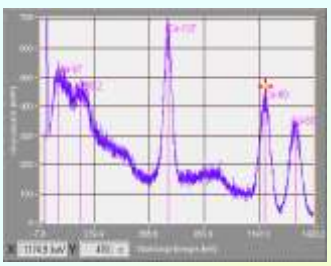
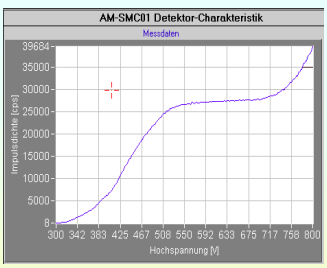
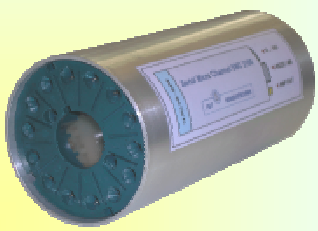
Manual

Hardware

Serial Micro Channel SMC 2100







HIGHLIGHTS for Radiation Measurement

- **Modular Hardware Design**
  - MCA with 2048 channels
  - Spectroscopy Amplifier
  - I/F Converter 10,5 decades
  - Discriminator - Analyser
  - Anti-Coincidence/Coincidence
  - Counter-Timer unit
  - Serial Interfaces RS232/RS485
  - High Voltage Power Supply
- **Network feasibility up to 126 modules with RS485 bus**
- **Detector connections for**
  - scintillation detectors
  - Lucas cells
  - solid state devices
  - proportional counters
  - Geiger-Müller tubes
  - Ionisation chambers
- **AEC NIM standard connectors**
- **Comfortable Software for all module variations under Windows 2000/XP/VISTA/7-10®**

FST SENSORTECHNIK

0 Safety Instructions

Connect or disconnect the detector only when Serial Micro Channel SMC 2100 is switched off.

See detector connection, Manual External Connections!

1) **Caution !!! High voltage is supplied to the SHV connector when the SMC 2100 is switched on.**

2) **The housing may be opened by competent personnel only.**

1 Serial Micro Channel SMC 2100

1.1 Application Characteristics

The Serial Micro Channel SMC 2100 offers an “intelligent stand alone” electronics solution for the radiation measuring technique´s in nuclear and atomic physics. Such as, environmental analysis, X-ray analytical methods, many fields of nuclear medicine, the acquisition of radiation pulses, energy proportional radioactivity determination, for the survey of radioactive contamination and the spread of radioactivity, and including dose rate and dose measurements.

The Serial Micro Channel SMC 2100 modular concept design is flexible and capable of being connected to a serial interface of a PC. Using the RS485 serial interface on a PC, a network structure can be generated. The flexibility of module design, allows for stand alone applications.

The Serial Micro Channel 2100 is supported by a range of modules, which are necessary in certain applications for the measurement of radiation pulses. Hence it is possible to directly connect any detector for radiation measurement, such as proportional counters, scintillation detectors, solid state devices, Geiger-Müller tubes, and ionisation chambers, to a PC, Laptop, or Notebook.

The Serial Micro Channel SMC 2100 may be directly coupled to a detector, which therefore makes the realisation of an “intelligent radiation detector” with serial link.

1.2 Modular Design

The structure of the Serial Micro Channel SMC 2100 is modular and consists of

basic module and **variation module**

The functional groups of the basic module are:

*** Counter Timer Unit**

*** 16 bit Controller**

*** DC Power Supply,**

*** High Voltage Power Supply**

The current range of supporting functional modules:

SMC - type	supporting functional module	characteristics
SMC/MCA	Spectroscopy Amplifier Multichannel-Analyser Single Channel Analyser	V = 1x till 250x 2048 Channels (MCA) 1 Window, 1 Counter
SMC/DS	Spectroscopy Amplifier Double Single Channel Analyser	V = 1x till 250x 2 Windows, 2 Counters
SMC/QS	Spectroscopy Amplifier Quadruple Single Channel Analyser	V = 1x till 250x 4 Windows, 4 Counters
SMC/DA	2x Spectroscopy Amplifier 2x Double Single Channel Analyser	2x V = 1x till 250x 4 Windows, 4 Counters
SMC/DC	Preamplifier/Amplifier/Discriminator	V = 50x till 250x Disc. Level, 1 Counters
SMC/DD	Double Preamplifier/Double Amplifier/Double Discriminator	V = 50x till 250x Disc. Level, 2 Counters
SMC/AK	Double Preamplifier/Double Amplifier/Double Discriminator Anti-Coincidence/Coincidence Logic	V = 50x till 250x Disc. Level, 4 Counters
SMC/IFI	Current-to-Frequency Converter for Ionisation Chambers	I = 0,05pA till 1,0 mA
SMC/IFP	Current-to-Freqeuncy Converter for Photomultipliers (with compensation)	I = 20 pA till 2 µA

1.3 Principle Structure, Connections, Adjustment Elements

This principle structure shows some kind of Serial Micro Channel SMC 2100 with input and output connections and trimmer resistors for adjustment.

