

Medium Voltage Power Supplies

MCA - Series

power classes up to 9000W

certified according to
ISO 9001 : 2008

Operating Instructions

This instruction is only dedicated to electrical experts and people with a suitable technical education, which are familiar with electrical risks and can keep the risk for themselves and other people as low as possible.

For the operation of this unit only a.m. persons are admitted.

Content:

1.	Safety Instructions	3
2.	General	4
2.1	Setup Information	5
2.2	Preparation for commissioning	5
3.	Description	6
3.1	Front Panel, Controls	6
3.2	Rear side, Connections	7
3.3	Assembly	7
3.4	Mode of operation	8
4.	Operation with local controls	9
5.	Maintenance	10
6.	Options	11
6.1	Analog Programming	11
6.1.1	Directly Connected Analog Programming	11
6.1.2	Floating Analog Programming (2kV)	11
6.2	Digital Interface PROBUS V (Option)	14
7.	Technical Data	15
8.	Calibration	16
9.	Certificate of Conformity	16
10.	Accessories	16
11.	Warranty, Repairs	16
12.	Special Models, Modifications	16

1. Safety Instructions

The units of the series MCA deliver dangerously High Voltages! Ensure that nothing, and nobody, will be endangered by this High Voltage before putting the unit into operation!

Attention !

The full dielectric strength of the high voltage connectors is only achieved if fully mated together.

Before Commissioning

Make sure that you have read and understood the operating instruction manual! Ensure that you observe all the hints and warnings contained within it. In not following the operating instructions, you contravene the safety regulations for operating units of this type. FuG accepts no liability for consequences arising from the failure to follow these safety instructions.

Mains voltage

Check whether the input voltage for your power supply, noted on the type label, corresponds to your actual mains voltage.

Earth

The unit is provided with a safety earth (German safety class I). For protection against electric shocks, the unit must be connected to the mains via a suitable 3 or 5-pole cable with a non-fused earth conductor. For electrical potential equalization to the load, and to the center of the AC-supply, the earth stud must be used.

High leakage current!

Labeled by a sticker on the rear. At a high leakage current is an earth connection to the Earth stud mandatory.

Operating environment

The units may only be operated in a clean, dry environment. Please make sure that no objects or liquids can enter the casing through the ventilating apertures. Because of the risk of sparks, the unit must not be operated in the vicinity of flammable gases or fumes.

Cooling

To ensure a adequate cooling, the ambient temperature must not exceed **40°C**. This unit is air cooled by convection or at units >800J/s by forced ventilation. Therefore , please ensure an adequate air-flow is available, and ensure that nothing is placed either above or below the unit which may impede this air-flow. Don't operate table top units without the mounted legs. Do not expose the unit directly to solar radiation. If the unit is used as a plug-in component, sufficient air-flow must be provided, (1HU = 44,5 mm above and below clear).

Opening the unit

Before opening, ensure that the unit is disconnected from the mains! The unit may be opened by operating personnel only for the purpose of operating switches as described in the operating instructions, (e.g. baud rate switch of Probus V, which is inside).

Danger:

The electronic boards inside the power supply are connected to one output pole. During operation, the electronic boards lie on up to 2000V.

ATTENTION!

The unit contains capacitors, which discharge only very slowly (typical discharge time 5 min) or, in worst case, do not discharge at all.

For switch over use isolated tools only.

Maintenance or repair of this unit should only be carried out by trained service personnel who are aware of the inherent dangers of such equipment.

Symbols



Adhere strictly to the operating instructions before you either change switches, or connect sockets, marked with this symbol!



Symbol for high Voltage outputs



Symbol for cassis earth, potential safety earth

2. General

The units of the series MCA (**M**edium Voltage **C**hopper **A**utoranging **P**ower Supplies) are high stable DC- power supplies..

High Voltage Output Polarity

ATTENTION The units supply dangerously HIGH VOLTAGE!

At units up to **1500V** nominal voltage the **output is floating**. Either the positive or the negative output pole may be connected to earth.

Units with **3000V** nominal voltage will be delivered with **positive or negative** polarity. The polarity has been fixed in the factory and cannot be changed. One output terminal carries high voltage, the other pole „0V“ is intern connected to earth via a wire link.

Output Isolation Load and “0V” Terminal

At units **up to 400V** nominal voltage each output terminal may float up to **max. ±500V**, **at 750V** nominal voltage up to **max ± 1000V** **and at 1500V** up to **max. ±2000V** with respect to earth.

Short-circuit Protection

All units are short-circuit proof. The maximum current can be supplied for all output voltages, even into a short-circuit.

ATTENTION! During short-circuit or flash over, the internal filter-capacitors will be discharged very fast. The output current is only limited by internal safety resistors, and can reach 500 x the nominal value.

