ETSYSTEM® | THE WORLD OF POWER

海洋儀器®

致力于电子测试、维护领域!

LAB-SMS/E

用户手册

Table of Contents

TECHNICAL SPECIFICATIONS

INPUT SPECIFICATION:

	LAB/SMS/E					
Device Power	3kW	4kW	5kW	6kW	8kW	10kW
Connection	3 Leitungen (1P+N+E) / 5 Leitungen (3P+N+E)					
Input 1P/230	1 x 230VAC (207-253VAC 47-63Hz)					
Input 3P/200	3 x 200VAC (180-220VAC 47-63Hz					
Input 3P/209	3 x 208VAC (187-229VAC 47-63Hz)					
Input 3P/400	3 x 400VAC (360-440VAC 47-63Hz)					
Input 3P/440	3 x 440VAC (396-484VAC 47-63Hz)					
Input 3P/480	3 x 480VAC (432-528VAC 47-63Hz)					
Max allowed non symetry (3P-Systeme)	< 3%					
Input current [1,2] 1P/230 Modell	22 A eff	28 A eff	33 A eff	X [14]	X [14]	X [14]
Input current [1,2] 3P/200 Modell	15 A eff	20 A eff	25 A eff	30 A eff	40 A eff	50 A eff
Input current [1,2] 3P/208 Modell	14 A eff	19 A eff	23 A eff	28 A eff	37 A eff	46 A eff
Input current [1,2] 3P/400 Modell	7,5 A eff	10 A eff	11,5 A eff	15 A eff	20 A eff	22,9 A eff
Input current [1,2] 3P/440 Modell	7 A eff	9 A eff	11 A eff	14 A eff	18 A eff	21 A eff
Input current [1,2] 3P/480 Modell	6,5 A eff	8 A eff	10 A eff	12,5 A eff	16,5 A eff	19,5 A eff
Inrush transient current	<25 A	<25 A	<25 A	<51 A	<51 A	<51 A
Nominal current Internal Fuse 3P/400 Modelle	15 A	15 A	15 A	30 A	30 A	30 A
Recommended Supply breaker 3P/400 Model (value and curve)	16A Type D/K	16A Type D/K	16A Type D/K	32A Type D/K	32A Type D/K	32A Type D/K
Leakage current	<35 mA					
cos phi	>0,7					
Harmonic content [3]	50Hz = 72% / 100Hz = 2% / 150Hz = 0,9% / 200Hz = 0,1% / 250Hz = 11% / 350Hz = 0,6%					
Efficiency Type	94%					

[1] For nominal current and voltage
[2] For nominal input voltage
[3] Total harmonic distortion input current ([%] I in)
[4] 250A is the maximum possible current for an 5kW Unit
[5] If the ripple is not specified, maximum allowed ripple is 0,2% of F.S.
[6] The measurement of the peak peak ripple is strongly dependent of the measurement setup
[7] The given accuracy is also all interfaces valid
[9] Higher number is possible, ask manufacturer
[11] The ripple measurment methode of ET-System is specified at application note „ET Ripple-Spec. (Page 32)
[12] The ripple specification is reservation to change on the part of manufacturer
[13] Device is at the moment only available with highspeed output (Low output cap.)
[14] Not as standard Unit available

OUTPUT SPECIFICATIONS:

Regulation	Static Regulation	± 0,1% of F.S.															
	Line Regulation Voltage	± 0,02% F.S.															
	Line Regulation Current	± 0,02% F.S.															
	Load Regulation Voltage	± 0,05 % F.S. ± 2mV															
	Load Regulation Current	± 0,05% F.S. ± 20mA															
	Dynamic Response Time @ Load Step 10 - 90%	< 3ms															
Output Current	Output Voltage / [V]	15	20	25	35	40	45	70	80	100	150	300	600	800	1000	1200	1500
	SMS/E 3KW Unit / [A]	200	x	x	90	x	70	45	x	x	20	10	5	x	3	2,6	2
	SMS/E 4KW Unit / [A]	x	200	x	115	x	90	60	x	x	30	15	7	x	4	3,4	x
	SMS/E 5KW Unit / [A]	x	250	200	150	125	120	75	65	50	35	17	8,5	6,5	5	4,2	3,3
	SMS/E 6KW Unit ([A]	400	300	x	175	x	140	90	x	x	40	20	10	x	6	5	x
	SMS/E 8KW Unit [A]	x	440	320	230	x	180	115	x	x	55	30	15	x	8	6,7	x
	SMS/E 10KW Unit / [A	x	500	x	350	250	250	175	130	100	75	40	17	13	10	8	6,6
		Other combinations of Voltage and Current also possible, ask the Manufakturer Basic calculation of possible combinations are: Pout = Vout x Iout / Pmax for one Unit 90KW / Cmax = 250A each 5KW															
Ripple and Noise [11]	Voltage ripple (p-p) 20MHz	40 [12]	80 [12]	80 [12]	80 [12]	140 [12]	140 [12]	140 [12]	140 [12]	140 [12]	900 [12]	900 [12]	900 [12]	1000 [12]	1200	2500	2500
	Voltage ripple (p-p) 300KHz	15 [12]	35 [12]	35 [12]	35 [12]	60 [12]	60 [12]	60 [12]	60 [12]	60 [12]	400 [12]	400 [12]	400 [12]	700 [12]	800	1500	1500
	Voltage ripple (rms) [5] mV 20MHz	15	35	35	35	60	60	60	60	60	400	400	400	400	400	400	500
	Voltage ripple (rms) [5] mV 300KHz	10 [12]	25 [12]	25 [12]	25 [12]	40 [12]	40 [12]	40 [12]	40 [12]	40 [12]	300 [12]	300 [12]	300 [12]	300 [12]	300	300	400
	Current ripple (p-p)	<0,5 % of F.S.															
	Current ripple (rms)	<0,4 % of F.S.															
Isolation	Primary / Sekundary	3.000VAC															
	DC - Output / Earth	500VDC											2.000VDC				
	Primary / Earth	2.150VDC															
Output speed	Rise time full load [13]	6 ms	6 ms	6 ms	6ms	12 ms	12 ms	12 ms	20 ms	20 ms	20 ms	20 ms	20 ms	40 ms	40 ms	40 ms	6 ms
	Rise time no load [13]	5 ms	5 ms	5 ms	5 ms	10 ms	10 ms	10 ms	10 ms	10 ms	10 ms	10 ms	10 ms	10 ms	20 ms	20 ms	5 ms
	Fall time full load [13]	15 ms	15 ms	15 ms	15 ms	20 ms	20 ms	20 ms	20 ms	20 ms	40 ms	40 ms	50 ms	60 ms	80 ms	100 ms	25 ms
	Fall time no load	5 s unter 50VDC															
Accuracy	Rel.Accuracy ±[%] [7]																
	Voltage [V] 0,25	0,038	0,050	0,063	0,088	0,100	0,113	0,175	0,200	0,250	0,375	0,750	1,500	2,000	2,500	3,000	3,750
	Current [A] 0,4	1,000	1,000	0,800	0,580	0,500	0,480	0,288	0,260	0,200	0,140	0,068	0,034	0,026	0,020	0,017	0,013
	Relative accuracy for sense operation (worst case) [%]																
	Voltage [V] 0,5	0,075	0,100	0,125	0,175	0,200	0,225	0,350	0,400	0,500	0,750	1,500	3,000	4,000	5,000	6,000	7,500
	Max. Sense Voltage over nominal Voltage [7]	±1% of F.S.												Sens nicht in Standardgeräten			
	Max. Sense voltage inside inside the nominal range [7]	5% of F.S. (if higher voltage is needed ask manufacturer)												no Sense at standard units			
Resolution	Resolution voltage display &	10V - 69,99V						70V - 99,9V		100V - 999V					1.000V - 1.500V		
	Voltage setting resolution	00.00						00.0		000					0000		
	Resolution current display &	2A - 69,99A						70A - 99,9A		100A - 999A					1.000A - 2.000A		
	Current setting resolution	00.00						00.0		000					0000		
Device Function	OVP	Over Voltage Protection: is adjustable between 0% and 120% of Voltage full range															
	OCP	Over Current Protection: is realised by the current set point, the output current can not go over the set output current															
	OTP	Over Temperature Protection: if the internal heat sink tempearatury is go above 90°C the divice will automaticaly shut down															
	UI-Modus	Voltage and Current operation mode: Voltage and current are setable															

