EPS/HPE

EPS Stromversorgung GmbH
Alter Postweg 101
86159 Augsburg
www.eps-germany.de

Software version: V69
September 2016

Table of Contents

TECHNICAL SPECIFICATIONS

AMBIENT CONDITIONS

Cooling	Fan
Operating temperature	0 - 50 °C
Storage temperature	-20 - 70 °C
Humidity	< 80 %
Operating altitude	< 2000 m
Vibration	10 - 55 Hz/1 min/2G XYZ
Shock	< 20 G
Weight	5 kW 19 kg, 10 kW 26 kg, 15 kW 33 kg

INPUT SPECIFICATIONS

Version	5 kW	10 kW	15 kW	20 kW	30 kW	45 kW	60 kW
Connection	5 wire (3P+N+E)						
Input 3P/208	3 x 208 V_{ac} (187-229 V_{ac} 47-63 Hz)						
Input 3P/400	3 x 400 V_{ac} (360-440 V_{ac} 47-63 Hz)						
Input 3P/440	3 x 440 V_{ac} (396-484 V_{ac} 47-63 Hz)						
Input 3P/480	3 x 480 V_{ac} (432-528 V_{ac} 47-63 Hz)						
Max. allowed non symmetry	< 3 %						
Input Current (3 phase) 3P/400 model[1,2]	11.5 A_{eff}	22.9 A_{eff}	34.4 A_{eff}	45.8 A_{eff}	68.7 A_{eff}	103.1 A_{eff}	137.5 A_{eff}
Inrush Transient Current[2]	< 25	< 51	< 76	< 102	< 153	< 229	< 305
Nominal Current Internal Fuse[3]	20 A	40 A	60 A	80 A	120 A	180 A	240 A
Breaking Capacity Fuse/Automatic Fuse[3]	built-in Circuit Breaker: KLK 20 A						
Recommended Supply Breaker (value and curve)	16 A Type D/K	32 A Type D/K	63 A Type D/K	63 A Type D/K	< 80 A Type D/K	< 120 A Type D/K	< 150 A Type D/K
Leakage Current	< 35 mA	< 35 mA	< 35 mA	< 35 mA	< 35 mA	< 35 mA	< 35 mA
Cos phi	> 0.7	> 0.7	> 0.7	> 0.7	> 0.7	> 0.7	> 0.7
Harmonic Content[4]	50 Hz = 72 %						
	100 Hz = 2 %						
	150 Hz = 0,9 %						
	200 Hz = 0,1 %						
	250 Hz = 11 %						
	350 Hz = 0.6 %						
Efficiency Type[1]	94 %	94 %	94 %	94 %	94 %	94 %	94 %
Dissipated Power	300 W	600 W	900 W	1,200 W	1,800 W	2,700 W	3,600 W

[1] for nominal current and nominal voltage
[2] for nominal input voltage
[3] internal main fuse
[4] total harmonic distortion input current ([%]/Iein)

OUTPUT SPECIFICATIONS

Static voltage regulation	± 0.05 % + 2 mV
Static current regulation	± 0.1 % + 2 mA
Dynamic regulation	< 1-3 ms (typ.)
Ripple	< 0.2 % RMS (typ.)
Stability	± 0.05 %
Programming accuracy (V_{out})	± 0.05 % +2 mV
Programming accuracy (I_{out})	± 0.05 % +2 mA
Display accuracy (V_{out})	< ± 0.5%
Display accuracy (I_{out})	< ± 0.5%
Isolation	3,000 V
Over voltage protection	0 - 120 % V_{max}
Circuit protection	OC/OV/OT/OP
Line Regulation	< ± 0.1 % + 2 mV

AI INTERFACE

Digital outputs (CV, Standby, Error)	Output type: Open collector with pull-up resistor 10 k after + 5 V $I_{sinkmax}$: 50 mA
Digital inputs (Ext. Control, Standby)	Input resistance: 47 kΩ Maximum input voltage: 50 V High level: U_e > 2 V Low level: U_e < 0.8 V
Analog outputs (X_{mon})	Output resistance: 100 Ω Minimum permissible load resistance: 2 kΩ Minimum load resistance for 0.1 % accuracy: 100 kΩ
Analog inputs (X_{set})	Input resistance: 1 MΩ Maximum permissible input voltage: 25 V
Reference voltage	Reference voltage U_{ref}: 10 V ± 10 mV Output resistance: < 10 Ω Maximum output current: 10 mA (not short-circuit-proof)
5 V - Supply voltage	Output voltage: 5 V ± 300 mV Maximum output current: 50 mA (not short-circuit-proof)

RS 232

Signal inputs (RxD, CTS)	Maximum input voltage: ± 25 V Input resistance: 5 kΩ (Type) Switching thresholds: U_H < - 3 V, U_L > + 3 V
Signal outputs (TxD,RTS)	Output voltage (at R_{Last} > 3 kΩ): min ± 5 V, Type ± 9 V, max ± 10 V Output resistance: < 300 Ω Short circuit current: Type ± 10 mA

RS 485

Maximum input voltage	± 5 V
Input resistance	> 12 kΩ
Output current	± 60 mA Max
High level	U_d > 0.2 V
Low level	U_d < - 0.2 V

IMPORTANT SAFETY INSTRUCTIONS

Please read this manual thoroughly before putting the device into operation. Pay regard to the following safety instructions and keep this manual nearby for future purpose.

This operating manual is based on the state of technology at the time of printing. However, it is possible that despite regular control and correction, the present document contains printing errors or deficiencies. EPS Stromversorgung GmbH assumes no liability for any technical, printing or translational errors within this manual.

INITIAL OPERATION

UNPACKING

Please make sure that the shipping carton and the packaging is free of damage. If external damage is found, it is important to record the type of damage. Please keep the original packaging to ensure the device is adequately protected in case it needs to be transported in the future or claims for compensation need to be asserted.

SETTING UP

To avoid electric shocks and product failure, the device should be installed in a temperature and humidity controlled indoor environment. The ambient temperature must not exceed 50 °C. The device must never be exposed to liquids or extreme humidity.

VISUAL INSPECTION

The unit must be examined immediately for defects or damages in transit. Damages caused during transport may be loose or broken control knobs and bent or broken connectors. Do not use the device if any physical damage is apparent. Please inform the carriers and a representative of EPS Power Supplies immediately.

MAINS OPERATION

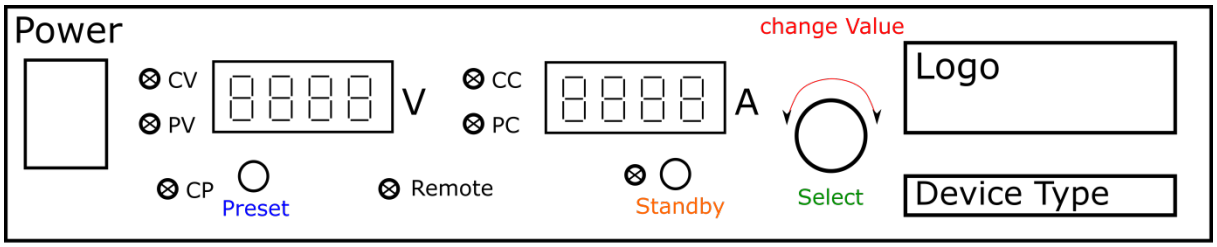
Make sure to verify the model number and voltage stated on the nameplate. Damages due to wrong power feed are not covered by guarantee conditions.

