Series 6000 LHC

VME -64x

User's Manual

*00625.A0

General Remarks

The only purpose of this manual is a description of the product. It must not be interpreted as a declaration of conformity for this product including the product and software.

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Terms

The Terms "Crate" and "Subrack" are used interchangeable in this document

Mains Voltage and Connection

The Power supplies are equipped with a "World"- mains input, which works properly form 94VAC up to 264VAC and within a frequency range of 47 to 63Hz. Before connecting to the mains please double-check correspondence.

Mains input connection at the power supply side is done with a 3-pin "Hirschmann" 16A-connector or power terminals. This input is approved for max. 16 A current. An adequate **16A external fusing per power box** has to be installed at user side.

Hirschmann.	Signal	Description	Color of the Wire
Pin 1	L	Phase	black or brown
Pin 2	N	Return, Neutral	blue
Pin 3		not connected	
Earth	PE	Protective Earth	green/yellow

Safety

After connecting the Power box to the mains, the mains input module is powered permanently. Filter and storage capacitors of the power factor correction module are charged with about **400VDC**. The DC-On-Signal as well as a power switch at control board (if any installed) operates as a DC on/off switch only and not as a mains breaker. **Therefore it becomes dangerous if the box cover is open. In this case a lot of components on high voltage potential get touchable!**

Before starting any kind of work inside the power box remove the unit from mains and wait a couple of minutes with your activities! Discharge the primary DC Filter-capacitors by use of a well isolated 22 ohm 10W resistor.

We recommend in case of any male function to send the power box to Wiener or to one of our representative for service

Grounding Stud

Each VME- bin is outfitted with a grounding stud which has to be wired to mains earth or zero potential line **according to CERN's rule / law.**

The stud is situated at the right side panel behind the fan space (rear view).

Declaration of Conformity

Art. 10.2 of 89/336 and 89/392 / ECC

W-IE-NE-R

Plein & Baus GmbH

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declare under our own responsibility that the product

VME / 6021Crate

Items: 0B0x.xxxx, 0F0x.xxxx, 0P0x.xxxx

to which this declaration relates, is in conformity with the following standards or normative documents :

1. EN 50 081 - 1
2. EN 61 000 3 - 2
3. EN 50 082 - 1
4. EN 60 950

Conditions:

This crate is not a final product. The use after installation and powered modules inside needs possibly additional screenings to be in conformity of the definition. Admitted for powering by all mains.

Name and signature of authorized person — Place and Date

Name und Unterschrift des Befugten — Ort und Datum

Juergen Baus

Techn. Director — Febr. 2000

Table of contents:

1 General Information

1.1 6021 Subracks / Crates

Different versions are foreseen to fulfill the requirements of the LHC community.

Two formats, 6Ux160mm depth and 9U x 400mm depth are available, both with transition cages.

9U crates may optionally equipped with a **4slot 6U x 160mm front cage**, positioned on slot 1-4, but recessed in respect to the front panels of the 9U modules (connectors all on backplane level).

The crates are equipped either with 21 slot 64x backplane or with custom designed ones.

Topped on **slot 1 a temperature sensor** is situated. A second sensor will be delivered with each subrack for free positioning by the user. The **W-IE-NE-R** VME 64x backplane offers 7 free plugs at the top between different slots, to connect further sensors among slot-1-sensor.

According to IEEE1101.10 the mechanics are equipped with **easily replaceable EMC gaskets**

The power requirement of the bin (according to the label sticker) is stored in a bin memory **(Plug & Play)**. This memory logic compares any connected power supply for compatibility before enabling power on switch at fan tray front panel.

1.1.1 6021 Crate with Remote Power Supplies

1.1.1.1 Subrack Variant 1 (Remote)

The VME -Crate 6021- Variant 1 consists of a bin UEV 6021 with a 2 U high fan tray space for a UEL 6020 fan tray. The total height is 2U+modul format (6U or 9U)+1U wiring space in top of the bin. Totally 12U high for 9U and 9U high for 6U subracks.
Behind this wiring chamber there is a terminal board situated. This bears all power-contacts (thread-studs) and the sense/control connector, a 37 pin Sub D type for connecting subrack and remote power supply.

