels is the same.

**CAUTION!**

Caution with the determination of the assigned parameter set, especially if different parameter sets are assigned in channel 1 and channel 2!

**84, 85 Channel 2 selection analog input for "*U1 and U2 AINSelU1, AINSelU2*"**
Selection of the analog inputs to be used for the measuring voltages U1 and U2 of channel 2 (see description of setting parameters 06 and 07). Either the same analog inputs, as for channel 1 can be used, or other, physically separated analog inputs can be used.

The setting values must be defined by the responsible engineer and checked for correctness during commissioning.

### *5.2.10. Group 9: Channel 2 Paralleling conditions (only SYN 6202)*

The settings of the paralleling conditions in channel 2 depend on the largest setting value of the corresponding parameter of all the used and assigned parameter sets of channel 1.

**90 Channel 2 slip limit "*smax*"**
Recommended setting: 0.1% greater than the maximum slip limit of all used and assigned parameter sets of channel 1.

**91 Channel 2 angle limit "*αmax*"**
Recommended setting: at least 2 DEG greater than the maximum angle limit of all used and assigned parameter sets of channel 1.

**NOTE!**

Exception: when using automatic synchronization with manual release („Operator window"), the angle window can be set to 10 DEG but not less than:

$$\propto max = 3.6 * f1 * smax_{CH2} * t\ on + 2\ DEG$$

**92 Channel 2 maximum voltage difference "*ΔUmax*"**
Recommended setting: 2 % greater than the maximum voltage difference of all used and assigned parameter sets of channel 1.

**95 Channel 2 maximum zero voltage "*CH2 U0max*"**
Adjust only when dead bus is used
Recommended setting: same as the largest U0max of all used and assigned parameter sets of channel 1.

**98 Channel 2 TTI-function ON/OFF "*CH2 TTI Select*"**
Switching the TTI-function on and off and assigning to which measuring voltage the function should act.

| *TTISel-setting* | *Meaning* |
|---|---|
| 0 | TTI = OFF |

| | |
|---|---|
| 1 | TTI = ON and acts on U1 |
| 2 | TTI = ON and acts on U2 |

Setting according to the specification of engineering.

## 5.3. 31 Configuration binary input „Config of BIN“

### 5.3.1. 3101…3113 Function configuration of the binary inputs

Normally, the configuration is fixed prior to commissioning. The settings are therefore based on the project-planning data.

**NOTE!**

For the SYN6202 dual-channel unit, the binary inputs BIN01 to BIN06 must remain at the factory setting and cannot be used freely for configuration, unless the parameter set selection of channel 2 is always "1" (parameter 3127 = ON), or it accepts the old selection of channel 1 (parameter 3128 = ON). See C*hapters 3.3.2* and *6.3.3*

The following table shows all possible functions for the binary inputs:

| *Setting value* | *Function* | *Remarks* |
|---|---|---|
| 0 | Binary input has no function or is used for the TTI-function | If a binary input is used, it does not have to be set to zero. **However, the binary inputs used for the TTI must be set to zero!** |
| ±1<br>…<br>±20 | Selection:<br>Paralleling point 1 & Parameter set 1<br>…<br>Paralleling point 20 & Parameter set 20 | The parameter set is only selected if no other input programmed with values from 21 to 40 is active. |
| ±21<br>…<br>±40 | Selection:<br>Channel 1, parameter set 1<br>…<br>Channel 1, parameter set 20 | These programming settings are only required if the ordinal numbers of parameter set and paralleling point differ. (see *Chapter 3.3 and 6.3*) |
| ±41 | Selection operation mode TEST | Normal synchronization, but the paralleling relay is not operated. A configurable output relay with the value 60 can be used (see below). |
| ±42 | Stop synchronization | Second STOP command |
| ±43 | Start synchronization | Second START command |
| ±44 | Cancel fault and set device to “Ready” | If an error is detected, the device automatically changes to the status 'Blocked with error'. This function can be |

| Setting value | Function | Remarks |
|---|---|---|
| | | used to cancel the error and return the device to readiness for operation. |
| ±45 | BLK REM | Blocking for field bus |
| ±46 | Lock synchrocheck | Synchrocheck only releases when the manual command has not yet been applied. (see *Chapter 3.6.2 and 6.8.2*) |
| ±47 | Operator window | Input for „Operator window“-function (see *Chapter 3.6.3 and 6.9*) |
| ±48 | Blockiing of the command generation | Command generation function can be blocked by means of a configurable binary input. |
| ±49 | Blocking of the matchers | The matching function can be blocked by means of a configurable binary input. |
| ±51…54 | Block the analog outputs 1 to 4 | *External analog outputs are not yet available* |
| ±55 | Remote device selection: „Active redundant“ | No function for this device, only for SYN 6302 |
| ±56 | Remote device selection: “Blocked redundant” | No function for this device, only for SYN 6302 |
| ±57 | Indication of reaching a new stage for tap changers | If the TTI-function is used with running contact, this configuration is needed (see *Chapter 6.10 Use of the Transformer Tap Indication* TTI ) |
| ±58 | External trigger for the disturbance recorder | |
| ±59 | Manually generating an error | The device can be manually brought into the ERROR state |
| ±60 | 1PPS (Time synchronization) | Input for relative time synchronization by means of pulse (1 second or a whole multiple thereof) |

**NOTE!**

The "+" in front of the setting value indicates that the related function via operating control interface will be blocked as long as a blocking input (value 45) is active. A "-" in front of the input value indicates that this function cannot be blocked (see also *Chapter 6.4.2*).

### *5.3.2. 3114…3126 Selection operation mode of the binary inputs*

The following table illustrates the operating modes of the binary inputs:

| *Setting value* | *Operating mode* | *Remarks* |
|---|---|---|
| 0 | Normal | The configured function is executed when the signal is active |
| 1 | Always ON | The configured function is executed |
| 2 | Always OFF | The configured function is never executed |
| 3 | Inverted | The configured function is executed when the signal is not active |

Application example: only one paralleling point / parameter set is used. This function is executed by setting the input to „Always ON"

**NOTE!**

In the case of the dual channel device SYN 6202, the selection of channel 2 must also be set „always parameter set 1" for electronic, permanent selection (see *Chapter 3.3.2 and 6.3.3*).

### *5.3.3. 3127, 3128 Channel 2 control (only SYN 6202)*

**3127 Channel 2 always parameter set 1 CH2 AlwaysPs1**
With parameter 3127 „CH2 AlwaysPs1" it is possible to select whether channel 2 should accept the parameter set selection from the hardware inputs or from channel 1, or should be operated exclusively with parameter set 1.

| *Setting value* | *Function* | *Remarks* |
|---|---|---|
| OFF | Channel 2 reads the parameter set selection from the binary inputs BIN01 to BIN06, or from channel 1 | Factory setting!<br>The parameter set selection is read either from the hardware inputs BIN01 to BIN06 or from channel 1, depending on parameter 3128 „CH2Ctrl by CH1"(see there). |
| ON | The parameter set selection in channel 2 is always parameter set 1. | Channel 2 exclusively activates parameter set 1, which can then be combined with any parameter set from channel 1. |

**3128 Channel 2 – control by channel 1 CH2Ctrl by CH1**
With parameter 3128 „CH2Ctrl by CH1", it is possible to select whether channel 2 should accept the control signals from the hardware inputs or from channel 1. The individual control signals are treated as follows:

| *Control signal* | *Setting CH2Ctrl by CH1* | *Considered signal sources* |
|---|---|---|
| STOP | OFF/ON | HW-input and channel 1 (regardless of setting) |
| START and Release DB | OFF | HW-input |
| | ON | HW-input and channel 1 |
| Parameter set selection 1 to 6 | OFF | HW-inputs BIN01 to BIN06 |
| | ON | Channel 1 |

| *Control signal* | *Setting CH2Ctrl by CH1* | *Considered signal sources* |
|---|---|---|
| | | **Remarks:**<br>• HW-inputs BIN01…BIN06 are ignored and can be used for other purposes<br>• Diagnostic function for checking the correspondence of selection at the binary inputs and selection of the output relay for the paralleling point selection is deactivated.<br>• Diagnostic function for checking the correspondence of the selection in channel 1 and in channel 2 is not possible |

**Behavior of channel 2 as function of both parameters, 3127 and 3128:**

| *Setting CH2 AlwaysPs1* | *Setting CH2Ctrl by CH1* | *Considered signal sources* |
|---|---|---|
| OFF | OFF | STOP: HW-input, channel 1<br>START, Release DB: HW-input<br>Parameter set selection: HW-inputs |
| ON | OFF | STOP: HW- input, or channel 1<br>START, Release DB: HW-inputs<br>Parameter set selection: always set 1 |
| OFF | ON | STOP: HW- input, channel 1<br>START, Release DB: HW- inputs, channel 1<br>Parameter set selection: HW-inputs |
| ON | ON | STOP: HW- input, channel 1<br>START, Release DB: HW-inputs, channel 1<br>Parameter set selection: always set 1 |

## 5.4. 32 Configuration binary outputs „Config of BOUT“

### 5.4.1. 3201…3211 Configuration of the relay outputs

Normally the configuration is fixed prior to commissioning. The settings are therefore based on the project planning data.
The following table shows all possible function for the **outputs**:

| *Setting Value* | *Function* | *Remarks* |
|---|---|---|
| 1…20 | Paralleling point | The relay is operated if the corresponding paralleling point is active, ie. selected and the synchronizing process is started. |
| 21…40 | Parameter set | The relay is operated if the corresponding parameter set is active, ie. selected and the synchronizing process is started. |
| 41 | Parameter set ≠ Paralleling point | The relay is operated if the number of the parameter set and the number of the paralleling point is different. |
| 42 | Release dead bus given | The relay is operated if the signal Release DB is present at the input (irrespective of the operating status) |
| 43 | Rejection (STOP) | The relay is operated if the signal Stop is present at the input (irrespective of the operating status) |
| 44 | Phase-angle difference within tolerance band | These signals can only be active in ‚OPERATING‘, or in ‚TEST‘ mode (configurable). |
| 45 | Slip within tolerance band | |
| 46 | Voltage difference within tolerance band | |
| 47 | U1 leading (α = positive) | |
| 48 | U1 lagging (α = negative) | |
| 49 | Oversynchronous (s = negative) | |
| 50 | Subsynchronous (s = positive) | |
| 51 | U2 > U1 | |
| 52 | U2 < U1 | |
| 53 | U1 outside of permitted range (Umin, Umax and U0max) | |
| 54 | U2 outside of permitted range (Umin, Umax and U0max) | |
| 55 | U1 < U0max | |
| 56 | U2 < U0max | |
| 57 | U2 and U2 < U0max | |
| 58 | U1 or U2 < U0max | |
| 59 | CHK RELEASE channel 1 | Release paralleling command in channel 1 |
| 60 | Paralleling command display in TEST mode | If TEST mode is active (see configurable inputs, value 41), the paralleling command is passed to |

| *Setting Value* | *Function* | *Remarks* |
|---|---|---|
| | | this relay. |
| 61 | CMD active | Channel 1 command relay is closed (read from auxiliary contact) |
| 62 | CH2 REL active | Command release relay of channel 2 is closed (read from auxiliary contact; SYN 6202 only) |
| 63 | CMD and CH2 REL active | Command relay channel 1 and command release relay channel 2 are closed |
| 64 | Contact monitoring of paralleling command circuits triggered | The relay is operated if at least one of both command relays (channel 1 or channel 2) is in the wrong position (eg, fail to open) |
| 65 | Contact monitoring of paralleling command circuits **not** triggered | Inversion of #63: The relay is operated if both command relays are in the correct position. |
| 66 | U+ | Second adjusting command output |
| 67 | U- | |
| 68 | f+ | |
| 69 | f- | |
| 70 | ERROR | The relay is operated on detection of an error |
| 71 | NO ERROR | The relay is operated if no error is present |
| 72 | READY | The relay is operated if the device is ready for operation (normal status of the device when commissioned) |
| 73 | OPERATING | The relay is operated if the synchronizing process is running (following expiry of t block) |
| 74 | BLOCKED | The relay is operated if the device is in ‚BLOCKED' status |
| 75 | Feedback operating mode TEST selected | The relay is operated if the TEST mode is selected, or during running process in TEST mode. |
| 76 | Single device configuration | No function for this device, only for SYN 6302 |
| 101-116 | Output functions 1...16 of the control logic | Free outputs in case of a control logic |

### 5.4.2. 3212…3124 Configuration of the LEDs

For the LEDs, the same function table as for the relay outputs applies (see *Chapter 5.4.1*).

The numbering of the LEDs is as follows:

| LED | Standard function |
|---|---|
| 01 | U+ |
| 02 | U- |
| 03 | f+ |
| 04 | f- |

| LED | Standard function |
|---|---|
| 09 | |
| 10 | |
| 11 | CH2 RELEASE |
| 12 | COMMAND |

| | |
|---|---|
| 05 | ΔU<ΔUmax |
| 06 | s < smax |
| 07 | α < αmax |
| 08 | U1/U2 = 0 |

| | |
|---|---|
| xx | READY |
| xx | OPERATING |
| 13 | BLOCKED |
| xx | ERROR |

### 5.4.3. 3225…3240 Configuration of the events (only SynView 6)

16 configurable events that can take over functions from the function table for the relay outputs, are available (see *Chapter 5.4.1*).

## 5.5. Configuration and addressing of the operating interface

### 5.5.1. Selection of the protocol

**3301 Selection of the protocol „ProtocolSelect“**
The following table shows the coding for the selection of the various protocols for the operating interface:

| Code | Protocol |
|---|---|
| 0 | No operating interface |
| 1 | Modbus RTU |
| 2 | Profibus DP |
| 3 | IEC 61850 |

### 5.5.2. Configuration Modbus RTU

The configuration of the Modbus RTU-interface is carried out using the following setting parameters:

**3302 Setting the slave address MB SlaveAddr**
Setting range: 1 to 247

**3303 Setting of the Baud rate MB BaudRate**

| *Code* | *Baud rate* |
|---|---|
| 0 | 1200 |
| 1 | 2400 |
| 2 | 4800 |
| 3 | 9600 |
| 4 | 19200<br>(factory setting) |
| 5 | 38400 |
| 6 | 57‘600 |
| 7 | 76‘800 |
| 8 | 115‘200 |

**3304 Setting of the parity MB Parity**

| *Code* | *Parität* |
|---|---|
| 0 | none, 1 stop bit |
| 1 | odd, 1 stop bit |
| 2 | even, 1 stop bit |

**NOTE!**

The electrical mode (RS232 or RS485) is configured by connecting or not connecting Pin 3 to +5V and Pin 2 (see also Chapter 11.3.3 under „Modbus RTU“).

If the SYNCHROTACT 6 device is configured in RS485-mode and if it is the first or last component in the bus, a connector with integrated termination must be used to prevent reflections on the bus line.

### *5.5.3. Addressing Modbus RTU*

20 words with 16 bits each are transmitted. The addressing is as follows:

| *Address* | *Content* | *Word class* | *Transmission direction* | *Format* | *Scaling* |
|---|---|---|---|---|---|
| 1 | Binary inputs | Bit-coded | read and write | -- | -- |
| 2 | Binary outputs | Bit-coded | read | -- | -- |
| 3 | Binary outputs | Bit-coded | read | -- | -- |
| 4 | Actual value $\Delta$U | Analog value | read | signed integer** | 0,1 % of Un |
| 5 | Actual value $\alpha$ | Analog value | read | signed integer | 0,1 DEG |
| 6 | Actual value s | Analog value | read | signed integer | 0,01 % |
| 7 | Actual value U1 | Analog value | read | signed integer | 0,1 % of Un |
| 8 | Actual value U2 | Analog value | read | signed integer | 0,1 % of Un |
| 9 | Actual value f1 | Analog value | read | signed integer | 0,01 Hz |
| 10 | Actual value f2 | Analog value | read | signed integer | 0,01 Hz |
| 11 | Actual value ds/dt | Analog value | read | signed integer | 0,01 %/s |
| 12 | Confirmation of selected parameter set | Analog value | read | unsigned integer *** | Number of the selected parameter set |

| *Address* | *Content* | *Word class* | *Transmission direction* | *Format* | *Scaling* |
|---|---|---|---|---|---|
| 13 | Software version (Version of the Simulink application) | Analog value | read | unsigned integer | Pro Nibble (half byte) a digit of the version number |
| 14 | Command counter parameter set 1 | Analog value | read | unsigned integer | None |
| 15 | Command counter parameter set 2 | Analog value | read | unsigned integer | None |
| 16 | Command counter parameter set 3 | Analog value | read | unsigned integer | None |
| 17 | Command counter parameter set 4 | Analog value | read | unsigned integer | None |
| 18 | Command counter parameter set 5 | Analog value | read | unsigned integer | None |
| 19 | Command counter parameter set 6 | Analog value | read | unsigned integer | None |
| 20 | Command counter parameter set 7 | Analog value | read | unsigned integer | None |

* Read = read data from SYNCHROTACT 6
** signed integer = Integers
*** unsigned integer = Positive integers

### Resolution of the bit-coded words into separate binary signals:

Address 1 (Index 0):

| *Bit* | *Binary signal* |
|---|---|
| 0 | START |
| 1 | STOP |
| 2 | Release DB |
| 3 | Reset |
| 4 | Blocking of the operating interface (read only!)<br>**Note**: The signal is also shown in address 2, bit 4. Here it is only for reasons of compatibility with SYNCHROTACT 5. |
| 5 | -- |
| 6 | -- |
| 7 | -- |
| 8 | Configurable binary input BIN01 |
| 9 | Configurable binary input BIN02 |
| 10 | Configurable binary input BIN03 |
| 11 | Configurable binary input BIN04 |
| 12 | Configurable binary input BIN05 |
| 13 | Configurable binary input BIN06 |
| 14 | Configurable binary input BIN07 |
| 15 | -- |

Address 2 (Index 1):

| *Bit* | *Binary signal* |
|---|---|
| 0 | Status $\Delta U<\Delta Umax$ |
| 1 | Status s<smax |
| 2 | Status $\alpha<\alpha max$ |
| 3 | Status U1 or U2 < U0max |
| 4 | Operating interface blocked |
| 5 | -- |
| 6 | -- |
| 7 | -- |
| 8 | Configurable binary output BOUT01 |
| 9 | Configurable binary output BOUT02 |
| 10 | Configurable binary output BOUT03 |
| 11 | Configurable binary output BOUT04 |
| 12 | Configurable binary output BOUT05 |
| 13 | Configurable binary output BOUT06 |
| 14 | Configurable binary output BOUT07 |
| 15 | -- |

Address 3 (Index 2):

| *Bit* | *Binary signal* |
|---|---|
| 0 | Status ERROR |
| 1 | Status BLOCKED |
| 2 | Status READY |
| 3 | Status OPERATING |
| 4 | Status U+ |
| 5 | Status U- |
| 6 | Status f+ |
| 7 | Status f- |
| 8 | Status CMD channel 1 (SW-signal to the relay) |
| 9 | Status CH2 REL (SW-signal to the relay) |
| 10 | Status COMMAND (feedback contacts to both relays, CMD and CH2 REL) |
| 11 | -- |
| 12 | -- |
| 13 | -- |
| 14 | -- |
| 15 | -- |

### *5.5.4. Configuration Profibus DP*

The configuration of the Profibus DP-interface is made by means of the following adjusting parameter:

**3305 Setting of the Slave Address PB SlaveAddr**
Setting range: 1 to 125

**Remark about baud rate**
The transmission speed (baud rate) is automatically detected by SYNCHROTACT 6 in the range from 9.6 kbit/s to 12Mbps.

**NOTE!**

If the SYNCHROTACT 6 device is the first or last component in the bus, a connector cable with integrated termination must be used in order to prevent reflections on the bus cable.

### *5.5.5. Addressing Profibus DP*

20 words with 16 bits each are transmitted. The addressing is as follows:

| *Address* | *Content* | *Word class* | *Transmission direction* | *Format* | *Scaling* |
|---|---|---|---|---|---|
| 1 | Binary inputs | Bit coded | read and write | -- | -- |
| 2 | Binary outputs | Bit coded | read | -- | -- |
| 3 | Binary outputs | Bit coded | read | -- | -- |
| 4 | Actual value $\Delta U$ | Analog value | read | signed integer** | 0,1 % of Un |
| 5 | Actual value $\alpha$ | Analog value | read | signed integer | 0,1 DEG |
| 6 | Actual value s | Analog value | read | signed integer | 0,01 % |
| 7 | Actual value U1 | Analog value | read | signed integer | 0,1 % of Un |

| *Address* | *Content* | *Word class* | *Transmission direction* | *Format* | *Scaling* |
|---|---|---|---|---|---|
| 8 | Actual value U2 | Analog value | read | signed integer | 0,1 % of Un |
| 9 | Actual value f1 | Analog value | read | signed integer | 0,01 Hz |
| 10 | Actual value f2 | Analog value | read | signed integer | 0,01 Hz |
| 11 | Actual value ds/dt | Analog value | read | signed integer | 0,01 %/s |
| 12 | Confirmation of selected parameter set | Analog value | read | unsigned integer *** | Number of selected parameter set |
| 13 | Software version (Version of the Simulink Application) | Analog value | read | unsigned integer | Pro Nibble (half byte) a digit of the version number |
| 14 | Command counter parameter set 1 | Analog value | read | unsigned integer | None |
| 15 | Command counter parameter set 2 | Analog value | read | unsigned integer | None |
| 16 | Command counter parameter set 3 | Analog value | read | unsigned integer | None |
| 17 | Command counter parameter set 4 | Analog value | read | unsigned integer | None |
| 18 | Command counter parameter set 5 | Analog value | read | unsigned integer | None |
| 19 | Command counter parameter set 6 | Analog value | read | unsigned integer | None |
| 20 | Command counter parameter set 7 | Analog value | read | unsigned integer | None |

* Read = Read data from SYNCHROTACT 6
** Signed integer = integers
*** Unsigned integer = positive integers

### Resolution of the bit-coded words into separate binary signals:

Address 1 (Index 0):

| *Bit* | *Binary signal* |
|---|---|
| 0 | START |
| 1 | STOP |
| 2 | Release DB |
| 3 | Reset |
| 4 | Blocking of the operating interface (read only!) **Note**: The signal is also shown in address 2, bit 4. Here it is only for reasons of compatibility with SYNCHROTACT 5. |
| 5 | -- |
| 6 | -- |
| 7 | -- |
| 8 | Configurable binary input BIN01 |
| 9 | Configurable binary input BIN02 |
| 10 | Configurable binary input BIN03 |
| 11 | Configurable binary input BIN04 |
| 12 | Configurable binary input BIN05 |
| 13 | Configurable binary input BIN06 |
| 14 | Configurable binary input BIN07 |
| 15 | -- |

Address 2 (Index 1):

| *Bit* | *Binary signal* |
|---|---|
| 0 | Status $\Delta U<\Delta Umax$ |
| 1 | Status s<smax |
| 2 | Status $\alpha<\alpha max$ |
| 3 | Status U1 or U2 < U0max |
| 4 | Operating interface blocked |
| 5 | -- |
| 6 | -- |
| 7 | -- |
| 8 | Configurable binary output BOUT01 |
| 9 | Configurable binary output BOUT02 |
| 10 | Configurable binary output BOUT03 |

| Bit | Binary signal |
|---|---|
| 11 | Configurable binary output BOUT04 |
| 12 | Configurable binary output BOUT05 |
| 13 | Configurable binary output BOUT06 |
| 14 | Configurable binary output BOUT07 |
| 15 | -- |

Address 3 (Index 2):

| Bit | Binary signal |
|---|---|
| 0 | Status ERROR |
| 1 | Status BLOCKED |
| 2 | Status READY |
| 3 | Status OPERATING |
| 4 | Status U+ |
| 5 | Status U- |
| 6 | Status f+ |
| 7 | Status f- |
| 8 | Status CMD channel 1 (SW-signal to the relay) |
| 9 | Status CH2 REL (SW-signal to the relay) |
| 10 | Status COMMAND (feedback contacts to both relays, CMD and CH2 REL) |
| 11 | -- |
| 12 | -- |
| 13 | -- |
| 14 | -- |
| 15 | -- |

### 5.5.6. IEC 61850 Data model

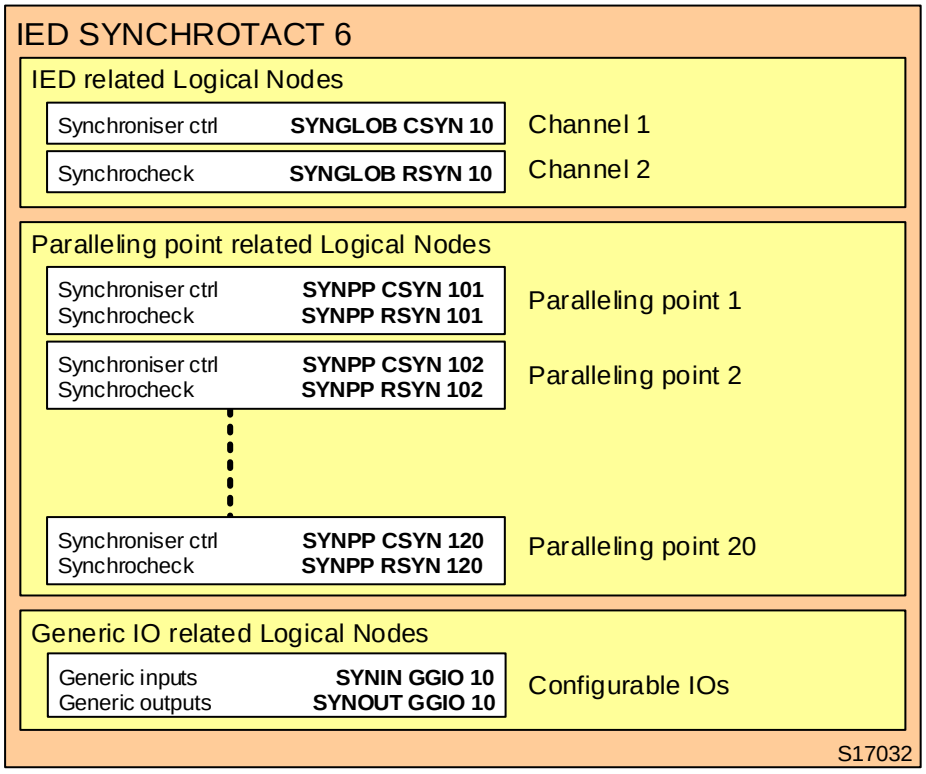



*Figure 5-6 IEC 61850 Data model*

### 5.5.7. Overview - Logical Nodes

| LN Name | Content | Comments |
|---|---|---|
| ***IED related Logical Nodes*** | | |
| SYNGLOB CSYN 10 | IED related | Controls, Status Information, MV |
| SYNGLOB RSYN 10 | IED related | Status Information (only SYN 6202) |
| ***Paralleling point related Logical Nodes*** | | |
| SYNPP CSYN 101 | Paralleling point 01 | Controls, Status Information, MV (CH1) |
| … | … | … |
| SYNPP CSYN 120 | Paralleling point 20 | Controls, Status Information, MV (CH1) |
| SYNPP RSYN 101 | Paralleling point 01 | Status Information (CH2)<br>(only SYN 6202) |
| … | … | … |
| SYNPP RSYN 120 | Paralleling point 20 | Status Information (CH2)<br>(only SYN 6202) |
| ***Generic IO related Logical Nodes*** | | |
| SYNIN GGIO 10 | Binary inputs 1-20 | • Configurable binary inputs (1-13)<br>• 14 to 20: not used |
| SYNOUT GGIO 10 | Binary outputs 1-20 | • Configurable binary outputs (1-11)<br>• 12 to 20: not used |

### 5.5.8. Logical Node 0

The Status Information DO “Beh” of the LLN0 is used to map the SYNCHROTACT 6 status:

**LLN0**

| IEC 61850 Data Object | SYNCHROTACT 6 name | Comments | DR | GR |
|---|---|---|---|---|
| ***Descriptions*** | | | | |
| NamPlt | xxx | Name plate | No | No |
| ***Controls*** | | | | |
| Mod | | Status SYNCHROTACT 6 (Note: Mod can only be used as status information) | Yes | No |
| ***Status Information*** | | | | |
| Beh | Status | Behavior: Feedback Status SYNCHROTACT 6 (see below) | Yes | No |
| Health | | Health | Yes | No |

**DR** = Data Report
**GR** = GOOSE Report

**Assignment of the SYNCHROTACT 6 status to the values for “Beh”:**

| Value | Mode | SYNCHROTACT 6 name | Comments |
|---|---|---|---|
| 1 | on | READY / OPERATING | Normal operation |
| 2 | on-blocked | BLOCKED | Maintenance / Commissioning |
| 3 | test | BLOCKED & TEST | SEEK functions active (during commissioning) |
| 4 | test/blocked | n/a | not used in SYNCHROTACT application |
| 5 | off | BLOCKED & ERROR | Common failure (can be fault of the SYNCHROTACT, but can also be a wrong setting, wrong handling, or external problem: However, no synchronizing process is possible |

## 5.5.9. IED related Logical Nodes

### Channel 1: SYNGLOB CSYN 10

| *IEC 61850 Data Object* | *SYNCHROTACT 6 name* | *Comments* | *DR* | *GR* |
|---|---|---|---|---|
| ***Controls*** | | | | |
| SynPrg | START / STOP | TRUE = START, FALSE = STOP | Yes | No |
| RelDeaBus | RELEASE DB | | Yes | No |
| ***Status Information*** | | | | |
| Beh | | Status global synchronizing function | | No |
| Health | | Health | | No |
| Cmd | COMMAND | Display of the paralleling command of SYNCHROTACT 6 | Yes | No |
| Rel | CHK REL | Display of the paralleling command release of SYNCHROTACT 6 in synchrocheck mode (channel 1) | Yes | No |
| RV | U+ | | Yes | No |
| LV | U- | | Yes | No |
| RHz | f+ | | Yes | No |
| LHz | f- | | Yes | No |
| VInd | ΔU < ΔUmax | TRUE = ΔU > ΔUmax<br>FALSE = ΔU < ΔUmax | Yes | No |
| AngInd | α < αmax | TRUE = α > αmax<br>FALSE = α < αmax | Yes | No |
| HzInd | s < smax | TRUE = s > smax<br>FALSE = s < smax | Yes | No |
| RotDir1 | RotDirU1 | 1 = clockwise<br>2 = anti-clockwise<br>3 = unknown | Yes | No |
| RotDir2 | RotDirU2 | 1 = clockwise<br>2 = anti-clockwise<br>3 = unknown | Yes | No |
| ***Measured Values*** | | | | |
| DifVClc | ΔU | Voltage difference | No | No |
| DifHzClc | s | Slip | No | No |
| DifAngClc | α | Phase-angle difference | No | No |
| V1Clc | U1 | Voltage U1 | No | No |
| V2Clc | U2 | Voltage U2 | No | No |
| Hz1Clc | f1 | Frequency f1 | No | No |
| Hz2Clc | f2 | Frequency f2 | No | No |
| AccClc | ds/dt | Acceleration | No | No |

**DR** = Data Report
**GR** = GOOSE Report

### Status allocation of the global synchronizing function for “Beh”:

| *Value* | *Mode* | *SYNCHROTACT 6 Name* | *Comments* |
|---|---|---|---|
| 1 | on | OPERATING | Synchronizing procedure is running |
| 2 | on-blocked | READY | Synchronizing procedure is running, ready for operation |
| 3 | test | n/a | not used |
| 4 | test/blocked | n/a | not used |
| 5 | off | n/a | not used |

**Channel 2: SYNGLOB RSYN 10 (only SYN 6202)**

| *IEC 61850 Data Object* | *SYNCHROTACT 6 Name* | *Comments* | *DR* | *GR* |
|---|---|---|---|---|
| ***Status Information*** | | | | |
| Rel | CH2 REL | Display of the paralleling command release of SYNCHROTACT 6 (channel 2) | Yes | No |

## *5.5.10. Paralleling point related Logical Nodes*

**Channel 1: SYNPP CSYN 101 to 120**

| *IEC 61850 Data Object* | *SYNCHROTACT 6 Name* | *Comments* | *DR* | *GR* |
|---|---|---|---|---|
| ***Status Information*** | | | | |
| Beh | | Status paralleling point | | No |
| Health | | Health | | No |
| Cmd | COMMAND | Display of the paralleling command of the assigned PP | Yes | Yes |
| Rel | CHK REL | Display of the paralleling command release of the assigned PP in synchrocheck mode (ch 1) | Yes | Yes |
| RV | U+ | U+ of the assigned PP | Yes | Yes |
| LV | U- | U- of the assigned PP | Yes | Yes |
| RHz | f+ | f+ of the assigned PP | Yes | Yes |
| LHz | f- | f- of the assigned PP | Yes | Yes |

**DR** = Data Report
**GR** = GOOSE Report

**Status allocation of the global synchronizing function for "Beh":**

| *Value* | *Mode* | *SYNCHROTACT 6 Name* | *Comments* |
|---|---|---|---|
| 1 | on | n/a | Paralleling point x active addressed |
| 2 | on-blocked | n/a | Paralleling point x not addressed |
| 3 | test | n/a | not used |
| 4 | test/blocked | n/a | not used |
| 5 | off | n/a | not used |

**Channel 2: SYNPP RSYN 101 bis 120 (only SYN 6202)**

| *IEC 61850 Data Object* | *SYNCHROTACT 6 Name* | *Comments* | *DR* | *GR* |
|---|---|---|---|---|
| ***Status Information*** | | | | |
| Rel | CH2 REL | Display of the paralleling command release of the assigned PP (ch 2) | Yes | Yes |

**DR** = Data Report
**GR** = GOOSE Report

### 5.5.11. Logical Nodes for generic binary inputs SYNIN GGIO 10

| IEC 61850 Data Object | SYNCHROTACT 6 Name | Comments | DR | GR |
|---|---|---|---|---|
| **Controls** | | | | |
| SPCSO01 | BIN01 | Binary input 01 | Yes | No |
| … | … | … | Yes | No |
| SPCSO13 | BIN13 | Binary input 13 | Yes | No |
| SPCSO14 | | not used | | |
| SPCSO15 | | not used | | |
| SPCSO16 | | not used | | |
| SPCSO17 | | not used | | |
| SPCSO18 | | not used | | |
| SPCSO19 | | not used | | |
| SPCSO20 | | not used | | |

**DR** = Data Report
**GR** = GOOSE Report

### 5.5.12. Logical Nodes for generic binary outputs SYNOUT GGIO 10

| IEC 61850 Data Object | SYNCHROTACT 6 Name | Comments | DR | GR |
|---|---|---|---|---|
| **Status Information** | | | | |
| SPSSO01 | BOUT01 | Binary output 01 | Yes | No |
| … | … | … | Yes | No |
| SPSSO11 | BOUT11 | Binary output 11 | Yes | No |
| SPSSO12 | | not used | | |
| SPSSO13 | | not used | | |
| SPSSO14 | | not used | | |
| SPSSO15 | | not used | | |
| SPSSO16 | | not used | | |
| SPSSO17 | | not used | | |
| SPSSO18 | | not used | | |
| SPSSO19 | | not used | | |
| SPSSO20 | | not used | | |

**DR** = Data Report
**GR** = GOOSE Report

### 5.5.13. Configuration IEC 61850

No special configuration is required for the optional IEC 61850 – interface. The necessary information (IP addresses of the SYNCHROTACT 6-device in the IEC 61850 network and the time server) are contained in the project-specific SCD-file.

The SCD file is produced by the responsible project engineer and is then downloaded to the SYNCHROTACT 6 – device.

**NOTE!**

If the same connection is used for both IEC 61850 and SynView 6, both IP addresses must be different in order to prevent conflicts (see *Chapter 6.11.3*)

## 5.6. 45 SEEK-Functions

The execution of the SEEK-functions is described in *Chapter 8.1.7* with the MCP and in *Chapter 8.2.6* with SynView 6.

The following table shows the coding of the states of SEEK State in the display of the MCP:

| Code | State |
|---|---|
| 0 | No SEEK-function active |
| 10 | SEEK ton selected |
| 11 | SEEK ton waiting for confirmation, start conditions not fulfilled |
| 12 | SEEK ton waiting for confirmation, start conditions fulfilled |
| 13 | SEEK ton is executed |
| 14 | SEEK ton aborted |
| 20 | SEEK dUdt selected |
| 21 | SEEK dUdt waiting for confirmation, start conditions not fulfilled |
| 22 | SEEK dUdt waiting for confirmation, start conditions not fulfilled |
| 23 | SEEK dUdt is executed |
| 24 | SEEK dUdt aborted |
| 30 | SEEK dfdt selected |
| 31 | SEEK dfdt waiting for confirmation, start conditions not fulfilled |
| 32 | SEEK dfdt waiting for confirmation, start conditions fulfilled |
| 33 | SEEK dfdt is executed |
| 34 | SEEK dfdt aborted |

# Chapter 6 - Engineering instructions

## 6.1. General advice

### 6.1.1. Cable connections

Cables or wires with cross sections of 0.4 $mm^2$ to 2.5 $mm^2$ can be connected to all the connection terminals. It is recommended that 1 $mm^2$ should be used for control circuits and power supply connections; at least 1.5 $mm^2$ should be used for measuring circuits. Connection of more than one cable to a terminal is not permitted.

