

PU20

Wide-Range Railway Power Supply Unit, 24 to 110 VDC, 120 W

3U 6 HP PSU



User Manual



Contents

- Contents 2**
- About this Document 4**
- Product Safety 6**
- Legal Information 7**
- 1 Product Overview 9**
 - 1.1 Product Description 9
 - 1.2 Product Architecture 10
 - 1.2.1 Interfaces 10
 - 1.2.2 Functions 12
 - 1.3 Technical Data 13
 - 1.4 Product Identification 15
- 2 Getting Started 16**
 - 2.1 Connecting and Starting 16
- 3 Functional Description 17**
 - 3.1 Power Supply 17
 - 3.2 Parallel Mode 19
 - 3.3 Redundant Mode 19
 - 3.4 Using an Integrated Shelf Controller 19
 - 3.5 Voltage Range Compliance 20
 - 3.5.1 Manual Voltage Range Configuration 20
 - 3.5.2 Voltage Variations or Interruptions 20
 - 3.5.3 Inrush Current and Reverse Polarity Protection 21
 - 3.6 Voltage and Current Management 21
 - 3.6.1 Output Voltages 21
 - 3.6.2 Standby Voltage 21
 - 3.6.3 Load Sharing 22
 - 3.7 Status LED 22
 - 3.8 Isolation 23
 - 3.8.1 Isolation Groups 23
 - 3.8.2 Isolation Voltages 23
 - 3.9 Catastrophic Failure Protection 23
- 4 Maintenance 24**
 - 4.1 Fuse Protection 24

Figures

Figure 1. Front interfaces9
Figure 2. Board layout – top view.....10
Figure 3. Functional diagram11
Figure 4. Product labels.....14
Figure 5. Safety application.....22
Figure 6. Position of fuse for PSU protection.....23

Tables

Table 1. Pin assignment of rear H15 PSU connector.....16
Table 2. Signal mnemonics of PSU interfaces.....17
Table 3. Possible input voltages19
Table 4. Capacitive Load21
Table 5. General status LED at front panel21
Table 6. Isolation groups22
Table 7. Isolation voltages22

About this Document

This user manual is intended only for system developers and integrators, it is not intended for end users.

It describes the design, functions and connection of the product. The manual does not include detailed information on individual components (data sheets etc.).



PU20 product page with up-to-date information and downloads:
www.men.de/products/pu20/

History

Issue	Comments	Date
E1	First issue	2014-06-05
E2	Updated photos and front panel - cosmetics only	2014-06-30
E3	Structure update, added information regarding fuse, update of technical content	2017-11-03
E4	Removed automatic voltage range detection	2018-07-12

Conventions



Indicates important information or warnings concerning situations which could result in personal injury, or damage or destruction of the component.



Indicates important information or warnings concerning the use of voltages that could lead to a hazardous situation which could result in personal injury, or damage or destruction of the component.



Indicates important information concerning electrostatic discharge which could result in damage or destruction of the component.



Indicates important information or warnings concerning proper functionality of the product described in this document.



The globe icon indicates a **hyperlink** that links directly to the Internet. When no globe icon is present, the hyperlink links to specific information within this document.

Italics Folder, file and function names are printed in *italics*.

Comment Comments embedded into coding examples are shown in green text.

IRQ#
/IRQ Signal names followed by a hashtag "#" or preceded by a forward slash "/" indicate that this signal is either active low or that it becomes active at a falling edge.

In/Out Signal directions in signal mnemonics tables generally refer to the corresponding board or component, "in" meaning "to the board or component", "out" meaning "from the board or component".

0xFF Hexadecimal numbers are preceded by "0x".

0b1111 Binary numbers are preceded by "0b".

Product Safety

Electrostatic Discharge (ESD)



Computer boards and components contain electrostatic sensitive devices. Electrostatic discharge (ESD) can damage components. To protect the PCB and other components against damage from static electricity, you should follow some precautions whenever you work on your computer.

- Power down and unplug your computer system when working on the inside.
- Hold components by the edges and try not to touch the IC chips, leads, or circuitry.
- Use a grounded wrist strap before handling computer components.
- Place components on a grounded antistatic pad or on the bag that came with the component whenever the components are separated from the system.
- Only store the product in its original ESD-protected packaging. Retain the original packaging in case you need to return the product to MEN for repair.

