



4-channel amplifier

user manual

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Product information and technical support

www.emka.fr / www.emkatech.com

For additional support and information, refer to the chapter of this user manual dedicated to technical support.

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important notice

disclaimer

All the hardware and software materials described in this user manual are not intended to be used, and should not be used in human experimentation or applied to humans in any way.

verification

emka TECHNOLOGIES hardware and software are extensively tested and calibrated before leaving our factory or warehouse. Researchers should independently verify the basic accuracy of materials delivered.

warranty

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Warranty applies only if material is used in a way specified by this user manual.

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safety warning

If hardware materials are used in a way not specified by this user manual, the protection provided by the hardware material may be impaired.

caution! To preclude injury or death due to electrical shock, make sure that you connect the 4-channel amplifier to a socket which includes a fully functional ground connection. If in doubt about the quality of your ground connection, please ask your in-house electrician to test the ground connection.

This manual contains all information about which precautions to take to avoid injury due to electrical shock. Please read this manual before using the 4-channel amplifier. In any case, never open the amplifier: the amplifier should be opened by authorized **emka** TECHNOLOGIES representative only.

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about this manual

conventions

The conventions listed below are used in this manual.



note: note.

Text in this font alerts you to a note, comment or specific information.



important! important note.

Text in this font alerts you to important information.



caution! caution note.

Text in this font warns you of precautions to take to avoid danger, injury, the loss of data, or a system crash.

related documentation

The documents listed below contain useful information:

iox user manual

equipment symbols

The different types of symbols on the device are described below.



Attention, consult accompanying documents.



Battery



Device falls within the scope of the European Union's Waste Electrical and Electronic Equipment (WEEE) Directive (2002/95/EC). Customers should segregate the product from other waste at end-of-life.

chapter 1 introduction

The amplifier is used to amplify different types of signals according to which modules are fitted (4our slots are available):

- **strain-gage amplifier module:** signal from a force transducer
- **single-lead ecg amplifier module:** 1-lead ecg signal
- **standard leads ecg amplifier module:** 6 ecg limb leads This module is twice as wide as the other two modules and takes up two slots.



strain-gage
(chapter 4)

single-lead ecg
(chapter 5)

standard leads ecg
(chapter 6)

Before plugging in the amplifier, please comply with installation instructions.

chapter 2 product overview

The main components of the amplifier are:

- a metallic mainframe, available as a desktop model or a rackable model (19" x 2 units).
- power supply module.
- amplifier module(s).

The modules consist of a front panel and a printed circuit board (hidden from view during use) in the "Eurocard" format. They are fitted inside the mainframe.

The amplifier is delivered with:

- 4 BNC-BNC cables.
- a screw driver for making adjustments on the strain-gage module.



caution! do not connect or disconnect cables or transducers when the amplifier is switched on.

2.1 front

The amplifier shown in figure 1 is fitted with 4 strain-gage modules.

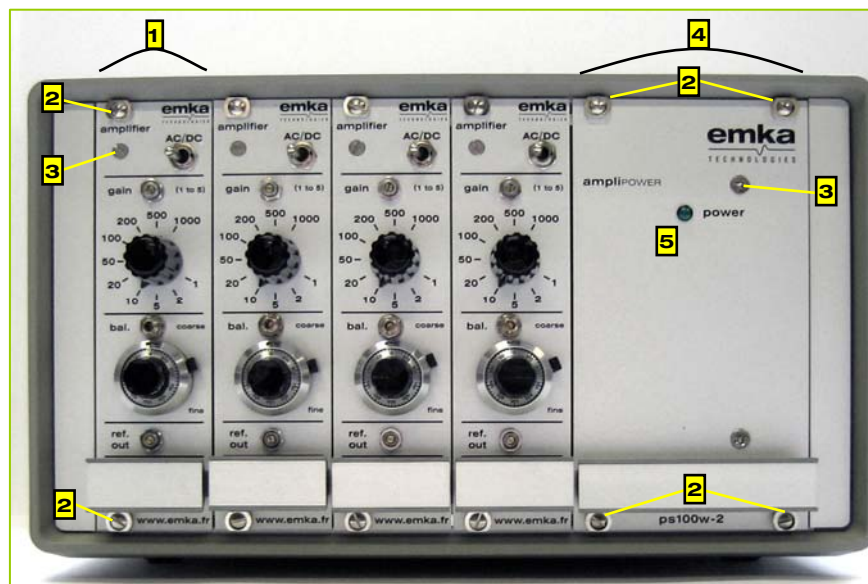


figure 1 amplifier - front panel

- 1 strain-gage amplifier module**
- 2 module screws** (4 per power module, 2 per amplifier modules).
For fixing module to mainframe.
- 3 board screws**
For fixing the printed circuit board to the front panel of the module.
Normally, this screw should not be touched.
- 4 power module**

- 5 power led**
Is on when the amplifier is powered on.

panels (not shown)
Unusual slots have a metallic protective plate fitted.

2.2 power module

The amplifier requires a mains power supply in the range of 100V-240 V, 1.6A - 0.5A at a frequency of 50 Hz or 60 Hz. No internal adjustment is required for the voltage of the power supply (115 V or 230 V).



caution! although there is no internal switch for the power supply voltage, fuses of different rating are used for a 115 V and 230 V power supply (as described in section 2.3)..

The power module generates $\pm 15V$ DC voltage from the mains power supply.

2.3 back

The back panel of the amplifier is shown in figure 2.

