TECHNICAL MANUAL

TECHNICAL MANUAL

PILOT A, CE

Serial N° 15789806 to...

Fresenius HemoCare

Fresenius Vial
Infusion Technology

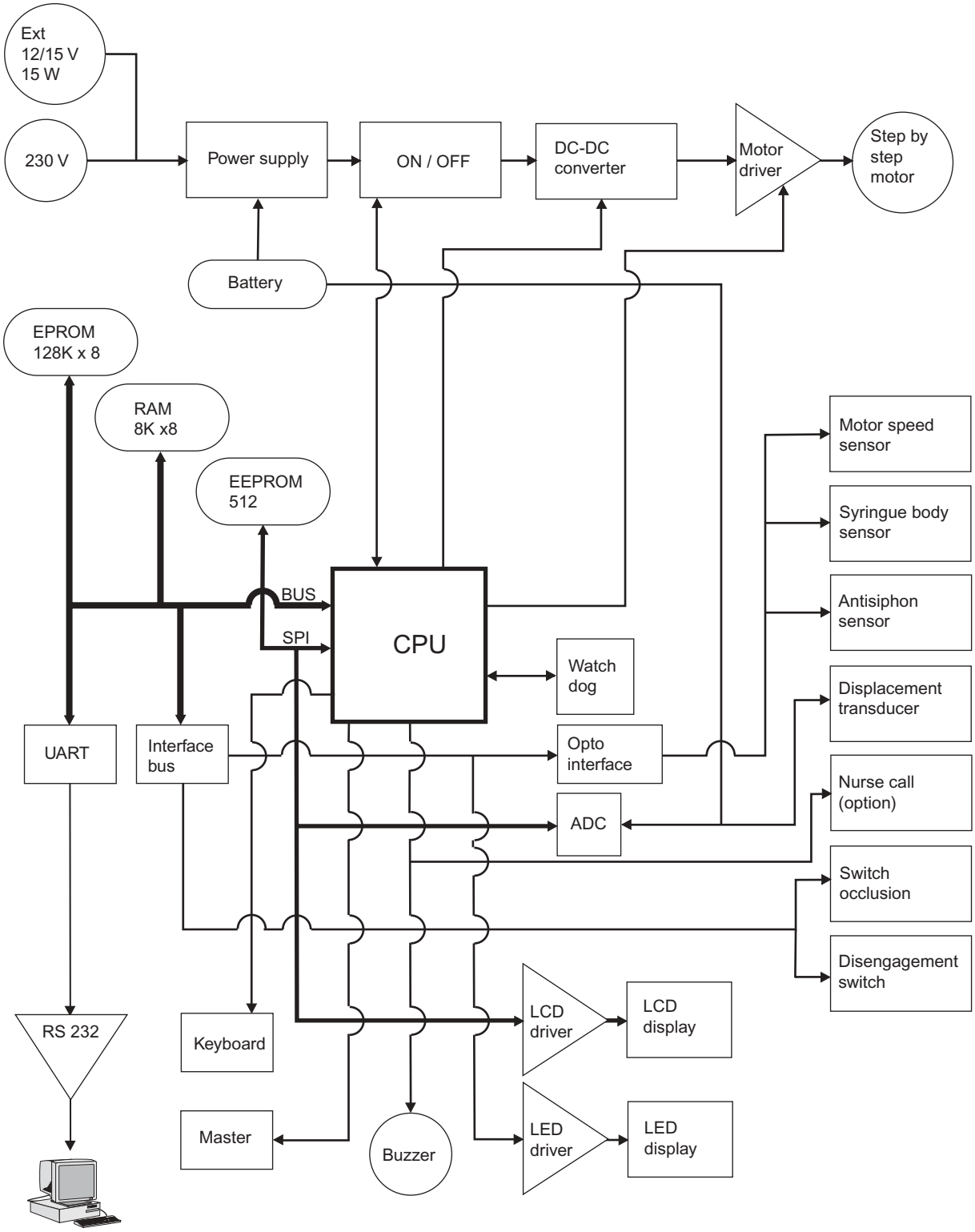
1 Overview

1.1 General

The **Pilot A** is a syringe pump intended for the infusion of intravenous agents at a accurate, low flow rate. The wide choice of syringes, the use of the universally recognised control symbols and the synoptic display of the alarms contribute to making the **Pilot A** easy to use. The adjustable occlusion detection, the correct positioning detection and the overall syringe protection system guarantee optimum safety.

Its technical characteristics, the flow range from 0.1 to 120 ml/hr and its excellent accuracy (±1% on the equipment) contribute to making the **Pilot A**, the ideal instrument for medical services.

1.2 Overview diagram



1.3 Precautions to be taken before use

The symbol ⚠ in the Quick Start Guide recommends that the manual should be read in full in accordance with standard EN 60601-1.

Fresenius Vial may in no case be held responsible for medical problems or any other problems resulting from inadequate use of the equipment.

Refer to the User's Instructions for further details.

1.4 Internal safety features

As soon as it is switched ON, the equipment activates a continuous function inspection system. Any internal failure or any problem in the usage procedure is detected immediately. Nevertheless, abnormal operation of the equipment with no obvious cause must always be reported to the qualified technicians in your organization or our After Sales service.

If a fault occurs, an alarm is activated for any flow rate deviation greater than 5% in comparison with the normal flow rate.

A second check activates an alarm in the event of deviation of 1 ml in comparison with the anticipated infused volume, or if a flow rate greater than 20% is identified. The alarm is triggered by the deviation detected first.

The **Pilot** is fitted with an internal battery to continue operation in the event of a power cut. Furthermore, a safety fuse protects the mains from further disturbance.

1.5 Technical characteristics

1.5.1 Electrical

- Power supply: 230 V - 50-60 Hz.
- Max. consumption : 23 VAC.
- Fuse F2: 100 mAT 250 V IEC 127.
- Battery: 6 V - 1.1 Ah.
- External power supply: 12 - 15 V DC - 15 W.

1.5.2 Electronics

The **Pilot** syringe pump is fitted with 3 circuit boards:

- Motor power supply and control board.
- CPU board.
- Keyboard display board.

1.5.3 Mechanical characteristics

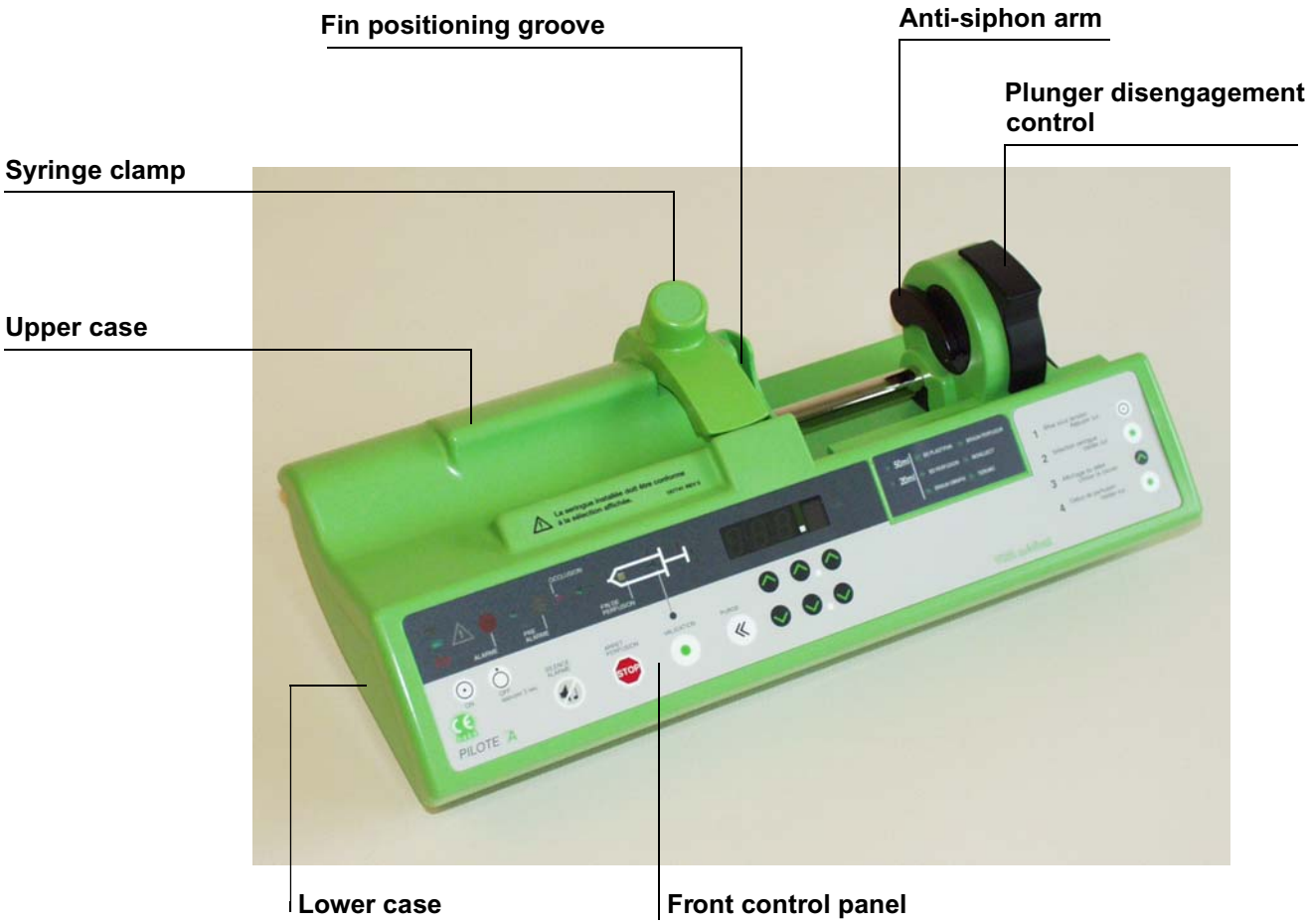
- Overall dimensions H x W x D: 120 x 330 x 155 mm.
- Weight: 2.2 kg approx.

1.5.4 Conformity, standards

- In compliance with the European Directive 93/42 EEC related to Medical Equipment: CE0459.
- In compliance with the European Directive 89/336 EEC: Electromagnetic compatibility.
- Compliant with the standards EN 60601.2 and PrEN60601-2-24.
- Protection against leakage currents: CF type.
- Protection against electric shock: Class II.
- IP34 : Protection against ingress of liquid

2 Description and operation

2.1 Physical description



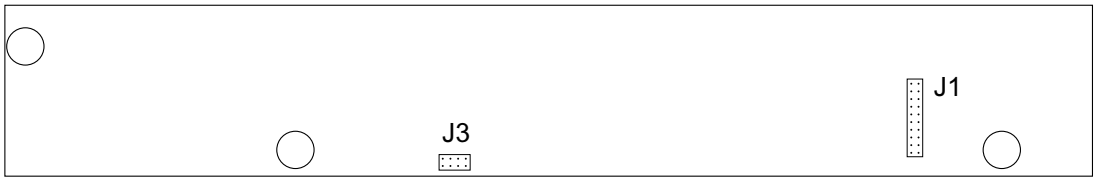
The **Pilot A** is composed of an upper case and a lower case.

- The upper case holds the syringe clamp and contains:
  - A display board associated with the front control panel.
  - A CPU board.
- The lower case contains:
  - A power supply board and a storage battery.
  - A mechanical base unit.
  - A plunger unit.

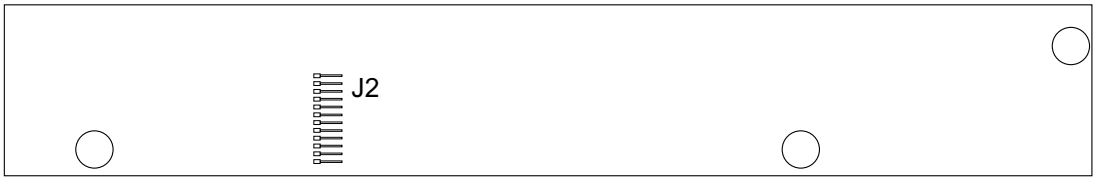
2.1.1 The display board and the front panel

The display board is mounted under the front control panel and is fitted with all the items required for man-machine interaction.

- Input keyboard.
- Control lamps and overview diagrams.
- 7-segment display units.



Solder side display board.



Component side display board.

This board is connected to the different parts of equipment by means of connectors.

J1 connector to CPU board

Pin	Description	
1	SEG1 display matrix	Line 1
2	SEG2 display matrix	Line 2
3	SEG3 display matrix	Line 3
4	SEG4 display matrix	Line 4
5	SEG5 display matrix	Line 5
6	SEG6 display matrix	Line 6
7	SEG7 display matrix	Line 7
8	SEG8 display matrix	Line 8
9	COL1 display matrix	Column 1
10	COL2 display matrix	Column 2
11	COL3 display matrix	Column 3
12	diode FAIL control	Fail
13	COL/DIG 9 LED type control	"
14	LIG1 keyboard interface	Line 1
15	LIG2 keyboard interface	Line 2
16	LIG3 keyboard interface	Line 3
17	LDSECT lighting control	Mains LED
18	+5V power supply	
19	VBAT power supply	
20	GND power supply	

J2 connector to keyboard

Pin	Description
1	Column 1
2	Column 2
3	Column 3
4	Column 4
5	Column 5
6	Column 6
7	Line 1
8	Line 2
9	Line 3
10	TON
11	TOFF
12	Gnd power supply

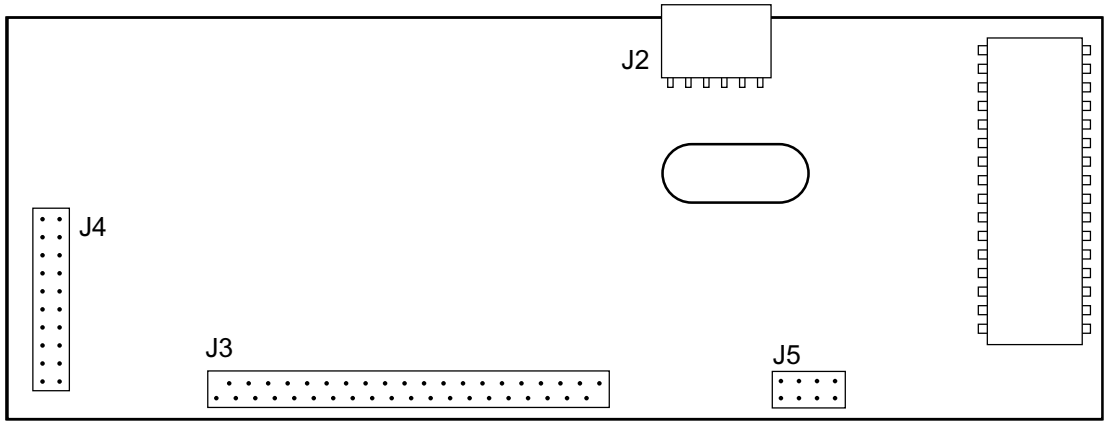
J3 connector to CPU board

Pin	Description
1	TON on key
2	TOFF off key
3	SPI SI bus
4	SPI CLK bus
5	SPI CSLCD bus
6	BUZZER buzz control
7	VBAT power supply
8	Gnd power supply

2.1.2 CPU board

The CPU board holds an 80C32 microcomputer. It is mounted and connected to the display board by connectors J4 and J5.

A ribbon cable connects this to a power supply board by means of a connector J3.



CPU board

J2 connector to fin detection switch and syringe detection opto-electronic sensor

Pin	Description
1	Opto anode diode +5V
2	Common points between cathode diode and opto 1 and opto 2 transistor emitters.
3	Opto 1 transistor collector
4	Opto 2 transistor collector

J3 connector to power supply board

Pin	Description
1	+5V controlled power supply
2	Gnd power supply
3	+VBAT power supply
4	Gnd power supply
5	Phase A motor control
6	Phase B motor control
7	Phase C motor control
8	Phase D motor control
9	I signal motor control
10	BOOST signal motor control
11	Sopt1 opto rotation motor output
12	Sopt2 opto anti-siphon
13	n.u.
14	Cdopt1 opto rotation motor control output
15	Cdopt2 opto anti-siphon module control
16	OFF signal off key pressed
17	SECT mains supply presence signal
18	CDALIM power cut signal
19	LDSECT mains LED control
20	CTS clear to send Line 2

J3 connector to power supply board

Pin	Description	
21	DEB/OFF disengagement signal	
22	RTS request to send	Line 2
23	OCC/OFF stoppage signal	
24	BUZ nurse call relay control	
25	EOC end of adc conversion	
26	CSADC spi adc bus select	
27	CLK spi adc bus clock	
28	SI data in spi adc bus	
29	SO data out spi adc bus	
30	CDANA analogue sensor power supply control	
31	Rx2 receive data ttl	Line 2
32	Tx2 transmit data ttl	Line 2
33	Txd1 transmit data ttl	Line 1
34	Rxd1 receive data ttl	Line 1
35	TON on key	
36	TOFF off key	
37	+VBAT power supply	
38	Gnd	
39	+5V	
40	Gnd	

J4 connector to keyboard

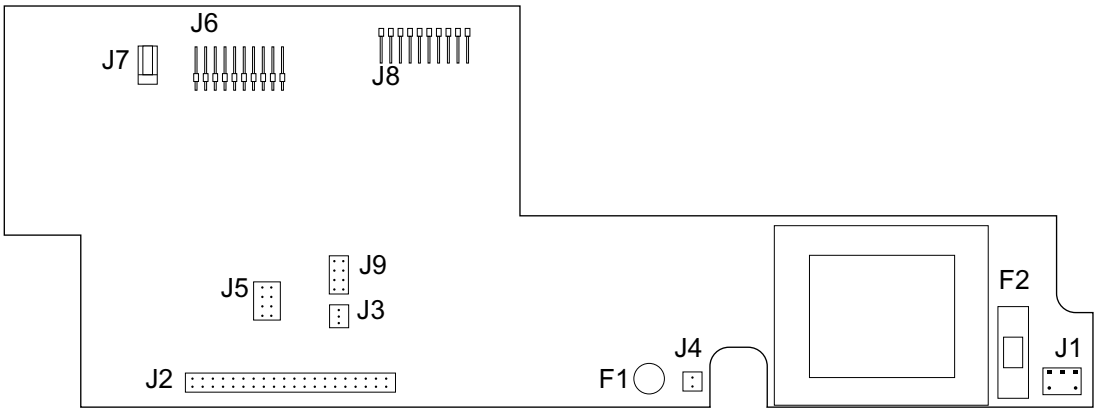
Pin	Description	
1	SEG1 display matrix	Line 1
2	SEG2 display matrix	Line 2
3	SEG3 display matrix	Line 3
4	SEG4 display matrix	Line 4
5	SEG5 display matrix	Line 5
6	SEG6 display matrix	Line 6
7	SEG7 display matrix	Line 7
8	SEG8 display matrix	Line 8
9	COL1 display and keyboard matrix	Column 1
10	COL2 display and keyboard matrix	Column 2
11	COL3 display and keyboard matrix	Column 3
12	FAIL LED control fail	
13	RSCRT display power reduction control	
14	LIG1 keyboard interface	Line 1
15	LIG2 keyboard interface	Line 2
16	LIG3 keyboard interface	Line 3
17	LDSECT mains LED control	
18	+5V power supply	
19	VBAT power supply	
20	Gnd power supply	

J5 connector to display board

Pin	Description
1	TON on key
2	TOFF off key
3	SI bus spi
4	CLK bus spi
5	CSLCD bus spi
6	BUZZ buzzer control
7	VBAT power supply
8	Gnd power supply

2.1.3 Power supply board and battery

The power supply board is mounted on the bottom of the lower case. It supplies all electronic parts using the mains 230 V AC or the external 12 V DC. It also provides electrical supply to the 1.1 or 1.2 Ah battery.



Power supply board.

This board is connected to the different items of equipment by means of connectors.

J1 connector to mains power supply board

Pin	Description
1	Neutral
2	Phase

J2 connector to CPU board

Pin	Description
1	+5V controlled power supply
2	Gnd power supply
3	+VBAT power supply
4	Gnd power supply
5	Phase A motor control
6	Phase B motor control
7	Phase C motor control
8	Phase D motor control
9	I signal motor control
10	BOOST signal
11	Sopt1 opto rotation output module
12	Sopt2 opto anti-siphon output module
13	N.U
14	Cdopt1 opto rotation control module
15	Cdopt2 opto anti-siphon control module
16	OFF off signal key pressed (ON/OFF)
17	SECT mains supply presence signal
18	CDALIM power cut signal
19	LDSECT mains LED control
20	CTS clear to send
21	DEB/OFF disengagement signal active at 0

J2 connector to CPU board

Pin	Description	
22	RTS request to send	
23	OCC/OFF occlusion signal active at 0	
24	BUZ nurse call relay control	
25	EOC end of ADC conversion	
26	CSADC SPI ADC bus select	
27	CLK SPI ADC bus clock	
28	SI data IN SPI ADC bus	
29	SO data out SPI ADC bus	
30	CDANA analogue sensors power supply control	
31	RX2 TTL receive data	Line 2
32	TX2 TTL transmit data	Line 2
33	TXD1 TTL transmit data	Line 1
34	RXD1 TTL receive data	Line 1
35	TOFF OFF key	
36	TON ON key	
37	+VBAT power supply	
38	Gnd	
39	+5V	
40	Gnd	

J3 connector to potentiometer

Pin	Description
1	VREF
2	Centre point
3	Gnd

J4 connector to internal battery

Pin	Description
1	+ battery
2	- battery

J5 connector to motor

Pin	Description
1	+VBAT
2	+VBAT
3	Phase D
4	Phase C
5	Phase B
6	Phase A
7	Opto rotation anode diode /+5V
8	Opto rotation cathode diode
9	Opto rotation transistor collector
10	GND/ opto rotation transistor emitter

J6 connector to RS232 and Master plugs

Pin	Description	
1	TX1 transmit data	Line 1
2	+5V	
3	RX1 receive data	Line 1
4	Gnd	
5	Interface validation	
6	Nurse call relay common point	
7	Nurse call relay normally open	
8	Nurse call relay normally closed	
9	CD ON external on	
10	CD OFF external off	
11	I-OPTON motor output control	
12	I-SECT mains LED	
13	+VBAT external power supply plug	
14	RX2 receive data	Line 2
15	TX2 receive data	Line 2
16	Gnd	
17	CTS	
18	RTS	

J7 connector to external DC power supply

Pin	Description
1	± external power supply
2	± external power supply

J8 connector to disengagement micro-switch, force sensor and anti-siphon switch

Pin	Description
1	+VREF + internal gauge bridge
2	E1 Internal gauge bridge input / occlusion ON
3	E2 Internal gauge bridge input / occlusion ON
4	Gnd – internal gauge bridge
5	Opto anti-siphon LED cathode
6	Opto anti-siphon LED anode / +5V
7	Opto anti-siphon transistor collector
8	Disengagement micro-switch ON
9	Disengagement micro-switch OFF
10	Gnd

Remember to dismount the ribbon cable holder on the power supply board before extracting the mechanical assembly from the case (the ribbon cable may break).

J9 connector, test points

Pin	Description
1	gnd
2	Position sensor output
3	Battery discharge control output
4	Amplified force sensor output
5	n.u.
6	Motor control optical switch output
7	Force and position sensor reference voltage
8	Piston head detection optical switch output

2.1.4 Mechanical base unit

The mechanical base unit is composed of a motor-reducer block driving a screw-and-nut unit. At the shaft end, the motor receives a control panel associated with an opto-electronic switch.

The mechanical base unit also accommodates a potentiometer fitted with a rack pinion system.

2.1.5 Mechanical plunger unit

The mechanical plunger unit is mounted onto the mechanical base unit. The latter carries out the long travel guiding and displacement of the plunger by means of the screw-and-nut system.

The plunger is fitted with a disengagement control allowing to separate it from the screw-and-nut system.

2.2 Functional description

From a functional point of view, the **Pilot A** is composed of three sub-assemblies :

- A syringe position control and maintenance sub-assembly.
- A motorisation sub-assembly.
- An external connection sub-assembly.

2.2.1 Syringe control and maintenance sub-assembly

The syringe if fitted into the upper case and held in position by means of a syringe clamp. Accurate positioning of fins is carried out by the syringe clamping groove.

Detection of the syringe size (60 cc or 20 cc) is carried out by two opto-electronic sensors mounted onto the syringe clamp.

Associated with an opto-electronic sensor, the anti-siphon arm controls the piston position.

Composed of a micro-switch fitted to the plunger, an anti-occlusion system triggers an alarm whenever force on the piston is excessive.

2.2.2 Motorisation sub-assembly

This sub-assembly moves the piston in the syringe.

It is put into motion by means of a motor-reducer unit associated with a screw-and-nut system.

A motor rotation disk mounted on the shaft end of the motor and associated with an opto-electronic sensor controls the rotation.

A potentiometer controls the plunger movement by means of a rack pinion system.

A micro-switch allows for control of the disengagement device.

2.2.3 External connection sub-assembly

The **Pilot A** has three connectors located at the rear end of the lower case:

- A 12-15 V DC, 15 W type external power supply connector.
- An optional RS 232 connector.

3 Description of the menus

3.1 Configuration menu of the basic operation parameters

The configuration menu enables users to adapt the **Pilot** to specific needs. It provides access to the menus allowing for customisation of the parameters associated with basic operation modes.

