



实验室电源供应器系列
Laboratory Power Supply Series

PS 8000 DT

320W - 1500W

16V - 360V

4A - 60A



PS 8016-20 DT: 09 200 130
PS 8032-10 DT: 09 200 131
PS 8065-05 DT: 09 200 132
PS 8032-20 DT: 09 200 133
PS 8065-10 DT: 09 200 134

PS 8160-04 DT: 09 200 135
PS 8080-40 DT: 09 200 136
PS 8080-60 DT: 09 200 137
PS 8360-10 DT: 09 200 138
PS 8360-15 DT: 09 200 139



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安全说明



危险电压

警告: 本产品输出电压可能上升至危险级别(> 60 VDC)!

产品上所有带电元件必须有外遮盖。输出端的所有操作必须在产品与主电源(电源开关关闭)断开时才能执行,且可只有受过训过电流危险知识的专业人员执行此类操作。负载与本产品间的任何连接必须有防碰擦装置。连到功率输出端的应用设备必须配置好,并且有保险丝熔断保护,这样可防止使用过程中由于过载或误操作损坏产品或更严重事情发生。



重要说明! 请谨记!

- 请仅在铭板标示电压下操作该仪器。
- 请勿将任何机械零件,特别是金属件,插入通风孔内。
- 请避免在本产品周围使用任何液体物质,以免进入产品内。
- 请勿立即触摸从电源插座上拔下的电源线插头接触片,因会有触电的危险。
- 产品功率输出打开的同时,请勿将负载,特别是低阻的负载连接到产品上,因有可能产生火花,从而损坏产品,并伤到手。
- 从后板插槽安装接口卡时,请遵循一般防静电规则。
- 只能在产品完全关闭(电源开关为关闭状态)后插入和取出接口卡。
- 产品老化以及超负荷使用都可能导致如按钮、旋钮类的控制件操作不稳定。

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1. 介绍

PS 8000 DT系列实验室电源因其桌面式外壳，特别适用于学校、实验室和工厂使用。

除电源产品的标准功能外，用户还可定义和恢复5组不同的预设值，或使用可在0...5V或0...10V普通电压范围内工作的内置模拟接口。从而提供一简易的监控本产品或完全远程控制的方法。

可选数字接口卡通过电脑实现更宽范围的控制和监控功能。1000W以上型号的特点为有一可调功率调整线路，以及“System Bus”端，它能实现主-从操作下的串联或共享总线下的并联。

通过接口卡的使用可轻易地将产品整合于现有系统内，且根本不需配置接口卡或仅需配置少数设定值。

本产品通过接口卡可连接其他类型电源，并借此控制它们。或者通过外置控制系统，如PLC-可编程控制器，对本产品进行控制和监测。

本产品由微处理器控制，得以使之能准确、快速地测量并显示各实际值。

主功能一览：

- 0...100%范围内的设定电压和电流
- 0...110% U_{Nom} 可调过压门限
- 0...100%可调功率 (1kW型号起)
- 插拔式接口卡 (CAN, USB, RS232, IEEE/GPIB, Ethernet/LAN, Profibus)
- 外部控制和监测用模拟接口，用0...5V或0...10V (可选)控制0...100%的范围值
- 功率级别：320W，640W，1000W和1500W
- 温控风扇
- 状态(OT, OVP, CC, CV, CP)指示灯
- 5种可选内存集
- 串联时的主-从操作 (1kW型号起)
- 并联时的共享总线操作 (1kW型号起)

2. 技术规格

2.1 控制面板和显示器

型号

显示器：点阵显示，202 x 32点
分三个区域

旋钮：2个旋钮，9+2个按钮

显示格式

额定值限定最大可调范围。

电压和电流的实际值同时显示，而过压门限设定值、欠压极限、电流和功率 (1kW型号起) 则分开显示。

电压的显示

分辨率：4位数
格式：0.00V...99.99V
0.0V...999.9V

电流的显示

分辨率：4位数
格式：0.000A...9.999A
0.00A...99.99A

功率的显示 (1kW型号起)

分辨率：4位数
格式：0.000kW...9.999kW

2.2 各型号详细规格

	PS 8016-20 DT	PS 8032-10 DT	PS 8065-05 DT	PS 8032-20 DT	PS 8065-10 DT
电源输入					
输入电压	90...264V	90...264V	90...264V	90...264V	90...264V
输入电压功率降额	-	-	-	-	-
230V时输入电流	max. 1.8A	max. 1.8A	max. 1.8A	max. 3.2A	max. 3.4A
100V时输入电流	max. 3.8A	max. 3.8A	max. 3.8A	max. 7.5A	max. 7.5A
输入频率	45...65Hz	45...65Hz	45...65Hz	45...65Hz	45...65Hz
输入保险丝	T 8A	T 8A	T 8A	T 8A	T 8A
功率因数	> 0.99	> 0.99	> 0.99	> 0.99	> 0.99
输出 - 电压					
额定电压 U_{Nom}	16V	32V	65V	32V	65V
可调范围	0V... U_{Nom}	0V... U_{Nom}	0V... U_{Nom}	0V... U_{Nom}	0V... U_{Nom}
市电波动范围在 $\pm 10\% \Delta U_{IN}$ 时的稳定度	< 0.02%	< 0.02%	< 0.02%	< 0.02%	< 0.02%
带载10...90%时的稳定度	< 0.05%	< 0.05%	< 0.05%	< 0.05%	< 0.05%
纹波 LF BWL 20MHz	< 4mV RMS	< 10mV RMS	< 20mV RMS	< 8mV RMS	< 10mV RMS
纹波 HF BWL 20MHz	< 40mV P-P	< 100mV P-P	< 150mV P-P	< 100mV P-P	< 150mV P-P
精确度*	$\leq 0.2\%$	$\leq 0.2\%$	$\leq 0.2\%$	$\leq 0.2\%$	$\leq 0.2\%$
显示器分辨率	10mV	10mV	10mV	10mV	10mV
远程感测补偿	max. 2V	max. 2V	max. 2V	max. 2V	max. 2V
过压保护门限 (可调)	0...17.6V	0...35.2V	0...71.5V	0...35.2V	0...71.5V
输出 - 电流					
额定电流 I_{Nom}	20A	10A	5A	20A	10A
可调范围	0A... I_{Nom}	0A... I_{Nom}	0A... I_{Nom}	0A... I_{Nom}	0A... I_{Nom}
市电波动范围在 $\pm 10\% \Delta U_{IN}$ 时的稳定度	< 0.05%	< 0.05%	< 0.05%	< 0.05%	< 0.05%
带载0...100% ΔU_{OUT} 时的稳定度	< 0.15%	< 0.15%	< 0.15%	< 0.15%	< 0.15%
纹波 LF BWL 20MHz	< 10mA RMS	< 7mA RMS	< 3mA RMS	< 10mA RMS	< 3mA RMS
纹波 HF BWL 20MHz	< 60mA P-P	< 35mA P-P	< 12mA P-P	< 65mA P-P	< 25mA P-P
精确度*	$\leq 0.2\%$	$\leq 0.2\%$	$\leq 0.2\%$	$\leq 0.2\%$	$\leq 0.2\%$
显示器分辨率	10mA	10mA	1mA	10mA	10mA
负载从10...90%瞬态恢复时间	< 2ms	< 2ms	< 2ms	< 2ms	< 2ms
输出 - 功率					
额定功率 P_{Nom}	320W	320W	325W	640W	650W
降低额定功率	-	-	-	-	-
可调范围	-	-	-	-	-
精确度*	-	-	-	-	-
调节分辨率	-	-	-	-	-
效率	$\leq 90.5\%$	$\leq 89\%$	$\leq 93\%$	$\leq 90.5\%$	$\leq 91\%$
其它					
制冷	风扇	风扇	风扇	风扇	风扇
环境温度	0...50°C	0...50°C	0...50°C	0...50°C	0...50°C
储存温度	-20...70°C	-20...70°C	-20...70°C	-20...70°C	-20...70°C
相对湿度	< 80%	< 80%	< 80%	< 80%	< 80%
尺寸 (WxHxD)	330x118x308mm	330x118x308mm	330x118x308mm	330x118x308mm	330x118x308mm
重量	6,5kg	6,5kg	6,5kg	6,5kg	6,5kg
并联用Share bus	无	无	无	无	无
产品编号	09200130	09200131	09200132	09200133	09200134
串联	可执行, 总电压最高可达600V				
并联	可执行, 经该Share bus可最多连接1000W以上的30台产品				
湿度	< 80%				
绝缘耐压	输入端对输出端: 2500V; 输出端对外壳: 500V				
安全标准	EN 60950				
EMC标准	EN 61326, EN 55022 等级 B				
过压等级	等级 II				
保护等级	等级 I				
模拟编程					
电压范围	0...5V 或 0...10V (可选)				
设定/实际值精确度	$\leq 0.2\%$				
输入阻抗	约 53k Ω				

* 与额定值有关, 该精确度决定设定值与实际值间允许最大误差。

举例: 一台80V型号产品的电压精确度最少为0.2%, 即为160mV。当设定5V电压时, 且允许最大误差为160mV, 故得出实际值可能在4.84V和5.16V之间。

	PS 8160-04 DT	PS 8080-40 DT	PS 8360-10 DT	PS 8080-60 DT	PS 8360-15 DT
电源输入					
输入电压	90...264V	90...264V	90...264V	90...264V	90...264V
输入电压功率降额	-	-	-	90...150V	90...150V
230V时输入电流	max. 3.2A	max. 4.8A	max. 7.5A	max. 7.5A	max. 7.5A
100V时输入电流	max. 7.5A	max. 11.4A	max. 11.4A	max. 11.4A	max. 11.4A
输入频率	45...65Hz	45...65Hz	45...65Hz	45...65Hz	45...65Hz
输入保险丝	T 8A	T 16A	T 16A	T 16A	T 16A
功率因数	> 0.99	> 0.99	> 0.99	> 0.99	> 0.99
输出 - 电压					
额定电压 U_{Nom}	160V	80V	360V	80V	360V
可调范围	0V... U_{Nom}	0V... U_{Nom}	0V... U_{Nom}	0V... U_{Nom}	0V... U_{Nom}
市电波动范围在 $\pm 10\% \Delta U_{IN}$ 时的稳定度	< 0.02%	< 0.02%	< 0.02%	< 0.02%	< 0.02%
带载 10...90% 时的稳定度	< 0.05%	< 0.05%	< 0.05%	< 0.05%	< 0.05%
纹波 LF BWL 20MHz	< 20mV RMS	< 4mV RMS	< 11mV RMS	< 4mV RMS	< 8mV RMS
纹波 HF BWL 20MHz	< 120mV P-P	< 10mV P-P	< 30mV P-P	< 10mV P-P	< 50mV P-P
精确度*	$\leq 0.2\%$	$\leq 0.2\%$	$\leq 0.2\%$	$\leq 0.2\%$	$\leq 0.2\%$
显示器分辨率	100mV	10mV	100mV	10mV	100mV
远程感测补偿	max. 2V	max. 2.5V	max. 8V	max. 2.5V	max. 8V
过压保护门限 (可调)	0...176V	0...88V	0...396V	0...88V	0...396V
输出 - 电流					
额定电流 I_{Nom}	4A	40A	10A	60A	15A
可调范围	0A... I_{Nom}	0A... I_{Nom}	0A... I_{Nom}	0A... I_{Nom}	0A... I_{Nom}
市电波动范围在 $\pm 10\% \Delta U_{IN}$ 时的稳定度	< 0.05%	< 0.05%	< 0.05%	< 0.05%	< 0.05%
带载 0...100% ΔU_{OUT} 时的稳定度	< 0.15%	< 0.15%	< 0.15%	< 0.15%	< 0.15%
纹波 LF BWL 20MHz	< 1mA RMS	< 7mA RMS	< 0.45mA RMS	< 7mA RMS	< 0.45mA RMS
纹波 HF BWL 20MHz	< 3mA P-P	< 19mA P-P	< 1mA P-P	< 19mA P-P	< 1mA P-P
精确度*	$\leq 0.2\%$	$\leq 0.2\%$	$\leq 0.2\%$	$\leq 0.2\%$	$\leq 0.2\%$
显示器分辨率	1mA	10mA	10mA	10mA	10mA
负载从 10...90% 瞬态恢复时间	< 2ms	< 2ms	< 2ms	< 2ms	< 2ms
输出 - 功率					
额定功率 P_{Nom}	640W	1000W	1000W	1500W	1500W
降低额定功率	-	-	-	1000W	1000W
可调范围	-	0... P_{Nom}	0... P_{Nom}	0... P_{Nom}	0... P_{Nom}
精确度*	-	$\leq 0.2\%$	$\leq 0.2\%$	$\leq 0.2\%$	$\leq 0.2\%$
调节分辨率	-	1W	1W	1W	1W
效率	$\leq 92\%$	$\leq 93\%$	$\leq 92\%$	$\leq 93\%$	$\leq 93\%$
其它					
制冷	风扇	风扇	风扇	风扇	风扇
环境温度	0...50°C	0...50°C	0...50°C	0...50°C	0...50°C
储存温度	-20...70°C	-20...70°C	-20...70°C	-20...70°C	-20...70°C
相对湿度	< 80%	< 80%	< 80%	< 80%	< 80%
尺寸 (WxHxD)	330x118x308mm	330x118x388mm	330x118x388mm	330x118x388mm	330x118x388mm
重量	6.5kg	8.5kg	8.5kg	8.5kg	8.5kg
并联用 Share bus	无	有	有	有	有
产品编号	09200135	09200136	09200138	09200137	09200139
串联	可执行, 总电压最高可达600V				
并联	可执行, 经该Share bus可最多连接1000W以上的30台产品				
湿度	< 80%				
绝缘耐压	输入端对输出端: 2500V; 输出端对外壳: 500V				
安全标准	EN 60950				
EMC标准	EN 61326, EN 55022 等级 B				
过压等级	等级 II				
保护等级	等级 I				
模拟编程					
电压范围	0...5V 或 0...10V (可选)				
设定/实际值精确度	$\leq 0.2\%$				
输入阻抗	约 53k Ω				

* 与额定值有关, 该精确度决定设定值与实际值间允许最大误差。

举例: 一台80V型号产品的电压精确度最少为0.2%, 即为160mV。当设定5V电压时, 且允许最大误差为160mV, 故得出实际值可能在4.84V和5.16V之间。

3. 产品描述

3.1 产品图



图 1. 前视图

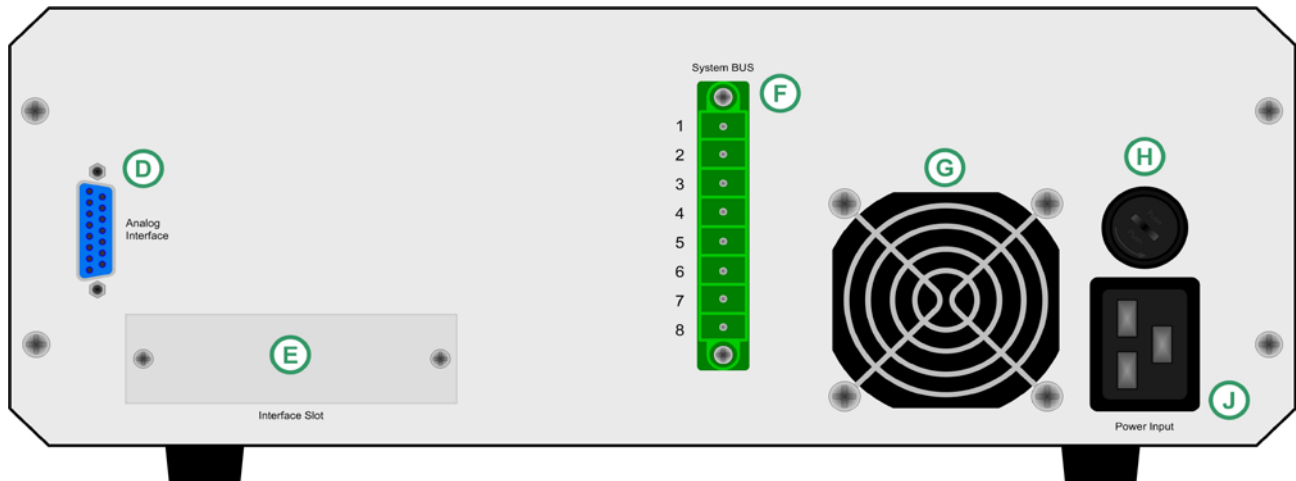


图 2. 后视图

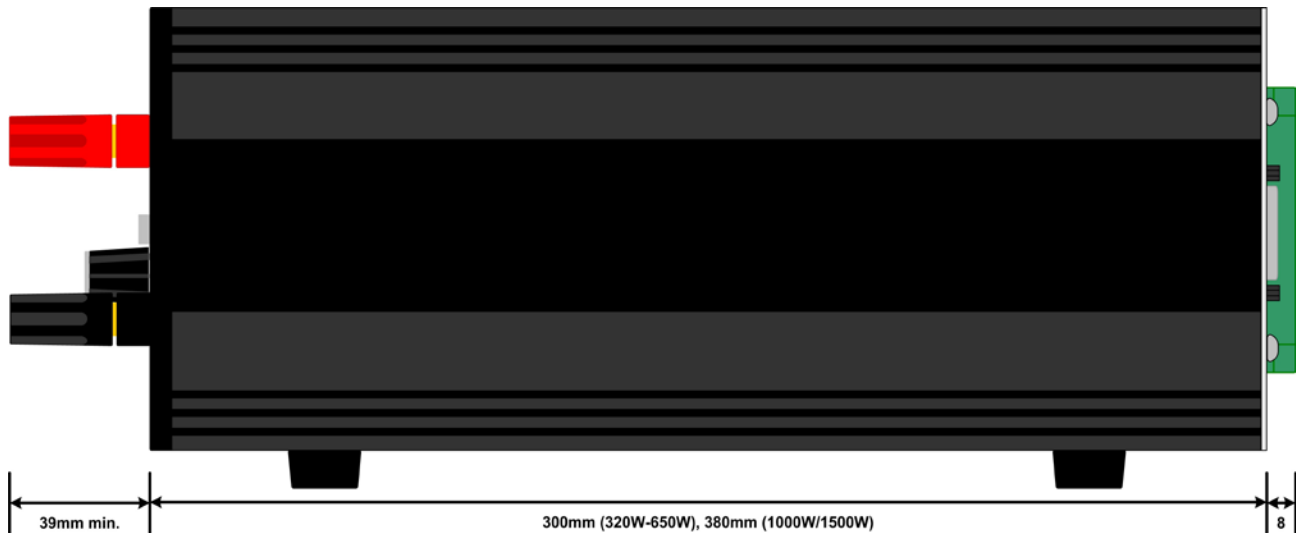


图 3. 右视图

3.2 插图说明

- A- 电源开关
- B- 控制面板
- C- 电源输出
- D- 模拟接口, 15脚, 母座
- E- 外接数字接口卡插槽
- F- 系统总线
- G- 风扇
- H- 输入保险丝 (具体值请看章节“2.2 各型号详细规格”)
- J- 电源输入插座, 3脚, IEC 60320

3.3 供应清单

- 1 x 电源供应器
- 1 x 印刷版使用说明书
- 1 x 电源线
- 1 x 系统总线插头

4. 一般信息

4.1 序言/安全警告

本说明书和产品专给对电源有基本了解的人士使用。不应给无基本电器知识的人士操作, 因本说明书未作此方面描述。操作不当和未遵守安全说明的操作, 可能会损坏产品或丧失产品保修权!