Subracks of Variant 1 have free unimpeded access to backplane rear side for
21 transition modules:
6U subracks features 160mm depth and 6U height, optionally 80mm deep,
9U subracks features 220mm depth and 9U height, optionally 160mm deep

1.1.1.2 Subrack Variant 1a (Remote)

Divergent from variant1 the variant 1a version is equipped with custom backplane(s)

1.1.2 6021 Crate with Local Power Supplies

1.1.2.1 Crate Variant 2 (Local)

The VME -Crate 6021- Variant 2 consists of a bin UEV 6021 with a 2 U high fan tray space for a UEL 6020 fan tray. The total height is 2U+modul format (6U or 9U). Totally 11U high for 9U and 8U high for 6U subracks.

The **Local Power supply** is placed behind the J1 Level. Therefore the access to backplane rear side is limited to the J2 and J3 (for 9U format) only.

Subracks of Variant 2 have limited access to backplane rear side for
21 transition modules:
6U crates have nothing foreseen, optionally 3U to J2, 160mm or 80mm deep,
9U subracks features 160mm depth and 6U height to J2/J3, optionally 220mm deep

1.2 6020 Fan Trays

The-fan trays are plugged into the bin from the front side. For efficient cooling, controlling and monitoring of the crate various fan trays are constructed according to the slot deepness. Air entry is from bottom side in general, which gives full cooling efficiency. Fan rotation speed is shown on the monitoring display and can be regulated. Furthermore temperature of the air entry and optionally the exhaust above selected slots.

The UEL 6020 fan tray and control unit occupies two units of a 6021 crate below the slots. To achieve an excellent airflow homogenization through the inserted VME modules, all fan trays for 400mm modules (and larger ones) are outfitted with a topped plenum chamber which acts as a pressure volume below the VME modules.

Among the different types high performance super blower with four or six blowers can be used, too.

All DC voltages (up to 8) at backplane level and the corresponding currents among other are shown by the alphanumeric monitoring. The threshold-limits (minimum / maximum voltages and currents) can be set manually or piloted by remote control and remain stored even after lack of voltage. In case of global trip off, the fault will be displayed by the diagnostic system.

VME-signals as ACFAIL and SYSRESET are generated according to VME-Specs. SYSRESET can also be released manually.

1.3 6021 Power Supplies

The VME power supply of the 6000 series is a micro-processor controlled switching power supply designed in the high density W-Ie-Ne-R - cavity technology, which provides a very low noise output voltage.

The mains input with power factor correction (PFC) works according to EN 61000-3-2 - IEEE 555-2. An external fuse or circuit breaker has to be installed (16A for 3U boxes with 3kW).

The inrush current is limited by a soft start-circuit and not higher as 16A, when the cold unit has been connected to the mains.

The AC- input module is permanently powered after connecting the unit to the AC- mains. Any POWER ON/OFF Switch activates only the DC on/off function of the power inverter modules.

The EN 50 081-1 for generic emissions as well as the EN 50 082-1 or 2 for immunity standards, in particular EN 55 011 RFI rejection (incl. VDE 0871 class B) and EN 55 022 electromagnetic compatibility is accomplished. The insulation performs the EN 60 950, ISO 380, VDE 0805 (SELV)! Furthermore are considered UL 1950, UL 1012, UL 478, C 22.2.950, C 22.2.220/234.

Therefore the UEP 6021 power supplies can fulfill the CE rules comprehensively and can CE marked for use at all power nets.

Turning on the power supply all voltages reach the nominal values nearly simultaneously within 50 ± 2.5 ms (start-end-time) whereby the voltage versus time curve shows a monotonic behavior. The switch-off-time is 5±2.5 ms. within this time the DC outputs are discharged to 10% of the nominal voltages or less.

