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Kipp & Zonen

INSTRUCTION MANUAL

BD SINGLE

SINGLE CHANNEL FLATBED RECORDER

BD DUAL

DUAL CHANNEL FLATBED RECORDER



0350 300

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IMPORTANT USER INFORMATION

Reading this entire manual is recommended for a full understanding of this product.



The exclamation mark within an equilateral triangle is intended to alert the user to the presence of important operating and maintenance instructions in the literature accompanying the instrument.

Should you have any comments on this manual, we will be pleased to receive them.

KIPP & ZONEN reserves the right to make changes in the specifications without prior notice.

WARRANTY AND LIABILITY

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Manual version: 0304

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CE

Declaration of Conformity

According to EC guideline 89/336/EEC 73/23/EEC

We **Kipp & Zonen B.V.**
Röntgenweg 1
2624 BD Delft

Declare under our sole responsibility that the product

Type: BD 11, BD 11E and BD 12, BD 12E
Name: Flatbed recorder

to which this declaration relates is in conformity with the following standards

Imissions

EN 50082-1	Groupstandard	
IEC 1000-4-2	IEC 801-2	8 kV
IEC 1000-4-3	IEC 801-3	3 V/m
IEC 1000-4-4	IEC 801-4	1 kV

Emissions

EN 50081-1	Groupstandard
EN 55022	

Safety standard

IEC 1010-1

Following the provisions of the directive

KIPP & ZONEN B.V.
Röntgenweg 1
2624 BD Delft
Product management



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1. SAFETY

Read this page carefully before installation and use of the instrument.

1.1 INTRODUCTION

The instrument described in this manual is designed to be used by properly trained personnel only. Adjustment, maintenance and repair of the exposed equipment shall be carried out only by qualified personnel, that is aware of the hazards involved.

1.2 SAFETY PRECAUTIONS

For the correct and safe use of the instrument it is essential that both operating and servicing personnel follow generally accepted safety procedures in addition to the safety precautions specified in this manual. Specific warning and caution statements, where they apply, will be found throughout the manual. Where necessary, the warning and caution statements and/or symbols are marked on the apparatus.

1.3 CAUTION AND WARNING STATEMENTS

Caution:	Is used to indicate correct operating or maintenance procedures in order to prevent damage to or destruction of the equipment or other property.
Warning:	Calls attention to a potential danger that requires correct procedures or practices in order to prevent personal injury.

1.4 SYMBOLS



To preserve the protection afforded by the instrument from damage the operator must refer to an explanation in the instruction manual.

1.5 IMPAIRED SAFETY-PROTECTION

Whenever it is likely that safe operation is impaired, the instrument must be made inoperative and secured against unintended operation. The appropriate servicing authority must then be informed.

Equipment connected to this unit must comply with the relevant IEC, UL and CSA standards.
To comply with the UL and CSA safety standards only fuses of the same type and rating may be used. Such as Wickmann type 19195 according to IEC 127, UL recognised 250 mA for 115V and 125 mA for 230 V.

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2. GENERAL INFORMATION

2.1 INTRODUCTION

The flatbed recorder is available in four different versions, with one or two channels and with or without electrical penlift and remote control.

BD 11	single channel flatbed recorder
BD 12	dual channel flatbed recorder
BD 11E	single channel recorder with electrical penlift and remote control
BD 12E	dual channel recorder with electrical penlift and remote control

The BD 11/11E / 12/12E recorder is a compact recorder meeting today's technology. The recorder uses a null balancing potentiometric system. The two-channel recorder offers two completely independent and isolated servo systems. Both pens use the full-scale width (200 mm). Disposable fibre pens are used, avoiding the inconvenience of a bleeding ink system. Many combinations of measuring ranges and additional options are possible (see appendix C - E).

2.2 PRINCIPLE OF OPERATION

The recorder transports the chart paper at a constant velocity, which may be as slow as 0.1 mm per minute or as fast as 20 mm per second. The positions of two independent pens represent the levels of the two corresponding inputs of which the time functions are drawn. The full scale input sensitivity range from 1 mV to 20 VDC. The recorder is equipped with one chart drive control panel and with two independent servo system control panels, one for each channel.

A number of functions can be controlled by means of the operator panel, as well as by external signals. They comprehend chart drive control and for both channels pen up and down and servo markers. A complete description of these functions and the interface can be found in chapter 4.

Due to the nature of the two-channel recorder, the pen of channel 1 is always 2.5 mm behind the pen of channel 2.

2.2.1 Pen offset compensation module

In order to be able to compensate for the effect of the physical distance between pen of channel 1 and channel 2, the user can install a pen offset compensation module BD 1512, which is available from Kipp & Zonen under part number 1317-830. The pen offset compensation module allows a graphical representation of two input signals on the BD 12/12E recorder without any trace offset. Normally when a multi-pen recorder is used for monitoring signal variations, the traces are shifted in the direction of paper transport with respect to each other, because the pens cannot write at the same time at the same spot. This effect has been eliminated now. The signal of the second pen is not immediately written on the chart, but is stored until the chart is advanced by 2.5 mm, which is the distance between the pens, measured in the paper feed direction. For more information please refer to section 5.2.1 Pen offset compensation.

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2.3 SPECIFICATIONS

2.3.1 General specifications

Recording system	:	potentiometric servo balance system
Recording paper	:	roll chart
Pen	:	disposable fiber tip cartridges
Power Supply	:	93.5 - 132 V / 187 - 264 V, 50/60 Hz (Voltage selector) max. consumption 30 VA (1 ch.), 40 VA (2 ch.)
Safety	:	Certified in accordance with cUL 3101-1 and IEC 1010-1
Emission	:	EN 50081-1 (groupstandard) EN 55022
Imission	:	EN 50082-1 (groupstandard)
(EMF)	:	in accordance with IEC 1000-4-3 and
(EFT)	:	in accordance with IEC 1000-4-4
(ESD)	:	in accordance with IEC 1000-4-2 4 kV contact discharge and 8 kV air discharge
Earth leakage current	:	smaller than 0.5 mA in accordance with IEC 601-1 class B

Environmental conditions

Ambient temp. range	:	operating -10 to +40°C storage -40 to +75°C
Relative humidity	:	operating 20 - 85 % non condensing storage 5 - 95 %
Housing material	:	Bay Blend no FR 110-00005 flammability rating according to UL 94 V-0
Colour	:	grey / white
Weight	:	3.5 kg including roll of chart
Dimensions	:	380 x 290 x 90 mm (W x D x H)

2.3.2 Servo system

Span settings	:	1-2-5-10-20-50-100-200-500 mV, 1-2-5-10-20 V
Pen travel	:	200 mm
Number of pens	:	1 or 2, factory installed
Pen response time	:	< 0.2 s for 5-95% fsd (full scale deflection)
Span accuracy	:	< 0.3% full scale deflection
Non linearity	:	< 0.3% full scale deflection
Dead zone	:	< 0.2% full scale deflection
Input terminals	:	2 safety terminals
Input impedance	:	1 M0hm for DC, 10 k0hm in series with 1.5 µF for AC
Input current	:	less than 5 nA
Input configuration	:	floating
Maximum input voltage	:	42 VDC / 30 VAC (personal safety limits)
Zero adjustment	:	-50 to +150% full scale
Zero	:	selectable left-hand or right-hand side of the paper (default left-hand side)
Zero drift	:	< 1 µV/°C
Common mode rejection:		130 dB (DC and 50 Hz AC)
Mains frequency	:	permissible peak to peak max. 5 times interference (not visible)
Variable range setting	:	40 - 100% of selected span
Pen lift	:	mechanical pen 1 and 2 combined up/down,

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Options	:	- POC module ch.2 with RS232-C output - POC module ch.1 with RS232-C output - Electrical pen lift channel 1 and 2 independent, plus remote control connector

2.3.3 Chart drive system

Speed setting	:	0.1-0.2-0.5-1-2-5-10-20 mm/min or mm/sec
Step size	:	0.05 mm
Inaccuracy time base	:	better than +/- 50 ppm
Pulse width	:	greater than 1 µs
External drive	:	TTL pulse input maximum frequency 8 kHz (option)
External division factor	:	1 - 12000 selectable by chart speed setting
Recording paper	:	chart roll according to DIN 16230
Paper length	:	25 metres
Paper life	:	4100 hours at lowest chart speed 20 minutes at highest chart speed

2.3.4 External available I/O (remote control is optional)

The following functions are available at the15 pin sub D connector, which is located at the rear side of the recorder.

