Technical Document
User's Manual

Version 1.0.0

Park INNOVAARE: deliveryLAB
5234 Villigen, Switzerland
Mail: info@sensic.ch
Web: www.sensic.ch

Contents

1 Safety Information

Thank you for purchasing this product.

Before using, read this user manual to ensure correct usage through understanding. After reading, store them in a safe place for future reference. Incorrect handling of this product could result in personal injury or physical damage. *SenSiC GmbH* assumes no responsibility for any damage caused by mishandling that is beyond normal usage defined in these manuals of this product. Moreover, *SenSiC GmbH* reserves the right to change partially or entirely the contents of this manual at any time and without giving any notice. The manufacturer assumes no responsibility for any errors that may appear in this manual.

 **WARNINGS**

- Do not open the boxes in any manner, *SenSiC GmbH* decline all responsibility.
- Do not use this product in any manner not specified by the present document.
- Do not operate the device around explosive gas, vapor, or outdoor environments. This product is designed for indoor use.
- Do not substitute parts or perform any modification to the product.
- Do not use the device if it is damaged. Return it to the manufacturer for service and repair.
- Do not trash this product on municipal waste, check your local regulations.

2 Introduction

In this chapter the general characteristics and main features of the PCR4 4-Channel Bipolar Picoammeter are described.

2.1 General description

The PCR4 picoammeter by SenSiC is a 4-Channel, 24-bit resolution, wide-bandwidth, wide input dynamic range picoammeter with an integrated bias voltage source up to $\pm$ 20 [V], in his first version.

The device is composed of a specially designed trans-impedance input stage for current sensing combined with analog signal conditioning and filtering stages making use of state-of-the-art electronics. This device can perform bipolar current measurements from $\pm$ 25 [nA] (with a nominal resolution of about 3 [fA]) up to $\pm$ 50 [mA] (with a nominal resolution of 6 [nA]) with a sampling frequency of 53 [kHz] (for 4 channel at 24-bit resolution). Low-temperature drifts, good linearity, and low noise levels enable users to perform high-precision current measurements.
Communication is guaranteed by a standard 1000 Mbps Ethernet TCP/IP protocol, commands can be sent directly (see sec.3) or through EPICS modules (`https://github.com/epics-modules/quadEM`).

The PCR4 picoammeter is specifically designed for applications requiring high speed digital multichannel low-current measurements, a typical application being the currents readout of 4-quadrant photodiodes used for realtime monitoring of X-ray beams in synchrotrons and Free Electron Lasers (XFELs)

2.2 Front and Rear I/O Connectors

The front and rear panels of the PCR4 can be easily seen in Fig. 1 and 2.

Figure 1: Front view of the PCR4

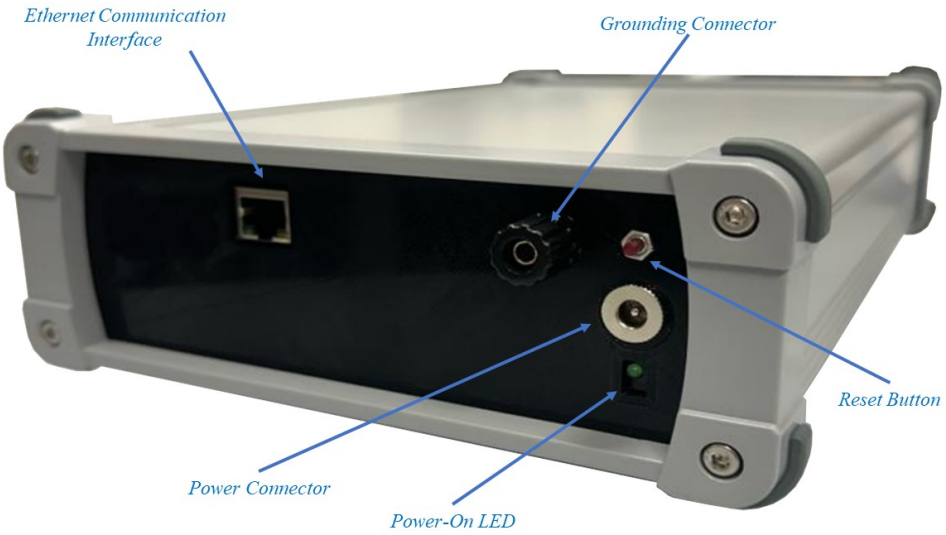


Figure 2: Rear view of the PCR4

The front side of the PCR4 is composed of four analog BNC current input

connectors for current measurements, one Bias Voltage BNC output connector for supplying up to $\pm$ 20 *V*, two I/O Lemo connectors for input and output triggering, left for input and right for output (the output trigger is not used yet and it is reserved for future use), and three Status LEDs.

Each LED has a specific color that defines the normal operation of the PCR4. In particular:

- the *Green LED*, positioned at the bottom, defines when the PCR4 is ready to accept commands. On power-on this LED is initially off and will only light up when the software is loaded in the CPU.
- the *Orange LED*, positioned at the center, lights up when PCR4 acquires the input currents. When the acquiring command is sent (*"ACQC:START\r\n"*, see sez. 3) the LED will light up, and when the stop acquiring command is sent (*"ACQC:STOP\r\n"*, see sez. 3) the LED will turn off
- the *Red LED*, positioned at the top, defines the Bias Voltage output state. If the LED is on it means that the output is enabled, if it is off it means that the output is disabled

The rear side of the PCR4 is composed of a power connector, a reset push button, a standard RJ45 Ethernet connector, a grounding connector, and a power-on status LED. The *Green LED* light up at the power-up of the PCR4.

2.3 Current ranges

The PCR4 input stage, the analog stage, is based on four inverting trans-impedance amplifiers (I/V converter), cascaded with particular signal conditioning stages, the main one being a filtering stage. This limits the analog bandwidth to less than 700[Hz] in order to minimize noises and ensure greater accuracy and stability of the measurement currents.