The unit must only be operated when connected directly to the mains. To avoid damage, do not connect the unit to isolating transformers, auto-transformers, magnetic current limiters or similar devices.

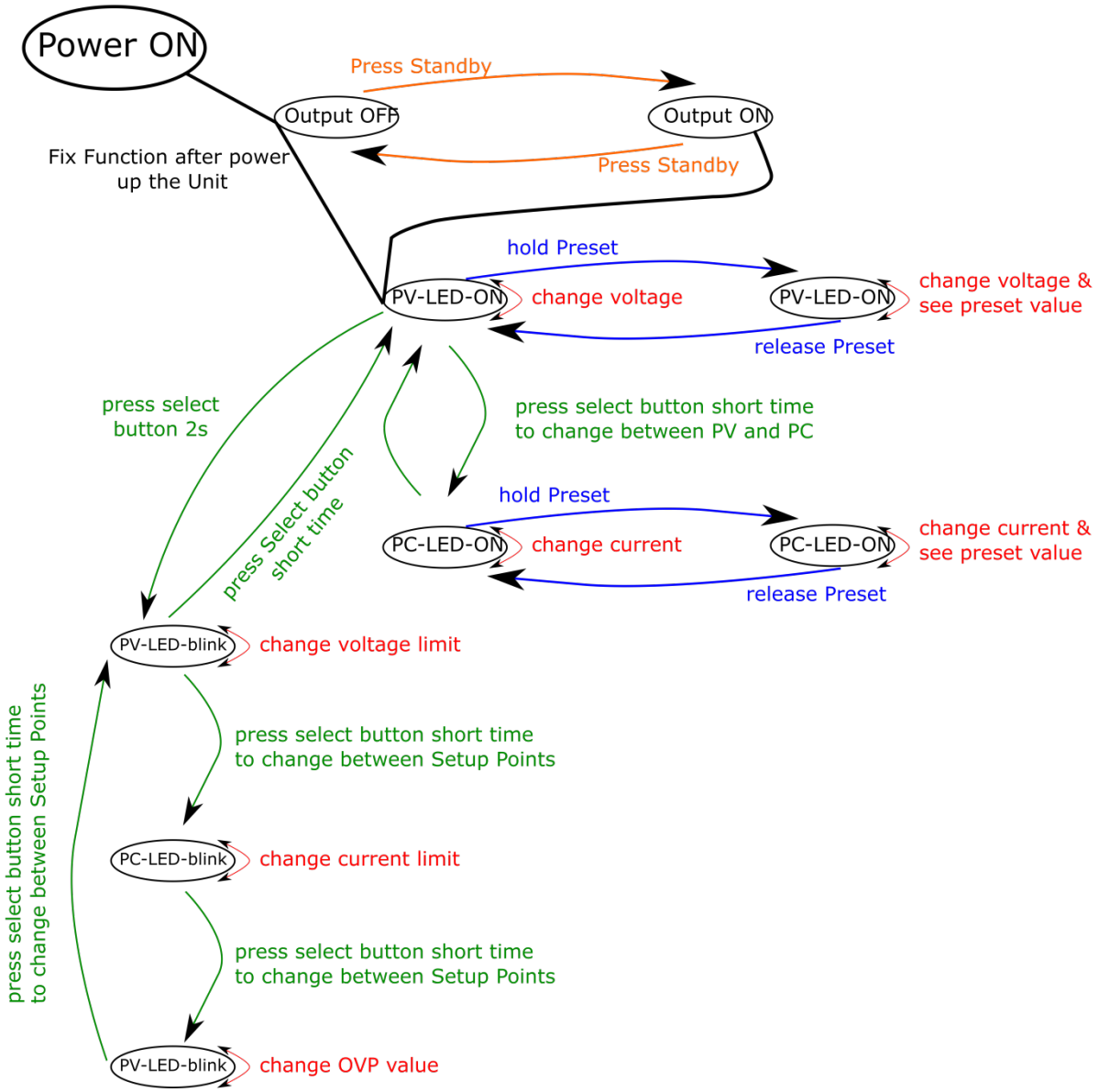
GENERAL SETTINGS

CONFIGURATION

The front panel has three buttons to change the parameters for voltage, current and OVP (Over Voltage Protection). Since the device is operated in UI mode only, the set values for voltage and current will be transferred directly to the switching regulator. There is no additional digital control. The following picture displays the control panel and control structure of the device.



Front panel control stucture



VOLTAGE SETTINGS

U_{LIMIT} AND I_{LIMIT}

U_{limit} limits the maximum output voltage. The output voltage is limited to the selected value, irrespective of the values that have been set at the front panel or at one of the interfaces. The adjustment range is 0 V up to the maximum rated voltage of the device.

I_{limit} limits the maximum output current. The output current is limited to the selected value, irrespective of the values that have been set at the front panel or at one of the interfaces. The adjustment range is 0 A up to the maximum rated current of the device.

These settings can only be changed at the display and they apply to all interfaces.

OVP (OVER VOLTAGE PROTECTION)

The output is shut immediately if the output voltage exceeds the selected value. The display indicates this status with the word *‚OVP'*. To reset this error, push the button ***Standby***. The OVP value applies to the front panel operation. There may apply different values for the AI-interface and the digital interface. The digital interface is initialized with the value which has been adjusted on the front panel. The adjustment range is 0 V up to the maximum rated voltage of the device + 20%.

AI-TYPE

This feature adjusts the voltage levels of analog input signals and analog output signals. Selectable ranges are 0-5 V and 0-10 V.

DESCRIPTION OF THE DIFFERENT LEDS

CV	Constant Voltage
PV	Preset Voltage
CC	Constant Current
PC	Preset Current
CP	Over Voltage Protection
Remote	Local or Remote Operation
Standby	Standby Status

UNIVERSAL INTERFACE (OPTION)

All interfaces of the digital interface are equal. There is no shift between the interfaces. For example, the first command can be issued via the IEEE interface while the second command can be issued via the RS232 interface. The return values will be sent from that interface the command was issued from.

COMMANDS

Communication is based on an ASCII protocol. The following chapters describe how to write a command and give an overview over the commands.

Format

A command consists of the command word, a parameter (if necessary) and a terminator. The character for the terminator is Carriage Return ***<CR>*** or Line Feed ***<LF>***.

Character	ASCII	Dec value	Hex value
Carriage Return	<CR>	13	0d
Line Fee	<LF>	10	0a

If the command contains a <DEL> or <ESC> character, it will not be processed. Therefore, a command can be cancelled while entering. Though, a terminator (***<CR>*** or ***<LF>***) is necessary.

Character	ASCII	Dec value	Hex value
Escape	<ESC>	27	1b
Delete	<DEL>	127	7f

Commands are not case sensitive and may be mixed up. Therefore, the effect of the following commands is the same: GTL, Gtl, gTL. Decimal places are optional and separated by a full stop '**.**' . The number of decimal places is not limited. Therefore, the effect of the following commands is the same: UA,10, UA,10.0, UA,10.000000000, UA,0010, UA,010.0000

The number of decimal places to be analyzed depends on parameter and unit type. It corresponds to the number of decimal places, a command without a parameter would return. As a rule, decimal places are analyzed until a resolution of 0.1% is reached.

