

Low Voltage Floating Power Supply Systems for LHC Experiments





PL 500- PL 600 Basic Systems

in 3U high power boxes

PL500 F8, F12

8- or 12- channel sense operated via long distance slow integrating sense compensation amplifier

PL600 F8, F12

8- or 12 channel sense operated for short distance or not sensed for long distances, too fast sense compensation amplifier

Outputs floating (>10k Ohm between channels)



General Technical Details

Standard Mains Inputs :

SE Version

90-265VAC, 47-63 Hz, <17,5A (DC power out <u><3kW</u>) <u>with PFC</u> (also: 155-455VAC 3phase with Neutral)

Moderate HE Version

230VAC +15/-10%, 47-420Hz, <16A (DC power out <2kW) <u>no PFC</u> (also: 275VAC, 380-420Hz, 3phase no Neutral, or 385VDC, >3kW)

HE Version

385VDC ±5%, <10A (DC power out >3kW) (also: 275VAC, 380-420Hz, 3phase no Neutral)

DC output power refers to nom. Voltage of 230/400VAC or 385VDC



Noise and Ripple

after 30m cable length, filtered with 330µF and ceramic capacitors



Low PARD / common mode noise: prevents resonance upset with cable inductivity guarantees excellent resolution in Data Acquisitions



Versions for SE-Area PL 500 / PL 600





- Individual channel trip off with fast output discharge Programmable voltage ramps, group behavior (F12) as well as warning and trip levels
- Extremely low noise and ripple
- Wide range sinusodial mains input
- W W W Interface, CAN, Ethernet

Optional:

- Individual Interlock
- Intelligent monitoring display



Versions for moderate HE Area



X-Y-Z directions f. B-field measurements

- 8 channel PL500 / PL6--
- ≤ 300 G Water cooled version
- 385VDC low current input voltage 230VAC with reduced output performance, No PFC
- <u><</u> 130 G Air cooled version works with PFC and full power even at 230VAC
- Tested up to 3,1krad (PSI)
- Embedded CANbus controller



Versions for moderate HE Area

B-field action related dependence





Versions for HE Area

Magnet field- and Radiation Tolerant New Power Supply System MARATON

- Watertaps with cut-off valve (as well as the counterparts)
- Overpressure valve (18 bar)
- Low current DC input 385V/<10A





Versions for HE Area Low current 385VDC Input

See the Advantage of low input current, i.g. active primary rectifier in SE area and 125 m distance:

MARATON needs 9A at 400VDC for 3kW, 10A at 360VDC (nom = 380V) U_{drop}=(250m/2,5mm²) *10A/56m*mm²/Ohm=17,9 V (<5% from nominal)

Same calculation for 45,6V (48V less 5%) low voltage version shows 79,2A for a ratio of 380/48 (without considering efficiency!):

U_{drop}=(250m/150mm²) *79,2A/56m*mm²/Ohm=2,35 V (<5% from nominal)

The relation in cross section is (380/48)²



Assembly, 19" Power Bin





- 4U high 19" assembly with air baffle for front or bottom cooling air entry (Custom power bins on request)
- F8 Power Bin with 5 pairs 230A, 4 pairs 115A connector plugs, 8mm and 6mm studs
- F12 Power Bin for 12 x 50 85 A connector plugs, 4mm or 5mm threads
- Sense connection terminals
- F8 CANbus and RS232 on rear 9pin Sub D
- F12 CANbus, TCP/IP, COM-port/ Telnet on frontal RJ 45

Optional: Alphanumeric Display



Water cooled Standard Modules

Selection

Voltage	Optimum	max.	Current	Output	B-Field	Rad.	Module	Reg
Range	Span	peak	cont.	Module	Toler	ance	Туре	Board
[V]	[V]	[A]	[A]	[W]	[G]			
0-8	2-7	115	100	1 x 600	<300	0,7kGy	MEH	DAC
0-8	2-7	58	50	2 x 300	<300	0,7kGy	MDH	DAC
0-8	2-7	58	50	2 x 300	<u>></u> 1280	3E+12p	MDM	Pot
0- 16	5-15	23	20	2 x 300	<300	0,7kGy	MDH	DAC
0- 16	5-15	23	20	2 x 300	<u>></u> 1280	3E+12p	MDM	Pot

- Customer specified Designs
- Can work in parallel with current sharing
- 6 Modules fit into a 3U power box (6U box for 10 Modules available)



Regulation Boards

Different types fit to all power modules



- 1. DAC type Processor controlled
- 2. HE Type with Trim-Pot adjustment

3. SE Type with "on board DSP controlling"



MARATON Test Module



Version with minimal features (What is not there can not be damaged!)