Legal Information

Changes

MEN Mikro Elektronik GmbH ("MEN") reserves the right to make changes without further notice to any products herein.

Warranty, Guarantee, Liability

MEN makes no warranty, representation or guarantee of any kind regarding the suitability of its products for any particular purpose, nor does MEN assume any liability arising out of the application or use of any product or circuit, and specifically disclaims any and all liability, including, without limitation, consequential or incidental damages. TO THE EXTENT APPLICABLE, SPECIFICALLY EXCLUDED ARE ANY IMPLIED WARRANTIES ARISING BY OPERATION OF LAW, CUSTOM OR USAGE, INCLUDING WITHOUT LIMITATION, THE IMPLIED WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE OR USE. In no event shall MEN be liable for more than the contract price for the products in question. If buyer does not notify MEN in writing within the foregoing warranty period, MEN shall have no liability or obligation to buyer hereunder.

The publication is provided on the terms and understanding that:

1. MEN is not responsible for the results of any actions taken on the basis of information in the publication, nor for any error in or omission from the publication; and
2. MEN is not engaged in rendering technical or other advice or services.

MEN expressly disclaims all and any liability and responsibility to any person, whether a reader of the publication or not, in respect of anything, and of the consequences of anything, done or omitted to be done by any such person in reliance, whether wholly or partially, on the whole or any part of the contents of the publication.

Conditions for Use, Field of Application

The correct function of MEN products in mission-critical and life-critical applications is limited to the environmental specification given for each product in the technical user manual. The correct function of MEN products under extended environmental conditions is limited to the individual requirement specification and subsequent validation documents for each product for the applicable use case and has to be agreed upon in writing by MEN and the customer. Should the customer purchase or use MEN products for any unintended or unauthorized application, the customer shall indemnify and hold MEN and its officers, employees, subsidiaries, affiliates, and distributors harmless against all claims, costs, damages, and expenses, and reasonable attorney fees arising out of, directly or indirectly, any claim or personal injury or death associated with such unintended or unauthorized use, even if such claim alleges that MEN was negligent regarding the design or manufacture of the part. In no case is MEN liable for the correct function of the technical installation where MEN products are a part of.

Qualified Personnel

The product/system described in this documentation may be operated only by personnel qualified for the specific task in accordance with the relevant documentation, in particular its warning notices and safety instructions. Qualified personnel are those who, based on their training and experience, are capable of identifying risks and avoiding potential hazards when working with these products/systems.

Conformity

MEN products are no ready-made products for end users. They are tested according to the standards given in the Technical Data and thus enable you to achieve certification of the product according to the standards applicable in your field of application.

RoHS

Since July 1, 2006 all MEN standard products comply with RoHS legislation.

Since January 2005 the SMD and manual soldering processes at MEN have already been completely lead-free. Between June 2004 and June 30, 2006 MEN's selected component suppliers have changed delivery to RoHS-compliant parts. During this period any change and status was traceable through the MEN ERP system and the boards gradually became RoHS-compliant.

WEEE Application



The WEEE directive does not apply to fixed industrial plants and tools. The compliance is the responsibility of the company which puts the product on the market, as defined in the directive; components and sub-assemblies are not subject to product compliance.

In other words: Since MEN does not deliver ready-made products to end users, the WEEE directive is not applicable for MEN. Users are nevertheless recommended to properly recycle all electronic boards which have passed their life cycle.

Nevertheless, MEN is registered as a manufacturer in Germany. The registration number can be provided on request.

Copyright © 2018 MEN Mikro Elektronik GmbH. All rights reserved.

Germany

MEN Mikro Elektronik GmbH
Neuwieder Straße 3-7
90411 Nuremberg
Phone +49-911-99 33 5-0

info@men.de
www.men.de

France

MEN Mikro Elektronik SAS
18, rue René Cassin
ZA de la Châtelaine
74240 Gaillard
Phone +33-450-955-312

info@men-france.fr
www.men-france.fr

USA

MEN Micro Inc.
860 Penlyn Blue Bell Pike
Blue Bell, PA 19422
Phone 215-542-9575

sales@menmicro.com
www.menmicro.com

China

MEN Mikro Elektronik Co., Ltd.
Room 301A,
#971 Dongfang Road
200122 Shanghai
Phone +86-21-5058-0963

sales@men-china.cn
www.men-china.cn

1 Product Overview

1.1 Product Description

Designed for Rail Applications, Vehicle and Wayside

The PU20 is a plug-in power supply unit for 19" systems (like VMEbus and CompactPCI Serial). It is especially designed for computer systems in public transport vehicles and for harsh environments, like railway applications, making it suitable for both rolling-stock and wayside use.

