SYNCHROTACT ® 5

Synchronizing and Paralleling Equipment and Systems for Synchronous Machines and Networks

ABB

Application

SYNCHROTACT® 5 is the fifth generation of synchronizing equipment produced by ABB Switzerland Ltd in Switzerland. SYNCHROTACT products from ABB are used for automatic synchronization of generators with power lines and for paralleling of synchronous lines. They are designed for fully automatic operation by dual-channel or single-channel systems.

Synchronizing equipment are used in power stations where a generator needs to be paralleled with a power line or in substations to parallel two synchronous lines.

Power circuit breakers can only be closed if voltage at both ends is synchronous. If it is not, it will cause a disturbance in the power network, trip the breaker, shock the generator and unit transformer. In extreme cases, it can damage both.

SYNCHROTACT 5 guarantees a safe and reliable synchronization whether as a monitoring element for manual paralleling or as an independent fully-automatic synchronizing unit.

SYNCHROTACT 5 covers the following areas of application:

1. Automatic synchronization and paralleling of generators with power lines (see Fig. 1 below),

2. Automatic paralleling for synchronous and asynchronous lines and busbars (see Fig. 2 below),

3. Monitoring (Synchrocheck) of automatic or manual paralleling of power lines, generators and voltage-free lines (dead bus), see Fig. 3 below.
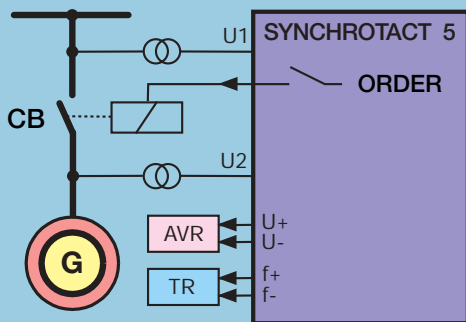
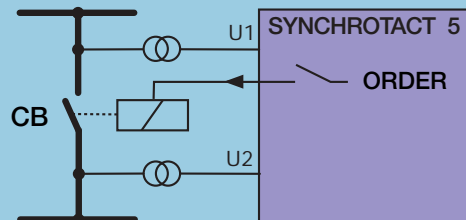Fig. 1: Automatic synchronizing and paralleling
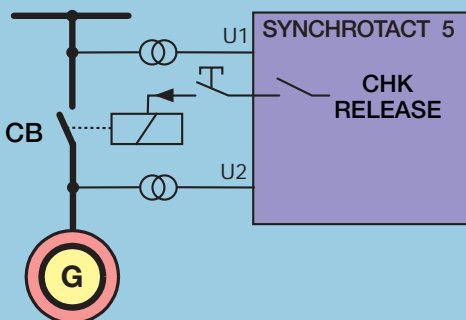
Fig. 2: Paralleling of power lines

Fig. 3: Monitoring of manual paralleling (Synchrocheck)

Legend:

U1	Network / busbar voltage
U2	Generator voltage
CB	Circuit breaker
G	Generator
AVR	Automatic voltage regulator
TR	Turbine regulator (governor)
ORDER	Paralleling command
U+, U-	Voltage adjusting commands
f+, f-	Frequency adjusting commands
CHK RELEASE	Paralleling command release

Safety and Availability

Thanks to the flexible design of SYNCHROTACT 5 it can be used in many different configurations in order to ensure the required maximum safety and availability.

Definition

In synchronizing, the term "dual channel" applies to a configuration of **two channels in series**, in which one channel blocks the faulty operation of the other. **This is to increase the safety of operation.**

The term "redundancy" applies to a configuration of **two devices in parallel**. If one fails the other one can take over the function. **This is to increase the availability of the synchronizing system**.

Maximum safety in automatic and manual operation

The safety of the generator and network, while synchronizing, is the first requirement for such an equipment.

The safe **automatic synchronization** is guaranteed by a compact dual-channel system including two devices with independent hardware and software which are connected in series (see Fig. 4). The first channel performs the automatic synchronization and the other one is an independent monitoring (Synchrocheck) of the first one. The hardware and software of each channel is designed by different development engineers using different microprocessors which protect the operation from any possible systematic failure.