Penlift channel 1 (option)
Penlift channel 2 (option)
Start of plot/major gridmark
Go to major gridmark
Servomarker channel 1
Servomarker channel 2
Home
Chart stop
External chartdrive pulse input
ground

Depending on which options have been installed and which have not been installed, the following external options may be available as well:

serial out ch.1/2 (9600 Baud)
POC on/off ch.2

Chapter 5 OPTIONAL EXTERNAL FUNCTIONS gives more information on these functions and the effect of installing options.

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3. PREPARATIONS FOR USE

3.1 UNPACKING

The recorder is packed in a specially developed shipping carton. If damage to this carton is evident, ask the carrier's agent to be present when the instrument is unpacked. Inspect the instrument for mechanical damage, and if there is damage, contact your local supplier. Verify the presence of all standard accessories and check the carton before throwing it away, to see if nothing is left inside.

Standard accessories for recorder model BD 11 / 11E

1 instruction manual
1 fibre pen blue (short)
1 paper chart roll
1 mains supply cord
2 sets of 2 fuses

Standard accessories for recorder model BD 12 / 12E

1 instruction manual
1 fibre pen blue (short) for channel 1
1 fibre pen red (long) for channel 2
1 paper chart roll
1 mains supply cord
2 sets of 2 fuses

For ordering accessories and spare parts see appendix E

3.2 INSTALLATION

3.2.1 Safety instructions for power connection

Before connecting the equipment to the mains, ensure that the protective mains earth is functioning correctly. Before any other connection is made, the instrument shall be connected to a protective earth conductor via the three-core mains cable. The mains plug should be inserted only into a socket outlet provided with a protective earth contact. The protective action should not be negated by use of an extension cord without protective conductor.

WARNING : Any interruption of the protective conductor inside or outside the instrument, or disconnection of the protective earth terminal, is likely to make the instrument dangerous. Intentional interruption is prohibited.

Adjust the recorder according to the available mains supply. As the voltage selector suggests, the recorder may be operated at 230 V or 115 V. The switch involved is located at the rear side of the recorder, but can only be seen in the absence of the paper roll. Taking away the paper roll reveals a small square hole through which both the selected voltage and the switch itself can be seen. With the use of a pointed object this switch can be moved to the left or to the right, whatever position is desired. The location of this switch is shown in figure 1.

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Before switching on the recorder, make sure that the required fuses are installed. Operating the recorder at 115 V requires 250 mA fuses, while an operation voltage of 230 V requires 125 mA fuses. The mains on/off switch is located on the left-hand side of the recorder. Make sure that only fuses of the required current rating and type are used for renewal. The use of repaired fuses, and/or the short-circuiting of fuse holders, is prohibited.
Fuses should only be renewed by a qualified person, who is aware of the hazards involved.

NOTE : *If the mains plug has to be adapted to the local situation, it should only be done by a qualified person.*

WARNING: *The instrument shall be disconnected from all sources when a fuse is to be renewed, or when the instrument is to be adapted to a different mains voltage.*

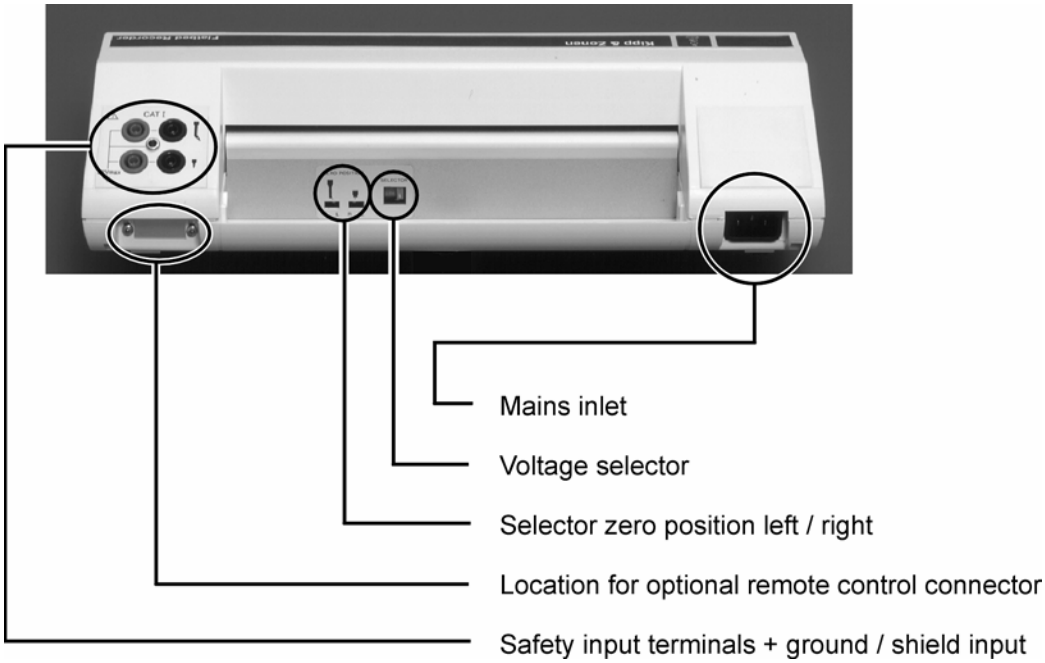


fig. 1 Rear side of the recorder

3.2.2 Changing paper

First lift the plastic transparent ruler off the paper (see fig. 2), turn it all the way to the top of the recorder and leave it in that position. In order to do so easily, place the fingers of both hands on top of the recorder housing and with both thumbs apply a gentle force to the respective ends of the ruler pointing upward and a little backward, for which purpose the ruler is equipped with small ridges. Figure 2 shows the lifting of the ruler.

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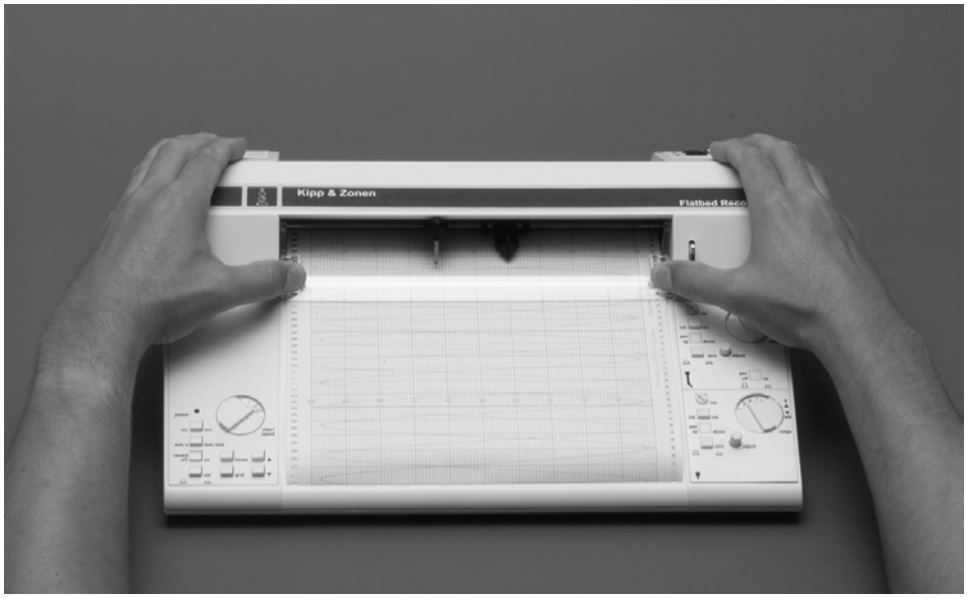


fig. 2 Lifting of the ruler

Then push the edge of the paper (with a fingernail for example) in order to loosen it from the sprocket wheels. After that, the remains of the paper roll together with the plastic shaft can be taken out of the back of the recorder. The paper roll can be lifted easily through a hole in the bottom of the recorder housing.