Water cooled dual Modul



MARATON dual module equipped with rad. tolerant DAC-regulator boards



Radiation Tested Modules

	Mains		2-7∨	//100A		+/-	5V/30A		-	+/-15V	Co	ontroller	
	Input			(2-7∨)		Αι	ix-Power		Board		
	-		si	ngle			Dual				C	ANbus	
	MNE		N	1EH			MDH			MUH		Micro	
	Module		Mc	odule		N	1odule		ſ	Module	Pro	ocessor	
	MARATO	N				MA	RATON		M	ARATON			
				•		I	MDM			MORT			
	AC/DC		DAC	-ر		2>	<300W		1	for ext.			
	Input		Rea	ulator		2x	60Apk		Ν	/lonitor-			
										board			
Faci	lity												
Α	A passed		pa	ssed		р	assed	sed fails		fails	pass	sed, excl.	CAN
									Ne	w Module			
В	B passed		passed		passed		F	bassed	fails	after 417	Gy		
	New Module												
С	C SEE 4.0E+10 p/cr		ра	ssed		р	assed		nc	ot tested	no	t tested	
	New Module										SEE	3,1krad	
D	D passed		not	tested		no	t tested		F	bassed	3x F	Power Cy	/cle
											for	passing	
	MARATON			MAF		MAF	RATON		MARATON				
E	Input 385V	DC	not	tested		Inpu	t 385VDC	>	Inpu	ut 385VDC	>		
	passed					pass	sed		pas	sed			
	A 2000		0	TCC2		722Gy			7.99E+12	2 n/o	cm²		
B 2002		2	TCC2		417Gy 7.69		7.69E+12	2 n/o	cm²				
	C 2002		2	Louvain SEE		SEE	1		1.0E+11 p/cm ²				
	D 200		2	PSI SEE			14krad			1.0E+11 p/cm ²			/
	E 2004		4	Louvair	ר צ	SEE				3,0E+12	p/cn		V
							<u> </u>						
All t	ests under	respor	sibilit	y of Cei	rn	Men	nber						

A-D equipped wit DAC-Regulatorboards, E with TrimPot



Rad Tolerant redundant Converter



- quasi-redundant principle of power conversion
- sharing operating voltage
- each is able to handle the power management alone



MARATON B-Field Test



CERN Magnet Facility, Hall 887, EHNI, Prevessin

Tests made by Bruno Allongue, CERN



MARATON B-Field Test



MARATON Test Device

Modular configuration:

Uo:	5V	100A
U1:	5V	100A
U2:	3,3V	200A
U3:	48V	12A
U4	5V	100A

Input 385VDC

Ext. Monitoring



MARATON B-Field Test



- X-direction (front-rear) Knee-point at 1567,5 G
- Y-direction (horizontal) Knee-point at 1280,6 G

Z-direction (vertical)
Knee-point at 1867,6 G



MARATON Screening Technology



- Iron box hosting (sealed) choke and transformer for one channel
- Coils for 60A peak current are displayed



Monitoring and Control Power supplies with embedded controller

🚝 UEP6000 (Measurement 8	34)							_ 0 ×
File Options Configuration H	lelp							
Power Supply Version	UEP600	0 2.02						
Network	CAN1.02	2: Addres	s 9, Gen	eral Call	127, Spe	ed Code	1	
Power Supply ID	210623	5/99						
Channel Name	+5¥0	+12V	CHAN.2	CHAN.3	-5V2	-12V	CHAN.6	-2V0
Calibration (U-Monitor)	758	1879	6924	569	767	1884	6848	761
Calibration (I-Monitor)	16673	2047	1169	12429	17446	2052	2722	17902
Modul Current [A]	115.00	11.50	23.00	115.00	115.00	11.50	23.00	115.00
Modul Current Limit [A]	115.00	11.50	22.50	112.50	115.00	11.50	22.50	115.00
Modul OVP (DAC)	234	186	231	154	243	186	231	93
Modul Unom (DAC)	239	196	220	146	240	196	220	75
min. Voltage [V]	4.87	11.69	23.37	3.04	5.07	11.69	23.37	1.89
max. Voltage [V]	5.25	12.60	27.00	4.00	5.46	12.60	27.00	2.09
max. Current [A]	115.00	11.50	23.00	115.00	115.00	11.50	23.00	115.00
Current limit [A]	115.00	11.50	22.50	112.50	115.00	11.50	22.50	115.00
OVP (DAC)	234	186	231	154	243	186	231	93
Unom (DAC)	239	196	220	146	171	196	220	75
Unom (adjustment)	120	123	128	128	118	119	128	141
max. Temperature	127	127	127	127	127	127	127	127
PS Temperature	25	OK	OK	OK	OK	OK	OK	OK
Operating Time	498525	minutes	(346 day	's, 4 hou	rs, 45 mi	nutes) 👘		
Status	OK	OK	OK	OK	OK	OK	OK	OK
POWER ON								
AC OK								
TRIP OFF ENABLED								
Voltage [V]	4.99	12.07	0.06	0.00	5.20	11.99	0.06	2.01
Current [A]	0.00	0.01	0.00	0.00	0.00	0.02	0.00	0.17