The safe **manual synchronization** is ensured by a monitoring device (Synchrocheck), which is in series with the manual paralleling switch (see Fig. 5).

Optimum availability

For higher availability of synchronizing equipment, the family range of SYNCHROTACT 5 offers various redundant configurations. See figures 6, 7 and 8. With those configurations both maximum safety and full availability is achieved.

The dual channel, automatic channel and single monitoring channel (Synchrocheck) systems are each provided in one casing. The redundant dual-channel system is in one casing, including interconnection wiring.
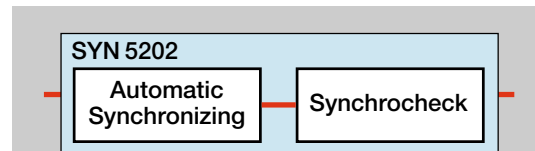

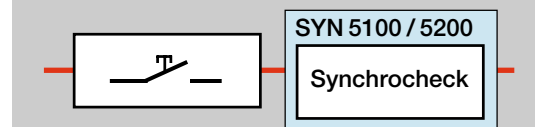Fig 4: Dual-channel system with automatic synchronizing device and Synchrocheck in series

Fig. 5: Manual paralleling switch and synchrocheck in series
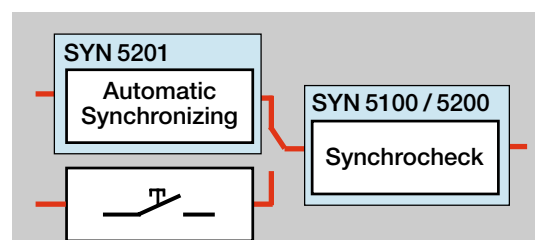

Fig. 6: Dual-channel system with automatic synchronizing device, manual paralleling switch in parallel and Synchrocheck in series
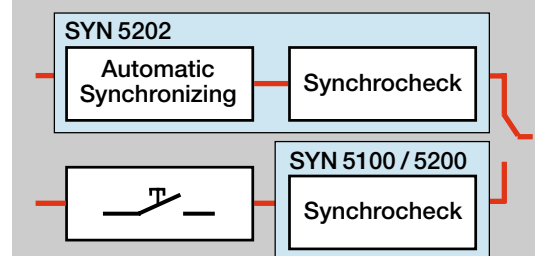

Fig. 7: Dual-channel main synchronizing system with bypass synchronizing system of manual paralleling switch and a Synchrocheck
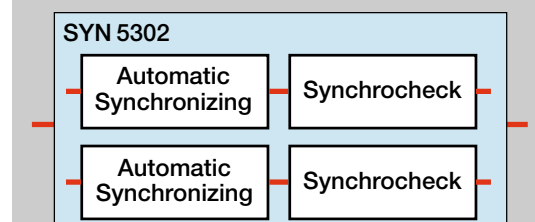

Fig. 8: Two automatic dual-channel systems for highest security and maximum availability

SYNCHROTACT 5 is utilizing state-of-the-art hardware and software technology, which includes a fundamentally improved service and maintenance tool.

Fig. 9: SYNCHROTACT 5 family

Special features

- Up to seven sets of parameter for seven different paralleling points can be stored in one device.

- Freely-configurable digital inputs and outputs.

- Operating with rated frequencies 50 Hz, 60 Hz and 16 $^2/_3$ Hz.

- For replacement of elder SYNCHROTACT systems or synchronization units made by other manufacturers.

Lower engineering costs

- Fewer auxiliary relays are required because the output contacts can carry higher currents. All I/Os are isolated.

- No separate power supply unit is required.

- A prefabricated unit is available for the selection of several paralleling points (SYN 5500)

- Much of the cabling is rendered unnecessary through integration in a bus control system (MODBUS, Profibus etc.).

Fast commissioning

- A user-friendly software called "**SynView**" allows simple and fast commissioning of a SYNCHROTACT 5 system.

- The **SynView** program recommends a value for each parameter and indicates minimum, maximum and default value for each parameter.