The power packs are readily replaceable. The maximum output power is ca. 3000W for a 3U power box. The available DC output power is in correspondence with the 92... 265VAC

input voltage. Also the installed modules urge the efficiency (3,3V module efficiency is some lower then those of a 48V module).

1.4 Remote Monitoring and control (Slow control)

All local monitoring functions of the crates are also remotely available. In addition, it is possible to read and change the power supply and fan tray operating parameters (E.g. Overvoltage, Trip Points,etc.). If fan-relevant parameters are accessed, the power supply communicates with the fan tray over a crate- internal serial link.

1.4.1 CAN (Controller Area Network)

The power supply has a CAN field bus interface built in. So it is possible to link up to 100 devices with a simple 2-wire connection. The transmission speed, network address and broadcast address are selectable with the fan tray.

The programming details of the CAN bus can be found in the "CAN-Bus Interface for W-IE-NE-R Crate Remote Control" (Part No. 00183.A0)

1.4.2 OPC access

A server according to OPC Data Access V2.05 is optional available.

OPC (**O**LE for **P**rocess **C**ontrol) allows fast and secure access to data and information under Windows operating systems. As an industry-spanning, multi-vendor software interface, OPC minimizes connection and maintenance overheads.

This server, running on a Computer with the Microsoft Windows 2000 operating system, enables access to all power supplies which are connected to the computers CAN network card(s). It is possible to

- access from any OPC Client application to the data of one or more servers
- encapsulating the properties specific to the server and type of communication
- commissioning support due to automatic scanning of the network and registration of communication stations
- restricting access rights by the underlieing Microsoft DCOM.

The details of the OPC server can be found in the "OPC Server for W-IE-NE-R Crate Remote Control"

2 Operation, Function and Connections

2.1 Fan Tray Operation and Control

All monitoring and control operations are performed by a micro-processor based alarm and control circuit placed inside the UEP 6021 power supply monitored by UEL 6020 fan trays. The reasons of a trip off will be displayed on the alphanumerical display and monitored via network (CANbus).

To protect both the power supply and the VME modules, a DC cut-off is started in the case of:

- **overheat**: in the power modules (each module is equipped with over temperature sensors);
- **overcurrent:** if peak currents have been exceeded (any lower programmed current limit releases an undervoltage- trip off)
- **overvoltage:** if voltage >125% (default, crow bar function) and if voltage >105% (default, upper Status-level programmable via fan tray or network)
- **undervoltage:** if voltage <97.5% % (default, lower Status- level, programmable via fan tray or network)
- **fan failure:** if one or more fans fail

Voltages, currents, cooling air temperatures, fan speed, power dissipation of inserted modules, operation time of power supply and fan tray and net parameters can be shown on the fan-tray display. ADC resolution is 10 bit. The accuracy of the voltage measurement is better than 0.5%.

The total accuracy of the current measurement depends on the corresponding voltage, i.e. for 2-7V module it is better than 2A in the range between 5A - 50A and. Above these current ranges the error is less than +/-2% of the final value. The ±12V accuracy is better than 0.2A for the 10A and 0.4A for the 20A versionin the whole current range.

2.1.1 Function of Fan Tray Switches

POWER ON /Off	1. main switch for ventilation and power supply 2. Reset trip off
MODE SELECT	selection switch to choose items and values for fan-tray and power supply monitoring and control
SYS RES	protected located switch for VME SYSRESET circuit activation
FAN SPEED	push button for step wise in- or decrease of fan speed.
FAN AUTO OFF	one of two functions, selected by software (see 2.1.5): 1. Switch off after fan-failure (yes/no) 2. Activate the "hot swap" function of the fan
ADDRESS	selects crate address for remote network
LOCAL	permits only data transmitting, no commands receiving

The adjusting range of fan speed is from 1200 RPM up to >3000 RPM. The displayed value of RPM concerns the average of all blowers inside the fan tray. This average value will compared with the pre selected reference speed. The display shows the fan speed in flashing mode if the selected speed is not equal with the true speed. This happens when either the fans are still accelerated to any other selected turns or the selected value is not reachable. This could be the case, if

1. more than 3000 RPM are selected and high density modules block the airflow
2. or one ore more blower are slow (bearing problems)

In case of example 2. the FAN FAIL circuit will detect this status as fan fail after a certain time!