Fresenius Vial recommends users to implement the selected configuration procedures in the presence of qualified personnel or an employee of the technical department.

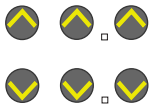
It is possible to exit the configuration mode at any time by pressing the OFF *key.*

This menu enables users to:

- PAr 1: Select the type of flow rate memorisation.
- PAr 2: Select the syringe selection mode.
- PAr 3: Modify the maximum flow rates which can be selected using the keyboard.
- PAr 4: Configure the list of syringes that can be selected.
- PAr 5: Select compulsory draining.
- PAr 8: Select the Master mode.
- PAr 9: Select the RS232 communication speed.
- PAr A: Select the empty syringe mode.

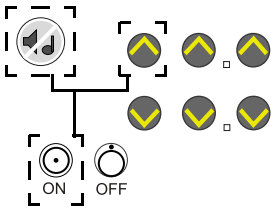
3.1.1 Access to menus

Keys used

Key	Function
	**ON**, is used to switch the machine on. **OFF**, is used to switch the machine off and, when pressed for over three seconds, to exit the configuration mode.
	**SILENCE ALARME**, is used to access the configuration mode of the current operation parameters.
	The selection keys allow to scroll the figures and letters on the tens, units, tens segments etc.
	**VALIDATION**, is used to validate a choice.
	**STOP**, is used to cancel the current configuration.

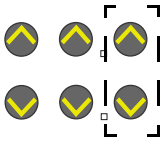
Switch to configuration mode.

- Press "SILENCE ALARME" and "DIZAINE" (TENS) simultaneously.
- Maintain this position while pressing "ON".



- When PAr is shown on the display unit, release the selection of "SILENCE ALARME" and "DIZAINE" (TENS) Validate within three seconds by pressing "VALIDATION".

- PAr 1 is shown by default.
- Switching from PAr 1 to PArA is carried out using the "tens" keys.



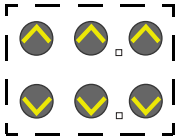
3.1.2 PAr 1, configuration of the memorisation type

This configuration enables users to choose whether or not to memorise the infusion flow rate when the **Pilot** is shut down.

- PAr 1, press "VALIDATION"

  - If MEM, the flow rate is memorised when the **Pilot** is shut down, this value will be displayed by default when the machine is next switched on.
  - If noME, the flow rate is not memorised, the default value is 00.0 each time the machine is switched on.

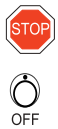
    - Select the memorisation type using the selection keys.



  - By validating once again, the type is memorised and it is possible to select another configuration .

The modification can be cancelled by pressing the "STOP" key.

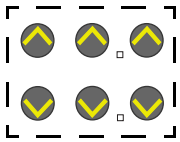
It is possible to exit the configuration mode at any time by pressing the "OFF" key.



3.1.3 PAr 2, configuration of the syringe selection type

This configuration enables users to choose the type of syringe selection.

- PAr 2, press "VALIDATION"
  - If SEL 1, automatic scrolling of the various types of syringues available, every 5 seconds.
  - If SEL 3, automatic validation of the only syringe that can be selected.
  - If SEL 4, when the **Pilot** is switched on, the user needs to select the type of syringe installed.
  - Choose the selection type using the selection keys.

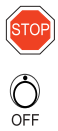


  - By validating once again, the type is memorised and it is possible to select another configuration .

*When mode SEL 3 is selected, and if there is a choice of more than one syringe, the **Pilot** automatically moves onto the configuration of the list of syringes that can be selected PAr 4 when the machine is next switched on.*

The modification can be cancelled by pressing the "STOP" key.

It is possible to exit the configuration mode at any time by pressing the "OFF" key.

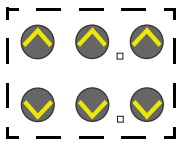


3.1.4 PAr 3, configuration of the maximum flow rate that can be selected by the keyboard.

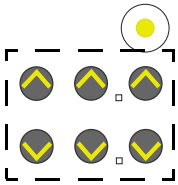
This configuration enables users to choose the maximum flow rate that can be selected using the keyboard for each type of syringe.

Syringe type	Min. flow rate (ml/hr)	Max. flow rate (ml/hr)
50/60 cc	0,1	120
20 cc	0,1	60

- PAr 3, press "VALIDATION"
  - Select the syringe type using the keys.
    - 20c, 20 ml.
    - 50c, 50 ml.



□ Press "VALIDATION"

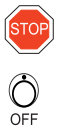


- Select the maximum flow rate using the keys.

□ By validating once again, the type is memorised and it is possible to select another configuration .

The modification can be cancelled by pressing the "STOP" key.

It is possible to exit the configuration mode at any time by pressing the "OFF" key.



3.1.5 PAr4, configuration of the list of syringes that can be selected

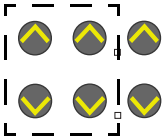
This configuration enables users to choose whether or not it can be selected for each type of active syringe.

■ PAr4, press "VALIDATION"

□ The LED of the syringe to be configured (50ml ou 20ml) flashes.

- If SEL , this type of syringe can be selected, in the configuration of the **Pilot** list.
- If noSEL , this type of syringe cannot be selected, in the configuration of the **Pilot** list.

□ Make your choice (whether it can be selected or not) using the keys.

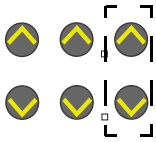


■ Press "VALIDATION" to memorise the modification.

□ The LED of the configured syringe is:

- On, if it can be selected.
- Off, if it cannot be selected.

*Pressing the "tens" key once displays the name of the syringe (see chapter 3 "**Syringe/name match table**").*



The modification can be cancelled by pressing the "STOP" key.

It is possible to exit the configuration mode at any time by pressing the "OFF" key.

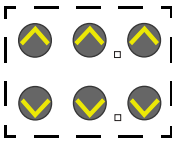
3.1.6 PAr 5, configuration of the compulsory priming

This configuration enables users to choose whether or not draining is compulsory after the syringe is selected.

■ PAr 4, press "VALIDATION"

- □ If Pur G, compulsory draining, pressing "BOLUS" during start-up is compulsory to be able to select the flow rate.
- □ If noPu, draining is not compulsory, the flow rate may be selected upon start-up straight after the syringe is validated.

□ Make your choice using the keys.



□ By validating once again, the type is memorised and it is possible to select another configuration.

The modification can be cancelled by pressing the "STOP" key.

It is possible to exit the configuration mode at any time by pressing the "OFF" key.

3.1.7 PAr 8, configuration of Master mode

This configuration allows to select between normal and Master modes.

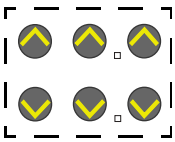
*In order to control a Pilot with a PC, users need to transmit the request using the appropriate command (see the RS232 link protocol for the **Pilote** computer interface).*

■ Pdr 8, press "VALIDATION"

- □ if - SP -, the pilot operates in a normal way.

□ if MASt, the pilot operates in Master mode.

- ♦ At start-up, the MAST message flashes. The pilot is expecting a command to switch to Master mode.
- ♦ The pilot keyboard is locked and an alarm is heard whenever it is used.



□ By validating once again, the type is memorised and it is possible to select another configuration.

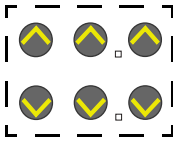
The modification can be cancelled by pressing the "STOP" key.

It is possible to exit the configuration mode at any time by pressing the "OFF" key.

3.1.8 PAr 9, configuration of the RS232 communication speed

This configuration enables the user to select the communication speed of the RS232 link.

- PAr 9, press "VALIDATION"
  - If 19t2, speed at 19,200 Bauds.
  - If 19t2, speed at 9,600 Bauds.
  - If 4800, speed at 4,800 Bauds.



  - Make your choice using the keys.
  - By validating once again, the type is memorised and it is possible to select another configuration.

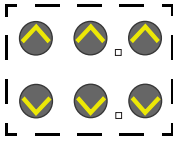
The modification can be cancelled by pressing the "STOP" key.

It is possible to exit the configuration mode at any time by pressing the "OFF" key.

3.1.9 PAr A, configuration of the empty syringe mode

This configuration enables users to select a type of operation for the instrument using the empty syringe mode.

- PAr A, press "VALIDATION"
  - If SU id, empty syringe mode activated.
  - If SU id, empty syringe mode desactivated.



  - Make your choice using the keys.
  - By validating once again, the type is memorised and it is possible to select another configuration.

The modification can be cancelled by pressing the "STOP" key.

It is possible to exit the configuration mode at any time by pressing the "OFF" key.

3.1.10 Syringe/name match table

Brand	Capacity (ml)	Name	Number
BD Perfusion	50	BPf	1
BD Plastipak	60	BDL	2
BD Plastipak	20	BDL	3
Braun Omnifix	50	BrO	4
Braun Perfusor	50	BrP	5
Braun Omnifix	20	BrO	6
Didactic Line	60	DiL	7
Fresenius Injectomat	50	FrI	8
Map Gliss	50	MGL	11
Monoject	60	SMJ	12
Terumo	50	Trm	13
Terumo	20	Trm	14
Monoject	20	SMJ	15
Didactic Perfusion	60	DiP	16
Dipomed Spritze	50	Dis	17
Fresenius P Spritze	50	FrP	18
Tutoject type T	50	DsP	19
Ivac	50	IVa	20
Braun Perfusor	20	BrP	24

3.2 Calibration menu

The calibration menu is reserved for authorised personnel only.
To determine the operation mode of the different calibrations, refer to the "Calibrations" chapter

This menu allows for calibration:

- CAL4 : of the three levels of battery voltage alarms.
- CAL6 : of the displacement potentiometer.

3.3 Service test menu

The service test menu is reserved for authorised personnel only. It enables users to perform a series of **Pilot** inspections to validate its operation (see **"Checks"**chapter). This must be carried out each time parts are replaced.

The Service tests may also be performed more easily and more quickly using a PC with installed maintenance software (consult our After Sales Service).

The service test menu enables users to perform a series of 15 tests or checks:

- tSt 1: Displays the running time and the maintenance date.
- tSt 2: Indicator lights test.
- tSt 3: Keyboard test.
- tSt 4: Displays the battery voltage.
- tSt 5: Displays the codes of the last 10 alarms.
- tSt 6: Displays the total running time.
- tSt 7: TTL serial link test.
- tSt 8: RS 232 serial link test.
- tSt A: Displays the software version.
- tSt b: Displays the analogue input.
- tSt C: Displays the plunger position.
- tSt d: Buzzer test.
- tSt E: Displays the calibration values.
- tSt F: Displays the syringe type.
- tSt G: Displays the syringe group.

4 Preventive maintenance

4.1 Recommendations

The **Pilot** syringe pump can only be inspected, serviced or repaired by **Fresenius Vial** or by an authorised and appointed service. The qualified technicians in your establishment and our After Sales Service should be notified of any abnormal operation of the device.

If a repair is necessary, send the instrument in its original packaging if possible with a precise description of the observed fault, to the official dealer for **Fresenius Vial**.

For further information concerning troubleshooting or the usage procedure, please contact our After Sales Service or our Sales Department.

Fresenius Vial is not liable for loss or damage to the equipment during transport to our After Sales Service.

4.2 Maintenance schedule

4.2.1 Use beyond the framework of the departmental order

Frequency	Name
12 months	Carry out a servicing inspection.
3 years	Replace the battery (see "Battery-holder and battery" operation sheet).

4.2.2 Use within the framework of the departmental order

When the equipment is used within the framework of the departmental order of October 3 1995, inspections are performed on a less frequent basis. This is due to the fact that the equipment is inspected before each use.

Frequency	Name
1st inspection in the 3rd year	Perform the first servicing inspection.
Then every 2 years	Perform a servicing inspection.
3 years	Replace the battery (see "Battery-holder and battery" operation sheet).

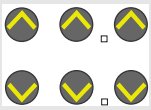
4.3 Checks

In order to perform equipment follow-up by means of preventive maintenance, a regular servicing inspection is recommended every 12 months (see “Regular servicing sheet”).

To ensure the check procedure is carried out efficiently, recharge the battery beforehand (16 hours).

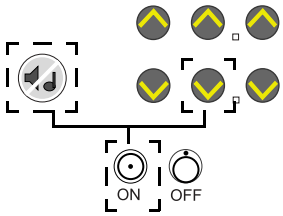
4.3.1 Test access

Keyboard description.

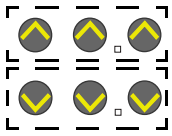
Key	Function
	**ON**, is used to switch the machine on. **OFF**, is used to switch the machine off when pressed for over three seconds.
	**SILENCE ALARME**, is used to access the test mode.
	**STOP**, is used to cancel the test in progress.
	**VALIDATION**, is used to validate a choice.
	"PRESSURE LIMIT", is used for the backpressure test.
	The selection keys allow to scroll the figures and letters on the tens, units, tens segments etc.

Activate the service test.

- Press "SILENCE ALARME" and "UNITS" keys simultaneously.
- Maintain this position while pressing "ON".



- When tSt. is displayed on screen, release selection of the "SILENCE ALARME" and "UNITS" keys, then validate within three seconds by pressing the "VALIDATION" key.
- By default, the equipment starts with test n°1 tSt.1
- By using the selection keys "+ or -", scroll the different tests on the display unit.



4.3.2 Visual check

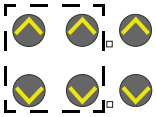
Check the general appearance of the case and labels, and check for any traces of shock.

4.3.3 Running time and servicing inspection date

This test allows for display of the **Pilot** running time since its last serving inspection. It also allows for display and modification of the “last” servicing inspection date. When the servicing inspection date is modified, the running time is reset.

- TST.1, press the "VALIDATION" key.
  - If ___.H: number of hours of use, 999 hours max.
  - If ___.d: number of days of use, 999 hours max.
  - If ___.M : number of months, 999 months max. (average duration of one month considered as 30 days).
- Press "VALIDATION" again to display the date of the last servicing inspection.
  - __.d, day of the servicing inspection date.
  - Validate once again,
    - __.M, month of the servicing inspection date.
  - By validating once again,
    - ____.__, year of the servicing inspection date.

Each time this information is read, the month, day and year of the servicing inspection date may be modified by using the tens and units "- and +" keys. This date will be stored in the EEPROM and the running time will be reset.



- By validating once again, a different test may be selected.

The test may be stopped at any time by pressing the "STOP" key, and a different test may be selected.

4.3.4 Indicator lights check

This test checks the efficiency of the indicator lamps, the display units and the front panel LCD screen.

- TST.2, press "VALIDATION".
  - All LEDs, 7-segment display units are ON.
  - By validating once again,
    - The LEDs and display units are scrolled one by one from left to right. (display of the LEDs, 7-segment display unit by segment and then by sets of 8.

The text is OK if all indicator lamps are lit up.

The test may be stopped at any time by pressing the "STOP" key, and a different test may be selected.

Preventive maintenance

4.3.5 Keyboard check

This test allows to check that all keyboard keys function correctly.

■ tSt.3, press "VALIDATION".
- ☐ The message CLAU is displayed.
- ☐ Keep each key pressed down, one by one,
  - ♦ Check the name of the key displayed on the display unit.

The name of each key is displayed as follows:

Display	Selected key
S IA.L	SILENCE ALARME
StoP	STOP
UAL	VALIDATION
boLu	BOLUS
S -..	+ tens
S.-	+ units
S..-	+ tens
S _..	- tens
S._.	- unit
S _..	- tens

If two or more keys are pressed simultaneously, the display unit shows Err *and three beeps are heard, indicating an error.*
The "OFF" key is not included in the keyboard test.

The test may be stopped at any time by pressing the ***"VALIDATION" key for over 3 seconds****. Another test can then be selected.*

If the display is faulty, replace the display board (see “Display and CPU boards”).

4.3.6 Checking the battery voltage

This test enables users to display the battery voltage in Volts and tenths of a Volt.

- tSt.4, press the "VALIDATION" key.
  - The voltage is displayed in Volts.
  - By validating once again, a different test may be selected.

4.3.7 Testing the last 10 alarms

This test enables users to display the last ten **Pilot** alarms.

- tSt.5, press the "VALIDATION" key.
  - The code of the most recent alarm is displayed ___.0.
  - Press the keys to display the following codes for ___.1 to ___.9.
  - By validating once again, a different test may be selected.

Meaning of the codes:

Alarm	Description	Error	Description
A10	Battery alarm	E50	ADC access self-test error.
A11	Syringe clamp alarm	E60	Error on: verification of syringe parameter consistency (inconsistency of the syringe diameter in relation to the motor pitch for 0.1 ml calculated at the time of syringe validation).
A12	End of infusion alarm	E70	Error on: motor frequency fault (motor pitch period calculated in relation to the syringe diameter and the flow rate selected, either too low or too high).
A13	Volume limit alarm	E80	Keyboard error or high electromagnetic interference (with V7.OC memory only).
A14	Disengagement alarm	E01	Rotation control error.
A15	Piston head alarm	E32	Error on: segment advance control
A16	Occlusion alarm	E52	Error on: advance during compensation for play.
		E72	Error on: advance over the whole length.
		E03	Communication error

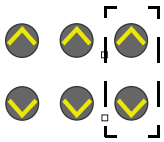
- Errors 10, 20, 30 and 40 cannot be stored in EEPROM.
- For a standard shutdown, the OF message is displayed.
- For a standard shutdown, OFF is displayed with a flashing F.

4.3.8 Total running time check

This test enables users to display the total running time of the **Pilot**. It is not possible to modify this time manually.

■ tSt.6, press the "VALIDATION" key.

- □ If ___.H: number of hours of use, 999 hours max.
- □ If ___.d: number of days of use, 999 days max.
- □ If ___.n : number of months, 999 months max.
  (average duration of one month considered as 30 days).
  - ♦ By keeping the "tens" keys pressed down, the number of times the equipment has been switched on is displayed.



- □ By validating once again, a different test may be selected.

4.3.9 TTL serial link test

This check only applies to CE2 Pilots.

4.3.10 RS 232 serial link check

This test enables users to check the efficiency of the RS232 (2691) serial link.

To perform this test, use a plug on which lines Rx and Tx, RTS and CTS are short-circuited (2 and 3, 7 and 8) on the RS232.

■ tSt.8, press the "VALIDATION" key.

- □ noUA is displayed if the UART is absent, the test cannot be performed.
- □ Operation test of the RTS and CTS lines.
  - ♦ If the test is unsuccessful norC is displayed, the test cannot go on.
- □ Lr is displayed.
  - ♦ If LrEt is displayed, the test is successful.
  - ♦ If LrEr is displayed, the test is unsuccessful.
- □ By validating once again, a different test may be selected.

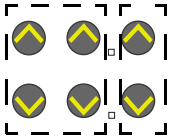
It is impossible to carry out this test when the PC is in communication with the Pilot. In this case, “OPEN” is displayed.

4.3.11 Checking the software version.

Run this test to display the software version and revision numbers.

■ tSt.A, press the "VALIDATION" key.

- ☐ ex. U07.0 is displayed:
  - ♦ 07, software version number.
  - ♦ .0, revision number
- ☐ Press on the tens keys to display the Eprom checksum. Ex.: 738.C.



- ☐ Press on the other keys to display the software version index. Ex.: b.
- ☐ By validating once again, a different test may be selected.

4.3.12 Checking the ADC

Run this test to read the result of the conversion of the five analogue inputs and three test inputs of the converter.

■ tSt.b, press the "VALIDATION" key.

- ☐ The result displayed is the first of the five analogue inputs (from 0 to 4). Ex.: 318.0.
- ☐ The second type of result displayed corresponds to the converter test based on the channel number, ...L is test input 0, ...M is the mid-scale test and ...H is the full-scale test for the ADC.

Use the "-" and "+" selection keys to move from one input to another.

4.3.13 Checking the position sensor

This test enables users to display the plunger position in mm and ten^{ths} of a mm.

■ tSt.C, using spacers ref. T300940E and T300775G,

- ☐ Position the spacer ref. T300940E and press "VALIDATION".
  - ♦ In the Up position the LCD screen shows 115.0 ± 0.5 mm.
- ☐ Position the spacer ref. T300940E and press "VALIDATION".
  - ♦ In the Down position the LCD screen shows 20.0 ± 0.5 mm.
- ☐ By validating once again, a different test may be selected.

If the value is out of limits, recalibrate the position sensor (see "CtA.6 Position sensor calibration.").

4.3.14 Buzzer test

Run this test to check that the buzzer is working.

■ tSt.d, press the "VALIDATION" key.

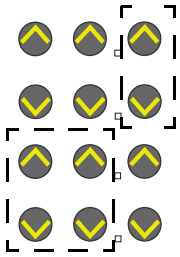
- ☐ The buzzer rings non stop and bEEP is displayed.
- ☐ By validating once again, a different test may be selected.

4.3.15 Displaying the calibration values

Run this test to display the calibration values stored in the EEPROM.

■ tSt.E, press the "VALIDATION" key.

- ☐ bAt.1 is displayed alternately with its calibration value.
  - ♦ Press a Tenths key to display the calibration number of that value



- ☐ Press a Unit or Tens key to move onto other values.

Display	Name
bAt.1	Alarm and pre-alarm battery voltage 6.3 V
bAt.2	Pre-alarm battery voltage 5.9 V
bAt.3	Alarm battery voltage 5.7 V
HIG.H	Displacement potentiometer with large 115.0 mm spacer
Lou	Displacement potentiometer with small 20.0 mm spacer
0.G	Force meter with 0 kg
5t.G	Force meter with 5 kg

4.3.16 Checking the syringe clamp

This test displays the type of syringe fitted to the **Pilot**.

■ tSt.F, press the "VALIDATION" key

using a 50 cc and 20 cc capacity syringe or the T301521 spacer.

- ☐ Place the syringe clamp in the higher position.
  The display shows ---.-
- ☐ Position the 50cc syringe or the T301521 spacer, 50cc mini/maxi. The display shows 50c.c
- ☐ Position the 20cc syringe or the T301521 spacer, 20cc mini/maxi. The display shows 20c.c
- ☐ Place the syringe clamp in the lower position.
  The display shows ---.-

Capacities which are non-existent or non-configured in the EEPROM are displayed in the form of ---.- .

- ☐ By validating once again, a different test may be selected.

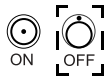
4.3.17 Checking the syringe group number

This test allows to display the list of syringes for which the equipment has been configured.

- ■ tSt.G, press the "VALIDATION" key.
  - □ The syringe group number programmed EEPROM is displayed, e.g. G01.
  - □ By validating once again, a different test may be selected.

4.3.18 Checking the disengagement

To carry out this operation, exit the test mode, press “OFF”.



- ■ Press "ON".
  - □ Lift the disengagement lever.
    - ♦ Check the mechanical disengagement alarm (red LED at the end of the syringe diagram).
  - □ Fit the 50 cc syringe onto the equipment, ensuring the fin and plunger are in position.
  - □ Release the disengagement lever.
    - ♦ Check that there is no mechanical lever release alarm.
    - ♦ Check that the plunger is locked.

4.3.19 Checking the anti-siphon arm

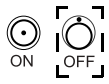
This check must be carried out for every syringe provided with the equipment.

- ■ Check the functionality.
  - □ Free travel, with no shaft play, and no dismounting of the latter.
- ■ Check that there is an alarm by locking only the syringe body in the clamp.
  - □ Anti-siphon arm in the upper position.
  - □ Anti-siphon arm in the lower position.

Check that no alarm goes off with spacers T301519 and T301518.

4.3.20 Checking backpressure

To carry out this operation, exit the test mode, press “OFF”,



- ■ Press "ON".
  - □ Fit the 50 cc syringe on the equipment and lock it into position using the clamp, ensuring the fin and plunger are correctly positioned.
  - □ Place the manometer (or any other pressure measurement equipment) at the syringe outlet.
  - □ Select a 50 ml "B-D PLASTIPAK" syringe by pressing "VALIDATION".
  - □ Check the position of the backpressure adjustment button  .

- ☐ Select a maximum flow rate of 120ml/h and initiate the infusion by pressing the “VALIDATION” key.
  - Ensure there is no acoustic and visual alarm (backpressure LED off).
  - Check that the infusion LEDs flash correctly.
  - Ensure the alarm is triggered for a value of 0.7 bar ± 0.1 bar.
- ☐ Stop the infusion cycle by pressing the "ARRET PERFUSION" ("STOP INFUSION") key.

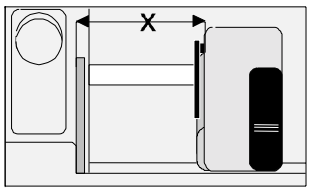
- ☐ Run this test again, adjusting the backpressure level to minimum and maximum levels.
  - Min. backpressure = 0.4 bar ± 0.1 bar.
  - Max. backpressure = 1.2 bar ± 0.2 bar.

The backpressure button should not be raised once the backpressure alarm threshold has been adjusted with the adjustment screw.