Unpack a new roll of paper, insert the shaft in the roll and put the two in place. Make sure that the orientation of the paper roll is such as to have the printed grid on top during normal operation. Then take the edge of the paper and slide it through the horizontal slit. (The transparent ruler still remains in the upright position.) Pull the paper towards you far enough to judge whether it is parallel to the recorder housing or not. Of course it should be. Then, with your fingertips make the holes in the edge of the paper fit the sprocket wheels, first at the left side and then at the right side.

This is because the holes in the left side guarantee exact paper positioning, while the oval holes at the right side only support vertical transport. When the paper is in the correct position, fitting both sprocket wheels, with one hand hold the paper in position and with the other hand lower the ruler. Then with both hands simultaneously apply a gentle force both at the left and right side of the ruler. A double click indicates the proper lowering of the ruler.

3.2.3. Changing pens

The recorder is shipped with two packages of felt pens, each package containing 1 pen. The blue pen, the short one, is used with channel 1. The other, red pen is used with channel 2. The best thing to do before changing pens is to switch off the recorder completely. The pen holding mechanisms may then be moved freely into such a position that taking out the used pen and replacing it with the new pen, can be done the easiest way.

If it is not desirable to switch off the recorder (to retain the home position for example) in order to be able to change pens, you should proceed as follows. For both channels the pens must be lifted by putting the penlift lever in the “up” position. When the optional electrical penlift is installed the respective switches marked “Pen Up / Down” must be in the upward position. Then the channel inputs must be zeroed by putting both the "Zero" switches in the downward position. Both pens will then remain at the position, which was chosen to correspond to the zero of scale. The moving of the pens has stopped and they can be replaced.

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After that, put back both zero switches into the upright operating position. Finally lower both pens to resume recording. Following this procedure, the only thing you get is a small gap in your recording, the size of which of course depends on both the paper speed and your manual dexterity. The time scale of your recording, however, has not been disturbed at all.

Before switching off the recorder make sure the pens are lifted to avoid ink stains on the chart. If you intend not to use the recorder for some time, it is advised to take out the pens and to put back the small caps, which protect the pens against drying up.

3.2.4 Inspection of the main functions

When you have gone through all the preparations described above, the recorder is ready for a short test of the main functions, which are described in the next sections. Remember that no external signal source has been connected to the recorder yet. A detailed description of all of the functions can be found, in chapter 4 OPERATING INSTRUCTIONS. Before performing the test, each of the two-position switches, which are on the control panel, must be put in the upward position. Also the pen-lift is in the lifted position.

3.2.4.1 Chart drive

Push the button, which is marked with a down arrow. After 0.5 second the paper must start moving slowly and after 2 seconds the paper must start moving faster. Then release this button and push the button marked “home” once. This should bring back the paper to the position where it was before you operated the arrow key. Try out the same with the other arrow key.

Each time you press the key indicated “grid”; the paper should advance one unit (i.e. 10 mm). Now press the button indicated “record on / off”. The paper should start moving at a speed corresponding to the setting of the chart speed turning knob. The speed you get of course still is in mm per second, because you started with all push buttons in the upward position.

3.2.4.2 Servo system

The testing described below can be performed separately for each of the two channels. The position of the "range" switch is of no importance, while performing these tests.

By operating the knob named zero-“adjust”, the pen can be positioned anywhere on the paper. Normally when there is no input, the pen is on the left-hand side edge of the paper.

The pens can be moved up and down by operating the pen-lift lever, which is located on the right-hand side just next to the extreme right position of the pens.
When the optional electric pen-lift is installed, pen 1 and 2 can be set up and down independently.

When this testing has been performed successfully, this means that the basic functions of your recorder are working properly.

NOTE: *The description given above is based on the assumption that the polarity switch is in the left-hand side position.*

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3.2.5 Polarity selection

If desired, the polarity of each of the channel inputs can be inverted independently. The selection is performed by setting the involved switches, which are located at the rear side of the recorder. The location of these switches is indicated in figure 1 in chapter 3 PREPARATIONS FOR USE. They can only be accessed after the paper roll has been taken out, as described in section 3.2.2 Changing paper.

The factory default setting of these switches is “left”. If one of these switches is set to “right”, the corresponding channel will have it zero position at the right hand side.

NOTE: *Inverting the input polarity does not result in a displacement of the zero position but in a mirrored channel performance.*

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4. OPERATING INSTRUCTIONS

4.1 GENERAL

4.1.1 Switching on and off

Switching on and off is done with the small black switch which is located at the left-hand side of the recorder. Once it is switched on, it immediately is ready for use. On power up the origin (home position) is set at the location the paper was at that moment. With the "set" button the origin can be defined at any desired position.

4.1.2 Fuses

The only problem that you may run into and which is user solvable is that of a blown fuse. There are two fuses, which are located next to the power switch. It is easy to replace them because you can take them out with the aid of a screwdriver or even the tip of your finger. If you have to replace one of the fuses, make sure to replace it with one of the same type. When the recorder is operated at 230 V the fuses are of the 125 mA type. When operated at 115 V they are of the 250 mA type. (see note on page 6)

4.2 OPERATOR PANEL FUNCTIONS

4.2.1 Chart drive

4.2.1.1 Record on / off

The function of this switch is to start and stop paper transport. When "record" is in the "off" position, it interrupts both the internal chart speed pulses and the external pulses. This switch must be put in the "off" position in order to be able to operate any of the following functions: “Forward / Reverse” (Arrows), “Home”, “Grid” and “Set”. When “record” is in the “on” position pressing any of the keys corresponding to the mentioned functions, has no effect at all.

4.2.1.2 Chart speed

The velocity at which the paper is moving is controlled by a combination of two choices. One concerns the position of the switch named "chart speed". There are eight possible positions, ranging from 0.1 to 20 units. The second choice concerns the applied unit, which is either mm/s or mm/min.

This combination gives you a lowest speed of 0.1 mm per minute at which the paper roll has an expected lifetime of 4100 hours and a highest speed of 20 mm per second, at which a new roll of paper gives up after 20 minutes.

4.2.1.3 Internal/ external (BD11E/12E)

The position of this switch determines the source of the pulses which make the paper move. When it is in the “Internal” position an internal clock, which can be adjusted as described in the previous section, is in effect. When the switch is in the "ext" position the chart drive must be fed with pulses from an external source. This is explained in more detail in chapter 4.

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4.2.1.4 Paper transport

The buttons associated with this function are marked with two small black triangles (arrows). With these buttons the paper can be positioned very precisely underneath the pens. Each time that one of these buttons is pressed shorter than one second, the paper is moved over a distance of 0.05 mm in the corresponding direction. If the key is held down, however, after one second the paper will start moving at a speed of 2 mm/s. It will do so for the next five seconds. So it moves over a distance of 10 mm.

If the button is still being held at the end of the sixth second, the paper will start moving at a speed of 20 mm/s. Using proper timing while operating, these paper transport keys make it possible to put the pens at any desired position very quickly. The paper can only be transported in this manner when the “Record” switch is in the “Off” position.

4.2.1.5 Home and set start of plot

These buttons can only be operated when the “record” switch is in the “off” position. Pressing the “Home” button will bring back the paper to the position where the origin is located. Origin is either the position during powering up or the position where the “set” button was last pressed. "set" is used for defining a new origin for "Home" and at the same time for the "Major grid mark" position. Be careful not to operate the "home"-button, if you are not certain about the location of the origin. If the origin lies within an area of the paper, which already has been torn off the recorder, the recorder of course will loose control of the paper. Seeking home takes place at a velocity of 20 mm/s.

NOTE: *When no optional electrical pen-lift is built in, the pens have to be lifted before “home” is activated to avoid a trace during paper reverse movement.*

4.2.1.6 Go to next grid mark

This function is activated by pressing “grid”, also in the record off mode. Each time it is pressed, the paper advances to the next major grid mark. The major grid mark lines are lines parallel to the paper-ruler with 1 cm intervals. When the origin has been set precisely on top of a grid mark, pressing the "grid" button will always bring the pen on top of the next grid mark. Paper transport takes place at a velocity of 20 mm/s for this function.

4.2.2 Servo system

The BD 12E is equipped with two fully independent servo systems. Each servo system has an operator panel for controlling its functions. The following explanation of these functions holds equally well for both channels.

The signals that are to be recorded must be connected to the corresponding input terminals at the rear side of the recorder. The black terminals are the negative ones and the red terminals the positive ones.

