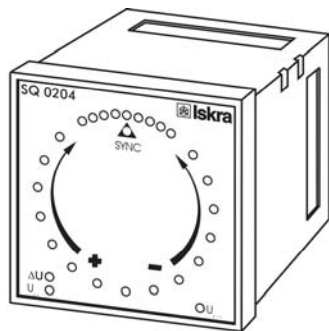
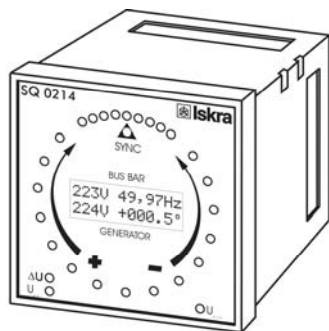


Synchroscope



SQ0204



SQ0214



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1. SAFETY SECTION


This Safety section should be read before commencing any work on the equipment.

1.1. Health and safety

The information in the Safety section of the product documentation is intended to ensure that products are properly installed and handled in order to maintain them in a safe condition. It is assumed that everyone who will be associated with the equipment will be familiar with the contents of the Safety section.

1.2. Explanation of symbols and labels

The meaning of symbols and labels, which may be used on the equipment or in the product documentation, is given below.

 **Caution:** refer to product documentation

 double isolation

 functional earth terminal

NOTE: this symbol may also be used for a protective/safety earth terminal if that terminal is part of a terminal block or sub-assembly e.g. power supply.

1.3. Warnings, regular information and remarks referring to CE-marking

In this manual installations and working instructions for the Synchroscope (SQ) SQ0204 and SQ0214 are to be found. Installation as well as use of the SQ will involve working with dangerous currents and voltages. Professionals must handle these areas. ISKRA MIS d.d. does not take any responsibility for the use and installation. If any doubt comes up concerning the installation or use of the system, on which the SQ is to be used, the person responsible for the power installation should be contacted.

The SQ is CE-marked according to the EMC-directive for industrial environment and for housing and light industry.

The SQ is CE-marked according to low-voltage directive for up to 400V phase to ground voltage, installation category III and pollution degree 2.

Before energising the equipment, the following should be checked:

Correct U_{GEN} and U_{BB} voltage connection.

Warning: Improper voltage can cause irregular operation or permanent damage to the SQ.

Disposal:

It is recommended that incineration and disposal to watercourses is avoided. The product should be disposed of in a safe manner.

The package contains the following items:

- Synchroscope SQ0204 or SQ0214
- User's manual
- Two fixing clamps
- A plugable connection(s)

2. APPLICATION AND FUNCTIONALITY

SQ0204 and SQ0214 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. SQ0214 version with LCD can replace two voltmeters and two frequency-meters. Circular set of 24 LEDs represents a phase difference. A lit LED displays momentary phase difference $\Delta\phi$ with a resolution of 20° el. (red LEDs). Within synchronising range $\pm 15^\circ$ el., the resolution is increased to 5° el. (green LEDs).

The SQ0214 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 $\Delta\phi$. The SQ0214 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.

2.1. 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° (top position) to $\pm 180^\circ$ (bottom position).

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

Basic synchronising condition settings (normal synchronising mode)

- for setting permitted phase difference $\Delta\phi$;
- for setting permitted voltage difference ΔU ;
- for a 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. 100ms, 300ms).

Additional settings are set upon customers request in a factory or by authorized dealer. Additional settings are set with three jumper switches inside SQ and/or with a special communication adapter.

WARNING: Only authorized personnel should set additional settings.

For more information, please contact ISKRA MIS d.d. support. Review of all settings is in table 1.

Dead bus bar synchronising

When this function is set, the synchronising relay will be activated and the SYNC LED will be lit, when the generator voltage exceeds 80% of its nominal voltage and the bus bar voltage is below allowed U_{BB} voltage noise level. The allowed U_{BB} 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 measurement. Additional check of the two 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 with the lower generator frequency than bus bar frequency is possible (under frequency synchronising).