For a large application flexibility, four standard measuring ranges are available. Table 1 shows the four available ranges with their respective characteristics. The choice of the gain is made through a specific command that sets the respective trans-impedance gain. To set the desired gain you need to connect the PCR4 to a host PC (for a complete description of the commands refer to sec. 3).

	Full Scale	Resolution (LSB)
RNG 0	$\pm$ 50 *mA*	6 *nA*
RNG 1	$\pm$ 250 μ*A*	30 *pA*
RNG 2	$\pm$ 2.5 μ*A*	300 *fA*
RNG 3	$\pm$ 25 *nA*	3 *fA*

Table 1: **PCR4 Current ranges**

2.4 Bias Voltage

The PCR4 is provided with a low-noise integrated Low-Voltage (LV) bias voltage, full bipolar rated at $\pm$ 20 [V]. The digital interface allows setting remotely the set point of the bias voltage source. Its value is settable by suitable software commands that will be better described in the following section.

This bias source is perfectly suited to be used as the bias voltage for the detecting system, when necessary, in order to increase the signal value (and thus to increase the signal-to-noise ratio). Please note that the bias source output is referred to the PCR4 ground (i.e. the BNC connector outer shield). When the Bias Voltage is OFF, the PCR4 shorts the output to the internal ground.

The traffic light style LED (*Red LED*), placed on the front panel acts as a status indicator for the bias voltage source: it is ON when the voltage output is enabled, and it is OFF when the voltage output is disabled.

2.5 Data Format and Sampling Frequency

The acquired data from the PCR4 unit are transmitted in ASCII format. This data stream is represented as strings in normalized scientific notation with a fixed length.

The internal sampling frequency for each channel is fixed to 53 kHz – i.e. 53 ksps. In the standard operation, an averaging of the sampled data is performed to reduce the transmission rate and high-frequency noise and increase the signal-to-noise ratio. The time window in which the samples are mediated can be modified using a specific command but with a minimum and maximum limit.

3 Software Command

This section describes the commands to use and configure the PCR4 correctly.

3.1 Syntax

Commands should be transmitted in ASCII format and consist of a "*command field*" and zero, one, or two "*setting fields*," separated by a colon (':'). The quantity of the "*setting fields*" depends on the specific command. Commands are case-sensitive, and thus, the command string must be sent using uppercase characters. Each instruction should conclude with a 'carriage return line feed' sequence "\r \n".

Example:

ACQC:START\r \n

where "**ACQC**" is the command field, "**:**" is the colon separator, "**START**" is the setting fields and "**\r \n**" is the carriage return line.

The PCR4 processes the commands individually. Once a command is sent, the user must wait for the requested action to be completed. For the user, to recognize the end of the action, upon completion of each command, the PCR4 sends a reply to the user. The response from the PCR4 depends on the type of command sent. Generally, the answers can be of three types:

- **ACK**: Acknowledgement, means that the sent command is valid and the operation was successfully executed;

- **ERR:XX**: Error, means that there was an error in the command or its execution. The answer is followed by an error code identifying the specific reason, see tab. 3 for more details;

- **General Data**: Generic data on request, such as voltage values, samples used, ranges and more.

3.2 Acquisition Commands

This section describes the commands used to acquire input current data. There are three acquiring commands currently available, and they differ according to how the samples are acquired and sent to the user. The actions carried out by the three acquisition commands are in contrast with each other. If one of the acquiring commands is sent, the process must be stopped to execute a different one. The PCR4 cannot run two or more acquiring commands in parallel.

3.2.1 ACQC

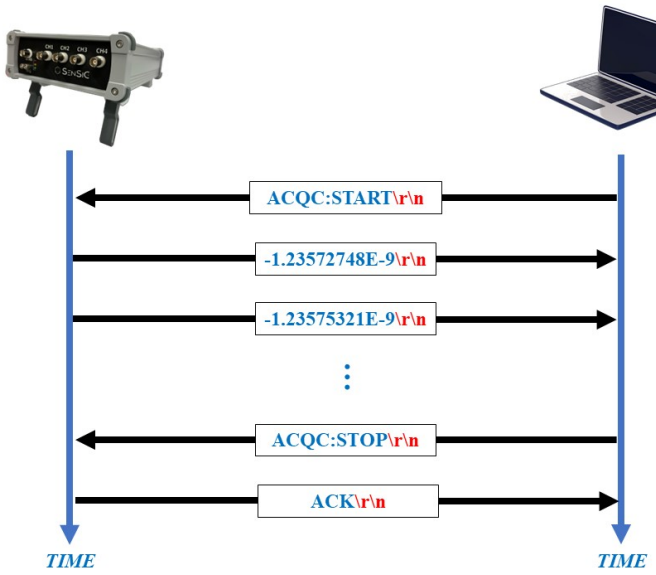
The *ACQC* commands allow the continuous acquisition of enabled channels and their continuous transfer to the user. To interrupt the data output streaming, the continuous end-of-acquisition command must be sent. At power-up, the acquisition is stopped by default. To start the continuous acquisition the command "*ACQC:START\r\n*" is required. After the command is processed, the PCR4 begins to take samples and send them continuously to the connected host. To stop continuous acquisition, the user must send the end-of-acquisition command "*ACQC:STOP\r\n*", and the PCR4 will reply with the acknowledgment "*ACK\r\n* and stop the acquisition.