The casing must be connected with the earth potential via the connection provided for this purpose.

In order to prevent polarity errors, marked cables should be used for all voltage transformers (measuring circuits).

**CAUTION!**

It is urgently advised not to switch off the unit by interrupting the power supply, since otherwise the monitoring of the paralleling contacts is no longer guaranteed. In the event of a possible contact fault, incorrect paralleling could occur the next time synchronization is selected.

**IMPORTANT!**

In order to be able to later perform tests with secondary feed without having to remove wires, it is recommended to use disconnect terminals for the measuring voltages, the adjustment commands and the paralleling command.

### 6.1.2. Recommended measures for long distances

For distances >100 m, the following is recommended:

- The cables for the actual value measurement should have a cross-section of ≥2.5 $mm^{2,}$ and should be twisted pair and shielded.
- The control circuits should be operated with a nominal voltage of ≥125 VDC in order to prevent inductive interference.
- All cables must be laid separately from high-voltage and high-current cables.

### 6.1.3. Auxiliary voltage

The voltage supply for the SYNCHROTACT 6 – device must be permanently applied.

**IMPORTANT!**

The start-up time from switching on the auxiliary voltage until reaching the operating state is almost one minute!

The feed-in may be redundant, ie. paralleling of two sources is possible. In this case, two power supplies are paralleled at the output and decoupled on the positive side by means of diodes. The negative side is directly connected without diodes. If circuit breakers are used, those with K-characteristics should be selected (eg. ABB S282 UC-K) and they should be laid out in a two-pole manner.
The auxiliary voltage should not be grounded, as the internal filter can be negatively affected by EMC disturbances.

### 6.1.4. Polling voltage

External voltage or the 24 VDC voltage output on the SYNCHROTACT 6 device can be used as a polling voltage for controlling the binary inputs.

In the latter case, if two SYNCHROTACT 6 devices are used, both outputs can be connected in parallel. The positive pole is decoupled internally by diodes. The distance between the devices (conductor length) should not exceed 10 m.

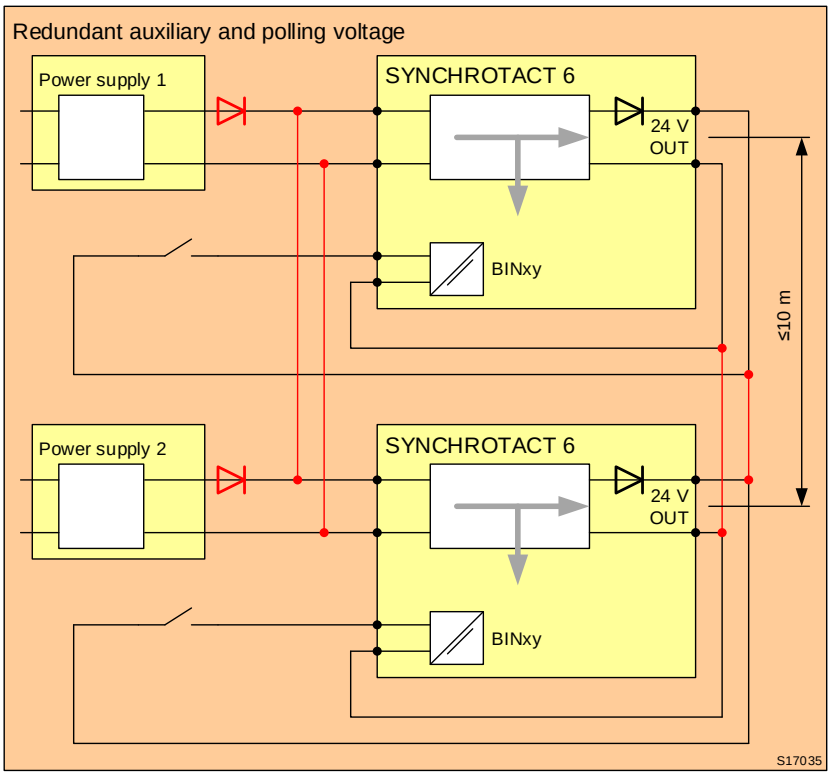



*Figure 6-1 Redundant auxiliary and polling voltage*

## 6.2. Sequences of the synchronizing process

The switch-on sequences are as follows:

- As a prerequisite, SYNCHROTACT 6 must be in READY state.
- Then all pre-selections must be made. Depending on the application, this is the selection of the operating mode (local, remote), the paralleling point, the parameter set selection, the control mode (AUTO, MAN, TEST) and the Release dead bus.
- The synchronization process is then started with the start pulse (START). The preselections can be made simultaneously with the start pulse. The pulse must be at least 0.5 s long (recommended length: 1 to 2 s), but can also be applied up to the end of the synchronization process (STOP).
- Immediately after the START, the relay contacts close for the selection of the paralleling point. The adjustable blocking time t block prevents a command output between selection and connection of the measuring voltages. On the factory side, t block is set to 2 seconds.
- During the ongoing synchronizing process (OPERATING), changes in the paralleling and parameter set selection are ignored.

Stopping the synchronizing process:

- Normally the synchronizing process is terminated with an auxiliary contact of the circuit breaker (CB closed = normally open). The signal is passed to the STOP input of SYNCHROTACT 6.
- In exceptional cases, a synchronizing process needs to be terminated without closing the circuit breaker. In this case, a parallel STOP command is to be sent to the SYNCHROTACT 6 (triggered manually or automatically).
- Depending on the setting of the parameters t tot, t stop and EffectSel, a STOP can be generated after a timeout. Optionally, this can be ERROR, or a normal STOP, along with an error message. However, the timeout parameters can also be switched off completely (see *Chapter 5.2.7*).

The stop signal should be at least 0.5 s long (recommended length: 1 to 2 s), but can be pending until a new synchronizing process is started.

Locking:
START and STOP are locked. STOP has priority.

## 6.3. Paralleling and parameter set selection

SYNCHROTACT 6 allows a lot of flexibility with the paralleling point and parameter set selection (see also *Chapter 3.3*). In order to keep the engineering work as simple as possible, the factory settings of the relevant setting parameters (parameter group 31) were selected in such a way that normally no or only minimal adjustments are necessary.

Therefore, the most frequent application is described below as a normal case and then the necessary measures for variants thereof.

**IMPORTANT!**

Only for the dual channel device SYN 6202:
When 2 to 6 parameter sets are used, channel 2 is normally selected via the hardware inputs (BIN1 to BIN6). In this case, the binary inputs BIN1 to BIN6 as well as the binary outputs BOUT1 to BOUT6 can no longer be configured or must be used with the factory setting (see C*hapter 3.3.2*).

### 6.3.1. Synchronizing 2 to 6 paralleling points

**Normal case**
Application: The synchronizing device is used only for automatic synchronization. Each paralleling point is assigned to one individual parameter set. The paralleling point and parameter set have the same ordinal number.

Implementation: Paralleling point and parameter set are selected together by means of binary inputs BIN01 to BIN06. All configuration parameters (esp. group 31) can be left to the factory setting.

**Variant 1: Common synchrocheck for manual synchronizing**
Application: in addition to automatic synchronizing (operating mode AUTO), SYNCHROTACT 6 as synchrocheck, can be manually synchronized (MAN operating mode). A common parameter set is used for the MAN operating mode.

Implementation: it is recommended to use parameter set 11 for the common synchrocheck function. In this case as well, no configuration parameters (esp. group 31) need to be changed. The factory settings for parameter set 11 are already prepared for synchrocheck operation, so that only two additional connections have to be wired:

- BIN11: to select MAN operating mode
- BOUT11: connects the manual paralleling switch in MAN operating mode in series with the paralleling release contact (see *Figure 6-2*)

Configuration parameters do not have to be set for this application.

Example for 2 paralleling points:
Operating behavior:

| ***Signal to:*** | ***Outputs:*** | ***Selected are:*** |
|---|---|---|
| Input BIN01 | BOUT01 closes | Parameter set 1 and paralleling point 1 |
| Input BIN02 | BOUT02 closes | Parameter set 2 and paralleling point 2 |
| Inputs BIN01 and BIN11 | BOUT01 and BOUT11 close | Parameter set 11 and paralleling point 1 |
| Inputs BIN02 and BIN11 | BOUT02 and BOUT11 close | Parameter set 11and paralleling point 2 |

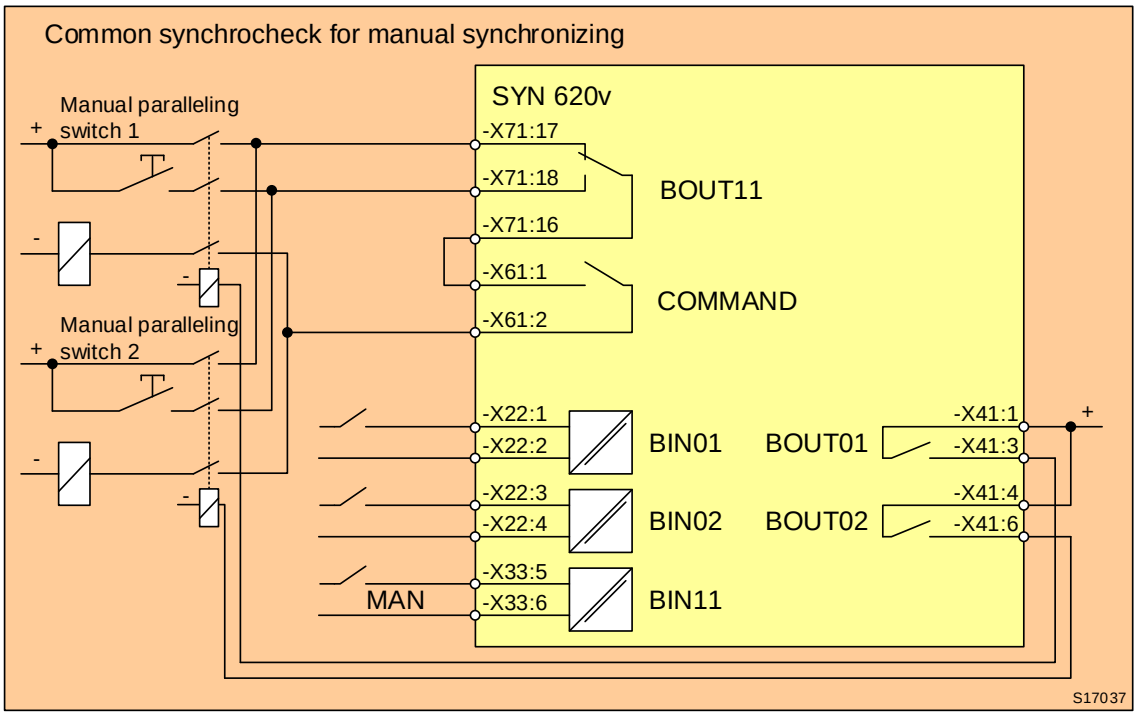



*Figure 6-2 Multiple paralleling points and manual synchronizing*

**IMPORTANT!**

Parameter settings for synchrocheck operation: see *Chapter 6.8*

**Variant 2: Individual synchrocheck settings for manual synchronizing**
Application: an individual parameter set is used for each paralleling point for the AUTO operating mode as well as for the MAN operating mode (eg. because the nominal values of the measuring voltages are different).

Implementation: The factory settings of the parameter sets 11 to 20 are already prepared for synchrocheck operation so that the parameter assignment for the MAN operating mode is best done as follows:

| *Paralleling point* | *Parameter set for MAN operating mode* |
|---|---|
| 1 | 11 |
| 2 | 12 |
| 3 | 13 |
| 4 | 14 |
| 5 | 15 |
| 6 | 16 |

Since only 13 binary inputs are available, free binary inputs must be determined and configured accordingly for the selection of parameter sets 11 to 16.

Example of a configuration for 4 paralleling points:

| *Paral-leling point* | *AUTO operating mode* | | *MAN operating mode* | | *Setting Configuration parameter* |
|---|---|---|---|---|---|
| | *Selection* | *Parameter set* | *Selection* | *Parameter set* | |
| 1 | BIN01 | 1 | BIN01<br>BIN07 | 11 | 3101 BIN01 Fct = +1<br>3107 BIN07 Fct = +31 |
| 2 | BIN02 | 2 | BIN02<br>BIN08 | 12 | 3102 BIN02 Fct = +2<br>3108 BIN08 Fct = +32 |
| 3 | BIN03 | 3 | BIN03<br>BIN09 | 13 | 3103 BIN03 Fct = +3<br>3109 BIN09 Fct = +33 |
| 4 | BIN04 | 4 | BIN04<br>BIN10 | 14 | 3104 BIN04 Fct = +4<br>3110 BIN10 Fct = +34 |

**NOTE!**

In the case of the dual channel device SYN 6202, the parameter set selection is normally determined by the binary inputs BIN01 to BIN06. When using several parameter sets for the same paralleling point, it is therefore not possible to use BIN01 to BIN06 for the selection of the second parameter set.

For this reason it is generally recommended to use the parameter sets 11 to 20 as second parameter sets and to use the binary inputs BIN07 to BIN13 for their selection.

As with variant 1, BOUT11 can be used to connect the manual paralleling switch in MAN operating mode in series with the paralleling release contact.

**Variant 3: Second parameter set for the same paralleling point**
Application: As with variants 1 and 2, several parameter sets are used for one paralleling point. A typical application is when synchronous networks, which are normally paralleled with small tolerance bands, are to be paralleled with coarser tolerances. Another example of variant 3 is individual settings of the frequency matcher in the pump and turbine operation of a pumped storage plant.

Implementation: The implementation is analogous to the variants 1 and 2, whereby the parameter sets that are preset for synchrocheck operation have to be set differently.

**Variant 4: 1 parameter set for several paralleling points**
Application: Several identical circuit breakers / machines shall be paralleled under the same conditions.

Implementation with SYN 6201: A binary input is determined for the parameter set selection. This must be activated electronically and configured accordingly. A further binary input is determined for each paralleling point.

Example for 3 paralleling points:
Determination of binary inputs and programming:

| ***Binary input*** | ***Intended Use*** | ***Programming*** |
|---|---|---|
| BIN01 | Permanent selection parameter set 1 | 3101 BIN01 Fct = +21<br>3114 BIN01 Mode = 1 |
| BIN02 | Selection paralleling point 1 | 3102 BIN02 Fct = +1 |
| BIN03 | Selection paralleling point 2 | 3103 BIN03 Fct = +2 |
| BIN04 | Selection paralleling point 3 | 3104 BIN04 Fct = +3 |

The output relay for the paralleling point selection can remain at the factory setting, ie BOUT01 selects paralleling switch 1 etc..

Operating behavior:

| ***Signal to:*** | ***Outputs*** | ***Selected are:*** |
|---|---|---|
| BIN02 | BOUT01 closes | Parameter set 1 and paralleling point 1 |
| BIN03 | BOUT02 closes | Parameter set 1 and paralleling point 2 |
| BIN04 | BOUT03 closes | Parameter set 1 and paralleling point 3 |

Implementation with SYN 6202: The same rules apply to the dual channel device. In addition, parameter set 1 must be permanently selected for channel 2:
Setting parameter 3127 „CH2 AlwaysPs1“ = ON

### *6.3.2. Synchronizing only one paralleling point*

**Normal case**
Application: The synchronizing device is only used for the automatic synchronization of a single paralleling point. No external selection is required.

Implementation: Parameter set 1 is permanently selected (with SYN 6202 in both channels).

Programming:

| *Device* | *Intended Use* | *Programming* |
|---|---|---|
| SYN 6201 | Permanent selection of paralleling point 1 and parameter set 1 | 3114 BIN01 Mode = “Always ON” [1] |
| SYN 6202 | Channel 1: permanent selection of paralleling point 1 and parameter set 1 | 3114 BIN01 Mode = “Always ON” [1] |
| | Channel 2: permanent selection of parameter set 1 | 3127 CH2 AlwaysPs1 = ON |

**Variant 1: Synchrocheck for manual synchronizing**
Application: In addition to automatic synchronizing (AUTO operating mode), SYNCHROTACT 6, as synchrocheck, can be used to synchronize manually (MAN operating mode).

Implementation: It is recommended to use parameter set 11 for the common synchrocheck function. For this purpose, the factory settings of parameter set 11 are already prepared for synchrocheck operation, so that only two additional connections have to be wired.

- BIN11: for the selection of MAN operating mode
- BOUT11: switches the manual paralleling switch in MAN operating mode in series with the paralleling release contact (see *Figure 6-2*)

Example:
Operating behavior:

| *Signal to:* | *Outputs:* | *Selected are:* |
|---|---|---|
| No signal | BOUT01 closes | Parameter set 1 and paralleling point 1 |
| BIN11 | BOUT01 and BOUT11 close | Parameter set 11 and paralleling point 1 |

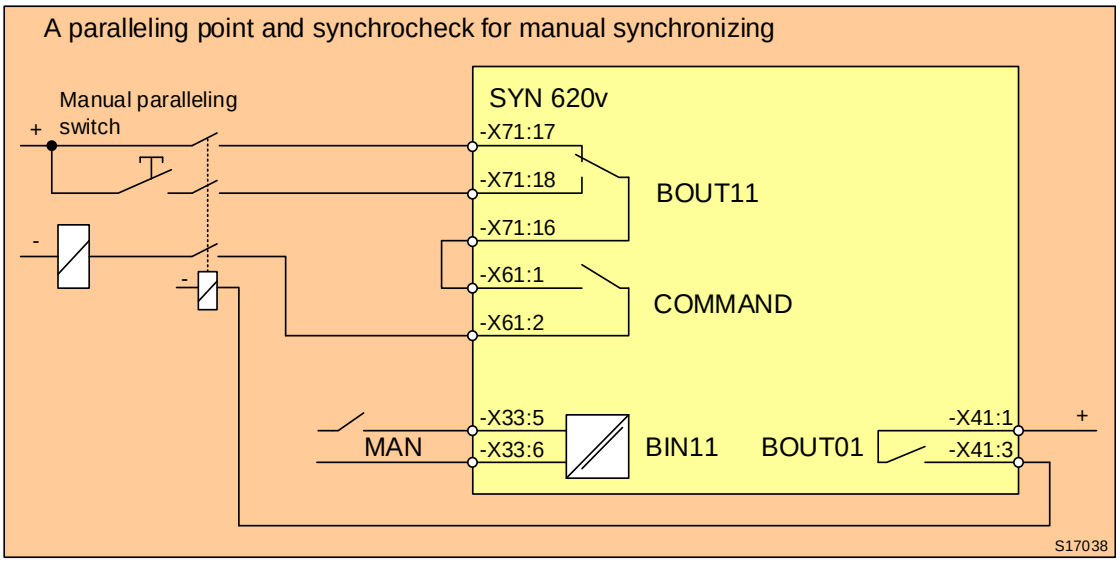



*Figure 6-3 One paralleling point and manual synchronizing*

**IMPORTANT!**

Parameter settings for synchrocheck operation: see *Chapter 6.8*

### *6.3.3. Synchronizing 7 or more paralleling points*

If 7 or more paralleling points are synchronized with a SYNCHROTACT 6 – device, the determination of the used IOs and the settings of the configuration parameters (groups 31 and 32) must be defined individually. The following is to be noted:

- 13 binary inputs (BIN01 to BIN13) are available for the selection of the paralleling point and parameter set at maximum.
- Maximum 11 relay outputs (BOUT01 to BOUT11) are available for the selection of the paralleling point.

- Maximum 20 parameter sets are available in the single-channel device SYN 6201, or in channel 1 of the dual channel device SYN 6202.
- SYN 6202: A maximum of 6 parameter sets are available in channel 2 of the dual channel device SYN 6202. Channel 2 accepts the parameter selection from the binary inputs BIN01 to BIN06 (not configurable). With more than 6 paralleling points, only parameter set 1 can be used. By means of programming (parameter: 3127 CH2 AlwaysPs1 = ON) parameter set 1 must be permanently selected in channel 2, then the binary inputs are no longer read. The use of only one parameter set in channel 2 generally presents no problem. The main reason for using individual parameter sets are eg. phase-shifted measurement voltages (which must be electronically compensated), or different nominal values of the measuring voltages.

## *6.4. Use of the operating interface for the selection*

### *6.4.1. Selection only via the operating interface*

The selection of the paralleling point and the parameter set can be effected via an operating interface, eg. IEC 61850. It is recommended to use the same binary inputs (software) as for a fixed wiring. The mode of operation is then also analogous as described in Chapter *6.3.*

**Special case SYN 6202:**
Since the operating interface acts on channel 1, channel 2 must accept the parameter set selection from channel 1 instead of the binary inputs.
By setting parameter 3128 CH2Ctrl by CH1 = ON, channel 2 behaves as follows:

- Hardware-selection (binary inputs BIN01 to BIN06) is ignored
- Parameter set selection is determined by channel 1 and the **Paralleling point selection of channel 1** is adopted.

The binary inputs are available for other functions.

**IMPORTANT!**

The transfer of the parameter set selection from channel 1 is not SIL-compatible, since two diagnostic functions cannot be used:

- Diagnostics function for checking the correspondence of selection at the binary inputs and selection of the output relay for the paralleling point selection is deactivated.
- Diagnostic function is not possible for checking the correctness of the selections in channel 1 and channel 2.

### *6.4.2. Mixed selection of hard wiring / operating interface*

If a mixed selection is desired (eg for local / remote operation), the access can be disabled via the operating interface when the local control is active. The hard-wired local control can be effected externally by interrupting the control voltage.

A free, configurable binary input (BIN01 bis BIN13) can be used to block the operating interface (example for BIN13: setting parameter BIN13 Fct = +45). See *Chapter 5.3.1*.

The active signal at the blocking input blocks the operation via the operating interface. Exempt from the blocking:

- The STOP-input is always active, ie. cannot be blocked.
- For the configurable inputs, the desired function code can be entered negatively (minus as a sign), then the corresponding input cannot be blocked.

In the following example, the binary inputs are used as follows:

- BIN01 to BIN03: blockable inputs (eg. parameter set selection)
- BIN04 not blockable
- BIN05 to BIN12 not used
- BIN13 = Blocking input (active signal blocks the remote control)

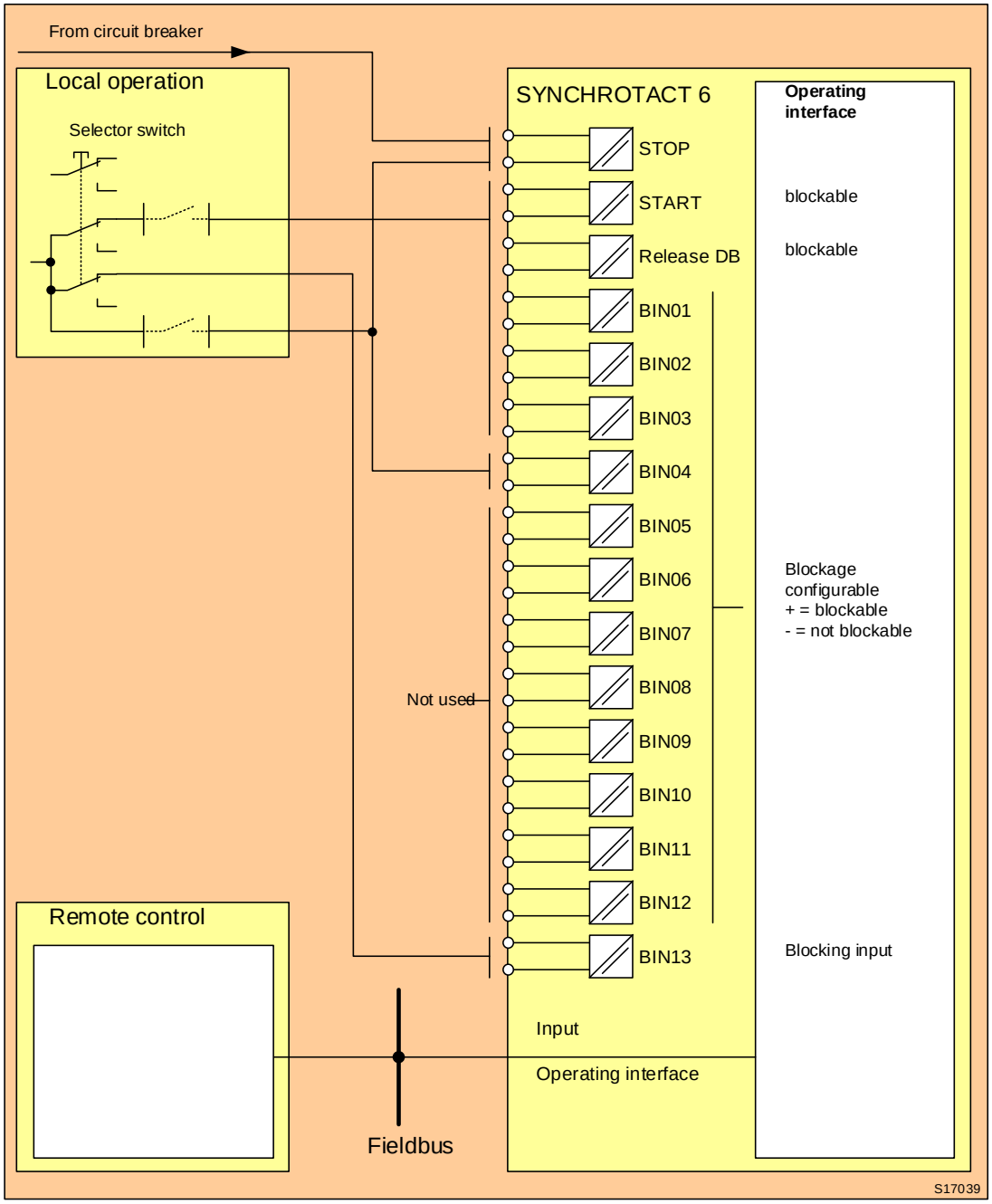



*Figure 6-4 Example of mixed operation local/remote*

## 6.5. Execution of the paralleling point selection


**DANGER!**

It must be ensured that the selection of the paralleling point and the associated parameter set always match.

It must also be ensured that all current circuits are selected and deselected with each other within the paralleling point selection. This applies in particular if parts of the paralleling point selection are handled electronically.

For this reason it is recommended to loop the paralleling point selection via the SYNCHROTACT 6 – device, as described in *Chapter 6.3.*

Die paralleling point selection can be performed in various ways:

- SYNCHROTACT 6 relay output contact to external contact multiplier
- Electronically, eg. via communication interface

### 6.5.1. Executing the paralleling point selection by means of relay contacts

The paralleling point / parameter set selection is done by means of binary inputs BIN01 to BIN13 on the SYNCHROTACT 6 – device. After receiving the START command, SYNCHROTACT 6 reads the selection and activates the corresponding parameter set and the output relay BOUT01 to BOUT11. This output contact is to be used to connect all paralleling point related circuits to the synchronizer (see also *Chapter 3.3*). As a switch, we recommend the SYN 6500 auxiliary device, or other products with forcibly guided contacts.

**Using SYN 6500**
The device essentially serves to connect the measuring and command circuits of several paralleling points alternatively to the synchronizing device. By means of corresponding programming of the switching bridges W1 to W6, either 2 * 16 single-pole signals, or 4 * 8 single-pole signals can be connected. In the latter case, the signals at the output must be bridged (see the diagram in *Chapter 12 - Schemata*).

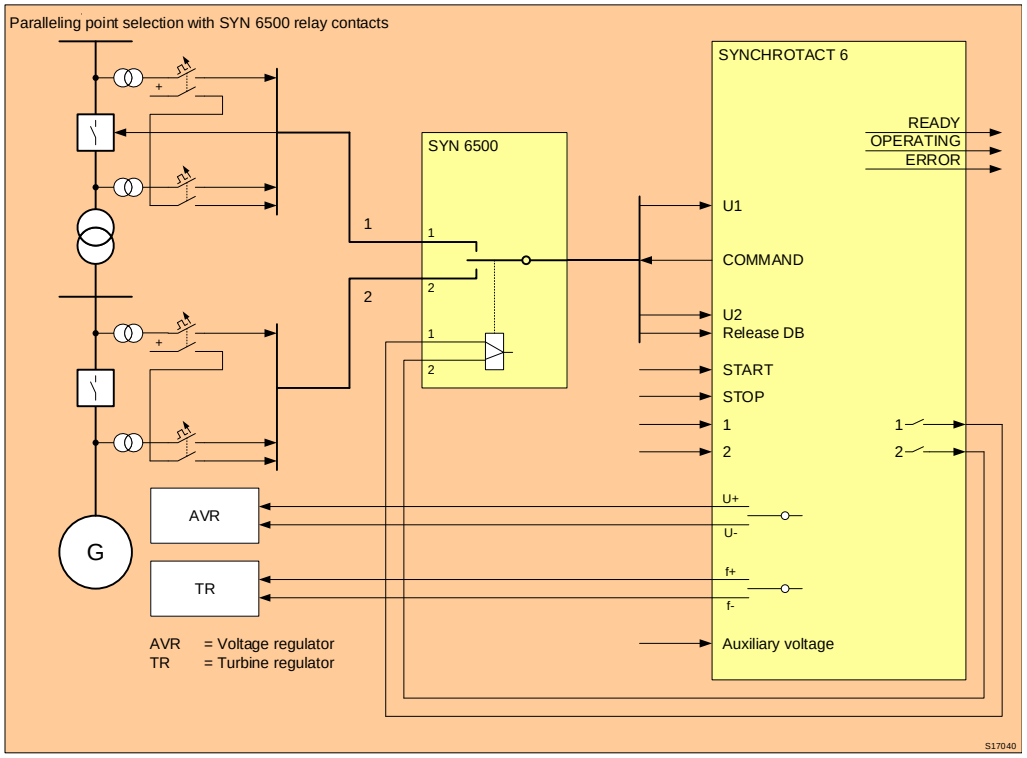



*Figure 6-5 Paralleling point selection with SYN 6500*

## *6.5.2. Electronic design of the paralleling point selection*

Depending on the application, parts, or the entire paralleling point selection can be executed electronically. The following parts can be executed electronically:

- Measuring point selection
- Selection of the adjusting commands
- Selection of the paralleling command circuits.

Other parts, eg, the release signal for dead bus (Release DB) can be carried out electronically by externally forming the criteria (circuit breaker polling of the relevant measuring voltages) and the release signal already arriving as a qualified signal at the synchronizing device.


**DANGER!**

It must be ensured that all circuits are selected and deselected with each other within the paralleling point selection.

For this reason, it is recommended to loop the entire paralleling point selection via the SYNCHROTACT 6 – device, as described in *Chapter 6.3.*

**Electronic design of the measuring point selection**
SYNCHROTACT 6 provides 8 analog inputs which can be selected electronically (see *Chapter 6.6.4*). The selection takes place in the corresponding parameter sets. That is, in each parameter set an analog input is assigned to the measuring voltages U1 and U2 by setting the parameters 06 AINSelU1 and 07 AINSelU2 (SYN 6202, channel 2: 84 AINSelU1 and 85 AINSelU2).

This automatically selects the measuring point when the parameter set is selected.

**Electronic design of the adjusting command selection**
The Raise and Lower commands for voltage and/or turbine regulators can be sent to the voltage, resp. turbine regulator via communication interface (eg. IEC 61850, GOOSE).

**NOTE!**

In the electronic selection of the adjusting command circuits, it is necessary to determine how voltage resp. turbine regulators react in the event of malfunctions in the data transmission of the adjusting commands.

**Electronic execution of the paralleling command circuit selection**
The paralleling command circuits can be sent to the circuit breaker via a communication interface (eg. IEC 61850, GOOSE).


**DANGER!**

In the case of electronic selection of the paralleling command circuits (COMMAND), it is important to note that errors in the data transmission of the paralleling command circuit can be dangerous. The use of this function for asynchronous sources (generator synchronization) is therefore not recommended.

With dual channel devices SYN 6202, the second channel is no longer independent!

## *6.6. Connection of the measuring voltages*

Eight analog inputs are available for SYNCHROTACT 6-Synchronizing devices.
These can be used either for the connection of single- or multi-phase measuring voltages. In principle, a single-phase measurement is sufficient for synchronizing. This means that the eight analog inputs are available for the electronic selection of the measuring voltage (instead of via external relay contacts).
If the task is assigned to the synchronization device, to detect a phase failure, and / or the phase sequence (direction of rotation), two or three analog inputs per measurement must be used. This automatically removes electronically selectable measurement inputs.

**CAUTION!**

Especially when using the dead bus function, it must be noted that an unrecognized phase failure can simulate a dead bus situation. The adjacent release signal for dead bus could trigger a synchronization error in such a case.

**CAUTION!**

When the measuring voltages are selected electronically, it must be ensured that they always match the rest of the paralleling point selection. For this, the recommendations in Chapter 5.2 are compulsory.

### *6.6.1. Single-phase measurement*

For the single-phase measurement, an analog input is assigned to each measuring channel by means of parameter setting.
In the case of the dual channel device SYN 6202, the inputs for channel 2 can be assigned separately. Normally, the measuring channels of channel 2 are assigned to the same analog inputs as channel 1. If, however, redundant voltage transformers are present, the measurement of both channels can be distributed to both transformers.
The assignment of different phases of the same transformer to both channels is described under the multi-phase measurement.

### *6.6.2. Multi-phase measurement*

In multi-phase measurement the 3 phases can be distributed to either two, or three (successive) analogue inputs. For the calculation of the parallel switching command, only the first analog input is used while the following analog inputs are used for the recognition of the phase sequence.
When measuring with two analog inputs, the phase sequence can be reversed (clockwise or counterclockwise) depending on the connection diagram. However, if both measuring channels are connected according to the same connection diagram, at least one can recognize whether the direction of rotation is the same or opposite.
An advantage of the variant with two analog inputs is that four different measurements can still be electronically selected with consideration of all three phases.
For the dual channel device SYN 6202 it is recommended to connect channel 2 to the second or third analog input. Thus all phases are integrated into the calculation of the paralleling command.
The detection of the phase loss does not work if one of the phases is grounded on the secondary side instead of the star point.

### 6.6.3. Selection of the connection diagram

There are a number of possible connection schemes, some examples of which are given below. The preferred connection diagrams are marked in yellow. The examples always show the synchronization of two circuit breakers.
The most important rule is that, if possible, both measuring voltages used for synchronizing are connected according to the same scheme.
The rotation detection expects a voltage shifted by +120 or -120 DEG at the following analog inputs. For this reason, the wires at the second analog input are for example not interchanged (180 DEG rotation), otherwise the phase shift will be 120 +180 = -60 DEG, which is not possible.
When measuring with 2 analog inputs, the directional detection at the second analog input expects the 120 DEG (and not the 240 DEG) following voltage, otherwise the sense of rotation is reversed.