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

Relative voltage display on LCD (SQ0214 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 400V, the displayed nominal voltage U_{LCDN} can be set to any voltage in range from 30V to 800kV). Resolution in range from 30V to 800V is 1V, from 0.81kV to 8.00kV is 10V, from 8.1kV to 80.0kV is 100V and from 81kV to 800kV is 1kV.

$$U_{LCD} = k \times U \quad 30V / U < k < 8 \times 10^5 V / U \quad (1)$$

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 0.1s to 1s in 0.1s 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 voltage noise level setting

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

<i>setting</i>		<i>buttons</i>	<i>jumper switches</i>	<i>software</i>
ΔU	BASIC	•		
DELAY		•		
$\Delta\phi$		•		

table 1a: Basic settings review

setting	buttons	jumper switches	software
$\pm\Delta\varphi$	ADDITIONAL	$\pm\Delta\varphi$ + $\Delta\varphi$ - $\Delta\varphi$	
Δt		cont 300ms 100ms	
$n\Delta t$			(100ms, 200ms,...1s)
DBB		•	
%DBB			10% 20% 30% 40%
U_{LCD}			see (1) on page 9

table 1b: Additional settings review (optional)

NOTE: End user can set only basic settings. Additional settings should be specified at placing the order.

2.2. 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 70% of a nominal voltage.

Status output (open collector output) is used to supervise the internal microprocessor. In case of microprocessor error the status output changes from low to high impedance state.

3. FRONT PANEL DISPLAY

Front panel display consists of 24 circularly distributed LEDs for an actual phase difference representation, 4 status LEDs and LCD display for a bus bar and generator voltage, frequency and/or phase difference display.

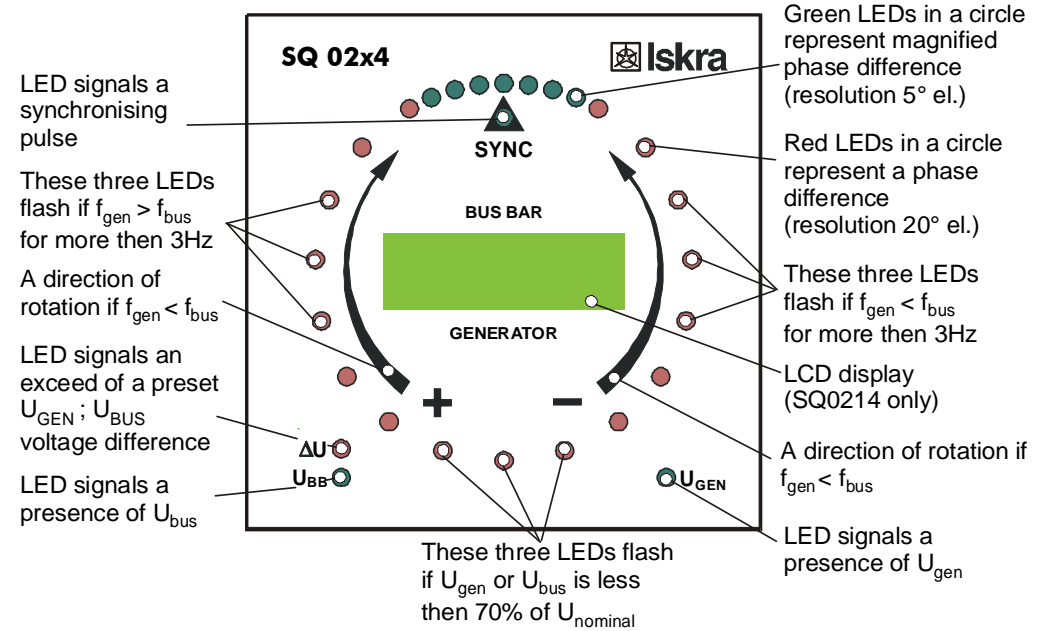


figure 1: Description of a front panel display

3.1. Function of LEDs

Circular set of 24 LEDs represents a phase difference. LED displays a momentary phase difference $\Delta\phi$ with a resolution of 20°el. (red LEDs). Within synchronisation range $\pm 15^\circ\text{el.}$, the resolution is increased to 5°el. (green LEDs). During a normal operation, only one LED is lit. The position of LEDs simulates an actual phase difference shown by an analog pointer.

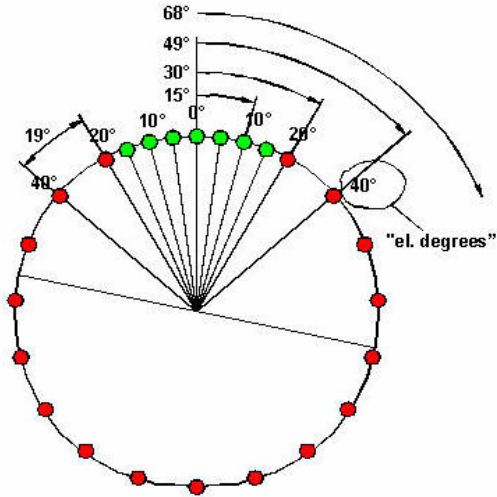


figure 2: Physical and electrical position of LEDs

The clockwise movement of the lit LED's position (+) indicates higher GEN frequency than BUS frequency and vice versa. When the frequency difference is more than 3Hz, the circulation would have been too fast. Three flashing LEDs on left or right side indicate such a condition (see figure 1).

