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## Service manual



## Power Supply MS2000

**version 1.5**  
9/15/2015



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## Intelligent Power Supply MS2000

MS2000 is a mains switching power supply (single-acting blocking converter) SELV with back-up. It is used for supplying devices in the industrial environment. The supply is designed for industrial use and installation into switchboards. There are control LEDs and terminal blocks for connection of the mains voltage, battery, terminal for signaling and terminals for the temperature sensor on the front panel.

The design and construction of this device allows for long-term loading and for this reason it is primarily determined for continuously running applications.

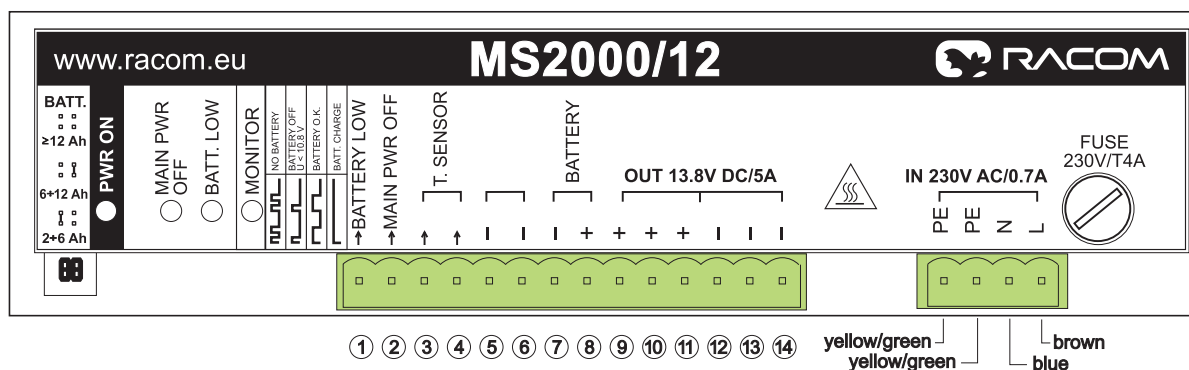
If necessary, the source can be produced in a version MS2000/12-P with output voltage 13.8 V DC / 5 A for MORSE components supply and MS2000/24-P with output voltage 24 V / 3.5 A for 24 V supplying. The built-in ventilator is switched on/off according to the power supply temperature. The version without ventilator provides reduced output current at higher surrounding temperature, see the table and diagram.



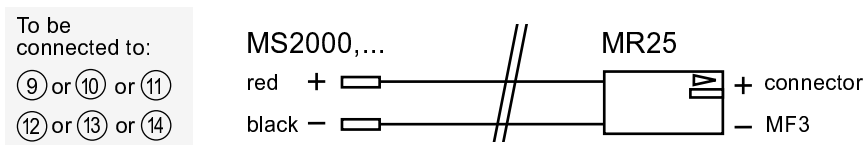
# 1. MS2000 connection to 230 V mains and linking with other devices

There are removable screw connectors for connection to 230 V mains. Cable *NKR9* for *MR25* is used for linking between the radio modem and the MS2000 and connection with the battery is done with cable *NKR4* for *MS2000*. The cable is protected by a cable fuse F6.3A.

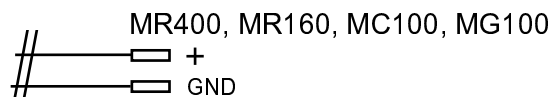
The wire connecting is apparent from the following diagram:



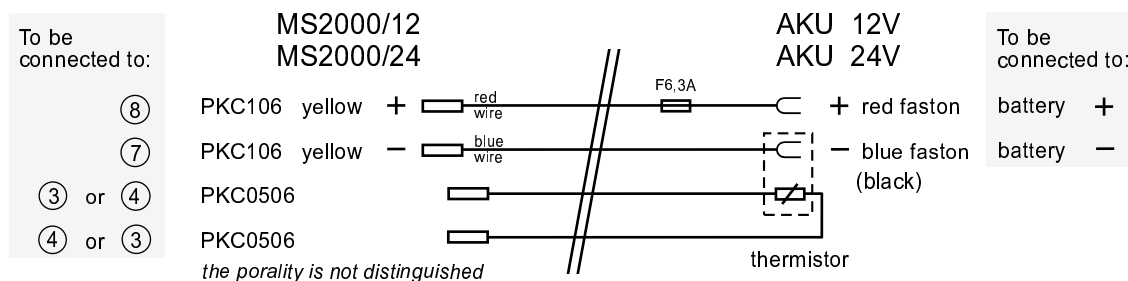
## NKR9 for MR25



## Simple cable for MR400



## NKR4 for MS2000



① has to be connected to PI pin in the powering connector on the RM400 radio modem

Connection of the terminals 1, 2, 5 and 6, see Section 2.3, "Signalizing of States".



disconnects the load after a capacitive overload and the MS2000 tries to connect the capacitive load again by PWM modulation with a smooth rise in voltage.

No current needs to be applied to PWR OUT for battery charge control to function correctly.



#### Note

For MS2000 power supplies manufactured before 09/2008 a minimum current of 300 mA needs to be applied to PWR OUT for battery charge control to function correctly.