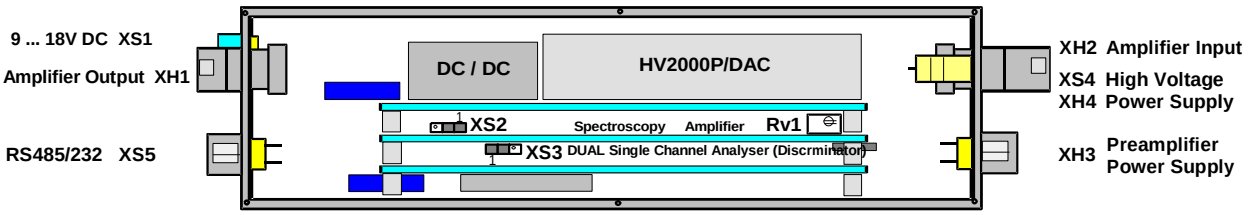


Fig.1: principle structure (without side panel) **SMC/MCA/DS**

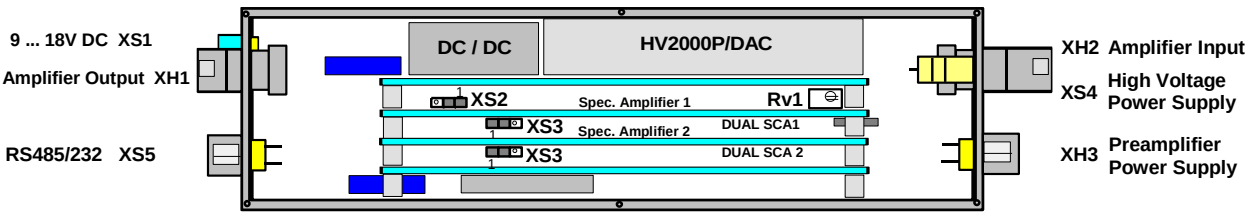


Fig.2: principle structure (without side panel) **SMC/QS/DA**

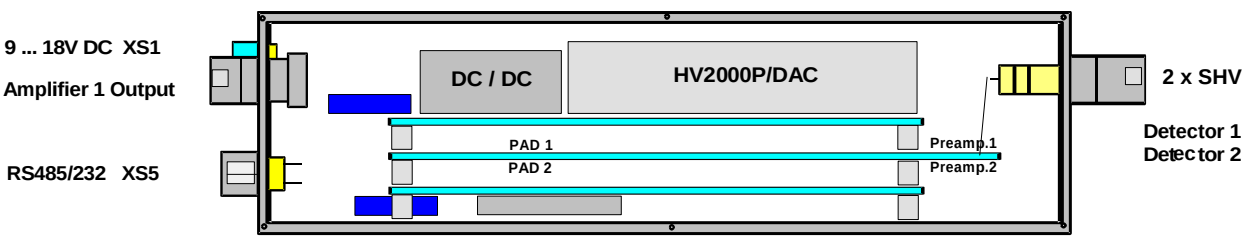


Fig.3: principle structure (without side panel) **SMC/DD/DC**

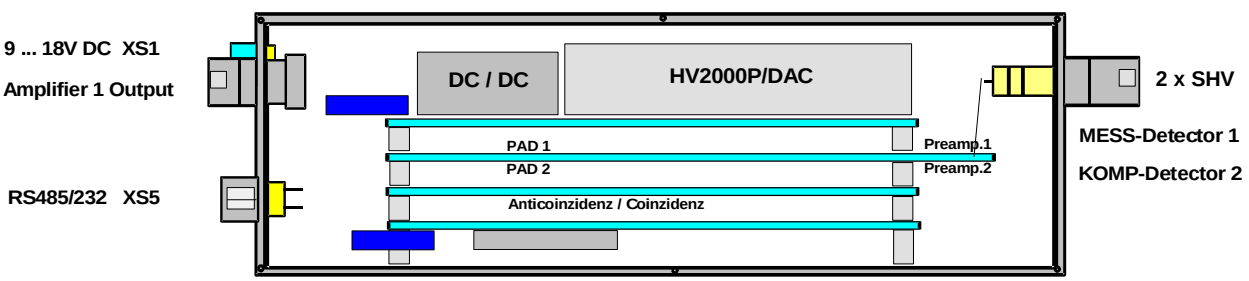


Fig.4: principle structure (without side panel) **SMC/AK**

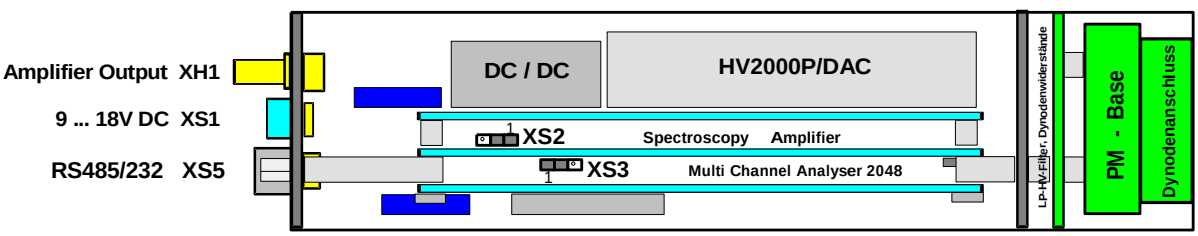
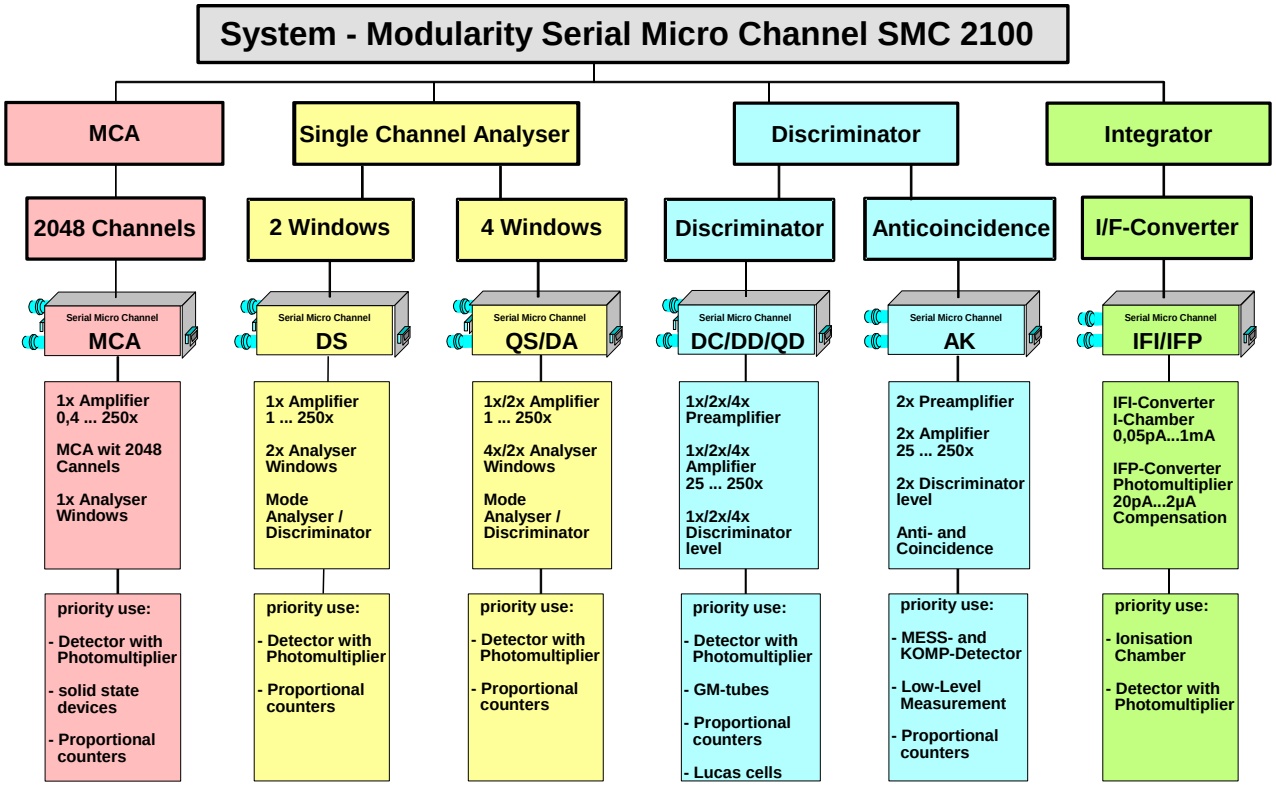


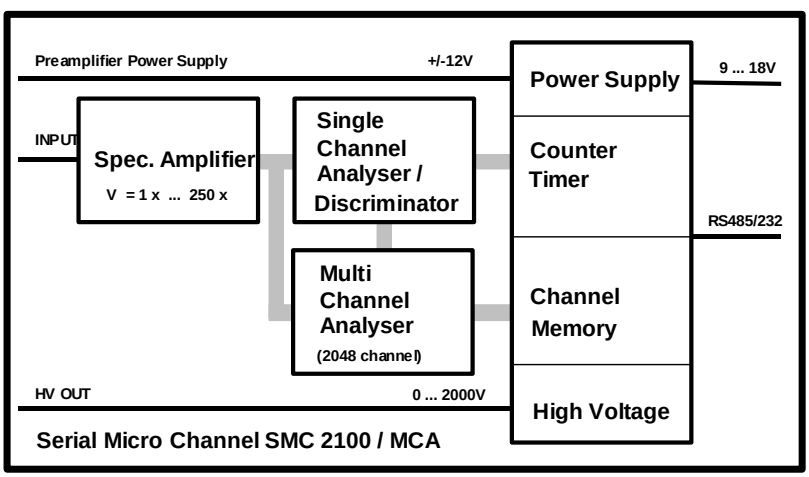
Fig.5: principle structure (without side panel) **SMC/MCA/DS**, for direct connection to a Photomultiplier Base

1.4 General System - Block Diagrams

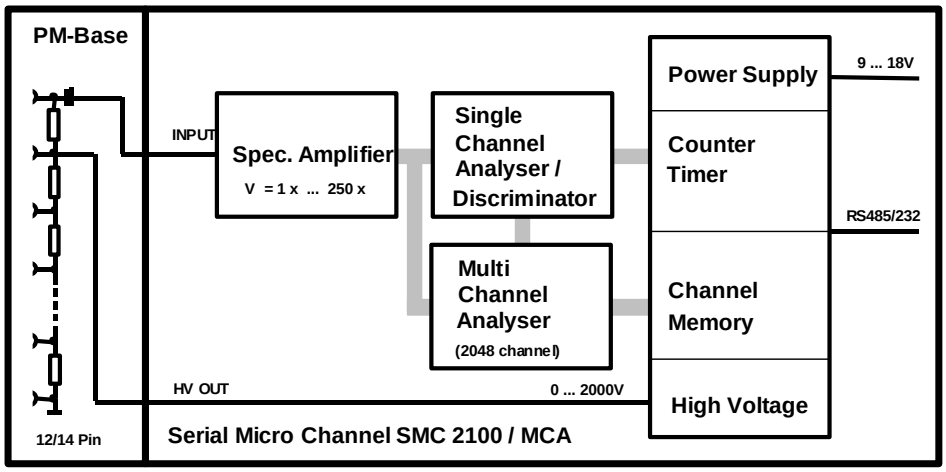


Block Diagrams

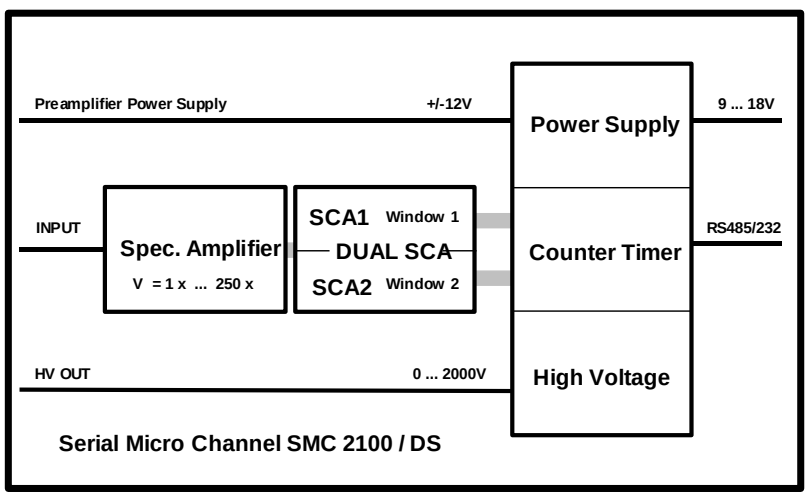
Serial Micro Channel 2100 / MCA - MultiChannel Analyser



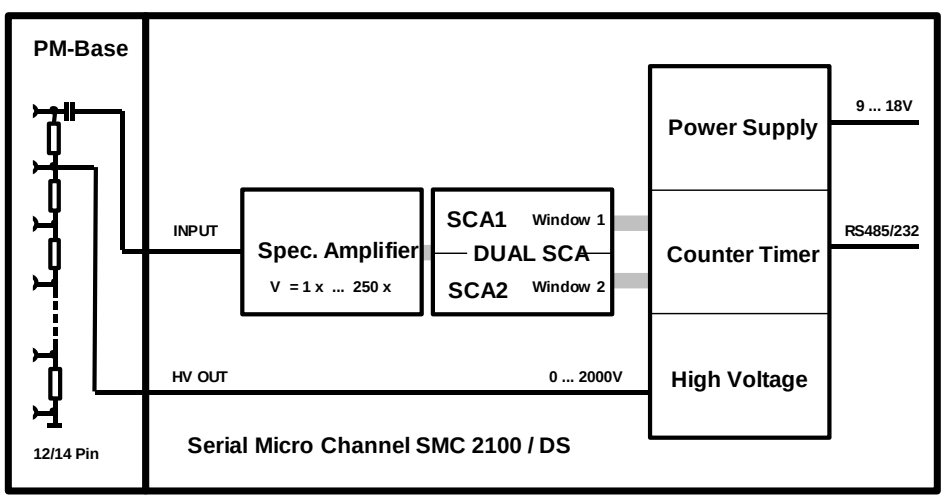
Serial Micro Channel SMC 2100 / MCA - **M**ulti**C**hannel **A**nalyser / **PMT Base**



