GE Healthcare

Datex-Ohmeda S/5 FM

Technical Reference Manual

Conformity according to the Council Directive 93/42/EEC concerning Medical Devices amended by 2007/47/EC

CAUTION: U.S. Federal law restricts this device to sale by or on the order of a licensed medical practitioner. Outside the USA, check local laws for any restriction that may apply.

All specifications subject to change without notice.

Order code M1181261
3rd edition
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Indications for use

The S/5 FM with L-FICU06 and L-FICU06A and N-FCREC Module are intended for multiparameter patient monitoring.
The S/5 FM with L-FICU06 or L-FICU06A software is indicated for monitoring of hemodynamics (including arrhythmia and ST-segment analysis) and respiratory status of all hospital patients.
Extension module N-FCREC (option N-FCREC or N-FC) is indicated for monitoring CO2 and respiration rate of all hospital patients.
CO2 measurements are indicated for patients weighing over 5kg (11lbs).
The S/5 FM Monitor and N-F(C)(REC) Extension Module are indicated for use by qualified medical personnel only.

The Datex-Ohmeda S/5 PSM module (consisting of E-PSM, E-PSMP and E-INTPSM Modules) and accessories is intended for monitoring hemodynamic parameters of hospitalized patients.
The Datex-Ohmeda S/5 PSM module (consisting of E-PSM, E-PSMP and E-INTPSM Modules) and accessories are indicated for monitoring of hemodynamic parameters of all hospital patients. The hemodynamic parameters of the module comprise ECG (including ST-segment and arrhythmia), Impedance respiration, NIBP, Temperature, SpO2 (including monitoring during conditions of clinical patient motion), and invasive blood pressure.
Impedance Respiration measurement is indicated for patients ages 3 and up.
The NIBP measurement is indicated for patients who weigh 5 kg (11 lbs.) and up.
The device is indicated for use by qualified medical personnel only.

NOTE: E-INTPSM Module is not in use with the S/5 FM.

Classifications

In accordance with IEC 60601-1

CLASS I AND INTERNALLY POWERED EQUIPMENT – the type of protection against electric shock.

TYPE BF or CF equipment. The degree of protection against electric shock is indicated by a symbol on each parameter module.

EQUIPMENT not suitable for use in the presence of a FLAMMABLE ANESTHETIC MIXTURE WITH AIR OR WITH OXYGEN OR NITROUS OXIDE.

CONTINUOUS OPERATION according to the mode of operation.

In accordance with IEC 60529

IPX1 - degree of protection against harmful ingress of water.

In accordance with EU Medical Device Directive

The Datex-Ohmeda S/5 FM is classified as IIb.

In accordance with CISPR 11: Group 1, Class A

- Group 1 contains all ISM (Industrial, scientific and medical) equipment in which there is intentionally generated and/or used conductively coupled radio-frequency energy which is necessary for the internal functioning of the equipment itself.
- Class A equipment is suitable for use in all establishments other than domestic and those directly connected to the public low-voltage power supply network that supplies buildings used for domestic purposes.

Responsibility of the manufacturer

GE Healthcare Finland Oy (GE) is responsible for the effects on safety, reliability and performance of the equipment only if:

- assembly, extensions, readjustments, modifications, servicing and repairs are carried out by personnel authorized by GE.
- the electrical installation of the monitor room complies with appropriate requirements.
- the equipment is used in accordance with the "User's Guide."

Trademarks

S/5, D-lite, D-lite+, Pedi-lite, Pedi-lite+, Mini D-fend, D-fend, D-fend+, MemCard, ComBar, ComWheel, EarSat, FingerSat, FlexSat, PatientO2, Entropy and Patient Spirometry are trademarks of GE Healthcare Finland Oy.

Datex, Ohmeda, and OxyTip+ are trademarks of GE Healthcare Finland Oy and Datex-Ohmeda, Inc.

All other product and company names are property of their respective owners.

Product availability

Some of the products mentioned in this manual may not be available in all countries.
Please, consult your local representative for the availability.

Datex-Ohmeda S/5 FM

Technical Reference Manual, Order code: M1181261
3rd edition

Part I, General Service Guide

Part II, Product Service Guide

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About this manual

Intended audience

This Technical reference manual is meant for service representatives and technical personnel who install, configure, maintain, administer, troubleshoot or repair *Datex-Ohmeda S/5 FM*.

Notes to the reader

As the monitor setup may vary, some functions described may not be available in the monitor you are using.

- The order code for the entire printed manual is **M1181261**. The manual includes Technical Reference Manual Slots and every slot has an individual document number.
- Part I gives the reader an overview of the S/5 FM. It contains the information needed to install, interface and troubleshoot the monitors. Instructions for functional check and planned maintenance are also included. Read the manual through and make sure that you understand the procedures described before the installation of the monitor. To avoid risks concerning safety or health, strictly observe the warning indications. If you need any assistance concerning the installation, please do not hesitate to contact your authorized distributor.
- Part II contains detailed descriptions of each component of the S/5 FM, such as frame unit, parameter modules Remote Controller and Device Interfacing Solution. Service check for each product, service menus and all the spare parts information for the Monitor is included.

The manufacturer reserves the right to change product specifications without prior notice. Although the information in this manual is believed to be accurate and reliable, the manufacturer assumes no responsibility for its use.

Installation and service are allowed by authorized service personnel only.

GE Healthcare Finland Oy (GE) assumes no responsibility for the use or reliability of its software in equipment that is not furnished by GE.

Ordering manuals

A paper copy of this manual will be provided upon request. Contact your local GE representative and request the part number on the cover page of the manual.

Related documentation

S/5 FM Monitor

For instructions for daily use including cleaning and daily maintenance, clinical aspects and basic methods of measurement see:
S/5 FM Monitor, User's Guide
S/5 FM Monitor, User's Reference Manual

For more information about the iCentral, S/5 Arrhythmia Workstation and anesthesia record keeping solution, see the "Technical Reference Manuals" and "User's Reference Manuals" for these products."

Software options and default settings are described in the "Default Configuration Worksheet" delivered with each monitor.

Available accessories are described in the "Supplies and Accessories" catalog.

Conventions used

To help you find and interpret information easily, the manual uses consistent text formats:

Sign the check form after performing the procedure.

Hard Keys	Names of the hard keys on the Remote Controller, Command Board, side panel and modules are written in the following way: **Others.**
Menu Items	Software terms that identify window parts or menu items are written in bold italic: ***ECG Setup.*** Menu access is described from top to bottom. For example, the selection of the **Monitor Setup** hard key, the ***Screen 1 Setup*** menu item and the ***Waveform Fields*** menu item would be shown as **Monitor Setup -** ***Screen 1 Setup - Waveform Fields***.
'Messages'	Messages (alarm messages, informative messages) displayed on the screen are written inside single quotes: 'Please wait'.
"Sections"	When referring to different sections in this manual or to other manuals, manual names and section names are enclosed in double quotes: See section "Cleaning and care." Please refer to "User's Reference Manual: Alarms."
Hypertext links	Hypertext links on PDF versions are written in blue color.
WARNING	Warnings are written in the following way:
WARNING	**This is a WARNING.**
CAUTION	Cautions are written in the following way:
CAUTION	This is a CAUTION.
NOTE	Notes are written in the following way:
	NOTE: This is a NOTE.
	In this manual, the word "select" means choosing and confirming.

Illustrations and names

All illustrations in this manual are only examples, and may not necessarily reflect your system settings or data displayed in your system. If a particular selection is not available in your system, the selection is shown grayed.

1 Introduction

The Datex-Ohmeda S/5 FM is a modular multiparameter patient monitor. The monitor is especially designed for monitoring in intensive care units. It can also be used during transportation within the hospital.

The modular design makes the system flexible and easy to upgrade. In addition to patient parameter modularity and easy upgrades, the monitor can be upgraded to wireless networking. External devices can be interfaced to the monitor with interface modules.

NOTE: Your system may not include all these components. Consult your local representative for the available components.

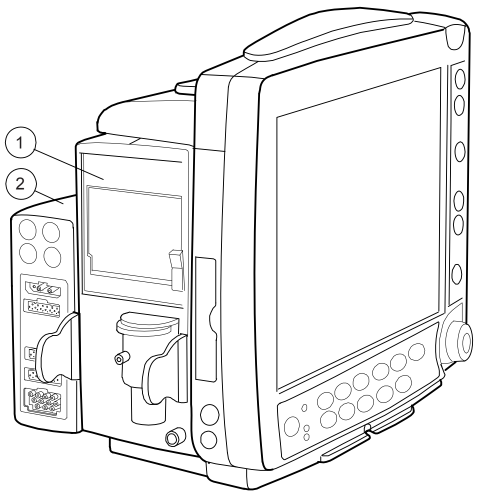


Figure 1 S/5 FM with N-FCREC (1) and E-PSM (2) modules

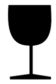
1.0.1 Compatibility

S/5 FM is compatible with:

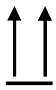
	S/5 L-FICU04/A	S/5 L-FICU06/A
Patient Side Modules, S/5 E-PSM and E-PSMP	×	×
Extension Module S/5 F-FC	×	×
Extension Modules, S/5 N-FCREC, and N-FREC	×	×
Device Interfacing Solution S/5 N-DISxxx, rev. 01 and later	×	×
S/5 Network and iCentral	×	×
Wireless LAN is available with WLAN option F-FMW	×	×

1.1 Symbols

1.1.1 Symbols on transport packaging

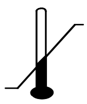


The contents of the transport package are fragile and must be handled with care.

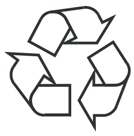


Indicates the correct upright position of the transport package.

The transport package must be kept in a dry environment.

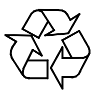


Indicates the temperature limitations within which the transport package should be stored.



This package can be recycled.

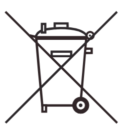
1.1.2 Symbols on equipment



Pb

This battery contains lead and can be recycled.

Dangerous voltage.



Pb/Cd/Hg

The separate collection symbol is affixed to a battery, or its packaging, to advise you that the battery must be recycled or disposed of in accordance with local or country laws. The letters below the separate collection symbol indicate whether certain elements (Pb=Lead, Cd=Cadmium, Hg=Mercury) are contained in the battery. To minimize potential effects on the environment and human health, it is important that all marked batteries that you remove from the product are properly recycled or disposed. For information on how the battery may be safely removed from the device, please consult the technical or service manual, or equipment instructions. Information on the potential effects on the environment and human health of the substances used in batteries is available at this url: http://www.gehealthcare.com/euen/weee-recycling/index.html

1.1.3 Equipment safety symbols

- Attention, consult accompanying documents.
- When displayed next to the HR value, indicates that the pacer is set on R.

- On the N-FC(REC) module indicates that the airway gases should be calibrated every 6 months in normal use and every two months in continuous use to ensure that the measurement accuracy remains within specifications.
- On the E-PSM(P) module:

WARNING **Protection against cardiac defibrillator discharge is due in part to the accessories for pulse oximetry (SpO_2), temperature (T) and invasive pressure (P) measurement.**

- On the rear or bottom panel:

WARNING **Electric shock hazard. Do not open the cover or the back. Refer servicing to qualified service personnel.**

WARNING **Do not touch the monitor during defibrillation procedure.**

WARNING **Disconnect from the power supply before servicing.**

WARNING **When using the monitor with mounting attached, make sure that the mounting is manufacturer approved.**

CAUTION For continued protection against fire hazard, replace the fuse only with one of the same type and rating.

CAUTION Lithium battery on the CPU board. Dispose of the battery in accordance with local environmental and waste disposal regulations.

- On top of the monitor beside the battery cover:

WARNING **Use manufacturer recommended batteries only. Dispose of the batteries in accordance with local environmental and waste disposal regulations.**

Type BF (IEC 60601-1) protection against electric shock.

Type BF (IEC 60601-1) defibrillator-proof protection against electric shock.

Type CF (IEC 60601-1) protection against electric shock.

Type CF (IEC 60601-1) defibrillator-proof protection against electric shock.

When displayed in the upper left corner of the screen, indicates that the alarms are silenced. When displayed in the menu or digit fields, indicates that the alarm source has been turned off or alarm does not meet the alarm-specific activation criteria.

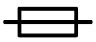
ESD warning symbol for electrostatic sensitive devices. Pins of connectors identified with the ESD warning symbol should not be touched. Connections should not be made to these connectors unless ESD precautionary procedures are used. For details, see section “1.2.2. ESD precautionary procedures”.

Symbol for non-ionizing electromagnetic radiation. Interference may occur in the vicinity of equipment marked with this symbol.

1.1.4 Other symbols

Equipotentiality. Monitor can be connected to potential equalization conductor.

Alternating current

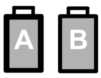


Fuse. Replace the fuse only with one of the same type and rating.

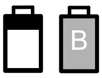
SN, S/N

Serial Number

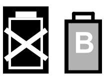
Submenu. Selecting an alternative marked with this symbol in a menu opens a new menu.



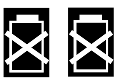
Battery operation and remaining capacity. The height of the green bar indicates the charging level.



Battery (A) charging (white bar)

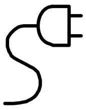


Battery (A) failure

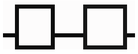


Both batteries have failed

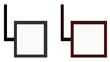
Battery (A) is missing



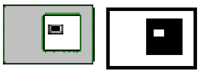
In the front panel: mains or external DC power. (External DC power for future use.)



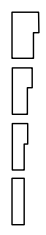
The monitor is connected to the Datex-Ohmeda Network (Local Area Network, LAN).



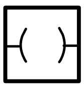
The monitor is connected to the Datex-Ohmeda S/5 Network (Wireless Local Area Network, WLAN).



Data Card (green) or Menu Card (white) is inserted.



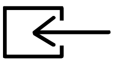
WLAN signal strength. The number of segments corresponds to the signal strength: four segments indicate strong signal, one segment weak signal. When connection to access point is being searched, the segments scroll from zero to four and back.



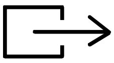
Ethernet connector

A blinking heart next to the heart rate or pulse rate value indicates the beats detected.

A lung next to the respiration rate value indicates that respiration rate is calculated from the impedance respiration measurement.



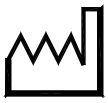
Gas inlet



Gas outlet

Do not reuse.

Use by. Indicates the last use day.

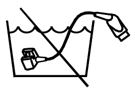


Date of manufacturer

Manufacturer name and address

LATEX FREE

Does not contain Latex.

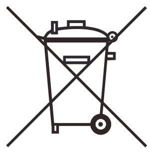


Do not immerse the sensor in liquids.

IPX class:

Degree of protection against harmful ingress of water as detailed in the IEC 60529:

IPX0 - Ordinary equipment
IPX1 - Protection against vertically falling water drops.
IPX2 - Protection against vertically falling water drops when enclosure tilted up to 15 °.
IPX3 - Protected against spraying water.
IPX4 - Protected against splashing water.
IPX7 - Protected against the effects of temporary immersion in water.
IPX8 - Protected against the effects of continuous immersion in water.



This symbol indicates that the waste of electrical and electronic equipment must not be disposed as unsorted municipal waste and must be collected separately. Please contact an authorized representative of the manufacturer for information concerning the decommissioning of your equipment.

1.2 Safety

The following list contains general warnings and cautions you should know before installing, maintaining or servicing the system. Warnings and cautions specific to the use of the system can be found in the User's Guide and User's Reference Manual.

1.2.1 Safety precautions

Warnings

WARNING **A WARNING indicates a situation in which the user or the patient may be in danger of injury or death.**

- The device is not able to withstand unpacked drops from a height of 1 m. If the device is dropped, please service the device before taking it back into use.

Power connection

- Always check that the power cord and plug are intact and undamaged.
- Do not use the power cord delivered with this product for any other product or purpose.
- Use only hospital-grade grounded power outlets and power cord. Do not remove the grounding pin from the power plug.
- Use only an intact and undamaged power cord. Replace the power cord if it is cracked, frayed, broken or otherwise damaged.
- All system devices must be connected to the same power supply circuit.
- Do not apply tension to the power cord otherwise the cord may get damaged.
- Do not use an additional multiple socket outlet, extension cord or adapters of any kind.
- Before starting to use the system, ensure that the whole combination complies with the international standard IEC 60601-1-1 and with the requirements of the local authorities. Do not connect any external devices to the system other than those specified.
- When detaching modules, be careful not to drop them. Always support with one hand while pulling out with the other.
- If the integrity of the external protective earth conductor arrangement is in doubt, use the monitor with battery operation.
- To avoid the risk of electric shock, this equipment must only be connected to a supply mains with protective earth.

Installation

- Do not incinerate a battery or store at high temperatures as it will explode.
- The monitor or its components should not be used adjacent to or stacked with other equipment. If adjacent or stacked use is necessary, the monitor and its components should be observed to verify normal operation in the configuration in which it will be used.
- Pins of connectors identified with the ESD warning symbol should not be touched. Connections should not be made to these connectors unless ESD precautionary procedures are used. For details, see section "1.2.2. ESD precautionary procedures."
- After transferring or reinstalling the monitor, always check that it is properly connected and all parts are securely attached. Pay special attention to this in case of stacked mounting.

- Do not use the monitor in high electromagnetic fields (for example, during MRI.)
- A printer or computer must be supplied from an additional transformer providing at least basic isolation (isolating or separating transformer).
- If you accidentally drop the monitor, modules or frames, have them checked by authorized service personnel prior to clinical use.
- To avoid explosion hazard, do not use the monitor in presence of flammable anesthetics.
- Do not touch the patient, table, instruments, modules or the monitor during defibrillation.
- Other transmitting radio devices using the same radio frequency band (Industrial Scientific and Medical 2.45 GHz band) may degrade or disturb the wireless network communication.

External connection

- Do not connect any external devices to the monitor other than those specified.

Explosion hazard

- To avoid explosion hazard do not use the monitor in the presence of flammable anesthetics.
- Do not incinerate a battery or store at high temperatures as it will explode.

Patient safety

- Do not perform any testing or maintenance on the monitor while it is being used on a patient.
- PACEMAKER PATIENTS: The impedance respiration measurement may cause rate changes in Minute Ventilation Rate Responsive Pacemakers. In this case, set the pacemaker rate responsive mode off or turn the monitor impedance respiration measurement off.
- Never install the monitor so that it is above the patient.
- When using the monitor with mounting attached, make sure that the mounting is manufacturer approved.
- Operation of the monitor outside the specified values may cause inaccurate results.

Autoclaving and sterilizing

- Do not autoclave any part of the system with steam or sterilize with ethylene oxide.

Cleaning and service

- Only trained personnel with proper tools and test equipment should perform the tests and repairs described in this manual. Unauthorized service may void the monitor warranty.
- Always unplug the monitor before cleaning or service. After cleaning or service ensure that every part of the monitor is dry before reconnecting it to the power supply.
- Do not touch any exposed wire or conductive surface while any cover is removed and the monitor is energized. The voltages present can cause injury or death.
- Pins of connectors identified with the ESD warning symbol should not be touched. Connections should not be made to these connectors unless ESD precautionary procedures are used. For details, see section “1.2.2. ESD precautionary procedures”.
- NOTE! The monitor is always internally powered when the batteries are connected.

- Electrostatic discharge through the PC boards may damage the components. Before handling PC boards, wear a grounded antistatic wristband. Handle all PC boards by their non-conductive edges and use antistatic containers when transporting them.
- Do not break or bypass the patient isolation barrier when testing PC boards.
- Always perform an electrical safety check and a leakage current test on the monitor after service.
- Handle the water trap and its contents as you would any body fluid. Infectious hazard may be present.
- Do not immerse any part of the device in any liquid, or allow liquid to enter the monitor or modules.
- If liquid has accidentally entered the system or its parts, disconnect the power cord from the power supply, remove the batteries from the monitor and have the equipment serviced by authorized service personnel.
- Since calibration gas contains anesthetic agents, always ensure sufficient ventilation of the room during calibration.

Accessories

- Use only accessories, including mounts, and batteries, and defibrillator-proof cables and invasive pressure transducers approved by GE Healthcare. For a list of approved supplies and accessories, see the “Supplies and Accessories” catalog. Other cables, batteries, transducers and accessories may cause a safety hazard, damage the equipment or the system, result in increased emissions or decreased immunity of the equipment or system or interfere with the measurement. (Protection against cardiac defibrillator discharge is due in part to the accessories for pulse oximetry (SpO2), temperature (T) and invasive pressure (P) measurement.)
- Single-use products are not designed to be reused. Reuse may cause a risk of cross-contamination, affect the measurement accuracy and/or system performance, or cause a malfunction as a result of the product being physically damaged due to cleaning, disinfection, re-sterilization and/or reuse.

Special components

Special components are used in these monitors that are vital to assure reliability and safety. GE Healthcare assumes no responsibility for damage, if replacement components not approved by GE Healthcare are used.

Batteries

The Lithium Ion batteries are recyclable. Follow your local recycling guidelines.

Refresh the batteries completely every six months.

To replace the batteries safely, please refer to the service instructions in this manual.

- Do not short-circuit the battery terminals, this may produce a very high current, which will damage the battery.
- Do not dispose of the battery into open flame, nor put the battery near fire, as it may explode.
- Do not dismantle the battery.
- After replacing a battery, always make sure to close the battery compartment by sliding the lid back to the right until it clicks.

See also section “Symbols”.

Storage and transport

Do not store or transport the monitor outside the specified temperature, pressure and humidity ranges:

Temperature	-20...+60 °C/-4...140 °F
Atmospheric pressure	670...1060 hPa/500...800 mmHg/670...1060 mbar
Relative humidity	10...90% noncondensing

Disposal

- Dispose of the whole device, parts of it and its packing material and manuals in accordance with local environmental and waste disposal regulations.
- Dispose the calibration gas container in accordance with local environmental and waste disposal regulations.

Cautions

CAUTION A CAUTION indicates a condition that may lead to equipment damage or malfunction.

Installation

- Leave space for air circulation to prevent the monitor from overheating.
- Before connecting the power cord to the power supply, check that the local voltage and frequency correspond with the rating stated on the device plate.
- Turn off the power before making any rear panel connections.

Before use

- Allow two minutes for warm-up and note any error messages or deviations from normal operation.

Fuse replacement

Replace a fuse only with one of the same type and rating.

Cleaning and service

- Do not use hypochlorite-, acetone-, phenol- or ammonia -based cleaners, abrasive material or harsh chemicals as they may damage the surfaces of the device.
- Do not use abrasive cleaning compounds, instruments, brushes or rough-surface materials.
- Do not apply pressurized air to any outlet or tubing connected to the monitor.

Special components

- Lithium battery on the CPU board. Dispose of the battery in accordance with local environmental and waste disposal regulations.

1.2.2 ESD precautionary procedures

- To avoid electrostatic charges building up, it is recommended to store, maintain and use the equipment at a relative humidity of 30% or greater. Floors should be covered by ESD dissipative carpets or similar. Non-synthetic clothing should be used when working with the component.
- To prevent applying a possible electrostatic discharge to the ESD sensitive parts of the equipment, one should touch the metallic frame of the component or a large metal object located close to the equipment. When working with the equipment and specifically when the ESD sensitive parts of the equipment may be touched, a grounded antistatic wristband intended for use with ESD sensitive equipment should be worn. Refer to the documentation provided with the wristbands for details of proper use.

ESD precautionary procedure training

It is recommended that all potential users receive an explanation of the ESD warning symbol and training in ESD precautionary procedures.

The minimum contents of an ESD precautionary procedure training should include an introduction to the physics of electrostatic charge, the voltage levels that can occur in normal practice and the damage that can be done to electronic components if they are touched by an operator who is electrostatically charged. Further, an explanation should be given of methods to prevent build-up of electrostatic charge and how and why to discharge one’s body to earth or to the frame of the equipment or bond oneself by means of a wristband to the equipment or the earth prior to making a connection.

2 System description

2.1 Introduction

Datex-Ohmeda monitors build up a freely configurable modular system. The architecture is designed to enable different module combinations so that the user is able to get the desirable parameter and feature set. This modular approach makes it possible to add new features when they are needed.

2.2 Bus structure

The operation of Datex-Ohmeda FM is based on two communication channels, the CPU bus and module bus. All units, including the modules, receive power from the same power supply, which is an integral part of the monitor frame.

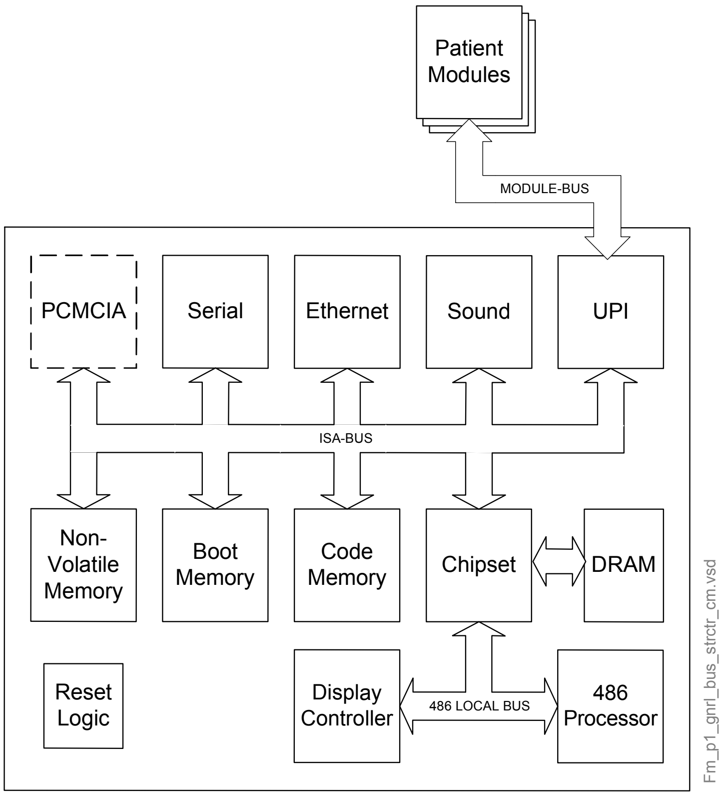


Figure 2 General bus structure of S/5 FM

The CPU bus is a communication channel used only for internal data transfer. It is based on the ISA bus used in IBM PC computers. Data is transferred on this 16 bit wide bus using the CPU clock frequency.

The module bus is for the parameter modules. The bus is based on the industry standard RS-485, which uses a differential serial method to transfer data. This type of bus is robust and it allows parameter modules to be inserted or removed while the power is on. The module bus uses a 500 kbps data transfer rate.

The RS-485 type of serial communication supports so-called multidrop or party line connections. This means that all parameter modules connected to the module bus use exactly the same lines for communication. The advantage of this is that all bus connectors are identical and the modules can be connected in any order and position.

2.3 Distributed processing

A system assembled from Datex-Ohmeda products is a multiprocessor system. All parameter modules have their own microprocessor, which performs functions such as module key control, waveform filtering, parameter related computing and pneumatic control, etc. At the same time the main CPU performs higher level tasks such as trending and alarm control. While the parameter modules and CPU are performing their tasks, the UPI (Universal Peripheral Interface) microprocessor handles all functions needed to transfer data between the parameter modules and the CPU.

This kind of parallel processing gives one major advantage to centralized processing. When new parameter modules are added to the system, the processing power is increased. As a result, the system does not slow down when new features are added.

2.4 Module communication

The communication master controlling data transfers between the CPU and parameter modules is called UPI processor. It sends data to each connected module 100 times a second. Modules respond to each data request immediately by sending a data package, whose length depends on the type of the module. This communication protocol ensures that each module receives and sends data every 10 ms. If a module does not respond to data requests, the UPI processor presumes that the module is disconnected.

Parameter modules may hold a static (fixed) or dynamic address, which the UPI processor uses when sending out data. Two parameter modules of the same type must not be fitted onto the same monitor since they might reply to a data request simultaneously, thus causing communication errors.

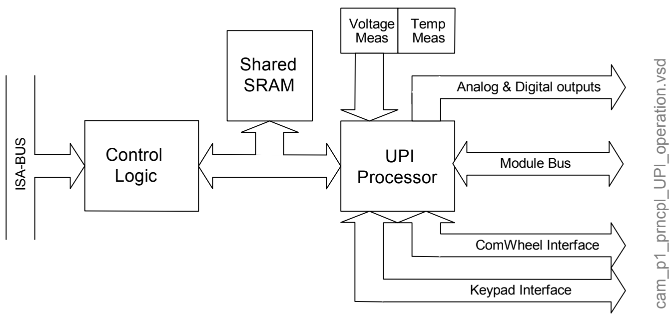


Figure 3 Principle of UPI section operation

The UPI processor collects and stores all data that is received from the parameter modules into a shared SRAM, which is mapped directly to the address space of the main CPU. The main CPU reads data from the memory while the UPI processor guarantees that the data is up to date. This operation also works in the other direction. In this the main CPU fills the shared SRAM with data and the UPI processor distributes it to the parameter modules.

2.5 Software loading

The program memory on the CPU board is loaded with monitor software at the factory. The software is used for running all the functions that are integrated into the PC board.

F-FM(W)-00

For service and upgrade procedures, the software loading is done by using a PCMCIA card or the SWDL Tool.

F-FM(W)-01

For service and upgrade procedures, the software loading is done by using the SWDL Tool only.

2.6 Parameter modules

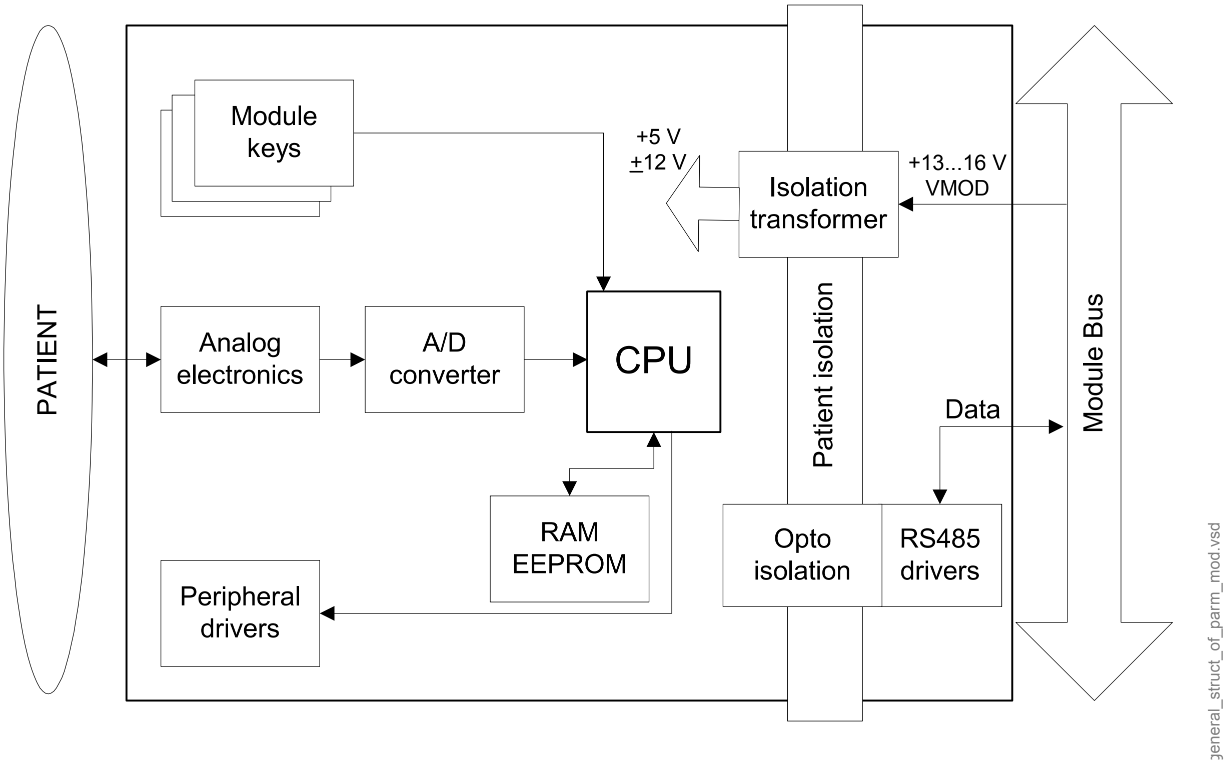


Figure 4 General structure of parameter modules with patient isolation

The detailed structure of a parameter module depends on the specific needs for each individual parameter. However, some common parts are used in the parameter modules. The electronics inside the module is usually divided into isolated (floating) and non-isolated sections. Typically, the non-isolated section consists of buffers to interface the parameter module to the module bus while the rest of the electronics is located in the isolated section. The isolated section includes the microcontroller together with memory components, the front-end analog electronics (amplifiers, etc.) and sensor drivers.

3 System installation

3.1 Unpacking instructions

1. Confirm that the packing box is undamaged. If the box is damaged, contact the shipper.
2. Open the top of the box and carefully unpack all components.
3. Confirm that all components are undamaged. If any of the components is damaged, contact the shipper.
4. Confirm that all components are included. If any of the components is missing, contact your GE Healthcare distributor.

3.2 Choosing location

Consider the following aspects:

- lighting
- space
- connections
- electromagnetic and radio frequency interference. For details see Appendix B. ElectroMagnetic Compatibility
- environment

WARNING **The monitor or its components should not be used adjacent to or stacked with other equipment. If adjacent or stacked use is necessary, the monitor and its components should be observed to verify normal operation in the configuration in which it will be used.**

CAUTION The monitor display is fragile. Ensure that it is not placed near a heat source or exposed to mechanical shocks, pressure, moisture or direct sunlight.

3.3 Mounting the S/5 FM

Mounting of S/5 FM to the Wall Mount, Rollstand, Wall Mount with standard arm or Counter Top Mount is described in a separate instruction sheet delivered with each mount.

WARNING **After transferring or reinstalling the monitor, always check that it is properly connected and all parts are securely attached. Pay special attention to this in case of stacked mounting.**

WARNING **The monitor must not be used without a manufacturer approved mounting attached.**

WARNING **Never install the monitor so that it is above the patient.**

3.3.1 E-PSM(P) Mounting Accessories

Intended use

The Module Bus Adapter for PSM is intended for connecting the Pole Mount for PSM to the Datex-Ohmeda S/5 FM monitor.

With Module Bus Adapter, the Pole Mount for PSM, short or long, can be connected to the Datex-Ohmeda S/5 FM monitor. The E-PSM(P) module can be removed from the FM monitor and docked to the Pole Mount for PSM, short or long.

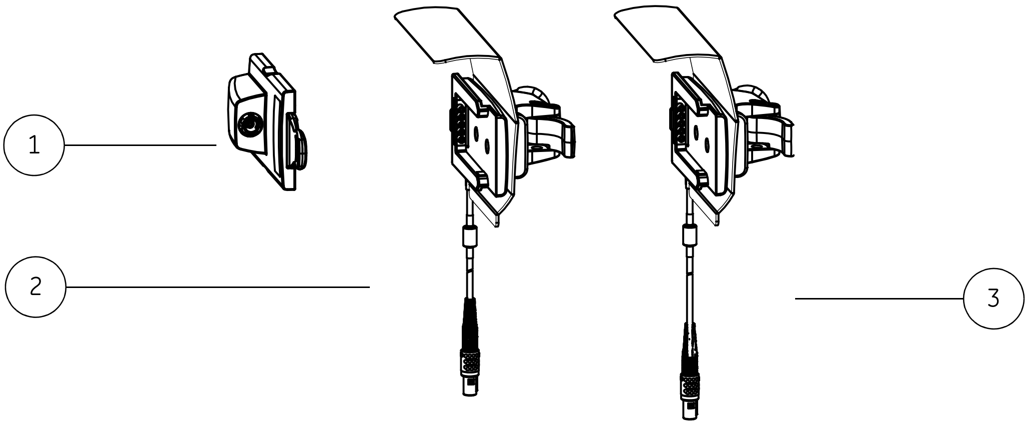
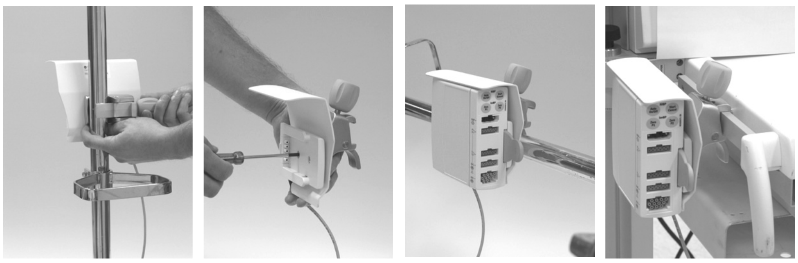


Figure 5 E-PSM(P) mounting accessories

1. M1051025 Module Bus Adapter for PSM
2. M1049197 Pole Mount for PSM, short
3. M1051023 Pole Mount for PSM, long

WARNING Make sure that the Pole Mount for PSM is always used in vertical position to prevent water from entering the E-PSM(P) module.

Pole Mount for PSM – Instructions for connecting to an IV pole, vertical position



Fasten the Pole Mount for PSM with the fastening screw of the clamp and tighten properly to an IV pole.

Pole Mount for PSM - Instructions for installing in horizontal position.

Remove the 2 screws from the clamp, turn the clamp and insert and tighten the screws back. Fasten the Pole Mount for PSM with the fastening screw of the clamp and tighten properly to a horizontal tube or rail with a diameter of 10 mm*25 mm.

Pole mount for PSM – Instructions for connecting to monitor

1. Attach the E-PSM(P) module to the Pole Mount.
2. Connect the cable of the Pole Mount for PSM to the S/5 FM monitor with the Module Bus adapter for PSM (M1031025).
3. Check the module communication of the E-PSM(P) module.

3.3.2 Monitor connections

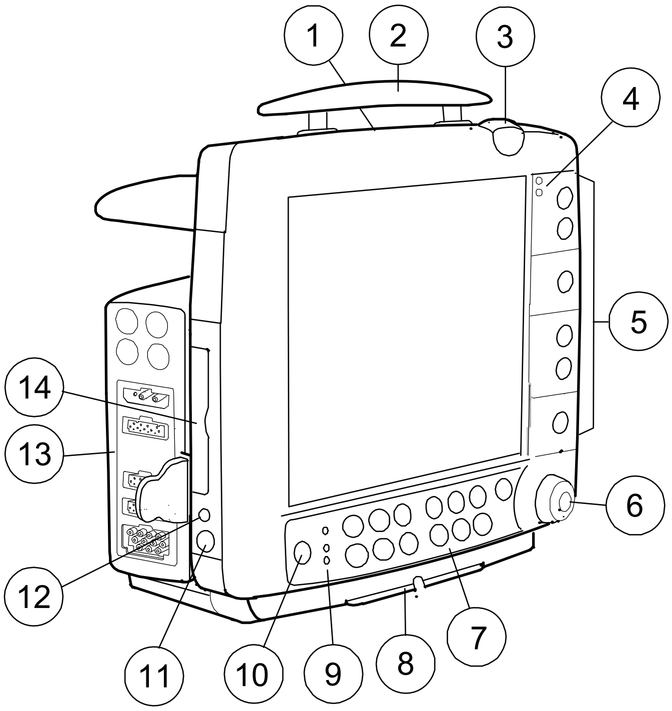


Figure 6 S/5 FM front panel

(1) Battery compartment
(2) Transportation handle
(3) Alarm light
(4) Alarm LED indicators
(5) Side panel keys
(6) The ComWheel
(7) Command Board keys
(8) Guide rail for GCX mounting
(9) Mains power and battery LEDs
(10) ON/standby key
(11) Connector for the Device Interfacing Solution (X6)
(12) Connector for defibrillator synchronization (X5)
(13) Measurement modules
(14) Slot for Data Card or Menu Card

You can use one E-PSM(P) and/or one N-F(C)(REC) module in the monitor at a time.

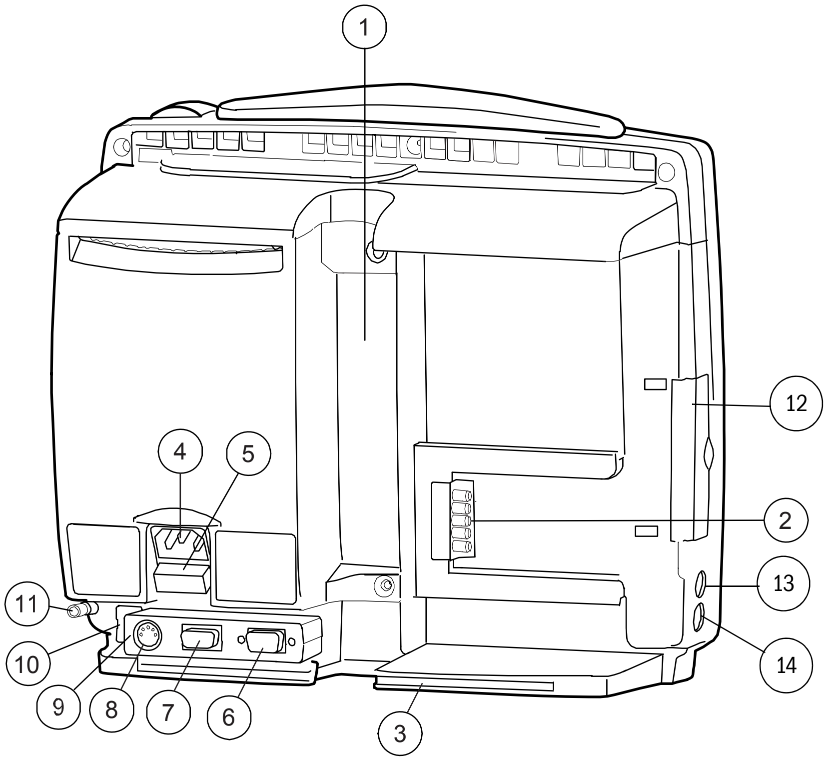


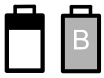
Figure 7 Rear panel connections

(1) Slot for infusion pole mounting
(2) Module connector
(3) Guide rail for GCX mounting
(4) Receptacle for power cord
(5) Fuse holder
(6) Serial port X9
(7) Network ID X8
(8) Connector for K-CREMCO X7
(9) Optional: Multi I/O adapter incorporating connectors 6 - 8 mentioned above
(10) Network connector X1
(11) Equipotential connector
(12) Slot for Data Card or Menu Card
(13) Defibrillator & IABP sync connector X5
(14) Connector for the Device Interfacing Solution (X6)

3.3.3 Connection to mains

Connect the power cord to the mains power inlet (4) at the back of the monitor and to the wall socket.

