

*Synchronisation meters for manual or semiautomatic synchronisation*

## Synchronization Meters SQ0114/SQ0104 Synchronization Meters SQ0214/SQ0204

- Microprocessor processing
- Output relay for synchronisation (pulse or continuous)
- "Dead bus bar or generator" functionality
- Dual voltage and frequency display
- Power supply from bus bar or generator
- Standard 96x96 mm or 144x144 mm din housing
- Status output

## PROPERTIES

- Measurement of phase difference between bus bar and generator
- Five instruments in one (SQ 0x14)
- Circular display of  $\Delta\phi$  phase difference
- Magnified display of phase difference  $\Delta\phi = \pm 20$  degree
- Microprocessor processing
- Simple synchronization conditions setting
- Output relay for synchronisation (pulse or continuous)
- "Dead busbar or generator" functionality
- Power supply from bus bar or generator
- Standard 96x96 mm or 144x144 mm din housing
- LCD with backlight for voltage, frequency and/or  $\Delta\phi$  monitoring (SQ 0x14 only)
- High immunity to EMC disturbances
- Special functions set with three jumpers inside the instruments
- Status output
- Green led for indication of both voltages
- Ship version (Bureau veritas certificate - SQ 02x4)

## APPLICATION AND FUNCTIONALITY

Synchronization meter (SQ0204, SQ0214, SQ0104 and SQ0114) is a microprocessor based synchronising unit. It is intended for a phase difference ( $\Delta\phi$ ) measurement between a bus bar and generator. It can be used in any kind of installation where a manual or semi-automatic synchronising is required. Circular set of 24 LEDs represents a phase difference. A lit LED displays momentary phase difference  $\Delta\phi$  with a resolution of  $20^\circ$ el. (red LEDs). Within synchronising range  $\pm 15^\circ$ el., the resolution is increased to  $5^\circ$ el. (green LEDs).

SQ0214 and SQ0114 has additional LCD with backlight for a display of a generator  $U_{GEN}$  and bus-bar  $U_{BB}$  voltage and both frequencies  $f_{GEN}$  and  $f_{BB}$  or  $\Delta\phi$ .

SQ0214 and SQ0114 can replace two voltmeters and two frequency meters, which are normally part of the synchronising set.

Status output is used to supervise the operation of a microprocessor inside synchroscope. In case of a microprocessor malfunction the status output changes state from low to high impedance.

## OPERATION AND SYNCHRONISING SETTINGS

The instrument samples a generator and bus bar voltages using A/D converter inside a microprocessor. Both voltages are galvanically separated with measuring transformers. The microprocessor computes voltages, frequencies and a phase difference between  $U_{GEN}$  and  $U_{BB}$ . The lit LED in a circular display represents an actual phase difference from  $0^\circ$  (top position) to  $\pm 180^\circ$  (bottom position).

LCD (SQ0214 and SQ0114 only) displays voltages and frequencies or phase angle. SQ can be supplied from  $U_{GEN}$  or  $U_{BB}$  side. A synchronising relay is activated when synchronising conditions are set. At the instrument rear side, three potentiometers are provided for adjusting basic synchronising condition setting:

- phase difference  $\Delta\phi$ ;
- voltage difference  $\Delta U$ ;
- delay of synchronising relay switch-on (DELAY).

A synchronising condition is set, when the phase difference and the voltage difference between  $U_{GEN}$  and  $U_{BB}$ , for a time of delay, are within the set limits. The synchronising check relay is then switched on and a SYNC LED is lit for a preset pulse time (e.g. 100 ms, 300 ms).

Additional settings are set upon customers request in a factory or by authorized dealer.

### DEAD BUS BAR OR GENERATOR SYNCHRONISING

When this function is set, the synchronising relay will be activated and the SYNC LED will be lit, when:

- ( $U_{GEN} > 80\% U_{NOM}$ ) AND ( $U_{BB} < \text{preset } U_{BB} \text{ noise level}$ ) or
- ( $U_{BB} > 80\% U_{NOM}$ ) AND ( $U_{GEN} < \text{preset } U_{GEN} \text{ noise level}$ )

The allowed  $U_{BB} / U_{GEN}$  voltage noise level is set in factory in range from 10% to 40% of nominal voltage.

### WARNING:

Detection of dead bus bar is done by a single-phase or phase-to-phase measurement. At phase to phase synchronisation, additional check of other phases is essential before using that function.