While the display shows average speed of all fans only, the CANbus option will transmit the turns of each fan tray separated.

2.1.2 Additional temperature sensors

The Slot-1-Sensor and optional installed temperature sensors, measure the temperature of the exhaust air and allows to switch the fans to stop. That will be achieved by keeping pushed the FAN SPEED button to lower speed about 10 seconds.

Also the sensors will

1. accelerate the fan speed to 3000 rpm if the first (FanUp) programmed temperature threshold exceeds (default: 45°C). During the air exhaust temperature is above these limits (max. 8 limits which may also different), the fan-speed-selection function is disabled, until the exhaust temperature is below the lowest of these limits again.

2. switch off the power supply if the second (PsOff) programmed temperature threshold exceeds (default: disabled).

Any additional installed sensor will be detected by the control logic of the power supply and monitored automatically.

2.1.3 Information by Fan Tray LED's

AC POWER	green large LED if *POWER* is on
STATUS	green LED if all voltages are within the limit
FAN FAIL	yellow LED if a fan failure is recognized
OVERHEAT	yellow LED if an overheat in the power supply occurs
SYS FAIL	red LED if VME-bus system generates the *SYSFAIL* signal
FAN SPEED	Red LED if fan speed below 100%
AUTO OFF	red LED indicates 1. DC cut off in case of fan fail disabled 2. hot swapping of fan tray enabled
LOCAL	indicates instruction receiving via network disabled

2.1.4 Hot Swapping of LX Fan Tray

If the "hot swap" function is activated (AUTO OFF), the crate can be full powered during withdrawal of the fan tray. The max. DC- on time (PsOff) has to be programmed (see 2.1.5).

The power supply will trip off to prevent damage of inserted modules

1. when the programmed time for hot swapping is over (PsOff)
2. when the programmed second limit of slot 1 temperature sensor (or of optional installed ones) exceed.

2.1.5 Programming of Fan tray

Fan tray parameters (and in the same way many power supply parameters!!) may be changed via the alphanumeric control.

Programmable parameters of a fan tray:

Mode	associated parameter submenu	Description
Fans	Watching x Fans	Display of the number of monitored fans
Fan Temp	Temp Display: °C Temp Display: °F	Select the temperature unit: Celsius or Fahrenheit
	Function of the FAN AUTO OFF switch	AUTO OFF DIS: The switch will disable the trip off function of the power supply if the fans are not working correctly. (DANGER: The VME modules can burn! Should be used only for service purpose.) HOT SWAP *time*: The switch will activate the "hot swap" feature. The maximum time the user has got to change the fan tray is set here.
Bin Temp x (≤ 8 sensors)	PsOff	If the temperature of sensor x is above this limit, the power supply will switch off.
	FanUp	If the temperature of sensor x is above this limit, the fan speed will increase to full speed.

The general programming procedure is described in the Technical Manual (00571)

SYS Reset Switch (protected)

Power On LED
Main Switch **ON / OFF**; Trip off Rest

Status LEDs:

Green	Status
Yellow	Fan Fail
Yellow	Over Heat
Red	SYS Fail

Alphanumeric Display

MODE SELECT Switch

Fan **SPEED** Switch and LED

AUTO OFF Switch and LED

Network **ADDR**ess Switch

LOCAL Switch and LED

CANbus connector 1 female

CANbus connector 2 male

2.1.6 LX fan-tray UEL 6020
Front panel with CANbus Connectors

2.1.7 Monitoring Display: Standard Measurement Ranges

Available Modes and Display Examples			
Mode	Monitored	Peak-Values	Description
+5V	5.00 V	115A.... 230A (460)	+5V channel
+12V	12.0 V	11.5 / 20A	+12V channel
+3,3V	3.30 V	115.... 230A (460)	3,3V channel
48V	48,0 V	13,5... 67A	
POWER	135	W	output power
FANS	3000	RPM	fan rotation speed
FAN TEMP	25	° C or °F	fan air inlet temp.
FAN TIME	82000,6	h	Operating time Fan tray
P.S. TIME	150000,0	h	Operating time Power Supply
Options			
BIN TEMP 1	35°C	° C or °F	bin slot 1 (?) temp.
BIN TEMP 2		° C or °F	bin slot 2 (?) temp.
..... up to			
BIN TEMP 8		° C or °F	bin slot 8 (?) temp.
Networks *			
SPEED	RATE	1.0 MBAUD	CANbus bit rate
CANBUS	ADDR	1	CANbus address
GENERAL CALL	ADDR	127	CANbus group address

2.2 6021- Bin Technical details

2.2.1 VME 64x Bus Current Ratings

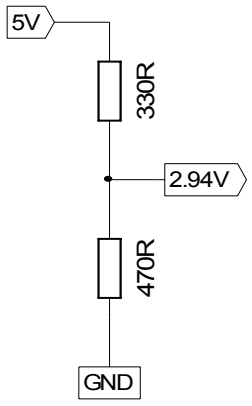
Bus current ratings

Power distribution **per slot**	**VME 64x** **20°C / 70°C ambient temp.**
+3,3V	17/12A
+5V with VPC in parallel	15,3/10,8A
5VSTDBY	1,7/1,2A
+/-12V	1,7/1,2A
48V (V1/V2)	1,7/1,2A
Layers	10
Type of ADC	active
Termination on board	active
Power Connections	Bugs, current copper sheets

2.3 Bus Termination

The active bus- termination is achieved by **four buffer chips**, placed in the corners of the backplane. A resistor divider generates the buffer input voltage, basically 2,94V (± 10%).

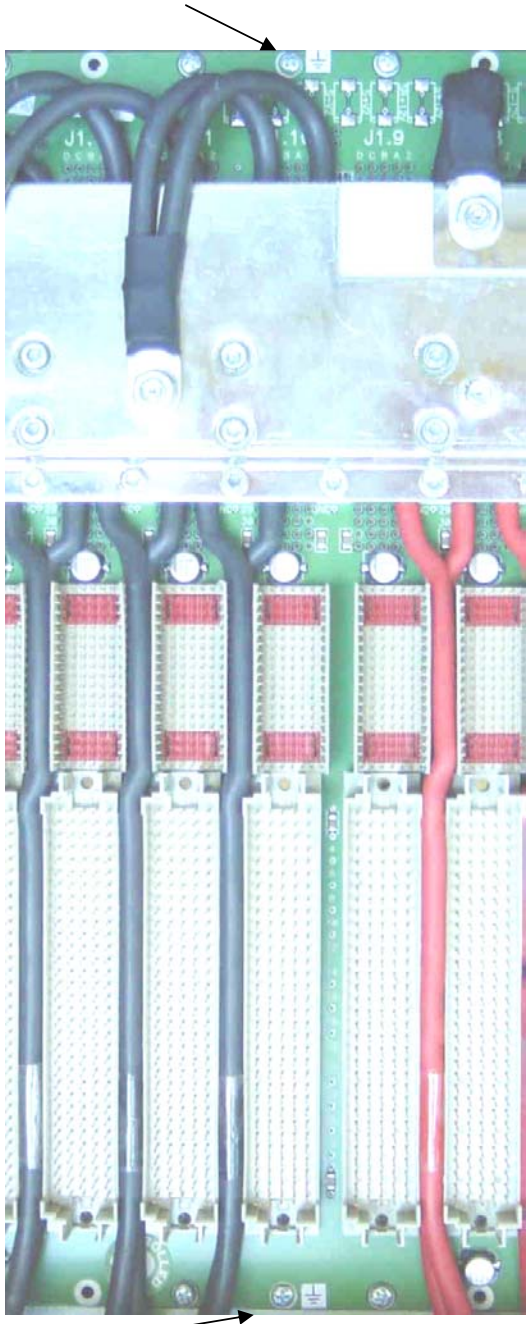
The termination network is connected to the 5V according to the VME Standard, in order to use power supplies without 3,3V, too.