4.2 制冷

要保持外壳底部进风孔和后板排风孔的清洁, 以确保良好的冷却。注意产品后方至少10cm以内无任何物体阻挡, 以保障空气流通顺畅。

4.3 拆开产品

若要拆开产品或用工具从产品内部拆除零件, 可能会有高压触电的危险。必须将本产品与主电源断开后方可进行, 否则用户自行承担风险。

有受过电流危险知识训练的人员方可进行相关的维护或修理。

5. 安装

5.1 目检

收到本产品后, 请检查是否有外观受损痕迹。如有, 请不要操作本产品, 应立即联系您的供应商。

5.2 与市电的连接

本产品通过电源线接地。故仅可与带接地触点的电源插座相连。且连线中间不可接无接地触点的延伸线!

还装有5x20mm的保险丝(具体数值请看规格参数表), 从电源插座内可拆装更换。

5.3 直流输出端

功率输出端位于产品前部。

本输出端**无**保险! 为避免损坏负载设备, 应随时注意负载机的额定值。

连接线的直径取决于多个条件, 像输出电流、线长和环境温度。

建议使用长为1.5m的连线:

10A 以下:	0,75mm ²	15A 以下:	1,5mm ²
30A 以下:	4mm ²	40A 以下:	6mm ²
60A 以下:	16mm ²		

针对**每根线**(弹性线)。

输出“+”和“-”极未接地, 若有必要, 可将其中一极接地。

注意! 将其中一输出极接地时, 请随时检查负载(如电子负载)的其中一极是否也已接地。否则将引起短路!

注意! 串联时注意输出极的电位转移! 此时仅建议带最低电位的极点接地。

5.4 “感测”端 (远程感测)

为补偿负载线上(每根线最大1V)的压降, 电源可“感测”负载端而不是输出端的电压。它将调整输出电压以使负载获得所需电压。

将远程感测线连到产品后方“**System Bus**”端子的1和2引脚上。见章节3.1。

(+) 感测端只能与负载设备(+)端相连, (-)感测端与(-)端相连! 否则会损坏两头的产品。

详情也可参考章节7.7。

5.5 接口卡插槽

可选择给本产品配上接口卡。接口卡插槽位于产品后端。更多信息见章节“10.4 各引脚描述”。

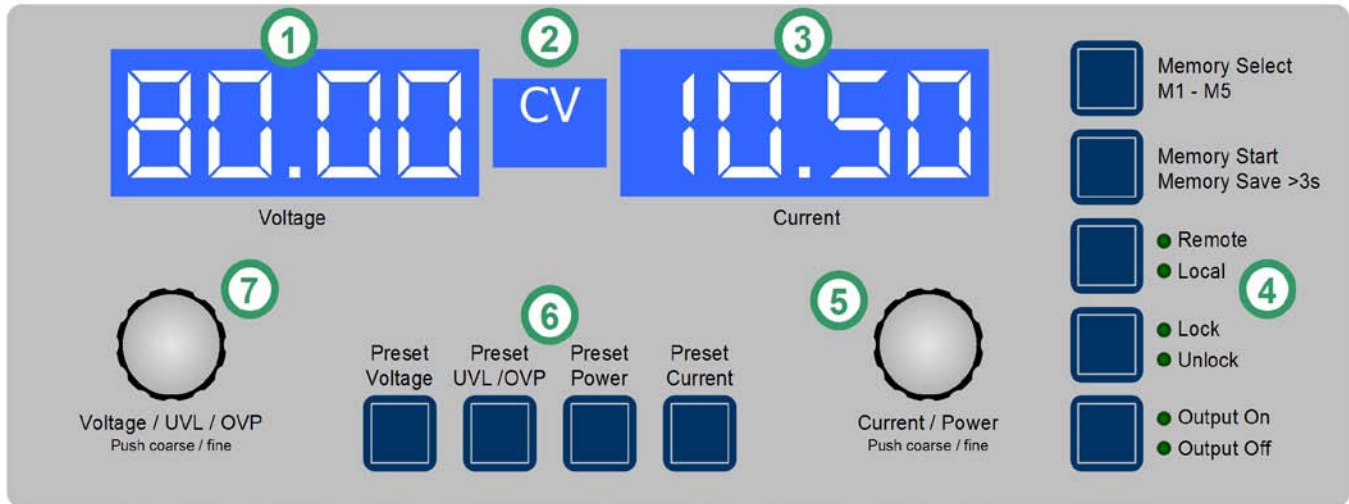


图 4. 控制面板

6. 操作

6.1 显示器

图4描绘了点阵显示器和控制面板全图。正常操作时，显示器显示实际电压（左边）和电流（右边），以及产品状态（中间）。在预设模式下，左显示区域显示电压设定值（预设电压），过压保护门限（预设OVP）或欠压极限（预设UVL）设定值。右显示区域显示电流（预设电流）或功率设定值（预设功率，仅针对1kW以上型号）。在产品设置模式下，显示器显示可调参数和设定。

中间的状态区域则显示下列状态：

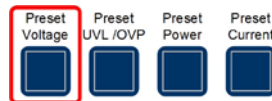
- CV** - 恒压调整 (只有当输出为“on”时)
- OT** - 过温错误
- OVP** - 过压错误
- CC** - 恒流调整 (只有当输出为“on”时)
- CP** - 恒功率调整 (只有当输出为“on”时)
- Fine** - 旋钮启用时细调

图解：

- 1 - 左显示区域：实际电压或V, UVL, OVP的设定值。
- 2 - 状态区域：显示状态，如CC, CV等。
- 3 - 右显示区域：实际电流或I, P的设定值。
- 4 - 控制按钮：设定产品条件等。
- 5 - 右旋钮：调节I和P设定值，以及在产品设定模式下的各项设定。
- 6 - 预设按钮：转为显示设定值。
- 7 - 左旋钮：调节V、UVL和OVP设定值，以及产品设定模式下的各项参数。

6.2 控制面板上各按钮

Preset Voltage按钮



正常操作模式下，该按钮可将实际输出电压值的显示转为预设输出电压值的显示（预设模式）。左显示区域将显示如下：



预设模式下，左旋钮(Voltage / UVL / OVP)与正常操作方式下一样的方法，调节0...100% U_{Nom} 范围内的电压设定值。调节值会立即传输到输出端！

注意！ 设定值的调节由欠压阈值UVL限制。见后面详述。

按两下该按钮立即退出预设模式，或者，如果没按预设按钮或有任一设定值被更改，则5s后自动退出。

由模拟或数字接口控制的远程控制模式下，可用预设模式检测远程输入的电压设定值。

用**LOCK**键可锁定该按钮。见后面详述。

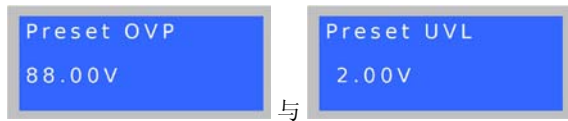
内存选择模式下，用该按钮可转为显示所选内存集的电压设定值，但是不会传输到输出端。左显示区域将显示如下：



Preset UVL / OVP按钮



正常操作模式下，该按钮可将欠压极限（按一下）或过压保护阈值（按两下）实际值的显示转为其设定值的显示（预设模式）。左显示区域将显示如下：



欠压极限(UVL)仅仅是输出电压的调节极限。意思是，如果设为0以外的任何值，则只能将电压设定值向下调低至UVL值。同样，UVL值只能往上调高至电压设定值。

左旋钮(Voltage / UVL / OVP)用来调节0... U_{Set} 范围内的UVL值。

按两下按钮，转为显示过压保护阈值预设值(OVP)。这个数值始终在0...110% U_{Nom} 范围内。

按三下按钮立即退出预设模式，或者，如果没按预设按钮或有任一设定值被更改，则5s后自动退出。

由数字接口控制的远程控制模式下，可用预设模式检测远程输入的OVP设定值。

用LOCK键可锁定该按钮。见后面详述。

内存选择模式下，该按钮可转为显示所选内存集的UVL值或OVP值，但是不会立即生效。左显示区域将显示如下：



Preset Power按钮



正常操作模式下，该按钮可将实际电流值的显示转为输出功率预设值（预设模式）。

仅1kW以上多数型号才有可调功率调整，右显示区域将显示如下：

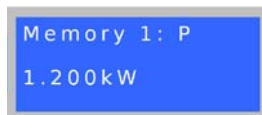


预设模式下，右旋钮(Current / Power)用来调节0...100% P_{Nom} 范围内的功率设定值。调节值会立即传输到输出端！

按两下该按钮立即退出预设模式，或者，如果没按预设按钮或有任一设定值被更改，则5s后自动退出。用LOCK键可锁定该按钮。见后面详述。

模拟或数字接口控制的远程控制模式下，可用预设模式检测远程输入的功率设定值。

内存选择模式下，用该按钮可转为显示所选内存集的功率设定值（仅针对1kW以上型号），但是不会传输到输出端。右显示区域将显示如下：



Preset Current按钮



正常操作模式下，该按钮可将实际输出电流值的显示转为预设输出电流值（预设模式）。以上多数型号都有可调功率调整。

右显示区域将显示如下：



预设模式下，右旋钮(Current / Power)可在正常操作模式下一样，调节0...100% I_{Nom} 范围内的电流设定值。调节值会立即传输到输出端！

按两下该按钮立即退出预设模式，或者，如果没按预设按钮或有任一设定值被更改，则5s后自动退出。

由模拟或数字接口控制的远程控制模式下，可用预设模式检测远程输入的电流设定值。

用LOCK键可锁定该按钮。见后面详述。

内存选择模式下，用该按钮可转为显示所选内存集的电流设定值，但是不会传输到输出端。右显示区域将显示如下：



Memory Select M1-M5按钮



该按钮在5个内存集间循环，每个内存集都有V、I、P、以及UVL和OVP的设定值。在这儿可编辑、存储或提交所选内存集。该按钮只有在输出为off时才工作。内存模式和所选内存集号显示如下：



用该按钮用户可执行下列操作：

a) 调节数值

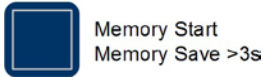
输出关闭，短按按钮，显示器变为第一个内存集，如上所示。

现在可调节所选内存集的电压(左)和电流(右)设定值。推动相应预设按钮可访问其它可调值。

再按按钮，会循环显示至内存集5，然后退出内存模式。

调节后数值一直保留，直至产品关闭，但是不会提交到输出设定值，也未存储下来！

Memory Start / Memory Save >3s按钮



该按钮用来将之前由**Memory Select M1-M5**按钮选好的内存集值提交给输出，或将内存保存于内置存储卡上。该按钮只有当输出为**off**时才工作。

用该按钮用户可执行下列操作：

b) 仅提交

输出关闭，选择内存集(1-5)，短按按钮 --> 内存集值提交为输出设定值，然后退出内存模式。要使用新值，先用**Output On**按钮或远程控制打开输出。

注意！内存集尚未保存！

c) 仅存储

输出关闭，选择一个或多个内存集，按需要调节数值，按住**Memory M1...M5**按钮不放，保持**3s**以上时间 --> 所有内存集被存储于内置存储卡，但不会被提交给输出。输出仍为关闭状态，保存内存集后退出内存模式。

也可利用数字接口（除**GPIO**外）通过远程控制和相应指令来定义内存集，并被即时存储。

用**LOCK**键可锁定该按钮。见后面详述。

Local按钮



本按钮激活/终止**LOCAL**模式。在**LOCAL**模式下不可进入远程控制模式。

注意！激活LOCAL模式将会即刻从远程控制模式退出（模拟或数字），并不再允许继续远程控制产品，除非再次退出LOCAL模式。

LOCAL模式由“**Local**”灯指示。只要**LOCAL**未激活，“**Remote**”灯就显示产品通过模拟或数字接口处于远程控制模式。

本按钮可在**LOCK**状态下锁定，见后面详述。

Lock / Unlock按钮



本按钮激活/终止控制面板锁定。**LOCK**模式下锁定所有的按钮，除**LOCK**按钮外。锁定控制面板可防止无意使用按钮和编码器。

注意！激活LOCK模式将会即刻从任何预设或内存模式退出，如果它们当前为激活状态。显示器会回到实际值的正常显示。

Output On / Output Off按钮



只要产品未处于遥控模式，可用此按钮手动打开或关闭电源输。输出状态通过按钮上面的“**Output On**”或“**Output Off**”LED灯指示出来。输出打开时，在显示器中间状态区域显示当前工作中的调整模式（**CC**、**CV**或**CP**（仅针对**1kW**以上型号））。

此按钮也可在**LOCK**状态下锁定。见上述相关内容。

输出的打开可通过模拟接口的**13脚(REM-SB)**来阻止。见章节“**10. 模拟接口**”。

此按钮还可用来确认错误消息。详情请见**7.4**和**7.5**章节。

6.3 其它控制键

可当按钮的旋钮



这两个旋钮有推动按钮功能。推动任何一个或两个会有下列作用：

a) 细调模式 (Fine)

短按任何一按钮可起用或停用细调模式。如果激活“**Fine**”，所有设定值、阈值和极限值都按最小的幅度调节，不管当前为何种模式（预设，内存等）。在状态显示区域以“**Fine**”文字显示出来。也可参考下面章节“**6.4 调节设定值**”。

b) 产品设置

当输出为**off**时，同时按住两个按钮，时间**>3s**，可将产品改至产品设置。按相同方式可退出。

6.4 调节设定值

1. 手工操作

在手工操作下，两旋钮可按预定幅度（见下表）在**0%**至**100%**的额定电压和电流设定值间连续调节。若想设置**OVP**和**UVL**，需按一下或两下**Preset UVL/OVP**按钮。若想设置功率设定值（**1kW**以上型号），需按**Preset Power**按钮。

注意！OVP值低于电压设定值，只要一打开输出，实际电压达到OVP门限，就会出现OV错误！

可通过细调或粗调手工完成设定值的设置，默认为粗调。需**Fine**-细调时按任一个旋钮来激活，幅度为**1**。

coarse-粗调则按额定值的下列步宽来进行（也可参考技术规格）：

电压			电流		
额定值	粗调	细调	额定值	粗调	细调
16V	0,1V	10mV	4A	50mA	1mA
32V	0,2V	10mV	5A	50mA	1mA
65V	0,5V	10mV	10A	0,1A	10mA
80V	0,5V	10mV	15A	0,1A	10mA
160V	1V	100mV	20A	0,2A	10mA
360V	2V	100mV	40A	0,5A	10mA
			60A	0,5A	10mA
功率					
额定值	粗调	细调			
1000W	0.01kW	0.001kW			
1500W	0.01kW	0.001kW			

重点！可调设定值的分辨率在某些型号上要高于输出电压分辨率。故有可能发生执行**2**或**3**个步宽后才能改变输出电压。

2. 通过模拟接口远程控制

模拟接口(简称为AI)允许同步远程控制电流、电压和功率(1kW以上型号起)。即,用AI来调节电压的同时,不可用前板旋钮调节电流,反之亦然。由于不可用AI调节门限,需要在远程控制模式前以手工设定。用预设按钮转为预设模式,显示转化后的设定值,放置于AI设定值引脚,作为电压。为了设置合适的设定值,用户可借助外电压源,或3脚的参考输出电压。

1kW以下型号不需要功率设定值PSEL起(见章节“10. 模拟接口”),因此不用输。

如只要求通过外部手段调节电压,电流设定值(CSEL)或功率设定值(PSEL)可连到参考电压(VREF)。

AI能以普通的0...5V或0...10V范围工作,并对应0...100%的额定值。产品设置模式(见章节“8. 产品设置”)下可选择所需电压范围。

以下适用:

0-5V: 参考电压 = 5V, 0...5V设定电压相当于0...100%的额定电压,在实际输出端(CMON, VMON),则相当于0...100%的实际数值。

0-10V: 参考电压 = 10V, 0...10V设定电压相当于0...100%的额定电压,在实际输出端(CMON, VMON),则对应0...100%的实际数值。

若输入超过极限的设定值,如>5V,当已选择0...5V电压范围,则将有关设定值减至100%而进行限制。

请千万别输入高于12V的设定输入值!