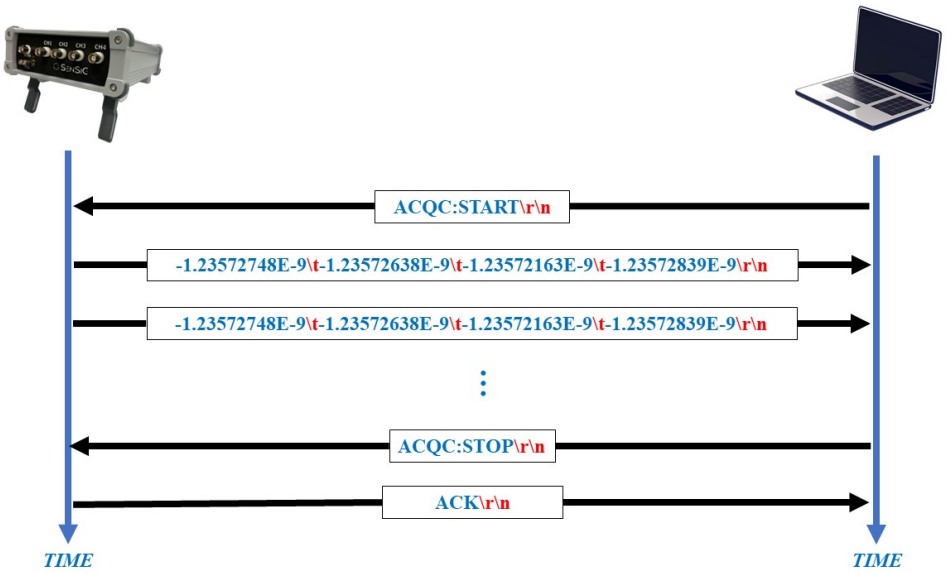
The transmitted data are in ASCII format and the length of the transmitted data depends on the number of channels enabled, see sec. 3.4.2 for more details. The output values are sent as a string in a normalized scientific notation. In this data format, the user can directly read the output stream without any conversion. An example of the used notation:

$$\overbrace{-1.81235642}^{A}\,E\,\overbrace{-09}^{B}$$

where *A*, the coefficient, is a non-zero real number such that the absolute value of A is always between 1 and 10 ($1 \leq |A| < 10$), and *B*, the exponent, is an integer number. Although the length of the data transmitted to the user depends on the number of channels enabled, the sampling frequency remains unchanged. The internal sampling frequency for each channel is fixed to

53 [kHz] – i.e. 53 ksps. Please note that in the standard operation, an averaging of the sampled data is performed to reduce the transmission rate and high-frequency noise and increase the signal-to-noise ratio. The time window in which the samples are mediated can be modified using a specific command but with a minimum and maximum limit, see sec. 3.4.3. Two examples of the *ACQC* command with 1 and 4 channels enabled:

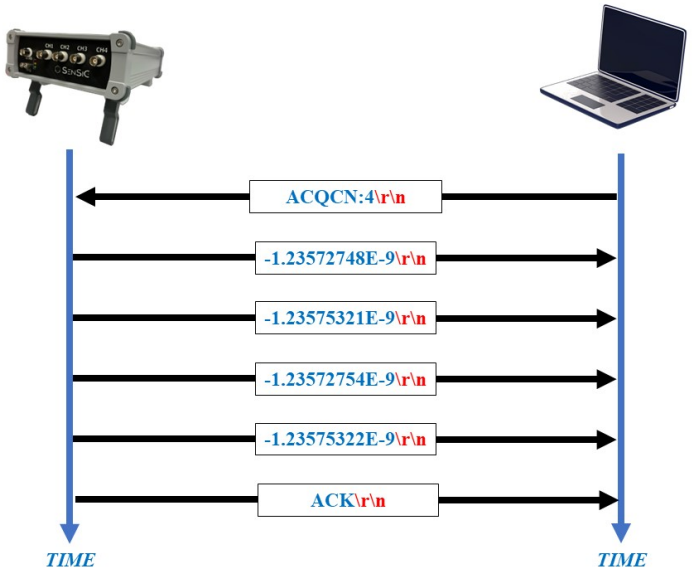




3.2.2 ACQN

Contrary to the continuous acquisition command (*ACQC*), the *ACQCN* command acquires a fixed number of samples transferring the data to the user. Thus, the purpose of the *ACQCN* command is to read a fixed number of samples, chosen by the user, without stopping the acquisition manually. Once all the samples have been transmitted correctly, the acquisition stops and the PCR4 will send the end of the transmission through an acknowledgment response.

As for the *ACQC* command, the transmitted data are in ASCII format and the length of the transmitted data depends on the number of channels enabled, see sec. 3.4.2 for more details, and the output values are sent as a string in a normalized scientific notation.



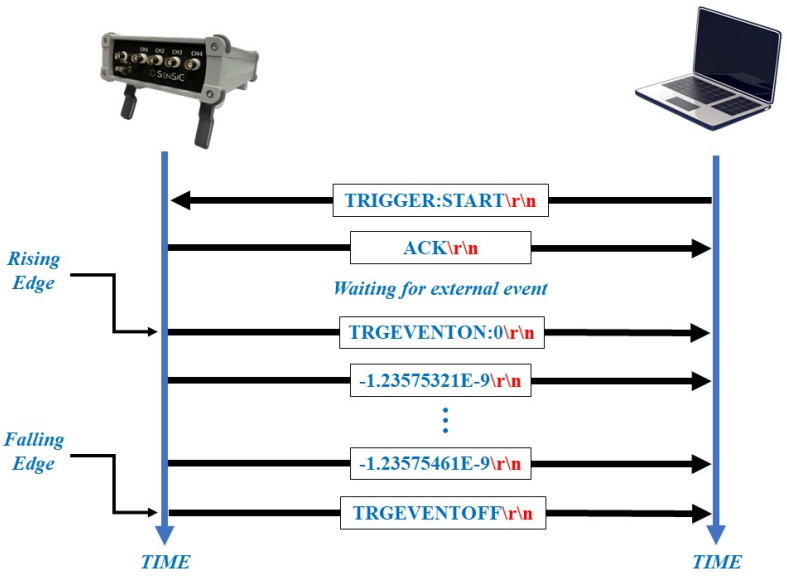
3.2.3 TRIGGER

The *TRIGGER* command, when enabled, synchronizes the acquisition of enabled channels with an external event through the input trigger connector, see sec. 6 for more details. To enable or disable trigger mode the commands are "*TRIGGER:START\r\n*" and "*TRIGGER:STOP\r\n*". **WARNING**, when trigger mode is enabled, the PCR4 is unable to receive any other acquisition commands, like *ACQC* or *ACQCN*. To use other acquisition modes, you must first

disable the trigger mode using "*TRIGGER:STOP\r\n*" command.