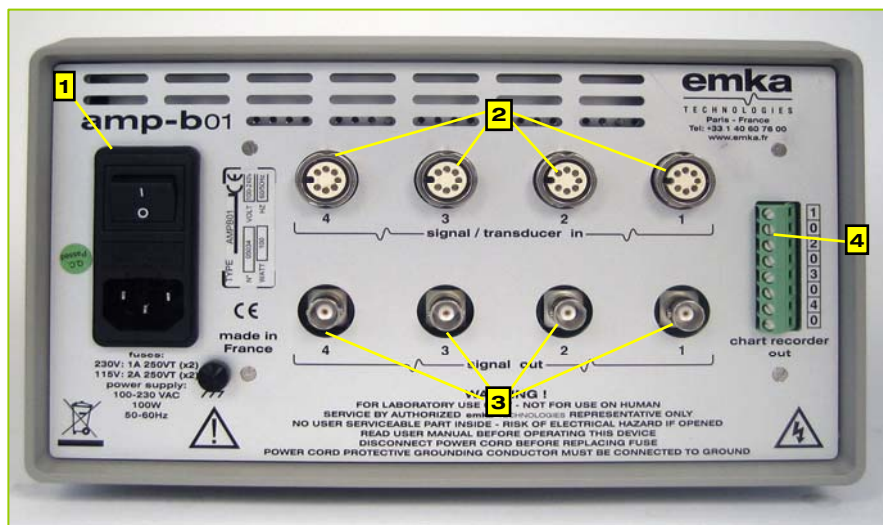
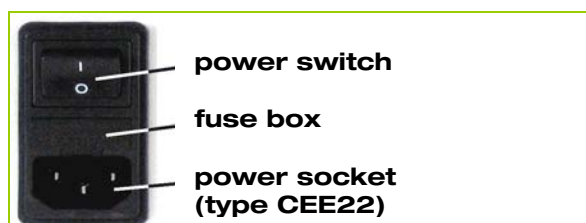


figure 2 amplifier - back panel

- 1 power assembly** (switch, fuses, power socket)



Contains two 1 A delayed fuses (for 230 V power supply) or two 2 A delayed fuses (for 115 V power supply)

- 2 din-7 sockets** (transducers or ecg cables are connected here)
- 3 analog output to chart recorder**

- 4** **BNC connectors** for output to data acquisition card on computer or other device. Internally, each BNC connector is linked to the din-7 socket just above.

2.4 chart recorder connector assignment

The amplifier can be connected directly to a chart recorder. The connector assignment is shown in figure 3.

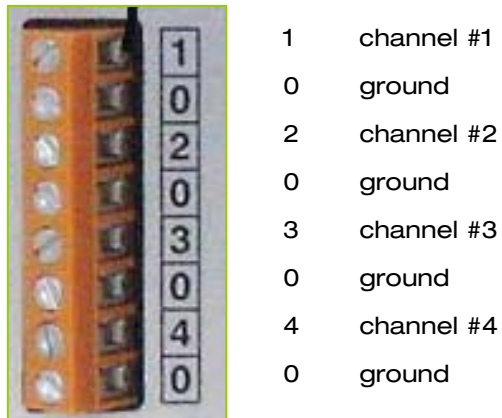


figure 3 assignment of connectors for chart recorder

chapter 3 getting started

3.1 inspection

After unpacking the device, visually inspect all external parts for possible damage to connectors, surface areas, etc. If damage is discovered, file a claim with the carrier and the provider. The shipping container and packing material should be stored in case reshipment is required.

3.2 mechanical installation

Ensure that all screws are tight and that any free slots are covered by a protective metallic plate.

3.3 electrical installation



caution! for your safety, please read this section very carefully

To avoid injury or death due to electrical shock, the third wire earth ground must be continuous to the facility power outlet. Before connecting to the facility power outlet, examine extension cords, auto-transformer, etc., between the amplifier and the facility power outlet for a continuous earth ground path.

To prevent damage to the device, ensure that instrument voltage and fuses are the correct type. Unless otherwise specified at the time of purchase, the amplifier is shipped from the factory with two 1 A delayed-action fuses (for operation on 230V AC). Amplifiers configured for 115 V AC are shipped with two 2A delayed-action fuses.

3.4 device environment

Specifications are valid at a temperature of $25^{\circ}\text{C} \pm 5^{\circ}\text{C}$.

Do not use the device in the following conditions:

- ambient temperature outside the range 0°C to 50°C
- abnormal humidity
- volatile atmosphere

Here are some simple measure to increase the lifetime of your amplifier:

- keep the amplifier away from heat sources
- avoid excessive mechanical vibration
- keep the amplifier away from devices that could create electrical disturbances

3.5 installation

Once you have taken the above precautions, you can connect up as follows:

1. Connect all the transducers and ecg cables to their specific amplifier modules
2. Connect the power supply cable to the amplifier and to the main power supply.
3. Switch the amplifier on.



caution! do not connect or disconnect cables or transducers when the amplifier is switched on.

chapter 4 strain-gage module

4.1 overview

Each strain-gage module (figure 4) provides a stable DC current to feed its transducer. The input signal arrives in differential mode.

The strain-gage module is supplied with a screw-driver (figure 5) for making certain adjustments .