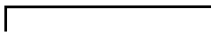
## 2.3. Signalizing of States

Information about mains failure **MAIN PWR OFF** and information about low battery voltage **BATTERY LOW**, (e.g. there will be a total voltage failure for a connected device) is linked to the output terminal – open collector. The current through the output transistors is not limited in any way and therefore it is important to connect an external resistor in series with the transistor to limit the current to an acceptable level (the maximum current value is 0.5 A). The following table contains the value of current through the transistor,  $I_D$ , the output voltage when the transistor is switched on,  $U_{DS}$ , and the value of the external series resistors,  $R_s$ , for a 13.8 V and 24 V power supply.

$I_D$ [mA]	$U_{DS}$ [mV]	$R_s$ [ $\Omega$ ]	
		$U_{\text{voltage}}$ 13.8 V	$U_{\text{voltage}}$ 24 V
20.8	5.5	680	1200
89.1	24.5	150	270
471	137.5	27	56

The wires having the low battery voltage information are connected between the screw connectors No.1 (**BATTERY LOW**) and 5 (**GND**), see the diagram. The information MAIN POWER OFF is given by wires connected to clamps No. 2 (**MAIN PWR OFF**) and 6 (**GND**) and it is evaluated by function (m)isc (b)att using the Setr utility, see the manual *MORSE firmware documentation*<sup>1</sup>.

LEDs indicate the state of voltage on the power supply output (green LED **PWR ON**), mains failure (red LED **MAIN PWR OFF**), low battery voltage (orange LED **BATTERY LOW**). The last orange LED indicates the state of the battery charging cycle. The meaning of each state is shown on the front panel.

<div style="display: flex; align-items: center; justify-content: center;"> <div style="border: 1px solid black; border-radius: 50%; width: 30px; height: 30px; margin-right: 10px;"></div> <div style="font-size: 24px; font-weight: bold;">MONITOR</div> </div>	
	NO BATTERY
	BATTERY OFF $U_{BATT} < 10,8 \text{ V}$
	BATTERY O.K.
	BATTERY CHARGE

<sup>1</sup> <https://www.racom.eu/en/support/firmware/mr400/misc.html>



### 3. Basic Technical Parameters

#### 3.1. Parameters for MS2000, version without ventilator

Tab. 3.1:

	<b>MS2000/12</b>	<b>MS2000/24</b>
Rated supply voltage	230 V AC / 50 Hz, $\pm 10\%$	230 V AC / 50 Hz, $\pm 10\%$
Rated supply current	0.7 A	0.6 A
Maximum working range of feed voltage	140–275 V	140–275 V
Safety fuse in the primary circuit	T4A	T4A
Rated output voltage	13.6 V (-0.3 V; +0.3 V)	24 V (-0.3 V; +0.3 V)
Rated output current at 20 °C	5 A	3.5 A
Rated output current at 55 °C	3 A	1.8 A
Output voltage ripple when $I_{OUT} = I_{nom}$	max. 150 mV	max. 150 mV
MTBF (mean time between failures)	> 100 000 hours	> 100 000 hours
Maximum charging current according to the internal switch:		
– for accu 2 Ah	0.7 A	0.7 A
– for accu 6 Ah	1.5 A	1.5 A
– for accu 12 Ah	2.5 A	2.0 A
The charging current cannot exceed the limit:	(rated output current) - (actual current on OUT DC)	
Recommended type of battery	Panasonic 12 V / 12 Ah	2× Panasonic 12 V / 12 Ah
Minimum accumulator voltage	10.8 V	21.6 V
Current drain from battery after disconnecting	1.5 mA	1.5 mA
Operating range of temperature	-30 to + 65 °C	-30 to + 65 °C
Relative humidity	10–90 %	10–90 %
Dimensions	104×50×186.5 mm	104×50×186.5 mm
Weight	0.8 kg	0.8 kg