2.3.1 Ground Connection

Two screws among the isolated backplane fastening screws are build in to connect the **VME Ground to mains earth** (bin mechanics). Disconnection is easily possible by accessing from the back side. The earth screw are near to slot 10 positioned.

The screws are marked with the earth symbol.



marked earth screw

2.3.2 Power Protection Memory PPM (Plug & Play Logic)

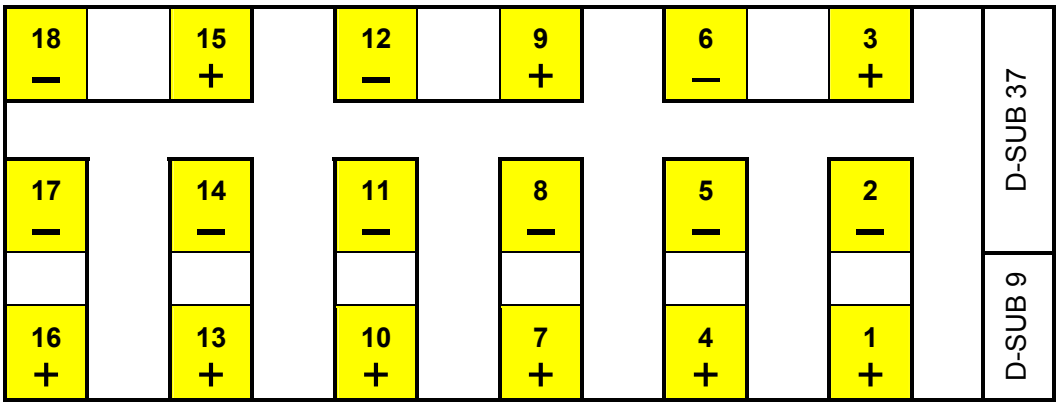
All Power requirements of the bin are stored in a memory to compare with the outputs of the connected power supply and check the compatibility.

An incompatible power supply will not start and the reason(s) will be displayed in the fan tray display as over/undervoltage related to the concerned output(s)

2.4 Power Supply UEP6021 LHC

UEP 6021 power supplies feature floating DC outputs, each with a separate regulation circuit. Therefore no cross regulation effects will occur, even not for dual outputs like +/- 12V. The common VME Ground is formed at backplane site. Separate isolated grounds can be foreseen on special custom backplanes. Due to the floating output characteristics no ground shift by voltage drops can happen.

2.4.1 Power Connector Board (Round Contacts)



Pin 10,11,13...18:		6mm, 120A max.
Pin 1...9+12:		8mm, 240A max
Ret.		**VME -Return** from common ground rail at backplane
	Note:	**Special Analog voltages** can be potential free floating

Ext. Res. is used for pin outs enlargement or keeping an output apart due to compatibilities.
Note: It is not an additional output! It will to be one of the available 8 outputs, connected to the related senses.

2.4.2 Control and Adjustment of 6021 Power Supply

2.4.2.1 Control of the Power Supply 6021 via CAN-Bus (optional)

The CAN Bus Signals are provided on the 9 Pin DSUB:

CAN_H: Pin 5

CAN_L: Pin 9

CAN_GND: Pin 4

The software protocol is described in a separate document (Part No *00183)

CANbus is an independent port. It may used to operate the power supply separately or in combination with the fan tray inside the bin

2.4.2.2 Control of the Power Supply 6021 via Fan tray

Many power supply parameters may be changed via the alphanumeric control of the connected fan tray.

The general procedure is described in detail in the Technical Manual (00571.A3)

After finishing the parameter programming, leave the submenu or configuration menu (POWER switch down).