Examples:

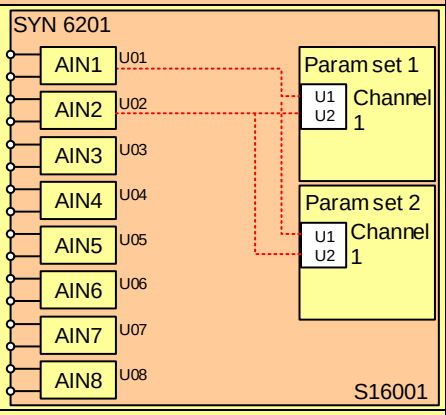
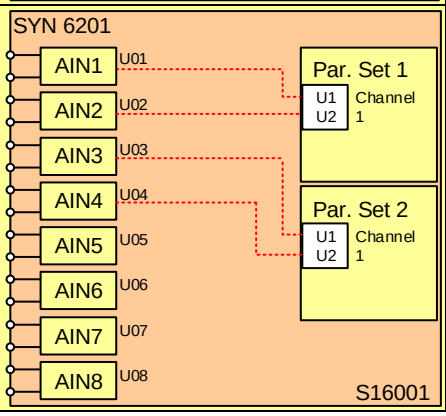
| *Analog input 1* | *Analog input 2* | *Analog input 3* | *Allowed?* |
|---|---|---|---|
| L1-L2 | L2-L3 | xx | Yes |
| L1-L2 | L3-L2 | xx | No |
| L2-L1 | L3-L2 | xx | Yes |
| L1-L2 | L3-L1 | xx | Yes, but not recommended, because sense of rotation is false |
| L1-L2 | L1-L3 | xx | No |
| L1-L2 | L2-L3 | L3-L1 | Yes |

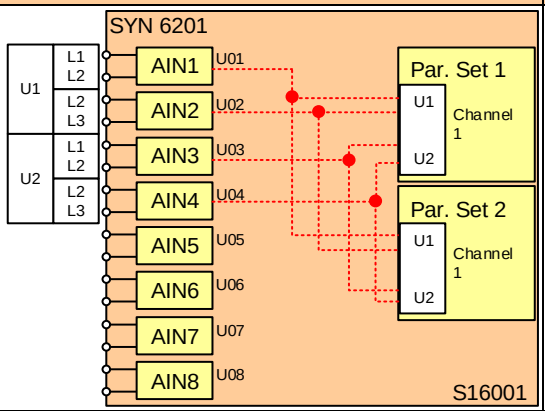
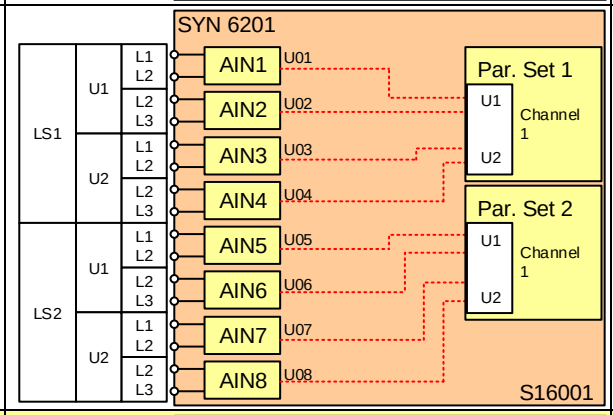
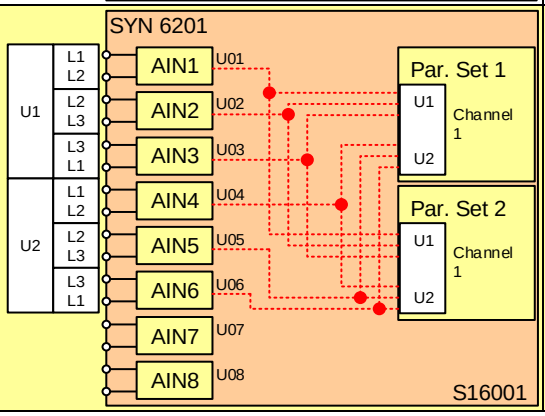
### 6.6.4. Connection examples

Reading support:

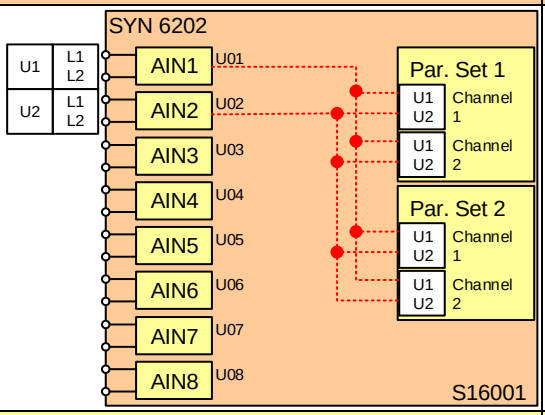
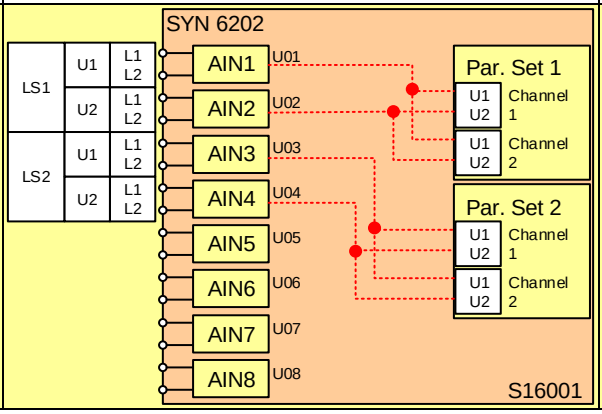
The circuit diagrams of all examples are always designed for the synchronization of two circuit breakers.
The first five examples are for single channel devices SYN 6201 and the second five examples for dual channel devices SYN 6202.
Then, a distinction is made between single-phase or two-phase (Ph-N, or Ph-Ph) and three-phase transformer connections (column on the left).
The number of analog inputs used for a measuring voltage can be set by means of parameters: 08 NoAIN = 1, 2, or 3. Successive analog inputs must be used for 2 and 3.
Example:
Setting: 08 NoAIN = 3; 06 AINSelU1 = 1; 07 AINSelU2 = 4
Meaning: U1 is measured at AIN1, AIN2, AIN3 and U2 at AIN4, AIN5, and AIN6.
When the measuring point is selected, it is specified whether the measuring voltages for the two circuit breakers are selected externally by means of relay contacts, or electronically.
The switching example shows the assignment of the measuring voltage at the physical input, as well as the allocation of the analog inputs to the measurement channels and parameter sets.

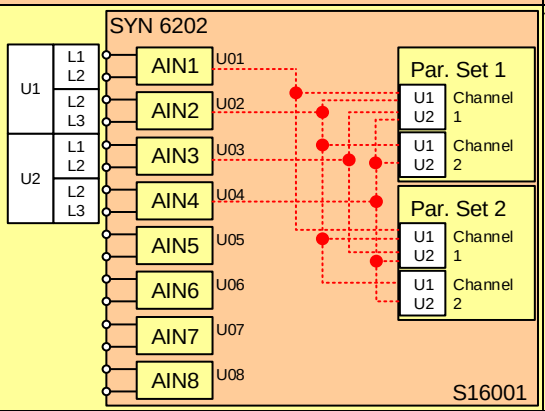
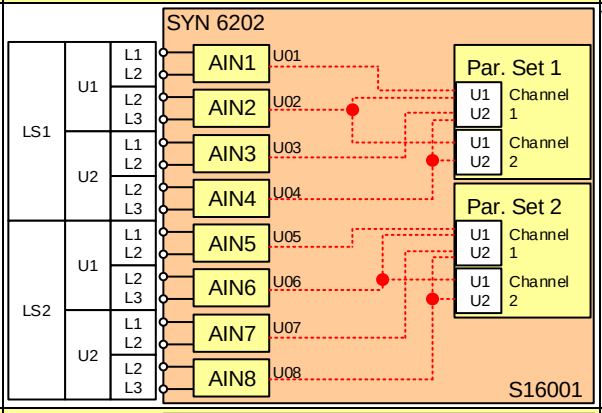
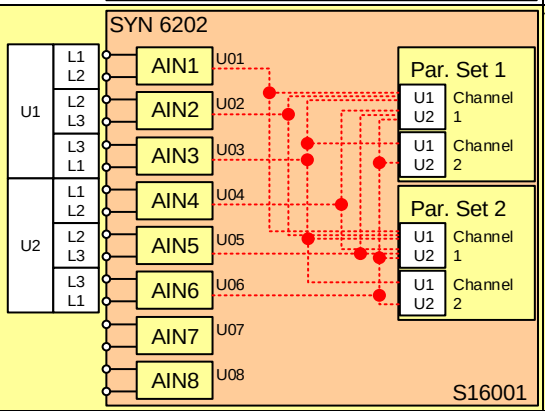
Connection examples for single-channel devices SYN 6201 and 2 circuit breakers:

| *Number of. trans-former phases* | *Number of AIN / voltage* | *Measuring point selection* | *Circuit diagram* | *Independent measurement* | *Detection of rotating field* |
|---|---|---|---|---|---|
| 1/2 | 1 | ext. contacts |  | No | No |
| 1/2 | 1 | electronic |  | No | No |

| *Number of. trans-former phases* | *Number of AIN / voltage* | *Measuring point selection* | *Circuit diagram* | *Independent measurement* | *Detection of rotating field* |
|---|---|---|---|---|---|
| 3 | 2 | ext. contacts |  | No | Yes |
| 3 | 2 | electronic |  | No | Yes |
| 3 | 3 | ext. contacts |  | No | Yes |

Connection examples for dual-channel device SYN 6202 and 2 circuit breakers:

| *Number of. trans-former phases* | *Number of AIN / voltage* | *Measuring point selection* | *Circuit diagram* | *Independent measurement* | *Detection of rotating field* |
|---|---|---|---|---|---|
| 1/2 | 1 | K1 & K2 common; ext. contacts |  | Yes, partly | No |
| 1/2 | 1 | K1 & K2 common; electronic |  | Yes, partly | No |

| Number of. trans-former | Number of AIN / voltage | Measuring point selection | Circuit diagram | Independent measurement | Detection of rotating field |
|---|---|---|---|---|---|
| 3 | 2 | K1 & K2 separated ext.contacts |  | Yes | Yes |
| 3 | 2 | K1 & K2 separated electronic |  | Yes | Yes |
| 3 | 3 | K1 & K2 separated ext. contacts |  | Yes | Yes |

### *6.6.5. Phase-angle compensation*

If the phase-angle difference and / or the voltage difference are not zero when the circuit breaker is closed, this can be compensated electronically by setting the parameters U1 / U2 and αOffset, for channel 1 and channel 2 separately.
If devices are used in parallel with the SYNCHROTACT 6, in which the electronic compensation is not possible (for example, a synchroscope), external compensating voltage transformers are to be used, to which the SYNCHROTACT 6 device is then connected.
In the case of external compensation, it is possible in many cases to dispense with a more expensive three-phase compensation VT by selecting the connections in favor of a single-phase compensator:

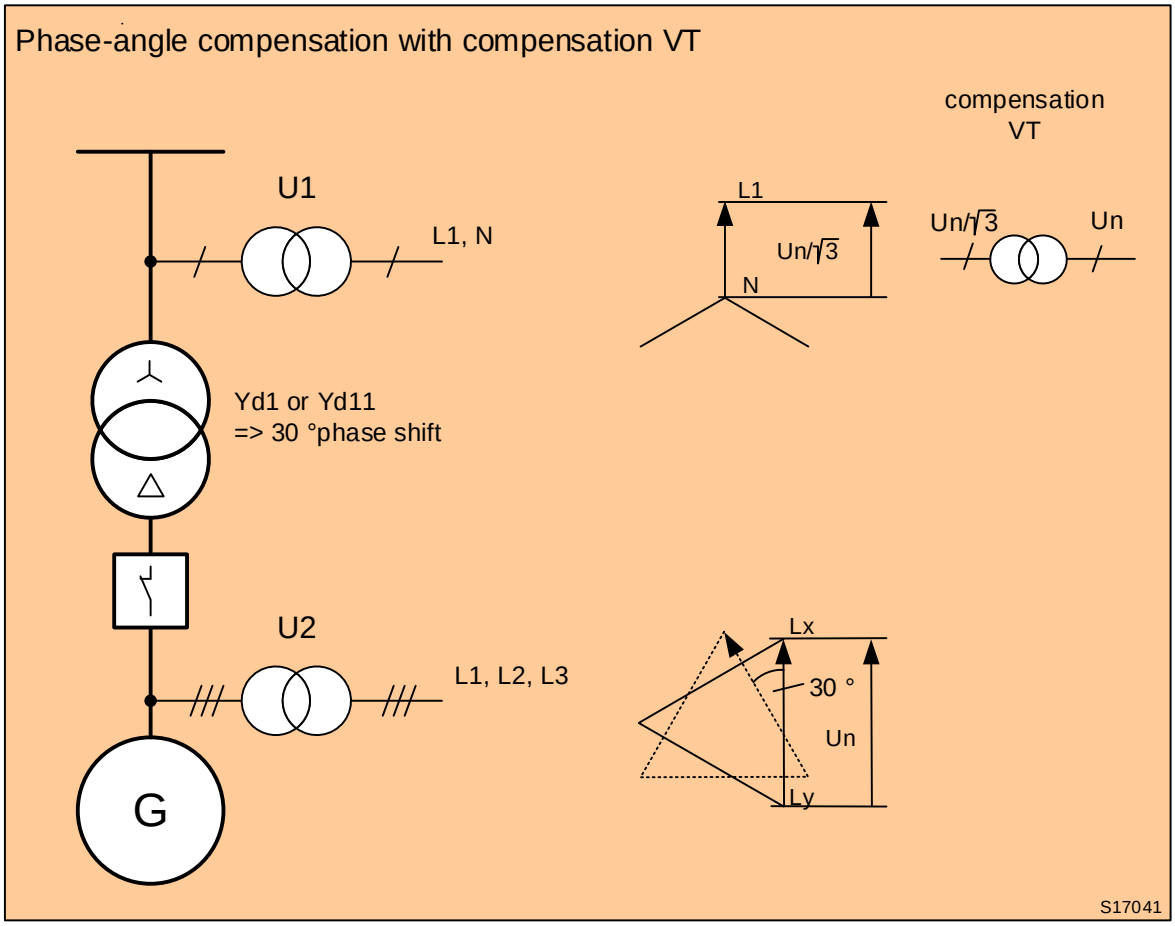



*Figure 6-6 Phase-angle compensation*

The low voltage side is rotated by +30 DEG resp. -30 DEG (= +330 DEG) against the high voltage side. When selecting the correct phases on the low voltage side, the phase difference is 0 DEG when the circuit breaker is closed.

## 6.7. Configurable I/Os: further possibilities

The configurable binary inputs and outputs, when not used for parameter set and paralleling point selection, can be used for other functions, eg. for signaling or additional control commands (for example remote reset, or selection TEST operating mode) (see function tables in *Chapter 5.3 and 5.4*).

The following must be noted:

All devices have 13 configurable hardware binary inputs, which are primarily intended for the selection of the parameter sets. The standard version has two, optionally twenty, parameter sets.

**NOTE!**

In the case of dual channel devices, the binary inputs BIN01 to BIN06 must be used for the selection of parameter sets 1 to 6 (= factory setting), except that the parameter set selection of channel 2 is always “1” (parameter 3127=ON), or it takes over the selection of channel 1 (parameter 3128=ON). See C*hapters 3.3.2, 6.3.3* and *6.4.1*). It must be noted that the transfer of the parameter set selection from channel 1 is not SIL-compliant.

If only one parameter set is used, 3114 BIN01 Mode can be set to "Always ON", then no wiring is necessary (see *Chapter 5.3.2*).

## 6.8. Synchrocheck operation

### 6.8.1. Use of the automatic synchronizing device as synchrocheck

If the device is to function as synchrocheck, the following parameter settings must be adapted in the corresponding parameter set:

1. Switch off command generation: CMDGen = OFF
2. Switch off voltage matcher: dU/dt = OFF
3. Switch off frequency matcher: df/dt = OFF

**IMPORTANT!**

If the device is used alternatively for automatic synchronization and synchrocheck, the configuration according to Chapter *6.3* can be executed.

### 6.8.2. Locking the synchrocheck

If the synchrocheck is to be operated with a lock (see *Chapter 3.6.2*), a free, configurable binary input (BIN01 to BIN13) must be defined which is then programmed with code +46.

**NOTE!**

As a prerequisite for this function, the external manual paralleling switch needs, in addition to the actual paralleling command contact, a second contact, that is wired to the binary input.

## 6.9. Manual release of the paralleling command („Operator window“)

The „Operator window“– function is switched off at the factory (tOpWin = 0.0 s). When used, the following must be done:

- Select free binary input BIN for the manual release and program it with code ±47
- Select free relay output BOUT for the display when the phase-angle difference is in the tolerance band, and program it with code 44.
- Determine the angle window and set it to parameter αmax (see parameter description)
- Determine the expiry time and set it to the tOpWin parameter (see parameter description).

At the same time, the binary input to be used and the relay output must be defined during the engineering phase and entered accordingly in the connection scheme.

The external manual release switch must have two pairs of contacts, one of which is connected in series with the command circuit and the other leads to the binary input used for the manual release.

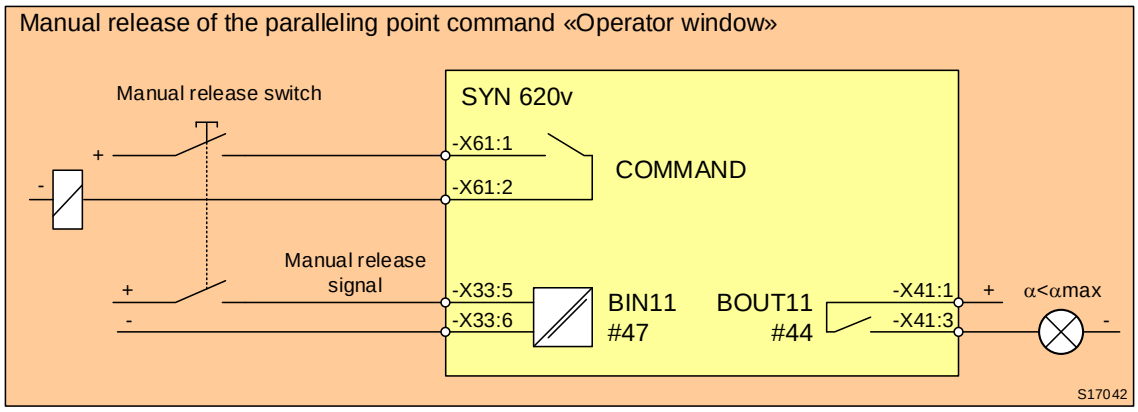



*Figure 6-7 “Operator window” function*

## 6.10. Use of the Transformer Tap Indication TTI

Function: see *Chapter 3.6.6*

During the engineering phase, the following properties of the TTI function must be defined:

**Measuring voltage U1 or U2 used for the TTI function**

For the dual-channel device SYN 6202, both channels must be set (equally).
The setting is made for channel 1 at parameter 70 „CH1 TTI Select“ and for channel 2 at parameter 98 „CH2 TTI Select.

| *TTI Select setting* | *Meaning* |
|---|---|
| 0 | TTI = OFF |
| 1 | TTI = ON and acts on U1 |
| 2 | TTI = ON and acts on U2 |

**Code type to be used**

The setting is made by means of parameter 71 „Codetype“
The following codes are available:

[1] = „Natural BCD“
[2] = Binary code „Binary“
[3] = „1-of-n“ code
[4] = Individual coding „Custom“

Selection of coding, either predefined code (eg. BCD, binary or 1-of-n), or individual coding. The latter is only possible upon request and with additional engineering effort.

**Number of taps of the tap changer**

The setting is made by means of parameter 72 „No Taps“
With n-binary inputs, $2^n$ – 1 taps can be read. The maximum number of taps is 63.

**Number of binary inputs used for decoding**

The setting is made by means of parameter 73 „NoBIN“ and depends on the code type and on the number of stages.

The minimum number of binary inputs required is as follows:

| *Number of taps* | *min. required BIN* |
|---|---|
| 3 | 2 |
| 4 to 7 | 3 |
| 8 to 15 | 4 |
| 16 to 31 | 5 |
| 32 to 63 | 6 |

If the moving contact is used to display a new tap, a binary input is also required.

**NOTE!**

The binary inputs used by the TTI function for decoding must be set manually to code „0“ (ConfigSelBINxy = 0)! Otherwise, the programmed function is executed in parallel.

**First binary input used for decoding**

The setting is made by means of parameter 74 „First BIN“

This determines which of the first binary inputs is used for the decoding. The remaining binary inputs used for the decoding must follow the first.

Example:
Definition: Number of BIN: 4; first BIN: BIN07
Result: the inputs used for decoding are: BIN07, BIN08, BIN09, BIN10.

**Step size between two taps**
The setting is made by means of parameter 75 „Step“
The percentage difference of the voltage amplitude between two stages is set.

**Tap that corresponds to the nominal value**
The setting is made by means of parameter 76 „Un Tap No“
UnTapNo is used to determine which tap corresponds to the set nominal voltage.

**NOTE!**

The number to be set corresponds to the decoded value, not to the number corrected with the offset!

**Offset for the tap numbering of the display**
The setting is made by means of parameter 77 „Offset“
In the synchronizing device, the tap numbering is (eg with 7 taps) 1 to 7. In practice, however, the tap with the nominal value is defined with zero and is counted upwards 1, 2, 3 and downwards -1, -2, -3. In this case, IndOffset must be set to -4.

**Use of a moving contact**
If a moving contact is provided to report that the tap changer has reached a new tap, an additional, configurable binary input must be used for this purpose.

**NOTE!**

The configurable binary input provided for this purpose must be programmed with the value „-57“.

## 6.11. Communication

### 6.11.1. Maintenance interface

The use of SynView 6 is provided in connection with the maintenance interface (see also *Chapter 3.11.1* and *8.2* as well as the detailed SynView 6 user manual, document number 3BHS840044 E80).

### 6.11.2. Field bus - Operating interface (option)

The operating interface is intended for operational control. It is not possible to change parameter settings in SYNCHROTACT 6 with this interface.
More about the transferable signals can be found in *Chapter 3.11.2.*

The data must be written to or read from certain addresses in the SYNCHROTACT 6 device (see also *Chapter 5.5*). The visualization must be implemented by the responsible project engineer (eg. control engineering).

### *6.11.3. IEC 61850 operating interfaces (option)*

**Use of communication ports**


There are four slots X11 to X14 on the back of the unit, top left, for connection to an IEC 61850 network, but X12 and X14 are currently unusable. Slots X11 and X13 are technically equivalent, but we recommend using X11 for connecting the IEC 61850 network.

In addition to the use for IEC 61850, the slots X11 and X13 can be used for the remote connection of SynView 6. This can be realized either parallel to IEC 61850, with a second, manually adjustable IP address on X11, or separately on X13 (even without IEC 61850).

SNTP time synchronization is available through the IEC 61850 network. If not, or if IEC 61850 is not available, one of the two slots -X11 or -X13 can nevertheless be used for the SNTP time synchronization.

To connect networks to the slots, communication modules are required, either for electrical or optical network connection (available connector types, see Chapter *11.3.3*).

For devices equipped with the IEC 61850 option (see type code in Chapter *4.1*), two corresponding communication modules are automatically supplied. Without the option, the desired communication module is available as an accessory.

**IEC 61850 Engineering**
The ICD file contains the data model, or describes the functionality of the SYNCHROTACT 6 – device. With an IEC 61850 System Engineering Tool, eg, the IET600 of ABB, the ICD files of all participants in a particular application and their relationships are defined and stored in an SCD file. Among other things, the identity of the SYNCHROTACT 6 – device is defined as an IED component.

The SCD file finally can be downloaded to the SYNCHROTACT 6 – device by means of SynView 6. The identity of the SYNCHROTACT 6 that is defined by the responsible engineer must be selected.

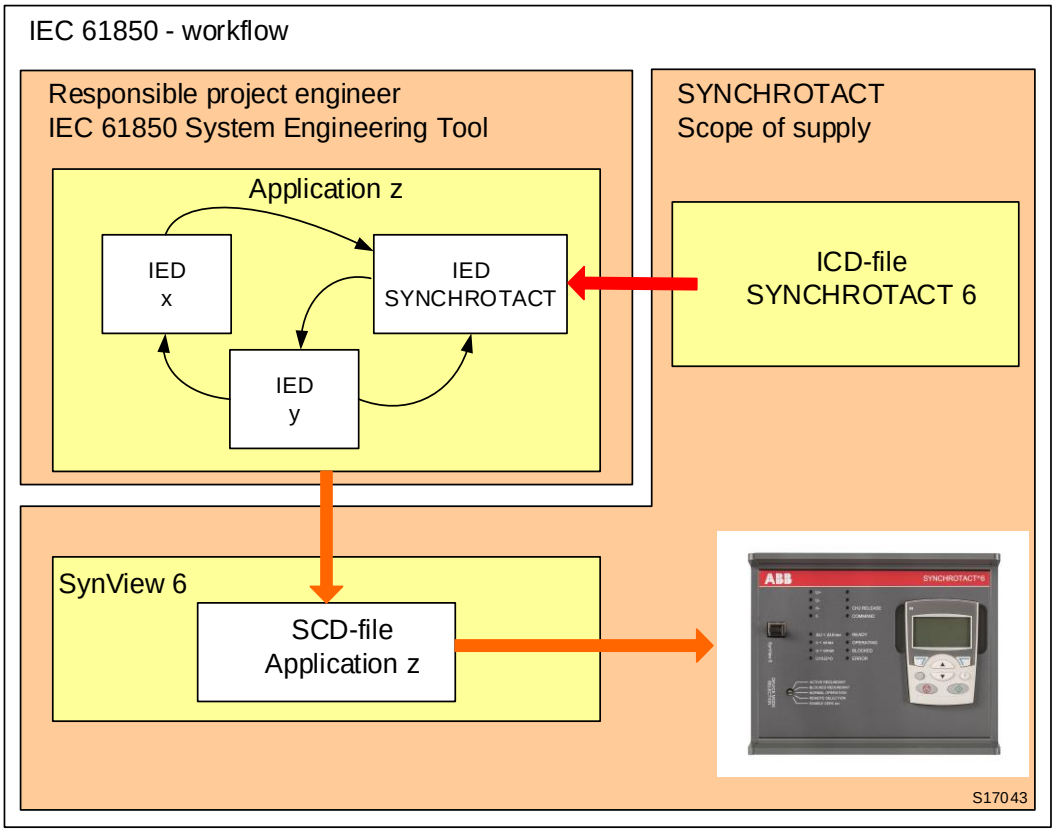



*Figure 6-8 IEC 61850 workflow*

The data sets are fixed and may not be changed at any time, neither at the configuration time, nor during operation (see also tables with logical nodes in *Chapters 5.5.6 until 5.5.13*).

**Using SynView 6 during the operating phase**

SynView 6 can be permanently connected to a PC or workstation, either to graph the actual values during the synchronization process, or to remotely maintain. In such a case, it is recommended for safety reasons to use SynView 6 in such a way that there are no write rights in normal operation, but these can be released after entering a password (see Access rights in the SynView 6 Operating Instructions, document number 3BHS840044 E80).

## 6.12. Time synchronization

### 6.12.1. Relative synchronization

The time is set during commissioning, once and with SynView 6.

The connection of the pulse synchronization to a configurable binary input (see function table in *Chapter 5.3*) detects the rising edges of the pulses, which are rounded up to whole seconds. The pulse intervals should therefore be 1 s or a multiple thereof (1 min, 1 h, 1 day).

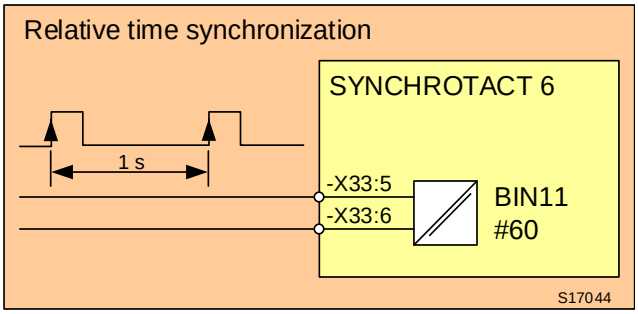



*Figure 6-9 Relative time synchronization*

### 6.12.2. Absolute synchronization by means of IEC 61850 - interface

Periodic transmission of date and time from SNTP-Server to the SYNCHROTACT 6 – device via the IEC 61850 - interface.

The SNTP-time synchronization is activated by means of SynView 6 („Enable“). See also SynView 6 user manual, document number 3BHS840044 E80.

**NOTE!**

The time server IP address is defined in the IEC 61850 SCD file and cannot be manually adjusted!

**NOTE!**

If only the SNTP-time synchronization is used, without IEC 61850 – network, the same IEC 61850 interface can still be used. In order to be able to connect the cable, a communication module, which is available as an accessory, is however necessary. Instead of taking the IP address of the time server from the SCD file (which is then not available), this can be set manually using SynView 6.

# Chapter 7 - Installation and Disposal


**DANGER!**

SYNCHROTACT 6 devices operate for example with dangerous voltages (>50 V), eg, measuring inputs up to 170 VAC and relay outputs up to 250 VAC/VDC. Manipulations on these parts can be a danger to life, injury to the person involved or damage to the environment. In case of appropriate environment and handling, according to this instruction, there is no risk.


**DANGER!**

During installation, all relevant regulations must be observed. It is essential that these safety instructions be read before starting any work on the SYNCHROTACT 6 equipment.


**CAUTION!**

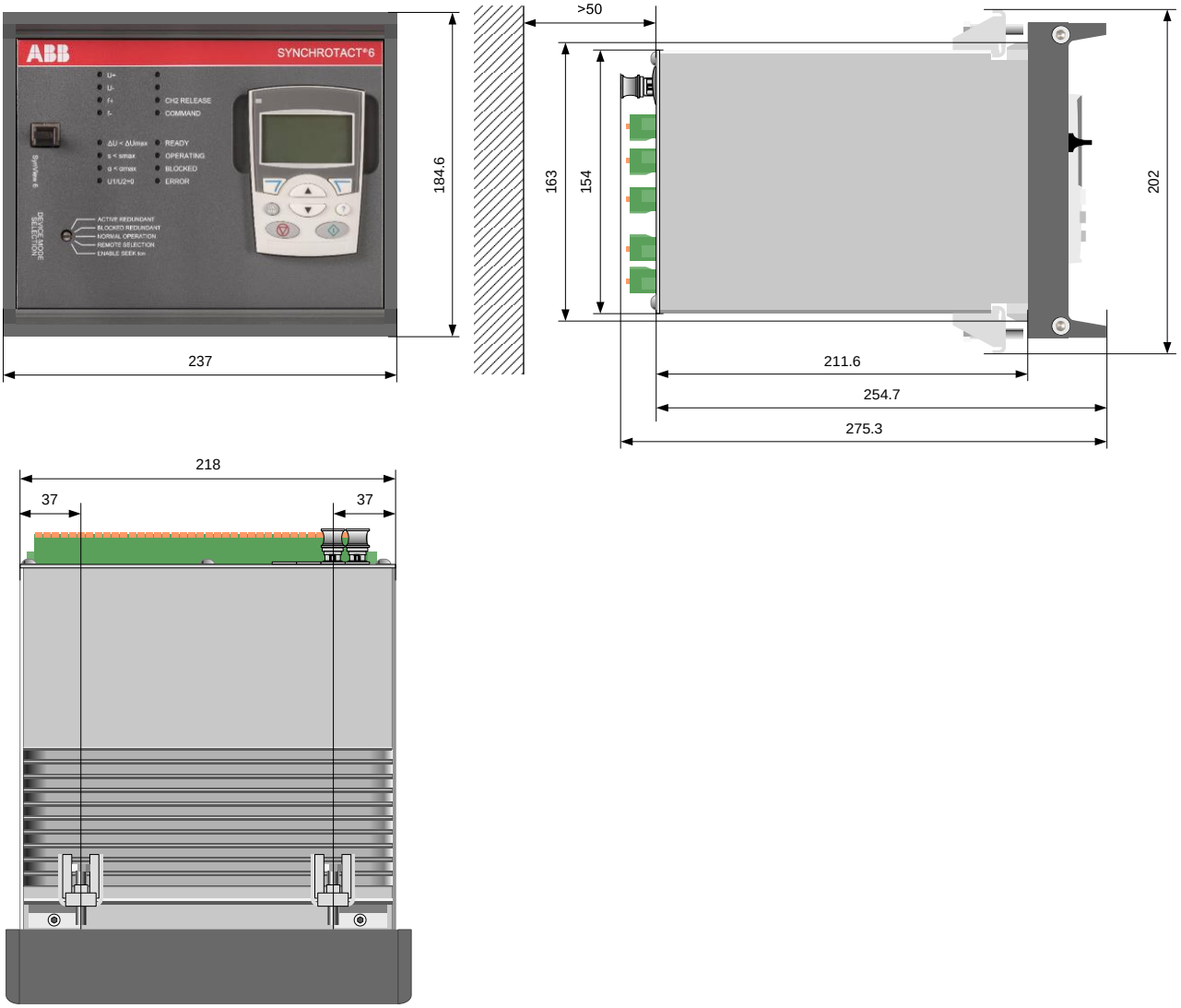
Safe operation of the device requires proper transport, storage, installation and assembly.

Packing and unpacking must be carried out with the usual care without the use of force and using suitable tools.

The device must be inspected by visual inspection for any damage that may occur during transport. Complaints concerning defects resulting from improper transport must be sent immediately to the receiving station or to the last freight carrier.

Only interior spaces which are dry and dust-free and contain no gases, acid fumes or the like are to be provided as installation sites.

## 7.1. Dimensions




Cutout: W x H = 222 x 164 mm

*Figure 7-1 Dimensional drawings*

## 7.2. Equipment installation

### 7.2.1. Minimum distances between device and adjacent component

The mounting brackets protrude approx. 25 mm from the upper and lower surfaces. Therefore, a minimum distance of 30 mm to the next component must be maintained at the top and bottom. (See dimension drawing).
The mounting brackets can be manually inserted laterally into the corresponding grooves at the top and bottom of the SYNCHROTACT 6 – housing and tightened from behind using a tool.
If there is not enough space on the side, the distance to the next component at the top and bottom should be increased to at least 60 mm, so that someone's hand can reach in between.
In order to ensure optimal cooling, a distance of at least 50 mm should be maintained from the upper surface to the next component.
In order to have sufficient space for the wiring, a distance of at least 50 mm should be maintained from the rear cover to the next component.

### 7.2.2. Mounting

1. Slide the unit from the front through the switchboard cutout.
2. Insert the mounting brackets into the groove: Insert 2 brackets on the top and 2 on the bottom of the device, either from the center or from the outside, and move up to a distance of 2 cm from the edge of the device to the two sides (see dimensional drawing).

**CAUTION!**

When attaching the mounting brackets in the grooves, make sure that the thread is not subjected to any mechanical stress.

3. Tighten all 4 mounting brackets evenly over the cross with a tightening torque of 2.0 Nm. Make sure that the front plate of the SYNCHROTACT 6 device rests against the mounting wall (wedges must pass through the cutout!).

## 7.3. Grounding and wiring

The housing must be connected to the ground potential via the designated connection to the nearest grounding point in the cabinet.
If possible, use the supplied grounding strap.

*Figure 7-2 Connection grounding strap*

The following figure shows the correct connection on the device: First, insert the grounding strap over the bolt, then the washer, the spring ring and finally fix everything with the nut. Tightening torque: 2.7 ± 0.5 Nm

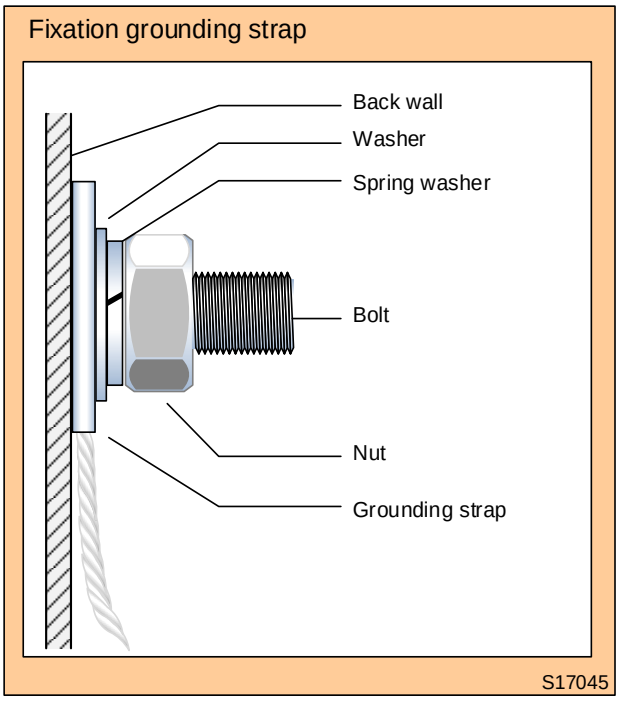



*Figure 7-3 Fixation grounding strap to device*

The cabinet must be properly connected to the grounding system. In this case, conductors with a core cross-sectional area of at least 4 $mm^2$ (AWG 12) must be used.
The use of shielded cables is not required. If, however, shielded cables are intended to be used to protect against high-frequency interference, it is recommended to place the shields on both sides as large as possible and directly at ground potential. If it is not possible to earth ground on both sides, one of the following measures can be taken:

- Ground the shield via a capacitor. The screen is grounded on one side directly and on the other side via a capacitor.
- Use of a double shielded cable: one of the two shields is grounded on one side, the second on the other side

Conductor cross-sections to be used: see *Chapter 6.1.1.*

## 7.4. Storage

In order to prevent damage or quality deterioration due to corrosion, dirt or mechanical damage, the following precautions must be observed from the time of storage to the time of installation:

- The system components must be stored in original packaging.
- The ambient conditions specified in the technical data (see *Chapter 11.6.1*) must be fulfilled during the entire storage period. The air temperature is typically between 20 and 25 ° C and the relative humidity is far below 93%.

## 7.5. Disposal

Used materials can serve as raw materials for recycling and other purposes. For ecological separation and disposal of materials, please contact your local authority or the local waste management company.

Dispose of the following components according to local regulations:

- Capacitors
- PCBs
- Electronic components

## 7.6. Instructions for recycling

The improper disposal of electrical equipment can endanger the environment. It is therefore important that the disposal of electronic equipment is carried out by qualified personnel.

The metallic housing as well as the lid and front frame do not pose a risk to the environment and can be fed to scrap metal recycling.

The PCBs must be removed and disposed of by a licensed disposal company. Environmentally damaging elements such as electrolytic capacitors must be separated from the printed circuit boards.

The SYNCHROTACT 6 units have been designed to be environmentally friendly. The circuit boards are easy to disassemble. The printed circuit boards must be removed and disposed of by an approved company.

