

SYNCHROTACT® 5

**Synchronizing and Paralleling Equipment and Systems
for Synchronous Machines and Networks**



Application

SYNCHROTECT 5 is the fifth generation of synchronizing equipment produced by ABB. The ABB SYNCHROTECT products 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 is used in power stations where a generator needs to be paralleled with a power line, or in substations to parallel two synchronous networks. Power circuit breakers can only be closed if voltages at both ends are synchronous. Otherwise, it will cause a disturbance in the power network or trip the breaker. In extreme cases, it can damage both the generator and the unit transformer. SYNCHROTECT 5 provides a safe and reliable synchronization either as a monitoring element for manual paralleling or as an independent fully-automatic synchronizing unit.

SYNCHROTECT 5 covers the following areas of application:

1. Automatic synchronizing 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, sometimes referred to as synchronism-check) of automatic or manual synchronizing/paralleling of power lines, generators and voltage-free lines (dead bus), (see Fig. 3 below)

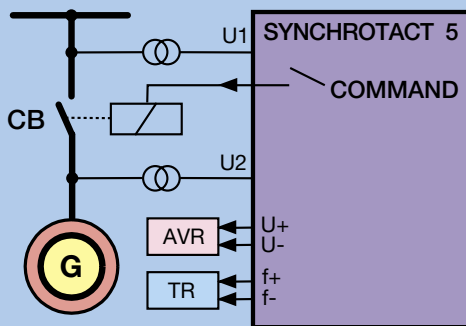


Fig. 1: Automatic synchronizing and paralleling

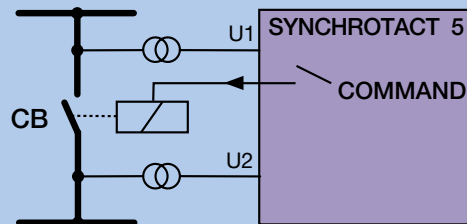


Fig. 2: Paralleling of power lines

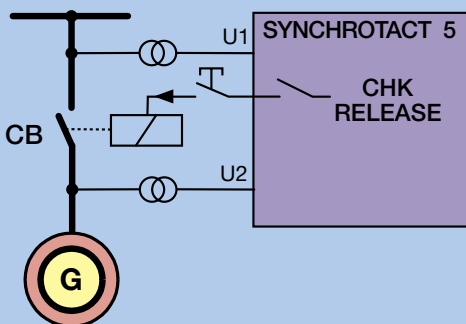


Fig. 3: Monitoring of manual paralleling (Synchrocheck)

Legend:

U1/V1	Network / busbar voltage
U2/V2	Generator voltage
CB	Circuit breaker
G	Generator
AVR	Automatic voltage regulator
TR	Turbine regulator (governor)
COMMAND	Paralleling command
U+/V+, U-/V-	Voltage adjusting commands
f+, f-	Frequency adjusting commands
CHK RELEASE	Paralleling command release

Safety and Availability

Thanks to its flexible design, SYNCHROTACT 5 can be used in many different configurations in order to provide the required 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 configuration increases the safety of operation.**

The term “redundancy” applies to a configuration of **two devices connected in parallel**. If one fails the other one takes over the function. **Redundant configuration increases the availability of the synchronizing system.**