The maximum input voltage, which is allowed across the terminals for each of the channels, is 30 VAC or 42 VDC for personal safety. If a higher input voltage is used, this will not damage your recorder, but the input terminals cannot be touched safely any more. The maximum allowable voltage difference across any two terminals of different channels is 500 V.

4.2.2.1 Span

The input span of each channel is selected with the rotating switch named "range". This switch has 14 positions. Turned counter-clockwise all the way, a span of 20 V is chosen. This means that an input voltage of 20 V will move the pen all the way from the left- hand edge to the right-hand edge of the paper. (Supposed, of course, that the zero-position was at the left side of the paper)

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When the range switch is turned fully clockwise, the span is 1 mV full scale. The whole range in between these spans is covered in 14 steps according to the sequence 1, 2, 5, and 10. The input spans have these calibrated values only when the "cal/var" switch is in the "cal" position.

4.2.2.2 Calibrated / Variable span

When this switch is in the "cal" position an input signal equal to the selected range will result in a full-scale deflection. It may, however, sometimes be desirable to have an input span, which lies in between the values that can be chosen with the range switch. In such a case, the "cal / var" switch must be put in the "var" position, after which the variable span can be set by turning a potentiometer (indicated with "var") with the aid of a small screwdriver.

Example: Suppose a signal varying between 0 and 25 mV has to be recorded and one wants to use the full-scale width.

1. Select the 50 mV range.
2. Put the “cal / var” switch in the “var” position.
3. And adjust the potentiometer until the amplitude reaches 100 % of scale.

Since the variable span allows for 40 % to 100 % span adjustment, any desired (non-calibrated) span between 0.4 mV and 20 V can be obtained.

4.2.2.3 Zero and zero adjust

When the "Zero" switch is in the down position, the pen will remain at its zero location. This is the location of the pen in the absence of an input voltage. The location of this point can be shifted to the left or to the right by turning the small knob zero "adjust". This function allows relocation of the zero point anywhere between the left and right edge of the paper. After the zero location has been chosen, the recorder must be put back into operation again by pressing the "zero" once again, which brings the switch back in the upward position.

If desired, the signal axis together with the location of its zero point can be mirrored with respect to the centre of the recorder. Please refer to section 3.2.5 polarity selection for more information.

4.2.2.4 Mechanical pen up / down (BD 11/12)

Both pens are lifted with the metal lever, which is located on the right-hand side in the top cover. This lever is being used for controlling vertical movement of both pens.
Make sure that when no chart movement takes place, the pens are lifted.
Also when power is switched off the pen have to be lifted, to avoid leaking of the pen and stains on the paper.

4.2.2.5 Electrical pen up / down (BD11E/12E)

When the optional electrical pen-lift is built in the pens can be lifted independent.
If the pen remains too long at the same position, ink-stains will form on the paper. To avoid this, the recorder automatically lifts the pen when there has been no paper movement for more than 30 seconds. This time interval is equal to the time between two chart speed pulses when the recorder is operating at the lowest possible speed (i.e. 0,1 mm per minute). This time-out is being accomplished by checking both the internal and external chart speed pulses. This includes checking the operation of the arrow keys on the operator panel.

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5. OPTIONAL EXTERNAL FUNCTIONS

5.1 GENERAL

When the recorder is fitted with the optional remote control cable, a number of functions of the BD 11E/12E can be remotely controlled. Some of these functions are standard BD 11E/12E functions; some others only are available when the respective options have been installed. The remote control uses a 15 pin sub D type connector, which is located at the rear side of the recorder. The location of this connector is as shown in figure 1 in chapter 3 PREPARATIONS FOR USE. Its pins carry the signals, which belong to the involved functions. Each of these signals is described in section 5.4 SIGNAL EXPLANATION.

5.2 OPTIONS

For special applications, the following types of options are available.

1. Pen Offset Compensation / RS232
2. Electrical pen-lift & remote control connector (BD11E/12E)

When both POC and remote control are built in, then the serial output of the channel with POC is available.
These options have to be purchased separately. The POC and remote control are described below. The electrical penlift is described in section 4.2.2.6. For a complete description, which covers installation and user information of the POC / RS232 option, refer to appendix B in this manual.

5.2.1 Pen offset compensation (optional)

Because of the nature of the BD 12/12E recorder, the two pens have a different position with respect to the time axis of the recorder. The pen of channel 1 is always 2.5 mm behind the pen of channel 2. When two time functions are drawn, using the BD 12/12E recorder with no POC installed, the curves in fact are shifted over a distance of 2.5 mm with respect to each other. This could cause interpretation problems. If this is the case, or if this just is not desired, the POC should be installed. The circuitry in this option delays the values of channel 1. The delay comprises 50 steps of 0.05 mm, which makes 2.5 mm.

5.2.2 Serial data output (BD 11E/12E)

When the POC and remote cable option are installed, input information for one channel is available in digitised form, for digital information of both channels two POC-options should be installed. This information can be directly read by any computer with an RS232-C interface. Data is sent in a time-multiplexed form. After each step of the paper transport mechanism, a digitised value for channel 1 and one for channel 2 are transmitted.

5.3 I/O Circuitry specifications for remote control (optional)

All incoming signals are received by input logic as shown in figure 8.

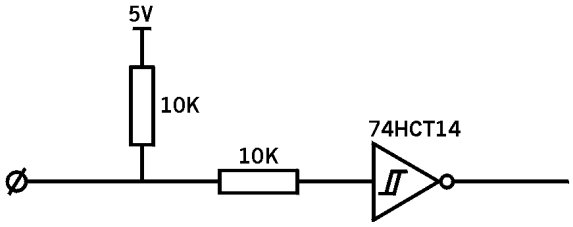


fig. 8 Input Logic

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When no signal is applied (open input), the pull-up resistor of 10 kOhm keeps the Schmitt-trigger input at a logical 1. This corresponds to a non-active situation for the respective function. This is true for all functions in the default situation (i.e. the way your BD 11E/12E was factory set and shipped) If the function has to be activated, a logical 0 (zero) must be applied. This can be done by either short circuiting the input to ground or by applying an active zero (TTL spec.).

5.4 Signal explanation

Figure 9 shows the connector lay out of the 15-pin sub D connector. Below a list is given with the functions that are available when these options are installed.

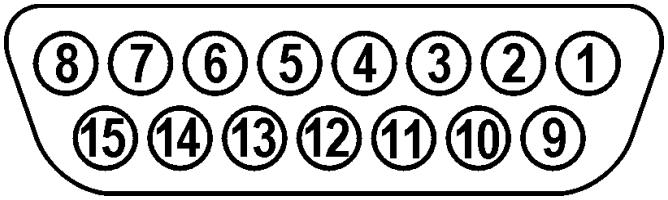


Fig. 9 15-pin sub D connector lay out

1	-	penlift channel 1	X	0	+
2	-	penlift channel 2	X	0	+
3	-	start of plot/major gridmark	X	0	
4	-	go to major gridmark	X	0	
6	-	servomarker channel 1		0	
7	-	servomarker channel 2		0	
8	-	home	X	0	
10	-	ground			
12	-	chart on/off	X		
14	-	external chartdrive pulse input	X		
15	-	ground			

x	=	only available in record on mode
0	=	“0” active or contact closure
+	=	only available when internal penlift is not active

When the POC (Pen Offset Compensation) option is installed, the following additional functions are available:

5	-	POC on / off
13	-	serial out ch.1/2 (9600 Baud)

In order to suppress unwanted interference from external origin, all signal inputs, except ECP (External Chartdrive Pulse) and servomarker, are being filtered. Any pulse that is shorter than 40 ms is rejected. As a consequence these signals are always delayed for 40 ms.

5.4.1 External chartdrive control (BD 11E/12E)

When an External Chartdrive Pulse (ECP) is used for moving the paper under the pens, a so-called divisor is applicable. This is a number between 1 and 12000, by which the number of received pulses is divided, before one step (i.e. 0.05 mm) is made. The value of this divisor depends on the position of both the two-state button “mm/min” or “mm/s” and the 8 position turning knob "chart speed". Switching from "mm/s" to "mm/min" increases the divisor with a factor 60 and turning "chart speed" from 20 towards 0.1

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accounts for a factor 200. The combination of these two results in a maximum dividend of 60*200, which equals 12000.

Method to determine the externally controlled chart speed:

S x F x 0. 0025 = Externally Controlled Chart Speed (mm/s).