Analog Interface

Digital outputs (CV, Standby, Error)	Output type: Open collector with pull-up resistor 10 kΩ after +5 V Isinkmax: 50 mA
Digital inputs (Ext. Control, Standby)	Input resistance: 47 kΩ Maximum input voltage: 50 V High level: Uin > 2 V Low level: Uin < 0.8 V
Analog outputs (Xmon)	Output resistance: 100 Ω Minimum permissible load resistance: 2 kΩ Minimum load resistance for 0.1 % accuracy: 100 kΩ
Analog inputs (Xset)	Input resistance: 1 MΩ Maximum premissible input voltage: 25 V
Reference voltage	Reference voltage Uref: 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)
Programming Response Time	< 10 ms

RS232

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

RS485

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

EMC AND SAFETY STANDARDS

Stafety standard	EN 60950
Emission	EN 61000-6-4:2007
Immunity	EN 61000-6-2:2005
Measurement, control- and laboratory equipment	EN 61010-1:2010

AMBIENT CONDITIONS

Cooling	Fans
Operating temperature	0 – 50°C
Storage temperature	-20°C – 70°C
Humidity	< 80 %
Operating height	< 2000 m
Weight / Dimension LAB SMS/E 3 – 5 kW	18 kg / 19" x 2 U x 440 mm
Weight / Dimension LAB SMS/E 6 – 10 kW	25 kg / 19" x 2 U x 600 mm
FAN Volume	42 – 43 dB

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. ET System electronic 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 ET System electronic immediately.