NOTE: Before taking the monitor into use for the first time, the batteries should be fully charged. Keep the monitor connected to the mains until the Battery charging symbol disappears, or in STBY mode the Orange Battery condition LED is off (may take up to 5 hours if the batteries are fully discharged).



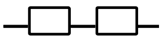
Battery charging

WARNING **The power cord may only be connected to a three-wire, grounded, hospital grade receptacle.**

3.3.4 Connection to Network

Use the Monitor-Network cable to connect the monitor to the network.

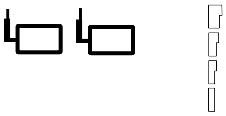
1. Make sure that the power is switched off.
2. Connect the Identification Plug and one RJ-45 connector to the connectors X8 and X1 at the back of the monitor.
3. Connect the other RJ-45 connector to the corresponding connector on the wallbox.
4. Switch on the power. Confirm that the network connection is indicated in the upper part of the screen.



3.3.5 Connection to Wireless Network

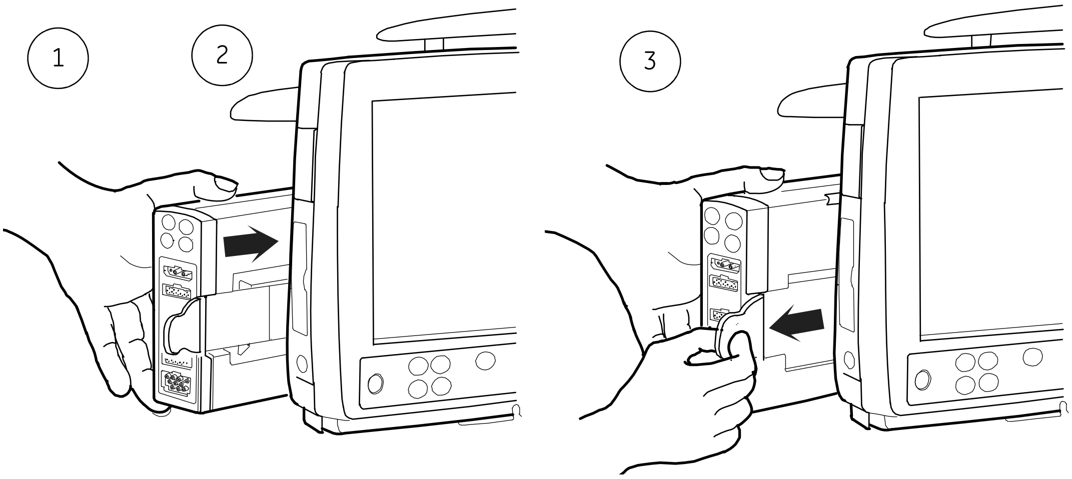
Wireless LAN is available only with S/5 FM Wireless LAN option F-FMW.

1. Disconnect the network cable.
2. The monitor will automatically connect to the Wireless LAN.
3. Confirm that the wireless LAN network symbol and the wireless LAN signal strength symbol are displayed in the upper part of the screen.



NOTE: The WLAN configuration in the monitor has to be set to correspond to the hospital WLAN.

3.3.6 Inserting and removing the parameter modules



1. Align the module with the insertion guides
2. Push the module into the monitor frame until it stops.
3. Pull the module outwards. Make sure not to drop it when it comes out.

WARNING **When detaching modules, be careful not to drop them. Always support with one hand while pulling out with the other.**

NOTE: Only one E-PSM(P) module and one N-F(C)(REC) module can be attached to S/5 FM.

NOTE: If you want to install both modules, you must install the FM Extension Module, (N-F(C)(REC) first and attach the E-PSM(P) module to it.

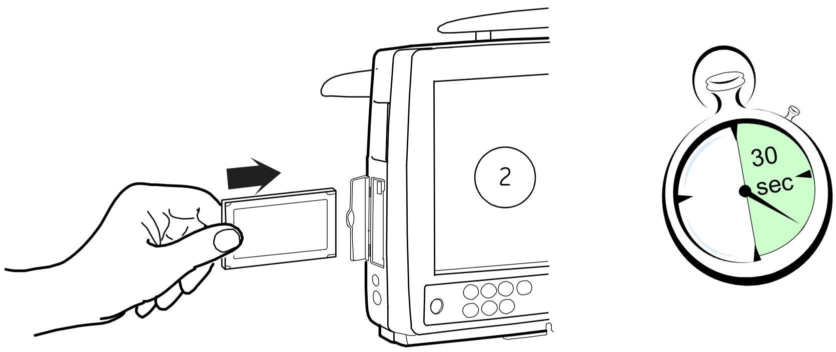
3.3.7 Downloading Monitor Software F-FM(W)-00

The following instructions apply to downloading of new monitor software in case of upgrade or service. Detailed instructions for downloading software are supplied with software PCMCIA cards.

NOTE: All user settings will be lost after downloading of new monitor software.

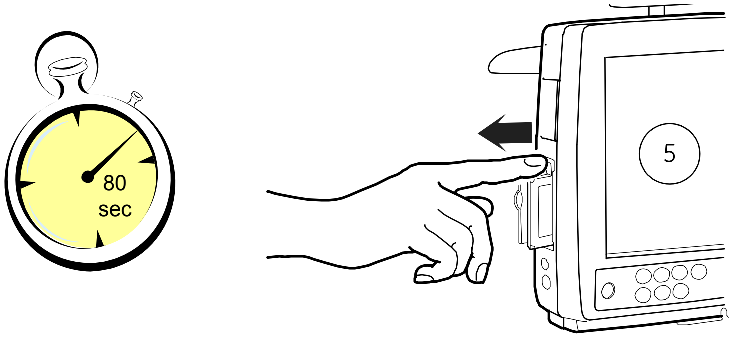
NOTE: During the downloading of software, the serial number of the monitor is written on the software card. The software can then be downloaded again to the same monitor, but not to any other monitor.

1. Make sure the monitor is switched to standby.



2. Open the cover for card drive slot. Insert the software card into the card drive slot and press the software card firmly into its place.

3. Switch the monitor on.
4. Wait for approximately 80 seconds. After the normal screen appears, enter the service menu and make sure that the information regarding monitor software has been updated. Memorize the serial number of new software.



5. Remove the software card.
6. Replace the original device plate for monitor software by the new one supplied with the software card.
7. Perform Factory Reset. Make sure that the monitor functions normally after the restart.
8. Set the time and date (**Monitor Setup** - ***Time And Date***).
9. Set the monitor's network communication according to the used network software, if necessary.

The communication is set in the monitor's ***Network*** service menu:

Monitor Setup - ***Install/Service*** (password 16-4-34) - ***Service*** (password 26-23-8) - ***Frame – Network***

Network software S-CNET01 -> DRI Level = 2001

Network software S-CNET02 -> DRI Level = 2001 or 2002 (WLAN)

Network software L-NET03 -> DRI Level = 2003

Network software L-NET05 -> DRI Level = 2003

NOTE: If the DRI level is changed, the monitor will restart automatically.

10. Fill out all necessary documentation regarding the new monitor software.

NOTE: The license agreement of monitor software needs to be in accordance with the monitor software serial number. Make sure you archive the license agreement in a secure location.

NOTE: The first start-up after software loading takes considerably longer.

3.3.8 Downloading Monitor Software, F-FM(W)-01

See "Software Download Tool - User Instructions."

Software Download Tool, L-SWDL, is the only way to download/replace software on F-FM(W)-01 frame by a field engineer. SWDL is a service tool that enables the installation of monitor service software from personal computer into legacy Datex-Ohmeda patient monitor.

3.3.9 Performing Factory Reset

NOTE: The Factory Reset is necessary after downloading of monitor software and after replacing the CPU board or SRAM/Timekeeper battery.

NOTE: The Factory Reset will restore all your customized defaults, including language selection, to factory defaults.

1. Press the **Monitor Setup** key.
2. Select ***Install/Service*** and password (16-4-34).
3. Select ***Service*** and password (26-23-8).
4. Select ***Set/Test*** and perform ***Factory Reset***.
5. The monitor will perform an automatic restart. After the restart is completed, restart the monitor also manually by the On/Standby switch.

3.3.10 Installing the Datex-Ohmeda Wireless Network Upgrade, U-FMW (F-FM-00)

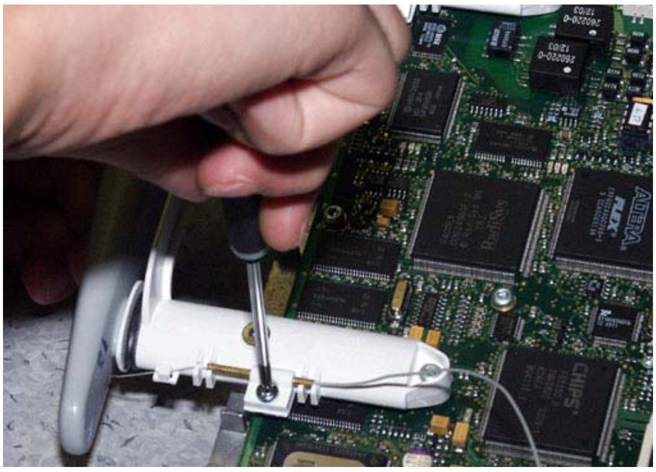
The following instructions apply to upgrading the monitor with the Wireless Network Upgrade. Detailed upgrade instructions are supplied with the corresponding product.

NOTE: You can download the option software only to one monitor. During the downloading of the option software, the serial number of the monitor is written on the software card, and if the downloading for some reason would fail, the software can be downloaded again.

1. Make sure that the monitor is switched to STANDBY.
2. Open the cover for the card drive slot (on the left side of the monitor). Insert the option software card into the card drive slot and press the software card firmly in position.
3. Switch the monitor ON.
4. Wait until the normal screen appears and check that the message 'Field upgrade OK' is displayed as a note of successful upgrade.
5. Remove the option software card.
6. Switch the monitor to STANDBY.
7. Disassemble the monitor in order to access the second PC card drive slot on the monitor CPU board.

NOTE: Follow instructions in the S/5 Frame for FM slot for disassembling the monitor.

8. Insert the WLAN interface card into the PC card drive slot.



9. Connect the WLAN antennas to the handle guide.

10. Connect the WLAN antennas to the WLAN interface card. Secure the antennas to the PC card drive slot with the holder included in the upgrade kit.

11. Reassemble the monitor.

NOTE: When reassembling the monitor make sure that the tips of the WLAN halfwave antennas do not get pinched between the monitor covers.

12. Switch the monitor ON.
13. Enter the service menu and make sure that the option software was downloaded successfully (**Monitor Setup** ***–Install/Service (16-4-34) – Service (26-23-8) – Frame):*** **Options = "WLAN"**
14. Enter the WLAN Configuration service menu (**Monitor Setup** ***–Install/Service (16-4-34) – Service (26-23-8) – Frame - Network – WLAN – WLAN Config***).

    Enter the appropriate **Network ID**, **WEP Algorithm**, **Key ID** and **Encryption Key** using the corresponding menu selections.

    For selecting allowed communication channels, enter the appropriate **Channel Mask** using the corresponding menu selection.
    See Appendix C. Channel Mask Selections for S/5 FM.

    Save the monitor's wireless LAN configuration by selecting ***Save Configuration - Save***.

NOTE: The settings must match up with the ones that are defined in the Access Point configuration. Refer to the related site configuration documentation for correct settings, if necessary.

15. Attach the RLAN card sticker above the device plate at the monitor rear panel.

    If the monitor is located in Czech Rebublic, Hong Kong, Poland, Singapore, Taiwan, South Africa or South Korea, attach also the corresponding country sticker (delivered with the WLAN interface card) to the place that is indicated with a dashed line on the RLAN card sticker.

16. Enter the Network Status service menu (**Monitor Setup *–Install/Service (16-4-34) – Service (26-23-8) – Frame - Network – Network Status***).

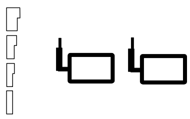
    Check that the Virtual ID sticker that is supplied with the Wireless Network upgrade, U-FMW corresponds with the **Location ID** that is displayed in the menu.

NOTE: The Location ID is the monitor’s ID on the Datex-Ohmeda Network and cannot be changed.

17. Attach the Virtual ID sticker above the RLAN card sticker at the monitor rear panel.
18. Configure the monitor’s Location ID in the S/5 Central Network setup.

NOTE: Refer to the Datex-Ohmeda S/5 Central, ViewStation and Network Technical Reference Manual for information about the configuration, if necessary.

19. Check that the monitor connects to the Datex-Ohmeda Wireless Network:
    - the wireless LAN network symbol is displayed on the monitor screen
    - the S/5 Central is listed in the monitor’s Network Status service menu
    - monitor data can be displayed on the S/5 Central



Wireless LAN network symbol on the S/5 FM monitor

20. Fill out all necessary documentation regarding the upgrade.

3.3.11 Installing the Datex-Ohmeda Wireless Network Service Option, N-FMWS (F-FM-00)

The following instructions apply to upgrading the monitor with the Wireless Network Service Option. Detailed upgrade instructions are supplied with the corresponding product.

NOTE: You can download the option software only to one monitor. During the downloading of the option software, the serial number of the monitor is written on the software card, and if the downloading for some reason would fail, the software can be downloaded again.

1. Make sure that the monitor is switched to STANDBY.
2. Open the cover for the card drive slot (on the left side of the monitor). Insert the option software card into the card drive slot and press the software card firmly in position.
3. Switch the monitor ON.
4. Wait until the normal screen appears and check that a message 'Field upgrade OK' is displayed as a note of successful upgrade.
5. Remove the option software card.
6. Enter the service menu and make sure that the option software was downloaded successfully (**Monitor Setup *–Install/Service (16-4-34) – Service (26-23-8) – Frame***): **Options** = **”WLAN”**
7. Enter the WLAN Configuration service menu (**Monitor Setup *–Install/Service (16-4-34) – Service (26-23-8) – Frame - Network – WLAN – WLAN Config***).

    Enter the appropriate **Network ID**, **WEP Algorithm**, **Key ID** and **Encryption Key** using the corresponding menu selections.

    For selecting allowed communication channels, enter the appropriate **Channel Mask** using the corresponding menu selection.

See Appendix C. Channel Mask Selections for S/5 FM.

Save the monitor’s wireless LAN configuration by selecting ***Save Configuration - Save***.

NOTE: The settings must match up with the ones that are defined in the Access Point configuration. Refer to the related site configuration documentation for correct settings, if necessary.

8. Enter the Network Status service menu (**Monitor Setup** ***–Install/Service (16-4-34) – Service (26-23-8) – Frame - Network – Network Status***).

   Check that the Virtual ID -sticker that is supplied with the Wireless Network upgrade, U-FMW corresponds with the **Location ID** that is displayed in the menu.

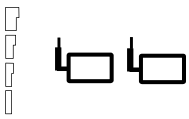
NOTE: The Location ID is the monitor’s ID on the Datex-Ohmeda Network and cannot be changed.

9. Attach the Virtual ID sticker above the RLAN card sticker at the monitor rear panel.

10. Configure the monitor’s Location ID in the S/5 Central Network setup.

NOTE: Refer to the Datex-Ohmeda S/5 Central, ViewStation and Network Technical Reference Manual for information about the configuration, if necessary.

11. Check that the monitor connects to the Datex-Ohmeda Wireless Network:
    - the wireless LAN network symbol is displayed on the monitor screen
    - the S/5 Central is listed in the monitor’s Network Status service menu
    - monitor data can be displayed on the S/5 Central



Wireless LAN network symbol on the S/5 FM monitor

12. Fill out all necessary documentation regarding the upgrade.

3.3.12 Installing the S/5 Wireless Network Upgrade, U-FMW-01

The following instructions apply to upgrading the monitor with the Wireless Network Upgrade. Detailed upgrade instructions are supplied with the corresponding product.

1. Perform main software upload to the monitor using Software Download Tool.

NOTE: Follow Software Download Tool User Instructions, if necessary.

– When generating the license key use N-FMW as an option.

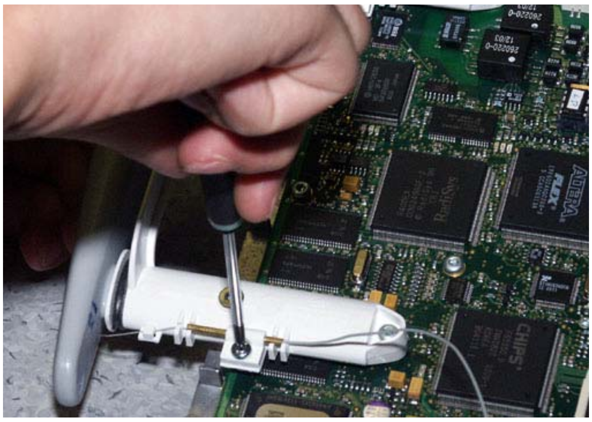
– Use the Virtual ID number that is supplied with the Wireless Network Upgrade, U-FMW-01 package to avoid ID conflict in the network.

– After the patient monitor has restarted for the first time after monitor software reinstallation, perform a factory reset to the patient monitor.

2. Enter the service menu and make sure that the WLAN option was activated successfully (**Monitor Setup** ***-Install/Service (16-4-34) - Service (26-23-8) - Frame)***:
Options = "WLAN"
3. Switch the monitor to STANDBY.
4. Disassemble the monitor in order to access the Compact Flash card drive slot on the monitor CPU board.

NOTE: Follow instructions in the S/5 Frame for FM slot for disassembling the monitor, if necessary.

5. Insert the WLAN interface card into the Compact Flash card drive slot.
6. Connect the WLAN antennas to the handle guide.



7. Connect the WLAN antennas to the WLAN interface card. Secure the antennas to the Compact Flash card drive slot with the holder included in the upgrade kit.

8. Reassemble the monitor.

NOTE: When reassembling the monitor make sure that the tips of the WLAN halfwave antennas do not pinch between the monitor covers.

9. Switch the monitor ON.

10. Enter the WLAN Configuration service menu (**Monitor Setup** ***-Install/Service (16-4-34) - Service (26-23-8) - Frame - Network - WLAN - WLAN Config)***.

    Enter the appropriate **Network ID**, **WEP Algorithm**, **Key ID** and **Encryption Key** using the corresponding menu selections.

    For selecting allowed communication channels, enter the appropriate **Channel Mask** using the corresponding menu selection. See Appendix C. Channel Mask Selections for S/5 FM.

    Save the monitor's wireless LAN configuration by selecting ***Save Configuration - Save***.

NOTE: The settings must match up with the ones that are defined in the Access Point configuration. Refer to the related site configuration documentation for correct settings, if necessary.

11. Attach the RLAN card sticker above the device plate at the monitor rear panel.

    If the monitor is located in Czech Rebublic, Hong Kong, Poland, Singapore, Taiwan, South Africa or South Korea, attach also the corresponding country sticker (delivered with the upgrade package) to the place that is indicated with a dashed line on the RLAN card sticker.

12. Enter the Network Status service menu (**Monitor Setup** ***-Install/Service (16-4-34) - Service (26-23-8) - Frame - Network - Network Status***).

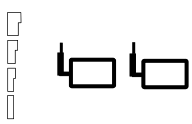
    Check that the Virtual ID -sticker that is supplied with the Wireless Network upgrade, U-FMW corresponds with the **Location ID** that is displayed in the menu.

NOTE: The Location ID is the monitor's ID on the S/5 Network and cannot be changed.

13. Attach the Virtual ID -sticker above the RLAN card sticker at the monitor rear panel.
14. Configure the monitor's Location ID in the S/5 Central Network setup.

NOTE: Refer to the Datex-Ohmeda S/5 Central, ViewStation and Network Technical Reference Manual for information about the configuration, if necessary.

15. Check that the monitor connects onto the S/5 Network wireless:
    - the wireless LAN network symbol is displayed on the monitor screen
    - the S/5 Central is listed in the monitor's Network Status service menu
    - monitor data can be displayed on the S/5 Central



Wireless LAN network symbol on the S/5 FM monitor

16. Fill out all necessary documentation regarding the upgrade.

3.4 Remote Controller, K-CREMCO

To connect a Remote Controller, K-CREMCO to S/5 FM plug the connector to the 5-pin DIN connector X7 in Multi I/O adapter at the back of the monitor.

3.5 Visual indicators

Function	Specification	Explanation
External power supply	Green LED	Indicates when monitor is powered from mains or ext. DC (External DC power for future use)
Battery operation	Green LED	Indicates when monitor is powered from internal batteries
Battery condition	Orange LED	Indicates when monitor is charging batteries (solid) or battery failure, one or both batteries missing (flashing).
Alarm LEDs	Red LED	Indicates a life threatening situation
	Yellow LED	Indicates serious but not life threatening problems
Alarm Light	Highly visible Red/	
	Yellow light	Ease alarm detection from distance. Brightness of the light and enabling the alarm light function are user configurable.

3.6 Troubleshooting

If a problem occurs during the functional examination, check the components of the monitor according to the following troubleshooting chart. If the problem persists, please refer to the part II.

Problem	What to do
Nothing functions	Unplug and re-plug Remote Controller Cable. Also confirm that the cable is intact. Unplug and re-plug the Power Cord. Also confirm that the cable is intact. Confirm that the fuses are intact.
E-PSM(P) module does not function	Remove and replace the module. Confirm that the desired parameters are configured to be displayed.
N-F(C)(REC) module does not function	Confirm that ‘Occlusion’ or ‘Calibrating Gas Sensor’ messages are not displayed. Confirm that a D-fend water trap and a sample tube are attached. Confirm that the desired parameters are configured to be displayed. Remove and replace the module.

4 Interfacing

External devices can be interfaced with the S/5 FM via the monitor's serial port and via the Device Interfacing Solution, N-DISxxx.

Printers and computers can be interfaced via the monitor's serial port.

Device specific N-DISxxx modules can be used with:

- Monitors
- Blood-gas analyzers

NOTE: The Device Interfacing Solution, N-DISxxx that is used on the S/5 FM must be of revision 01 or later.

4.1 Interfacing external bedside devices via Device Interfacing Solutions, N-DISxxx

The Device Interfacing Solution, N-DISxxx provides means for transferring physiological, waveform and event data from various bedside patient care devices to the Datex-Ohmeda monitoring system. The real-time and trended data can be displayed on the monitor screen and used for record keeping purposes. The interfacing module reads the data coming from the external device, converts it to a suitable format and sends it to the monitor.

See the following table of DIS modules and devices that you can interface with the Device Interfacing Solution.

Table 4 DIS modules and interfaced devices

	Device Monitors
N-DISOXIM3	Oximetrix 3[1]
N-DISQVUE	QVue /Q2[1]
N-DISVIGIL	Baxter-Vigilance[2]

1 Trademark of Hospira Inc. (previously trademark of Abbott Laboratories)
2 Trademark of Edwards Lifesciences Corporation

	Device Blood gas analyzers
N-DISOPT	Osmetech Opti CCA[1]

1 Trademark of Osmetech plc

For specific information on parameters transferred from the interfaced device to the Datex-Ohmeda monitor and the applicable software versions of the device refer to the Installation guide accompanying each DIS module.

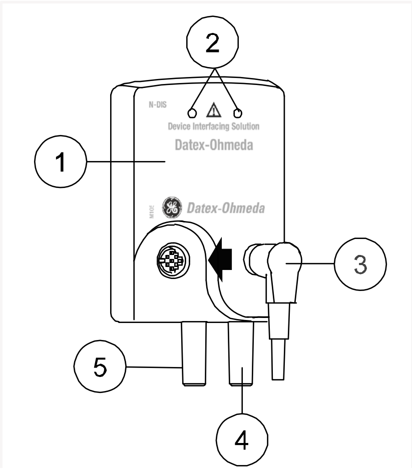
4.1.1 Device Interfacing Solution components

The Device Interfacing Solution consists of:

– a device specific interfacing module
– a device specific cable
– a bus cable
– a connector for another bus cable
– label specifying the external device

4.1.2 Connections

Connect the device specific cable to the external device and the bus cable to the monitor's DIS connector or to another interfacing module.



(1) label specifying the external device
(2) LED indicators
(3) black bus cable from another interfacing module, if needed
(4) gray device specific cable to the communication port of the external device
(5) black bus cable to the monitor's DIS connector (or to another interfacing module)

Figure 8 Connection cables and LED indicators

WARNING **The monitor, interfacing modules and interfaced devices must be situated in the same patient environment (as defined in IEC 60601-1-1).**

WARNING **Connecting electrical equipment together or using the same extension cord for more than one device may cause their leakage currents to exceed the limits specified in relevant safety standards. Always make sure that the combination complies with the international safety standard IEC 60601-1-1 for medical electrical systems and with the requirements of local authorities.**

WARNING **The manufacturer guarantees a reliable functioning of the devices with tested software versions only. Always refer to the Installation guide accompanying the DIS module and verify the compatibility before use.**

4.1.3 Mounting

The DIS module can be mounted on the side panel of the external device. Also IV pole placement is possible.

NOTE: As the Device Interfacing Solution works only with the device specified in the label of the interfacing module, it is recommended that the interfacing module always travels along with the external device.

For mounting accessories, please refer to the “Supplies and Accessories” catalog. See the following figure for an example of a device interfacing.

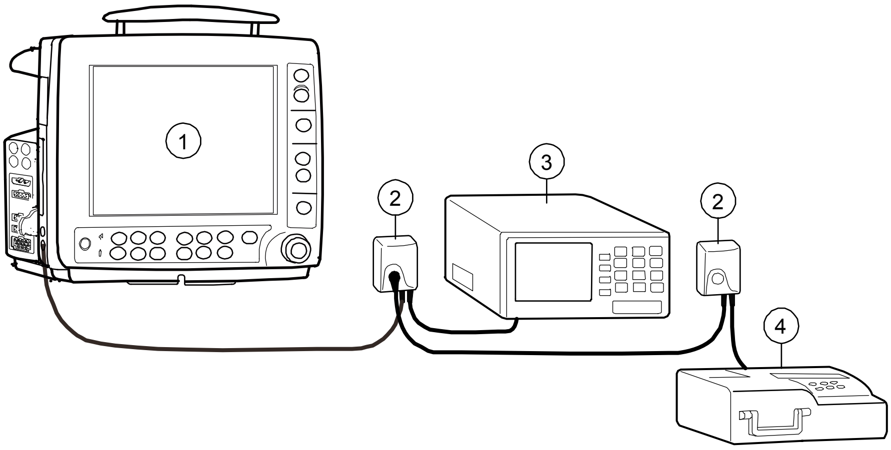


Figure 9 An example of interfacing external devices with Device Interfacing Solution

(1) Datex-Ohmeda S/5 FM

(2) Interfacing module

(3) Monitor

(4) Blood gas analyzer

NOTE: Only N-DISxxx version 01 or later is compatible with the S/5 FM.

NOTE: You can connect up to four (4) interfacing modules to one system simultaneously. Check the maximum number of modules: one meter cable = max. four ten modules, three meter cable = max. three modules, six meter cable = one module.

WARNING Make sure that the interfacing module is always used in vertical position to prevent water from entering the module.

WARNING Make sure that you are connecting the interfacing module to the device specified in the label. Always verify the compatibility of the software versions before use.

4.1.4 Selecting the external device

1. Turn off the monitor.
2. Turn off the external device.
3. Connect the interfacing module to the monitor’s connector for N-DIS or to another interfacing module.
4. Connect the device specific cable to the external device and turn the external device on.
5. Turn the monitor on. The monitor identifies the connected device automatically.

4.1.5 Functional check

There are two ways to check the function of the Device Interfacing Solution:

1. Press the **Monitor Setup** key.
2. Select ***Interfacing*** and open the ***Status Page*** menu. The status page shows you the current communication status of the interfacing module (1 - 4).

NOTE: The status message 'Connected' appears on the Status Page after you have connected the external device to the interfacing module and turned it on. Note also that the monitor and the interfacing module must be operational.

- Check the LED indicators on the interfacing module (the green LED indicates physical connections, the yellow LED software selections)

GREEN	YELLOW	INDICATION
lit ●	dark ○	Physical connections between the monitor, interfacing module and external device are in order and the device has been selected in the menu.
dark ○	lit ●	There is something wrong with the physical connections between the monitor, interfacing module and external device. The external device has not been selected in the menu.
lit ●	lit ●	Physical connections between the monitor, interfacing module and external device are in order but the external device has not been selected in the menu.
dark ○	dark ○	The interfacing module is not connected to the monitor.

4.1.6 Selecting the parameter data source

Select the external device via **Monitor Setup - *Interfacing*** menu:

- Select the desired measurement parameter (e.g., ***SvO$_2$***).
- Select the desired source by name (e.g., ***Oxim3***).

NOTE: The name of the device is visible on the list only if the device is correctly connected.

NOTE: Detailed information about interfacing module related mountings, connections and settings is included in the installation guides that are delivered with the interfacing modules.

4.2 Interfacing printer

It is possible to interface a laser printer (serial or parallel) with the S/5 FM via the monitors' serial port. The printer should be PCL5 compatible and should contain at least 2 MB of memory. Parallel printers require the use of Serial-to-Parallel Converter, order code 78030, model PI 130-R2.

WARNING **Always make sure that the combination complies with the international safety standard IEC 60601-1-1 for medical electrical systems and with the requirements of local authorities.**

WARNING **Connecting the power supply cord of the printer to the wall power outlet may cause the printer leakage current to exceed the limit specified for medical equipment. A printer must be supplied from an additional transformer providing at least basic isolation (isolating or separating transformer).**

4.2.1 Setting S/5 FM interface for printers

1. Press the **Print/Record** key.
2. Select ***Printer Connection***.
3. Select ***Serial.***
4. Press the **Normal Screen** key.

4.2.2 Connection to serial printers

A serial printer is connected to the serial port connector X9 in the Multi I/O adapter at the back of the frame unit.

Contact your authorized GE Healthcare distributor for advice on suitable serial printers.

4.2.3 Connection to parallel printers

A parallel printer is connected to the serial interface port connector X9 on the frame unit via the Serial-to-Parallel Converter, order code 78030, model PI130-R2.

Contact your authorized GE Healthcare distributor for advice on suitable parallel printers.

4.2.4 Installing the Serial-to-Parallel Converter

Order code 78030, model PI130-R2

A common serial modem cable, gender changer and parallel printer cable are required when connecting the serial to parallel converter between the monitor and a parallel printer. The converter gets power from the connected devices.

1. Make sure that power is switched off on both devices.
2. Connect a standard PC-to-parallel-printer cable (order code 713701) to the parallel printer.

3. Check the DIP-switch settings on the converter (order code 78030, model PI130-R2):

	Position							
	1	2	3	4	5	6	7	8
Flow Control: hardware	OFF							
LED: Enabled		ON						
Parity/D, Bits/S, Bit: None/8/1			OFF	OFF	OFF			
D.Rate (kbps): 115,2						OFF	ON	OFF

4. Connect a DB25 female-to-female gender changer (order code 78032) between the printer cable and converter.

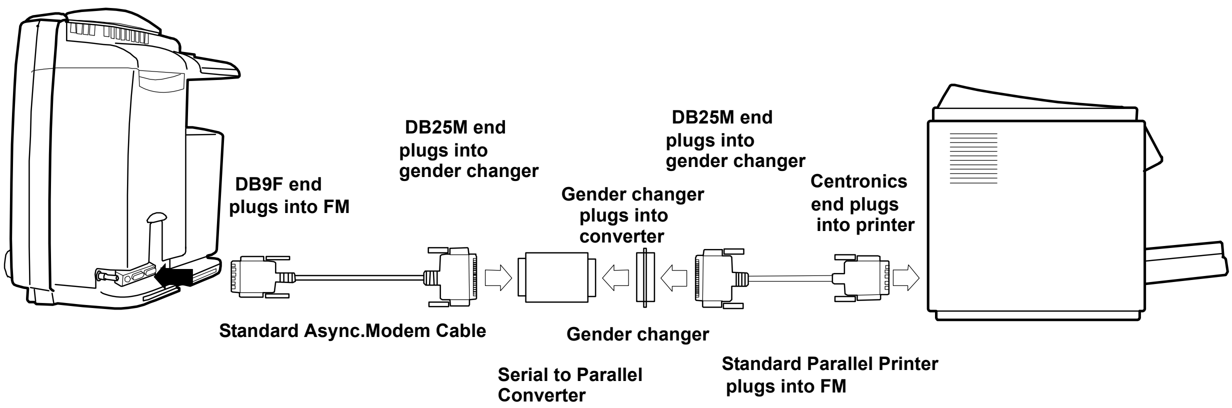


Figure 10 Connecting S/5 FM monitor to printer, converter model PI130-R2

5. Connect a common RS-232 modem cable's (order code 78031) DB9 connector to the serial port connector X9 on the monitor, and the DB25 connector to the converter.

The new Serial to Parallel Converter, PI1115A, is not compatible with the FM monitor.

4.2.5 Connection to printer

Setting the printing parameters

Refer to the documentation provided with the printer.

4.3 Interfacing computer

A computer is connected to the serial port connector on the Multi I/O connector.

Contact your authorized GE Healthcare distributor for further advice on computer interface.

WARNING **Always make sure that the combination complies with the international safety standard IEC 60601-1-1 for medical electrical systems and with the requirements of local authorities.**

WARNING **Connecting the power supply cord of the computer to the wall power outlet may cause the computer leakage current to exceed the limit specified for medical equipment. A computer must be supplied from an additional transformer providing at least basic isolation (isolating or separating transformer).**

4.4 Output signals

Analog/digital output signals on the connectors X5 and X8 can be used for interface with other devices. The pin assignments are illustrated in tables/pictures below.

Table 5 NET ID connector, X8 on Multi I/O adapter

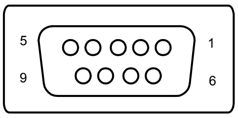
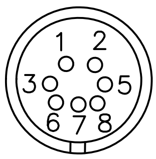
9 pin female D-connector	Pin	Signal
	1	NET_ID_CS (chip delect)
	2	NET_ID_CLK (clock)
	3	NET_ID_DO (data out)
	4	NET_ID_DI (data in)
	5	GND
	6	+5V_out
	7	GND
	8	Nurse call
	9	GND

Table 6 Defib & IABP sync connector, X5

Mini DIN7 connector	Pin	Signal
	1	Defib_sync_out
	2	Reserved
	3	Analog GND
	5	Digital GND
	6	Reserved
	7	Pressure_out
	8	Direct_ECG_out

4.4.1 Digital outputs

The digital output signals are as follows:

Defibrillation Sync (X5 pin 1)

Defibrillation Sync indication is generated by ECG. When active, the signal is state 1. After 10 ms the signal is reset to state 0. New Defibrillation Sync is not generated before the indication is deactivated. The delay from the R wave peak to the start of the signal is maximally 35 ms.

Nurse Call (X8 pin 8)

Nurse Call indication is generated by red and yellow alarms. When activated, it is set to state 1 and remains at that state until the alarm situation is over or SILENCE ALARM key is pressed.

The range of state 0 is from 0 to 0.5 V, and range of the state 1 is from 3.5 to 5 V.

4.4.2 Analog outputs

S/5 FM produces two analog real-time signals. The Direct ECG signal is available in Defib&IABP sync connector X5 pin 8. The other signal is Invasive pressure output. It is available in Synchronization connector X5 pin 7.

NOTE: When source of the selected analog output is invalid (e.g. invasive pressure channel is not zeroed), or becomes invalid (e.g. ECG lead is disconnected), the signal on the output is shown as flat line (0 VDC).

The pacemaker pulses have been replaced with 2 ms/5 V fixed digital pulses at the ECG analog output for IABP or defibrillator equipment. A device that fulfils the requirements of the IEC 60601-1 standard can be connected to the defibrillator & IABP synchronization connector. There are no other limitations, because the signals of the connector are galvanically isolated from patient applied part of the ECG and invasive blood pressure measurements.

Direct ECG (X5 pin 8)

From first user lead (ECG1)

Gain:	1 V/1mV ±20%
Delay:	< 15 ms
DC offset:	±100 mV max.
Output range:	±4 V
Noise:	50 mVpp max.
Frequency response:	0.05 Hz to 40 Hz

The signal requires input impedance of 100 kΩ.

Pressure out (X5 pin 7)

Invasive pressure signal: From pressure channel P1

Gain:	10 mV/1 mmHg ±20%
Delay:	< 35 ms
DC offset:	±100 mV
Output range:	-0.4 V to +3.2 V
Noise:	50 mVpp max.

The signal requires input impedance of 100 kΩ.

5 Functional check

These instructions include procedures for a functional check for Datex-Ohmeda S/5 FM. The functional check is mandatory after monitor installation.

These instructions include a "Functional check form, Datex-Ohmeda S/5 FM" which may be used when performing the procedures. The symbol ✍ in the instructions indicates that the check form contains space to record the results of the particular procedure. The procedures should be performed in ascending order, bypassing those that are not applicable for a particular monitor.

All menu selections related to Datex-Ohmeda products are written in following typeface: e.g. ***Parameters - Gas Unit.***

As you enter the service menus, you need the following passwords:

Monitor Setup - ***Install/Service*** (password 16-4-34) - ***Service*** (password 26-23-8)

In case you evaluate the measurement accuracy with a patient simulator, add simulator's accuracy specification to the one of the monitor.

An electrical safety check and a leakage current test are recommended to be performed prior to the monitor installation.

5.1 Recommended tools

NOTE: Use only properly maintained, calibrated and traceable measurement equipment for the specified calibrations and adjustments to ensure accuracy.

For product(s)	Tool	Order No.
Airway modules		
N-FC(REC)	Calibration gas	755580
	Regulator	755534-HEL
N-FC(REC)	CO_2 Sampling line 3m/10 ft	733163
Hemodynamic modules		
E-PSM(P)	**Multi-Link ECG accessories, IEC**	
	- Multi-link 3-leadwire set	412682-003
	- Multi-link 5-leadwire set	412681-003
	- Multi-link 5-leadwire set, C2-C6	416467-004
or	**Multi-Link ECG accessories, AHA**	
E-PSM(P)	- Multi-link 3-leadwire set	412682-001
	- Multi-link 5-leadwire set	416681-001
	- Multi-link 5-leadwire set, V2-V6	416467-003
E-PSM(P)	SpO_2 finger probe	OXY-F-UN
	SpO_2 Interconnect Cable	OXY-ES3
	Temperature test set	884515-HEL
	Adult NIBP cuff hose with cuff ID	2021285-001
	NIBP cuff	2753E
	Infant cuff hose without cuff ID	414874-001
	MemCard – Data or Menu	

For details on recommended accessories see the “Supplies and Accessories” catalog.

Table 7 Patient simulators’ compatibility with each hemodynamic module

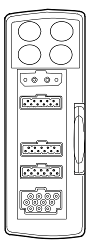
Module	Parameter	Patient simulator		
		M1010831	**MedSim**	**Lionheart & MPS450**
E-PSM(P) 	ECG	Cable included	Multilink ECG acc.	Multilink ECG acc.
	T	2016998-001	2016998-001 and M1010832	2016998-001 and M1010846
	InvBP	Cable included	M1010858 and 2005772-001	M1010862 and 2005772-001

Table 8 Adapter cables for hemodynamic patient simulators

Patient simulator	Adapter cables for simulators	
Hemodynamic patient simulator	- Dual temperature adapter cable	2016998-001
Hemodynamic patient simulator	- Dual Inv.BP adapter cable	2005772-001
Medsim	- Temperature adapter cable	M1010832
Medsim	- Inv.BP adapter cable	M1010858
Lionheart & MPS450	- Temperature adapter cable	M1010846
Lionheart & MPS450	- Inv.BP adapter cable	M1010862

5.2 Visual inspection

Make sure that the monitor is switched to standby.
Disconnect the mains power cord from the monitor.
If the monitor is connected to the Datex-Ohmeda Network, disconnect the Mon-Net cable from the monitor.

1. Check all units visually.

   Check that all parts are intact and that the cables and screws are connected and tightened properly. Especially check the following parts:

   – sampling line is connected to the extension module.