S = Chart Speed Setting (must be in mm/s).
F = External Pulse Generator Frequency.

NOTE: Divide by 60 to convert mm/min. to mm/s.

The maximum frequency at which External Chart Pulses may be sent to the BD 11E/12E recorder is 8 kHz. (Pulse duration at least 1 µs). Since the maximum stepping rate, corresponding to a maximum chart speed of 20 mm/s and a step size of 0.05 mm, equals 400 Hz, this maximum ECP frequency can only be handled properly by the recorder, if a dividend value of at least 25 is applicable. The user is responsible for maintaining this lowest value. If the steppermotor of the chart drive receives stepping pulses at a frequency greater than 400 Hz, it will stop turning regularly.

This special property of the BD 11E/12E has been built in to meet the requirements needed for unusual laboratory applications. Under normal circumstances External Chart Pulses do not need to have such a high frequency.

There is no maximum for the ECP pulse duration, but it is recommended to use pulses of at least 1 µs. As soon as the positive edge is received, the chart drive will make one step. This is only true when the dividend equals 1. When the dividend has a value of N, that step will not be made until the Nth positive edge has appeared.

5.4.2. Servo marker (BD 11E/12E)

When one of the servo marker functions is activated, the corresponding pen moves 10 mm to the left, with respect to the position it had. It then continues drawing the applied signal, only the drawn curve is shifted 10 mm to the left. As soon as the function is deactivated, the pen moves back to the position that represents the channel input value. This is true if the "zero" position is at the left-hand side of the paper. If it is at the right-hand side of the paper, then the pen moves to the right, when the servo marker function is activated.

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APPENDIX A

OPERATOR PANEL FUNCTIONS

A.1 SERVO SYSTEM (one for each channel)

Each of the functions is indicated with a letter, which corresponds to a location indicated in figure A.1 below.

a) range: Rotary switch with 14 positions selects span settings, ranging from 1 mV to 20 V fsd (full-scale deflection)

b) cal/var. span: 2-position push button selects between calibrated and user adjustable span

c) var. span: Potentiometer to set span range from 40 to 100% fsd

d) zero: 2-position push button switches one channel amplifier input to zero, used for zero adjustment of the pen

e) zero adjust: Potentiometer with thumb wheel, used to position the pen on the paper

f) pen up/down: 2-position push button, used to activate the optional electrical pen lift (pen 1 and pen 2 independent, BD 11E/12E)

g) pen up/down 2-position mechanical pen lever, moves pen 1 and 2 combined up and down (BD 11E/12E).

h) POC on/off 2-position push button selects between Pen Offset Compensation on and off.

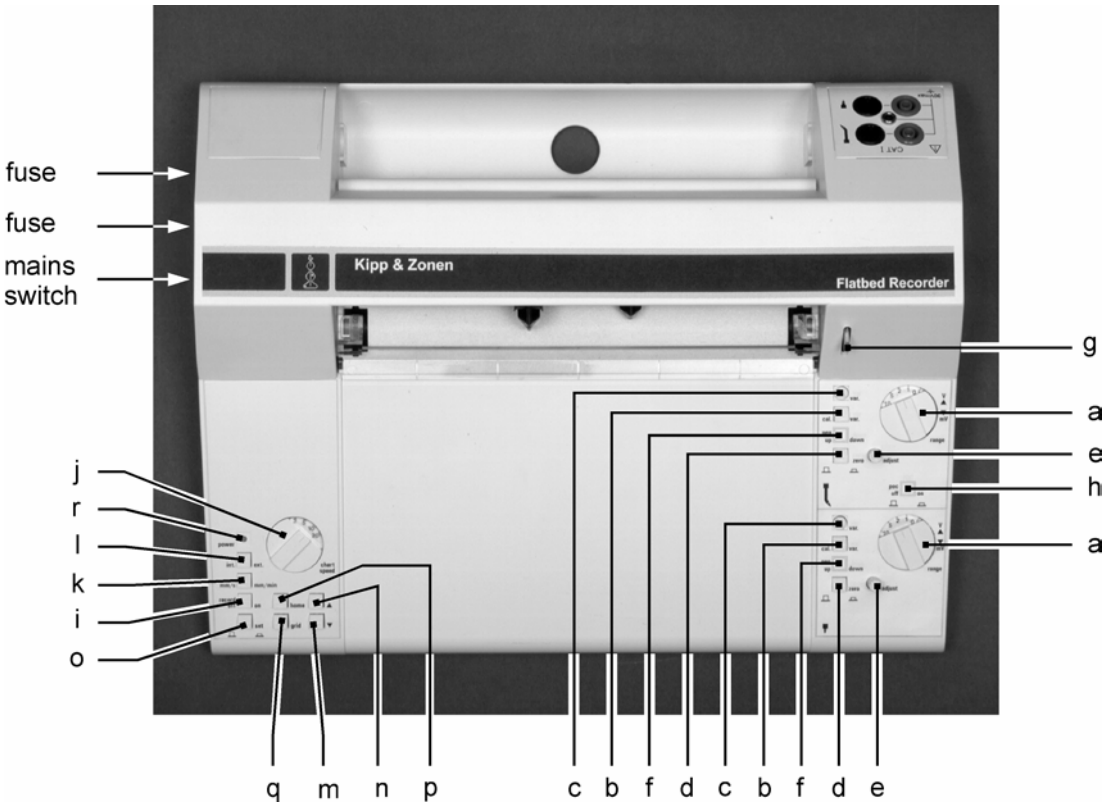


fig. A.1 Locations of functions

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A.2 CHART DRIVE (left hand side of recorder)

i) record on/off:	2-position push button switches between: - record on mode: internal chart speed settings or external pulse input and remote control functions - record off mode: keyboard control of chart drive; forward, reverse, home, zero set and go to major gridmark
j) chart speed:	8-position rotary switch for fixed chart speed settings
k) mm/sec or mm/min:	2-position push button switches selected chart speed unit from mm/sec to mm/min
l) int/ext.:	2-position push button, switches between keyboard selected chart speed and external chart pulse input (optional)
m) forward:	Push button, transports the paper forward with increasing speed
n) backward:	Push button, transports the paper backward with increasing speed
o) start of plot/ major grid mark:	Push button, sets start of plot and major grid mark position
p) home:	Push button, moves paper to start of plot position (with pen up)
q) grid:	Push button, moves the paper (always forward) to the next major grid mark (lines with 10 mm distance). When on grid mark the paper moves one grid mark further
r) Power:	Green LED to indicate power on

NOTE: The following functions are only available in record off mode:

m) forward
n) backward
o) start of plot and major grid mark setting
p) home
q) grid

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APPENDIX B

PEN OFFSET COMPENSATION MODULE (optional)

B.1 GENERAL

The Pen Offset Compensation (POC) module allows a graphical representation of two signals on a BD 12 / 12E recorder without any trace-offset. Normally, when a multi-pen recorder is used for monitoring signal variations, the traces are shifted with respect to each other, because the pens cannot write at the same time on the same spot.

This has been eliminated now: the signal value of the second pen is not immediately written on the chart but is stored until the chart has been advanced by 2.5 mm (the distance between two pens).