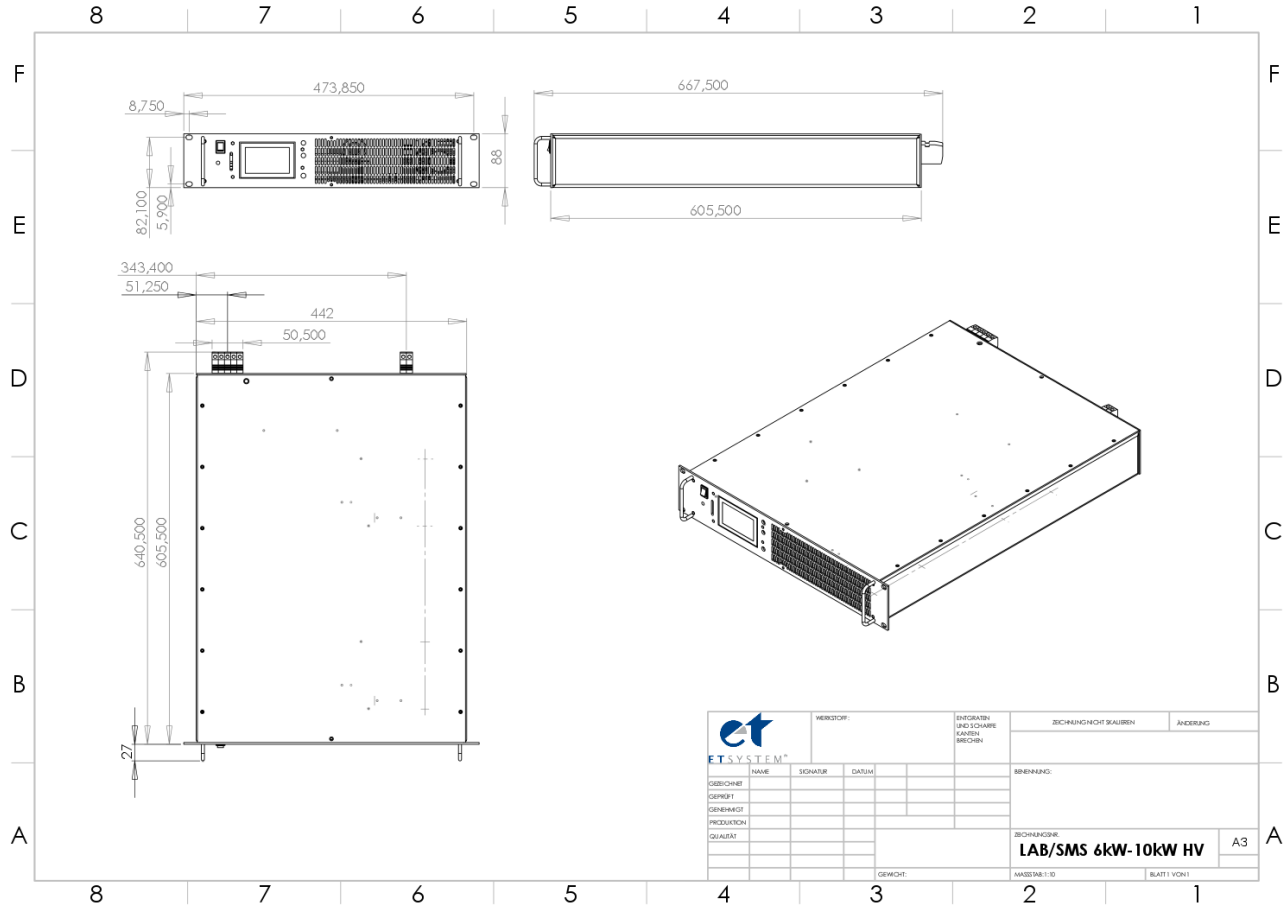
MAINS OPERATION

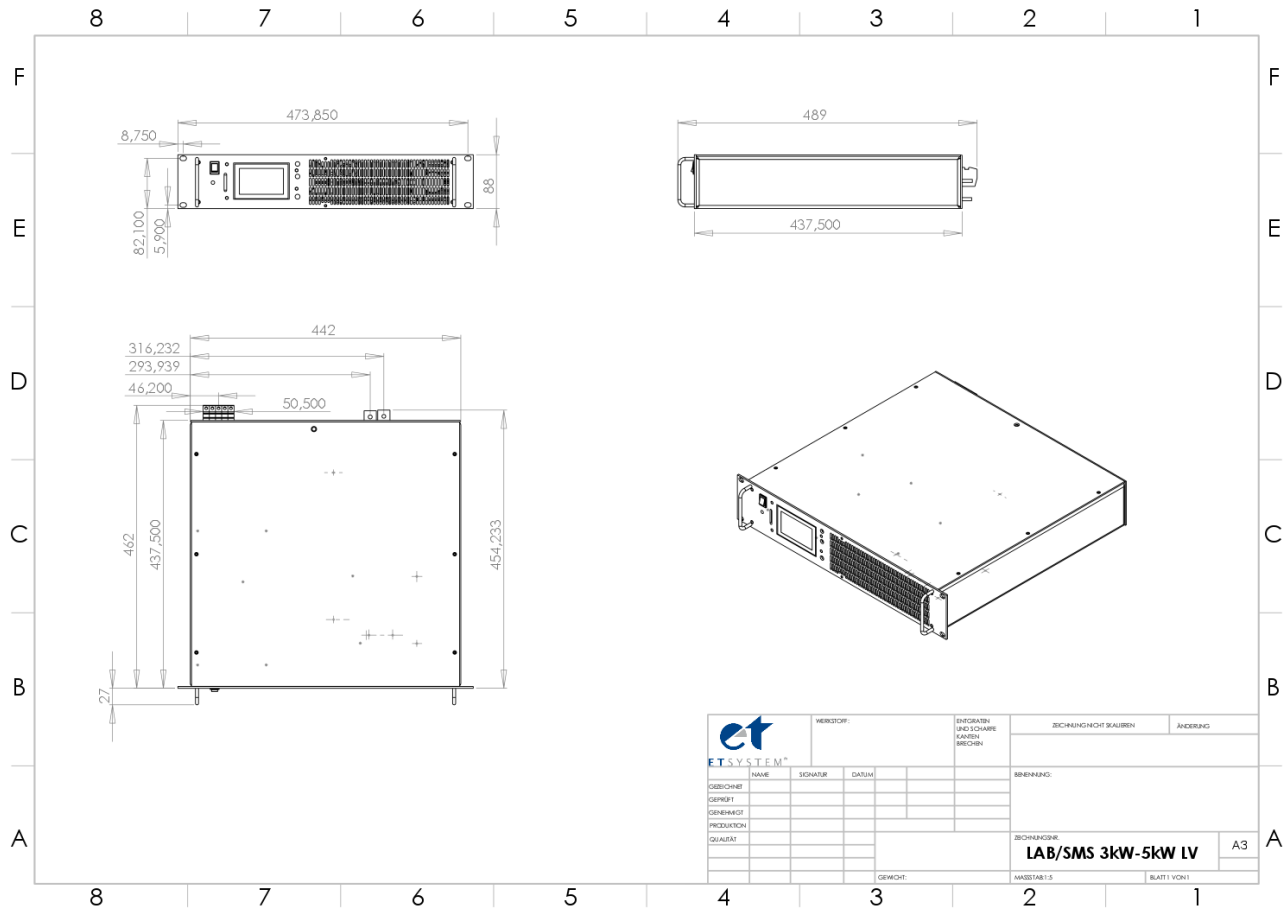
Make sure to verify the model number and voltage stated on the nameplate. Damages due to wrong power feed are not covered by guarantee conditions.

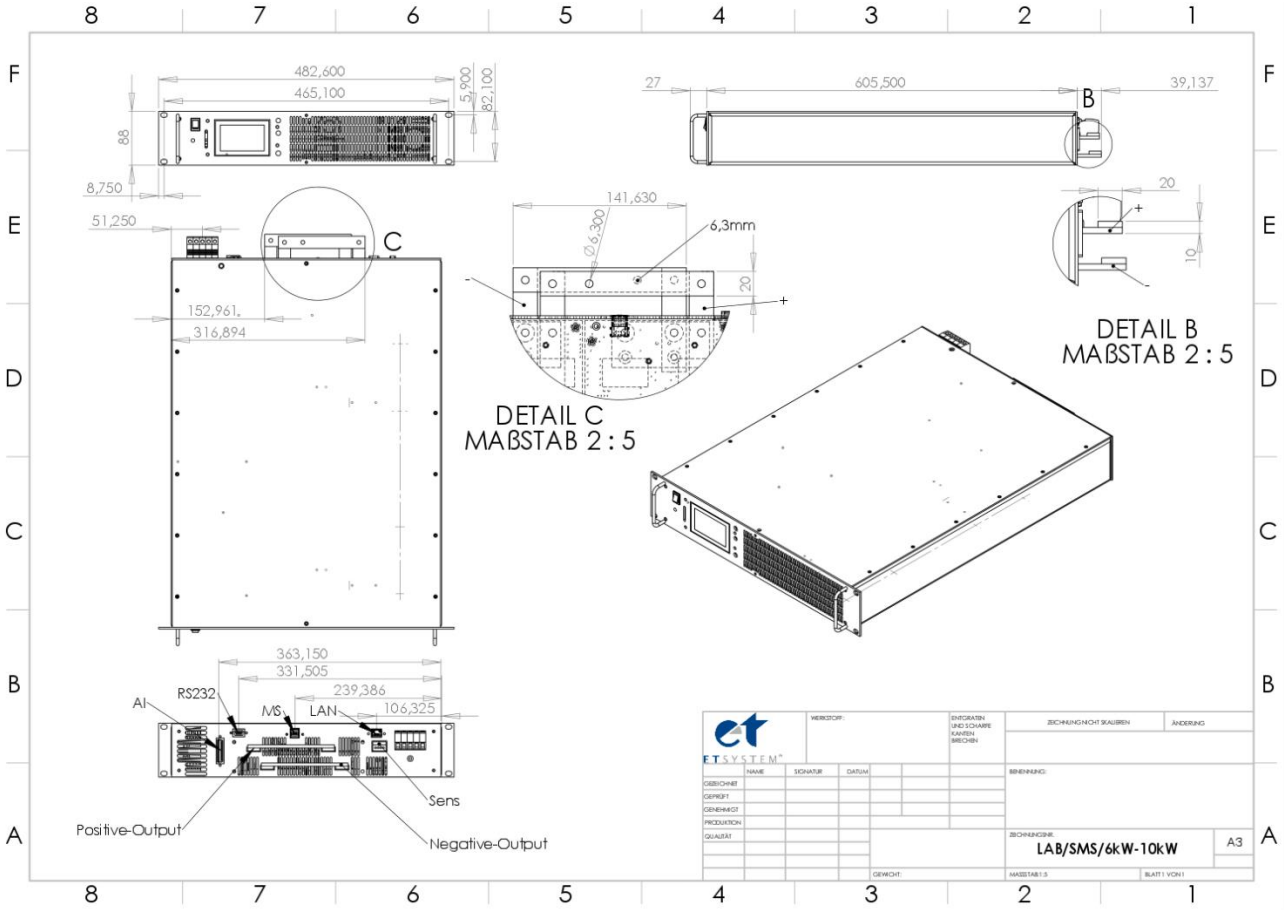
The unit must only be operated when connected directly to the mains. To avoid damage, do not connect the unit to isolating transformers, auto-transformers, magnetic current limiters or similar devices.

INTENDED USE

The device corresponds to protection class I and has a galvanic isolation between the input and the output circuit. The device must be grounded on the input side, since the grounding ensures protection against contact. In the case of locally variable devices, the earth is connected to the device by means of a cold-plug connector, and the ground is connected to the screw terminal provided for locally-variable devices (screw contacts at the grid input). In the case of devices with high leakage current (marking on the device), the existing grounding bolt must additionally be connected to the domestic installation earth. For compliance with the EMC and safety regulations (CE, approvals), the device may only be operated with PE connected. The device may only be operated by trained personnel and in accordance with the instructions for use. Typical fields of application are laboratories, industry and service engineering. Applications which can lead to injuries or death in the event of a fault in the device are not permitted.