Example: Evaluation of decimal places

EPS/HP/E with 600 V, 25 A
600 V * 0.1 % = 0.6 V → one decimal place
25 A * 0.1 % = 0.025 A → three decimal places

Optional, after a numerical value, a letter may be added to indicate the unit. However, this letter will not be analyzed.

Example: Attached letter as unit

UA,10.0 V → Resets output voltage to 10 V
UA,10.0 m → Caution! The ‚m' will not be evaluated, output voltage here is also 10 V

Example: A valid command with corresponding hex values

U	A	,	1	0	.	2	<CR>
55 h	41 h	2 ch	31 h	30 h	2 eh	32 h	0 dh

Example: Adjustment of output voltage 10 V/5 A (full command sequence)

OVP,100 → adjusts OVP to 100 V
UA,10 → adjusts output voltage to 10 V
IA,5 → current limiting 5 A
SB,R → output enabled

Instruction Set

The IEEE-488.2 standard demands several basic commands. Some commands may occur twice for compatibility reasons (once in the EPS version and once in the (old) IEEE-488.2 version). The following syntax is used to describe the commands:

[]	Square brackets	→ optional parameter
<>	Angle bracket	→ numerical value
{}	Curly bracket	→ selection list
|	Vertical line	→ separator within selection list

Example

GTR[,{0|1|2}] means that the command GTR can be used with or without parameters. If a parameter exists, it has to be 1, 2 or 3. Valid commands are: GTR GTR,1 GTR,2 GTR,3
IA[,<imax>] means that the command IA can be used either with or without parameters. If a parameter exists, it has to be a numerical value.

Quick view of commands

Command	Description	Result
CLS* or CLS	Clear Status	Deletes the status byte
DAT,<U>,<I>	DIP	Data for user-defined characteristic
DCL	Device Clear	Initialization data reset
GTL	Go To Local	Activates front panel operation
GTR[,{0|1|2}]	Go To Remote	Activates digital interface operation
IA[,<imax>]	Set I_{max}	Adjusts current limiting
ID or *IDN?	Identification	Displays identification string
LLO	Local Lockout	Deactivates LOCAL button
LIMI	Limit I_a	Reads maximum adjustable current limitation
LIMU	Limit U_a	Reads maximum adjustable voltage limitation
MI[,<Nr>]	Measure I_a	Measures present output current
MU[,<Nr>]	Measure U_a	Measures present output voltage
*OPT?	Optional Identification Query	Displays units current hardware/software version
OVP[,<U_{ovp}>]	Overvoltage Protection	Adjusts over voltage protection
PCx[,<baud>,<parity>, <data bits>,<stop bits>, <handshake>,<echo>, <timeout>]	Program Communication	Adjusts the interfaces
RI or *RST	Reset Instrument	Resets hardware (no return value)
SB[,{S|R|1|0}]	Standby	Enables/blocks the output
SS or *PDU	Save Setup	Saves previously made channel and interface parameter adjustments (no return value)
STATUS	Status	Query of the units' status (return values in binary format) (also see following table)
STB or *STB?	Interface Status	Displays the interface status.
UA[,<ua>]	Set U_a	Adjusts output voltage (if there are no parameters, present set point is displayed)

Detailed description of commands

CLS or CLS - Clear Status*

This command deletes the status byte. It affects only the status byte of the interface, the command was sent from. No return value. For detailed description of the status byte see the different interface chapters.

DAT,<U>,<I> - Data

Data for a user-defined characteristic. No return value. For detailed description of this command see → *Wavereset*.

DCL - Device Clear

This command resets the initialization data. No return value.
Caution: Interface parameters are also reset!

GTL - Go To Local

This command activates front panel operation. If ‚Local Lockout' (LLO) was activated before, it will also be reset. No return value.

GTR[,{0|1|2}] - Go To Remote

This command activates digital interface operation. The optional parameter affects the future behavior of the unit after switch on. Setting is saved permanently. No return value.

Optional parameter 0 = Deactivates automatic remote operation
The command GTR must be entered to activate the unit's remote operation mode. This mode is useful if the unit shall be operated manually and at the same time, measurement values shall be read out via the digital interface.

Optional parameter 1 = Activates remote operation on first addressing
Unit switches to remote operation when receiving a command via digital interface. The only exception is the GTL command, which switches the unit to local mode.

Optional parameter 2 = Activates remote operation immediately after switch on
After the unit was switched on, remote mode is immediately activated. Front panel operation is deactivated.

IA[,<imax>] - Set I_{max}

This command adjusts current limiting. Entering the command without parameters displays the set value. If the set value is higher than the maximum current of the unit, the range-error-bit within the ESR register of the interface is set. The present set value remains unchanged. If the set value is higher than the I_{limit} value, which was adjusted by the user's settings, but lower than the maximum current of the unit, the current is limited to the I_{limit} value. No error message.

Example: 300 A unit, I_{limit} adjusted to 200 A via configuration menu

GTR	Remote operation
OVP,200	Over voltage protection 200 V
UA,10	Output voltage 10 V
IA,100	Output current 100 A
SB,R	Output open
IA,400	Output current 400 A, this command is ignored, because the current is higher than the maximum current of the device. „Rangeerror" is set within the status byte.
IA,250	Output current 250 A, since the output current was limited to 200 A via configuration menu, current limiting is set to 200 A. Error bit is not set.
IA	Query of the adjusted current.
IA,200.0A	Unit answers: I_{limit} = 200 A

In master/slave mode, the current of a programmed device is adjusted. Connected in parallel, the total current is n x IA.

Example:

In M/S mode, 3 devices are connected parallel. IA,10 programs an output current of 10 A. All connected devices are set to 10 A. Since 3 devices have been connected parallel, the total current is 3 x 10A = 30A.

ID or IDN? - Identification

This command displays the identification string. Return value: <ID-String>.

LLO - Local Lockout

This command deactivates the ***Local*** button. Unit cannot be switched to local mode by holding the button ***Standby***. No return value.

LIMI - Limit I_a

With this command the user can read the maximum adjustable current limiting.

Example: 300A unit, I_{limit} was adjusted to 200 A via configuration menu

LIMI	Query of maximum adjustable current
LIMI,200.0A	Unit answers: I_{limit} = 200 A

LIMU - Limit U_a

Reads maximum adjustable voltage limitation. This command requests the previously defined maximum output voltage.

Example: 300 V unit was adjusted to 200 V via configuration menu

LIMU	Query of maximum adjustable current
LIMU,200.0V	Unit answers: U_{limit} = 200 V

MI[,<Nr>] - Measure I_a

This command measures the present output current.

Example:

GTR	Remote operation
OVP,200	Over voltage protection 200 V
UA,10	Output voltage 10 V
IA,1	Output current 1 A
SB,R	Output open
MI	Measures present output current
MI,0.567A	Unit answers: 567 mA

In master/slave mode with parallel connection the total current of all connected devices is displayed. Using the parameter <Nr> will show the value of each connected device. Numbering starts with 0.

Example:

MI,2 displays the measured output current at the bus of device number 3.