### OVER AND UNDER FREQUENCY SYNCHRONISING

This option offers more precise synchronising if the information, whether the generator frequency is falling or rising towards the bus-bar frequency, is available.

If the  $\Delta\phi$  window is set asymmetrically to  $+\Delta\phi$  only synchronising when the lower generator frequency is rising towards bus bar frequency is possible (under frequency synchronising).

If the  $\Delta\phi$  window is set asymmetrically to  $-\Delta\phi$  only synchronising when the higher generator frequency is falling towards bus bar frequency is possible (over frequency synchronising).

## RELATIVE VOLTAGE DISPLAY ON LCD (SQ0214 AND SQ0114 ONLY)

This option enables display of a voltage ( $U_{BB}$  and  $U_{GEN}$ ) relative to the actual measured voltage (e.g. if actual measured nominal voltage  $U_N$  is 400 V, the displayed nominal voltage  $U_{LCDN}$  can be set to any voltage in range from 30 V to 800 kV). LCD resolution depends on measuring range.

Range	Resolution
30 V to 800 V	1 V
0.81 kV to 8.00 kV	10 V
8.1 kV to 80.0 kV	100 V
81 kV to 800 kV	1 kV

$$U_{LCD} = k \times U \quad 30V / U < k < 8 \times 10^5 V / U$$

### LENGTH OF A SYNC PULSE

This value should be set according to the time characteristic of an external circuit breaker. It can be set to any value from 0.1 s to 1 s in 0.1 s steps.

For special purposes it can be set to continuous. With this setting enabled, the synchronising relay and the SYNC LED will be activated as long as the basic synchronising conditions are met:

- $U_{BB} - U_{GEN}$  phase difference inside the phase window
- $U_{BB} - U_{GEN}$  voltage difference inside the setting range

### DEAD BUS BAR / GENERATOR VOLTAGE NOISE LEVEL SETTING

Noise on the line, when BB bar or generator is dead, can prevent dead bus bar / generator synchronising. Noise rejection level can be set to 10%, 20%, 30% or 40% of nominal voltage.

### SUPPLY AND PROPER OPERATION

SQ is energized from a bus bar and generator input. For a proper operation at least one input voltage is required to exceed 80% of a nominal voltage.

## TECHNICAL DATA

### INPUT VOLTAGE

Nominal voltage $U_n$ ( $U_{L-N}$ to ground 400 $V_{MAX.}$ )	57.7 V, 63.5 V, 100 V, 110 V, 115 V, 120 V, 220 V, 230 V, 380 V, 400 V, 415 V, 440 V, 480 V, 500 V, 690 V
Voltage range	$U_n \pm 20\%$ ( $U_{L-N} = 400 V_{MAX.}$ )
Frequency range	40 ... 70 Hz
Self consumption	< 4 VA
Overload	cont. $1.2 \times U_n$ short $2 \times U_n, 3s$

### MEASURING PART

Resolution of $\Delta\varphi$ display	20 °el.
Magnified resolution range	$\pm 15$ °el.
Magnified resolution	5 °el.
Accuracy at $\Delta\varphi = 0$	$\pm 3$ °el.

### LCD QUANTITIES ACCURACY (SQ0214 AND SQ0114)

Voltage ( $U_{GEN}, U_{BB}$ )	1.5 %
Frequency ( $f_{GEN}, f_{BB}$ )	0.5 %
Phase difference between $U_{gen}$ and $U_{bb}$	$\pm 3$ °el.

### SYNCHRONISING PART

Voltage difference setting range	1 ... 10 %
Accuracy	$\pm 2,5$ %
Phase difference setting range	2 ... 20 °el.
Accuracy	$\pm 3$ °el.
Switch-on delay time range	0,1 ... 1 s
Accuracy	$\pm 10$ %
Synchronising pulse duration	Continuous 300 ms (default) Adjuststabel from 100 ms to 1 s)
Accuracy	$\pm 30$ ms
Relay	250 V, 1 A, 50 Hz, 250 VA

### LED DISPLAY

Red LED's visual angle	$\pm 80$ °
Green LED's visual angle	$\pm 30$ °
Luminosity	2500 mcd

