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USER MANUAL

OF THE POWER SYSTEM SI48-1U

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1. INTRODUCTION

This manual is intended for SI48-1U-8 and SI48-1U-16 type DC power system users. It includes specification and guidelines required for operation and set-up.

The power system is compatible with 48V rated voltage battery bank and is intended as a source of uninterrupted power for telecommunications devices and industrial automation systems powered by 230V, 50Hz.

2. SPECIFICATION

2.1. *Intended use*

SI48-1U power systems are sources of uninterrupted DC power for exchanges, access telecommunication systems and industrial automation systems up to 800W with positive output bus connected to protective earth.

Devices supplied by a power system shall feature an extended 48V supply voltage range required due to the use of battery banks.

The power system is compatible with two battery banks (valve-regulated lead-acid battery), with floating mode voltage with compensation depending on ambient temperature and preset correction factor.

2.2. *Specification*

2.2.1. Rated output parameters

Rated parameters	Output voltage *	No-battery operation	48V
		Battery operation	54.2V
	Maximum output current SI48-1U-8 SI48-1U-16		 8A 16A
Operation with battery bank	Nominal voltage (24 cells)		48V
	Nominal charging current SI48-1U-8 SI48-1U-16		 4A 8A
	Output voltage temperature compensation		-96mv/°C
Digital communication	SI48-1U-8-2 and SI48-1U-16-2 SI48-1U-8-3 and SI48-1U-16-3		RS-232 RS-485

* at 25°C

2.2.2. Safety

Protection class PN-EN 60950:2004	I
Ingress protection PN-EN 60529:2002 (U)	IP 20
Insulation electric strength: - between input (mains) and other circuits - between input (mains) and enclosure - between output and enclosure - between remote indication output and output circuits	 4200Vdc 2800Vdc 1400Vdc 500Vdc
Insulation resistance - cold - hot	 >20MΩ >5MΩ

2.2.3. Electrical data

Nominal values or factory settings (default) are underlined

Input parameters	**SI48-1U-8**	**SI48-1U-16**
Supply voltage	184...230...253V	
Frequency	47 ÷ 53 Hz	
Resistance to high and low supply voltage	176...265V	
Maximum voltage surge on power-up **	30A	60A
Leakage current on protective conductor	<1.0mA	<1.7mA
Power factor at rated conditions	> 0.92	
Supply voltage testing	Yes	
Maximum supply current	2.7A	5.4A
Output parameters		
Output voltage range ▪ w/o battery bank ▪ w/ battery bank *	 44.0...48.0...60.0V 42.0...54.2...56.6V	
Maximum output current (total for two outputs) ▪ w/o battery bank ▪ w/ battery bank	 3...8...8A 3...6.4...8A	 3...16...16A 3...12.8...16A
Output protection ▪ output 1 ▪ output 2	 20A 10A	
Output fuse blow-out indication	YES, for each fuse	
Maximum power output	400W	800W
Efficiency ▪ rated conditions ▪ for 50 % load	 min 87% min 86%.	
Accuracy of load distribution between rectifiers	-	±5%
Line regulation (no-battery bank operation)	<0.5%	
Load regulation 0..100% range (no battery bank operation)	<0.5%	
Broadband ripple	max 2mV	
Narrowband ripple ▪ RMS up to 300Hz ▪ RMS above 1kHz	 50mV <7 mV	
Battery bank operation (1 or 2)		
Floating mode voltage (at 25°C)	46...54.2...56V	
Floating mode voltage temperature compensation	0...-96...-144mV/°C	
Fast charging voltage	48.0...56.6...58.0V	
Maximum battery charging current (current limiting level)	1.5...4...10A	1.5...8...10A
Battery charging indication	YES	
Permissible current difference between the batteries - indication	0.5...1.0...5.0A	0.5...2.0...5.0A
Discharged battery disconnection voltage	36.0...42.0...48.0V	
High battery voltage – indication threshold and rectifier switch off threshold	55.0...58.8...60.0V	
Voltage drop between battery bank and output	<0.5V	
Battery overload protection	30A	
Battery circuit fuse blow-out indication	YES, for each circuit	
Digital communication		
▪ RS-232 link (**standard**) – transfer rate	57,600 b/s	
▪ RS-485 link (**optional**) – transfer rate	57,600 b/s	
General		
Quiescent power with LVDD connected and no load.	16.5W	
Quiescent power without LVDD (at power failure current is supplied by a battery).	2.0W	
Remote indication - relay (**POWER FAILURE**, **URGENT ALARM**, **NONURGENT ALARM**)	three switched contacts (NO and NC) (60V/0.5A)	