Load Types

The type of load is not critical. All passive bipolar loads can be connected.

Power Limitation

The maximum of supplied power is limited 750W / 1500W / 3000W.

Series Connection

A series connection is possible, paying attention to the stated output isolation. That means, at a series connection of power supplies the sum voltage of both power supplies may not exceed the mentioned value.

Parallel Connection

Parallel connection of power supplies with same output voltage is supported.

Type Number

From the type number you can see both the power class and the maximum output voltage of the unit.

Example: **MCA 750 - 3 000** = Power class 750W / Nominal voltage 3 000V

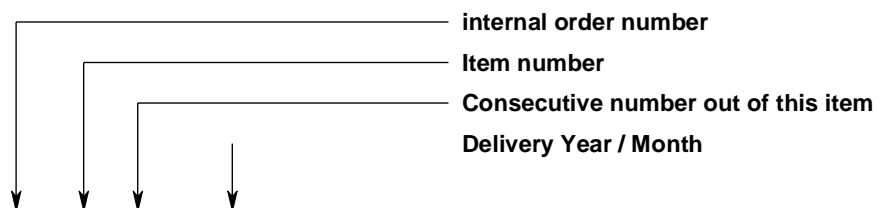
Modified types with differing electrical or mechanical data are indicated by "MOD" within the type number on the label at the rear panel.

(In this case pay attention to the description in section 8)

Serial Number

The label on the rear of the unit, the technical manual and the circuit diagrams show the serial number.

It has the following content:



Serial No.: AAAA-PP-NN YYYY/MM

IMPORTANT

Please indicate on all further enquiries for warranty, service or spare parts orders the serial number and the model number of the unit.

2.1 Setup Information

Operating position	The units may only be operated in horizontal position.
Class of pollution	The units are designed for the pollution class 1 (normal, not conductive pollution).
EMC	The units are built according to current standards. When length of signal- and control lines <3m.
Transport	If the power supply is equipped with lifting appliances or handles, the weight of the unit must be shared to these points.

2.2 Preparation for commissioning

Mains Voltage	Check whether the input voltage for your power supply, noted on the type label, corresponds to your actual mains voltage. Use only the enclosed delivered mains cable.
Earth, Safety Conductor	The unit is provided with a safety earth (German safety class I). For protection against electric shocks, the unit must be connected to the mains via a cable with a non-fused earth conductor. For electrical potential equalization to the load, and to the center of the AC-supply, the earth stud must be used.
High leakage current!	When this sticker is placed on the rear side of the unit or the text "High leakage current" is engraved, the unit must be grounded properly by using the appropriate grounding bolt with a cable of at least 10 mm ² cross section.



Fuses	Internal: See type label. External: On mains side next higher size, characteristics <u>delay-action</u> or if automatic cut-out is used, characteristics "C" or "K".
Return Current Flow	The return current must not flow via the mains earth! The screen of a HV-cable is always connected to earth. Only in some cases it may be used for the return current.
Load and "0V" Terminal	At units up to 400V nominal voltage each output terminal may float up to max. ±500V , at 750V nominal voltage up to max ± 1000V and at 1500V up to max. ±2000V with respect to earth.
Attention	At units with 3000V nominal voltage one pole lies on the HV terminal, the other one on the „0V“ terminal and is intern connected to earth by a wire link. In this operation mode the screen of the HV-cable may be used for the return current.
Earthy Operation	The link between „0V“ and earth may be disconnected by the customer. Open the unit, you will find this wire link inside between the „0V“ and the earth terminal. Pay attention to the safety instructions!
Attention	The „0V“-terminal than is earthy and may float up to max. ±300 V. For the return current a separate isolated line back to the „0V“ terminal has to be used, the screen of the HV-cable in this case must <u>not</u> be used, it always lies on earth. In this operation mode the „0V“ terminal is protected against overvoltage by an overvoltage arrester with 350 V, which must not be stressed for a longer time. Therefore it should be put on a fixed potential between 0 and 300 V.
Danger!	On load side a suitable overvoltage arrester (or earthing) must be provided to assure, that due to a inadvertent opened 0V back connection on the power supply, the voltage does not exceed the a.m. values with respect to earth. Use only safety connectors according to IEC 1010-1 or VDE 0110.

3. Description

In comparison to the standard powers applies the MCA-series offers a threesomes higher current/voltage range. The power is limited to the maximum value. Power supplies of the series MCA will be delivered in 19" table-top cases, depending on type. Rack adapters for table-top units are available as accessories.