Trigger activation can be configured to synchronize with the rising or falling edge of the external trigger signal, see sec. 3.4.5. Assuming therefore to configure the trigger on the rising edge. In this configuration, when the input signal changes polarity and goes from low to the high logical level the PCR4 will begin to acquire and transmit the data to the user until the logical high level is maintained. When the input signal reaches the low logical level, the PCR4 interrupts the acquisition and data transfer. This acquisition mode is kept until the "*TRIGGER:STOP\r\n*" command is sent. Each trigger session has a counter that numbers the trigger events that occurred. It is sent to each start of data transmission through the string *TRGEVENTON:A\r\n*, with A an integer number related to the event counter. The end of data transmission is instead terminated by the end trigger string *TRGEVENTOFF\r\n*.

As for the *ACQC* and *ACQCN* commands, the transmitted data are in ASCII format and the length of the transmitted data depends on the number of channels enabled, see sec. 3.4.2 for more details. An example of the trigger mode with one channel enabled is shown below.



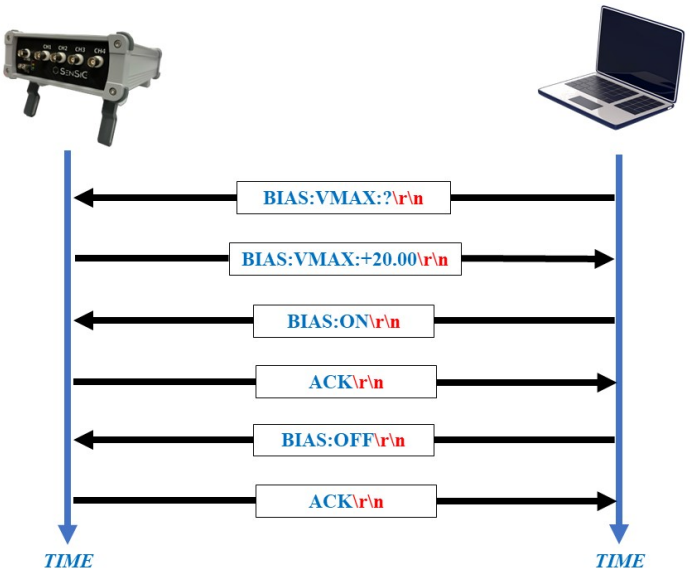
3.3 Bias Voltage Commands

This section describes the commands used to manage the output Bias Voltage. There are three specific commands currently available that are used to enable, disable, set, and read the current state of the bias voltage.

3.3.1 BIAS

The *BIAS* commands enable or disable the Output Bias Voltage. The "*BIAS:ON\r\n*" command enables the Bias Voltage. When it is enabled the voltage will automatically lead to the last set value (by default, on power-on, the output voltage has a zero value, 0 [V]). As described in sec. 2.4, the *Red LED*, placed on the front panel acts as a status indicator for the bias voltage source: it is ON when the voltage output is enabled, and it is OFF when the voltage output is disabled. To disable the Bias Voltage, the "*BIAS:OFF\r\n*" command is required. This command disables the Bias voltage shortening the output to the ground.

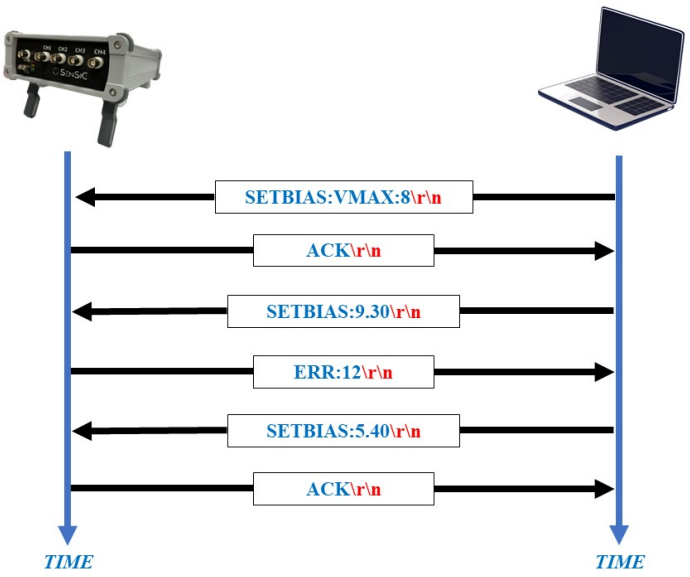
The *BIAS* commands can be also used to check the Voltage limit value by using the "*BIAS:VMAX:?\r\n*" and "*BIAS:VMIN:?\r\n*" commands. See *SET-BIAS* section to find out how to set Voltagelimits. An example of how to use the commands is shown below.



3.3.2 SETBIAS

The *SETBIAS* commands are used to define the output voltage value by sending the "*SETBIAS:V\r\n*" command, where *V* is the desired bias voltage expressed in [V].

The *SETBIAS* commands can be also used to define a maximum and minimum voltage limit, user-defined. It is not possible to set limits that exceed the technical characteristics of the output voltage, in the current version $\pm$20 [V]. Once a limit is set, if the user tries to set a voltage that exceeds them, the PCR4 will reply with an error code, see Tab. 3. In particular, the commands that allow the user to set the limits are "*SETBIAS:VMAX:N\r\n*" and "*SETBIAS:VMIN:N\r\n*", where *N* is the desired voltage limit expressed in [V]. An example of how to use the commands is shown below.



3.3.3 BIASSTATUS

The *BIASSTATUS* commands are used to read the current status of the output voltage by sending the "*BIASSTATUS:?\r\n*" command. If the output is disabled the PCR4 will reply with "*BIASSTATUS:OFF\r\n*", if it is enabled it will reply with "*BIASSTATUS:V\r\n*", where *V* is the value of the current Bias Voltage.