The products can be disposed of in two ways:

- Removable by hand
- Crushed in a shredder

### *7.6.1. Manual Disassembly*

The product is disassembled by hand; the parts are sorted according to the materials as follows:

- Aluminum (equipment housing, cooling unit, etc.)
- Plastics
- PCBs

Metal parts (iron, copper and aluminum) are easy to recycle; other materials are subject to local regulations.

### *7.6.2. Mechanical shredding*

This method mechanically divides the product into small parts. The materials are sorted using their own sorting methods. However, components containing environmentally damaging materials must be removed before shredding.

# Chapter 8 - Operation instructions

## 8.1. Commissioning and maintenance operation by means of MCP

### 8.1.1. General

**NOTE!**

1. Supply, see C*hapter 8.1.6*

**NOTE!**

The SYNCHROTACT 6 device must first be blocked for commissioning and maintenance work (write rights) (BLOCKED = no longer ready to synchronize), and then transferred to the setting mode (BLOCKED & EDIT = writing of parameter values enabled). Both steps can be performed on the MCP only on the main level, i.e., on normal display.

If, during operation, information is to be read out without changing the operating state of the device, the parameters and the event memory are sent directly from the normal display by pressing the menu button 2 "MENU".

**NOTE!**

A release code prevents the (READY) or (OPERATING) device from being inadvertently taken out of order.

Code for decommissioning (-> BLOCKED): Press the menu button 1 („STATUS“) and the confirmation button 1 (red symbol) within 3 s. If another key is pressed during that time, the command is not executed.

Code for recommissioning (BLOCKED -> READY), press the menu button 1 („STATUS“) and the confirmation button 1 (red symbol). If another key is pressed during that time, the command is not executed. The recommissioning command is also not executed, if a START command is pending at the same time. SYNCHROTACT 6 in this case goes to status BLOCKED & ERROR, accompanied by the display of error code 24916 „ActiveStart_Fail“. The error can be acknowledged by resetting the error (pressing the menu button 1 „RESET“). The START-signal must be removed before the next attempt.

**NOTE!**

After changing a parameter value, the new value can either be written to the working memory (RAM) or discarded. When set to READY, all setting values are written from the working memory to the read-only memory (FlashPROM).

### *8.1.2. Arrangement of the MCP*

The operating panel for maintenance purposes MCP (Maintenance Control Panel) can be arranged as follows:

- MCP Status LED
- Display
- Keypad


*Figure 8-1 MCP*

### *8.1.3. MCP Status LED*

Die MCP Status LED shows several states of the SYNCHROTACT 6 – device:

| ***Color*** | ***Meaning*** | ***Comments*** |
|---|---|---|
| Green | Normal operation | -- |
| Green, flashing | Alarms are pending | Alarm entries have been stored in the event memory. Synchronizing is still possible. |
| Red | Error state | SYNCHROTACT 6 is blocked and can no longer be used for sychronization. The BLOCKED & ERROR LEDs light up on the LED status display. |

### 8.1.4. Display

The display consists of 3 zones:

- Header: Display of the editing mode and information on menu navigation
- Main field: Main information, such as actual values, parameter values and events
- Footer: Current function of the menu keys

Example of the LCD-display:

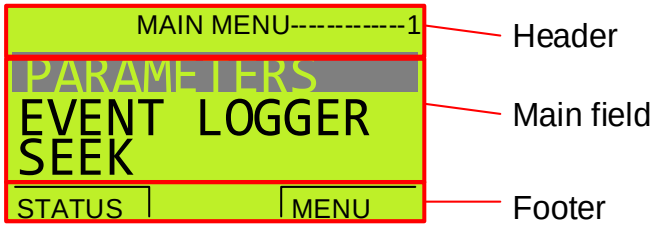



*Figure 8-2 LCD-Display*

**Normal display**

Header:

- In operation (read-only rights): empty (no adjustments possible)
- In edit mode (read and write rights): „EDIT“ (in this state, parameters can be adjusted)

Main field: Display of the three actual values ΔU, s and α.

Footer:

- Menu key 1: can be used to change the device status (READY, BLOCKED, adjusting mode etc.)
- Menu key 2: can be used to navigate in the menu

*In operation:*


*In edit mode:*


**Main menu**

Header:

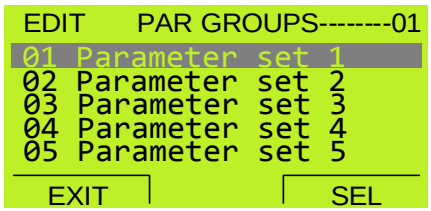
- Left: Display that shows if the device is in operation (empty field), or in edit mode („EDIT“)
- Right: Display of the actual main level (PARAMETERS, EVENT LOGGER, SEEK)

Main field: Display of the three main levels of the menu

Footer::

- Menu key 1: EXIT, can be used to get back to normal display
- Menu key 2: ENTER can be used to get to one of three main levels (here „PARAMETERS“)

### Navigate in the menu „PARAMETERS“



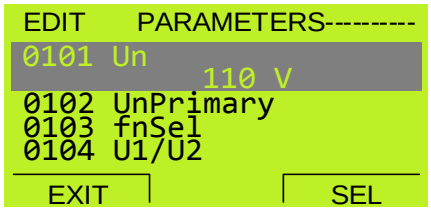

Header:

- Left: Display that shows if the device is in operation (empty field), or in edit mode („EDIT“)
- Right: Display of the actual parameter group

Main field: Display of five parameter groups (Level 1).
Footer:

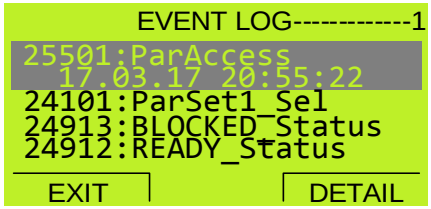
- Menu button 1: go back one level direction main menu
- Menu button 2: selection of the actual parameter group

### Selection of a parameter




The selection of a specific parameter (here 0101 Un) allows the visualization of the actual setting value. In editing mode (EDIT top left), the value can be adjusted.

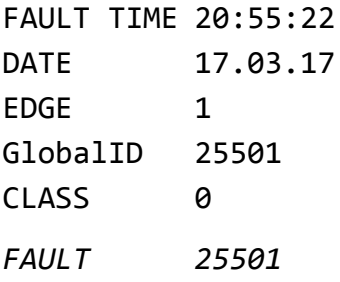
### Navigate in the menu „EVENT LOGGER“




Header: the number to the right shows how old the event is (1 = last event; 2 = second last event, etc.)

Main field: Display of events; the actual event (dark bar) is shown with time stamp.
Footer: Menu key 2 „DETAIL“ can be used to display all information associated with this event.

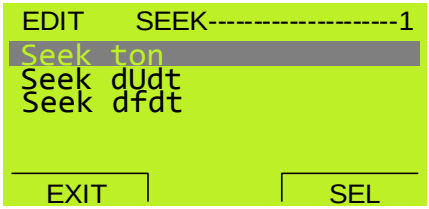
Functions assigned to an event:




Event time and date
**Note**: In contrast to the event memory in SynView 6, the time stamp on the MCP is always in UTC format.
EDGE: Trigger conditions:
0=falling edge
1=rising edge
GlobalID: global Identity code of the event
CLASS: Event type (see *Chapter 10.2.3*)
0=information
1=warning
2=alarm

**Note**: The diagnostic assistant (DIAG) is not used with this application.

**Navigate in the menu „SEEK“**




Header:

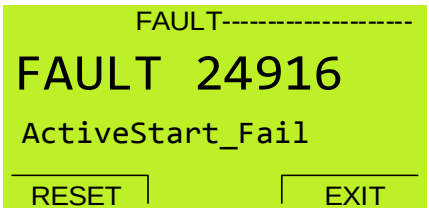
- Left: Display that shows if the device is in operation (empty field), or in edit mode („EDIT“)
- Right: Display of the actual SEEK function

Main field: Display of the three SEEK functions

Footer:

- Menu button 1: go back one level direction main menu
- Menu button 2: selection of the actual SEEK-Function

**Device in error state**




Header: Display of the error state

Main field: Display of the actual error

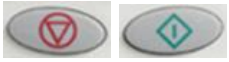
Footer:

- Menu button 1: can be used to acknowledge the error
- Menu button 2: can be used to access the normal display and navigate in the menu.

### *8.1.5. Keypad*

The keypad consists of 8 buttons and is protected by a code against undesired access (decommissioning). Reading is possible at any time.

Basic functions:

| ***Key*** | | ***Function*** |
|---|---|---|
| Up,<br>down |  | Move in the menu and raise/lower values. Pressing a button for approx. 3 seconds increases the speed of adjustment by factor ten. Likewise, it slows down again about 3 seconds after releasing. |
| Menu keys |  | Selection of functions, parameters, etc. Display of the actual function in the LCD footer. |
| REM/LOC |  | No function with SYNCHROTACT 6 |
| ? |  | Display of the Software-Version of the MCP (keep pressed while MCP is powering up) |
| Confirmation keys |  | To confirm adjusting values, states, etc. |

### 8.1.6. Commands

The following commands can be executed by means of the keypad:

| *Function* | *Command* | *Keys* |
|---|---|---|
| Status changes | Abandon synchronization process<br>OPERATING -> READY |  |
| | Block device<br>OPERATING -> BLOCKED, or<br>READY -> BLOCKED | „STATUS“  &  |
| | Adjusting mode ON/OFF<br>BLOCKED -> BLOCKED&EDIT<br>BLOCKED&EDIT -> BLOCKED |  |
| | Acknowledge error<br>BLOCKED & ERROR -> BLOCKED | „RESET“  |
| | Set device to “ready“<br>BLOCKED -> READY | „STATUS“  &  |
| Address change | Within one level |  |
| | To a lower level (submenu)<br>Normal view -> main view<br>Main view -> parameter groups<br>Parameter group -> parameter | „MENU“  ,<br>„ENTER“  ,<br>„SEL“<  |
| | Back to a higher level | „EXIT“  |
| Parameter values | Change parameter values |  |
| | Write a single parameter value into the working memory | „SAVE“  |
| | Reject changed parameter value | „CANCEL“  |
| | Write parameter values from the working memory to the read-only memory | This is done automatically when the BLOCKED status is changed to READY (see above in the table). |
| Read SynView 6 IP address | The IP address is displayed in menu parameter group 48. See *Chapter 5.1.7* | |

**NOTE!**

After changing a parameter on the commissioned device, the modification in the parameter list (setting protocol) must be compulsorily added. If SynView 6 is available, this work can be done more easily by creating a snapshot file.

If replacement devices are available, the change should also be executed there

### *8.1.7. Executing the SEEK functions by means of MCP*

**NOTE!**

Although the SEEK functions can be performed using the MCP (see the following description), the manual readout and transmission of the determined values to the correct position can easily lead to errors. Therefore it is recommended to use SynView 6 for the execution of the SEEK functions (see *Chapter 8.2.6*).

**1. SEEK ton**

**DANGER!**

When working on high-voltage circuits, the relevant regulations for work on high-voltage systems must be observed.

The SEEK-function closes the circuit breaker. The system should therefore be prepared as described in *Chapter 9.2.11 Test of the phase correctness and matching of the measuring voltages*

**CAUTION!**

The started SEEK function can manually be aborted by means of the confirmation button 1  .

Procedure:

1. Start conditions:
   - One voltage > Umin
   - The other voltage < U0max
   - Device selector switch “DEVICE MODE SELECTION” to Position “ENABLE SEEK ton”
   - Respective parameter set selected
   - Device blocked
2. Address change from main menu via SEEK to function SEEK ton
3. Select SEEK ton (SEL)

4. If the start conditions are fulfilled, confirm with release code: 1234

**NOTE!**

The code can be set using the „up“ and „down“ keys. Pressing a button for 3 seconds multiplies the adjusting speed by factor 10. Likewise, it slows down approx. 3 seconds after releasing the button.

5. Confirm the start of the SEEK function with SAVE.
6. Wait for the end of the SEEK function, then change of address to normal display.
7. Set device to the setting mode by pressing the confirmation button 1 (EDIT)
8. Change of address to parameter 4551 and read result for t on
9. Change of address to parameter 11 t on in the correct parameter set (!) and adjust read value manually
10. Write the value to the working memory by means of SAVE.
11. Set device selector switch “DEVICE MODE SELECTION” back to position “NORMAL OPERATION”.
12. Put SYNCHROTACT 6 temporarily to “READY“ and block again. This way, all parameter settings are written in the read-only memory.
13. Open circuit breaker again and bring the system to the state necessary for the next works.

**2. SEEK dUdt**

This SEEK function determines the plant-dependent setting value of the parameter dU/dt. After starting the SEEK function, SYNCHROTACT 6 outputs various Raise and Lower commands to the voltage regulator to check its sensitivity. The duration of the SEEK function is usually 1 to 2 minutes.

**CAUTION!**

The started SEEK function can be manually aborted by means of the confirmation key 1  .

**NOTE!**

When the voltage matcher is used as transformer tap matcher or with the INVERSE U function, the SEEK function makes no sense and is therefore blocked.

Procedure:

1. Start conditions:
   - Running machine
   - U1 and f1, both between 95 % and 105 %,
   - U2 and f2, both between 85 % and 115 %
   - Corresponding parameter set is selected
   - SYNCHROTACT 6: Parameter 43 INVERSE U = OFF
     Parameter 44 TVM = OFF
   - Device BLOCKED
2. Address change from main menu via SEEK to the function SEEK dUdt
3. Select SEEK dUdt (SEL)
4. If the start conditions are met, confirm with the release code: 1234

**NOTE!**

The code can be set using the „up“ and „down“ keys. Pressing a button for 3 seconds multiplies the adjusting speed by factor 10. Likewise, it slows down approx. 3 seconds after releasing the button.

5. Confirm the start of the SEEK function with SAVE.
6. Wait for the end of the SEEK function, then change of address to normal display.
7. Set device to the setting mode by pressing the confirmation button 1 (EDIT).
8. Change of address to parameter 4561 and read result for dU/dt
9. Change of address to parameter 40 dU/dt in the correct parameter set (!) and adjust read value manually
10. Write the value to the working memory by means of SAVE.
11. Put SYNCHROTACT 6 temporarily to “READY“ and block again. This way, all parameter settings are written in the read-only memory.

**NOTE!**

If the repeated SEEK function does not lead to a reasonable result, the setting value as described below should be empirically determined.

**3. SEEK dfdt**

This SEEK function determines the plant-dependent setting value of the parameter df/dt. After starting the SEEK function, SYNCHROTACT 6 outputs various Raise and Lower commands to the turbine regulator to check its sensitivity. The duration of the SEEK function is usually 1 to 2 minutes.

**CAUTION!**

The started SEEK function can be manually aborted by means of the confirmation key 1  .

**NOTE!**

When the frequency matcher is used with the INVERSE f function, the SEEK function makes no sense and is therefore blocked.

Procedure:

1. Start conditions:
   - Running machine
   - U1 and f1, both between 95 % and 105 %,
   - U2 and f2, both between 85 % and 115 %
   - Corresponding parameter set is selected
   - SYNCHROTACT 6: Parameter 53 INVERSE f = OFF
   - Device BLOCKED
2. Address change from main menu via SEEK to the function SEEK dfdt
3. Select SEEK dfdt (SEL)
4. If the start conditions are met, confirm with the release code: 1234

**NOTE!**

The code can be set using the „up“ and „down“ keys. Pressing a button for 3 seconds multiplies the adjusting speed by factor 10. Likewise, it slows down approx. 3 seconds after releasing the button.

5. Confirm the start of the SEEK function with SAVE.
6. Wait for the end of the SEEK function, then change of address to normal display.
7. Set device to the setting mode by pressing the confirmation button 1 (EDIT).
8. Change of address to parameter 4571 and read result for df/dt
9. Change of address to parameter 50 dU/dt in the correct parameter set (!) and adjust read value manually
10. Write the value to the working memory by means of SAVE.
11. Put SYNCHROTACT 6 temporarily to “READY“ and block again. This way, all parameter settings are written in the read-only memory.

**NOTE!**

If the repeated SEEK function does not lead to a reasonable result, the setting value as described below should be empirically determined.

## 8.2. Commissioning and maintenance by means of SynView 6

**NOTE!**

Minimum requirements: SynView 6 ≥V1.0.

For the connection of SynView 6, there is an Ethernet interface on the front and the back of the device.

**NOTE!**

The software has been tested for operation on the English Windows versions Windows 7 and Windows 10. Correct functioning on Windows versions in other languages cannot be guaranteed..

The following short guide documents the most important information and steps for a commissioning engineer how to operate the PC-Tool SynView 6.

A detailed user manual of the PC Tool SynView 6 can be found in the SynView 6 User Manual, document number 3BHS840044 E80.

### 8.2.1. Installation of SynView 6 for commissioning and maintenance

**NOTE!**

Setting up SynView 6 for network operation (remote control) is described in the SynView 6 User Manual, document number 3BHS840044 E80.

Minimum requirements: Microsoft Windows 7

**NOTE!**

If a SynView 6 version was already installed on the PC, some new user-specific data will be overwritten during the reinstallation. These can be secured as needed.

SynView 6 - data is treated as follows during an installation::

- SynView 6 – program files are removed after uninstalling and re-stored with the new installation. There are no user-specific data available underneath.
- SynView 6 – configuration („CT Configuration“):
  - Operator levels (see *Chapter 8.2.3*)
  - Zugriffsrechte (see *Chapter 8.2.3*)
  - Interface

The data is overwritten during installation, resp. set to factory settings. By exporting before the de-installation and importing after the reinstallation the old data can be taken over.

Export and import are performed in the menu "Settings“, using buttons  and  . For more details, see SynView 6 operating instructions, document number 3BHS840044 D80.

- Transient recorder templates: the standard templates are overwritten by new standard templates, user-defined templates are not overwritten
- Saved project data: setting parameters, event lists, transient recorder records, and data collections are retained

### *8.2.2. Direct connection SYNCHROTACT 6 - PC*

**Cable**: crossed

If SynView 6 is installed on the PC and the point-to-point connection with the cable is made, the PC IP address must be set. To do this, in the system control, switch from the automatic IP address assignment to a manually preselected address. The PC IP address should be chosen to be different from the SYNCHROTACT 6 address but within the same subnet (recommended: 172.16.0.63, netmask: 255.255.0.0).

SynView 6 can now be started.

**NOTE!**

The SYNCHROTACT 6 – IP address is 172.16.0.211, subnet mask: 255.255.0.0. It can be read on the MCP (Parameter group 48)

### 8.2.3. Access rights

After starting SynView 6 and connecting to the SYNCHROTACT 6 device, the user must log in to get the necessary access rights. Depending on the function / activity, different access rights are provided:

| *Level* | *Function / Activity* | *Default PW* | *Allowed actions* |
|---|---|---|---|
| 5<br>4 | Commissioning<br>Maintenance | None<br>test4 | **Read:** status bar, actual values, parameter settings, Events, transient recorder, slow trending, read diagnostic data (Data Collection)<br>**Operation**: SYNCHROTACT 6 status control, perform test functions (SEEK and sequential test), change and copy parameter settings (Snapshot), clear event memory, firmware handling, software licenses, IP addresses, set clock and time synchronization, IEC 61850 – configuration (SCD-file download)<br>**SynView 6 – settings:** language settings, scale synchronizing instruments |
| 3 | Diagnosis | test3 | **Read:** status bar, actual values, parameter settings, events, Transientenrekorder, Slow trending, read diagnostic data (Data Collection), read firmware version, software licenses, IP Addresses, time and time synchronization<br>**Operation**: SYNCHROTACT 6 status control, perform test functions (SEEK and sequential test) |
| 2<br>1 | Operation<br>View | test2<br>None | **Read:** status bar, actual values |

### 8.2.4. General screen elements

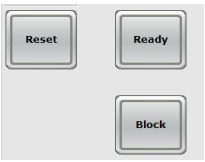
In the top part of the screen, in the status bar, the states of various SYNCHROTACT 6 signals as well as the device itself are displayed.
Depending on the access rights, the following status control keys can either be operated or are locked, though visible.

Status control key for the setting mode (red hand / green hand)

- **Red Hand** = SYNCHROTACT 6 is not in setting mode (parameter settings **cannot** be changed)
- **Green Hand** = SYNCHROTACT 6 is in setting mode (parameter settings can be changed)
- **Gray Hand** = Key is not in operation (no access right)

With a mouse click, the color of the hand changes from red to green, or from green to red.
After switching from red to green SYNCHROTACT 6 is in setting mode (BLOCKED & EDIT)
After changing from green to red, SYNCHROTACT 6 is in the BLOCKED state (see *Chapter 3.5)*

There are another three status control keys on the bottom right of the screen. The keys have the following meaning:




- Reset = Acknowledgment of an error (ERROR)
- Ready = Set device ready (READY)
- Block = Block device (BLOCKED)

Gray text = key not in operation (no access right)

On the right side of the screen in the middle part are the buttons for selecting the function modules:

| | | |
|---|---|---|
| Actual value module: tracking the synchronization process; execute SEEK and sequential test | Actual Values | *Chap. 8.2.5* |
| Parameter module: viewing and changing parameters (setting parameters and actual values) | Parameters | *Chap. 8.2.8* |
| Event memory | Events | *Chap. 8.2.12* |
| Transient recorder (Disturbance recorder) | Transient Recorder | *Chap. 8.2.13* |
| Login / Logout for specific access rights | Logout | |
| SynView 6 - Settings and SYNCHROTACT 6 - Configuration Settings | Options | *Chap. 8.2.14 - 8.2.21* |

### *8.2.5. Actual values module*

The actual value module can be used to track a synchronization process.
As soon as a synchronization process is started (OPERATING), or a parallel switch in the BLOCKED state is selected, the following additional displays appear:

- in the ΔU/s-diagram: set limit values (± smax and ±ΔU Umax) of the selected parameter set
- in the ΔU/s-diagram: Position of the actual value (green cross). After starting the synchronization, a track is shown that indicates the course of the actual value (delete the track using the "delete" key)
- in the synchroscope: set angle limits (gray lines)

The green triangle in the synchroscope shows the current lead angle
The scales of the ΔU/s-diagram are adjusted by right-clicking

**NOTE!**

With a right mouse-click on the desired instrument, the scales of the synchronizing instruments can be adjusted. This is limited to the access rights of stages 4 and 5 (maintenance and commissioning).

### *8.2.6. Executing the SEEK functions in the Actual Values module*

For this, the corresponding access rights must be present, e.g. registered as commissioning company.

**1. SEEK ton**


**DANGER!**

When working on high-voltage circuits, the relevant regulations for work on high-voltage systems must be observed.

The SEEK function closes the circuit breaker. The system should therefore be prepared as described in Chapter *9.2.11 Test of the phase correctness and matching of the measuring voltages.*

**CAUTION!**

The started SEEK function can be manually aborted as follows:

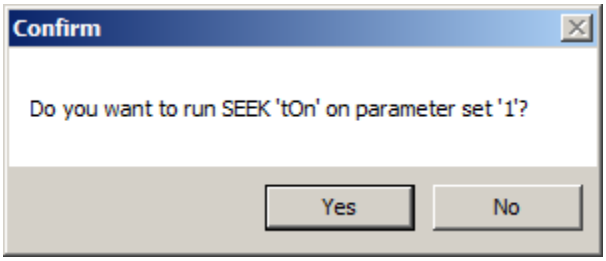
- SynView 6, SEEK-window: 
- MCP 

Procedure:

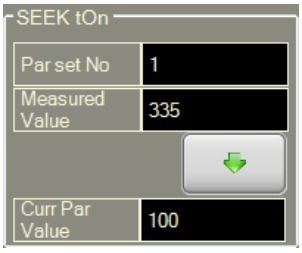
1. Start conditions:
   - One voltage > Umin
   - The other voltage < U0max
   - Device selector switch “DEVICE MODE SELECTION” to
   - Position “ENABLE SEEK ton”
   - Corresponding parameter set is selected
   - Device BLOCKED
2. Open SEEK window in Actual Values module: 

3. Start SEEK ton 

4. If the start conditions are met, confirm with the button ‘Confirm’


5. Then confirm the start of the SEEK function and the parameter set again


6. Wait for the end of the SEEK function, then write the result for t on in the read-only memory by clicking on the button with the green arrow.




7. Reopen circuit breaker and put the plant in the state that is necessary for the subsequent works.
8. Move the device selector switch “DEVICE MODE SELECTION” back to the “NORMAL OPERATION” position.

**2. SEEK dUdt**

This SEEK function determines the plant-dependent setting value of the parameter dU/dt. After starting the SEEK function, SYNCHROTACT 6 outputs various higher and lower commands to the voltage regulator to check its sensitivity. The duration of the SEEK function is usually 1 to 2 minutes.

**CAUTION!**

The started SEEK function can be aborted by means of the button.

**NOTE!**

When the voltage matcher is used as a transformer tap matcher or with the INVERSE U function, the SEEK dUdt function does not make sense and is therefore blocked.

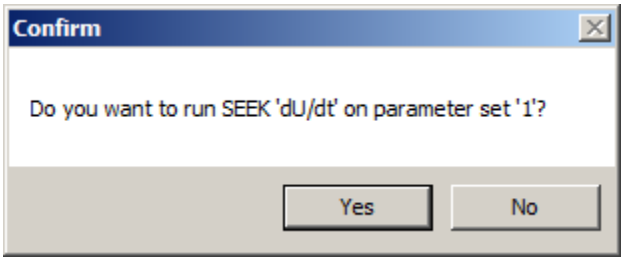
Procedure:

1. Start conditions:
   - Running machine
   - U1 and f1, both between 95 % and 105 %,
   - U2 and f2, both between 85 % and 115 %
   - Corresponding parameter set is selected
   - SYNCHROTACT 6: Parameter 43 INVERSE U = OFF / False
     Parameter 44 TVM = OFF / False
   - Device BLOCKED
2. Open SEEK window in Actual Values-Tool: 

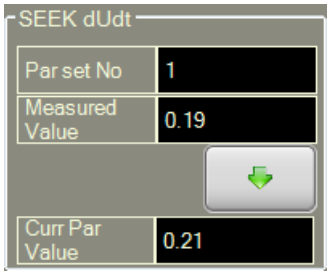
3. Start SEEK dUdt 

4. If the start conditions are met, confirm with the button ‘Confirm’


5. Then confirm the start of the SEEK function and parameter set again




6. Wait for the end of the SEEK function, then write the result for dU/dt in the read-only memory by clicking on the button with the green arrow.




**NOTE!**

If the repeated SEEK function does not lead to a reasonable result, the setting value as described below should be empirically determined.

**3. SEEK dfdt**

This SEEK function determines the plant-dependent setting value of the parameter df/dt. After starting the SEEK function, SYNCHROTACT 6 outputs various higher and lower commands to the turbine regulator to check its sensitivity. The duration of the SEEK function is usually 1 to 2 minutes.

**CAUTION!**

The started SEEK function can be aborted by means of the following button.

**NOTE!**

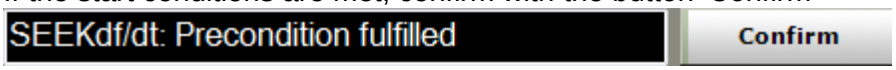
When the frequency matcher is used with the INVERSE f function, the SEEK dfdt function does not make sense and is therefore blocked.

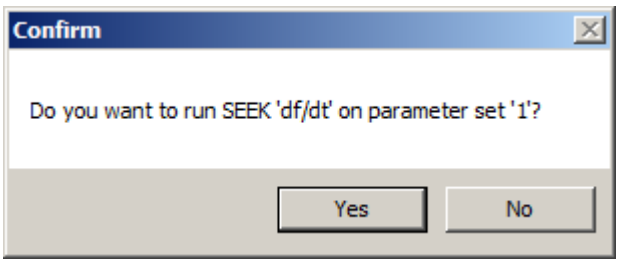
Procedure:

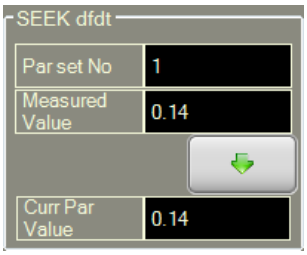
1. Start conditions:
   - Running machine
   - U1 and f1, both between 95 % and 105 %
   - U2 and f2, both between 85 % and 115 %
   - Corresponding parameter set is selected
   - SYNCHROTACT 6: Parameter 53 INVERSE f = OFF / False
   - Device BLOCKED

2. Open SEEK window in Actual Values Tool: 

3. Start SEEK dfdt 

4. If the start conditions are met, confirm with the button 'Confirm'


5. Then confirm the start of the SEEK function and the parameter set again


6. Wait for the end of the SEEK function, then write the result for df/dt in the read-only memory by clicking on the button with the green arrow:



**NOTE!**

If the repeated SEEK function does not lead to a reasonable result, the setting value as described below should be empirically determined.

### *8.2.7. Executing the sequential test function in the actual values module*

**NOTE!**

The sequential test function can be performed using SynView 6, but not by means of the MCP.

Access rights: ≥Level 3

**CAUTION!**

For safety reasons, the operator of the sequential test (eg commissioning engineer) must familiarize himself with the general test procedure (see C*hapter 3.6.5*).

The sequential test is a final test that is typically performed at the end of commissioning (see *Chapter 9.3.3*).

**CAUTION!**

In order that during the preparations no unwanted interactive action can take place with the system, SYNCHROTACT 6 should be BLOCKED during this phase.

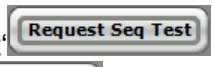
The final step before the test is that SYNCHROTACT 6 is changed from BLOCKED to READY.

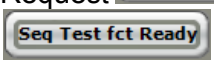
**Preparations for the sequential test:**

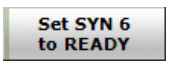
1. Upon need: Disconnect paralleling circuits, so that the circuit breaker cannot yet close.
2. Bring SYNCHROTACT 6 in BLOCKED state.
3. Start the generator, bring the generator speed in the proximity of the nominal speed and start excitation
4. Open window for the sequential test 


**NOTE!**

If the button to open the window for the sequential test is not available, the application software version of SYNCHROTACT 6 does not match the setting in SynView 6 (see *Chapter 8.2.15*).

5. Click on ‚Request' 

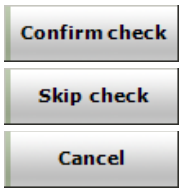
and confirm. Subsequently, the following message appears: 

6. Set SYNCHROTACT 6 to READY clicking on 

**Executing the sequential test:**

1. Start synchronization operation, ie paralleling point selection and START
2. By means of SynView 6, carry out the individual test steps. Before each step the following options can be chosen:

- Execute the displayed test step:
- Skip the displayed test step:
- Cancel the sequential test:
  Canceling the sequential test automatically sets the device to READY




The evaluation of the respective test step result is incumbent on the operator (for example, commissioning engineer). See *Chapter 9.3.3.*

### *8.2.8. Parameter module*

The parameter module is used to view and set the parameters (setting parameters and actual values resp. status displays). It consists of two display areas:

- Left side: „Groups“: Display of parameter groups under „Simulink“
- Right side: „Elements“: Display of the individual parameters

**NOTE!**

Parameter structure and parameter list: see *Chapter 5.1*

The various operating functions can be carried out by means of keys. Here are some of the essential features:

| | |
|---|---|
|  | Edit current parameter |
|  | Information about the highlighted parameter, for instance parameter description |
|  | Transfer values of the setting parameters to the read-only memory (Flash). This process will be executed automatically as soon as SYNCHROTACT 6 is changed from BLOCKED to READY. |
|  | Reading out, comparing, copying and documenting setting data in SYNCHROTACT 6 (snapshot file). See following *Chapter 8.2.9* |

### 8.2.9. Creating a snapshot file in the parameter module

For logging or copying of adjustment data, a snapshot file can be created or an existing one can be opened at the push of a button.

| *Function* | *Button in Parameter module* |
|---|---|
| Creating a snapshot file |  |
| Opening a snapshot file |  |

Recommended formats:

- **CT Snapshot** (internal format): can be reopened with the SynView 6-Tool and downloaded to a SYNCHROTACT 6 – device (eg. to copy settings to other SYNCHROTACT 6 – devices)
- **CSV** (Excel Export): can be saved as an Excel file and reopened with Excel at any time; it is no longer possible to download this format to SYNCHROTACT 6.

**NOTE!**

Die CSV-files are unsorted! That is, it is recommended to sort eg by column „Number“!

Storage location of the snapshot files: see *Chapter 8.2.22*
More details on this and the handling of snapshot files (open, compare, download on the SYNCHROTACT 6 - device can be found in the SynView 6 user manual, document number 3BHS840044 E80.

### 8.2.10. Copy setting data using the parameter module

As described above, a snapshot file from the SYNCHROTACT 6 source device must first be created.

Then connect to the SYNCHROTACT 6 target device and open the previously created snapshot file.

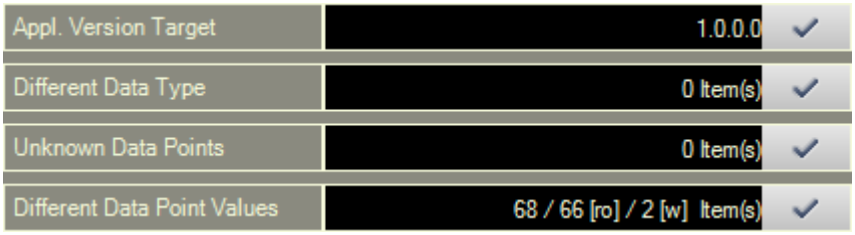
Now the file can be downloaded to the target device with the copy function "Write snapshot content to device" (see following table). In a first step, the data to be downloaded is compared with those in the target device.

With a further confirmation, the data is loaded to the SYNCHROTACT 6 device. The new data should now be written to the read-only memory (Flash).

| *Function* | *Button in Parameter module* |
|---|---|
| Write snapshot content to device |  |
| Write data to the flash (or set device to READY) |  |

**NOTE!**

Normally, there should be no different data types and unknown data points during comparison:

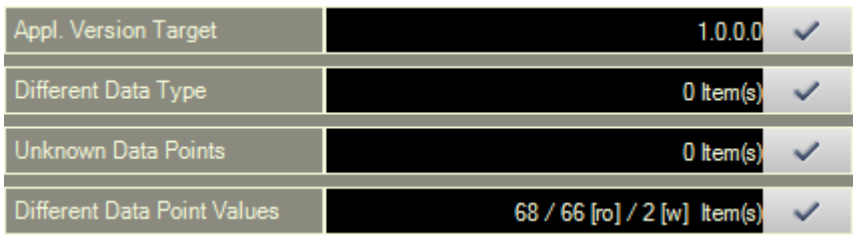


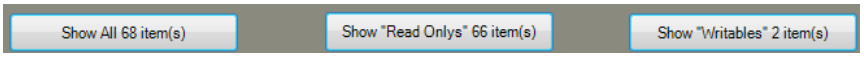

If so, then the compatibility must be clarified. If the compatibility is so poor that the correct function would be compromised, then the data cannot be downloaded at all (see SynView 6 Operating Instructions, document number 3BHS840044 E80).

### *8.2.11. Comparing a snapshot file with device data in the parameter module*

There are two possibilities:

1. **Direct comparison** of an open snapshot file with the device data (this possibility is executed by means of the function “Write snapshot content to device“ (download) , by which the function is only executed up to the comparison and afterwards aborted (see *Chapter 8.2.10)*
2. **Comparison of two open snapshot files**, one of which was created by the actual device data.

| ***Step*** | ***Direct comparison*** | ***Comparison of two snapshots*** |
|---|---|---|
| Open, resp. create comparison files | Connect SynView 6 to SYNCHROTACT 6<br>  Open snapshot file that is to be compared with the device data |  Open snapshot file that is to be compared with the device data<br>  Create snapshot file with the actual device data |
| Start comparison |  Start comparison by clicking the button “Write snapshot content to device” |  Start comparison |
| Select what should be compared |  <br>eg Data point Values | |

| | |
|---|---|
| Selection of the parameter types to be displayed |  <br>Read Onlys = Actual values, status displays<br>Writables = Setting parameters |
| Display information about a specific parameter |  With this button, detailed information about the previously marked parameter is displayed, eg, the "Qualified Name", which uniquely assigns the parameter to the parameter set. |

More details on this and the handling of snapshot files (open, compare, download to the SYNCHROTACT 6 – device) can be found in the SynView 6 User Manual, Document number 3BHS840044 E80.

### *8.2.12. Event module*

The event module shows the event list with the last 2000 entries (= factory setting). Every event is displayed with event type, code (ID) and an event name.