3. 通过数字接口卡远程控制

数字接口卡允许通过电脑设置电压、电流和功率,以及OVP门限和欠压极限UVL。当转为远程控制模式时,产品保留最后的设定值,直至被更改。因此可传送任意的设定值仅用来控制电压,而电流值保持不变。

数字接口(除GPIB外)传输的设定值永远为百分数,对应100%(hex: 0x6400)的额定值,或110%(hex: 0x6E00)的OVP门限。

使用GPIB时,给予的任何值都是真正的十进制值。

另外,数字接口卡允许查询和设定大量其它功能和数值。详情请参考章节“9. 数字接口卡”和IF卡的使用说明书。

7. 下列情形发生时的反应...

7.1 用电源开关打开

电源开关位于产品前端。打开产品后,显示器将显示一些信息:生产商名称,地址和标识,产品类型和固件版本。在设置模式下(见“8. 产品设置”)出现“AutoPwOn”(自动打开电源)选项,它决定产品打开时的输出状态。默认状态下为“on”,意思是可恢复产品最后关闭时V、I、P的设定值,OVP和UVL值,以及输出条件。如果该选项为“off”,V和设定值设为0,P的设定值为100%,输出在每一次开启后打开。

7.2 用电源开关关闭

用电源开关关闭产品如电源断电一样。它会保存最后设定值和输出条件。短时间过后,功率输出和风扇关闭,几秒钟后,产品完全关闭。

7.3 转至远程控制模式

a) 模拟接口: 如果产品没被LOCAL模式限制,或早已启动数字接口的远程模式,“Remote”引脚通过VSEL、CSEL和PSEL(1kW以上型号起),以及REM-SB引脚的设定值,将产品转为远程控制。输入1,2和13引脚(也可参考章节“10. 模拟接口”)的设定值和输出条件即刻被设置。从远程控制回到手工控制模式后,关闭输出,并保留最后远程调整的V、I和P设定值。

b) 数字接口: 通过相关指令转为远程控制,如未被模式禁止或未通过启动远程控制模式,将保留输出状态和设定值,直至被更改。退出远程控制,则关闭输出,且最后远程调整的V、I、P、OVP和UVL设定值被保留。

7.4 出现过压

过压错误可以因内部缺陷(输出电压上升且不可控)或外部电压太高而引起。过压保护(OVP)将关闭输出,并在显示器上以“OVP”文字和AI上的“OVP”引脚指示此错误。

应避免加载于输出端的外部电压超过额定电压的120%,否则产品内部元件会受损!

如果清除过压原因,输出会再次打开,“OVP”状态文字清除,这被视为确认。在手工操作模式下,以推动Output On按钮为确认方式,在模拟遥控模式下是“REM-SB”引脚,而在数字遥控模式下为相关指令。若错误仍然存在,不打开输出。

OVP错误以报警声记录于内部警报器。通过数字接口可读取该缓冲器。读缓冲器也表示确认。

注意: OV错误的状态优先于OT错误状态,当两个错误同时出现时会覆盖“OT”状态文字,且未经确认。

7.5 出现过温

应避免室温高过指定温度!

一旦因内部过热而出现过温(OT)错误,则关断输出,且出现“OT”状态文字。

同时Output On按钮上的灯会闪烁,指示出产品一旦冷却后即自动重启。如果不想这样,可手工关闭输出。LED灯停止闪烁,输出就不会自动启动。

OT错误要被确认。如果产品在冷却后还是关闭的,可使用Output on按钮或“REM-SB”引脚或相关指令来打开。如果输出为打开状态,可按一下Output on按钮,或给“REM-SB”引脚一由高至底的触发,或使用相关指令来关闭输出。

OT错误以报警声记录于内部警报器。通过数字接口可读取该缓冲器。读缓冲器也表示确认。

OT错误状态对于OV错误状态,具有较低的优先权。当两个错误同时出现时,“OVP”会覆盖“OT”状态文字。

7.6 调整电压、电流或功率

电源的输出电压和负载的阻值决定输出电流。只要输出电流低于设定电流极限值,产品以恒压(CV)模式操作,且以“CV”状态文字指示出来。

如果输出电流受限于电流设定值或额定电流，产品会转为恒流模式(CC)，并以“CC”状态文字指示出来。

输出功率在1kW以上的多数型号有一额外特征，即具有0...P_{Nom}的可调功率极限。如果产品实际电流和电压超过可调功率极限，即激活该功能，并覆盖恒压或恒流调整模式。功率极限最初影响输出电压。因为电压、电流和功率极限相互影响，有可能出现像下面这样的不同状况：

例1：产品进入恒压模式，然后限制了功率，因此，输出电压减少。较低的输出电压导致输出电流减小。如果负载阻值减小，输出电流会再次上升，输出电压进一步下降。

例2：产品进入恒流模式，输出电压有负载阻值决定。于是限制了功率，根据 $P = U * I$ 公式，输出电压和电流减少。如果电流设定值减少，输出电流和电压也会减少。产品的两个值，实际功率将低到之前设定的功率极限以下，产品由恒功率调整(CP)转为恒流调整(CC)。

7.7 远程感测被激活

远程感测操作用来补偿电源和负载间连线的压降。因为这受限于一定水平，建议按照输出电流选择适当直径的连线，以将压降减小到最小。

感测输入端位于产品后板，**System Bus**端子上。按正确极性连线到此。电源会自动检测外部感应端，并通过负载的实际电压而非输出电压，来补偿输出电压，从而按照电源与负载间的压降值提升输出电压。

最大补偿值：每根线为1V。

也可参考下图5。

7.8 市电出现欠压或过压

本产品的特征为采用主动式功率因素和宽范围的输入。意为，可在90V...264V，输入电压下操作。90V以下的输入电压被认为是断电，或完全关闭产品，它会保存产品最后条件，关断功率输出。

应避免输入端长期欠压或过压！

重要！ 1500W功率的产品在输入电压低于约150V时降额至1000W。

7.9 连接不同类型的负载

不同类型的负载，如阻性负载（台灯，电阻），电子负载或感性负载（马达），性能不同，它们会对电源起反作用。例如，马达会产生一反电压，导致电源因过压保护而关断输出。

电子负载有电压、电流和功率调整线路，他们与电源的相互作用，可能会提高输出纹波或其它多余的副作用。电阻负载几乎100%中性。故建议在安排应用时要考虑负载的特性。

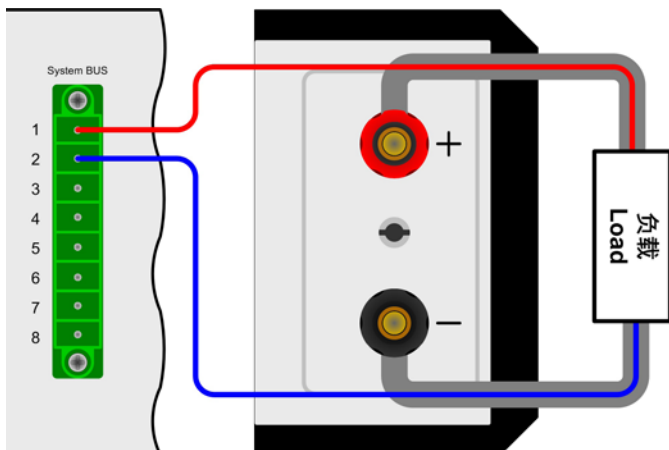


图5. 感测线的连接

8. 产品设置

产品设置目的在于设定不常变动的参数。通常有两个基本设置，其它设定仅在配上数字接口卡时才需要。

只有关闭输出，长按旋钮（见章节6.3）超过2s，才可进入产品设置。退出产品设置菜单与存储设定值操作方式一样。

若更换成一不同于数字接口卡的卡时，产品仍保留数字接口的所有设置不变。故用户不必每次更换接口卡类型时都设置一次。

具体有下列**基本设置**：

名称：**AutoPwrOn** 默认值：**on**

可设置值：**on, off**

解释：“Auto Power On”为“on”时，在产品关闭或停电时恢复最后输出状态。这适用于需要产品在供电恢复后可继操作的情形。当它设为“off”时，输出保持关闭状态。

名称：**AI range** 默认值：**0-10**

可设置值：**0-5, 0-10**

解释：通过模拟接口选择使用的电压范围。

名称：**Contrast** 默认值：**70**

可设置值：**50...100**

解释：调整LCD显示器的对比度。

下列设置适用于**所有**接口卡：

名称：**Device node** 默认值：**1**

可设置值：**1...30**

解释：选择产品位址（产品节点，来自CAN专业术语）。当将产品应用于总线系统(CAN或GPIB)时，每台产品必须有一独特的地址！

利用**CAN**接口卡-**IF-C1**才可进行下列设置：

名称：**Baud** 默认值：**100k**

可设置值：**10k, 25k, 50k, 100k, 125k, 250k, 500k, 1M**

解释：选择CAN传输波特率或以兆为单位的波特率。

名称：**RID** 默认值：**0**

可设置值：**0...31**

解释：选择重定位识别段(RID)。可参考CAN专业术语或IF-C1 CAN接口卡的说明书，查阅更多信息。

名称：**Bus term** 默认值：**on**

可设置值：**on, off**

解释：启用/停用CAN接口卡的总线终止电阻。仅在产品位于总线终端时需要。

利用**RS232**接口卡-**IF-R1**才可进行下列设置：

名称：**Baud** 默认值：**57600**

可设置值：**9600, 19200, 38400, 57600**

解释：选择以波特率为单位的串行传输速率。利用RS232不可配置其它参数，但可这样定义：

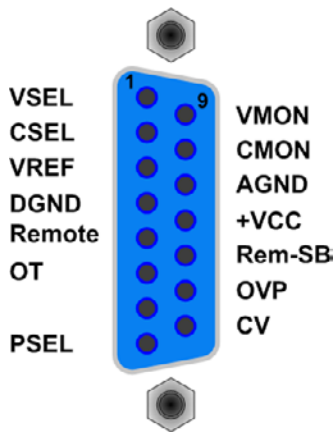
奇偶性 = 奇数

停止位 = 1

数据位 = 8

必须在电脑上设置相同的配置。

10.2 引脚分布总图



注意！请勿将模拟接口的地接到外控设备（比如：**PLC**）的负输出端，如果连上，就表示控制设备连到了电源输出负极（形成接地回路），负载电流流经控制线，从而损坏设备！

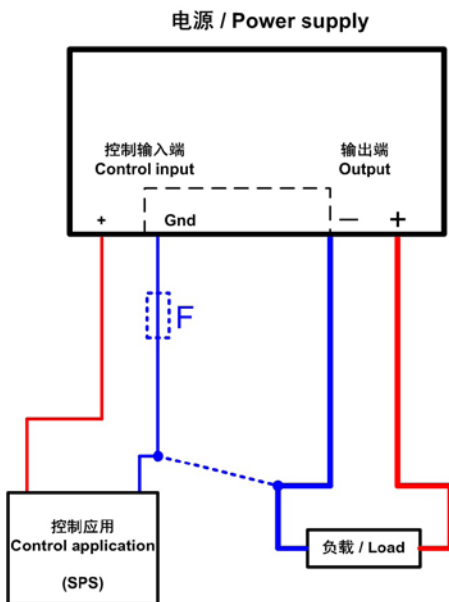


图 6

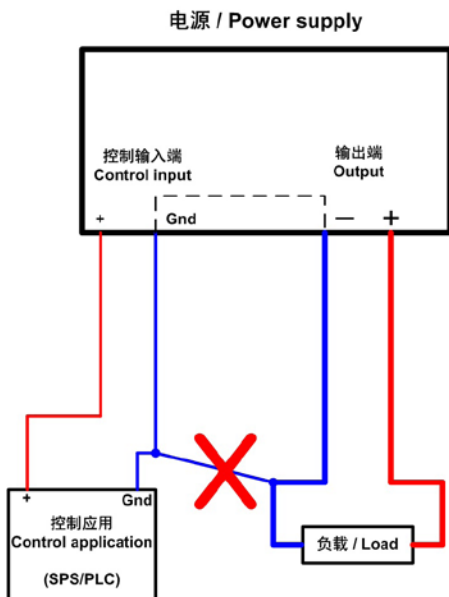


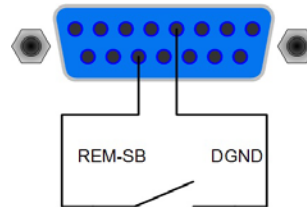
图 7

10.3 应用举例

输出关闭

“PREM-SB” 引脚一直都为工作状态，因此它不依靠远程模式。在无外部手段的条件下用来关闭输出。具体操作是，利用一低阻连接件，如开关、开集三极管或继电器，将该引脚接到地（DGND），这样就可关闭输出。

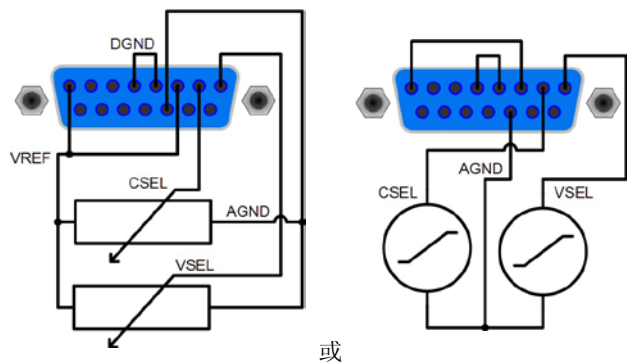
注意：PLC的数字输出脚有可能无法正确操作，因其阻抗可能不够低。故需随时检查您外部控制设备的技术规格。



远程控制电流和电压

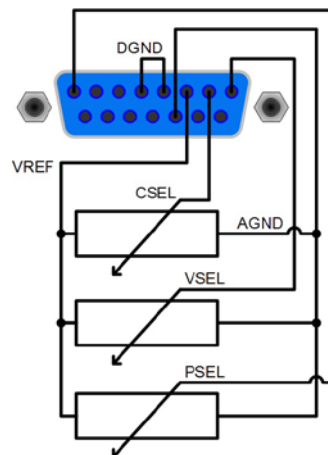
VREF和接地脚之间有两电位器，VSEL和CSEL输入端上有一滑动器。利用前板上的旋钮可控制电源，将它当作电流源或电压源用。如果VREF输出脚的电流最大为3mA，则需使用至少为10kOhm的电位器。

这儿显示的是带功率调整特点的产品型号，功率设定值束缚于VREF，因此为100%。



远程控制功率

与上述例子相似，但是用可调功率极限来完成。（仅适用于具有功率调节功能的产品型号）



10.4 各引脚描述

引脚	名称	类型 ⁽¹⁾	描述	水平	电气参数
1	VSEL	AI	设定值: 电压	0...10V 或 0...5V 对应 U_{Nom} 的 0..100%	精确度 < 0,2% 阻值 $R_i > 100k$
2	CSEL	AI	设定值: 电流	0...10V 或 0...5V 对应 I_{Nom} 的 0..100%	
3	VREF	AO	参考电压	10V 或 5V	$I_{Max} = +5mA$ 时, 精确度 < 0.2% 短路保护对 AGND
4	DGND	POT	数字控制信号参考电位		+Vcc, 控制和状态信号
5	REMOTE	DI	在内控和外控间切换	外控 = LOW, $U_{Low} < 1V$ 内控 = HIGH, $U_{High} > 4V$ 内控 = HIGH	电压范围 = 0 ...30V 输出 5V 时, $I_{Max} = +1mA$ 发送: 开集电极对 DGND
6	OT	DO	过温错误	OT = HIGH, $U_{High} > 4V$ 无 OT = LOW, $U_{Low} < 1V$	准开集电极上拉至 V_{cc} ⁽²⁾ 输出 5V 时, 电流最大 +1mA $U_{CE} = 0.3V$ 时, $I_{Max} = -10mA$ $U_{Max} = 0...30V$ 短路保护对 DGND
7	N.C.				不连
8	PSEL ⁽³⁾	AI	设定值: 功率	0...10V 或 0...5V 对应 P_{Nom} 的 0..100%	精确度 < 0.5% 阻值 $R_i > 100k$
9	VMON	AO	实际值: 电压	0...10V 或 0...5V 对应 U_{Nom} 的 0..100%	$I_{Max} = +2mA$ 时, 精确度 < 0.2% 短路保护对 AGND
10	CMON	AO	实际值: 电流	0...10V 或 0...5V 对应 I_{Nom} 的 0..100%	
11	AGND	POT	模拟信号参考电位		-SEL, -MON, VREF 信号
12	+Vcc	AO	辅助电压输出 (Ref: DGND)	11...13V	$I_{Max} = 20mA$ 短路保护对 DGND
13	REM-SB	DI	输出关闭	关 = LOW, $U_{Low} < 1V$ 开 = HIGH, $U_{High} > 4V$ 开 = OPEN	电压范围 = 0...30V 输出 5V 时, $I_{Max} = +1mA$ 发送: 开集电极对 DGND
14	OVP	DO	过压错误	OVP = HIGH, $U_{High} > 4V$ 无 OVP = LOW, $U_{Low} < 1V$	准开集电极上拉至 V_{cc} ⁽²⁾ 输出 5V 时, 电流最大 +1mA $U_{CE} = 0.3V$ 时, $I_{Max} = -10mA$ $U_{Max} = 0...30V$ 短路保护对 DGND
15	CV	DO	指示电压调整启用	CV = LOW, $U_{Low} < 1V$ CC = HIGH, $U_{High} > 4V$	$U_{CE} = 0.3V$ 时, $I_{Max} = -10mA$ $U_{Max} = 0...30V$ 短路保护对 DGND