MU[,<Nr>] - Measure U_a

This command shows the measurement value of the present output voltage.

Example:

GTR	Remote operation mode
OVP,200	Over voltage protection 200 V
UA,10	Output voltage 10 V
IA,1	Output current 1 A
SB,R	Output open
MU	Measures present output voltage
MU,10.0V	Unit answers: 10 V

In master/slave mode with serial connection the total current of all connected devices is displayed. Using the parameter <Nr> will show the value of each connected device. Numbering starts with 0.

Example:

MU,1 displays the measured output voltage at the bus of device number 2.

**OPT? - Optional Identification Query*

This command does an optional identification query, which means it displays the software version.

Example:

*OPT?	Query of version number
08.06.2012 V42	Unit answers: Version 42 vom 08.06.2012

OVP[,<U_{ovp}>] - Over Voltage Protection

This command adjusts the over voltage protection. Entering the command without parameter displays the present set point. If the set point is higher than a maximum of 1.2 x voltage of the unit, the range error bit within the ESR register of the interface is set. The present set point remains unchanged.

Example:

GTR	Remote operation mode

OVP,200	Over voltage protection 200 V
UA,100	Output voltage 100 V
IA,10	Output current 10 A
SB,R	Output open

PCx[,<baud>,<parity>,<data bits>,<stop bits>,<handshake>,<echo>,<timeout>] - Program Communication

This command adjusts the interfaces. The EPS/HP/E has a maximum of 3 digital interfaces (x = 1, 2 or 3). The corresponding commands are ***PC1***, ***PC2*** or ***PC3***. Type and number of parameters depend on the type of interface. Currently there are no settings available for GPIB and LAN. Entering the command without parameter displays present interface parameters.

Parameter	Function
<baud>	Baud rate in bps
<parity>	Data parity O = Odd = Uneven parity E = Even = Even parity N = None = No parity bit
<data bits>	Number of data bits
<stop bits>	Number of stop bits
<handshake>	Handshake H = Hardware S = Software N = None (no handshake)
<echo>	Character echo E = Echo = echo on N = None = echo off
<timeout>	Timeout in ms when switching between sending and receiving (RS485 only)

Allowed parameters for RS232 interface:
PCx,<baud>,<parity>,<data bits>,<stop bits>,<handshake>,<echo>

Parameter	Function
Baud:	1200, 2400, 4800, 9600, 14400, 19200, 38400, 57600, 62500, 115200
Parity:	O, E, N
Data bits:	7, 8
Stop bits	1, 2
Handshake:	H, S, N
Echo:	E, N

Allowed parameters for USB interface:
PCx,<baud>,<parity>,<data bits>,<stop bits>,<handshake>,<echo>

Parameter	Function
Baud:	1200, 2400, 4800, 9600, 14400, 19200, 38400, 57600, 62500, 115200
Parity:	O, E, N
Data bits:	7, 8
Stop bits	1, 2
Handshake:	H, S, N
Echo:	E, N

Note: The USB interface of the PC is controlled like a virtual COM port and therefore the parameters correspond to those of the RS232 interface.

Allowed parameters for RS485 interface:
PCx,<baud>,<parity>,<data bits>,<stop bits>,<timeout>

Parameter	Function
Baud:	1200, 2400, 4800, 9600, 14400, 19200, 38400, 57600, 62500, 115200
Parity:	O, E, N
Data bits:	7, 8
Stop bits	1, 2
Timeout:	0…100

If the interface parameters must be changed permanently, the data has to be saved after the ***PCx*** command with the command ***<SS>***. No return value.

Example:

PC1	Query of first interface parameters
PC1,RS232,9600,N,8,2,N,E	Unit answers: PC1 is a RS232 interface, 9600 bauds, 8 data bits, 2 stop bits, no handshake, no parity, echo on.
PC1,115200,N,8,2,N,E	Adjust baud rate to 115200 baud. The new baud rate is active immediately after the command has been sent!
PC2	Query of second interface parameters
PC2,RS485,9600,N,8,1,1	Unit answers: PC2 is a RS485 interface, 9600 bauds, 8 data bits, 1 stop bit. Timeout when switching between receiving and sending is 1 ms.
PC2,9600,N,8,1,50	Increase timeout to 50ms.
PC3	Query of third interface parameters
PC3, EMPTY	Unit answers: Interface 3 is not available in this unit.
SS	Save settings.

*RI or *RST - Reset Instrument*

The unit executes a hardware reset. No return value.

SB[,{S|R|1|0}] - Standby

This command enables/disables the output. Entering the command without parameters displays the present standby status. The commands ***SB,S*** and ***SB,1*** switch the unit to standby mode, the output is disabled. The commands ***SB,R*** and ***SB,0*** disable the standby mode, the output is enabled.

Example:

GTR	Remote operation mode
OVP,200	Over voltage protection 200 V
UA,100	Output voltage 100 V
IA,10	Output current 10 A
SB,R	Output is active
SB	Retrieve standby status
SB,R	Unit answers: output is active

STATUS - Status

Query of device status. Return value in binary units. Function of the bits within the status byte:

Bit	Function
D15	Number of units in M/S mode. If no other device is connected, 1 is displayed, if two devices are connected to the bus, 2 is displayed etc. If M/S mode was disabled via configuration menu, 0 is displayed.
D14	
D13	
D12	
D11	- reserved -
D10	- reserved -
D9	- reserved -
D8	Limit mode, unit in power limitation mode
D7	Limit mode, unit in current limitation mode
D6	Local lockout (1 = LLO active, 0 = LLO not active)
D5	Local (1 = front panel operation)
D4	Remote (1 = digital interface operation)
D3	- reserved -
D2	- reserved -
D1	Standby (1 = unit in standby mode)
D0	OVP (1 = shut down by over voltage protection)

Example:

STATUS	Status query
STATUS,0000000100010000	Unit answers: Remote operation mode, power limitation

*STB or *STB? - Interface Status*

Displays the interface status.

UA[,<U_{max}>] - Set U_{max}

This command adjusts the voltage limitation. Entering the command without parameters displays the present set point. If the set point exceeds the maximum voltage of the unit, the range error bit within the ESR register of the interface is set. The present set point remains unchanged. If the set point is higher than the selected value for U_{limit}, but lower than the unit's maximum voltage, voltage limitation is restricted to U_{limit}. There is no error message.

Example:

GTR	Remote control operation
OVP,320	Over voltage protection 320 V
UA,100	Output voltage 100 V
IA,10	Output current 10 A
SB,R	Output is active
UA,400	Output voltage 400 V. This command is ignored because the voltage is higher than the maximum voltage of the unit. Range error is set within the status byte.
UA,250	Output voltage 250 V. Since the output voltage was limited to 200 V via configuration menu, voltage limitation is adjusted to 200 V. An error bit is not set.
UA	Query of adjusted voltage
UA,200.0V	Unit answers: set point U_a = 200 V

In master/slave mode the voltage of the programmed device is set. In master/slave serial connection the total voltage is n x UA.

Example:

3 devices are connected in series while in M/S mode. With UA,10 an output voltage of 10V is programmed. Therefore all connected devices are adjusted to 10V. Since three devices are connected in series, the total voltage is 3 x 10 V = 30 V.