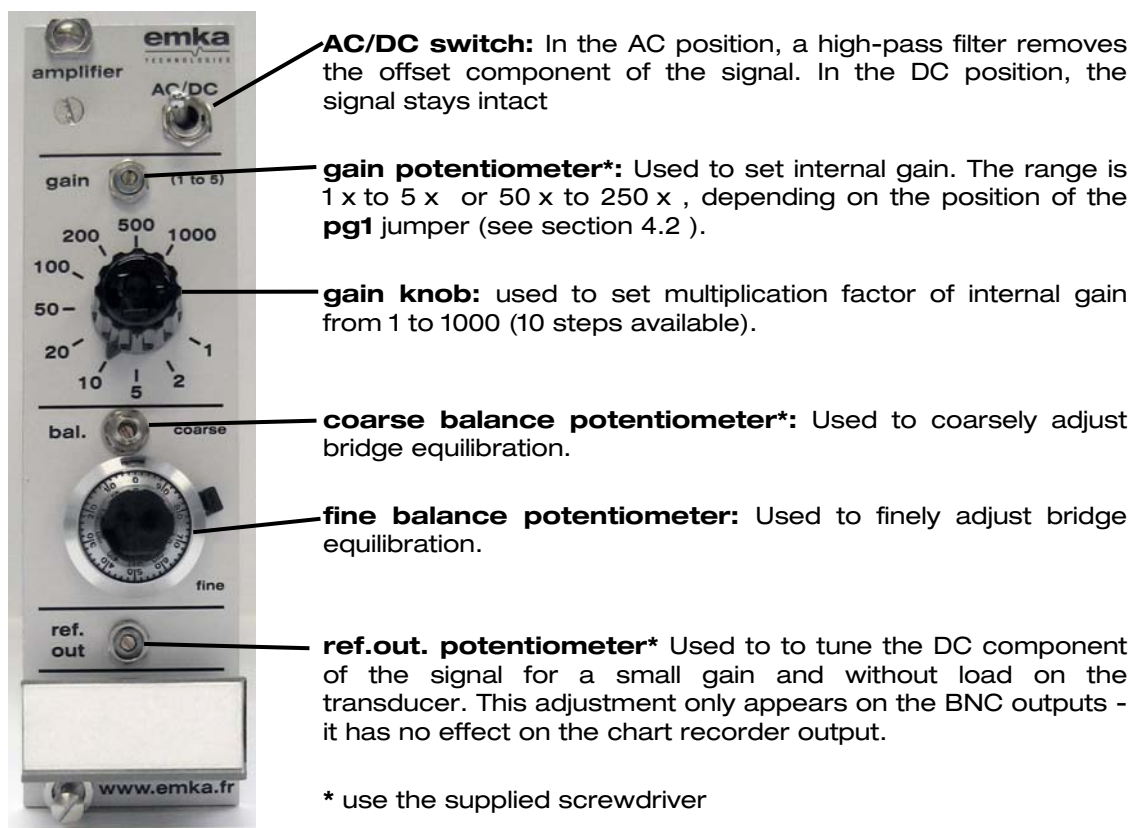


figure 4 strain-gage module



figure 5 screwdriver (supplied)

4.2 internal settings

Several user-adjustable settings are available on the printed circuit boards inside each module (figure 6).

To access the printed circuit board:

- switch off the mainframe.
- remove the power cable from the power socket..
- unscrew the two module screws on the front panel.
- pull out the module.

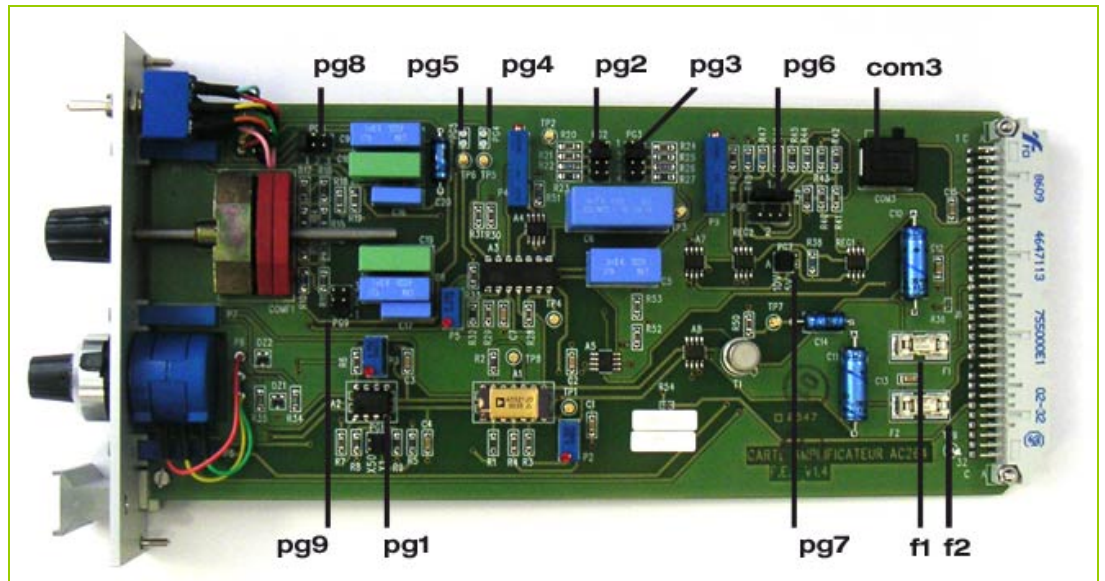


figure 6 user-adjustable settings on amplifier module

Jumper **pg1** is used to adjust the internal gain:

- position X1: gain stays the same.
- position X50: gain is multiplied by 50.

Jumpers **pg2** and **pg3** are used to adjust the cut-off frequency of the low-pass filter:

- position 1: 500 Hz.
- position 2: 35 Hz.
- position 3: 10 Hz.
- position 4: 0.1 Hz.

The fall-off is 40 dB/decade.

Jumper **pg4** is used to suppress the action of the high-pass filter on the chart recorder output (J2 connector):

- jumper present: no filter.
- no jumper: filter applied.



note: jumper **pg4** is only present on older modules which do not have an AC/DC switch.

Jumper **pg5** is used to suppress the action of the high-pass filter on the BNC outputs:

- jumper present: no filter.
- no jumper: filter applied.



note: jumper **pg5** is only present on older modules which do not have an AC/DC switch.

Jumper **pg6** is used to add an offset of - 5 V on the analog outputs of the BNC connectors. In this way, 0 V on the transducer will have a - 5 V output (this is useful with some acquisition cards):

- position 1: addition of -5 volts.
Used, for example, when using iox software with a force transducer.
- position 2: no addition.
Used, for example, with chart recorders or pulmonary applications.