The following table shows some displays and operating functions:

| | |
|---|---|
|  | No green check mark: event comes<br>Green check mark: event goes |
|  | Information about the event that is highlighted on the screen |
|  | Turning the event filter on and off.<br>• Switched on: no informative events are displayed<br>• Switched off: all events are displayed |
|  | Clear event memory |
|  | Export the event list in tabular form (CSV format). Storage location of the file: see *Chapter 8.2.22* |

**NOTE!**

If the date and time of the timestamp are not correct, the clock can be set in the menu „Options \ Tools \ Time”

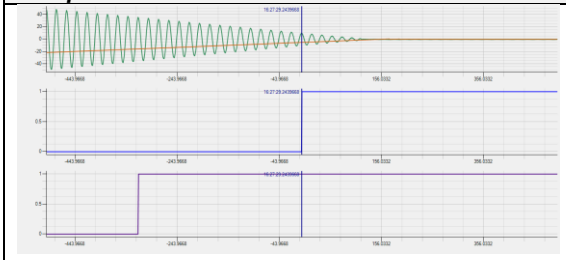
It can be easily checked by changing the status of SYNCHROTACT 6 using status control buttons, e.g. from BLOCKED to READY and back to BLOCKED.

## 8.2.13. Transient recorder module

**Overview::**
Using the transient recorder module, recordings stored in the SYNCHROTACT 6 can be displayed. Of the recorded signals (18 or 26), a maximum of 12 can be displayed simultaneously. Templates are available ex works for which a signal selection has already been made. These can be changed manually afterwards. This document describes only the default application.
The following recorders and templates are available:

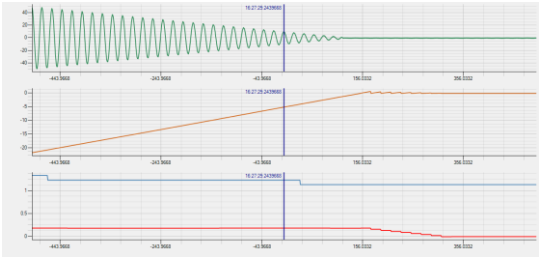
| ***Recorder name*** | ***Purpose*** | ***Default templates*** | ***Trigger / Recording area*** |
|---|---|---|---|
| Instant Value Recorder | Recording shortly before and after paralleling command | 1. Δu, α, CMD, CH2 REL<br>2. Δu, α, s, ΔU | CMD / -8 to +2 s |
| RMS Value Recorder | Recording of the whole synchronization process | α; START/STOP; CMD & CH2 REL; U+, U-, ΔU; f+, f-, s | CMD / -100 to +2 s |
| Configurable Recorder | User-configurable recorder | Not described here (see SynView 6 User Manual Document number: 3BHS840044 E80) | |
| dUdt_Recorder<br>dfdt_Recorder | For internal use only | | |

***Instant Value Recorder***
***Template 1: SYNCHROTACT 6 Instant Value 01 CMD***



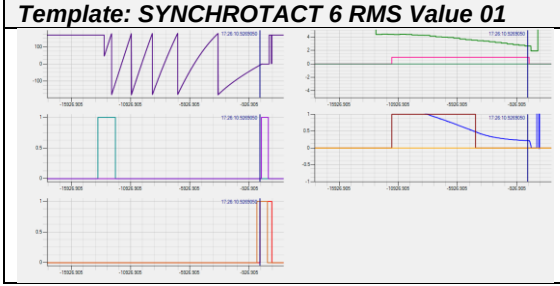
Group 1: Δu = u1-u2 (instantaneous value)
α = phase-angle difference
Group 2:
CMD = paralleling command (Kanal 1)
Group 3:
CH2 REL = paralleling command release (K 2)

***Instant Value Recorder***
***Template 2: SYNCHROTACT 6 Instant Value 02 a, s, DU***



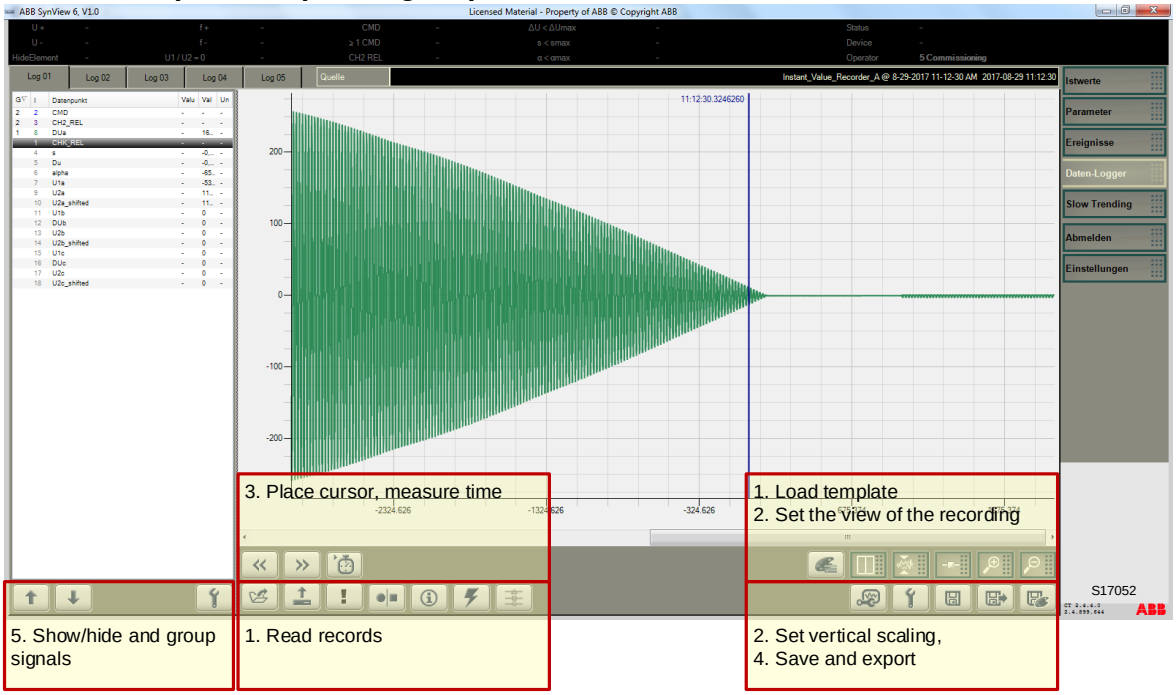
Group 1:
Δu = u1-u2 (instantaneous value)
Group 2:
α = Phase-angle difference
Group 3:
ΔU = Voltage difference (Amplitude)
s = Slip

***RMS Value Recorder***
***Template: SYNCHROTACT 6 RMS Value 01***

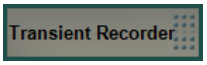
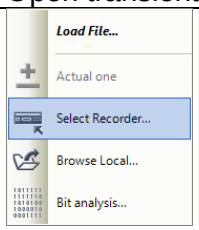
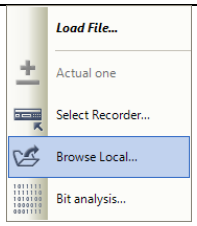
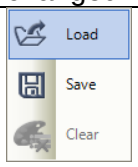


Group 1:
α
Group 2:
START / STOP
Group 3:
CMD / CH2 REL
Group 4:
ΔU / U+ / U-
Group 5:
s / f+ / f-

## The most important operating steps:




## 1. Reading a recording:

| *Step* | *from SYNCHROTACT 6* | *from file to PC* |
|---|---|---|
| Open transient recorder module   | Start SynView 6<br>Connect to SYNCHROTACT 6<br>Log on (at least OL 3)<br>Open transient recorder module | Start SynView 6<br>Log on (at least OL 3)<br>Open transient recorder module |
| Select recorder  |   eg. Instant Value Recorder |   |
| Select file | The latest recording is at the bottom of the list; the sorting can be changed | |
| Load template  |   Select template (see overview above), eg, “SYNCHROTACT 6 Instant Value 01 CMD“ | |

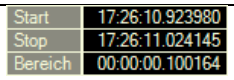
**NOTE!**

Click  to read out the most recent recording from the SYNCHROTACT 6 device.

**2. Set recording view:**

| *Step* | *Control element* | *Comment* |
|---|---|---|
| Legend |  | Show / hide legend left / right |
| Split diagram |  | Single diagram or one diagram per signal / group |
| Measuring points |  | Show / hide marking of measuring points |
| Zoom |  | Increase or decrease the timeline |
| Vertical scaling |  | Set vertical scaling.<br>Procedure: Change from „Automatic Scaling“ to „User-Defined“ and then enter „Min. Scaling“ and „Max. Scaling“ |

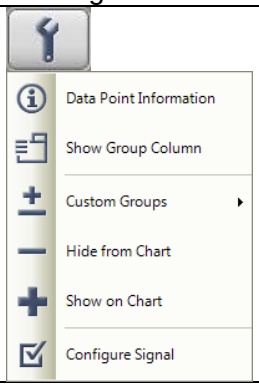
**3. Set cursor and measure time:**

| *Step* | *Control element* | *Comment* |
|---|---|---|
| Set cursor 1 | Doubleclick the diagram | |
| Set cursor 2 |  and left mouseclick on the diagram | |
| Move cursor |  | The cursor can also be moved with the mouse |
| Read time |  | Start = Time of Cursor 1<br>Stop = Time of Cursor 2<br>Range = Time difference |

**4. Save or export file:**

| *Step* | *Control element* | *Comment* |
|---|---|---|
| Save recording |  | Save the recording in the SynView 6 - format<br>File location: see *Chapter 8.2.22* |
| Export of the recording (Data and graphics) |  | Export the data points in tabular form.<br>Choice between the following formats:<br>• CSV<br>• COMTRADE binary<br>• COMTRADE ASCII<br><br>Export the graphic (PNG)<br>(The graphic is adjustable before export)<br>File location: seee *Chapter 8.2.22* |
| Export the recording (graphic only) |  | Export the graphic (PNG)<br>(The graphic is adjustable before exporting)<br>File location: seee *Chapter 8.2.22* |

**5. Show / hide / group signals:**

| *Step* | *Control element* | *Comment* |
|---|---|---|
| Mark signal | Highlight this signal or the desired signals in the legend. The legend needs to be displayed for that reason. | |
| Open menu |  | The button is located at the bottom, right edge of the legend. |
| Group signals | Select „User-defined Groups“ | |
| Show / Hide signals | Select „Show“, or „Hide” | |

### *8.2.14. SynView 6 – Language setting*

The SynView 6 language can be changed under Options\General\Language settings. The newly selected language does not become active until SynView 6 is restarted.

### *8.2.15. SynView 6 – Set application Software version*

When connecting a SYNCHROTACT 6 – device, its application software version must be identical to the setting in SynView 6. If the setting does not match, the button for the sequential test function is not displayed in the actual values module when the device is connected (see *Chapter 8.2.7*).

The current application software version is shown under Options\General\Device Configuration under  .

The setting can be made under Options\Operations\Command Editor\  \Sequential Test 0\Application Version.

After the setting, SynView 6 must be closed and restarted for the new setting to become active.

### *8.2.16. SynView 6 - Tools*

In the Option module under Tools, there is a number of functions. The most important ones are listed and described below (For access rights, see *Chapter 8.2.3*)

| | |
|---|---|
| Time | Manual adjustment of the SYNCHROTACT 6 clock |
| TimeSync | Settings related to the SNTP time synchronization |
| IP Config | Configure IP addresses |
| Data Collection | Creation of a data collection |
| IEC 61850 Config | Download of the IEC 61850 – configuration file (SCD file) |

A detailed description can be found in the SynView 6 User Manual (Document number: 3BHS840044 E80).

### 8.2.17. Set SYNCHROTACT 6 time manually

The SYNCHROTACT 6 clock of can be adjusted under Options\Tools\Time. Either the PC system time or a manually adjustable time can be downloaded.

### 8.2.18. SNTP-time synchronization

The SNTP Time synchronization can be activated or deactivated under Options\Tools\TimeSync. The time server IP address can be set when TimeSync is activated.

### 8.2.19. IP Addresses

The IP addresses of the various interfaces can be read or adjusted in Options\Tools\IP Config.

SYNCHROTACT 6 uses the following IP addresses:

| ***Connection*** | | ***SYNCHROTACT 6*** | ***IP Address 1*** | ***IP Address 2*** |
|---|---|---|---|---|
| ***Purpose*** | ***Indication*** | ***Internal Port*** | | |
| Maintenance SynView 6 | Front & -X17 | Port 1 | 172.16.0.211<br>255.255.0.0 | not used |
| IEC 61850 Station bus | -X11 | Port 0 | 192.168.0.161<br>255.255.255.0 | Address of SCD-file |
| | -X12 | not used | | |
| IEC 61850 Process bus | -X13 | Port 2 | 192.168.2.161<br>255.255.255.0 | Address of SCD-file |
| | -X14 | not used | | |

The IP address of the SynView 6 maintenance interface (port 1) in the SYNCHROTACT 6 device is fixed and cannot be changed.

The IP addresses 1 and 2 of the two IEC 61850 interfaces (port 0 and port 2) must be set differently, that is, four different addresses (see the following note).

**NOTE!**

The IEC 61850 interfaces are normally used only for connection to the IEC 61850 network, so only the address 2 of a port is used. The IP address is defined in this case by the SCD file. Address 1 must then be set to a different subnet. Otherwise, it could lead to conflicts if any other IED in the network is given the same IP address.

If the IEC 61850 interfaces are used for another purpose, e.g. As SynView 6 remote connection (see *Chapter 6.11.3*), the address 1 of the corresponding port can be set as required.

If both addresses of an IEC 61850 interface are used (for example for IEC 61850 and SynView 6 remote operation), both addresses must be assigned in the same subnet.

**NOTE!**

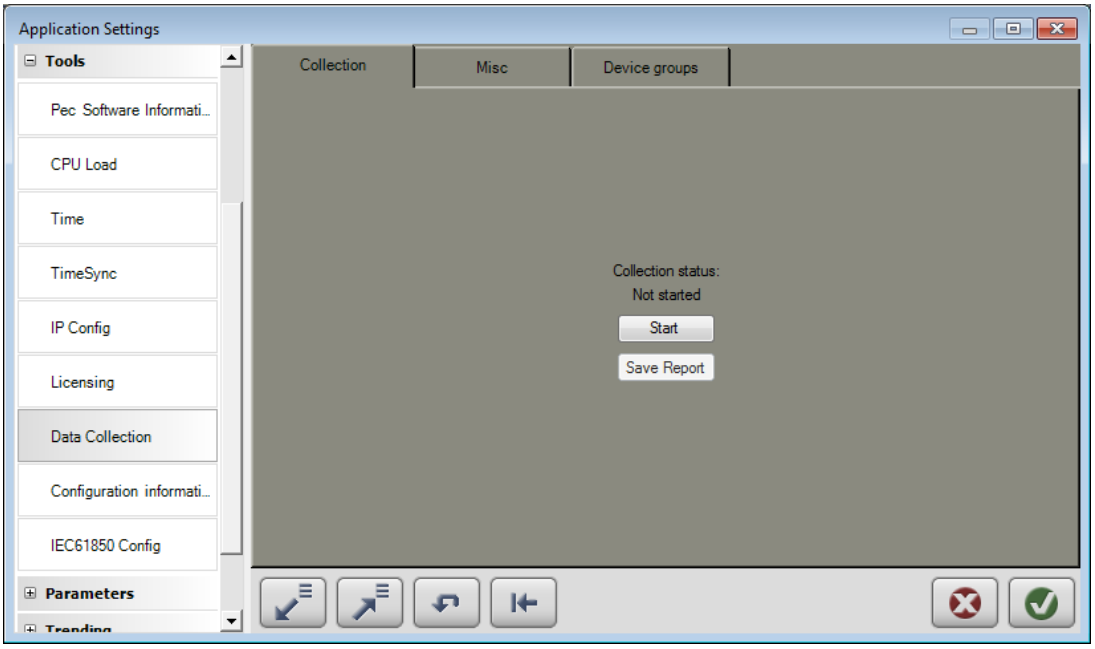
After an IP address has been adjusted, the auxiliary voltage of the SYNCHROTACT 6 device must be interrupted and switched on again for the new address to take effect.

### *8.2.20. Create a data collection*

A data collection can be created under “Options\Tools\Data Collection”.

In case of technical problems, all device data relevant for the diagnosis can be created as a data collection by the push of a button and sent to the appropriate ABB site.

Click the button “Start” to begin the creation of the data collection
This can take a couple of minutes




In connection with the creation of the data collection, there are the following collection status messages:

| ***Collection status*** | ***Meaning*** |
|---|---|
| Not started | The creation of the data collection has not yet started |
| is running... | The data collection is created; this can take several minutes |
| Finished | The creation of the data collection is complete. All information is stored in a zip file. The default file location is set to C:\Temp\DataCollectionExport (see *Chapter 8.2.22*) It is recommended, not to change the file location. |
| Failed | The creation of the data collection has failed<br>Possible causes:<br>• No connection to the device<br>• Wrong IP address in the SYNCHROTACT 6. The IP address of the SYNCHROTACT 6 maintenance interface is fix (172.16.0.211; see *Chapter 8.2.19*). SynView 6 tries to connect with this address.<br>• Wrong address setting in SynView 6. This address can only be adjusted with administrator rights. The IP address should not be changed with notebooks |

| *Collection status* | *Meaning* |
|---|---|
| | intended for temporary connection to the maintenance interface (see below note how to connect to the operating interface). |

**NOTE!**

If SynView 6 is to be connected to the operating interface (IEC 61850) for operation on a communication network, a different IP address than the maintenance interface must be assigned (see *Chapter 8.2.19*). For this project-specific case, the SynView 6 - IP address for the data collection must be set with administrator rights.

After completion of the data collection process – successful or not – a report should be generated by clicking the appropriate button (file location: see *Chapter 8.2.22)*. Typically, the following parts are mentioned as not successful in this report:

- **"Fast Trending"**; Message: "Operation could not be completed: Source does not exist"; Reason: The function "Fast Trending" is not used for SYNCHROTACT 6.
- **Windows Logs** (Application, System, Security); message: "Operation could not be completed"; Reason: SynView 6 wants to read the windows logs on the connected maintenance PC. This does not work, since SynView 6 (normally) does not have administrator rights on the PC. This message can be ignored, because the Windows logs of the PC are irrelevant with this application.

### *8.2.21. IEC 61850 configuration*

Under Options\Tools\IEC 61850 config, the IEC 61850 SCD file can be downloaded. During this process it is necessary to select which IED name from the SCD file should be assigned to the IED SYNCHROTACT 6.

### *8.2.22. Location of SynView 6 – files on the PC*

**NOTE!**

Not all directories may be visible if the PC is set to not show hidden directories.

**SynView 6 – program files:** C:\Program Files (x86)\ABB\CT\SynView 6

**SynView 6 – Data**:
C:\ProgramData\ABB\Control Terminal\x.y\SynView 6
(x.y = first two digits of the SynView 6 Version)

These include, but are not limited to, operator levels, access rights, and user interface, which can be exported prior to uninstalling SynView 6 and reimported after reinstallation (see *Chapter 8.2.1)*. Otherwise, the factory settings are adopted. The export file (zip file) is stored in the "User-specific project data" (see below: "SynView 6 configuration").

## User-specific project data

(The path is only valid for the English Windows-version, the file locations must be checked with other language versions of Windows).

| | |
|---|---|
| Windows 7 (EN):<br>Windows 7 (DE):<br>Windows 10 (EN):<br>Windows 10 (DE) | My Documents\Control Terminal\SynView 6<br>Eigene Dokumente\Control Terminal\SynView 6<br>Documents\Control Terminal\SynView 6<br>Dokumente\Control Terminal\SynView 6 |

In detail these are:

| ***Name*** | ***Description*** | ***File location*** |
|---|---|---|
| Setting parameters (Snapshots) | Saved / exported SYNCHROTACT 6 – Parameter settings<br>• SynView 6 – Format (CT)<br>• Exported (CSV) | • \Export\System Snapshot\ <file>.snapshot<br>• \Export\System Snapshot\<file>.csv |
| Events | Exported event list | \Export\Alarms and Events\<Datei>.csv |
| Transient recorder recordings | Saved / exported TR-recordings:<br>• SynView 6 – format<br>• Exported (Table and graphics) | • \Data\Transient Recorder\SYN 6 local\<file>.logs<br>• \Export\Transientrecorder\<file>.csv and <file.png> |
| TR templates | Saved TR templates, standard, or user-defined | \Settings\Trending\Transient Recorder\<file>.logs |
| SynView 6 configuration | zip file containing SynView 6 – settings, exported by the PC user (see user specific SynView 6 – data, above) | \Export\<CT Configuration file>.zip |

## File location of the data collections:

| | |
|---|---|
| • Data collection<br>• Report on the creation process | • C:\Temp\DataCollectionExport\<file>.zip<br>• C:\Temp\DataCollectionExport\<file report>.txt |

## 8.3. Operation control

The operation of the commissioned and ready-to-operate device is done via the binary control inputs on the device.

### 8.3.1. Start and stop the synchronizing process

The selection (start command) triggers the synchronizing process.

For devices with several used parameter sets or configured control inputs, the appropriate preselections must be made before the synchronization process starts.

No operations are necessary during operation. Parameter settings cannot be changed during normal operation.

After the circuit breaker is closed, its auxiliary contact (normally open) issues the automatic stop command. The synchronization process can be terminated prematurely by means of a stop command.

### 8.3.2. Test mode

If a corresponding binary input and a corresponding binary output was configured, the operating mode TEST can be used. If this is selected, the device goes to BLOCKED state. The paralleling relay is blocked. The relay configured for this purpose will close in its place.

### 8.3.3. Switchover conventional operation <-> operating interface

If a selector switch for the switchover of conventional operation (eg. local operation) <-> operating interface (eg. remote operation) is foreseen, one of the two operation modes can be activated, the other blocked. The switchover can take place in any operating situation of the synchronizing device.

### 8.3.4. Operating interface

Instead of the conventional wiring, control commands and status messages can be routed via the (optional) operating interface (IEC 61850, Modbus RTU, Profibus DP). Closing the circuit breaker via the operating interface is not permitted. It is not recommended to send voltage or frequency matching commands without consulting the manufacturer.

### *8.3.5. IEC 61850 Operating interfaces*

The same applies to the IEC 61850 operating interfaces as to the other operating interfaces (see *Chapter 8.3.4*).

Besides, it is possible to use the same physical interface for SynView 6, eg, for the graphic display of the actual values (synchroscope etc.) (See *Chapter 6.11.3*).

### *8.3.6. Maintenance during the operating phase*

When the device is put into operation, service operation is usually not necessary. If this is to be done using the built-in MCP operation, eg, to read out actual values, adjusting values or the software number, this can be done by pressing the buttons according to the table in *Chapter 8.1.6.* The commands do not change the function of SYNCHROTACT 6, unless a blocking command is issued, ie, the device remains in READY or OPERATING state (LEDs).

For a better orientation in the menu, see *Chapter 5.1.*

As an alternative to MCP operation, SYNCHROTACT 6 can also be permanently connected to an engineering workstation, where SynView 6 is installed. In this case, it should be ensured that the access rights are executed according to the application and the safety concept of the system.

Setting up SynView 6 for network operation (remote control) is described in the SynView 6 User Manual, document number 3BHS840044 E80.

# Chapter 9 - Commissioning

## 9.1. Warnings and instructions


**DANGER!**

SYNCHROTACT 6-devices process to some extent dangerous voltages (>50 V) eg, voltage transformer inputs up to 170 VAC and relay outputs up to 250 VAC/VDC. Manipulations of these parts can be a danger to life, injury to the people involved or damage to the environment. In case of proper handling, there is no risk.


**DANGER!**

All relevant regulations must be observed during commissioning. It is essential that these safety instructions are read before starting any work on the SYNCHROTACT equipment.


**DANGER!**

After the device has been switched off, it must be ensured by measuring that no measuring voltages and control voltages >50 V are applied to the terminals, before working on the device, eg disconnect the device when replacing it. In order to prevent unwanted closing of open voltage circuits by third parties, the affected circuits shall be marked at the disconnection point (eg with a warning sign).


**DANGER!**

If work is being carried out in the environment of the SYNCHROTACT 6 device, eg on the relay control, electronics power supply, synchronizing instruments, all voltages greater than 50 V which are connected to the system must be switched off.

**CAUTION!**

Before switching on, always check whether all connectors are plugged in.

**CAUTION!**

The device may only be opened by qualified personnel. It is essential that ESD regulations are complied with.

## 9.2. Work carried out with the machine at a standstill

### 9.2.1. Wiring check

The casing must be connected with the ground potential via the connection provided for this purpose. All electrical connections must be checked against the system schematic (connection point and cross-section).

### 9.2.2. Check of the programming of SYN 6500

If SYN 6500 is used with 4*8, instead of 2*16 single pole signals, the positions of the jumpers have to be checked according to the drawing. For that purpose, the cover of SYN 6500 has to be removed.

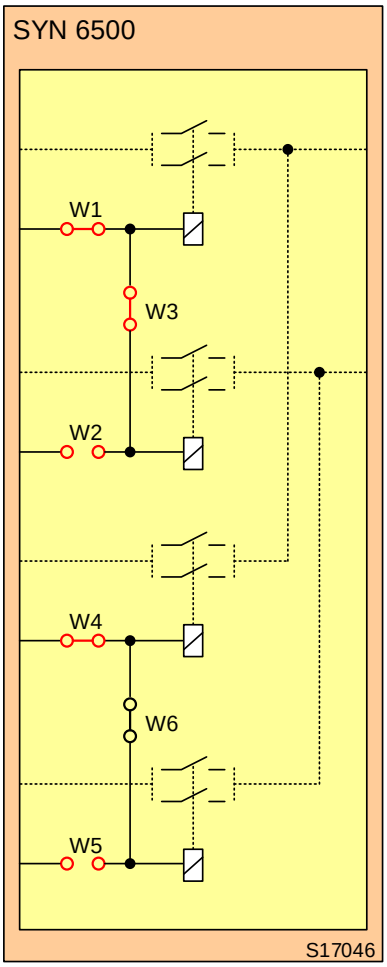



*Figure 9-1 SYN 6500 jumpers W1 to W6*

### 9.2.3. Adjustment of the binary inputs

The binary inputs of the SYNCHROTACT 6 device can be controlled either via potential-free contacts and internal 24 VDC supply or directly via a voltage in the range of 24 up to 250 VDC, or 100 up to 230 VAC from the plant control system.

### 9.2.4. First power-up

Interrupt paralleling circuit(s): Bring the machine breaker or circuit breaker to test position, draw out the carriage, pull the command relay or unplug paralleling command connector –X61 on the rear of the device.

Switch on auxiliary voltage: The yellow BLOCKED LED lights up. The standard display appears on the LCD.

**NOTE!**

If voltage has already been applied to the device, at least one parameter setting saved and then set to READY, the green LED READY lights up instead of the yellow LED. In this case, in order to carry out commissioning work the device must be brought into BLOCKED state (see *Chapter 8.1.6*).

### 9.2.5. Connection of PC / SynView 6

The connection of the PC with the SYNCHROTACT 6 has to be carried out according to *Chapter 8.2.2*.

### 9.2.6. Time synchronization

If SynView 6 is used, date and time should always be set in the SYNCHROTACT 6 device. The adjustment is made via the following path: Options\Tools\Time. (For details, refer to user manual SynView 6, Document number 3BHS840044 E80).

The time can be entered in one of two ways:

- Adopt PC time
- Manually set the time. Either the local time or the UTC time can be entered.

SYNCHROTACT 6 automatically takes over the UTC time, which is calculated by entering the the local time, based on the time zone set in the PC.

**NOTE!**

Since SYNCHROTACT 6 does not know the time zone, the time stamps in the event memory on the device (MCP) always appear as UTC time, while the same event in SynView 6 is displayed in local time.

If SynView 6 is installed on a PC which is operated in different time zones (eg commissioner PC), then not the local time should be set, but the UTC time, unless the PC is set to the correct time zone.

The order of the events in the event memory list of the MCP is always chronological, ie, changing the time or date does not change the order.

In the event memory list of SynView 6, the order depends on the selected sorting.

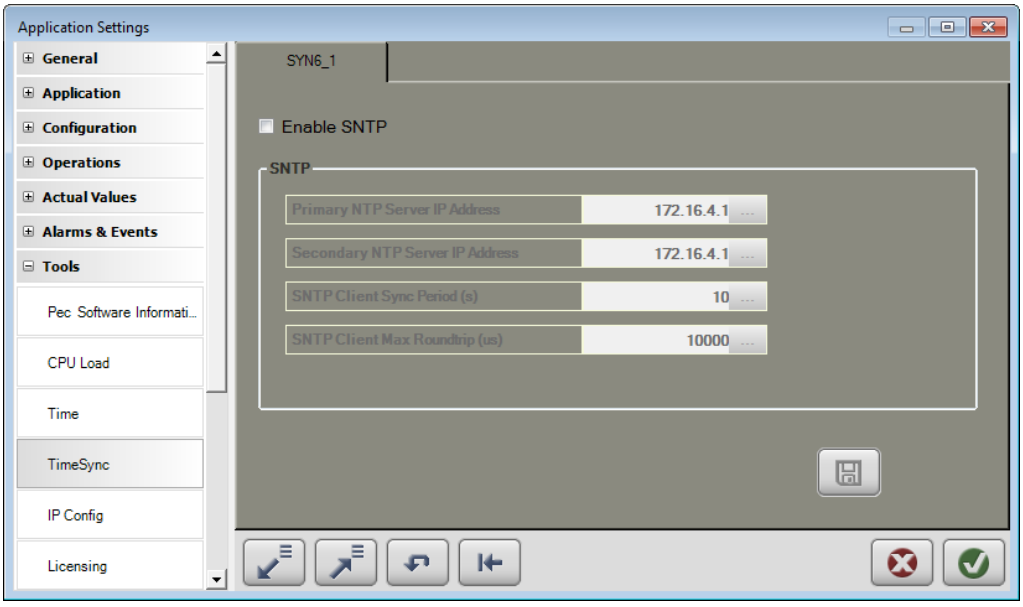
If the time synchronization is used, the corresponding electrical connections should be checked, after which a function check should be carried out.

Relative time synchronization:
Checking the programming of the binary input used for this purpose (group 31: code ±60). Then set pulse sequence less than one second (e.g., 0.5 s). If the pulse function works, the clock in the SYNCHROTACT 6 device will now run faster. This can be checked by comparing the SYNCHROTACT 6 time with the PC system time by means of SynView 6 under "Time" (see *Chapter 8.2.17*).

Absolute time synchronization (SNTP):
Before the time synchronization is connected (IEC 61850 net), the date and time must be read in the event memory. These values should not match those of the radio clock, otherwise they must be changed to a different value using the PC and SynView 6.

The following settings for the SNTP must now be carried out. The settings are made via the following path: Options\Tools\TimeSync (for details, refer to user manual SynView 6, Document number 3BHS840044 E01).

- Activate the SNTP time function (Enable SNTP)
- Configure the IP Addresses of the time server
- Period duration of the time synchronization
- SNTP Client maximum round trip



After the time synchronization is connected, the date and time of the radio clock are adopted by SYNCHROTACT 6. Compare the results in the event memory.

**NOTE!**

The data read from the event logger by SynView 6 are displayed in chronological order. If the time (or the date) is reset, an event may possibly appear further up in the list, even though it occurred last.

**NOTE!**

In order to make sure that a new event takes place, the device can, for example, be temporarily switched from BLOCKED to READY and back again to BLOCKED.

### *9.2.7. Check of the communication interface*

Connectors and cables to the communication interface have to be checked. The connector type and pin assignment are described in *Chapter 11.3.3*.

Depending on the interface, slave address, transmission rate and possibly further parameters have to be set. The required information can be found in *Chapter 5.5* under "Configuration" of the related interface.

If, alternatively, the conventional operation and the operating interface are used, the switchover with the blocking input to block the operating interface has to be checked (also refer to *Chapter 6.4.2*).

### *9.2.8. Function check*

**CAUTION!**

If no point-to-point connection exists and several devices are present: changing settings of the wrong device can lead to serious damage in the plant! For this reason, especially after commissioning, it has to be ensured that the correct device is accessed. It is recommended to get a confirmation of the correct addressing by phone from a person standing in front of the device.

Check data transfer by sending and receiving data that is not safety relevant (eg switchover READY/BLOCKED/READY with SynView 6, reading actual values with operating remote control

### 9.2.9. Parameter presets

**IMPORTANT!**

Refer to *Chapter 8 - Operation* for proper operation of the local maintenance control panel MCP. Information on the parameter settings can be found in *Chapter 5 -Parameters, actual values, events*.

If several parameter sets are used, the following settings must be carried out for all parameter sets / paralleling points.

If necessary, some parameter settings can already be determined and set or checked while the machine is standing still. The following parameters are concerned:

- Channel 1: 01 Un, 02 UnPrim, 03 fn, 06 AINSelU1, 07 AINSelU2, 08 NoAIN, 10 CMDGen, 12 tp on, 13 t supC, 14 t supD, 15 t supS, 16 MULTIPLE CMD, 17 tOpWin, 20/21 ±smax, 22/23 ±αmax, 24/25 ±ΔUmax, 26 Umax, 27 Umin, 28 dα/dtmax, 30 CH1 U0max, 31 U1not, 32 U2not, 33 U1*U2not, 34 ExclDB, parameters of group 6 and if used group 7.
- Channel 2 (only SYN 6202): 80 Un, 81 fn, 84 AINSelU1, 85 AINSelU2, 90 smax, 91 αmax, 92 ΔUmax, 95 CH2 U0max and if used 98 CH2 TTI Select
- Configuration parameters (groups 31, 32 and 33)

Basically, a good synchronization is achieved with the factory settings.

### 9.2.10. Comparison of measuring points and switching points


**DANGER!**

If there are several paralleling points, it is essential to check whether the paralleling command and the measuring circuits (both) go to the same circuit breaker and correspond with the correct parameter set.

### 9.2.11. Test of the phase correctness and matching of the measuring voltages

**CAUTION!**

The following tasks are the most important ones during the entire commissioning. They do not concern the synchronization device itself, but their correct connection to the measuring voltages. In case of ignorance, damages may be caused to the plant.

**CAUTION!**

It is a prerequisite for the following work and for the correct functioning of the synchronization that the two measuring voltages display the correct values in % (Un is set).


**DANGER!**

When disconnecting high voltage cables, it is essential that the corresponding regulations for working on high voltage installations are complied with.

**CAUTION!**

Wrong polarity cannot be detected by the synchronizing device. A paralleling with polarity error can cause huge damage. Therefore, the following test must be carried out:

In order to perform this test, a voltage source (U1 or U2) must be disconnected as a prerequisite and the other voltage source must be present. The circuit breaker is then closed.

**Procedure:**

1. First select which of the two voltage sources is to be disconnected and which is to be connected. Depending on the system and situation, there are different possibilities for the separation and also the voltage may not be available on both sides.

   The following options are available to disconnect:
   - Open the isolator on the generator side, resp. star point isolator
   - Open the isolator on the busbar side

**CAUTION!**

When it is decided to open the star point isolator, the generator at standstill is energized during the test. There is no current flowing, since the star point of the stator winding is open.

There are, however, generator voltage transformers (normally mounted on the generator) that do not measure the full generator voltage on the primary side (voltage divider). By opening the star point, since no current flows, the VT would be connected to the full generator voltage and could thus be damaged.

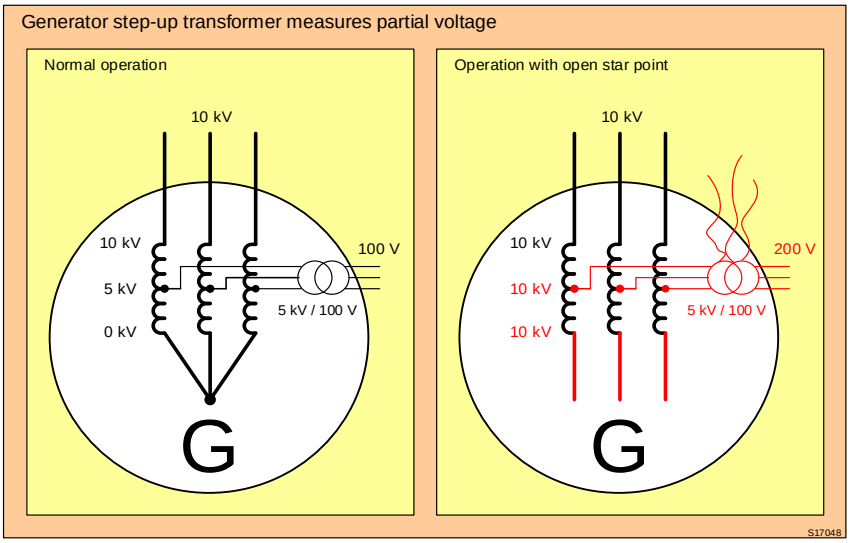



*Figure 9-2 Generator step-up transformer measures partial voltage*

In such a case, a separation possibility on the busbar side must be selected.

