

Operating Manual
16-channel preamplifier CPA16
Rev.B

multichannel*
systems

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Imprint

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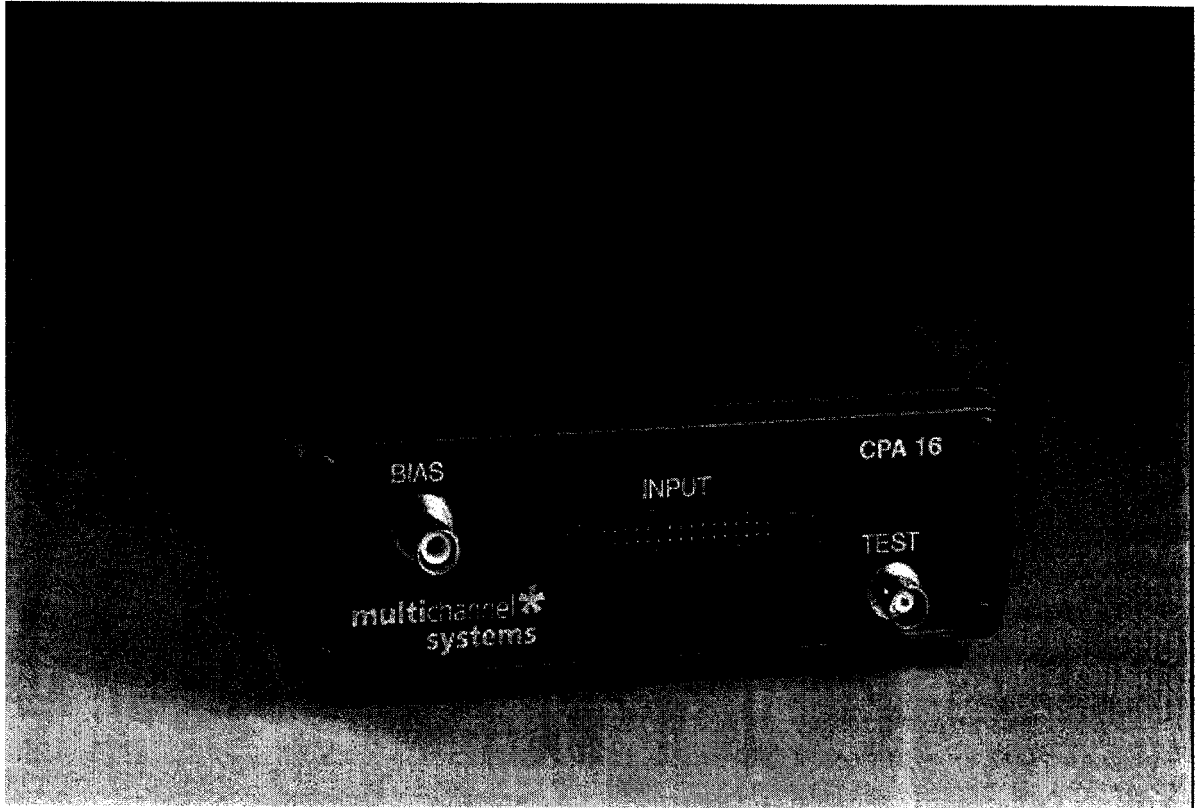
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Foreword

This manual will help you to become acquainted with the 16-channel CPA16 and its proper use. Important safety instructions and warnings will help you to operate the 16-channel preamplifier CPA16 safely and competently.

The right to make technical modifications is reserved.

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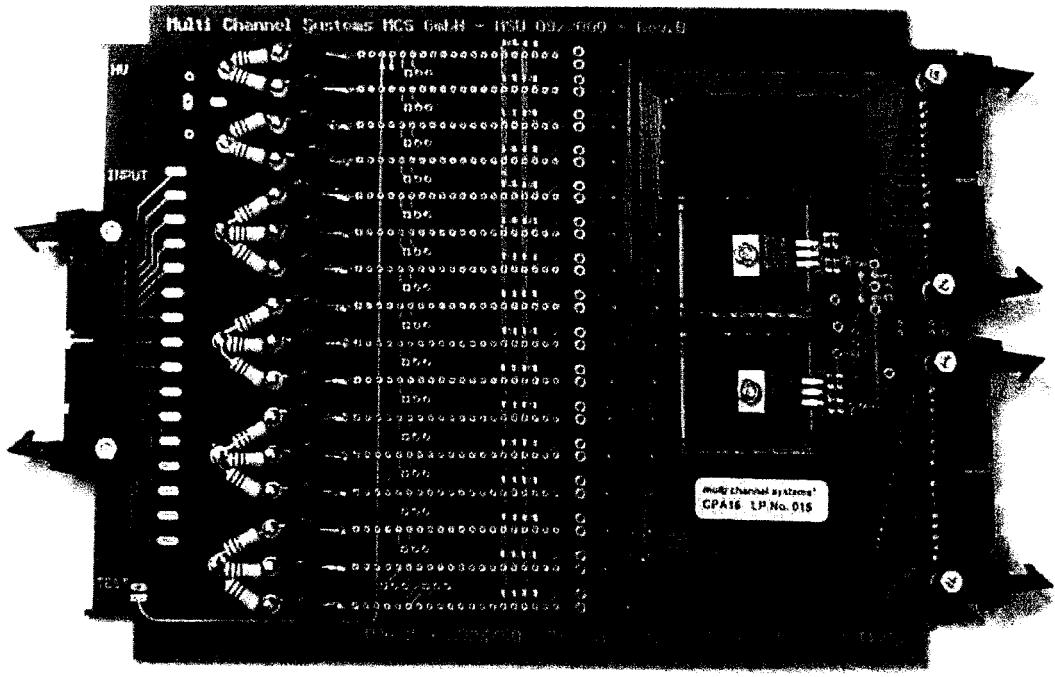