Jumper **pg7** is used to select the voltage for feeding the gauge bridge of the transducer:

- position A : + 10 V.
- position B : + 5.4 V.

Jumper **pg8** is used to adjust the cut-off frequency of the high-pass filter for the chart recorder output.

- position 1 : 0.075 Hz.
- position 2 : 0.25 Hz.
- position 3 : 1 Hz.

This adjustment is useful only if pg4 is not present.

Jumper **pg9** is used to adjust the cut-off frequency the high-pass filter for the BNC outputs.

- position 1 : 0.075 Hz.
- position 2 : 0.25 Hz.
- position 3 : 1 Hz.

This adjustment is useful only if pg5 is not installed.

The **com3** switch inverts the DC voltage polarity feeding the gauge bridge:

- position 1 : inverted voltage (position of the mark on the card)
- position 2 : non inverted voltage (normal position).

f1 and **f2** are the two fuses, whose rating depends on the power supply:

- for a 230 V power supply: two 1 A delayed fuses
- for a 115 V power supply: two 2 A delayed fuses

Section 8.3 gives the procedure to change the fuses.

4.3 calibration and adjustment

4.3.1 adjustment

1. Connect the transducers to the inputs
2. Connect a voltmeter or acquisition software to the output.
3. Set **gain knob** to 1.
4. With the screwdriver, adjust the **ref.out. potentiometer** in order to obtain a positive value close to 0 V. If jumper pg6 in position 1 (-5V added), you need to aim for a value close to - 5V.

If this adjustment has no effect, with the signal "stuck" at the top (constant 5V) or at the bottom (constant -5V), common causes are:

- a damaged transducer.
- a very "out-of-tune" amplifier.
In this case, you cannot see the effect of your adjustments because the signal is out of range.. The remedy is to first use the **coarse balance potentiometer** to move the signal trace to the screen. Then, use a combination of the **coarse balance potentiometer** and **ref-out potentiometer** to make the trace visible again, then bring it to the required value (close to 0 or close to -5V).
- a problem with the interface box - acquisition card connection.

First check that the cable is properly connected.

You should also visually inspect the pins of the connectors on the interface box and the acquisition card. If any are bent, use a thin or pointed object to very carefully straighten them.

5. Adjust the **gain knob** step by step to the highest value for which there is no saturation, ie. for which the signal does not extend beyond the -5 to +5V display of the iox calibration pane.
6. Adjust the **coarse balance potentiometer** then **fine balance potentiometer** to keep the output close to 0 V (or -5V).
7. Repeat steps 4 and 5 until you reach the required gain.

4.3.2 calibration

Take the low calibration point without any physical stress applied to the transducer.

Take the high calibration points while applying a known physical stress to the transducer (known weight or pressure etc).

In iox software, the calibration is performed in "2 points (sampled)" mode (please refer to the *iox user manual* for step-by-step instructions).



note: you may also use a non-zero value as low point of your calibration. For better resolution, choose the low and the high values so that they cover the measuring range. For example, to measure forces between 0 and 6g, calibrate between 0 and 5g, or 0 and 10g rather than between 0 and 1g. if you change any settings in gain or balance, you must re-calibrate.

4.4 typical settings (by application)

	application				
	isolated tissue/organ by emka or wpi (IT-1, FORT)	isolated tissue/organ by Grass (FT-03)	pulmonary (dpt and ppt transducers)	cardiovascular: fluid-filled catheters (e.g. blood pressure, pleural pressure)	cardiovascular Millar Mikro-Tip catheters. (e.g. left ventricular pressure, blood pressure)
jumper					
pg1 (internal gain)	X1	X1	X50	X1	X1
pg2 & pg3 (low pass filters)	position 2	position 2	position 2	position 1	position 1
pg6 (offset)	position 1	position 1	position 2	position 1	position 1
pg7 (excitation voltage)	position A	position B	position A	position A	position B
pg8 & pg9 (high pass filters)	position 1	position 1	position 2	position 1	position 1

chapter 5 single-lead ecg module

5.1 overview

The single-lead ecg amplifier module provides ecg amplification and filtering with or without external reference, allowing both in vivo and in vitro studies on isolated heart.

The single-lead ecg amplifier module is delivered with a 3-wire ecg cable (positive, negative, reference) with 5-pin standard DIN plug. This plug connects to the 7-pin socket of the mainframe. Output is available on the rear panel both on the BNC output and the analog output to chart recorder.

5.2 front panel

Several user-adjustable settings are available on the front panel (figure 7).