### 3.2. Parameters for MS2000, version equipped by ventilator

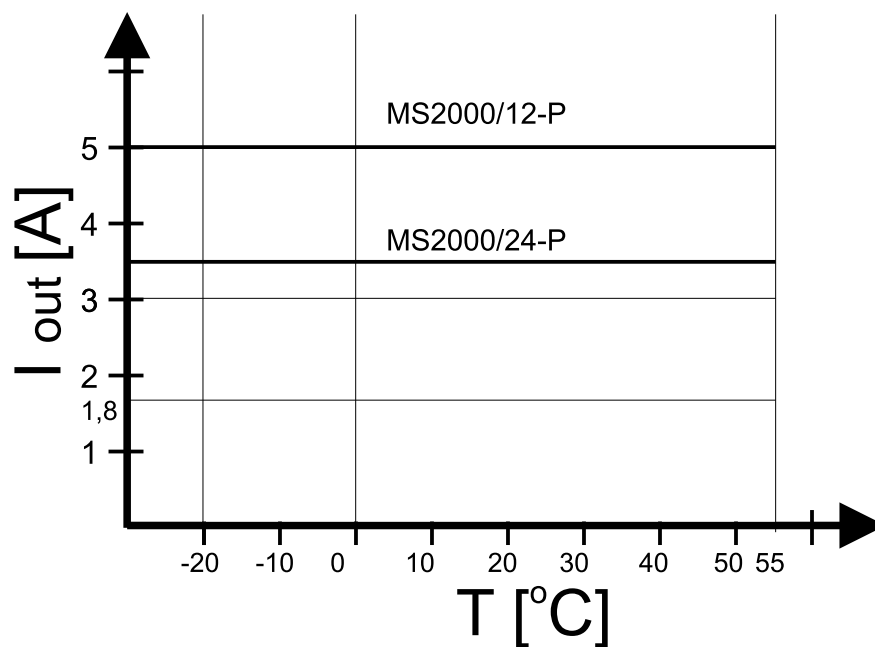
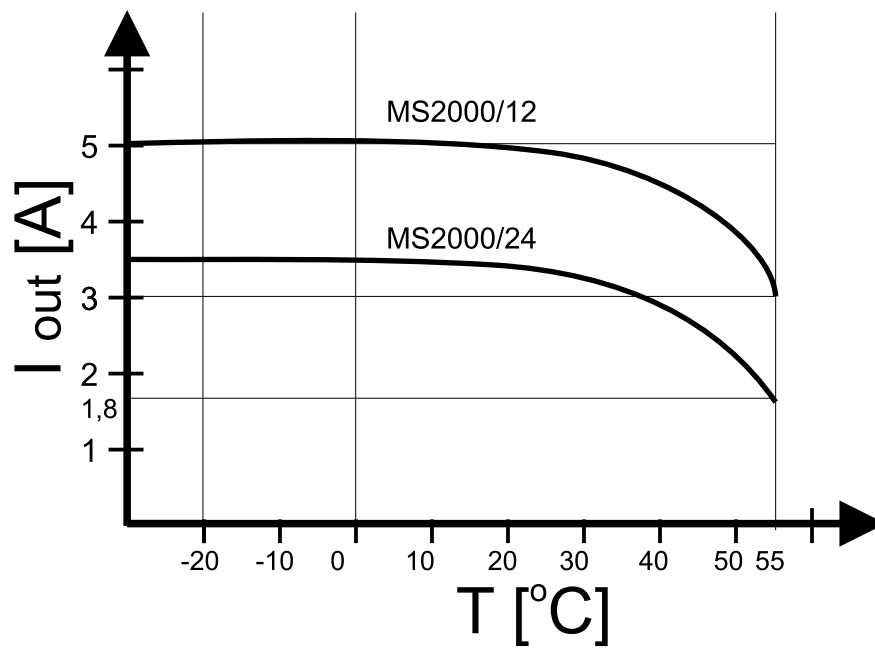
**Tab. 3.2:**

	<b>MS2000/12-P</b>	<b>MS2000/24-P</b>
Rated supply voltage	230 V AC / 50 Hz, $\pm 10\%$	230 V AC / 50 Hz, $\pm 10\%$
Rated supply current	0.7 A	0.6 A
Maximum working range of feed voltage	140–275 V	140–275 V
Safety fuse in the primary circuit	T4A	T4A
Rated output voltage	13.6 V (-0.3 V; +0.3 V)	24 V (-0.3 V; +0.3 V)
Rated output current at 20 °C	5 A	3.5 A
Rated output current at 55 °C	5 A	3.5 A
Output voltage ripple when $I_{OUT} = I_{nom}$	max. 150 mV	max. 150 mV
MTBF (mean time between failures)	> 100 000 hours	> 100 000 hours
Maximum charging current cannot exceed the limit:		
– for accu 2 Ah	0.7 A	0.7 A
– for accu 6 Ah	1.5 A	1.5 A
– for accu 12 Ah	2.5 A	2.0 A
The charging current cannot exceed the limit:	(rated output current) - (actual current on OUT DC)	
Recommended type of battery	Panasonic 12 V / 12 Ah	2× Panasonic 12 V / 12 Ah
Minimum accumulator voltage	10.8 V	21.6 V
Current drain from battery after disconnecting	1.5 mA	1.5 mA
Operating range of temperature	-30 to + 65 °C	-30 to + 65 °C
Relative humidity	10–90 %	10–90 %
Dimensions	104×50×186.5 mm	104×50×186.5 mm
Weight	0.8 kg	0.8 kg

**The supply fulfils following standards:**

- safety: CSN EN 60 950
- EMC: CSN EN 50 081-1, CSN EN 55 022 class B, CSN EN 61 000-6-2

### 3.3. Allowed output current in dependence on the surrounding temperature



## 4. MS2000 Installation instructions

- The device is designed for industrial use for assembly into premises with limited access (electrical switchboard).
- Wiring up must be carried out by an individual with knowledge of the regulation No. 50/78 Coll.
- The supply is designed for assembly into switchboards by attaching either to a mounting plate by means of M3 screws or on to a DIN rail. The mounting plate and DIN rail must be properly grounded in accordance with valid standards. The source must be located in such a way so as not to prevent air circulation necessary for cooling purposes.
- Conductors must be wired into labelled terminals in accordance with valid standards. Terminals are only designed for connecting copper conductors of max. diameter  $2.5 \text{ mm}^2$  and do not serve for switching devices under voltage.
- For accumulator connection is recommended using only connection conductors produced by RACOM. These conductors contain temperature sensor and safety fuse F6,3 A. Without the original connection conductor will not be optimized charging process depending on ambient temperature!
- The producer does not recommend to change accumulator poles when wiring up.
- Color coding of low voltage conductors must comply with the requirements of respective standards.
- The producer recommends to protect the 230 V AC input by circuit breaker of 6 A rated current with characteristics C.
- The source must be disconnected from the battery when replacing fuses. Only the same types of fuses with the same current rating can be used for replacement.
- When using the device as a source of SELV voltage the extra low voltage side must be electrically and spatially separated from low voltage conductors.