CPA16 with 16 channels, low bias up to 500 volts, bias & test input

preamplifier
module
PA3300



the device CPA16, housing & printed circuit board



Short Description

The Multi Channel Systems device CPA16 is a complex electronic equipment for analog signal processing of (multi-channel) detectors like microstrip silicon detectors (MSSD), proportional counter (arrays) or position-sensitive detectors (PSD).

The main parts consist of an analog board with the precision pre- & shaping amplifier modules PA3300 and a high voltage de-coupling network. The device includes a power supply stage stabilizing the voltages need for operation. The modules PA3300 are low noise and high stability preamplifier with internal pole-zero cancellation. Key parameters of PA3300 have been specified by the customer; i.e. decay time, gain, shaping time, signal width.

In a first stage of the preamplifier PA3300, the current signal of a detector will be transformed in a voltage signal. The following stage of PA3300 modifies and amplifies the signal with the aim to create the analog signal with a timing specified by the customer. The total analog conversion of the high gain stage is set to about 2 V / pC, the conversion of the low gain is set to about 0.1 V / pC. The shaped analog pulse has a width of about 3 μ s. Therefore, a high counting rate of at least 100 kHz can be applied without pulse pile-up. The outputs are able to drive a 50 Ω cable with an amplitude of ± 2 V.

The detector signals are delivered to the device using a multiple pin connector on the front side of the housing consisting of aluminium. A test input connector of BNC type is installed on the front. For signal output, a multiple pin connector is mounted on the housing's rear side.

On the rear side of the equipment's housing, 2 green LED's are installed indicating the correct working power. The customer delivers the raw voltages need for working of the equipment parts. These voltages can range from ± 6.0 V to ± 12.0 V. Due to the fact, that each of the preamplifier consumes about 0.05 amperes of the positive and of the negative rail, it causes a lot of power loss dissipation. Therefore, a supply voltage of about 6 V is recommended. The temperature of the environment should be limited to about 40 °C. The stabilization stage is mounted on a heat sink. The power supply has a short-circuit protection and is protected against over-temperature. The advantage of the used linear regulation technique is the low noise compared to a switched mode power supply. The power is delivered to the electronics using a 3-pin LEMOSA connector.

The high voltage will be in-coupled using a SHV male connector mounted on the front side of the housing. The maximum rate should not exceed 500 V if the customer uses the multiple pin connectors. Otherwise you risk to damage the equipment.

Physical Dimensions

CPA16

total width:	169 mm
total length:	200 mm
total height:	52 mm

Weight

net:	2,0 kg
ship:	5,0 kg

Important note !

For safety use and for your own health, do not remove the cover of the housing before switching off the high voltage. Wait for discharge of high voltage capacities before opening the housing!

Device Specifications

CPA16

channel number	16
preamplifier	PA3300, modular
HV network	installed

Connectors

signal input	34pin 2-row connector, Au plated
HV input	SHV
test input	BNC
signal output	34pin 2-row connector, Au plated
power supply	9pin Sub-D connector (supply side) 3pin LEMOSA, type 1S (device side)

PA3300 (intern)

low gain stage	0.09 V / pC
high gain stage	1.63 V / pC
decay time	220 μ s (only internal observable)
shaping time	100 ns
e ⁻ noise equivalent	about 1200
power supply voltage	\pm 5.0 V
power supply current	\pm 50 mA each module
input protection network	built of clamping diodes

POWER SUPPLY

external

supply voltage	from \pm 6.0 V to \pm 12.0 V
----------------	----------------------------------

internal

positive rail	
voltage:	+ 5.0 V
current:	+ 0.8 A
negative rail	
voltage:	- 5.0 V
current:	- 0.8 A

OPERATING TEMPERATURE

air temperature:	T _A = 10°C to 40°C
------------------	-------------------------------

Electrical Connections & Power Supply

Power Supply

The supply voltage ranges from ± 6.0 V to ± 12.0 V.

The internal power supply voltages are 5.0 V, positive and negative polarity. The stabilization is made using the linear regulation technique. The power loss dissipated is distributed to the environment using heat sinks.