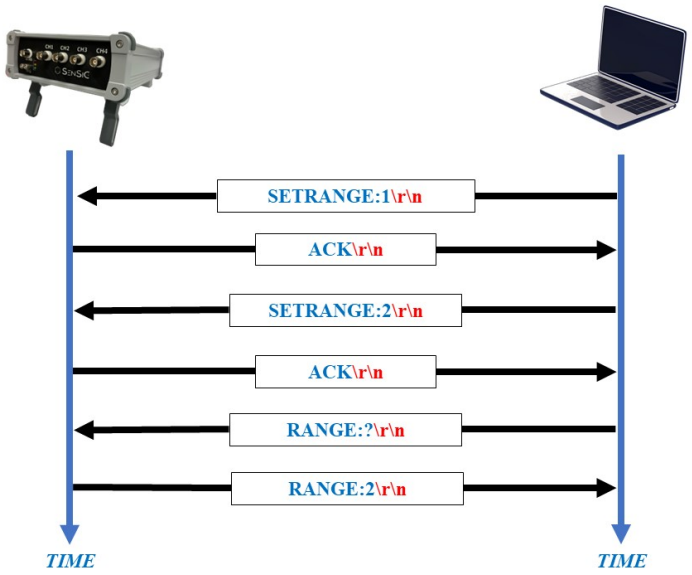
3.4 Configuration Commands

This section describes the configuration commands that are used to read and set the PCR4 to suit the user's needs.

3.4.1 RANGE and SETRANGE

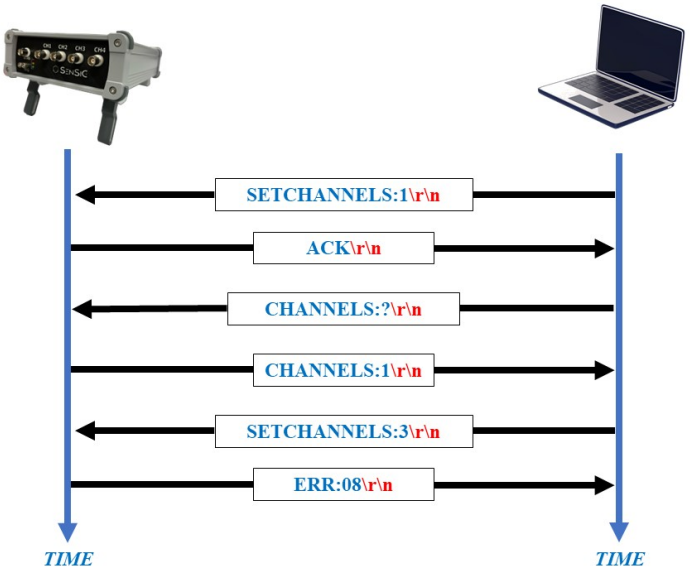
The *RANGE* and *SETRANGE* commands are used to read or configure the trans-impedance gain, indeed are used to set the proper current range of the PCR4. For large application flexibility, the PCR4 can be configured in four standard measuring ranges, as described in sec. 2.3. Table 1 shows the four available ranges with their respective characteristics. At power-on, by default, the preset range is the higher, ± 50 [mA], in order to avoid possible damage. To change the range the command "*SETRANGE:N\r\n*" is used. It simultaneously sets all channels in the desired current range, where *N* is an integer number that identifies the specific current range, see tab. 2 for more details.

Instead, the *RANGE* command is used to read the current range. When "*RANGE:?\r\n*" is transmitted to the PCR4 unit, it replies with "*RANGE:M\r\n*", where *M* is the current range presently set.



3.4.2 CHANNELS and SETCHANNELS

The *CHANNELS* and *SETCHANNELS* commands are used to read or configure the number of active input channels enabled. In particular, the command "*SETCHANNELS:N\r\n*", whit *N* equal to 1, 2 or 4, enable one, two or all the channels of the PCR4. For further details about the configuration see tab. 2. At power-up, by default, all four channels are enabled. Instead the command "*CHANNELS:?\r\n*" is used to read the configuration of the enabled channel. It is important to figure out that the number of channels does not affect the sampling frequency.



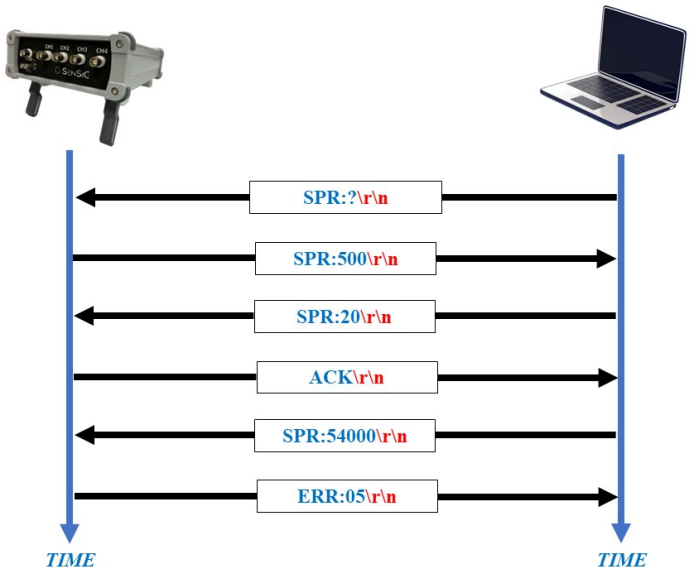
3.4.3 SPR

The *SPR* command is used to define the *"Sample Per Read"* on which the averaging is computed. Each current value that is transmitted during the acquisition is an average value of a time window defined by this parameter. At power-up, by default, the time window is $N = 500$ [samples], so each transmitted value will be the average of 500 samples. Considering the internal sampling frequency of 53 [kHz] final sampling frequency f_{out} will be given by

$$f_{out} = \frac{f_{internal}}{N}$$

To set the desired *"Sample Per Read"* value, the command "*SPR:N\r\n*" is required, where $[1 \leq N \leq 52734]$. Instead, to read the current *SPR* setting

send the "*SPR:?\r\n*" command. Increasing this value affects the quality of the final data but also the signal bandwidth and the transfer speed. **WARNING**, this parameter affects all the capture modes of the PCR4. Before starting any session the user is sent to set this parameter according to their needs. An example is shown below.