## 5. Electric Characteristics

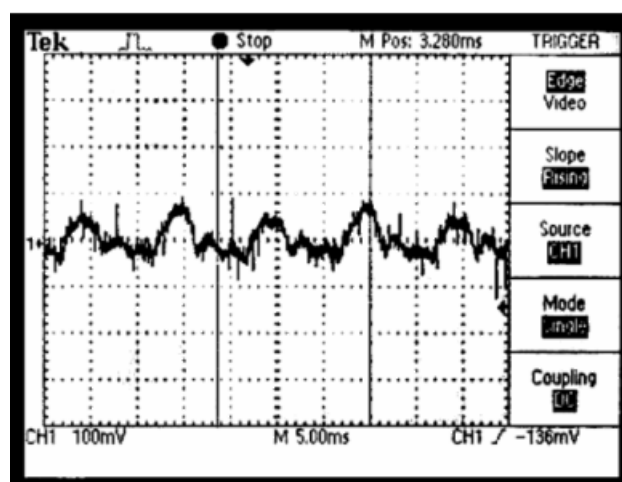


Fig. 5.1: Voltage ripple in output at rated current output

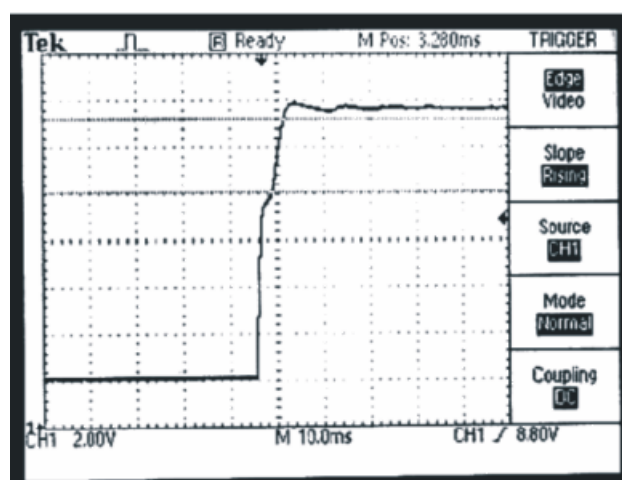


Fig. 5.2: Smooth rise in output voltage when supply starts (without battery)

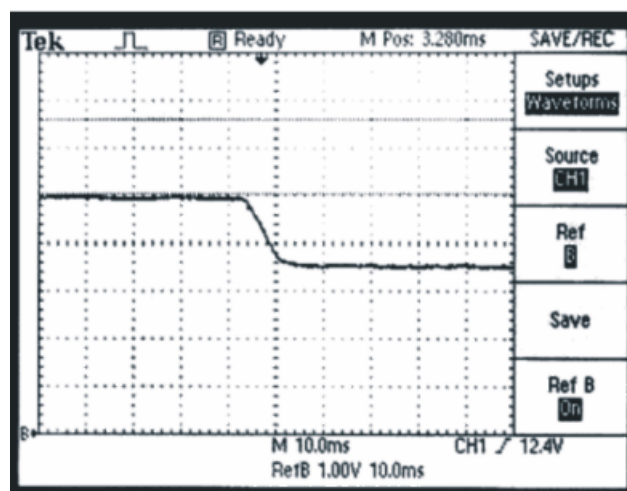


Fig. 5.3: Voltage characteristic at the output of the MS2000 supply when changing over to back-up (battery 12 V / 12 Ah,  $I = 2$  A)

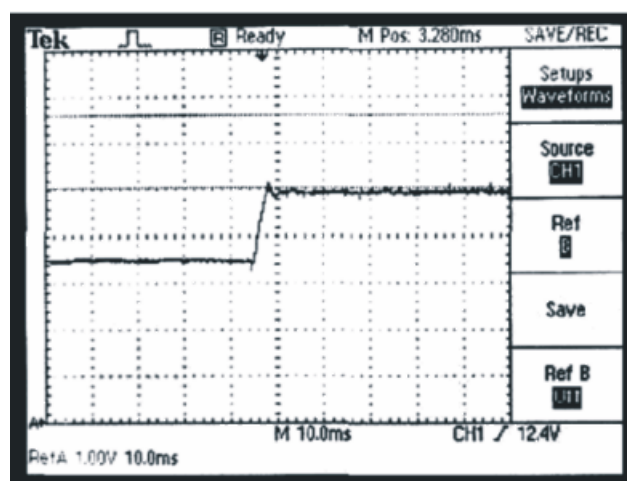


Fig. 5.4: Voltage characteristic at the output of the MS2000 supply when changing over from back-up to feeding from mains 230 V (battery 12 V / 12 Ah,  $I = 2$  A)

## 6. Parameters of Recommended Batteries

The supplied battery is PANASONIC 12 V / 12 Ah (type LC-RA). The following characteristics are taken from Panasonic documentation.