Response String

The response string has the following format:

command comma value unit <CR> <LF>

The value is a floating point string with a '**.**' as delimiter.

Command	Response
IA	IA,12.34A
LIMU	LIMU,500.0V
LIMI	LIMI,30.00A
LIMP	LIMP,15000W
LIMRMIN	LIMRMIN,0.015R
LIMRMAX	LIMRMAX,0.110R
LIMR	LIMR,0.015R,0.110R

Command	Response
MU	MU,10.0V
PA	PA,12W
RA	RA,0.015R
UA	UA,100.0V
UMPP	UMPP,90.2V
IMPP	IMPP,10.01A
OVP	OVP,600.0V

Example: Command as ASCII and HEX protocol

L	I	M	U	,	5	0	0	.	0	V		
4C	49	4D	55	2C	35	30	30	2E	30	56	0D	0A

The digits after the decimal point correspond to the resolution of the unit.

Example

UA at a 600 V unit UA,123.4V
UA at a 50 V unit UA,23.44V

The digits before the decimal point depend on the present measurement value.

Example: 600 V unit

UA,10.4V
UA,220.3V
UA,1.1V

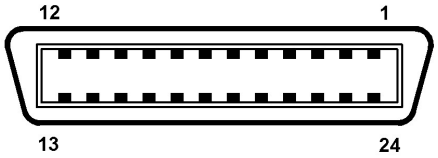
Example: 50 V unit

UA,1.23V
UA,10.47V
UA,0.01V

EXT. CONTROL: COMPUTER

GPIB

Connection is carried out with a 24pin Centronics connector. The device address is adjusted with the DIP switches S1-S5. Here, S1 has the lowest priority and S5 the highest.



No	Name	Function
1	DIO1	Data line 1
2	DIO2	Data line 2
3	DIO3	Data line 3
4	DIO4	Data line 4
5	EOI	End or Identify
6	DAV	Data Valid
7	NRFD	Not Ready For Data
8	NDAC	No Data Accepted
9	IFC	Interface Clear
10	SRQ	Service Request
11	ATN	Attention
12	SHIELD	Shield
13	DIO5	Data line 5
14	DIO6	Data line 6
15	DIO7	Data line 7
16	REN	Remote Enable
18 - 23	GND	Ground
24	SGND	Signal Ground

Table: Device address

S1	S2	S3	S4	S5	Address
Off	Off	Off	Off	Off	0
On	Off	Off	Off	Off	1
Off	On	Off	Off	Off	2
On	On	Off	Off	Off	3
Off	Off	On	Off	Off	4
On	Off	On	Off	Off	5
Off	On	On	Off	Off	6
On	On	On	Off	Off	7
Off	Off	Off	On	Off	8
On	Off	Off	On	Off	9
Off	On	Off	On	Off	10
On	On	Off	On	Off	11
Off	Off	On	On	Off	12
On	Off	On	On	Off	13
Off	On	On	On	Off	14
On	On	On	On	Off	15

S1	S2	S3	S4	S5	Address
Off	Off	Off	Off	On	16
On	Off	Off	Off	On	17
Off	On	Off	Off	On	18
On	On	Off	Off	On	19
Off	Off	On	Off	On	20
On	Off	On	Off	On	21
Off	On	On	Off	On	22
On	On	On	Off	On	23
Off	Off	Off	On	On	24
On	Off	Off	On	On	25
Off	On	Off	On	On	26
On	On	Off	On	On	27
Off	Off	On	On	On	28
On	Off	On	On	On	29
Off	On	On	On	On	30
On	On	On	On	On	31

The device address is read in only when the unit is switched on. Changing the DIP switches while the unit is active will not change the device address!

Table: Device equipment (according to IEEE-488.1)

SH1	Source Handshake function available
AH1	Acceptor Handshake function available
T6	Talker, Serial Poll, end addressing by MLA
L4	Listener function, end addressing by MTA
SR1	Service request available
RL1	Remote/Local function available
PP0	No parallel poll function
DC1	Device clear function available
DT0	No trigger function
C0	no controller function
E1	Open-collector driver

Status Word

The status word can be read with the command ***<STB>*** or ***<*STB?>***. Return value: STB,xxxxxxxx

Table: Reading the status word

Bit	Function
D7	n/a
D6	SRQ is set, if SRQ was requested
D5	ESB is set, if a byte was set within the SES register
D4	MAV is set, if a message is available
D3	n/a
D2	see table
D1	see table
D0	see table

Table: Error messages

D3	D2	D1	D0	Error
0	0	0	1	Syntax
0	0	1	0	Command
0	0	1	1	Range
0	1	0	0	Unit
0	1	0	1	Hardware
0	1	1	0	Read

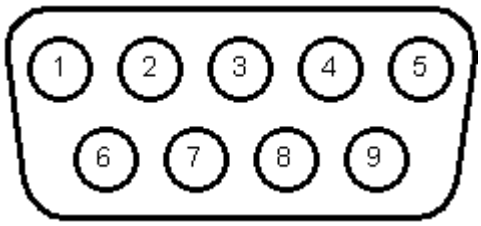
ESR-Register - Event-Status-Register

The ESR register can be read using the command ***<*ESR?>***. Return value: ESR,xxxxxxxx. After the query, the ESR register is deleted.

Bit	Function
D7	Power on
D6	Command error
D5	User request
D4	Execution error
D3	Device dependent error
D2	Query error
D1	Request control
D0	Operation complete

RS232 INTERFACE

The connection of the RS232 interface is carried out with a 9pin sub D connector. A null modem cable must be used as connector cable.



No	Name	Function
1	N.C.	
2	TxD	Data line from unit to PC
3	RxD	Data line from PC to unit
4	N.C.	
5	GND	GND
6	N.C.	
7	CTS	Reception of the PC, signal direction from PC to unit (only required for active Hardware handshake)
8	RTS	Reception of the unit, signal direction from unit to PC (only required for active Hardware handshake)
9	N.C.	

The interface can be operated using the following parameters:

Baud rate:	1200, 2400, 4800, 9600, 14400, 19200, 38400, 57600, 62500, 115200
Parity:	O = Odd = uneven parity
	E = Even = even parity
	N = None = no parity bit
Number of data bits:	7 or 8
Number of stop bits:	1 or 2
Handshake:	H = Hardware
	S = Software
	N = None (no handshake)
	The defined character for XON is 0 x 11 and for XOFF it is 0 x 13.

Interface parameters in delivery state are 9600 baud, no parity, 8 data bits, 1 stop bit, echo on. The status word can be read with the command ***<STB>*** or ***<*STB?>***. The following functions are assigned to the bits:

Bit	Function
D15	Parity error
D14	Over run error
D13	Framing error
D12	Timeout error
D11	Echo on
D10	used internally, can be 1 or 0
D9	Hardware handshake (RTS/CTS)
D8	Software handshake (XON/XOFF)
D7	Parity enable
D6	Parity mode (1 = odd, 0 = even)
D5	Stop bit (1 = 2 stop bits; 0 = 1 stop bit)
D4	Data format (1 = 8 bit; 0 = 7 bit)
D3	used internally, can be 1 or 0
D2	→ Table
D1	→ Table
D0	→ Table

Table: Error messages

D2	D1	D0	Error
0	0	1	Syntax
0	1	0	Command
0	1	1	Range
1	0	0	Unit
1	0	1	Hardware
1	1	0	Read

If echo is on, the interface confirms each incoming character by sending the same character back to the sender. The interface parameters can be adjusted via software and the command ***<PCx>***. These settings can be saved with the command ***<SS>***.