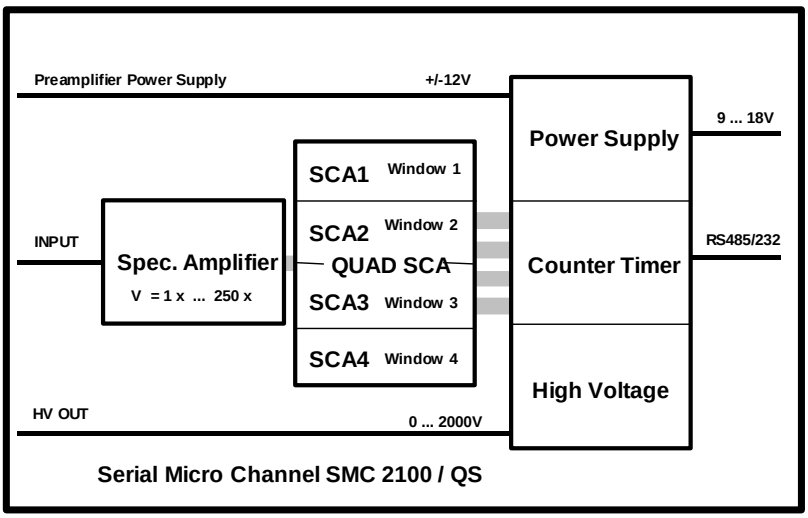
Serial Micro Channel SMC 2100 / DS - **D**ual **S**ingle Channel Analyser



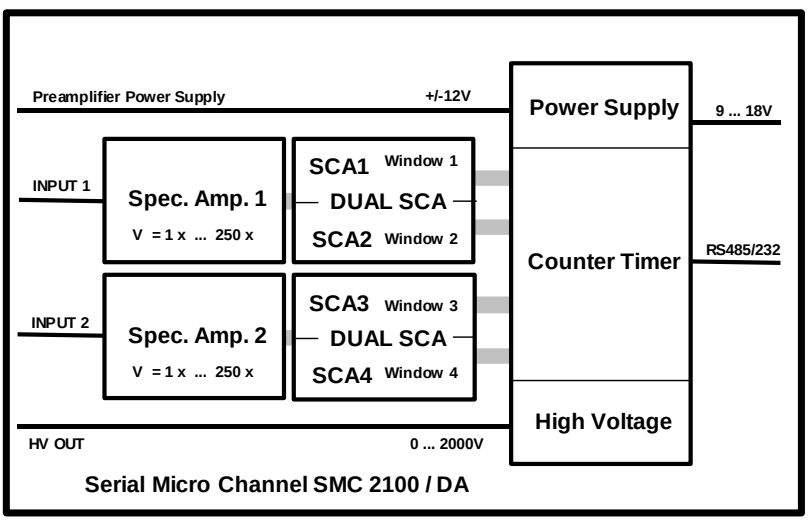
Serial Micro Channel SMC 2100 / DS - **D**ual **S**ingle Channel Analyser / **PMT Base**



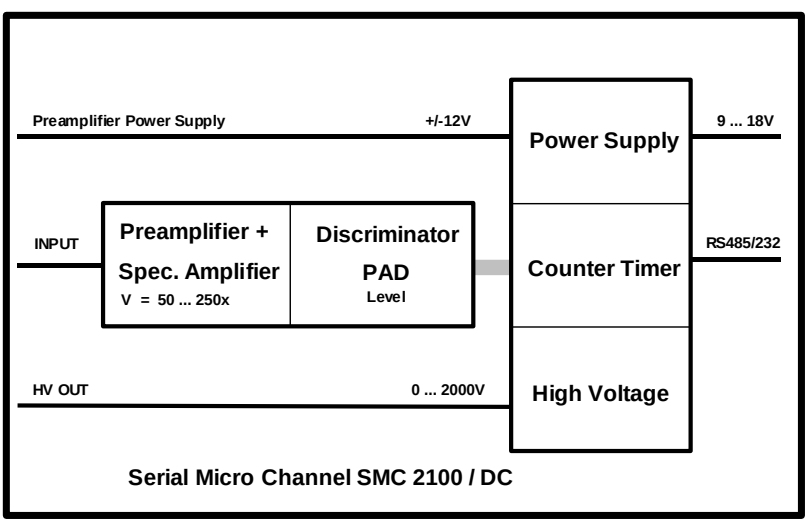
Serial Micro Channel SMC 2100 / QS - **Q**uad **S**ingle Channel Analyser



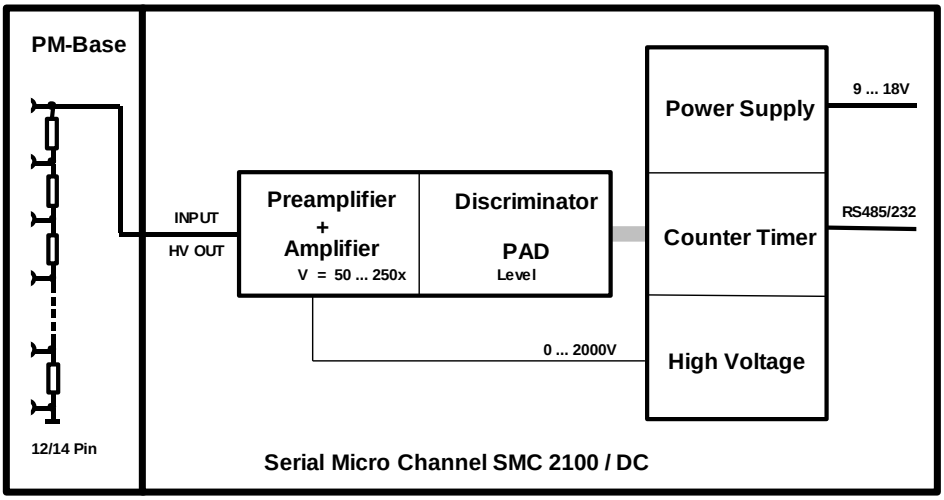
Serial Micro Channel SMC 2100 / DA - **D**ouble **A**mplifier



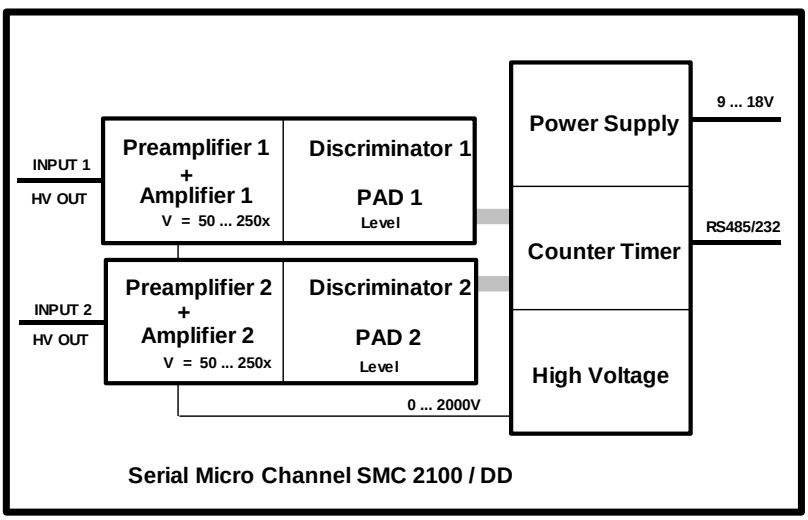
Serial Micro Channel SMC 2100 / DC - **D**is**C**riminator



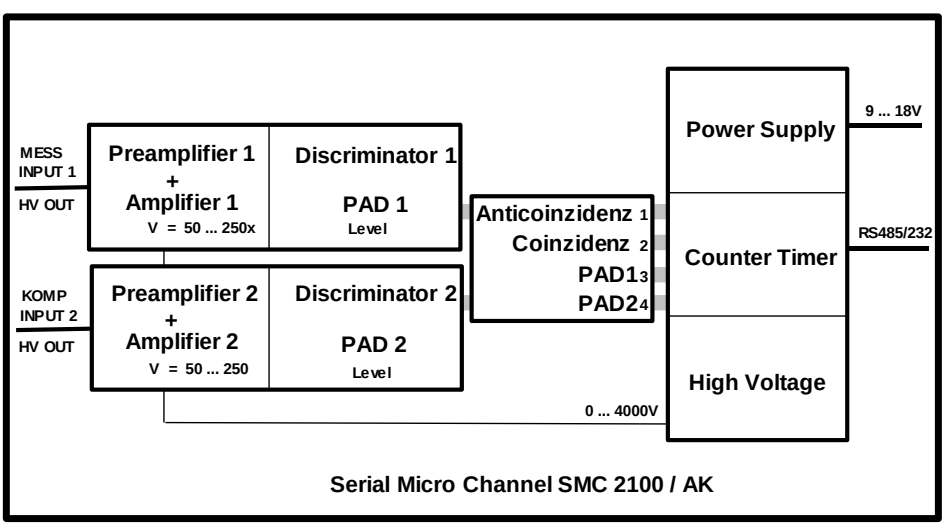
Serial Micro Channel SMC 2100 / DC - DisCriminator / PMT Base



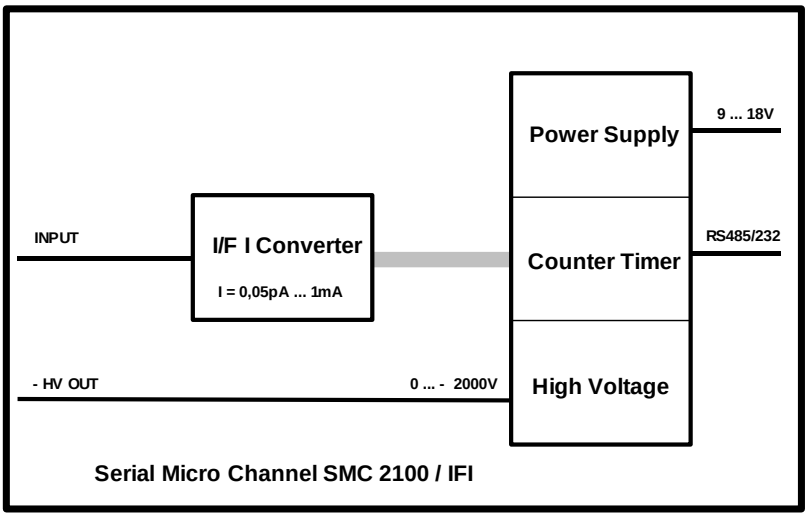
Serial Micro Channel SMC 2100 / DD - Dual Discriminator