### STATUS OUTPUT

Type	Open-collector
Max. voltage	24 Vdc + 20%
Max. current	30 mA

### HOUSING

Material of housing	PC/ABS Uninflammable, according to <b>UL 94 V-0</b>
Enclosure protection	IP52 for case, IP20 for terminals with protective cover
Safety	According to <b>EN 61 010-1</b> 400 V, installation category III Pollution degree 2
Weight	0.53 kg (SQ02x4) 0.60 kg (SQ01x4)

### ENVIRONMENTAL CONDITIONS

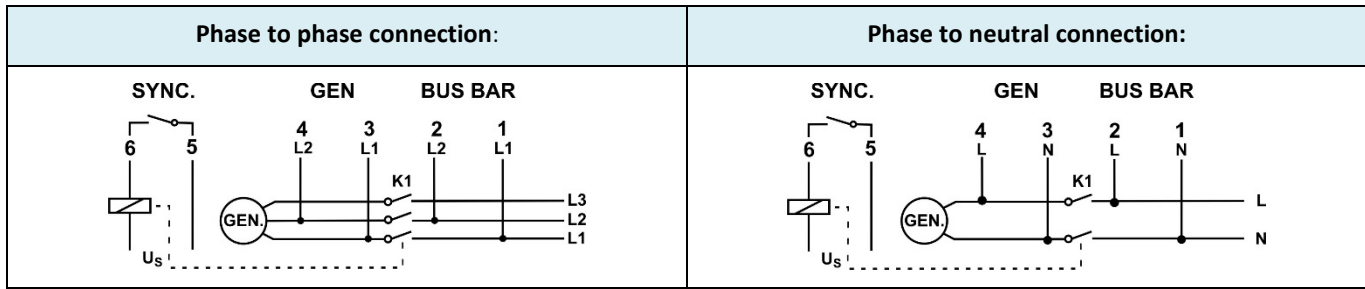
Temperature:	
Reference temperature	0 ... 50 °C
Operating temperature	-20 ... 55 °C
Storing temperature	-40 ... 70 °C
Relative humidity	Up to 95% (without condensing)

### NOTE!

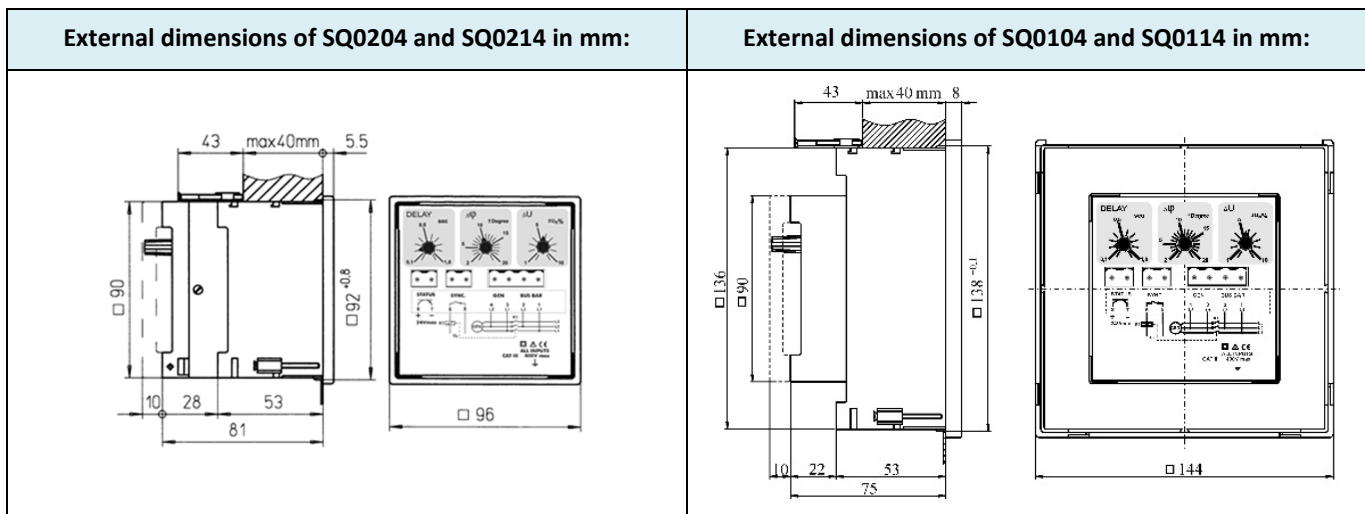
SQ should not be directly exposed to the sun.