4.3.21 Checking the end of infusion pre-alarm

To carry out this operation, exit the test mode, press “OFF",

- ■ Press "ON".
  - ☐ Fit the syringe on the equipment, ensuring the fin and plunger are in position.
  - ☐ Check that the correct syringe is detected, e.g. 50c.c .
  - ☐ Select a 50 m/l "B-D PLASTIPAK" syringe filled to 20 ml.
  - ☐ Select a flow rate of 120 ml/h.
    - For normal flow rates, the pre-alarm is activated 5 minutes before end of infusion.
    - Flow rate example: > 72 ml/h, the pre-alarm is activated when the remaining volume equals 10% of the total syringe capacity.
    - Ensure the end of infusion pre-alarm is present.
  - ☐ Press the "SILENCE ALARME" and "TENS" simultaneously.
    - The acoustic alarm is silenced and the visual signal is maintained.
  - ☐ Measure the “hard height” at “end of infusion”.
    - 18.5 ≤ x ≤ 19.5.



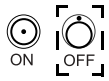
Top view

For accurate checking of the "hard height", do not move the plunger when measuring.

If the "hard height" reading is out of limits, recalibrate the position sensor (voir “Et A.5 Position sensor calibration.”).

4.3.22 Checking the linearity

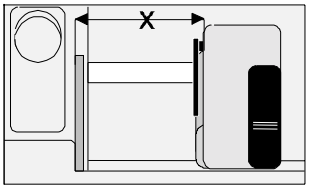
To carry out this operation, exit the test mode, press “OFF",



- Equipment required: Chronometer, calliper square, BD Plastipak 50 ml. syringe.

- Press "ON".

  - ☐ Fit the equipment with the "B-D PLASTIPAK" 50 ml syringe, ensuring the fin and plunger are in starting position.
  - ☐ Measure the distance X in mm.



Top view

  - ☐ Check that the correct syringe is detected, e.g. 50c.c .
  - ☐ Select a B-D PLASTIPAK" syringe filled to 50 ml.
  - ☐ Select a flow rate of 50 ml/h.
  - ☐ Press "VALIDATION" to start infusion and simultaneously start the chronometer

  - ☐ At 50 minutes, stop the infusion by pressing "STOP" and measure the distance X2.

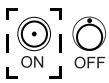
  - ☐ Ensure X = X1 - X2 lies between 74.96 mm ≤ X ≤ 76.47 mm.

For accurate checking of the linearity do not move the plunger when measuring.

4.3.23 Checking mains/battery operation

To carry out this operation, exit the test mode, press “OFF",

- Connect the equipment to a mains supply.
  - ☐ Check the operation of the mains presence Led (indicator in the shape of a plug).
- Connect the equipment to a test power supply.
  - ☐ Disconnect the equipment from the mains.
  - ☐ Remove the battery holder.
  - ☐ Remove the battery.
  - ☐ Remove the connection lugs.
  - ☐ Connect the battery lugs to a stabilised supply set at 6.3 V. Mind the polarities.
  - ☐ Press "ON".



  - ☐ Select a syringe from the syringe list proposed by the equipment.
  - ☐ Press "VALIDATION"

  - ☐ Select a flow rate and validate.

- ☐ Reduce the test power supply voltage until the battery discharge is triggered.
  - ♦ Ensure this is triggered between 5.8 V and 6 V.

The acoustic alarm can be temporarily silenced by pressing "SILENCE ALARME" (2 minutes).

- ☐ Reduce the test power supply voltage again until the battery discharge alarm is triggered.
  - ♦ Ensure this is triggered between 5. 6V and 5.8 V.

If the results obtained during the tests differ from the values indicated, recalibrate the battery voltage levels (see “Ɛ ŧ Я.Ч Calibration of the 3 battery voltage levels.”).

4.3.24 Battery autonomy test

■ Recharge the battery for 15 hours.

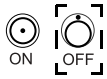
(100 % of capacity) Battery life is 5 hours minimum, with a 50 ml BD Plastipak syringe, with a flow rate of 5ml/h.

■ Run a battery life test greater than one hour.
- ☐ Select a flow rate of 120 ml/h for a 50 ml/h B-D Plastipak syringe, then validate.
- ☐ The "battery discharge" pre-alarm informs the user on the remaining time, between 60 minutes to 5 ml/h.
  - ♦ The "total battery discharge" will sound before the infusion is stopped.

4.3.25 Continuity test

Using a multimeter.

To carry out this operation, exit the test mode, press “OFF",



■ Connect the multimeter to an ohmmeter.
- ☐ Check the electrical resistance shown by the ohmmeter is over 10 MΩ:
  - ♦ between phase and metal tube.
  - ♦ between neutral and metal tube.

4.3.26 Regular inspection sheet

Use this table to note the results of the different tests.

Equipment type:	Code:	Equipment series N°:

N°	Procedure	Resulting value	Conformity Yes	Conformity No
1	■ Check the general condition of the case and its labels.			
2	■ Display total running time, tSt 1 (in hours, days or months):**********			
3	■ Display the last servicing inspection date, tSt 1 (in days, months or years):**********			
4	■ Check all indicator lights, tSt2.			
5	■ Check the keyboard, tSt3.			
6	■ Display the total running time, tSt6 (in hours, days or months):**********			
7	■ Check the position sensor, tStC: ☐ High position with T300940 spacer, check that the displayed value is 115.0 ± 0.5 mm: ********** ..... ☐ Low position with T300775 spacer, check that the displayed value is 20.0 ± 0.5 mm: **********			
8	■ Check the syringe clamp, tStF: ☐ Syringe clamp in high position, check that the displayed value is ---.- :********** ..... ☐ Position the 50cc syringe or the T301521 spacer, 50cc mini/maxi. Check that he value displayed is 50c.c :********** ..... ☐ Position a 20cc syringe or a T301521 spacer, 20cc mini/maxi. Check that he value displayed is 20c.c :********** ..... ☐ Syringe clamp in low position, check that the displayed value is ---.- :**********			
9	■ Check the anti-siphon arm: ☐ Free travel without end play. ☐ Presence of the alarm in high and low position. ☐ No alarm in presence of 20 cc and 50 cc syringe piston or T301519 et T301518 spacers.			
10	■ Check the backpressure (use a **Fresenius Vial** dynamometer): ☐ Position of adjustment knob  0.6 ≤ X bar ≤ 0.7: **********			
11	■ Check the end of infusion pre-alarm: ☐ Eg.: for a flow rate of 50 ml/hr with a 60 cc BD, check that the pre-alarm is triggered at 5 mn ± 10 s before the end of infusion: **********			

N°	Procedure	Resulting value	Conformity Yes	Conformity No
12	■ Check the end of infusion alarm: ☐ With a 60 cc BD, check that the hard height range is 18.5 ≤ x mm ≤ 19.5: **********			
13	■ Check the linearity (60 cc BD Plastipack): ☐ Measure the plunger starting position range, XI mm:********* ..... ☐ Measure the plunger range after 50 mn pump running, X2 mm: ..... ☐ Check: 74.96 ≤ X1-X2 mm ≤ 76.47: **********			
14	■ Check the battery autonomy: ☐ Recharge the battery for 15 hours. ☐ Operate the **Pilot** for 1 hr at a flow rate of 120 ml/hr:*********			
15	■ Carry out the electrical tests according to standard EN 60601-1			

Name:	**Date:**	**Signature:**

Comments:

4.4 Flow rate control

4.4.1 Measurement with a computer

ISDébit software is required for measuring the flow with a computer. This software is the property of **Fresenius Vial**. Please contact our After Sales Service for any further information.

The operation mode defined by this software follows the project protocol of standard PrEN-60-601-2-24 for **infusion pumps.** It is up to the user to adapt this procedure to the software used.

*In order to purchase the ISDébit flow rate control software, contact the **Fresenius Vial** customer service.*

The test procedure defined below must be carried out using a 50 ml or 20 ml syringe.

Equipment required

- Scales coupled to a microcomputer:

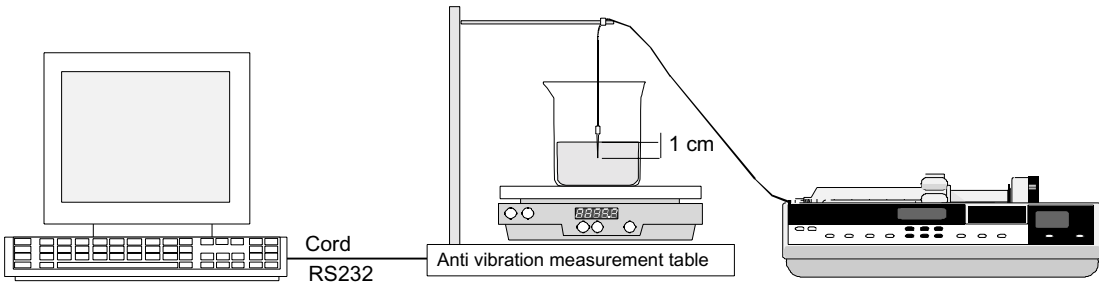
Flow rate value	Scales sensitivity
x ≤ 5 ml/hr	1/10000th
5 ml/hr < x ≤ 30ml/hr	1/1000th
x > 30 ml/hr	1/100th

- Multi scales acquisition programme.
- Test tube or beaker with 1 ml graduating
- Liquid: distilled water and oil
- Luer lock type plastic syringe (50 or 20 ml).
- Catheter extension with Luer Lock (length 100 cm, inside diameter 2,5 mm).
- Needle:

Flow rate value	Needle type
x ≤ 30ml/hr	G26
x > 30 ml/hr	G18 or G21

Installation

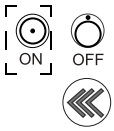
- According to the installation drawings shown below.



Make sure the horizontal installation plane is respected.

- Fill the syringe with 50 ml of distilled water.
  - ☐ Prime to eliminate any air bubbles.
- Secure the female Luer Lock end piece of the catheter extension onto the syringe and the male Luer lock end piece onto the needle.
- Fit the syringe onto the device.
- Fill the test tube ensuring the needle is dipped in the liquid (> 1 cm).
  - ☐ Add several drops of oil to create a greasy film on the surface of the liquid. This way the user will avoid any measurement error due to evaporation of the liquid.
- Place the test tube in the centre of the scales platform.
- Place the needle inside the test tube.

The infusion line (needle/catheter extension) must not rest on the scales/test tube assembly.



- Press "ON" (device in mains supply mode).
  - ☐ Prime the infusion line using the "BOLUS" key.
  - ☐ Check that there are no air bubbles.

Operating mode

The software works following the operating mode described in the PrEN-60-601-2-24 standard project for ***infusion pumps.***

- Start the acquisition programme for the scales.
- Enter the necessary data to launch the programme without validating the flow rate.
- Adjust the scales to the specified flow rate.
- Confirm the flow rate on the microcomputer so that the automatic setting of the scales can take place.
- Start the infusion by pressing the "CONFIRM" key, when 00.00 appears on the scales display screen.

- When the specified time is over, note the error percentage displayed on the screen.

4.4.2 Measurement with scales

Equipment required

- Stop clock
- Scales

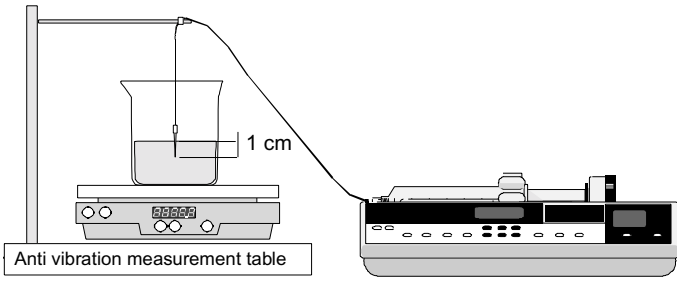
Flow rate value	Scales sensitivity
x ≤ 5 ml/hr	1/10000th
5 ml/hr < x ≤ 30ml/hr	1/1000th
x > 30 ml/hr	1/100th

- Test tube or beaker with 1 ml graduating
- Liquid: distilled water and oil
- Luer lock type plastic syringe (50 or 20 ml)
- Catheter extension with Luer Lock (length 100 cm, inside diameter 2,5 mm).
- Needle:

Flow rate value	Needle type
x < 30ml/hr	G26
x > 30 ml/hr	G18 or G21

Installation

- According to the installation drawings shown below.



Make sure the horizontal installation plane is respected.

- Fill the syringe with 50 ml of distilled water.
- Prime to eliminate any air bubbles.
- Secure the female Luer Lock end piece of the catheter extension onto the syringe and the male Luer lock end piece onto the needle.
- Fit the syringe onto the device.
- Fill the test tube ensuring the needle is dipped in the liquid (> 1 cm).
- Add several drops of oil to create a greasy film on the surface of the liquid. This way the user will avoid any measurement error due to evaporation of the liquid.
- Place the test tube in the centre of the scales platform.
- Place the needle inside the test tube.

The infusion line (needle/catheter extension) must not rest on the scales/test tube assembly.

- Press "ON" (device in mains supply mode).
  - ☐ Prime the infusion line using the "BOLUS" key.
  - ☐ Check that there are no air bubbles.

Operating mode

- Select a flow rate.

For low flow rates (< 5 ml/hr), validate and wait for the infusion to stabilise for 1 hour. For higher flow rates, wait for 10 to 30 minutes after infusion.

- Set the scales at 00.00 g.
- Start infusion by pressing the "CONFIRM" key, and start the stop clock at the same time, (if necessary make a note of the stop clock start value).
- Press the "STOP INFUSION" key to stop the test one hour later.
- Note the value in grams of the “infused” liquid.
- Calculate the difference between the design value and the real value.

1 gram = 1 ml.

- The error percentage can be calculated from this difference :

$$\frac{(\text{Real value} - \text{Design value})}{\text{Design value}} \times 100 = \text{Error percentage}$$

4.4.3 Measurement using a test tube

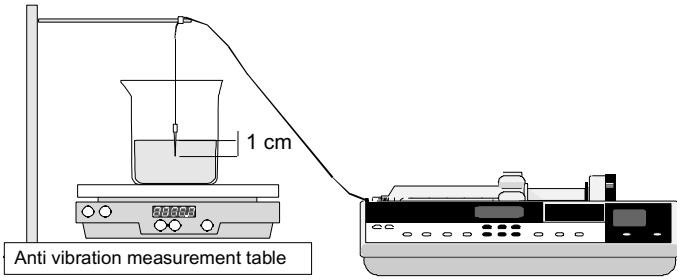
Equipment required

- Stop clock.
- Test tube or beaker with 1 ml graduating
- Liquid: distilled water and oil
- Luer lock type plastic syringe (50 or 20 ml)
- Catheter extension with Luer Lock (length 100 cm, inside diameter 2,5 cm).
- Needle:

Flow rate value	Needle type
x < 30ml/hr	G26
x > 30 ml/hr	G18 or G21

Installation

- According to the installation drawings shown below.



Make sure the horizontal installation plane is respected.

- Fill the syringe with 50 ml of distilled water.
  - ☐ Prime to eliminate any air bubbles.
- Secure the female Luer Lock end piece of the catheter extension onto the syringe and the male Luer lock end piece onto the needle.
- Fit the syringe onto the device.
- Fill the test tube ensuring the needle is dipped in the liquid (> 1 cm).
  - ☐ Add several drops of oil to create a greasy film on the surface of the liquid. This way the user will avoid any measurement error due to evaporation of the liquid.
  - ☐ Place the needle inside the test tube.

Operating mode

- Select a flow rate.

For low flow rates (< 5 ml/hr), validate and wait for the infusion to stabilise for 1 hour. For higher flow rates, wait for 10 to 30 minutes after infusion.

- Start infusion by pressing the "CONFIRM" key, and start the stop clock at the same time, (if necessary make a note of the stop clock start value).
- Once the whole infused syringe is in the test tube, calculate the difference between the design value and the real value:
  Real flow rate = 50 ml/time in hours
- The error percentage can be calculated from this difference :

$$\frac{(\text{Real value} - \text{Design value})}{\text{Design value}} \times 100 = \text{Error percentage}$$

4.5 Cleaning and disinfection

The syringe pump is part of the patient's immediate environment. It is advisable to clean and disinfect the external surfaces of the device on a daily basis in order to protect both patient and personnel from any risks of contamination.

- Disconnect the power cable from the wall socket before cleaning.
- Do not place in an AUTOCLAVE or IMMERSE the device, and do not allow liquid to penetrate inside the equipment case or power supply cover.
  - Use a cloth soaked in DETERGENT-DISINFECTANT, diluted in water if necessary, to eliminate micro organisms.
  - Avoid excessively abrasive brushing that could scratch the case.
  - Do not rinse or wipe the surfaces.
- If the equipment is used in a department with severe contamination risks, after disinfecting by wiping with a damp cloth, equipment should be left in the room during aerial disinfection.

Do not use TRICHLOROETHYLENE-DICHLOROETHYLENE.

- ¨TRICHLOROETHYLENE-DICHLOROETHYLENE:
  - AMMONIA.
  - AMMONIUM CHLORIDE
  - CHLORINE AND AROMATIC HYDROCARBON.
  - ETHYLENE DICHLORIDE-METHYLENE CHLORIDE
  - CETONE based cleaning products.

These aggressive agents could damage the plastic parts and lead to apparatus malfunctions.

Also beware of ALCOHOL SPRAYS (20% -40% alcohol) that tarnish and crack the plastic and fail to provide the cleaning action required prior to disinfection.

For further information, please contact the competent department in your hospital for supply of the appropriate cleaning and disinfecting products.

4.6 Storage

In case of prolonged storage, it is advisable to disconnect the battery using the battery access door on the bottom of the device. This operation should be done by an experienced technician.

The equipment must be stored in a dry and cool place.

- The recommended environmental temperature conditions for storage of the equipment are between 0°C and 40°C.
- Relative humidity tolerated: max. 85%, no condensation.

Fully recharge the battery before using the equipment to avoid any risks caused by micro power cuts in the mains supply and to ensure maximum autonomy.

5 Diagnosis

5.1 Troubleshooting

Problem	Cause	Solution
End of infusion detected too early (at approximately 10 ml).	■ The syringe used does not correspond to that selected.	■ Change the syringe.
No pre-alarm or alarm at end of infusion.		
Too much flow rate or displacement control drift.		
Occlusion alarm upon start-up	■ Inappropriate calibration of the force sensor.	■ Recalibrate the force sensor (see “ErA.9 Force sensor calibration”).
	■ Force sensor out of order.	■ Check the force sensor (see “ErA.9 Force sensor calibration”).
	■ Ribbon cable cut.	■ Replace the ribbon cable (see “Ribbon cable winding kit” operation sheet).
Occlusion alarm during operation.	■ Pressure limit selected is too low.	■ Select a medium pressure limit.
	■ Inappropriate calibration of the force sensor.	■ Recalibrate the force sensor (see “ErA.9 Force sensor calibration”).
	■ Ribbon cable cut.	■ Replace the ribbon cable (see “Ribbon cable winding kit” operation sheet).
Disengagement alarm upon start-up	■ Faulty disengagement micro-switch.	■ Replace the micro-switch (see “Syringe detection system” operation sheet)
Syringe piston detection alarm not justified.	■ Faulty photoelectric cell and/or syringe piston obturator.	■ Check the syringe clamp (see “Checking the syringe clamp”).
Syringe body clamp alarm not justified.		
Display fault: segments, LEDs	■ Control transistors and/or display board connections.	■ Check the display (see “Checking the indicator lights”). ■ Check the connectors.
After a fall.	■ Damaged mechanical elements.	■ Check that the input bearing and mechanical assembly are intact.

5.2 Error messages

Error code	Description	Recommended action
Electronic control and software* errors		
Er 10	■ Internal RAM error.	■ Reconfigure the **Pilot** (see “Basic operation parameter configuration menu”).
Er20	■ Enternal RAM error.	
Er30	■ EEPROM error.	
Er40	■ EEPROM error.	
Er50	■ ADC error.	■ Check the ADC (see “Checking the ADC”).
Er60	■ Syringe parameter error.	■ Reconfigure the **Pilot** (see “Current operation parameter configuration menu”)
Er70	■ Motor frequency error.	
Er80 *Version 7.OC only*	■ Faulty keyboard. ■ Short circuit in the keyboard.	■ Check the keyboard.
	■ Electromagnetic disturbance exceeding standard limits.	■ Check the operation environment of the **Pilot**.
* : When rewriting the EEPROM, when the equipment is switched off, the checksum is rewritten in the memory to save the parameters. If the Hardware cut-off delay is shorter than the software cut-off delay, the equipment is switched off before the EEPROM is fully rewritten: Checksum not compliant. Err(-)0 or CFPc: When the equipment is in CFPc, reconfiguration is compulsory: Faulty WATCH DOG.		
Motor errors		
Er01	■ Motor control failure. ■ Motor fault.	■ Check the motor power supply. ■ Replace the motor.
Plunger advance errors		
Er32	■ Error over a short distance.	■ Check the connectors. ■ Check that the potentiometer is tightened. ■ Check the ADC (see “Checking the ADC”). ■ Check the position sensor (see “Checking the position sensor.”).
Er52	■ Error during compensation for play.	
Er72	■ Error over the whole length.	
Er82	■ Error in relation to the flow rate.	

Error code	Description	Recommended action
Calculation parameter errors (motor and flow rate)		
Er 14	■ Motor period calculation error.	■ Check the ADC (see “Checking the ADC”). ■ Check the position sensor (see “Checking the position sensor.”).
Er24	■ Motor rotation direction error.	
Er34	■ Flow rate/period calculation error.	
Er44	■ UART and micro-controller crystal frequency error.	
Configuration errors		
CFPc	■ The configuration self-test upon start-up was not satisfactory.	■ Reconfigure the **Pilot** using the IS Control software.

6 Operation sheets

This chapter lists the set of dismounting/remounting sheets.

N°1, Procedure: Display and central unit boards

Safety:

For safety reasons, the technician should not carry out any maintenance when the device is connected to the 230 V mains supply voltage.

Disconnect the mains power supply cable.

Equipment required:

- 1 Posidriv Z1 screwdriver.
- 1 antistatic wriststrap.

Maintenance level:

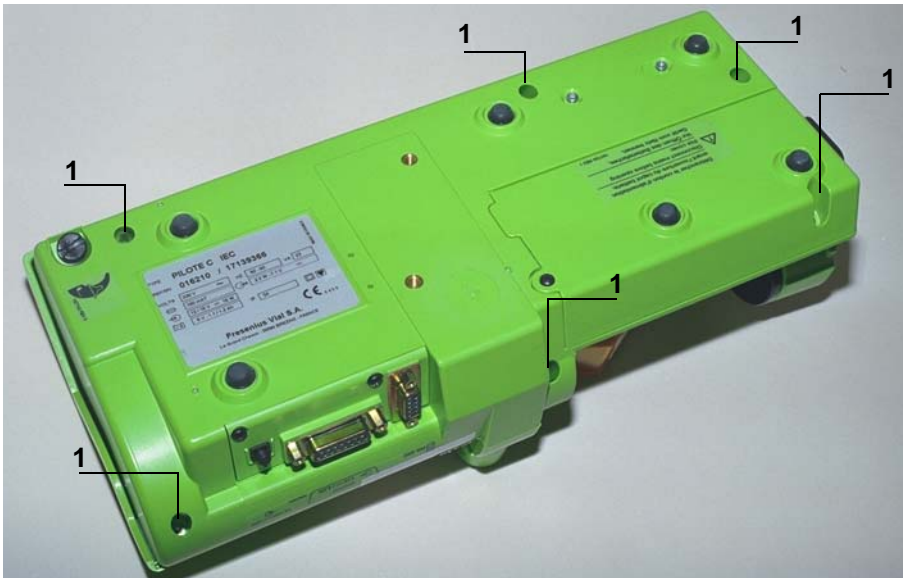
Level 2, specialised technician (see documentation on biomedical training).

Procedure:

Access

- Turn the **Pilot** over onto the upper case.
- Unscrew the 6 Phillips head screws (ref. 1) located at the bottom of the lower case, which link this to the upper case.
- Keep the **Pilot** assembled and turn it over onto the lower case.
- Remove the upper case making sure the CPU board flat jumper is not accidentally removed in the process.
- Disconnect the CPU board flat jumper.

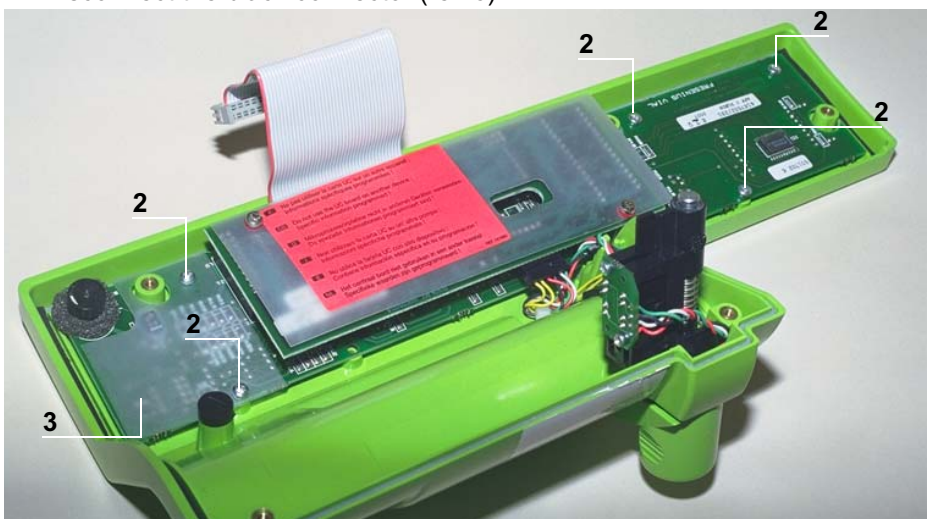
Hands must not come into contact with the CPU boards.