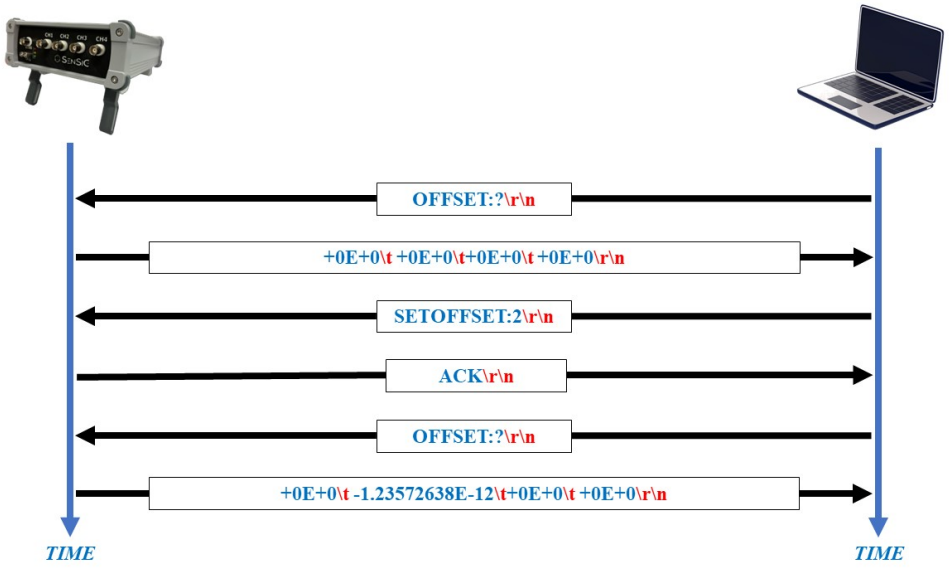
3.4.4 OFFSET and SETOFFSET

The *OFFSET* and *SETOFFSET* commands are used to read or configure a user-defined offset value [A] for each channel. The PCR4 is already calibrated, however for general purpose measurements and for large application flexibility, the user can perform offset correction in order to obtain the desired response from the measurement unit, for example to null the application-related offsets. When the offset correction is enabled the output current value is given by

$$I_{out} = I_{calibrated} + Offset_{user}$$

To define the offset you must use the command "*SETOFFSET:N\r\n*", where *N* is the parameter that identifies the channel in which you want to set, see tab. 2. When the command is sent, the PCR4 will sample the channel for a fixed time window and add the measured offset. However, the measured offset will not be active in subsequent measurements. To activate the offset

you must use the command "*OFFSET:ON\r\n*" to enable offset correction. Instead, to disable it send the "*OFFSET:OFF\r\n*" command. These commands enable or disable the offset in all channels, not in a single one. Finally, to read the current offset stored use "*OFFSET:?\r\n*". For example

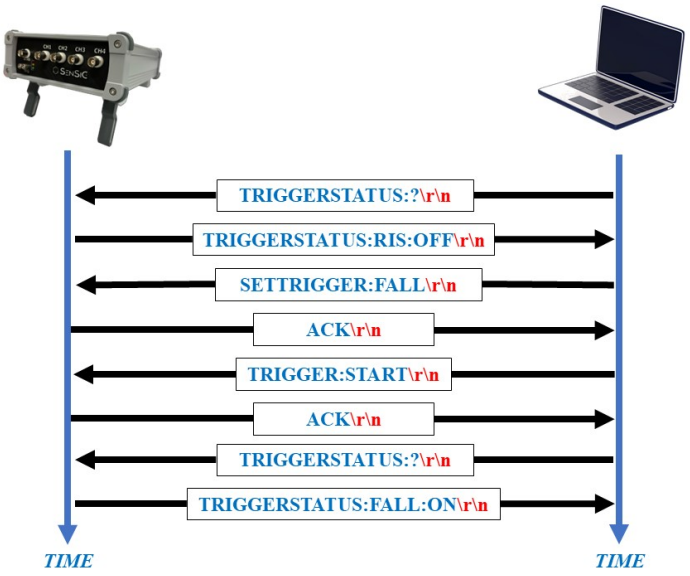


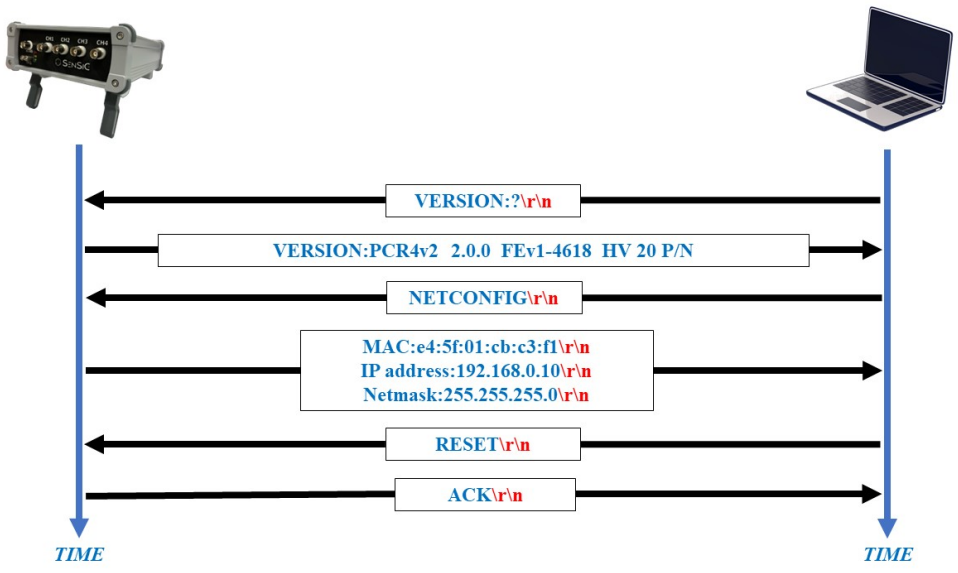
3.4.5 SETTRIGGER and TRIGGERSTATUS

The *SETTRIGGER* and *TRIGGERSTATUS* commands are used to read or configure the trigger acquisition modality. In particular, using the "*SETTRIGGER:N\r\n*" command you can define the trigger to be active in rising edge if *N=RIS* or in the falling edge if *N=FALL*. Instead, using the command "*TRIGGERSTATUS:?\r\n*" the PCR4 will reply with a string indicating the mode (*RIS* or *FALL*) and if it is active or not (*ON* or *OFF*). An example is shown above.