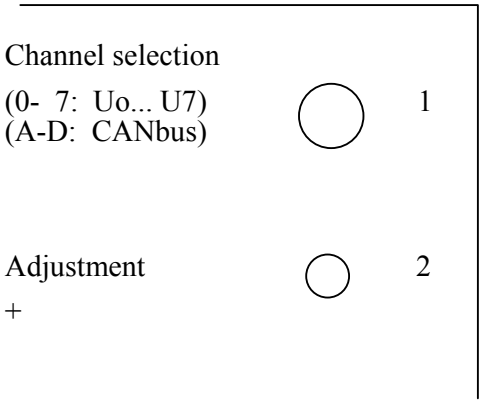
2.4.2.2.1 Table 1 List of manual Programming Features

Mode	associated parameter submenu	Description
Any Voltage (e.g. +5V or U0)	Ilim	Output Current limit
	Uadj	Output voltage fine adjustment. The same function as the switches in the power supply
	Unom	Output voltage coarse adjustment.
	Imax	Monitoring: Maximum current for good status.
	Umin	Monitoring: Minimum voltage for good status.
	Umax:	Monitoring: Maximum voltage for good status.
Power	Auto Power On No Auto Power On	After AC-fail 1. Automatic switch power on 2. Remains off (manual start necessary)
	Switch Off Normal Switch Off Delay	Delayed switch off: POWER switch has to push down for 5 seconds until the power supply switches off

2.4.3 Output Voltage Adjustments

All output voltages can be adjusted manually via the two rotary switches situated on the power supply top.

1. the 1. rotary switch selects the function which has to be adjust
2. the 2. rotary switch will change the settings when turned (right/left = +/-)



Mode Selection	Function
0-7	Adjust Voltage of U0-U7
A	CAN Address (low, Bit 0-3)
B	CAN Address (high, Bit 4-6)
C	CAN General Call Address (low, Bit 0-3)
D	CAN General Call Address (high, Bit 4-6)
E	CAN Transmission Speed Index

2.4.4 Power Supply AC on / off

A rocker switch for AC on / off is situated at the rear side of the power supply.

Please note that this connector do not disconnect the power supply from mains completely! Many internal components remains under high voltage (about 400VDC).

When this switch is in OFF Position all other functions are disabled, including any remote control action. Also the Main Switch at fan tray front panel doesn't work until the rear rocker switch is in "Power Supply AC on" position again.

2.4.5 CANbus Option, Transmission Speed Index

Index	Max. Distance	Bit Rate	Type
0	10 m	1.6 Mbit/s	high- speed
1	40 m	1.0 Mbit/s	
2	130 m	500 kbit/s	(needs termination)
3	270 m	250 kbit/s	
4	530 m	125 kbit/s	
5	620 m	100 kbit/s	low-speed
6	1.300m	50 kbit/s	
7	3.300 m	20 kbit/s	
8	6.700 m	10 kbit/s	
9	10.000 m	5 kbit/s	

For software protocol see separate manual No. *00183

APPENDIX A: Technical Details of 6021 Power Supplies for LHC

Mains input: 92...265VAC, 16A (plug approval!) peak +15%

Sinusoidal: **CE** EN 60555, IEC 555 pow. fact. 0,98 (230VAC),
Inrush current: 10 A, cold unit

Isolation Inp.- outp. **CE** EN 60950, ISO 380, VDE 0805, UL 1950, C22.2.950

DC Output power with different mains inputs (16A), calculated with typical efficiency of 75%

115VAC / 1.380Wnom, 1580Wpeak **230VAC / 2.760W, 3170Wpeak**

(modules selected for 64x application, 5V- 3,3V-+/-12V- 48V)

Available modules	min. to max. range	max. output, peak	nominal output
Type MEH	2... 7,0V	115A / 630W	100A / 550W
Type MEH	7... 16V	46A / 630W	40A / 550W
Type MEH	30... 60V	13,5A / 650W	12A / 580W
Type MDL (+/-)	7... 24V	11,5A / 2x276W	10A / 2x240W
Type MDH (+/-)	7... 14V	23A / 2x276W	20A / 2x280W