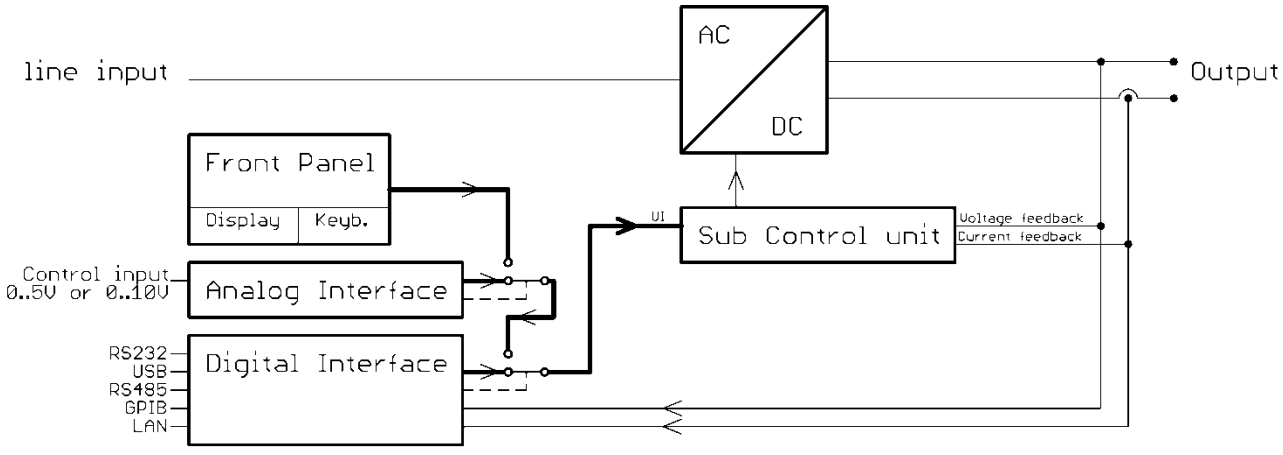






FUINCTIONAL DESCRIPTION

THE FOLLOWING BLOCK DIAGRAM GIVES INFORMATION ABOUT THE VARIOUS ADJUSTMENT OPTIONS.

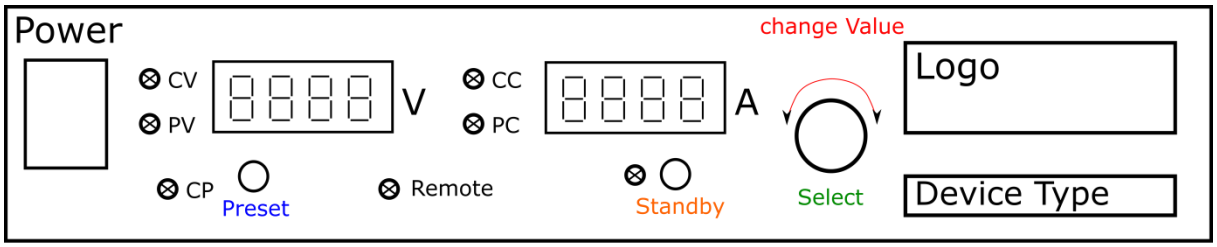


UI-Mode	Unit is operated with current and voltage limitation.

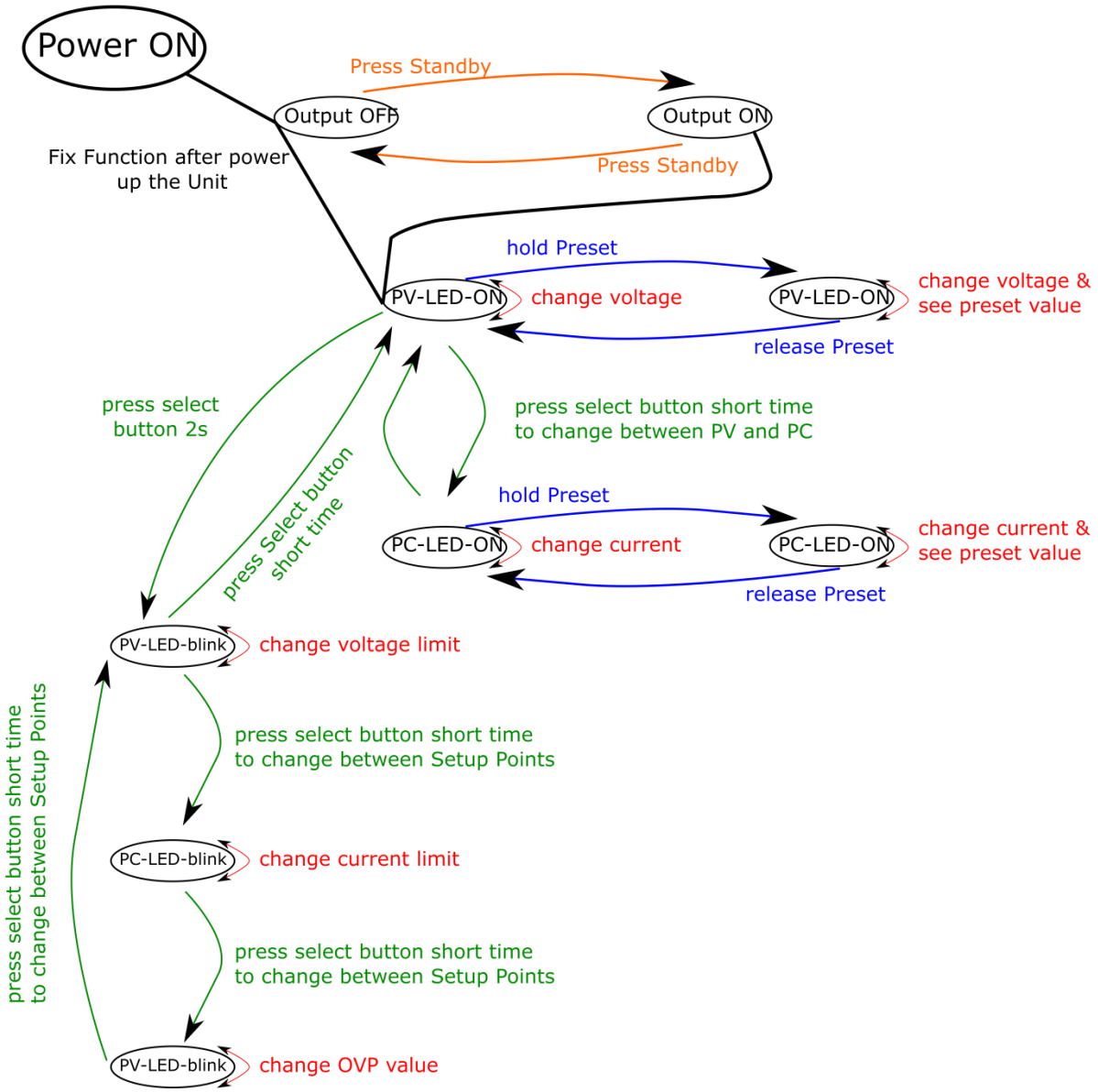
GENERAL SETTINGS

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 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

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.

Example: Evaluation of decimal places of power supplies maximum output voltage and current

Range	10V - 69,99V	70V - 99,9V	100V - 999V	1000V - 1500V
Voltage	0.00	00.0	000	0000
Range	2A - 69,99A	70A - 99,9A	100A - 999A	1000A - 2000A
Current	0.00	00.0	000	0000

Example: LAB/SMS/E 580 (80VDC; 62,5A) digital interface reading Voltage 0.0 – 80.0V; Current 0.00 – 62.50A

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 ETS 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
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.

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,200A	Unit answers: I_{limit} = 200 A

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,200A	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,200V	Unit answers: U_{limit} = 200 V

MI[,<Nr>] - Measure I_a

This command measures the present output current.