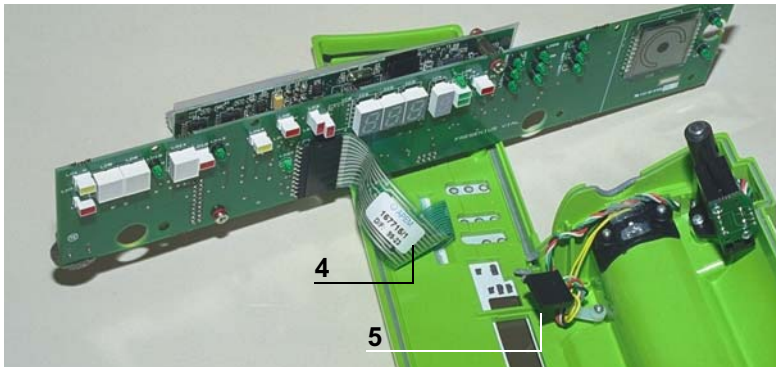


Dismounting

When electronic components are handled, it is recommended to wear an antistatic wriststrap linked to ground and to work on an antistatic foam mat.

- Unscrew the 5 Phillips head screws (ref. 2) located at the display board, which link this to the upper case.
- Remove the board insulator (ref. 3) located on the left.
- Lift the display board slightly and remove the display unit flat jumper (ref. 4).
- Disconnect the black connector (ref. 5).





Remounting

*A specific type of board corresponds to each **Pilot** "CPU and display board" ; It is important to avoid reversing the references between each **Pilot** and order the part number corresponding to your device.*

Carry out the same procedures in reverse to reassemble the parts.

When mounting the display board, it is important to reduce the torque in the plastic inserts so as to avoid causing damage to these.
When fitting the upper case, ensure the joint is perfectly positioned in its slot after reassembly.

Recalibrate the **Pilot** (see "Calibrations") then carry out the regular servicing tests (see "Regular servicing sheet").

N°2, Procedure: Syringe clamp

Safety:

For safety reasons, the technician should not carry out any maintenance when the device is connected to the 230 V mains supply voltage.

Disconnect the mains power supply cable.

Equipment required:

- 1 Posidriv Z1 screwdriver.
- 1 Posidriv Z1 flat screwdriver.

Maintenance level:

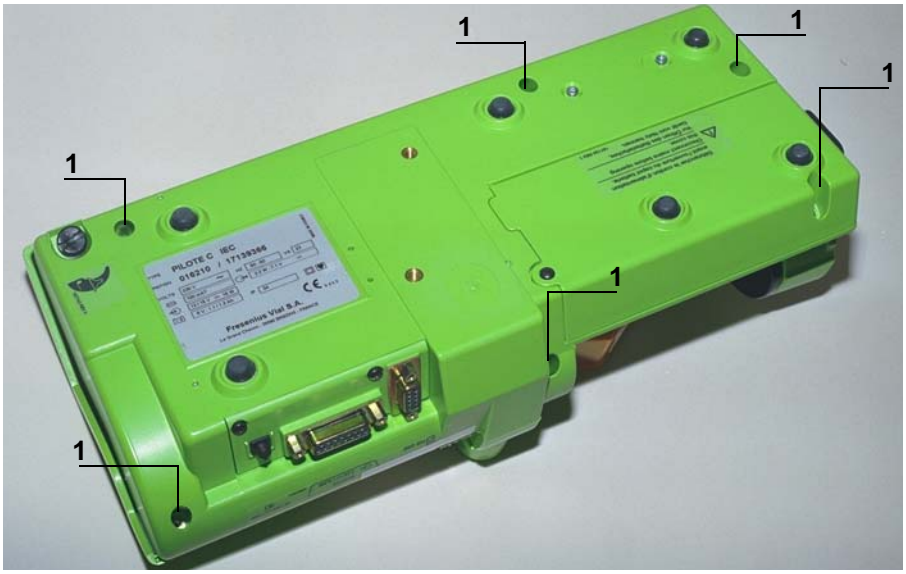
Level 2, specialised technician (see documentation on biomedical training).

Procedure:

Access

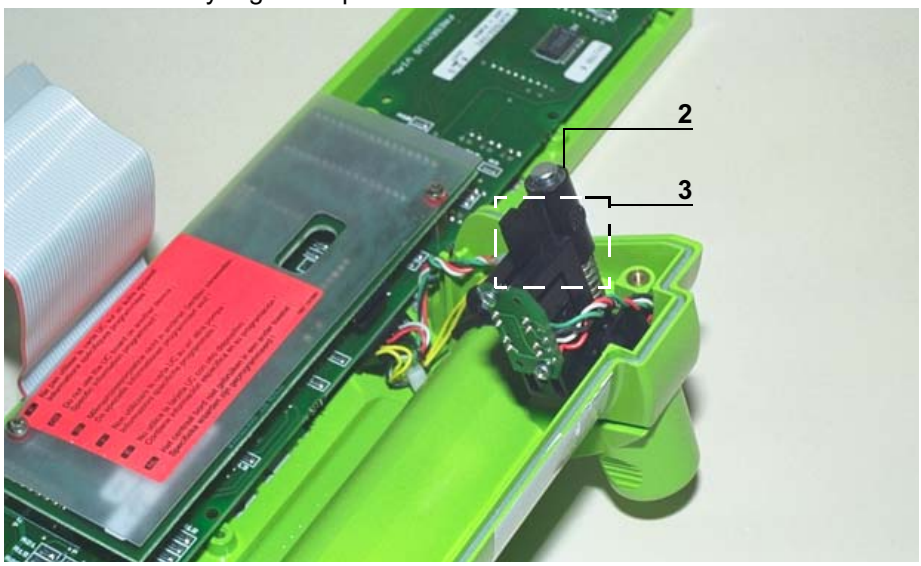
- Turn the Pilot over onto the upper case.
- Unscrew the 6 Phillips head screws (ref. 1) located at the bottom of the lower case, which link this to the upper case.
- Keep the Pilot assembled and turn it over onto the lower case.
- Remove the upper case making sure the CPU board flat jumper is not accidentally removed in the process.
- Disconnect the CPU board flat jumper.

Hands must not come into contact with the CPU boards.



Dismounting

- Remove the spring retaining ring (ref. 2) located on the syringe clamp shaft, which holds this to the CPU support.
- Remove the obturator and the spring (ref. 3).
- Remove the syringe clamp.



Reassembly

Carry out the same procedures in reverse to remount the unit.

When fitting the upper case, ensure the joint is perfectly positioned in its slot after reassembly.

Perform the regular servicing tests (see "Regular servicing sheet").

N°3, Procedure: Syringe detection system

Safety:

For safety reasons, the technician should not carry out any maintenance when the device is connected to the 230 V mains supply voltage.

Disconnect the mains power supply cable.

Tools required:

- 1 Posidriv Z1 screwdriver.
- 1 antistatic wriststrap.
- 1 soldering iron
- "RADIEL Sn60Pb RI 1" welding wire (cleaning not required for rewelding) or equivalent.
- Silicone ref. 161249.

Maintenance level:

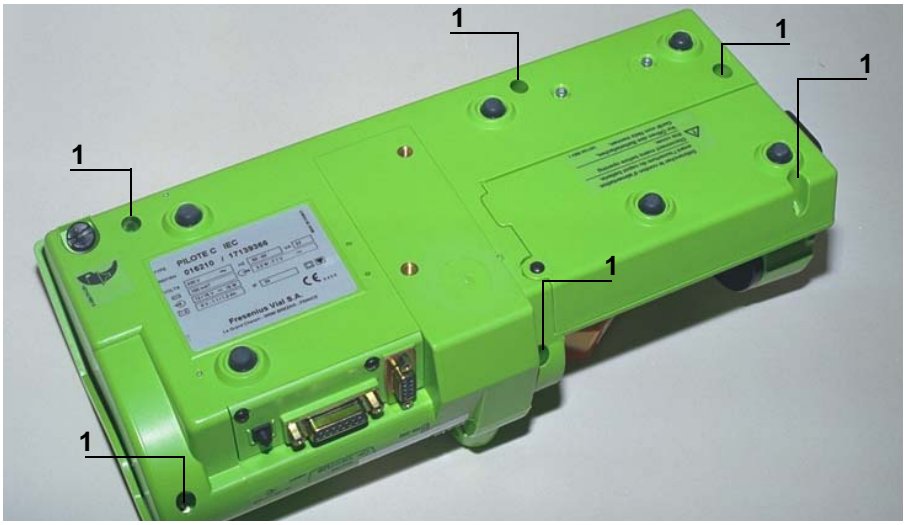
Level 2, specialised technician (see documentation on biomedical training).

Opto replacement procedure:

Access

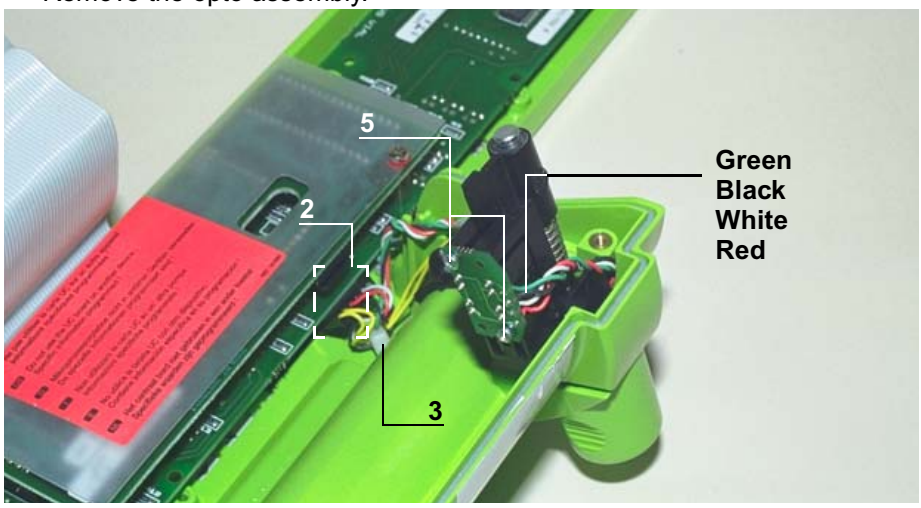
- Rotate the **Pilot** on the upper case.
- Unscrew the 6 Phillips head screws (ref. 1) Located at the bottom of the lower case, which tighten the latter to the upper case.
- Keep the **Pilot** assembled and turn it over onto the lower case.
- Remove the upper case making sure the CPU board flat jumper is not accidentally removed in the process.
- Disconnect the CPU board flat jumper.

Hands must not come into contact with the CPU boards.



Dismounting

- Disconnect the connector (ref. 2).
- Unscrew the Phillips head screw (ref. 3) which holds the conductor to the upper case.
- Unscrew the 2 Phillips head screws (ref. 5) which hold the opto PCB in position.
- Remove the opto assembly.



Reassembly

- Place the new opto assembly on the PCB support.
- Screw the 2 Phillips head screws (ref. 5) which hold the “PCB and opto” assembly in position.

When mounting the "PCB and opto"*, it is important to reduce the torque in the plastic inserts so as to avoid causing damage to these.*

- Connect the conductor to the CPU board.
- Tighten the Phillips head screw holding the conductor (ref. 2).

Carry out the same procedures in reverse to remount the unit.

When fitting the upper case, ensure the joint is perfectly positioned in its slot after reassembly.

Perform the regular servicing tests (see “Regular servicing sheet”).

N°4, Procedure: Motor + Opto + Disk

Safety:

For safety reasons, the technician should not carry out any maintenance when the device is connected to the 230 V mains supply voltage.

Disconnect the mains power supply cable.

Equipment required:

- 1 Posidriv Z1 screwdriver.
- 1 antistatic wriststrap.

Maintenance level:

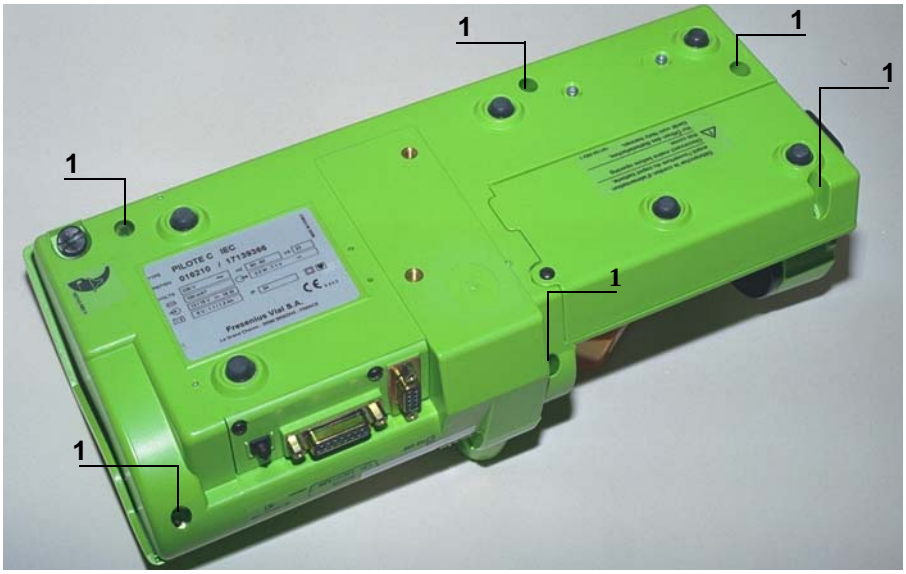
Level 2, specialised technician (see documentation on biomedical training).

Procedure:

Access

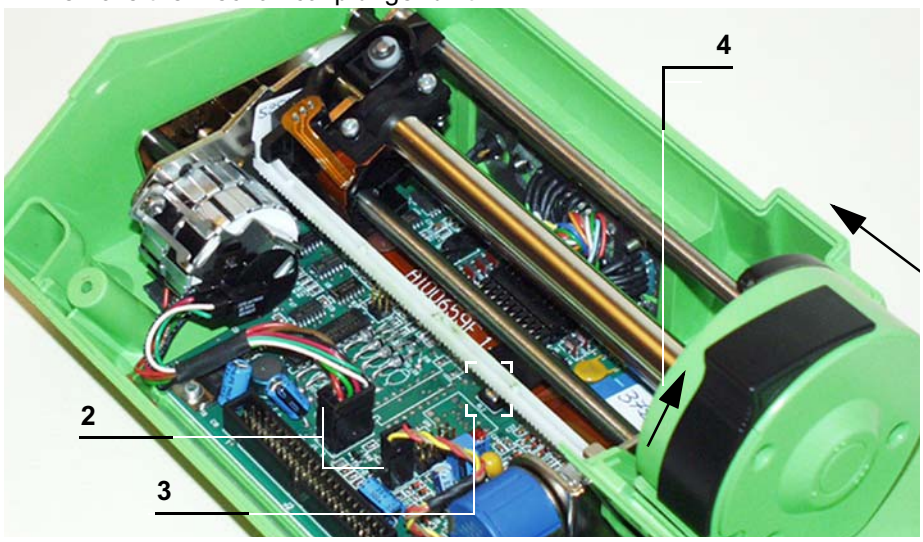
- Turn the Pilot over onto the upper case.
- Unscrew the 6 Phillips head screws (ref. 1) located at the bottom of the lower case, which link this to the upper case.
- Keep the Pilot assembled and turn it over onto the lower case.
- Remove the upper case making sure the CPU board flat jumper is not accidentally removed in the process.
- Disconnect the CPU board flat jumper.

Hands must not come into contact with the CPU boards.

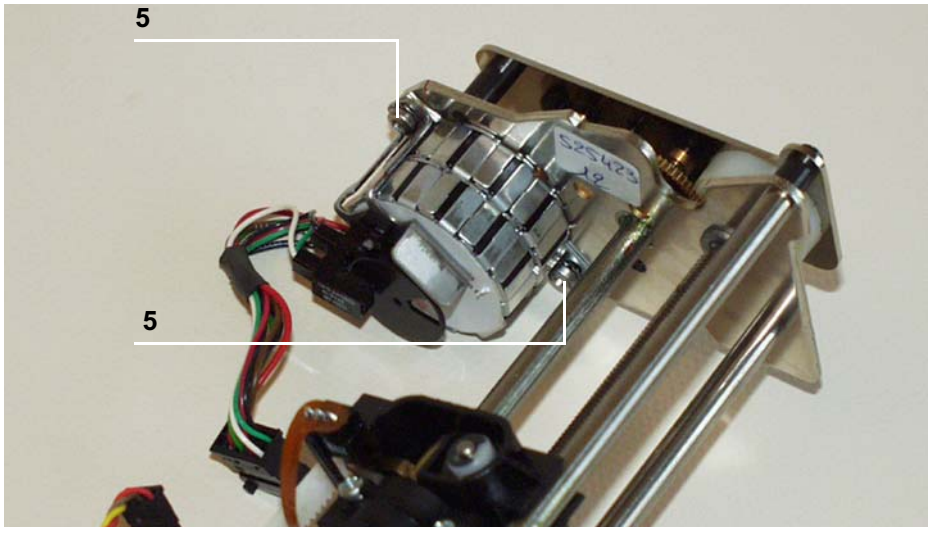


Dismounting

- Press the syringe pump disengagement lever towards the back of the Pilot as far as possible.
- Maintain this position and slide the whole unit to the back left.
- Remove the plunger guide.
- Disconnect the black connectors (ref. 2).
- Unscrew the flat jumper mounting lug (ref. 3) without removing it.
- Remove the mechanical plunger unit from its slot.
- Disconnect the blue connector from the flat jumper (ref. 4).
- Remove the mechanical plunger unit.



- Unscrew the 2 Phillips head screws (ref. 5).
- Remove the motor, opto and disk assembly.



Reassembly

Carry out the same procedures in reverse to remount the unit.

When fitting the upper case, ensure the joint is perfectly positioned in its slot after reassembly.

Perform the regular servicing tests (see “Regular servicing sheet”).

N°5, Procedure: Dynamometer sensor

Safety:

For safety reasons, the technician should not carry out any maintenance when the device is connected to the 230 V mains supply voltage.

Disconnect the mains power supply cable.

Equipment required:

- 1 Posidriv Z1 screwdriver.
- 1 hexagon socket key (2.5).
- 1 soldering iron.
- "RADIEL Sn60Pb RI 1" welding wire (cleaning not required for re-welding) or equivalent.

Maintenance level:

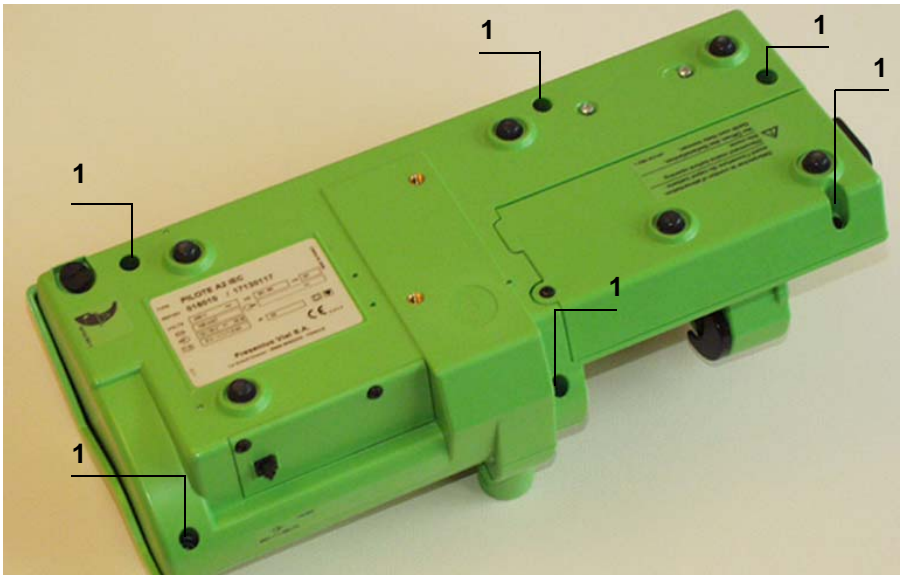
Level 2, specialised technician (see documentation on biomedical training).

Procedure:

Access

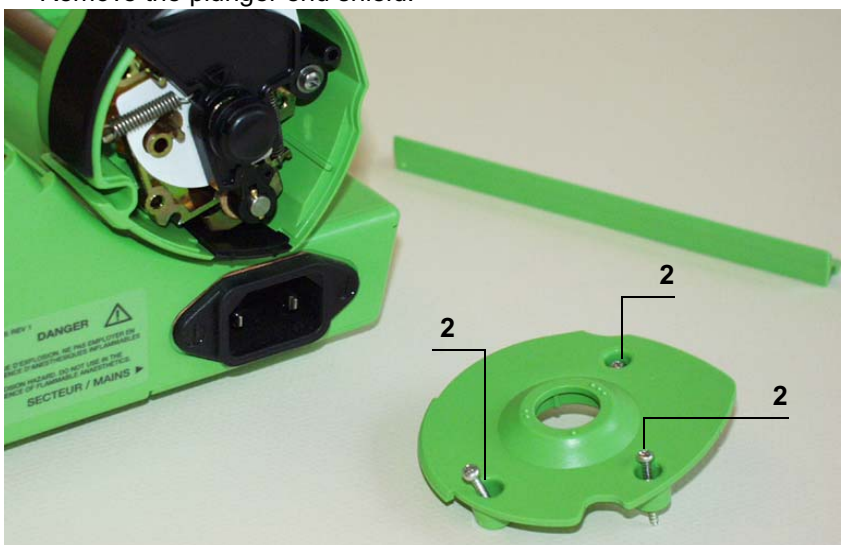
- Turn the **Pilot** over onto the upper case.
- Unscrew the 6 Phillips head screws (ref. 1) located at the bottom of the lower case, which link this to the upper case.
- Keep the **Pilot** assembled and turn it over onto the lower case.
- Remove the upper case making sure the CPU board flat jumper is not accidentally removed in the process.

Hands must not come into contact with the CPU boards.

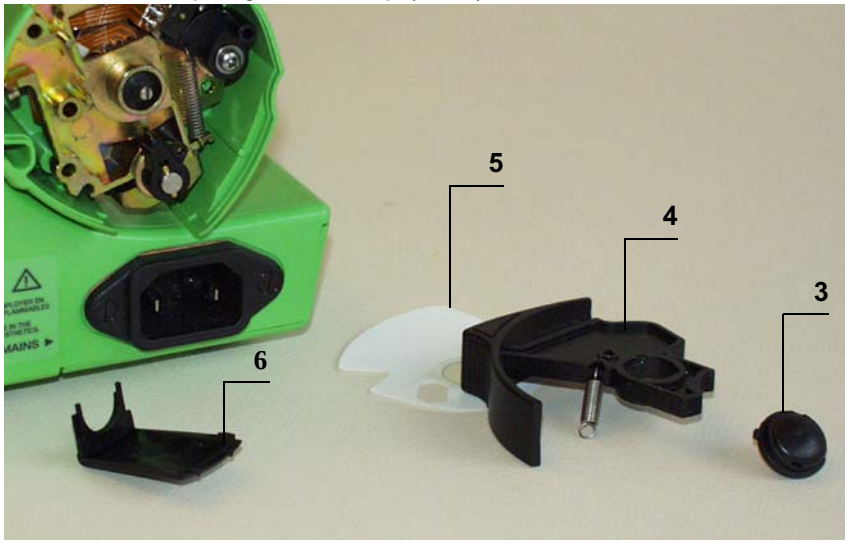


Dismounting

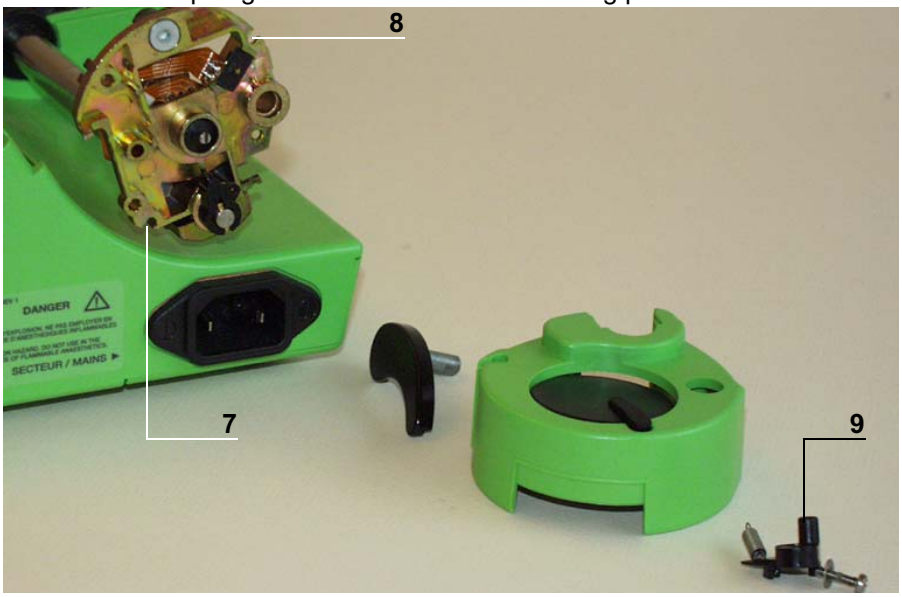
- Press the syringe pump disengagement lever towards the back of the Pilot as far as possible.
- Maintain this position and slide the whole unit to the back right.
- Remove the plunger guide.
- Unscrew the 3 Phillips head screws (ref. 2) located at the bottom of the plunger end shield which links this to the plunger cover.
- Remove the plunger end shield.