- All PS parameters programmed (=>calibration + setup via software / network RS232, CAN-bus, Ethernet)
- programmable current limits and over- / under voltage trip off points
- Fully self protected (over temp, over load, OC, UV, OV, ...)
- Firmware updates via software / network (RS232, CAN-bus, Ethernet



Monitoring and Control TCP/IP over Ethernet SNMP

- SNMP is a well defined protocol
- Presently version 2c is in use (access control with community names)
- Different access rights
- Many utilities available (Windows/Unix,): Command Line (Batch files), PERL, PHP (stand alone or in the APACHE WEB-server)



Monitoring and Control TCP/IP over Ethernet SNMP

Control by SNMP Command Line Tools (www.net-smnp.org)

- C:\>snmpget –v 2c –m +WIENER-CRATE-MIB –c puplic 192.168.91.80 outputMeasurementSenseVoltage.U1
- WIENER-CRATE-MIB::outputMeasurementSenseVoltage.U1 = Opaque: Float; 12.020000 V
- C:\>snmpget –v 2c –m +WIENER-CRATE-MIB –c guru 192.168.91.80 outputVoltage.U0 F4.0

WIENER-CRATE-MIB::outputVoltage.U0 = Opaque: Float; 4.000000 V



Monitoring and Control TCP/IP over Ethernet

 Pass word protected instruction buttons 1

- HTTP Port 80: WWW Interface Pass Word protected
- TCP/IP Port 69: Special WIENER protocol to access all data
- TELNET Port 23: Connection to other RS232 ports only

EP6000/PL500 - Microsoft Inter	rnet Explorer			-
Edit View Favorites Tools He	lp			
Back - 🕥 - 💌 🗟 🏠	🔎 Search 👷 Favorites 🔮	Media 🚱 🍰 🔛	• 📴 🔛	
ss 🙋 C: \Documents and Settings \Andr	reas Ruben\My Documents\WIENER\VMB	E Crates\TCPIP_WEB.htm 🛛 🄁	Go Norton AntiVirus 归 👻	
<u>UEP6000/PL500</u>				W-IE-NE-R
MAIN POWER	VME SYSRE	SET	FAN SLC	WER FAN FASTER
		Global Status		
Power Supply Status			OFF	
Fan Tray Status			OK	
Fan Speed			0 RPM	
Fan Temperature			-25°C	
		Output Voltages	276	
Channel	Name	Voltage	Current	Status
U0	+5V0	0.00V	0A	OK
U1	+12V	0.0V	0.0A	OK
	12V	0.0V	0.04	OK



Monitoring and Control

- Open software systems: <u>OPC server</u> (OLE for Process Control / Win NT/2k) for CAN-bus
- Available at CERN

Basic design: University of Krakow

<u>F</u> ile <u>E</u> dit ⊻iew <u>H</u> elp		
D 😅 🖬 X 🖻 🖻 🎒 🤗		
	Port Attributes	
	Port ID	CAN1
	Boud Rate	125000 💌
	Read Queue Lenght	100
⊡- <mark>128</mark> TEMP_BRANCH 128 Temp 128 Temp	Write Queue Lenght	0
	Net Timeout [ms]	
	Default	OK
Energy Engrade Energy E		



MARATON Basic Configuration

Input: 385 V DC, 10 A



Output: Up to 12 independent channels



MARATON Basic Control

- Clock generation and power fail detection only
- Automatic switch on after input power is applied
- Switch off (by the regulator boards) in case of OVERVOLTAGE or OVERTEMPERATURE
- No other remote control or failure detection foreseen



MARATON Control with Parallel Interface



Output: Up to 12 independent channels



Parallel Interface (ext. Monitoring)

- Each sense line is connected to the ParIF connector via a protection resistor
- A combined STATUS / Switch On line is available for each channel.
- All signals of 6 channels are fed to an 37-pin Sub-D connector
- Monitoring connection via 40-pin shielded round cable per 6 channels, twisted-pair. The outer diameter of a halogenfree (AWG26) cable is 12 mm.



External Monitoring Module VME Size



- VME monitoring board for 6 channels with display
- 12 channel module with two Sub- d connectors (no display)
- Both can be used in standard VME /VME64x crates
- Special version with information interchange via J2



MARATON Control with CAN & TCP/IP-



Output: Up to 12 independent channels



Can Interface (CanIF) Description

- Redundant micro controller system (to be protected against SEE)
- All voltages, currents and temperatures are measured
- Separate status comparator can switch off bad channels in case of over voltage, under voltage or over current
- All information are transferred by CAN bus (2 wires) to the protected zone, TCP/IP could be an option, too
- Development + RAD tests continues



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