Example:LAB/SMS/E 10100 (100VDC; 100A)

GTR	Remote operation
OVP,140	Over voltage protection 120 V
UA,100	Output voltage 100 V
IA,50	Output current 50 A
SB,R	Output open
MI	Measures present output current
MI,50A	Unit answers: 50 A

MU[,<Nr>] - Measure U_a

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

Example:LAB/SMS/E 10100 (100VDC; 150A)

GTR	Remote operation mode
OVP,120	Over voltage protection 120 V
UA,10	Output voltage 10 V
IA,1	Output current 1 A
SB,R	Output open
MU	Measures present output voltage
MU,10V	Unit answers: 10 V

*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 LAB/SMS/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	-reserved-
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,200V	Unit answers: set point U_a = 200 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,500V
LIMI	LIMI,30.00A

Command	Response
MU	MU,10.0V
UA	UA,100V
OVP	OVP,600V

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,123V
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,10V
UA,220V
UA,1V

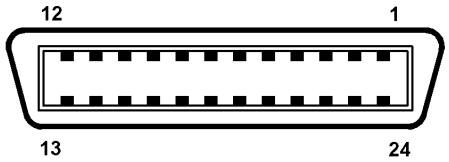
Example: 50 V unit

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

EXT. CONTROL: COMPUTER

GPIB (OPTION)

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	DIO8	Data line 8
17	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

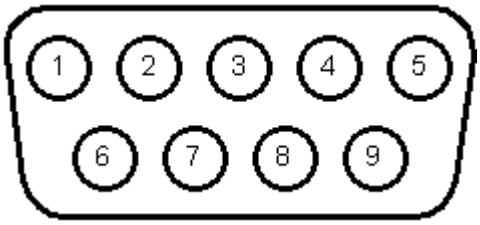
ESR-Register - Event-Status-Register

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	RxD	Data line from PC to unit
3	TxD	Data line from unit to PC
4	N.C.	
5	GND	GND
6	N.C.	
7	RTS	Reception of the unit, signal direction from unit to PC (only required for active Hardware handshake)
8	CTS	Reception of the PC, signal direction from PC to unit (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

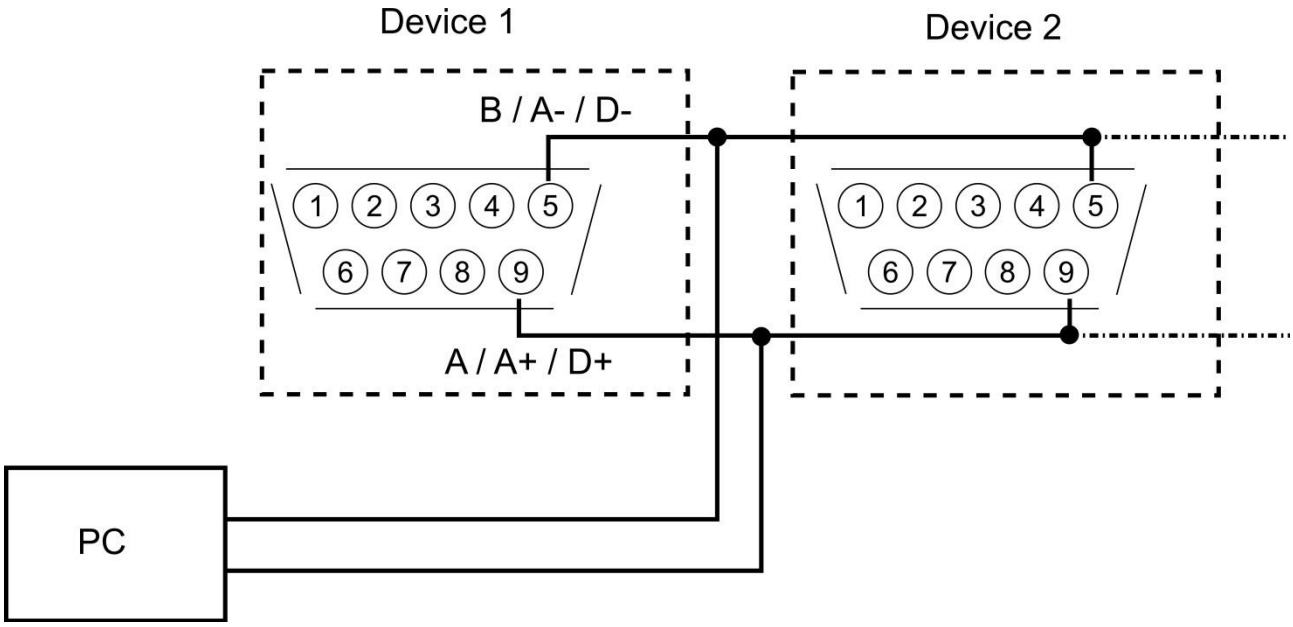
If echo is on, the interface confirms each incoming character by sending the same character back to the sender. The interface parameters can be adjusted via software and the command ***<PCx>***. These settings can be saved with the command ***<SS>***.

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 (OPTION)



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*

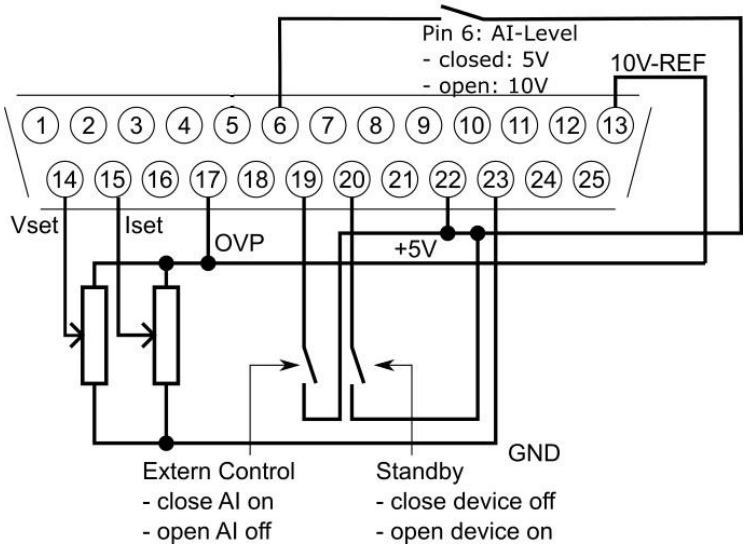
EXT. CONTROL: AI INTERFACE

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} PRESET	Monitor set point U PRESET
2	analog out	I_{mon} PRESET	Monitor set point I PRESET
3	-nc-		
4	-nc-		
5	-nc-		
6	digital in	ATI level 5/10VDC	Set ATI level 5VDC or 10VDC
7	digital out	CV	Signals „Const. Voltage“ mode
8	analog out	U_{istmon} Real value	Monitor output voltage Real on output
9	gnd	GND	-
10	digital out	Standby	Signals standby
11	gnd	GND	-
12	-nc-	-	-
13	REF 5/10	5-10 V-V_{ref}	Output 5/10 V reference voltage
14	analog in	U_{set}	Set point U
15	analog in	I_{set}	Set point I
16	-nc-		-
17	analog in	OVP_{set}	Set point OVP
18	-nc-		-
19	digital in	Ext. Control	Activates analog control
20	digital in	Standby	Activates standby
21	analog out	I_{istmon} Real value	Monitor output current Real on output
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-	-	-

BD25 Connector



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:

LAB/SMS/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})

Example:

LAB/SMS/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 (OVP_{set})

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 rest this error, standby mode must be activated. Adjustment range is 0 V up to the maximum rated voltage of the device + 20%.

Example:

LAB/SMS/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} PRESET)

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

Example:

LAB/SMS/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} PRESET)

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

Example:

LAB/SMS/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 Output Voltage (U_{Istmon} Real value)

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

Example:

LAB/SMS/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} Real value)

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

Example:

LAB/SMS/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*'.

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) (OPTION)

To communicate with the LAB/SMS/E 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.