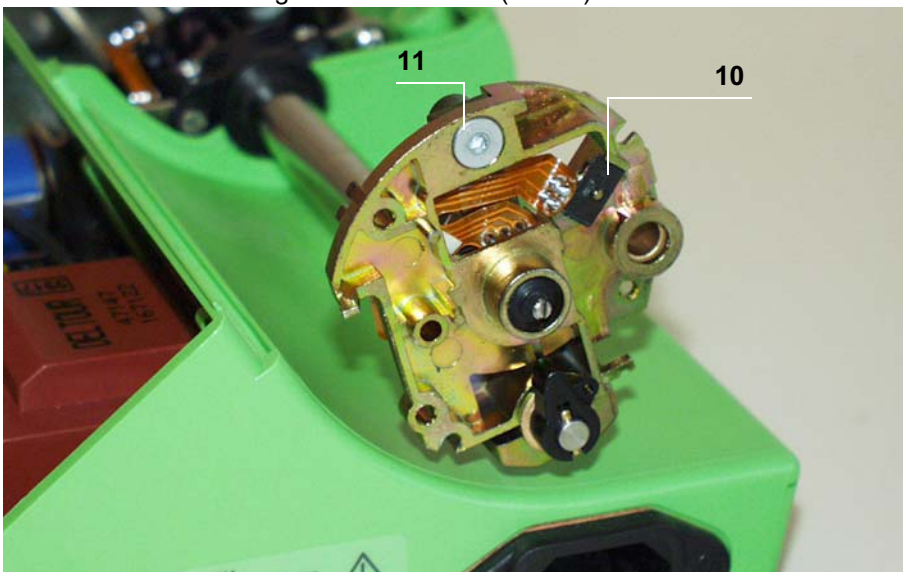
- Remove the backpressure adjustment button (ref. 3).
- Remove the disengagement lever and its spring (ref. 4) as well as the protective plunger film (ref. 5).
- Remove the plunger cover clip (ref. 6).



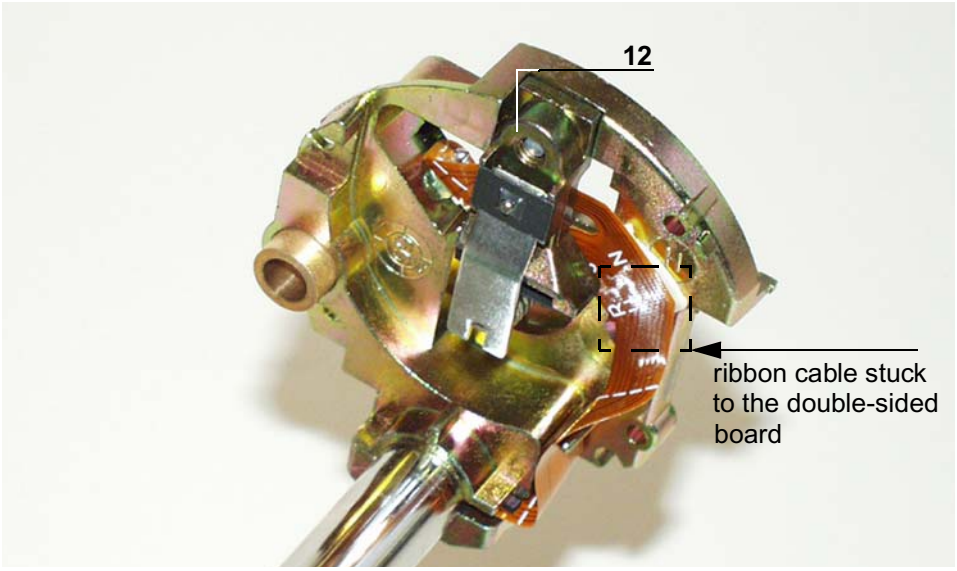
- Unscrew the 2 Phillips head screws (ref. 7 and 8) which link the plunger support to the plunger cover.
- Unscrew and remove the Phillips head screw and the washer (ref. 9) which attach the anti-siphon cam to the anti-siphon arm.
- Remove the cam/arm assembly.
- Remove the plunger cover fitted with the bonding pad.



- Remove the retaining ring that holds the anti-siphon opto in place (ref. 10).
- Unscrew the 6 hexagon socket screws (ref. 11).



- Remove the backpressure micro support/spring leaf (ref. 12).
- Pull off the ribbon cable from the double-sided board



Welding and unwelding operations are carried out using a soldering iron fitted with a tip in good condition, constantly tapered and kept clean. The temperature of the iron should be between 315°C and 340°C.

- Unweld the sensor wires on the flex circuit.

When dismounting the force sensor, ensure the welding pellets are not damaged.

- ☐ Add more weld to facilitate the unwelding process.
- ☐ Heat and pull on the wires one by one.

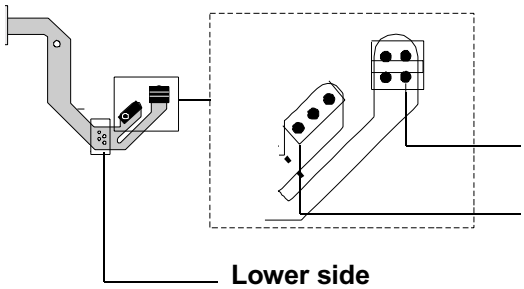
Reassembly

■ Weld the ribbon cable to the new pressure switch, ensuring the mounting procedure is carried out in order:

- □ Taper the 3 welding points.
- □ Weld the 3 points.
- □ Check that the welding has been carried out correctly. It should not form a ball, but should lie against the length of the component snubbers.

■ Repeat the operation for the anti-siphon opto (4 welding points).

■ Stick the bottom side of the ribbon cable to the double-sided board.



■ Impregnate with weak loctite and screw the 6 hexagon socket screws (ref. 11), which hold the spring leaf/backpressure micro support in position.

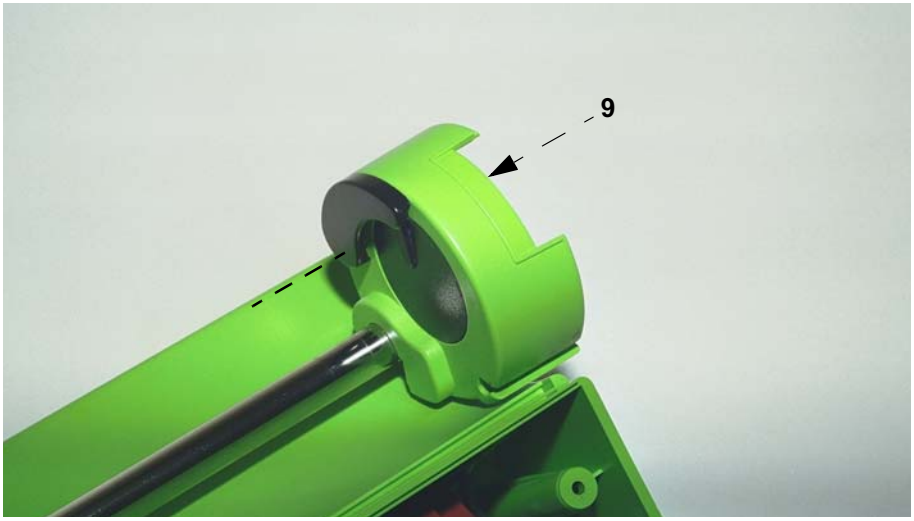
■ Position the opto and its retaining ring (ref. 10).

■ Mount the plunger cover onto the plunger support. Impregnate the screw with weak loctite (rep. 9).

■ Position and screw the cam/anti-siphon arm unit using the Phillips head screw and the washer (ref. 9).

■ Screw the 2 Phillips head screws (ref. 8 and 7) which link the plunger support to the plunger cover.

■ Position the plunger cover clip (ref. 6).



- Cover the plunger with the protective film, mount the disengagement lever, its spring and the adjustment button. Screw the plunger end shield back on (ref. 5, 4 and 3).
- Position the plunger cover and screw it back on (ref. 2).

Carry out the same procedures in reverse to remount the unit.

When fitting the upper case, ensure the joint is perfectly positioned in its slot after reassembly.

Recalibrate the pressure sensor (see "Calibrations") then carry out the regular servicing tests (see "Regular servicing sheet").

N°6, Procedure: Plunger advance control potentiometer

Safety:

For safety reasons, the technician should not carry out any maintenance when the device is connected to the 230 V mains supply voltage.

Disconnect the mains power supply cable.

Equipment required:

- 1 Posidriv Z1 screwdriver.
- 1 flat screwdriver.
- 1 flat key (12).
- 1 potentiometer dismounting tool ref. T300869.

Maintenance level:

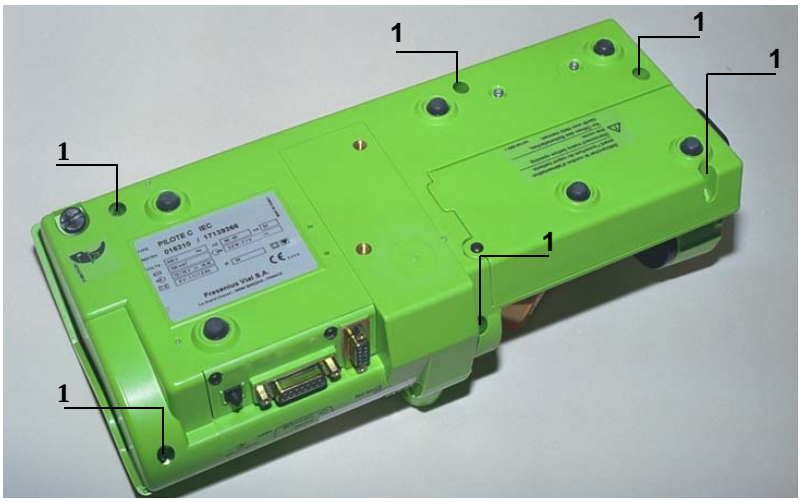
Level 2, specialised technician (see documentation on biomedical training).

Procedure:

Access

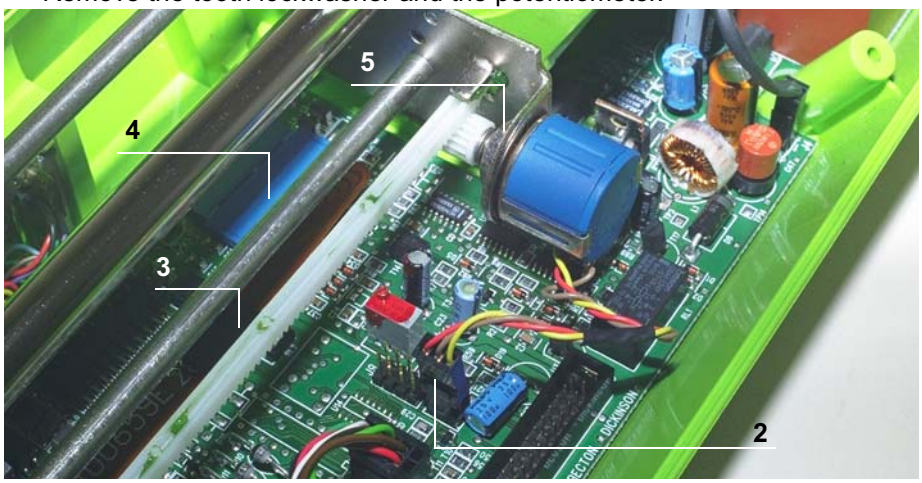
- Turn the Pilot over onto the upper case.
- Unscrew the 6 Phillips head screws (ref. 1) located at the bottom of the lower housing case, which link this to the upper case.
- Keep the Pilot assembled and turn it over onto the lower case.
- Remove the upper case making sure the CPU board flat jumper is not accidentally removed in the process.
- Disconnect the CPU board flat jumper.

Hands must not come into contact with the CPU boards.



Dismounting

- Press the syringe pump disengagement lever towards the back of the Pilot as far as possible.
- Maintain this position and slide the whole unit to the back left.
- Remove the plunger guide.
- Disconnect the black connectors (ref. 2).
- Unscrew the flat jumper mounting lug (ref. 3) without removing it.
- Remove the mechanical plunger unit from its slot.
- Disconnect the blue connector from the flat jumper (ref. 4).
- Remove the mechanical plunger unit.
- Unscrew the potentiometer lock nut (ref. 5).
- Remove the tooth lockwasher and the potentiometer.



Reassembly

- Dismount the end shield from the reducer frame.
- Mount the potentiometer onto the end shield (screw the nut onto a thread).
- Position the end shield in equipment T 300 869 and lock it into position using the knurled screw.
- Position the potentiometer in the device and bring it up against the end shield.
- Tighten the potentiometer.
- Extract the end shield from device T 300 869.
- Mount the pinion on the potentiometer (match up the indexing plane).
  - ☐ The larger diameter of the pinion must be flattened against the potentiometer.
- With the potentiometer facing you, turn the pinion anticlockwise until it blocks, then turn it ¼ of a turn in the opposite direction.
- Mount the moving mechanical assembly onto the reducer frame.
- Slide the end shield onto the guides and rack.
  - ☐ Check the position of the input bearing which must be on the plunger side.
  - ☐ Ensure the flex circuit is not damaged when mounting (folding).
- Secure the end shield using the three M3x3 TC screws.
- Secure the input bearing using the two M3x3 TC screws.

When fitting the upper case, ensure the joint is perfectly positioned in its slot after reassembly.

Recalibrate the position sensor (see "Calibrations") then carry out the regular servicing tests (see "Regular servicing sheet").

N°7, Procedure: Plunger cover and/or disengagement lever + anti-siphon arm

Safety:

For safety reasons, the technician should not carry out any maintenance when the device is connected to the 230 V mains supply voltage.

Disconnect the mains power supply cable.

Equipment required:

- 1 Posidriv Z1 screwdriver.

Maintenance level:

Level 2, specialised technician (see documentation on biomedical training).

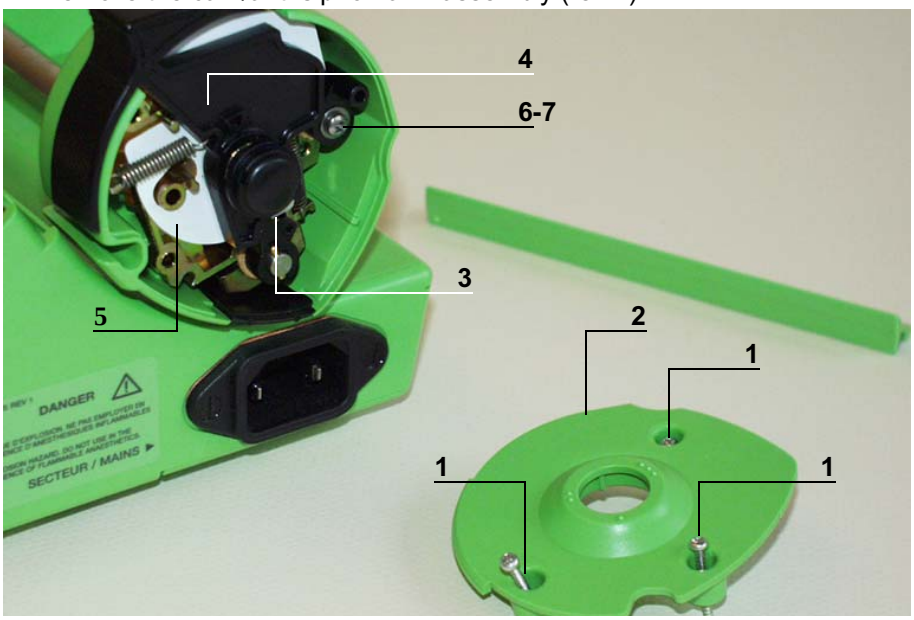
Procedure:

Access

- Press the syringe pump disengagement lever towards the back of the Pilot as far as possible.
- Maintain this position and slide the whole unit to the back right.

Dismounting

- Unscrew the 3 Phillips head screws (ref. 1) located at the bottom of the plunger end shield which links this to the plunger cover. Remove the plunger end shield (ref. 2).
- Remove the backpressure adjustment button (ref. 3), then the disengagement lever and its spring (ref. 4) as well as the protective plunger film (ref. 5).
- Unscrew and remove the Phillips head screw and the washer (ref. 6) which attach the anti-siphon cam to the anti-siphon arm.
- Remove the cam/anti-siphon arm assembly (ref. 7).



Reassembly

Carry out the same procedures in reverse to remount the unit.

- Impregnate the screw with weak loctite (ref. 6) before mounting the cam and arm assembly.

When fitting the upper case, ensure the joint is perfectly positioned in its slot after reassembly.

Perform the regular servicing tests (see “Regular servicing sheet”).

N°8, Procedure: Power supply board

Safety:

For safety reasons, the technician should not carry out any maintenance when the device is connected to the 230 V mains supply voltage.

Disconnect the mains power supply cable.

Tools required:

- 1 Posidriv Z1 screwdriver.
- 1 small flat screwdriver.
- 1 antistatic wriststrap.

Maintenance level:

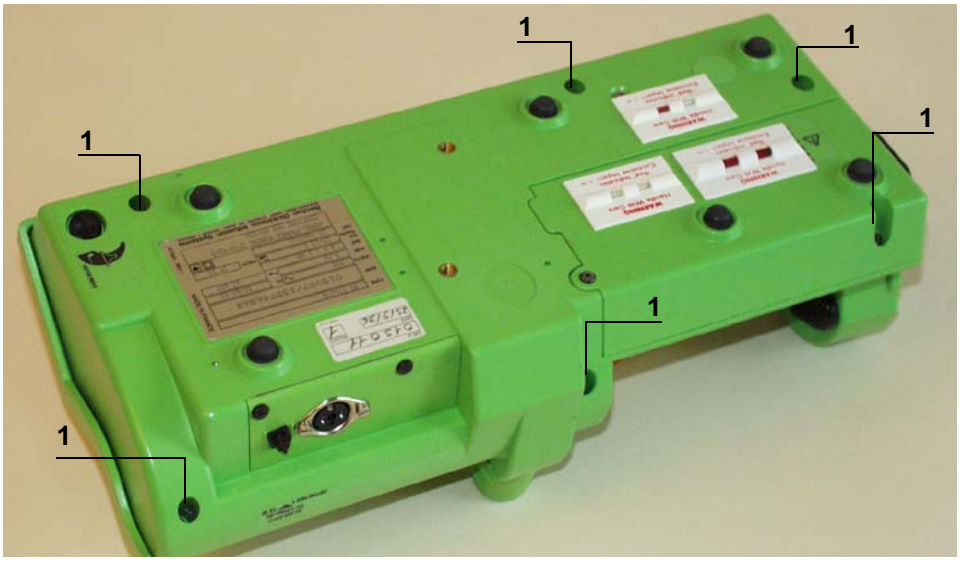
Level 2, specialised technician (see documentation on biomedical training).

Procedure:

Access

- Rotate the **Pilot** on the upper case.
- Unscrew the 6 Phillips head screws (ref. 1) located at the bottom of the lower case, which tighten the latter to the upper case.
- Keep the **Pilot** assembled and turn it over onto the lower case.
- Remove the upper case making sure the CPU board flat jumper is not accidentally removed in the process.
- Disconnect the CPU board flat jumper.

Hands must not come into contact with the CPU boards.

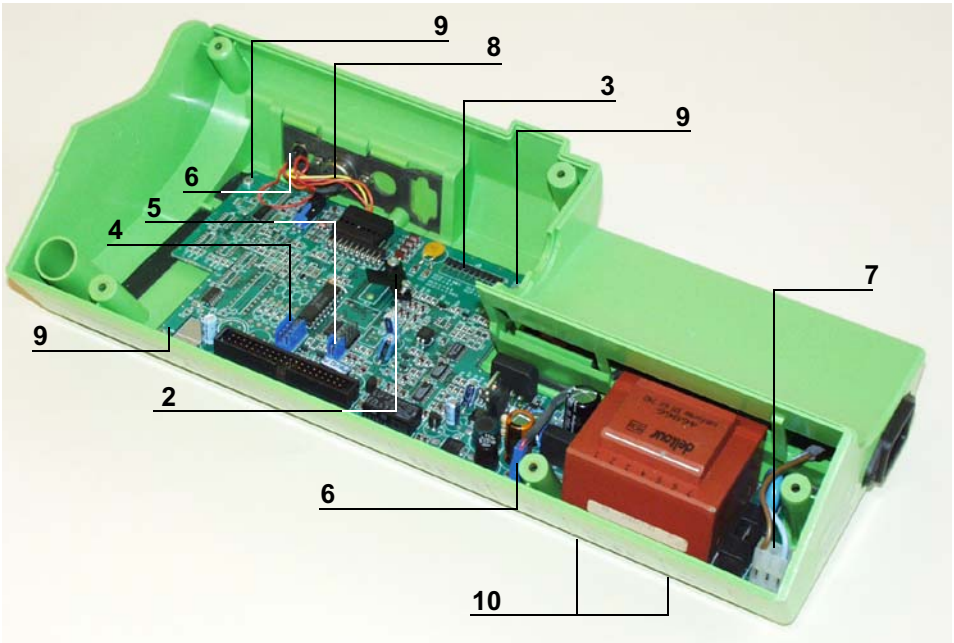


Dismounting

- Press the syringe pump disengagement lever towards the back of the Pilot as far as possible.
- Maintain this position and slide the whole unit to the back left.
- Remove the syringe pump guide.
- Disconnect the black connectors.

When electronic components are handled, it is recommended to wear an antistatic wriststrap linked to ground and to work on an antistatic foam mat.

- Unscrew the flat jumper mounting lug (ref 2) without removing it.
- Remove the mechanical plunger unit from its slot.
- Disconnect the blue connector from the flat jumper (ref. 3).
- Remove the mechanical plunger unit.
- Disconnect the connectors (ref 4, ref 5, ref. 6, ref. 7, ref. 8)
- Unscrew the 3 Phillips head screws (ref. 9) located on the power supply board, which tighten the latter to the lower case.
- Unscrew the 2 Phillips head screws (ref. 10) located on lower case, which tighten the latter to the power supply board.
- Remove the power supply board.



Reassembly

Carry out the same procedures in reverse to remount the unit.

When fitting the upper case, ensure the joint is perfectly positioned in its slot after reassembly.

Recalibrate the force sensor (see "Calibrations") then carry out the regular servicing tests (see "Regular servicing sheet").

N°9, Procedure: Battery holder and battery

Safety:

For safety reasons, the technician should not carry out any maintenance when the device is connected to the 230 V mains supply voltage.

Disconnect the mains power supply cable.

Equipment required:

- 1 Posidriv Z1 screwdriver.

Maintenance level:

Level 2, specialised technician (see documentation on biomedical training).

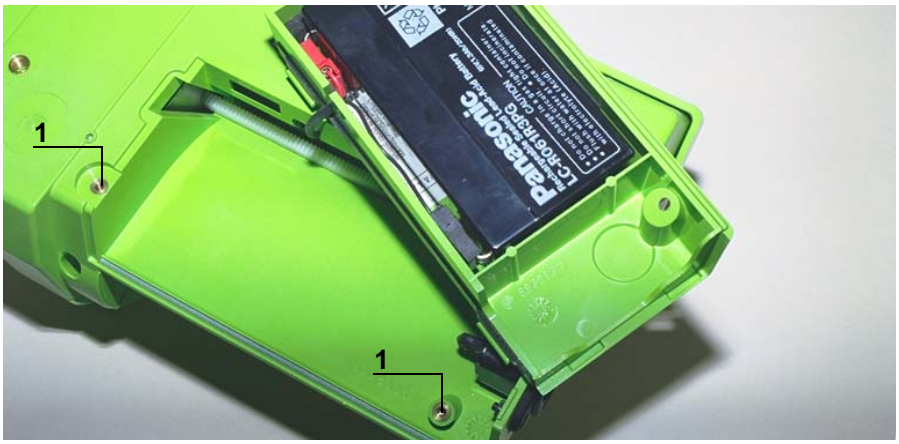
Procedure:

Access

- Turn the **Pilot** over onto the upper case.

Dismounting

- Unscrew the 2 Phillips head screws (ref. 1) to be found in the lower case battery holder kit, which link this to the lower case.
- Swivel the battery holder and remove the battery.
- Disconnect this.



Reassembly

Carry out the same procedures in reverse to remount the unit.

It is recommended to perform a full loading and unloading cycle to ensure the battery is in working condition.

Perform the regular servicing tests (see "Regular servicing sheet").

N°10, Procedure: Rear plug support

Safety:

For safety reasons, the technician should not carry out any maintenance when the device is connected to the 230 V mains supply voltage.

Disconnect the mains power supply cable.

Tools required:

- 1 Posidriv Z1 screwdriver.