   Check that modules go in smoothly and lock up properly.

5.3 Functional inspection

WARNING Handle the water trap and its contents as you would any body fluid. Infectious hazard may be present.

5.3.1 General

1. Connect the mains power cord.
   Check that the Mains power LED is lit.
2. Switch the monitor on.
   Check that the monitor starts up properly, i.e. a normal start-up sound is heard from the loudspeaker, the alarm LEDs turn on and off, and the monitoring screen appears.
   No error messages should appear on the screen.
3. Configure the screen for the parameters that are connected.
4. Enter the ***Service Menu***.
5. When applicable, check from the corresponding ***Parameters*** submenu that the Timeouts, Bad checksums and Bad c-s by mod values of inserted modules are not increasing faster than by 5 per second. Check also that the module memories have passed the internal memory test, i.e. RAM, ROM and EEPROM all state OK.

   If connected, the recorder should record two lines of start-up information.

Preset the measurement settings for those parameters that are connected, for example:

Print/Recorder - ***Record Waveforms - Waveform 1 - ECG1***
- Waveform 2 - P1
- Waveform 3 - P2

Invasive Pressures - ***P1 'ART' Setup -- Label – ART***
- P2 'CVP' Setup -- Label – CVP

Others ***-SPO2 Setup - Pleth Scale –AUTO***

Airway Gas ***- CO2 Setup - Resp Rate Source – AUTO***
- Measurement – ON
- Detection Limit – AUTO

5.3.2 Display

1. Check that the picture on the screen is displayed properly.

5.3.3 Keyboard(s)

Tests with the Command Bar:

– Press the **Monitor Setup** key. Turn the ComWheel in both directions and check that the cursor in the menu moves correspondingly. Select ***Normal Screen*** and check that the menu disappears from the screen.
Check the rest of the menu keys by pressing them one by one.

Tests with the Remote Controller:

– Enter the ***Keyboard*** service menu.

– Check the function of the ComWheel.

– Press all keys. Check that each key produces a sound from the loudspeaker, or the Message count value in the service menu increases.

5.3.4 Frame unit

1. Check that the clock on the screen shows correct time. Readjust the time and date, if necessary.

5.3.5 Extension Module with CO_2 measurement

Wait until the message 'Calibrating gas sensor' disappears from the screen.

1. Block the tip of the sampling line with your finger and check that the message 'Sample line blocked' appears on the monitor screen within 30 seconds.
2. Detach the Mini D-fend and check that the message 'Check D-fend' appears on the monitor screen within 30 seconds.

Breathe to the sampling line briefly. Check that the CO2 information is updated on the screen.

5.3.6 Multiparameter Hemodynamic Modules

ECG and RESP measurements

1. Connect an ECG cable to the module. Connect the cable leads to a patient simulator. Check that all ECG and impedance respiration information is shown on the monitor screen as configured on the simulator.

   Turn the simulator off. Check that the 'Asystole' and 'Apnea' messages appear on the screen.

Temperature measurement

2. Check the temperature channels with a patient simulator.

   Check that temperature measurement information is shown on the monitor screen as configured on the simulator.

Invasive blood pressure measurement

3. Check the function of the module and side panel membrane keys.
4. Check the InvBP channels with a patient simulator.
5. Zero the InvBP channels and check that the values and waveforms correspond to the simulator settings.

SpO2 measurement

6. Connect an SpO2 finger probe to the module. Check that the message 'Probe off' is shown when the probe is not connected to a finger.
7. Attach the SpO2 probe to your finger. Check that a reading of 95-99 and a pleth waveform appear on the screen

Non invasive blood pressure measurement

8. Check the function of the module and side panel membrane keys.
9. Attach an adult NIBP cuff onto your arm and check that the module identifies the cuff, i.e. the text 'Adult' appears in the NIBP digit field for a short time.

   Perform a NIBP measurement and check that the module gives a reasonable measured result.

5.3.7 Data Card and Menu Card function

1. Insert a Data card or a Menu card to the slot.

   Check that the corresponding symbol appears on the monitor screen.

5.3.8 Recorder

1. Press the **Start/Stop** sidepanel key and check that the module starts recording the selected waveforms. Press the **Start/Stop** sidepanel key again to stop recording.
2. Check that the quality of the recordings is acceptable.

5.3.9 Network connection

1. Check that the Mon-Net cable connector is clean and intact, then connect it to the Network connector on the backside of the monitor.

   Check that the monitor connects to the network, i.e. the network symbol appears on the upper right-hand corner of the screen. Also a message regarding the connected Central should appear in the message field on the screen.

5.3.10 Wireless Network Option

1. Check that the WLAN signal strength symbol scrolls between zero and full or stays fixed on the monitor screen.
2. Check that the wireless LAN network symbol appears on the upper right-hand corner of the screen when the monitor connects to the Datex-Ohmeda Network.

NOTE: If the monitor does not connect to the Datex-Ohmeda Network, check the WLAN configuration on the monitor and on the network.

5.3.11 Device Interfacing Solution, N-DISxxx

1. Make sure that the monitor receives all necessary parameter data from the connected devices. Check the screen configuration and the related interfacing settings, if necessary. Check also via the Interfacing menu that the connected DIS module status is correct:

   Monitor Setup - ***Interfacing - Status Page***

5.3.12 General

- Switch the monitor to standby
- Perform final cleaning
- Fill in all necessary documents

6 General troubleshooting

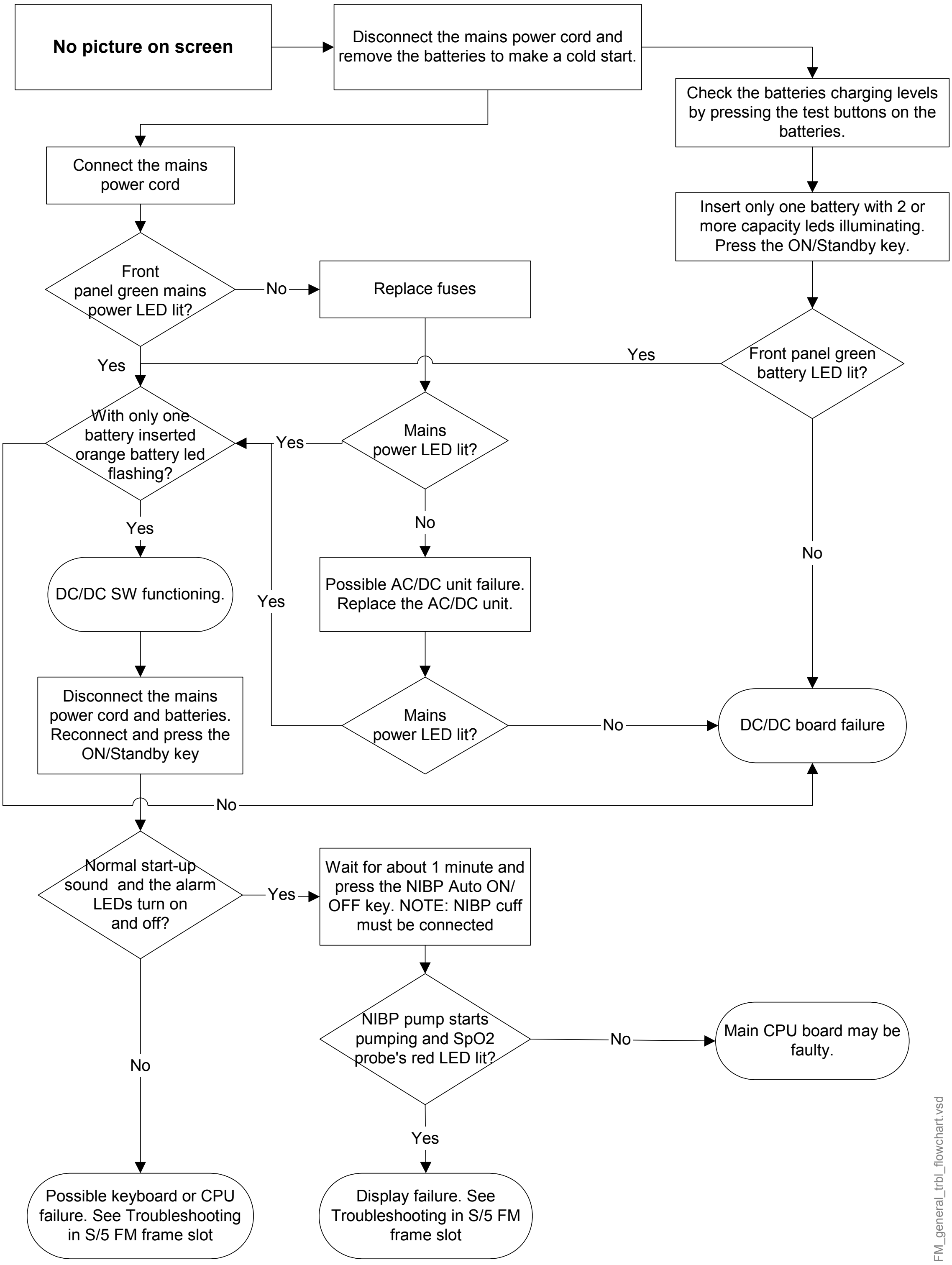


Figure 11 S/5 FM general troubleshooting flowchart

For your notes:

APPENDIX A: Functional check form, Datex-Ohmeda S/5 FM

Customer	
Service	
Service engineer	Date

Measuring equipment / test gases used:				
Equipment / tool / gas:	Manufacturer:	Model/Type/Part Number:	Serial Number / ID:	Calibration Date:

Monitor Installation			
L-	E-	N-	F-

OK = Test OK **N.A. = Test not applicable** **Fail = Test failed**

Visual Inspection			**OK**	**N.A.**	**Fail**
1. Check all units visually.			☐	☐	☐

Functional Inspection		**OK**	**N.A.**	**Fail**
5.3.1. General		☐	☐	☐
5.3.2. Display	S/N	☐	☐	☐
5.3.3. Keyboard(s)	S/N	☐	☐	☐
5.3.4. Frame unit	S/N	☐	☐	☐
5.3.5. Extension Module with CO2 measurement	S/N	☐	☐	☐

Functional Inspection		OK	N.A.	Fail
5.3.6. Multiparameter Hemodynamic Modules	S/N	☐	☐	☐
. ECG and RESP measurements		☐	☐	☐
. Temperature measurement		☐	☐	☐
. Invasive blood pressure measurement		☐	☐	☐
. SpO2 measurement		☐	☐	☐
. Non invasive blood pressure measurement		☐	☐	☐
5.3.7. Data Card and Menu Card function		☐	☐	☐
5.3.8. Recorder		☐	☐	☐
5.3.9. Network connection		☐	☐	☐
5.3.10. Wireless Network Option		☐	☐	☐
5.3.11. Device Interfacing Solution, N-DISxxx	S/N	☐	☐	☐
5.3.12. General		☐	☐	☐
Notes				

Signature

APPENDIX B: ElectroMagnetic Compatibility

Table 1 Guidance and manufacturer's declaration – electromagnetic emissions

Guidance and manufacturer's declaration – electromagnetic emissions		
The S/5 FM is intended for use in the electromagnetic environment specified below. The customer or the user of the S/5 FM should assure that it is used in such an environment.		
Emissions test	**Compliance**	**Electromagnetic environment - guidance**
RF emissions CISPR 11	Group 1	The S/5 FM[1] uses RF energy only for its internal function. Therefore, its RF emissions are very low and are not likely to cause any interference in nearby electronic equipment.
	Group 2	The S/5 FM[2] must emit electromagnetic energy in order to perform its intended function. Nearby electronic equipment may be affected.
RF emissions CISPR 11	Class A	The S/5 FM is suitable for use in all establishments other than domestic and those directly connected to the public low-voltage power supply network that supplies buildings used for domestic purposes.
Harmonic emissions IEC 61000-3-2	Class A	
Voltage fluctuations/ flicker emissions IEC 61000-3-3	Complies	

(1 S/5 FM equipped with S/5 Frame for FM, F-FM

(2 S/5 FM equipped with S/5 Frame for FM with WLAN, F-FMW

Table 2 Guidance and manufacturer's declaration – electromagnetic immunity

Guidance and manufacturer's declaration – electromagnetic immunity			
The S/5 FM is intended for use in the electromagnetic environment specified below. The customer or the user of the S/5 FM should assure that it is used in such an environment.			
Immunity test	**IEC 60601 test level**	**Compliance level**	**Electromagnetic environment - guidance**
Electrostatic discharge (ESD) IEC 61000-4-2	±6 kV contact ±8 kV air	±6 kV contact ±8 kV air	Floors should be wood, concrete or ceramic tile. If floors are covered with synthetic material, the relative humidity should be at least 30%.
Electrical fast transients/bursts IEC 61000-4-4	±2 kV for power supply lines ±1 kV for input/output lines	±2 kV for power supply lines ±1 kV for input/output lines	Mains power quality should be that of a typical commercial or hospital environment.
Surge IEC 61000-4-5	±1 kV differential mode ±2 kV common mode	±1 kV differential mode ±2 kV common mode	Mains power quality should be that of a typical commercial or hospital environment.
Voltage dips, short interruptions and voltage variations on power supply lines IEC 61000-4-11	<5% U_T (>95% dip in U_T) for 0.5 cycle 40% U_T (60% dip in U_T) for 5 cycles 70% U_T (30% dip in U_T) for 25 cycles <5% U_T (>95% dip in U_T) for 5 sec	<5% U_T (>95% dip in U_T) for 0.5 cycle 40% U_T (60% dip in U_T) for 5 cycles 70% U_T (30% dip in U_T) for 25 cycles <5% U_T (>95% dip in U_T) for 5 sec	Mains power quality should be that of a typical commercial or hospital environment. If user of the S/5 FM requires continued operation during power mains interruptions, it is recommended that the S/5 FM be powered from an uninterruptible power supply or a battery.
Power frequency (50/60 Hz) magnetic field IEC 61000-4-8	3 A/m	3 A/m	Power frequency magnetic field should be at levels characteristic of a typical location in a typical commercial or hospital environment.
NOTE U_T is the a.c. mains voltage prior to application of the test level.			

Table 3 Guidance and manufacturer's declaration – electromagnetic immunity

Guidance and manufacturer's declaration – electromagnetic immunity

The S/5 FM is intended for use in the electromagnetic environment specified below. The customer or the user of the S/5 FM should assure that it is used in such an environment.

Immunity test	IEC 60601 test level	Compliance level	Electromagnetic environment - guidance
			Portable and mobile RF communications equipment should be used no closer to any part of the S/5 FM, including cables, than the recommended separation distance calculated from the equation applicable to the frequency of the transmitter. **Recommended separation distance**
Conducted RF IEC 61000-4-6	3 Vrms 150 kHz to 80 MHz	3 Vrms	$d = 1.2\sqrt{P}$
	3 Vrms 150 kHz to 80 MHz	1 Vrms [1]	$d = 3.5\sqrt{P}$
Radiated RF IEC 61000-4-3	3 V/m 80 MHz to 2.5 GHz	3 V/m	$d = 1.2\sqrt{P}$ 80 MHz to 800 MHz $d = 2.3\sqrt{P}$ 800 MHz to 2.5 GHz where *P* is the maximum output power rating of the transmitter in watts (W) according to the transmitter manufacturer and *d* is the recommended separation distance in metres (m). Field strengths from fixed RF transmitters, as determined by an electromagnetic site survey, [a] should be less than the compliance level in each frequency range. [b] Interference may occur in the vicinity of equipment marked with the following symbol: 

NOTE 1 At 80 MHz and 800 MHz, the higher frequency range applies.

NOTE 2 These guidelines may not apply in all situations. Electromagnetic propagation is affected by absorption and reflection from structures, objects and people.

[a] Field strengths from fixed transmitters, such as base stations for radio (cellular/cordless) telephones and land mobile radios, amateur radio, AM and FM radio broadcast and TV broadcast cannot be predicated theoretically with accuracy. To assess the electromagnetic environment due to fixed RF transmitters, an electromagnetic site survey should be considered. If the measured field strength in the location in which the S/5 FM is used exceeds the applicable RF compliance level above, the S/5 FMshould be observed to verify normal operation. If abnormal performance is observed, additional measures may be necessary, such as reorienting or relocating the S/5 FM.

[b] Over the frequency range 150 kHz to 80 MHz, field strengths should be less than 3 V/m or 1 V/m [1].

[1] For impedance RESP measurement

Table 4 Recommended separation distances between portable and mobile RF communications equipment and the S/5 FM

<table>
<tr><td colspan="4">Recommended separation distances between portable and mobile RF communications equipment and the S/5 FM.</td></tr>
<tr><td colspan="4">The S/5 FM is intended for use in an electromagnetic environment in which radiated RF disturbances are controlled. The customer or the user of the S/5 FM can help prevent electromagnetic interference by maintaining a minimum distance between portable and mobile RF communications equipment (transmitters) and the S/5 FM as recommended below, according to the maximum output power of the communications equipment.</td></tr>
<tr><td rowspan="2">Rated maximum output power of transmitter
W</td><td colspan="3">Separation distance according to frequency of transmitter
m</td></tr>
<tr><td>150 kHz to 80 MHz
$d = 1.2\sqrt{P}$
$d = 3.5\sqrt{P}$ (1</td><td>80 MHz to 800 MHz
$d = 1.2\sqrt{P}$</td><td>800 MHz to 2.5 GHz
$d = 2.3\sqrt{P}$</td></tr>
<tr><td>0.01</td><td>0.12
0.35 (1</td><td>0.12</td><td>0.23</td></tr>
<tr><td>0.1</td><td>0.38
1.1 (1</td><td>0.38</td><td>0.73</td></tr>
<tr><td>1</td><td>1.2
3.5 (1</td><td>1.2</td><td>2.3</td></tr>
<tr><td>10</td><td>3.8
11 (1</td><td>3.8</td><td>7.3</td></tr>
<tr><td>100</td><td>12
35 (1</td><td>12</td><td>23</td></tr>
<tr><td colspan="4">For transmitters rated at a maximum output power not listed above, the recommended separation distance d in meters (m) can be estimated using the equation applicable to the frequency of the transmitter, where P is the maximum output power rating of the transmitter in watts (W) according to the transmitter manufacturer.
NOTE 1 At 80 MHz and 800 MHz, the separation distance for the higher frequency range applies.
NOTE 2 These guidelines may not apply in all situations. Electromagnetic propagation is affected by absorption and reflection from structures, objects and people.</td></tr>
</table>

(1 For impedance RESP measurement.

APPENDIX C: Channel Mask Selections for S/5 FM

NOTE: The selections are country specific. Make sure that you are using the correct selection.

Selection	Allowed Band	DS Channels
07FF	2.400 - 2.4835	01 - 11
1FFF	2.400 - 2.4835	01 - 13
1C00	2.4465 - 2.4835	11 - 13
00F0	2.418 - 2.457	05-08

Datex-Ohmeda

S/5^{TM} FM

Planned Maintenance Instructions

Conformity according to the Council Directive 93/42/EEC concerning Medical Devices amended by 2007/47/EC

CAUTION: U.S. Federal law restricts this device to sale by or on the order of a licensed medical practitioner. Outside the USA, check local laws for any restriction that may apply.

All specifications subject to change without notice.

Document number M1187318-003

2 February, 2010

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Table of contents

1 Planned maintenance instructions

1.1 Introduction

These instructions include procedures for planned maintenance (PM) for the Datex-Ohmeda S/5 FM. The Planned maintenance should be performed once a year.

These instructions include *"Planned maintenance check form, Datex-Ohmeda S/5 FM"* which may be used when performing the procedures.

The symbol in the instructions means that the procedure performed should be signed in the check form.

The procedures should be performed in ascending order, bypassing those that are not applicable for a particular monitor.

If you need further information on how to perform a certain planned maintenance procedure, please refer to the corresponding slot in the Technical Reference Manual.

All menu selections related to the Datex-Ohmeda monitors are written in the following typeface:

e.g. ***Parameters - Gas Unit***

As you enter the service menus, you need following passwords:

Monitor Setup - ***Install/Service*** (password 16-4-34) **-** ***Service*** (password 26-23-8)

In case you evaluate the measurement accuracy with a patient simulator, add the simulator's accuracy specification to the one for the monitor.

WARNING **Handle the water trap and its contents as you would any body fluid. Infectious hazard may be present.**

WARNING **Only trained personnel with appropriate equipment should perform the tests and repairs outlined in this section. Unauthorized service may void warranty of the unit.**

WARNING **Wear a grounded antistatic wristband when handling PC boards. Electrostatic discharge may damage components on the board.**

WARNING **Failure on the part of all responsible individuals, hospitals or institutions, employing the use of this device, to implement the recommended maintenance schedule may cause equipment failure. The manufacturer does not, in any manner, assume the responsibility for performing the recommended maintenance schedule, unless an equipment maintenance agreement exists. The sole responsibility rests with the individuals, hospitals, or institutions utilizing the device.**

1.2 Recommended tools

NOTE: Use only properly maintained, calibrated and traceable measurement equipment for the specified calibrations and adjustments to ensure accuracy.

For product(s)	Tool	Order No.
N-FC(REC)	Flowmeter	
	Calibration gas (CO2, 5%, 4 cans per package)	755580
	Regulator	755534-HEL*
	CO2 sampling line 3 m/10 ft	733163
	Sampling line, 6 m/20 ft	73306
Hemodynamic modules		
E-PSM(P)	Adult NIBP cuff hose with cuff ID	2021285-001
	Adult NIBP cuff	2753E
	Infant cuff hose without cuff ID	414874-001
	InvBP transducer	70077-001
	Pressure manometer	
	Multi-Link ECG accessories, IEC	
E-PSM(P)	- Multi-link 3-leadwire set	412682-003
	- Multi-link 5-leadwire set	412681-003
	- Multi-link 5-leadwire set, C2-C6	416467-004
or	**Multi-Link ECG accessories, AHA**	
E-PSM(P)	- Multi-link 3-leadwire set	412682-001
	- Multi-link 5-leadwire set	4162681-001
	- Multi-link 5-leadwire set, V2-V6	416467-003
E-PSM(P)	SpO_2 finger probe	OXY-F-UN
	SpO_2 Interconnect Cable	OXY-ES3
	Temperature test set	884515-HEL
Monitor / Modules		
	MemCard – Menu	
	MemCard – Data	
	Torx screwdrivers; T8, T10	

NOTE: * Ensure that the calibration gas and regulator are functioning properly before calibration. Perform annual maintenance on the regulator as required. For more information see section “Adjustments and calibrations” in N-FC(REC) slot.

1.2.1 Hemodynamic patient simulators

The following tables present the patient simulators' compatibility with each hemodynamic module, and the accessories needed:

Table 1 Patient simulators' compatibility with each hemodynamic module

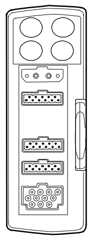
Module	Parameter	Patient simulator		
		M1010831	**MedSim**	**Lionheart & MPS450**
E-PSM(P)	ECG	Cable included	Multilink ECG acc.	Multilink ECG acc.
	T	2016998-001	2016998-001 and M1010832	2016998-001 and M1010846
	InvBP	Cable included	M1010858 and 2005772-001	M1010862 and 2005772-001

Table 2 Adapter cables for hemodynamic patient simulators

Patient simulator		
Hemodynamic patient simulator	Dual temperature adapter cable	2016998-001
Hemodynamic patient simulator	Dual Inv.BP adapter cable	2005772-001
Medsim	Temperature adapter cable	M1010832
Medsim	Inv.BP adapter cable	M1010858
Lionheart & MPS450	Temperature adapter cable	M1010846
Lionheart & MPS450	Inv.BP adapter cable	M1010862

1.3 Recommended parts

For product(s)	Part	Order No.
N-F(C)REC	Recorder paper	74205-HEL

1.4 Planned maintenance parts

1.4.1 PM parts for Airway Module, N-FC(REC)

Part	Order No.	For product(s)
Special tube (Nafion 2 pcs)	733382-HEL	All Airway modules
Mini D-fend O-ring (2 pcs)	656565	N-FC(REC)
Mini D-fend	8002174 (pkg of 10 pcs)	N-FC(REC)
Zero valve air filter	M1011471	N-FC(REC), every 3 years
CO_2 Sampling line 3.0 m	733163	N-FC(REC)
PM sticker	893108	All Airway modules

1.4.2 PM parts for S/5 FM frame, F-FM

Part	Order No.	For product(s)
SRAM/Timekeeper battery	197230-HEL-S	F-FM, every 8 years

For details on recommended accessories see the “Supplies and Accessories” catalog.

2 Planned maintenance check list

2.1 Visual inspection/preparation

2.1.1 General

WARNING **Wear a grounded antistatic wristband when handling PC boards. Electrostatic discharge may damage components on the board.**

Make sure that the monitor is turned off.

Disconnect the mains power cord. If the monitor is connected to the Datex-Ohmeda Network, disconnect the Mon-Net cable from the monitor. Remove any memory cards.

1. Check all the units visually. Check that all parts are intact and that the cables and screws are connected and tightened properly.
2. Replace the batteries, if necessary.

   The manufacturer recommendations are:

   – Replace the SRAM/Timekeeper battery on the CPU board every 8 years.

   NOTE: The Factory Reset must be performed if the SRAM/Timekeeper battery is replaced.
3. Check that the fuses are of the correct rating.
4. Check the ventilation holes of the monitor and clean of dust if necessary.
5. Check the battery status from ***Battery setup*** menu: If "failed", renew the battery. If "condition", perform the condition cycle.

NOTE: Batteries are recommended to be conditioned every six months.

2.1.2 Extension module, N-F(C)(REC)

MiniC unit

1. Remove the module cover.
2. Check that all cables and tubes are connected properly and that there are no loose objects inside the module.
3. Install the PM Kit:
   – Replace the special tube (Nafion™).
   – Replace the Zero valve air filter every three years.
   – Check the D-fend body connector O-rings and replace them, if necessary.
   – Replace the Mini D-fend and the sampling line.

NOTE: Use only approved sampling lines to ensure proper functioning.

4. Check that the tubing inside the module is not contaminated. Any contamination inside the tubing may indicate that the valves or sensors are contaminated, too.

   This can increase the risk of faulty operation in the valves or sensors. It is not possible to clean valves or gas sensors in the field. Therefore, if you notice any contamination in the module tubing, send the module to GE Healthcare for factory service.
5. Reattach the module cover and connect the module to the monitor frame.

2.1.3 Recorder unit

1. Clean the recorder.
   – Open the paper compartment hatch and remove the paper roll, if installed.
   – Remove any paper chaff from the paper compartment.
   – Clean the thermal printhead and the small glass window in front of the static brush with a cotton swab dipped in isopropyl alcohol, if necessary.

NOTE: Avoid contact with the rubber paper roller. Be careful to limit the application of alcohol to the thermal printhead and the window.

   – Reinstall the paper roll.

2.1.4 E-PSM(P) Module

1. Check the NIBP pump filter. Replace the filter, if necessary.
   Plug the module back into the frame.

2.2 Functional inspection

2.2.1 General

1. Connect the mains power cord. Check that the Mains power LED is lit.
2. Switch the monitor on.
   Check that the monitor starts up properly, i.e. the alarm LEDs turn on shortly, normal start-up sound is heard from the loudspeaker and the monitoring screen appears.
   No error messages should appear on the screen.
3. Configure the screen for the parameters that are connected.
   Check that all the connected modules are recognized, i.e. the required parameter information is shown on the screen.
   If connected, the recorder should record two lines of start-up information.
   Preset the measurement settings for those parameters that are connected, for example:

   Print/Recorder - ***Record Waveforms - Waveform 1 - ECG1***
   - Waveform 2 - P1
   - Waveform 3 - P2

   Invasive Pressures - ***P1 'ART' Setup - Label - ART***
   - P2 'CVP' Setup - Label - CVP

   Others - ***SPO2 Setup - Pleth Scale - AUTO***

   Others - ***Resp Setup - Size - 1.0***
   - Resp Rate Source - AUTO
   - Measurement - ON
   - Detection Limit - AUTO

4. Check that the monitor goes to battery use if the main cord is disconnected.

2.2.2 Display

1. Check that the picture on the screen is correct.

2.2.3 Keyboard(s)

1. Tests with the Command Board:
   – Press the **Monitor Setup** key. Turn the ComWheel in both directions and check that the cursor in the menu moves correspondingly. Select ***Normal Screen*** and check that the menu disappears from the screen.
   Check the rest of the menu keys by pressing them one by one.

   Tests with the Remote Controller:
   – Enter the ***Keyboard*** service menu.
   – Check the function of the Comwheel.
   – Press all keys. Check that each key produces a sound from the loudspeaker, or the Message count value in the service menu increases.
2. Check that the clock on the screen shows correct time.

   Readjust the time and date, if necessary.
3. Enter the ***Service Log*** service menu.
   Check the content of the Service Log for possible problems.

2.2.4 N-FC(REC)

1. Enter the ***Gas Unit*** service menu.
2. Enter the ***General*** service menu: Check that the Time-outs, Bad checksums and Bad c-s by mod values are not increasing faster than by 5 per second.
3. Enter the ***Gases*** service menu: Check that the 'Ambient' value displayed corresponds with the current ambient pressure (±20 mmHg).
4. Check that the flow measurement offset, i.e. the sample 'Zero' value displayed is within ±10 ml/min.
5. Perform a sampling system leak test.
6. Check the flow rates. Adjust the sampling flow, if necessary.
7. Block the tip of the sampling line with your finger and check that the message 'Sample line blocked' appears on the monitor screen within 30 seconds.

   Remove the Mini D-fend and check that the message 'Check D-fend' appears on the screen within 30 seconds.
8. Perform a gas calibration:

NOTE: For maximum accuracy, a warm-up time of 30 minutes is recommended.

NOTE: Noisy sampling pump might indicate possible problems with motor bearing. Replace the noisy sampling pump by a new one if needed.

2.2.5 Multiparameter Hemodynamic Modules

ECG and RESP measurements

1. Enter the ***ECG*** service menu.

   Check that the Time-outs, Bad checksums and Bad c-s by mod values are not increasing faster than by 5 per second. Check that the ECG/RESP board memories have passed the internal memory test, i.e. RAM, ROM and EEPROM all state OK.

2. Check that the 'Power Freq' value is set according to the mains power frequency. Correct the setting, if necessary.

   Connect a 12-lead ECG trunk cable without a lead set to the module. Check that the message 'Leads off' is displayed on the screen.

3. Connect both 5-leadwire sets to the trunk cable. Connect the cable leads to a patient simulator. Check that the 'Cable type' shows 10 lead.

4. Disconnect one of the leads and check that the corresponding electrode in the service menu shows OFF within 10 seconds from the disconnection, then reconnect the lead.

   Check the rest of the leads using the same method.

NOTE: With E-PSM module: when any of the limb leads is disconnected, the measurement will automatically change to 3 electrode ECG measurement.

NOTE: The asystole and different leads off messages are shown using certain priority. Even though one of the leads is disconnected, the related leads off message may not appear on the screen.

NOTE: When RA, LA, LL or RL electrode is disconnected, all V electrodes show OFF.

5. Check that all ECG and impedance respiration information is shown on the monitor screen as configured on the simulator.

   Check that the pacer count value in the service menu is shown according to the simulator configuration.

   Change baseline impedance on the simulator and check that appropriate RESP waveform and RR values are shown again within 30 seconds.

   Turn the simulator off. Check that the 'Asystole' and 'Apnea' messages are displayed.

Temperature measurement

6. Enter the ***STP*** service menu.

   Check that the Time-outs, Bad checksums and Bad c-s by mod values are not increasing faster than by 5 per second. Check that the STP board memories have passed the internal memory test, i.e. RAM, ROM and EEPROM all show OK.

7. Check the temperature measurement calibration using temperature test plugs.

NOTE: Make sure that the protection for temperature calibration is set on, if calibration is needed.

Invasive blood pressure measurement

8. Check the function of the module front panel membrane keys.
9. Check the InvBP channels with a patient simulator.

   Zero the InvBP channels, then check that the values and waveforms correspond to the simulator settings.

SpO2 measurement

10. Check that the message 'No probe' is shown, when no SpO_2 sensor is connected.

    Connect an SpO_2 finger probe to the module. Check that the message 'Probe off' is shown, when the probe is not connected to a finger.
11. Attach the SpO_2 probe to your finger. Check that a reading of 95-99 and a pleth waveform appear on the screen.

Non invasive blood pressure measurement

12. Enter the ***NIBP*** module service menu.
    Check that the Time-outs, Bad checksums and Bad c-s by mod values are not increasing faster than by 5 per second. Check that the NIBP board memories have passed the internal memory test, i.e. RAM, ROM and EEPROM all show ***OK***.
13. Check the function of the front panel membrane keys.
14. Check the NIBP tubing system for leakages by performing ***Calibrations - Active leak test.***
15. Perform NIBP calibration by selecting ***Calibration.***
16. Check the safety valve by performing ***Safety Valve – Adult*** and ***Infant.***
17. Attach an adult NIBP hose and cuff onto your arm and perform one NIBP measurement. Check that the module identifies the cuff, i.e. the text 'Adult' appears in the NIBP digit field for a short time.

    Check that the module gives a reasonable measurement result.

E-PSM(P):

18. Attach a NIBP cuff hose without cuff identification and check that the module identifies the hose:
    - The message 'Select inflation limits' appears in the NIBP digit field.
    - When you try to start the measurement, the monitor automatically opens the selections ***NIBP Setup - Inflation Limits***.

2.2.6 Memory

1. Enter the ***MemCards*** service menu:

   Check that the memory unit is recognized properly, i.e. Present and Active state YES.
2. Check that the memories and the PCMCIA controller have passed the tests. The status for each should be OK.

3. Select ***Communication***.

   Check that the Interface status states Active continuously and the error counter values on the bottom part of the menu are stable.

4. Select ***Status***.

   Insert Data card into the slot.

   Wait until the information is fully updated in the service menu, then check that the Card types are correct and the ‘File system’ states ATA.

   Check that the rest of the information is reliable and no errors have been detected.

2.2.7 Recorder

1. Open the paper compartment cover. Check that the message ‘Recorder: Cover open’ appears on the screen, then close the cover.
2. Press the **Start/Stop** sidepanel key and check that the module starts recording the selected waveforms. Press the **Start/Stop** sidepanel key again to stop recording.
3. Check that the quality of the recordings is acceptable.

2.2.8 Network

1. Check that the Mon-Net cable connector and the Identification plug are clean and intact, then connect them to the monitor via **the** Multi I/O adapter. Check that the monitor connects to the Datex-Ohmeda Network, i.e. the network symbol appears on the upper right-hand corner of the screen. Also a message regarding the connected Central should appear in the message field on the screen.

   NOTE: If necessary, reselect the monitor’s network communication according to the used network software in the ***Network*** service menu.

2. Enter the ***Network - Ethernet*** service menu:

   Check that the counters for data errors (CRC, Frame, Transm.) are stable.

   Check that the counters for hardware errors (Intern., Missed, FIFO, Overrun) all show 0.

2.2.9 Wireless Network Option

1. Check that the WLAN signal strength symbol scrolls between zero and full or stays fixed on the monitor screen.
2. Check that the wireless LAN network symbol appears on the upper right-hand corner of the screen when the monitor connects to the Datex-Ohmeda Network.

NOTE: If the monitor does not connect to the Datex-Ohmeda Network, check the WLAN configuration on the monitor and on the network.

2.2.10 Device Interfacing Solution, N-DISxxx

1. Enter the ***DIS Interfacing*** service menu:

   Check that the DIS module 'tout' and 'cse' values do not increase faster than by 5 per second. Check also that the DIS module memories have passed the internal memory test, i.e. Ram, Rom and EEPROM state all OK.

   Perform the same check for all connected DIS modules.

2.2.11 General

1. Storing trend data

   Check that the monitor is capable of storing the trend information and temporary settings in a short (max. 15 minutes) standby situation with no power cord.

2. Service reset

   Check the Service Reset. Switch off the monitor. Disconnect the power cord and remove the batteries to reset the monitor. Wait at least for 30 seconds, insert the batteries back, switch the monitor back on and check that the monitor performs a Cold Start, i.e. all trend information is cleared.

3. Watchdog

   Enter the ***Set/Test*** service menu and perform ***Watchdog***
   Check that the monitor restarts.

4. Service Log reset

   Enter the ***Service Log*** service menu.

   Clear the content of the Service Log by selecting ***Reset Log*** from the menu.

5. Electrical safety check

   Perform an Electrical safety check and a leakage current test. Check that the monitor and all connected units function normally after the performed test.

6. Save information about the performed planned maintenance into the ***Maintenance*** service menu by performing ***Plan. Maint - 1 year PM - Save***.

7. Final cleaning

   Switch the monitor to standby and perform final cleaning.
   Fill in all necessary documents.

For your notes:

APPENDIX A: Planned maintenance check form, Datex-Ohmeda S/5 FM

Customer	
Service	
Service engineer	Date

Measuring equipment / test gases used:				
Equipment / tool / gas:	Manufacturer:	Model/Type/Part Number:	Serial Number / ID:	Calibration Date:

Monitor Installation			
L-	E-	N-	F-
N-	N-	N-	N-
K-			

OK = Test OK **N.A. = Test not applicable** **Fail = Test failed**

Visual Inspection		**OK**	**N.A.**	**Fail**
2.1.1. General		☐	☐	☐
2.1.2. Extension module, N-F(C)(REC)	S/N	☐	☐	☐
. MiniC unit		☐	☐	☐
2.1.3. Recorder unit		☐	☐	☐
2.1.4. E-PSM(P) Module	S/N	☐	☐	☐
Notes				

Functional Inspection		OK	N.A.	Fail
2.2.1. General		☐	☐	☐
2.2.2. Display		☐	☐	☐
2.2.3. Keyboard(s)		☐	☐	☐
2.2.4. N-FC(REC)		☐	☐	☐
Notes				
2.2.5. Multiparameter Hemodynamic Modules		☐	☐	☐
. ECG and RESP measurements		☐	☐	☐
. Temperature measurement		☐	☐	☐
. Invasive blood pressure measurement		☐	☐	☐
. SpO2 measurement		☐	☐	☐
. Non invasive blood pressure measurement		☐	☐	☐
Notes				
2.2.6. Memory		☐	☐	☐
2.2.7. Recorder		☐	☐	☐
2.2.8. Network		☐	☐	☐
2.2.9. Wireless Network Option		☐	☐	☐
2.2.10. Device Interfacing Solution, N-DISxxx	S/N	☐	☐	☐
	S/N	☐	☐	☐
	S/N	☐	☐	☐
	S/N	☐	☐	☐
Notes				

Functional Inspection		OK	N.A.	Fail
2.2.11. General				
1. Storing trend data		☐	☐	☐
2. Service reset		☐	☐	☐
3. Watchdog		☐	☐	☐
4. Service Log reset		☐	☐	☐
5. Electrical safety check		☐	☐	☐
6. Save information into the Maintenance service menu		☐	☐	☐
7. Final cleaning		☐	☐	☐
Notes				

Used Spare Parts			
Notes			

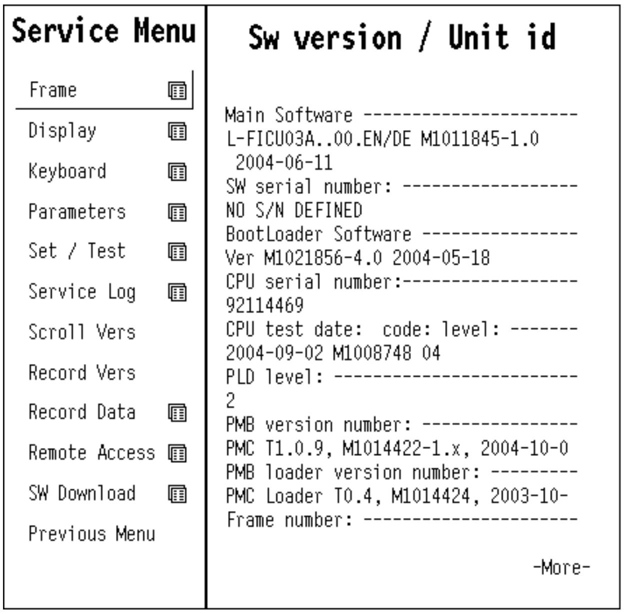
Signature

For your notes:

Datex-Ohmeda

S/5™ FM

Service Menu



Conformity according to the Council Directive 93/42/EEC concerning Medical Devices amended by 2007/47/EC

CAUTION: U.S. Federal law restricts this device to sale by or on the order of a licensed medical practitioner. Outside the USA, check local laws for any restriction that may apply.

All specifications subject to change without notice.