When U_{GEN} or U_{BB} is not present (is smaller than 70% of U_N), three LEDs on the bottom of the circle start flashing and a LED U_{GEN} or U_{BB} respectively, turns off. (see figure 1).

LED ΔU signals that a (U_{GEN} , U_{BB}) voltage difference is higher than a pre-set voltage difference. Allowed voltage difference is set with ΔU potentiometer at the instrument rear side (see figure 3).

LED *SYNC* signals (in combination with a synchronising relay activation) set synchronising conditions (see chapter 2.1).

3.2. Operation of the LCD display (SQ0214 only)

Additional feature of the SQ0214 is 2×12 char. LCD with a backlight for a display of a generator U_{GEN} and bus bar U_{BB} voltage and both frequencies f_{GEN} and f_{BB} or $\Delta\phi$. The SQ0214 voltage, frequency and phase difference reading is accurate enough to replace two voltmeters and two frequency meters, which are normally part of a synchronising set.

NOTE: Temperature range for a normal operation of LCD is from 0°C to 50°C . Outside that range LCD might fail to operate. Normal functionality of a synchroscope will not be affected (for more information see TECHICAL DATA - ENVIRONMENTAL CONDITIONS, ch. 5).

v1.5 220V
SN:000000001

At power on, a software version, nominal voltage and a serial number is displayed for a short time;

229V 50.07Hz
231V 50.73Hz

22.9kV f50.7
23.1kV f50.8

Normal operation mode. U_{GEN} and U_{BUS} voltage and frequency are displayed

229V 50.07Hz
231V +015.4°

When a frequency difference is less than 0.02Hz, a phase difference is displayed

Ubb TOO LOW
231V 50.73Hz

When the voltage (U_{GEN} or U_{BUS}) is not present “Ubb TOO LOW” or “Ugn TOO LOW” is displayed

231V 50.73Hz
Ugn TOO HIGH

When the voltage (U_{GEN} or U_{BUS}) is higher than 120% of U_N “Ubb TOO HIGH” or “Ugn TOO HIGH” is displayed

Fbb TOO LOW
231V 50.73Hz

When a frequency (f_{GEN} or f_{BUS}) is too low for an accurate representation “Fgn TOO LOW” or “Fbb TOO LOW” is displayed (at approx. 20Hz and lower)

231V 50.73Hz
Fgn TOO HIGH

When a frequency (f_{GEN} or f_{BUS}) is too high for an accurate representation “Fgn TOO HIGH” or “Fbb TOO HIGH” is displayed (at approx. 80Hz and higher)

DEB ON 10%
231V 50.73Hz

When a DEAD BUS BAR function is active, a dead bus offset level ($\%U_N$) is displayed

4. TERMINALS AND WIRING

At the SQ rear side are potentiometers for basic synchronising settings, GEN and BUS plugable connectors, sync. Relay plugable connector, STATUS output plugable connector (marine version) and wiring diagram.

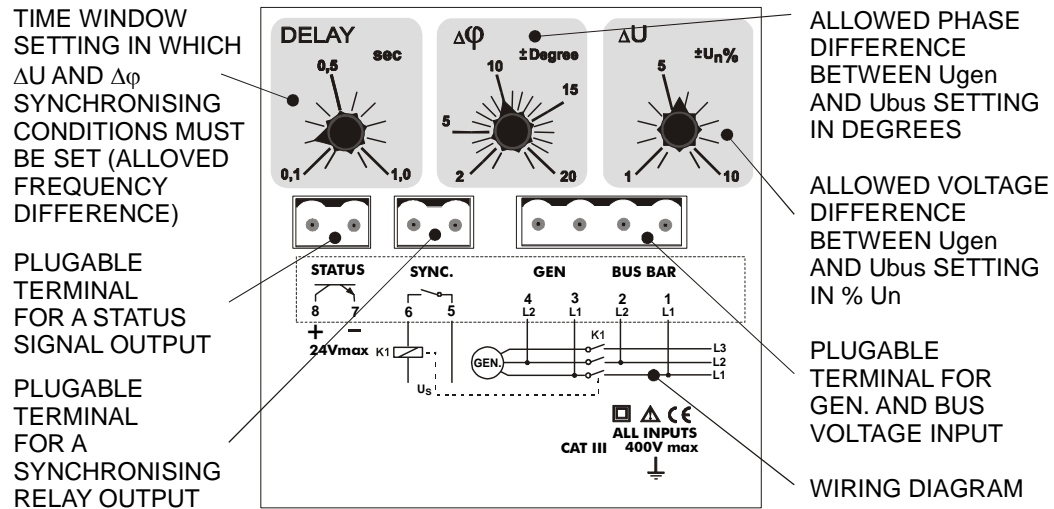


figure 3: SQ's rear side

Terminal list:

Terminal No.	Signal symbol	Signal name
1	L1 ¹	Bus bar voltage
2	L2 ¹	Bus bar voltage
3	L1 ¹	Generator voltage
4	L2 ¹	Generator voltage
5	SYNC.	Relay output
6	SYNC.	Relay output
7	STATUS	Status output
8	STATUS	Status output

¹ When phase to neutral voltages are used, signal symbols are »L« and »N« and a wiring diagram shows a correct voltage connections (see figures 4a and 4b).

NOTE: It is recommended to use a rear side cover all the time to prevent unwanted terminal disconnection.

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.

NOTE: SQ should not be directly exposed to the sun.

NOTE: It is recommended to use only water and alcohol based cleansers. Avoid using sharp objects to clean front panel.

Wiring diagram:

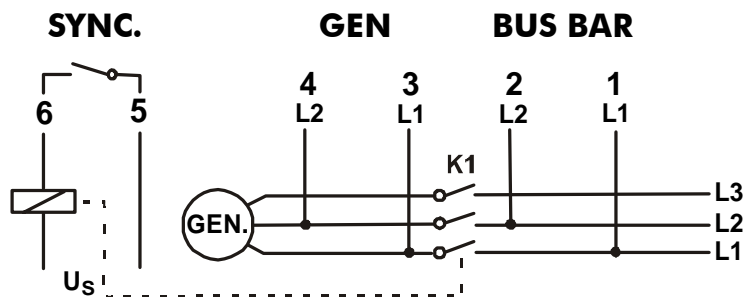


figure 4a: Wiring diagram for a phase to phase connection

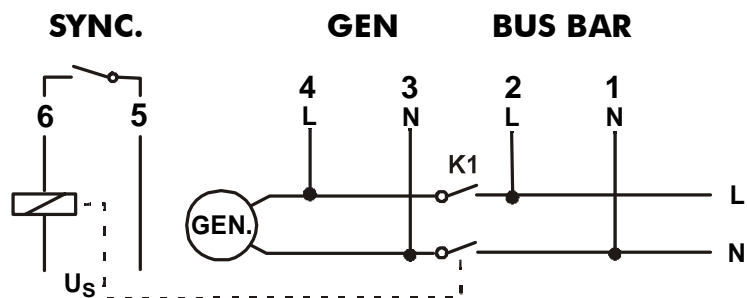


figure 4b: Wiring diagram for a phase to neutral connection (single phase or 3-phase system)

5. TECHNICAL DATA

INPUT VOLTAGE:

Nominal voltage U_n
($U_n(L-N)/U_n(L-L)$ AC)

57V, 63V, 100/110V, 120V,
220/230V, 380V, 400V, 415V,
440V, 500V

Voltage range

$U_n \pm 20\%$

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 $\Delta\phi$ display

20 °el.

Magnified resolution range

± 15 °el.

Magnified resolution

5 °el.

Accuracy at $\Delta\phi = 0$

± 3 °el.

LCD QUANTITIES ACCURACY (SQ0214):

Voltage (U_{GEN}, U_{BB})

1,5 %

Frequency (f_{GEN}, f_{BB})

0,5 %

Phase difference between

U_{gen} and U_{bb}

± 3 °el.

SYNCHRONISING PART:

Voltage difference setting range	1 ... 10 %
Accuracy	± 2,5 %
Phase difference setting range	2 ... 20 °el.
Accuracy	± 3 °el.
Switch-on delay time range	0,1 ... 1 s
Accuracy	± 10 %
Synchronising pulse duration	- cont. - 300 ms - adjustable 100 ms to 1 s)
Accuracy	± 30ms
Relay	250 V, 6A, 50 Hz, 1500 VA

LED DISPLAY:

Red LED's visual angle	± 80 °
Green LED's visual angle	± 30 °
Luminosity	2500mcd

STATUS OUTPUT:

Type	open-collector
Max. voltage	24Vdc
Max. current	100mA

HOUSING:

Material of housing	PC/ABS Uninflammable, according to UL 94 V-0
Enclosure protection	IP52 for case, IP20 for terminals with protective cover
Safety	According to IEC 1010-1 400 V, installation category III Pollution degree 2
Weight	0,53 kg

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.