B.2 SPECIFICATIONS

Modular design	Both channels can be retrofitted with a Pen Offset Compensation unit without any calibration (channel 1 for RS232-C output).
POC-distance	0, 2.5 mm switch selectable
Input sampling	Continuous tracking; 1 digitised value for each chart step
Resolution time axis	0.05 mm
Resolution X-axis	0.07 mm; 12 bit
Inaccuracy X-axis	0.04% fsd max.
Digital output filter	two successive digitised values are averaged
Serial output RS232-C	each unit transmits optically isolated serial data, the real time digitised input voltage is transmitted, transmission starts after each chart-step
Maximum chart speed for correct data-transfer	0.5 mm/s
Block transmission format	space/channel code/4 data bytes (CR/LF, switch selectable)
Data byte value	0000 to 4095 (3685 +/- 3% for a full scale deflection)
Word length	8 bit/character 7 bit ASCII and the 8th bit zero one start bit one stop bit no parity
Transmission rate	9600 baud fixed
Dimensions	50 x 60 mm and 10 mm high

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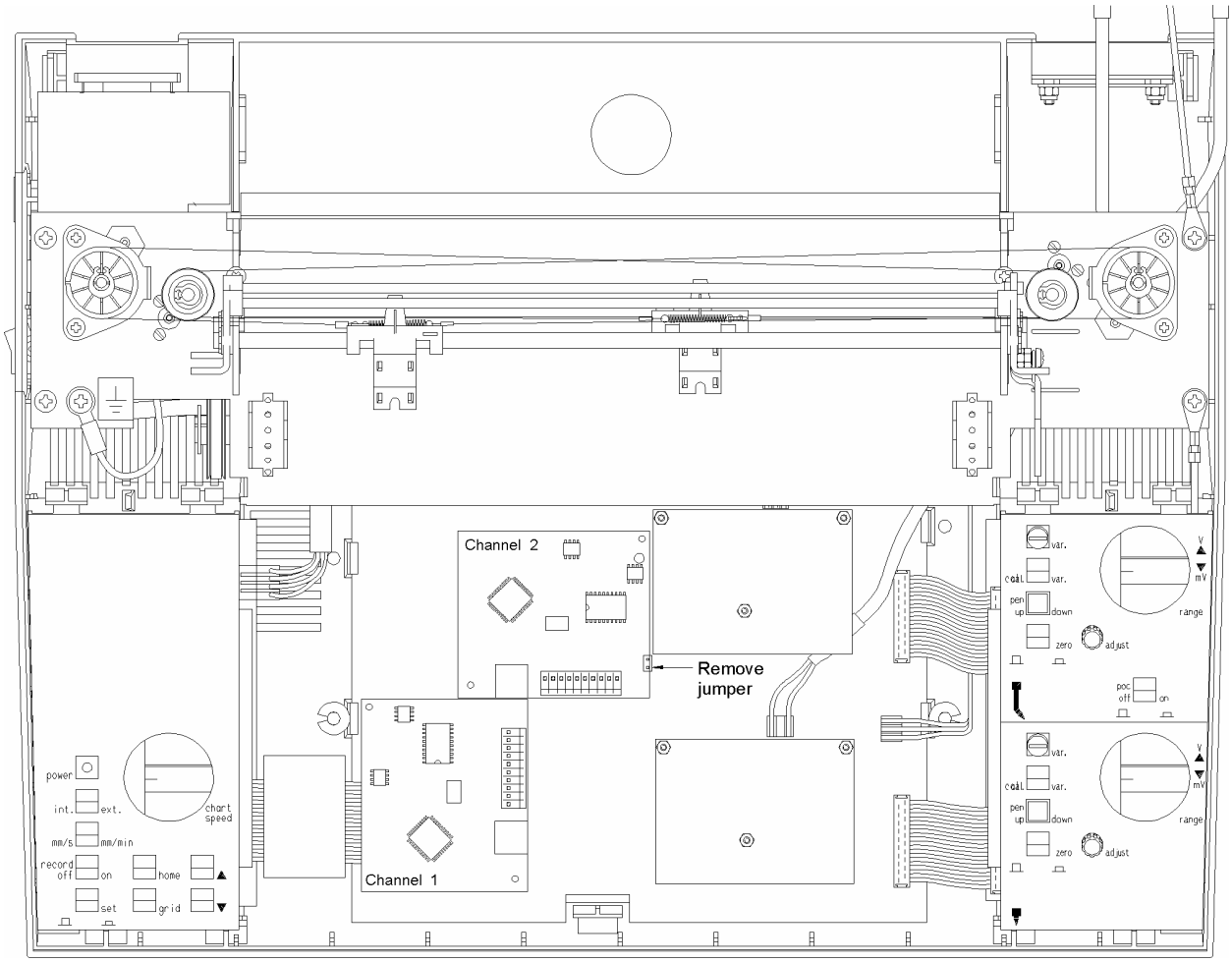


fig. B.1 Mainboard lay out with 2 POC modules

B.3 INSTALLATION

A POC / RS232-C module can be placed on each channel.
On channel 2 the POC module can be used for both POC and digital output *).
On channel 1 it only can add digital output *).
When the option is factory installed the on/off function is built in the right-hand side control panel for channel 2. When the POC module is purchased later, the switch can be mounted by a qualified service engineer. Then the option has to be ordered with “retrofit switch for BD 12 / 12E”
When a pen offset compensation module is not mounted yet, proceed as follows:

*) When optional remote control is mounted.

1) Switch off the recorder
2) Refer to section B3.1 of this manual for opening the case and remove the jumper from the two-pin header next to the female socket (only channel 2)
3) Set the switch on the module for channel 1 to “0” or “8” and the switch for channel 2 to “1” or “9” see fig. B.2 on the next page.
4) Attach the POC module(s) onto the socket, see fig. B.1. (fig B.1 shows the locations of the modules on the main board)
5) when necessary mount the POC switch plus components
6) Close the case.

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switch setting	delay stance (mm)	first character "space" 1	channel code 2	data msd 3	data 4	data 5	data lsd 6	7	8
0	0	SP	Z	d3	d2	d1	d0		
1	2.5	SP	Y	d3	d2	d1	d0		
8	0	SP	Z	d3	d2	d1	d0	CR	CR
9	2.5	SP	Y	d3	d2	d1	d0	LF	LF

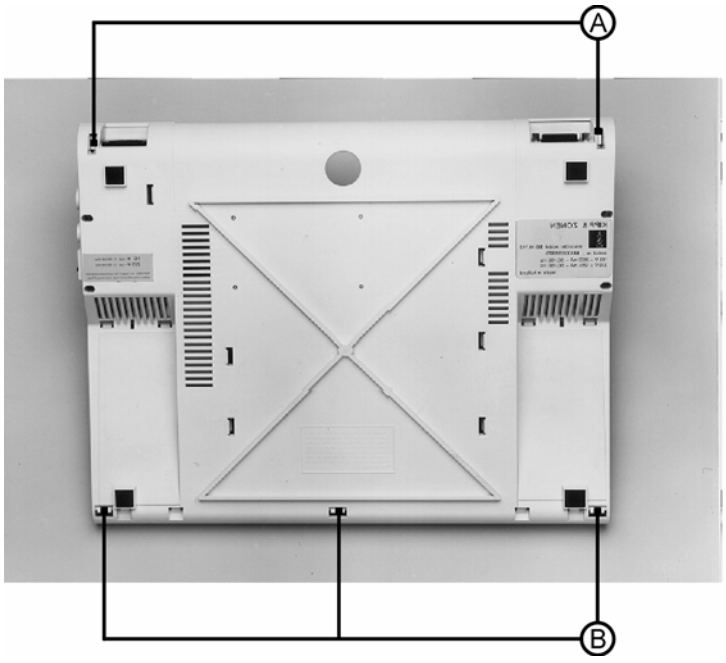
fig. B.2 Switch setting and data format

NOTE: To synchronise both channels the signal of channel 2 must be delayed. The POC module must therefore be mounted on channel 2. The non-delayed pen needs no POC module. When nevertheless a POC module is mounted (for RS232 output), it must be set to "0" mm.

When interchanging two modules or mounting a new one take care of the correct settings of the pen offset compensation switch.

B.3.1 Mounting the POC module in the recorder

Switch off the recorder, remove the mains cord, paper roll and ink pens and turn the recorder upside down. The top cover of the recorder housing is fixed to the bottom cover by means of five small ridges. Figure B.3 shows the position of the five ridges.



A: Ridges to be opened by screwdriver.

B: Ridges to be opened by hand.

fig. B.3 Location of the ridges

An easy procedure for taking off the top cover is the following one. With the recorder still upside down, put the nails of your fingers of one hand against the bottom cover and at the same time place your thumbnail against the top cover inside the groove, starting at one of the rear side corners. Doing so you apply a gentle opening force and at the same time operate a screwdriver with the other hand to carefully bend away the ridge a little bit towards the side. This should allow for separating the top from the bottom cover for about half a centimetre. Repeat this with the other rear side corner. Figure B.4 shows this approach.

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Applying the opening force between the top and bottom cover could of course also be done by means of a screwdriver, but it is very likely that the recorder housing would be damaged that way.

After that, repeat the same action for the three ridges at the front side. These three ridges can easily be bent forward by hand, so no screwdriver is needed here. When this has been done, put back the recorder upright again. You must do this, however, without applying too much “closing force”, otherwise you have to repeat the steps, described before.