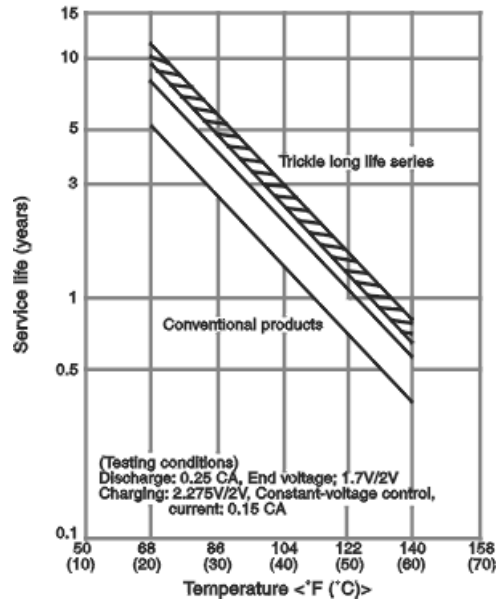


Fig. 6.1: Influence of temperature on trickle life

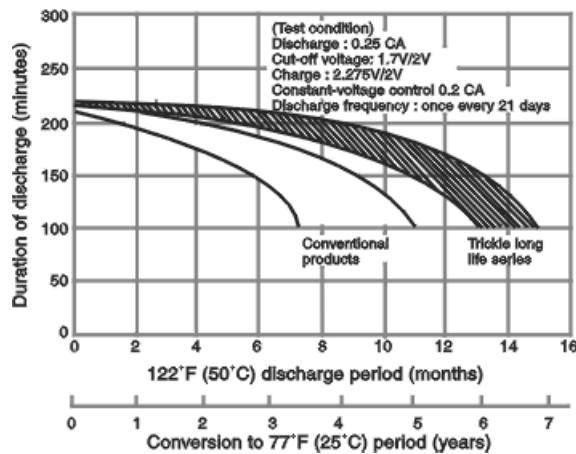


Fig. 6.2: Influence of self-discharging to remain battery capacity

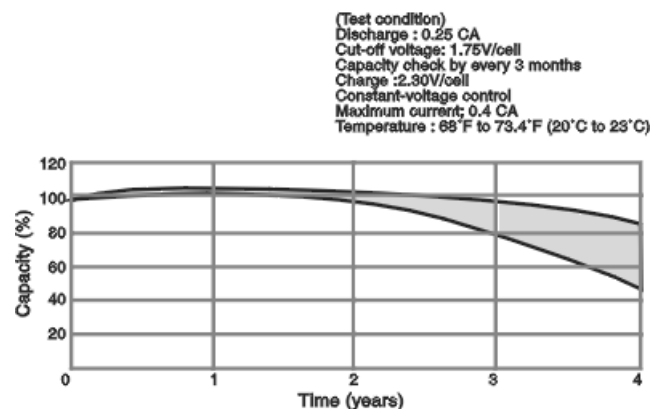


Fig. 6.3: Trickle (Float) life characteristic (LC-T, LC-R and LC-L)