3.1 Front Panel, Controls

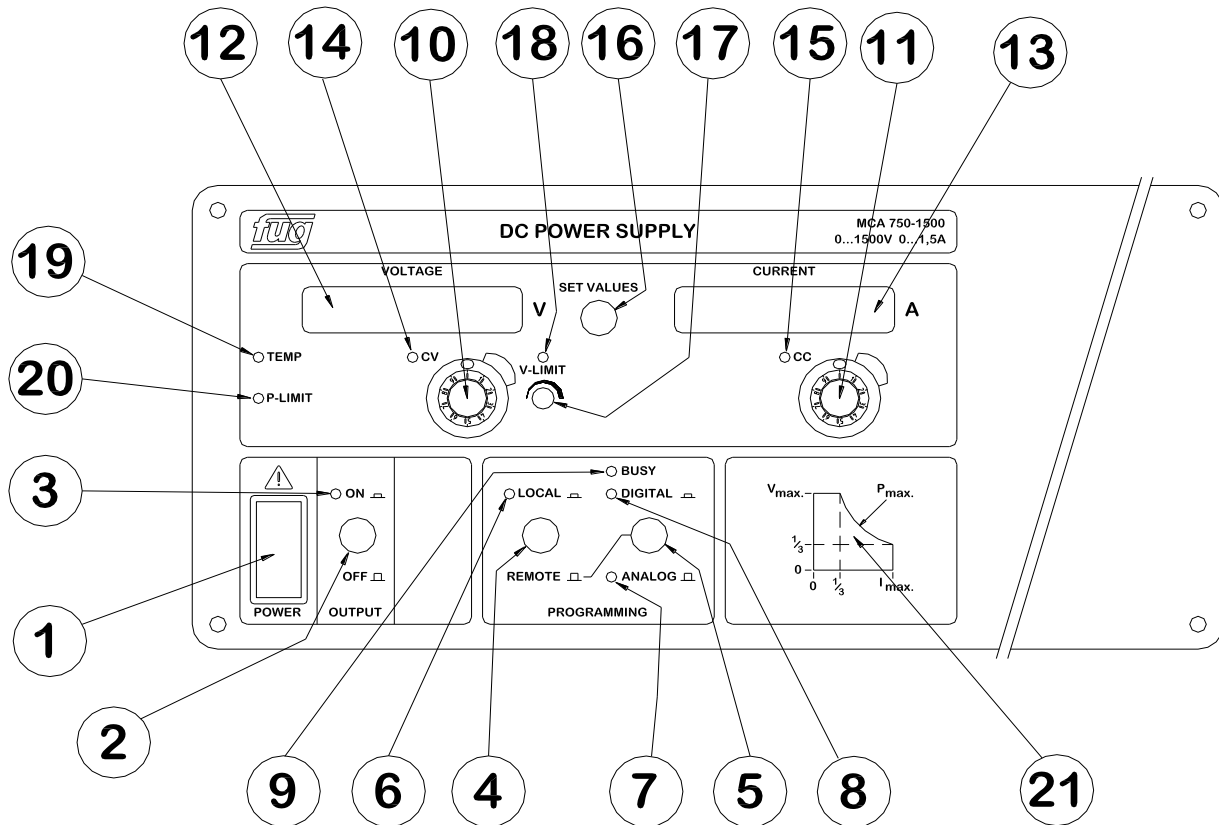


Figure: Front panel of a MCA 750 – 1500 unit. The dimensions of devices with higher power are different to this type.

1	Mains Power Switch. Provides two pole isolation from mains network	13	current display: flashing: set value is displayed non flashing: actual value is displayed
2	Output release. No mains disconnection.	14	indicates control state Constant Voltage CV
3	Output release status. Indicates controller and output active.	15	indicates control state Constant Current CC
4	(Option) Selects control between LOCAL and REMOTE	16	switches display to set value
5	(Option) Selects control between REMOTE/ANALOGUE and REMOTE/DIGITAL	17	Potentiometer for voltage set value limitation (adjustable only with a tool)
6,7,8	(Option) Indicates the active control input	18	indicates active voltage set value limitation
9	(Option) indicates Data traffic on digital interface	19	indicates overtemperature (ambient temperature too high, fan failed or dusty)
10	lockable Potentiometer for voltage set value	20	(Option) indicates control state power limitation
11	lockable Potentiometer for current set value	21	Operating range of MCA units
12	voltage display: flashing: set value is displayed non flashing: actual value is displayed		