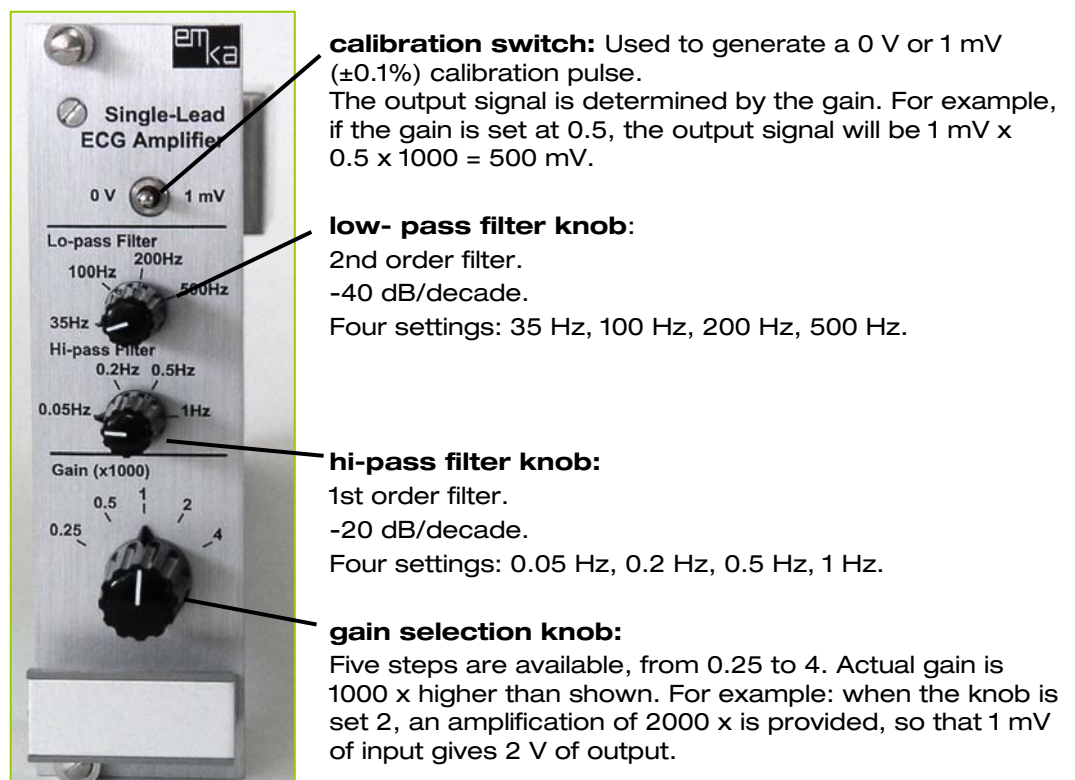


figure 7 front panel of single-lead ecg amplifier module

chapter 6 standards leads ecg amplifier module

6.1 overview

The standard leads ecg amplifier module provides ecg amplification and filtering on 6 standard leads, allowing both in vivo and in vitro studies.

The 6 standard leads are leads I, II and III (Einthoven bipolar leads) and leads aVR, aVL, aVF (Goldberger unipolar leads).

The standard leads ecg amplifier module is supplied with a 5-wire ecg cable (3 measurement points + shield + reference).

The ecg cable is fitted with a 5-pin standard DIN plug, which connects to the 7-pin socket of the mainframe.

6.2 front panel

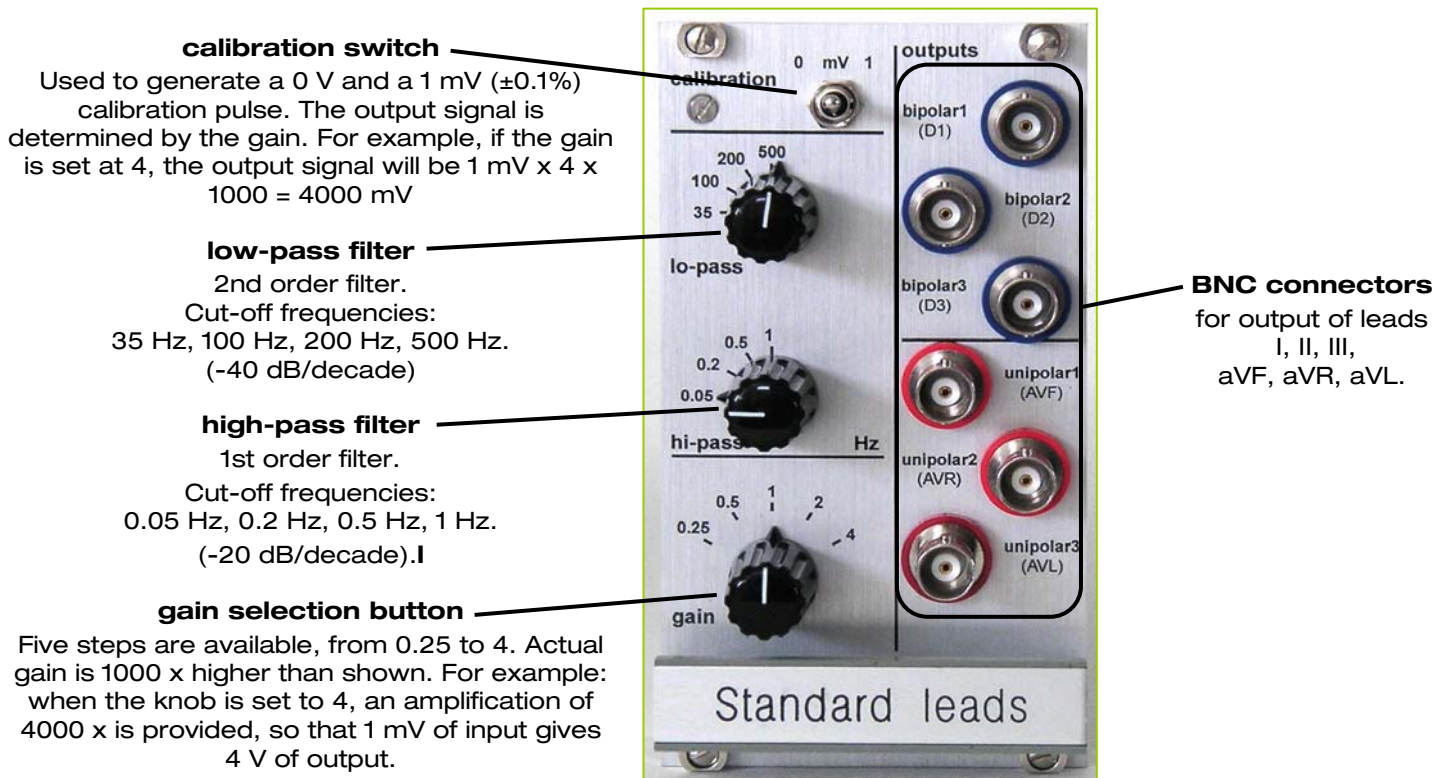


figure 8 front panel of standard leads ecg amplifier module



note: when using the 6-lead-ecg card, the BNC connector in the back of the amplifier is not used.