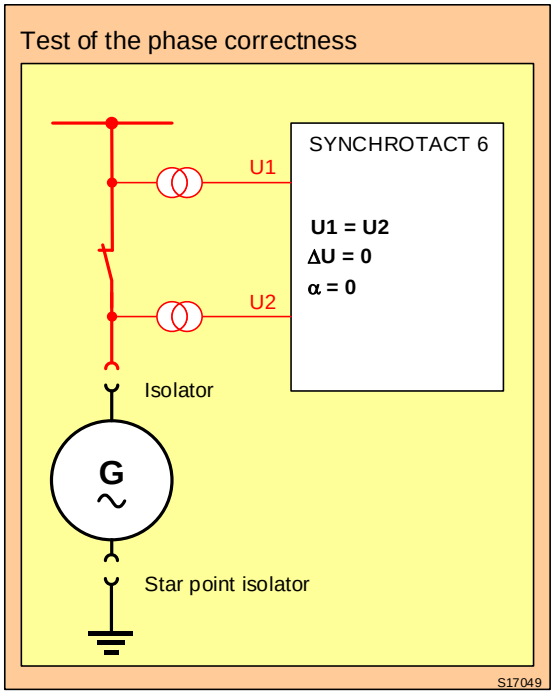



*Figure 9-3 Test of the phase correctness*

2. If there are several paralleling points, the correct paralleling point and the corresponding parameter set must be selected. It must be ensured that the assignment of measuring points and switching points (see *Chapter 9.2.10*) is the same and that these also match the desired parameter set.

3. After the two voltage sources have been prepared, the circuit breaker must be brought into the operating position, so that it can be closed manually or by the SYNCHROTACT 6 SEEK ton function (see *Chapter 9.3.1*). The procedure for using SEEK ton is described in *Chapter 8.2.6*.

4. The circuit breaker should now be closed

   If SEEK ton is used, the paralleling time t on can be determined and accepted in the same step.

5. The phase-angle difference $\alpha$ must be 0 DEG in this state. Otherwise, either the measuring lines are connected incorrectly (due to polarity) or there is a phase shift, which must be compensated.

   The synchronizing instruments (double voltmeter, double frequency meter and synchroscope have to be checked, if present in the system). The synchroscope must stand at “twelve o’clock“!

   If this is not the case, the measuring circuits must be checked.

**NOTE!**

If the synchroscope stands at “six o‘clock”, one voltage has been incorrectly connected. In other positions, either measuring is being carried out on incorrect phases or a phase shift caused by the connection group of a step-up transformer has not been compensated.

6. The voltage difference should also be $\Delta U = 0$ %. Otherwise, the value must be corrected by means of parameter 04 U1/U2.

7. After the correct connection of the measuring voltages has been checked, the two measuring voltages adjusted and the paralleling time set, the circuit breaker can be opened again and secured against re-closing (eg, bring in circuit breaker test setting and/or interrupt paralleling circuit.

**CAUTION!**

If there is no possibility to check the phase correctness according to the above entries, the test of the measuring circuits must not be dispensed with. For example, the phase layers can be tested using high-voltage measuring probes.

## *9.3. Work carried out while the machine is running*

### *9.3.1. Adjusting the paralleling time ton*

If the paralleling time ton is known, it can be set directly. If the paralleling time is not known, the setting value can be determined by means of the SEEK ton function (see *Chapter 8.2.6*). If this is not possible, the setting value can be determined empirically (see *Chapter 5.2.2*).

### *9.3.2. Adjusting the matchers to the plant*

While the machine is running, the voltage and speed matchers must be adapted to the plant. Normally, the SEEK functions SEEK dUdt and SEEK dfdt can be used for this purpose. The procedure is described in *Chapter 8.2.6*.

**CAUTION!**

In any case, the polarity of Raise and Lower commands has to be checked. Before carrying out a test function or before a function test, one should be prepared to be able to stop the test function resp. the synchronization process prematurely if necessary.

A number of special cases require a matcher with fixed pulse times and variable pause intervals. In such cases, the parameters INVERSE U resp. INVERSE f must be set to ON. The SEEK functions then cannot be used. Procedure for correct setting according to

*Chapter 5.2.5* switchover to variable pause times for INVERSE U resp. *Chapter 5.2.6* for INVERSE f.

### *9.3.3. Function tests*

Now that all settings have been made, the functional test can be performed. This can be done in two ways:
a) Automatically by means of a sequential test (only with SynView 6, see *Chapter 8.2.7*)
b) Manually by means of individually performed tests

**a) Automatic function test**
The sequential test allows the checking of voltage, frequency matcher and paralleling command release individually without the need for temporary parameter settings.

**CAUTION!**

For safety reasons, the operator of the sequential test (eg commissioning engineer) must familiarize himself with the general test procedure.

**CAUTION!**

Because this test does not normally need a live synchronization, the paralleling circuits should be interrupted so that the circuit breaker cannot close yet. (Bring machine circuit breaker to test position, draw out the carriage, pull command relay or unplug paralleling relay connector –X6 on the rear of the device) If it is desired to close the circuit breaker during the test, this step is omitted.

The procedure for the sequential check is described in *Chapter 8.2.7*.

If necessary, individual test steps can be skipped. Since normally the sensitivity for higher and lower commands is the same, one test step of the voltage and frequency adjuster can be skipped at a time.

The last step (paralleling command) can only be executed if the paralleling conditions are met. This is normally the case after the previous test steps. Otherwise generator voltage and frequency must be set manually.

**Assessment of the result of the sequential test**

**Voltage matching tests (under- and over-excited)**

**Aim**: At the end of the test step, the generator voltage should be well within the tolerance band.

**Evaluation:**
- During the running test, it should be observed whether the set pause time ts U is sufficiently long, so that U2 is stable before the second adjustment command is issued.
- Ideal value: final value U2 is in the middle of the set tolerance band ±ΔUmax
- Good setting: final value U2 between ½ +ΔUmax and ½ -ΔUmax
- Insufficient: final value outside the tolerance band

**Frequency matching tests (over- and undersynchronous)**

**Aim**: At the end of the test step, the slip value should be well within the tolerance band, but not too close to zero (otherwise the phase-angle difference is not changing anymore).

**Evaluation:**
- During the running test, it should be observed whether the set pause time ts f is sufficiently long, so that f2 is stable before the second adjustment command is issued.
- Ideal value: final value s is in the middle between slip limit +smax (resp. –smax) and zero
- Good setting: final value s is between 1/3 +smax (resp. –smax) and 2/3 +smax (resp. –smax)
- Insufficient: final value outside +smax, or f2 becomes oversynchronous (resp. undersynchronous)
- If the generator frequency is very stable and very close to the target value, consider a much longer pause time ts f than the minimum. This gives the phase-angle difference time for a zero crossing.

If one of both smax limits has been set to zero, the target values and the evaluation of both tests are identical.

**CMD-Test: Paralleling command issue**

**Aim**: Command must be issued at the right moment

**Evaluation:**
Evaluation of the moment of giving the command using transient recorder and / or synchroscope, either from SynView 6, or from an external recorder, or synchroscope. The commissioning engineer should judge whether the command was issued at the right moment. This can be done using the SynView 6 Transient Recorder and / or Synchroscope, or an external recorder, or synchronous scope (see section "Checking the paralleling" below).

**NOTE!**

When evaluating by means of the transient recorder or SynView 6 synchroscope, it should be noted that these measurements are not independent. If the commissioning work has been carried out successfully and the correct connection of the measuring voltages have been checked, the use of these values can be considered safe.

**NOTE!**

When evaluating with an external transient recorder or synchroscope, it must of course be ensured that their values are correct. If the commissioning work has been carried out correctly and the correct connection has been verified, the use of these values can be considered safe.

**b) Manual function test**

**Checking the voltage matcher**

**CAUTION!**

During the check of the voltage matcher, the command circuit of the circuit breaker must be disconnected for safety reasons (bring machine circuit breaker to test position, draw out the carriage, pull the command relay or plug –X61 of the paralleling relay on the back of the device). Otherwise, the system should be operable.

- Set the generator voltage manually to a value below the line or busbar voltage.
- Start SYNCHROTACT 6. Voltage and frequency matchers are now trying to adjust the voltage and frequency. Possibly turn off the frequency matcher (df/dt = 0) temporarily in order to be able to better observe the functioning of the voltage regulator alone. If a fault message appears on the LCD, proceed according to the error list.

If the parameters ±ΔUmax, dU/dt, ts U and tp Umin are set correctly, a single adjustment command U+ is sufficient to reach the tolerance band, provided the excitation is stable.

The adjustments must be repeated and observed several times. Different working points must be considered. If pendulums occur, the setting value dU/dt must be increased until no more pendulums occur. It is also possible to repeat the SEEK function SEEK-dUdt.

### Checking the frequency matcher

**CAUTION!**

For safety reasons, interrupt the command circuit of the circuit breaker (bring machine circuit breaker to test position, draw out the carriage, pull the command relay or plug –X61 of the paralleling relay on the back of the device). Otherwise, the system should be operable.

- Set the generator frequency manually to a value below the line or busbar frequency.
- Start SYNCHROTACT 6. Frequency and voltage matchers are now trying to adjust the voltage and frequency. Possibly turn off the voltage matcher (dU/dt = 0) temporarily in order to be able to better observe the functioning of the frequency matcher alone.

If a fault message appears on the LCD, proceed according to the error list.

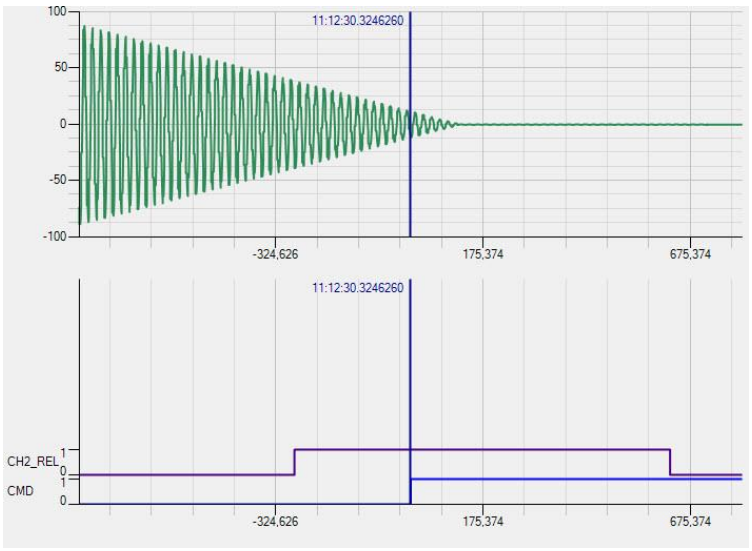
If the parameters ±smax, df/dt, ts f and tp f are set correctly, a single adjustment command f+ is sufficient to reach the tolerance band, provided the turbine controller is working in a stable manner.

The adjustments must be repeated and observed several times. Different working points must be considered. If pendulums occur, the setting value df/dt must be increased until no more pendulums occur. It is also possible to repeat the SEEK function SEEK dfdt.

### Checking the paralleling

At the end of the commissioning process, "blind" synchronization should be carried out several times (circuit breaker in the test position). The differential voltage and the paralleling command should thereby be recorded using the transient recorder of the **SynView 6** PC tool or using an external transient recorder. At the same time, the synchronization process should be observed using synchronizing instruments in the plant or, if these are not installed, using the synchronizing instruments of **SynView 6**.

Bring the circuit breaker to the operating position, adjust the voltage and frequency carry out “live” synchronization. Record the synchronization process.



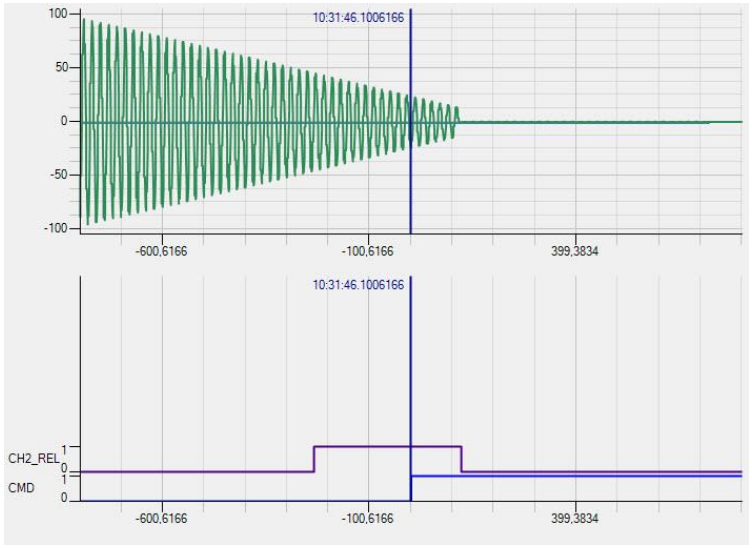

**Correct paralleling**

Voltage difference u1 – u2

CH2 REL = Paralleling command release channel 2 (only SYN 6202)

CMD = paralleling command (channel 1)

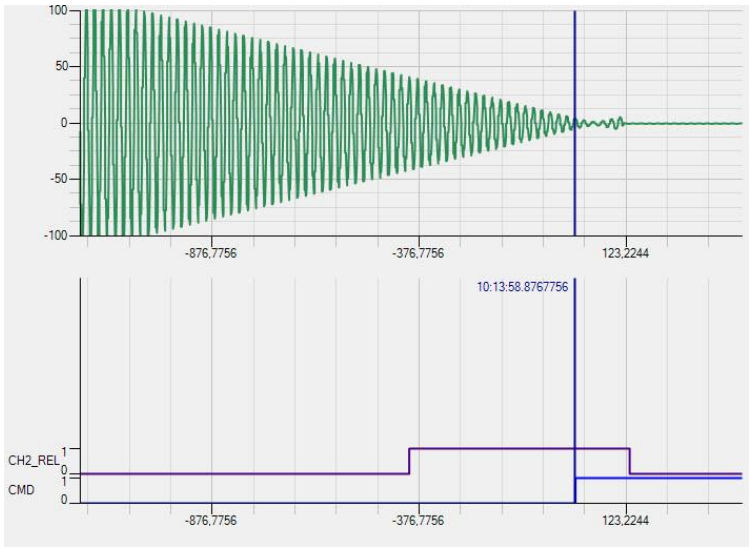
*Figure 9-4 Correct paralleling*




**Angle error**
(switches too early)

Possible causes:

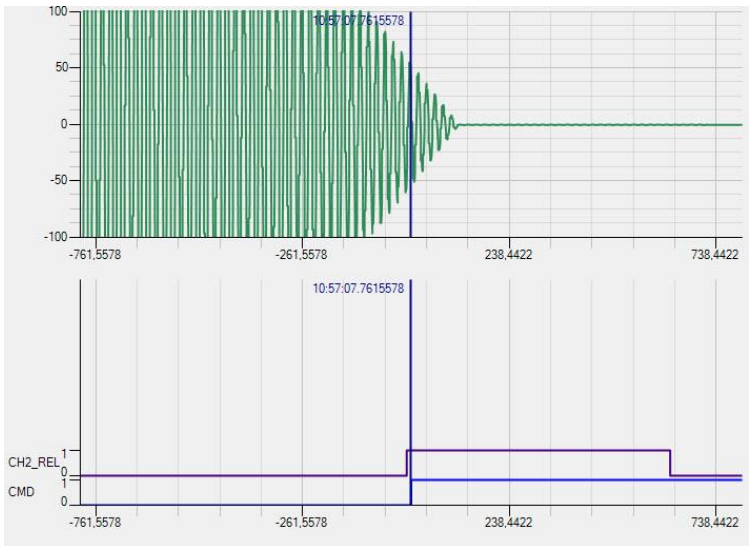
- t on zu gross eingestellt
- α-Messung falsch (αOffset falsch eingestellt oder im Extremfall Phasenfehler)




**Angle error**
(switches too late)

Possible causes:

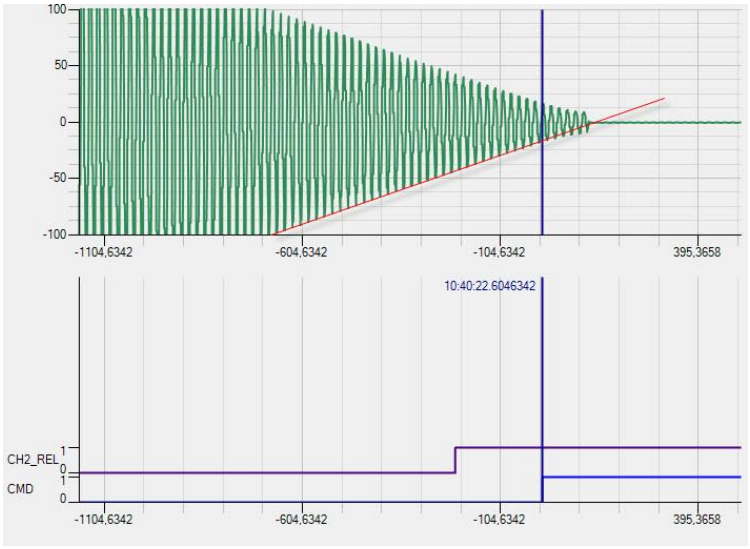
- t on set too low
- α-measurement wrong (αOffset set incorrectly or in extreme cases phase error)




**Slip/angle error too big**

Possible cause:

- smax set too high




**Voltage difference**

Possible causes:

- ΔUmax set too high
- Measuring error (actual value calibration)

*Figure 9-5 Several errors*

### *9.3.4. Completion of the commissioning work and reporting*

Once the adjusting work has been completed, SYNCHROTACT 6 can be set to READY status.

If error messages occur, they must be removed according to the error list (see *Chapter 10.2*).

At the end of commissioning, the parameter settings must be documented in a protocol. There are two possibilities:

- Create a snapshot file using SynView 6
- Creation of a setting protocol with manually entered parameter settings.

**Snapshot-file as setting protocol**

See also *Chapter 8.2.9*, or refer to the SynView 6 User Manual for more details, document number 3BHS840044 E80.
The *.csv file format is recommended for the protocol itself. It is however advantageous to store a second file in CT Snapshot format, which can be used to download the setting data again, or as a copy, eg to a replacement device.

**Setup log with manually entered parameter settings**

For this purpose, a setup log template can be used, which is located at the end of this user manual.

# Chapter 10 - Maintenance and Troubleshooting

## 10.1. Maintenance

The components of the SYNCHROTACT products are designed in such a way that they survive a standard life of approximately 20 years without replacement. Nevertheless, there can always be failures. In order to protect the system against failures or to reduce the downtime in the event of a fault, an assessment of the following points is recommended:

- **Safety concept**: to protect the system against dangerous faults (such as faulty synchronizing), which could lead to damage to machine parts, a safety concept should be made during the planning process. It is recommended to check the safety concept at least once after commissioning. Is the system fault tolerant? Are the settings of all components involved in the synchronization correctly matched?
- **Synchronization time**: Sometimes, synchronous components (synchronizing device, voltage regulator, speed controller, control circuit, circuit breaker) are not correctly matched. The result is that the synchronizing process sometimes, or always, takes an unusually long time. The system-dependent settings should therefore be checked. In this case, it may be the case that adjustment changes are not only necessary at the synchronizing device in order to shorten the duration of the synchronization process.
- **Downtime**: The downtime can be shortened by the following measures:
  - **Use redundant system**
    The most efficient way to reduce the downtime is to use a redundant - automatic or manual - synchronization system. However, this must be taken into account when planning the synchronizing system, if necessary.
  - **Fast identification of the error cause**
    Since the synchronization is not required most of the time, but the microprocessors are constantly running, it is possible to detect and correct a fault in time before the next use. A normally closed contact "ERROR" in the SYNCHROTACT 6 device provides the necessary signal.
    Tests in the operating mode TEST, or during the revision, by secondary feeding, can help, but are only limited representative. In addition, an available machine is required in the TEST mode and disconnect terminals must be provided for the secondary supply.
  - **Spare parts concept**
    If there is no redundancy, spare parts management helps to reduce the duration of a possible failure. SYNCHROTACT 6 devices can be replaced easily and quickly thanks to wiring the electrical connections on connector strips. It is recommended to preset the parameters of the replacement devices so that no adjustment work is necessary.
    Unfortunately, electronic components are constantly discontinued and the purchased spare parts are perhaps already very long in stock. It is therefore advisable to check the spare parts in stock and to check their availability (life cycle status) from time to time.

  - **Fast repair**
    Ensuring short repair times is a further factor of influence on downtime.

- **Replacement of the synchronizing device:** in order to achieve an optimal failure rate, it is recommended to replace the synchronizer after approx. 20 years. The date for the replacement should be adjusted to the lifetime of the remaining equipment. The optimum is achieved if, for the first synchronizing device and for its successor, the operating times are as long as possible.

### *10.1.1. ABB Support*

On request, ABB offers the following services for all synchronizing systems:

- **Engineering and commissioning of new plants**
  It is not mandatory to use certified personnel for configuring and commissioning SYNCHROTACT synchronizing systems. Nevertheless, the use of our trained specialists helps to increase the reliability of the system.

- **ABB University**
  Our Learning Center ABB University also offers training programs that enable the necessary commissioning and maintenance work to be carried out.

- **Service**
  For urgent service cases, ABB offers a 24 - hour hotline (see *Chapter1.4*), whose response time can be guaranteed by means of a service contract.

- **Consultancy and condition analysis**
  Analysis of the existing synchronizing system and consultation regarding safety, optimization of the synchronization process, spare parts, replacement, etc.

- **Test performances**
  Work on existing installations. eg, simulation tests with secondary supply and the recordings made in the process.

- **Replacement of synchronizing devices**
  - Adjust the existing layout scheme for the device with the same functionality
  - Installation and electrical connection of our SYNCHROTACT – devices in the system
  - Commissioning
  - Completion of the modified installation scheme

- **Replacement of complete synchronizing systems**
  - Consulting and sale of complete synchronizing cubicles
  - Engineering (schematic drawing, construction, etc.)
  - Commissioning

## 10.2. Faults

### 10.2.1. General


**DANGER!**

SYNCHROTACT 6-devices operate with in some cases dangerous voltages (>50 V), eg voltage transformer inputs up to 170 VAC and relay outputs up to 250 VAC/VDC. Manipulations carried out on these parts can cause death or injury to the people involved or damage to surrounding objects. If handled correctly and in the proper environment, as described in these instructions, there is no risk.


**DANGER!**

All relevant regulations must be observed during fault-rectification. It is essential that these safety regulations are read before starting any work on the SYNCHROTACT 6 equipment.


**DANGER!**

If work is being carried out in the environment of the SYNCHROTACT 6 device, eg on the relay controls, electronics power supply, synchronizing instruments, all voltages >50 V which are connected to the system must be switched off. In order to prevent open voltage circuits being accidentally closed by third parties, the circuits in question should be marked at the disconnection point (eg, with a warning sign).

**CAUTION!**

Before switching on again, all connectors must always be plugged in.

### 10.2.2. Troubleshooting

A fault message from the SYNCHROTACT 6 refers not only to internal causes but also to external ones. It is therefore important to make sure that the environment of the synchronizing device is in order before sending the device in for repair (pointlessly).

The following situations can be distinguished:

1. SYNCHROTACT 6 is in error status (ERROR LED and remote display contact ERROR): Try to locate the cause with the aid of the fault and event table in *Chapter 10.2.3.*

2. SYNCHROTACT 6 is not in error status, but the synchronizing process cannot be started, takes a very long time or paralleling does not take place:

    1. SYNCHROTACT 6 is blocked: the BLOCKED LED lights up: the device is not ready for operation (eg following manipulation of the settings) or TEST mode is selected.

    2. SYNCHROTACT 6 is ready (READY LED or in operation (OPERATING LED): temporarily set t tot to a low value (eg 1 minute). On a further attempt, the synchronizing process will be aborted after the set time. Read error codes from the LCD or using SynView 6 and proceed in accordance with *Chapter 10.2.3*

3. Faults in connection with a communication interface: refer to *Chapter 10.3*.

If this advice does not lead to success, proceed in accordance with *Chapter 10.2.4*.

### *10.2.3. Events*

All detected events are stored in the event memory with a time stamp. The event memory contains a table with the last 2000 entries. They are stored there until they are overwritten by newer events or until the list is manually deleted.

In doing so, both normal operation events and those occurring due to problems or errors are recorded. For easier identification of the events, different event types are distinguished.

The visibility of an event is different, depending on the event type. The following options exist to see specific events:

1. Local or remote: manual readout from the event list via MCP or SynView 6. This event list can be stored and/or printed.
2. Local or remote: automatic display in the dynamic event list in the SynView 6 event tool.
3. Local: automatic display on the MCP
4. Local: automatic display on the LEDs on the SYNCHROTACT 6 front
5. Remote: automatic display with SYNCHROTACT 6 relay contacts

The following table shows the most important properties of the different event types:

| ***Event type*** | ***Influence on the operation*** | ***Visibility*** | ***Reset*** |
|---|---|---|---|
| **I** Information | none | Event list (SynView 6, or MCP)<br>partly: LED on the front panel and/or relay contacts | automatic |
| **W** Warning | none | Event list (SynView 6, or MCP)<br>partly: LED on the front panel and/or relay contacts | automatic |
| **A** Alarm | Depending on the alarm, the device can be taken out of service, or not | Event list (SynView 6, or MCP)<br>Dynamic event list (SynView 6)<br>Automatic display (MCP) | automatic |
| **E** Error | Device is taken out of service | Event memory (SynView 6, or MCP)<br>Dynamic event list (SynView 6)<br>Automatic display (MCP, LEDs BLOCKED & ERROR on the front panel and relay contact ERROR) | manual |

| *Configurable Events* | | | |
|---|---|---|---|
| **Type** | **Code** | **Indication** | **Remarks** |
| **I** | 23500<br>…<br>23515 | PIO_ConfigurableEvent01<br>…<br>PIO_ConfigurableEvent16 | Configurable events<br>In total 16 events can be assigned to functions. The possible functions are the same as for the configurable relay outputs. See Table in Chapter *5.4.1* |

| *Parameter set- and paralleling point selection* | | | |
|---|---|---|---|
| **Type** | **Code** | **Indication** | **Remarks** |
| **I** | 24101<br>…<br>24120 | PSPP_ParSet1_Selected<br>…<br>PSPP_ParSet20_Selected | Selection parameter set 1 to 20<br>Display is shown immediately after START (<1 s), or in “BLOCKED“ state when the selection is active |
| **I** | 24121<br>…<br>24140 | PSPP_ParPoint1_Selected<br>…<br>PSPP_ParPoint20_Selected | Selection paralleling point 1 to 20<br>Display is shown immediately after START (<1 s), or in “BLOCKED“ state when the selection is active |
| **E** | 24141 | PSPP_SelInvalid_Fail | Error in the paralleling point-/parameter set selection<br>Incorrect combination of the control signals. The selection can be made by hard wiring, via the operating interface, or by programming.<br><br>Remedy:<br>• Check which type of selection is provided<br>• Check required signals<br>• Check the programming of the configurable IOs. The operating mode of a binary input could be set to “Always ON” (eg parameter 3114 ModeSelBIN1 = #1)<br>• For SYN 6202: check the programming of the parameters „CH2 AlwaysPs1“ and „CH2Ctrl by CH1“ |
| **E** | 24142 | PSPP_SelTimeout_Fail | Error in the paralleling point-/parameter set selection<br>Selection comes too late, or not at all. Selection must take place ≤ 1 s after start-up. The selection can be made by hard-wiring, via the operating interface, or by programming.<br><br>Remedy:<br>• Check which type of selection is provided<br>• Check required signals<br>• Check programming of the configurable IOs<br>• For SYN 6202: check the programming of the parameters „CH2 AlwaysPs1“ and „CH2Ctrl by CH1“ |

| *Analog measuring inputs* | | | |
|---|---|---|---|
| **Type** | **Code** | **Indication** | **Remarks** |
| **E** | 24200 | Meas_AINSel_Fail | Incorrect setting when selecting the analog inputs. AINSel U1 and AINSel U2 must both be set differently. The setting value must also be between 1 and 8 for both. |
| **E** | 24201 | Meas_DCDetU1_Fail | DC component in the measuring voltage U1 was determined<br>Remedy:<br>• Check external measuring signals<br>• Possibly temporarily use another analog input for comparison purposes |
| **E** | 24202 | Meas_DCDetU2_Fail | DC component in the measuring voltage U2 was determined<br>Remedy:<br>• Check external measuring signals<br>• Possibly temporarily use another analog input for comparison purposes |

| *Command generation* | | | |
|---|---|---|---|
| **Type** | **Code** | **Indication** | **Remarks** |
| **I** | 24300 | CmdGen_TestModeCmd_On | Command output active in TEST mode |
| **I** | 24301 | CmdGen_OpWin_Blk | The “Operator window“-function blocks the command generation. Manual release not given, or given at the wrong time.<br>Remedy:<br>a) „Operator window“-function not used:<br>• Switch off the function: tOpWin = 0.0 s<br>b) „Operator window“-function used:<br>• Check the settings of the parameters (tOpWin, ±αmax and binary input for the manual release) (see *Chapter 6.9*);<br>• Check the wiring of the manual release signal<br>• Manual release must be given at the right moment |
| **A** | 24302 | CmdGen_Ch2_Blk | Only SYN 6202: Channel 2 has prevented at least once the delivery of the parallel switching command from channel 1.<br>Check:<br>• Are both measuring voltages continuously in phase during the entire synchronizing process? Are the measuring voltages correctly connected?<br>• Has the calibration of the measuring voltages been carried out correctly (U1/U2 and αOffset)?<br>• Are the set limit values in both channels correct? |

| | | | |
|---|---|---|---|
| | | | • Does the parameter set selection match in both channels?<br>• SYN 6202 only: Binary inputs BIN01 to BIN06 must be used with factory settings unless the parameter set selection in channel 2 is either always set to "1" (parameter 3127=ON) or channel 1 is selected (parameter 3128=ON ). See also *Chapter 3.3.2.*<br>• When using the TTI function: is the parameter “CH2 TTI Select” switched on? (see Channel 1) |
| **I** | 24303 | CmdGen_BlkInput_Blk | A binary input programmed with #48 (= command generation blocking) has prevented the command release at least once. |
| **W** | 24305 | CmdGen_tOn_OutOfRange | The SEEK ton result is not within the setting range of t on = 1…999 ms.<br>Check:<br>• Effectiveness of the paralleling command issued by SEEK ton (LED, relay contacts, external circuits up to the circuit breaker) |
| **W** | 24306 | CmdGen_VolPreCond_Fail | Start conditions for the SEEK ton function are not fulfilled.<br>• One voltage must be <U0max, the other >Umin |
| **W** | 24307 | CmdGen_SEEKtOnRel_Fail | Command generation for SEEK ton- function is blocked, because device selector switch “DEVICE MODE SELECTION” is not in “ENABLE SEEK ton” position.<br>Remedy: Put device selector switch in correct position and then reset it again. |
| **W** | 24309 | CmdGen_SEEKtOnCh2_Fail | Only SYN 6202: Start conditions for the SEEK ton function are not fulfilled in channel 2.<br>• One voltage must be <U0max, the other between >50 % and <130 % Un<br>• Parameter set selected<br>• Received release for the SEEK ton function from channel 1 |

| *Monitoring* | | | |
|---|---|---|---|
| **Type** | **Code** | **Indication** | **Remarks** |
| I | 24400 | Mon_U1_IsMin | U1<Umin |
| I | 24401 | Mon_U1_IsMax | U1>Umax |
| I | 24402 | Mon_U2_IsMin | U2<Umin |
| I | 24403 | Mon_U2_IsMax | U2>Umax |
| I | 24404 | Mon_f1_IsOut | f1 outside of tolerance band (fn ±5 Hz) |
| I | 24405 | Mon_f2_IsOut | f2 outside of tolerance band (fn ±5 Hz) |
| I | 24406 | Mon_DU_IsOut | ΔU outside of tolerance band ±ΔUmax |
| I | 24407 | Mon_s_IsOut | s outside of tolerance band ±smax |
| I | 24408 | Mon_alpha_IsOut | α outside of tolerance band ±αmax |
| I | 24409 | Mon_RotDir1_Fail | Sense of rotation (phase sequence) of the measuring voltage U1 cannot be measured.<br>Possible causes:<br>• Phase failure<br>• Connection of the measuring voltage faulty or missing completely<br>• Incorrect selection of the analog inputs |
| I | 24410 | Mon_RotDir2_Fail | Sense of rotation (phase sequence) of the measuring voltage U2 cannot be measured.<br>Possible causes:<br>• Connection of the measuring voltage faulty<br>• Incorrect selection of the analog inputs |
| I | 24411 | Mon_RotDir_IsDiff | Unequal sense of rotation (phase sequence) of the measuring voltages U1 and U2.<br>Possible causes:<br>• Phase failure<br>• Connection of the measuring voltage faulty or missing completely<br>• Incorrect selection of the analog inputs |
| I | 24412 | Mon_TrsDet_Blk | Transient detected on the measuring voltage.<br>The transient detection consists of the following sub-functions:<br>• Amplitude comparison between unfiltered instantaneous value and filtered mean value; Response threshold: deviation> 5% Un<br>• Period-duration comparison between unfiltered instantaneous value and filtered mean value; Response threshold: deviation> 3%<br>• Zero crossing test indicates that more than 103% of the measured period has elapsed since the last zero crossing<br>If one of the above-mentioned sub-functions responds, the synchronization function is blocked and displayed as an event. The monitoring function is reset at least two seconds after the transients have disappeared. |
| I | 24413 | Mon_ExclDB_Blk | Exclusive dead bus – Function blocked<br>Possible causes:<br>a) „Exclusive DB“ used: |

| | | | |
|---|---|---|---|
| | | | • Release DB is active, but there is no dead bus – situation, instead two existing voltages are present<br>b) „Exclusive DB not used:<br>• Exclusive DB is switched on, but should be switched off (34 ExclDB = OFF) |
| **I** | 24414 | Mon_SynchroChkInt_Blk | Synchrocheck interlocking active.<br>Possible causes:<br>a) Interlocking used:<br>• The operator has given the paralleling command too toon, before the synchrocheck has released.<br>• Synchrocheck-release occurs at the wrong time (incorrect parameter setting or incorrect measuring)<br>b) Interlocking not used:<br>• Set the binary input for the lock (code 46) to "Always OFF" |
| **I** | 24415 | Mon_dalphadt_IsIn | Synchronous, or quasi-synchronous sources discovered (dα/dt < dα/dtmax).<br>Under these conditions, two networks could be switched by means of SYN RELEASE without waiting for the phase match.<br>The other conditions must be observed during the monitoring time t supS. |
| **W** | 24416 | Mon_U1DB_Fail | U1 < U0max, but release DB is missing<br>Possible causes:<br>• It was forgotten to issue the Release DB command<br>• Protection switch of measurement U1 open. In this case, actually, voltage could be present! |
| **W** | 24417 | Mon_U2DB_Fail | U2 < U0max, but release DB is missing<br>Possible causes:<br>• It was forgotten to issue the Release DB command<br>• Protection switch of measurement U2 open. In this case, actually, voltage could be present! |

| ***Voltage matcher*** | | | |
|---|---|---|---|
| **Type** | **Code** | **Indication** | **Remarks** |
| **I** | 24500 | RUPulse | Voltage adjusting command U+ (increase U2) |
| **I** | 24501 | LUPulse | Voltage adjusting command U- (reduce U2) |
| **W** | 24502 | UMatch_U1PreCond_Fail | Start condition for SEEK dUdt not fulfilled:<br>U1 is not between 95 and 105% Un |
| **W** | 24503 | UMatch_f1PreCond_Fail | Start condition for SEEK dUdt not fulfilled:<br>F1 is not between 95 and 105% fn |
| **W** | 24504 | UMatch_U2PreCond_Fail | Start condition for SEEK dUdt not fulfilled:<br>U2 not between 85 and 115% Un |
| **W** | 24505 | UMatch_f2PreCond_Fail | Start condition for SEEK dUdt not fulfilled:<br>F2 is not between 85 and 115% fn |

| | | | |
|---|---|---|---|
| **W** | 24506 | UMatch_InvPreCond_Fail | Start condition for SEEK dUdt not fulfilled:<br>INVERSE U must be OFF. Parameter dU/dt has no function at fixed pulse times. |
| **W** | 24507 | UMatch_TapChgPreCond_Fail | Start condition for SEEK dUdt not fulfilled.<br>TVM must be set to OFF. Parameter dU/dt has no function for tap changer. |
| **W** | 24508 | UMatch_CancelCond_Reached | Abort criterion for SEEK dUdt:<br>$\lvert \Delta U \rvert \geq 10\%$ |
| **W** | 24509 | UMatch_UMatching_NoEffect | Abbreviation criterion for SEEK dUdt:<br>Voltage adjustment command has no effect |
| **W** | 24510 | UMatch_dUdt_OutOfRange | The result of SEEK dUdt is outside the setting range of dU/dt |
| **W** | 24511 | UMatch_License_Fail | License for voltage matcher not available |
| **I** | 24512 | UMatch_Matching_Blk | Voltage matcher blocked by blocking input (# 49). |