Internal power supply:

positive rail:

supply voltage: + 5.0 V

supply current: + 0.8 A

negative rail:

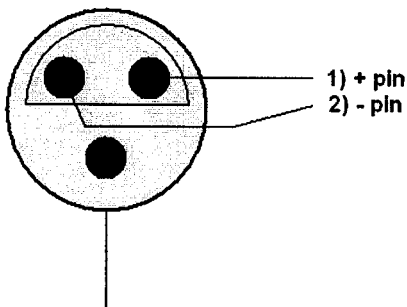
supply voltage: - 5.0 V

supply current: - 0.8 A



Attention: Do not mismatch the polarity of the external power supply. False connection will harm the unit permanently.

Pin layout of the power supply connector, type LEMOSA 1S



3) ground connection

pin 1: positive rail

$U > + 6.0$ V

pin 2: negative rail

$U < - 6.0$ V

pin 3: ground

The power cable connector on the supply side is a male 9pin SUB-D connector. The pins used are: pin 1 & 2 for ground, pin 5 for positive voltage and pin 8 for negative voltage. These pins are used due to the fact that the pins 4, 6, 7 and 9 deliver the NIM standard voltages of ± 12 V and of ± 24 V. Be careful, wrong connections may be damage power supply bin.

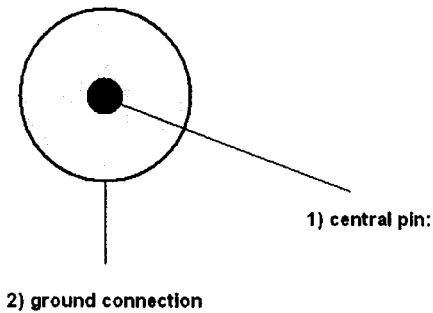
Signal Connections

Several signal connections have to be made before using the device. On the front side of CPA16, the connectors for input signals, for the high voltage and, optionally, for testing the device are located. The output signal connector, the power supply connector and 2 LEDs are mounted on the rear side.

Each of the connections are described now briefly.

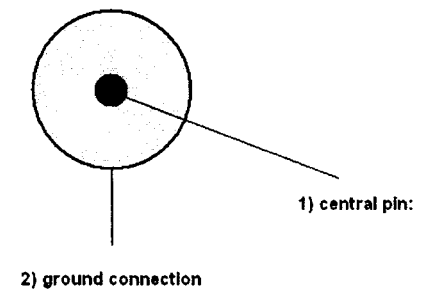
Front Panel Connection

- SHV - high voltage input. Note: if the input signal connector is not from a HV type, please use only voltages up to about 500 V.



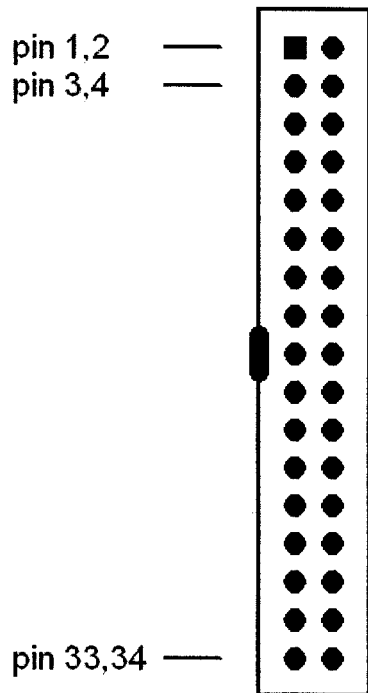
**pin 1: high voltage
positive rail
 $U_{max} = + 500 V$
pin 2: ground**

- BNC – test input (terminated by 50 ohms internally)



**pin 1: test signal input
pin 2: ground**

- input signal connector



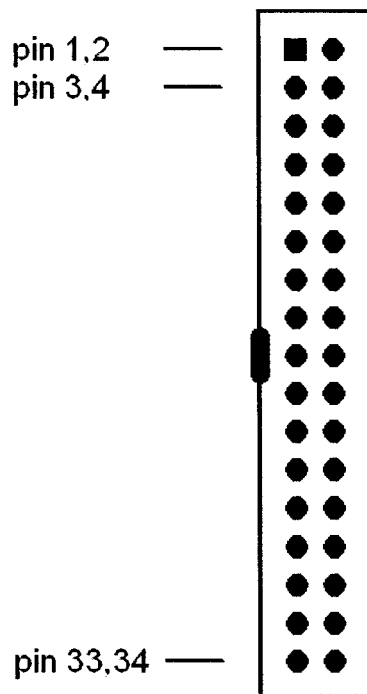
- | | |
|-----|------------|
| 1) | channel 1 |
| 3) | channel 2 |
| 5) | channel 3 |
| 7) | channel 4 |
| 9) | channel 5 |
| 11) | channel 6 |
| 13) | channel 7 |
| 15) | channel 8 |
| 17) | channel 9 |
| 19) | channel 10 |
| 21) | channel 11 |
| 23) | channel 12 |
| 25) | channel 13 |
| 27) | channel 14 |
| 29) | channel 15 |
| 31) | channel 16 |

All other pins are connected to ground!