3.2 Rear side, Connections

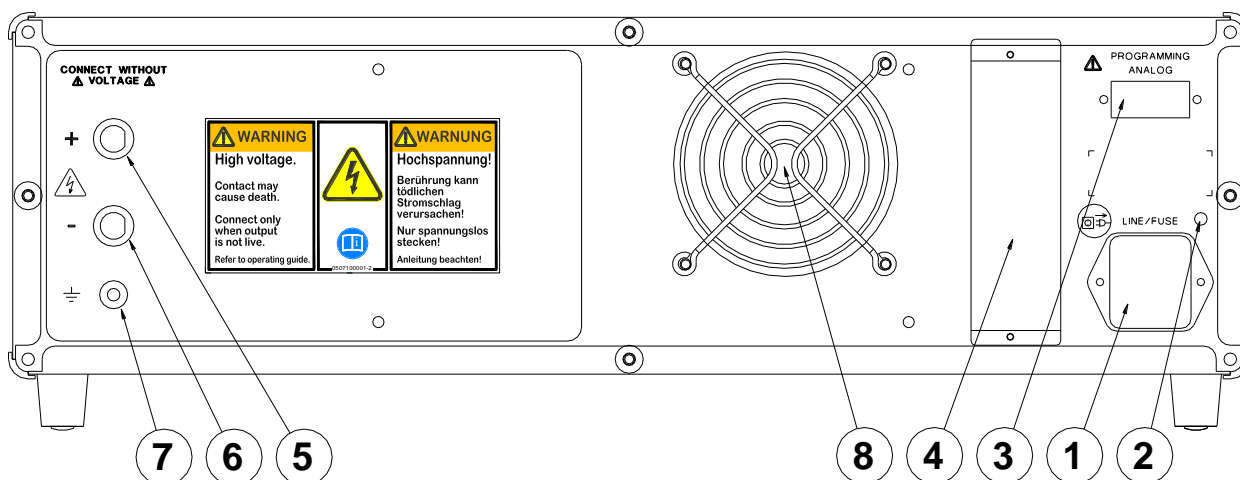


Figure: Rear side of a MCA 750 – 1500 unit. The dimensions of units with higher power and/or other voltages are different to this type. In this case the arrangement of the elements can be different as shown above.

1.	Mains power input, built in fuses up to 700W: Mains plug as shown above. 1400W and higher: Tightly with automatic cutout and cable connection or mainsplug C20 (IEC60320).
2.	earth stud. (only with high leakage current)
3.	mounting place for optional analog programming
4.	mounting place for optional interface Probus V (i.e. IEEE-488, RS232, USB, LAN)
5.	Positive high voltage output socket
6.	Negative 0V connector (internally connected to earth, connection can be removed if necessary)
7.	earth stud.

3.3 Assembly

The power supply consists basically of 4 main units

- Mains source and oscillating unit
- HV-transformer, HV-rectifier with filter, HV-divider and current measuring shunt
- Control unit with measuring and control amplifier, reference voltage source, pulse width modulator, source for the control unit from the mains transformer and a ± 15 V voltage stabilizer.
- Front panel board with 7-segment display, microcontroller, digital calibration

3.4 Mode of operation

	<p>The rectified mains voltage feeds the rectangular push-pull oscillator stage. For the regulation, the rectangular voltage is pulse width modulated.</p>
High voltage	<p>This rectangular voltage is transformed by a HV-transformer and dependent on type or nominal voltage rectified by a bridge or a multiplier circuit.</p>
Filtering	<p>The High Voltage so generated is filtered by a R-C- filter and fed to the output via a protection resistor.</p>
Voltage measurement	<p>A precision HV-divider feeds the measured voltage to the control circuit. For a better performance, a voltage derived from a capacitive divider on the end of the rectifier is added. The divided voltage is normalized by an integrated amplifier to $+10V = V_{nominal}$.</p>
Voltage control	<p>The normalized voltage forms the actual value for the control amplifier. The measuring socket and the V-monitor are also supplied from this voltage. The voltage control amplifier compares this voltage with the setting voltage (reference voltage divided by the setting potentiometer or an external programming voltage). The difference is amplified and fed, as control signal, to the input of the PWM- circuit, which drives the oscillator unit.</p>
Monitor	<p>The normalized actual value ($0 - 10V = 0 - \text{nominal value}$) is also the reference for the measuring voltage on the monitor terminals.</p>
Voltage limitation	<p>The voltage set value can be limited by a potentiometer on the front panel. The limitation is always active, independent of the operation mode of the power supply.</p>
Current measurement	<p>The current in the earthy pole of the HV-rectifier flows through a current measuring resistor. The voltage drop on this resistor is also normalized by an integrated amplifier, ($+10V = \text{nominal current}$).</p>
Current Limitation	<p>This nominal voltage is also used as actual value for the current limitation and is connected to the current monitor. The control amplifier for the output current limitation compares this voltage with the setting value. The difference gets amplified and is feed to the input of the PWM</p>
Power Limitation	<p>The product of the normalized current and voltage monitors. The output power is limited to the maximum value up to 9000W. The operation in power limitation is indicated by the yellow LED "Power Limit". The transition between voltage control, current control and power limitation occurs automatically.</p>
Internal supervision	<p>The $\pm 15 V$ source of the control electronics is monitored. Operation of the control unit is only released if the supply voltages are within their limits.</p>
Overtemperature	<p>The temperature of the internal power circuits in fan cooled units is monitored. In case of overtemperature, the power circuits are electronically switched off and LED OT (overtemp) goes on. Reset after cooling down by switching the unit off and on again. Possible reasons for overtemperature: fan blocked or dusty, ventilation slits blocked</p>