| ***Frequency matcher*** | | | |
|---|---|---|---|
| **Type** | **Code** | **Indication** | **Remarks** |
| **I** | 24600 | RfPulse | Frequency adjusting command f+ (increase f2) |
| **I** | 24601 | LfPulse | Frequency adjusting command f- (reduce f2) |
| **W** | 24602 | FMatch_U1PreCond_Fail | Start condition for SEEK dfdt not fulfilled:<br>U1 is not between 95 and 105% Un |
| **W** | 24603 | FMatch_f1PreCond_Fail | Start condition for SEEK dfdt not fulfilled:<br>f1 is not between 95 and 105% fn |
| **W** | 24604 | FMatch_U2PreCond_Fail | Start condition for SEEK dfdt not fulfilled:<br>U2 not between 85 and 115% Un |
| **W** | 24605 | FMatch_f2PreCond_Fail | Start condition for SEEK dfdt not fulfilled:<br>f2 is not between 85 and 115% fn |
| **W** | 24606 | FMatch_InvPreCond_Fail | Start condition for SEEK dfdt not fulfilled:<br>INVERSE f must be OFF. Parameter df/dt has no function at fixed pulse times. |
| **W** | 24607 | FMatch_CancelCond_Reached | Abort criterion for SEEK dfdt:<br>$\lvert s \rvert \geq 6\%$ |
| **W** | 24608 | FMatch_fMatching_NoEffect | Abort criterion for SEEK dfdt:<br>Frequency adjustment command has no effect |
| **W** | 24609 | FMatch_dfdt_OutOfRange | The result of SEEK dfdt lies outside the setting range of df/dt |
| **W** | 24610 | FMatch_License_Fail | License for frequency matcher not available |
| **I** | 24611 | FMatch_Matching_Blk | Frequency matcher blocked by blocking input (# 49). |

| *Fault Handler* | | | |
|---|---|---|---|
| **Type** | **Code** | **Indication** | **Remarks** |
| **I** | 24800 | FH_Reset | Fault reset |
| **E** | 24802 | FH_ContactMonK1_Fail | Contact monitoring: discrepancy between control signal and auxiliary contact of command relay K1 (channel 1)<br>Remedy: possibly device error: contact the SYNCHROTACT support line and state the following:<br>• Does the error occur permanently or temporarily?<br>• When does the error occur: during synchronization (OPERATING), at command output (CMD), or in idle state (READY) (see Event memory)?<br>• Read and send data from the device ➔ Options \ Tools \ Data collection |
| **E** | 24803 | FH_ContactMonK2_Fail | Contact monitoring: discrepancy between relay control signal and auxiliary contact of command relay K2 (SYN 6201: channel 1; SYN 6202: channel 2)<br>Remedy: see event 24802 |
| **E** | 24804 | FH_ExternalTrip_Fail | SYNCHROTACT 6 was set to the "ERROR" state by a configurable binary input programmed with # ± 59. |
| **E** | 24806 | FH_Ch2ver_Fail | Discrepancy between SW versions of channel 1 and channel 2 (SYN 6202) |
| **E** | 24807 | FH_Power_Fail | Fault in the power supply<br>Remedy:<br>• Are there any other events that have occurred in connection with this error?<br>• Reset the device by interrupting the power supply (≥10 s)<br>• Possible device error: use replacement device; Recommendation: contact SYNCHROTACT support line first to determine how to proceed |
| **E** | 24808 | FH_WatchDogTsA_Fail | Watchdog of Task A (= 1 ms-Task) triggered at least twice<br>Remedy:<br>• Are there any other events that have occurred in connection with this error?<br>• Reset the device by interrupting the power supply (≥10 s)<br>• Possible device error: use replacement device; Recommendation: contact SYNCHROTACT support line first to determine how to proceed |

| | | | |
|---|---|---|---|
| **E** | 24809 | FH_WatchDogTsB_Fail | Watchdog of Task B (= 10 ms-Task) triggered<br>Remedy: see event 24808 |
| **E** | 24810 | FH_WatchDogTsC_Fail | Watchdog of Task C (= 100 ms-Task) triggered<br>Remedy: see event 24808 |
| **E** | 24811 | FH_WatchDogTsD_Fail | Watchdog of Task D (= 1 s-Task) triggered<br>Remedy: see event 24808 |
| **E** | 24812 | FH_WatchDogCB_Fail | Watchdog of Control Builder task triggered<br>Remedy: see event 24808 |
| **E** | 24814 | FH_OtherSystemLink_Fail | No function with SYN 6201 and SYN 6202 |
| **E** | 24815 | FH_Ch2Link_Fail | Connection error between channel 1 and channel 2<br>• Reset the device by interrupting the voltage supply (≥10 s)<br>• Possible HW error: use replacement device; Recommendation: Contact SYNCHROTACT-Support-line beforehand to determine how to proceed |
| **E** | 24816 | FH_IOextensionLink_Fail | Connection error "IO connection" (for connection of peripheral devices)<br>• Check the attachment of the plug<br>• Check the connection cable<br>• Setting parameter "IOextension_On" (in group 32) must be OFF if no peripheral device is connected, or ON, if one is connected.<br>• Possible HW error: use replacement device; Recommendation: Contact SYNCHROTACT-Support-line beforehand to determine how to proceed |
| **E** | 24817 | FH_MainPower_Fail | Fault in main power supply<br>Remedy:<br>• Check whether the auxiliary voltage is within the permissible range (observe the return line!)<br>• Check whether the voltage source can supply sufficient current (see Chapter 11.1)<br>• Check the connection cable / contact surfaces<br>• Is the plug loose, defective, or disconnected?<br>• Possible HW error: use replacement device; Recommendation: Contact SYNCHROTACT-Support-line beforehand to determine how to proceed |
| **E** | 24818 | FH_AuxPower_Fail | Fault at 24 VDC - auxiliary voltage output -X42<br>Remedy:<br>• Check the height of the load (see *Chapter 11.2*)<br>• Short-circuit at the auxiliary voltage output?<br>• Possible HW error: use replacement device; Recommendation: Contact SYNCHROTACT-Support-line beforehand to determine how to proceed |

| | | | |
|---|---|---|---|
| **E** | 24819 | FH_BackupSupply_Fail | Fault in contact hold monitoring.<br>Remedy:<br>• Reset the device by interrupting the voltage supply (≥10 s)<br>• Possible HW error: use replacement device; Recommendation: Contact SYNCHROTACT-Support-line beforehand to determine how to proceed |
| **E** | 24820 | FH_AnalogPower_Fail | Error in the power supply of the measuring inputs<br>Remedy:<br>• Reset the device by interrupting the voltage supply (≥10 s)<br>• Possible HW error: use replacement device; Recommendation: Contact SYNCHROTACT-Support-line beforehand to determine how to proceed |
| **E** | 24821 | FH_EthernetPower_Fail | Error in the power supply of the Ethernet interfaces<br>Remedy:<br>• Reset the device by interrupting the voltage supply (≥10 s)<br>• Possible HW error: use replacement device; Recommendation: Contact SYNCHROTACT-Support-line beforehand to determine how to proceed |
| **E** | 24822 | FH_Ch2Reset_Fail | Channel 2: Startup error; on start-up, channel 2 outputs a corresponding status signal at channel 1; if it does not arrive, the event is generated.<br>Remedy:<br>• Reset the device by interrupting the voltage supply (≥10 s)<br>• Possible HW error: use replacement device; Recommendation: Contact SYNCHROTACT-Support-line beforehand to determine how to proceed |
| **E** | 24823 | FH_HwCmdEnable_Fail | HW monitoring of channel 1, or channel 2 has been addressed and the command generation is blocked.<br>Remedy:<br>• Reset the device by interrupting the voltage supply (≥10 s)<br>• Possible HW error: use replacement device; Recommendation: Contact SYNCHROTACT-Support-line beforehand to determine how to proceed |

| | | | |
|---|---|---|---|
| **E** | 24824 | FH_HwCmdLatch_Fail | The command generation is blocked, either because the HW monitoring triggered (see 24823), or because the value of the main voltage supply (24817) is too low.<br>Remedy: clarify in which context this event is displayed and then continue there. |
| **I** | 24826 | FH_CmdRelay_Cls | Command relay CMD is closed (read back from auxiliary contact of the command relay) |
| **I** | 24827 | FH_Ch2RelRelay_Cls | Command release relay CH2 REL is closed (read back from the auxiliary contact of the command enable relay) |
| **E** | 24828 | FH_Channel2_Fail | Error in channel 2 (SYN 6202); possibly incorrect configuration of the binary inputs or outputs: under certain conditions, the binary inputs (BIN1 to BIN6) and outputs (BOUT1 to BOUT6) must not be configured differently than with the factory setting (see *Chapter 3.3.2 and 6.3*)<br>Remedy:<br>• Check the configuration of the binary inputs and outputs and either reset to factory settings, or set the channel 2 - parameter set selection to either "always 1" (parameter 3127), or to “accept parameter set selection from channel 1” (parameter 3128)<br>• Reset the device by interrupting the voltage supply (≥10 s)<br>• Possible HW error: use replacement device; Recommendation: Contact SYNCHROTACT-Support-line beforehand to determine how to proceed |

| ***State control (Main State Machine)*** | | | |
|---|---|---|---|
| **Type** | **Code** | **Indication** | **Remarks** |
| **W** | 24900 | MSM_tTot_Exp | Synchronization process stopped (STOP) due to exceedance of t tot (“Abort after START”)<br>Procedure: Clarify why the synchronization process could not be completed normally:<br>• Was LS closed? STOP signal interrupted?<br>• Command output (CMD) occurred? Are there other contacts in series?<br>• Do the matchers function?<br>• Parameter settings / tolerance bands?<br>• Are the measuring voltages correctly connected? |
| **E** | 24901 | MSM_tTot_Fail | Synchronization process has been aborted with an error message (ERROR) because of the expiry of t tot (“Abort after START”)<br>Procedure: Same as for Event 24900 |

| | | | |
|---|---|---|---|
| **W** | 24902 | MSM_tStop_Exp | Synchronization process stopped (STOP) due to exceeding of t stop (“Abort after CMD”)<br>Procedure: Clarify why the synchronization process could not be completed normally:<br>• Was LS closed? STOP signal interrupted?<br>• Are there other contacts in series with the command contact? |
| **E** | 24903 | MSM_tStop_Fail | Synchronization process was aborted with an error message (ERROR) due to exceeding of t stop (“Abort after CMD”)<br>Procedure: As for event 24902 |
| **W** | 24904 | MSM_SystemOff_Fail | Set to READY, or START is blocked because the device selector switch "DEVICE MODE SELECTION" has switched off the device.<br>Switched off means all positions, except "NORMAL OPERATION".<br>Remedy:<br>Set the device selector switch to "NORMAL OPERATION". |
| **W** | 24905 | MSM_TestModeActive_Fail | Set the device to READY, or start of the SEEK function failed because the TEST mode is active.<br>Remedy: Deactivate TEST mode (configurable binary input with # ± 41) |
| **W** | 24906 | MSM_TestFuncActive_Fail | Set device to READY, or select mode TEST failed because a SEEK function is active.<br>Remedy: Deactivate SEEK function |
| **W** | 24907 | MSM_NotBlocked_Fail | SEEK function cannot be started because the device is not in the BLOCKED state (without fault).<br>Remedy: Set device to BLOCKED, select corresponding parameter set, then start SEEK function |
| **I** | 24908 | MSM_Startup_Str | SYNCHROTACT 6 is started up<br>Event is triggered when the application SW is started (positive edge of startup flag). |
| **I** | 24909 | MSM_SYNCHROTACT_Str | Synchronizing process started START |
| **I** | 24910 | MSM_SYNCHROTACT_Stop | Synchronizing process stopped STOP |
| **I** | 24911 | MSM_ERROR_Status | Device status ERROR, SYNCHROTACT 6 not ready |
| **I** | 24912 | MSM_READY_Status | Device status READY, SYNCHROTACT 6 ready |
| **I** | 24913 | MSM_BLOCKED_Status | Device status BLOCKED, SYNCHROTACT 6 not ready<br>without errors = maintenance operation;<br>with errors = malfunction in connection with the synchronization (in the device, or outside) |
| **I** | 24914 | MSM_TestMode_Str | SYNCHROTACT 6 in test mode started |

| | | | |
|---|---|---|---|
| **I** | 24915 | MSM_TestMode_Stop | SYNCHROTACT 6 in test mode stopped |
| **E** | 24916 | MSM_ActiveStart_Fail | Pending START signal blocks changeover to READY.<br>Remedy: first remove START signal |
| **W** | 24917 | MSM_SEEKtOnRel_Fail | SEEK function cannot be started because the "DEVICE MODE SELECTION" device selector is not set to "ENABLE SEEK ton".<br>Remedy: Reset the device selector switch to the correct position and after the function has been completed, reset to normal operation! |

| ***Events related to the TTI-function*** | | | |
|---|---|---|---|
| **Type** | **Code** | **Indication** | **Remarks** |
| **W** | 25000 | TTI_InvalidTap_Blk | Selection of an invalid transformer tap<br>Possible cause: Error in coding, or wrong selection signals |
| **E** | 25001 | TTI_License_Fail | License for TTI software license for the TTI function (transformer tap) is missing. This function requires a corresponding SW license. |

| *Events related to the Software licenses* | | | |
|---|---|---|---|
| **Type** | **Code** | **Indication** | **Remarks** |
| **W** | 25400 | VarM_Ch2License_Fail | Event not used (reserved on MCP) |
| **W** | 25401 | VarM_RedundancyLicense_Fail | Event not used (reserved on MCP) |
| **W** | 25402 | VarM_FBusLicense_Fail | Operating interface (IEC 61850, Modbus, Profibus) has been released with SynView 6, but the corresponding license is missing.<br>Using the operating interface requires a corresponding SW license. |
| **W** | 25403 | VarM_CSLLicense_Fail | Control System Logic (CSL) has been released with SynView 6, but the corresponding license is missing.<br>Using the CSL requires a corresponding SW license. |
| **W** | 25404 | VarM_IOExtLicense_Fail | Event not used (reserved on MCP) |
| **W** | 25405 | VarM_Ch2Detection_Fail | The detection of channel 2 does not match the stored software configuration. Either Channel 2 is missing, or it is present, but the SW configuration is for a single channel device. |

| *Events related to the parameter check (parameter monitoring)* | | | |
|---|---|---|---|
| **Type** | **Code** | **Indication** | **Remarks** |
| **E** | 25500 | ParM_Ch2ParMismatch_Fail | The parameter values read back from channel 2 do not match the copy of the values stored in channel 1. In addition to a transmission error, or a device fault, the possible cause can be a parameter change with an incorrect tool (not SynView 6).<br>Remedy: Transfer the parameters from channel 1 to channel 2 again by switching the unit to the setting mode (EDIT) and back again. |
| **I** | 25501 | ParM_ParAccess | Access to changing parameter setting values (= SYNCHROTACT 6 in setting mode) |
| **E** | 25517 | ParM_ParDownloadTimeout_Fail | Downloading the parameters took too long.<br>Remedy: Repeat download, if possible after restart |

| *System events (intern)* | | | |
|---|---|---|---|
| **Type** | **Code** | **Indication** | **Remarks** |
| **W** | 60000 | SYS_MN_TEMP_SYS_WARNING | Warning, internal device temperature high: Non-critical state, device can continue to be operated; Are there any means to lower the temperature? |
| **W** | 60001 | SYS_MN_TEMP_CARRIER_WARNING | |
| **W** | 60008 | SYS_MN_ECC_WARNING | |
| **A** | 60009 | SYS_MN_TEMP_SYS_ALARM | Alarm, internal device temperature in the critical range.<br>Remedy: Switch off the device;<br>Recommendation: Contact the SYNCHROTACT support line to determine how to proceed |
| **A** | 60010 | SYS_MN_TEMP_CARRIER_ALARM | |
| **A** | 60011 | SYS_MN_ECC_ALARM | |
| **I** | 60040 | SYS_EVB_CLEARED_EVENT | Event logger was cleared |

### *10.2.4. Troubleshooting unsuccessful*

The following advice can be of assistance in difficult cases. In order to interpret a fault more accurately, it is important to make a distinction as to which phase the synchronizer is currently in:
1. System testing
2. Commissioning
3. Operation

**System testing**
- Is the wiring correct?
- Is the sequence of control commands correct? (eg, parameter set selection first, then Start command).
- Critical examination for errors in project planning (eg. selection of paralleling point and parameter set, especially if these are made entirely or partly electronically; the selection of the operating mode TEST by means of configurable inputs puts the device in BLOCKED state. If a start command follows, commands are issued in the blocked state, but none on the CMD relay!).
- Does the applied test method correspond to reality?

**Commissioning**
Faults which occur during commissioning often have their cause in incorrect handling, setting, inadmissible external conditions or connection errors at the interface between plant and synchronizing system.

If the synchronizing process takes a long time:
Voltage or frequency matchers are not functioning correctly: optimize adjusting commands using the SEEK-function or empirically (see Chapter on commissioning). Theoretically, only one pulse is required in order to reach the tolerance band.

The simplest way to check the synchronization is using the synchroscope. If the plant does not feature one of these, the synchroscope of the PC-Tool SynView 6 can be used for that purpose. However, this display depends on the SYNCHROTACT 6, ie measuring errors cannot be detected.

If it seems, that the SYNCHROTACT should really have acted by now, it should be checked which conditions could not be fulfilled. This can be seen simply from the LEDs $\Delta U < \Delta U max$, $s < s max$ and $\alpha < \alpha max$. All three conditions must always be fulfilled (LEDs lit), in order for a command to be issued. The second channel should also be considered (SYN 6202): do its settings match channel 1, does the LED „CH2 REL“ light in comparison to the LED „COMMAND“ of channel 1 at the right moment?

Some turbine governors do not operate in a very stable manner. The set tolerance band for the slip can often not be achieved for a long time, or not at all. In this case, the problem may be remedied by increasing the smax settings. However, it should not go beyond the usual values of 0.1 to 0.5 % without making sure that the machine can withstand this (see *Chapter 5.2.3*).

If synchronization fails due to the voltage condition, it should be checked whether the limits Umax and Umin are maintained. If the voltage regulator is switched to manual regulation (field current regulator), the actual value, together with the generator voltage, is also dependent on the turbine speed. It can thus be difficult to bring the voltage within the tolerance band if the speed of the turbine varies greatly. Under certain circumstances, the voltage matcher may have to be set differently for field current regulator operation (different parameter set) than for voltage regulator operation.

Poor synchronization:
If increased active or reactive power surges occur during synchronization, it is essential to connect through again and check the measurement of U1 and U2 for angle and equal voltage. Using the transient recorder of the PC tool SynView 6 or using an external transient recorder, it should also be checked whether the breaker was actuated in the zero passage of the ΔU signal. Otherwise the breaker closing time t on must be adjusted.

**Following commissioning (operation)**
In this case, setting errors can usually be ruled out. It should be considered whether any changes were made to the plant prior to the failed synchronization which could affect the synchronizing process.

If the synchronizing process already took a long time beforehand, it may be that a fault message might suddenly appear due to a difference in the duration of the process. This can possibly be remedied with an optimization of the setting parameters. Otherwise, poor contacts, dropped connections, malfunctioning relays or tripped fuses may be the cause.

### *10.2.5. Fault rectification*

**Canceling faults**
Once the cause of the fault has been found and eliminated, the active error message can be canceled on the SYNCHROTACT 6.

**Replacing a SYNCHROTACT 6**
If a device is replaced, the circuit breaker must be set to test position or its command circuit must be interrupted to ensure that it can no longer be actuated.

1. Switch off SYNCHROTACT 6 and isolate all voltages which are still present from the SYNCHROTACT 6.


**DANGER!**

It must be ensured, by measuring, that no measuring voltages or control voltages >50 V are present at the terminals before anything is done to the device itself.

2. Rear panel connectors: loosen screws and unplug connectors

3. Loosen fixing clips and remove device from the cut-out.

The replacement unit is installed in reverse order. The commissioning and function check of the replacement unit is carried out as described in the section on commissioning. As far as the settings are known, they can be applied (see settings log).

**Sending the device in for repair**
If it has been definitely established that the synchronizer is defective, it must be sent in for repair. In order to ensure a smooth running of the repair, it is essential to contact the responsible ABB office and to complete the Return Form received by them.
Since the test conditions in the ABB plant are not exactly the same as those in the plant, it is possible that an error that has occurred in the plant does not show up during the test in the factory. In order to prevent any problems related to the repair process (queries, etc.), we recommend to fill in the questionnaire at the end of the document and to create a data collection using SynView 6 (see *Chapter 8.2.20*). If the creation of the data collection is not possible, a copy of the setting protocol and, if available, the event memory data also help. All mentioned information should be returned together with the device.

## *10.3. Faults in connection with a communication interface*

### *10.3.1. Checking the PC*

**SynView 6 maintenance interface:** read SYNCHROTACT 6 IP address from SYNCHROTACT 6 MCP (refer to parameter group 48 in Chapter *5.1.7*; The IP address must be: 172.16.0.211. If this is not the case, it is recommended to contact the SYNCHROTACT support line to determine how to proceed. Otherwise, the address must be compared with the address selected in the SynView 6 of the host system (eg PC). If necessary, adapt the IP address in the PC (see *Chapter 8.2.19*). If necessary, use the ping command in the "Command Prompt" program to check the connection. Command Prompt is usually located in the Windows Start menu under Accessories.

**IEC 61850 /Remote SynView 6**: Check the addressing: is the correct device addressed? (IP address in the SCD file).

**CAUTION!**

Changing settings of the wrong device can lead to serious damage in the plant! Therefore, especially when intervening with Remote SynView 6 (maintenance) after commissioning, make sure the right device is accessed. For this purpose, it is advisable to contact a person who is directly on the device by telephone and to have the correct addressing confirmed.

**Modbus, Profibus:** Check configuration of the related interface according to *Chapter 5.5* and modify if required.

### *10.3.2. Checking the connection*

Check status displays of the related communication interface according to *Chapter 10.3.4* to *10.3.6*. Is the LED of the interface defective? Test: When switching the power supply on, both LEDs shall light up at least once alternately.
Check cable connection (contact pins, connector, cable crossed or 1:1?).

### *10.3.3. Checking the SYNCHROTACT 6 - device*

Check whether the blocking input for the operating interface is active. A configurable binary input can be used with the code +45 to block the operating interface (see *Chapter 6.4.2*.)

Check whether the SYNCHROTACT 6 device works well if the communication interface is not used. Is SYNCHROTACT 6 in READY, OPERATING or BLOCKED status?

Possibly switch off and on the auxiliary voltage and wait for the end of initialization (ie approximately 1 min or till the alternately flashing Ethernet LEDs stop).

Possibly replace the device with a spare one, if available.

### *10.3.4. Status displays SynView 6 interfaces –X1 and –X17*

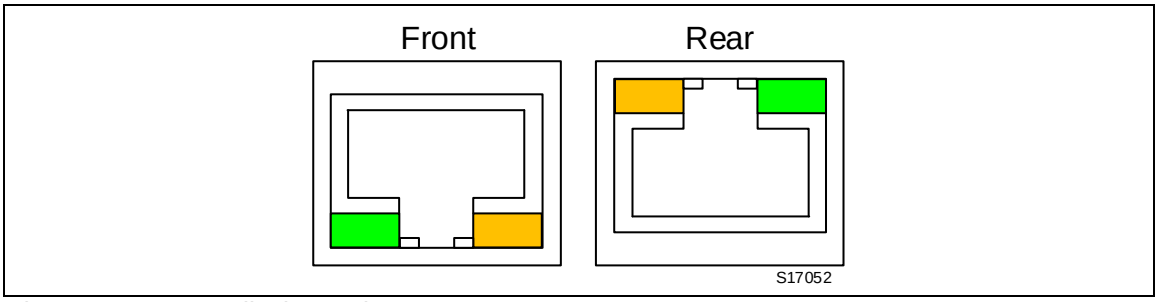



*Figure 10-1 Status displays Ethernet*

**Orange LED: Transmission speed indication (Speed)**

| *Color* | *Description* | *Remarks* |
|---|---|---|
| Dark | Link with 100 Mbps | Transfer speed |
| Yellow | Link with 10 Mbps | |

**Green LED: Transmission indication (Activity)**

| *Color* | *Description* | *Remarks* |
|---|---|---|
| Dark | Interface OFF | -- |
| Green | No transmission | Interface active, no transmission |
| Green flashing | Transmission | Data transmission is running |

### 10.3.5. Status displays Modbus

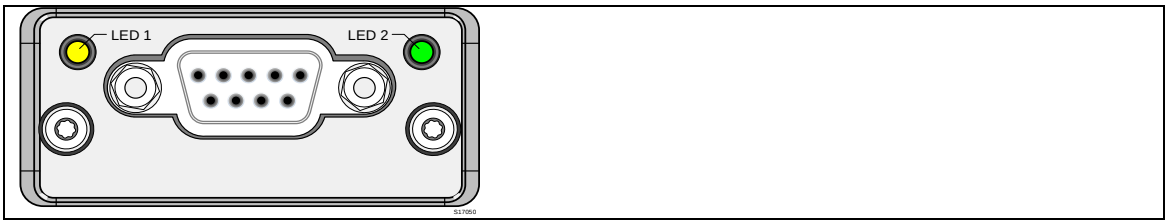



*Figure 10-2 Status displays Modbus*

| LED | Indication | Color | Meaning |
|---|---|---|---|
| LED 1 | Communication display | OFF | Power supply OFF, or, or no data traffic |
| | | yellow flashing | Data are sent and received correctly (20 ms ON, 40 ms OFF) |
| | | red | Error in data traffic |
| LED 2 | Status display | OFF | Power supply OFF, or initialization phase |
| | | green | Interface in operation, no error |
| | | red | Interface error, or error that cannot be fixed |
| | | red simple flashing | Communication or configuration error Incorrect or changed configuration during operation (the device must be restarted after a change of the interface configuration) |

### 10.3.6. Status displays Profibus

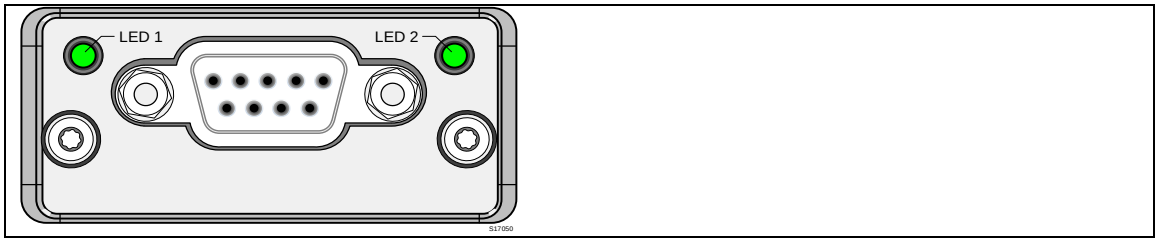



*Figure 10-3 Status displays Profibus*

| LED | Indication | Color | Meaning |
|---|---|---|---|
| LED 1 | Communication display | OFF | Power supply OFF, or no data traffic |
| | | green flashing | Data are sent and received correctly (20 ms ON, 40 ms OFF) |
| | | red | Error in data traffic |
| LED 2 | Status display | OFF | Power supply OFF, or initialization phase |
| | | green | Interface in operation, no error |
| | | red | Interface error, or error that cannot be fixed |
| | | red simple flashing | Communication or configuration error Incorrect or changed configuration during operation (the device must be restarted after a change of the interface configuration) |
| | | red double flashing | Configuration error |

## 10.4. Faults in SynView 6

In general, the SynView 6 operating instructions should be consulted (document number 3BHS840044 E80). The most relevant information is listed below:

- Parameters are not displayed even though the connection to the device exists.
  Remedy: Switch to another module (eg actual values), then back.
- Sequential check button is missing.
  Remedy: see final note in *Chapter 8.2.7.*

# Chapter 11 - Technical Data

## 11.1. Inputs

**Auxiliary voltage**

| | | |
|---|---|---|
| Nominal voltage range | | 24...250 VDC<br>100…230 VAC |
| Nominal frequencies | | 50 Hz, 60 Hz, $16^2/_3$ Hz |
| Permissible voltage range | | 19,2...300 VDC<br>75...300 VAC |
| Start-up time, after switching on the auxiliary voltage | | <1 min |
| Power consumption | not excited (READY) | <22 W/<35 VA |
| | excited (OPERATING) | <24 W/<37 VA |
| Maximum (all options and all relays active): | | <90 W/<140 VA |

**Measuring inputs U1, U2**

| | |
|---|---|
| Nominal voltage range | 50 ... 130 VAC |
| Voltage range | 0 ... 130 % Un |
| Nominal frequency | $16^2/_3$ / 50 / 60 Hz |
| Frequency range | 10 ... 100 Hz |
| Maximum power consumption per channel | <0,2 W / <0,2 VA |

**Binary inputs**

| | |
|---|---|
| Nominal voltages | 24…125 VDC<br>100…125 VAC |
| Permissible voltage range for operation | 18…150 VDC<br>75…130 VAC |
| Current consumption | ≤2 mA |

**Relay inputs from SYN 6500**

| | |
|---|---|
| Coil nominal voltage | 24 VDC |
| Operate voltage | ≥18 VDC |
| Release voltage | ≤3,6 VDC |
| Coil resistance | 1152 Ω |
| Coil inductivity | 1000 mH |

## 11.2. Outputs

**Paralleling relay**

| | |
|---|---|
| Security relay (forcibly guided contacts) | Mechanically linked contacts |
| Maximum contact voltage | 250 VAC/VDC |
| Limiting making capacity | 12 A |
| Short time current limit | 25 A; 20 ms |
| Limiting continuous current | 10 A |
| Limiting breaking capacity | 6 A |

| | |
|---|---|
| Maximum switching power ON AC/DC | 3000 VA/W |
| Maximum switching power OFF AC/DC (resistive) | 3000/85 VA/W (resistive);<br>55 W at L/R ≤40 ms |

**Relay from SYN 6500**

| | |
|---|---|
| Maximum contact voltage | 250 VAC/VDC |
| Limiting breaking capacity | 6 A |
| Limiting continuous current | 10 A |
| Limiting making capacity | 20 A |
| Maximum switching power ON AC/DC | 1500 VA/W |
| Maximum switching power OFF AC/DC (resistive) | 1500/150 VA/W |

**Adjusting command and signaling relays**

| | |
|---|---|
| Maximum contact voltage | 250 VAC/VDC |
| Limiting continuous current | 4 AAC/ADC |
| Maximum switching power ON/OFF AC/DC | 1000/75 VA/W (resisitive);<br>45 W at L/R ≤40 ms |

**Auxiliary voltage output for binary inputs**

| | |
|---|---|
| Rated power output | 4 W |
| Maximum power output | 8 W |

## 11.3. Interfaces

### 11.3.1. Operating panel for maintenance purposes MCP

**Battery**

| | |
|---|---|
| Battery type | UL1642 or CR2032 |
| **Note:** The battery is not necessary in the SYNCHROTACT 6 application. Therefore, no battery is inserted ex works. | |

### 11.3.2. Maintenance interfaces (front and rear)

**Ethernet for SynView 6**

| | |
|---|---|
| Bridgeable distance | 100 m |
| Connector type | RJ45 |

### 11.3.3. Operating interfaces

**IEC 61850 electrical**

| | |
|---|---|
| Bridgeable distance | 100 m |
| Connector type | RJ45 |

**IEC 61850 optical**

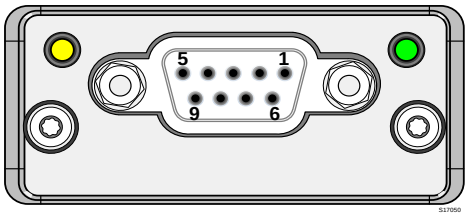
| | |
|---|---|
| Bridgeable distance | 2000 m |
| Connector type | LC |
| Cable | Multimode<br>100BASE-FX |

**„IO connection“ for the connection of peripheral devices**

| | |
|---|---|
| Bridgeable distance | 45 m (POF)<br>100 m (HCS) |
| Connector type | Versatile |
| Cable | POF 1 mm /<br>HCS 200 |

**Modbus RTU**

Pin-assignment:




1: GND
2: +5 V bus
3: PMC*
4: Not used
5: RS485 B-line
6: Not used
7: RS232-RX
8: RS232-TX
9: RS485 A-line
PE: Shield

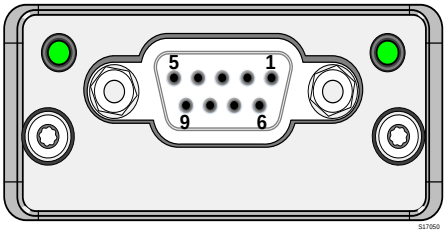
A shielded cable is recommended for the Modbus RTU-connexion.

* Configuration electric Mode:

- RS232: Connect PMC Pin3 with +5 V Pin2
- RS485: Do not leave PMC Pin3 connected

**Profibus DP**

Pin-assignment




1: Not used
2: Not used
3: B-line
4: RTS (Request to send)
5: Isolated Ground bus
6: Isolated +5 V bus
7: Not used
8: A-line
9: Not used
PE: Shield

A shielded cable is recommended for the Modbus RTU-connexion.