Maintenance level:

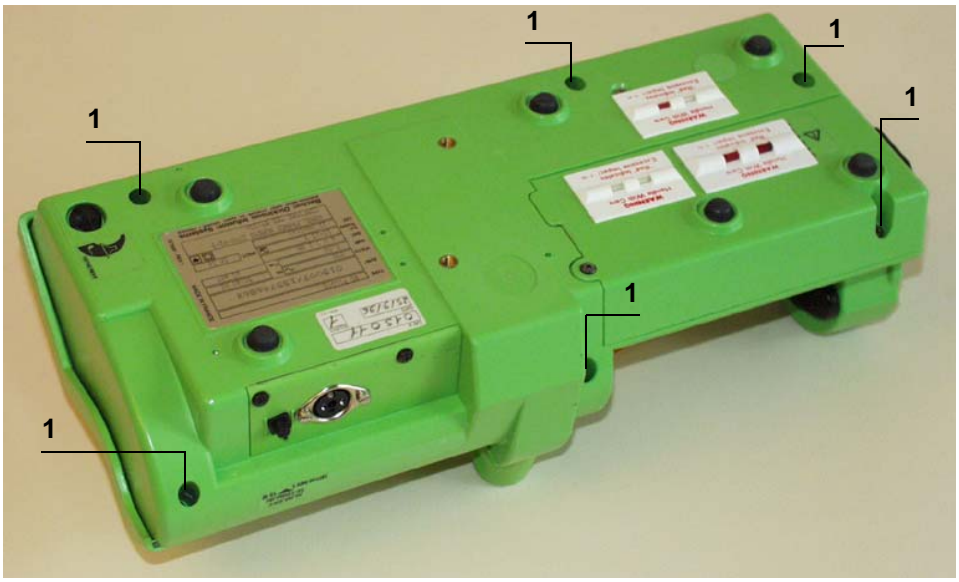
Level 2, specialised technician (see documentation on biomedical training).

Procedure:

Access

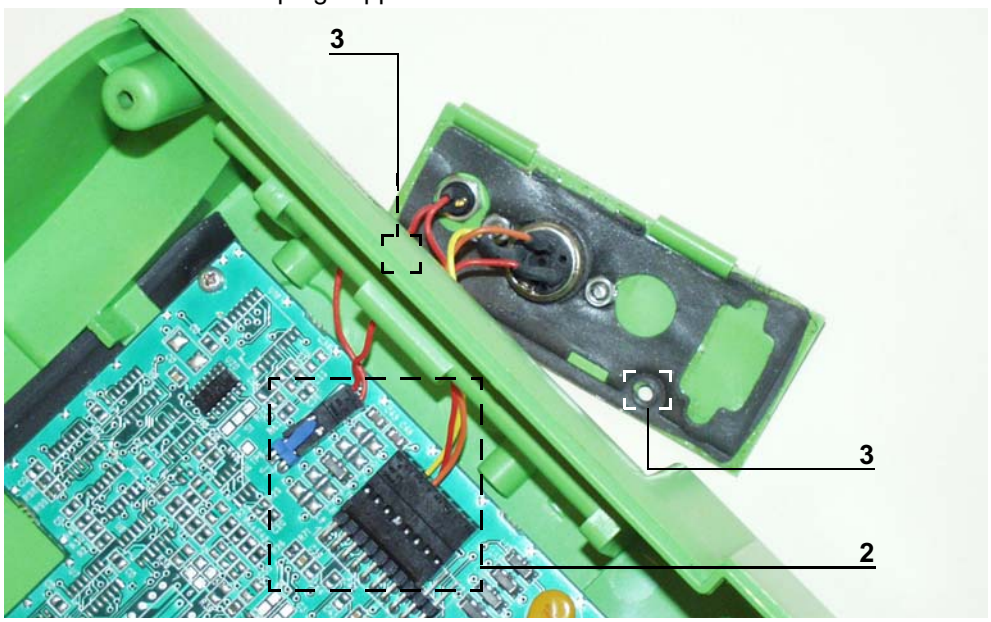
- Rotate the **Pilot** on the upper case.
- Unscrew the 6 Phillips head screws (ref. 1) located at the bottom of the lower case, which tighten the latter to the upper case.
- Keep the **Pilot** assembled and turn it over onto the lower case.
- Remove the upper case making sure the CPU board flat jumper is not accidentally removed in the process.
- Disconnect the CPU board flat jumper.

Hands must not come into contact with the CPU boards.



Dismounting

- Disconnect the two black connectors (ref 2).
- Unscrew the 2 Phillips head screws (ref. 3) located on the cabled plug support, which link this to the lower case.
- Remove the cabled plug support.



Reassembly

Carry out the same procedures in reverse to remount the unit.

If the number of rear door connector points is different to the number of power supply board points, make the connections as described below.

Perform the regular servicing tests (see “Regular servicing sheet”).

N°11, Procedure: Ribbon cable winding kit

Safety:

For safety reasons, the technician should not carry out any maintenance when the device is connected to the 230 V mains supply voltage.

Disconnect the mains power supply cable.

Equipment required:

- 1 Posidriv Z1 screwdriver.

Maintenance level:

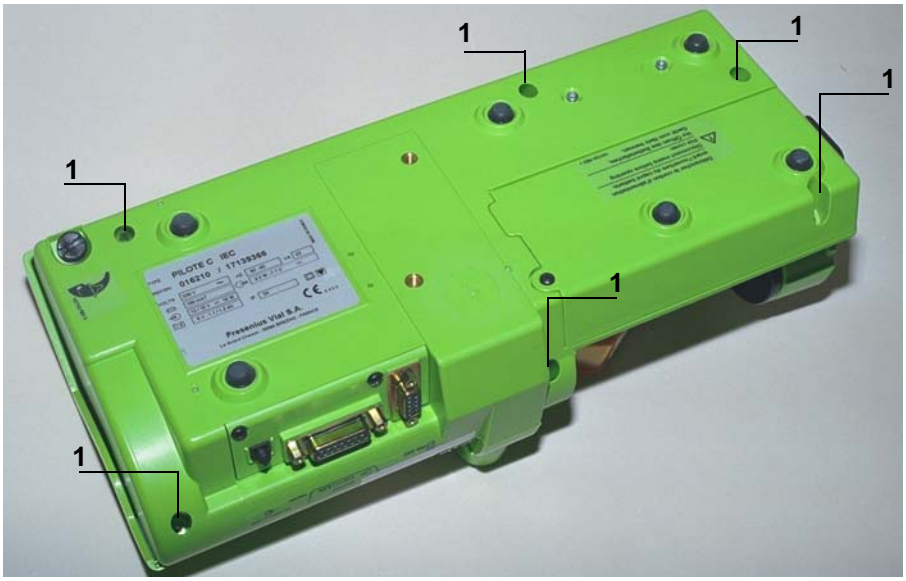
Level 2, specialised technician (see documentation on biomedical training).

Procedure:

Access

- Turn the **Pilot** over onto the upper case.
- Unscrew the 6 Phillips head screws (ref. 1) located at the bottom of the lower case, which link this to the upper case.
- Keep the **Pilot** assembled and turn it over onto the lower case.
- Remove the upper case making sure the CPU board flat jumper is not accidentally removed in the process.

Hands must not come into contact with the CPU boards.

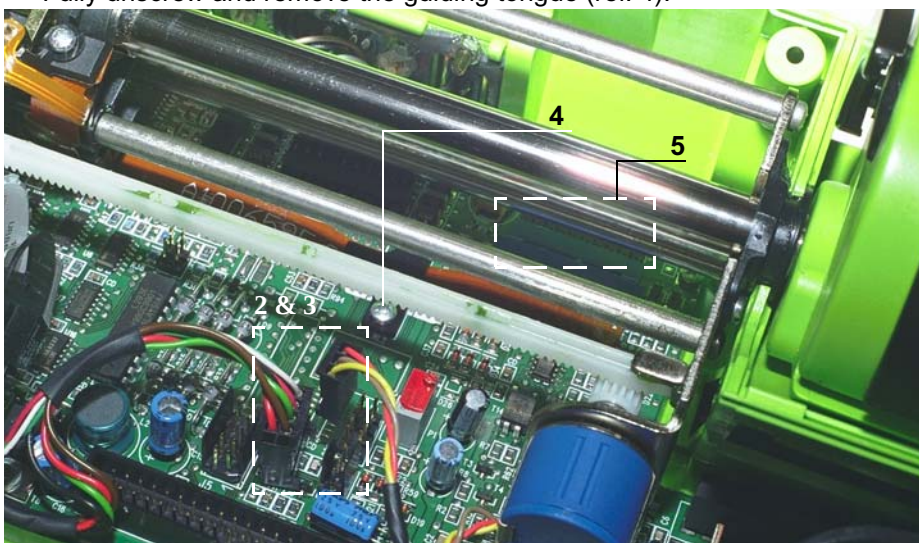


Dismounting

- Press the syringe pump disengagement lever towards the back of the Pilot as far as possible.
- Maintain this position and slide the whole unit to the back left.
- Remove the plunger guide.
- Disconnect the black connectors (ref. 2 and ref. 3).

When electronic components are handled, it is recommended to wear an antistatic wriststrap linked to ground and to work on an antistatic foam mat.

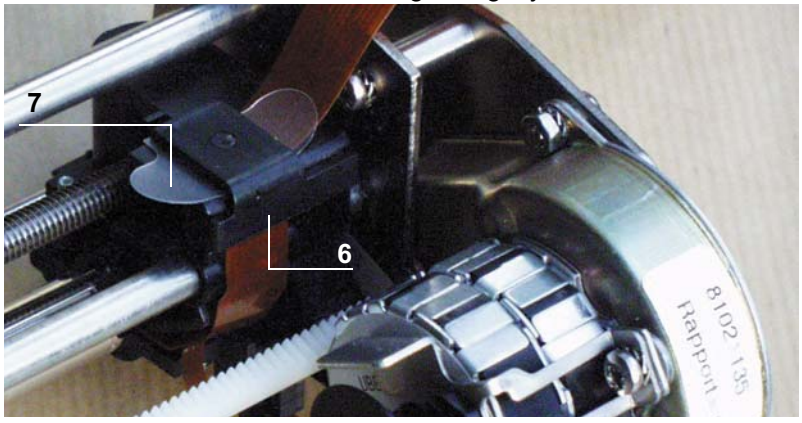
- Unscrew the flat jumper tongue (ref. 4) without removing it.
- Remove the mechanical plunger unit from its slot.
- Disconnect the blue connector (ref. 5) from the flat jumper.
- Remove the mechanical plunger unit.
- Fully unscrew and remove the guiding tongue (ref. 4).



Remounting

Fitting the flexible tongue:

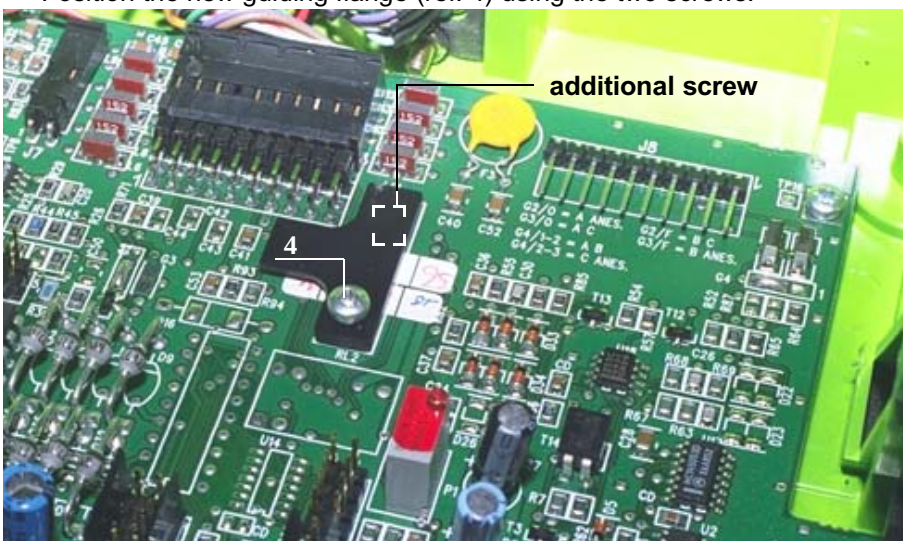
- Remove the clip (ref. 6).
- Stick the flexible tongue (ref. 7) with the adhesive facing the ribbon cable.
- Reposition the clip making sure the ribbon cable and the flexible tongue are centred on the mechanical unit sprocket.
- Lift both ends of the flexible tongue slightly.



Fitting the guiding flange:

There are several types of flange tongues. If you have an older version, replace it with that provided with the kit.

- Position the new guiding flange (ref. 4) using the two screws.



- Disconnect the blue connector (ref. 5) from the flat jumper.
- Position the whole mechanical plunger unit making sure the ribbon cable is centred under the flange.
- Perform a few round cycles to check the ribbon cable winds up correctly.
- Connect the black connectors (ref. 2 and ref. 3).
- Replace the plunger guide.

Carry out the same procedures in reverse to remount the upper case.

When fitting the upper case, ensure the joint is perfectly positioned in its slot after reassembly.

Perform the regular servicing tests (see "Regular servicing sheet").

N°13, Procedure: Centering ring kit

Safety:

For safety reasons, the technician should not carry out any maintenance when the device is connected to the 230 V mains supply voltage.

Disconnect the mains power supply cable.

Equipment required:

- 1 Posidriv Z1 screwdriver.
- 1 cutter.
- GEB type 100% silicone grease.

Maintenance level:

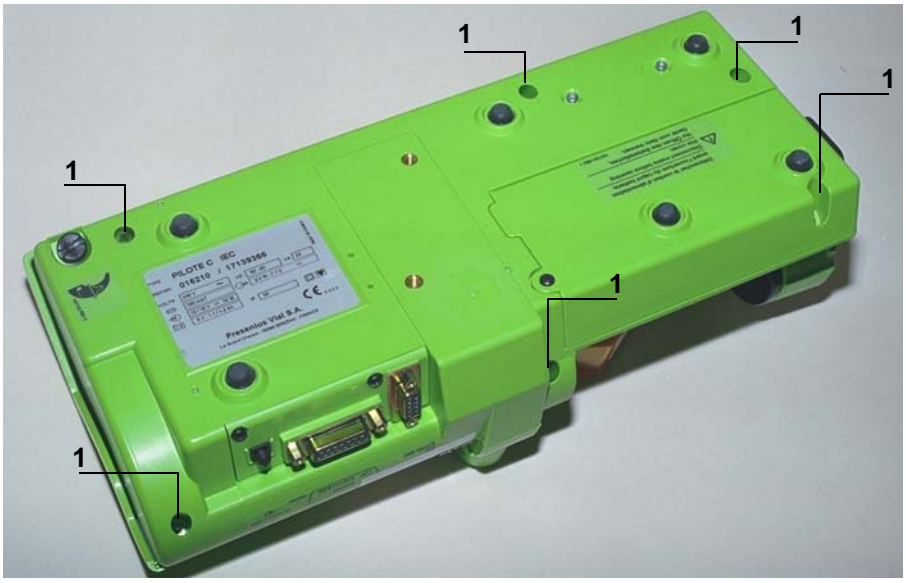
Level 2, specialised technician (see documentation on biomedical training).

Procedure:

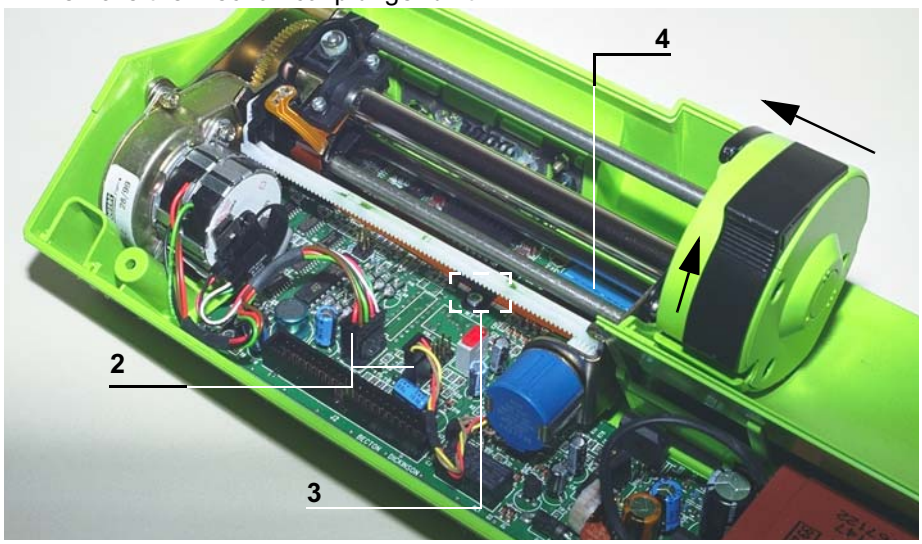
Access

- Turn the **Pilot** over onto the upper case.
- Unscrew the 6 Phillips head screws (ref. 1) located at the bottom of the lower case, which link this to the upper case.
- Keep the **Pilot** assembled and turn it over onto the lower case.
- Remove the upper case making sure the CPU board flat jumper is not accidentally removed in the process.

Hands must not come into contact with the CPU boards.



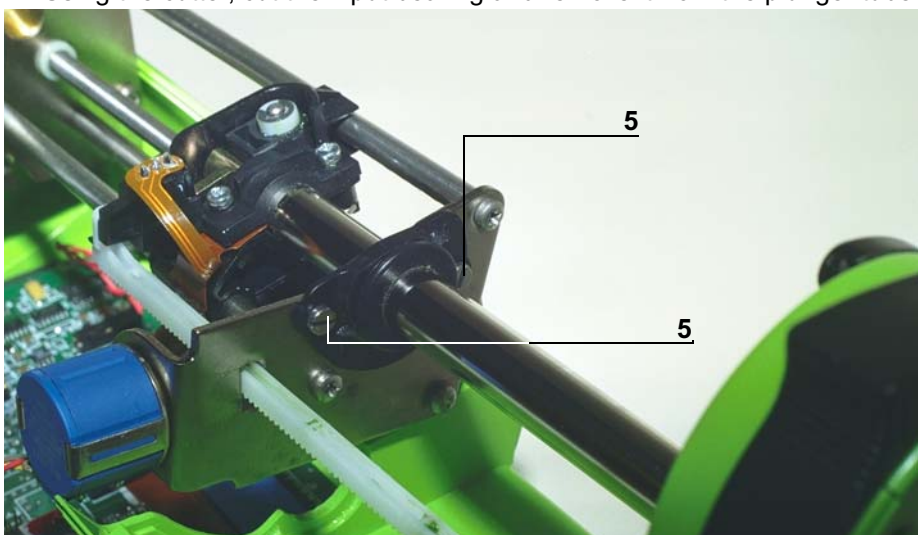
- Press the syringe pump disengagement lever towards the back of the Pilot as far as possible.
- Maintain this position and slide the whole unit to the back left.
- Remove the plunger guide.
- Disconnect the black connectors (ref. 2).
- Unscrew the flat jumper mounting lug (ref. 3) without removing it.
- Remove the mechanical plunger unit from its slot.
- Disconnect the blue connector from the flat jumper (ref. 4).
- Remove the mechanical plunger unit.



- Press the syringe pump disengagement lever towards the back of the Pilot as far as possible.
- Maintain this position and slide the whole unit to the back right.

Dismounting

- Unscrew the 2 slotted head screws (ref. 5) which link the centering ring to the mechanical end shield.
- Using the cutter, cut the input bearing and remove it from the plunger tube.



Remounting

- Mount the new slotted input bearing onto the plunger tube by twisting it.
- Laying it flat on a table, cut the O-ring using a cutter.
- Place the O-ring around the tube.
- Fit the O-ring into the centering ring slot (horizontal cut, so as to avoid lining it up with the centering ring cut).
- Mount the stainless steel slotted plate onto the pin, by twisting it.
- Place the silicone grease cord onto the plate around the passage of the pin.
- Place the plate on the input bearing.
- Position the whole assembly against the mechanical end shield and screw it on using the two slotted screws (ref. 5).
- Check the plunger slides correctly.

It should slide uniformly across the entire centering ring and slight friction is due to the O-ring scraping against the tube.

Perform the regular servicing tests (see "Regular servicing sheet").

N°14, Procedure: Flex circuit and tube kit

Safety:

For safety reasons, the technician should not carry out any maintenance when the device is connected to the 230 V mains supply voltage.

Disconnect the mains power supply cable.

Equipment required:

- 1 Posidriv Z1 screwdriver.
- 1 antistatic wriststrap.

Maintenance level:

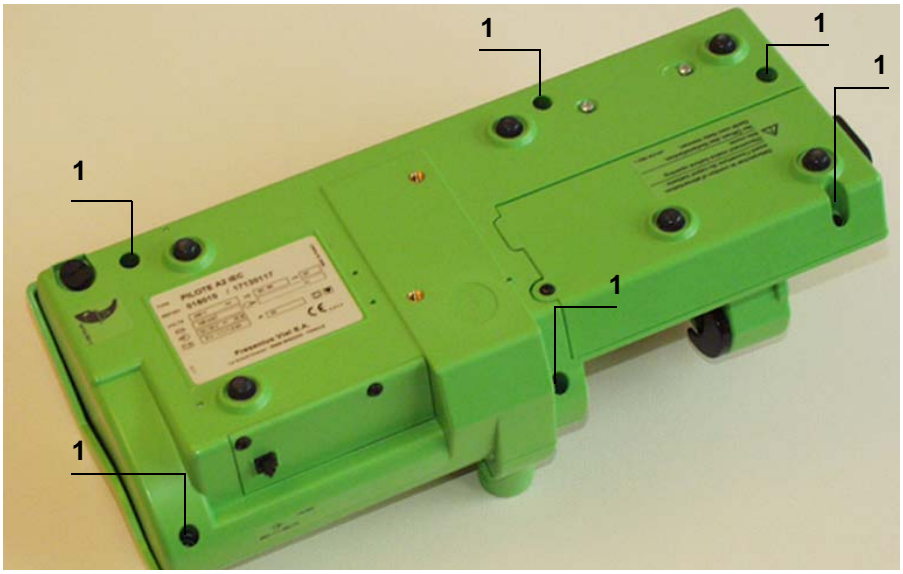
Level 2, specialised technician (see documentation on biomedical training).

Procedure:

Access

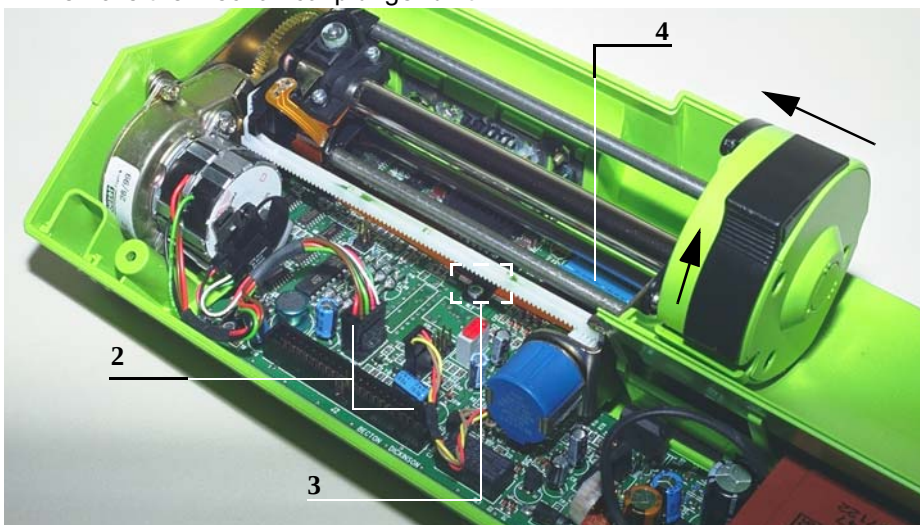
- Turn the Pilot over onto the upper case.
- Unscrew the 6 Phillips head screws (ref. 1) located at the bottom of the lower case, which link this to the upper case.
- Keep the Pilot assembled and turn it over onto the lower case.
- Remove the upper case making sure the CPU board flat jumper is not accidentally removed in the process.
- Disconnect the CPU board flat jumper.

Hands must not come into contact with the CPU boards.



Dismounting

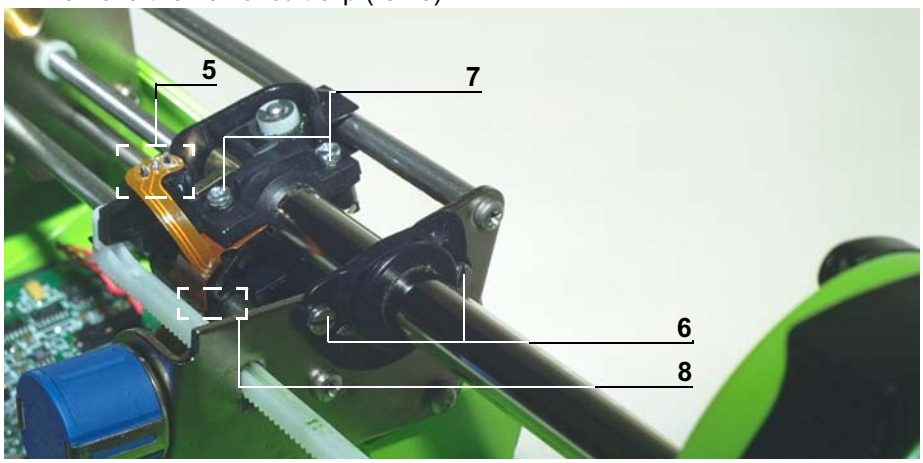
- Press the syringe pump disengagement lever towards the back of the Pilot as far as possible.
- Maintain this position and slide the whole unit to the back left.
- Remove the plunger guide.
- Disconnect the black connectors (ref. 2).
- Unscrew the flat jumper mounting lug (ref. 3) without removing it.
- Remove the mechanical plunger unit from its slot.
- Disconnect the blue connector from the flat jumper (ref. 4).
- Remove the mechanical plunger unit.