6.3 inputs and outputs

The inputs from the electrodes to the standard leads ecg amplifier module are shown in table 1.









inputs	IEC electrode color (Europe)	AAMI electrode color (US, Japan)
electrode 1 on left arm (LA)		
electrode 2 on right arm (RA)		
electrode 3 on left leg (LL)		
electrode 4 on right leg (RL)		

table 1 inputs for standard leads module

The mainframe calculates the output signals as follows:

$$I = LA - RA$$

$$II = LL - RA$$

$$III = LL - LA = II - I$$

$$aVF = II - \frac{1}{2}(I)$$

$$aVR = -\frac{1}{2}(I+II)$$

$$aVL = I - \frac{1}{2}(II)$$

LA, RA and LL are the signals from the electrodes. Leads I and II are used to calculate the remaining 4 leads, which therefore do not have to be measured directly.

chapter 7 recording ecg

The amplifier offers several possibilities for recording ecg data:

- **1-lead ecg in one to four subjects**
The mainframe is fitted with one to four 1-lead amplifier modules.
- **6-lead ecg in one subject**
The mainframe is fitted with 1 standard leads ecg amplifier module.
Slots 3 and 4 remain empty.
- **6-lead ecg in two subjects**
The mainframe is fitted with 2 standard leads ecg amplifier modules.

When the standard lead ecg amplifier module is used, jumpers **pg1** and **pg2** must be set according to the ecg configuration used (figure 9).

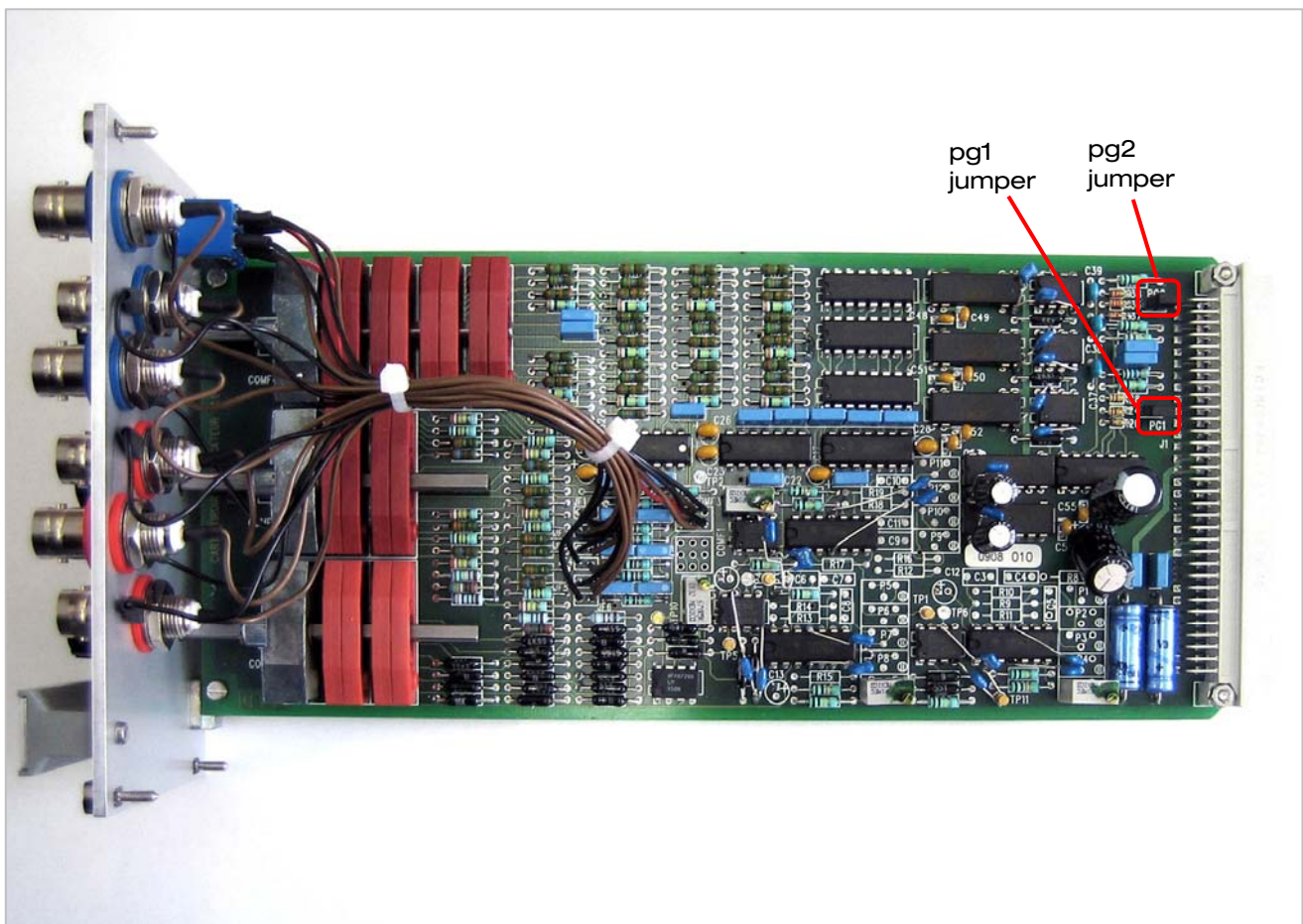


figure 9 location of pg1 and pg2 jumpers on standard leads modules

7.1 6-lead ecg in one subject

Jumper **pg1** must be present.
Jumper **pg2** must be absent.

7.2 6-lead ecg in two subjects

Jumpers **pg1** and **pg2** must be absent on one or both of the standard leads modules (figure 10).