Wide-Range Input

The PU20 has a nominal input power range of 24 V DC to 110 V DC with a max. input voltage range of 14.4 V DC to 154 V DC (according to EN 50155 and S-9401). The PU20 has a configurable voltage range for 24, 36, 48, 74, 96, 110 V DC or wide input range, which is controlled by a rotary switch.

Advanced Power Supply Functionality

The standard output voltage is 12.6 V DC with a dynamic load sharing between 12.6 V DC and 5 V DC with 120 W. The output power at 3.3 V is 30 W, which is shared with the 5 V load. Switch-on behavior is independent of the load.

The PU20 also has a standby voltage of 5 V with 5 W to supply the independent shelf controller, and to support wake-on-LAN functionality. The standby voltage is always on.

The PSU provides an inhibit port for switching the output voltages. It also indicates the event of an input power failure, output voltage failure or an over temperature.

Rugged Design

The PSU is coated conformally, and all components are secured against vibration. When more power supplies run in parallel, there is a load sharing. The double voltage monitoring ensures that the output voltage is within the valid range. In case of error, the voltage is powered-down. The thermal stress is extremely low due to integrated heat sinks, and diversion of dissipated heat over the mounting surface.

The PU20 is compliant with EN 50155, meeting all shock, vibration, EMC and isolation requirements. It operates under temperatures from -40 to +70°C with increments to +85°C for 10 minutes (class TX), with a hold up time of 10 ms in accordance with EN 50155 Class 2.

1.2 Product Architecture

1.2.1 Interfaces

Figure 1. Front interfaces

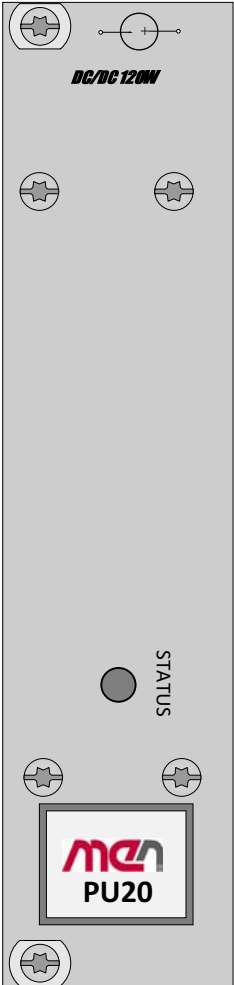
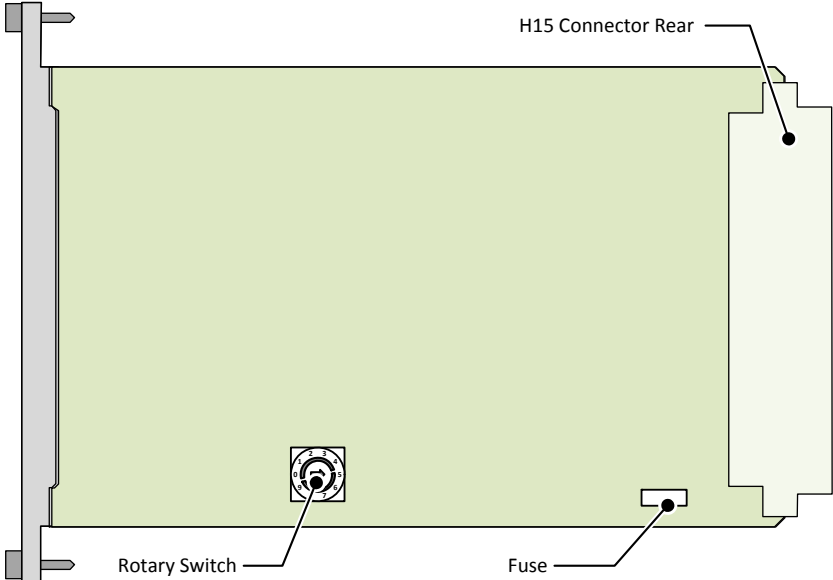
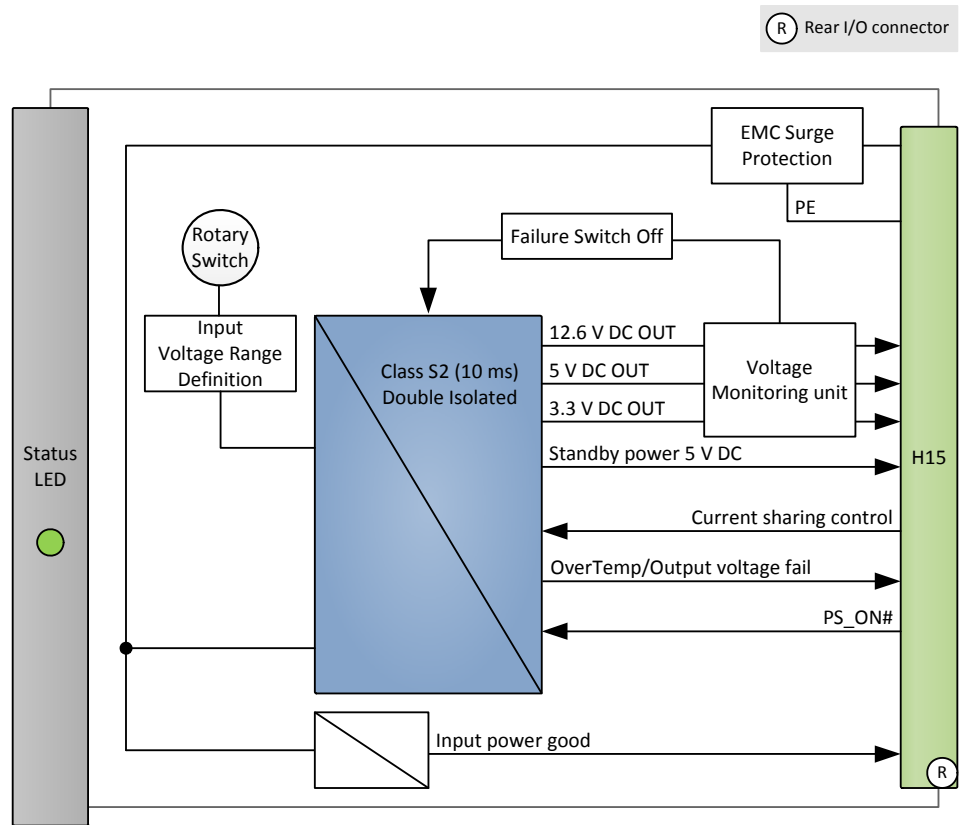