## 11.4. Transmission values

### 11.4.1. Measuring ranges

**Channel 1**

| | | |
|---|---|---|
| Voltage | U1, U2 | 0...1,30*Un |
| Phase-angle difference | $\alpha$ | -180...+180 DEG |
| Frequency | f1, f2 | 10...100Hz |
| Slip | s | 0...±100 % |
| Acceleration | ds/dt | 0...10 %/s |
| Paralleling time | t on | 0...1 s |

**Channel 2 (SYN 6202)**

| | | |
|---|---|---|
| Voltage | U1, U2 | 0...1,30*Un |
| Phase-angle difference | $\alpha$ | -180...+180 DEG |

| | | |
|---|---|---|
| Frequency | f1, f2 | 10...100Hz |
| Slip | s | 0...100 % |

### 11.4.2. Accuracy

**Measurement accuracy channel 1**

| | | |
|---|---|---|
| Voltage | U1, U2 | ≤ 0,15 V |
| Phase-angle difference | α | ≤ 0,3 DEG |
| Slip | s | ≤ 0,01 % |

**Switching accuracy channel 1**

| | | |
|---|---|---|
| Maximum voltage difference | ΔUmax | ≤ 0,35 V |
| Phase coincidence | α | ≤ 1 DEG |
| Slip limit | smax | ≤ 0,01 % |
| Paralleling time | t on | ≤ 0,5 ms |

**Channel 2 (SYN 6202)**

| | | |
|---|---|---|
| Voltage difference | ΔU | 0,5 % |
| Phase-angle difference | α | ≤ 1 DEG |
| Slip | s | ≤ 0,03 % |

## 11.5. Security related tests

### 11.5.1. Isolation

| | | |
|---|---|---|
| Dielectric test | IEC 60255-27:2013 | 2,5 kVeff/50 Hz; except:<br>communication interfaces:<br>1 kVeff/50 Hz<br>Via open contacts:<br>CMD-Relay: 1,5 kV<br>Adjustment command relay:<br>1 kV |
| Impulse voltage withstand test | IEC 60255-27:2013 | 5 kV; 5+/5-; 1 s; except:<br>communication interfaces:<br>1 kV |
| Insulation resistance | IEC 60255-27:2013 | 500 VDC; >5 s; >100 MOhm |
| PE resistance | IEC 60255-27:2013 | <0.1 Ohm; 60 s |

### 11.5.2. Degree of protection according to IEC 60529

IP 50

### 11.5.3. Flammability

| | | |
|---|---|---|
| Flammability | IEC 60255-27:2013 | Isolation material: FR-4 IPC4101/126 (Tg >170 °C) |
| | IEC 60695-11-10 :2013<br>EN 45545-2:2013 | Classification:<br>• Front plate: HB<br>• Connector housing: V-0<br>• PCB: V-0 |

## 11.6. Environmental values

### 11.6.1. Climatic stability

**Temperature ranges:**

| | |
|---|---|
| Transport/storage | -40 ... +85 °C |
| Operation <16 h | -40 ... +85 °C |
| Operation (compliance with technical data) | -25 ... +55 °C |
| Relative air humidity (storage, operation) | <93 % |
| Air pressure (Transport, storage, operation) | 86…106 kPa |
| Site altitude | <2000 m a.s.l. |

**Tests:**

| | | |
|---|---|---|
| Cold | IEC 60068-2-1:2007 | Operation:<br>-25 °C/96 h & -40 °C/16 h<br>Storage:<br>-40 °C/96 h |
| Dry heat | IEC 60068-2-2:2007 | Operation:<br>+55 °C/96 h & +85 °C/16 h<br>Storage:<br>+85 °C; 96 h |
| Damp heat, steady state | IEC 60068-2-78:2012 | +30 °C; 93 %RH; 10 days |
| Damp heat, cyclic | IEC 60068-2-30:2005 | Db; 55 °C/6 cycles |
| Change of temperature | IEC 60068-2-14:2009 | Nb; 1°C/min; 5 cycles |

### 11.6.2. Mechanical stability

| | | |
|---|---|---|
| Vibration | IEC 60255-21-1:1988 | 5..8 Hz: 7.5 mm |
| Vibration response | IEC 60068-2-6:2007 | 8…500 Hz: 20 m/s2 |
| Endurance | | 20 cycles in each axis<br>1 octave/min |
| Shocks and bumps | IEC 60255-21-2:1988 | class 2 |
| Shock response | | 10 g |
| Withstand | | 30 g |
| Bump | | 20 g |
| Earthquake | IEC 60255-21-3:1993 | Method A |
| Single-axis sine sweep seismic test (Operability) | | 5..13 Hz: 7,5 mm<br>13…35 Hz: 50 m/s2<br>20 cycles in each axis<br>1 octave/min |

| | | |
|---|---|---|
| | | CFA:<br>• no status change of the CMD relay contacts<br>• no damage to the mechanical structure<br>• no function failure |

### *11.6.3. Emission and immunity (EMC)*

| | | |
|---|---|---|
| Emission AC mains (conducted) | CISPR 22:2008 | Class B<br>**0,15..0,5 MHz**:<br>66..56 dB(µV) QP<br>56..46 dB(µV) AV<br>**0,5..5 MHz**:<br><56 dB(µV) QP<br><46 dB(µV) AV<br>**5..30 MHz**:<br><60 dB(µV) QP<br><50 dB(µV) AV |
| Emission enclosure (radiated) | CISPR 11:2016 | Group 1, class A<br>**3 m distance, QP**:<br>30..230 MHz: <50 dB(µV/m)<br>230..1000 MHz: <57 dB(µV/m) |
| | CISPR 22:2008 | Class A<br>**3 m distance**<br>**1..3 GHz**:<br><56 dB(µV/m) AV<br><76 dB(µV/m) P<br>**3..6 GHz**:<br><60 dB(µV) AV<br><80 dB(µV) P |
| Electrostatic discharges | IEC 60255-26:2013<br>IEC 61000-4-2:2008<br>IEEE C37.90.3-2001 | Class 4<br>Contact: 8 kV; air: 15 kV<br>CFA: B & DS (IEC 61000-6-7) |
| Electromagnetic fields | IEC 60255-26:2013<br>IEC 61000-4-16:2015 | **Line freq. continuous:**<br>Class 3: 10 V;<br>DC, 16.7, 50, 60, 150<br>180 Hz;<br>All electrical connections,<br>except AC-supply voltage<br>CFA: DS (IEC 61000-6-7)<br><br>**Line frequency short time:**<br>Class 4:<br>300 V common mode &<br>150 V differential mode<br>DC, 16.7, 50, 60 Hz<br>All electrical connections<br>CFA: A (IEC 60255-26) |

| | | |
|---|---|---|
| | | **Frequency sweep:**<br>15 Hz…150 kHz: 30 V common mode; constant, without reduction<br>All electrical connections<br>CFA: A (IEC 60255-26) |
| | IEC 60255-26:2013<br>IEC 61000-4-6:2013 | Frequency sweep:<br>0,15…80 MHz:<br>20 V; 80 %AM<br>CFA: A<br><br>Single frequencies:<br>27; 68 MHz:<br>10 V; 80 %AM<br>CFA: A |
| | IEC 60255-26:2013<br>IEC 61000-4-3:2010<br>IEEE C37.90.2-2004 | Frequency sweep:<br>25…1000 MHz: 20 V/m; 80 %AM<br>1,4..2,7 GHz: 20 V/m; 80 %AM<br>CFA: A<br>2...6 GHz: 3 V/m; 80 %AM<br>CFA: DS (IEC 61000-6-7)<br><br>Single frequencies:<br>80/160/380/450/900 MHz, 1,85/2,15/5,15/5,75 GHz:<br>10 V/m; 80 %AM; >10 s<br>CFA: A |
| Power frequency magnetic fields | IEC 60255-26:2013<br>IEC 61000-4-8:2009 | Class 5<br>100 A/m (continuous)<br>1000 A/m (3 s)<br>CFA: A |
| Fast transients | IEC 60255-26:2013<br>IEC 61000-4-4:2012<br>IEEE C37.90.1-2012<br>("fast transient") | All el. connections: 4 kV common mode & differential mode<br>Refresh rate:<br>5 kHz & 100 kHz<br>CFA: A & IEEE C37.90.1, Ch. 9 |
| Non-repetitive damped oscillatory transients (ring-waves) | IEC 61000-4-12:2006 | 2,5 kV, Line-to-ground<br>1 kV, Line-to-line<br>CFA: A |
| Damped oscillatory wave | IEEEC37.90.1-2012<br>(„oscillatory“)<br>IEC 61000-4-18:2010 | 2,5 kV common mode & differential mode<br>oscillation frequency: 1 MHz & 100 kHz<br>refresh rate: 400 Hz<br>CFA: A & IEEE C37.90.1, Ch. 9 |
| Surge voltage | IEC 60255-26:2013<br>IEC 61000-4-5:2014 | Zone A |

| | | |
|---|---|---|
| | | **Communication** (unshielded):<br>Line-to-ground: 0,5/1/2/4 kV<br>**All other electrical connections:**<br>Line-to-ground: 0,5/1/2/4 kV<br>Line-to-line: 0,5/1/2 kV<br>CFA: A |
| AC-supply voltage: voltage dips, short interruptions | IEC 60255-26:2013<br>IEC 61000-4-11:2004 | **Tests with 0 % Uresidual:**<br>1 cycle; CFA: A<br>2,5 cycles; CFA: A<br>250 cycles; CFA:DS, C<br>**Test with 40 % Uresidual:**<br>10 cycles; CFA:DS, C<br>**Test with 70 % Uresidual:**<br>25 cycles; CFA:DS, C<br>100 % = 100 VAC; 50 Hz<br>CFA DS according to IEC 61000-6-7 |
| DC-supply voltage: voltage dips, short interruptions | IEC 60255-26:2013<br>IEC 61000-4-29:2000 | **Tests with 0 % Uresidual:**<br>10, 20, 50 ms; CFA: A<br>1 s, 5 s; CFA: C<br>**Tests with 40 % Uresidual:**<br>10 ms; CFA: DS and C<br>100, 200 ms, 1 s; CFA: C<br>**Tests with 70 % Uresidual:**<br>10 ms; CFA: DS<br>300, 500 ms; CFA: C<br>100 % = 100 VDC<br>CFA DS according to IEC 61000-6-7 |
| DC supply voltage: Ripple | IEC 61000-4-17:2009 | 15 % Un; f = 100 Hz; Un = 24 VDC & 250 VDC |
| | SN-62.1008-1:2010 | 10 % Un; 120 Hz; Un = 24 VDC & 125 VDC |
| Gradual shut-down/start-up of power supply voltage | IEC 60255-26 :2013 | DC; ramp: 2x60 s;<br>power off time: 5 min<br>CFA: C |
| | IEC 60255-27 :2013 | DC; ramp: 1 V/min<br>CFA : IEC 60255-27 ; Chapter 10.6.6 |
| DC supply voltage<br>Reverse polarity and short circuit | SN-62.1008-1 :2010<br>IEC 60255-27 :2013 | Reverse polarity: 1 min with –Un<br>CFA: SN-62.1008-1, Chapter |

| | |
|---|---|
| | 7.15.1 & IEC 60255-27, Chapter 10.6.6 |
| | short-circuit against ground: 3 short circuits ±; 1 s / 10 s CFA SN-62.1008-1, Chapter 7.15.2 |

## 11.7. Relevant standards

**CE-conformity**

| | | |
|---|---|---|
| EMC directive: | 2014/30/EU | EN 60255-26:2013 |
| Low voltage directive: | 2014/35/EU | EN 60255-27:2014 |

**Product standards**

| | |
|---|---|
| Measuring relays and protection equipment | IEC 60255-1:2009 |
| EMC-requirements for measuring relays and protection equipment | IEC 60255-26:2013 |
| Product standard for measuring relays and protection equipment | IEC 60255-27:2013 |
| | IEC 61850-3:2013 |
| Hydro Québec standard for electronic equipment and relays | SN-62.1008-1:2010 |
| IEEE-standard for Relays | IEEE C37.90-2005 |

**Relevant standards for SIL**

| | |
|---|---|
| Functional safety of E/E/PE safety-related systems | IEC 61508-series |
| Requirements for the immunity of safety-related systems and equipment that perform a safety function | IEC 61000-6-7:2014 |

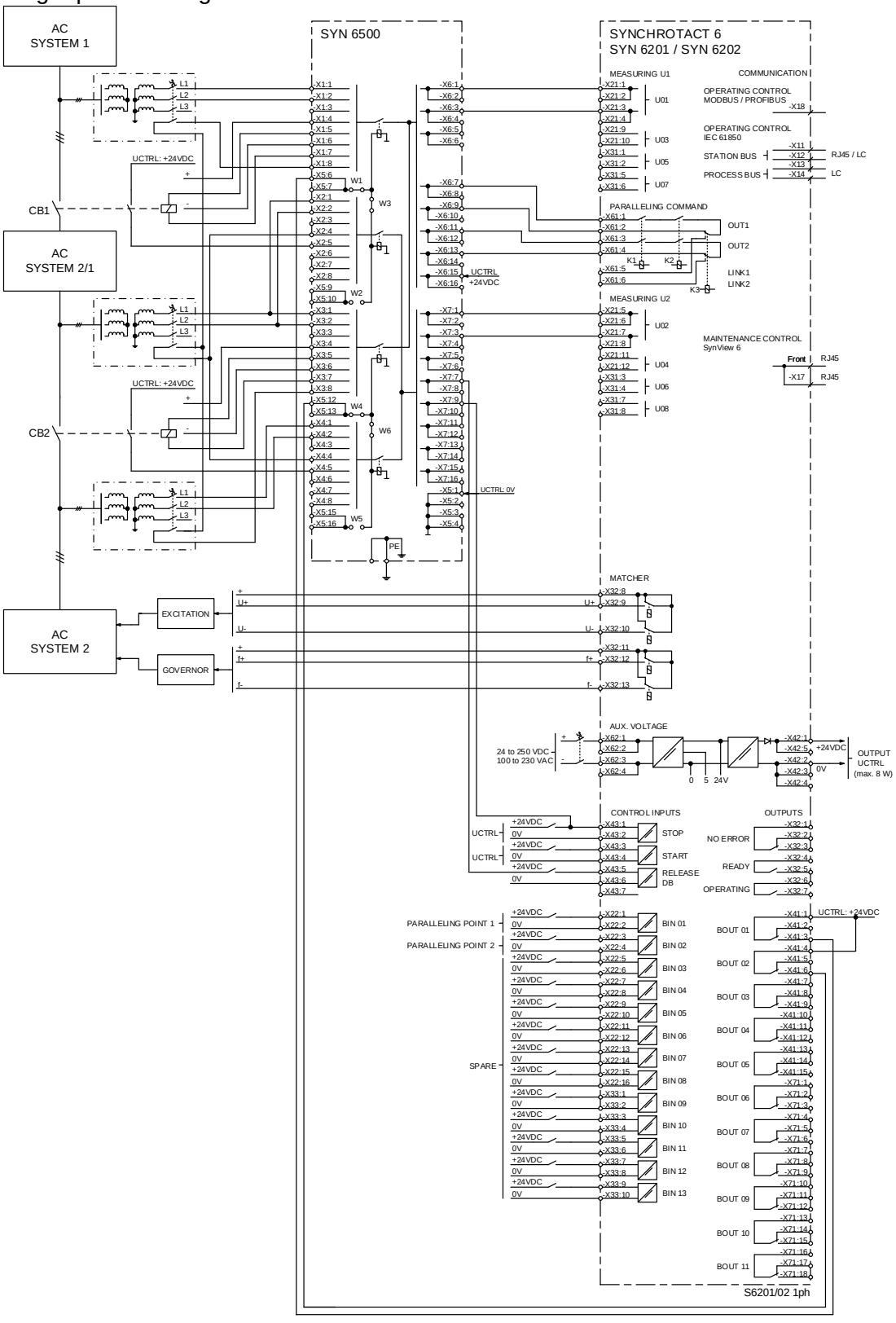
## 11.8. Construction data

**Weight**

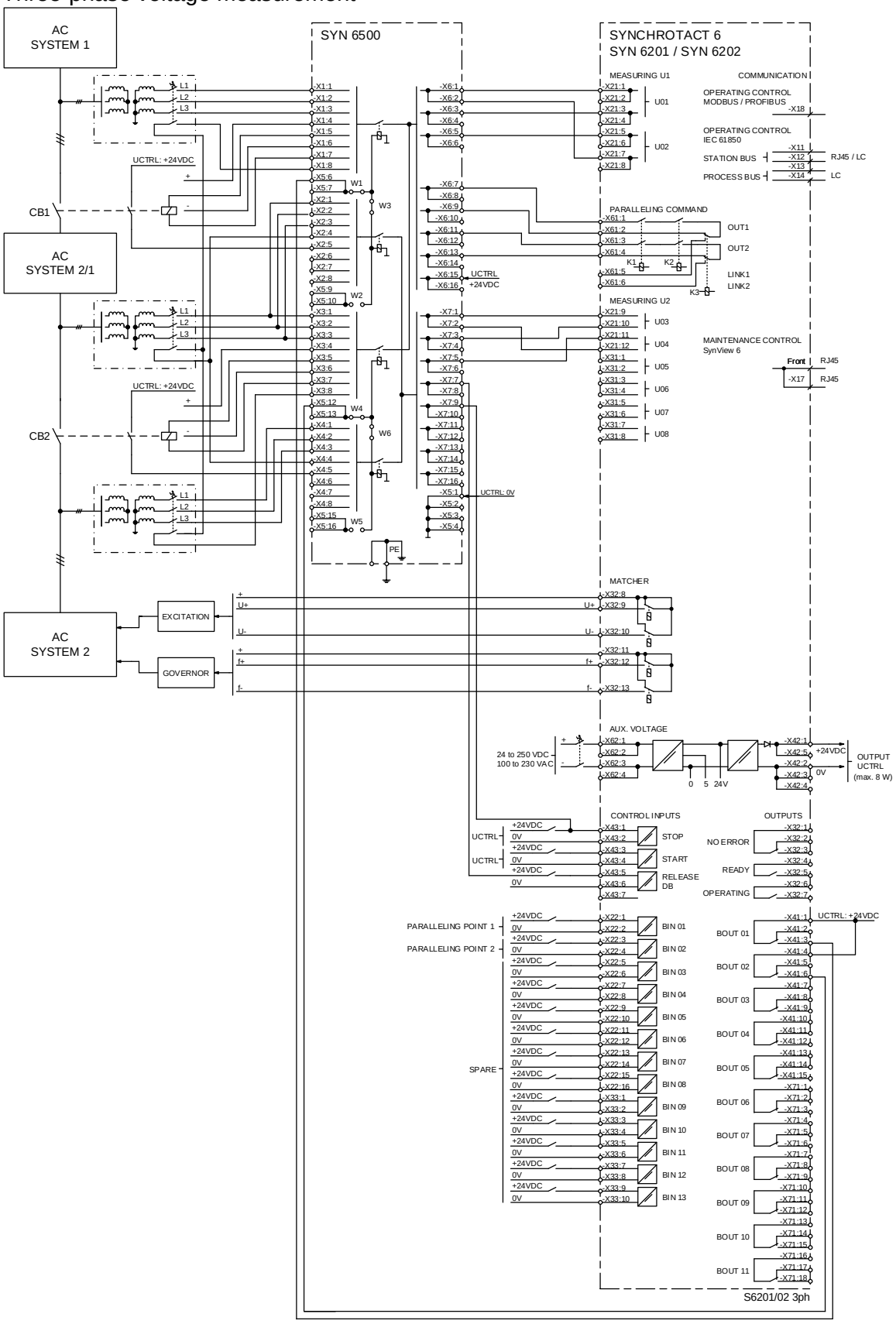
| | |
|---|---|
| SYN 6201/SYN 6202 | 7 kg<br>10 kg (with packaging) |

# Chapter 12 - Schemata

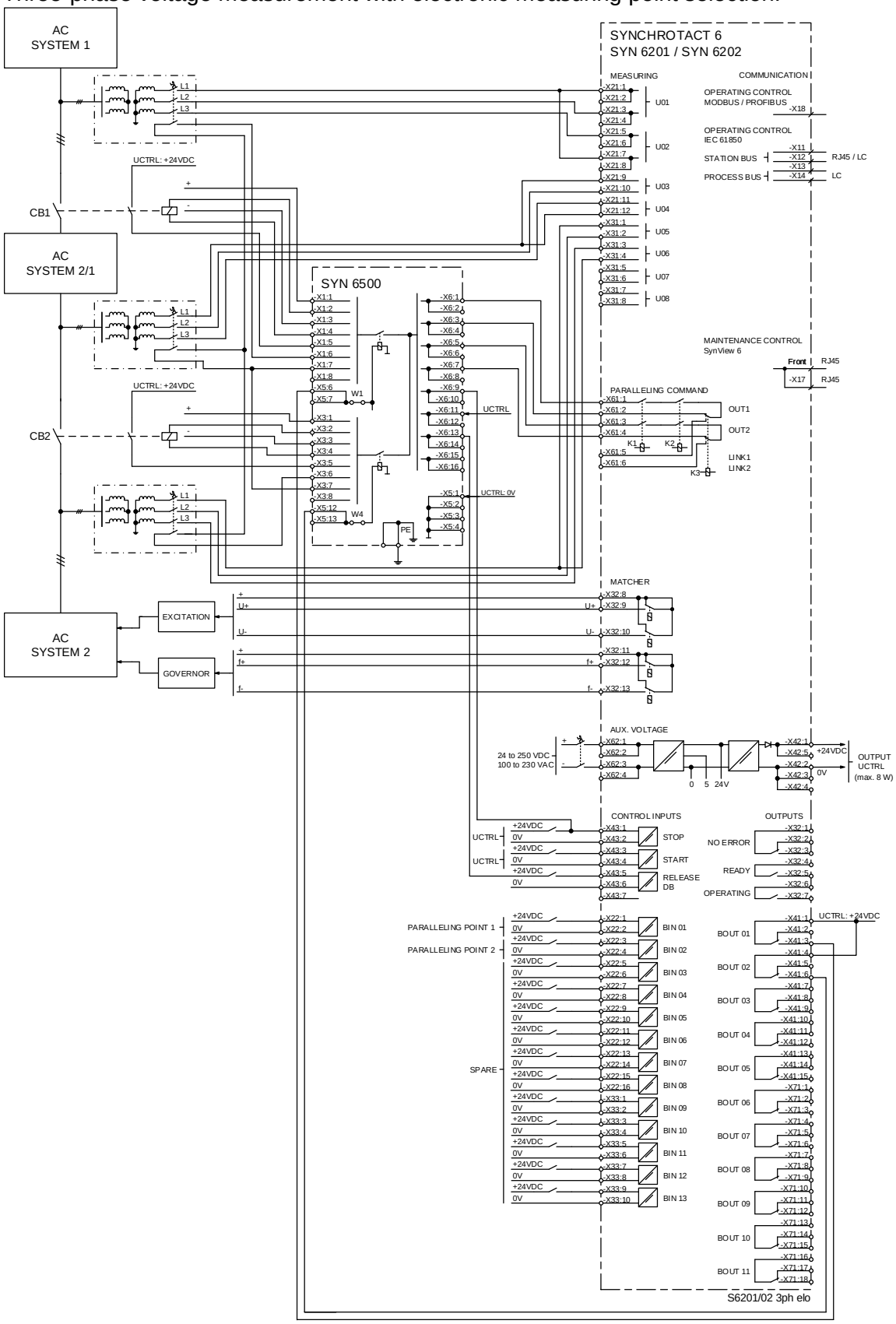
## Single-phase voltage measurement

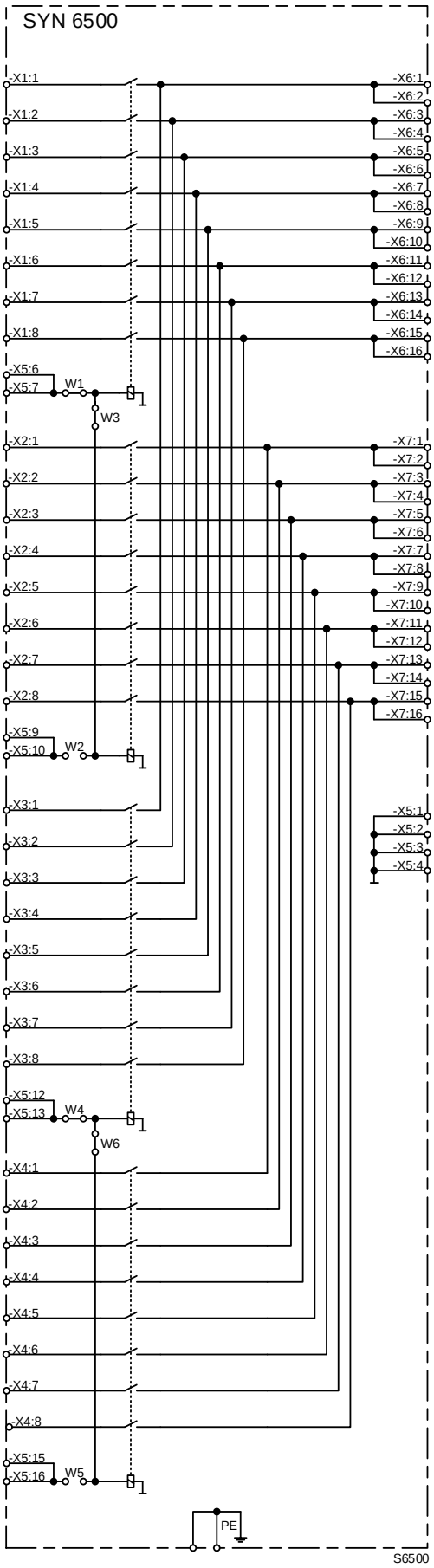


## Three-phase voltage measurement



Three-phase voltage measurement with electronic measuring point selection:




SYN 6500
X1:1
X1:2
X1:3
X1:4
X1:5
X1:6
X1:7
X1:8
X5:6
X5:7
W1
W3
X2:1
X2:2
X2:3
X2:4
X2:5
X2:6
X2:7
X2:8
X5:9
X5:10
W2
X3:1
X3:2
X3:3
X3:4
X3:5
X3:6
X3:7
X3:8
X5:12
X5:13
W4
W6
X4:1
X4:2
X4:3
X4:4
X4:5
X4:6
X4:7
X4:8
X5:15
X5:16
W5
PE
S6500
-X6:1
-X6:2
-X6:3
-X6:4
-X6:5
-X6:6
-X6:7
-X6:8
-X6:9
-X6:10
-X6:11
-X6:12
-X6:13
-X6:14
-X6:15
-X6:16
-X7:1
-X7:2
-X7:3
-X7:4
-X7:5
-X7:6
-X7:7
-X7:8
-X7:9
-X7:10
-X7:11
-X7:12
-X7:13
-X7:14
-X7:15
-X7:16
-X5:1
-X5:2
-X5:3
-X5:4

# Chapter 13 - Protocol and questionnaire

## 13.1. Setting protocol SYNCHROTACT 6

Name and address of the client: _____

_____

_____

Plant: _____

Oder No.: _____

Plant scheme No.: _____

**Device identification:**
Nameplate:

Delivery date: _____

Software no: _____

**SynView 6:**
Available: Yes: ☐ No: ☐

**Remarks:**

**Place and date of commissioning:**

Name: Company:

**Important**: Please send a copy of the protocol to the following address:

ABB Switzerland Ltd
Synchronizing devices and voltage regulators
CH-5300 Turgi
eMail: pes@ch.abb.com

## Parameter settings

| *Parameter sets* | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | ***Parameter name*** | ***Symbol*** | ***Parameter sets*** | | | | | ***Unit*** |
| **0** | **Channel 1 Measurement** | | **1** | … | … | … | ... | |
| 01 | Nominal Voltage | Un | | | | | | VAC |
| 02 | Primary Nominal Voltage | UnPrim | | | | | | kV |
| 03 | Nominal Frequency | fn | | | | | | Hz |
| 04 | Voltage ratio | U1/U2 | | | | | | % |
| 05 | Angle Tuning | αOffset | | | | | | DEG |
| 06 | Channel 1 Selection AIN for U1 | AINSelU1 | | | | | | - |
| 07 | Channel 1 Selection AIN for U2 | AINSelU2 | | | | | | - |
| 08 | No of used AIN/Measurement | NoAIN | | | | | | - |
| **1** | **Command generation** | | | | | | | |
| 10 | Command generation ON/OFF | CMDGen | | | | | | - |
| 11 | Paralleling time | t on | | | | | | ms |
| 12 | Paralleling command length | tp on | | | | | | ms |
| 13 | Monitoring time synchronous | t supC | | | | | | s |
| 14 | Monitoring time voltage-free | t supD | | | | | | s |
| 15 | Mon. time synchr. + angle drift | t supS | | | | | | s |
| 16 | Multiple commands | MULTIPLE CMD | | | | | | - |
| 17 | Validity period „Oper. window“ | tOpWin | | | | | | s |
| **2** | **Channel 1 Paralleling conditions** | | | | | | | |
| 20 | Slip limit oversynchronous | -smax | | | | | | % |
| 21 | Slip limit subsynchronous | +smax | | | | | | % |
| 22 | Angle limit, negative | -αmax | | | | | | DEG |
| 23 | Angle limit, positive | +αmax | | | | | | DEG |
| 24 | Max. Voltage difference. underexcited | -ΔUmax | | | | | | % |
| 25 | Max. Spannungsdiff. untererregt | +ΔUmax | | | | | | % |
| 26 | Maximum voltage | Umax | | | | | | % |
| 27 | Minimum voltage | Umin | | | | | | % |
| 28 | Synchronous detection limit | dα/dtmax | | | | | | DEG/s |
| **3** | **Channel 1 dead bus conditions** | | | | | | | |
| 30 | Maximum zero voltage | U0max | | | | | | % |
| 31 | Release U1 = no-voltage | U1not | | | | | | - |
| 32 | Release U2 = no-voltage | U2not | | | | | | - |
| 33 | Rel. U1 & U2 = no-voltage | 1*2not | | | | | | - |
| 34 | „Exclusive DB“-Function | ExclDB | | | | | | - |
| **4** | **Voltage matcher** | | | | | | | |
| 40 | Voltage adjustment characteristic | dU/dt | | | | | | %/s |
| 41 | Pulse interval | ts U | | | | | | s |
| 42 | Minimum pulse duration | tp Umin | | | | | | s |
| 43 | Switchover to variable intervals | INVERSE U | | | | | | - |
| 44 | Switchover to tap changer | TVM | | | | | | - |
| **5** | **Frequency matcher** | | | | | | | |
| 50 | Frequency adjustment characteristic | df/dt | | | | | | %/s |
| 51 | Pulse interval | ts f | | | | | | s |
| 52 | Minimum pulse duration | tp fmin | | | | | | s |
| 53 | Switchover to variable intervals | INVERSE f | | | | | | - |

## Parameter settings

| *Parameter sets* | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | ***Parameter name*** | ***Symbol*** | ***Parameter sets*** | | | | | ***Unit*** |
| **6** | **Timing** | | 1 | … | … | … | … | |
| 60 | Lockout period after START | t block | | | | | | s |
| 61 | Abort after START | t tot | | | | | | min |
| 62 | Abort after CMD | t stop | | | | | | s |
| 63 | Effect of abortion | EffectSel | | | | | | - |
| **7** | **Channel 1 TTI-Parameter** | | | | | | | |
| 70 | TTI-Function ON/OFF | CH1 TTI Select | | | | | | - |
| 71 | Code type | Code type | | | | | | - |
| 72 | Number of taps | No Taps | | | | | | - |
| 73 | Number of utilized BIN | No BIN | | | | | | - |
| 74 | 1. BIN used for decoding | First BIN | | | | | | - |
| 75 | Step size between two taps | Step | | | | | | % |
| 76 | Step that corresponds to Un | Un Tap No | | | | | | - |
| 77 | Offset for the step numbering | Offset | | | | | | - |
| **8** | **Channel 2 Measuring (SYN 6202)** | | **1** | … | … | … | ... | |
| 80 | Nominal Voltage | Un | | | | | | VAC |
| 81 | Nominal Frequency | fn | | | | | | Hz |
| 82 | Voltage ratio | U1/U2 | | | | | | % |
| 83 | Angle tuning | αOffset | | | | | | DEG |
| 84 | Channel 2 Selection AIN for U1 | AINSelU1 | | | | | | - |
| 85 | Channel 2 Selection AIN for U2 | AINSelU2 | | | | | | - |
| **9** | **Channel 2 Paralleling conditions (SYN 6202)** | | | | | | | |
| 90 | Slip limit | smax | | | | | | % |
| 91 | Angle limit | αmax | | | | | | DEG |
| 92 | Max. voltage difference | ΔUmax | | | | | | % |
| 95 | Maximum zero voltage | CH2 U0max | | | | | | % |
| 98 | TTI-Function ON/OFF | CH2 TTI Select | | | | | | - |

**Parameter settings**

| *Configuration parameters of binary inputs* | | | |
|---|---|---|---|
| | ***Parameters*** | ***Symbol*** | ***Unit*** |
| **31** | **Function configuration** | | |
| 01 | Function Binary input BIN01 | BIN01 Fct | |
| 02 | Function Binary input BIN02 | BIN02 Fct | |
| 03 | Function Binary input BIN03 | BIN03 Fct | |
| 04 | Function Binary input BIN04 | BIN04 Fct | |
| 05 | Function Binary input BIN05 | BIN05 Fct | |
| 06 | Function Binary input BIN06 | BIN06 Fct | |
| 07 | Function Binary input BIN07 | BIN07 Fct | |
| 08 | Function Binary input BIN08 | BIN08 Fct | |
| 09 | Function Binary input BIN09 | BIN09 Fct | |
| 10 | Function Binary input BIN10 | BIN10 Fct | |
| 11 | Function Binary input BIN11 | BIN11 Fct | |
| 12 | Function Binary input BIN12 | BIN12 Fct | |
| 13 | Function Binary input BIN13 | BIN13 Fct | |
| | **Operating mode** | | |
| 14 | Operating mode binary input BIN01 | BIN01 Mode | |
| 15 | Operating mode binary input BIN02 | BIN02 Mode | |
| 16 | Operating mode binary input BIN03 | BIN03 Mode | |
| 17 | Operating mode binary input BIN04 | BIN04 Mode | |
| 18 | Operating mode binary input BIN05 | BIN05 Mode | |
| 19 | Operating mode binary input BIN06 | BIN06 Mode | |
| 20 | Operating mode binary input BIN07 | BIN07 Mode | |
| 21 | Operating mode binary input BIN08 | BIN08 Mode | |
| 22 | Operating mode binary input BIN09 | BIN09 Mode | |
| 23 | Operating mode binary input BIN10 | BIN10 Mode | |
| 24 | Operating mode binary input BIN11 | BIN11 Mode | |
| 25 | Operating mode binary input BIN12 | BIN12 Mode | |
| 26 | Operating mode binary input BIN13 | BIN13 Mode | |
| 27 | Channel 2 always parameter set 1 | CH2 AlwaysPs1 | |
| 28 | Channel 2 control by channel 1 | CH2Ctrl by CH1 | |

## Parameter settings

| *Configuration parameters binary outputs* | | | |
|---|---|---|---|
| | ***Parameters*** | ***Symbol*** | ***Setting value*** |
| **32** | **Relay outputs** | | |
| 01 | Function Binary output BOUT01 | BOUT01 Fct | |
| 02 | Function Binary output BOUT02 | BOUT02 Fct | |
| 03 | Function Binary output BOUT03 | BOUT03 Fct | |
| 04 | Function Binary output BOUT04 | BOUT04 Fct | |
| 05 | Function Binary output BOUT05 | BOUT05 Fct | |
| 06 | Function Binary output BOUT06 | BOUT06 Fct | |
| 07 | Function Binary output BOUT07 | BOUT07 Fct | |
| 08 | Function Binary output BOUT08 | BOUT08 Fct | |
| 09 | Function Binary output BOUT09 | BOUT09 Fct | |
| 10 | Function Binary output BOUT10 | BOUT10 Fct | |
| 11 | Function Binary output BOUT11 | BOUT11 Fct | |
| **32** | **LEDs** | | |
| 12 | Function LED01 (U+) | LED01 Fct | |
| 13 | Function LED02 (U-) | LED02 Fct | |
| 14 | Function LED03 (f+) | LED03 Fct | |
| 15 | Function LED04 (f-) | LED04 Fct | |
| 16 | Function LED05 ($\Delta U<\Delta Umax$) | LED05 Fct | |
| 17 | Function LED06 (s<smax) | LED06 Fct | |
| 18 | Function LED07 ($\alpha<\alpha max$) | LED07 Fct | |
| 19 | Function LED08 (U1/U2 = 0) | LED08 Fct | |
| 20 | Function LED09 (-) | LED09 Fct | |
| 21 | Function LED10 (-) | LED10 Fct | |
| 22 | Function LED11 (CH2 REL) | LED11 Fct | |
| 23 | Function LED12 (COMMAND) | LED10 Fct | |
| 24 | Function LED13 (BLOCKED) | LED11 Fct | |
| **32** | **Configurable events** | | |
| 25 | Function Event 01 | Event01 Fct | |
| 26 | Function Event 02 | Event02 Fct | |
| 27 | Function Event 03 | Event03 Fct | |
| 28 | Function Event 04 | Event04 Fct | |
| 29 | Function Event 05 | Event05 Fct | |
| 30 | Function Event 06 | Event06 Fct | |
| 31 | Function Event 07 | Event07 Fct | |
| 32 | Function Event 08 | Event08 Fct | |
| 33 | Function Event 09 | Event09 Fct | |
| 34 | Function Event 10 | Event10 Fct | |
| 35 | Function Event 11 | Event11 Fct | |
| 36 | Function Event 14 | Event12 Fct | |
| 37 | Function Event 15 | Event13 Fct | |
| 38 | Function Event 16 | Event14 Fct | |
| 39 | Function Event 17 | Event15 Fct | |
| 40 | Function Event 01 | Event16 Fct | |

**Parameter settings**

| ***Konfigurationsparameter Betriebsschnittstelle*** | | | |
|---|---|---|---|
| | ***Parameter*** | ***Zeichen*** | ***Einstellwert*** |
| **33** | **Betriebsschnittstelle** | | |
| | Auswahl Protokoll | ProtocolSelect | |
| | Slave Adresse für Modbus | MB SlaveAddr | |
| | Baudrate für Modbus | MB BaudRate | |
| | Parität für Modbus | MB Parity | |
| | Slave Adresse für Profibus | PB SlaveAddr | |

## *Configuration IEC 61850*

| ***Connection*** | | ***IP Address 1*** | ***IP Address 2*** (Address in SCD-file) |
|---|---|---|---|
| ***Purpose*** | ***Indication*** | | |
| IEC 61850 Station bus | -X11 | | |
| | -X12 | | |
| IEC 61850 Process bus | -X13 | | |
| | -X14 | | |

**SYN 6500**

| ***Gerät Nr.*** | ***Gerät 1*** | ***Gerät 2*** | ***Gerät 3*** | ***Gerät 4*** |
|---|---|---|---|---|
| **Name** | | | | |
| **Brücke** | offen / geschlossen | offen / geschlossen | offen / geschlossen | offen / geschlossen |
| **W1** | | | | |
| **W2** | | | | |
| **W3** | | | | |
| **W4** | | | | |
| **W5** | | | | |
| **W6** | | | | |

## 13.2. Questionnaire SYNCHROTACT 6

| | |
|---|---|
| Plant _____<br>Client address _____<br>Techn. Staff _____<br>Telephone No. _____<br>Fax. No. _____ | Is there a warranty claim?<br>Yes ☐<br>No ☐<br>Date of the error detection? (YY/MM/DD):<br>_____<br>Commissioning of the plant? (YY/MM/DD):<br>_____ |
| Nameplate:<br>Ident.-Number _____ Manufacturing number _____ Type _____ | |
| **Configuration:**<br>Supply-/control voltage…….VDC/.....VDC<br>Nominal measuring voltage……..VAC<br>Ambient temperature……..°C | Replacement device used? Yes ☐ No ☐<br>Which parameter set causes problems?..... |
| **Description of the error type** (eg: adjustment commands U +, U-, f +, f- and paralleling command or release?): | |
| State of **Display** and **LEDs** in case of error<br>LCD:.....<br>.....<br>.....<br>..... | LED READY ☐ light ☐ dark<br>LED OPERATING ☐ light ☐ dark<br>LED BLOCKED ☐ light ☐ dark<br>LED ERROR ☐ light ☐ dark |
| **When did the failure occur?**<br>☐ Test<br>☐ Commissioning<br>☐ Operation | **Error rate**<br>☐ Always<br>☐ At times, frequency:..... |
| **Remarks** | |
| **Date:** _____ | **Signature:** _____ |

# *History*

| Rev. Ind. | Page (P) Chapter (C) | Description (or revision state) | Date Dpt./executed |
|---|---|---|---|
| - | | First issue | May 02 / 2018 IAPG-E/WZ |