Interface Reconfiguration

In case, the user has forgotten the active setup, there are two ways of reconfiguring the interface:

- sending the command ***<PCx>*** from one of the other interfaces
- using the display to configure the interface → *Interface Parameters*

RS485 Interface

The interface works with the following parameters:

Baud rate:	1200, 2400, 4800, 9600, 14400, 19200, 38400, 57600, 62500, 115200
Parity:	O = Odd = uneven parity
	E = Even = even parity
	N = None = no parity bit
Number of data bits:	7 or 8
Number of stop bits:	1 or 2
Timeout:	0-100 ms

A timeout is the time between receipt and sending of a message. The connected device is selected by entering the command and placing the number of the device and '#' before it. When using the word ‚ALL' instead of a number, the following command will be executed by all connected devices (e. g. *#1,ID; #22,GTR, #ALL,GTL*).

Example:

#1,ID
#22,GTR
#ALL,GTL

The status word can be read with the command ***<STB>*** or ***<*STB?>***. The following functions are assigned to the bits:

Bit	Function
D15	Parity error
D14	Over run error
D13	Framing error
D12	Timeout error
D11	n/a
D10	n/a
D9	n/a
D8	n/a
D7	Parity enable
D6	Parity mode (1 = odd, 0 = even)
D5	Stop bit (1 = 2 Stop bits; 0 = 1 Stop bit)
D4	Data format (1 = 8 bit; 0 = 7 bit)
D3	n/a
D2	→ Table
D1	→ Table
D0	→ Table

Table: Error messages

D2	D1	D0	Error
0	0	1	Syntax
0	1	0	Command
0	1	1	Range
1	0	0	Unit
1	0	1	Hardware
1	1	0	Read

Interface parameters are configured via software using the command ***<PCx>***. The settings can be saved with the command ***<SS>***.

Interface Reconfiguration

In case, the user has forgotten the active setup, there are two ways of reconfiguring the interface:

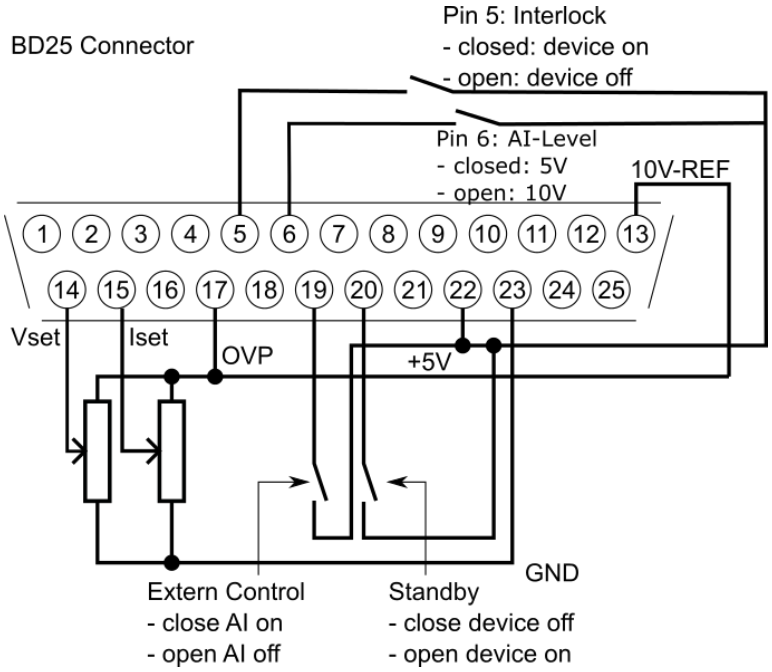
- sending the command ***<PCx>*** from one of the other interfaces
- using the display to configure the interface → *Interface Parameters*

EXT. CONTROL: AI INTERFACE (OPTION)

The device can be controlled via control signals and by using the analog/digital In/Out.

PIN ASSIGNMENT AI INTERFACE

No (BD25)	Dir	Name	Function
1	analog out	U_{mon}	Monitor set point U
2	analog out	I_{mon}	Monitor set point I
3	analog out	P_{mon}	Monitor actual value P
4	analog out	OVP_{mon}	Monitor actual value OVP
5	digital in	Soft-Interlock	Interlock function (Caution: Interlock does not correspond to the machinery directives)
6	-nc-	-	-
7	digital out	CV	Signals „Const. Voltage“ mode
8	analog out	U_{istmon}	Monitor output voltage
9	gnd	GND	-
10	digital out	Standby	Signals standby
11	gnd	GND	-
12	-nc-	-	-
13	REF10	10 V-V_{ref}	Output 10 V reference voltage
14	analog in	U_{set}	Set point U
15	analog in	I_{set}	Set point I
16	analog in	In 2	-
17	analog in	OVP_{set}	Set point OVP
18	analog in	In 4	-
19	digital in	Ext. Control	Activates analog control
20	digital in	Standby	Activates standby
21	analog out	I_{istmon}	Monitor output current
22	pwr	+ 5 V	Output 5 V supply voltage
23	gnd	GND	-
24	digital out	Error	Signals shut down by OVP
25	gnd	GND	-
26	-nc-	-	-



All digital outputs are OC outputs with a pull-up resistance after + 5 V. All analog inputs and outputs can be operated in 0-5 V or in 0-10 V mode.

ANALOG INPUT

Set points are adjusted as dc voltage (0-5 V or 0-10 V) on the analog inputs. The voltage range can be chosen in the configuration menu. To save all changes after changing the voltage range, the unit must be restarted.

Set Point U (U_{Set})

Set point output voltage. The set point refers to the rated voltage of the unit.

Example:

EPS/HP/E at 600 V output voltage, AI is adjusted to 10 V, desired output voltage = 100 V.
U_{set} = 10 V · 100 V ÷ 600 V = 1,667 V

Set Point I (I_{Set})

Set point output current. The set point refers to the rated current of the unit.

Example:

EPS/HP/E at 100 A output voltage, AI is adjusted to 10 V, desired output current = 2 A.
I_{set} = 10 V · 2 A ÷ 100 A = 0.200 V

Set Point OVP (U_{OVP})

The output is deactivated immediately if the output voltage exceeds the adjusted value. This error is indicated on the display with the word „Error“. To reset this error, standby mode must be activated. Adjustment range is 0 V up to the maximum rated voltage of the device + 20%.

Example:

EPS/HP/E with 600 V output voltage, AI is adjusted to 10 V, desired OVP voltage = 650 V.
Adjustment range: 600 V + 20% = 720 V
U_{set} = 10 V · 650 V ÷ 720 V = 9.028 V

ANALOG OUTPUT

On the analog outputs, present measurement values are displayed as dc voltage values (regardless of the actual operation mode). Therefore, the AI interface can be used for monitor purposes. Maximum voltage is 5 V / 10 V.

Monitor Set Point U (U_{mon})

Present set point of the output voltage. Measurement value refers to the rated voltage of the device.