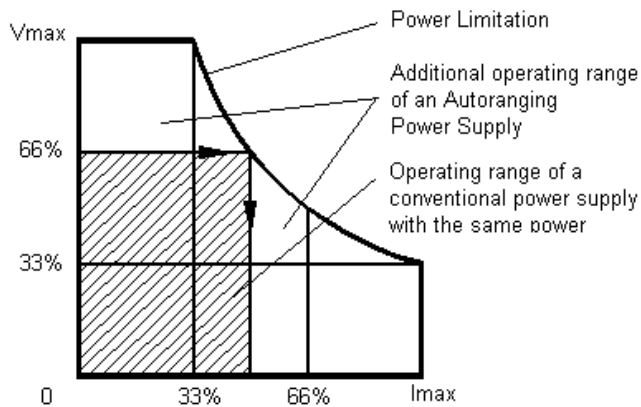
4. Operation with local controls



**The unit delivers dangerously High Voltage!
Please notice in particular safety instructions in section 1
and Load and 0V connection in section 2.2**

- Select local operation** If your power supply is equipped with one of the options analog or digital programming, set switch (4) to LOCAL.
- Save switch on** First, set switch OUTPUT (2) to OFF.
Now, you can switch on the Power Switch (1). The output will remain OFF.
The LED LOCAL (6) is on, indicating local operation.
- Set value Display** Shortly pressing SET VALUES (16) switches both displays to display the valid set values.
With potentiometers Voltage (10) and Current (11) the needed setvalues can be adjusted.
The displays begin to flash, indicating the set value display mode, and switch back after some seconds to actual value display.
Pressing the SETVALUES key longer than app. 2 seconds, the displays stay in set value display mode until the key is pressed again.
- Adjustment Range** The internal potentiometers provide an adjustment range of appr. 0,1% to 100% of their nominal value.
- Adjustment of voltage limit** Turn the voltage potentiometer clockwise to its limit and switch to set value display. Now you can adjust the maximum voltage with a screwdriver on potentiometer (17). During this, the LED V-LIMIT is on and the limitation voltage is displayed on the left display.
If you wish no limitation, simply turn the potentiometer (17) clockwise to it's limit. LED V-LIMIT goes off.
Turn voltage potentiometer back to the desired setvalue and switch display mode to actual value display (press key SET VALUES (16))
- The voltage limitation is always active. It limits the maximum output voltage also in operating mode analog programming or digital programming.**
- OUTPUT release** After adjustment of the set values, the output voltage can be release with switch OUTPUT (2).
The LED ON (3) indicates the released output.
- Control mode indication** Depending on the adjusted set values and connected load, the power supply will run either in constant voltage CV (14) or constant current mode CC (15).
- Power Limitation** The output power is limited to the maximum value 750W / 1500W / 3000W.
The operation in power limitation is indicated by the yellow LED "Power Limit".
The transition between voltage control, current control and power limitation occurs automatically.
- Save switch off** The following switch off procedure is recommended:
First, inhibit the output with key OUTPUT (2). LED ON (3) goes off.
After the output voltage has reached a low and save value, you can switch off the power supply with switch POWER.
This procedure gives you more safety, because the slow ramping down of the output voltage can be monitored on the display.
At immediate switch off with POWER switch, there could be charged capacitors remaining on dangerously high voltage that cannot be recognized.

Operating area of MCA units



Auto ranging power supplies from FuG have a three times larger operating area, compared with standard power supplies with equal power. The power supply can operate with full nominal voltage and about 1/3 nominal current - or full nominal current and about 1/3 nominal voltage. Other values correspond to the left diagram (e.g. 66% nominal voltage at 50% nominal current).

5. Maintenance

At units with fan the fan grids must be cleaned from time to time, depending on the pollution.

For the rest the MCA series needs no maintenance.