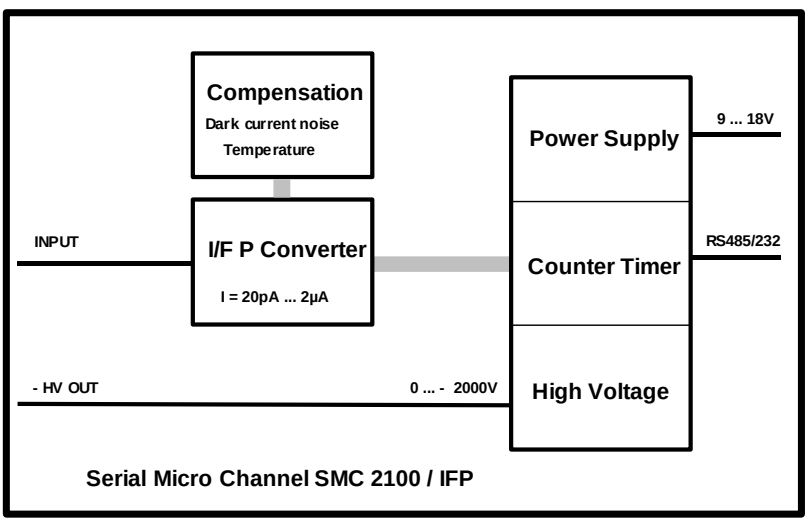
Serial Micro Channel SMC 2100 / AK - Anti-Coincidence/Coincidence



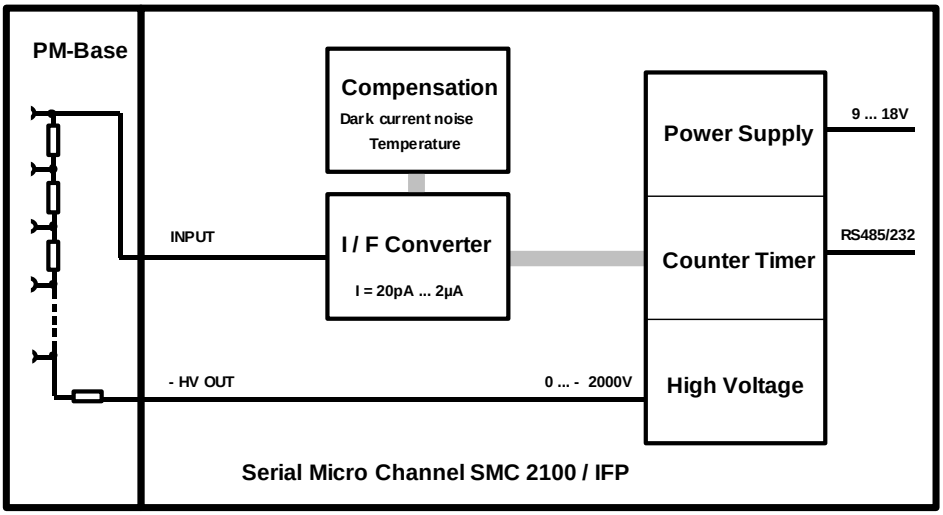
Serial Micro Channel SMC 2100 / IFI - I/F-Converter for ionisation chamber



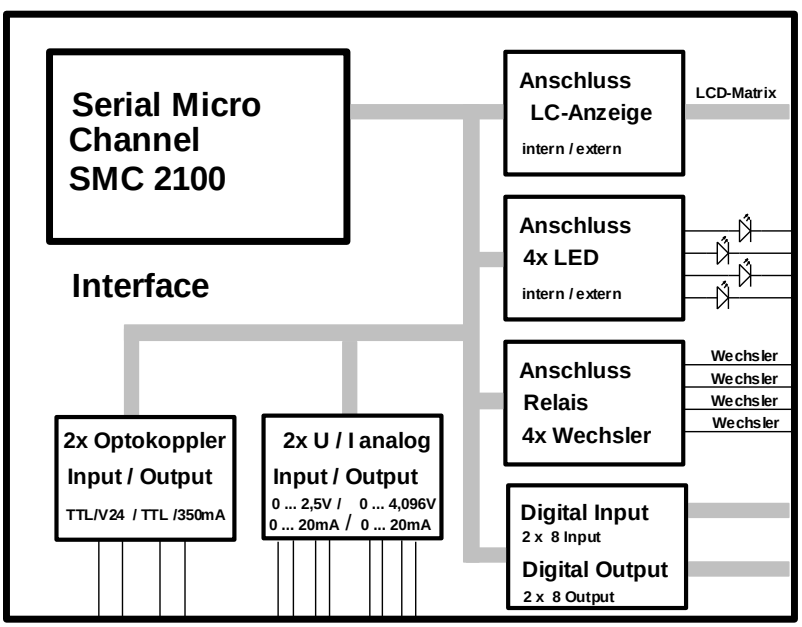
Serial Micro Channel SMC 2100 / IFP - I/F-Converter for **P**hotomultiplier



Serial Micro Channel SMC 2100 / IFP - **I/F**-Converter for **P**hotomultiplier / **PMT Base**

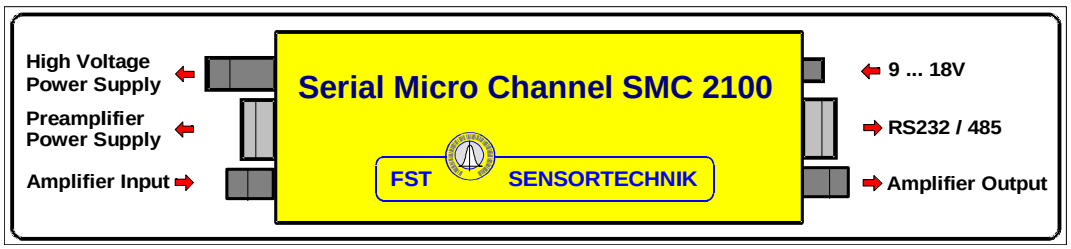


Serial Micro Channel SMC 2100 / with extended hardware interface

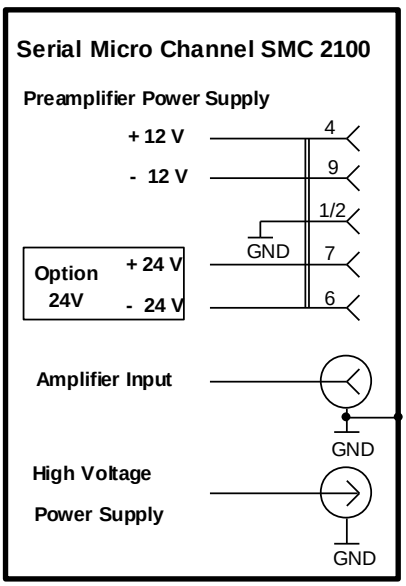


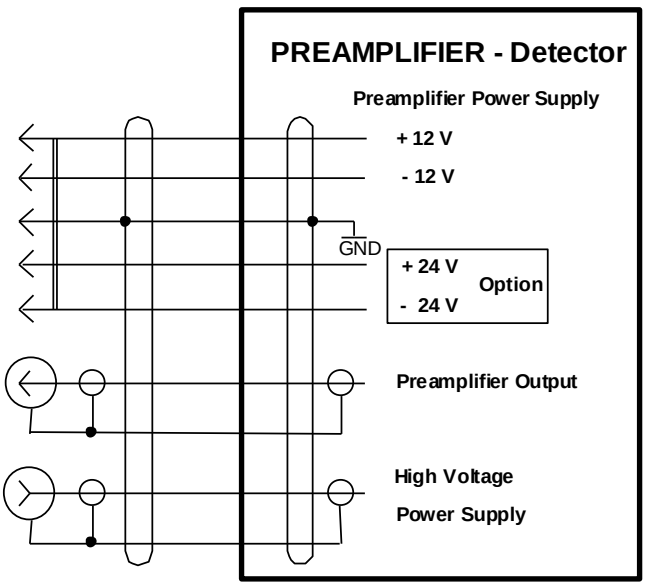
1.5 External Connections SMC/MCA/DS/QS

The connection of any radiation detector to the Serial MicroChannel SMC 2100 is in accordance with AEC NIM standard. The principle is shown in the following figure:

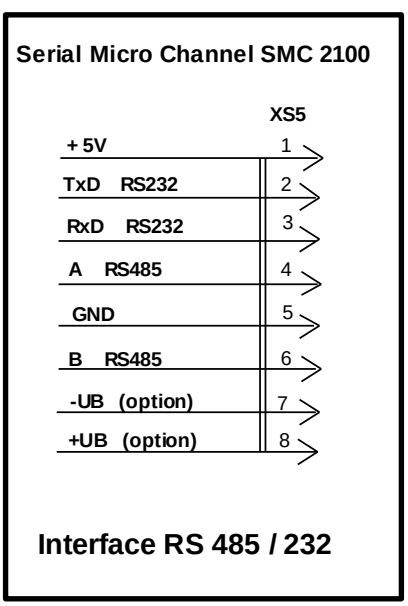


Detector connection

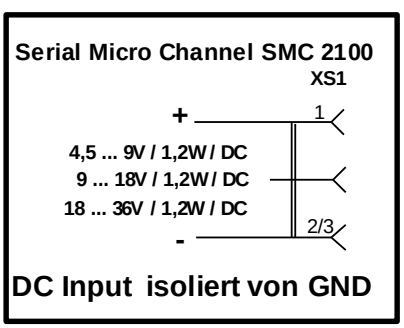




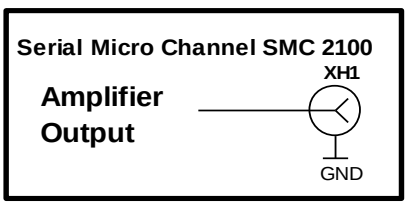
Connection serial interface



Terminal power supply

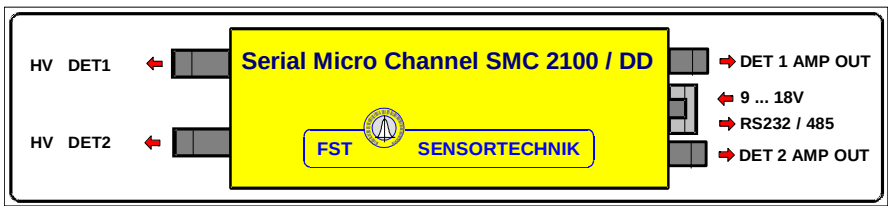


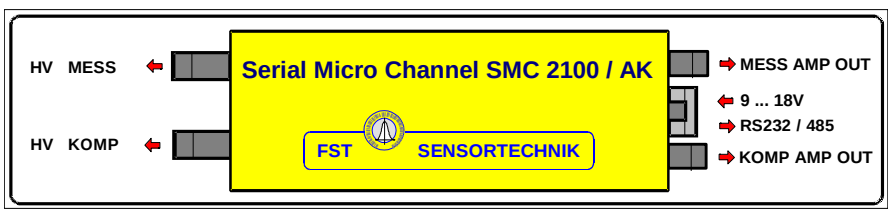
Terminal amplifier output

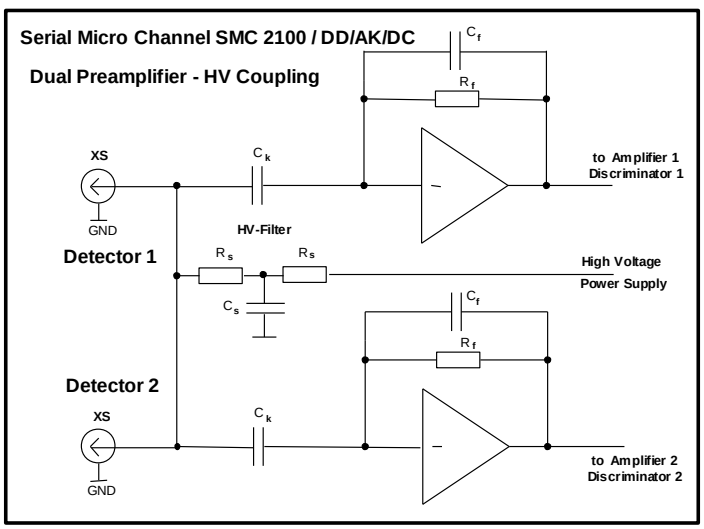


1.6 External Connections SMC/DD/DC/AK

The connection of radiation detectors without preamplifier and without HV filter to the Serial Micro Channel SMC 2100 is made according to the following principles:



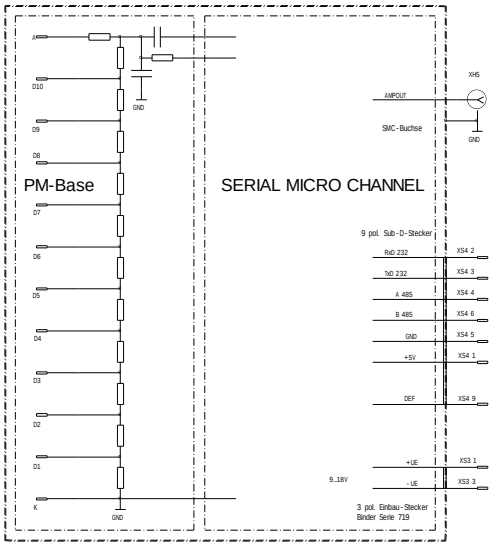




1.7 External Connections SMC/MCA/DS/DC with PMT Base

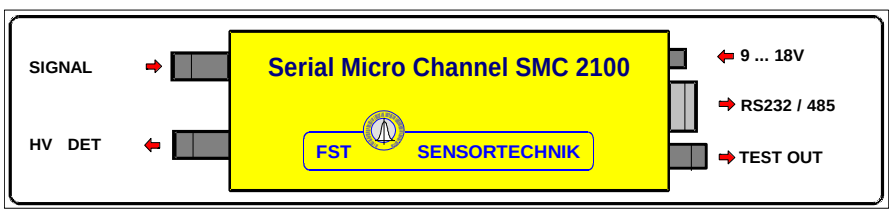
E.g., the connection of 12/14/21 pin PMT base and SMC / MCA / DS in an Al tube with length = 134mm und ∅ 47/59 mm for the use of 1,5" or 2" photomultipliers.

Connection of a Serial Micro Channel SMC 2100 to a PMT Base according to the following principle:



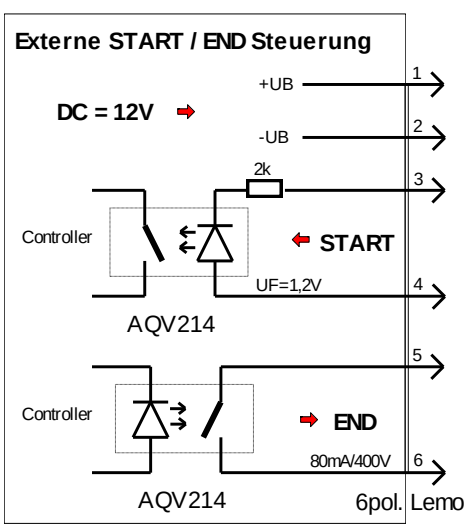
1.8 External Connections SMC/IFI and SMC/IFP

The connection of ionisation chambers or PMTs is made according to the following principle:



1.9 External START/END Control (Option)

With the external trigger signal START the inside the module existing counters can be started. At the end of each measurement an END signal will be sent from the module to an external device. The external trigger signals to the controller are coupled galvanically separated.

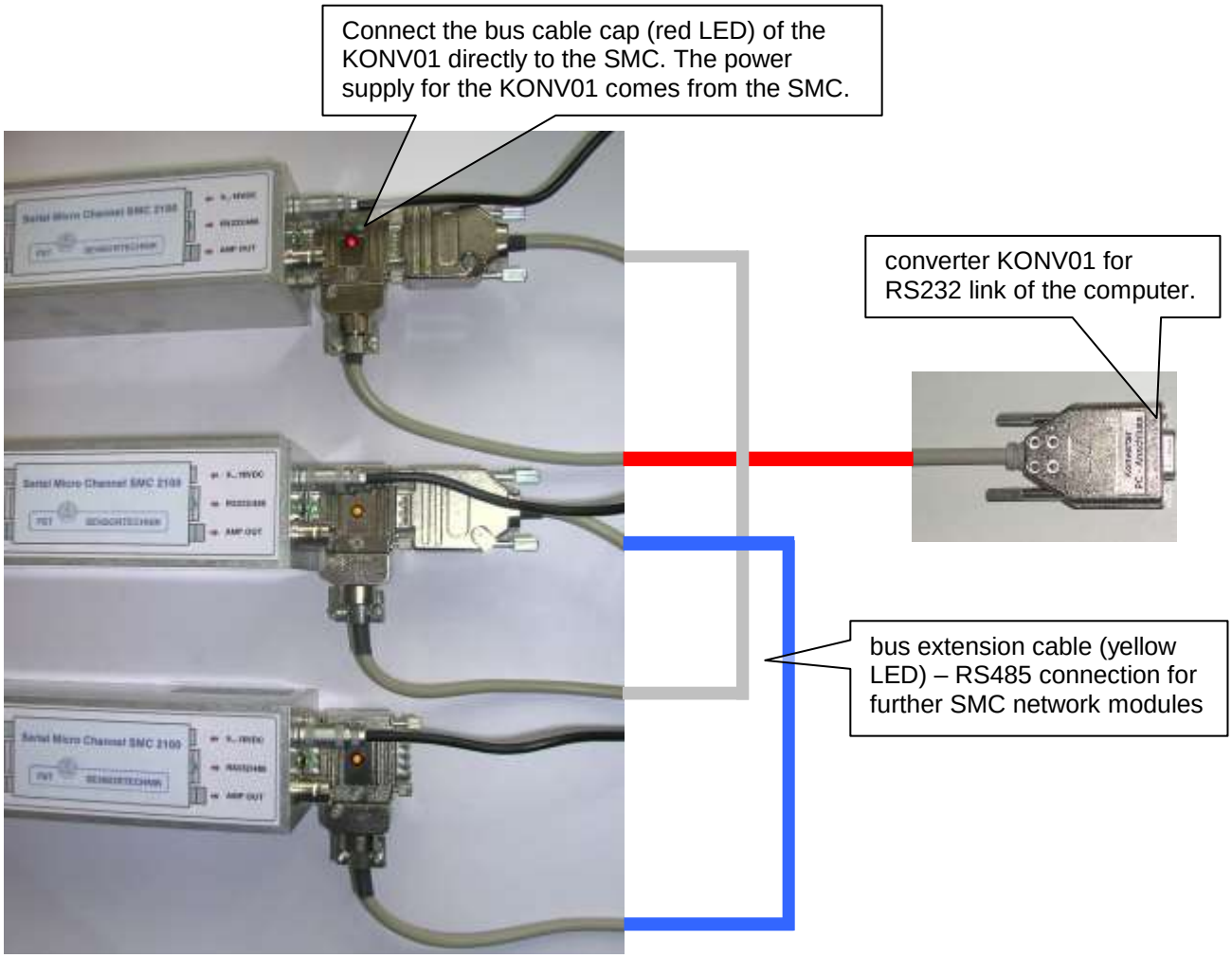


The 12 VDC power supply is lead to the 6-pole Lemo plug and can be used externally up to a current of 0,5 A.