Figure 2. Board layout - top view



1.2.2 Functions

Figure 3. Functional diagram



1.3 Technical Data

Input Characteristics

- Nominal voltage input: 24 V, 36 V, 48 V, 72 V, 96 V, 110 V (according to EN50155)
 - Max. input power range of 14.4 VDC to 154 VDC or
 - 9 VDC to 36 VDC (on request)
 - Configurable voltage range for 24, 36, 48, 74, 96, 110 VDC or wide range
 - Power-on/-off threshold according to EN 50155
 - Nominal input voltage of 74 VDC provided (according to S-9401)
 - Voltage range for 74 VDC: 20 to 130 VDC
 - Power-on/-off threshold according to EN 50155
- Power Variations
 - No functional disturbance with input voltage variations according to EN 50155
- Inrush current peak: 35 A for max. 150 ms at 24 VDC input voltage

Output Characteristics

- Output voltages: 12.6 VDC, 5 VDC and 3.3 VDC
- Output currents: 9.5 A for 12.6 VDC, 24 A for 5 VDC and 9.1 A for 3.3 VDC
- Total maximum power consumption: 120 W
- Standby output voltage: 5 VDC with a 5 W load
- Accuracy:
 - +3.3 V (-1%/+1% of the nominal value)
 - +5 V (-1%/+1% of the nominal value)
 - +12.6 V (-1%/+1.5% of the nominal value)
 - +5 VSB (-1%/+1% of the nominal value)
- Holdup time: 10 ms according to Class S2
- Dynamic load distribution
 - 120 W for complete temperature range without forced airflow
 - Load sharing: 220 W with 2 PSUs, 330 W with 3 PSUs

Front Interfaces

- 1 Status LED

Rear Interfaces

- Type H15, DIN 41612 plug connector
- Overtemperature, PS_ON and power good signal for input and output