6. Options

6.1 Analog Programming

Features	Controlling of Voltage, current and output on/off by the analog interface. Provides the readout of actual values as analog voltages and latest control modes as digital status signals.
Select analog programming	Set switch (4) to REMOTE. If the power supply is additionally equipped with option Probus V (digital programming), set also switch (5) to ANALOGUE. LED ANALOGUE (7) indicates analog programming selected Now, the power supply is controlled by the signals on connector (3). Voltage and current are controlled by standard control voltages of 0..10V. 0...10V control voltage can be derived from an external potentiometer or some other source, i.e. PLC. Through special connections internal and external control can be combined. See examples below.
Voltage limitaion	The voltage set value limitation is always active. Adjustable with Potentiometer V-LIMIT (17) on the front panel.
Cable shielding	Connection cables to the analog programming connector must be shielded. The cable shield must be connected to earth, i.e. to the mounting nuts of the connector.
Three versions	Please refer to 6.1.1, Fehler! Verweisquelle konnte nicht gefunden werden. and 6.1.2

6.1.1 Directly Connected Analog Programming

ATTENTION!	The reference pins "0V" (pin 6 and 9) for all external programming voltages are connected to the 0V output terminal "A-". At an open connection to "0V" - earth, the programming can float up to ± 300 V. Please make sure that the connection cable for the programming and the following equipment has a dielectric strength of min. 500V against earth (screen). (A programming connector with 500 V rating is enclosed).
-------------------	---

Precision, Linearity, Stability and Temperature Drift

Due to the direct coupling, there is no degradation of the power supply performance.

6.1.2 Floating Analog Programming (2kV)

Mode of Operation	The analog signals for voltage and current set values as well as the monitor signals for voltage and current are galvanically isolated by means of optical fibre. Digital signals are also isolated with optical fibre.
Identification	You can see, if your power supply is equipped with directly connected or floating analog programming on a label or engraving "FLOATING ANALOGUE PROGRAMMING" on the backpanel.
Pin Assignment	Same as Directly Connected Analog Programming, but Pins 4 and 5 are not connected. Use of internal potentiometers not possible.
Isolation	There is no galvanic connection between the power supply output potential and the programming potential. The isolation is rated for 2kVDC. The 0V potential of the power supply can be operated fully floating up to +/- 300V. Maximum potential on the programming connector is ±30V DC with respect to earth.
Accuracy, Linearity and Stability	$<\pm 1 \times 10^{-5}$ based on nominal value (10V)
Temperature Drift	$<\pm 1 \times 10^{-5}/K$ of nominal value (10V)

Examples for wiring an analog interface:

Note:

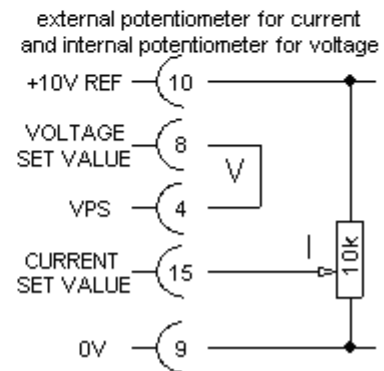
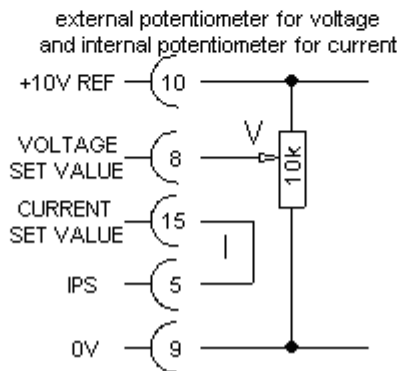
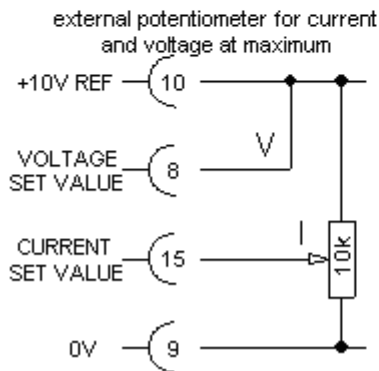
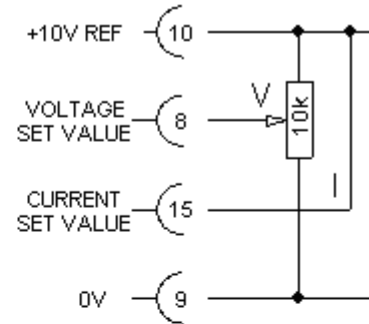
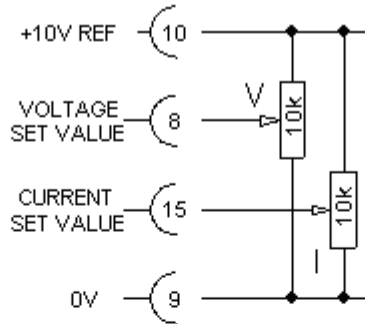
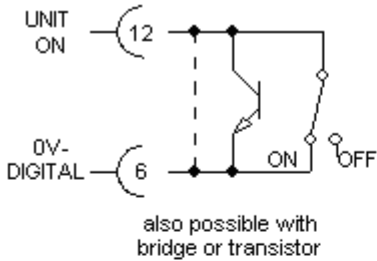
An external voltage adjustment implicitly requires the wiring of the current control and vice versa!