External two-state signal outputs **AL IN1** (ext. alarm 1), **AL IN2** (ext. alarm 2) (2 lines with positive bus potential)	5V/1mA
Sound indication	Yes
External temperature probe (standard power system equipment) ▪ measured temperature range ▪ measuring accuracy	 -35...+75°C ±2°C
Digital voltmeter class	0.5
Digital ammeter class	1.0

* Specified range includes discharged battery bank voltage (end of battery operation mode) and fast charging voltage.

2.2.4. Electromagnetic compatibility (EMC)

SI48-1U power systems meet the following requirements:

Conducted disturbances PN-EN 55022:2000		Class B
Harmonic current emissions PN-EN 61000-3-2:2002		Class A
Electrical fast transient/burst immunity PN-EN 61000-4-4:1999/A2:2003	power supply and PE terminal	2kV
	constant-current output terminal	1kV
	signal terminal	1kV
Surge resistance PN-EN 61000-4-5:19998/A1:2003	between line conductors	1kV
	between line conductor and ground	2kV
	output circuits and signal lines	1kV
Voltage sags, short interruptions and voltage variations immunity PN-EN 61000-4-11:1997/A1:2003		0% (10ms)
		70% (500ms)
		0% (5s)
Electrostatic discharge immunity PN-EN 61000-4-2:1999/A2:2003	air	8kV
	contact	6kV

2.2.5. Mechanical data

Overall dimensions (W × H × D)	483 ×45 × 270mm
Weight:	
SI48-1U-8	4.2 kg
SI48-1U-16	5.1 kg
Installation	in 19" rack with guides, 4 mounting holes at front panel

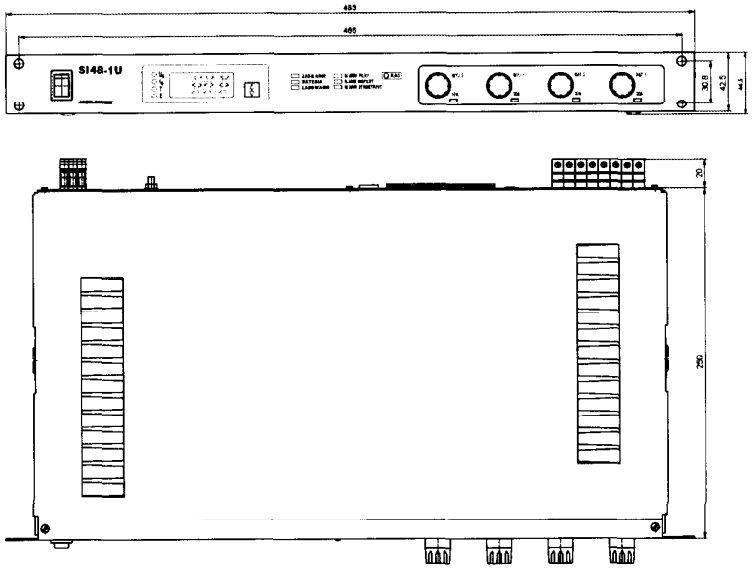


Fig. 1. Power system dimensions with a hole layout at front panel

2.3. *Description of the operational environment*

Allowable storage temperature	-40°C ÷ +85°C
Recommended storage temperature	+5°C ÷ +40°C
Ambient temperature during operation (loadability of the system shown in Fig. 1)	-33°C ÷ +55°C
Relative humidity (no condensation)	30% ÷ 80%
Atmospheric pressure	84 ÷ 107 kPa
True altitude	up to 1500m
Corrosion aggressiveness level of environment according to PN H 04651: 1971	B
Dustiness group according to PN-83/T-42106	Z4
Direct insolation	Inadmissible
Sinusoidal vibration admissible during operation: - amplitude - frequency	 0,15mm 10 ÷ 55Hz
Shocks during operation	Inadmissible
Vibration and shocks during transport	acc. PN-83/T-42106