⁽¹⁾ AI = 模拟输入, AO = 模拟输出, DI = 数字输入, DO = 数字输出, POT = 电位

⁽²⁾ 内控 $V_{cc} = 13...15V$

⁽³⁾ 仅针对 1kW 以上型号

11. 其它

11.1 终端系统总线的功能

带8个引脚的**System Bus**端子位于产品后端，用来连接远程感测线或串联或并联多台产品。

各引脚分布说明：

- 1: 感测 +
- 2: 感测 -
- 3: 主机输出电流
- 4: 主机输出电压
- 5: 辅机输入电流
- 6: 辅机输入电压
- 7: 共享总线
- 8: 地

注意！ 3-8引脚的功能如下面段落描述，仅对输出功率为**1000W**以上的产品才有用。

11.2 串联

注意：160V和720V型号产品无此操作。

注意：该操作仅针对额定功率为1kW以上的产品！

串联时，建议只针对具有相同输出电流的产品，否则额定输出电流最低的产品将定义为系统的最大电流。

一台设备总是下一台的主机，然后这个下一台成为辅机和再下一台的主机，如此类推。连接两台以上产品时，建议将某一台作为主机，其它为辅机。辅机由主机通过**System Bus**端子的辅机输入引脚3和4来控制。可同时控制其电压和电流，也可分开控制。

图8为连线举例。由主机提供电压和电流。如果只控制电压或电流其中一个，那另外一个的设定值应设为100%。

要远程控制整个系统，经模拟或数字接口控制主机即可。读出实际值时，电流监控值会代表整个系统的电流，但是电压监控值仅代表主机的输出电压。若想获得实际读数，可将串联（只有当所有产品为同型号时适用）在一起的多台产品的实际电压相乘，或者分开读出它们。

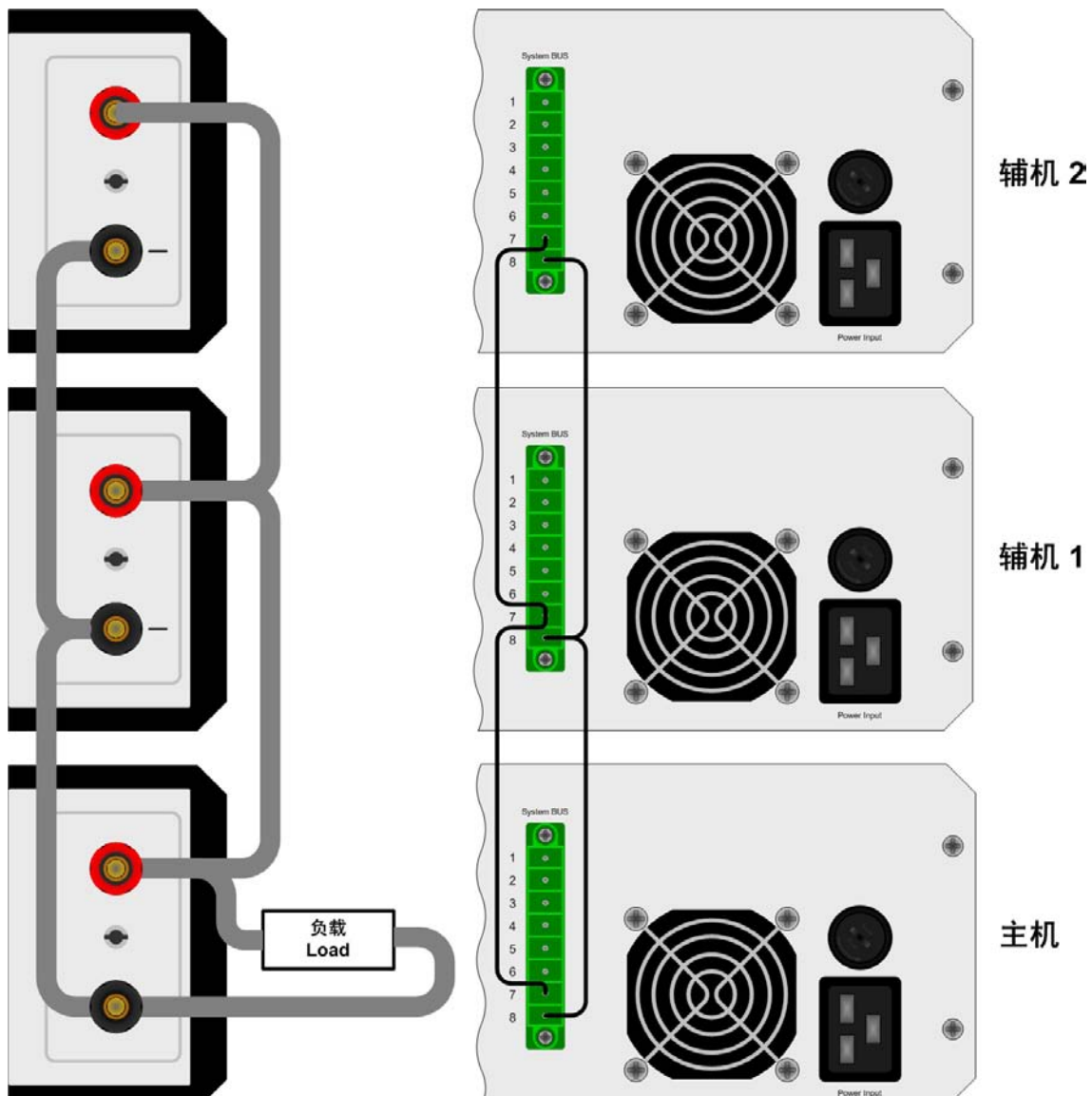
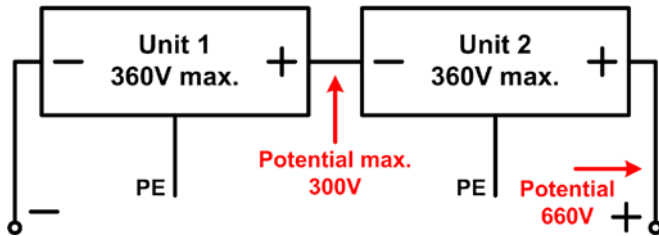


图 8. 主机-辅机的串联

鉴于安全和隔离的原因，需考虑下面一些限制和规则：

- 串联时任何一台产品的负直流输出端对地(PE)的电压不可上升到 **>300V** 的电位！
- 共享总线端不可连线！
- 串联中各产品模拟接口的地(AGND, DGND)不可相互连接！
- 远程感测端不可连线！

举例：额定电压为360V的两台同型号产品，比如：PSI 8360-10 DT。按计算，它们串联后的总电压可能高达720V。鉴于产品负输出端的电位，第二台产品的负直流端电压可能会上升到360V。这是绝对不允许的！所以必须将较低电位的的产品限制到某一最大值。下图阐述了最后形成的总电压将为660V。



警告！串联时允许最大总电压不能超过600V！

11.3 共享总线模式下的并联

注意：该操作仅针对额定功率为以上的产品！

注意！只有相同型号（输出电压和电流相同）的产品才可用于下列操作模式。

若想增加输出电流，可并联两台或更多同型号的产品。必须总是确保负载连线具有足够大的直径！理想情况下，连到负载的所有连线应该具有相同长度和直径。

需要进行下列连接：将所有产品的(+)直流输出极相互连接。所有产品**System Bus**端子的7（共享总线）和8（地）引脚并联连接。如果还需远程感测，则将所有感测+和感测-的输入脚并联后与负载连接。

建议定义一台产品为控制系统电压和电流的主机。将所有辅机的电压、电流和功率设定值设为100%。

所有产品显示各自实际数值，不会出现系统输出电流的总值。

远要远程控制整个系统，经模拟或数字接口控制主机即可。读出实际值时，电压监控值会代表整个系统的电压，但是电流监控值仅代表主机的输出电流。若想获得实际读数，可将并联（只有具有相同输出电流的产品适用）在一起的多台产品的实际电流相乘，或者分开读出它们。

图9为连线举例。

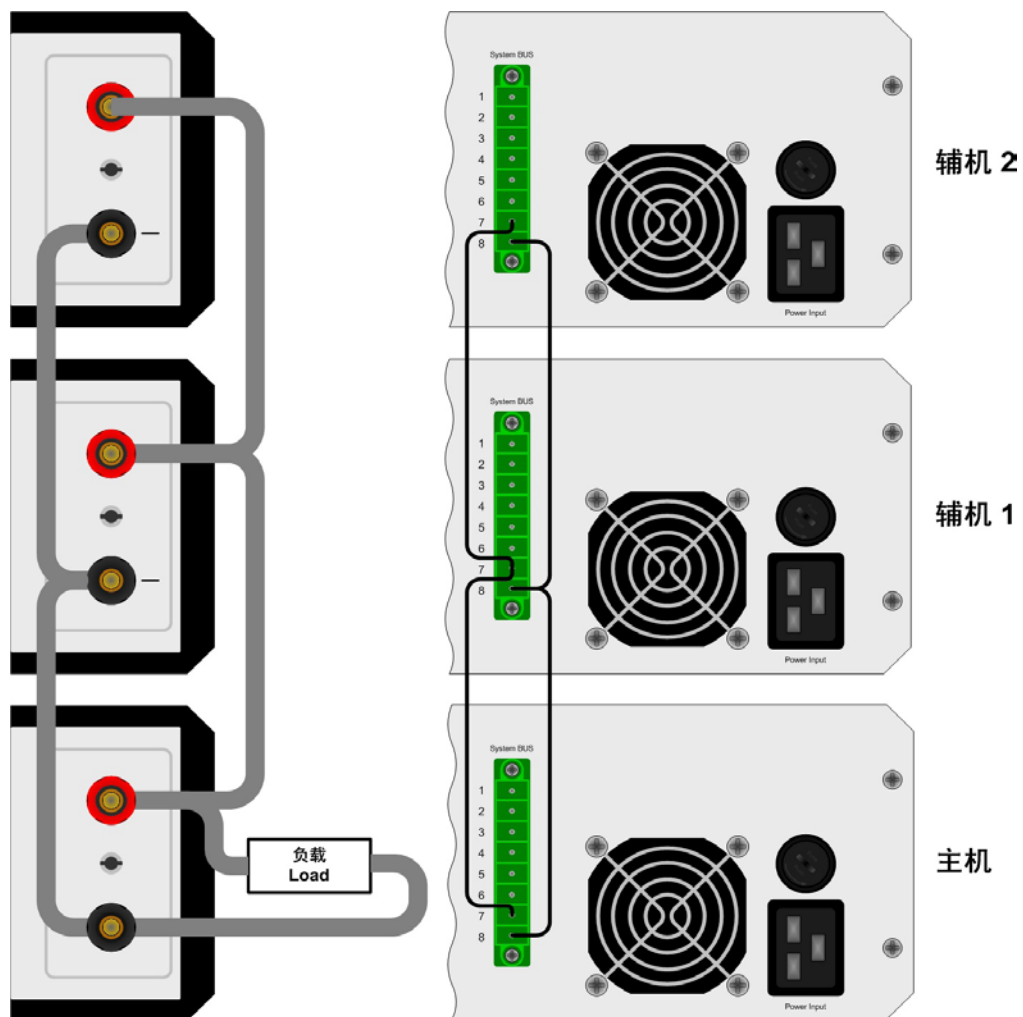


图 9. 在共享总线上并联

11.4 连网

图10和11描述了多台产品在数控状态下以星形（USB, RS232）或车形（CAN, GPIB）配置的连网举例。

适用总线系统和接口的限制和技术规格。

通过**USB**，一台电脑可控制多达30台产品，且需使用带特制电源的USB集线器。这也基本适用于RS232。区别在于操作和线长。

通过**CAN**，每个地址段上的多达30台电源，可容入新的或现有的CAN总线系统。它们由产品节点和RID（见“8. 产品设置”）组成。

通过**GPIB**，每一条总线限制最多15台产品用一台GPIB主机控制。一台电脑上可安装多台主机，这样能增加可编址单元数。

11.5 其它附件和选项功能

注意：关于附件和选项功能详情，可参考另外的用户指导手册。

有下列附件可供：

a) USB-转-模拟接口UTA12

经USB（电脑这边）和产品内部模拟接口可远程控制。

b) 数字接口卡

还配USB, RS232, CAN, GPIB/IEEE (仅SCPI) 或以太网/LAN (仅SCPI) 或Profibus用可插拔式数字接口卡。

有下列选项功能可供：

a) High Speed Ramping

通过减少输出电容容量来增加输出电压的动态。必须指出的是其它相关输出值也增加！

注意：这是个永久性更改，不可更改回来。

11.6 固件更新

只有当产品出现错误行为或者应用新功能时才需进行产品固件更新。

要更新一台产品固件，需要用到某一数字接口卡，新的固件文档，称作“更新工具”的Windows软件。

下列这些接口卡才能用于固件更新：

- IF-U1 (USB)
- IF-R1 (RS232)
- IF-E1 (Ethernet/USB)
- IF-PB1 (Profibus/USB)

如果手上没有一张上述接口卡，则不可更新。请立即联系您的产品销售方寻求解决方案。

产品对应的更新工具和固件文档可从产品制造商网站获取，或者发邮件索取。更新工具将会指导用户整个半自动更新过程。

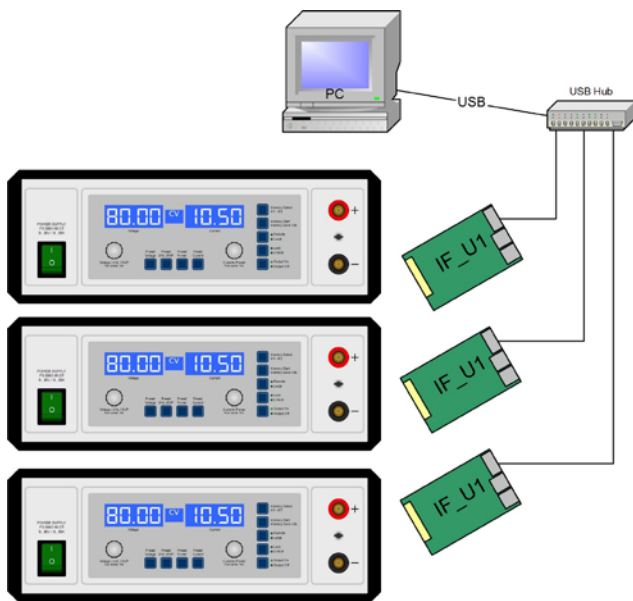


图10. 通过USB或RS232连网

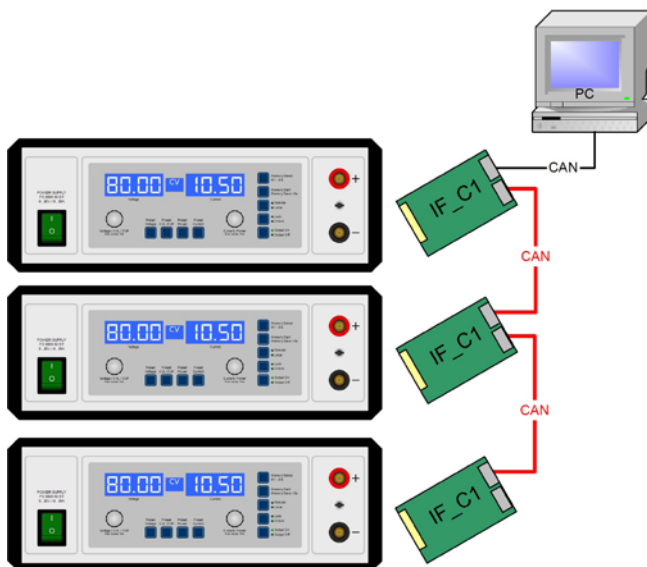


图11. 用CAN卡连网的范例，也适用于GPIB卡

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Safety instructions



Dangerous voltage

Caution: The output voltage can rise to dangerous levels (> 60 VDC)!

All live parts have to be covered. All actions at the output terminals have to be done while the unit is switched off from the mains (mains switch OFF) and may only be executed by personnel which is instructed about the hazards of electrical current. Any connection between the load and the unit (at the output terminals) have to be scoop-proof. Applications connected to the power output must be configured and fused in a way that prevents the use of these to cause a damage or worse to the unit by overload or malfunction.



Important! Keep in mind!

- Only operate the unit at the voltage stipulated on the type plate
- Never insert mechanical parts, especially from metal, into the unit, there is risk of an electrical shock and the unit might get damaged
- Avoid the use or presence of liquids in the proximity of the unit, the liquid might get into the unit and cause damage
- Never touch the contacts of the mains plug at the mains cord directly after unplugging it from the mains socket, because there is risk of an electrical shock
- Never connect loads, especially ones with low resistance, to the unit while the power output is switched on, because it can cause sparks which might damage the unit and injure the hands
- In order to equip interface cards into the slots on rear, the common ESD regulations have to be followed
- The interface card may only be plugged and unplugged while the unit is completely switched off (mains switch OFF)
- Aging of the device, as well heavy use may result in unpredictable behaviour of control elements like pushbuttons and rotary knobs.

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1. Introduction

The laboratory power supplies of the series PS 8000 DT are ideally suited for school, laboratory and workshop use because of their desktop case.

Apart from standard functions of power supplies the user can define and recall 5 different presets of set values or make use of the integrated analogue interface, that can handle the common voltage ranges of 0...5V or 0...10V. This offers a way of easily monitoring the device as well as total remote control.

The optionally available, digital interface cards provide an even wider spectrum of control and monitoring functions by means of a PC. Models from 1000W feature an adjustable power regulation circuit, as well as a „System Bus“ terminal which enables series connection as master-slave or parallel connection with share bus.