6. DIMENSIONS

All dimensions are in mm.

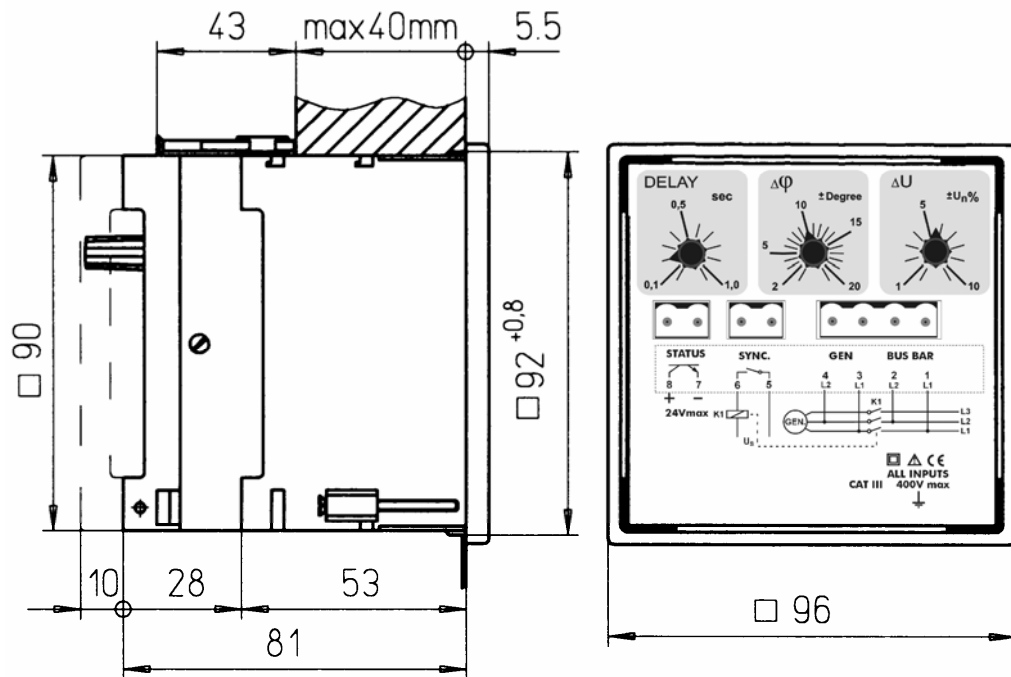


figure 5: External dimensions in mm

Weight: Approx. 0,53 kg

Cutout: 92 × 92 mm + 0,8

7. ORDER SPECIFICATIONS

Order should include type of the SQ, nominal voltage and required functions.

Order code:

SQaaaa-bcdefgh

SQ02x4		Value	Code
a	Type	SQ0204	0204
		SQ0214	0214
b	Nominal (L-L) voltage	57 V	A
		63 V	B
		100 V	C
		110 V	D
		230 V	E
		400 V	F
		500 V	G
		others	H
c	Connection	Phase to phase	L
		Phase to neutral	N

SQ02x4		Value	Code
d	Synchronising relay	Pulse 100ms	1
		Pulse 300ms	2
		Adjustable pulse length* 100ms < x < 1000ms	3
		continuous	4
		without relay	0
e	“Dead busbar” function	none	0
		10% Un	1
		20% Un	2
		30% Un	3
		40% Un	4
f	Status output	none	0
		Status relay	S
g	$\Delta\phi$ setting	Default range +/- 2 ... 20 el. st.	0
		Setting range +2 ... +20 el. st	1
		Setting range -2 ... -20 el. st	2
h	Voltage display options (see pg. 9)	Default display value	0
		Other display value*	X

* Values have to be specified with the order (see SQ ordering example)

SQ ORDERING EXAMPLE

SQ with LCD, phase to phase nominal voltage 400V, 300ms relay output, Dead bus bar function with an offset of 20% Un and voltage display 28kV at 400V input.

SQ0214-FL2200-28kV/400V

SQ without LCD, phase-to-phase nominal voltage 110V and without relay.

SQ0204-DL

DEFAULT SETTINGS

Default setting for SQ0204:
SQ0204-FL2

Default setting for SQ0214:
SQ0214-FL2



Iskra MIS, d.d.

Ljubljanska c. 24a
SI-4000 Kranj
Slovenia
tel.: +386 4 237 21 40
fax: +386 4 237 21 29
e-mail: info@iskra-mis.si
www.iskra-mis.si