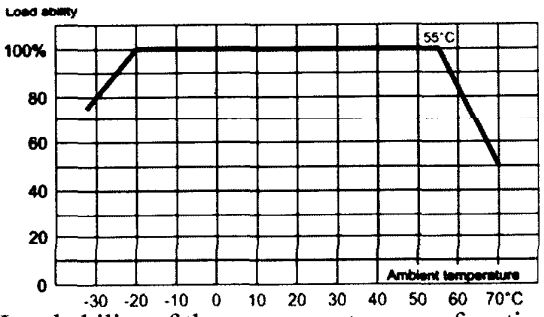


Fig. 1 Load ability of the power system as a function of ambient temperature

2.4. *Method of operation*

2.4.1. General

The power system is supplied by single-phase mains and generates stabilized voltage at its output(s). A voltage on battery bank is maintained by the power system at the level of full charge depending on the type and required value of temperature compensation. It provides battery protection against excessive discharge that may lead to permanent damage. The power system features sound and visual indication of an operation mode and generates alarm indications.

2.4.2. Block diagram

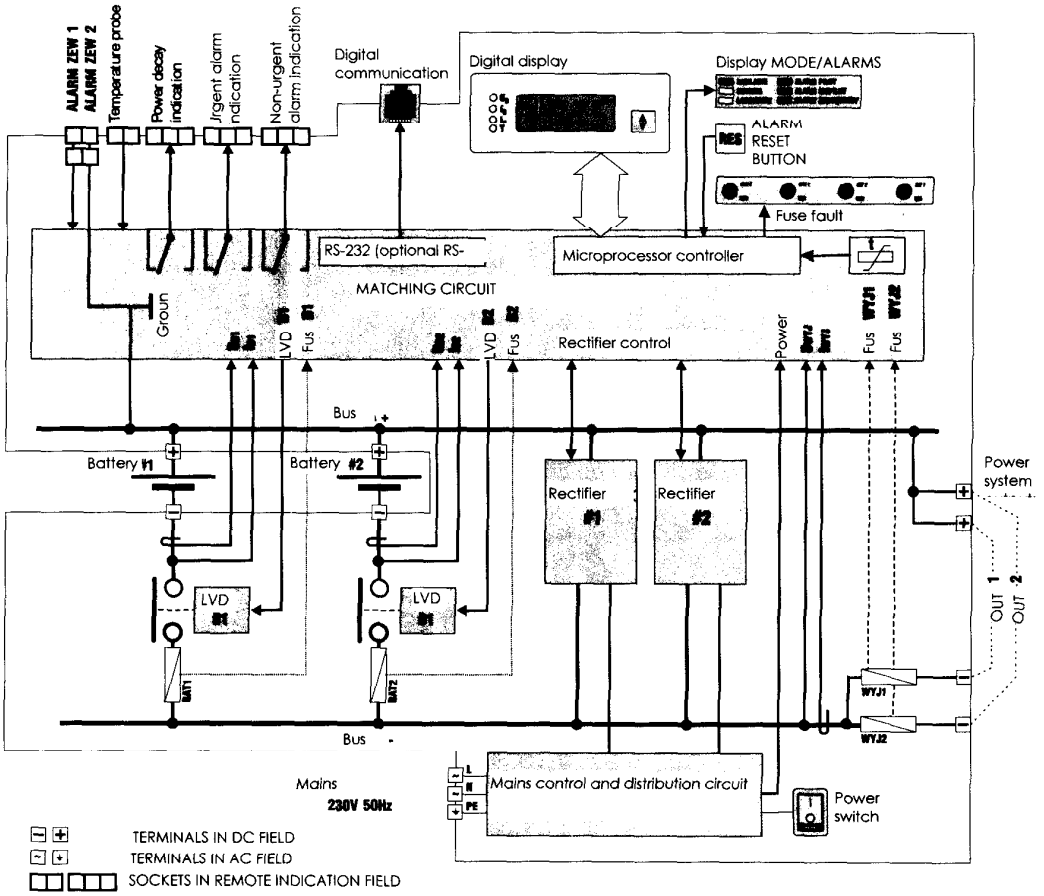


Fig. 2 Block diagram of SI48-1U-16 power system

2.4.3. Alarms

URGENT ALARM (indicated by a relay, **URGENT ALARM** LED and sound indication).