Maximum safety in automatic and manual operation

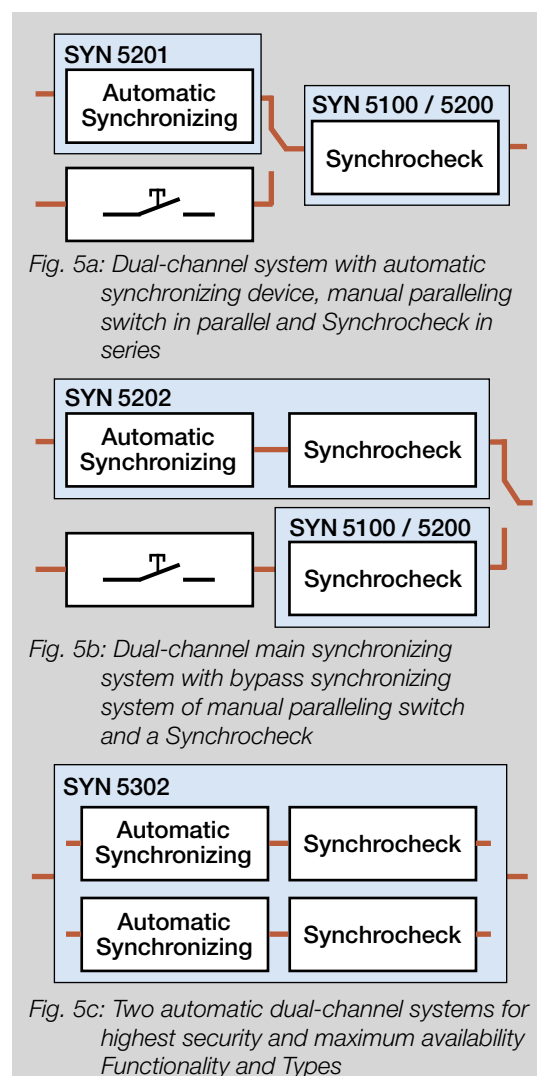
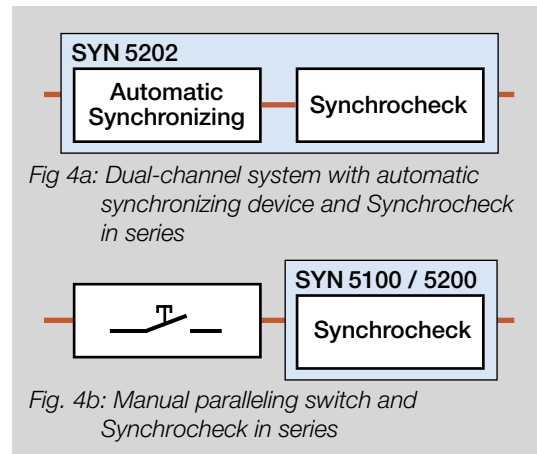
The ability to save the generator and network components from damage during synchronization is the first requirement for this kind of equipment.

The safe **automatic synchronization** is provided by a compact dual-channel system including two devices with independent hardware and software architecture which are connected in series (see Fig. 4a). While the first channel performs the automatic synchronization, the second channel independently monitors the first one (Synchrocheck). In order to protect the operation from any possible systematic failure, the hardware and software of each channel are designed separately using different microprocessors. The safe **manual synchronization** is provided by a monitoring device (Synchrocheck) connected in series with the manual paralleling switch (see Fig. 4b).

Optimum availability

For higher availability of synchronizing equipment, the family range of SYNCHROTACT 5 offers various redundant configurations (see Figures 5a, 5b and 5c). These configurations result in both enhanced safety and high availability of the system.

Automatic Synchronizing and Synchrocheck functions are available as stand-alone units (SYN 5100, SYN 5200, SYN 5201) or in combinations built in one casing (SYN 5202, SYN 5302).



Functionality and Types

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



Fig. 6: SYNCHROTACT 5 family

Special features

- Up to seven parameter sets for seven different paralleling points can be stored in one device.
- Configurable digital inputs and outputs.
- Operating with rated frequencies 60 Hz, 50 Hz and 16 $\frac{2}{3}$ Hz.
- Can replace previous generations of SYNCHROTACT devices or synchronizers 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.
- Prefabricated interface device is available for the selection of several paralleling points (SYN 5500).
- Integration in a SCADA Control system (MODBUS, Profibus etc.) reduces cabling.

Fast commissioning

- A user-friendly software called “**SynView**” allows simple and fast commissioning of SYNCHROTACT 5.
- **SynView** indicates setting range, default and recommended value of the settings.

After interaction with the generator, the firmware recommends a certain setting value that depends on power characteristics of circuit breaker, voltage regulator and speed governor.

- Commissioning of SYNCHROTACT 5 can also easily be done with the key pad and the display on the front panel.



5302

Easy integration in superimposed control system

SYNCHROTACT 5 can easily be integrated in a modern SCADA 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 a physically separated, independent module within the plant.

Remote maintenance saves traveling costs

Another interface is provided for remote maintenance. In this case, SYNCHROTACT 5 gets its own IP address and the communication is done via Ethernet interface with TCP/IP protocol. This allows the PC software **SynView** to access the device directly via the Internet.