Parallel Connection

- Up to six power supply units can be used in parallel
 - Extends availability (backup protection against faults)
 - Extends power
 - Increases performance
 - Ensures redundancy

Miscellaneous

- Overload and short circuit protection
- Standby voltage at power down, always available
- Reverse polarity protection for input voltage and short circuit
- Output voltage and temperature supervision
- Overtemperature and overvoltage shutdown

Electrical Specifications

- Isolation (according to EN 50155)
 - Input/output: 3100 VAC
 - Input/shield: 3100 VAC
 - Output/shield: 1000 VAC

Mechanical Specifications

- Dimensions: 3U, 6HP
- Integrated heat sink
- Weight: 630 g

Environmental Specifications

- Temperature: -40° to 70°C, with up to 85°C for 10 minutes according to class TX (EN 50155) (assembled in the rack)
- Temperature range (storage): -50°C to +85°C
- Cooling concept
 - Air-cooled, natural convection, or
 - Air-cooled, forced convection with fan tray at system bottom
 - Conduction-cooled in MEN CCA frame
- Cooling test according to EN 60068-2-1
- Dry heat test according to EN 60068-2-2
- Shock: 50 m/s², 30 ms (EN 61373)
- Vibration (function): 2.02 m/s², 5 Hz to 200 Hz (EN 61373)
- Vibration (lifetime): 11.44 m/s², 5 Hz to 200 Hz (EN 61373)

MTBF

- 600 000 h min. @ 40°C according to IEC/TR 62380 (RDF 2000)

Safety

- Flammability (PCBs)
 - UL 94 V-0
- Fire Protection
 - EN 5510-2

- Electrical Safety
 - EN 60950-1
 - UL 60950-1 (UL certification no: Dk-52670-UL)
 - CAN/CSA C22.2
 - Insulation measurement test according to EN 50155 (12.2.9.1)
 - Voltage withstand test according to EN 50155 (12.2.9.2)

EMC

- EMC line filter required to reach class B for radiated and conducted emissions
- EMC Emission:
 - EN 55022: CISPR 22 - Class A
 - FCC 15.109 and S-9401
- EMC Immunity: EN 55024 - Class A
- EN 50121-3-2 (EMC of rolling stock)
- EN 55011 (radio disturbance)
- IEC 61000-4-2 (ESD)
- IEC 61000-4-3 (electromagnetic field immunity)
- IEC 61000-4-4 (burst)
- IEC 61000-4-5 (surge)
- IEC 61000-4-6 (conducted disturbances)

1.4 Product Identification

MEN documentation may describe several different models and design revisions of the PU20. You can find the article number, design revision and serial number affixed to the PU20.

- **Article number:** Indicates the product family and model. This is also MEN's main ordering number. To be complete it must have 9 characters.
- **Revision number:** Indicates the design revision of the product.
- **Serial number:** Unique identification assigned during production.

If you need support, you should communicate these numbers to MEN.

Figure 4. Product labels



2 Getting Started

2.1 Connecting and Starting

You can use the following check list when installing the board in a system for the first time and with minimum configuration.

- » The PU20 is hot pluggable, it is therefore not necessary to shut down the host system during installation, there will also be no significant interruptions to the system while installing or replacing this unit.
- » Only operate the PU20 in a suitable housing, i.e. in such a way that no parts of the PU20 except the front panel can be touched.
- » Make sure that enough convection airflow is provided.
- » Do not remove any covers or other mechanical parts.
- » The guide rails should be made of synthetic material and not touch any components.



To reduce the risk of electrical shock, do not disassemble or attempt to repair the power supply unit. Replace it only with the specified units from the MEN PSU family.

3 Functional Description

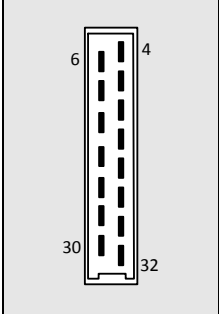
3.1 Power Supply

The PU20 must be connected via the H15 connector at the rear of the unit.

Connector type:

- 15-pin H15 receptacle according to IEC 60603-2
- Mating connector: 15-pin H15 plug according to IEC 60603-2

Table 1. Pin assignment of rear H15 PSU connector

	6	Vo1+	4	Vo1+
	10	Vo2-	8	Vo1-
	14	5 V Standby	12	-
	18	Vo2+	16	T1
	22	FAL#	20	Vo3+
	26	PUL, i	24	DEG#
	30	Vi+	28	PE
			32	Vi-

Note: Pin 32 is longer than the other pins.