Regulation

static: MEH 550W/650W <15mV(+/-100% load, +/- full mains range)
MDL/MDH : <0,05% (+/-100% load, +/- full mains range)

dyn.: MEH <100mV (50% ⇔ 75% load, 1A/µs)
MDL/MDH <0,7% (+/-25% load, 1A/µs)

Recovery time +/-25% load:	within +-1%	within +-0,1%
Modules 550W	< 0,2ms	< 0,5ms
Modules 650W	< 0,5ms	< 1,0ms
MDL/MDH	0,0ms	< 1,0ms

Sense compensation range: full difference between min. and max. output voltage (OVP has to be adjusted accordingly)

Noise and Ripple

at Backplane side: <20mVpp, (0-20MHz) <3mVrms (0-2MHz)

at Power Supply output: <40mVpp, (0-20MHz) <3mVrms (0-2MHz)

EMI

RFI-rejection, emission: **CE** EN 50081-1 VDE 0871B
EMC immunity: **CE** EN 50082-1 or 2

Operation temperature: 0....50°C without derating, Storage:-30°C ... +85°C

Temp.-coefficient: < 0,2% / 10K
Stability (conditions const.): 10mV or 0,1% / 24 hours, 25mV or 0,3% / 6 month

Current limits: adjustable to any lower level

Voltage rise characteristics: monotonic 50ms, processor controlled.

Protection Provisions

Overvoltage crow bar protection: trip off adjusted to 125% of nominal voltage each output
DC Off (trip off): within 5ms if >+5 /-2,5% (≥ 5V output) deviation from nominal values, adjustable,
after overload, overheat, overvoltage, undervoltage (bad status) and fan fail
if temperatures exceed 110°C heat sink, 70°C ambient

Trip off points adjustable, processor controlled. Output capacitors will be discharged by the crow bars

Efficiency: 68% ... 85%, depends on used modules

M T B F

Power Supply air cooled 40°C ambient >65 000 h 25°C ambient >100 000h
Power supply water cooled 20-40°C water, 40°C ambient >100.000h

APPENDIX B: Available Fan Trays

Fan Tray	Type	No. of Blowers	Cooling Frontmodules	Space for Transitionmod	Max. Air Flow total
6020/9 690mm	9U fan tray	9 x DC 118mm²	400 mm	220mm	>1600m ^{3} / h
6020/6 400mm	9U fan tray	6 x DC 118mm²	400mm	No	>1000m ^{3} / h
6020/6 340mm	6U fan tray	6 x DC 118mm²	160mm	160 mm	>1000m ^{3} / h
6020/3 160mm	6U fan tray	3x DC 118mm²	160mm	No	>540m ^{3} / h
6020/4s 400mm	9U fan tray	4 x DC-Super 150mm	400mm	No	>1500m ^{3} / h
6020/6s 690mm	9U fan tray	6 x DC-Super 150mm	400mm	220mm	>2200m ^{3} / h

all fan trays for bottom air inlet only.

Except the 6U fan tray for 160mm front modules **all fan trays** are equipped with a topped plenum pressure chamber, 25mm high, for optimized air flow homogenization through all slots as well as for mixed module depths.

The construction features a second chamber, a sucking plenum, below the fan tray blowers which allows tight space free mounting above a heat exchanger.

APPENDIX C Technical Details of blower types (muffin fans)

Static pressure at 3000 RPM:	Blower type 1134 574	8 mm H_2O column
	Blower type 1450 352 (Super Blower)	14 mm H_2O column
Max. Speed of Rotation:	>3000 RPM	
Power Consumption per Blower:	Blower type 1134 574	6-8W typical
	Blower type 1450 352	12-15W Typical
Start up Current:	Limited by soft start circuit	
Operating Voltage:	Fan tray 30VDC, internal Blowers 0-24VDC,	

Most gainful Operating Range:	Blower type 1134 574	100-160m^3/h,	2- 3,8mmH_2O
	Blower type 1450 352	180-320m^3/h,	4- 5mmH_2O
Operating Temperature:	0... 70°C		
MTBF:	>65 000 h at 40°C ambient, > 85 000 h at 25°C ambient		