- Charging (discharging) current exceeded in floating mode
- Maximum charging current exceeded in fast charging mode
- Maximum battery/output voltage exceeded
- Battery 1 or battery 2 LVDD disconnected
- Maximum battery current difference exceeded in floating mode
- Maximum battery current difference exceeded in fast charging mode
- Rectifier #1 or rectifier #2 fault
- Maximum output current exceeded
- Output fuse (1 or 2), BAT 1 or BAT 2 fuse disconnected
- External alarm 1
- Power system overheating
- Maximum fast charging time exceeded
- Battery loaded at power supply
- Minimum voltage exceeded at battery test
- Battery circuit integrity fault
- Battery 1 or 2 configuration error

NON-URGENT ALARM (indicated by a relay and **NONURGENT ARARM**) LED
- Minimum voltage exceeded at battery/output
- External alarm 2
- Minimum permissible temperature exceeded
- Maximum permissible temperature exceeded
- Maximum permissible temperature exceeded at fast charging
- Temperature probe fault at the power system
- Temperature probe configuration error

Alarm locked (event does not cause alarm indication)
- Power failure (indicated by fading **POWER** LED and **POWER FAULT**) relay
- RTC error

POWER FAILURE – indicated by a separate **POWER FAILURE** relay

3. SETUP, OPERATION AND MAINTENANCE

3.1. *Operation and maintenance safety*

The power system as a Class I device in accordance with PN-EN 60950-1:2004, is intended for connection to a single-phase mains with a protective earth wire. The system shall be connected to the mains and utilize a protective earth circuit as a protection against electric shock in accordance with PN-IEC 60364-4-41: 2000 (IEC364) "Electrical installations of buildings". The metal enclosure of a power system is connected to a protective terminal at the back panel. Battery and temperature probe output circuits are separated from the mains and enclosure. Remote indication relay contacts and COM link are separated from other circuits (and outputs). Electrical insulation strengths are specified in item 2.2.2.

Rectifier units feature Y type safety capacitors. Leakage current in the protective conductor may be up to 3mA. The enclosure is connected to an earth terminal at the back panel.

3.2. *Set-up*

3.2.1. General guidelines

The power system is installed in a cabinet with 19" racks. The location of terminals at the back panel requires use of cabinets providing an access at the back and constant access on site.

System features PHOENIX type screw terminals as an output, battery and mains terminals, for installation of mains cables up to 4mm^2 in diameter and output and battery cables up to 6mm^2 in diameter. Remove 11mm of the mains cable and 7mm of the output and battery cable insulation before installation.

Remote indication circuits are connected to the PHOENIX COMBICON type terminal block. Removable temperature probe is connected via MINI-JACK socket, digital communication utilizes RJ12 6/6 type socket.

3.2.2. Connection to the mains

SI48-1U Power system is supplied by a single-phase mains at the terminals on the right side of a back panel. Maximum conductor diameter is 4mm^2. Irrespective of the mains connection, enclosure shall be connected to protective earth, either locally or via a PE protective conductor. Power system earth terminal is a M5 screw terminal - it requires min. 1.5mm^2 earth conductor with ring terminal.

3.2.3. Battery installation

Power system is compatible with two 48V battery circuits connected to two terminals marked as **BAT 1** and **BAT 2**. Each circuit is protected by a fuse located in the fuse holder at the front panel. Blown out fuses are indicated with a LED located by the fuse holder of a specific battery circuit. The battery shall be connected with a max. 6 mm^2 conductor.

Positive bus common for both battery circuits has the same potential.