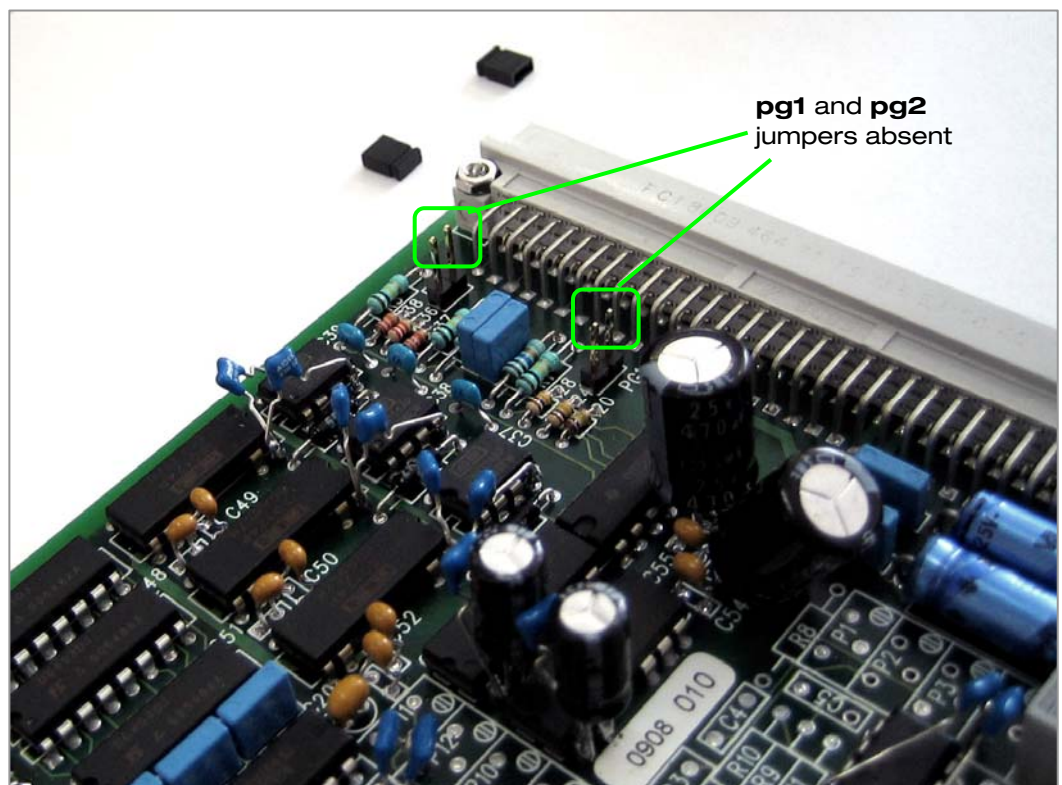


figure 10 pg1 and pg2 jumper settings for 6-lead ecg recording in two subjects

chapter 8 procedures

8.1 removing a module/panel

1. Switch off the mains power.
2. Disconnect the mains power cable.
3. Unscrew upper and lower module screws on the module/panel.
4. Gently remove the module/panel by pulling the grip.

8.2 inserting a module

1. Remove the old module/panel.
2. Gently slide in the new module.
3. Ensure that the plastic inserts are in the correct position in order to fit in the upper and lower parts of the module.
4. Push the board firmly into the mainframe by applying pressure at the top and bottom of the front face.
5. Tighten the module screws.

8.3 changing the fuses

1. Switch off the mains power.
2. Disconnect the mains power cable.
3. Insert an object with a thin, flat tip (e.g. a screwdriver) into the ridge below and behind the fuse box (figure 11).
4. Gently pull the fuse box towards you - it will slide outwards then downwards.
5. Change the fuses. As a reminder, you will need:
 - o either two 1A delayed fuses for 230 V power supply
 - o or two 2A delayed fuses for 115 V power supply
6. Push the fuse box into the mainframe.



figure 11 changing fuses

8.4 cleaning ecg cable

You must disconnect cables before cleaning them. Use a damp cloth with standard disinfection products.

Do not put any liquid on the mainframe socket.

chapter 9 troubleshooting

led does not go on when the power supply is turned on

Ensure that power is reaching the mainframe, by checking fuses on the power supply module, fuses in the plug, on/off power switch etc.

See section 8.3 for details on how to access the fuses.

If the led remains off, please contact **emka** TECHNOLOGIES.

none of the channels work

Check the connection between the amplifier mainframe and the PC or chart recorder.

one strain-gage channel does not function

Check the transducer.

Check the connection between the amplifier and the transducer.

Swap the non-functioning module with a functioning module of another channel.

If the new module works properly in the slot, the problem is with the first module; in this case, check fuses f1 and f2 located on the first module. If the new module does not work, the problem is with the mainframe back panel.

the signal is saturated (out of dynamic range)

When using an ecg amplifier, make sure it is not set to calibration mode

For the strain gage module, check that the signal is zero for the lowest gain, then increase the gain and adjust the balance at each step (see strain gage chapter for more information)

chapter 10 technical specifications

10.1 mainframe

parameter	description	value			unit	notes
		min	typ	max		
O_{RH}	operating humidity	30		70	% RH	
S_{RH}	storage humidity	20		80	% RH	
OT	operating temperature	0		50	°C	
ST	storage temperature	-25		50	°C	
	dimensions	140 x 250 x 250 mm			mm	h x w x d
	weight					
V_{AC}	mains power supply	115		230	V	
F	mains power frequency	50		60	Hz	
P_w	power consumption	4		100	W	

table 2 specifications of the mainframe

10.2 strain-gage module

parameter	description	value			unit	notes
		min	typ	max		
G	gain	1	200	5000	V/mV	
F_{cL}	low cut-off frequency	0.075	0.25	1	Hz	
F_{cH}	high cut-off frequency	0.1	35	500	Hz	Can be switched of for DC.