The integration into existent systems is done very comfortably by using an interface card, while there is no need to configure the card at all or with only a few settings.

Via the analogue interface, a power supply can also be operated in connection to other power supply units, controlling these via the interface. Or they can be controlled and monitored by an external control system, like a PLC.

The devices are microprocessor-controlled and thus delivers fast and accurate measurement and indication of actual values.

The main functions at a glance:

- Set voltage and current, each with 0...100%
- Adjustable overvoltage threshold 0...110% U_{Nom}
- Adjustable power 0...100% (models from 1kW)
- Pluggable interface cards (CAN, USB, RS232, IEEE/GPIB, Ethernet/LAN, Profibus)
- Analogue interface for external control and monitoring with 0...5V or 0...10V (selectable) for 0...100%
- Powers of 320W, 640W, 1000W and 1500W
- Temperature controlled fan
- Status indication (OT, OVP, CC, CV, CP)
- 5 selectable memory sets
- Master-Slave operation for series connection (from 1kW)
- Share-Bus operation for parallel connection (from 1kW)

2. Technical specifications

2.1 Control panel and display

Type

Display: Dot matrix display 202 x 32 dots, separated into three areas

Knobs: 2 rotary knobs, 9+2 pushbuttons

Display formats

The nominal values define the maximum adjustable range.

Actual values of voltage and current are displayed simultaneously, the set values of the overvoltage threshold, the undervoltage limit, voltage, current and power (models from 1kW) are displayed separately.

Display of voltage values

Resolution: 4 digits

Formats: 0.00V...99.99V
0.0V...999.9V

Display of current values

Resolution: 4 digits

Formats: 0.000A...9.999A
0.00A...99.99A

Display of power values (models from 1kW)

Resolution: 4 digits

Formats: 0.000kW...9.999kW

2.2 Technical specifications

	PS 8016-20 DT	PS 8032-10 DT	PS 8065-05 DT	PS 8032-20 DT	PS 8065-10 DT
Mains input					
Input voltage	90...264V	90...264V	90...264V	90...264V	90...264V
Input voltage with derating	-	-	-	-	-
Input current at 230V	max. 1.8A	max. 1.8A	max. 1.8A	max. 3.2A	max. 3.4A
Input current at 100V	max. 3.8A	max. 3.8A	max. 3.8A	max. 7.5A	max. 7.5A
Input frequency	45...65Hz	45...65Hz	45...65Hz	45...65Hz	45...65Hz
Input fuse	T 8A	T 8A	T 8A	T 8A	T 8A
Power factor	> 0.99	> 0.99	> 0.99	> 0.99	> 0.99
Output - Voltage					
Nominal voltage U_{Nom}	16V	32V	65V	32V	65V
Adjustable range	0V... U_{Nom}	0V... U_{Nom}	0V... U_{Nom}	0V... U_{Nom}	0V... U_{Nom}
Stability at mains fluctuation $\pm 10\% \Delta U_{IN}$	< 0.02%	< 0.02%	< 0.02%	< 0.02%	< 0.02%
Stability at 10...90% load	< 0.05%	< 0.05%	< 0.05%	< 0.05%	< 0.05%
Ripple LF BWL 20MHz	< 4mV RMS	< 10mV RMS	< 20mV RMS	< 8mV RMS	< 10mV RMS
Ripple HF BWL 20MHz	< 40mV P-P	< 100mV P-P	< 150mV P-P	< 100mV P-P	< 150mV P-P
Accuracy*	$\leq 0.2\%$	$\leq 0.2\%$	$\leq 0.2\%$	$\leq 0.2\%$	$\leq 0.2\%$
Resolution of display	10mV	10mV	10mV	10mV	10mV
Remote sense compensation	max. 2V	max. 2V	max. 2V	max. 2V	max. 2V
Overvoltage protection threshold (adjustable)	0...17.6V	0...35.2V	0...71.5V	0...35.2V	0...71.5V
Output - Current					
Nominal current I_{Nom}	20A	10A	5A	20A	10A
Adjustable range	0A... I_{Nom}	0A... I_{Nom}	0A... I_{Nom}	0A... I_{Nom}	0A... I_{Nom}
Stability at mains fluctuation $\pm 10\% \Delta U_{IN}$	< 0.05%	< 0.05%	< 0.05%	< 0.05%	< 0.05%
Stability at 0...100% ΔU_{OUT}	< 0.15%	< 0.15%	< 0.15%	< 0.15%	< 0.15%
Ripple LF BWL 20MHz	< 10mA RMS	< 7mA RMS	< 3mA RMS	< 10mA RMS	< 3mA RMS
Ripple HF BWL 20MHz	< 60mA P-P	< 35mA P-P	< 12mA P-P	< 65mA P-P	< 25mA P-P
Accuracy*	$\leq 0.2\%$	$\leq 0.2\%$	$\leq 0.2\%$	$\leq 0.2\%$	$\leq 0.2\%$
Resolution of display	10mA	10mA	1mA	10mA	10mA
Transient recovery time 10...90% load	< 2ms	< 2ms	< 2ms	< 2ms	< 2ms
Output - Power					
Nominal power P_{Nom}	320W	320W	325W	640W	650W
Nominal power at derating	-	-	-	-	-
Adjustable range	-	-	-	-	-
Accuracy*	-	-	-	-	-
Resolution of adjustment	-	-	-	-	-
Efficiency	$\leq 90.5\%$	$\leq 89\%$	$\leq 93\%$	$\leq 90.5\%$	$\leq 91\%$
Miscellaneous					
Cooling	by fan	by fan	by fan	by fan	by fan
Ambient temperature	0...50°C	0...50°C	0...50°C	0...50°C	0...50°C
Storage temperature	-20...70°C	-20...70°C	-20...70°C	-20...70°C	-20...70°C
Humidity rel.	< 80%	< 80%	< 80%	< 80%	< 80%
Dimensions (WxHxD)	330x118x308mm	330x118x308mm	330x118x308mm	330x118x308mm	330x118x308mm
Weight	6,5kg	6,5kg	6,5kg	6,5kg	6,5kg
Sharebus for parallel connection	no	no	no	no	no
Article number	09200130	09200131	09200132	09200133	09200134
Series connection	possible, up to max. 600V total voltage				
Parallel connection	possible, max. 30 units, models from 1000W via Share bus				
Humidity	<80%				
Isolation	Input to output: 2500V, Output to enclosure: 500V				
Safety	EN 60950				
EMC standards	EN 61326, EN 55022 Class B				
Overvoltage class	Class II				
Protection class	Class I				
Analogue programming					
Voltage range	0...5V or 0...10V (selectable)				
Accuracy set/actual values	$\leq 0.2\%$				
Input impedance	approx. 53k Ω				

* Related to the nominal value, the accuracy defines the maximum allowed deviation between set value and actual value.

Example: a 80V model has min. 0.2% voltage accuracy. This is 160mV. When setting a voltage of 5V and with an allowed maximum deviation of 160mV, the resulting actual value could be between 4.84V and 5.16V.

	PS 8160-04 DT	PS 8080-40 DT	PS 8360-10 DT	PS 8080-60 DT	PS 8360-15 DT
Mains input					
Input voltage	90...264V	90...264V	90...264V	90...264V	90...264V
Input voltage with derating	-	-	-	90...150V	90...150V
Input current at 230V	max. 3.2A	max. 4.8A	max. 7.5A	max. 7.5A	max. 7.5A
Input current at 100V	max. 7.5A	max. 11.4A	max. 11.4A	max. 11.4A	max. 11.4A
Input frequency	45...65Hz	45...65Hz	45...65Hz	45...65Hz	45...65Hz
Input fuse	T 8A	T 16A	T 16A	T 16A	T 16A
Power factor	> 0.99	> 0.99	> 0.99	> 0.99	> 0.99
Output - Voltage					
Nominal voltage U_{Nom}	160V	80V	360V	80V	360V
Adjustable range	0V... U_{Nom}	0V... U_{Nom}	0V... U_{Nom}	0V... U_{Nom}	0V... U_{Nom}
Stability at mains fluctuation $\pm 10\% \Delta U_{IN}$	< 0.02%	< 0.02%	< 0.02%	< 0.02%	< 0.02%
Stability at 10...90% load	< 0.05%	< 0.05%	< 0.05%	< 0.05%	< 0.05%
Ripple LF BWL 20MHz	< 20mV RMS	< 4mV RMS	< 11mV RMS	< 4mV RMS	< 8mV RMS
Ripple HF BWL 20MHz	< 120mV P-P	< 10mV P-P	< 30mV P-P	< 10mV P-P	< 50mV P-P
Accuracy*	$\leq 0.2\%$	$\leq 0.2\%$	$\leq 0.2\%$	$\leq 0.2\%$	$\leq 0.2\%$
Resolution of display	100mV	10mV	100mV	10mV	100mV
Remote sense compensation	max. 2V	max. 2.5V	max. 8V	max. 2.5V	max. 8V
Overvoltage protection threshold (adjustable)	0...176V	0...88V	0...396V	0...88V	0...396V
Output - Current					
Nominal current I_{Nom}	4A	40A	10A	60A	15A
Adjustable range	0A... I_{Nom}	0A... I_{Nom}	0A... I_{Nom}	0A... I_{Nom}	0A... I_{Nom}
Stability at mains fluctuation $\pm 10\% \Delta U_{IN}$	< 0.05%	< 0.05%	< 0.05%	< 0.05%	< 0.05%
Stability at 0...100% ΔU_{OUT}	< 0.15%	< 0.15%	< 0.15%	< 0.15%	< 0.15%
Ripple LF BWL 20MHz	< 1mA RMS	< 7mA RMS	< 0.45mA RMS	< 7mA RMS	< 0.45mA RMS
Ripple HF BWL 20MHz	< 3mA P-P	< 19mA P-P	< 1mA P-P	< 19mA P-P	< 1mA P-P
Accuracy*	$\leq 0.2\%$	$\leq 0.2\%$	$\leq 0.2\%$	$\leq 0.2\%$	$\leq 0.2\%$
Resolution of display	1mA	10mA	10mA	10mA	10mA
Transient recovery time 10...90% load	< 2ms	< 2ms	< 2ms	< 2ms	< 2ms
Output - Power					
Nominal power P_{Nom}	640W	1000W	1000W	1500W	1500W
Nominal power at derating	-	-	-	1000W	1000W
Adjustable range	-	0... P_{Nom}	0... P_{Nom}	0... P_{Nom}	0... P_{Nom}
Accuracy*	-	$\leq 0.2\%$	$\leq 0.2\%$	$\leq 0.2\%$	$\leq 0.2\%$
Resolution of adjustment	-	1W	1W	1W	1W
Efficiency	$\leq 92\%$	$\leq 93\%$	$\leq 92\%$	$\leq 93\%$	$\leq 93\%$
Miscellaneous					
Cooling	by fan	by fan	by fan	by fan	by fan
Ambient temperature	0...50°C	0...50°C	0...50°C	0...50°C	0...50°C
Storage temperature	-20...70°C	-20...70°C	-20...70°C	-20...70°C	-20...70°C
Humidity rel.	< 80%	< 80%	< 80%	< 80%	< 80%
Dimensions (WxHxD)	330x118x308mm	330x118x388mm	330x118x388mm	330x118x388mm	330x118x388mm
Weight	6,5kg	8,5kg	8,5kg	8,5kg	8,5kg
Sharebus for parallel connection	no	yes	yes	yes	yes
Article number	09200135	09200136	09200138	09200137	09200139
Series connection	possible, up to max. 600V total voltage				
Parallel connection	possible, max. 30 units, models from 1000W via Share bus				
Humidity	<80%				
Isolation	Input to output: 2500V, Output to enclosure: 500V				
Safety	EN 60950				
EMC standards	EN 61326, EN 55022 Class B				
Overvoltage class	Class II				
Protection class	Class I				
Analogue programming					
Voltage range	0...5V or 0...10V (selectable)				
Accuracy set/actual values	$\leq 0.2\%$				
Input impedance	approx. 53k Ω				

* Related to the nominal value, the accuracy defines the maximum allowed deviation between set value and actual value.

Example: a 80V model has min. 0.2% voltage accuracy. This is 160mV. When setting a voltage of 5V and with an allowed maximum deviation of 160mV, the resulting actual value could be between 4.84V and 5.16V.

3. Device description

3.1 Views



Figure 1. Front side

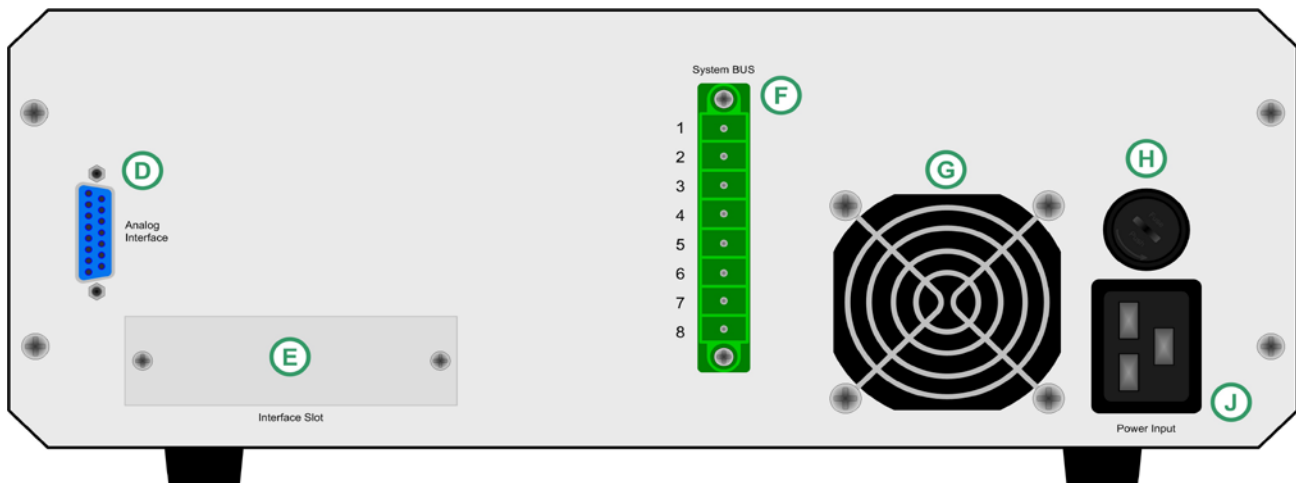


Figure 2. Rear side

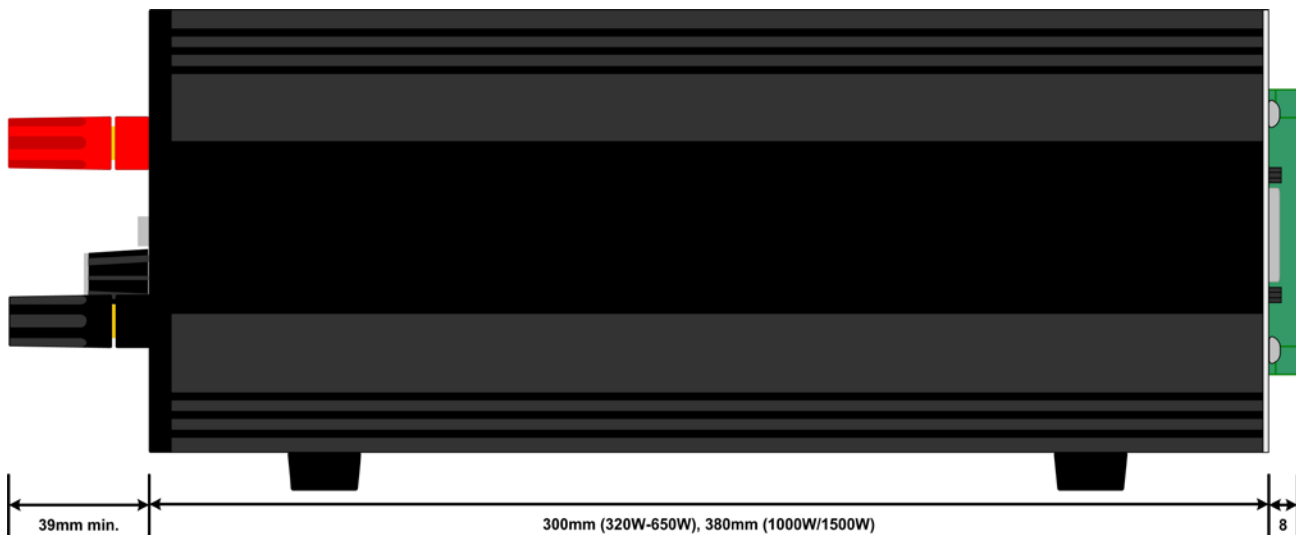


Figure 3. Side view from the right

3.2 Legend

- A - Power switch
- B - Control panel
- C - Power output
- D - Analogue interface, 15pole, female
- E - Slot for digital extension cards
- F - System Bus
- G - Fan
- H - Input fuse (for value see section "2.2 Technical specifications")
- J - Power input socket, 3pole, IEC 60320

3.3 Scope of delivery

- 1 x Power supply unit
- 1 x Printed user manual
- 1 x Mains cord
- 1 x Plug for System Bus

4. General

4.1 Prologue / Warning

This instruction manual and the device are intended to be used by users who know about the principle of a power supply. The handling of the device should not be left to persons who are unaware of the basic terms of electrotechnology, because these are not described in this manual. Inappropriate handling and non-observance to the safety instructions may lead to a damage of the device or loss of warranty!

4.2 Cooling

The air inlets on the bottom and the air outlet on the rear have to be kept clean to ensure proper cooling. Take care of at least 10cm distance at the rear to any surrounding objects in order to guarantee unimpeded air flow.