3.2.4. Load connection

SI48-1U-16 Power system features two output circuits with terminals at the back panel marked as **OUT 1** and **OUT 2**. Each circuit is protected by a fuse located in the fuse holder at the front panel. Blown out fuses are indicated with a LED located by the fuse holder of a specific output circuit. Load shall be connected with a max. 6 mm^2 conductor.

3.2.5. Connection of a temperature probe

SI48-1U-16 Power system provides a dependence of output voltage value in floating mode to the ambient temperature. The end of a temperature probe is located by the battery, and the MINI-JACK socket at the other end of a cable is connected to **SONDA TEMP** (temperature probe) socket at the back panel.

3.2.6. Connection of alarm signals

Outputs marked as **URGENT ARARM**, **NONURGENT ALARM** and **POWER FAULT** are switchable relay contacts separated from power system circuits. Since all the sockets are connected to the relay contacts, a correct use of double pins enables use of NO and NC contacts.

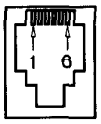
All connections require $0.5mm^2 \div 1mm^2$ conductors with COMBICON (PHOENIX) pins.

3.2.7. Connection of external alarm signals

The power system maintains 2 external two-state signals at **AL IN1**, **AL IN2** outputs, each with the positive bus potential. Alarm is generated at a short circuit of a specific line with a positive bus. All connections require $0.5mm^2 \div 1mm^2$ conductors with pins.

3.2.8. Connection of external communication

Back panel features 6/6 RJ12 type **COM** socket providing external digital communication with a power system. Power system features RS232 module or optional RS485 module. Depending on the module used, signals are transmitted as specified below.



Front view socket

Pin no.	RS-232	RS-485
1	nc	nc
2	DCD	GND
3	RxD	A
4	TxD	B
5	GND	GND
6	nc	nc

Transmission parameters:

- rate 57600 b/s
- no. of data bits 8
- parity testing No
- no. of stop bits 1

Fig. 3. Digital COM socket

3.3. *Power plant operation mode indication*

3.3.1. Local indication

LCD displays current output voltage. Pressing the button several times changes the displayed information: output current, battery current, temperature and information on the cause of alarm (alarm code), if present. Another press of the button causes the output voltage to be displayed. Type of currently displayed information is indicated by a LED on the left side of the display.

Front panel features LEDs indicating a system operation mode (**POWER**, **BATTERY**, **CHARGE** and alarm event (**URGENT ALARM**, **NONURGENT ALARM**, **OUTER ALARM**).

Urgent alarms are indicated by a sound indication. Sound indication is switched off by pressing **CLEAR** button on the right side of LEDs. Pressing the button for more than 5 sec. causes the alarm to be reset, although the alarm indication can be permanently reset when alarm cause is removed.

LEDs at the front panel by the fuse holders indicate blown out fuses of a specific circuit.

Details of local indication of each operation mode are presented below, and the method of alarm event indication (local and remote) depends on the configuration - default (factory) assigned indications concerning specific causes are presented in item 3.4.2.

Key:

1 LED/relay on
1/1 LED blinking 1 Hz
0 LED/relay off
- *state does not depend on the condition specified in the row*

		POWER	BATTERY	CHARGE
FLOATING MODE	battery charging	1	0	1/1
	no-battery charging	1	0	0
FAST CHARGING		1	0	1
BATTERY OPERATION at *power failure*		0	1	0
Battery load at mains		1	1	0
Battery voltage below preset indication level *(battery almost discharged)*		0	1/1	0
Battery discharged		0	0	0

3.3.2. Remote indication

Remote power system indication is realized by the following outputs **URGENT ALARM**, **NONURGENT ALARM**, **POWER FAULT**. A correct use of pins in sockets of alarm outputs, allows use of those signals as separated from other NC and NO contacts.

Current power system operation parameters can be read using a digital socket and communication software (optional).

3.4. *General notes*

All electrical parameters and alarm assignments are factory preset.

Detailed diagnostics and change of power system settings are carried out by a manufacturer via a digital socket without intervention inside the device. Optional software enables diagnostics and change of power system settings.