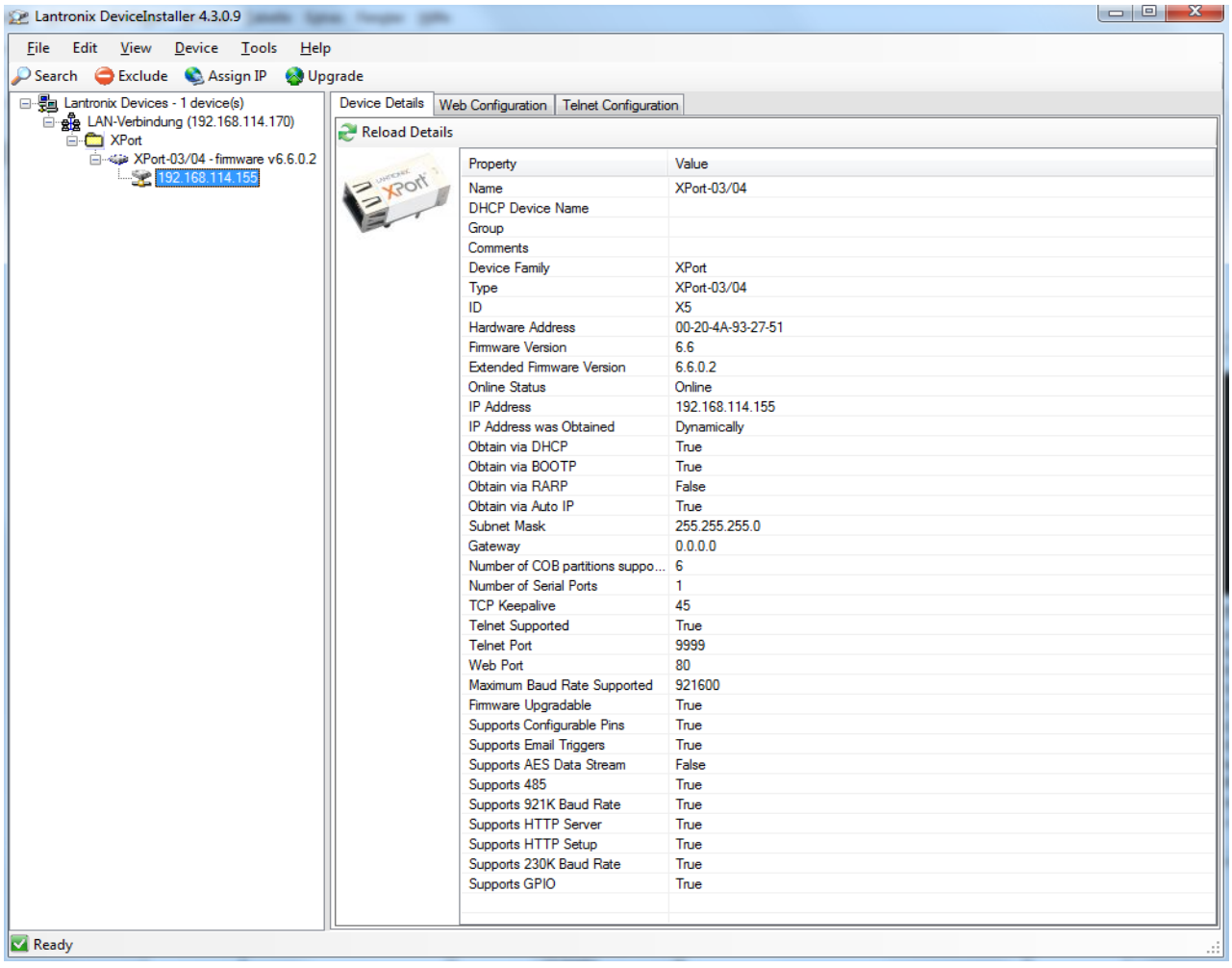
The status word can be read with the command ***<STB>*** or ***<*STB?>***. Only bits from D0 up to D2 are in use. All other bits can be 1 or 0.

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

DETERMINATING THE IP USING THE DEVICE INSTALLER BY LANTRONIX

With the program Deviceinstaller, Lantronix offers a program to easily detect a device within the network. After executing the program and clicking the button ***Search***, all XPORTS within the network are displayed. The current assigned (dynamical) IP will also be displayed. This IP can be entered in the address line of a browser.
If you want to set a static IP Adress use “Assign IP”.



CONTROLLING THE DEVICE VIA TELNET

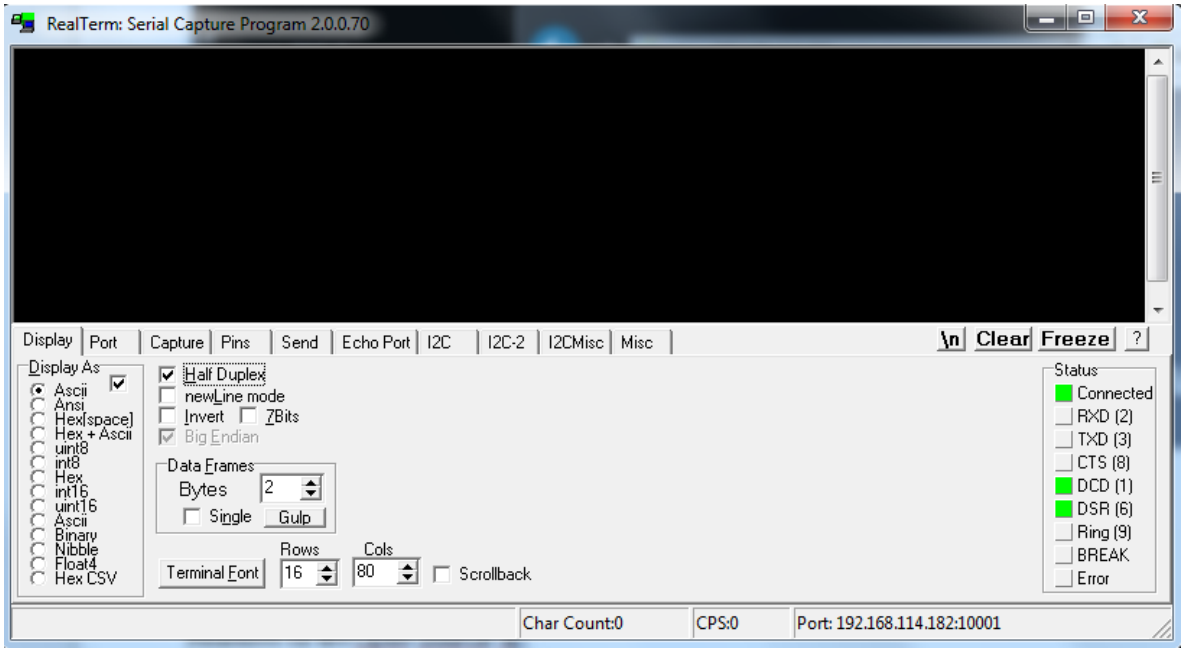
The device can be controlled directly via port 10001. After the console has been opened, a click on ‚Start' and ‚Ausführen' opens an input field. After the commands ***cmd*** or ***command*** have been entered, a DOS window opens with: telnet xxx.xxx.xxx.xxx 10001.
Alternatively, many terminal programs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

TELNET CONNECTION WITH REALTERM

Realterm is a free OpenSource terminal program, which may be downloaded here: http://realterm.sourceforge.net/

After the program was installed and executed, the box ***Half Duplex*** must be checked within the tab ***Display***.



The IP address must be entered within the tab ***Port*** in the following format: xxx.xxx.xxx.xxx:10001. Afterwards the button ***Open*** must be clicked. In the terminal box the desired commands can be sent to the device.