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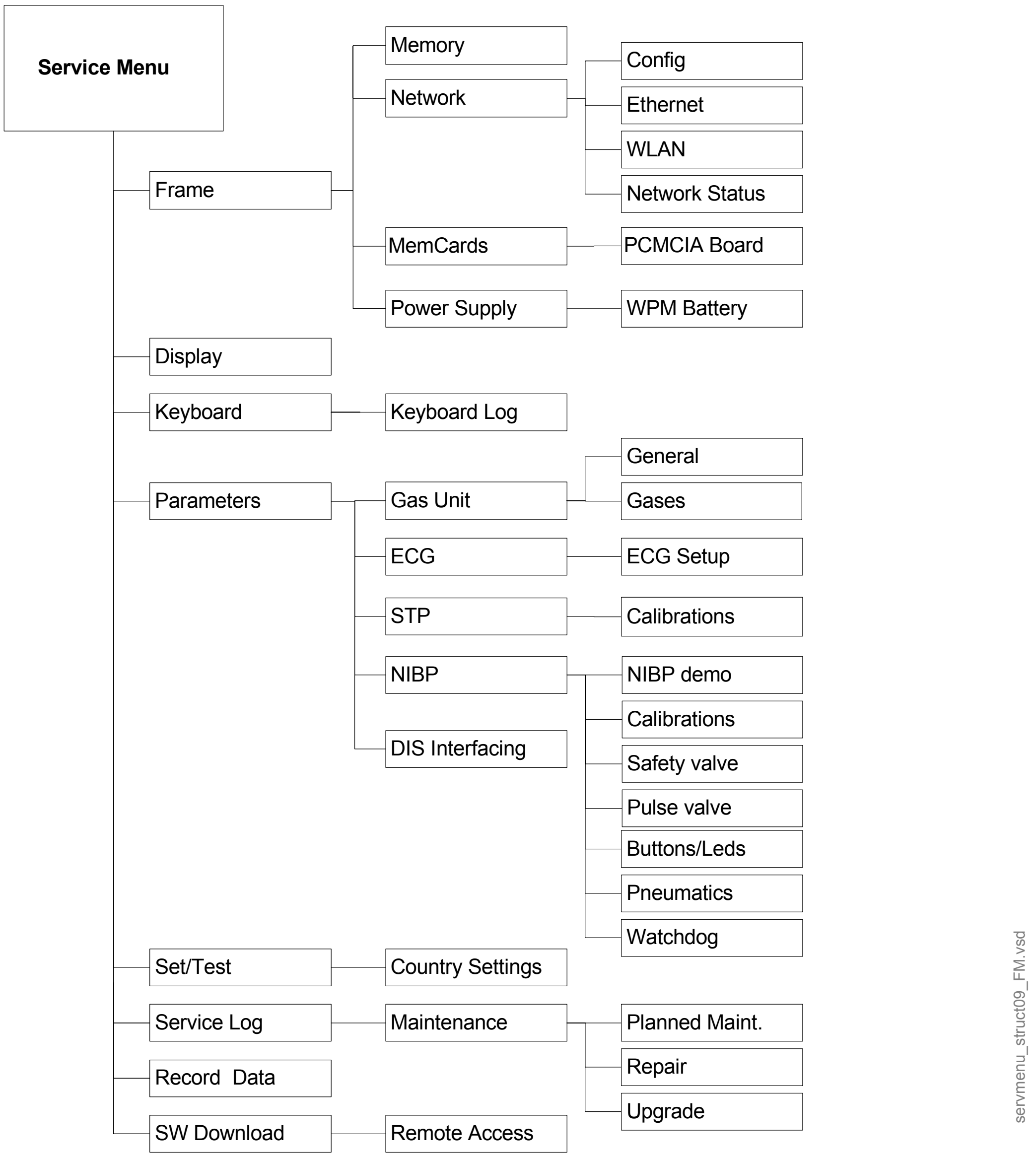
Table of contents

Introduction

The monitor has a **Service Menu**, which is a useful tool to examine monitor functions and to troubleshoot in case a fault occurs.

Service Menu structure

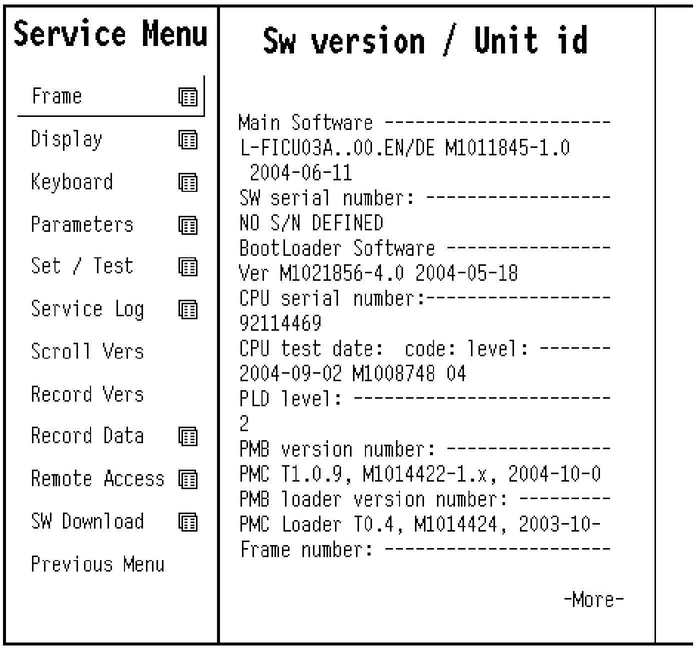


NOTE: The Service Menu structure can vary depending on the software version.

Service Menu

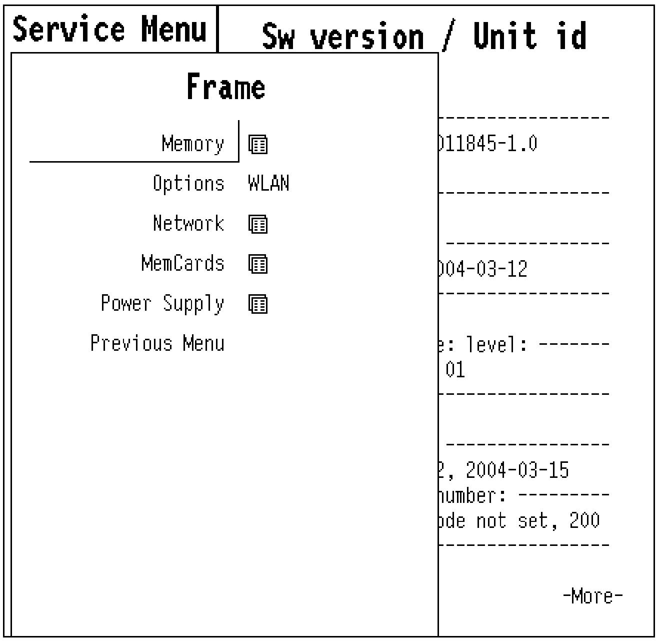
NOTE: The Service Menu pictures are for reference only. Details on the menu page can vary depending on the software version and the module type in use.

1. Press the **Monitor Setup** key.
2. Select ***Install/Service*** (password 16-4-34).
3. Select ***Service*** (password 26-23-8).



1 Frame

The Frame menu includes service menus common for the frame.



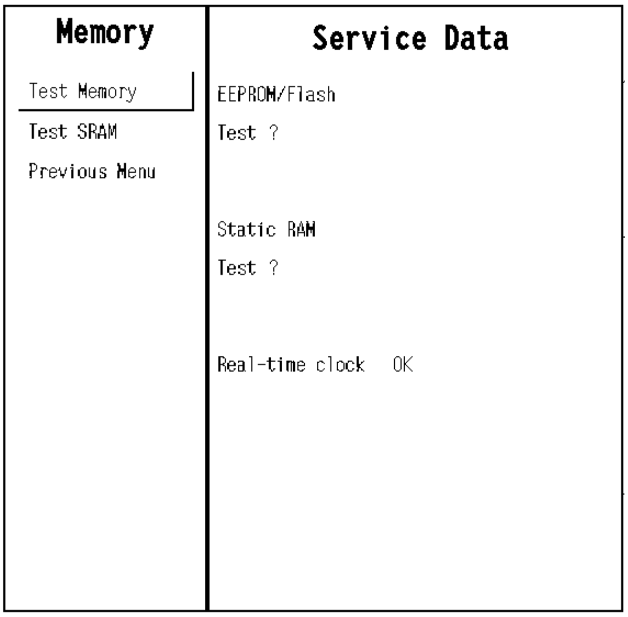
1.1 Memory

A service menu to check the status of the memory used in the CPU board of the monitor.

Test Memory tests the condition of the EEPROM/Flash memory component of the CPU board. If the result of the test is **Fail**, see section “Error messages” in the slot.

Test SRAM tests the Static RAM memory of the CPU board in a similar way as the EEPROM/Flash memory. If the result of the test is **Fail**, see section “Error messages” in the slot.

Real-time clock test is run at every start up and also during the operation of the monitor. If the result of the test is **Fail**, the battery for the SRAM timekeeper should be replaced.



1.2 Network

1.2.1 Network Status

The Network Status view shows the general status of the network

Location ID: Monitor's location given at the setup.

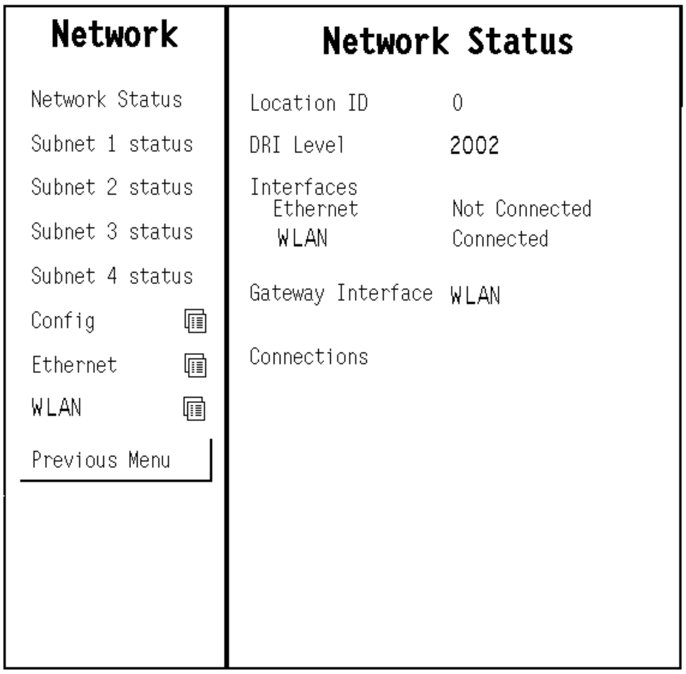
DRI level: Shows the selected level of network communication. The network communication is set according to the network software used (e.g. S-CNET02)

Interfaces: The field indicates if there is a connection to the Datex-Ohmeda Network

Current Interface: The field indicates the active network interface (None/Ethernet/WLAN)

Connections: Names of subnet id:s connected

The field represents the subnet status menus, i.e. shows the connected subnets. The three first connections are reserved permanently for Datex-Ohmeda Central, and the fourth is reserved for another subnet, e.g. Datex-Ohmeda S/5 Arrhythmia Workstation.

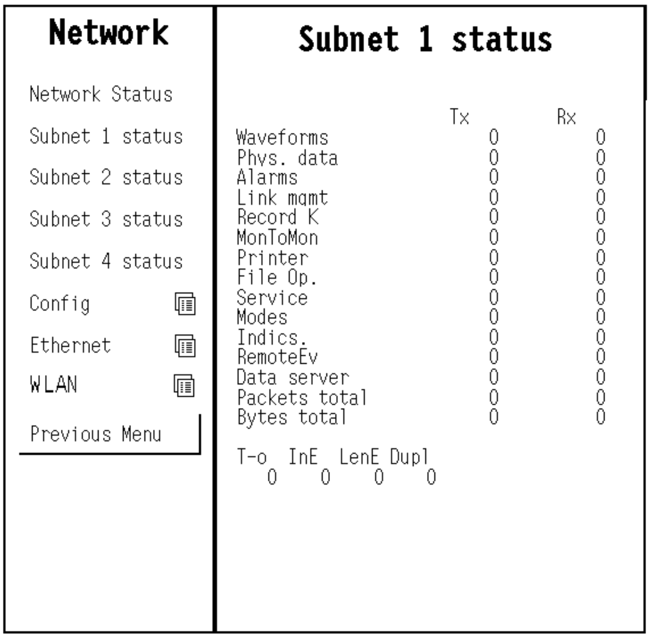


Subnet Status

The Subnet status view gives more accurate information of the different subnet id:s connected. All four **Subnet status** menus have a similar structure. The number of different packets transmitted and received by the monitor are shown in the columns below Tx and Rx. The packet types are:

Waveforms:	Waveform data
Phys. data:	Physiological numerical data
Alarms:	Alarms, alarm profiles and alarm limits
Link mgmt:	Network management messages
Record K:	Record Keeper data
MonToMon:	Monitor-to-monitor communication related data
Printer:	Printing data and control messages
File Op.:	File operation messages, saving and loading of cases
Service:	Maintenance and service
Modes:	User mode data
Indics.:	Remote indications sent to monitor
RemoteEv:	Remote events
Data server:	Packets of the data server (Arrhythmia Workstation)
Packets total:	Total number of packets sent/received
Bytes total:	Total number of bytes sent/received

T-o	Number or resendings
InE	Received faulty packets
LenE	Erroneous packet length
Dupl	Same packet received as a duplicate

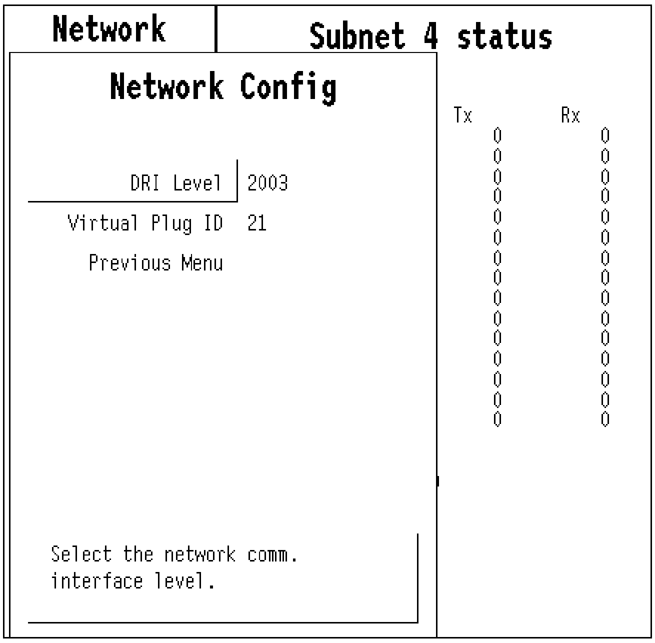


1.2.2 Network Config

The DRI Level is for setting the monitor's network communication. The network communication is set according to the network software used (e.g. S-CNET01).

Network software S-CNET01 ->DRI Level = 2001
Network software S-CNET02 ->DRI Level = 2001 or 2002 (WLAN)
Network software L-NET03 ->DRI Level = 2003
Network software L-NET05 ->DRI Level = 2003

Virtual Plug ID indicates the monitor's location (Network ID). Virtual Plug ID is automatically defined when downloading the WLAN option to the monitor.



1.2.3 Ethernet

The **Ethernet Status** view shows the general status of the ethernet network communication.

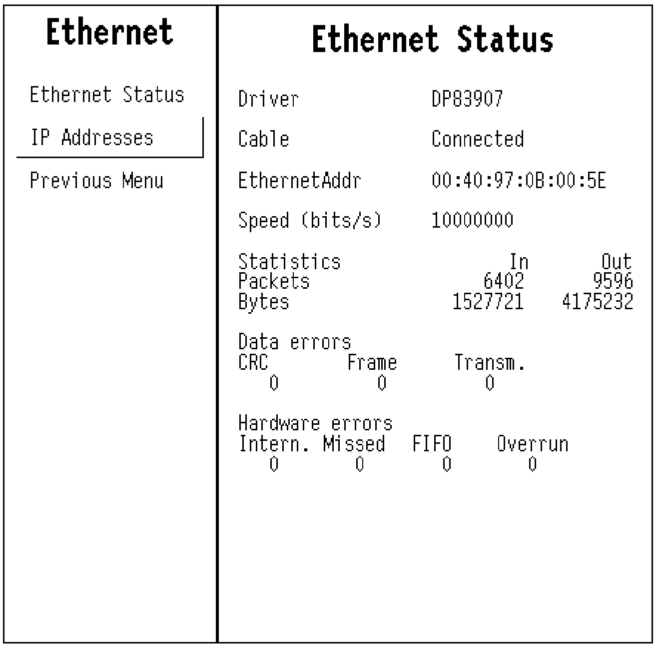
Driver: Ethernet chip name (DP83902, DP83907)

Cable: Indicates if the ethernet cable is connected.

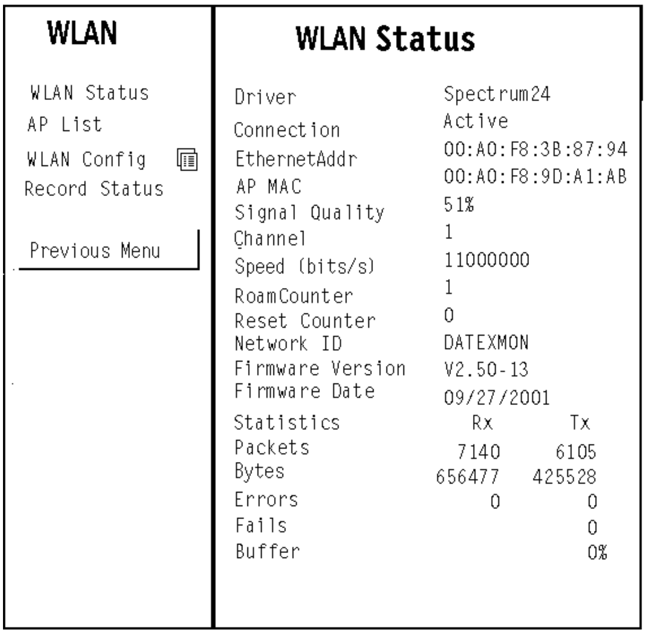
EthernetAddr: Monitor's ethernet address.

Speed: Indicates the current ethernet communication speed.

The service data related to the ethernet status view is described in the following table.



1.2.4 WLAN



Driver: WLAN driver chip name.

Connection indicates the state of the WLAN connection.

Ethernet Addr: Ethernet address of the WLAN card used.

AP MAC: Ethernet address of the access point where the monitor is currently connected.

Signal Quality indicates the quality of the radio signal between the monitor and the access point (0...100%).

Channel is the WLAN channel configured to the access point where the monitor is currently connected.

Speed indicates the current communication speed with the access point.

RoamCounter Occurred roamings between access points.

Reset Counter *

Network ID: Identifies the WLAN network used.

Firmware version: *

Firmware date: *

Statistics (Packets, Bytes, Errors, Fails, Buffer) shows the WLAN communication related statistics.

* WLAN PCMCIA card related information

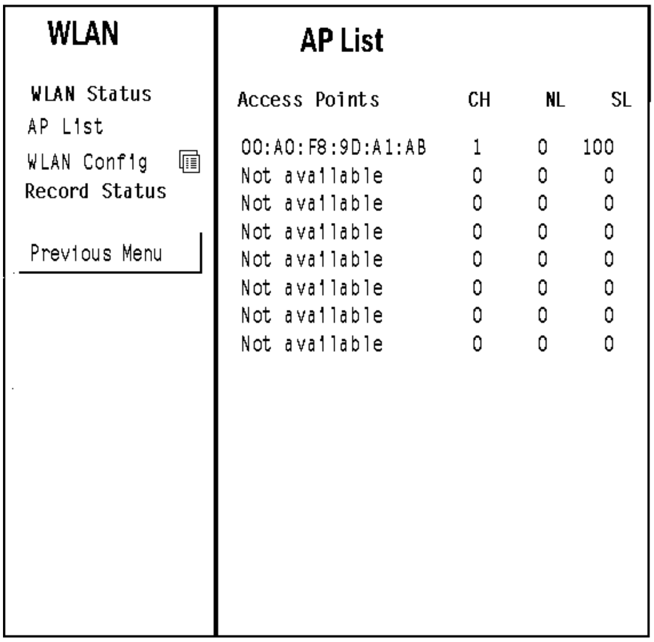
AP List

Access Points: shows the access points (max. eight) which are visible for the monitor.

CH is the WLAN channel configured to this particular access point.

NL indicates the noise level of the channel used (0...100%)

SL indicates the signal level of the channel used (0...100%)



WLAN Config

Network ID is for setting the correct WLAN network ID name.

WEP Algorithm is for setting the level of the encryption (width of encryption key) used for WLAN security (40 bit or 128 bit).

Key ID is for choosing the encryption key used.

Encryption key is for setting the encryption key.

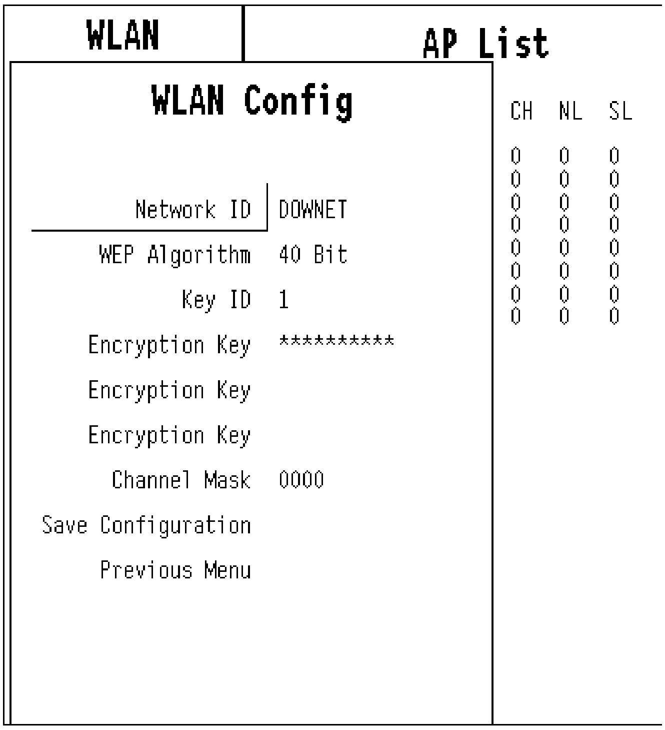
NOTE: When selecting 40 bit encryption, enter 10 Hex digit characters (divided into 2 fields).

When selecting 128 bit encryption, enter 26 Hex digit characters (divided into 2 fields).

NOTE: Use only hexadecimal characters.

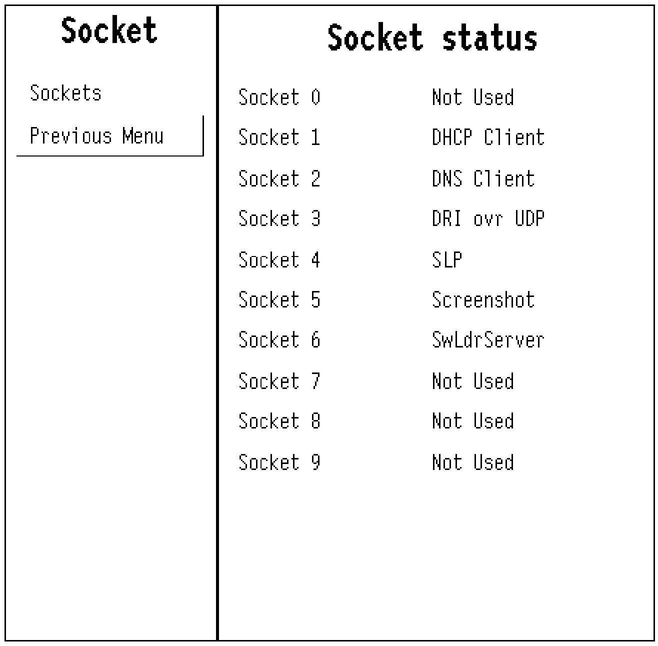
NOTE: For all the monitors and access points in the same WLAN network, the previous parameters must be set to be the same.

Channel Mask is for selecting allowed communication channels, see Appendix C, Channel Mask Selections in the first manual slot.



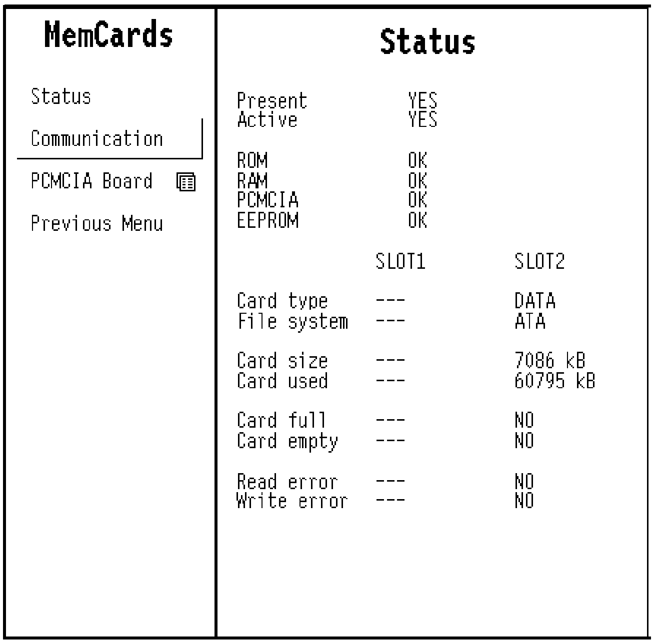
1.2.5 Socket

For factory use only.



1.3 MemCards

1.3.1 Status



Present and **Active** indicate the status of the PCMCIA controller on the CPU board. Possible values are YES and NO.

ROM indicates the status of the ROM memory. Possible values are OK and ERR.
RAM indicates the status of the RAM memory. Possible values are OK and ERR.
PCMCIA indicates the status of the PCMCIA controller. Possible values are OK and ERR.
EEPROM indicates the status of the EEPROM memory. Possible values are OK and ERR.

SLOT1 and **SLOT2** indicate the left hand slot and the right hand slot, respectively.

Card type indicates whether the card is MENU or DATA card. If a duplicated card is inserted, type DUPL.

File system indicates the type of the memory card in use. The only supported file system is ATA. If a memory card using another file system is used, the message 'UNKNOWN' is shown. If the card is poorly attached, the message 'LOOSE' is shown.

Card size indicates the total amount of disk space in the card in kilobytes.

Card used indicates the total amount of used disk space in the card in kilobytes.

Card full indicates whether all the disk space in the card is used. Possible values are YES and NO.

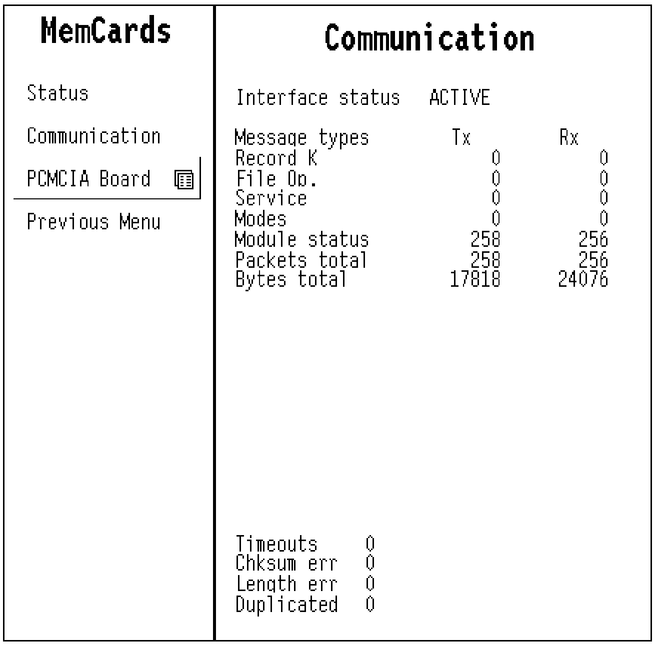
Card empty indicates the lack of menu files in the MENU card or no files in the DATA card. Possible values are YES and NO.

Read error indicates whether the reading from the card has failed. Possible values are YES and NO.

Write error indicates whether the writing to the card has failed. Possible values are YES and NO.

All values can be '- - -' to indicate 'No data available'.

1.3.2 Communication



Interface status indicates the status of the data link between the monitor and memory module. The status should always be on ACTIVE. If the status blinks between ACTIVE and CLOSED, a communications error has occurred.

Message types indicates the type of data packets that have been sent (**Tx**) and received (**Rx**) since the last monitor start. Data types are listed on the lines below **Message types** text.
Record K indicates the communication between the Monitor and Record Keeper.
File Operation indicates the operations of Patient data.
Service indicates the memory module operations.
Modes indicates the User Mode operations.
Module status indicates the number of sent/received data packets that relate to the memory module status.
Packets total indicates the total amount of data packets that have been sent/received since the last monitor start.
Bytes total indicates the total amount of data bytes that have been sent/received since the last monitor start.

The last four lines indicate transmission errors:

Timeouts indicates the number of timeouts that have occurred in memory module data transmission since the last monitor start.
Chksum err indicates the number of checksum errors in data packets from the memory module since the last monitor start.
Length err indicates the number of data packets with erroneous length from the memory module since the last monitor start.
Duplicated indicates the number of duplicate data packets from the memory module since the last monitor start.

1.3.3 PCMCIA Board

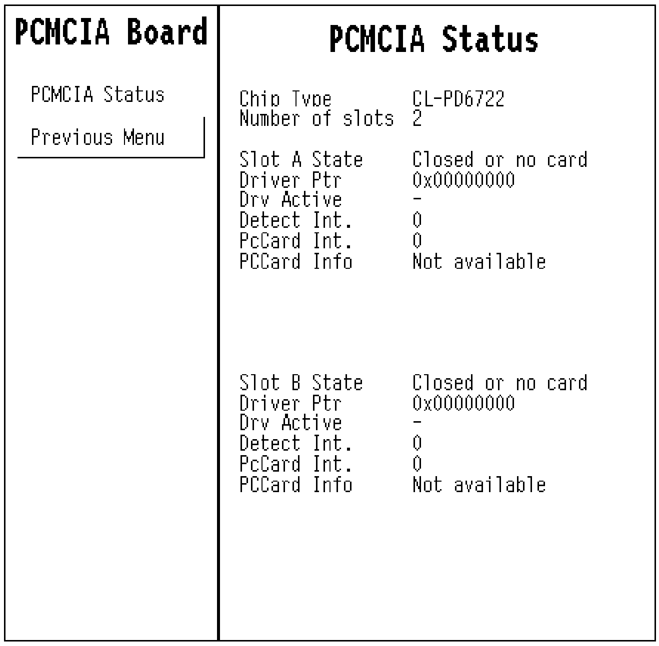
Chip type is the type of the PCMCIA controller chip used.

Number of slots is the number of PCMCIA card slots on the CPU board (0, 1 or 2).

Slot A/B State and **Drv Active** indicate if the PCMCIA card slot is active.

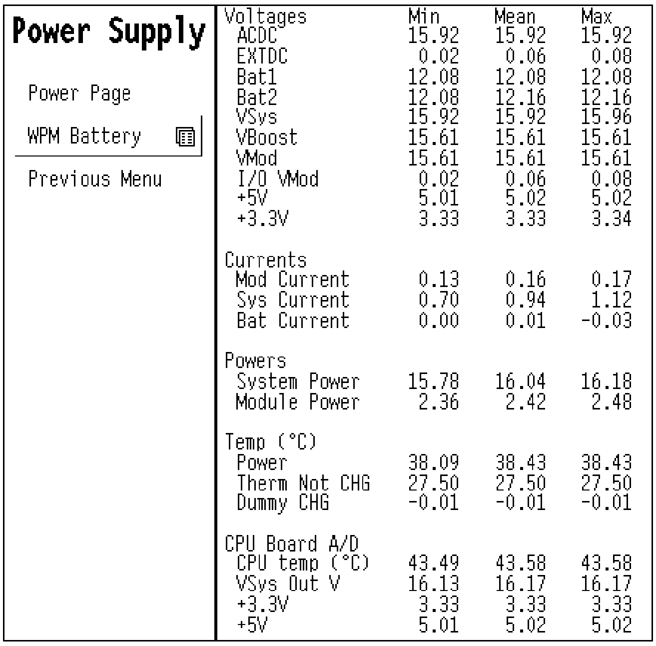
Driver Ptr, Detect Int and **PcCard Int**: PCMCIA card driver software related data.

PcCard info: General PCMCIA card related information.



1.4 Power supply

The menu shows the voltages and temperature measured by the DC/DC board and CPU board. The values in the column under **Mean** are the mean values of last one second, the **Min** column shows the minimum mean value, and the **Max** column the maximum mean value of the voltages and temperature measured during the current power ON.



The voltages and currents are measured by the DC/DC Board, except the four lowest under heading CPU Board A/D, which are measured by the CPU Board. +5V and +3.3V values come thus both from the DC/DC Board and CPU Board. System power and Module power are calculated by the DC/DC Board.

ACDC AC/DC converter's output voltage, used as monitor input voltage when the mains cord is connected. Range when present: 15.25…16.55V (Note: this includes the measurement inaccuracy).

EXTDC External DC input voltage, can be used as monitor input voltage when present, if the mains cord is not connected. Range when present: 10…16.5V (External DC power for future use).

Bat1 Battery A voltage measured at DC/DC Board. Range 9…12.6V for Li-ION battery

Bat2 Battery B voltage measured at DC/DC Board. Range 9…12.6V for Li-ION battery

VSYS System voltage at DC/DC Board. This is the monitor input voltage measured at the DC/DC Board after input voltage selection. Range 9…16.5V.

VBOOST Boost converter's output voltage at DC/DC Board. Boost converter's input is VSYS, which is raised to a higher level for module bus voltage and battery charging, if needed. Range 14…16V.

VMOD Supply voltage for modules. VBOOST is fed through a circuit breaker to VMOD. Range 13.8…16V.

I/O_VMOD Module bus supply voltage that can be connected to Multi I/O Connector at the rear of the monitor. Connecting depends on the DC/DC Board software. Range when connected: 13.8…16V

+5V At DC/DC Board. Range 4.8…5.3V.

+3.3V At DC/DC Board. Range 3.15…3.45V.

Mod Current Current from module bus voltage VMOD. Depends on the module configuration.

SYS Current Current from system voltage VSYS. Depends on the system configuration and battery charging.

Bat current Current from or to the battery selected (discharge or charge). Measured at DC/DC Board. Depends on the system configuration and battery charging.

System power Power from VSYS, calculated by DC/DC Board software. System power = VSYS * SYS Current

Module power Power from VMOD, calculated by DC/DC Board software. Module power = VMOD * Mod Current

Power Temp Power supply unit temperature, measured at DC/DC Board.

Therm Not CHG This is subject to change.

Dummy CHG This is subject to change.

CPU Board Temp Temperature measured at CPU Board.

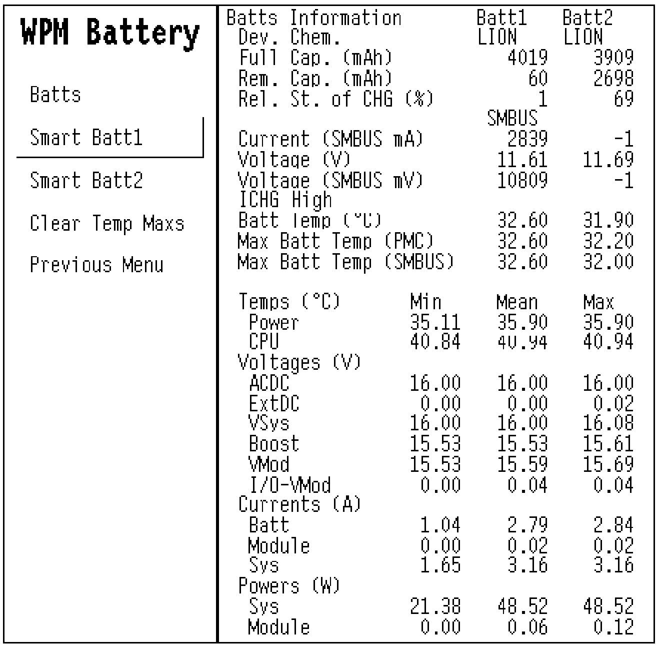
VSYS_OUTVSYS that is connected to CPU Board and Backlight Inverter by a FET. Measured at CPU Board. Range 9...16.5V.

+3.3V Measured at CPU Board. Range 3.15...3.45V.

+5V Measured at CPU Board. Range 4.75...5.25V.

1.4.1 WPM Battery

Batts



This page contains information related to the batteries and power supplies. The power supply part is practically the same as in Power Page. Battery information includes also data measured by the smart batteries themselves and transmitted to the DC/DC Board via SMBus.

SMBus is System Management Bus, a two-wire interface closely resembling I2C. SMBus is used for battery communication.

Batts information section of the page has two columns: Batt1 for battery A data and Batt2 for battery B data.

NOTE: Text ‘SMBus’ above Current (SMBus mA) line shows which battery is connected to the SMBus.

NOTE: When there are two batteries, the software may read charge information only from one of the batteries where as the other battery charge shows -1. This is not indication of the failure and the other battery can also be charged.

Dev. Chem.	Device chemistry. FM monitor supports only Li-ION batteries.
Full Cap.(mAh)	Full charge capacity of the battery; capacity of the battery when it is fully charged.
Rem. Cap. (mAh)	Remaining battery capacity.
Rel. St. of CHG (%)	Relative state of charge of the battery. Expressed as a percentage of Rem. Cap. (mAh) / Full Cap.(mAh).
Current (SMBus mA)	Battery current (discharge or charge) measured by the battery, transmitted via SMBus to DC/DC Board.
Voltage (V)	Battery voltage measured at the DC/DC Board
Voltage (SMBus mV)	Battery voltage measured by the battery.
ICHG	Charging power level for charger hardware, this bit can have values high or low. High is the normal setting, low is used when the DC/DC Board software determines to limit the total power consumption of the monitor by limiting the charging power (i.e. due to high temperature).
Batt Temp (°C)	Battery temperature. This is real time data for the battery connected to SMBus.
Max Batt Temp (PMC)	This is subject to change.
Max Batt Temp (SMBus)	Maximum battery SMBus temperature from entering the service pages. Max values are updated in real time for the battery connected to the SMBus.
Other measurements	See explanation in the previous power pages.

Smart Batt1, Smart Batt2

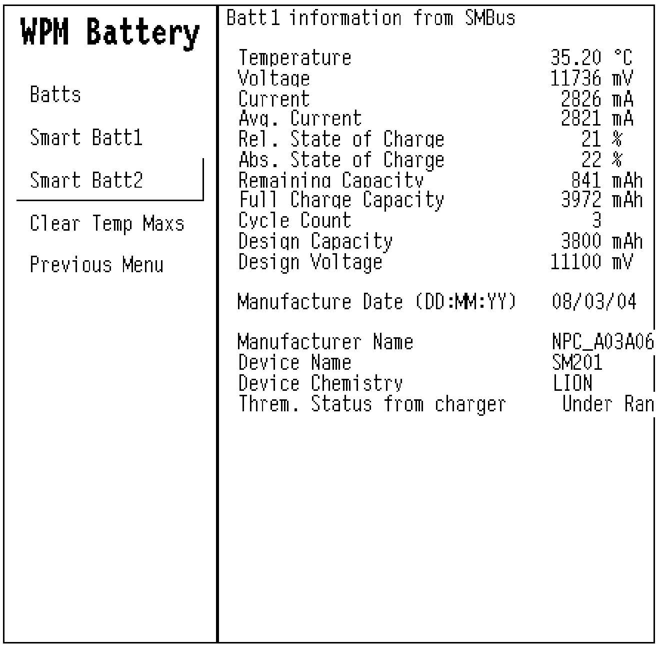
Clear Temp Maxs

This command is useful only when the WPM Battery Batts view is selected.
The Clear Temp Maxs command clears the maximum values of Batt Temp (SMBus) and Batt Temp (PMC).

Note: Power temp and CPU temp maxs are not cleared.

These menus give additional battery information via SMBus. Batt1 stands for Battery A, Batt2 for Battery B. If Smart Battx is selected for the battery connected to the SMBus, the menu contains the following:

Smart Batt1



Battx information from SMBus (all this information comes from the battery via SMBus)

Temperature Battery temperature

Voltage Battery voltage

Current Battery current (discharge or charge)

Avg. Current Rolling average of the battery current

Rel. State of Charge
Relative state of charge of the battery. Expressed as a percentage of Rem. Cap. (mAh)/ Full Cap.(mAh).

Abs. State of Charge
Absolute state of charge. Expressed as a percentage of Rem. Cap. (mAh)/ Design Capacity (mAh).

Remaining Capacity
Remaining battery capacity (mAh).

Full Charge Capacity
Capacity of the battery when it is fully charged.

Cycle Count Number of cycles the battery has experienced.
A cycle is an amount of discharge approximately equal to the value of Design Capacity.

The exact value of cycle count threshold is stored in the battery permanent memory.

Design Capacity Theoretical capacity of a new battery.

Design Voltage Theoretical value for nominal voltage of a new battery.

Manufacture Date (DD:MM:YY)
The date the battery pack was manufactured.

