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 Δϕ phase difference
- Magnifield display of phase difference Δϕ = ±20 degree
- Microprocessor processing
- Simple synchronisation 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 Δϕ 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 (Δϕ) 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 Δϕ with a resolution of 20°el. (red LEDs). Within synchronising range ±15°el., the resolution is increased to 5°el. (green LEDs).

SQ0214 and SQ0114 has additional LCD with backlight for a display of a generator UGEN and bus-bar UBB voltage and both frequencies fGEN and fBB or Δϕ.

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 UGEN and UBB. The lit LED in a circular display represents an actual phase difference from 0° (top position) to ±180° (bottom position).

LCD (SQ0214 and SQ0114 only) displays voltages and frequencies or phase angle. SQ can be supplied from UGEN or UBB 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 Δϕ;
- voltage difference ΔU;
- delay of synchronising relay switch-on (DELAY).

A synchronising condition is set, when the phase difference and the voltage difference between UGEN and UBB, 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:

- (UGEN > 80% UNOM) AND (UBB < preset UBB noise level) or
- (UBB > 80% UNOM) AND (UGEN < preset UGEN noise level)

The allowed UBB / UGEN 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 Δϕ window is set asymmetrically to + Δϕ only synchronising when the lower generator frequency is rising towards bus bar frequency is possible (under frequency synchronising).

If the Δϕ window is set asymmetrically to -Δϕ 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 $U_{LCD}$ can be set to any voltage in range from 30 V to 800 kV). LCD resolution depends on measuring range.

<table>
<thead>
<tr>
<th>Range</th>
<th>Resolution</th>
</tr>
</thead>
<tbody>
<tr>
<td>30 V to 800 V</td>
<td>1 V</td>
</tr>
<tr>
<td>0.81 kV to 8.00 kV</td>
<td>10 V</td>
</tr>
<tr>
<td>8.1 kV to 80.0 kV</td>
<td>100 V</td>
</tr>
<tr>
<td>81 kV to 800 kV</td>
<td>1 kV</td>
</tr>
</tbody>
</table>

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

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

<table>
<thead>
<tr>
<th>Nominal voltage $U_n$ ($U_{L-N}$ to ground 400 V MAX.)</th>
<th>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</th>
</tr>
</thead>
<tbody>
<tr>
<td>Voltage range</td>
<td>$U_n \pm 20%$ ($U_{L-N} = 400$ V MAX)</td>
</tr>
<tr>
<td>Frequency range</td>
<td>40 ... 70 Hz</td>
</tr>
<tr>
<td>Self consumption</td>
<td>&lt; 4 VA</td>
</tr>
<tr>
<td>Overload</td>
<td>cont. $1.2 \times U_n$, short 2 $\times U_n$, 3s</td>
</tr>
</tbody>
</table>

MEASURING PART

| Resolution of $\Delta \phi$ display               | 20 *el.                                                                                  |
| Magnified resolution range                         | $\pm 15\%$                                                                               |
| Magnified resolution                               | $5\%$                                                                                    |
| Accuracy at $\Delta \phi = 0$                      | $\pm 3\%$                                                                               |

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 $U_{BB}$   | $\pm 3\%$                                                                               |

SYNCHRONISING PART

| Voltage difference setting range                  | 1 ... 10%                                                                               |
| Accuracy                                           | $\pm 2.5\%$                                                                             |
| Phase difference setting range                     | 2 ... 20 *el.                                                                           |
| Accuracy                                           | $\pm 3\%$                                                                               |
| Switch-on delay time range                         | 0.1 ... 1 s                                                                             |
| Accuracy                                           | $\pm 10\%$                                                                              |
| Synchronising pulse duration                       | Continuous                                                                              |
| Accuracy                                           | $\pm 30\%$                                                                              |
| Relay                                              | $\pm 30\%$, 250 V, 1 A, 50 Hz, 250 VA                                                   |

LED DISPLAY

| Red LED's visual angle                             | $\pm 80^\circ$                                                                          |
| Green LED's visual angle                           | $\pm 30^\circ$                                                                          |
| Luminosity                                         | 2500 mcd                                                                               |

STATUS OUTPUT

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

HOUSING

| Material of housing                                | PC/ABS Unflammable, according to UL 94 V-0                                               |
| Enclosure protection                               | IP52 for case, IP20 for terminals with protective cover                                  |
| Safety                                             | According to EN 61 010-1, 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**

<table>
<thead>
<tr>
<th>Terminal No.</th>
<th>Signal symbol</th>
<th>Signal name</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>L1 or N2</td>
<td>BUS bar voltage</td>
</tr>
<tr>
<td>2</td>
<td>L2 or L1</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>L1 or N2</td>
<td>Generator voltage</td>
</tr>
<tr>
<td>4</td>
<td>L2 or L1</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>SYNC.</td>
<td>Relay output</td>
</tr>
<tr>
<td>6</td>
<td>SYNC.</td>
<td>Status output</td>
</tr>
<tr>
<td>7</td>
<td>STATUS</td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>STATUS</td>
<td></td>
</tr>
</tbody>
</table>

**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 \((D_{BB}+D_{GN})\) with an offset of 20% \(U_n\), standard +/- \(\Delta \phi\) setting and voltage display 28 kV at 400 V input.

**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.
## Technical Documentation

### Type of Connection

<table>
<thead>
<tr>
<th>Type</th>
<th>Voltage Inputs</th>
<th>Display</th>
</tr>
</thead>
<tbody>
<tr>
<td>X X X X X</td>
<td>Default (displayed value equal to voltage input)</td>
<td>0</td>
</tr>
<tr>
<td>X</td>
<td>Other displayed value - to be specified with order</td>
<td>X</td>
</tr>
</tbody>
</table>

### Status Output

- A: Standard
- H: HVE (tropical)
- S: Ship
- P: IP54
- G: HVE (tropical) + IP54
- R: Ship + IP54
- T: Ship + HVE (tropical)

### Dead Busbar or Generator Function

- S: Default value +/- 2 ... 20 el. *
- V: Setting range + 2 ... 20 el.
- U: Setting range – 2 ... 20 el.

### Relay Output

| N | None *
| 1 | DB 10% Un
| 2 | DB 20% Un
| 3 | DB 30% Un
| 4 | DB 40% Un
| 5 | DG+DB 10% Un
| 6 | DG+DB 20% Un
| 7 | DG+DB 30% Un
| 8 | DG+DB 40% Un

### Delta phi Setting

| N | No *
| S | Yes

### Display (SQ0114 only)

- RO: Without
- RC: Continual Impulse
- R3: Impulse 300 ms – Fixed*
- 01: Impulse 100 ms
- 02: Impulse 200 ms
- 03: Impulse 300 ms
- 04: Impulse 400 ms
- 05: Impulse 500 ms
- 06: Impulse 600 ms
- 07: Impulse 700 ms
- 08: Impulse 800 ms
- 09: Impulse 900 ms
- 10: Impulse 1000 ms

### Voltage Levels

- 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

### Connection Types

- SQ0104
- SQ0114
- SQ0204
- SQ0214

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**SQ0114/0104 & SQ0214/0204 Synchronization Meters**