Rear panel connections

The power connector is mounted on the rear side of the housing. The pin layout is described above. Two green LED's are also installed on the rear panel. They indicate the stabilized 5 V of both polarities. A non-permanent illumination indicates a failure of the power stage: an over-temperature, a short-circuit or a voltage reduction. The next section shows the pin layout of the output signal connectors which is from 34pin 2-row type with Au plated contacts.

- output signal connectors



- | | |
|-----|------------|
| 1) | channel 1 |
| 3) | channel 2 |
| 5) | channel 3 |
| 7) | channel 4 |
| 9) | channel 5 |
| 11) | channel 6 |
| 13) | channel 7 |
| 15) | channel 8 |
| 17) | channel 9 |
| 19) | channel 10 |
| 21) | channel 11 |
| 23) | channel 12 |
| 25) | channel 13 |
| 27) | channel 14 |
| 29) | channel 15 |
| 31) | channel 16 |

All other pins are connected to ground!

The outputs are delivered using 2 connectors having the same pin layout. The difference consists of the signal amplification: one delivers the low gain signals, the other one the high gain signals.

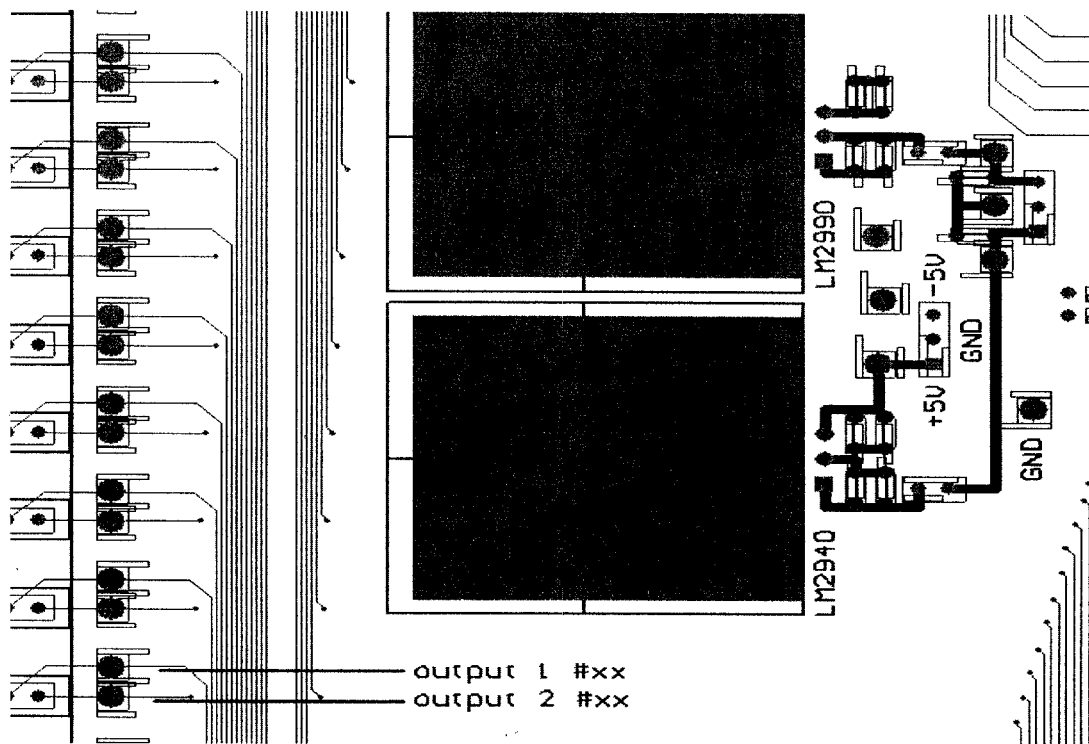
Points of Measurements

Analog signals

The signals delivered by the preamplifiers PA3300 can be checked using the free pads on the main board shown in the next figure. The pads are on the output side of PA3300. Note: Please use only the professional measuring tools to check the individual preamplifier signals yourself.

Power supply

The supply voltage can be measured on some points on the main board. Be careful, short circuits of the power supply input line can destroy the external power stage! The measuring point are situated in front of the regulator IC's.

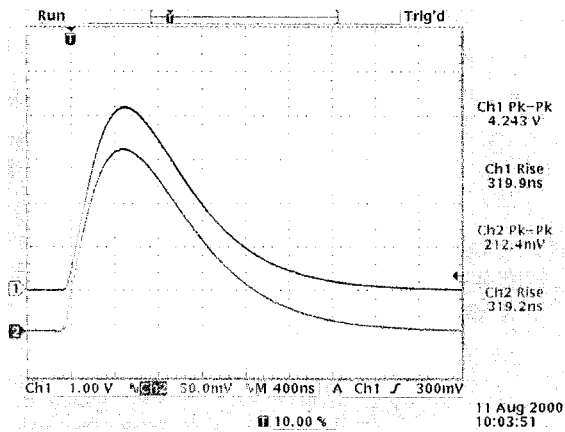


The measuring point are indicated using the following markers:

- ALxx: low gain output of channel xx
- AHxx: high gain output of channel xx
- PS_P: positive internal voltage
- PS_N: negative internal voltage
- PS_GND: ground