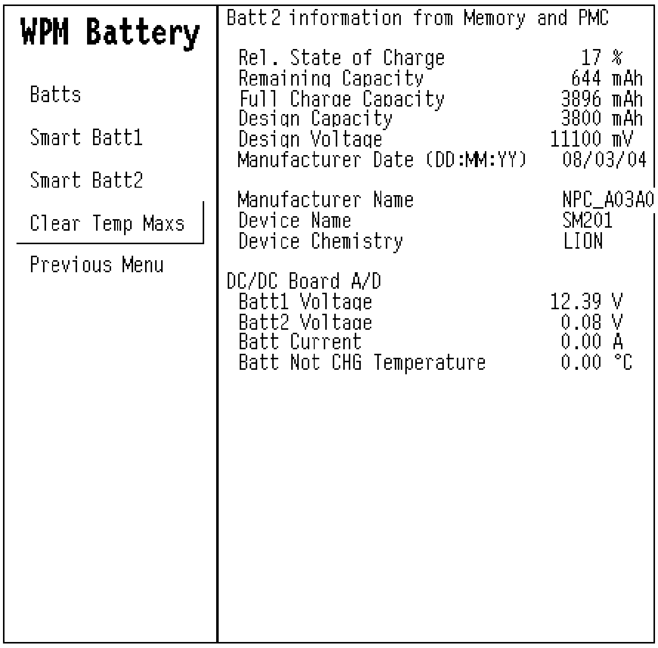
Manufacturer Name
Acronym of the battery pack manufacturer name.

Device Name Battery pack model name.

Device Chemistry
Battery chemistry of the cells used.

Therm. Status from charger
Status of the battery thermistor or code resistor read by Smart Battery Charger IC. The thermistor or code resistor is always connected to the charger whenever the corresponding battery is connected to the charger and SMBus.

Smart Batt2



If Smart Battx is selected for a battery NOT connected to the SMBus, the menu contains the following:

Battx information from Memory and PMC (This information comes from the DC/DC Board memory or is measured by the DC/DC Board. SMBus data in this menu is not real time, because this battery is not connected to the SMBus).

NOTE: This page may not contain information if SMBus has been connected only to the other battery. Page can be updated by battery disconnection and reconnection, if desired.

Rel. State Charge
Relative state of charge of the battery. Expressed as a percentage of Rem. Cap. (mAh) / Full Cap.(mAh).

Remaining Capacity
Remaining battery capacity (mAh).

Full Charge Capacity
Capacity of the battery when it is fully charged.

Design Capacity Theoretical capacity of a new battery.

Design Voltage Theoretical value for nominal voltage of a new battery.

Manufacturer Date (DD:MM:YY)
The date the battery pack was manufactured

Manufacturer Name
Acronym of the battery pack manufacturer name.

Device Name Battery pack model name.

Device Chemistry
Battery chemistry of the cells used.

Batt1 Voltage Battery A voltage measured at the DC/DC Board.

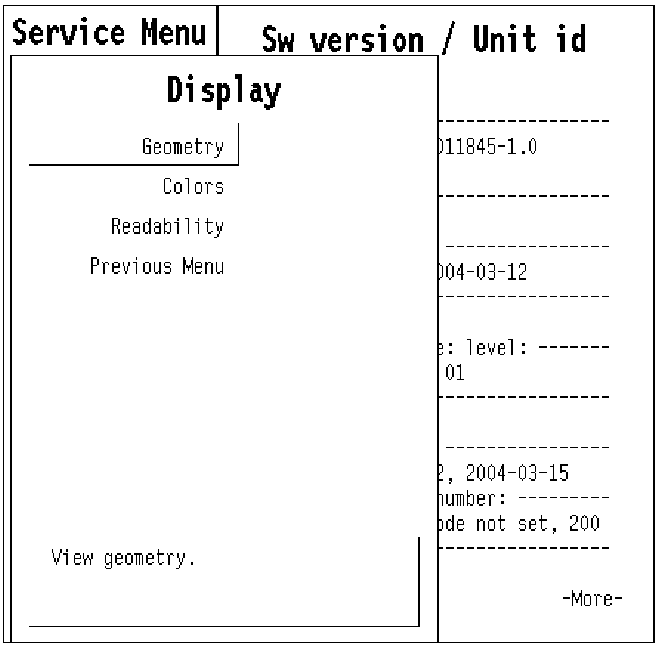
Batt2 Voltage Battery B voltage measured at the DC/DC Board.

Batt Current Battery current (discharge or charge) for the battery connected to SMBus. Measured at the DC/DC Board.

Batt Not CHG Temperature
This is subject to change

2 Display

Geometry views the geometry of the display.
Colors views the color of the screen.
Readability views the readability of the screen.



3 Keyboard

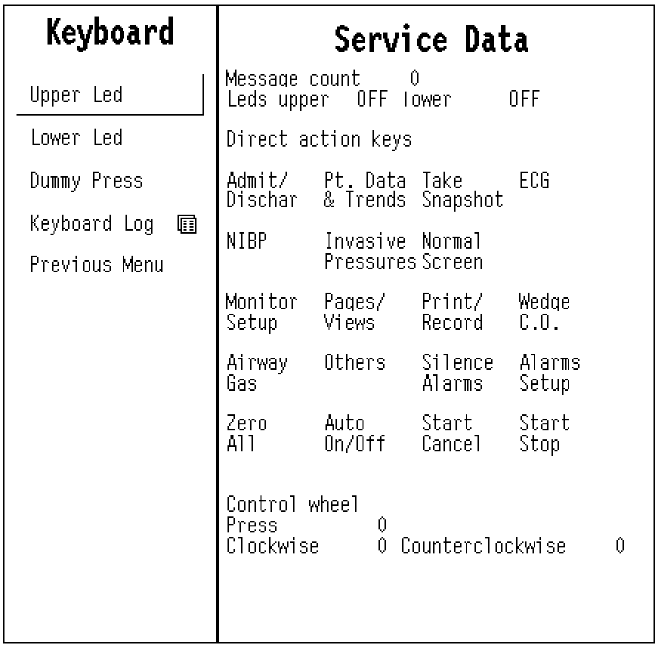
Keyboard

The service menu for testing the command board functions.

Upper Led is for testing the upper alarm LED (red) on the command board. When the text is highlighted, the upper alarm LED can be turned on and off by pressing the ComWheel.

Lower Led is for testing the lower alarm LED (yellow) on the command board. When the text is highlighted, the lower alarm LED can be turned on and off by pressing the ComWheel.

Dummy Press is for testing the ComWheel. When the text is highlighted, pressing the ComWheel creates a sound from the loudspeaker and the corresponding number on the service data field increases.



Service Data

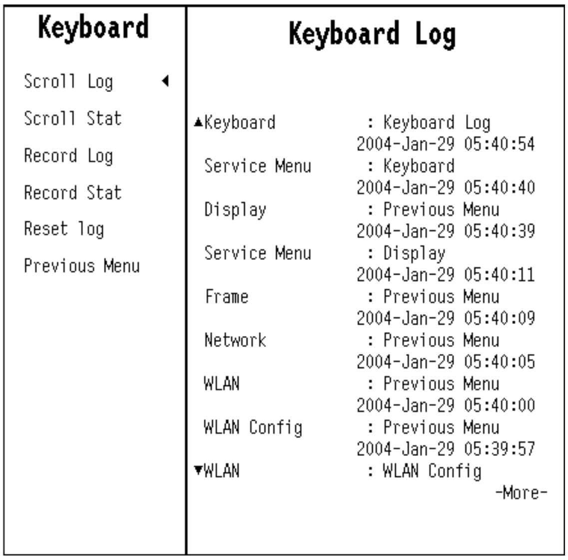
Message count counts the number of messages that are sent out to the main CPU board.
Leds upper and **lower** indicate the states of the alarm LEDs on the command board.
Direct action keys texts are indications to the command board membrane keys. When a key on the command board is pressed, the corresponding text in the menu changes its colour.
Control wheel, Press counts the ComWheel pressings.
Control wheel, Clockwise and **Counter clockwise** indicate the ComWheel turnings.

3.1 Keyboard Log

Keyboard Scroll Log

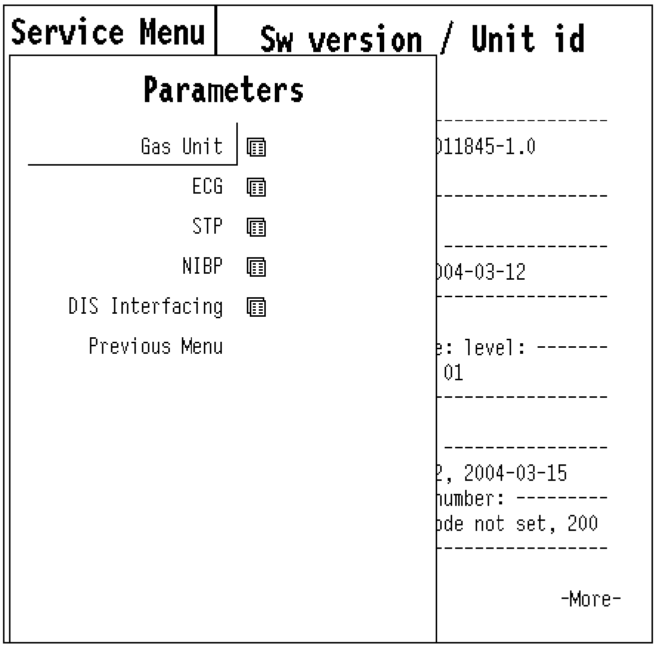
All the keyboard presses and the commands given by the ComWheel are recorded in the Keyboard Log. The keyboard log is saved in the permanent memory of the monitor. The length of the log is 1150 events. The log is FIFO type.

Scroll Stat enables to scroll the keyboard events.

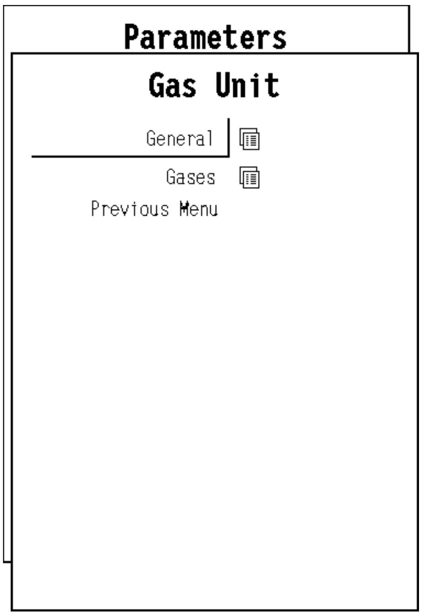


4 Parameters

NOTE: Parameter values in Service Data fields are only for reference in this section.

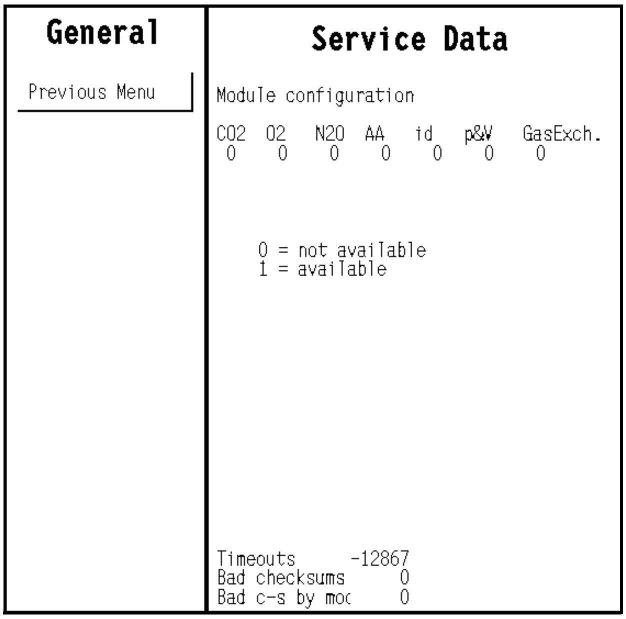


4.1 Gas Unit



4.1.1 General

Service Data



Module configuration shows which measurement options are available, i.e. are detected by the module.

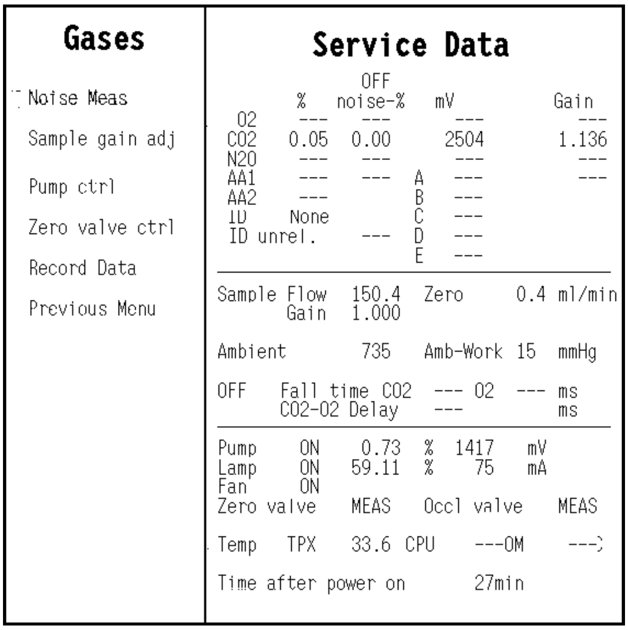
Timeouts is a cumulative number that indicates how many times the module has not responded to the monitor's inquiry.

Bad checksums is a cumulative number that indicates how many times communication from the module to monitor has broken down.

Bad c-s by mod is a cumulative number that indicates how many communication errors the module has detected.

The monitor starts counting these items at power up and resets to zero at power off. The values may also be reset when a module is attached to the monitor frame and be set to 32769 or continuous counting may be started when the module is removed from the monitor frame.
The nonzero values do not indicate a failure, but the continuous counting (more than 5 per second) or value 32769 indicates either a serial communication failure or a module not in place. Also failures in other modules may cause these numbers to rise or be set to 32769.

4.1.2 Gases



Noise Meas activates the noise measurement.

Sample gain adj adjusts the sampling pump gain, i.e. for adjusting the sample flow measurement.

Pump ctrl A manual control for the sampling pump.

Zero valve ctrl A manual control for the zero valve.

Record Data prints out the shown service data and board information (id. serial number and software id.) onto the recorder module, N-FCREC, N-FREC.

Service Data

CO_2% field shows real-time concentrations.

CO_2noise-% is standard deviation of concentration.

CO_2 /channels A-E

mV field: signal is scaled to mV.
Gain: User gain. It is scaled as (User gain)/(Factory gain).

O2, N2O, AA Not in use with S/5™ Extension Modules

ID Not in use with S/5™ Extension Modules

ID unrel. Not in use with S/5™ Extension Modules

Sample Flow is calculated from differential pressure and adjusted by the module. **Zero** value as measured during initialization when the pump is off. **Gain**: sample flow measurement can be calibrated by adjusting the gain.

Ambient Ambient pressure is measured continuously. **Amb-Work**: ambient pressure - sampling system internal pressure.

Fall time Not in use with S/5™ Extension Modules

CO_2-O_2 Delay Not in use with S/5™ Extension Modules

Pump Can be toggled ON/OFF. PWM output 0-100% is shown. Pump voltage is also shown.

Lamp The state, PWM control, and current of the lamp are shown.

Fan Not in use with S/5™ Extension Modules

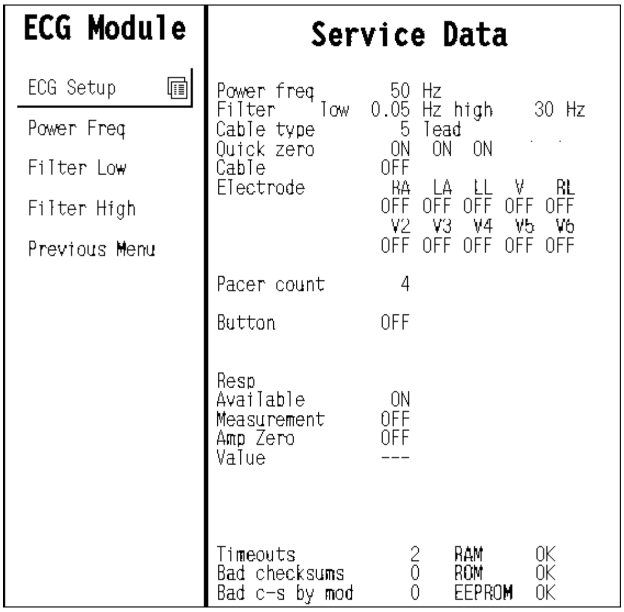
Zero and Occl valve

Can be toggled between the measurement state (MEAS) and zeroing/occlusion states (ZERO/OCCL).

Temp Temperatures measured by the module from TPX, CPU, and OM.

Time after power on In minutes after power on.

4.2 ECG Module



Power freq: Set power frequency; 50 Hz/60 Hz.

Filter low: Set filter low frequency; 0.05 Hz/0.5 Hz.

Filter high: Set filter high frequency; 30 Hz (40 Hz if power freq is 60 Hz) /150 Hz.

Service Data

Power freq, and Cable type show the values chosen or detected, **Filter low and high** defines the selected filter (Monitor/Diagnostic/ST).
Quick zero module is ON when the ECG signal is beyond the scale, and therefore, is quickly returned to optimal range using fast signal processing methods. All the **Quick zero** bits are ON at the same time.
Cable shows ON when ECG cable is connected.

Electrode shows ON when each of these electrodes are connected.

Pacer count is a running number for pacemaker users.

Button No effect on the module.

Resp Available indicates that ECG hardware is capable of measuring impedance respiration.

Measurement shows ON when the respiration measurement is on.

Amp zero shows ON when zeroing of the respiration amplifier takes place.

Waveform **VALUE** will be updated in one second interval.

Timeouts is a cumulative number that indicates how many times the module has not responded to the monitor's inquiry.
Bad checksums is a cumulative number that indicates how many times communication from the module to the monitor has broken down.
Bad c-s by mod is a cumulative number that indicates how many communication errors the module has detected. The monitor starts counting these items at power up and resets to zero at power off. The values may also be reset when a module is attached to the monitor frame and be set to 32769 or continuous counting may be started when the module is removed from the monitor frame.
The nonzero values do not indicate a failure, but the continuous counting (more than 5 per second) or value 32769 indicates either a serial communication failure or a module not in place. Also failures in other modules may cause these numbers to rise or be set to 32769.

RAM indicates the state of the RAM memory.
ROM indicates whether the checksum at the EPROM is in accordance with the one the software has calculated.
EEPROM indicates if the values stored in the permanent memory are valid.
The state is either **OK, Fail** or **?** (module not in place or a communication error).

4.2.1 ECG Setup

Filter filters the ECG signal high frequency noise and slow respiratory artefacts.

Monit (monitor) filter is used in routine monitoring. It effectively filters the artefacts caused by the electrosurgery unit and respiration.

Diagn (diagnostic) filter is used if more accurate information of the waveform is needed (e.g. of P-wave or AV block). The diagnostic filter is more susceptible both to high frequencies and baseline wander than the monitor filter.

STfilt (ST filter) permits more accurate information of ST segment. It filters the high frequency artefacts caused by the electrosurgery unit, but catches the slow changes in ST segment. The ST filter is more susceptible to baseline wander than the monitor filter.

5-lead cable selects five or three electrodes. With the 12-lead ECG the selection is automatic.

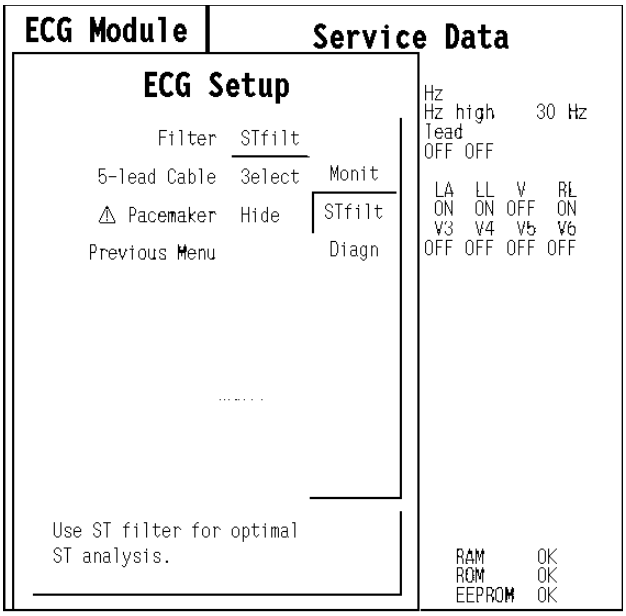
Pacemaker selects how to display the pacing pulse of cardiac pacemaker. The selections are **Show, Hide**, **ON R** and **Sensit**.

Hide, the pacing pulse is filtered away from ECG data.

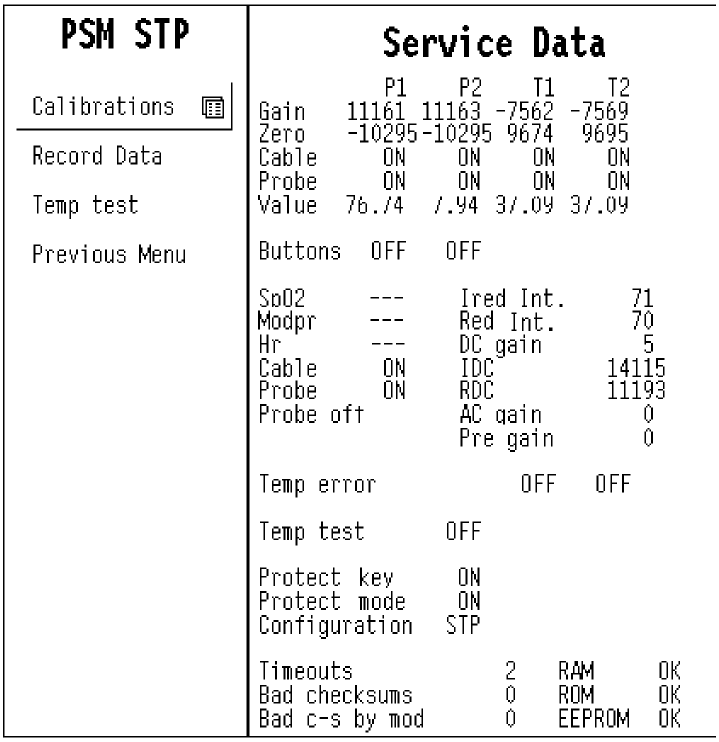
Show, the pacer pulse is filtered away from ECG data but the pulse is displayed as a constant height marker.

ON R, pacing pulses are not filtered away from ECG data. This improves ECG monitoring with A-V pacemaker patients, as QRS complexes are counted even if the pacing pulse hits the QRS complex. However, during asystole the monitor may count pacing pulses as heart beats.

Sensit selection uses a more sensitive pacemaker detection. Pacemaker spike is displayed on ECG.



4.3 PSM STP



Record Data prints out the shown service data and board information (id, serial number and sw id) onto the recorder.

Temp Test activates the automatic temperature test for the temperature channels T1 and T2. The result from the test is shown in the service data field.

NOTE: The Temp Test needs to be selected twice before the test starts.

Service Data field

Gain is a coefficient to compensate gain error. Usually the values for P1 and P2 are between 17000 and 25000 and for T1 and T2 between 13000 and 14300.

Zero indicates the offset compensation value of each parameter in the A/D converter. Typically the values for P1 and P2 are within ±1000 and for T1 and T2 between -150 and +300. Calibrate if zero and/or gain value is outside the ranges.

Cable shows ON when a corresponding cable is connected to the front panel and **Probe** shows ON when a corresponding probe is connected to the cable.

Under **Value**, the measured numeric values are displayed simultaneously. Pressure values are real time values and shown in mmHg. Temperature values are shown in degrees Celsius.

The front panel STP keys functions are confirmed by pressing each key and observing that ***OFF*** turns to ***ON*** at **Button**. T1 button is not in use with E-PSM(P).

SpO2 shows the measured beat-to-beat SpO_2 value.

Modpr is a modulation % that indicates the AC/DC ratio in the measured signal.

Hr is a pulse rate calculated from every beat.

Cable and **Probe** can be either ***OFF*** or ***ON***, and these indicate the state PROBE OFF.
Under them there is a message field for SpO_2. It can be OK, PULSE SEARCH, NO PROBE, PROBE OFF, NO PULSE, ARTEFACT, POOR SIGNAL, or CHECK PROBE.

Balance between leds is adjusted by changing the intensity of red/infrared. Intensity of infrared (**Ired int.**) is in the range of 40 to 255 and red intensity (**Red int.**) is in the range of 40 to 255.

DC gain shows the gain of DC signal adjusted by the module.

IDC is the value of infrared signal.

RDC is the dc value of red signal.

AC gain is the gain of infrared and red ac signals. AC gain values can be 1 or 0. Value 1 means high ac gain and 0 means low gain.

Pre gain is a preamplifier gain for infrared and red signals. Pre gain values can be 1 or 0. Value 1 means normal operation. Value 0 means that signal levels are very low and extra gain is taken into use.

Temp error shows the status of the temperature test. No errors found show the status (OFF) and errors found (ON).

Protect key shows normally OFF but turns to ON when the button at the bottom of the module is pressed.
Protect mode is normally ON. It turns to OFF, when Protect is switched to OFF for the temperature calibration in Calibration Menu.
Configuration shows the chosen module configuration: TP, ST, or STP.

Timeouts is a cumulative number that indicates how many times the module has not responded to the monitor's inquiry.
Bad checksums is a cumulative number that indicates how many times communication from the module to the monitor has broken down.
Bad c-s by mod is a cumulative number that indicates how many communication errors the module has detected. The monitor starts counting these items at power up and resets to zero at power off. The nonzero values do not indicate a failure, but the continuous counting (more than 5 per second) indicates either a serial communication failure, or a module not in place. Also other modules can cause communication errors that cause these numbers rise.

RAM indicates the state of the RAM memory.
ROM indicates whether the checksum at the EPROM is in accordance with the one the software has calculated.
EEPROM indicates if the values stored in the permanent memory are valid.
The state is either **OK, Fail** or **?** (module not in place or a communication error).

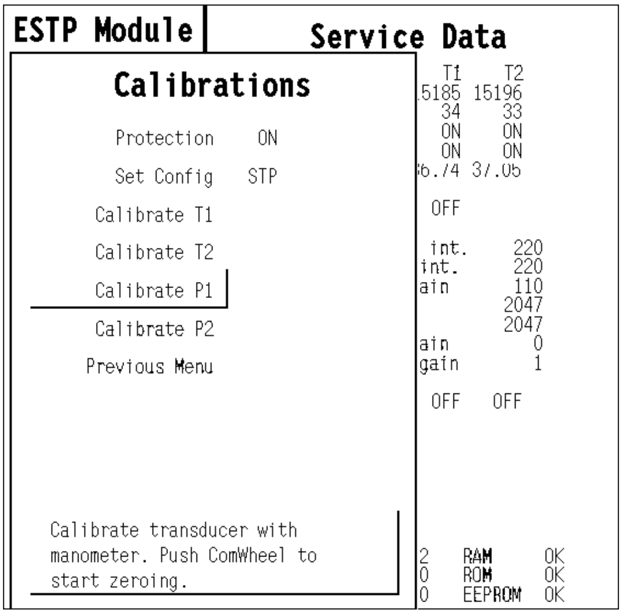
4.3.1 Calibrations

Protection: Protection for the configuration can be set ON and OFF.

Set Config: The module configuration should be set according to the module type. The setting is possible only when the protection is set OFF. The available selections are TP, ST or STP. The configuration setting should be checked, if the STP board is replaced.

Calibrate T1 / Calibrate T2: The functions are for calibrating the temperature channels T1 and T2.

Calibrate P1 / Calibrate P2: The functions are for calibrating the invasive blood pressure channels P1 and P2.



How to calibrate T1/ T2

The calibrations are possible only when the protection is set ***OFF***. The temperature calibration requires accurate test plugs of value 25 °C and 45 °C.

1. Select ***Calibrate T1/Calibrate T2.***
2. Insert the test plug 25 °C into the T1/T2 connector.
3. Press the ComWheel.
4. Insert the test plug 45 °C into the T1/T2 connector.
5. Press the ComWheel.

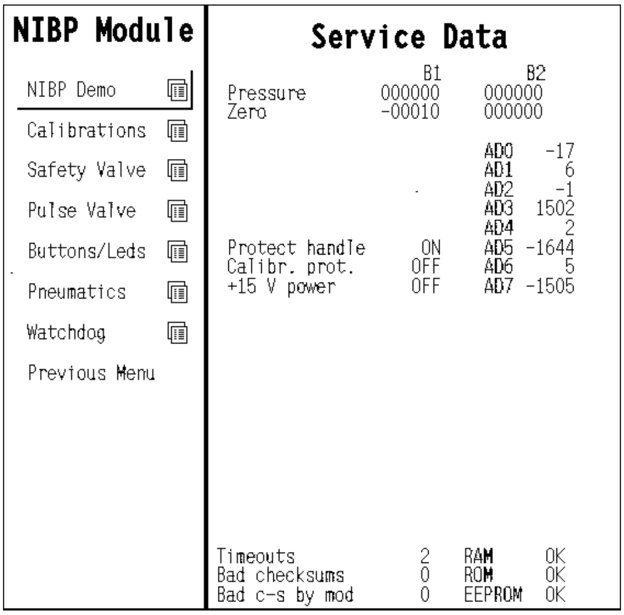
How to calibrate P1/ P2

The calibrations require a pressure transducer (with appropriate cable) and a pressure manometer.

1. Connect the pressure transducer with the pressure manometer to the P1/P2 connector. Select ***Calibrate P1/Calibrate P2***. Leave the transducer to room air pressure.
2. Press the ComWheel to start zeroing.
3. Supply a pressure of 100 mmHg to 300 mmHg to the transducer. The recommended pressure is 200 mmHg.
4. Set the pressure on the display to match the pressure reading on the manometer and press the ComWheel.

4.4 NIBP Module

Service menu for Non-invasive Blood Pressure Modules.



Service Data

Pressure shows the measured pressure multiplied by 10. This value is automatically zero-drift compensated.

Zero shows the difference between the zeroing value in the permanent memory (stored when the module is calibrated) and the current automatic zero-drift compensation multiplied by 10. The value can change between +20 and -20 mmHg. If the zero drift exceeds ± 10 mmHg, the module should be recalibrated.

Protect handle indicates hardware protection for EEPROM memory. It should be ON all the time in normal operation. If it is OFF data can not be read from or written to EEPROM, only the calibration protection can be set or reset by software. It can be turned to OFF by pressing the the NIBP module buttons **Auto ON/OFF** and **Start Cancel** simultaneously for 3 seconds, which also enables ***Protection ON/ OFF*** menu selection in the calibration menu.

Calibr. prot. shows software calibration protection and it should be OFF to enable calibration.

+15 V power refers to legacy NIBP modules. Not used in E-PSM(P).

AD0 to **AD7** show the values of each eight channels of the A/D converter. AD7 is not used in E-PSM(P).

Timeouts is a cumulative number that indicates how many times the module has not responded to the monitor's inquiry.
Bad checksums is a cumulative number that indicates how many times communication from the module to the monitor has broken down.
Bad c-s by mod is a cumulative number that indicates how many communication errors the module has detected. The monitor starts counting these items at power up and resets to zero at power off. The nonzero values do not indicate a failure, but the continuous counting (more than 5 per second) indicates either a serial communication failure, or a module not in place. Also other modules can cause communication errors that cause these numbers rise.

RAM indicates the state of the RAM memory.
ROM indicates whether the checksum in the EPROM is in accordance with the one the software has calculated.
EEPROM indicates if the values stored in the permanent memory are valid.
The state is either **OK, Fail** or **?** (module not in place or a communication error).

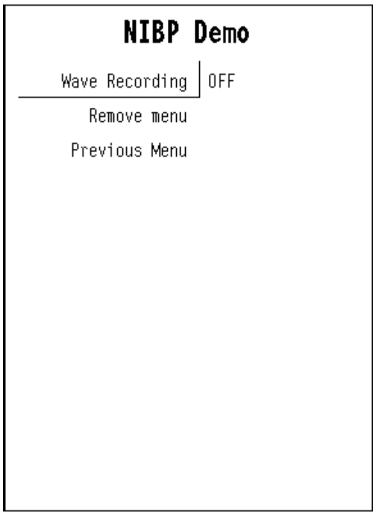
4.4.1 NIBP Demo

A service menu for demonstrating the oscillometric method of NIBP measurement. The menu shows the real-time pressure signals that are measured from the NIBP cuff. The measurement result is shown in the adjoining digit field.

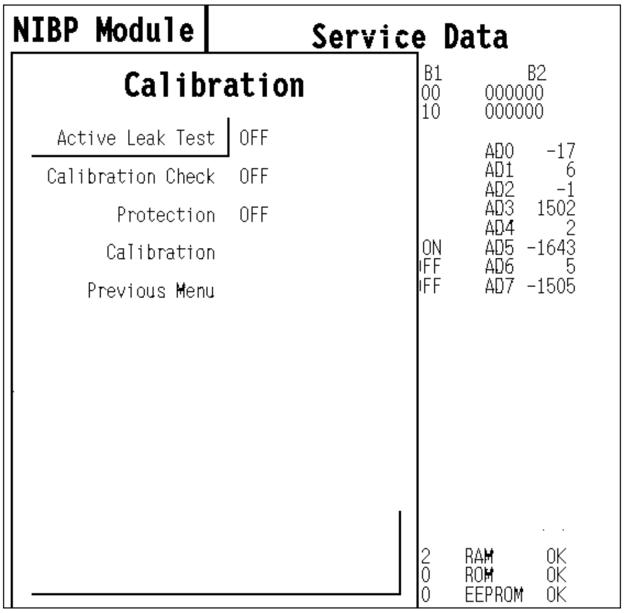
Wave Recording is for selecting the recording option. If ON is selected, the pressure signals are printed out in real-time on the recorder after the recorder **Start/Stop** button is pressed.

Remove menu widens the displayed waveform area.

The menu can be closed by selecting the **Previous Menu** or just by pressing the ComWheel if the **Remove menu** was selected.



4.4.2 NIBP Calibration



Active Leak Test: Wrap an adult cuff around a pipe and connect the cuff to the module. Select the active leak test (ON). The module automatically pumps a pressure of 260 mmHg into the cuff. Wait for several seconds until the pressure stabilizes. Then check that the pressure reading does not drop more than 6 mmHg per minute. If it does, leaking point(s) should be detected and fixed. Cancel the test by selecting the Active leak test OFF.

Calibration Check: After the calibration check is selected (ON), the module zeroes the pressure transducers at the beginning of the calibration check. Do not pump pressure until the text 'Calibrating' appears in the NIBP digit field or the zeroing will fail. After the zeroing is done, manually pump pressure into the module and make sure that the same pressure values are shown both on the display and on the manometer. Pressure of both pressure channels B1 and B2 are shown. The pressure values are automatically zero-compensated, so the readings of B1 and B2 should be the same as the manometer readings.

Protection: Software calibration protection (ON/OFF). Select ***OFF*** when calibrating. ***Protection*** selection becomes available in the menu after pressing the NIBP module buttons **Auto ON/OFF** and **Start/Cancel** simultaneously for 3 seconds.

How to Calibrate

Calibration selection is available only when protection is OFF.

NOTE: Both channels B1 and B2 must be calibrated simultaneously.

NOTE: The module must be in the frame during the whole procedure.

NIBP calibration can be performed in the NIBP Service menu as follows:

1. If ***Protection*** is ***ON***, change it to ***OFF*** by pressing the NIBP module buttons **Auto ON/OFF** and **Start Cancel** simultaneously for 3 seconds, which enables the ***Protection*** selection. Select protection OFF in the calibration menu and press the ComWheel. Then press the buttons again for 3 seconds to enable ***Calibration***.

NOTE: When the buttons have been pressed, the NIBP field shows an error message 'Calibration switch on!'.

NOTE: When calibration is enabled, a message 'Calibration not protected' appears.

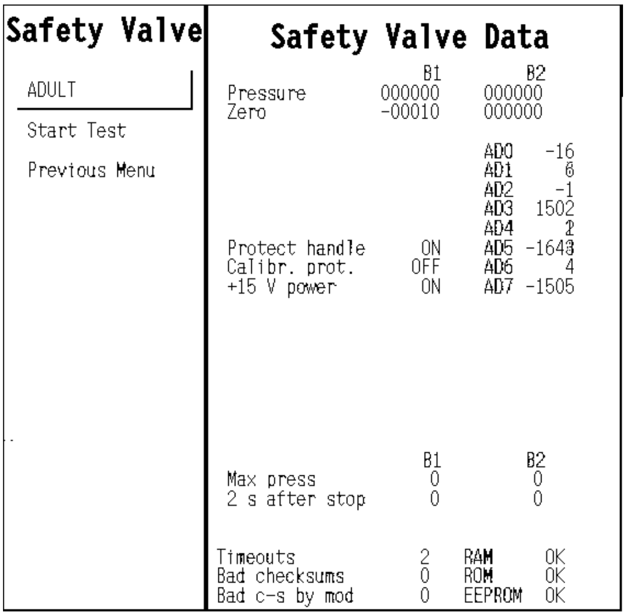
2. For proper zeroing to take place, remove the hose from the front panel connector. Select ***Calibration*** and push the ComWheel. Messages 'Zeroing' and 'Zeroed' will appear in the NIBP message field. After this, a pressure bar will appear beside the menu and the text 'Calibrating' will appear in NIBP digit field.
3. Connect an external mercury manometer with a pump to the module through the both tubes of the hose. Pump up to about 200 mmHg pressure (range of 150 to 300 mmHg allowed) according to the manometer. Verify that both pressure values in the prompt field match the manometer reading. If not, adjust by turning the ComWheel.

4. When the values are equal, push the ComWheel to confirm the calibration. After a few seconds the ‘Calibrated’ message will appear in the NIBP digit field, which means that the calibration data has now been saved.

NOTE: When calibrating NIBP, always change the displayed pressure value slightly with the ComWheel, even in cases where the value would be correct. For example, change the value one step higher and then back one step lower. The ‘Calibrated’ text should appear in the display. This ensures that the calibration procedure is correctly registered and stored by the module.

5. Use the module buttons again to enable **Protection** setting and set it ON, and finally disable **Protection** setting.

4.4.3 NIBP Safety Valve



Test: Start test is for starting and **Stop test** is for stopping the Safety Valve test.

Safety Valve Data:

For information on general items **Pressure, Zero, Protect handle, Calibr. prot., +15 V power, AD0** to **AD7** as well as **Timeouts** etc., see service data descriptions in section “4.4 NIBP Module”.

Max. press and **2 s after stop** show the measured values at Safety Valve test.

Safety Valve Test Adult/Infant
Wrap an adult cuff around a pipe and connect the cuff to the module. Highlight **Start test** and give the ComWheel a push. The test ends automatically or when **Stop test** (appears in place of **Start test**) is pushed.

Max. press indicates the pressure at which the safety valve opens and is normally 300 ±15 mmHg for adult and 150 mmHg ±15 mmHg for infant.

2 s after stop indicates the pressure at 2 seconds after the pump has stopped and is normally > 270 mmHg for adult and > 130 mmHg for infant. If the value is less, check leakage by the active leak test.

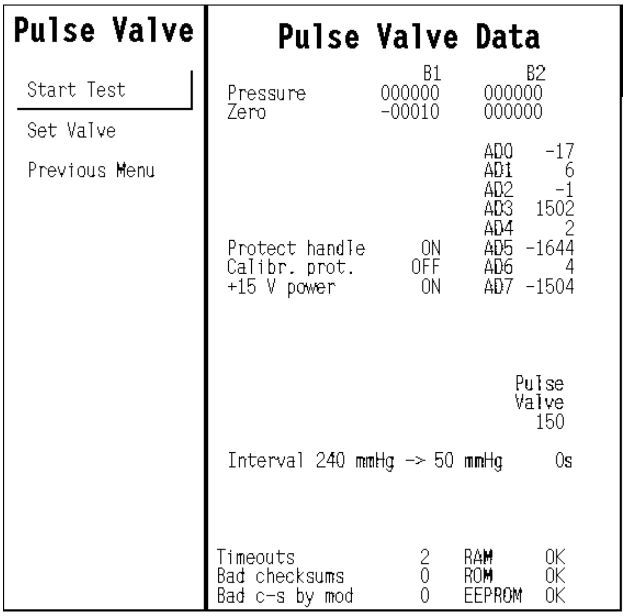
4.4.4 NIBP Pulse Valve

Start test is for starting and **Stop test** is for stopping the test.

Set Valve lets you adjust the opening of the pulse valve.

Pulse Valve Data

For information on general items **Pressure, Zero, Protect handle, Calibr. prot., +15 V power, AD0** to **AD7** as well as **Timeouts** etc., see section “4.4 NIBP Module”.



How to check Pulse Valve

Wrap an adult cuff around a pipe and connect the cuff to the module. Select **Start test** and push the ComWheel. The pressure rises beyond 240 mmHg and stops. The pulse valve opens. The module counts the time it takes for the pressure to go down from 240 mmHg to 50 mmHg and displays it on the screen. The test can be manually stopped by selecting **Stop test**.

The valve can be adjusted between 0 and 255 (0 for fully closed and 255 for fully open). First select **Set Valve** and push the ComWheel. See the pulse valve value and adjust it by turning the ComWheel. Then push the ComWheel to confirm the value.

The **Interval 240 mmHg -> 50 mmHg** time should be less than 60 seconds when the valve is 150 and less than 10 when fully opened (255). When fully closed (0), the system should be airtight and the pressure does not drop. Depending on an individual, the pulse valve may remain closed up to approx. value 100.