The complete technical data for the opto-relay can be supplied upon request.

1.10 SMC 2100 – Network Connection

Connection of a network of Serial Micro Channels SMC 2100 to a computer RS232 link via the RS232-RS485 converter of type KONV01



2 Spectroscopy Amplifier

2.1 Functional Instructions

The amplifier of the Serial Micro Channel SMC 2100 consists of a spectroscopical signal path and a fast inspection path.
The spectroscopical signal path of the amplifier is intended for the gain of the detector-preamplifier signal, for the differentiation as well as for the Gaussian signal shaping and the provision of the output signals of the amplifier. The inspection path is intended for the controlling of the baseline restorer (BLR) and the Pile-Up recognition. The amplifier output can be used as SCA input.

Application: **Serial Micro Channel SMC / MCA / DS / QS / DA** (complete functional range)
Serial Micro Channel SMC / DC (with fixed gain steps)
Serial Micro Channel SMC / DD / AK (BLR, pulse shaping, gain)

2.2 Specific Requirements

Pole Zero Compensation

For the accurate function of the spectroscopy amplifier, particularly for high pulse rates and big over controls, a pole zero compensation is necessary. The pole zero compensation is a method to avoid oscillations below the baseline of the signal pulses after the differentiation in the spectroscopical signal line.
The adjustment range of the pole zero compensation (corresponds to the range of the fall time constant of the detector preamplifier) covers for the shaping time T0 the range from 4 µs till infinite.
The Serial Micro Channel SMC 2100 is pre-adjusted to about 10 µs fall time constant. An accurate adjustment is necessary only for high pulse rates and big over controls.

The pole zero compensation is carried out as follows:

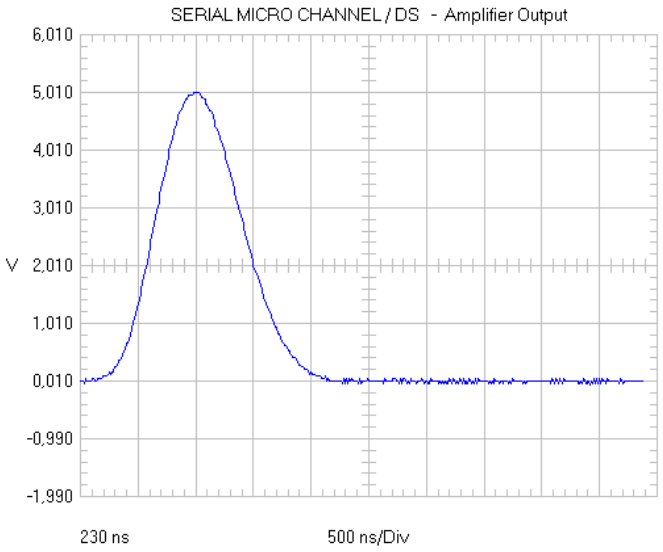
1. Connect an oscilloscope to the amplifier output XH1 of the Serial Micro Channel SMC 2100.

2. Connect the detector to the Serial Micro Channel SMC 2100. Select the parameters in such a way that the amplitude at the amplifier output XH2 amounts to about 2 till 4 V.

3.Adjust the radiation source in such a way that about 1 till 50 $x10^3$ cps reach the amplifier input of the Serial Micro Channel SMC 2100.

4. Adjust the turn-potentiometer Rv1 (take away the side panel, see Manual 1.3, Connection and Adjustment Elements) in such a way that the falling pulse line leads in the baselinewithout oscillations under or above this line, as shown on the following figure:

Signal shape of the amplifier output



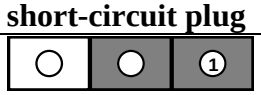
Inspection Line – VALID pulses

The inspection line of the amplifier serves for the pile-up recognition and provides with the VALID pulse that the following DUAL SCA (QUAD SCA) in operational mode SCA-VALID only triggers upon pulses without pile-up.
Only VALID signals are produced at the amplifier output to trigger the DUAL SCA with pulse heights from 0,1 V upwards.
For pulse heights at the amplifier output less then 0,1 V no VALID signals will be produced to trigger the DUAL SCA (See 3.2 Triggering the SCA!).

Amplifier Output – SCA Input

The connector HX1 is operated in the standard mode as Amplifier Output but may be configurated as SCA Input too (See 1.3 Connection and Adjustment Elements!).

<u>Caution:</u> XH 1 only may be used with short-circuit plug XS2/2-3 as SCA Input. The trigger mode of the analyser has to be adjusted via software to Triggering Lower Level.

connector XH1	**short-circuit plug**
Amplifier Output	 XS2 standard
SCA Input	 XS2 option

In this way the counting of external pulses is possible (See 6.2!).

3 Multichannel Analyser

3.1 Functional Instructions

The Multichannel Analyser operates with 2048 channels. All pulses arriving from the spectroscopy amplifier are passing the window of an existing Single Channel Analyser. The window covers a range up to 2048 channels. The range of the MCA can be selected from 1 to 2048 channels.
The analog pulses of the spectroscopy amplifier are digitized by a fast 12 bit ADC to the peak maximum. The recognition of the peak maximum is made in the MCA. The ADC values are stored in the MCA and are normalized upon 2048 channels.

Application: Serial Micro Channel SMC / MCA

3.2 Specific Requirements

Serial Transfer of the Energy Spectrum

The energy spectrum acquired with the MCA, channel number and pulse counts, can be transfered via the serial interface of the SMC 2100. For a fast actualisation of the spectrum on the PC monitor it is possible for example to transfer only each eighth channel without misrepresenting the total counts. At the end of each measurement all channels will be transfered.

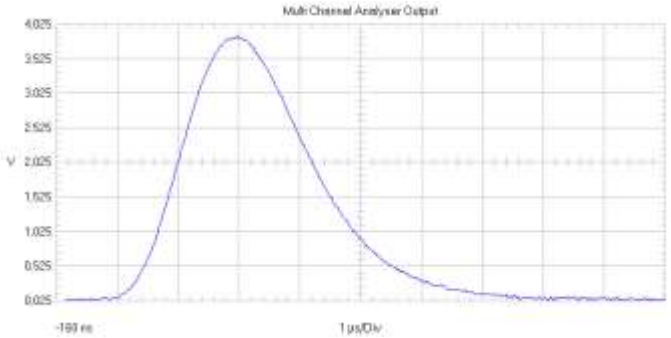
Pole Zero Adjustment

The pole zero adjustment for the spectroscopy amplifier in the SMC/MCA is possible via basic software AM-SMCA01 in the menue basic paramters or with the initial values of the SMC/MAC via the service sofware AM-SMCSERV01.

The pole zero adjustment is carried out as follows:
1. Connect an oscilloscope to the amplifier output XH1 of the Serial Micro Channel SMC 2100.
2. Connect the detector to the Serial Micro Channel SMC 2100. Select the parameters in such a way that the amplitude at the amplifier output XH2 amounts to about 1 till 3 V.
3.Adjust the radiation source in such a way that about 1 till 20 x10^3 cps reach the amplifier input of the Serial Micro Channel SMC 2100.
4. The pole zero adjustment value can be choosen between 0 til 255. The pole zero adjustment value has to be determined in such a way that the falling pulse line leads in the baseline without oscillations under or above this line, as shown on the following figure:

Signal Shaping Multichannel Analyser – Amplifier Output

signal shape amplifier MCA



Adjustment Fast Discriminator

Inside the spectroscopy amplifier of the MCA there operates a fast discriminator which recognizes in the amplifier´s inspection line peaks and pile-up events. This discriminator level is adjustable in a range from 1 till 255, settable as parammeter in the initial values „Fast Discriminator“. For most of the applications the threshold is already adjusted in the company before delivery.

3.3 MCA / SCA - Mode

With the PC software AM-SMCA01 and with its option MCA one can operate in two different modes.
In the pulse height analysis mode of the software AM-SMCA01 the MCA function is active, e.g., a 2048 channels MCA spectra is acquired. The count range each channel is maximum 2^{24} pulses. The time pre-selection starts from 200ms upto 36,4 hours. The average (AVG) mode offers an indefinite measurement with the storage of interim spectra.

In the start-stop measurement of the PC software AM-SMCA01 the counting mode is active, e.g., no spectra will be acquired, only pulses are counted. The advantage of this mode is that higher count rates can be processed. The counting range is upto 2^{32} pulses. The time pre-selection starts from 200ms upto 36,4 hours. A maximum of 65500 single measurements can be acquired in one series.

4 Single Channel Analyser

4.1 Functional Instructions

The **D**ual **S**ingle **C**hannel **A**nalyser is intended for the amplitude selection of the amplifier output signals. The DUAL SCA generates 2 analyser windows. The comparator thresholds of these windows are generated by a 4 x 12 bit DAC in the range of 0 to 5,0 V.
The operational mode “discriminator” allows the measurement of all pulses which are passed over the Lower Level without an analyser upper limit.
The discriminator level in the versions SMC / DD / DC / AK is set by the controller with a 8 bit resolution in the range from 0 till 2,5 V.

Application: **Serial Micro Channel SMC / DS / QS / DA / MCA**
Serial Micro Channel SMC / DD / DC / AK (only discriminator SCA LL)

4.2 Specific Requirements

The DUAL SCA of the Serial Micro Channel SMC 2100 can be operated in the two modes Discriminator or Analyser. The change from Discriminator to Analyser is set by software. In the discriminator mode all pulses are evaluated which are above the lower level LL. In the analyser mode pulses are evaluated which are between the lower level LL and the upper level UL.