- The system includes an intelligent program, which after interaction with the generator, can recommend values for certain parameters that are dependent on the power system's circuit breaker, voltage regulator and speed governor.

- The commissioning of SYNCHROTACT 5 can also be comfortably performed without a PC, using the controls on the front panel of the casing.
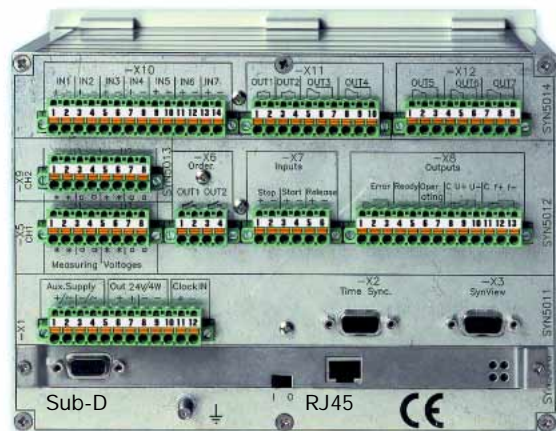
5302

Sub-D   RJ45   CE

Fig. 10:   The conventional connections are made via plug-contact strips. These are largely unnecessary where the communications interface is used; instead, the signals are passed via the 9-pin Sub-D connector at the lower left. The connection to the Ethernet for remote servicing is made via the RJ45 socket.

Fig. 11:   Auxiliary device SYN 5500 (for top-hat rail mounting)

Easy integration in super-imposed control system

SYNCHROTACT 5 can be easily integrated in a modern bus control system. The communication interface supports the protocols MODBUS RTU, Profibus DP or LON-Bus.

At the same time, as a safety-relevant component, the synchronizing device remains an independent and protected module within the system.

Remote servicing saves travelling costs

Another interface is provided for remote servicing. In this case, SYNCHROTACT 5 gets its own IP address, and communication is done via an Ethernet interface with TCP/IP protocol. This allows the PC software "**SynView**" to directly access the device via the Internet. This access is switched on and off on the rear plate of the device.
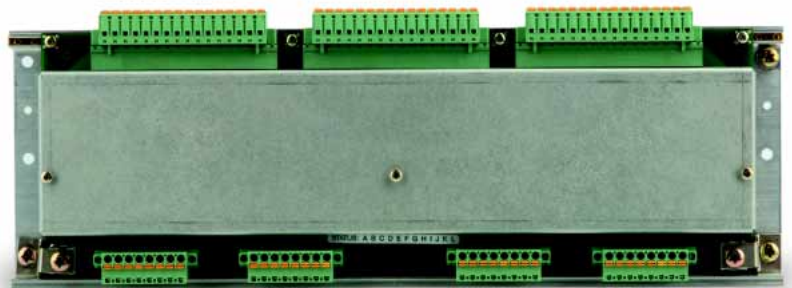
Type	Description
SYN 5100	Simple Synchrocheck
SYN 5200	Synchrocheck with advanced functionality
SYN 5201	Automatic single-channel synchronizing device with frequency and voltage adjustment
SYN 5202	Automatic dual-channel synchronizing system with Synchrocheck in series as second channel
SYN 5302	Redundant automatic dual-channel synchronizing system
SYN 5500	Auxiliary device for connection of several paralleling points

SynView is for simple and quick commissioning of SYNCHROTACT 5 equipment. German, English or French can be selected in SynView which runs under Microsoft® Windows™ 95, 98, 2000 or NT.

Functions

SynView program offers the following four main functions:

- **Setting of parameters**
  Very simple and user-friendly parameter setting display (Fig. 12).

- **Display of actual values**
  Synchroscope, voltage and frequency display with real-time data (Fig. 13).

- **Transient recorder function**
  Transient recorder data is displayed – a separate recorder during commissioning is not necessary (Fig. 14).