3.4.6 VERSION, NETCONFIG and RESET

To have information about the PCR4 unit the *VERSION* and *NETCONFIG* commands can be used. The "*VERSION:?\r\n*" command gives you information about the PCR4 model, the software version, the Front-End model, and the Bias voltage module. The "*NETCONFIG\r\n*" command returns information about the network configuration, in particular, the *MAC* address and the predefined IP address and Netmask. Instead, the "*RESET\r\n*" command performs the reset of the PCR4, thus re-initializing the unit. For example,


TRIGGERSTATUS:?\r\n
TRIGGERSTATUS:RIS:OFF\r\n
SETTRIGGER:FALL\r\n
ACK\r\n
TRIGGER:START\r\n
ACK\r\n
TRIGGERSTATUS:?\r\n
TRIGGERSTATUS:FALL:ON\r\n
TIME
TIME


VERSION:?\r\n
VERSION:PCR4v2 2.0.0 FEv1-4618 HV 20 P/N
NETCONFIG\r\n
MAC:e4:5f:01:cb:c3:f1\r\n
IP address:192.168.0.10\r\n
Netmask:255.255.255.0\r\n
RESET\r\n
ACK\r\n
TIME
TIME

4 Commands Summary Table

COMMAND	ACTION	PARAMETERS
ACQC:<*par*>	*Start Continuous Acquisition* *Stop Continuous Acquisition*	START STOP
ACQCN:<*par*>	*Acquire a fixed number of sample*	number of samples
BIAS:<*par*>	*Enable Output Bias Voltage* *Disable Output Bias Voltage* *Read the maximum voltage limit* *Read the minimum voltage limit*	ON OFF VMAX:? VMIN:?
BIASSTATUS:<*par*>	*Read the Bias Voltage State*	?
CHANNELS:<*par*>	*Read the number of channels enabled*	?
NETCONFIG	*Read PCR4 network configuration*	
OFFSET:<*par*>	*Enable offset for all channels* *Disable offset for all channels* *Read the offset status of each channel*	ON OFF ?
RANGE:<*par*>	*Read the current range*	?
RESET	*Reset PCR4*	
SETBIAS:<*par*>	*Set the desired output voltage* *Set Bias Voltage upper limit* *Set Bias Voltage lower limit*	$[-20; +20]$ VMAX:[V] VMIN:[V]
SETCHANNELS:<*par*>	*Set channel 1 as a reading channel* *Set channels 1 and 2 as a reading channel* *Set all channels as a reading channel*	1 2 4
SETOFFSET:<*par*>	*Set offset for all channels* *Set offset for channel 1* *Set offset for channel 2* *Set offset for channel 3* *Set offset for channel 4*	0 1 2 3 4
SETRANGE:<*par*>	*Set* $\pm$ 50 *mA current range* *Set* $\pm$ 250 μ*A current range* *Set* $\pm$ 2.5 μ*A current range*	0 1 2

	Set ± 25 nA current range	3
SETTRIGGER:<*par*>	*Set the rising edge for triggering* *Set the falling edge for triggering*	RIS FALL
SPR:<*par*>	*Read the averaging sample* *Set the falling edge for triggering*	? [1; 52734]
TRIGGER:<*par*>	*Start continuous triggered acquisition* *Stop continuous triggered acquisition*	START STOP
TRIGGERSTATUS:<*par*>	*Read the trigger status*	?
VERSION:<*par*>	*Read PCR4 version*	?

Table 2: **Commands Summary**

5 Error Code Summary Table

ERROR CODE	DESCRIPTION
ERR:01	Invalid Command
ERR:02	The number of sample to average exceed the limit
ERR:03	Communication problem with ADC
ERR:04	Channels enabled different from 1, 2 or 4
ERR:05	Number of samples on which to average exceeds the maximum limit (SPR)
ERR:06	Number of samples on which to average exceeds the minimum limit (SPR)
ERR:07	The channel specified don't exist (SETOFFSET)
ERR:08	The channel specified don't exist (SETCHANNEL)
ERR:09	Communication problem with DAC
ERR:10	Internal Bias Out error
ERR:11	Invalid parameter (BIAS:ON/OFF)
ERR:12	Value entered exceeds hardware limits (SETBIAS:VMAX/VMIN)
ERR:13	Value entered exceeds user defined limits (SETBIAS)
ERR:14	Communication problem with Analog Front-end
ERR:15	The selected range is invalid

Table 3: **Error Codes**

6 Device connection

This chapter describes the PCR4 connectors, going specifically to their functionality and technical characteristics.

6.1 Power Supply

The power connector is the standard 2.1*x*5.5 [mm] male jack connector and the rated input voltage is a +12 [V]. Figure 3 shows the power connector. When the PCR4 is powered on, it will perform autonomously the turn-on routine, and after a few seconds, it is ready for use. Above the power connector, there is also a reset button.

WARNING, before removing the power supply from the PCR4 you must use the reset button, hold it for a few seconds, and then disconnect the power.

Figure 3: Power Supply Connector - Rear panel

6.2 Input Connectors

In the front panel of the PCR4 four BNC input connectors are used to make current measurements. The four connectors are numbered from left (CH1) to right (CH4), as shown in Figure **??**.