Triggering SCA VALID / SCA LL

SCA VALID: The triggering is made at the peak maximum of the amplifier output signal. In this triggermode the SCA works with a low dead time, as the SCA only triggers on pulses without Pile-Up.
Standard version for SMC/MCA/DS/QS/DA

SCA LL: The triggering is made on the falling edge of the amplifier output signal on the Lower Level LL. The SCA output signal is generated on the Lower Level.
Standard version for SMC/DD/DC/AK

5 High Voltage Power Supply

5.1 Functional Instructions

The functional group of the basic module supplies all connectable radiation detectors with a detector high voltage of extremly high stability and a very small ripple. The high voltage power supply is protected against permament overloading and short-circuit.
The high voltage is controlled upwards with a slow rise to the preset value. After switch-off, the high voltage is controlled downwards with the same speed to the final value of 1 V. The adjustment of the high voltage setting point is made by software.

5.2 Specific Requirements

Polarity

Please state the requested polarity of the high voltage together with the order. According to the application of the module the requested polarity of the high voltage can be set.

Change of Detector

Remark: The detector should be changed only when the Serial Micro Channel SMC 2100 is switched off. Please take care before switching off the SMC 2100 that the high voltag supply will be shut down.

6 Counter-Timer Unit

6.1 Functional Instructions

The counter-timer unit is intended for the counting of pulses generated by the MCA, the Single Channel Analyser, Double SCA (DS), Quadruple SCA (QS/DA), Double Discriminator (DD), Discriminator (DC), Anti-Coincidence/Coincidence (AK) and Current-to-Frequency converters (IFI/IFP). The counter-timer unit consists of:

1 (one) time counter 16 bit
4 (four) pulse counters each 32 bit

6.2 Specific Requirements

Counting of External Pulses – Option for the Variations DS, QS, DA

The counting of external pulses with TTL shape is possible in such a way that the to be counted pulses will be joint to the connector XH1 of the Serial Micro Channel SMC 2100. The levels of the SCA has to be set according to the amplitude of the external pulses (but not more than 5 V). In the standard version the connector XH1 is operated as amplifier output, but it can be configurated as SCA input as well when external pulses are to be counted (See 6.2 Amplifier Output – SCA Input and 1.3 Connection and Adjustment Elements!).

7 Preamplifier-Amplifier-Discriminator (PAD)

7.1 Functional Instructions

The charge-sensitive preamplifier with a high voltage filter circuitry for the voltage coupling and signal decoupling is used for the direct supply to radiation detectors, such as for example Geiger-Müller tubes, proportional detectors, and plastic scintillation probes).

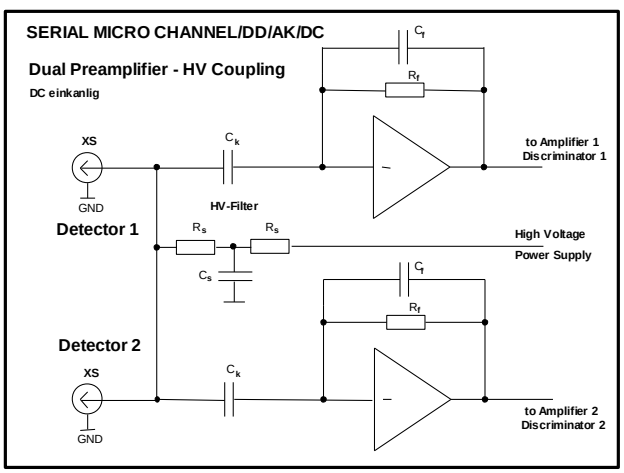
***P*reamplifier and high voltage coupling together with the *A*mplifier and the *D*iscriminator are one unit (PAD). This unit has a dual structure and is carried out in the version Serial Micro Channel SMC / DD / AK (Double or Dual PAD).** The four discriminator levels are adjustable by software.

Application: **Serial Micro Channel SMC / DD / DC / AK**

7.2 Specific Requirements

The following block diagram shows - for detector 1 only - the preamplifier input with high voltage coupling and signal output of the Serial Micro Channel SMC / DD / DC / AK.

Detector Input of the DUAL PAD



Discriminator Level DUAL PAD

The both discriminator levels (SCA LL1/2) of the DUAL PAD will be adjusted by the controller with a 8 bit resolution in a range from 0 till 2,5 V.

8 Current-to-Frequency Converter

8.1 Functional Instructions

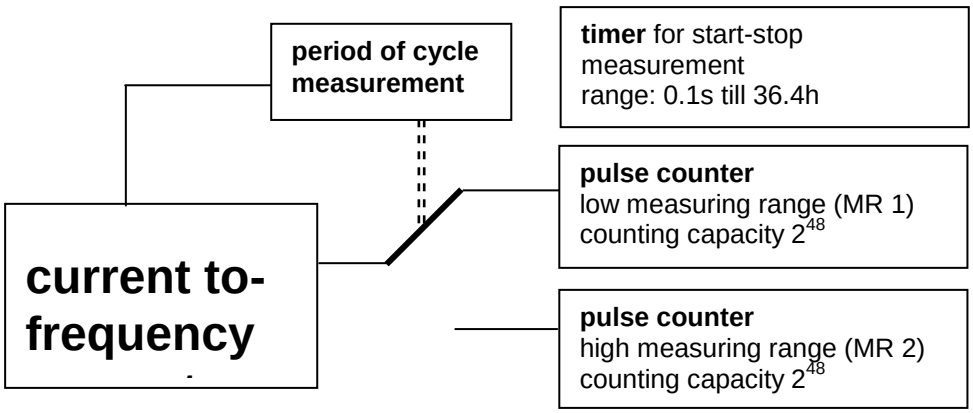
For the application of a current-to-frequency converter the serial Micro Channel SMC 2100 / IFI can be connected to an ionisation chamber. The measuring range covers 10,5 decades from 0,05 pA up to 1 mA.

The I/F converter is used to convert the current of an ionisation chamber or a photomultiplier tube into a direct proportional frequency.

8.2 Functional Instructions I/F I

The **I/F I** converter is used for gamma, beta, and neutron ionisation chambers covering a measuring range of 10,5 decades with two overlapping regions.

The hardware/firmware part has the following structure:



Automatic selection of measuring range:

Settings for switch over:
from low (MR1) to high measuring range (MR2): 80 nA
from high (MR2) to low measuring range(MR1): 40 nA

The current-to-frequency converter operates with two measuring ranges (MR 1 and MR 2) to transform an input current from 50fA till 1mA (10½ decades) into an output frequency from 0.0125Hz till 100kHz, direct and linear proportional to the current.

The switch over between the both measuring ranges (MR 1and MB 2) is done automatically.

As criteria for the switch over a period of cycle measurement of the output frequency of the current-to-frequency converter is used. Caused by the system, the minimum measuring time for a period of cycle measurement is about 800µs. To even out the deviations of the output frequency due to radiation, a mean value is continuously calculated taking the three latest measured values of the running period of cycle measurements.

Reaching an output frequency of 20kHz (at 80nA = 8Hz related to MR 2) in the low current measuring range (MR 1) it switches over to the high current measuring range (MR 2).

Coming from the high current measuring range (MR 2) and reaching an output frequency of 4Hz (at 40nA = 10kHz related to MR 1) it switches back to the low current measuring range (MR 1).

As a result a sufficient large hysteresis between both settings for switch over is generated.

Due to the switch over the output pulses of the current-to-frequency converter will be lined to the correspondent pulse counter for MR 1 or MR 2. Each pulse in the high current measuring range (MR 2) is rated like 2500 pulses in the low current measuring range (MR 1).

When switching over between the both measuring ranges the measurement will be interrupted for 1ms (for both pulse counters as well as for the timer).

8.3 Functional Instructions I/F P

The **I/F P** converter is used for photomultiplier tubes. The measuring range covers 5 decades in one region.

Application: **Serial Micro Channel SMC / IFI / IFP**

9 Anti-Coincidence/Coincidence Logic

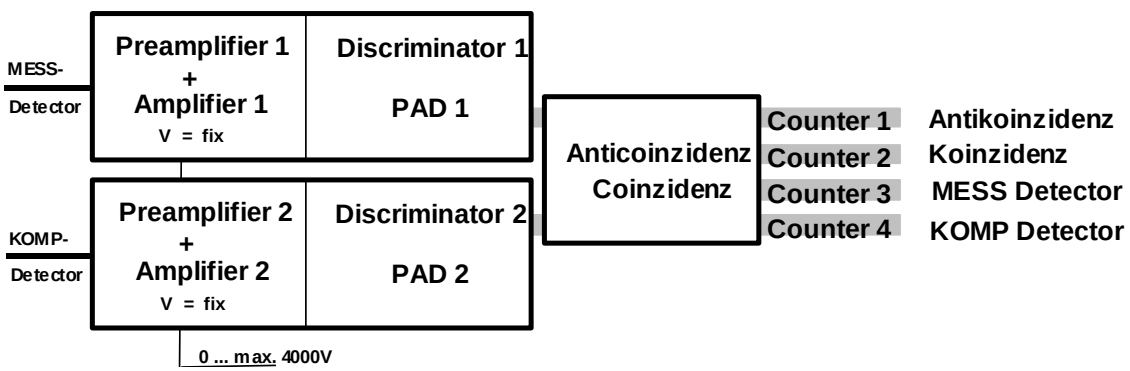
9.1 Functional Instructions

The module anti-coincidence/coincidence links the output signals of the dual module ***P***reamplifier-***A***mplifier-***D***iscriminator (DUAL PAD). The module generates pulses if both output signals PAD1 and PAD2 meet in a certain time gap (coincidence) or rather not (anti-coincidence).
By this method the signals coming from a measuring detector **MESS** and the signals coming from a guard or compensation detector **KOMP** can be related to its generating events.
By means of this structure 2 detectors can be connected to one Serial Micro Channel SMC / AK.
The connection to each detectors is made by a SHV or BNC-HT connector.