4.3 Opening the device

When opening the unit or removing parts from the inside with tools there is risk of electric shock by dangerous voltages. Open the unit only at your own risk and disconnect it from the mains before.

Any servicing or repair may only be carried out by trained personnel, which is instructed about the hazards of electrical current.

5. Installation

5.1 Visual check

After receipt, the unit has to be checked for signs of physical damage. If any damage is found, the unit may not be operated. Also contact your dealer immediately.

5.2 Mains connection

The unit is grounded via the mains cord. Thus the unit may only be operated at a mains socket with grounding contact. This must not be interrupted by an extension cable without ground conductor!

The unit is fused with a 5 x 20mm safety fuse (for value see technical specs table), which is accessible on the rear.

5.3 DC output terminal

The power output is located on the front of the device.

The output is **not** fused! In order to avoid damage to the load application, always take care for the nominal values of the load.

The cross section of the load leads depends on several conditions, like the output current, the lead length and the ambient temperature.

Up to 1.5m lead length we recommend to use:

up to 10A :	0,75mm ²	up to 15A :	1,5mm ²
up to 30A :	4mm ²	up to 40A :	6mm ²
up to 60A :	16mm ²		

per cable (flexible wire).

The outputs "+" and "-" are not grounded, so that **one** of them may be grounded if necessary.

Attention! When grounding one of the output poles always check if one of the poles of the load (eg. electronic load) is also grounded. This could result in a short-circuit!

Attention! Watch the potential shift of the output poles when using series connection! Grounding is hereby only recommended at the pole with the lowest potential against ground.

5.4 Terminal „Sense“ (Remote sense)

In order to compensate the voltage drop along the load leads (max. 1V per lead), the power supply can „sense“ the voltage at the load instead at the output. It will regulate the output voltage so that the desired voltage is provided to the load.

The connection for remote sense is done at the terminal „**System Bus**“ on the rear side, pins 1 and 2. See section 3.1.

(+) Sense must only be connected to (+) at the load application and (-) Sense must only be connected to (-)! Else both systems can take damage.

For additional information also see section 7.7.

5.5 Interface card slot

The unit can be equipped with an optional interface card. The slot to insert the card is located at the rear side. Further information about the interface cards can be found in section "9. Digital interface cards".

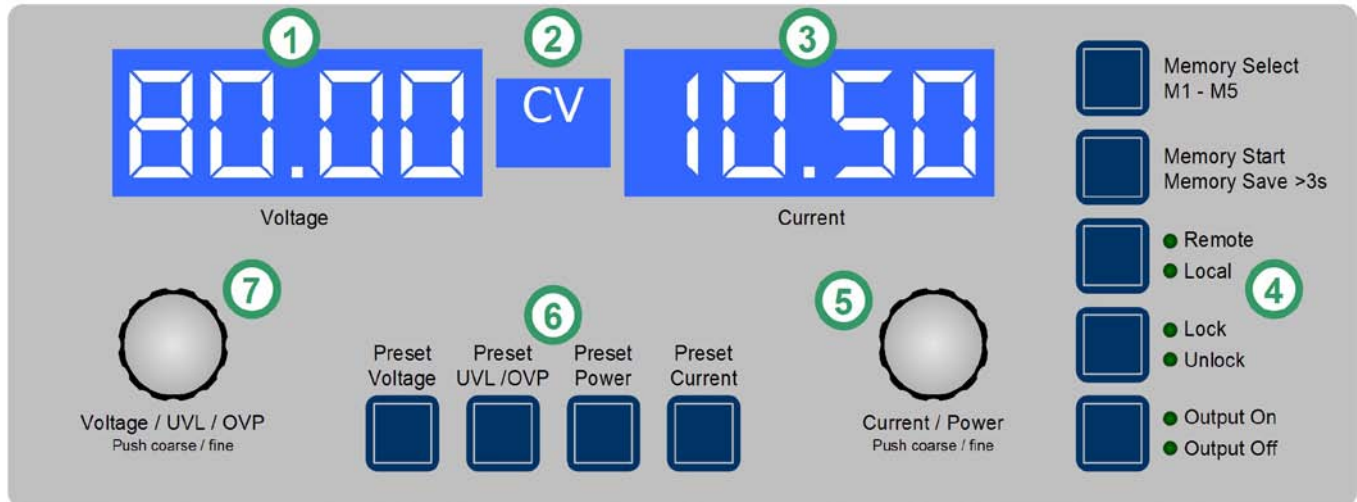


Figure 4. Control panel

6. Handling

6.1 The display

Figure 4 depicts an overview of the dot matrix display and the control panel. During normal operation, the display areas show the actual values of voltage (left side) and current (right side) and device status (middle). In preset mode, the left display area shows the set values of voltage (Preset Voltage), of the overvoltage protection threshold (Preset OVP) or the undervoltage limit (Preset UVL). The right display area shows the set values of current (Preset Current) or power (Preset Power, only models from 1kW). In the device setup the display is used to show adjustable parameters and settings.

The status area in the middle can show following status:

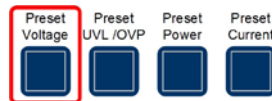
- CV** - Constant voltage regulation (only when output is „on“)
- OT** - Overtemperature error
- OVP** - Overvoltage error
- CC** - Constant current regulation (only when output is „on“)
- CP** - Constant power regulation (only when output is „on“)
- Fine** - Fine adjustment for both rotary knobs active

Legend:

- 1 - Left display area: Actual voltage or set value U, UVL, OVP
- 2 - Status area: status display like CC, CV etc.
- 3 - Right display area: Actual current or set value I, P
- 4 - Control buttons: Setting the device condition etc.
- 5 - Rotary knob right: Set value adjustment of I and P, as well as settings in the device setup
- 6 - Preset buttons: Switching to set value display
- 7 - Rotary knob left: Set value adjustment of U, UVL, OVP, as well as parameters in the device setup

6.2 Pushbuttons on the control panel

Pushbutton **Preset Voltage**



During normal operation the button is used to switch the display from actual to preset value of the output voltage (preset mode). The left display area will then show like this:



In preset mode, the left rotary knob (**Voltage / UVL / OVP**) is used to adjust the voltage set value the same way as during normal operation from 0...100% U_{Nom} . The adjusted value is instantly transferred to the output!

Attention! The set value adjustment can be limited by the undervoltage threshold UVL. See below.

A second push exits the preset mode instantly or it is exited automatically after 5s, if no preset button is pushed or any set value is altered.

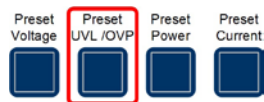
During remote control by analogue or digital interface the preset mode can be used to check the voltage set value that is given from remote.

The button may be locked by the condition **LOCK**. See below.

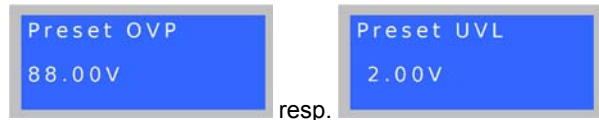
In memory selection mode the button is also used to switch to the voltage set value of the selected memory set, but in this mode the set value is not transferred to the output. The left display area will then show like this:



Pushbutton **Preset UVL / OVP**



During normal operation the button is used to switch the display from actual voltage to the set value of the undervoltage limit (one push) or the overvoltage protection threshold (two pushes). The left display area will then show like this:



The undervoltage limit (UVL) is only an adjustment limit for the output voltage value. It means, if UVL is set to anything above 0, the voltage set value can only be adjusted down to the UVL value. Also, the UVL value can only be adjusted up to the voltage set value.

The left rotary knob (**Voltage / UVL / OVP**) is used to adjust the UVL value from 0... U_{Set} .

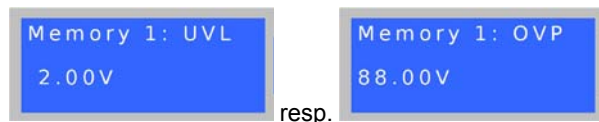
A second push of the button changes to overvoltage protection threshold preset (OVP). This value can always be adjusted from 0...110% U_{Nom} .

A third push exits the preset mode instantly or it is exited automatically after 5s, if no preset button is pushed or any set value is altered.

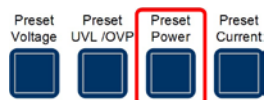
During remote control by digital interface the preset mode can be used to check the OVP set value that is given from remote.

The button may be locked by the condition **LOCK**. See below.

In memory selection mode the button is also used to switch to the UVL or OVP value of the selected memory set, but in this mode the values are not valid yet. The left display area will then show like this:



Pushbutton **Preset Power**



During normal operation the button is used to switch the display from actual current to preset value of the output power (preset mode).

Only models from **1kW** feature an adjustable power regulation and will show like this on the right display area:

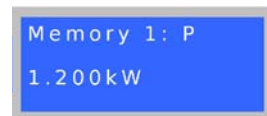


In preset mode, the right rotary knob (**Current / Power**) is used to adjust the power set value from 0...100% P_{Nom} . The adjusted value is instantly transferred to the output!

A second push exits the preset mode instantly or it is exited automatically after 5s, if no preset button is pushed or any set value is altered. The button may be locked by the condition **LOCK**. See below.

During remote control by analogue or digital interface the preset mode can be used to check the power set value that is given from remote.

In memory selection mode the button is also used to switch to the power set value (only models from 1kW) of the selected memory set, but in this mode the set value is not transferred to the output. The right display area will then show like this:



Pushbutton **Preset Current**



During normal operation the button is used to switch the display from actual to preset value of the output current (preset mode).

The right display area will then show like this:



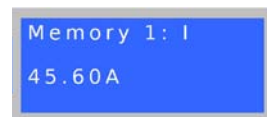
In preset mode, the right rotary knob (**Current / Power**) is used to adjust the set value of current from 0...100% I_{Nom} the same way as in normal operation. The adjusted value is instantly transferred to the output!

A second push exits the preset mode instantly or it is exited automatically after 5s, if no preset button is pushed or any set value is altered.

During remote control by analogue or digital interface the preset mode can be used to check the current set value that is given from remote.

The button may be locked by the condition **LOCK**. See below.

In memory selection mode the button is also used to switch to the current set value of the selected memory set, but in this mode the set value is not transferred to the output. The right display area will then show like this:



Pushbutton **Memory Select M1-M5**



This button cycles through the 5 memory sets, each with set values for U, I and P, as well as UVL and OVP. From here, the selected memory set can be edited, stored or submitted. The button only works if the output is **off**. The memory mode and the selected memory set number are displayed like this:



By using the button the user can:

a) Adjust values

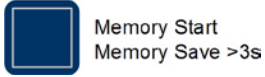
Output off, short push of the button, the display changes to the first memory set as displayed above.

Now the set values of U (left) and I (right) of the selected memory set can be adjusted. The other adjustable values can be accessed by pushing the corresponding preset buttons.

Further pushes will cycle through the memory sets up to number 5 and then exit memory mode.

The adjusted values remain as long the device is powered, but are not submitted to the output set values **and are not saved yet!**

Pushbutton **Memory Start / Memory Save >3s**



This pushbutton is either used to submit the values of the memory set that has been selected before by button **Memory Select M1-M5** to the output or to save the memory to internal flash. The button only works if the output is **off**.

By using the button the user can:

b) Submit only

Output off, memory set is selected (1-5), button is pushed **shortly** --> the values of the memory set are submitted to the set values of the output and the memory mode exits. In order to use the new set values, the output is switched on as usual by button **Output On** or by remote control.

Attention! Submitting the values does not save them!

c) Save only

Output off, select memory set(s), adjust the values as desired, the push the button **>3s** --> all memory sets are saved to internal flash, but none is submitted to the output. The output remains off, the memory mode exits after saving.

The memory sets can also be defined by remote control and corresponding commands using a digital interface (except GPIB). They're stored immediately.

The button may be locked by the condition **LOCK**. See below.

Pushbutton **Local**



This pushbutton activates or deactivate the LOCAL mode. In LOCAL mode not remote control of the device is possible.

Attention! Activation of LOCAL mode results in immediate return from remote control (analogue or digital) and locks the device against further attempts to control it remotely, until LOCAL is cleared again.

LOCAL mode is indicated by LED „Local“. As long as LOCAL is not active, the LED „Remote“ indicates an active remote control by analogue or digital interface.

The button may be locked by the condition **LOCK**. See below.

Pushbutton **Lock / Unlock**



This pushbutton activates or deactivates the control panel lock. The LOCK mode locks all buttons, except the LOCK button itself, and the rotary knobs against unintended operation.

Attention! Activation of the LOCK mode instantly exits any preset or memory mode, if currently active. The display will return to normal display of actual values.

Pushbutton **Output On / Output Off**



This pushbutton is used to manually switch the power output on or off, as long as the device is not in remote control mode. The output condition is always indicated by the LEDs „Output On“ or „Output Off“. If the output is switched on, the device indicates the currently active regulation mode (CC, CV or CP (only models from 1kW)) in the status area in the middle of the display.

The button may be locked by the condition **LOCK**. See above.

Switching the output on may be inhibited by pin 13 (REM-SB) of the analogue interface. See section "10. Analogue interface".

The button also acknowledges the errors. See sections 7.4 and 7.5 fore more information.

6.3 Other control elements

Pushbuttons **Rotary knob**



Both of the rotary knobs have a push button function. Pushing any or both of these will effect following:

a) Fine adjustment mode (Fine)

A short push of any of both buttons activates or deactivates the fine adjustment mode. If „Fine“ is active, all set values, thresholds and limits can be adjusted in smallest possible steps, no matter what mode is currently active (preset, memory ect.). It is indicated by the status text „Fine“ in the status area. Also see section "6.4 Adjusting set values" below.

b) Device setup

Pushing **both** buttons together for >3s while the output is **off** changes to device setup. It is exited the same way.

6.4 Adjusting set values

1. Manual operation

During manual operation, both rotary knobs are used to continuously adjust the set values of voltage and current from 0% to 100% nominal value in predefined steps (see table). In order to set the values for OVP and UVL the button **Preset UVL/OVP** has to be pushed once or twice. In order to set the power set value (models from 1kW only) the button **Preset Power** has to be pushed.

Attention! *The OVP value can be lower than the voltage set value and will cause an OV error as soon as the output is switched on and the actual voltage reaches the OVP threshold!*

Setting values manually can be done in fine or coarse steps, whereas coarse is default. **Fine** is required to be activated by the one of rotary knob pushbuttons and has a step width of 1.

For **coarse** adjustment, following step widths apply in dependency of the nominal values (also refer to technical specs):

Voltage			Current		
Nom. val.	Coarse	Fine	Nom. val.	Coarse	Fine
16V	0,1V	10mV	4A	50mA	1mA
32V	0,2V	10mV	5A	50mA	1mA
65V	0,5V	10mV	10A	0,1A	10mA
80V	0,5V	10mV	15A	0,1A	10mA
160V	1V	100mV	20A	0,2A	10mA
360V	2V	100mV	40A	0,5A	10mA
			60A	0,5A	10mA
Power					
Nom. val.	Coarse	Fine			
1000W	0.01kW	0.001kW			
1500W	0.01kW	0.001kW			

Important! *The resolution of the set value adjustment in some cases is, depending on the nominal values, higher than the one of the output voltage. Thus it can happen that the output voltage only changes every 2 or 3 steps.*

2. Remote control by analogue interface

The analogue interface (short: AI) allows to remotely control current, voltage and power (models from 1kW), always in combination. It means, that it's not possible to adjust voltage by the AI and the current with the rotary knob on the front at the same time, or vice versa. Because the OVP threshold can not be adjusted via the AI, it's required to set it manually on the device before using the remote control. Switching to preset mode with the preset buttons shows the translated set values, that are put into the set value pins of the AI as voltages. In order to put in appropriate set values, the user can either use an external voltage source or the reference output voltage on pin 3.

Models under 1kW output power don't require the power set value PSEL (see section "10. Analogue interface") and thus it must not be given.

In case it is only required to adjust voltage by external means, the current set value (CSEL) resp. power set value (PSEL) can be bridged to the reference voltage (VREF).

The AI can be operated with the common 0...5V or 0...10V ranges, each corresponding to 0...100% nominal values. The desired control voltage range is selected in the device setup (see section "8. Device setup").

Following applies:

0-5V: Reference voltage = 5V, 0...5V set value voltage correspond to 0...100% nominal value, 0...100% actual value correspond to 0...5V at the actual value outputs (CMON, VMON).

0-10V: Reference voltage = 10V, 0...10V set value voltage correspond to 0...100% nominal value, 0...100% actual value correspond to 0...10V at the actual value outputs (CMON, VMON).

Putting in set values that exceed the limit, for example >5V while the 0...5V range is selected, is intercepted by clipping the concerned set value to 100%.

Never input voltages higher than 12V to the set value inputs!

3. Remote control by digital interface card

The digital interface cards allow to set voltage, current and power, as well as the OVP threshold and undervoltage limit UVL by means of a PC. When changing to remote control mode, the device keeps the last set values until they're altered. Hence it would be possible to control only voltage by sending arbitrary set values and the current set value would remain unaltered.

Set values given by the digital interface (except GPIB) are always percentage and correspond at 100% (hex: 0x6400), resp. at 110% (hex: 0x6E00) for the OVP threshold, to the nominal values of the device.

Using GPIB, any value is given as real decimal value.

Furthermore, the digital interfaces allow to query and set a lot of other features and values. For details refer to section "9. Digital interface cards" and the user manual of the IF cards.