3.4.1. Verification of power system configuration

At power-up, power system recognizes current operation mode, i.e. detects number of connected batteries and the presence of a temperature probe. Verification of power system configuration is confirmed by a single audible signal.

If detected configuration differs from the default, a non-urgent alarm is generated (indicated by the LED at the front panel and the remote indication socket).

3.4.2. Indication of local alarm cause

LCD displays current output voltage, and pressing the button changes the display to an output current, battery current, temperature and alarm cause, if present.

All detected alarm events and displayed codes are indicated below.

U: urgent alarm; NU: non-urgent alarm; -: inactive (external indication not activated)

Alarm code	Description	Default settings
E01	Charging (discharging) current exceeded in floating mode	U
E02	Maximum charging current exceeded in fast charging mode	U
E03	Maximum battery/output voltage exceeded	U
E04	Minimum voltage exceeded at battery/output	NU
E05	Disconnecting battery 1 LVDD	U
E06	*Disconnecting battery 2 LVDD*	U
E07	Maximum battery current difference exceeded in floating mode	U
E08	Maximum battery current difference exceeded in fast charging mode	U
E09	Rectifier fault #1	U
E10	Rectifier fault #2	U
E11	Maximum output current exceeded	U

Alarm code	Description	Default settings
E12	Output fuse disconnected (1 or 2)	U
E13	BAT 1 fuse disconnected	U
E14	BAT 2 fuse disconnected	U
E15	External alarm 1	U
E16	External alarm 2	NU
E17	Minimum permissible temperature exceeded	NU
E18	Maximum permissible temperature exceeded	NU
E19	Power system overheating	U
E20	Maximum permissible temperature exceeded at fast charging	NU
E21	Maximum fast charging time exceeded	U
E22	Battery loaded at power supply	U
E23	Minimum voltage exceeded at battery test	U
E24	Battery circuit integrity fault	-
E25	Power failure	-
E26	*Currently not in use*	
E27	Temperature probe fault at the power system	NU
E28	RTC error	-
E29	Battery 1 configuration error	U
E30	Battery 2 configuration error	U
E31	Temperature probe configuration error	NU
E32	*Currently not in use*	

3.5. *Maintenance and repairs*

Device does not require special maintenance. Normal operation requires proper cleanness of power system surroundings.

All warranty and post-warranty repairs are carried out by the manufacturer or specialized unit authorized by the manufacturer.

3.6. *Service*

The only components that can be replaced by a user are fuses of the battery and output circuits at the front panel. When fuse fault is indicated by the LED it shall be replaced with a fuse of the same specification. Fuse types are presented in the following table.

Protected circuit	Fuse type	No.
Power system output 1 (**OUT 1**)	6.3x32mm 20A T	1 pc
Power system output 2 (**OUT 2**)	6.3x32mm 10A T	1 pc
Battery circuit (**BAT 1 and BAT 2**)	6.3x32mm 30A T	2 pcs
Mains circuit *	WTA 250V/3.15A T (5x20mm)	2 pcs

** fuses are inside the device and are not available for maintenance*

4. ADDITIONAL INFORMATION

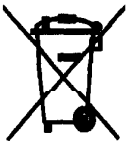
4.1. *Manufacturer's remarks*

The manufacturer reserves the right to introduce changes in the design and technology which shall not impair quality of the product.

4.2. *Handling of the package, waste and batteries*

The package of the product is made of non-hazardous materials (wood, paper, corrugated fiberboard, plastics) which could be recycled.

Unused packages should be handed over to a dust collector, after having them segregated.



The used out product constitutes non-hazardous waste, not to put into the general waste container. Instead, it should be handed over to the local collector of the waste electric and electronic equipment.

Professional handling of the waste electric and electronic equipment (WEEE) shall limit negative effects on human health and environment of improper storage and processing of this waste.

The used out batteries should be handled according to local regulations. e.g. introduced as the implementation of the Battery Directive (Directive 2006/66/EC of the European Parliament and of the Council of 6 September 2006).

The power system should cooperate with sealed, maintenance-free, valve-regulated (equipped with a pressure relief valve) lead acid batteries. When used out they constitute hazardous waste, coded in the European Waste Catalogue as 16 06 01*.