CONNECTION

SISTEM



DIMENSIONAL DRAWING:



CONNECTION TERMINALS:

Terminal No.	Signal symbol	Signal name
1	L1 <sup>1</sup> or N <sup>2</sup>	BUS bar voltage
2	L2 <sup>1</sup> or L1 <sup>2</sup>	
3	L1 <sup>1</sup> or N <sup>2</sup>	Generator voltage
4	L2 <sup>1</sup> or L1 <sup>2</sup>	
5	SYNC.	Relay output
6	SYNC.	
7	STATUS	Status output
8	STATUS	

WARNING:

When a synchronising is done by a single phase measurement (3-phase system, phase to neutral connection), a proper connection of the other two phases is essential.

DATA FOR ORDERING

When ordering the SQ, all required specifications shall be stated in compliance with the ordering code. Also additional information could be stated. Most typical options are shown as an example.

EXAMPLE OF ORDERING

SQ in 96 x 96 mm housing, with LCD, phase to phase nominal voltage 400 V, 300 ms relay output, Dead BB bar function (D<sub>bb</sub>+D<sub>gn</sub>) with an offset of 20% U<sub>n</sub>, standard +/- Δφ setting and voltage display 28 kV at 400 V input.

**SQ0214 L 400V R3 N 6 S A 28 kV/400 V**

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| | | | | | | |
| | | | | | | |
| | | | | | | 28 kV at 400 V input
| | | | | | | Finish: Standard
| | | | | | | Display: Default value +/- 2...20 el. *
| | | | | | | Dead Busbar Function: DG+DB 20% Un
| | | | | | | Status output: No *
| | | | | | | Relay output: Impulse 300 ms – Fixed*
| | | | | | | Nominal voltage: 400 V
| | | | | | | Type of connection: phase to phase
    
```

Type: **SQ0214**

Type	Type of connection	Voltage Inputs	Relay Output	Status output	Dead Busbar or generator function	Delta phi setting	Finish	Display (SQ 0x14 only)
X	X	X	X	X	X	X	X	X
								0 Default (displayed value equal to voltage input) X Other displayed value - to be specified with order <b>A Standard</b> <b>H HVE (tropical)</b> <b>S Ship</b> <b>P IP54</b> <b>G HVE (tropical) + IP54</b> <b>R Ship + IP54</b> <b>T Ship + HVE (tropical)</b> <b>S</b> Default value +/- 2 ... 20 el. * <b>V</b> Setting range + 2 ... 20 el. <b>U</b> Setting range - 2 ... 20 el. <b>N</b> None * <b>1</b> DB 10% Un <b>2</b> DB 20% Un <b>3</b> DB 30% Un <b>4</b> DB 40% Un <b>5</b> DG+DB 10% Un <b>6</b> DG+DB 20% Un <b>7</b> DG+DB 30% Un <b>8</b> DG+DB 40% Un <b>N</b> No * <b>S</b> Yes <b>RO</b> Without <b>RC</b> Continual Impulse <b>R3</b> Impulse 300 ms – Fixed* <b>01</b> Impulse 100 ms <b>02</b> Impulse 200 ms <b>03</b> Impulse 300 ms <b>04</b> Impulse 400 ms <b>05</b> Impulse 500 ms <b>06</b> Impulse 600 ms <b>07</b> Impulse 700 ms <b>08</b> Impulse 800 ms <b>09</b> Impulse 900 ms <b>10</b> Impulse 1000 ms
		<b>57.7 V</b> 57.7 V <b>63.5 V</b> 63.5 V <b>100 V</b> 100 V <b>110 V</b> 110 V <b>115 V</b> 115 V <b>120 V</b> 120 V <b>220 V</b> 220 V <b>230 V</b> 230 V <b>380 V</b> 380 V <b>400 V</b> 400 V <b>415 V</b> 415 V <b>440 V</b> 440 V <b>480 V</b> 480 V <b>500 V</b> 500 V <b>690 V</b> 690 V						
	L							
	N							
<b>SQ0104</b>	SQ0104							
<b>SQ0114</b>	SQ0114							
<b>SQ0204</b>	SQ0204							
<b>SQ0214</b>	SQ0214							

NOTES:

Lined area for notes with horizontal ruling lines.

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