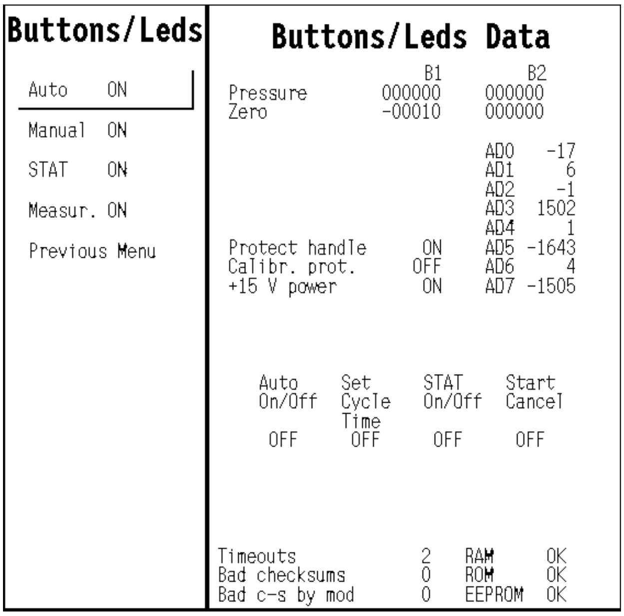
If the measured time deviates much from those above, then the pulse valve or its tubes are faulty.

4.4.5 NIBP Buttons/Leds

The selections ***Auto ON/OFF, Manual ON/OFF***, ***STAT ON/OFF***, and ***Measur. ON/OFF***.

Buttons/Leds Data

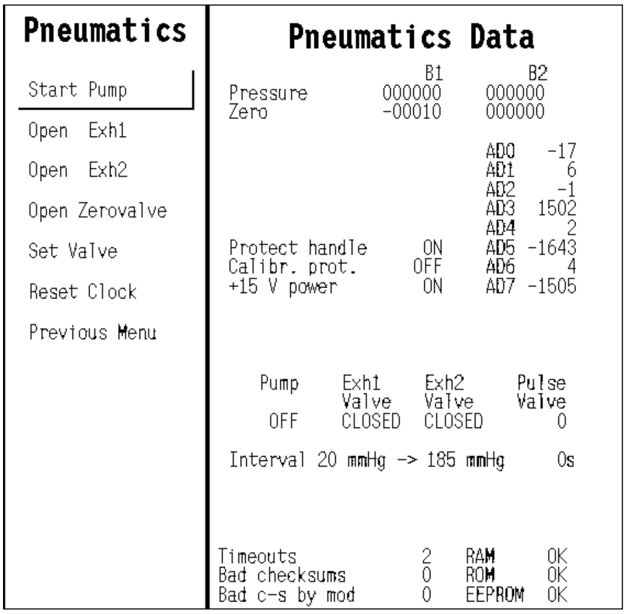
For information on general items **Pressure, Zero, Protect handle, Calibr. prot., +15 V power, AD0** to **AD7** as well as **Timeouts** etc., see section "4.4 NIBP Module".



Buttons Checking

The front panel keys function is confirmed by pressing and releasing the key and observing that **OFF** turns to **ON** at **Auto On/Off**, and **Start Cancel**. Set Cycle Time and STAT On/Off are not in use with E-PSM(P).

4.4.6 NIBP Pneumatics



Start Pump/Stop Pump: A manual control for the pump. The selection changes to **Stop Pump** when the pump turns on.

Open Exh1/Close Exh1: This function is not used with E-PSM(P) modules.

Open Exh2/Close Exh2: A manual control for the exhaust valve 2. The selection changes to **Close Exh2** when the valve is opened.

Open Zero valve: This function is not in use with E-PSM(P) modules.

Set Valve: The opening of the pulse valve is adjusted between 0 and 255 (0 for fully closed and 255 for fully open). First push the ComWheel, then turn it to adjust the value on the screen and finally push to set the value.

Reset Clock is not in use with E-PSM(P) modules.

Pneumatics Data field

For information on general items **Pressure, Zero, Protect handle, Calibr. prot., +15 V power, AD0** to **AD7** as well as **Timeouts** etc., see section “4.4 NIBP Module”.

Pump, Exh1 Valve, and **Exh2 Valve** show their states. NOTE: **Exh1 Valve** has no effect on the module.

Pulse Valve shows how much the valve is opened (0 to 255) during Valve Setting.

How to check Interval 20 mmHg -> 185 mmHg

Select **Start pump** at different combinations of the valves open/closed and push the ComWheel. The module counts the time it takes for the pressure to go up from 20 mmHg to 185 mmHg and displays it. When all the valves are closed, the pump should be able to pump the pressure in about 1 to 4 seconds into an adult cuff wrapped around a pipe. The pump does not stop without selecting **Stop Pump** by pushing the ComWheel.

4.4.7 NIBP Watchdog

Test ADULT: No effect on the module.

Test INFANT: No effect on the module.

Stop Test: No effect on the module.

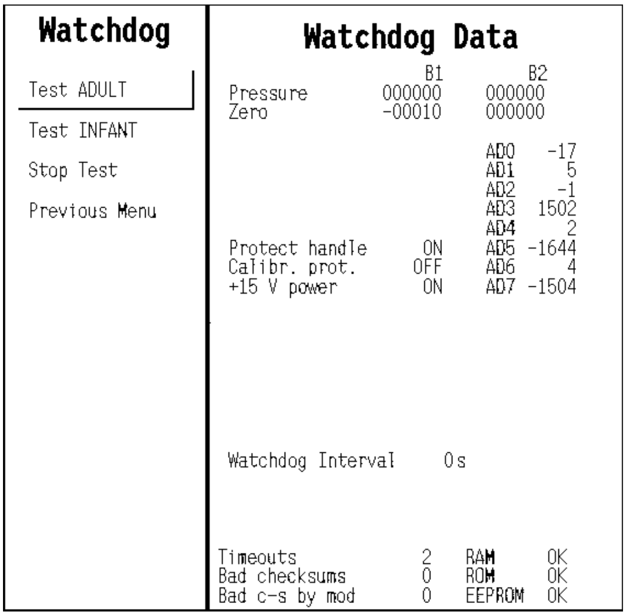
Watchdog Data field

For information on general items **Pressure, Zero, Protect handle, Calibr. prot., +15 V power, AD0** to **AD7** as well as **Timeouts** etc., see section "4.4 NIBP Module".

Watchdog Interval: No effect on the module.

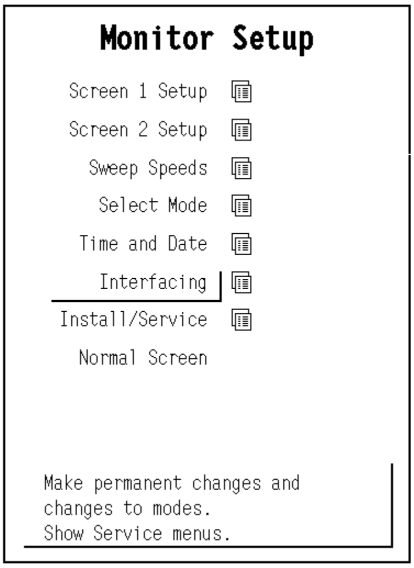
Adult watchdog time testing
No effect on the module.

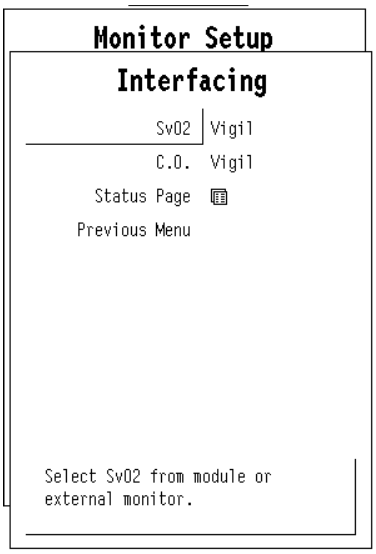
Infant watchdog time testing
No effect on the module.



4.5 DIS Interfacing

4.5.1 Interfacing





How to interface

To select the parameter data source:

- Press the **Monitor Setup** and select ***Interfacing***.
- Select the desired measurement parameter.
- Select the desired source by name.

NOTE: The name of the device is visible on the list only if the device is correctly connected to the module.

4.5.2 Status Page

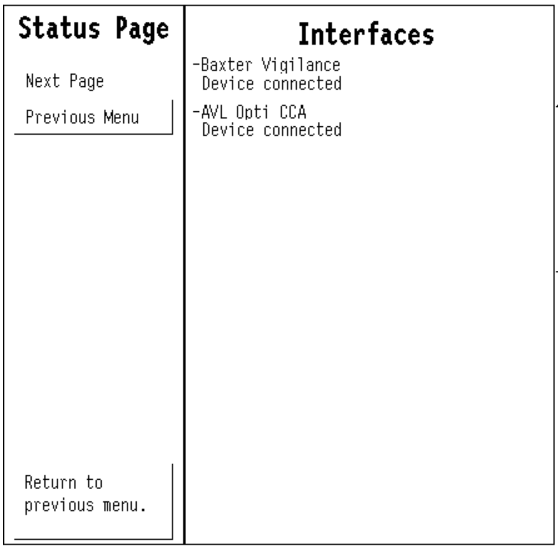
Access via **Monitor setup -** ***Interfacing.***

The selection **Next page** is available, if more than 8 DIS modules are connected to the DIS bus simultaneously.

Interfaces

The menu displays a list of all connected DIS modules and the statuses of the corresponding external devices.

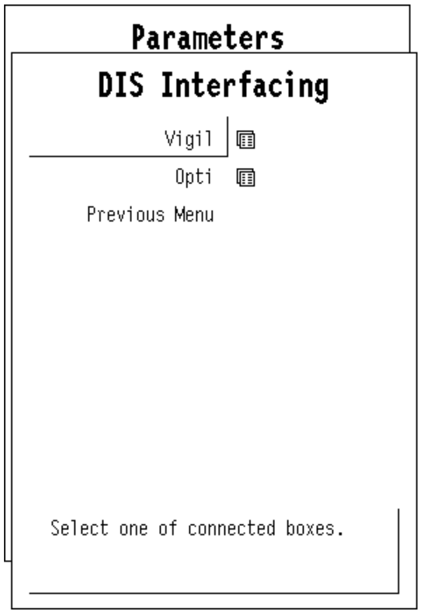
If the bus voltage is too low, you cannot add more devices. 'DIS module bus voltage low. Do not add more devices or reduce cable length' message appears.



4.5.3 DIS Interfacing service menu

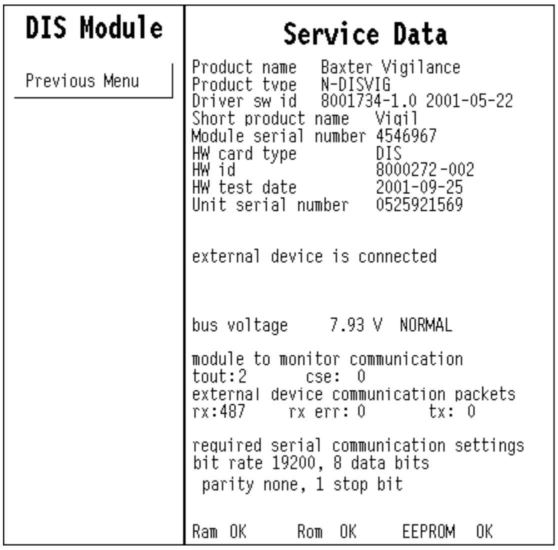
Access via **Monitor setup -** ***Install/Service-Service***

The menu displays submenus for all connected DIS modules.



4.5.4 DIS Module specific page

Service Data



Product name: DIS module name.
Product type: DIS module type.
Driver sw id: DIS module software and its release date.
Short product name: DIS module name.
Module serial number: DIS module serial number.
HW card type: PCB type.
HW id: DIS module PCB identification number.
HW test date: DIS module PCB testing date.
Unit serial number: DIS module PCB serial number.

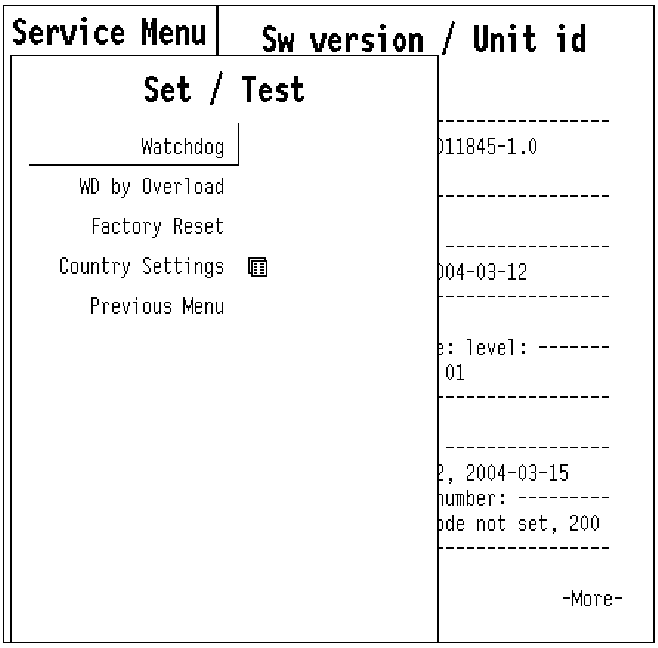
Comment field: Indicates the status of the external device.

bus voltage: DIS bus voltage.

tout: DIS module timeouts, seen by the monitor. The value should not increase more than by 5 per second.
cse: DIS module checksum errors, seen by the monitor. The value should not increase more than by 5 per second.
rx: The number of data packets from the external device received by the DIS module.
rx err: The number of data errors from the external device received by the DIS module.
tx: The number of data packets to the external device sent by the DIS module.

Ram: Status of DIS module RAM memory.
Rom: Status of DIS module ROM memory.
EEPROM: Status of DIS module EEPROM memory.

5 Set/Test



The power supply unit contains a watchdog circuitry, which needs refreshment at every 1.5 seconds. If the refreshment did not occur, the watchdog circuitry will reset the main CPU. In normal operation, the main CPU refreshes the watchdog circuitry at every 0.2 seconds.

The purpose of the watchdog circuitry is to restart the monitor, if there was a serious malfunction. This feature is useful in two cases: when the main CPU is not able to control the monitor, or when the CPU controls the monitor but detects a serious malfunction. Watchdog tests check proper functionality of the watchdog circuitry in various conditions.

Watchdog test ensures directly that the watchdog of the power unit functions properly. Choosing this test prevents the watchdog circuitry from refreshing and shows running seconds with an accuracy of 0.1 seconds.

The test should have the following result when the watchdog circuitry is working properly: The monitor will restart after 1.5 seconds from the start of the test. In malfunction: '>20 s' is displayed, and the test will be interrupted. In this case, the fault is in the watchdog circuitry of the power unit.

WD by Overload test ensures the functionality of a feature, where the software controls the monitor, but detects an overload situation in the main CPU.

The test should have the following result when the feature is working properly: The monitor will restart after 15 seconds from the start of the test.

Factory Reset restores the factory default settings and clears the data memories. Factory reset should be run if the monitor software is replaced or if the SRAM/Timekeeper battery is replaced.

5.1 Country Settings

Language

Select the software language.

National Reqs

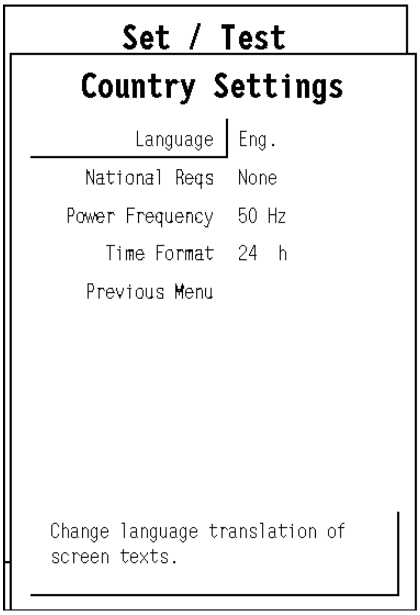
Select the software features, which include national requirements.

Power Frequency

Set the power frequency (50 Hz/60 Hz). This setting is used to filter out possible power frequency interference from the parameter measurements.

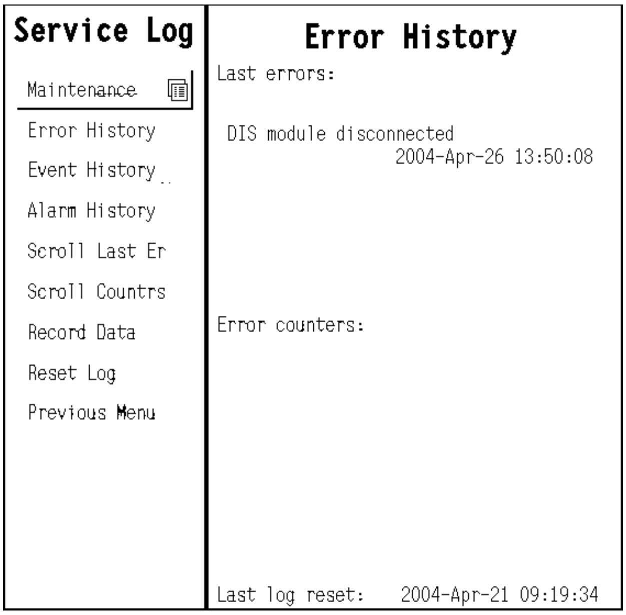
Time format

Set the time format of the real time clock (24 h/12 h).



6 Service Log

Error, event, alarm and maintenance data is stored in Service Log.
The service log contains information about the occurred monitor errors, events and alarms since the last factory reset or service log reset. The service log is saved in the EEPROM memory of the main CPU board. The user can also store different maintenance events in the maintenance log.



Maintenance menu is for setting and viewing the maintenance information of the monitor.

Error History is for selecting the error history view onto the right side of the menu.

Event History is for selecting the event history view onto the right side of the menu.

Alarm History is for selecting the alarm history view onto the right side of the menu.

Scroll Last Er (Ev) is for scrolling the error / event / alarm information on the right side of the menu.

Scroll Counters is for scrolling the error / event / alarm counters on the right side of the menu.

Record Data is for recording the service log information onto the recorder.

Reset Log is for clearing up the content of the service log. This function should be run after a performed maintenance. In Error/Event history view, the Reset Log command clears up both the error and the event log. In the Alarm History view, the Reset Log command resets only the alarm history log.

6.1 Maintenance

The Maintenance History Log gives the user a possibility to store the maintenance history of the monitor. The user can store different planned maintenance (PM) events, repairs and upgrades in the maintenance history log.

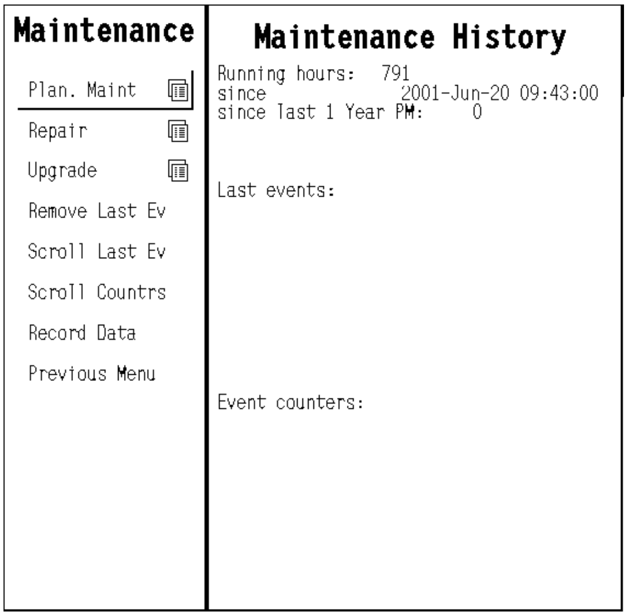
Running hours: shows how many hours the monitor has been on. User cannot reset this value.

since This date and time is set at the factory and it shows the manufacturing date and time. User cannot reset this date and time.

since last 1 year PM: shows the running hours since the last 1 year PM storing.

Last events: The section shows the last maintenance events and the time of their occurrence.

Event counters: The section contains counters for each different maintenance events. The time of occurrence of the last event is shown beside each counter.

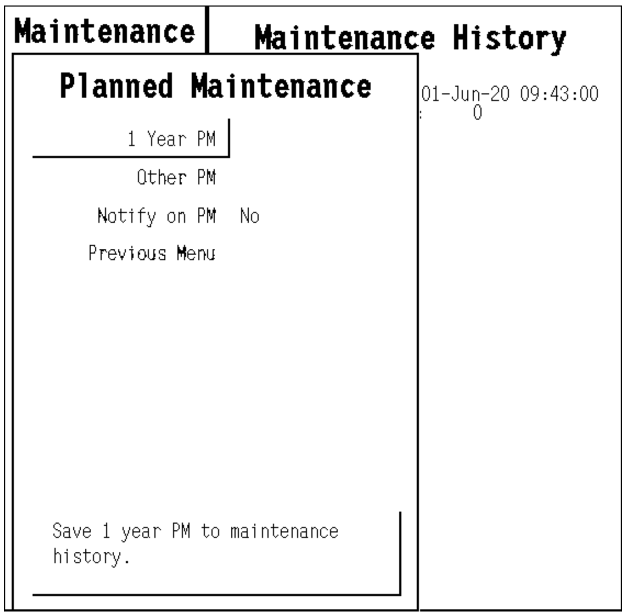


6.1.1 Planned Maintenance

1 Year PM gives you the possibility to store a 1 year PM event in the maintenance history log.

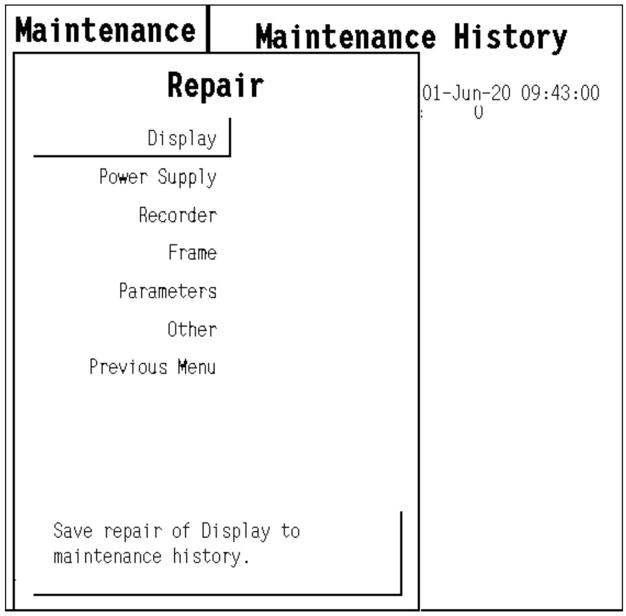
Other PM gives you the possibility to store another PM event in the maintenance history log.

Notify on PM This feature is for future purposes.



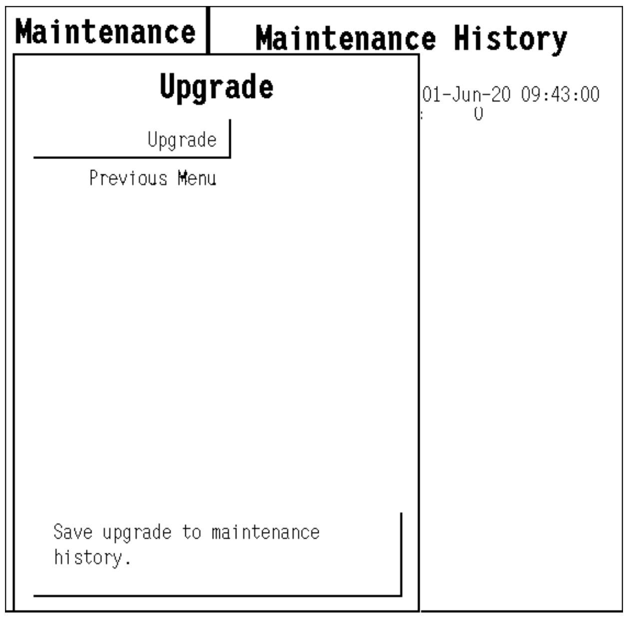
6.1.2 Repair

The repair menu gives the user a possibility to store repair events in the maintenance history log. The different repairs that can be saved are: **Display, Power Supply, Recorder, Frame** (e.g. board in the frame), **Parameters** (e.g. a board in the parameter module) or **Other** (a miscellaneous repair not specified by previous options).



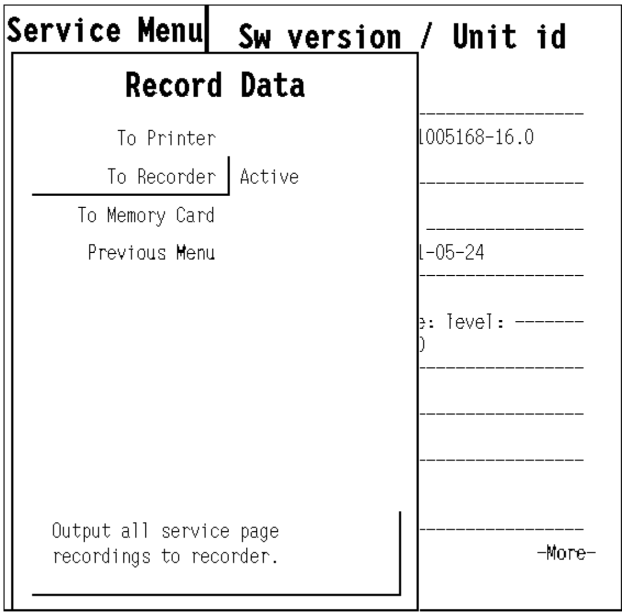
6.1.3 Upgrade

The upgrade menu gives the user a possibility to store the upgrades in the maintenance history log.



7 Record Data

In this menu, the user can specify where to print from any service menu. The setting goes into the permanent memory of the monitor. Only one option can be chosen at a time. The options where to print are: **To Printer, To Recorder** and **To Memory Card**. Only the option **To Recorder** can be selected. When the front panel key for the recorder is pressed, the output is the recorder despite of the setting of the Record Data menu.



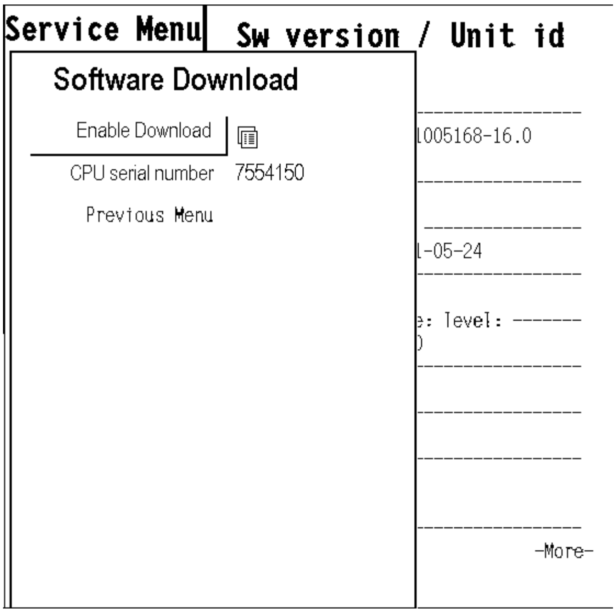
8 SW Download

Menu for downloading monitor software via the network port.

Enable Download enables software download mode and restarts the monitor.

CPU serial number shows the serial number of the CPU board.

The SWDL tool is intended to be used by GE Healthcare service organization and authorized distributors only. For more information on the SWDL tool, see “Software Download Tool - User Instructions.”

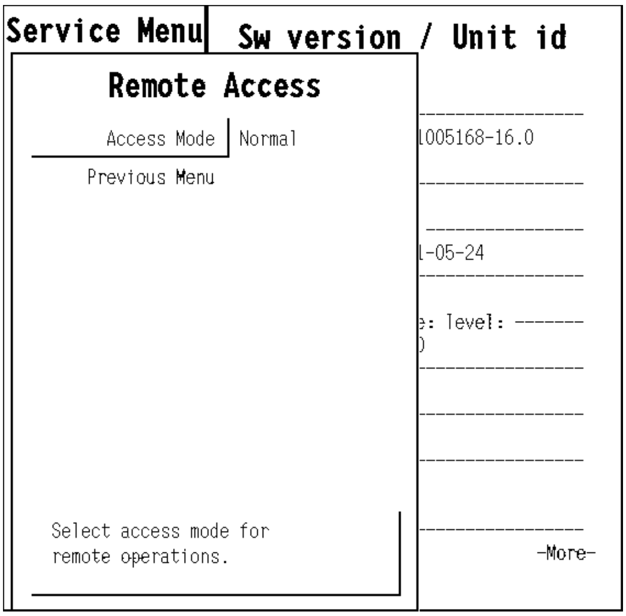


8.1 Remote Access

Remote Access menu is for setting the interface with an external PC that runs the Virtual Support software, which is a service diagnostic tool for remote diagnostics purposes.

When the access mode is set to **Normal** (the default), the PC can only read service menu data from the monitor.
With the access mode **Extended,** the PC can also activate the monitor’s service menu functions.

NOTE: Patient monitoring is not possible, when the access mode Extended is selected. The access mode turns back to Normal, if the monitor is restarted or if the service menu is closed.



For your notes:

Datex-Ohmeda

Frame for FM

Technical Reference Manual Slot

Conformity according to the Council Directive 93/42/EEC concerning Medical Devices amended by 2007/47/EC

CAUTION: U.S. Federal law restricts this device to sale by or on the order of a licensed medical practitioner.
Outside the USA, check local laws for any restriction that may apply.

All specifications subject to change without notice.

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9 February, 2012

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Table of contents

Table of figures

Introduction

This section provides information about the maintenance and service of the following products:

- S/5 Frame for FM, F-FM.
- Software Licenses L-FICU04, L-FICU04A. L-FICU06, L-FICU06A.
- WLAN option F-FMW.

Figure 1 S/5 Frame for FM

1 Specifications

1.1 Frame for FM

Dimensions

Height	302 mm (11.8 in)Handle Up 274 mm (10.7 in)Handle Down
Width	302 mm (11.8 in) Without modules 337 mm (13.3 in) With modules
Depth	143 mm (5.6 in) Without extension module 156 mm (6.1 in) With extension module 200 mm (7.8 in) With extension and PSM modules

Weight

FM	5.0 kg	FM without modules, batteries included
FM + E-PSM	5.6 kg	FM with PSM
FM + N-FCREC + E-PSM	6.6 kg	FM with PSM and extension module with recorder and CO_2

1.1.1 Electrical requirements

Any fluctuations within the specified limits do not affect the performance.

Mains input

Rated voltage	100 - 10% to 240 +10% Vac
Rated current	1.25A at 100V, 625mA at 240V
Rated frequencies	50/60Hz
Power consumption	150 VA

Ext. DC Input

Voltage	10 - 16V
Current	6 A max

(External DC power for future use)

Cooling Convection

1.1.2 Environmental requirements

Operating temperature		
normal operation	10 to 40°C	50 to 104 °F
while charging batteries	10 to 35°C	50 to 95 °F
Storage temperature	-20 to +60°C	-4 to 140 °F
Relative humidity	10 ... 90%. Non-condensing	
Atmospheric pressure	670 to 1060 mbar (500 to 800 mmHg, 670 to 1060 hPa)	

1.2 LCD display

Display size	10.4 in (diagonal)
Display type	Active Matrix Color TFT LCD
Resolution	SVGA 800x600
Number of waveforms	Up to 6
Number of digit fields	Up to 4
Display layout and colors	User-configurable
Horizontal viewing angles	Left and right side 50°

Vertical viewing angles	Lower side 45° Upper side 35°
Backlight	cold cathode fluorescent lamp, replaceable
Backlight lifetime	40 000 h
Backlight intensity	250 Cd/m^2 typ.

Integrated Command Board with direct function keys, menu keys and ComWheel for selections and adjustments in menus.

1.3 Batteries

Number of batteries	2
Battery type	Exchangeable Lithium-Ion
Voltage	11.1V (nominal)
Capacity	3.5 Ah
Capacity indicator	Fuel gauge on monitor screen and on battery pack
Operation time	up to 4.5 hours
Charge time	2.5 hours per battery pack
Battery life	300 cycles to 50% capacity
Conditioning	Manual

1.4 MemCards

MemCard capacity	6 MB minimum
Data storage capacity	2 days of continuous physiological data trends
Operating system	Datalight ROM-DOS
File system	MS-DOS compatible
MemCards	PCMCIA-ATA compatible memory cards

1.5 Network

Connector type	RJ-45
Network type	10 Base-T
Isolation	1500 V, 60/50Hz, 1 min.
Network ID	Network ID key and virtual network ID
Communication protocol	DRI 01, 02 and 03
Network Connectivity	D-O Central and iCentral

Meets IEEE802.3 specifications (10MBASE-T)

Hospital grade approved data transformer

Coding element interface

1.6 Wireless Network, F-FMW

Type	Built-in transceiver and antenna
Frequency range	Worldwide product covering 2.4 to 2.5 GHz, programmable for different country regulations
Data rate	11 Mbps per channel (max.)
Output power	100 mW
Data transmission	IEEE 802.11b compliant, Direct Sequence Spread Spectrum (DSSS)
Security	Wired Equivalent Privacy (WEP) 40 and 128 bit encryption

1.7 Analog Outputs, direct ECG and synchronization

ECG	From first user lead (ECG1)	
	Gain:	1 V/1mV ±20%
	Delay:	< 15 ms
	DC offset:	±100 mV max.
	Output range:	±4 V
	Noise:	50 mVpp max.
	Frequency response:	0.05 Hz to 40 Hz
InvBP	From pressure channel P1	
	Gain:	10 mV/1 mmHg ±20%
	Delay:	< 35 ms
	DC offset:	±100 mV
	Output range:	-0.4 V to +3.2 V
	Noise:	50 mVpp max.

The pacemaker pulses have been replaced with 2 ms/5 V fixed digital pulses at the ECG analog output for IABP or defibrillator equipment. A device that fulfils the requirements of the IEC 60601-1 standard can be connected to the defibrillator & IABP synchronization connector. There are no other limitations, because the signals of the connector are galvanically isolated from patient applied part of the ECG and invasive blood pressure measurements.

Synchronization pulse	Pulse width	10 ms positive pulse
	Delay	< 35 ms (R-wave peak to leading edge of pulse)
	Amplitude	CMOS compatible 3.5 V min. at 1 mA sourcing 0.5 V max. at 5 mA sinking
	Output impedance	50 ohm
	Current limit	10 mA

The signal requires input impedance of 100 kΩ.

1.8 Digital outputs

Nurse call	Low State: 0 - 0.5V; High State: 3.5 - 5V Generated on red and yellow alarms
Serial Output	Asynchronous Serial data interface, uses RS-232 standard Baud rate max 115.2 kbps Parity: None; Data bits: 8; Stop bit: 1

2 Functional description

2.1 Main components

2.1.1 Keyboards

User interface parts

Vertical and Horizontal Membrane keypad containing 20 keys. The keypads are foil membrane keypads. The keypads are connected to the UPI section of the CPU board.

ComWheel is used for menu selection.

2.1.2 Display

The 10.4" LCD display with SVGA 800 x 600 resolution has bright long live lamps and a wide viewing angle.

NOTE: The LCD display backlight circuit runs on a high voltage. Do not touch the inverter board or the backlight tube leads when powered.

Backlights

Replaceable backlight lamp unit consists of two integrated cold cathode fluorescent lamps. The backlight lamp unit is driven by a separate inverter board.

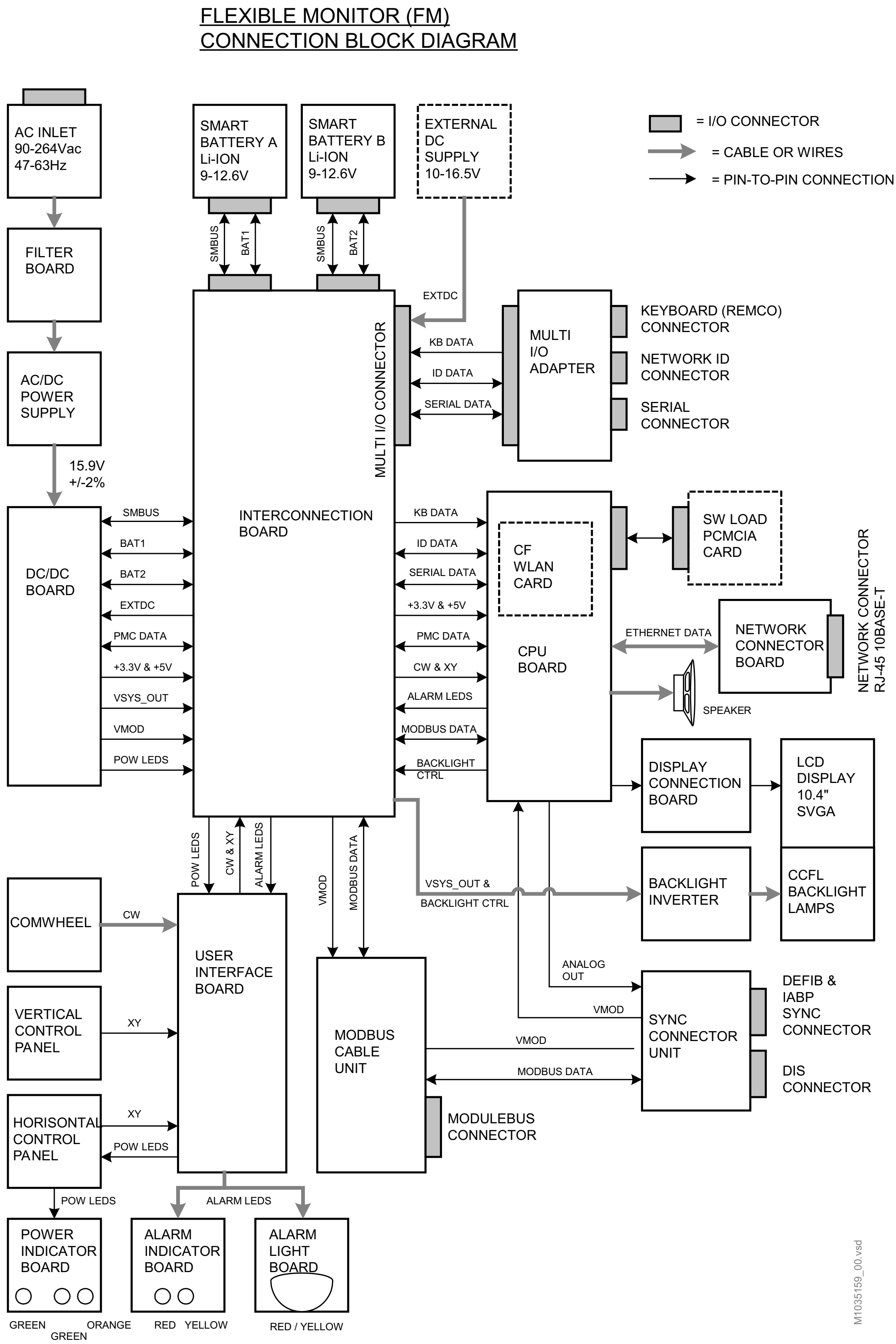


Figure 2 FM Monitor connection block diagram

2.1.3 CPU board F-FM(W)-01

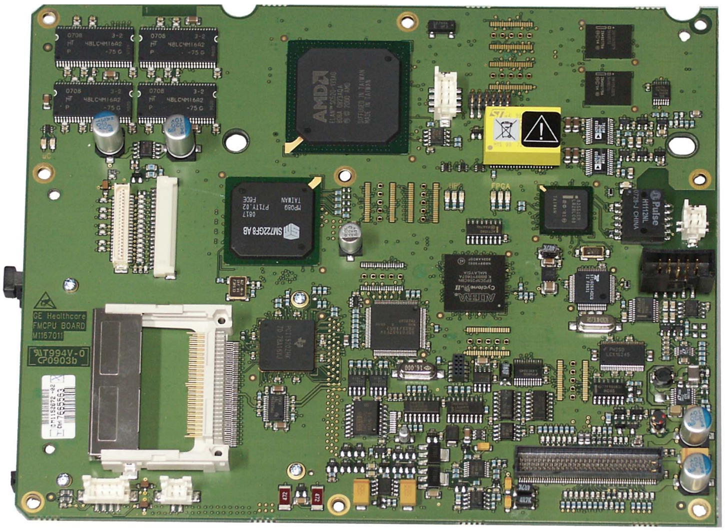


Figure 3 CPU board F-FM(W)-01

The board is based on AMD Élan SC520 microcontroller. Other features include a flat panel display controller, 10/100 Mbit/s Ethernet interface, PCMCIA interface, sound system and Renesas H8SX based UPI.

The CPU section takes care of the central processing.

The main features are:

- Élan SC520 processor
- Internal clock frequency 133MHz
- 32 Mbytes SDRAM
- 16+16 Mbytes flash memory
- 32 Kbytes static RAM with real time clock
- 4 channel UART:
  - 3 serial channels with signals in AC logic level
  - 1 serial channel signals in RS232 level
- Programmable alarm sound generator
- PC-card slot

The SRAM with real-time clock is backed up by a lithium battery.