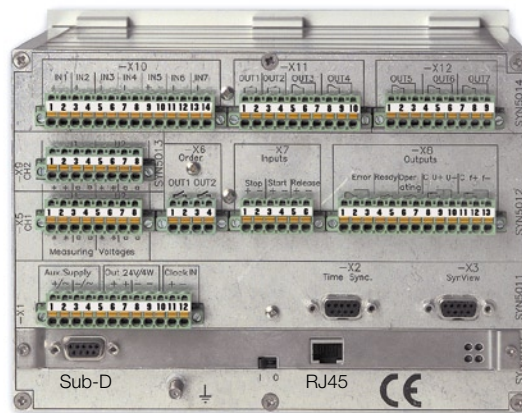


Fig. 7: Usually the connections are made via pluggable terminal blocks. The alternative use of the serial interface reduces the number of wires considerably.

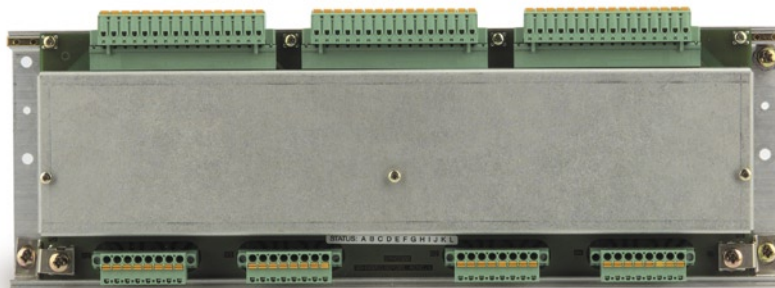


Fig. 8: Auxiliary device SYN 5500 (for top-hat rail mounting)

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 Tools

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

Functions

SynView program offers the following four main functions:

- **Setting of parameters**
Very simple and user-friendly parameter setting display (Fig. 9).
- **Display of actual values**
Synchroscope, voltage and frequency display with real-time data (Fig. 10).

- **Oscillography waveform capture (transient recorder) function**
Oscillography data is displayed – a separate recorder during commissioning is not necessary (Fig. 11).
- **Event recorder function**
Display in clear text with time stamp for the last 256 events (Fig. 12).