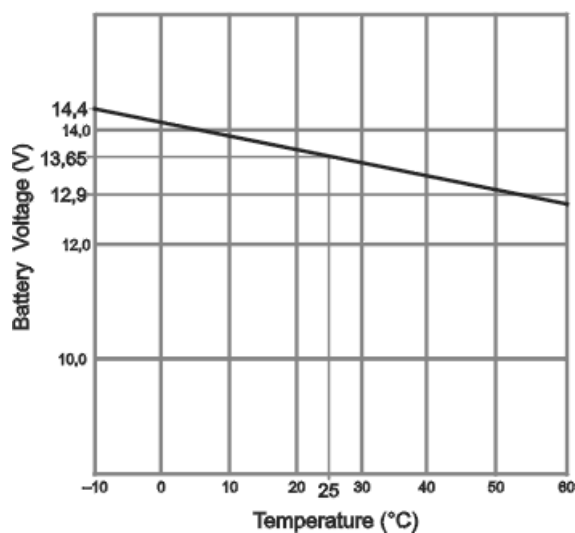


Fig. 6.4: Influence of battery voltage on temperature



## 7. Charging process

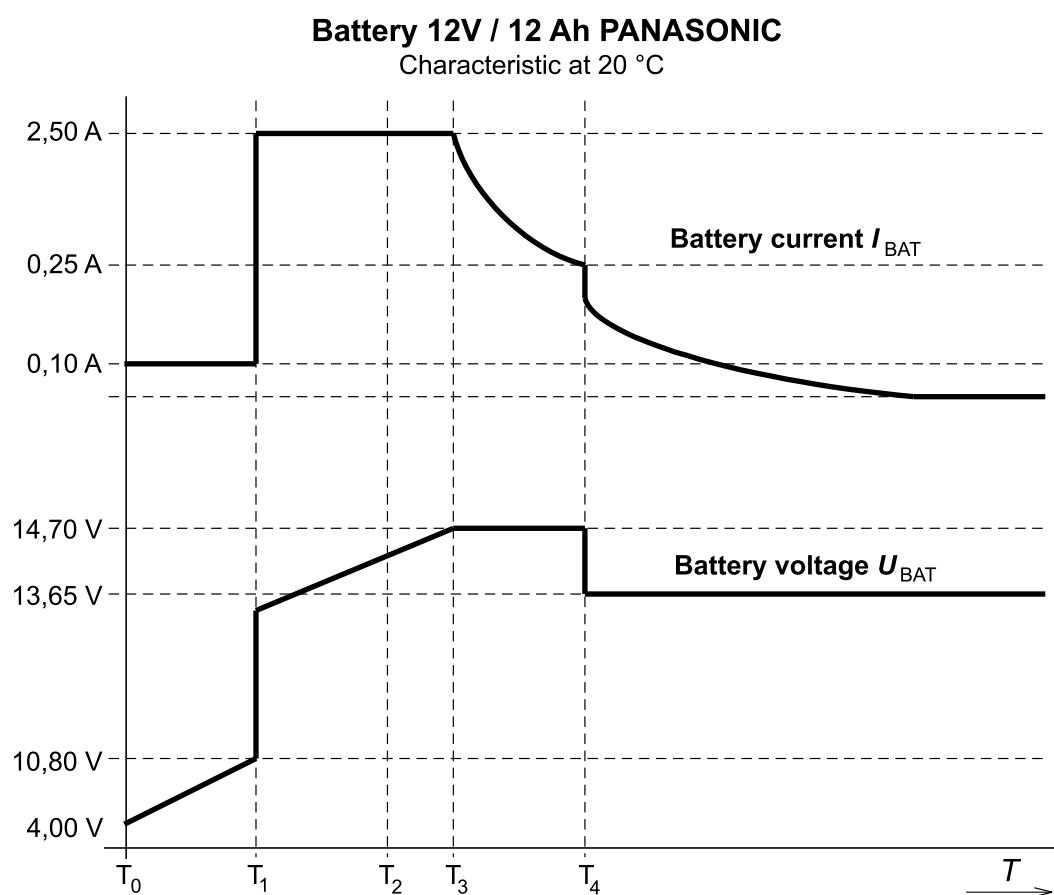


Fig. 7.1: Typical characteristic of recharging cycle for MS2000/12-P

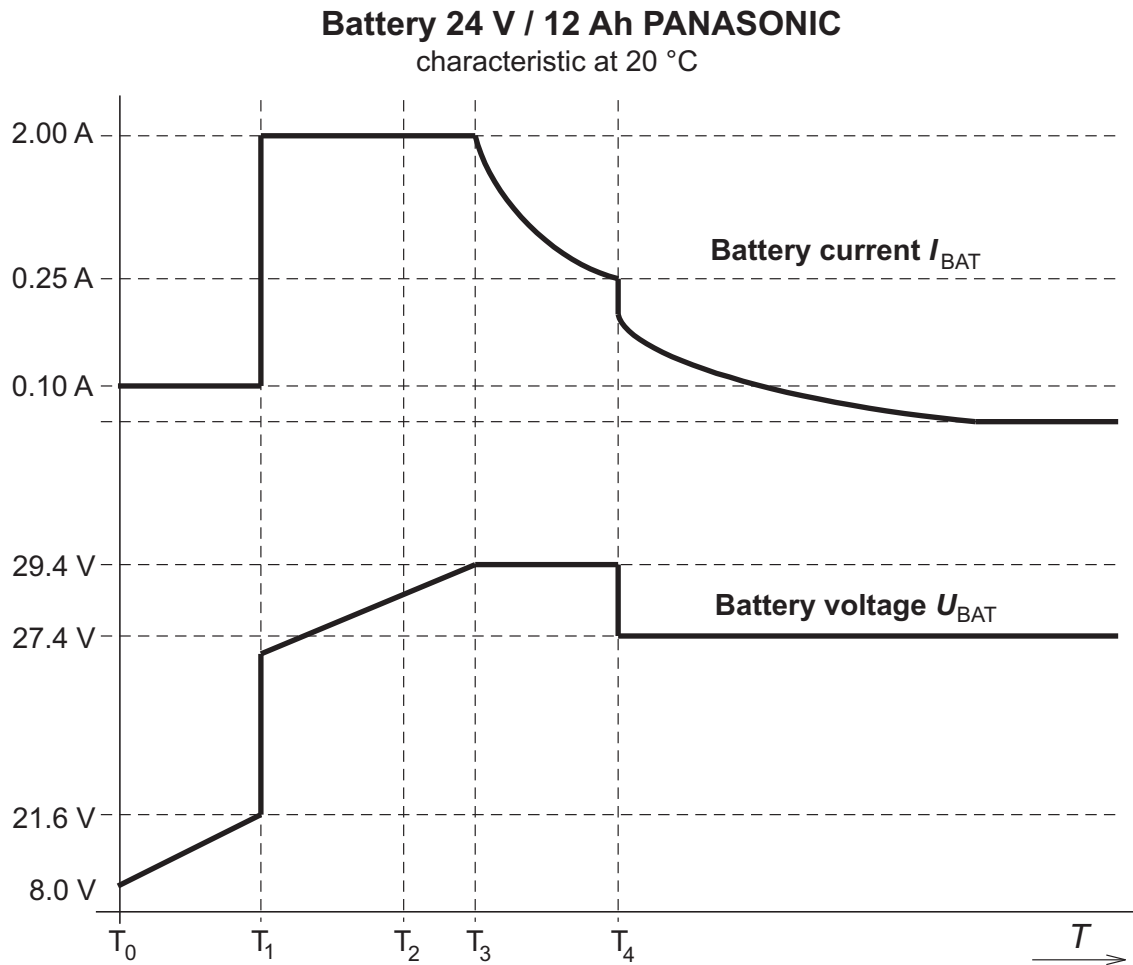
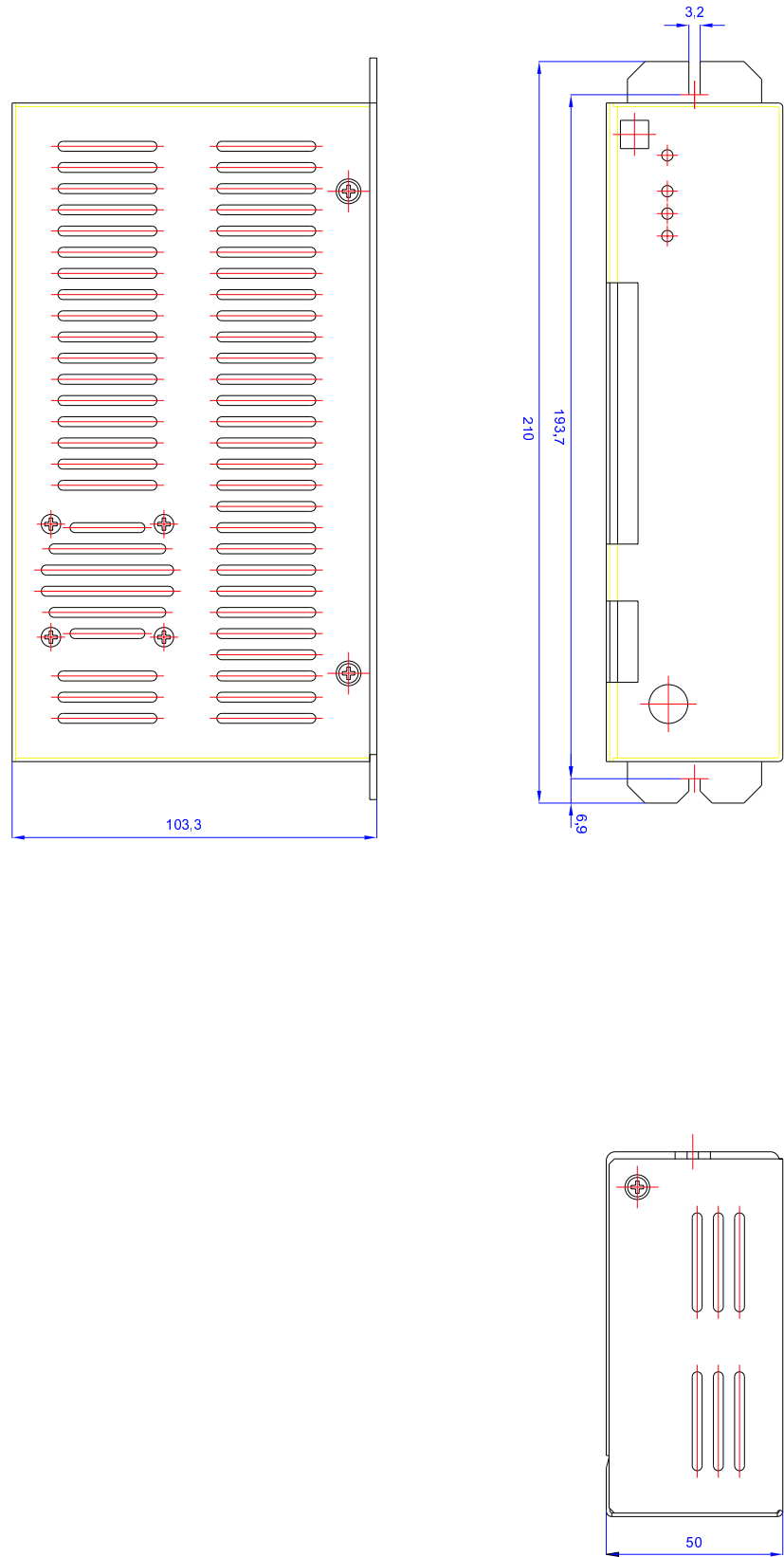