Table 2. Signal mnemonics of PSU interfaces

Pin	Signal	Function
4	Vo1+	Output 1 pos (+5 VDC)
6	Vo1+	Output 1 pos (+5 VDC)
8	Vo1-	Output 1 neg. (GND)
10	Vo2-	Output 2 neg. (GND)
14	5 V Standby	5V Standby
16	T1	5V load share
18	Vo2+	Output 2 pos (+12.6 VDC)
20	Vo3+	Output 3 pos (+3.3 VDC)
22	FAL#	Input_Voltage_Good: Indicates when input voltage is within the valid range, Indicates when input voltage falls below the under-voltage threshold
24	DEG#	OverTemp: Indicates when the temperature is within 15K of a thermal power shut down or output voltage fail
26	PUL, i	PS_ON#: Allows CPU to remotely control the power supply for soft on/off and Wake-on-LAN. <ul style="list-style-type: none"> ▪ TTL low: the three main DC output voltages are turned on ▪ TTL high or open-circuit: the DC output voltages do not deliver current
28	PE	Prot. Earth PE
30	Vi+	Input pos.
32	Vi-	Input neg.

3.2 *Parallel Mode*

The PU20 can be used in parallel with up to six additional units from the MEN PSU family, which are easily scalable so that the required output power can be achieved. This not only increases the output power, but also allows balanced dissipation loss for all units, which leads to a better MTBF.

3.3 *Redundant Mode*

The PU20 can also be used in a redundant configuration. Redundancy maximizes the availability of a system in critical applications. In addition, reliability is enhanced as the modules are operating below the full output current rating, thereby reducing power dissipation and temperature rise. An output voltage fault, or the complete failure of one power supply will not affect the remaining PSUs.



The PU20 can be used in parallel with the **PU21**, which is also available from MEN.

3.4 *Using an Integrated Shelf Controller*

When using multiple PSUs, an independent shelf controller can be installed between two units. The shelf controller allows communication between units, and controls and supervises the speed of up to three cooling fans.

The shelf controller also provides a front panel display which displays the PSU supply status and hosts the power button.



For more information on the shelf controller, please refer to the host system manual. An overview of complete systems and documentation is available on the **MEN website**.

3.5 Voltage Range Compliance

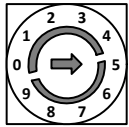
The PU20 is fully compliant with the voltage requirements for input voltages as specified by the EN50155 railway standards and provides the nominal input voltages 24, 26, 48, 72, 96 and 110 VDC. In addition, the PU20 also provides the possibility to extend the power input with an assembly option which allows an input range from 9 up to 36 VDC.

The PU20 is also compliant with the S-9401 Standard for Railroad Electronics Environmental Requirements, and provides a nominal input voltage of 74 VDC with a voltage range of 20 to 130 VDC.

3.5.1 Manual Voltage Range Configuration

The PU20 features a rotary switch which allows the voltages to be manually configured.

Table 3. Possible input voltages

Rotary Switch	Switch Position	Input Voltage
	0	reserved
	1	24 V
	2	36 V
	3	reserved
	4	48 V
	5	72 V
	6	96 V
	7	110 V
	8	74 V (USA)
	9	16-154 V

3.5.2 Voltage Variations or Interruptions

Input voltage variations of $0.6 \times U_n$ up to $1.4 \times U_n$ for less than 0.1s, and $1.25 \times U_n$ up to $1.4 \times U_n$ for less than 1s, will not cause any functional disturbance.

The PU20 is compliant with class S2 of EN50155 power interruption and input short circuit regulations. Interruptions of up to 10 ms will not lead to any disturbances.

The PU20 is unconditionally stable under all load conditions, including capacitive load, see [Table 4, Capacitive Load on page 22](#)

3.5.3 Inrush Current and Reverse Polarity Protection

The PU20 is equipped with an inrush current limiter to protect the components from damaging levels of inrush current at start up, which could lead to a reduction of equipment life.

The PSU provides a reverse polarity protection using active switchable transistors to provide minimum power dissipation.

3.6 Voltage and Current Management

3.6.1 Output Voltages

The output voltages of the PU20 are 12.6 VDC, 5 VDC and 3.3 VDC. The unit also supplies a standby voltage of 5 VDC with 5 W.