The reference voltage (+10V) or the set value voltages can be supplied by some other sources, i.e. PLC or PC plug-in cards (0V must be connected)

The UNIT-ON command (Pins 12-6) **must** be connected implicitly.

ATTENTION!

If the unit is switched off or mains fails possibly existing output voltages or currents will not be displayed on the monitor terminals.



Versions of analog Programming

Plug connection			View of solder side Plug		
All voltages and currents are specified in DC			Standard Non-isolated	600V potential free	2kV potential free
			Isolation maximal 30V against ground (see catalog „Options and Modification“)		
Isolation of the digital Inputs			0V	600 V	2000V
Isolation of the digital Outputs			0V	600 V	2000V
Isolation of the analog In and Outputs			0V	600 V	2000V
Pin No.	Description	Type	Function	Function	Function
1	CC	DA	Supplies appr. +15V if power supply is in constant current mode. Equivalent to LED CC on front panel.		
2	CV	DA	Supplies appr. +15V if power supply is in constant voltage mode. Equivalent to LED CV on front panel.		
3	I-MON	AA	Actual output current monitor signal 0..+10V represents 0..nominal current Ri ca. 10kΩ	Ri ca. 2kΩ	Ri ca. 11kΩ
4	VPS	AA	Slider Voltage Pot on front panel 0..+10V for 0..nom. Voltage Ri ca. 10kΩ	Not used	Not used
5	IPS	AA	Slider Current Pot on front panel 0..+10V for 0..nom. Voltage Ri ca. 10kΩ	Not used	Not used
6	OVD	DE	Ground for digital signals, may be current loaded		
7	POL-SET (option)	DE	For device of MCA series without function		
8	V-SET	AE	0...+10V controls 0...nominal voltage Input resistance to 0V appr. 10MΩ		
9	0V	A-GND	Ground for analog signals, must not carry any current		
10	+10VREF	AA	+10V Reference		
11	V-MON	AA	Actual output voltage monitor signal.0...+10V represents 0...nom. voltage Ri ca. 10kΩ	Ri ca. 2kΩ	Ri ca. 11kΩ
12	UNIT ON	DE	A connection to Pin 6 (OVD) releases the output voltage Same function as switch OUTPUT on front panel.		
13	POL-Status (option)	DA	For device of MCA series without function		
14	+NC		Not connected		
15	I-SET	AE	0..+10V controls 0..nominal current Input Resistance to 0V appr. 10MΩ		

ANALOG PROGRAMMIERUNG STANDARD

6.2 Digital Interface PROBUS V (Option)

The flexible Interface System Probus V consists of two parts, that communicate over a fiber optic connection.

- Unit ADDAT30 (short "ADDA") is an AD/DA interface that controls the power supply. ADDA is connected to an interface converter via fiber optics. ADDA is located as a plug on module on the power supply electronics. It is accessible after opening the left side panel of the housing.
- The interface converter that connects ADDA to different bus-systems, is located at the back panel of the power supply. It can also be operated outside the power supply. In that case, the outside connection is fiber optic and therefore, a maximum of EMC ruggedness can be achieved.

At the moment, interface converters are available for the following bus-systems:

- USB
- IEEE-488
- LAN (Ethernet)
- RS232
- RS422
- RS485
- Profibus
- CANopen
- Analog 0..10V

Features (short form)	<p>"Probus V" provides commands to set output voltage, output current and to switch the output voltage. Set values can be ramped with defined speed. High resolution read back of actual values.</p>
Programming speed	Up to 2000 set values per second possible. (depending on the interface converter)
Select Digital Interface	<p>Set switch (4) to REMOTE. If the power supply is additionally equipped with an "analog programming" option, set also switch (5) to DIGITAL. LED DIGITAL (8) indicates digital programming selected</p>
Status indication	LED BUSY (9) flashes on data traffic.
Voltage limitaion	The voltage set value limitation is always active. Adjustable with Potentiometer V-LIMIT (17) on the front panel.
Further Information	A detailed description of the Probus V system (command set, driver installation etc.) is provided in separate manuals that come along with Probus V.

7. Technical Data

All here stated data are valid for voltage and current control in internal operation.