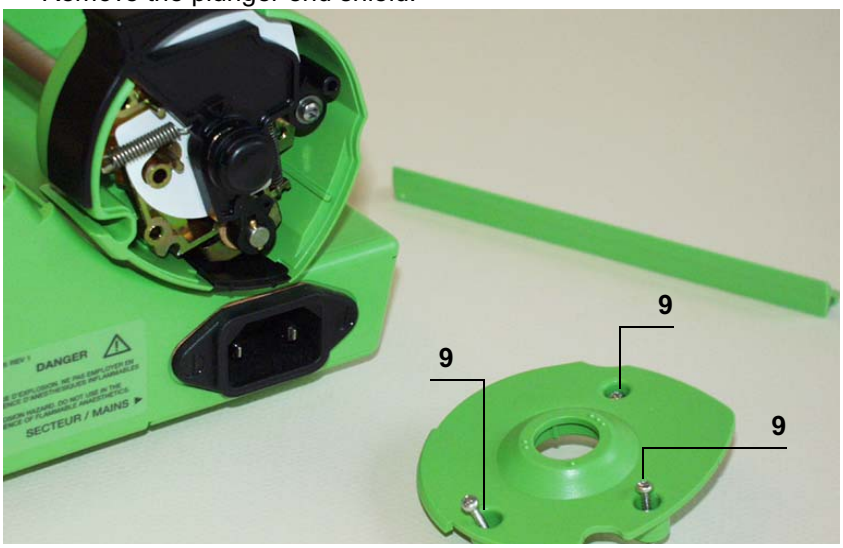
- Press the syringe pump disengagement lever towards the back of the Pilot as far as possible.
- Maintain this position and slide the whole unit to the back right.

Welding and unwelding operations are carried out using a soldering iron fitted with a tip in good condition, constantly tapered and kept clean. The temperature of the iron should be between 315°C and 340°C.

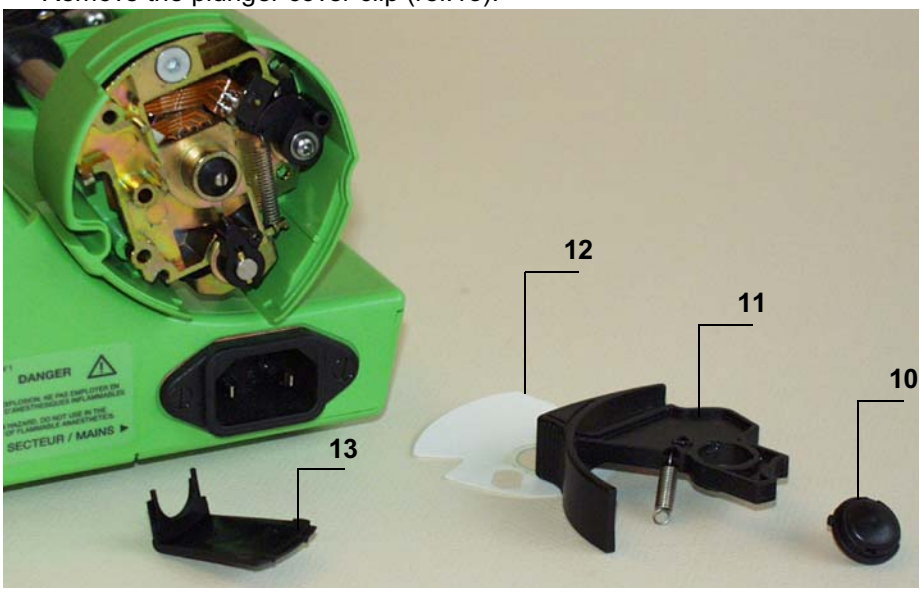
- Unweld the flex circuit (ref. 5) ensuring the disengagement switch is not damaged in the process.
- Unscrew the 2 slotted head screws (ref. 6) which link the centering ring to the mechanical end shield.
- Unscrew the 2 Phillips head screws (ref. 7) which link the centering ring to the mechanical end shield.
- Remove the flex circuit clip (ref. 8).



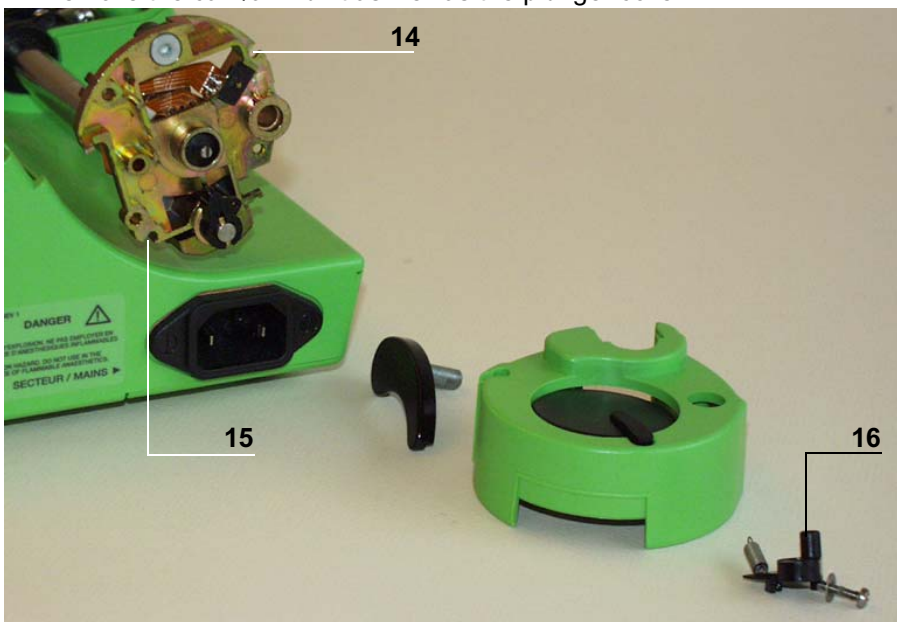
- Remove the plunger guide.
- Unscrew the 3 Phillips head screws (ref. 9) located at the bottom of the plunger end shield which links this to the plunger cover.
- Remove the plunger end shield.



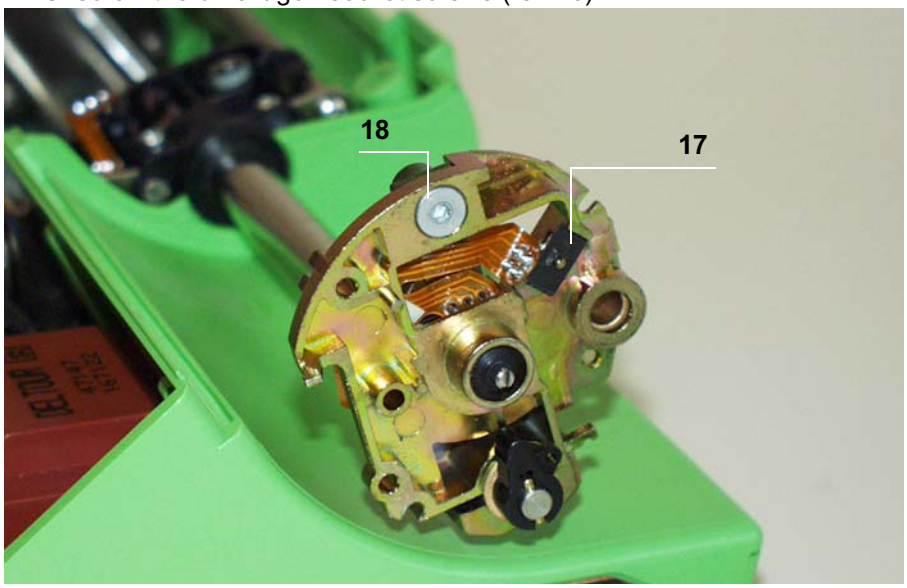
- Remove the backpressure adjustment button (ref. 10).
- Remove the disengagement lever and its spring (ref. 11) as well as the protective plunger film (ref. 12).
- Remove the plunger cover clip (ref.13).



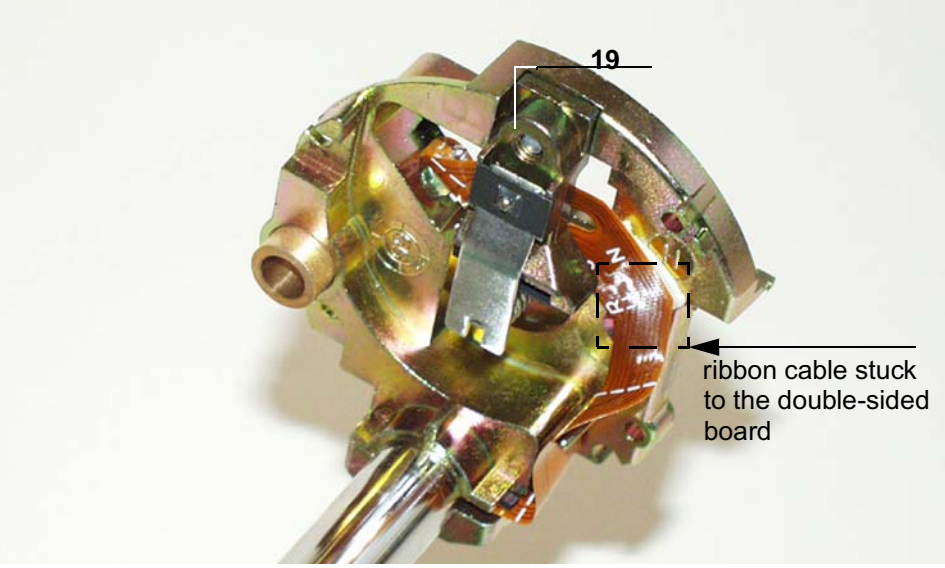
- Unscrew the 2 Phillips head screws (ref. 14 and 15) which link the plunger support to the plunger cover.
- Unscrew and remove the Phillips head screw and the washer (ref. 16) which attach the anti-siphon cam to the anti-siphon arm.
- Remove the cam/arm unit as well as the plunger cover.



- Remove the retaining ring that holds the anti-siphon opto in place (ref. 17).
- Unscrew the 6 hexagon socket screws (ref. 18).



- Remove the backpressure micro support/spring leaf (ref. 19).
- Pull off the ribbon cable from the double-sided board



Welding and unwelding operations are carried out using a soldering iron fitted with a tip in good condition, constantly tapered and kept clean. The temperature of the iron should be between 315°C and 340°C.

- Unweld the sensor wires:

When dismounting the force sensor, ensure the welding blocks are not damaged and the square is not removed in the process.

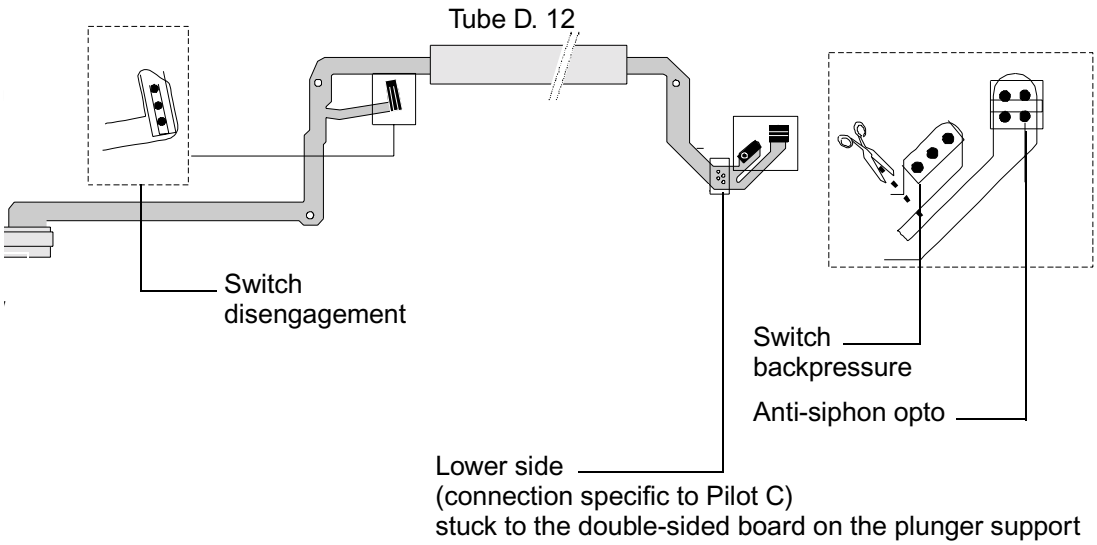
- ☐ Add more weld to facilitate the unwelding process.
- ☐ Heat and pull on the wires one by one.

- Remove the flex circuit and tube kit from the plunger support.

Reassembly

- Remove the sticky tape holding the flex circuit to the tube.
- Mount the new flex circuit onto the plunger support.
- Weld the ribbon cable to the new pressure switch, ensuring the mounting procedure is carried out in order:
  - Taper the 3 welding points.
  - Weld the 3 points.
  - Check that the welding has been carried out correctly. It should not form a ball, but should lie against the length of the component snubbers.

- Repeat the operation for the anti-siphon opto (4 welding points).
- Stick the bottom side of the ribbon cable to the double-sided board.
- Repeat the operation for the disengagement switch. (3 welding points)



Carry out the same procedures in reverse to remount the unit.

Do not forget to impregnate the cam/arm clamping screw (rep. 16) with weak loctite.

When fitting the upper case, ensure the joint is perfectly positioned in its slot after reassembly.

Recalibrate the force sensor (see "Calibrations") then carry out the regular servicing tests (see "Regular servicing sheet").

N°15, Procedure: Upper and lower cases

Safety:

For safety reasons, the technician should not carry out any maintenance when the device is connected to the 230 V mains supply voltage.

Disconnect the mains power supply cable.

Equipment required:

- 1 Posidriv Z1 screwdriver.
- 1 antistatic wriststrap.
- 1 soldering iron.
- "RADIEL Sn60Pb RI 1" welding wire (cleaning not required for rewelding) or equivalent.

Maintenance level:

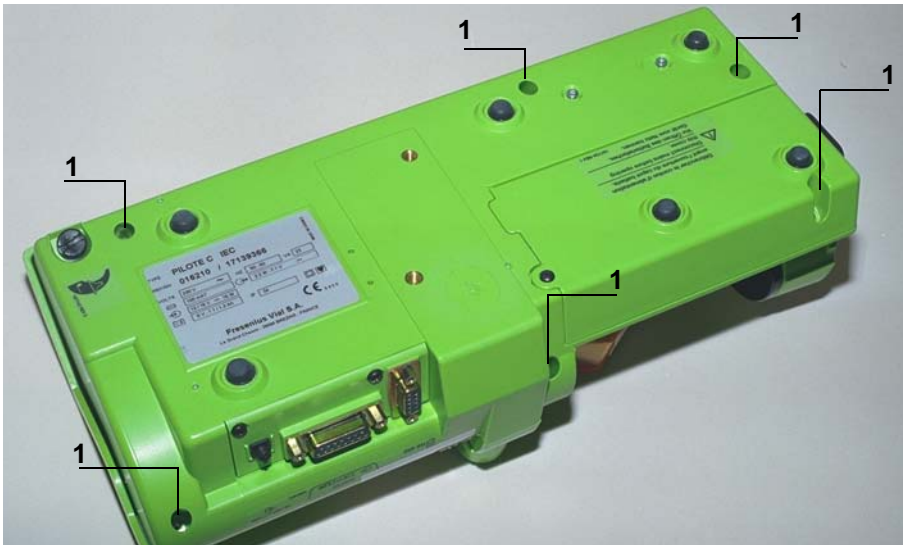
Level 2, specialised technician (see documentation on biomedical training).

Procedure:

Access

- Turn the **Pilot** over onto the upper case.
- Unscrew the 6 Phillips head screws (ref. 1) located at the bottom of the lower case, which link this to the upper case.
- Keep the **Pilot** assembled and turn it over onto the lower case.
- Remove the upper case making sure the CPU board flat jumper is not accidentally removed in the process.
- Disconnect the CPU board flat jumper.

Hands must not come into contact with the CPU boards.



Dismounting the upper cover

- Dismount the central unit and display boards (see corresponding sheet).
- Dismount the syringe clamp (see corresponding sheet).
- Dismount the syringe detection system (see corresponding sheet).

Remounting the upper cover

- Remount the syringe detection system (see corresponding sheet).
- Remount the syringe clamp (see corresponding sheet).
- Remount the central unit and display boards (see corresponding sheet).

  □ If the original lower case is fitted with a removable buzzer bell, you can use your “CPU and display board” kit without having to adapt it.
  □ If the original lower case has a cylindrical guide for accommodating the buzzer, the buzzer from the “CPU and display board” kit must be replaced with the buzzer supplied with the spare parts as the latter is fitted with snubbers and a separate foam joint.
  Follow the mounting diagram shown below to carry out this adaptation procedure.

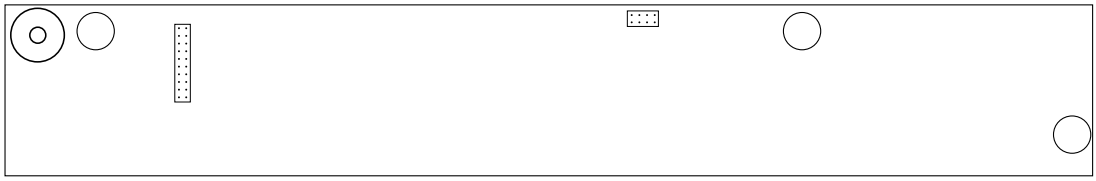
Welding and unwelding operations are carried out using a soldering iron fitted with a tip in good condition, constantly tapered and kept clean. The temperature of the iron should be between 315°C and 340°C.

□ Unweld the snubbers from the buzzer:
- add more weld to facilitate the unwelding process.
- Heat and pull on the buzzer pins one by one.

Clean the buzzer slot surfaces using a cloth soaked in rubbing alcohol.

□ Weld the snubbers of the new buzzer:

Buzzer with snubbers



Display board

- taper the 2 buzzer pins to be welded.
- place the buzzer onto the board following the mounting diagram.
- weld to buzzer onto the board.
- check that the welding has been carried out correctly. It should not form a ball, but should lie against the length of the wire.

Continue with the remounting procedure, referring to the “central unit and display board” sheet.

Perform the regular servicing tests (see "Regular servicing sheet").

Dismounting the lower cover

- Dismount the power supply board (see corresponding sheet).
- Dismount the battery holder (see corresponding sheet).
- Dismount the rear plug support (see corresponding sheet).

Remounting the lower cover

Carry out the remounting procedure in reverse.

Perform the regular servicing tests (see "Regular servicing sheet").

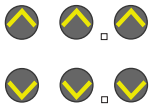
7 Calibration

7.1 Calibration procedure

The calibration menu is for trained personnel only.

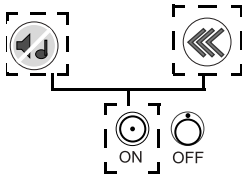
7.1.1 Calibration access

Keyboard description.

Key	Function
	**ON**, is used to switch the machine on. **OFF**, is used to switch the machine off when pressed for over three seconds.
	**SILENCE ALARME**, is used to access the calibration mode.
	**VALIDATION**, is used to validate a choice.
	**BOLUS**, is used to access the calibration mode.
	The select keys allow to scroll the figures and letters on the LCD screen, on the units, tens, tens segments etc.

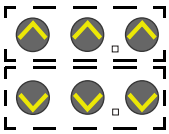
Activate calibration

- Press the "SILENCE ALARME" and "BOLUS" keys simultaneously.



- Maintain this position while pressing "ON".
- When EtA. is displayed, release the “SILENCE ALARME” and “PURGE/BOLUS” keys, then validate within three seconds by pressing the “VALIDATION" key.

- The equipment initiates the EtA.4 calibration by default
- Scroll the different display unit calibration states using the "+ or -" select keys.



  - EtA.4: calibration of the 3 battery voltage levels.
  - EtA.6: calibration of the position sensor.

7.1.2 CAL.4 Calibration of the 3 battery voltage levels.

This menu enables the user to store the three Bat1, Bat2 and Bat3 battery voltage values in an EEPROM.

■ CAL.4, press "VALIDATION".

- □ bAt.1: Supply the equipment with 6.3 V± 0.05 using a stabilised power supply.
  - ♦ Press "VALIDATION".
    The voltage is read and stored in the EEPROM.
- □ Press "VALIDATION".
- □ bAt.2: Supply the equipment with 5.9 V± 0.05 using a stabilised power supply.
  - ♦ Press "VALIDATION".
    The voltage is read and stored in the EEPROM.
- □ Press "VALIDATION".
- □ bAt.3: Supply the equipment with 5.7 V± 0.05 using a stabilised power supply.
  - ♦ Press "VALIDATION".
    The voltage is read and stored in the EEPROM.

□ By validating once again, it is possible to select another calibration.

7.1.3 CAL.6 Calibration of the position sensor.

This menu enables users to store both high and low displacement limit values in the EEPROM.

■ CAL.6, press "VALIDATION".

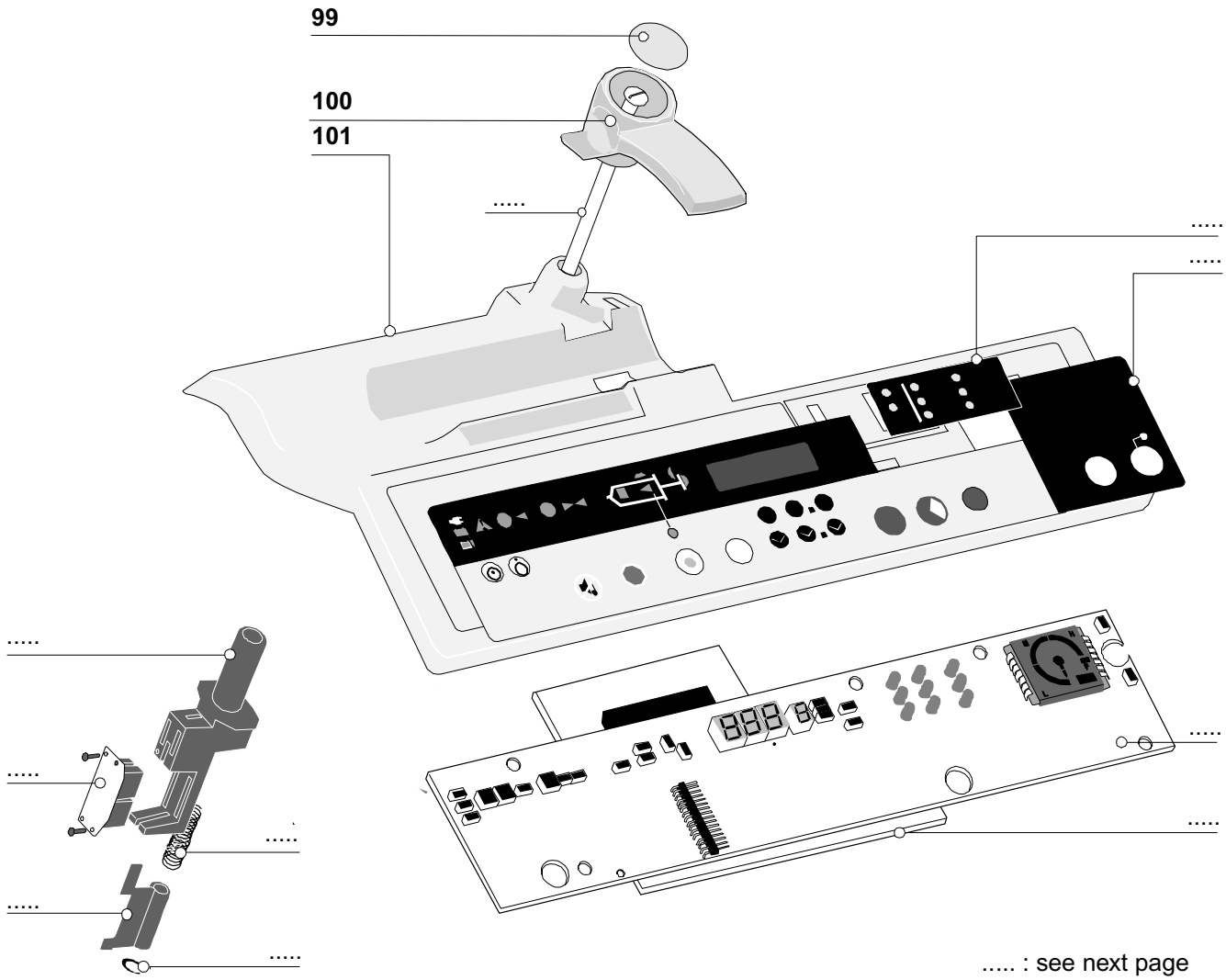
- □ HIGH: Place a spacer measuring 115 mm ± 0.05 ref. T 300940, into the fin groove.
  - ♦ Position the plunger in contact with the spacer.
  - ♦ Keep the plunger disengaged and press "VALIDATION".
    The position value is read and stored in the EEPROM.
- □ Press "VALIDATION".
- □ LOW: Place a spacer measuring 20 mm ± 0.05 ref. T 300775, into the fin groove.
  - ♦ Position the plunger in contact with the spacer.
  - ♦ Keep the plunger disengaged and press "VALIDATION".
    The position value is read and stored in the EEPROM.