- **Event and error logging**
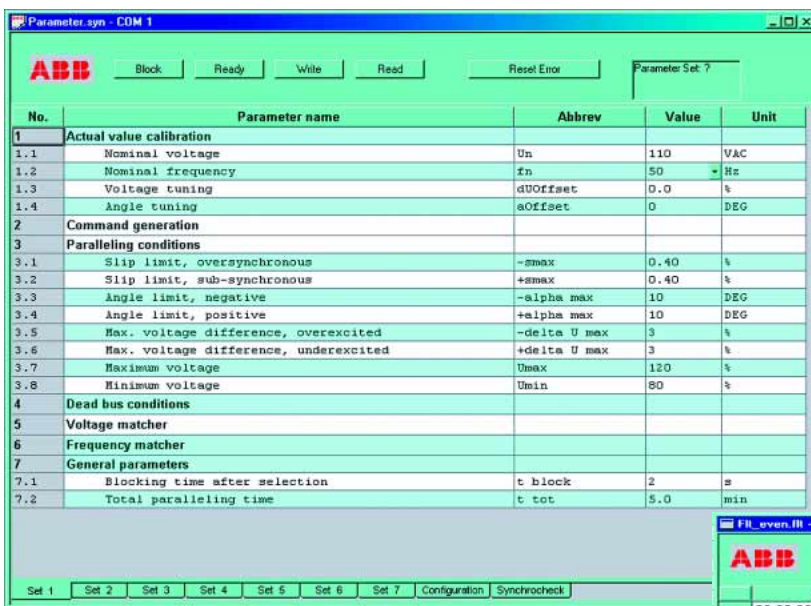 Events and errors in clear text with time stamp for the last 256 events (Fig. 15).

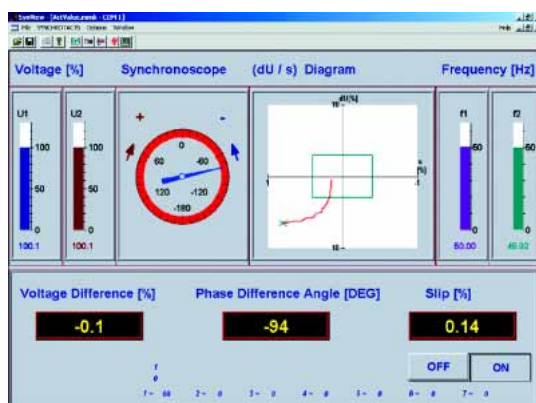Fig. 12: Parameter setting using SynView
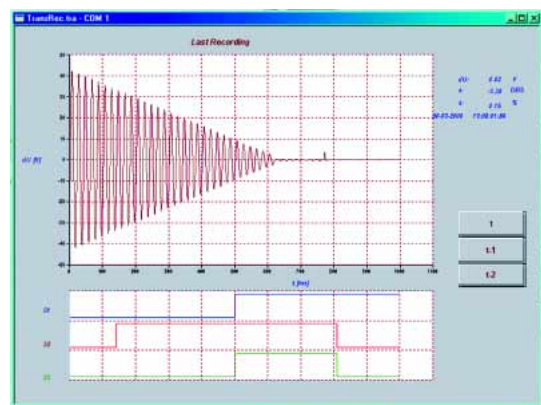

Fig. 14: Transient recorder window of SynView

Fig. 13: Measuring window of SynView

Fig. 15: Event Recorder window of SynView

Technical Data

Auxiliary voltage _____
Nominal voltage ranges	$24 / 48 V_{DC}$
	100 to $125 V_{AC/DC}$
	220 to $250 V_{DC}$
Permissible voltage range	0.75 to $1.25 \times U_n$
Maximum power consumption (SYN 5302)	25 W / 35 VA

Measuring inputs U1, U2 _____
Nominal voltage range	50 to $130 V_{AC}$
Permissible voltage range	0 to $1.3 \times U_n$
Nominal frequency	$16\,^2/_3 / 50 / 60$ Hz

Digital inputs _____
Nominal voltages	$24 / 48 V_{DC}$
Current consumption	6 to 8 mA

Paralleling relays _____
Maximum switching voltage	$250 V_{AC/DC}$
Maximum switching current, continuous	$5 A_{AC/DC}$
Max. switching power DC/AC ON	1000 W / VA
Max. switching power DC/AC OFF	30 W / 30 VA