7. Behaviour of the device when...

7.1 Switching on by power switch

The power switch is located at the front. After switching on, the device will show some information in the display: manufacturer's name, address and logo, device type and firmware version. In the device setup (see section "8. Device setup") there is an option „AutoPwrOn“ (auto power-on) that determines the output condition after the device is switched on. Default is „on“. It means, that the set values of U, I, P, the values of OVP and UVL and the output condition are restored to what was present when the device was switched off the last time. In case the option is set to „off“, the set values of U and I are set to 0, the set value of P to 100% and the output is switched on after every start.

7.2 Switching off by power switch

Switching the device off by power switch is handled as mains blackout. The device will save the last set values and output condition. After a short time, power output and fans will be switched off and after a few seconds more, the device will be completely off.

7.3 Switching to remote control

a) *Analogue interface*: Pin „Remote“ switches the device to remote control by the set values pins VSEL, CSEL and PSEL (only models from 1kW), as well as REM-SB, if not inhibited by LOCAL mode or remote control by digital interface already being active. The output condition and the set values which are put into pins 1, 2 and 13 (also see section "10. Analogue interface") are immediately set. After return from remote control, the output will be switched off and the last remotely adjusted set values of U, I and P are kept.

b) *Digital interface*: Switching to remote control by the corresponding command (here: object), if not inhibited by LOCAL mode or remote control via AI already being active, keeps output state and set values until altered. Returning from remote control switches the output off and the last, remotely adjusted set values of U, I P, OVP and UVL are kept.

7.4 Overvoltage occurs

An overvoltage error can occur due to an internal defect (output voltage rises uncontrolled) or by a too high voltage from external. The overvoltage protection (OVP) will switch off the output and indicate the error on the display by the status text „OVP“ and on the pin „OVP“ of the analogue interface.

External voltages higher than 120% nominal voltage at the output must be avoided, or else internal components of the device might be destroyed!

If the cause of the overvoltage is removed, the output can be switched on again and status text „OVP“ will disappear. This is considered as acknowledgement. In manual operation, it is done by pushing button **Output On**, in analogue remote control with pin „REM-SB“ and in digital remote control by the corresponding command. If the error is still present, the output is not switched on.

OVP errors are recorded as alarm into the internal alarm buffer. This buffer can be read out via the digital interface. Reading the buffer will also acknowledge.

Note: The status of an OV error has priority over the status of an OT error and will overwrite the status text „OT“ in case both errors occurred the same time and are not acknowledged yet.

7.5 Overtemperature occurs

Ambient temperatures higher than specified must be avoided!

As soon as an overtemperature (OT) error occurs by internal overheating, the output is switched off and the status text „OT“ is indicated.

Simultaneously, the LED „Output On“ will flash, indicating that the output will automatically switch on again as soon as the device has cooled down. In case this is not wanted, the output can be manually switched off. Then the LED stops flashing and the output won't switch automatically on.

OT errors have to be acknowledged. If the output is off after the device has cooled down, this is done by switching the output on using button **Output on** or pin „REM-SB“ or the corresponding command. If the output is on, acknowledgement is done by pushing the button **Output on** once or giving pin „REM-SB“ a high-to-low toggle or using the corresponding command to switch the output off.

OT errors are recorded as alarm into the internal alarm buffer. This buffer can be read out via the digital interface. Reading the buffer will also acknowledge.

OT error status has lower priority than OV error status. In case an OV error occurs while an OT error is present and indicated, the status text „OT“ will be overwritten by „OVP“.

7.6 Voltage, current and power are regulated

The output voltage of the power supply and the resistance of the load determine the output current. If this current is lower than the current limitation set by the current set value, then the device is working in constant voltage (CV) regulation, indicated by the status text „CV“.

If the output current is limited by the current set value or by the nominal current, the device will change to constant current (CC) regulation mode, indicated by the status text „CC“.

Models from 1kW output power additionally feature an adjustable power limitation for $0 \dots P_{Nom}$. It becomes active and overrides constant voltage or constant current regulation mode, if the product of actual current and actual voltage exceeds the adjusted power limitation or nominal power of the device. The power limitation primarily affects the output voltage. Because voltage, current and power limitation affect each other, various situations like these may occur:

Example 1: the device is in constant voltage regulation, then the power is limited down. As a result, the output voltage is decreased. A lower output voltage results in a lower output current. In case the resistance of the load is then decreased, the output current will rise again and the output voltage will sink further.

Example 2: the device is in constant current regulation, the output voltage is defined by the resistance of the load. Then the power is limited down. Output voltage and current are decreasing to values according to the formula $P = U \cdot I$. If the current set value is then decreased, the output current would also decrease and thus the output voltage. The product of both values, the actual power, would sink below the previously set power limit and the device would change from constant power regulation (CP) to constant current regulation (CC).

7.7 Remote sense is active

Remote sense operation is used to compensate voltage drops along the leads between the power supply and the load. Because this is limited to a certain level, it is recommended to match the cross section of the load leads to the output current and thus minimise the voltage drop.

The sense input is located on the rear, at terminal **System Bus**, where the sense leads are connected to the load with correct polarity. The power supply will detect the external sense automatically and compensate the output voltage by the actual voltage at the load instead of the output. The output voltage will be raised by the value of the voltage drop between power supply and load.

Maximum compensation: 1V per lead.

Also see figure 5 below.

7.8 Mains undervoltage or overvoltage occurs

The device features an active rectification with PFC and a wide range input. This means, it can be operated at input voltages of approx. 90V...264V. Input voltages below 90V are considered as blackout, respectively as complete switch-off and will store the last condition, as well as switch off the power output.

Permanent input undervoltage or overvoltage must be avoided!

Important! Models with 1500W nominal power will derate the output power down to 1000W at input voltages below approx. 150V.

7.9 Connecting different types of loads

Different types of loads, such as ohmic loads (lamp, resistor), electronic loads or inductive loads (motor) behave differently and can retroact to the power supply. For example, motors can induce a countervoltage which may cause the overvoltage protection of the power supply to shut off the output.

Electronic loads have regulator circuits for voltage, current and power that can counteract to the ones of the power supply and may result in increased output ripple or other, unwanted side effects. Ohmic loads are almost 100% neutral. It is recommended to consider the load situation when planning applications.

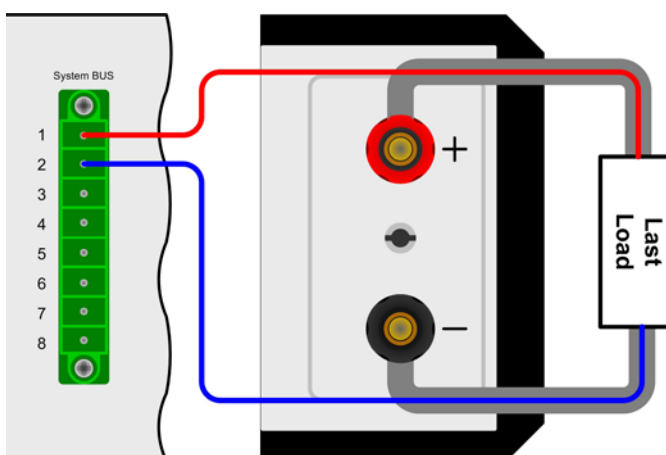


Figure 5. Wiring the sense

8. Device setup

The device setup is intended to set parameters that are not constantly altered. Three elementary settings are always available, other settings only if a digital interface card is equipped.

The device setup can be accessed while the output is switched off and by pressing both pushbuttons of the rotary knobs (see section 6.3) simultaneously >2s. Leaving the setup and storing the settings is done the same way.

All digital interface specific settings remain unmodified when inserting a different card. Thereby, the user don't has to setup the interface cards everytime the type changes.

Following **elementary settings** are available:

Name: *AutoPwrOn* Default: *on*

Settings: *on, off*

Meaning: „Auto Power On“, if set to „on“ it activates the restoration of the last output state when the device was switched off or when a blackout occurred. This is intended to be used in case the power supply is supposed to continue working as soon as it is powered again. With „off“ the output remains switched off.

Name: *AI range* Default: *0-10*

Settings: *0-5, 0-10*

Meaning: selects the control voltage range to use with the analogue interface.

Name: *Contrast* Default: *70*

Settings: *50 . . . 100*

Adjusts the contrast of the LCD display.

For **all** interface cards this setting applies:

Name: *Device node* Default: *1*

Settings: *1 . . . 30*

Meaning: Selects the device's address (device node is taken from the CAN terminology). When using the device on a bus system (CAN or GPIB), every device must have a unique address!

Following settings only with **CAN interface IF-C1**:

Name: *Baud* Default: *100k*

Settings: *10k, 25k, 50k, 100k, 125k, 250k, 500k, 1M*

Meaning: Selects the CAN transmission baud rate or Megabaud.

Name: *RID* Default: *0*

Settings: *0 . . . 31*

Meaning: Selects the relocatable identifier segment (RID). Refer to CAN terminology or instruction manual of the IF-C1 CAN interface card for further information.

Name: *Bus term* Default: *on*

Settings: *on, off*

Meaning: activates/deactivates the bus termination resistor of the CAN interface card. This is required if the device is at the end of the bus.

Following settings only with **RS232 interface IF-R1**:

Name: Baud Default: 57600

Settings: 9600, 19200, 38400, 57600

Meaning: Selects the serial transmission baudrate in baud. Further parameters for the RS232 are not configurable, but defined as follows:

Parity = odd

Stop bits = 1

Data bits = 8

and have to be set to the same configuration at the PC.

Following settings only with **Profibus interface IF-PB1**:

Name: Profi bus Default: 1

Settings: 1 - 125

Meaning: Define the Profibus address of the device. This address is used apart from the device node to implement and access the unit on a field bus system.

9. Digital interface cards

The device supports following pluggable interface cards:

IF-U1 (USB)

IF-R1 (RS232)

IF-C1 (CAN)

IF-G1 (GPIO/IEEE)

IF-E1 (Ethernet/LAN + USB)

IF-PB1 (Profibus)

The cards require only a little or no setup after insertion. The card specific settings are kept, even if the card is replaced by one of different type. Thereby it is not necessary to configure the card settings everytime a card is inserted.

Details about the technical specs of the interface cards and the handling, as well as instructions to implement the device into a bus system or to control the device by means of a PC (LabView etc.) can be found in the user manual for the IF cards.

Important! Insertion or removal only if the device is completely switched off (power switch)!

About configuration of the plugged cards see section "8. Device setup".

10. Analogue interface

10.1 General

The integrated, 15 pole analogue interface is located on the front and offers, amongst others, following possibilities:

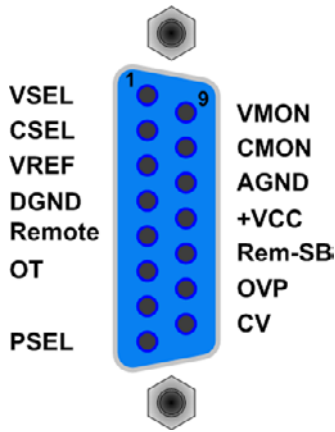
- Remote control of output voltage and current
- Remote control of output power (only models from 1kW)
- Remote monitoring of status (OT, OVP, CC, CV)
- Remote monitoring of actual values
- Remotely switching the output on/off

The control voltage range that is going to be used is selected in the device setup. See section "8. Device setup". The reference voltage at output pin 3 is related to the chosen setting and will be either 5V or 10V.

Usage instructions:

- Controlling the device with analogue voltages requires to switch it to remote control with pin „REMOTE“ (5).
- Before connecting the application that is used to control the power supply, make sure to wire all leads correctly and check if the application is unable to put in voltages higher than specified (max. 12V).
- The input REM-SB (remote standby, pin 13) overrides the pushbutton **Output On**. It means, the output can not be switched on by the button if the pin defines the output state as „off“ So it can be as emergency power off.
- The output VREF can be used to build set values for the set value inputs VSEL, CSEL and PSEL. For example, if only current control is required, pin VSEL and PSEL can be bridged to VREF. CSEL is then either fed by an external voltage (0...5V or 0...10V) or via a potentiometer between VREF and ground. Also see next section.
- Putting in set values up to 10V while the 0...5V range is selected will ignore any voltage above 5V (clipping) and keep the output value at 100%.
- **The grounds of the analogue interface are related to minus output.**

10.2 Pin overview



10.3 Attention! Never connect grounds of the analogue interface to minus (negative) output of an external control application (PLC, for example), if that control application is otherwise connected to the neative power supply output (ground loop). Load current may flow over the control leads and damage the device!

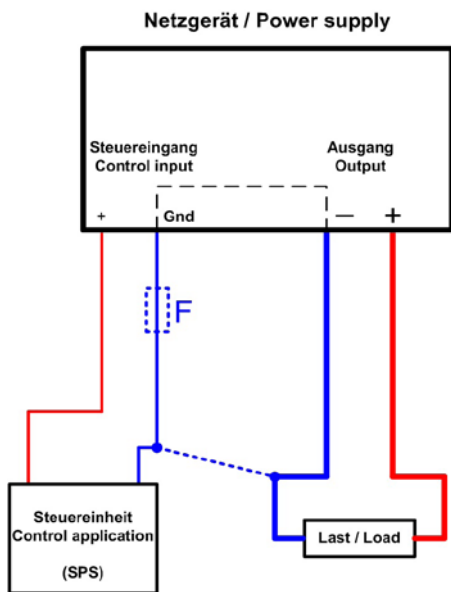


Figure 6

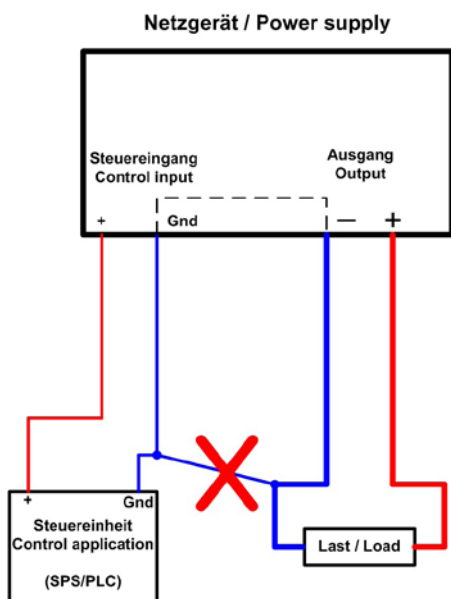


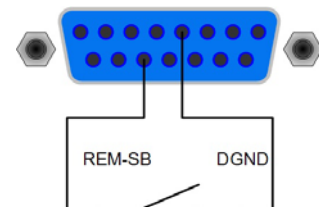
Figure 7

10.4 Example applications

Output off

Pin „REM-SB“ is always operative and does not depend on the remote mode. It can thus be used to switch off the output without extra means. Switching the output off is done by connecting the pin to ground (DGND) via a low-resistive contact like a switch, open collector transistor or relay.

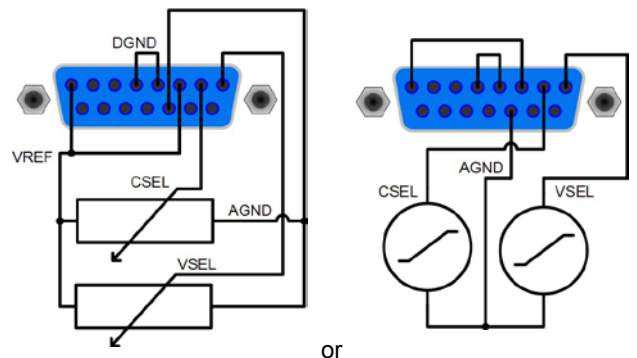
Note: a digital output of, for example, a PLC may not be able to do this correctly, because it might not be low-resistive enough. Always check the technical specifications of your external control application.



Remote control of current and voltage

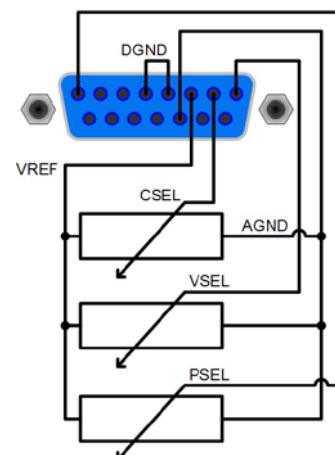
Two potentiometers between VREF and ground, sliders at the inputs VSEL and CSEL. The power supply can be controlled as with the rotary knobs on the front and can either operate as current or voltage source. In compliance with the max. 3mA for the VREF output, potentiometers with at least 10kOhm have to be used.

The power set value is here, for models with power regulation feature, tied to VREF and thus 100%.



Remote control with power

Similar to the example above, but with adjustable power limit. (only applicable on models with power adjustment).