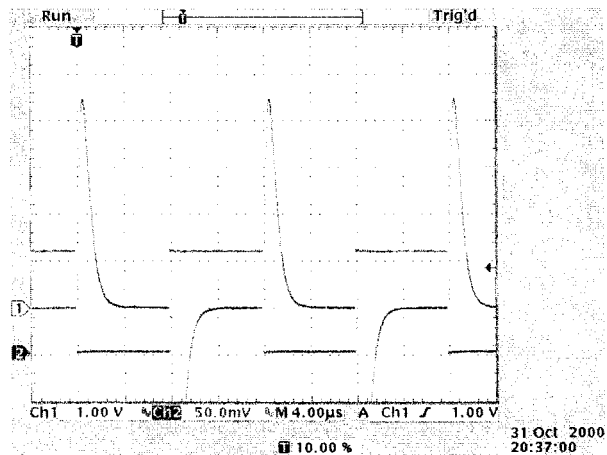
Test Measurement of PA3300 & CPA16

Each of the 16 PA3300 modules has been checked for proper work. The figure on the right is an example of such measurement. The line (depicted by 1 on the left) is a typical preamplifier pulse response of a square wave signal on the test input. The signal has an amplitude of about 4 V, the line (depicted by 2) has 200 mV. On the right column of the figure, the width and the rise time of the two signals are indicated. CH2 is the test signal



All modules have been checked using the settings as described above. The notes of the measurements are available in the appendix. Several checks have been done after mounting the printed circuit board of the analog part into the housing. One of these concerns the power distribution to the main board. The voltages have been measured and found to be correct. A next step has checked the power consumption with all installed PA3300 modules. After mounting the analog main board into the housing, the high voltage stability has been tested using a HV power supply. All the detector inputs have been connected to a test circuit simulating a detector capacity of about 100 pF.

The figure on the right gives an example of the high repetition frequency of PA3300. The input signal is a square wave with an amplitude of about 105 mV.



Hardware and Software

- 1) 16-channel preamplifier device CPA16
incl.
 - 1 analog board
 - 16 units preamplifier module PA3300
 - 1 3-wire power supply cable
 - 1 flat band cable with a 34pin connector
- 2) 2 spare unit preamplifier module PA3300
- 3) this manual