Changes of the technical data with the options analog and digital programming see corresponding sections.

AC - Input	230V $\pm 10\%$ 47 - 63 Hz or 400V $\pm 10\%$ 3phasig 47 - 63 Hz, depending on the type, see type label. Overvoltage category II according to IEC664. N-connection and PE (non fused earth) always necessary! For devices with high leakage current required PEN At plug-type connections: performance according to - IEC 60320-C14 until 700W - IEC 60320-C19 700W until 1400W - Cable connect (Three Phase Current)
EMC Standards	See Certificate of Conformity.
Safety	See Certificate of Conformity.
Environment Conditions	Operating room: Only for indoor usage (see section 2.1.) Temperature: 0 °C to 40 °C Air humidity: Max. relative humidity 80% until 31 °C, linear decreasing until 50% relative humidity at 40 °C Atm press: Altitude max. 2000 m over sea level Contamination: 1
Protection Class	IP20
Output Voltage / Current	See front panel of the power supply.
Power Limitation	Depending on type, the output power is limited to 750W / 1500W or 3000W.
Output Polarity	Up to 1500V nominal voltage it is floating (each output terminal may get earthed) At 3000V nominal voltage it is positive or negative (see indication on the front panel). The „0V“ terminal is intern fix connected to earth.
Output Isolation	At units up to 400V nominal voltage each output terminal may get max. $\pm 500V$, at 750V max $\pm 1000V$ and at 1500V max. $\pm 2000V$ with respect to earth. Attention ! Not valid for units with "analog programming", see section 6.1.1
Setting Range Voltage	With Potentiometer VOLTAGE appr. 0,1% to 100% from nominal value
Current	With Potentiometer CURRENT appr. 0,1% to 100% from nominal value
Reproducibility	$\pm 1 \times 10^{-3}$ from nominal value,
Setting Resolution	With potentiometer on the front panel 1×10^{-4} from nominal value
Residual Ripple	$< 2 \times 10^{-4}$ pp +200mVpp from nominal value
Deviation	$< \pm 1 \times 10^{-5}$ from nominal value, for $\pm 10\%$ mains voltage variation $< 5 \times 10^{-4}$ from nominal value, for 0 to 100% load variation $< \pm 2 \times 10^{-4}$ from nominal value, over 8 hours $< \pm 1 \times 10^{-4} / K$ from nominal value
Recovery Time	
voltage control	$< 1ms$ for load variations from 10% to 100% or 100% to 10%
current control	$< 10ms$ for load variations causing an output voltage variation less than 10% of the nominal voltage.
Discharging Time Constant	at unloaded output max. 10 sec
Programming speed:	$< 300ms$ for changes of output voltage from 10% to 90% resp. 90% to 10%
Volage and Current Display	DVM for voltage and current, extent ± 20000 Digits
Status Display	LEDs for constant voltage, constant current, set value limitation active, setting of programming switch, Output ON, overtemperature, power limitation
Mechanical size	Depending on type, changes reserved.

8. Calibration

Certificate of Calibration All guaranteed data for our power supplies are tested in the factory and documented in an internal test protocol. Furthermore we offer within the scope of our ISO 9001 : 2008 certified quality system a calibration in our plant. The customer receives a certificate of calibration. We certify the output data and the compliance with our catalog data.

The blue calibration sticker refers to the next recommended date of calibration.

Subsequent Calibration Generally we recommend an annual subsequent calibration.

9. Certificate of Conformity

The power supplies carry the CE-sign. Please read the Certificate of Conformity.

10. Accessories

**Connectors, Cables
Mounting instructions**

See enclosed Mounting Instructions

Rack Adapter

Attention! Before opening the power supply, disconnect from mains!

The front panel handles must be exchanged separately. (Please don't exchange together, because the front panel would not be fixed).

Is the power supply only be used as plug-in unit, the stands may be removed.

For that remove the bottom sheet. The stands can be removed by using a screwdriver for recessed-head screws. Then place back the bottom sheet.

Caution!!

After removing the stands, the power supply may not longer be used as a table-top unit, because no convection cooling is possible, risk for overheating.

11. Warranty, Repairs

Your power supply has been assembled and tested under stringent quality assurance procedures.

We provide a 2 years warranty, commencing with the delivery date stated in the serial number.

This warranty does not cover misuse or attempted repair by untrained personnel.

Enclosed you will find one set of circuit diagrams for service purposes.

In all further enquiries for service or spare parts, please provide both the model and serial number of the unit

12. Special Models, Modifications

Power Supplies that are equipped with special modifications are identified with "MOD" within the type designator (i.e. MCA 750 – 1500 MOD) on the label at the rear panel .

Please refer to the separate data sheet attached.