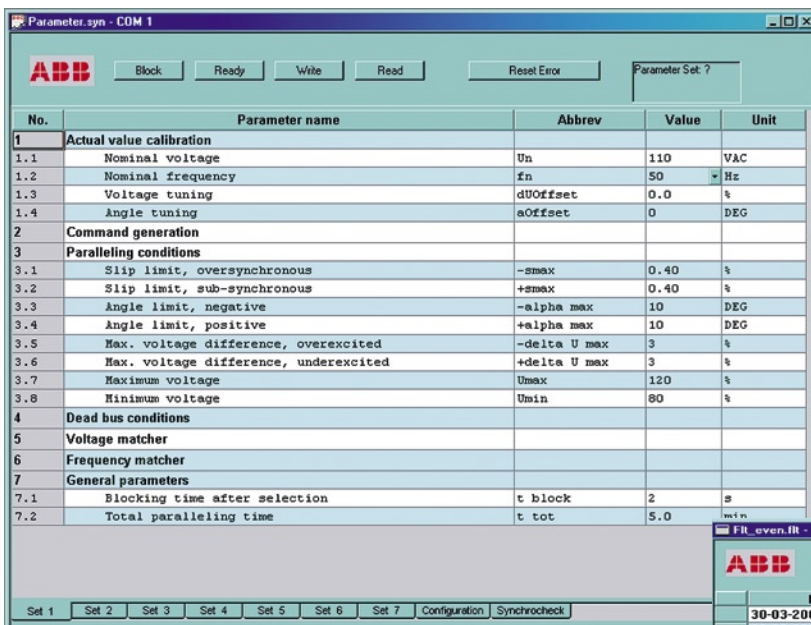


Fig. 9: Parameter setting using SynView

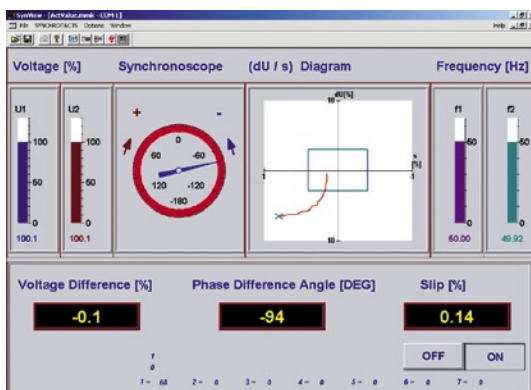


Fig. 11: Actual values window of SynView

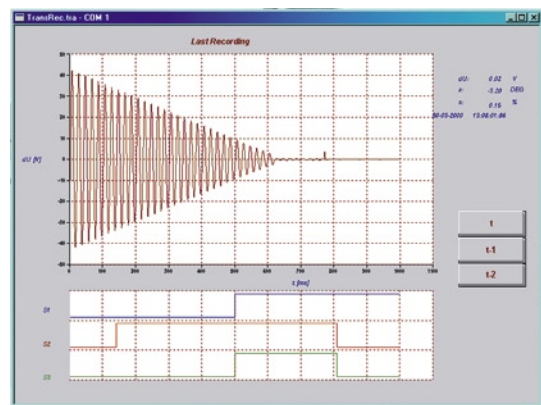


Fig. 10: Transient recorder window of SynView

Event Recorder window showing event list:

Date / Time	Relative Time	Code	Text
30-03-2000 11:28:43:23	00:00:00:00	3	SYNCHROTECT selected
30-03-2000 11:28:45:37	00:00:02:14	23	Adjusting command f+
30-03-2000 11:28:45:46	00:00:02:23	21	Adjusting command U+
30-03-2000 11:29:05:20	00:00:21:97	25	Release contact closes
30-03-2000 11:29:06:21	00:00:22:98	26	Release contact opens
30-03-2000 11:29:20:12	00:00:36:89	25	Release contact closes
30-03-2000 11:29:20:65	00:00:37:42	27	Paralleling command contact closes
30-03-2000 11:29:20:94	00:00:37:71	26	Release contact opens
30-03-2000 11:29:21:65	00:00:38:42	28	Paralleling command contact opens
30-03-2000 11:32:40:23		4	SYNCHROTECT stopped
30-03-2000 11:32:40:33		5	Device ready
30-03-2000 11:32:40:63		6	Device not ready
30-03-2000 11:32:42:43		11	Changed data
30-03-2000 11:32:52:95		5	Device ready
30-03-2000 11:33:06:83		6	Device not ready
30-03-2000 11:33:06:83		11	Changed data
30-03-2000 13:04:02:01		1	Auxiliary voltage on
30-03-2000 13:04:02:01		5	Device ready
30-03-2000 13:04:02:02		101	Select parameter set 1
30-03-2000 13:07:25:34		4	SYNCHROTECT stopped
30-03-2000 13:07:26:35	00:00:00:00	3	SYNCHROTECT selected
30-03-2000 13:07:28:48	00:00:02:13	23	Adjusting command f+
30-03-2000 13:07:28:57	00:00:02:22	21	Adjusting command U+
30-03-2000 13:07:51:20	00:00:24:85	25	Release contact closes
30-03-2000 13:07:51:85	00:00:25:50	26	Release contact opens
30-03-2000 13:08:01:50	00:00:35:15	25	Release contact closes
30-03-2000 13:08:01:89	00:00:35:54	27	Paralleling command contact closes
30-03-2000 13:08:02:17	00:00:35:82	26	Release contact opens
30-03-2000 13:08:02:89	00:00:36:54	28	Paralleling command contact opens
30-03-2000 13:08:06:91		4	SYNCHROTECT stopped
30-03-2000 13:08:06:96		5	Device ready

Fig. 12: Event Recorder window of SynView

Technical Data

Auxiliary voltage

Nominal voltage range	24 to 48 V _{DC} 100 to 125 V _{AC/DC} 220 to 250 V _{DC}
Permissible voltage range	0.75 to 1.25 × V _n (U _n)
Maximum power consumption	(SYN 5302) 24W / 35VA

Measuring inputs V1, V2 (U1, U2)

Nominal voltage range	50 to 130 V _{AC}
Permissible voltage range	0 to 1.3 × V _n (U _n)
Nominal frequency	16⅔ / 50 / 60 Hz