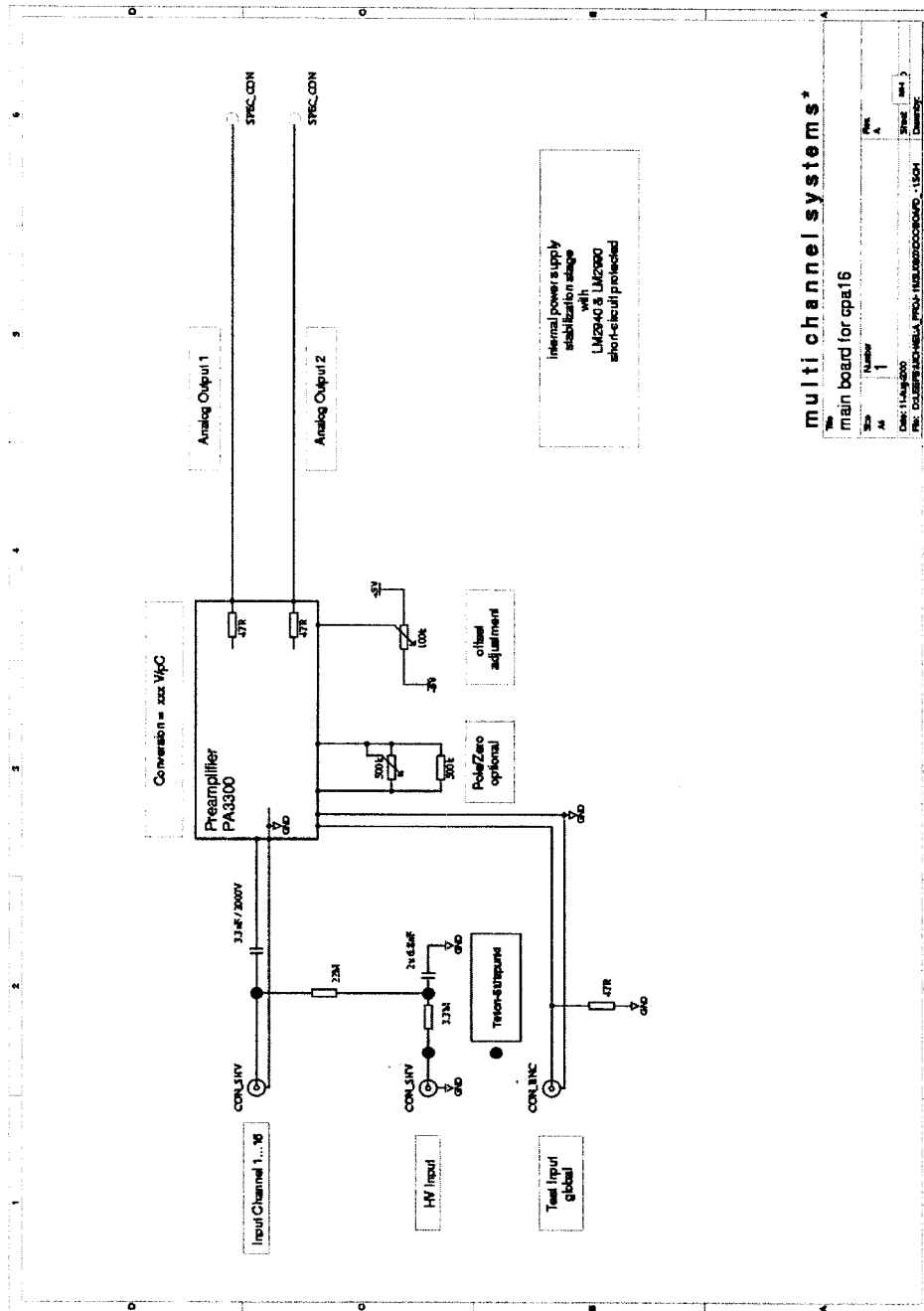
Service

Multi Channel Systems offers a fast factory repair service with quality check. Please contact Multi Channel Systems or your local representative before shipping your device. Please include a detailed description of the malfunction and send it to the address indicated on the front page of this manual.

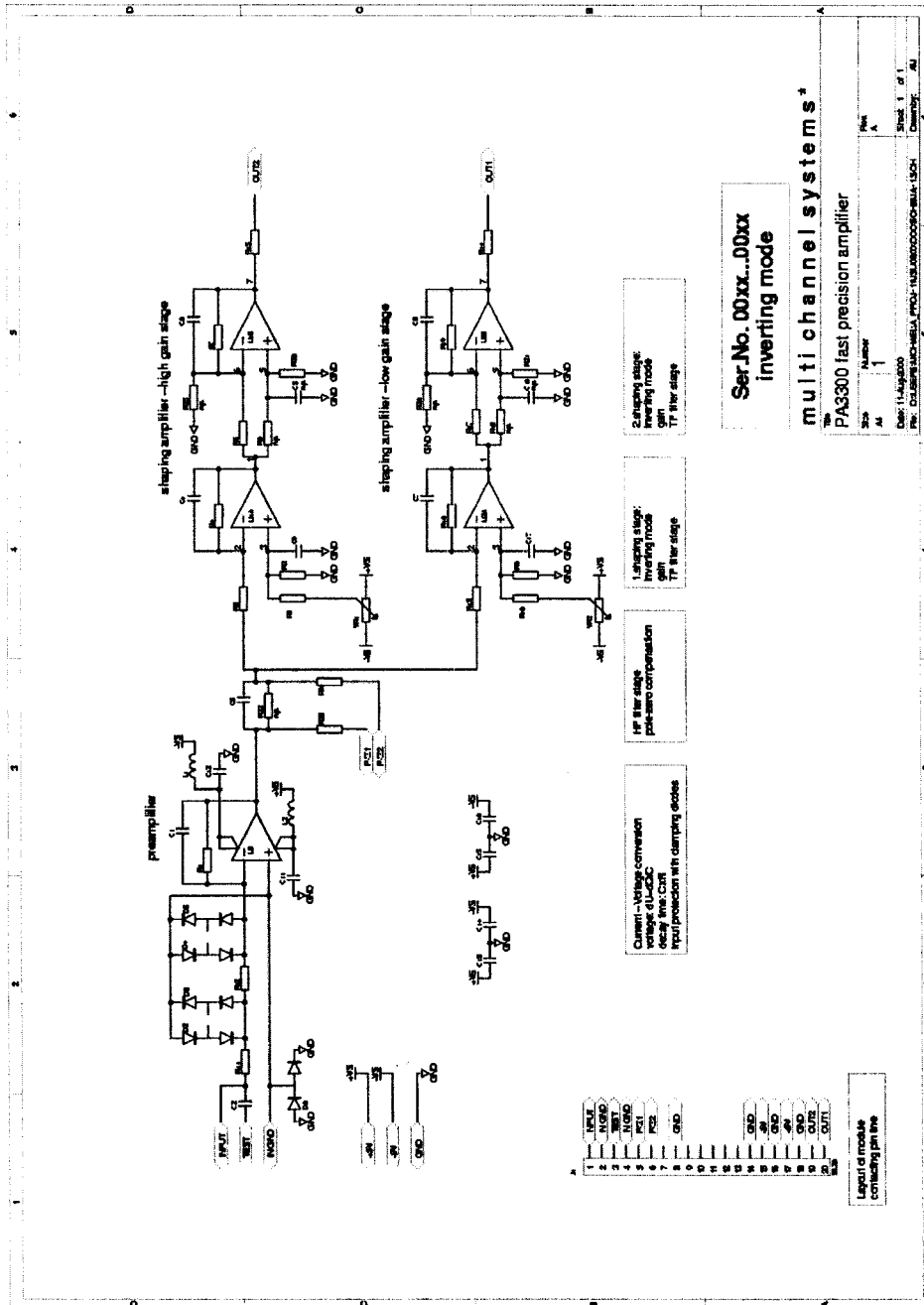
Appendix

- 1) principle electronic design of CPA16
- 2) electronic design of PA3300
- 3) printed circuit board of PA3300
- 4) printed circuit board of main board
- 5) PA3300 module check
- 6) to do – steps for installing / changing of CPA16 parts
- 7) list of serial numbers of PA3300 & CPA16