10.5 Pin description

Pin	Name	Type ⁽¹⁾	Description	Level	Electrical specification
1	VSEL	AI	Set value: voltage	0...10V or 0...5V correspond to 0..100% of U_{Nom}	Accuracy < 0,2% Impedance $R_i > 100K$
2	CSEL	AI	Set value: current	0...10V or 0...5V correspond to 0..100% of I_{Nom}	
3	VREF	AO	Reference voltage	10V or 5V	Accuracy < 0.2% at $I_{Max} = +5mA$ Short-circuit-proof against AGND
4	DGND	POT	Reference potential for digital control signals		For +Vcc, control and status signals
5	REMOTE	DI	Toggle between internal or external control	External = LOW, $U_{Low} < 1V$ Internal = HIGH, $U_{High} > 4V$ Internal = open	U range = 0 ...30V $I_{Max} = +1mA$ at 5V Sender: Open collector against DGND
6	OT	DO	Overtemperature error	OT = HIGH, $U_{High} > 4V$ no OT = LOW, $U_{Low} < 1V$	Quasi open collector with pull-up to Vcc ⁽²⁾ At 5V at the output there will be max. +1mA $I_{Max} = -10mA$ at $U_{CE} = 0.3V$ $U_{Max} = 0...30V$ Short-circuit-proof against DGND
7	N.C.				Not connected
8	PSEL ⁽³⁾	AI	Set value: power	0...10V or 0...5V correspond to 0..100% of P_{Nom}	Accuracy < 0.5% Impedance $R_i > 100K$
9	VMON	AO	Actual value: voltage	0...10V or 0...5V correspond to 0..100% of U_{Nom}	Accuracy < 0.2% at $I_{Max} = +2mA$ Short-circuit-proof against AGND
10	CMON	AO	Actual voltage: current	0...10V or 0...5V correspond to 0..100% of I_{Nom}	
11	AGND	POT	Reference potential for analogue signals		For -SEL, -MON, VREF signals
12	+Vcc	AO	Auxiliary voltage output (Ref: DGND)	11...13V	$I_{Max} = 20mA$ Short-circuit-proof against DGND
13	REM-SB	DI	Output off	off = LOW, $U_{Low} < 1V$ on = HIGH, $U_{High} > 4V$ on = OPEN	U range = 0...30V $I_{Max} = +1mA$ at 5V Sender: Open-Collector against DGND
14	OVP	DO	Overvoltage error	OVP = HIGH, $U_{High} > 4V$ no OVP = LOW, $U_{Low} < 1V$	Quasi open collector with pull-up to Vcc ⁽²⁾ At 5V at the output there will be max. +1mA $I_{Max} = -10mA$ at $U_{CE} = 0.3V$ $U_{Max} = 0...30V$ Short-circuit-proof against DGND
15	CV	DO	Indication of voltage regulation active	CV = LOW, $U_{Low} < 1V$ CC = HIGH, $U_{High} > 4V$	$I_{Max} = -10mA$ at $U_{CE} = 0.3V$ $U_{Max} = 0...30V$ Short-circuit-proof against DGND

⁽¹⁾ AI = Analogue input, AO = Analogue output, DI = Digital input, DO = Digital output, POT = Potential

⁽²⁾ Internal Vcc = 13...15V ⁽³⁾ Only with models from 1kW

11. Miscellaneous

11.1 Functions of terminal System Bus

The 8pole terminal **System Bus** is located on the rear and is used to connect leads for remote sense or to wire multiple devices for series or parallel connection.

Pin assignment:

- 1 : Sense +
- 2 : Sense -
- 3 : Master output Current
- 4 : Master output Voltage
- 5 : Slave input Current
- 6 : Slave input Voltage
- 7 : Share Bus
- 8 : Ground

Attention! The functions of pins 3-8, as described in the subsequent paragraphs, are only available at models from 1000W output power.

11.2 Series connection

Note: not available for 160V and 720V models!

Note: only available with devices from 1kW nominal power!

For a series connection, it is recommended to use only devices with identical output current, else the unit with the lowest nominal output current will define the maximum current of the system.

One unit is always the master of the next unit, which becomes slave, and so on. When connecting more than two units, it is recommended to consider one certain unit as master and any other as slave. The slave(s) are controlled by the master via the slave input pins 3 and 4 of the terminal **System Bus**. Voltage and current can be controlled simultaneously, but also separately.

For an example wiring see figure 8 below. Voltage and current are here given by the master. In case only one of both, voltage or current, is going to be controlled, the other set value should be set to 100%.

In order to control the whole system remotely, it is sufficient to control the master via its analogue or digital interface. When reading actual values, the current monitor value will represent the overall system current, but the voltage monitor only the output voltage of the master. In order to get accurate readings, either the actual voltage is multiplied by the number of unit in the series connection (only applicable if all are same type) or all units will have to be read separately.

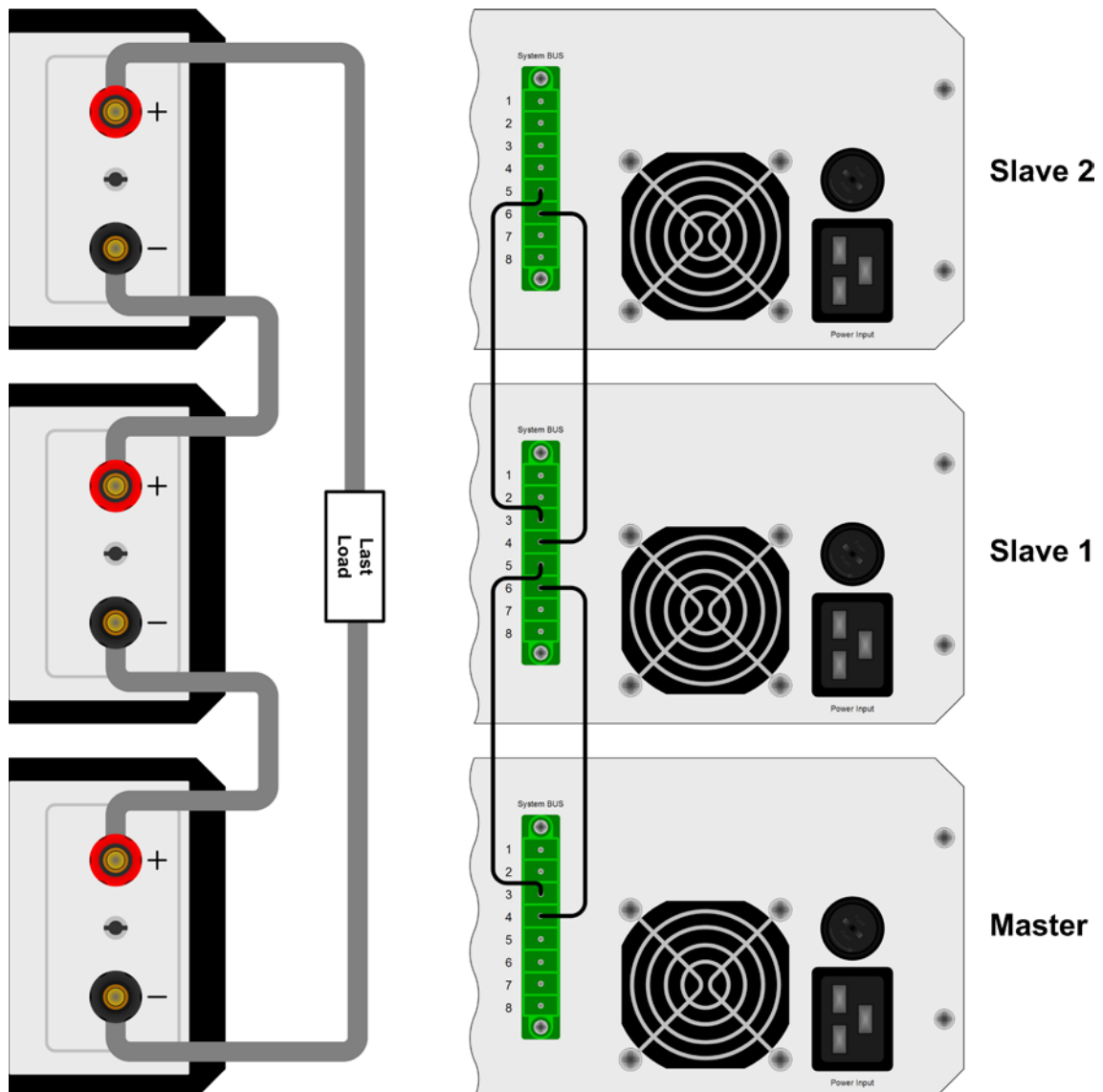
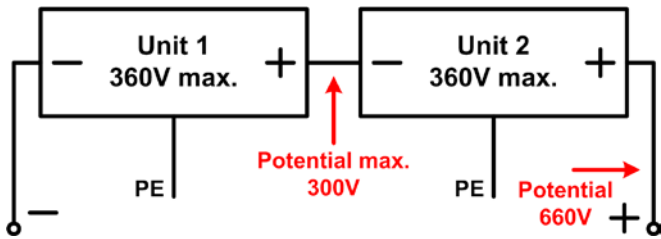


Figure 8. Series connection in Master-Slave

There are some restrictions and rules to consider because of safety and isolation reasons:

- No negative DC output pole of a unit in the series connection may be raised to a potential >300V against ground (PE)!
- The Share bus must not be wired!
- The grounds (AGND, DGND) of the analogue interfaces of the units must not be wired to each other!
- Remote sense must not be wired!

Example: Two identical units with 360V nominal voltage, for example PSI 8360-10 DT, shall be connected in series. When calculating, the total voltage of that series connection could go up to 720V. Looking at the resulting potentials on the negative outputs of the units, the 2nd unit's negative DC pole could be raised to 360V. This is not permitted! So the lower unit has to be limited to a certain maximum. The figure below clarifies that the resulting total voltage would be 660V:



Caution! A total voltage of a series connection of 600V should not be exceeded!

11.3 Parallel connection in Share Bus mode

Note: only available with devices from 1kW nominal power!

Attention! Only units of the same type (voltage and current) must be used for this operation mode.

In order to increase the output current, two or more units of the same type can be connected in parallel. Always take care for a sufficient cross section of the load leads! Preferably, all leads to the load should be of same length and cross section.

Following connections are required: connect all (+) DC outputs of the units to each other and all (-) DC outputs to each other. Pin 7 (Share Bus) and pin 8 (Ground) of terminal **System Bus** of all units are also connected in parallel. In case remote sense is also required, all Sense+ and all Sense - inputs are connected in parallel and also with the load.

It is recommended to define one unit as master that controls voltage and current of the system. At any slave the set values of voltage, current and power (if available) should be set to 100%.

All units displays their actual values, there will be no totals formation of the system output current.

In order to control the whole system remotely, it is sufficient to control the master via its analogue or digital interface. When reading actual values, the voltage monitor value will represent the overall system voltage, but the current monitor only the output current of the master. In order to get accurate readings, either the actual current is multiplied by the number of units in the parallel connection (only applicable if all have the same nominal output current) or all units will have to be read separately.

For an example wiring see figure 9.

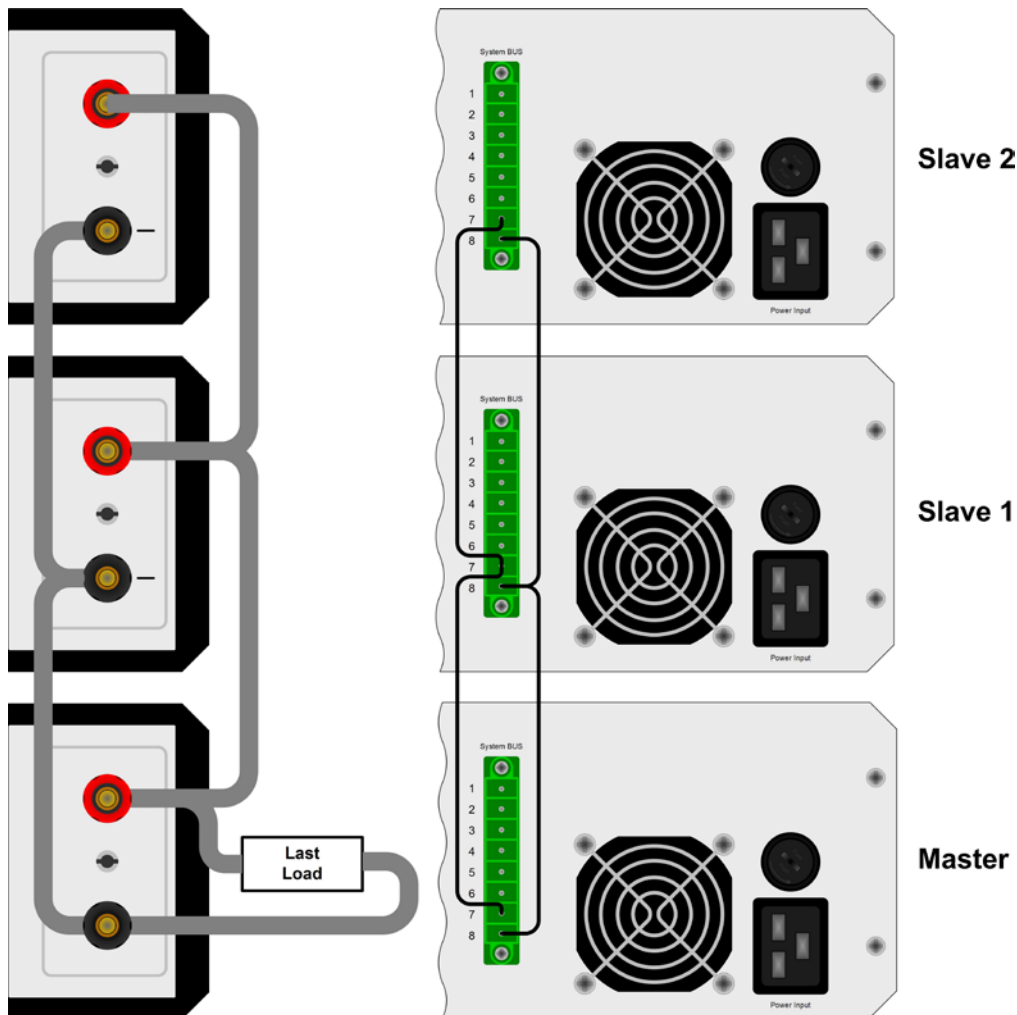


Figure 9. Parallel connection with Share Bus

11.4 Networking

The figures below depict networking examples for the digital control of multiple devices in star-shaped (USB, RS232) or bus-like (CAN, GPIB) configuration.

Limitations and technical specifications of the bus systems and the interfaces apply.

With **USB** up to 30 units can be controlled with one PC, appropriate USB hubs with custom power supply assumed. This basically applies to RS232, too. Differences lie in the handling and the cable lengths.

With **CAN** up to 30 power supplies per address segment can be integrated into a new or existing CAN bus system. They are addressed by the device node and the RID (see "8. Device setup").

With **GPIB** there is a limitation of max. 15 units on one bus, controlled by a GPIB master. Multiple GPIB masters can be installed in a PC in order to increase the number of addressable units.

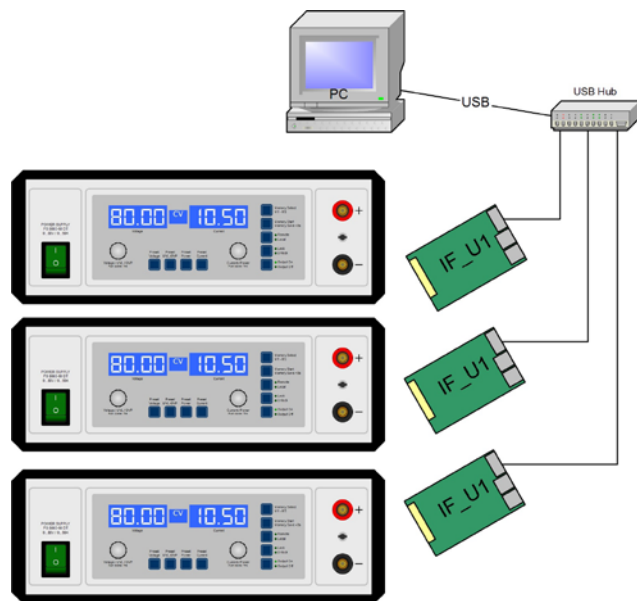


Figure 10. USB or RS232 networking

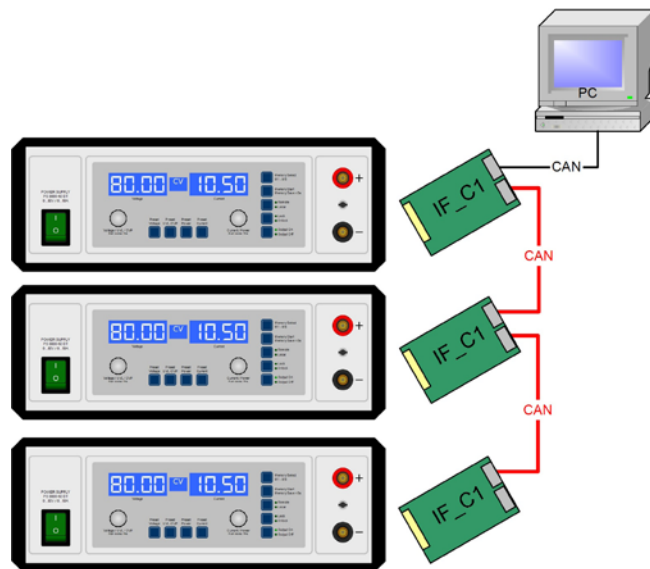


Figure 11. CAN networking example, also applies to GPIB

11.5 Accessories and options

Note: Details about options and accessories are available in separate user guides.

Following accessories are optionally available:

a) USB-to-Analogue interface UTA12

Galvanically isolated remote control via USB (on PC side) and the device internal analogue interface.

b) Digital interface cards

Pluggable and retrofittable, digital interface cards for USB, RS232, CAN, GPIB/IEEE (SCPI only), Profibus or Ethernet/ LAN (SCPI only) are available.

Following options are available:

a) High Speed Ramping

Increased dynamics of the output voltage by reduced output capacity. It must be pointed out, that other output related values also increase!

Note: this is a permanent modification which is not switchable.

11.6 Firmware update

A firmware update of the device should only be done if the device shows erroneous behaviour or if new features have been implemented.

In order to update a device, it requires a certain digital interface card, a new firmware file and a Windows software called „Update tool“.

These interfaces are qualified to be used for a firmware update:

- IF-U1 (USB)
- IF-R1 (RS232)
- IF-E1 (Ethernet/USB)
- IF-PB1 (Profibus/USB)

In case none of the above interface types is at hand, the device can not be updated. Please contact your dealer for a solution.

The update tool and the particular firmware file for your device are obtainable from the website of the device manufacturer, or are mailed upon request. The update tool will guide the user through the semi-automatic update process.



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