10.3 ecg modules

The specifications apply to:

- single-lead ecg amplifier module
- standard leads ecg amplifier module

parameter	description	value			unit	notes
G	gain	250	1000	4000	V/mV	
Fc _L	low cut-off frequency	0.05	0.5	1	Hz	
Fc _H	high cut-off frequency	35	100	500	Hz	

10.4 connector pin assignments

10.4.1 strain-gage transducer

The strain-gage cable has a 7-pin DIN connector. The connector pin assignments of the strain-gage cable are shown in table 3.

	pin # 1: + measure pin # 2: ground pin # 3: - feeding pin # 4: - measure pin # 5: + feeding pin # 6: nc pin # 7: nc
--	---

table 3 connector pin assignments of the strain gage cable (socket side)

10.4.2 single-lead ecg

The single-lead ecg cable has a 7-pin DIN connector. Pin assignments are shown in table 4.

	pin # 1: positive input signal (yellow) pin # 2: not used pin # 3: shielding pin # 4: negative input signal (red) pin # 5: reference (black) pin # 6: nc pin # 7: nc
--	---

table 4 pin assignments of the single-lead ecg cable (socket side)

10.4.3 6- lead ecg

The 6-lead ecg cable has a 5-pin DIN connector. Pin assignments are shown in figure 12.

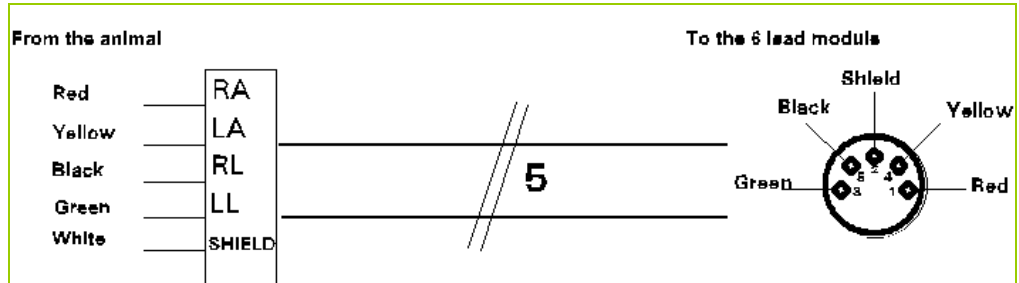


figure 12 pin assignments of the standard ecg cable (pins side)

chapter 11 technical support

The answers to most technical issues are contained within this document. In particular, the 'troubleshooting' and 'frequently asked questions' chapters contain answers to the most commonly occurring issues. If you cannot find a solution in this manual, please:

- check the website
- contact **emka** TECHNOLOGIES
- respect the returns policy when returning equipment
- fax back the 'support form' in the 'customer feedback' chapter

11.1 check the website

For technical support, please go to **www.emka.fr** and then the sections **services » faq** or **services » knowledge base**.

For customers with a private account: you can obtain technical support from your assigned sales representative and exchange files in a confidential manner.

If you do not have an account, we recommend that you apply for one (go to **services » my account**).

11.2 contact **emka** TECHNOLOGIES

If you still need a solution, contact **emka** TECHNOLOGIES.

corporate headquarters

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11.3 returns policy

The support team may decide that it is necessary to return the equipment to our workshop for further evaluation. In this case, you will be given an RMA (return material authorization) number to indicate on the packaging. An RMA number is compulsory for all returns.

Before returning equipment to **emka** TECHNOLOGIES, it must be cleaned and also disinfected/sterilized where necessary, to eliminate the risk of contaminating our premises and the people who work there and handle the equipment.

For these reasons, non-clean equipment will not be evaluated but immediately returned to the sender, who will also be charged the delivery costs.

Unauthorized returns (i.e. without an RMA) will be handled in the same manner.

chapter 12 customer feedback

12.1 support form

Photocopy this page and fill it out each time you encounter problems. Completing this form accurately helps us to answer your question more effectively.

personal information:

name:

title/function:

company:

address:

fax/phone (please indicate which):

describe the problem here:

Please return the form by post or fax

emka TECHNOLOGIES (corporate headquarters)
59, bd. Général Martial Valin 75015 Paris - France
Fax: +33 (0)1 40 60 65 55

emka TECHNOLOGIES INC (sales and support office for North America)
307 Annandale Road, suite 203, Falls Church, VA 22042 - USA
Fax: +1 (703) 237-9006

12.2 feedback on this user manual

emka TECHNOLOGIES strongly encourages feedback on its products and services. Please let us know what you think about this user manual by returning the form below. This information will enable us to continue to improve our documentation.

My feedback concerns:

4-channel amplifier user manual v.1.1 revision 1 SEPTEMBER 2009

personal information:

name:

title/function: company:

address:

fax/phone (please indicate which):

Please tell us whether you think that this manual is (circle your answer)

exhaustive Yes / No

clear, easy to understand Yes / No

well organized Yes / No

useful Yes / No

If you have specific comments or suggestions for improving the manual, please mention them here:

If there are any errors in the user manual, please describe them here (with page number/ section)

Thank you for your time. Your feedback is valuable to us.

please return the form by post or fax

emka TECHNOLOGIES (corporate headquarters)

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fax: +1 (703) 237-9006

12.3 general feedback form

emka TECHNOLOGIES strongly encourages feedback on its products and services.

This form may be used to provide feedback on any of our products and services. This information will enable us to continue to provide quality products to meet your needs.

product or service concerned:

personal information:

name:

title:

company:

address:

fax/phone (please indicate which):

provide your feedback here:

Thank you for your time. Your feedback is valuable to us.

please return the form by post or fax

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End of user manual.



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