Example:

EPS/HP/E at 600 V output voltage, AI is adjusted to 10 V, voltage at output U_{mon} = 2 V.
Present set point: U_{set} = 2 V * 600 V ÷ 10 V = 120 V

Monitor Set Point I (I_{mon})

Present set point of the output current. Measurement value refers to the rated current of the device.

Example:

EPS/HP/E at 100 A output current, AI adjusted to 10 V, voltage at output I_{mon} = 2 V.
Present set point: I_{set} = 2 V * 100 V ÷ 10 V = 20 A

Monitor Actual Value P (P_{mon})

Present set point for output power. It is calculated by the controller from measurement values of output voltage and output current. Measure value refers to the rated power of the device.

Example:

EPS/HP/E at 15 kW rated power, AI adjusted to 10 V, voltage at output P_{mon} = 5 V.
Present output power P_{out} = 5 V * 15 kW ÷ 10 V = 7.5 kW

Analog Output OVP (U_{OVPmon})

Present set point for over voltage protection. Measurement value refers to the rated voltage of the device + 20%.

Example:

EPS/HP/E at 600 V output voltage, AI adjusted to 10 V, voltage at output U_{mon} = 2 V. Signal refers to 600 V + 20% = 720 V.
Present set point: U_{ovp} = 2 V * 720 V ÷ 10 V = 144 V

Monitor Output Voltage (U_{Istmon})

Present measure value point value for output voltage. Measurement value refers to the rated voltage of the device.

Example:

EPS/HP/E at 600 V output voltage, AI adjusted to 10 V, voltage at output U_{istmon} = 6 V.
Present output voltage U_{out} = 6 V * 600 V ÷ 10 V = 360 V

Monitor Output Current (I_{Istmon})

Present measure value for output current. Measurement value refers to the rated current of the device.

Example:

EPS/HP/E at 100 A output current, AI adjusted to 10 V, voltage at output I_{istmon} = 4 V.
Present output current I_{out} = 4 V * 100 A ÷ 10 V = 40 A

DIGITAL INPUT

The digital inputs can be used to adjust the operation mode for the analog control. Inputs are low active.

Activation (Ext. Control)

The input ‚Ext. Control' can be used to chose the operation mode ‚*AI*'. The AI interface is activated by an applied voltage of + 5 V up to + 10 V. Front panel operation is deactivated. Operation mode is marked as ‚*AI*' on the display. The digital interface takes priority over the AI interface. The settings from AI interface have no effect if the device is toggled to ‚*Remote*'.

Soft-Interlock

The Interlock deactivates the unit immediately, when the connection between interlock input (Pin 5) and +5 V voltage is opened. In this case, the output of the unit cannot be activated, neither by interface nor by front panel. The difference between Soft-Interlock and Interlock is that a Soft-Interlock does not correspond to the machinery directives. If the Soft-Interlock is triggered, the unit switches into Interlock-Mode.

Blocking (Standby)

The standby mode is activated by an applied voltage of + 5 V up to + 10 V.
The output signal is enabled, if the input ‚*Standby*' is toggled inactive.

DIGITAL OUTPUT

On the digital outputs, actual device adjustments are displayed (irrespective of the actual operation mode). Therefore the AI interface may be used for monitoring functions also. Gauges are consistent with a negative logic: S = Set = log. 0; R = Reset = log. 1

A set output has a voltage level of < 0.6 V. A reset output has a voltage level of > 1.2 V.

Blocking (Standby)

The blocking of the output is set, if the unit is in standby mode.

CONST. VOLTAGE MODE (CV)

Constant voltage mode is set, when the unit is in constant voltage mode.

ERROR

An error is set, if the unit has been shut down by OVP. To reset this error, the standby mode must be activated.

EXT. CONTROL: ETHERNET (LAN)

To communicate with the EPS/HPE via network, it is necessary to assign an IP address to the device first. In delivery status, the device automatically draws an IP from the network. In its practical operation, this behavior is unfavorable, because after each activation the device has a new IP address. Therefore, to each device an individual, permanent IP address should be assigned.

The status word can be read with the command ***<STB>*** or ***<*STB?>***. Only bits from D0 up to D2 are in use. All other bits can be 1 or 0.

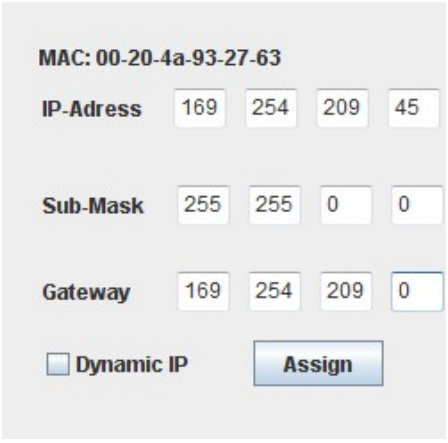
Table: Error messages

D2	D1	D0	Error
0	0	1	Syntax
0	1	0	Command
0	1	1	Range
1	0	0	Unit
1	0	1	Hardware
1	1	0	Read

MANUAL ASSIGNMENT OF AN IP UNDER MICROSOFT WINDOWS®

After the console has been opened, clicking on ‚Start' and ‚Ausführen' opens an input field. After this, the command ***cmd*** or ***command*** opens a DOS window. The following has to be entered: arp -s xxx.xxx.xxx.xxx yy-yy-yy-yy-yy-yy. ‚xxx' is the desired IP address, ‚yy' is the MAC address of the unit, which can be read from the unit's back panel.

The entry of the IP has been added to the ARP table. The device has no new IP yet. Execute telnet with new IP on port 1: telnet xxx.xxx.xxx.xxx 1. ‚xxx' is the desired new IP address. Connection fails but the new IP address is thus assigned to the device. The assignment of the IP is still dynamical, which means that these settings get lost after the device has been cut off from the network. The user interface can be loaded by entering the new IP address: http://xxx.xxx.xxx.xxx. By selecting the menu item ‚Config', the IP address can be adjusted. Java must be supported by your browser to adjust the IP.



MONITORING THE DEVICE VIA BROWSER

The user interface opens via direct request of the IP address: http://xxx.xxx.xxx.xxx. The item menu ‚Control' opens the control of the unit. Java must be supported by your browser to control the device.

CONTROLLING THE DEVICE VIA TELNET

The device can be controlled directly via port 10001. After the console has been opened, a click on ‚Start' and ‚Ausführen' opens an input field. After the commands ***cmd*** or ***command*** have been entered, a DOS window opens with: telnet xxx.xxx.xxx.xxx 10001.

Alternatively, many terminal programs offer the possibility to establish a TCP/IP or telnet connection.

When controlling the device via port 10001, the user interface of the device must not be open in a browser!

EXT. CONTROL: USB

The USB interface provides a virtual COM port for the PC. Via this port, the unit can be controlled as with a normal RS232 interface, e. g. with a terminal program. Corresponding drivers for all current operating systems are available as download: http://www.ftdichip.com/Drivers/VCP.htm.

The status word can be read with the command ***<STB>*** or ***<*STB?>***.