Once both high and low values have been stored in the EEPROM, the equipment indicates the number of LSB in decimals between the two measurement points. This value should be 772 ± 10 LSB.

□ If the value is out of limits, carry out the calibration procedure once again.
□ By validating once again, it is possible to select another calibration.

8 Spare parts catalogue

8.1 Upper case



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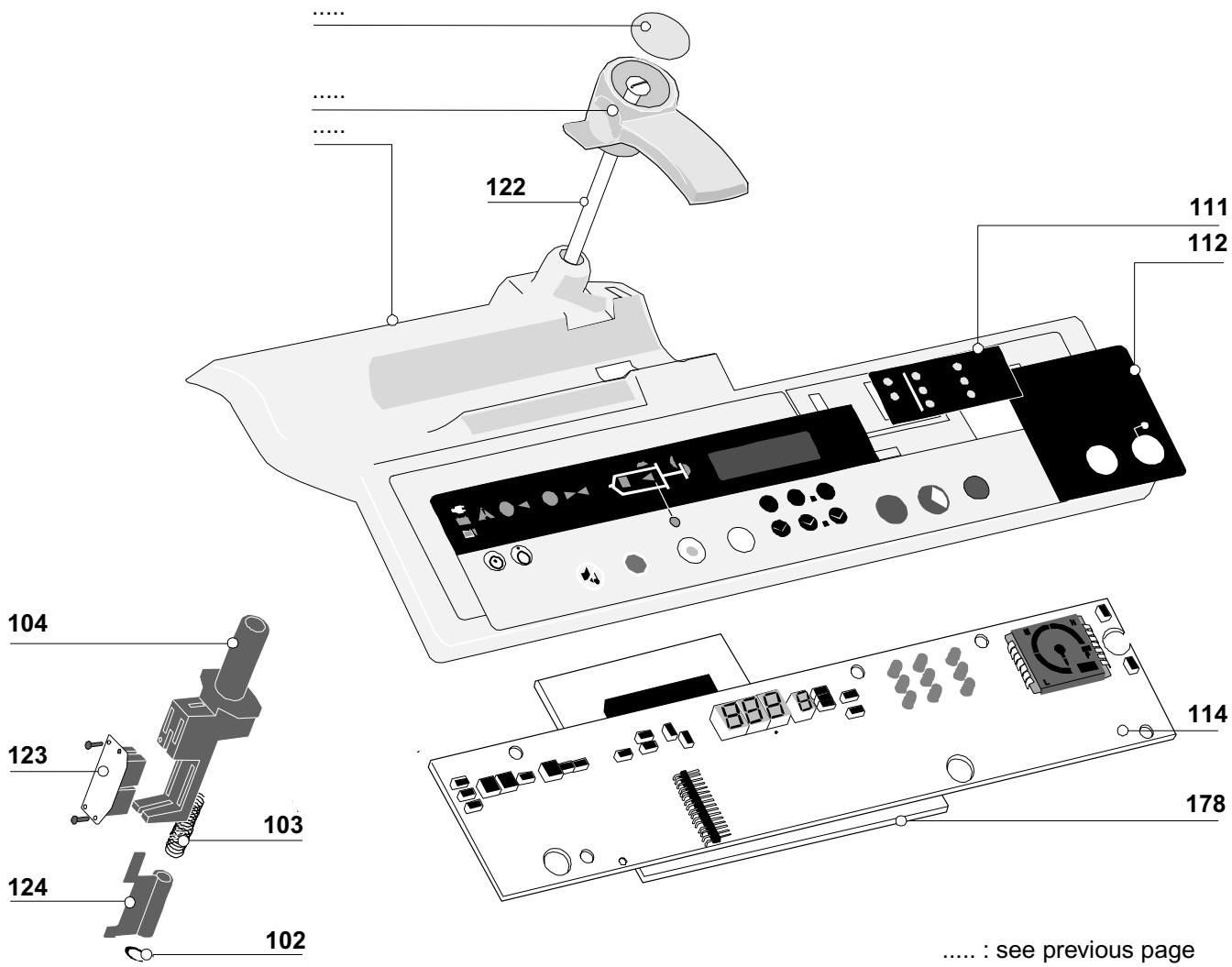
Mark	Qty	Reference	Name
	1	167246	LCD transparent pilot window
	1	167629	6 diam injected bumper
	2	199560	Female M3x12 hybrid spacer
	1	167067	PCB 500 protective film
	1	167296	Adhesive flat jumper protective film
	1	167632	Buzzer foam
	1	167636	Buzzer foam bell
99	1	167744	17.5 diam Pilot label
100	1	167476	Injected syringe clamp
101	1 1 1	199214 199218 199222	Upper case kit DIN version Upper case kit NL version Upper case kit IS version



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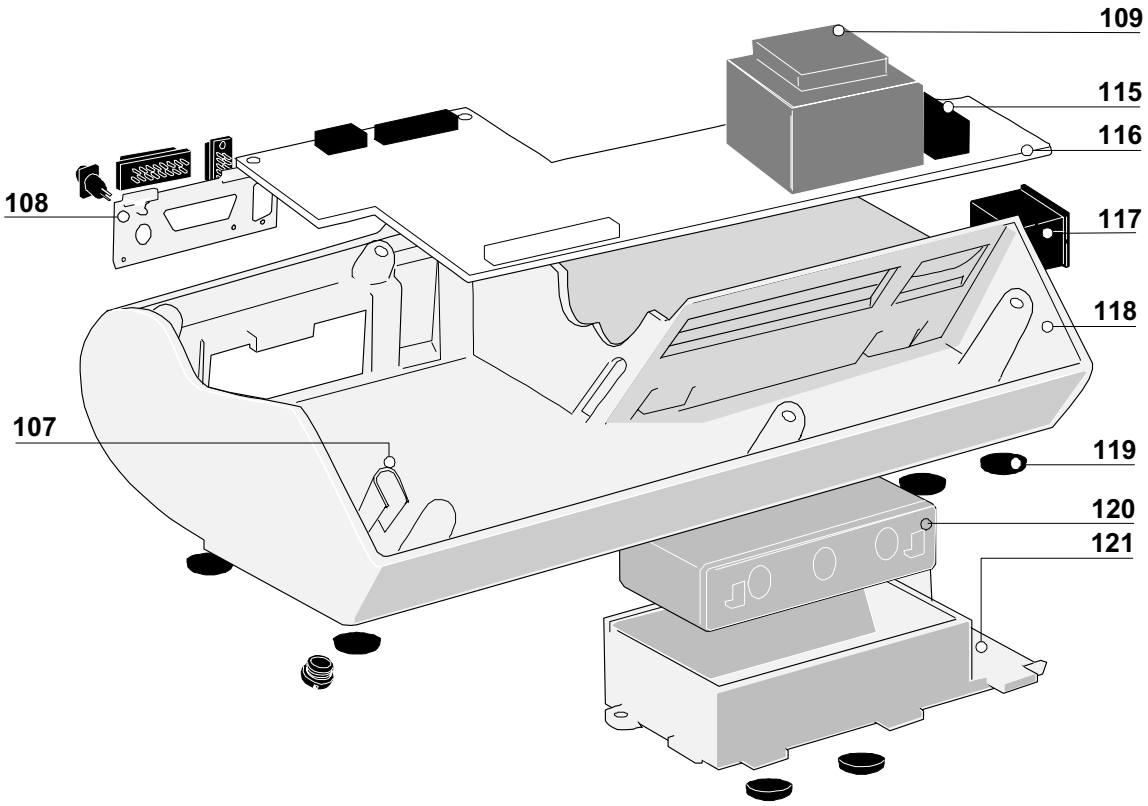
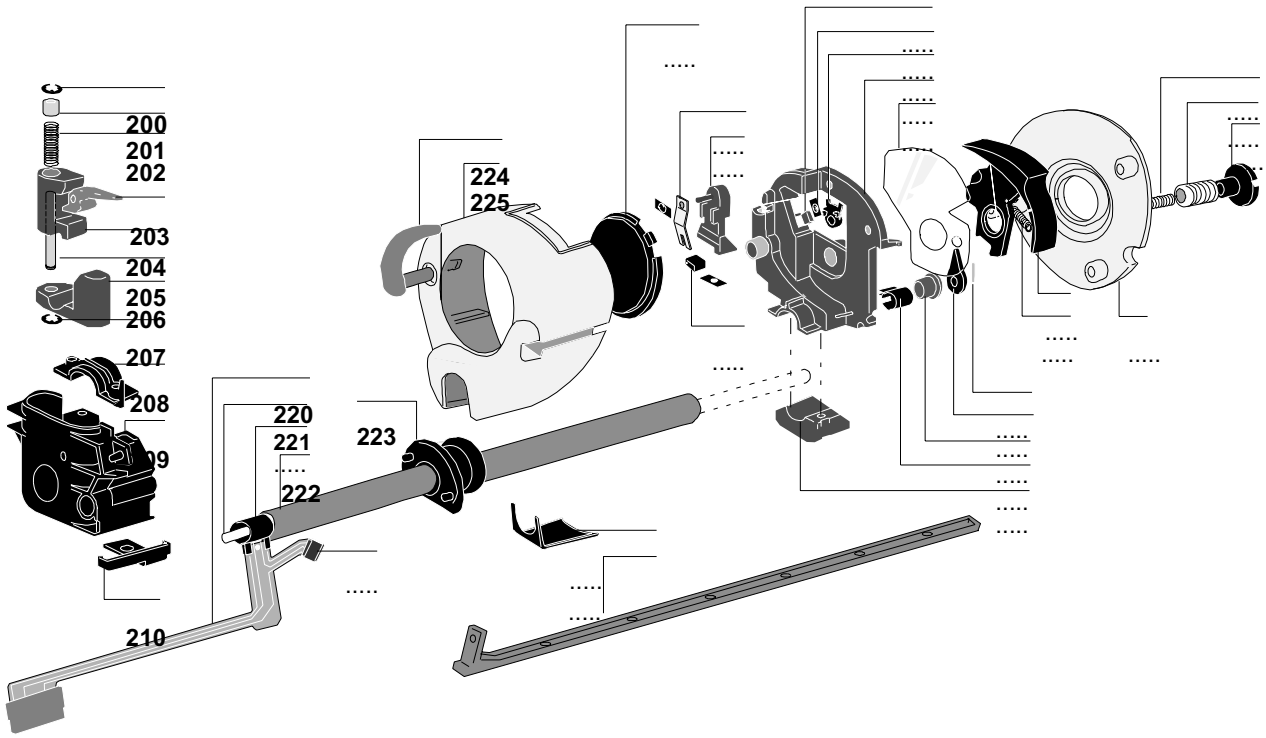
Mark	Qty	Reference	Name
102	1	167361	5 diam retaining ring
103	1	167310	Syringe clamp compression spring
104	1	167452	Injected PCB support (opto)
111	1	167670	Syringe list label
112	1	167640	A IEC pilot front panel
114	1	167550	Display board
	1	167713	Keyboard (active part)
122	1	167458	Syringe clamp shaft
123	1	167932	C.I. opto cabled
124	1	167459	Pilot 20/60 ml obturator
178	1	167190	CPU board

8.2 Lower case



Mark	Qty	Reference	Name
	1	167059	Pilot guide rail
	1	167299	Buzzer adjustment washer
	1	167297	Spring washer
	1	167923	HE13 battery connector
	1	167122	Injected flexible PCB flange
		167370	Flexible tongue
	1	167355	Mains fibre gasket
	1	170416	Mains cord
107	1	167093	Buzzer bell
108	1	167967	Pilot A wired plug support
109	1	177201	Transformer
	1	167432	Buzzer adjustment button
115	1	170228	Fuse F2
116	1	167078	Pilot A power supply board
117	1	167942	Wired mains socket
118	1 1 1	199201 199202 199203	Lower case kit DIN version Lower case kit NL version Lower case kit IS version
119	6	167249	Black stop piece
120	1	174019	6V 1.3 Ah battery
121	1	199169	Pilot battery holder kit

8.3 Plunger unit



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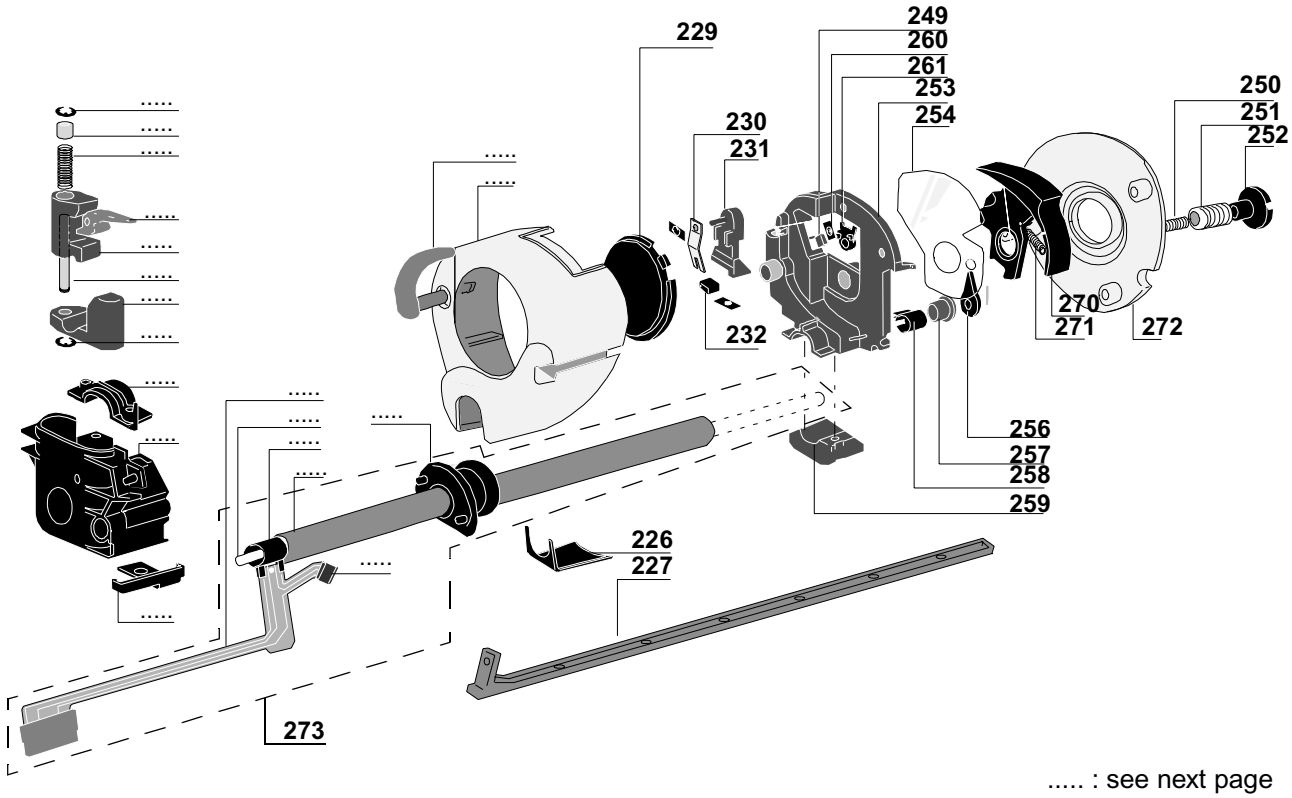
Mark	Qty	Reference	Name
	1	167264	Anti-siphon spring
200/207	2	167360	3.5mm diam retaining ring
201	1	167465	Disengagement spring follower
202	1	167469	Disengagement follower
203	1	167460	Injected disengagement cam
204	1	167471	Injected upper mechanism nut
205	1	167464	Disengagement spring shaft
206	1	167472	Injected lower mechanism nut
208	1	167466	Mechanical flange
209	1	167281	Injected slug + mechanical block
210	1	167275	Flexible PCB clip
220	1	167271	Flex circuit
221	1	167317	Full disengagement shaft
222	1	167240	12 diam tube (20/60 ml version)
223	1	167403	Slotted injected input bearing
	1	177203	O-ring (to put in the bearing)
	1	177204	Stainless steel plate (to be mounted between the bearing and the end shield)
224	1	167291	Pilot anti-siphon arm
225	1	199252	Pilot A plunger kit



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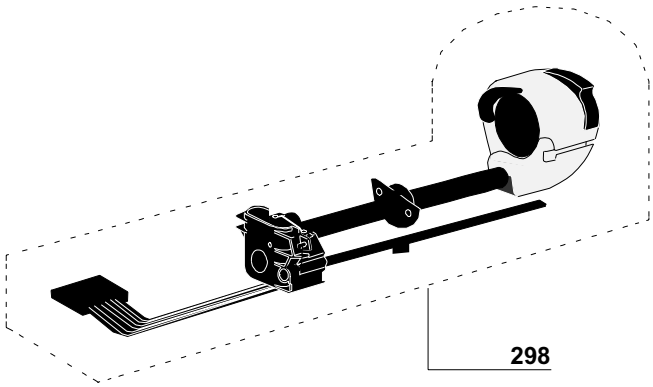
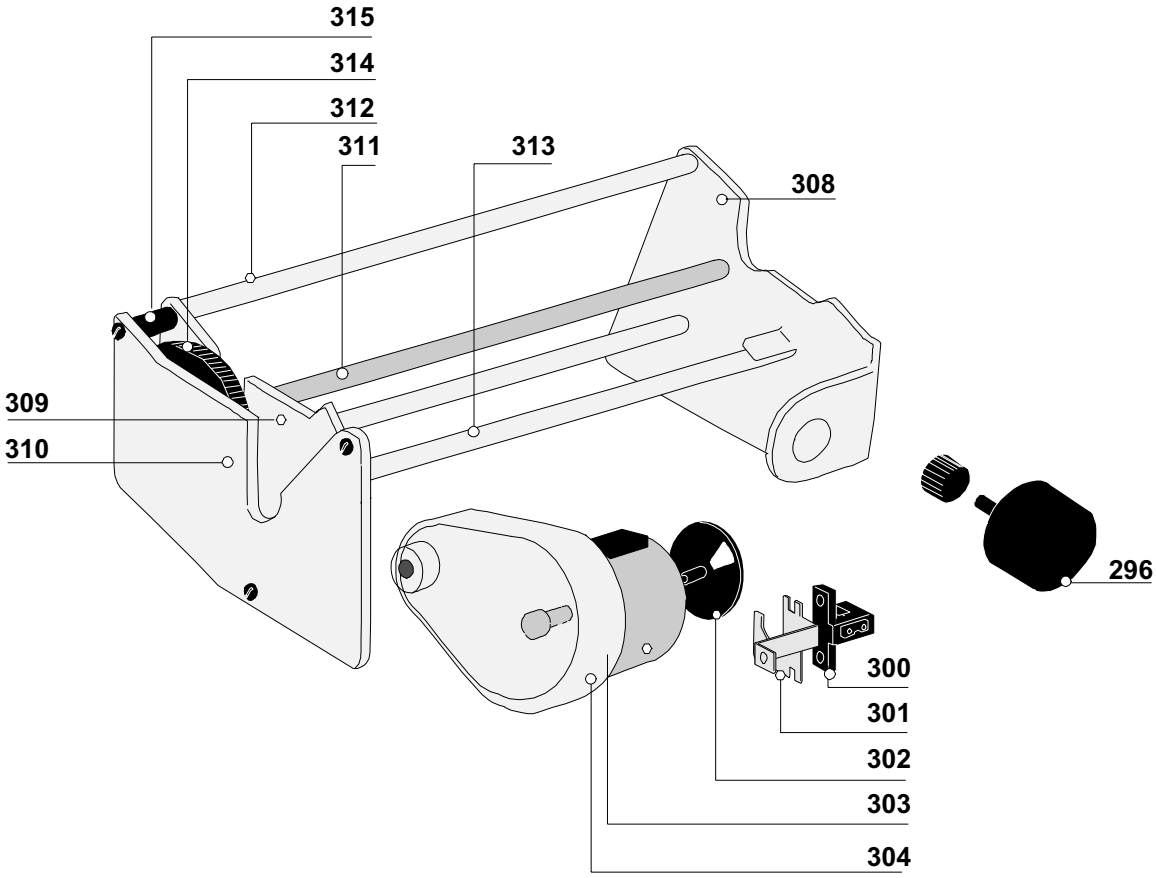
Mark	Qty	Reference	Name
226	1	167259	Plunger cover clip
227	1	167442	Injected M 0.5 rack
229	1	167237	Bonding pad
230	1	167411	Backpressure spring leaf
231	1	167273	Backpressure micro support (plunger)
232	1	173408	OMRON micro-switch
249	1	162311	Photo switch (type RP I 131)
250	1	167492	Backpressure spring
251	1	167270	Backpressure spring leaf adjusting screw
252	1	167269	Backpressure adjustment button
253	1	167282	Plunger bracket
254	1	167493	Protective plunger film
256	1	167488	Disengagement finger
257	1	167487	Sintered disengagement shaft bearing
258	2	167298	Injected flexible PCB protector
259	1	167272	Injected clamping collar
260	1	190714	Retaining ring
261	1	167385	Anti-siphon cam
270	1	167260	Disengagement lever
271	1	167245	Disengagement lever spring
272	1	167055	PILOT A plunger end shield
273	1	199103	Flexible circuit + tube kit



Mark	Qty	Reference	Name
298	1	199135	Mechanical kit

8.4 Mechanical gear box



Mark	Qty	Reference	Name
	2	190714	Retaining ring
296	1	167930	Wired potentiometer connector
300	1	167128	Motor rotation switch
301	1	167145	Standard motor opto support
302	1	167111	Motor rotation disk
304	1	167156	Reducer
303 to 304	1	167948	Motor reducer Pilot A wired blue connector
303 to 304	1	167964	Motor reducer Pilot A wired black connector
308	1	167117	Mechanical end shield
309	1	167140	Intermediate end shield
310	1	167158	Standard reducer end shield
311	1	167142	T M6 2 x 100 threaded rod
312/313	3	167143	Ø 6 guide pin
314	1	167144	Pinion (64 teeth)
315	1	167157	Spacer

8.5 Labels

Mark	Qty	Reference	Name
	1	167970	Instruction guide label DIN
	1	167770	Instruction guide label IS/BS
	1	167827	Instruction guide label NL
	1	167773	Instruction guide label IT
	1	167855	Instruction guide label SP
	1	167890	Label DIN, IS/BS, NL, IT, SP
	1	167742	Buzzer adjustement label DIN, IS/BS, NL, IT, SP
	1	167979	Danger selection label DIN
	1	167776	Danger selection label IS/BS
	1	167811	Danger selection label NL
	1	167778	Danger selection label IT
	1	167858	Danger selection label SP
	1	167734	Battery door label DIN, IS/BS
	1	167812	Battery door label NL, IT
	1	167734	Battery door label SP
	1	167731	0.63 m AT label (inside) DIN, IS/BS, NL, IT, SP
	1	167978	Danger mains label DIN
	1	167725	Danger mains label IS/BS
	1	167814	Danger mains label NL
	1	167800	Danger mains label IT
	1	167725	Danger mains label SP
	1	167648	Keyboard (front panel) DIN
	1	167644	Keyboard (front panel) IS
	1	167658	Keyboard (front panel) NL
	1	167652	Keyboard (front panel) IT
	1	167655	Keyboard (front panel) SP
	1	167713	Keyboard active part DIN, IS, NL, IT, SP

Useful addresses

SALES DEPARTMENT		
	Fresenius Vial Le Grand Chemin, 38590 Brézins	
	CUSTOMER SERVICE	Tel.: 00 33 (0) 4 76 67 10 81 or 00 33 (0) 4 76 67 10 54 or 00 33 (0) 4 76 67 11 08 Fax: 00 33 (0) 4 76 67 11 34
	SALES MANAGEMENT	Tel.: 00 33 (0) 4 76 67 10 81 Fax: 00 33 (0) 4 76 67 11 34
TRAINING DEPARTMENT		
	Fresenius Vial Le Grand Chemin, 38590 Brézins	Tel.: 04 76 67 10 76 Fax: 04 76 67 11 22
AFTER SALES SERVICE		
FRANCE	After Sales Service Division GRENOBLE **Fresenius Vial** Le Grand Chemin, 38590 Brézins FRANCE	Tel.: 04 76 67 10 34 Fax: 04 76 67 11 22
BELGIUM	**Fresenius Vial** NV/SA Vial Médical Division Molenberglei 7 2627 Schelle BELGIUM	Tel.: 32/388.07307 Fax: 32/388.05007
GERMANY	**Fresenius MCM** AM-Neuen Berg 63749 ALZENAU GERMANY	

Fresenius Vial S.A. Headquarters: Le Grand Chemin - 38590 Brézins (FRANCE)
Public Company with board of directors and advisory council, and with a capital of 90,128,000FF
SIREN Grenoble B 408 720 282.
Design and development: SONOVISION-ITEP