Adjusting, command and signalling relays _____
Maximum switching voltage	$250 V_{AC/DC}$
Maximum switching current, continuous	$1.5 A_{AC/DC}$
Max. switching power DC/AC ON/OFF	50 W / 50 VA

Serial interface _____
for PC software "SynView"	RS 232

Measuring ranges _____
Voltage	U1, U2	0 to $1.3 \times U_n$
Angle matching	α	-179 to $+180$ DEG
Frequency		10 to 100 Hz
Slip	s	0 to 50 %
Acceleration	ds/dt	0 to 10 %/s
Paralleling time	t ON	0 to 1 s

Isolation _____
Dielectric test	IEC 60255-5	2 kV
Impulse voltage test	IEC 60255-5	5 kV

Degrees of protection acc. to IEC 60529 _____
Front	IP 54
Rear	IP 50

Temperature ranges _____
Transport/storage	+15 to + 185 °F
Functionable	+40 to + 160 °F
Operation (compliance with technical data)	+40 to + 130 °F

Mechanical stability _____
Vibration	IEC 60255-21-1	10 to 150 Hz Class 2
Vibration response		1 g
Endurance		2 g
Shocks and Bumps	IEC 60255-21-2	Class 2
Shock response		10 g
Withstand		30 g
Endurance		20 g
Earthquake	IEC 60255-21-3	Method A 5g in each axis

Emission / immunity (EMC) _____
Emission, terminal disturbance	IEC 55011	0.15 to 0.5 MHz:	79 /66 dB
		0.5 to 30 MHz:	73 /60 dB
Emission, radiation disturbance	IEC 55011	30 to 230 MHz:	30 dB
		230 to 1000 MHz:	37 dB

Emission / Immunity (EMC) (continued) _____

Electrostatic discharges	IEC 61000-4-2	Contact:	6 kV
		Air:	8 kV
Electromagnetic fields	IEC 61000-4-6	0.15 to 80 MHz	
		10 V, 80 % AM	
	IEC 61000-4-3	80 to 1000 MHz	
		10 V/m, 80 % AM	
		and PM / 900 MHz	
Fast transients/Bursts	IEC 61000-4-4	±1 kV / ±2 kV	
Surge voltage	IEC 61000-4-5	±0.5 kV/±1 kV/±2 kV/±4 kV	
Voltage dips	IEC 61000-4-11	AC: 30 %:	10 ms
		60 %:	100 ms
		> 95 %:	5000 ms
1 MHz burst disturbance	IEC 60255-22-1		
common mode		2.5 kV	
differential mode		1 kV	

CE conformity _____

LV Directive	73/23/ECC	EN 60950
EMC Directive	89/336/ECC	EN 50081-2
		EN 50082-2

Construction data

SYN 5100 _____

Modular casing designed to snap onto top-hat rail

Orientation		Horizontal
Casing size	W × H × D	8 $^5/_{64}$" × 5 $^2/_{64}$" × 3 $^{15}/_{64}$"
Weight		0.66 lbs

SYN 5200, SYN 5201, SYN 5202 _____

Plug-in type casing (Option: surface mounting)

Orientation		Horizontal
Table cutout	W × H	8 $^{47}/_{64}$" × 6 $^{29}/_{64}$"
Device profile	W × H × D	8 $^{45}/_{64}$" × 6 $^{27}/_{64}$" × 8 $^{43}/_{64}$"
Front frame	W × H	8 $^{57}/_{64}$" × 6 $^{47}/_{64}$"
Weight		8.82 lbs

SYN 5302 _____

Plug-in type casing for 19" rack

Orientation		Horizontal
Table cutout	W × H	17 $^{29}/_{64}$" × 6 $^7/_{64}$"
Device profile	W × H × D	17 $^{27}/_{64}$" × 6 $^5/_{64}$" × 8 $^{43}/_{64}$"
Front frame	W × H	17 $^{27}/_{64}$" × 6 $^5/_{64}$" × 8 $^{43}/_{64}$"
Weight		17.6 lbs

SYN 5500 _____

Board designed to snap onto top-hat rail

Dimensions	W × H × D	15" × 5" × 2"
Weight		3 lbs