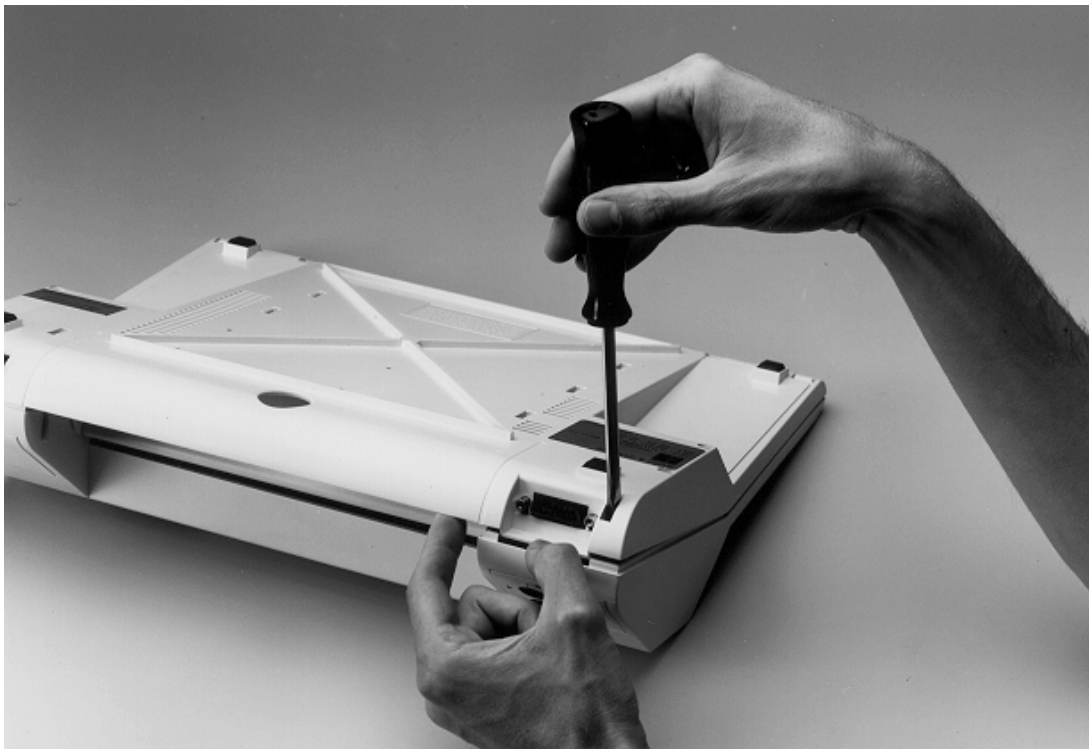


fig. B.4 Opening the recorder housing

Once it is upright again, you can easily remove the top cover. It remains connected to the inside of the recorder however, because the top cover holds the input connectors. The connecting wires are just long enough to let the top cover rest at the table upside down behind the bottom part of the recorder housing.

B.3.2 Mounting the POC switch

The POC switch plus two additional components have to be soldered on the servo control board as indicated in fig B.5
The cover plate is already prepared for this switch only the white square where the knob will come has to be pressed out.
Make sure that the knob is mounted in the same way as the other switches, with the lower side facing the front.

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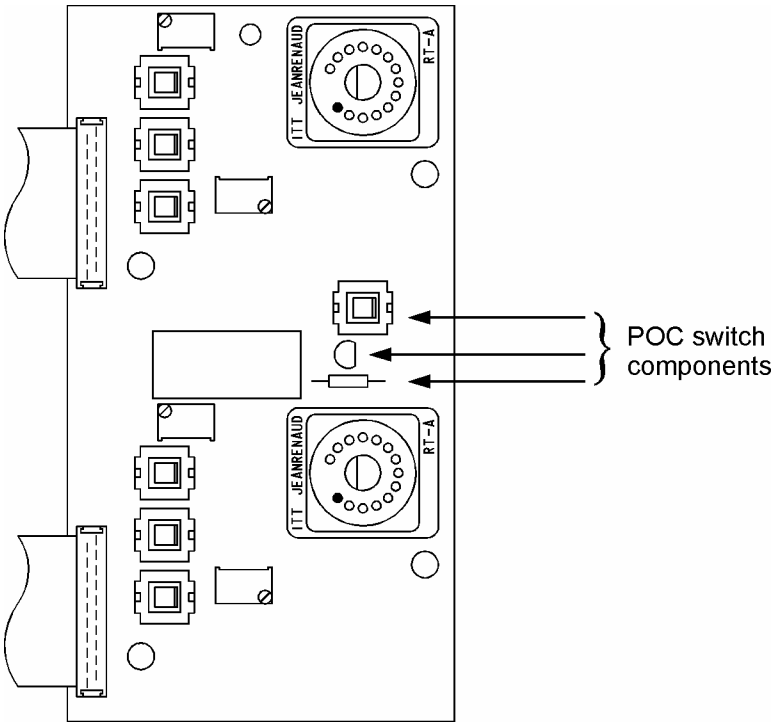


fig. B.5 location of the POC switch

When the changes have been made, you can replace the top cover by placing it over the bottom part and bringing it precisely into position. When this is done accurately enough, hardly any force is needed. As soon as the top cover is correctly in place, the housing can be closed again by pinching softly the top and bottom part of the cover together at each of the corners. Soft clicks will confirm your proper handling.

B.3.3 Removing the POC module

When the POC module for channel 2 is to be removed the same actions has to be performed as described in section B3.1. for opening the housing. Remember that the jumper has to be replaced as indicated in figure B.1 The POC module for channel 1 has no jumper.
The POC switch mounted on the right hand panel can remain there although it has no function.

B.4 OPERATION

When the modules are installed into the recorder and the case is closed switch the power on. To facilitate zero adjustment for each pen, the pen-offset compensation is automatically switched-off when the zero switch of the input module is set to zero. When turning the switch from zero, the pen of channel 2 will start tracking his input signal after a delay that is needed to compensate for the distance between the pens.

When the POC module is factory installed the POC can be switched on and off by means of the POC switch on the right-hand control panel.

Switching off the Pen Offset Compensation of channel 2, can also be accomplished by pulling pin 5 of the 15 pins sub D low (Connecting pins 5 and 15 from the optional remote control connector).

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B.4.1 The RS232-C output

The POC module in combination with the remote control connector has an additional feature. On the optional remote control connector of the recorder is a fully floating serial RS232-C output available.

The POC-modules (options) permit RS232-C serial interface cables to be connected according to the EIA standard. The recorder can be connected directly to other equipment configured as DCE (= Data Communication Equipment) with a special interface cable with 25-pin connector recorder). See figure B.6.

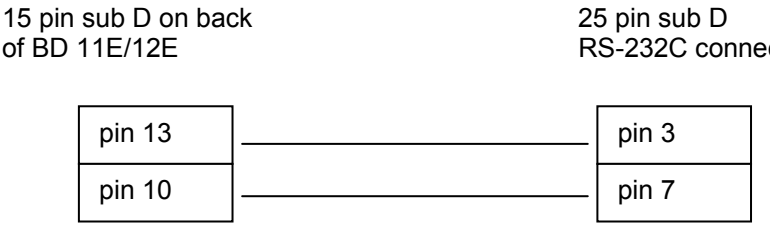


fig. B.6 Cable layout

B.4.1.1 Description of the RS232-C serial interface

The serial data outputs of more than one channel are combined, so that information of both channels can be transmitted over the same two wires. So, a computer or printer can be used easily for further adaptation of the data, related to the pen deflection, while a full mutual isolation is maintained.

Transmission of data occurs after each step of the chart drive. A block containing the data of all channels is sent in ascending sequence, starting at the POC module with a switch that is set to “0”. See the previous section and table 1.

The value of the data transmitted is proportional to the deflection of the pen. This value is 3685 +/- 3% for a full-scale deflection. The maximum of 4095 and the minimum of 0000 are out of scale. The resolution is about 0.07 mm or 15 points/mm.

An example of an RS232-C input routine written for an Epson PX-4 computer, and for a PC, handling two channels (X and Y) of the BD 12E is given in section B.5

B.4.1.2 Maximum permissible chart speed for RS232-C operation

Remember the maximum permissible chart speed when the recorder is connected to another device (e.g. printer, computer) is 0.2 mm/s.