Application: **Serial Micro Channel SMC / AK**

Anti-Coincidence	**Counter 1**
Coincidence	**Counter 2**
MESS detector	**Counter 3**
KOMP detector	**Counter 4**

Block Diagram of the AK - Counters



10 Interfaces

10.1 Serial Interfaces

Two serial asynchronous interfaces are available for the user on the Serial Micro Channel SMC 2100. The interfaces operate with the parameters 8 bit, even parity, 1 stop bit, 38400 baud. The working together with the Serial Micro Channel SMC 2100 is organized by means of a binary listing.

The description of the instructions are optionally available for the user to integrate the devices into his own software.

Network Operation

for the operation of serveral devices on one bus **interface type RS485** as two-wire circuit (half duplex!)

Single Device Operation

for the operation as single device **interface type RS232** as three-wire circuit ("half-duplex: one instruction - one reply")

10.2 Extended Hardware Interface

The extended analog and digital hardware interface consists of the following units:

LCD - Terminal

LC matrix display for internal or external connection, 0,5 m cable length for external connection

LED - Terminal

4x LED for signalisation of status information

Relays with 2 floating contacts

4x relays with 2 floating contacts each for use in an external systems

Optocoupler input

2x digital optocoupled input

Analog input Voltage/Current

for measurement with 12 bit resolution of analog voltage and analog current input from external devices

Digital input/output

2x 8 Bit digital ouput and 2x 8 Bit digital input.

Analog input/output U / I

2x analog input with measurement of voltage U and measurement of current I.
2x analog output from SMC 2100 with voltage U and with current I.

11 Technical Data

11.1 Spectroscopy Amplifier

Input: positive pulse input from 0 to 5 V from detector/preamplifier
input impedance 1 kOhm,
fall time 4 µs up to infinite,
rise time 10 ns to 500 ns,
BNC connector according to AEC NIM standard

Output: positive pulse linear from 0 to 5 V,
BNC connector,
output impedance 50 Ohm, short-circuit proof
optional with plug XS2/2-3 as SCA input configurable

Gain: continuously adjustable from 1x to 250x in steps of 1 (SMC/MCA/DS/QS/DA)
continuously adjustable from 50x to 250x in steps of 1 (SMC/DD/DC/AK)

Pulse shaping: Gaussian shaping,
pulse width approximately 2,5x peak time (all amplifier)

Shaping time: T = 1,0 µs peak time (all amplifier),
T = 3,0 µs peak time for MCA

Integral non-linearity: ≤ 0,1 %

Gain stability: ≤ 0,01 %

Baseline restorer: gated active baseline restore.

Baseline temperature drift: < 20 µV/K

Noise: ≤ 30 µV RMS in relation to the amplifier input

11.2 Multichannel Analyser

Channels: 2048 channels, adjustable by software

Channel range: Single Channel Analyser, window width till 2048 channels in steps of 1 adjustable,
minimum 5 channels window width, adjustable by software.

Count rate: approx. 50´000 cps with dead time,
dead time on/off switchable by software

Counts per channel: max. 2^{32} pulses

Time preset: from 200 ms up to 36,4 h, adjustable by software

11.3 Single Channel Analyser

Lower/Upper Level: 0 till 5 V with resolution of 12 bit (SMC/MCA/DS/QS/DA)

Lower Level: 0.till 2,5 V with resolution of 8 bit (SMC/DD/DC/AK)

Integral non-linearity: ≤ 0,05 % (SMC/MCA/DS/QS/DA)

Threshold stability: ≤ 0,005 % / K (SMC/DS/QS/DA)

Pulse pair resolution: ≤ 300 ns (SMC/DS/QS/DA)

SCA input: amplifier output can be configurated with short-circuit plug XS2/2-3
and XS4 as SCA input, input level 0 till 5 V

SCA output signal: TTL pulse H-L-H, active low, pulse width approx. 200 ns

Discriminator output: TTL pulse H-L-H, active low, pulse width approx.1µs (SMC/DD/DC/AK)

Trigger mode: selection by software possible

SCA VALID triggering at time of the peak maximum
SCA LL triggering on the falling edge on Lower Level (option)

11.4 High Voltage Power Supply

Output voltage: 0 till +2000 V (4000 V optional),
continuously adjustable by software in steps of 1 V

Output current: ≤ 0,50 mA in the range from 0 V till 1500 V
≤ 0,25 mA in the range from 1500 V till 2000 V,
short-circuit proof

Rise of high voltage: approx. 200 V/s

Ripple: ≤ 70 mV (peak to peak)

Stability: ≤ 0,01 % / 24 h,
≤ 0,005 % / K,
≤ 0,01 % at load alteration 90%

Integral non-linearity: ≤ 0,05 %

Output HVPS.: high voltage coax-plug, series SHV or BNC-HT
plug according to AEC NIM standard or Siemens standard

High voltage polarity: positive / negative, depending on the module
HV2000X/DAC / HV4000X/DAC

11.5 Micro Controller – Counter-Timer Unit

Micro controller: 16 bit micro controller

Memory size: RAM 128 k Byte,
data logger function as option

Interfaces: serial interface RS232 and
serial interface RS485, network ability up to 126 subscribers

Time preset: from 200 ms up to 36,4 h

Pulse counter: separated counting channels with maximum
2^{32}-1 pulse counts each with time preset
2^{16}-1 pulse counts each with puls preset
(maximum 4 separated counting channels)

Maximum count rate: 3 MHz

Measured value output: counts and measuring time for each channel

Option: external start/stop signal

11.6 Preamplifier

Charge sensitivity: 0,7 V/pC charge coupled with low-noise FET

Rise time: < 40 ns

High voltage filter: 10 MOhm / 3,3 nF (1,2 nF) 2000 V (4000 V)

High voltage coupling capacitor: 3,3 nF (1,2 nF)

11.7 I/F I Converter

Input signal: negative dc current

Input current range: 0,05 pA till 1,0 mA, 10,5 decades

Range 1: 0,05 pA till 100 nA
Output frequency: 0,0125 Hz till 25 kHz
Sensitivity: 0,25 Hz / 1,0 pA

Range 2: 10 nA till 1,0 mA
Output frequency: 1,0 Hz till 100 kHz
Sensitivity: 100 Hz / 1,0 µA

Non-linearity: < 10 % in the range 0,05 pA till 0,1 pA
< 5 % in the range 0,1 pA till 10 pA
< 1 % in the range10 pA till 1,0 mA

Settings for switch over: from MR1 to MR2 at 80 nA
from MR2 to MR1 at 40 nA

Switch between 2 ranges: automatical with firmware

11.8 I/F P Converter

Input signal: negative dc current

Input current range: 20 pA till 2,0 µA, 5 decades

Output frequency: 1,0 Hz till 100 kHz

Sensitivity: 1 Hz / 20 pA

11.9 Anti-Coincidence/Coincidence Logic

Input signals: TTL active low MESS detector
TTL active low KOMP detector

Time range for anti-co/coincidence: 2 µs till 16 µs, adjustable

Output signals:

TTL, active low, anti-coincidenc	counter 1
TTL, active low, coincidenc	counter 2
TTL, active low, MESS	detector counter 3
TTL, active low, KOMP	detector counter 4

11.10 Electrical and Mechanical Connection Requirements

Power supply: mains adapter power pack, 4,5 till 9 V DC,
9 till 18 V DC or 18 till 36V DC

High voltage output: SHV connector according to AEC NIM standard or
BNC-HT according to Siemens standard

Amplifier input: BNC connector

Amplifier output: BNC connector

Serial interface: 9 pole SUB-D-connector for RS232 or RS485

Preamplifier power supply: 9-pole SUB-D-connector according to
AEC NIM or Siemens standard
for the connection to any charge-sensitive preamplifier

PIN 1,2	GND
PIN 4	+12 V / 40 mA
PIN 9	–12 V / 40 mA

Optinon ± 24 VDC

Dimensions:	HF tight metal housing 140 mm x 60 mm x 45 mm

11.11 Serial Interfaces

Serial interface:	RS232 as 3-wire, half-dublex, single user RS485 as 2-wire, half-dublex, network user
Rate:	38400 baud
Interface parameters:	8 bit, even parity, 1 stop bit, binary protocol

11.12 Extended Hardware Interface

LC-display:	alphanumeric matrix-display with / without backlight, with external connection cable, length maximum 1 m
LED-display:	maximum 4x LED with Ø = 8 mm, red / green / yellow
Relay:	maximum 4 relays, with 2 floating contacts each, contact burden max. 150 V / 0,5 A
Optocoupler input:	maximum 2 optocoupled digital inputs
Analog input:	2x voltage input 0 till 2,5 V, with 12 bit accuracy 2x current input 0 till 20 mA, with 12 bit accuracy
Analog ouput:	2x voltage output 0 till 4,096 V, with 12 bit accuracy 2x current input 0 till 20 mA, with 12 bit accuracy
Digital input:	8x TTL-Input 8x V24-Input with range of ± 20 V
Digital output:	8x TTL-Ouput with 10 TTL 8x open drain with current max. 350 mA

12 Software

The program package AM-SMCA01 is available with serveral options, depending on the purpose of applications and the connected hardwares.

The following program options are available:

Program Option	**name**	**explanation**
basic version	AM-SMCA01	configuration and data acquisition software for SMC modules under Windows 98/ME/NT/2000/XP/7-10 for one unit SMC 2100
network option	AM-SMCA01/Netz	network function for the application of up to 16 units SMC 2100
MCA option	AM-SMCA01/MCA	special data acquisition and evaluation for SMC/MCA (Multichannel Analyser). It can be operated in a network with other SMC 2100 or as single unit.
WKP option	AM-SMCA01/WKP	software for repetitive measurements, controlling the device function by comparision the results with the reference values and parameters

For the configuration of initial parameters in a stand alone operated Serial Micro Channel SMC 2100 we offer the user a PC-software:

Program	**name**	**explanation**
service software	AM-SMCSERV01	software to configurate and to save initial parameters in all variations of SMC 2100 under Microsoft Windows 98/ME/NT/2000/XP/7-10 application for stand alone operated SMC 2100