Principle electronic design of CPA16

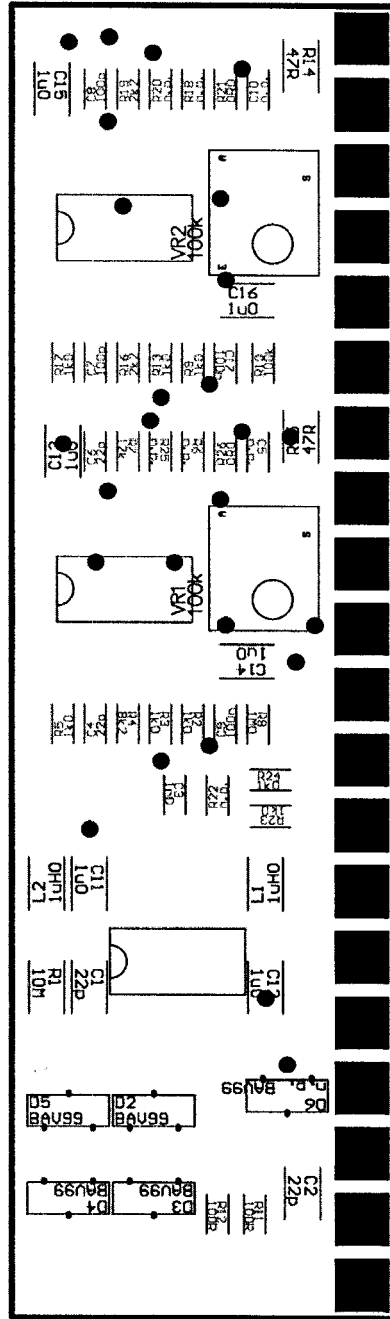


Electronic design of preamplifier module PA3300

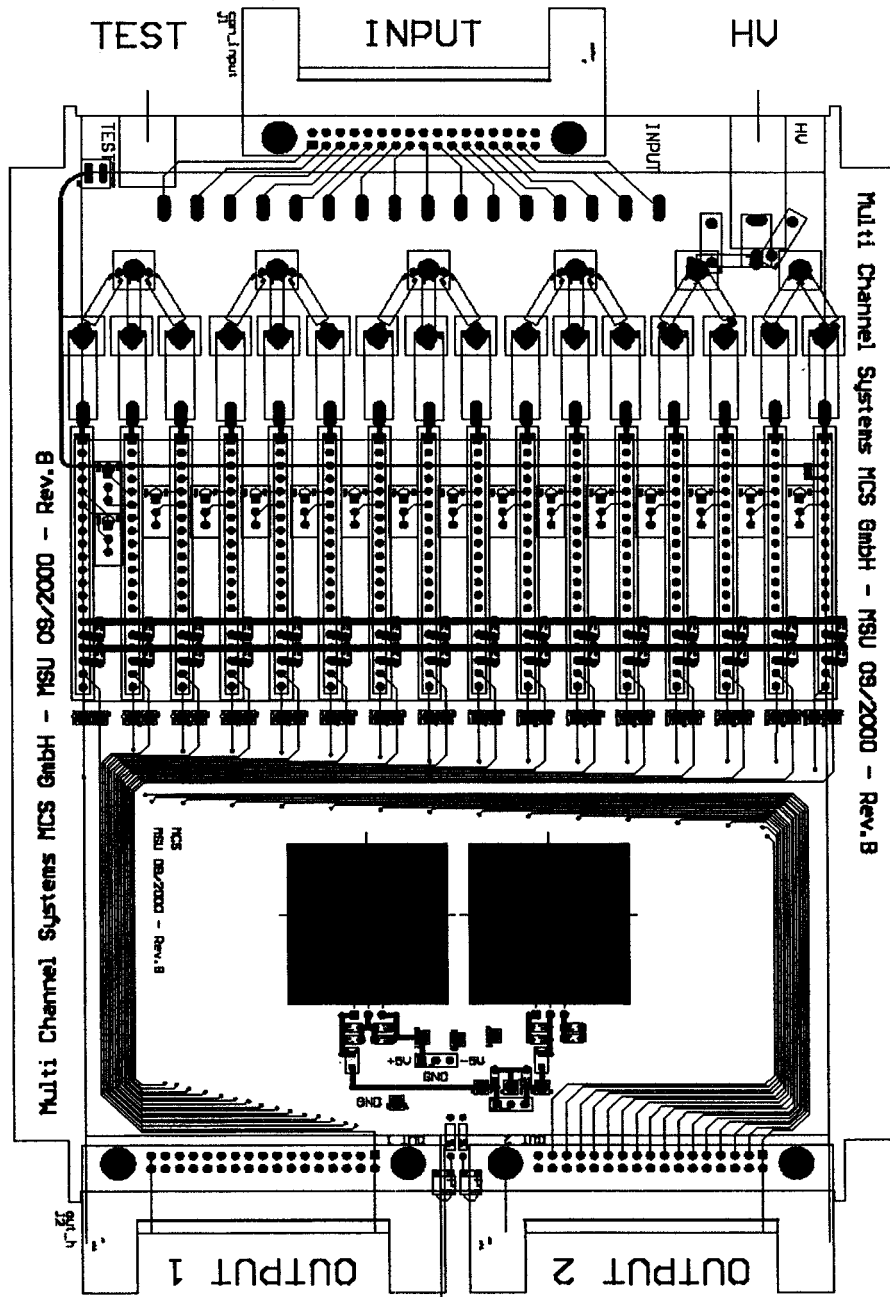


Printed circuit layout of PA3300

PA3300 inverting mode
MCS - Project: MSU 08 / 2000
Ser.No. 00xx...00xx

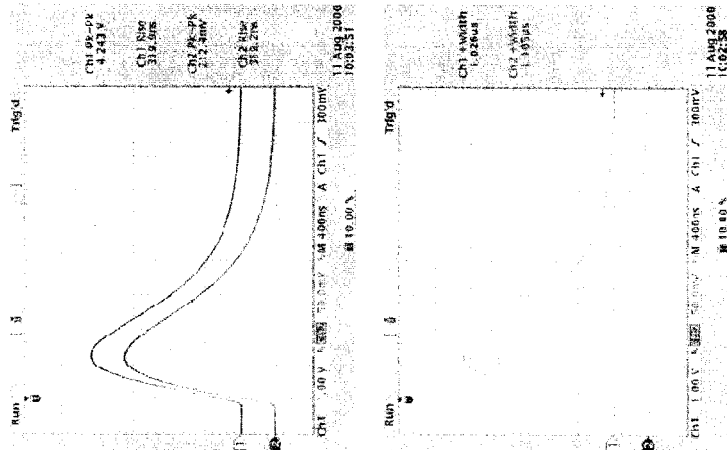


Printed circuit layout of main board



Check of preamplifier modules PA3300 / testversion

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Test of preamplifier modules PA3300
Ser.No. 0001 ... 0010 inverting mode
Ser.No. 0011 ... 0020 non-inverting mode

Input signal: square wave with about 110 mV amplitude
oscilloscope Tektronix TDS9022
amplitude, rise time & signal width @ FWHM have been checked, results are given in the tables.

Ser.No.	amplitude / mV	signal width / µs @ 1	rise time / ns @ 2	amplitude / V	signal width / µs @ 1	rise time / ns @ 2
0001	242	1.03	320	4.68	1.00	320
0002	247	1.04	322	4.68	1.02	320
0003	240	1.05	322	4.68	1.02	320
0004	248	1.04	318	4.71	1.01	322
0005	243	1.03	325	4.75	1.02	320
0006	235	1.05	328	4.82	1.03	322
0007	237	1.04	319	4.80	1.01	322
0008	244	1.04	321	4.87	1.01	320
0010	248	1.05	327	4.97	1.04	320

Ser.No.	amplitude / mV	signal width / µs @ 1	rise time / ns @ 2	amplitude / V	signal width / µs @ 1	rise time / ns @ 2
0011	213	1.11	318	4.27	1.03	322
0012	205	1.11	322	4.17	1.02	318
0013	208	1.10	322	4.21	1.02	317
0014	205	1.10	320	4.15	1.03	318
0015	209	1.12	321	4.29	1.02	318
0016	211	1.11	323	4.26	1.03	318