CAUTION

Lithium battery on the CPU board. Dispose of the battery in accordance with local environmental and waste disposal regulations.

Connectors

Interconnection board connector X3

Flat panel connector X7 (to display connection board)

Speaker connector X17

Analog output board connector X4 (to sync connector board)

Ethernet connector X14 (network cable to network connector board)

System watchdog and voltage supervision

There is a voltage supervisor chip that controls +1.2V, +2.5V, +3.3V and +5V internal operating voltages and it generates system reset if undervoltage situation occurs in monitored voltages.

There is a separate watchdog supervisor chip that generates system reset if watchdog refresh period exceeds 1.6 seconds.

F-FM(W)-00

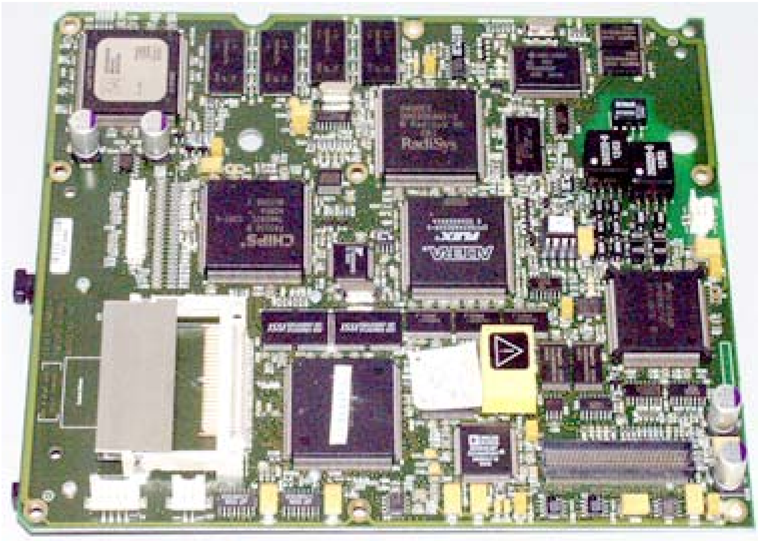


Figure 4 CPU board F-FM(W)-00

The board is based on AMD 486DX4 microprocessor and Radisys R400EX chip set. Other features include a flat panel display controller, 10 Mbit/s Ethernet interface, PCMCIA interface, sound system and Hitachi H8S based UPI.

The CPU section takes care of the central processing.

The main features are:

- 486 processor
- Internal clock frequency 100MHz
- 32 Mbytes DRAM
- 8 Mbytes program flash memory
- 32 Kbytes static RAM with real time clock
- 4 channel UART:
  - 2 serial channels with signals in AC logic level
  - 2 serial channel signals in RS232 level
- Programmable alarm sound generator
- PC-card slot for software updates

The SRAM with real-time clock is backed up by a lithium battery.

CAUTION Lithium battery on the CPU board. Dispose of the battery in accordance with local environmental and waste disposal regulations.

Connectors

Interconnection board connector X3

Flat panel connector X7 (to display connection board)

Speaker connector X17

Analog output board connector X4 (to sync connector board)

Ethernet connector X20 (network cable to network connector board)

System watchdog and voltage supervision

There are two voltage supervision chips that control the system reset signals.

The +3.3V supervision chip outputs reset signals for +3.3V devices. Reset is activated when voltage is below 3.08V. It also has a watchdog that is refreshed in normal operation and in standby.

The +5V supervision chip outputs reset signals for +5V devices. Reset is activated when voltage is below 4.63V. +5V reset causes also +3.3V reset through a FET.

2.1.4 DC/DC board

The DC/DC board converts the output voltage of AC/DC unit, external DC unit (External DC power for future use) or battery voltage to various supply voltages for the electronics of FM monitor. The DC/DC board takes care of the battery charging.

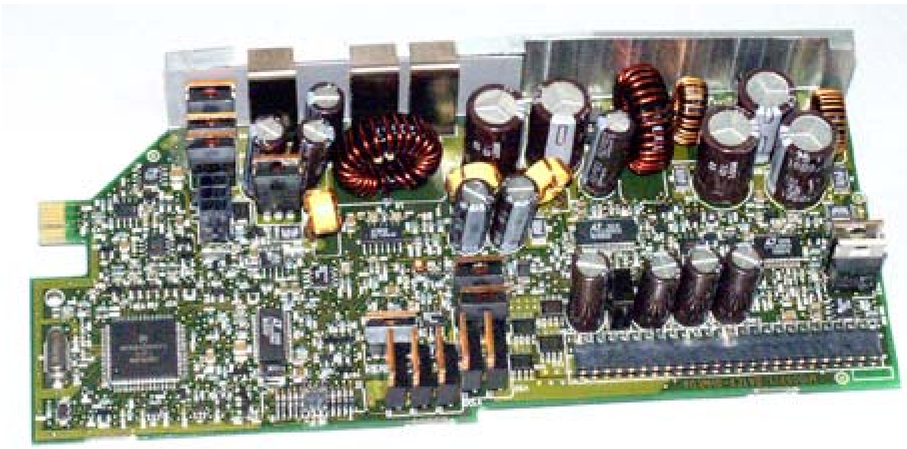


Figure 5 DC/DC Board

DC/DC board functional blocks

DC/DC board operation is controlled by the PMC (Power Management Controller) CPU. PMC takes care of power path controlling and power supplies' sequencing. It communicates with the main CPU via serial communication. PMC also measures DC/DC board voltages and currents.

High efficiency switching power supplies and power path switches are used on the DC/DC board. This is because of no-fan requirement for FM monitor as well as maximizing the battery time.

Circuit breakers make VSYS and MOD voltages short-circuit protected. Also the battery charger, +5V and +3.3V switchers withstand short-circuit. +5V_OUT is disconnected from +5V by a circuit breaker in case of +5V_OUT overload.

The boost converter can be set to two different output levels. The higher one is used to give the battery charger adequate input voltage when the DC/DC board input comes from an external DC source. The lower one is set in AC/DC use to keep the boost converter enabled but passed by a diode and thus not switching, which minimizes the power loss. When the AC/DC voltage drops, the boost converter starts regulating its output and keeps the MOD voltages at a level a little lower than the one in AC/DC use. In battery use, the lower output voltage yields a little better efficiency, too.

Smart batteries, battery charger and PMC communicate via SMBus (System Management Bus). It is a two-wire interface closely resembling I2C. Smart battery controls the charging and calculates and stores the capacity information as well as other battery related data. Batteries can be charged when external DC or AC/DC voltage is present.

Block diagram of the power supplies is represented in Figure 6.

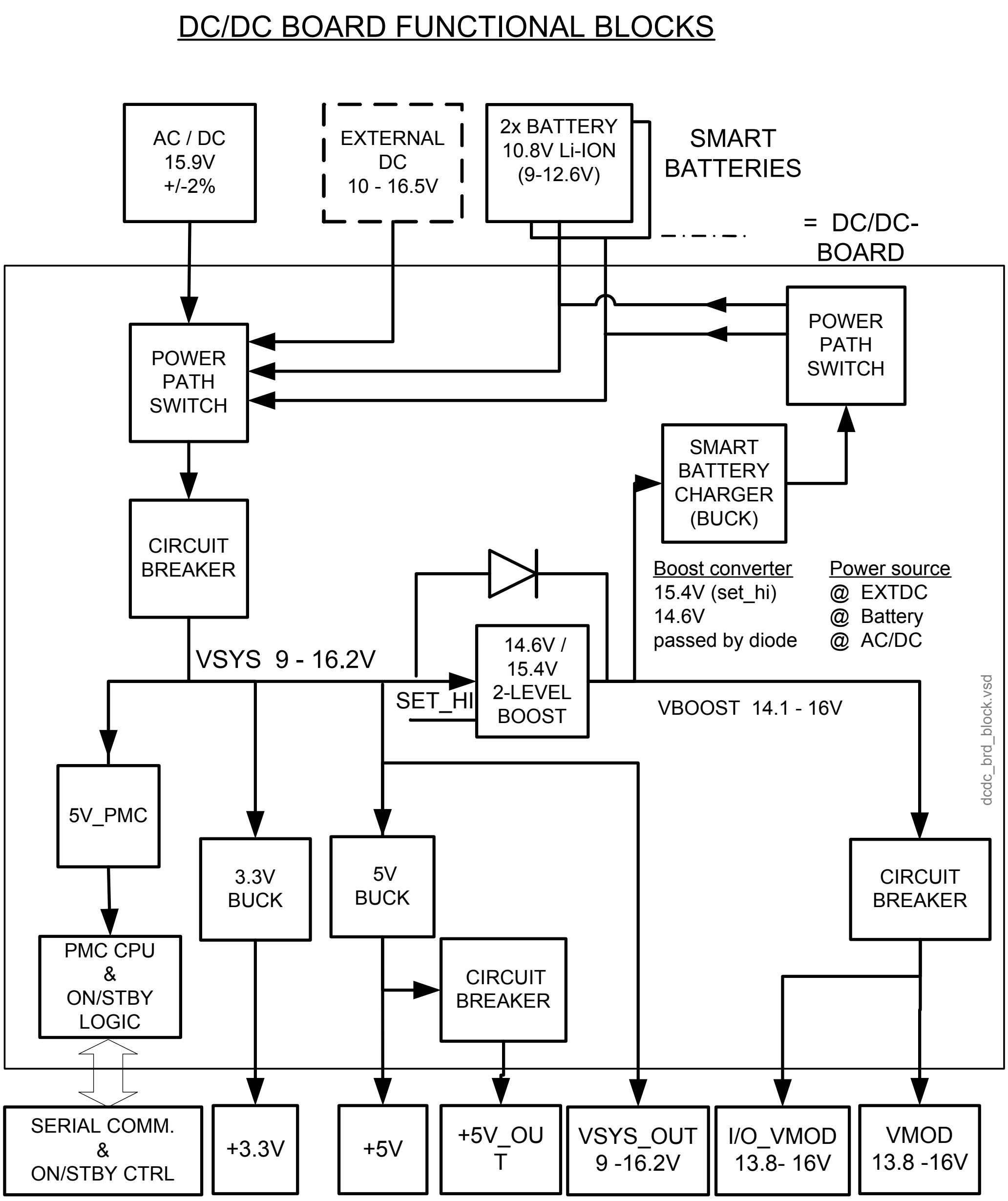


Figure 6 DC/DC board block diagram

Battery charger

Battery charger is a Level 2 Smart Battery Charger. It communicates with the batteries and PMC CPU via SMBus interface. The charger acts as an SMBus slave device that responds to charging current and charging voltage values sent to it by a Smart Battery.

The charger includes an input current limiting feature. In a case where the input current exceeds the limit, the charger reduces the output current to keep the input within the limit. The currents of the MOD voltages (VMOD, I/O_VMOD) are taken through this current measurement as well. This results that the charger reduces its output current if the sum of the charger input current and MOD currents exceeds the input limit. The purpose of this is to prevent the input power sources from getting overloaded if MOD power is increased during charging.

Power path switching electronics

The power source to be used (batteries, external DC or AC/DC output) is chosen initially by a 'power path controller' inside this block. The PMC CPU has full control over the power path management after the initial choice is made at startup.

2.1.5 AC/DC unit

Figure 7 AC/DC unit

AD/DC unit

The AC/DC unit is a compact medical power supply based on high-efficiency technology. It is designed for 65 watt continuous output power, universal AC input and 15.9V output voltage.

Because FM is convection cooled, AC/DC unit's output is not loaded with full rated power to reduce heat dissipation.

2.1.6 Module bus cable unit

Figure 8 Module bus cable unit

Interconnection Board connector

Module bus connector (pins 21...25)

CPU board connector

DIS connector X4

Sync IABP & DEF connector

2 pcs grounding wires

2.1.7 Interconnection board

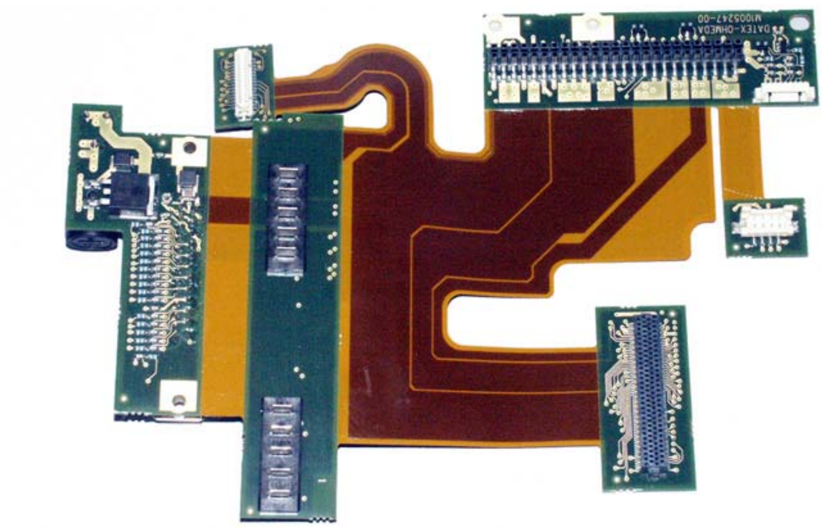


Figure 9 Interconnection board

Interconnection board takes care of most of the monitor internal cabling.

CPU board connector X2

Module bus flex board connector X6

Fuse for External DC input (for future use)

DC/DC board connector X8

Backlight inverter connector X9

Multi I/O connector X5

Battery 1 connector X3

Battery 2 connector X4

User interface board connector X1

2.1.8 Display connection board

Figure 10 Display connection board

CPU board connector X1

Display connector X2

2.1.9 Front cover parts

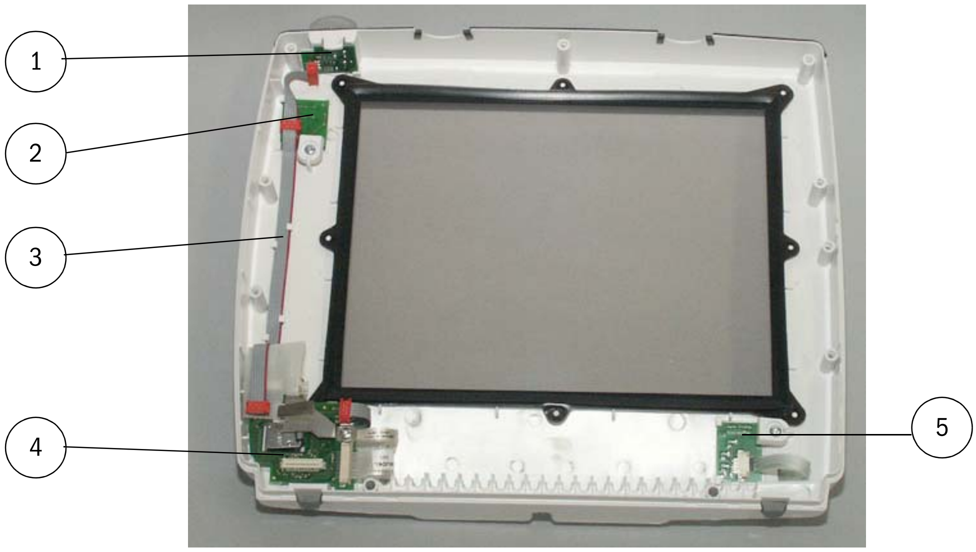


Figure 11 Parts inside Front cover

(1) Alarm light board

(2) Alarm indicator board

(3) Indicator ribbon cable

(4) User interface board

(5) Power indicator board

2.1.10 Wireless LAN option, F-FMW

Datex-Ohmeda Wireless Network is an extension to, or an alternative for, a wired Datex-Ohmeda Monitor network. It provides same network services than the wired Datex-Ohmeda Network.

The monitor network is a local area network based on standard Ethernet technology. The monitor network is formed by connecting one Central and up to 32 bedside monitors together.

The Central and the bedside monitors are connected to a 10 Mbps hub. The hub works as a multiport repeater and controls the information flow between all the devices connected to the monitor network.

The communication protocol for the monitor network is Datex-Ohmeda specific.

Wireless bedside monitors can use both the wired and wireless network. If the network cable is connected, the wired Datex-Ohmeda Network is used.

Network connection is changed automatically between LAN and WLAN. LAN overrides when available.

For using Wireless LAN connection, the monitor frame with ready-fitted WLAN option F-FMW is required.

For configured parameters please refer to the Datex-Ohmeda Network, Wireless LAN Installation Guide.

2.1.11 Batteries

The S/5 FM has two lithium-ion batteries, located in the battery compartment. The DC/DC board connects one of the batteries to be the power source, if no power is received from the AC/DC unit or from an external DC unit (External DC power for future use). The battery charging is controlled by the DC/DC board.

The batteries can be charged separately, and screen symbols and monitor frame LED indicators indicate their charging level and possible failure.

NOTE: When the monitor is battery powered, the green battery LED is on. When the monitor is mains/external DC powered, the green mains/external DC LED is on.

2.2 Connectors and signals

2.2.1 External connectors

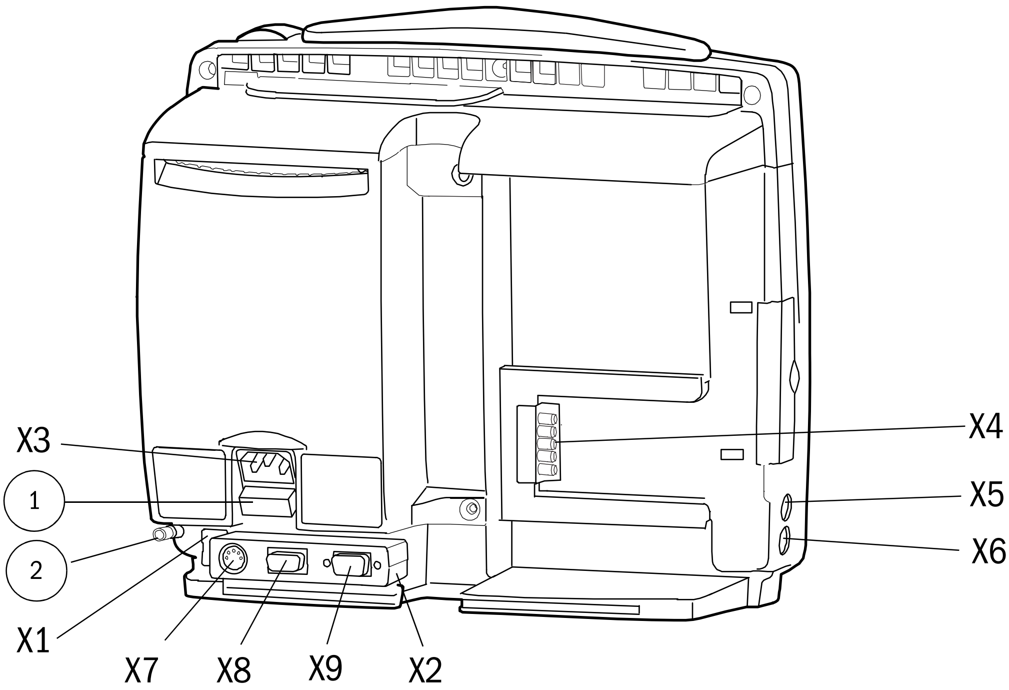
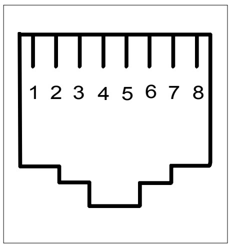


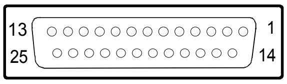
Figure 12 External connectors of Frame for FM

(1) Fuses
(2) Potential equalization connector
X1 NET connector
X2 Multi IO connector
X3 Receptacle for power cord
X4 Module Connector for E-PSM, E-PSMP or N-FMC, N-FMCREC, N-FMREC
X5 Defib & IABP sync connector
X6 Connector for DIS interfacing system
X7 Connector for Remote Controller K-CREMCO
X8 NET ID connector
X9 Serial connector

Network connector, X1

RJ45 connector	Pin	Signal
	1	Tx +
	2	Tx -
	3	Rx +
	4	N/C
	5	N/C
	6	Rx -
	7	N/C
	8	N/C

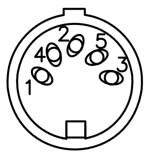
Multi I/O connector X2

25 pin female connector	Pin	Signal
	1	GND
	2	NET_ID_DO, TTL out
	3	NET_ID_DI, TTL input
	4	NET_ID_CLK, TTL out
	5	NET_ID_CS, TTL out
	6	TXD, RS-232 output
	7	RXD, RS-232 input
	8	NURSE_CALL, CMOS output
	9	reserved
	10	Data -, RS-485 I/O
	11	CONNECTOR_ID, TTL input
	12	EXTDC+, 10-16V, input (for future use)
	13	GND
	14	GND
	15	KB_DATA#, TTL, I/OPin
	16	KB_CLK#, TTL, I/O
	17	+5V_OUT, +5V, output
	18	CTS#, RS-232 input
	19	RTS#, RS-232 output
	20	REMOTE_ON#
	21	reserved
	22	Data +, RS-485 I/O
	23	I/O_VMOD, 13.8 - 16V
	24	EXTDC+, 10-16V, input (for future use)
	25	GND

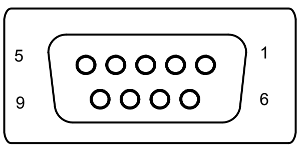
Multi I/O adapter

Figure 13 Multi I/O adapter

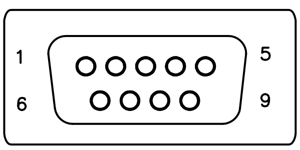
Connector for K-CREMCO X 7

5 pin connector	Pin	Signal
	1 2 3 4 5	KB_CLK KB_DATA not in use GND +4.75 - +5.25V

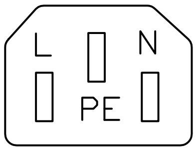
Net ID connector X8

9 pin female connector	Pin	Signal
	1 2 3 4 5 6 7 8 9	NET_ID_CS, TTL out. NET_ID_CLK, TTL out. NET_ID_DO, TTL out. NET_ID_DI, TTL input GND +4.75 . . . +5.25V Not in use NURSE_CALL, CMOS output GND for Network ID

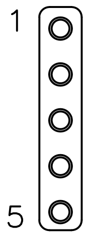
Serial port X9

9 pin male connector	Pin	Signal
	1 2 3 4 5 6 7 8 9	GND RXD, RS-232 input TXD, RS-232 output +4.75 . . . +5.25V GND N/C RTS#, RS-232 output CTS#, RS-232 input N/C

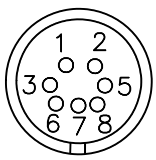
Main power X3

Mains connector	Pin	Signal
	L	Live
	PE	Protected earth
	N	Neutral

Module connector X4

5 pin connector	Pin	Signal
	1	GND
	2	Vmod 13.8 - 16 V
	3	Data +
	4	Data -
	5	Shield

Defib & IABP sync connector X5

Female mini din7 connector	Pin	Signal
	1	Defib sync
	2	Marker_in
	3	Analog GND
	5	Digital GND
	6	Reserved
	7	Pressure_out
	8	Direct_ECG

DIRECT_ECG: Output signal follows first user lead (ECG1 lead) including augmented leads. If pace is on, there is an enhanced pacer pulse (5 volts at 2 milliseconds) when pacemaker triggering is detected.

In the event of a LEAD FAIL, refer to the following:

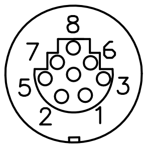
Lead Failed	ECG Analog Out
Right arm	III
Left arm	II
Left leg	I
Chest	II

On LEADS OFF situation ECG analog output is flat line (0V).

In 5-lead mode, the chest lead must be labeled V1, otherwise output will follow lead II.

PRESSURE_OUT: The pressure labeled ART is sent to the analog out. If no pressure is labeled ART, P1 is sent to the analog out. Output is set to flat line (0V) if the pressure channel is not zeroed.

DIS connector, X6 DIS interface (RS485)

8 -pin female connector	Pin	Signal
	1 2 3 4 5 6 7 8	Data + Data - 13.8 -16 VMOD GND N/C GND N/C N/C

2.2.2 Digital and analog outputs

Digital outputs

There are separate digital outputs. Both signals use TTL-level. The outputs are: Defibrillation Sync. and Nurse Call.

Defibrillation Sync (X5, pin1) indication is generated by ECG. When active, the signal is in state 1. After 10 ms the signal is reset to state 0. New Defibrillation Sync is not generated before the indication is deactivated. The delay from the R wave peak to the start of the signal is maximally 35 ms.

Nurse Call (X8, pin 8) indication is generated by red and yellow alarms. When activated, it is set to state 1 and remains at that state until the alarm situation is over or SILENCE ALARM key is pressed.

The range of state 0 is from 0 to 0.5 V, and the range of state 1 is 3.5 to 5 V.

If the output signals are used simultaneously with the coding element, the B-UPINET Y-cable, order number 889308, should be used.

Analog outputs

S/5 FM produces two analog real-time signals.

NOTE: When the source of the selected analog output is invalid (e.g. invasive pressure channel is not zeroed), or becomes invalid (e.g. ECG lead is disconnected), the signal on the output is shown as flat line (0 VDC).

Direct ECG (X5, pin 8):	Delay (max.):	15 ms
	Gain ECG (out)/ECG (in):	1 V/1 mV ±20%
	Pacer:	5 V and 2 ms pulse

The signal requires input impedance of 100 kW.

Invasive pressure signal (X5, pin 7):

From pressure channel P1	
Delay (max.):	35 ms
Gain Signal (out) / Pressure (in):	10 mV/1 mmHg ±20%
Output range:	-0.4 V to +3.2 V

The signal requires input impedance of 100 kΩ.

2.2.3 Printer connection

For connecting a printer to the S/5 FM, the serial data interface is used. When parallel printing is desired, a serial to parallel converter (ref. 78030) is needed.

For further information see Part I, Interfacing.

For your notes:

3 Service procedures

3.1 General service information

The field service of S/5 FM is limited to replacing faulty PC boards and mechanical parts. Return the faulty PC boards to GE Healthcare for repair.

GE Healthcare is always available for service advice. Provide the unit serial number, full type designation and a detailed fault description.

WARNING **Only trained personnel with appropriate tools and equipment should perform the tests and repairs outlined in this section. Unauthorized service may void the warranty of the unit.**

3.2 Service check

3.2.1 S/5 FM

These instructions include complete procedures for a service check. The service check is mandatory after any service repair. However, the service check procedures can also be used for determining possible failures.

The procedures should be performed in ascending order.

The instructions include a check form (APPENDIX A:) which may be used when performing the procedures.

The symbol in the instructions indicates that the check form contains space to record the results of the particular procedure.

3.2.2 Recommended tools

Table 1 Recommended tools

Tool	Notes
Power cord	
Screwdrivers	Torx T8, T10 and T15
MemCard - Menu	for MemCard Option
MemCard - Data	for MemCard Option
E-PSM(P)	
N-F(C)REC	

Table 2 **Patient simulators' compatibility with each hemodynamic module**

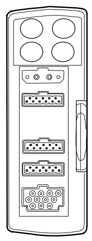
Module	Parameter	Patient simulator		
		M1010831	MedSim	Lionheart & MPS450
E-PSM(P) 	ECG	Cable included	Multilink ECG acc.	Multilink ECG acc.
	T	2016998-001	2016998-001 and M1010832	2016998-001 and M1010846
	InvBP	Cable included	M1010858 and 2005772-001	M1010862 and 2005772-001

Table 3 **Adapter cables for hemodynamic patient simulators**

Patient simulator	Adapter cables for simulators	
Hemodynamic patient simulator	Dual temperature adapter cable	2016998-001
Hemodynamic patient simulator	Dual Inv.BP adapter cable	2005772-001
Medsim	Temperature adapter cable	M1010832
Medsim	Inv.BP adapter cable	M1010858
Lionheart & MPS450	Temperature adapter cable	M1010846
Lionheart & MPS450	Inv.BP adapter cable	M1010862

3.2.3 Recommended parts

Table 4 **Recommended parts**

Part	Order No.	Notes
Recorder paper	74205-HEL	for recorder unit

3.2.4 Before beginning

- Make sure that the monitor is switched to standby.
- If the monitor is connected to Datex-Ohmeda Network, disconnect the Mon-Net cable from the monitor. Take out the memory card, if installed.
- Disconnect the power cord and detach the batteries.
- Detach the fuse holder and the rear cover.

WARNING **Wear a grounded antistatic wristband when handling PC boards. Electrostatic discharge may damage components on the board.**

3.2.5 General

1. Internal parts

   Check that:

   – the screws are tightened properly

   – the cables are connected properly

   – the connector pins are intact

   – there are no loose objects inside the monitor

   Reassemble the monitor.

2. External parts

   Check that:

   – all stickers are intact

   – the LCD display screen is intact

   – the ComWheel cover is intact and is attached properly

   – all mechanical parts are functioning properly

3. Module installation

   Check that the modules go in smoothly and lock up properly.

   Leave the modules connected.

4. Command Board LEDs

   Connect the power cord and check the Command Board LEDs:

   – the green mains power LED is on

   – the green battery LED is off

   – the orange battery LED is on or off continuously (not blinking)

5. Start-up

   Switch the monitor on.

   Check that the monitor starts up properly, i.e. the alarm LEDs turn blank, the start-up sound is heard from the loudspeaker and the normal monitoring screen appears.

   No error messages should appear on the screen.

   If the monitor contains the recorder unit, two lines of start-up information should be recorded.

6. Module recognition

   Configure the monitor screen so that all needed parameter information is shown:

   Monitor Setup

   Screen 1 Setup

   Waveform Fields

   Digit Fields

   Check that the selected parameter information is shown on the screen.

   NOTE: InvBP waveforms are not shown without a patient simulator.

   Do no connect the simulator to the monitor at this stage.

   ✍

7. LCD display picture

   Check that the picture on the LCD display screen is straight, clear and stable.

   ✍

8. Time and date

   Check that the time and date are correct, adjust them if necessary.

   Monitor Setup

   Set Time and Date

   NOTE: The selection SET TIME AND DATE cannot be accessed if a case is started, or a patient has been admitted.

   NOTE: If the clock shows time 0:00 continuously (at successive start-ups), the SRAM/ TIMEKEEPER battery on the CPU board needs to be replaced.

   The FACTORY RESET should be performed after the battery replacement.

   ✍

9. Loudspeaker

   Check the loudspeaker by setting the alarm volume:

   Alarms Setup

   Alarm Volume

   Test the whole volume scale from 1 to 10 by turning the ComWheel and check that the alarm volume changes correspondingly. The alarm sound should be clear and audible with all the settings.

   ✍

10. Display brightness

    Select

    Monitor Setup

    Display Brightness

    Push the ComWheel and check that the display brightness follows the selected brightness.

    ✍

11. Monitor software

    Enter the service menu:

    Monitor Setup

    Install Service (Password 16-4-34)

    Service (Password 26-23-8)

    Take down the information regarding Monitor software.

    ✍

12. Content of the service log

    Select ***Service Log*** from the menu.

    Check the contents of the Service Log for possible problems. If the monitor contains the recorder unit, record the Service Log onto the recorder by selecting ***Record Log***.

    ✍

13. Voltages

    Check the power supply output voltages through the service menu:

    Monitor Setup

    Install Service (Password 16-4-34)

    Service (Password 26-23-8)

    Frame

    Power Supply

    Check that all the displayed values are within reasonable limits.

    ✍

14. Watchdog circuitry

    Select:

    Monitor Setup

    Install Service (Password 16-4-34)

    Service (Password 26-23-8)

    Set/Test

    Perform the tests WATCHDOG and WD BY OVERLOAD. Check that the monitor restarts in each case.

    NOTE: When selecting WD BY OVERLOAD, restarting should take place approximately after 15 seconds.

    ✍

    Preset monitor settings:

    Record/Print

    Record Waveforms

    Waveform 1 --> ECG1

    Waveform 2 --> P1

    Waveform 3 --> P2

Delay --> Off

Paper Speed --> 6.25 mm/s

Length --> 30 s

15. Alarm LEDs

    Enter the ***Keyboard*** service menu:

    Monitor Setup

    Install Service (Password 16-4-34)

    Service (Password 26-23-8)

    Keyboard

    Select the text ***Upper Led***. Check that the red alarm LED turns on and off when pressing the ComWheel. Check also the yellow alarm LED by selecting ***Lower Led*** from the menu.

16. Membrane keys

    Press the keys on the monitor command board one by one. Check that each key generates a sound from the loudspeaker. Also, the corresponding text in the menu should change from yellow to red.

    Check also the functioning of the side panel keys.

17. ComWheel

    Turn the ComWheel clockwise and counterclockwise and check that each step generates a sound from the loudspeaker and the corresponding values at the bottom of the menu increase.

    Select ***Dummy Press***. Push the ComWheel and check that the press generates a sound and the corresponding value in the menu increases.

18. Module communication

    Connect a patient simulator to the module.

    Enter the parameter service menus one by one:

    Monitor Setup

    Install Service (Password 16-4-34)

    Service (Password 26-23-8)

    Parameters

    ECG, STP and NIBP

    Check that the ‘Timeouts’, ‘Bad checksums’ and ‘Bad c-s by mod’ values do not increase faster than by 5 per second.

19. Batteries

    Enter the ***BATTERY*** service menu:

    Monitor Setup

    Install Service (Password 16-4-34)

    Service (Password 26-23-8)

    Frame

    Power Supply

    WPM Battery

    Smart Batt1

    Smart Batt2

    Check that all values are within reasonable limits.

    NOTE: In order to update values for a desired battery, disconnect the other battery shortly.

20. Battery operation

    Disconnect the power cord (without switching the monitor to standby).

    Check that the monitoring continues normally. Check also the Command board LEDs:

    - the green mains power LED is off
    - the green battery LED is on
    - the orange battery LED is off

21. Battery charging

    Reconnect the power cord.

    Check that the monitoring continues without problems. Check also the Command board LEDs:

    - the green mains power LED is on
    - the green battery LED is off
    - the orange battery LED is on or off continuously (not blinking)

3.2.6 Recorder Unit

22. Recorder messages

    Open the recorder unit cover. Check that the message 'Recorder: Cover open' appears on the screen, then close the cover.

23. Recording

    Press the key **Start/Stop** and check that the module starts recording the selected waveforms. Press the key again on the module to stop recording.

NOTE: InvBP waveforms are not recorded without a patient simulator.

NOTE: If no recording appears, check that the paper roll is installed in a correct way. Only one side of the paper is printable.

24. Paper speed

Press the key **Start/Stop** again and this time wait until the recording stops. Check that the length of the recorded waveform scale is 18.7 cm (± 1.5 cm).

Change the paper speed setting to 1 mm/s:

Print/Record

Record Waveforms

Paper Speed --> 1 mm/s

Press the key **Start/Stop** and wait until the recording stops. Check that the length of the scale is now 3.0 cm (± 0.5 cm).

25. Quality of recording

Check that the quality of the recordings is acceptable.

3.2.7 MemCard option

26. Module recognition

Enter the Memory Card service menu:

Monitor Setup

Install Service (Password 16-4-34)

Service (Password 26-23-8)

Frame

MemCards

Check that the memory option is recognized properly, i.e. 'Present' and 'Active' state YES.

27. Memories and PCMCIA controller

Check that the Memory board memories and the PCMCIA controller have passed their tests. The status for each should be OK.

28. Communication

Select ***Communication***. Check that 'Interface status' states 'ACTIVE' continuously and the error counter values on the bottom part of the menu are stable.

29. Data Card recognition

    Select ***Status.*** Insert a Memory card labelled "Data" in the memory card slot. Check that the message 'Data Card inserted' appears on the message field and the green menu card symbol on the upper right hand corner of the screen within 1 minute.

    Wait until the information regarding SLOT2 is fully updated in the service menu, then check that the 'Card type' states DATA and the 'File system' ATA.

    Check that the rest of the information for SLOT2 is reliable and no errors have been detected.

    Remove the memory card.

30. Menu Card recognition

    Select ***Status.*** Insert a Memory card labelled 'Menu' in the memory card slot. Check that the message 'Menu Card inserted' appears on the message field and the white menu card symbol in the upper right hand corner of the screen within 1 minute.

    Wait until the information regarding SLOT2 is fully updated in the service menu, then check that the 'Card type' states MENU and the 'File system' ATA.

    Check that the rest of the information for SLOT2 is reliable and no errors have been detected.

31. Menu card function

    Enter the SAVE MODES menu:

    Monitor Setup

    Install Service (Password 16-4-34)

    Save Modes (Password 13-20-31)

    Save the current modes in the Menu card by selecting

    Load Modes

    To Menu Card --> Save.

    Wait until the saving is complete, then return to the previous menu.

    Change the name for the mode number 1:

    Highlight the mode number 1, push the ComWheel and select -***Name***. Select suitable characters from the list by turning and pressing the ComWheel, then confirm the new name by selecting ***End***.

    Load the original modes from the Menu card by selecting

    Load Modes

    From Memory Card --> Load.

    Wait until the loading is complete (may take a couple of minutes), then return to the previous menu.

    Check that the mode number 1 has got back its original name.

3.2.8 Network

32. Connection to network

    Check that the Mon-Net cable connector is clean and intact, then connect it to the monitor.

    Check that the monitor connects to the Datex-Ohmeda Network, i.e. the network symbol appears under the clock in the upper right hand corner of the screen. Also a message regarding the connected Central should appear in the message field of the screen.

    If the message regarding the Central does not appear, check the status of the network.

33. Ethernet address

    Enter the network service menu:

    Monitor Setup

    Install Service (Password 16-4-34)

    Service - Frame (Password 26-23-8)

    Network- Ethernet

    Check that the service menu counters for the received ('In') and transmitted ('Out') data are updated frequently.

34. Data error counters

    Check that the counters for data errors ('CRC', 'Frame', 'Transm.') are stable.

    NOTE: The counters may show values higher than 0, however, if any of the values is increasing continuously, it indicates a problem.

35. Hardware error counters

    Check that the counters for hardware errors ('Intern.', 'Missed', 'FIFO', 'Overrun') show all 0. If any of the counters show a value higher than 0, replace the network board.

36. Disconnection recognition

    Disconnect the Mon-Net cable from the monitor. Check that the message 'Network down:' appears in the message field within 30 seconds. When the message appears, the service menu values are no longer updated.

    Reconnect the Mon-Net cable and check that the monitor connects to the Datex-Ohmeda Network again.

37. ID-plug recognition

    Switch the monitor to standby. Disconnect the Identification plug from the monitor. Switch the monitor back on and check that the message 'Check network connectors' appears in the message field.

Reconnect the Identification plug and check that the monitor connects to the Datex-Ohmeda Network.

✍

3.2.9 Wireless LAN option

38. Signal strength

    Check that the WLAN signal strength symbol roams or stays fixed on the monitor screen.

39. Configure access point

    Configure one access point appropriately. Bring the monitor to good WLAN coverage area. Check that the field level indicator stops scrolling.

    Go to the ***WLAN Status page*** (... ***Service -> Frame -> Network -> WLAN - WLAN Status***).

    Check that the Connection is active, AP MAC address is recognized and the connection Speed is at least 2 Mbits/s.

40. Connection to Network

    Make sure that the monitor is in line of sight with a wireless LAN access point antenna. Check that the monitor connects to the Datex-Ohmeda Network, i.e. the wireless LAN network symbol appears in the upper right-hand corner of the screen.

    ✍

3.2.10 General

41. Trends retaining

    Check that the monitor is capable of storing the trend information and temporary settings in a short (max. 15 minutes) standby.

    Press the membrane key **Pt.Data & Trends -->** ***Trends.*** Check that there is trend information available for the monitored parameters.

    Switch the monitor to standby and disconnect the power cord. Wait for two minutes, then reconnect the power cord and switch the monitor back on.

    Check that the trend information is still available.

    ✍

42. Battery capacity

    Condition the batteries.

    ✍

43. Service Log reset

    Enter the Service Log in the ***Service*** menu:

    Monitor Setup

    Install Service (Password 16-4-34)

    Service (Password 26-23-8)

    Service Log

Clear the content of the Service Log by selecting RESET LOG from the menu.

44. Electrical safety check

    Perform electrical safety check and leakage current test.

    Check that the monitor functions normally after the performed electrical safety check.

45. Final cleaning

    Switch the monitor to standby, disconnect the power cord and perform final cleaning.

46. Fill in all necessary documents

3.3 S/5 FM disassembly and reassembly

WARNING **The S/5 FM is always energized by the internal batteries. A short circuit may cause internal damage. Do not touch any exposed wiring or conductive surface inside, this may cause an electric shock.**

WARNING **Always perform an electrical safety check and a leakage current test on the monitor after service.**

NOTE: The backlight circuit runs on high voltage.

Do not touch the inverter board or the backlight tube leads when powered.

3.3.1 Before disassembly

WARNING **Wear a grounded, antistatic wristband when handling PC boards. Electrostatic discharge may damage components on the board.**

Make sure that the monitor is turned off.

Disconnect the main power cord. If the monitor is connected to the Datex-Ohmeda Network, disconnect the Mon-Net cable.

To reassemble the monitor, reverse the order of the disassembly steps.