Bit	Function
D15	Parity error
D14	Over run error
D13	Framing error
D12	Timeout error
D11	Echo on
D10	used internally, can be 1 or 0
D9	Hardware handshake (RTS/CTS)
D8	Software handshake (XON/XOFF)
D7	Parity enable
D6	Parity mode (1 = odd, 0 = even)
D5	Stop bit (1 = 2 Stop bits; 0 = 1 Stop bit)
D4	Data format (1 = 8 bit; 0 = 7 bit)
D3	used internally, can be 1 or 0
D2	→ Table
D1	→ Table
D0	→ Table

Table: Error messages

D2	D1	D0	Error
0	0	1	Syntax
0	1	0	Command
0	1	1	Range
1	0	0	Unit
1	0	1	Hardware
1	1	0	Read

The defined character for XON is 0 x 11 and for XOFF it is 0 x 13.

Interface parameters are adjusted by software with the command ***<PCx>*** and afterwards they can be saved with the command ***<SS>***.

Interface Reconfiguration

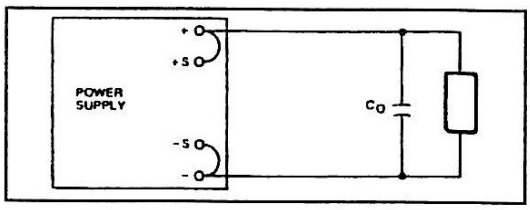
In case, the user has forgotten the active setup, there are two ways of reconfiguring the interface:

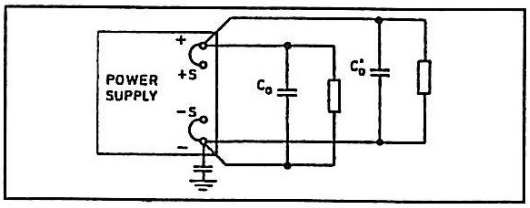
- sending the command ***<PCx>*** from one of the other interfaces
- using the display to configure the interface → *Interface Parameters*

SENSE MODE

LOAD CONNECTION WITHOUT SENSOR CONDUCTOR

Almost all our power supplies are provided with sensor conductor connectors to compensate the voltage drop on the load. In case, these connectors are not in use, they must be short-circuited with correct polarity to the load outputs and directly to the output connectors. By no means, current may flow over the sense connectors. In case of multiple loads, the user has to provide a central load distribution point. To reduce peak loads and for an HF impedance terminator, a 1-10 µF capacitor should be connected to the output.

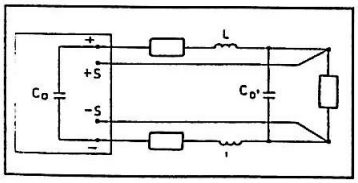


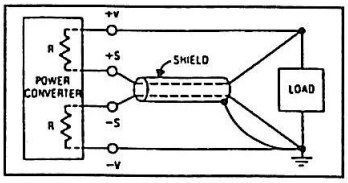


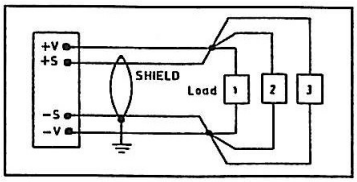
LOAD CONNECTION WITH SENSOR CONDUCTOR

The following points must be considered, when existing sense cables are connected directly to the load or to the central load distribution point:

- remove existing sense cable bridges from the power supply
- directly connect + sense and - sense with correct polarity to the load distribution point
- connect + sense and - sense conductors to a 1-47 µF capacitor
- protect sense cable or at least twist + sense and - sense
- select load line cross section, so that voltage drop is < 0.4 V
- avoid overload of power supplies (voltage drop per line x current)



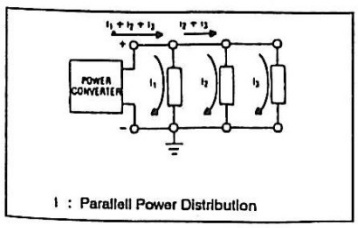


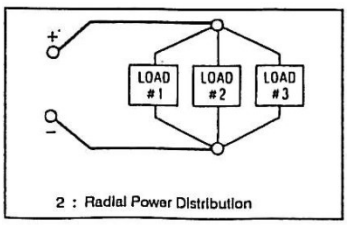


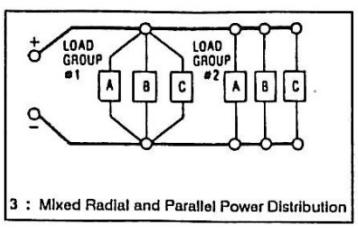
If thus you paid attention to the points stated above, oscillation occurs through load or power induction and complex load situations, please contact our company EPS.

LOAD DISTRIBUTION WITHOUT SENSOR CONDUCTOR

To ensure a proper use, a central load distribution situation is essential. Illustration 2 shows a correct load distribution. Illustration 1 shows an insufficient supply of load 2, load 3 etc. via parallel load conductors. In practice, it may occur that an optimal distribution is not possible. Illustration 3 shows a mixed distribution, where at least the largest consumers are supplied centrally.







APPENDIX

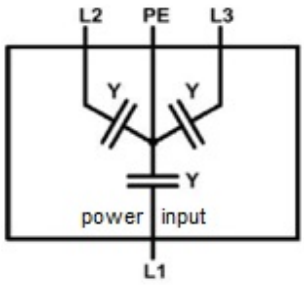
EQUIVALENT LEAKAGE CURRENT MEASUREMENT ACCORDING TO VDE 0701

The equivalent leakage current measuring according to DIN VDE 0701-1 may deliver results beyond the norm.
Cause: Measurements are primarily performed on so-called EMC-filters at the AC input of the units. These filters are built symmetrical, that means capacitors are installed between L1/2/3 and PE. While measuring, L1, L2 and L3 are connected together and the current flow to PE is measured. Therefore, up to 3 capacitors are connected parallel which doubles or triples the measured leakage current. This is permissible according to the norm.

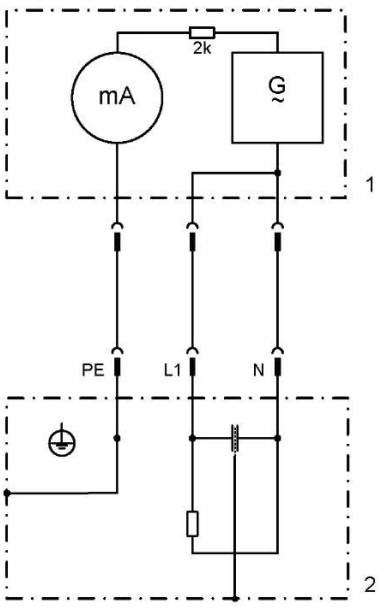
Quotation from the norm of 2008, appendix D:

> *„When measuring protection conductor currents with the equivalent leakage current measuring method, it is important to note that devices with protective grounds and symmetrical circuits may have results, due to the wiring, that are up to three or four times higher than the leakage current of one phase.“*

Graphical representation of a balanced circuit:



Example illustration from the norm protective ground measuring - equivalent leakage current measuring method:



Note: The illustration shows the measurement method for two-phase power supplies. In the three-phase version, phase N is replaced by L2 and/or L3.

NOTES

EPS Stromversorgung GmbH
Alter Postweg 101
86159 Augsburg
www.eps-germany.de