B.4.1.3 RS232-C data format

Data is transmitted in blocks of 6 or 8 ASCII bytes. Each block contains the information for one channel. The channels are transmitted sequentially, the data coming from the POC module with the lowest setting first. A data block is built up as shown in fig. B.4. CR and LF stand for “carriage return” (code 13) and “line feed” (code10) and are selectable as indicated in section B.3

space	channel code	data 3	data 2	data 1	data 0	CR	LF

fig. B.7 RS232-C Data-format

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The "channel code" can be used by the computer for identification, and the "optional" CR LF for acknowledgement of the data block received. See also fig. B2 for more information.

B.5 DEMONSTRATION PROGRAMS

The printed demonstration programs were written on a PX4 Epson hand held computer and IBM PC in the BASIC language, to give the user more information on how to handle the serial data output.

B.5.1 demo 1

```
10      REM     demo 1 (PX4)
20      :
30      :
40      :
50      REM demo BD 11E/12E RS232 data transmission
60      REM receive data from channels 1 and 2
70      REM display values and draw curves
80      :
90      :
100
110     REM enable input, set baudrate and clear screen
120     OPEN "i", #1"com0: (e) ": DEFINT P,G,V,X,Y
125     PRINT:PRINT:PRINT:PRINT:PRINT:PRINT:PRINT:YV=200:XV=200: GOTO 340
130     :
140     REM wait for code “Y”
150     IF INPUT$(1,#1)<>"Y" THEN 150
160     RETURN
170     :
180     REM wait for code “Z”
190     IF INPUT$(1,#1)<>”Z” THEN 190
200     RETURN
210     :
220     REM get pen position value
230     G=VAL(INPUT$(4,#1)):RETURN
240     :
250     REM scaling
260     P=-G*.037+235.5:RETURN
270     :
280     REM draw line
290     PSET(VP,Y-1): LINE-(P,Y):VP=P:RETURN
300     :
310     :
320     :
330     REM     main program
340     GOSUB           190:GOSUB 230:GY=G:GOSUB 260:GOSUB190:
        Y=Y+1:VP=YV:GOSUB 290:YV=P
350     GOSUB           150:GOSUB 230:GX=G:GOSUB 260:GOSUB 150:VP=XV: GOSUB
        290:XV=P
360     GOSUB 190:IF Y=63 THEN Y=55:PRINT"Y";GX;TAB(8);"Z";GY: PSET(83,Y)
370     GOSUB 150:PSET(84,Y):GOTO 340
```


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B.5.2 demo 2

```
10      REM     demo 2 (Px4)
20      :
30      :
40      REM     print all characters received
50      :
60      OPEN "i", #1,1"com0:(e)":PRINT:PRINT:PRINT:PRINT:PRINT:PRINT :PRINT
70      PRINT INPUT$(6,#1);:GOTO 70
```

B.5.3 demo 3

```
10      REM     demo 3 (PC)
20      :
30      :
40      CLOSE
50      CLS
60      OPEN "COM1:9600,N,8,1,RS,CSO,DSO,CDO" AS #I
70      A$=INPUT$(6,#1)
80      IF LEFT$(A$,2)=" Z" THEN 110
90      LOCATE 8,10:PRINT A$;
100     GOTO 70
110     LOCATE 10,10:PRINT A$;
120     GOTO 70
```


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APPENDIX C

THERMO MODULES

For the BD 11/11E / 12/12E three different temperature modules are available.

- J thermocouple module with linearisation from –50 to +1200ºC
- K thermocouple module with linearisation from –50 to + 600ºC
- Pt100 module with linearisation from –100 to +850ºC

See appendix E for type numbers

Both J and K thermocouple modules are active temperature measuring units, providing linearisation and automatic cold junction compensation.
Linearisation is according to IPST 68. The output voltage is 1 mV/ºC.

So a selected range of 100 mV gives a full scale deflection of exactly 100ºC.
and a selected range of 500 mV gives a full scale deflection of exactly 500ºC.

The Pt100 module is an active measuring unit, suitable for measurement with the use of an external Pt100 element based on DIN 43760.
The linearisation is based on DIN 43760. The output voltage is 1 mV/ºC.

All temperature modules are powered from a separate power supply (3...12 VDC adapter).



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APPENDIX D

ATTENUATOR AND SHUNTS

For measuring higher voltages and currents five different attenuators and shunts are available.

Attenuators:
100 x, maximum voltage 500 Volt
10 x, maximum voltage 500 Volt

See appendix E for type numbers

These attenuators have completely shielded banana inputs and outputs, to guarantee maximum safety.

Shunts:
0-20 mA shunt (100 Ohm) giving full scale (20 mA) with input range on 2 Volt
4-20 mA shunt (125 Ohm) giving full scale (20 mA) with input range on 2 Volt (zero shifted)
0-16 A shunt (10mOhm) giving full scale (10A) with input on 0.1 Volt

The shunts also have completely shielded banana inputs, to allow currents with a high voltage related respect to ground.



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Appendix E

ACCESSOIRES AND SPARES

Mains cord USA	2570-042
Mains cord Europe	2570-041
Mains cord UK	3444-293
Set of 10 fuses 125 mA for 230 V	2655-154
Set of 10 fuses 250 mA for 115 V	2655-245
Instruction manual (English)	0350-300
Standard packing with 10 chart rolls, linear graduation (zero left)	2643-918
Standard packing with 10 chart rolls, linear graduation (zero right)	2643-962

Fibre pens (short) for the BD 11/11E recorder and channel 1 of the BD 12/12E recorder:

5 fibre pens, black	2643-908
5 fibre pens, red	2643-909
5 fibre pens, green	2643-910
5 fibre pens, blue	2643-852

Fibre pens (long) for channel 2 of BD 12 / 12E recorder:

5 fibre pens, red	2643-853
5 fibre pens, black	2643-858
safety banana plug red	2523-597
safety banana plug black	2523-598
15 pin sub D connector	2524-560
dust cover	2067-031
service manual	0350-350
spillage cover	9013-928
remote control cable (1.5 m)	2570-167
Attenuator 100x, 500V max.	0328-322
Attenuator 10x, 500V max.	0328-324
Current shunt 0-20 mA	0328-320
Current shunt 4-20 mA	0328-321
Current shunt 0-16A	3300-001
POC module	1317-830
Temperature module type J	0336-706
Temperature module type K	0336-705
Temperature module type Pt100	0336-704

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APPENDIX F

RECALIBRATION SERVICE

Data acquisition recorders, flatbed recorders and XY(t) recorders

Kipp & Zonen B.V. recorder systems comply with the most demanding international standards. In order to maintain the specified performance of these instruments,
Kipp & Zonen B.V. recommends to calibrate their instruments annually

Recorders that are used in applications, for which the initial factory specifications are not required, can be calibrated against a standard with the same accuracy as the initial recorder specification.

Instruments used in certified laboratories or institutions and applications that require optimal precision need to be calibrated against a high quality standard. Calibration to the highest standard is done by using a calibration standard with at least three (3) times better specifications.

The Kipp & Zonen B.V. calibration facility allows calibration to the highest standard, which is traceable to the (Inter) National Standard.
After recalibration to this standard, Kipp & Zonen B.V. provides a Calibration Certificate with all relevant data about instrument accuracy and calibration conditions.

For more information about recalibration complete the following form and fax it to Kipp & Zonen B.V.

Name	:		
Company	:	Instrument	:
Address	:	City	:
Postal/Zip code	:	Country	:
Phone number	:	Fax number	:

☐ I would like to receive a price list for recalibration service.

☐ I would like to submit my instrument for recalibration.

FAX: +31 15 2620351

or mail to: Kipp & Zonen B.V., P.O. Box 507, 2600 AM Delft, The Netherlands

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Customer Support

Our customer support remains at your disposal for any maintenance or repair, calibration, supplies and spares. The address is as follows:

Für Servicearbeiten und Kalibrierung, Verbrauchs-material und Ersatzteile steht Ihnen unsere Customer Support Abteilung unter folgender Adresse zur Verfügung:

Notre service 'Support Clientèle' reste à votre entière disposition pour tout problème de maintenance, réparation ou d'étalonnage ainsi que pour les accessoires et pièces de rechange. Leur adresse est la suivante :

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