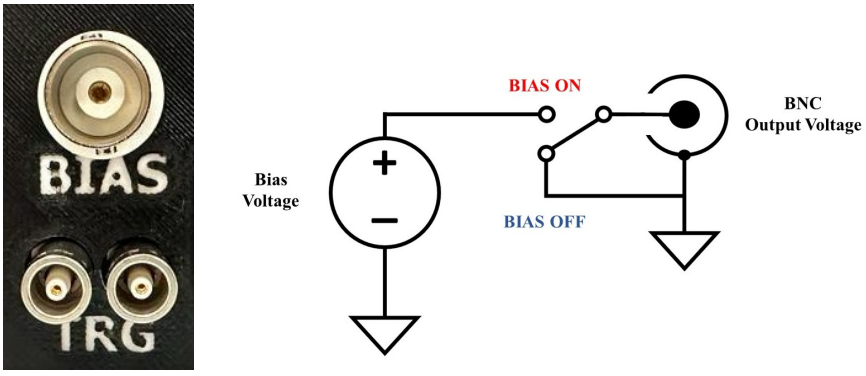
To obtain a more optimal measurement, especially when small currents are to be measured, it is necessary to use cables that are not too long and possibly low-noise. The quality and length of the cables, the distance between the PCR4 and the current source that you want to measure, have a great impact on the quality of the measurement.

Figure 4: Input Current Connectors - Front panel

6.3 Output Bias Voltage and Trigger Connectors

The Output Bias Voltage connector is a standard BNC connector placed in the PCR4 front panel, as shown in Figure 5a. The PCR4 is provided with a low-noise integrated Low-Voltage (LV) bias voltage, full bipolar rated at $\pm$ 20 [V]. Moreover, when the Bias Voltage is OFF, see Figure 5b, the PCR4 shorts the output to the internal ground.

At the bottom of the Output Bias Voltage connector, there are the I/O Trigger Connectors, both of which are LEMO coaxial connectors. More specifically, the left LEMO connector is used as an Input Trigger, instead, the right one, as an Output Trigger. The input trigger signals are TTL, LVTTL, and CMOS compatible.

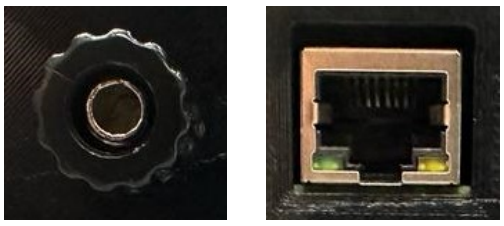


(a) (b)

Figure 5: (a) Bias Voltage and Trigger Connectors - Front panel and (b) Bias Schematic

6.4 Grounding and Ethernet Connector

In the rear panel of the PCR4 are present the Grounding and the Ethernet connectors, as shown in Figure 6. As regards the grounding connector, the purpose of connecting an electrical system to the physical ground (earth) is to limit the voltage imposed by lightning events and contact with higher voltage lines. The Ethernet connector is a classical RJ45 connector and is linked to a true 10/100/1000 Mbps physical device.



(a) (b)

Figure 6: (a) Grounding and (b) Ethernet Connectors - Rear panel

The device is shipped with a default IP address, subnet mask and TCP-IP communication port:

IP Address	192.168.0.10
Subnet mask	255.255.255.0
TPC/IP Port	3000

Table 4: TCP-IP protocol parameters

7 Technical Specifications

PERFORMANCE PARAMETERS	SenSiC PCR4 Picoammeter
Number of Channels	4
Channels Connectors	BNC
Current Polarity	Bipolar
Dynamic Ranges	24 bits
Measuring Range (R0-R1-R2-R3)	RANGE0: ±50 mA RANGE1: ±250 µA RANGE2: ±2.5 µA RANGE3: ±25 nA
Acquisition Speed	Up to 53 kSample/s
Analog Bandwidth -3 dB	700 Hz
Current Resolution LSB (R0-R1-R2-R3)	RANGE0: 6 nA RANGE1: 30 pA RANGE2: 300 fA RANGE3: 3 fA
Bias Voltage Source	± 20 V (Bipolar)
Bias Voltage Connectors	BNC
External Signals	Configurable trigger input/output
External Signals Connector	LEMO
Communication Interface	10/100/1000 Mbit Ethernet TCP-IP
Interface	EPICS - QuadEM
Input Voltage Supply	+12 V
Status Indications	4 LEDs
Weight	800 g
Physical Dimension	200 W x 300 L x 75 H [mm]

8 Mechanical Dimensions

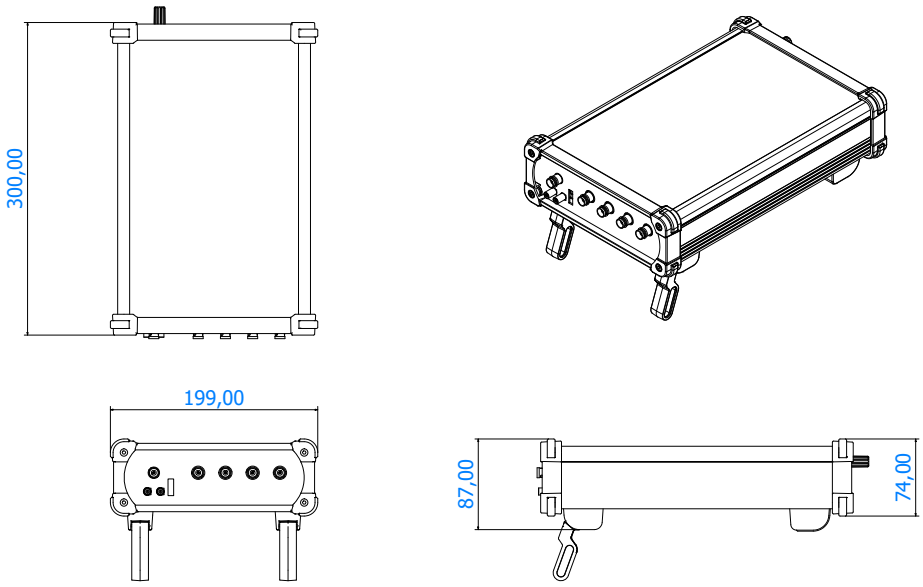


Figure 7: PCR4 Mechanical Dimension