0017	216	1.11	319	4.34	1.03	321
0018	205	1.12	325	4.17	1.05	323
0019	220	1.11	321	4.46	1.04	322
0020	214	1.12	322	4.32	1.04	320

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To do – steps for changing of CPA16 parts

This subsection describes the steps for replacing preamplifier modules. The customer should pay highest attention to exclude electrostatic discharges during the work. Please use only the right mechanical tools for screws and nuts. Please be careful if you change preamplifier modules. Do not bend the module pins.

Changing PA3300 modules

- switch off the power supply
- disconnect all external connections
- open the device on the rear side
- disconnect the internal power supply connector
- remove the rear panel
- open the device on the front side
- take out the main board
- change the module of interest
- take the steps described vice versa to close the device

List of serial numbers of PA3300 & CPA16

device CPA16 SN021
non-inverting mode
PA3300 with SN from 0191 to 0206

device CPA16 SN022
non-inverting mode
PA3300 with SN from 0207 to 0222

device CPA16 SN023
non-inverting mode
PA3300 with SN from 0223 to 0238

spare units non-inverting mode SN from 0075 to 0080

device CPA16 SN024
inverting mode
PA3300 with SN from 0141 to 0156

device CPA16 SN025
inverting mode
PA3300 with SN from 0157 to 0172

device CPA16 SN026
inverting mode
PA3300 with SN from 0173 to 0188

spare units inverting mode SN from 0135 to 0140