Fig. 7.2: Typical characteristic of recharging cycle for MS2000/24-P

- In the interval  $T_0-T_1$  until the voltage 10.8 V (21.6 V for 24 V) is reached the battery is charged by little current to prevent any battery damage at possible failure (shortcut at any battery cell).
- In the interval  $T_1-T_3$  until the voltage 14.7 V (29.4 V) is reached the battery is charged by constant current 2.5 A (2.0 A).
- In the interval  $T_3-T_4$  until the charging current drops under 0.25 A is charged by constant voltage 14.7 V (29.4 V).
- In the interval over  $T_4$  is charged by constant voltage 13.65 V (27.4 V) with the charging current drops gradually to zero.
- The maximum charging current for various versions is written in the table Basic Technical Parameters. For each case this current cannot exceed the limit (Rated output current) - (Actual current on OUT DC).

8. Mechanical parameters



## 9. Conditions for MS2000 Operation

### 9.1. Important Warning

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Under no circumstances is the Racom or any other company or person responsible for incidental, accidental or related damage arising as a result of the use of this product. The manufacturer shall not provide the user with any form of guarantee containing assurance of the suitability and applicability for its application. RACOM products are not developed, designed or tested for use in equipment which directly affects the health and life functions of humans or animals and neither as part of other important equipment, and RACOM does not provide a guarantee if company products are used in such equipment.


### 9.2. Conditions of Liability for Defects and Instructions for Safe Operation of Equipment.

Please read these safety instructions carefully before using the product:

- Liability for defects does not apply to any product that has been used in a manner which conflicts with the instructions contained in this operator manual, or if the case in which the equipment is located has been opened, or if the equipment has been tampered with.
- Equipment mentioned in this operator manual may only be used in accordance with instructions contained in this manual. Error-free and safe operation of this equipment is only guaranteed if this equipment is transported, stored, operated and controlled in the proper manner. The same applies to equipment maintenance.
- Only undermentioned manufacturer is entitled to repair any devices.