Digital inputs

Nominal voltages	24 to 48V _{DC}
Current consumption	6 to 8 mA

Paralleling relays

Maximum switching voltage	250 V _{AC/DC}
Maximum switching current, continuous	10 A _{AC/DC}
Maximum switching power	DC/AC ON 1500 W / VA
Maximum switching power	DC/AC OFF (resistive) 1500 VA / 150 W

Adjusting commands and non-tripping relays

Maximum switching voltage	250 V _{AC/DC}
Maximum switching current, continuous	1.5 A _{AC/DC}
Maximum switching power	DC/AC ON/OFF 50 W/VA

Ethernet interface

for PC software "SynView"

Measuring ranges

Voltage	V1 (U1), V2 (U2)	0 to 1.3 × V _n (U _n)
Phase angle difference		-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

Insulation

Dielectric test	IEC 60255-5	2 kV
Impulse voltage withstand test	IEC 60255-5	5 kV

Degrees of protection

Front	NEMA 54
Rear	NEMA 50

Temperature ranges

Transport/storage	+15° F to +185° F (-10° C to +85° C)
Functionable	+40° F to +160° F (+5° C to +70° C)
Operation (compliance with technical data)	+40° F to +130° F (+5° C to +55° C)

Mechanical stability

Vibration	IEC 60255-21-1	10 to 150 Hz Class 2
Response test		1 g
Endurance test		2 g
Shocks and Bumps	IEC 60255-21-2	Class 2
Response test		10 g
Withstand test		30 g
Bump test		20 g
Earthquake	IEC 60255-21-3	Method A, 5 g in each axis

Emission / immunity (EMC)

Emission, conducted disturbance	IEC 55011	0.15 to 0.5 MHz: 79/66 dB 0.5 to 30 MHz: 73/60 dB
Emission, radiated disturbance	IEC 55011	30 to 230 MHz: 30 dB 230 to 1000 MHz: 37 dB
Electrostatic discharges	IEC 61000-4-2 IEEE Std C37.90.3	Contact: 8 kV Air: 15 kV Contact: 8 kV Air: 15 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
	IEEE Std C37.90.2	25 to 1000 MHz 20 V/m, 80% AM

Technical Data

Emission / Immunity (EMC) (continued)

Fast transients/Bursts	IEC 61000-4-4 & IEEE Std C37.90.1	±4 kV
Surge voltage	IEC 61000-4-5	±1 kV/±2 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 & IEEE Std C37.90.1	2.5 kV

Product standards

Measuring relays and protection equipment IEC 60255-6
Relays and Relay Systems associated with Electric Power Apparatus IEEE Std C37.90

Construction data

SYN 5100

Modular casing designed to snap onto top-hat rail

Orientation	Horizontal
Casing size	W x H x D $8\frac{5}{64}" \times 5\frac{7}{64}" \times 3\frac{15}{64}"$ (205 x 128 x 82 mm)
Weight	0.66 lbs (0.3 kg)

SYN 5200, SYN 5201, SYN 5202

Plug-in type casing (Option: surface mounting)

Orientation	Horizontal
Table cutout	W x H $8\frac{47}{64}" \times 6\frac{29}{64}"$ (222 x 164 mm)
Device profile	W x H x D $8\frac{45}{64}" \times 6\frac{27}{64}" \times 8\frac{43}{64}"$ (221 x 163 x 220 mm)
Front frame	W x H $8\frac{57}{64}" \times 6\frac{47}{64}"$ (226 x 171 mm)
Weight	8.82 lbs (4.0 kg)

SYN 5302

Plug-in type casing for 19" rack

Orientation	Horizontal
Table cutout	W x H $17\frac{29}{64}" \times 6\frac{7}{64}"$ (443 x 155 mm)
Device profile	W x H x D $17\frac{27}{64}" \times 6\frac{5}{64}" \times 8\frac{43}{64}"$ (442 x 154 x 220 mm)
Front frame	W x H $17\frac{27}{64}" \times 6\frac{5}{64}" \times 8\frac{43}{64}"$ (447 x 171 mm)
Weight	17.6 lbs (8.0 kg)

SYN 5500

Board designed to snap onto top-hat rail

Dimensions	W x H x D $15" \times 5" \times 2"$ (381 x 128 x 50 mm)
Weight	3 lbs (1.4 kg)

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