For more Information please look at:
http://www.et-system.de/en/produkte/applications-special-units.html

EXT. CONTROL: USB (OPTION)

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

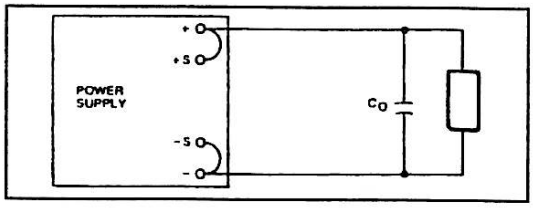
In case, the user has forgotten the active setup, there are two ways of reconfiguring the interface:

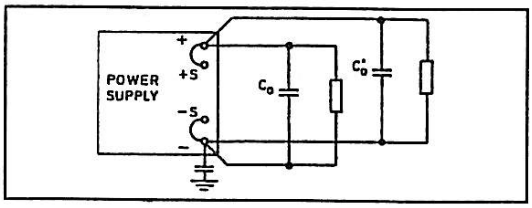
- sending the command ***<PCx>*** from one of the other interfaces
- using the display to configure the interface → *Interface Parameters*

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.

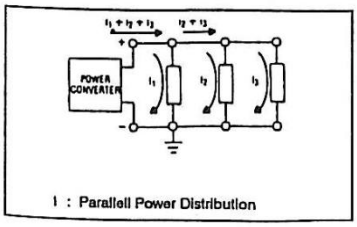


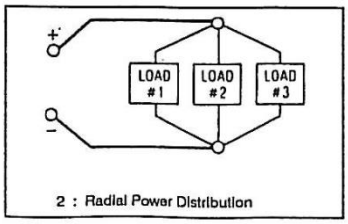


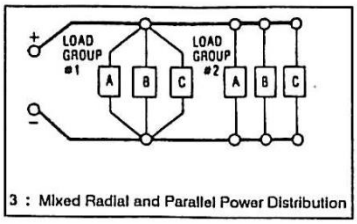
If thus you paid attention to the points stated above, oscillation occurs through load or power induction and complex load situations, please contact our company ET System.

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.



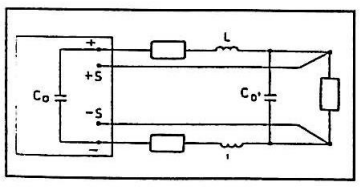


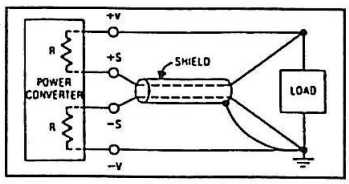


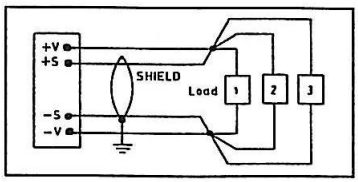
LOAD CONNECTION WITH SENSOR CONDUCTOR

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)



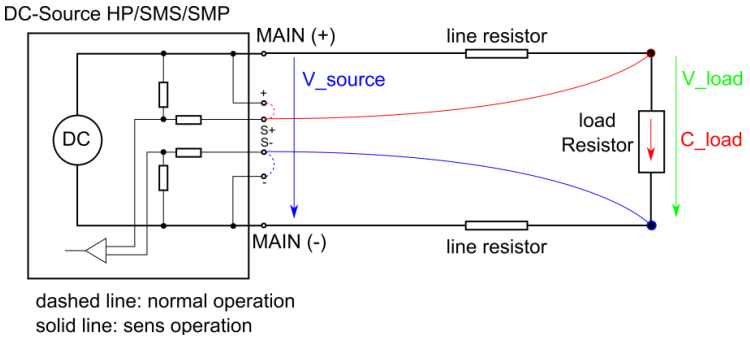




If thus you paid attention to the points stated above, oscillation occurs through load or power induction and complex load situations, please contact our company ET System.

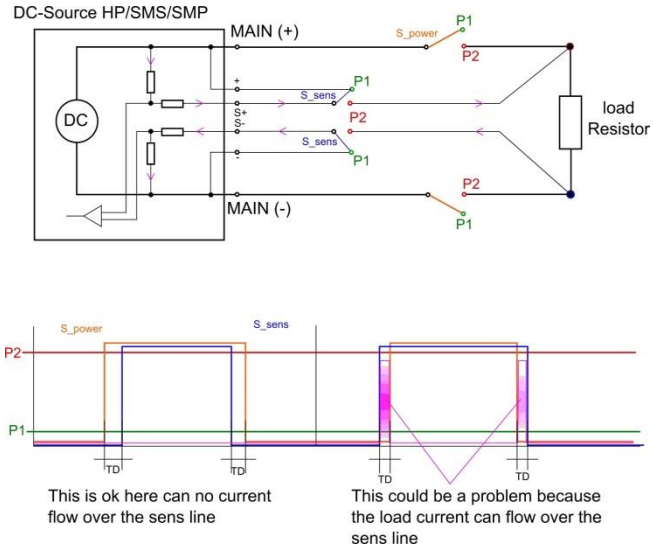
GENERAL INFORMATION FOR SENSING

The sensing line moves the measuring point of the output voltage measurement to the load. The voltage measurement is carried out with a differential amplifier, the last resistor in the chain being "short-circuited" with a low-resistance parallel resistor. When the sensing line is opened, the output voltage increases between 1% and 2% of the nominal voltage, depending on the model. The displayed voltage on the display does not change. When the Sens is connected to the load, the power resistor is mathematically transformed into the device, resulting in a residual error of up to 0.5% depending on the load line used. More detailed information can be obtained from the manufacturer.



WARNING INSTRUCTIONS FOR USING RELAYS TO THE LOAD DRAFT

In an application where the load is for example should be dropped with a relay and the Sens is used at the same time, care must be taken to ensure that the load current can not flow through the sensing lines as this can lead to the destruction of the sensor. This is shown schematically in the following figure.



The circuit breaker (S_power) must be closed when starting before the Sens (S_sens). When switching off, the Sens must first be opened and then the circuit breaker can be opened. Otherwise, a current flow may occur across the sensing line, and this may be particularly critical when disconnecting.

APPENDIX

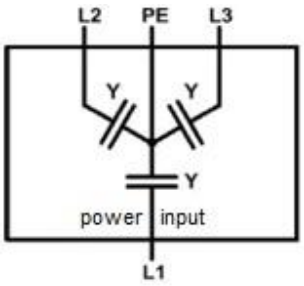
EQUIVALENT LEAKAGE CURRENT MEASUREMENT ACCORDING TO VDE 0701

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.

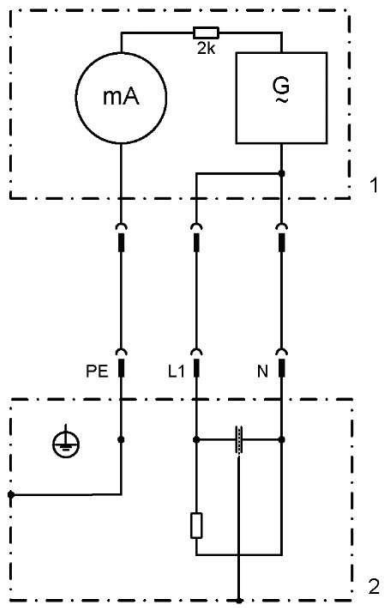
Quotation from the norm of 2008, appendix D:

> „*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:

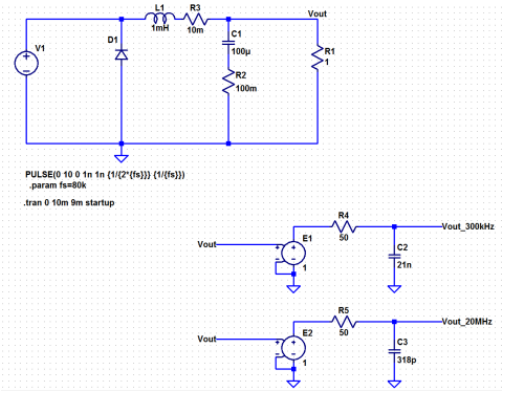


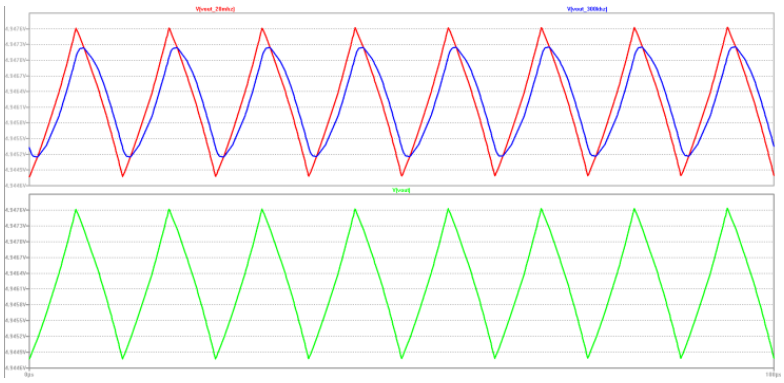
Note: The illustration shows the measurement method for two-phase power supplies. In the three-phase version, phase N is replaced by L2 and/or L3.

ET-System Rippel Measurment Specification

Theoretical Analysis

The component of the output ripple is built by the output current and the equivalent series resistor of the output capacitor. Picture 1 show a basic circuit which was used to simulate the ripple.

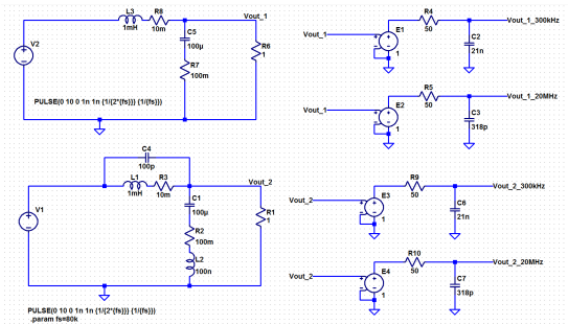


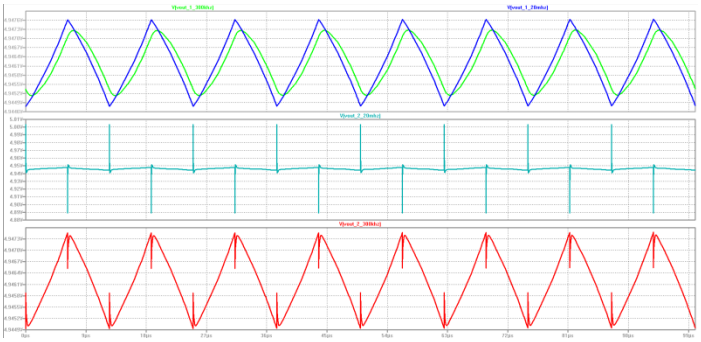


Picture 2 show the ripple without spikes. Picture 2 shows also the different between the used measurement bandwidth. At this example the switching frequency of the converter was 80kHz (this is also the switching frequency of the LAB/HP and LAB/SMS series).The red line shows the measured ripple by using a bandwidth of 20MHz and the blue line shows the measured ripple by using a measure bandwidth of 300kHz.

This example shows that the measurement bandwidth have a strong influence of the measurement result.

The spike or noise of the ripple will generate by the switching noise of the power supply. The spikes which will be measured strongly depend on the used measurement method. One point is the using measurement bandwidth the other point is the test setup. The influence of the measurement method is show at picture 4. Picture 3 show the previous know circuit and also the same circuit with some added leakage component how are contribute to the output noise.

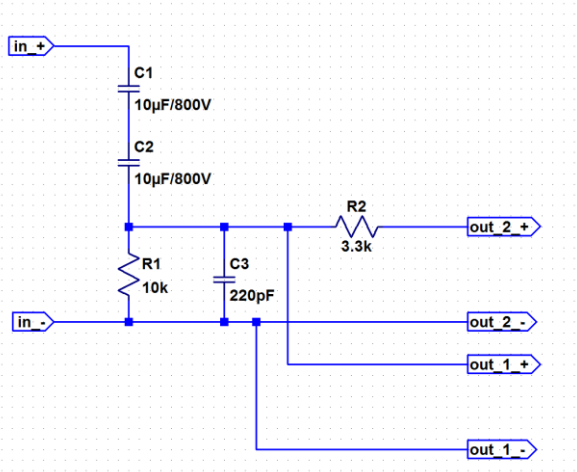




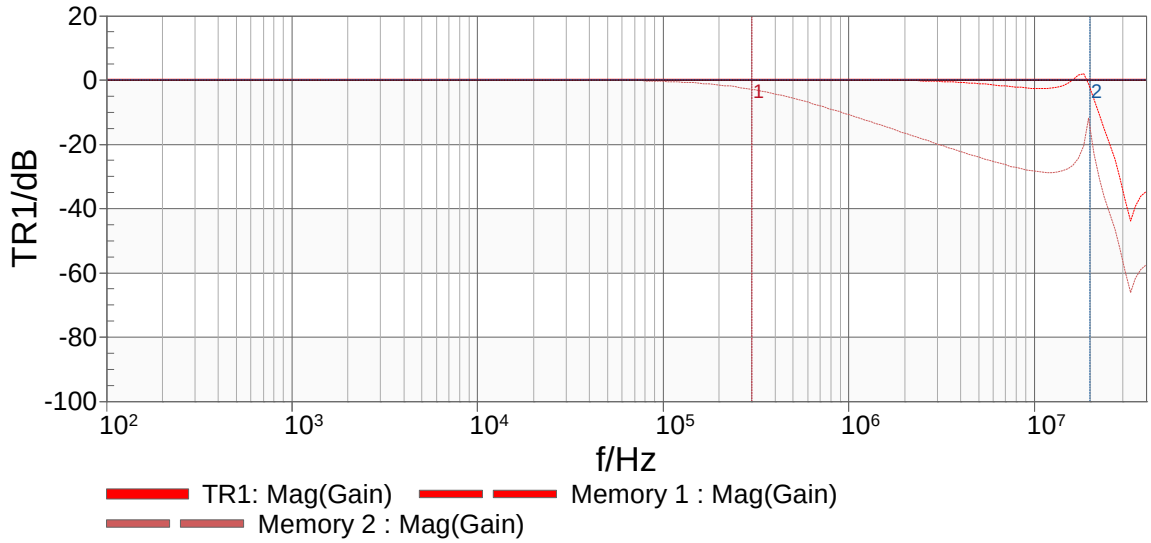
This example show that the measurement bandwidth do influence the spikes or noise measurement.

Pratical Rippel Measurment.

ET-System measured the ripple with the test setup how is show at picture 5. Tow high voltage capacitor in serie with a 10k Ohm resistor is use to measured only the AC-Component of the output voltage of the power supply. The circuit have tow output. Output 1 have a measurment bandwith of 20MHz and output 2 have a bandwith of 300kHz. This rippel circuit was build at the labortory and was tuned by using a frequency analyser (Bode 100). Also the used 1:1 Oscilloscope probe was during the tuning procedure connectet to the rippel measurment setup to elemenate the influence of the probe to the measurment bandwith.



Picture 6 show the result of frequency analyses of the tuning measurement. Point 1 shows the 3dB point of the 300kHz output. Point 2 show the 20MHz point.



The bode plot show that the transfer function of this circuit is very linear. This allowed making a clean and real measurement of the output ripple of a power supply also at high voltage devices.