### 9.3. RoHS and WEEE compliance

The Power Supply MS2000 is fully compliant with the European Commission's RoHS (Restriction of Certain Hazardous Substances in Electrical and Electronic Equipment) and WEEE (Waste Electrical and Electronic Equipment) environmental directives.

**RoHS**  Restriction of hazardous substances (RoHS)

The RoHS Directive prohibits the sale in the European Union of electronic equipment containing these hazardous substances: lead, cadmium, mercury, hexavalent chromium, polybrominated biphenyls (PBBs), and polybrominated diphenyl ethers (PBDEs).

End-of-life recycling programme (WEEE)




The WEEE Directive concerns the recovery, reuse, and recycling of electronic and electrical equipment. Under the Directive, used equipment must be marked, collected separately, and disposed of properly. Racom has instigated a programme to manage the reuse, recycling, and recovery of waste in an environmentally safe manner using processes that comply with the WEEE Directive (EU Waste Electrical and Electronic Equipment 2002/96/EC).


**Battery Disposal**—This product may contain a battery. Batteries must be disposed of properly, and may not be disposed of as unsorted municipal waste in the European Union. See the product documentation for specific battery information. Batteries are marked with a symbol, which may include lettering to indicate cadmium (Cd), lead (Pb), or mercury (Hg). For proper recycling return the battery to your supplier or to a designated collection point.

## 10. Declaration of conformity

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**RACOM**  
RADIO DATA NETWORKS




**Declaration of Conformity – MS2000**

- in accordance with **73/23/EEC** Directive of 19<sup>th</sup> of February 1973 on the harmonisation of the laws of Member States relating to electrical equipment designed for use within certain voltage limits and **89/336/EEC** Directive of 3<sup>rd</sup> of May 1989 on the approximation of the laws of the Member States relating to electromagnetic compatibility.

**Producer:**  
**Address:**  
**VAT:**  
**Product:**  
**Purpose of use:**

**RACOM s.r.o.**  
**Mirova 1283, 592 31 Nove Mesto na Morave, Czech Republic**  
**46343423**  
**MS2000**  
**Power Supply**



**We, the manufacturer of the above mentioned product, hereby declare that this product:**


- conforms to the essential requirements of the European Union directives **73/23/EEC** and **89/336/EEC**;
- is safe on condition of usage mentioned in the operating manual.

**This Declaration of Conformity is based on the following documents:**

Test specification:	Document No.:	Date of issue:	Laboratory:
730-595/2001	CSN EN 61000-3-2:2001	03.08. 2001	VTUPV Vyskov
730-595/2001	CSN EN 61000-3-3:1997	03.08. 2001	VTUPV Vyskov
730-590/2001	CSN EN 61000-3-11:1996	02.08. 2001	VTUPV Vyskov
730-591/2001	CSN EN 61000-4-2:1997+A1:1999	02.08. 2001	VTUPV Vyskov
	CSN EN 61000-4-3:1997		
	CSN EN 61000-4-4:1997		
	CSN EN 61000-4-5:1997		
	CSN EN 61000-4-6:1997		
	CSN EN 61000-6-2:2000		
	ENV 50204 :1995		
EMC-462/00	CSN EN 50081-1	20.07. 2000	TESTCOM Praha
EMC-467/00	CSN EN 55022 class B	28.07. 2000	TESTCOM Praha
740-14/02	CSN EN 60950:2001	25.03. 2002	VTUPV Vyskov

Nove Mesto na Morave, 22<sup>nd</sup> of August 2006

Jiri Hruska, Managing Director



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**[www.racom.eu](http://www.racom.eu)**

Fig. 10.1: Declaration of conformity

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Power Supply MS2000 – © RACOM s.r.o.

## 11. Country of Origin


**RACOM**  
 RADIO DATA NETWORKS

**Country of Origin Declaration**


**Manufacturer:** RACOM  
**Address:** Mirova 1283, 592 31 Nove Mesto na Morave, Czech Republic  
**VAT No:** CZ46343423

**We, the manufacturer, hereby declare that Country of Origin of the MR radio series and its accessories is the Czech Republic, EU.**

Part Number	Description
MC 100	Controller, modules according to spec.
MD 160 25W	160 MHz, 12.5 or 25 kHz, 25W, full-duplex, modules according to spec.
MR 160 25W	160 MHz, 12.5 or 25 kHz, 25W, half-duplex, modules according to spec.
MR 160 5W	160 MHz, 12.5 or 25 kHz, 5W, half-duplex, modules according to spec.
MR 300 5W	300 MHz, 12.5 or 25 kHz, 5W, half-duplex, modules according to spec.
MR 400 25W	400 MHz, 12.5 or 25 kHz, 25W, half-duplex, modules according to spec.
MR 400 5W	400 MHz, 12.5 or 25 kHz, 5W, half-duplex, modules according to spec.
MW 160 25W	160 MHz, 200 kHz, 25W, half-duplex, modules according to spec.
MX 160 25W	160 MHz, 200 kHz, 25W, full-duplex, modules according to spec.
MG 100	Cellular router, modules according to spec.
MS2000/12	230 V AC / 13.8 V DC, intelligent back-up
MS2000/24	230 V AC / 24 V DC, intelligent back-up
MSU120	Arbitrary solar panel / 14.7 V DC
DCC24	20–60 V DC / 13.8 V DC

Nove Mesto na Morave, 1 of March 2014

Jiri Hruska, CEO



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[www.racom.eu](http://www.racom.eu)

ver. 1.1

Fig. 11.1: Country of Origin declaration for MS2000