In the event of an internal fault, all output voltages are protected against an under or over-voltage of approximately 5%. All output voltages are also protected against overload and short circuits.

In the event of an overload, the output switches itself off. An output overload occurs with a load of 20% more than the maximum load which lasts longer than 1 second. An overload and short circuit will not cause any damage to the PSU.

3.6.2 Standby Voltage

The standby voltage of 5 VDC is also available when all other voltages are switched off. After removal of the power, the +5 VSB standby voltage output remains steady for a minimum hold-up time of 16 ms, until the output begins to decrease in voltage. There are no other voltage disturbances at or following the removal of DC power. If the standby voltage is not used when the output voltages are switched off, the PU20 will have a power consumption of less than 0.5 W.

Standby voltage supports the following functions:

- Wake on LAN
- Wake on WLAN
- System Management Controller
- RTC application
- Suspend to RAM application

3.6.3 Load Sharing

The PU20 includes an active power sharing feature. This ensures that each of the paralleled PSUs contribute an equal share of the current to the load, which avoids any supply output from drifting higher than the others, and prevents premature failure of the power supply.

The maximum power output over all voltages, for the entire temperature range with convection airflow, is 120 W. The load sharing is between 12.6 VDC and 5 VDC output, including 3.3 VDC, which has a minimum of 35 W output power.

- The switch on behavior of the output voltages is independent of the load, so the dynamic load sharing has no effect on it.
- All output voltages have a maximum accuracy of approximately 1% of their nominal value.
- The maximum over and under shoot at all outputs is less than +4% / -2% of its nominal voltage.

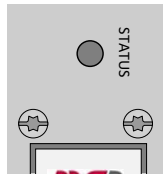
Each output voltage of the PU20 is able to power up and operate within regulation limits, and with simultaneous capacitances as shown in the table below:

Table 4. Capacitive Load

Output	Capacitive load (μF)
12.6 VDC	10 000
5 VDC	10 000
3.3 VDC	10 000
5 VDC (standby)	5 000

3.7 Status LED

Table 5. General status LED at front panel

Appearance	Label	Color	Function
	STATUS	Green	Indicates the status of the input and output voltages <ul style="list-style-type: none"> ▪ On: output voltages are in valid range ▪ Off: input voltage range is not valid ▪ Blinking: output voltages are not in valid range

3.8 Isolation

3.8.1 Isolation Groups

The PU20 provides the following isolated groups:

Table 6. Isolation groups

Group	Name
1	Primary power (voltage input)
2	Secondary power (all outputs and status ports)
3	Shield

3.8.2 Isolation Voltages

The PU20 can withstand high voltages according to the following table:

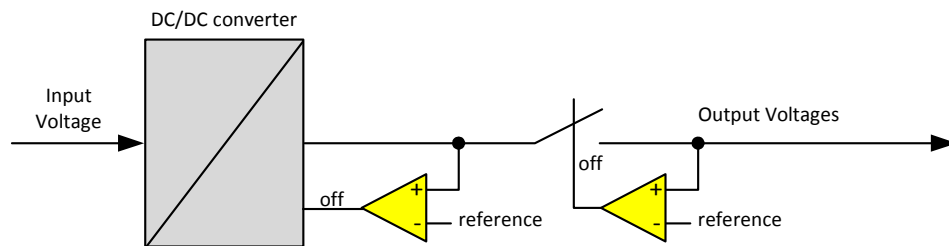
Table 7. Isolation voltages

Group	1	2	3
1	-	-	-
2	3100 VAC	-	-
3	3100 VAC	1000 VAC	-

3.9 Catastrophic Failure Protection

The PU20 features a catastrophic failure protection function and voltage accuracy is consistently double checked. In the event of one unit failing, another unit will continue to check the accuracy and switch all voltages off if necessary, before any thermal damage is caused.

Figure 5. Safety application



Repeated switching on and off of the DC input voltage with a maximum load will not cause any damage to the power supply, nor will it cause the input fuse to blow.

4 Maintenance

4.1 Fuse Protection

The voltage inputs of the PSUs are protected by a fuse.



Fuses are not intended to be exchanged by the customer. Your warranty for the PU20 will cease if you exchange fuses on your own. Please send the product to MEN for repair if a fuse blows.

- Current rating: 10 A
- Type: time-lag
- Size:
 - l = 20 mm
 - d = 5.2 mm

Figure 6. Position of fuse for PSU protection