Tools needed

- screwdrivers, TORX; T8, T10, T15
- crosshead screwdriver; M15
- flat blade screwdriver
- sockets; M4.5, M7, M11
- antistatic wristband

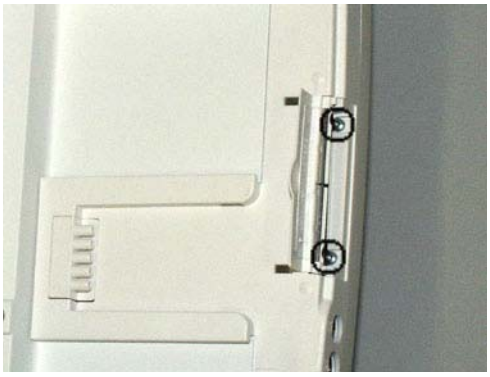
To separate the back cover from the monitor frame

1. From the back side of the monitor, remove:

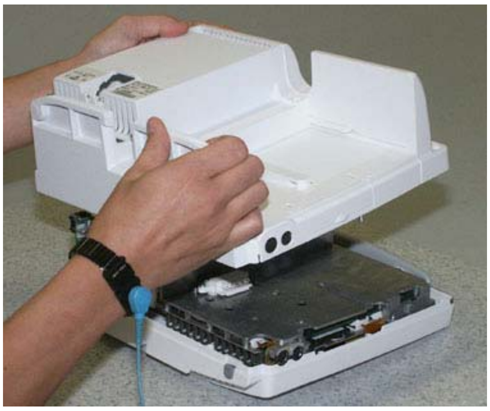
- both batteries
- Multi I/O adapter
- the fuse holder
- three (T8) screws from the top of the back cover
- two (T15) screws with star washers
- one (T15) screw

Notice the places of the star washers.

2. Remove the two (T15) screws from the front side of the monitor.



3. Remove the two (T8) screws from the datacard slot.



4. Place the monitor face down on a non-adrasive, static-free surface.

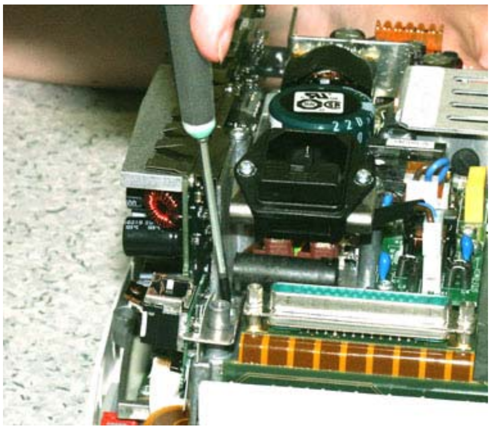
NOTE: Be careful not to damage the ComWheel.

- Lift the back cover up.

Now you can access the following field replaceable parts. Follow the instructions below:

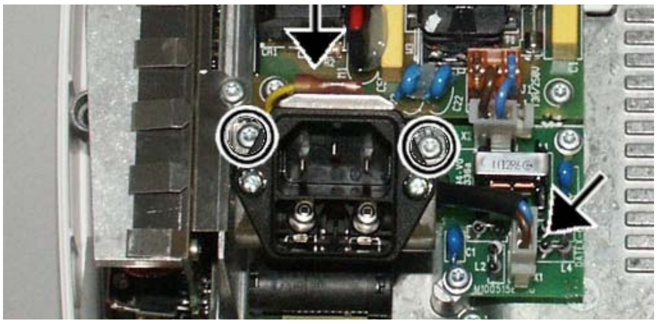
- “To remove the network connector board unit”
- “To remove the main power connector unit”
- “To remove the Multi I/0 connector (25 pins)”
- “To remove the DC/DC board”
- “To remove the AC/DC unit and the battery brake”
- “To remove the filter board”

To remove the network connector board unit



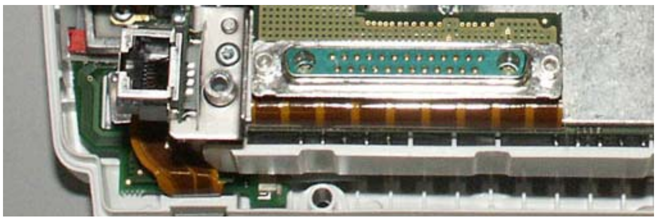
- Remove the screw (T10) holding the unit to the frame.
- Disconnect the cable coming from the Network connector board
- Remove the Network connector board

To remove the main power connector unit



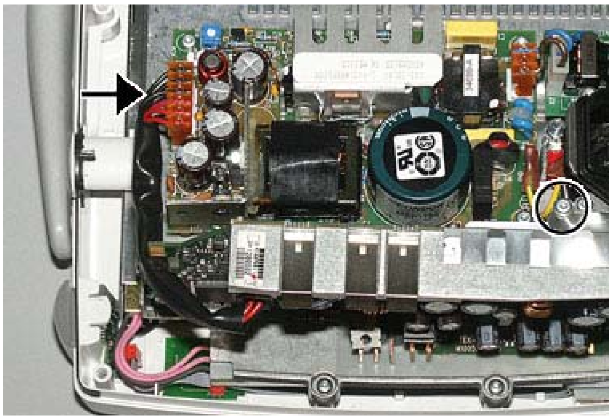
- Remove the two screws (T10) holding the unit to the frame.
- Disconnect the X1 connector and the protective earth connector from the receptacle.

To remove the Multi I/0 connector (25 pins)

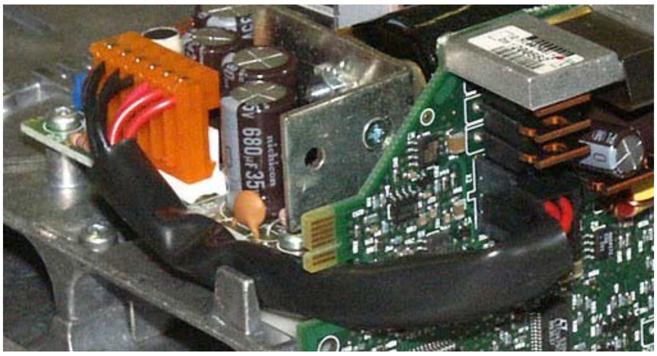


- Remove the two terminal screws (M4,5) with washers holding the connector to the frame.

To remove the DC/DC board

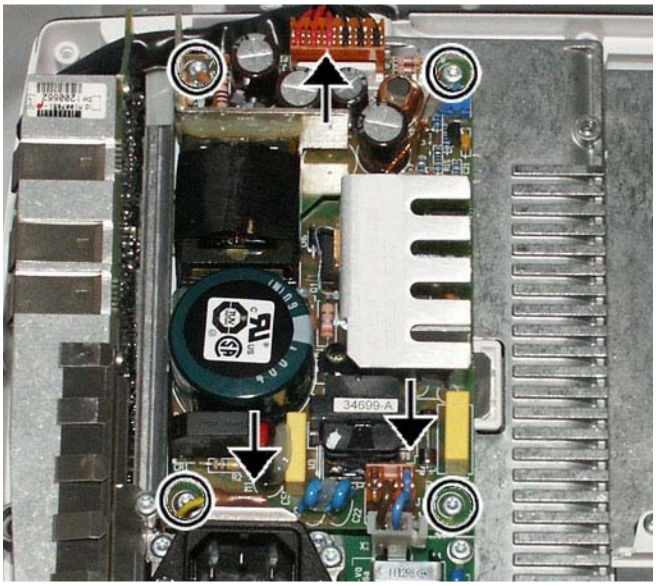


- Remove the AC/DC board connector.
- Remove the screw (T10) holding the unit to the frame.
- Disconnect the DC/DC board from the frame by lifting it up carefully.



- While reassembling, route the AC/DC board - DC/DC board cable according to the picture.

To remove the AC/DC unit and the battery brake



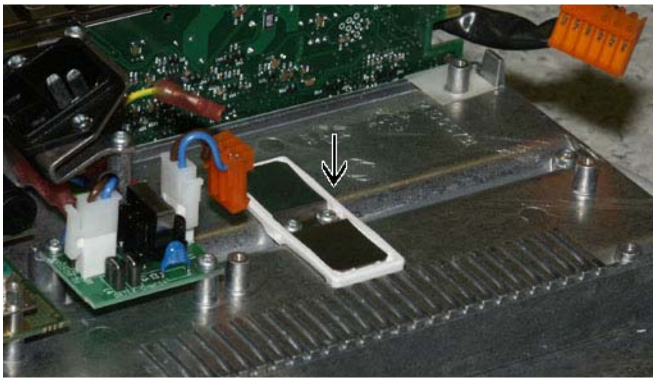
Disconnect:

- the AC/DC unit - DC/DC unit cable connector
- the AC/DC board - Filter board cable connector
- the protective earth cable connector

Remove:

- the four screws (T10) holding the AC/DC unit to the frame
- the AC/DC unit

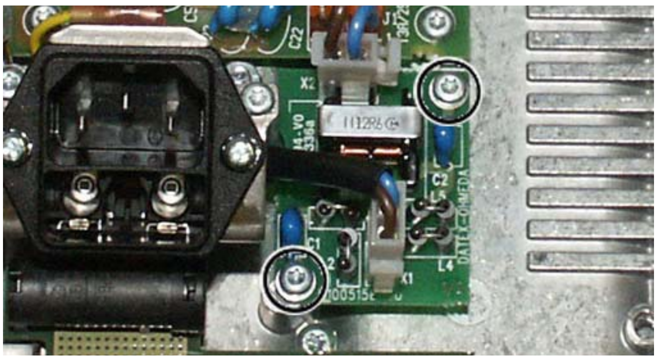
NOTE: It is not allowed to repair the AC/DC power unit in the field. Return the faulty AC/DC power unit to GE Healthcare for service.



To remove the battery brake:

- remove the two (T10) screws

To remove the filter board



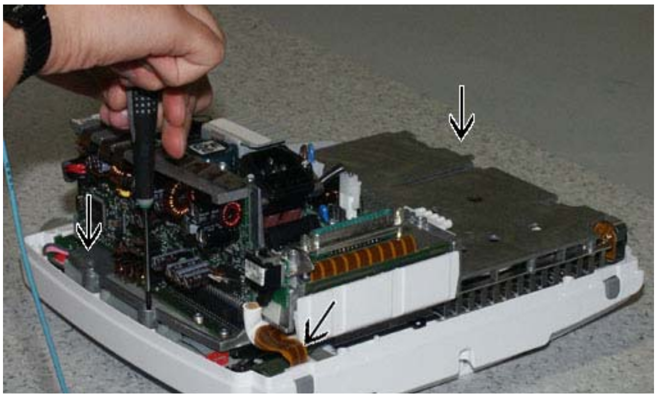
- Remove the two (T10) screws holding the filter board to the frame.

To separate the frame assembly from the front cover unit

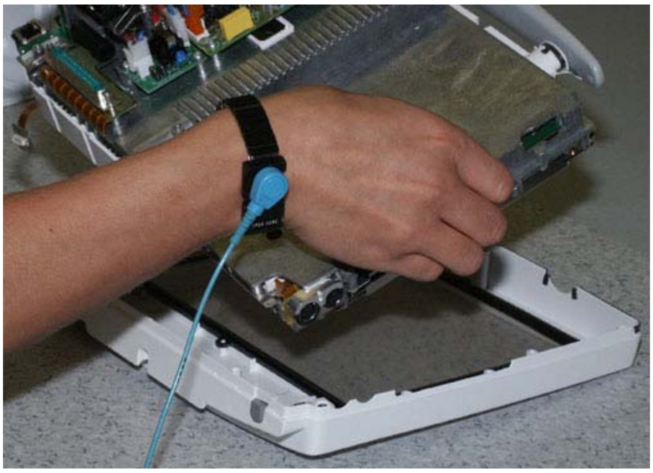
WARNING **Wear a grounded antistatic wristband and soft cotton gloves (dust free) when handling the LCD display parts. Hold them by their corners or edges. Do not touch the connector pins.**

In normal circumstances it is very difficult to keep the LCD display component and the display shield surfaces free of dust when the LCD display unit is exposed to room air. If dust particles remain on the LCD display component and the display shield surfaces, they may impair the picture quality on the screen.

If you can provide a dust free environment, follow the instructions below.



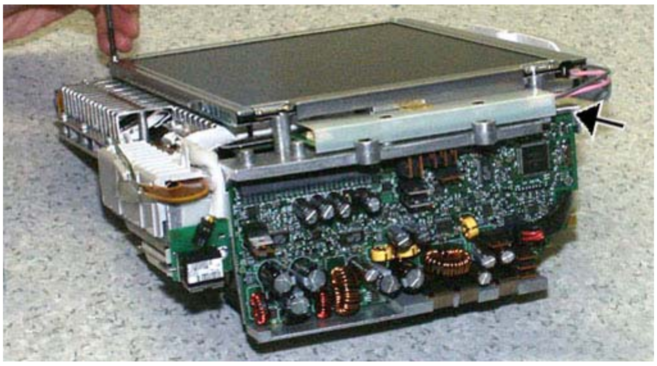
- Disconnect the interconnection flex board connector from the user interface board.
- Remove the three (T8) screws from the borders of the frame unit, one on the other, two on the other side of the frame.



- Lift the frame unit carefully up.

NOTE: The backlight circuit runs on high voltage. Do not touch the inverter board or the backlight tube leads when powered.

To change the LCD backlight



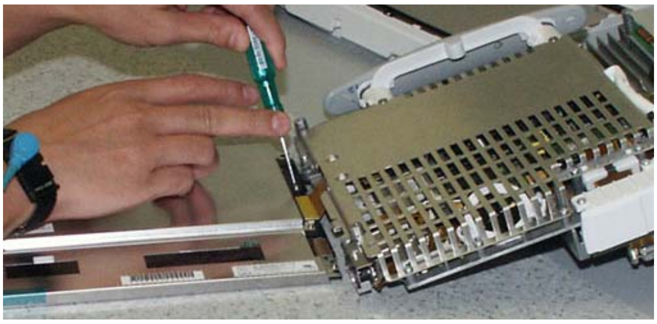
- Disconnect the connector from the inverter board.
- Push the lid beside the backlight to release the backlight tube. Pull the backlight carefully out.

NOTE: Do not bend the backlight tube.

NOTE: Do not touch the backlight tube with your hands.

To separate the LCD display from the frame unit

- Remove the four (T10) screws holding the display to the frame unit.
- Disconnect the connector from the inverter board.



- Lift the display carefully up.
- Disconnect the LCD display flat cable carefully from the display.

NOTE: When reassembling the LCD display, be careful that no dirt or finger prints are left between the LCD display element and the protection glass window.

NOTE: Do not use excessive force when fastening the display to the frame. Fastening the screws too tightly might bend the display too much and break it. The screws must also be fastened gradually, first fasten all screws slightly, then more tightly.

3.3.2 Handling and storage of LCD display component

Handling of LCD display component and protective window

If the LCD Display component surface becomes dusty, wipe it gently with absorbent cotton, chamois or other soft material. If necessary, breathe onto the display surface and wipe immediately. The display surface may also be cleaned using a small amount of normal hexane. Do not use acetone, toluene or alcohol because they cause chemical damage to the polarizer.

1. Wipe off saliva and water drops as soon as possible. Their prolonged contact with the polarizer cause deformations and color fading.
2. Do not open the component case because internal circuits are sensitive to electrostatic discharges.

Taking a spare part LCD Display component or a display shield into use:

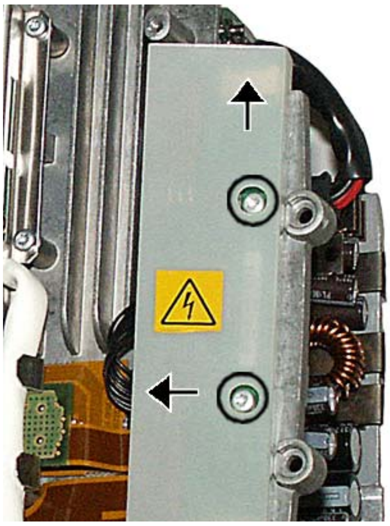
Peel off the protective film slowly (in more than 10 seconds) from the display or protective window surface. Fast peeling may generate enough static electricity to destroy the LCD Display component.

Storaging an LCD display component as a spare part for a long period

1. Store the display in a dark place. Do not expose it to sunlight or fluorescent light. Keep the temperature between 5 °C and 35 °C / 41 °F and 95 °F at normal humidity.
2. The polarizer surface should not come into contact with any other object. It is recommended that the display unit is stored in the container in which it was originally shipped.

To remove the inverter board

NOTE: The inverter board is sensitive to bending.



- Remove the two (T10) screws and the insulator plate.
- Disconnect the backlight connector(s) and the inverter cable connector.

NOTE: When reassembling make sure that the connectors are fastened properly.

Inverter Board F-FM(W)-01

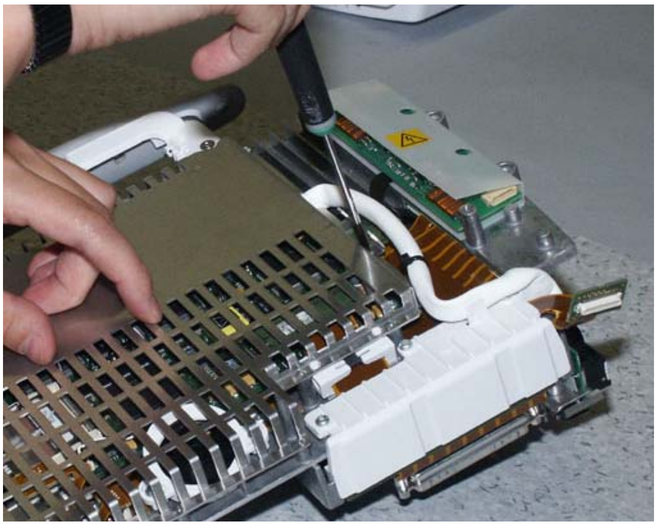
Inverter Board F-FM(W)-00

NOTE: When replacing the Inverter board, fasten the inverter screws gently, using only as much force as necessary to fasten the board firmly enough in place. The screws must not be fastened so tightly that the board will be bent from around the screws.

To remove the handle

- Remove the two screws (T15) holding the handle to the handle guide unit.

To remove the EMC shield



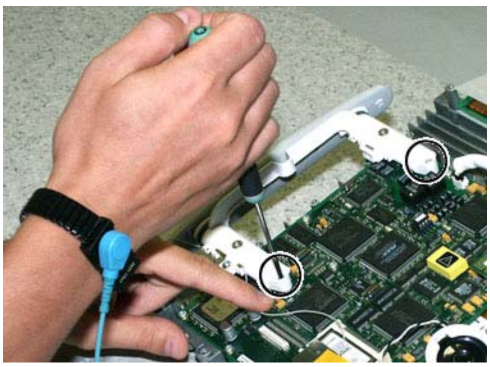
- Remove the 14 screws (T10) holding the shield to the frame unit. One of the screws is under the Network connection cable. Lift the shield carefully up.

NOTE: When reassembling the monitor, remember to connect the grounding wire of the Sync connector unit to the EMC shield.

Now you can access the following field replaceable spare parts. Follow the instructions below:

- “To remove the handle guide unit”
- “To remove the CPU board”
- “To remove the loudspeaker unit”
- To remove the Network cable, disconnect the cable connectors from the CPU board and the Network connector board.

To remove the handle guide unit



- Remove the WLAN antenna from the handle guide.
- Remove the two screws (T10) holding the handle guide unit to the frame.

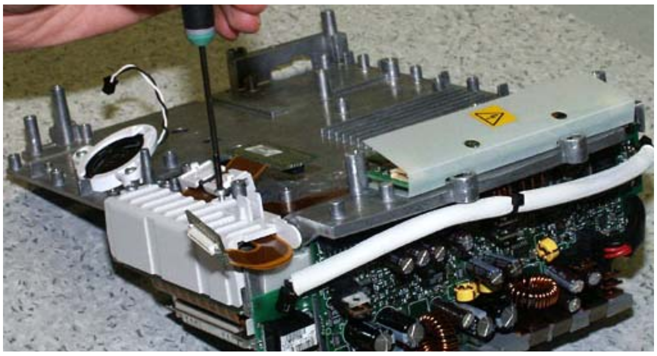
To remove the CPU board

- Disconnect the following cables from the CPU board:
  - loudspeaker cable
  - Sync connector cable
  - interconnection board connector cable
  - network connection cable
- Remove the eight screws (T10) holding the CPU board to the frame.
- Lift the CPU board carefully up and remove it from the frame.

To remove the loudspeaker unit

- Remove the two screws (T10) holding the loudspeaker unit to the frame.
- Disconnect the loudspeaker cable from the CPU board.

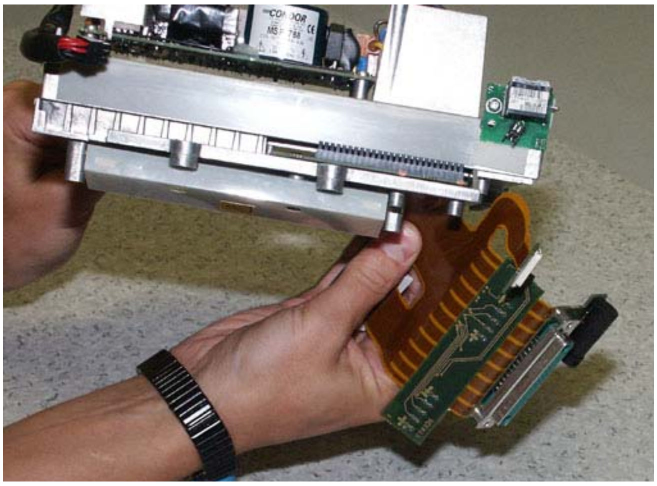
To remove the interconnection board



- Remove the three screws (T10) holding the plastic flex board cover.

- Turn the frame around. Remove the two screws (T10) holding the flex board to the frame.
- Disconnect the interconnection board connector from the module bus cable.

NOTE: When reassembling the monitor, check that a cellular rubber sealing is attached to the module bus cable connector.



- Remove the interconnection board carefully from the frame.

To remove the power supply frame

- Remove the two screws (T15) holding the power supply frame to the inner frame.

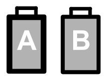
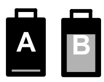
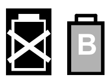
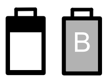
- Now you have access to replace the inner frame and Modulebus cable unit sub-assembly.

3.4 Batteries

3.4.1 Battery indicators

The S/5 FM messages, screen symbols and front panel LED indicators tell the user about the status of the batteries. For screen symbols, see “Part 1 Symbols”. For LED indicators, consult the table below and for messages, see section “Troubleshooting.”

Table 5 Battery indicators

Screen symbol	Explanation	Front panel battery LED indicators	
	Monitor is battery powered. Batteries are fully charged and the size of the green bar indicates the charging level.	● ○	green lit orange dark
	Monitor is battery powered. Battery A is empty, battery B is ok.	● ○	green lit orange dark
	Monitor is battery powered. Battery A failure, battery B is ok.	● 	green lit orange flashing
	Monitor is mains powered. Battery A is being charged (white bar), battery B is already charged.	○ ●	green dark orange lit
	Monitor is battery powered. Battery A is missing, battery B is ok.	● 	green lit orange flashing
no screen symbol	Monitor is mains powered. No battery backup: batteries have failed or they are not inserted.	○ 	green dark orange flashing

3.4.2 To change the batteries

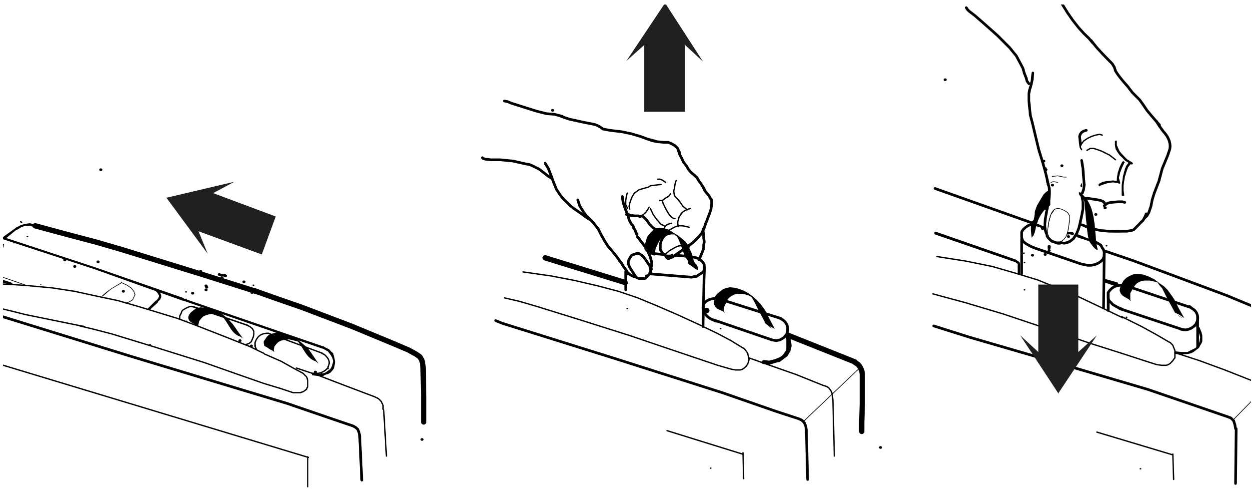


Figure 14 Inserting a battery

(1) Open the lid of the battery compartment located behind the handle by sliding it to the left.

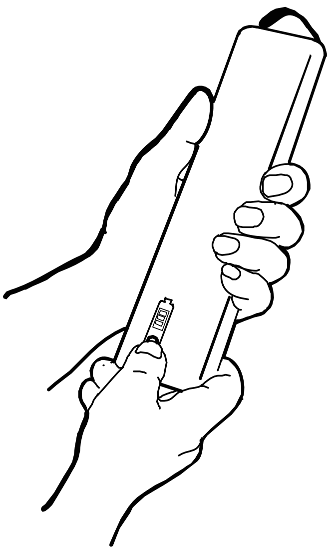
(2) Lift up the battery you want to change. Check the indicators and messages on the screen to make sure that you change the battery with lower charge.

(3) Push in the new battery. Make sure that the charging indicator is facing forward and push the battery down all the way. Check the monitor indicators.

CAUTION After having replaced a battery, always make sure that you close the battery compartment by sliding the lid back to the right until it clicks.

WARNING Do not incinerate a battery or store at high temperatures as it will explode.

3.4.3 To check the battery



Check the battery charging level by pressing the test button on the battery as indicated in the drawing on the left.

The green bar lights up and the number of lit segments indicates the charging level: the more lit segments, the higher the capacity level.

Figure 15 Capacity indicator on the battery

3.4.4 Conditioning the batteries

Condition the batteries regularly to maintain their useful life. Condition a battery every six months or when the message 'Condition Battery x'' appears on the screen. Always observe the messages and symbols on the screen to see the battery status. You can also check the status through **Monitor Setup** - ***Battery Setup***. Conditioning a battery is best done on an external charger. If you do not have an external charger, proceed according to the following instructions.

NOTE: You cannot condition batteries during patient monitoring. Always disconnect the modules first.

1. Continue normal battery use until the green bar of a battery charge indicator is less than 3/4 of the full height. After this, remove the battery. Continue monitoring with one battery until its charge is less than 3/4 of the full capacity.
2. Insert both batteries and connect the monitor to the power supply. The monitor starts charging both batteries, and the capacity indicators scroll accordingly. Keep charging the batteries until both capacity indicators are full height.
3. Continue charging for another two hours. After this, check that the orange battery LED in the front panel is no longer on. If it is, continue charging until it goes off.
4. Disconnect the monitor from the power supply and leave it on until the batteries run out and the monitor switches off. Wait for another 15 minutes.
5. Reconnect the monitor to the power supply and turn it on. Continue charging the batteries until both capacity indicators are full height and no longer scrolling.
6. Keep charging for another two hours. After this, check that the orange battery LED in the front panel is no longer on. If it is, continue charging until it goes off to indicate that the battery conditioning is complete.

NOTE: If only one battery is inserted during conditioning, the orange LED will keep flashing and will not go off.

3.5 To replace the fuses

3.5.1 Primary fuses

Pull out the fuse holder under the mains connector at the back of the monitor. Replace the fuses with fuses of exactly the same type and rating.

3.5.2 Fuse for external DC

External DC power for future use only.

Remove the rear cover. Replace the fuse that is located inside the fuse holder under the receptacle with a fuse of exactly the same type and rating.

3.6 To download the software on CPU board

In case of a faulty CPU board refer first to section “To remove the CPU board“ and then follow the instructions for downloading service software.

NOTE: All user settings will be lost after downloading of new monitor software.

NOTE: During the downloading of software the serial number of the monitor is written on the software card. The software can then be downloaded again to the same monitor, but not to any other monitor. (For F-FM(W)-00 frame version).

3.7 Adjustments and calibrations

It is not necessary to perform calibrations or adjustments on S/5 Frame for FM.

4 Troubleshooting

4.1 S/5 Frame for FM

Table 6 S/5 Frame for FM troubleshooting chart

Problem	Cause	What to do
Monitor is not starting.	1. The batteries are empty. 2. Fuses may be blown. 3. If power cord connected, AC/DC unit may be faulty. 4. If AC/DC unit is working, the DC/DC board may be faulty. 5. On/Stby key may be faulty.	1. Connect the power cord. 2. Replace fuses. 3. Replace the AC/DC power unit. 4. Replace the DC/DC unit. 5. Replace the command board panel keyboard foil.
Monitor is not starting.	1. The connection between DC/DC board and CPU board may be faulty. 2. Faulty CPU board.	1. Check the connector and the interconnection board. 2. Replace the CPU board.
The monitor starts (alarm leds are lit and a beep is heard), but the display remains black.	1. The LCD display cables are loose. 2. The backlights are not lit.	1. Check the LCD display connection board connectors. 2. Check backlight connector. Check inverter cable. Backlights may be faulty. Replace the backlights. Backlight Inverter may be faulty. Replace the Inverter board.
Display and monitor operating but alarm leds not illuminating in start-up.	1. Loose connectors. 2. Ribbon cable faulty. 3. CPU not working.	1. Check all connectors from CPU to led board. 2. Replace ribbon cable. 3. Replace CPU.
Display and monitor operating but no audible beep in start-up.	1. Loudspeaker connector or wires loose or faulty.	1. Check loudspeaker connector and wires.
Display is too dim.	1. Incorrect brightness adjustment. 2. Backlight faulty. 3. Backlight inverter faulty.	1. Adjust display brightness higher. 2. Replace backlight. 3. Replace backlight inverter.
Stripes or white areas on screen.	1. Loose faulty display connection flexboard connectors in CPU and display.	1. Check display connection flexboard connectors in CPU and display.
Module data disappears from the screen. 'Module power supply overload' message.	Parameter module current (in module bus) too high.	Detach and change parameter module.
Module data disappears.	1. Module bus voltage or signals path broken.	1. DC/DC board module power section may be faulty. Replace the DC/DC board. 2. Replace the Module bus cable unit.

Problem	Cause	What to do
'Battery failure' message on the screen.	1. Problem in communication between battery and DC/DC board. 2. Battery too old or defected. 3. DC/DC board may be faulty.	1. Replace battery. 2. Replace battery. 3. Replace the DC/DC board.
'Frame temperature high' message.	The temperature inside the frame is too high.	Check monitor ventilation holes.
'Battery temperature high' message on the screen.	Battery SMBus temperature is too high.	Check monitor ventilation holes. Replace battery.
After shut off, the trend and patient data does not remain 15 min in the memory.	1. The On/Stby switch has been pressed over 10 s. (= service reset). 2. Empty battery. 3. Only one battery inserted.	1. When switching off, the On/Stby switch has to be pressed less than 10 s. 2. Replace the battery. 3. Use always two batteries.
Keyboard not working, but module communication is OK.	Keyboard cables and connectors, or interconnection board connectors may be faulty.	Check the interconnection board connectors. Check the keyboard cable connection to the user interface board.
Keyboard not working, and module communication not working.	UPI section of the CPU board not functioning normally.	Restart the monitor. Replace the Central Processing Board.
Keyboard partly not working.	1. Keyboard faulty. 2. Keyboard cables and connectors, or interconnection board connectors may be faulty.	1. Replace the keyboard foil. 2. Check the interconnection board connectors. Check the keyboard cable connection to the user interface board.

4.2 Memory option

Table 3 Memory option troubleshooting chart

Error message	Cause	What to do
'No menus in Menu Card' message	There are no menus in the Menu card.	Insert a Menu card with valid menu configuration files in the module.
'Faulty Data Card - change card'	An error has occurred during Data card read/write operation.	Change Data card.
'Faulty Menu Card - change card'	An error has occurred during Menu card read/write operation.	Change Menu card.

4.3 NET section

Table 4 NET section troubleshooting chart

Problem	Cause	What to do
Monitor does not connect to the network. Monitor connects to the network, but disconnects unexpectedly ('Network connection down' message on the monitor screen).	Patch panel	Patch cable not connected to HUB or to panel.
	Patch cable	Patch cable or connector defective.
		HUB not connected to power supply.
		HUB port closed due to physical layer problems.
		HUB port temporarily closed and reopened due to physical layer problems.
		Hubs not properly connected to each other.
	Monitor-Network cable	Cable not properly connected to the wallplate or to the monitor.
		Cable or connector defective.
	Network cable (inside the monitor) defective	Replace the Network cable.
	Network Connector Board defective	Replace the Network Connector Board Unit.
	Net section of the CPU board	The NET section is defective. Replace the CPU board.
	NET section memory on the CPU board	The SRAM of the NET section is defective or uninitialized. The NET cannot be used. See network service page for details.
	Wrong identification number	Use the Virtual ID number with monitors that have WLAN option installed.
	Identification plug	There is no identification plug attached to the monitor. The identification plug is defective or uninitialized. The plug cannot be used.
	Multi I/O adapter faulty	Replace multi I/O adapter.

Problem	Cause	What to do
'Check network connectors' message shows on the monitor screen	Monitor-Network cable	Cable not properly connected to the wallplate or to the monitor. Cable or connector defective.
	Network cable (inside the monitor) defective	Replace the Network cable.
	Network Connector Board defective	Replace the Network Connector Board Unit.
	Multi I/O adapter faulty	Replace multi I/O adapter.
	Identification plug	There is no identification plug properly attached to the monitor. The identification plug is defective or uninitialized. The plug cannot be used. See network service page for details.
'Network board error' message shows on the monitor screen	NET section on the CPU board NET section memory on the CPU board	The NET section is defective. The board cannot be used. See network service page for details. The SRAM memory of the NET section is defective or uninitialized. The board cannot be used. See network service page for details.
Other Site View shows no waveforms	No waveforms are set up for Monitor-to-Monitor communication	Run Network Setup to verify current Monitor-to-Monitor communication setup.
Network printing fails	Print server is busy	Network manager's print server is busy at the moment and cannot take more print jobs. Try again after 15 seconds.
	Print queue is full	There are too many unprinted documents waiting in the print queue. Check the printer, as it is not operating properly.
	Printer is off-line	Printer cable is loose, printer is out of paper, there is a paper jam or the printer is simply switched to off-line state.
Record keeper menus are blank	There are no menus for the record keeper	Run Network Setup to verify the current setup.

For your notes:

APPENDIX A: Service check form, Datex-Ohmeda S/5 Frame for FM, F-FM

Customer		
Service	Module type	S/N
Service engineer		Date

Monitor Installation			
L-	E-	F-	N-
N-	N-	N-	N-
N-			

OK = Test OK **N.A. = Test not applicable** **Fail = Test failed**

General	OK	N.A.	Fail		OK	N.A.	Fail
1. Internal parts	☐	☐	☐	2. External parts	☐	☐	☐
3. Module installation	☐	☐	☐	4. Command Board LEDs	☐	☐	☐
5. Start-up	☐	☐	☐	6. Module recognition	☐	☐	☐
7. LCD display picture	☐	☐	☐	8. Time and date	☐	☐	☐
9. Loudspeaker	☐	☐	☐	10. Display brightness	☐	☐	☐
11. Monitor software	☐	☐	☐	12. Content of the service log	☐	☐	☐
13. Voltages	☐	☐	☐	14. Watchdog circuitry	☐	☐	☐
15. Alarm LEDs	☐	☐	☐	16. Membrane keys	☐	☐	☐
17. ComWheel	☐	☐	☐	18. Module communication	☐	☐	☐
19. Batteries	☐	☐	☐	20. Battery operation	☐	☐	☐
21. Battery charging	☐	☐	☐				

Recorder unit							
	OK	N.A.	Fail				
22. Recorder messages	☐	☐	☐	23. Recording	☐	☐	☐
24. Paper speed	☐	☐	☐	25. Quality of recording	☐	☐	☐
Notes							

MemCard Option				S/N			
	OK	N.A.	Fail		OK	N.A.	Fail
26. Module recognition	☐	☐	☐	27. Memories and PCMCIA controller	☐	☐	☐
28. Communication	☐	☐	☐	29. Data Card recognition	☐	☐	☐
30. Menu Card recognition	☐	☐	☐	31. Menu card function	☐	☐	☐
	☐	☐	☐		☐	☐	☐
Notes							

Network Option				S/N			
	OK	N.A.	Fail		OK	N.A.	Fail
32. Connection to network	☐	☐	☐	33. Ethernet address	☐	☐	☐
34. Data error counters	☐	☐	☐	35. Hardware error counters	☐	☐	☐
36. Disconnection recognition	☐	☐	☐	37. ID-plug recognition	☐	☐	☐
	☐	☐	☐		☐	☐	☐
Notes							

Wireless LAN option					**S/N**		
	OK	**N.A.**	**Fail**		**OK**	**N.A.**	**Fail**
38. Signal strength	☐	☐	☐	39. Configure access point	☐	☐	☐
40. Connection to Network	☐	☐	☐		☐	☐	☐
Notes							

General							
	OK	**N.A.**	**Fail**		**OK**	**N.A.**	**Fail**
41. Trends retaining	☐	☐	☐	42. Battery capacity	☐	☐	☐
43. Service Log reset	☐	☐	☐	44. Electrical safety check	☐	☐	☐
45. Final cleaning	☐	☐	☐	46. Fill in all necessary documents	☐	☐	☐
Notes							

Used spare parts			

Signature

For your notes:

Patient Side Module, E-PSM, E-PSMP (Rev. 01)

Technical Reference Manual Slot

Conformity according to the Council Directive 93/42/EEC concerning Medical Devices amended by 2007/47/EC

CAUTION: U.S. Federal law restricts this device to sale by or on the order of a licensed medical practitioner. Outside the USA, check local laws for any restriction that may apply.

All specifications subject to change without notice.

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Introduction

This Technical Reference Manual Slot provides information for the maintenance and service of the Patient Side Modules E-PSMP and E-PSM.

Please also refer to "Technical Reference Manual" of the monitor for system specific information e.g. related documentation, conventions used, symbols on equipment, safety precautions, system description, system installation, interfacing, functional check and planned maintenance.

The E-PSMP and E-PSM modules provide general hemodynamic parameters.

Figure 1 Patient Side Module, E-PSMP

Table 1 Patient Side Module options

Parameter	E-PSMP	E-PSM
Two invasive blood pressures	x	
Impedance respiration	x	x
ECG	x	x
Pulse oximetry	x	x
Two temperatures	x	x
NIBP	x	x

Intended purpose (Indications for use)

The Patient Side Module (model family E-PSM(P)) and accessories are indicated for the monitoring of hemodynamic parameters of all hospital patients. The hemodynamic parameters of the module comprise ECG including ST-segment and arrhythmia, Impedance respiration, NIBP, Temperature, SpO_2 (including monitoring during conditions of clinical patient motion), and invasive blood pressure.

Impedance respiration measurement is indicated for patients aged 3 and up. The NIBP measurement is indicated for patients who weigh 5 kg (11 lb.) and up. This device is indicated for use by qualified medical personnel only.

Monitor software compatibility

Patient Side Module, E-PSM(P) Rev. 00 and 01 are designed for use with Datex-Ohmeda monitors as follows:

– S/5 FM monitors using software L-FICU04(A) or later.

– S/5 Anesthesia Monitors using software L-ANE04(A) or later equipped with 5-Module Frame, F-CU5(P) or with S/5 8-Module Frame, F-CU8. With the F-CU8, the E-INTPSM interface module is needed.

– S/5 Critical Care Monitors using software L-ICU04(A) or later equipped with 5-Module Frame, F-CU5(P) or with S/5 8-Module Frame, F-CU8. With the F-CU8, the E-INTPSM interface module is needed.

Equipment safety symbols

When displayed on the **E-PSM, E-PSMP** module, indicates that protection against cardiac defibrillator discharge is due in part to the accessories for pulse oximetry (SpO_2), temperature (T) and invasive pressure (P) measurement.

1 Specifications

1.1 General specifications

Module size	51 x 132 (171 w/ tab) x 140 mm
W x D x H	2 x 5.2 (67 w/ tab) x 5.5 in
Module weight	0.6 kg /1.4 lb.
Power consumption	2.3 W typical (NIBP pump off)
	7.5 W typical (NIBP pump on)
Operation temperature	10 to 40°C / 50 to 104°F

1.2 Typical performance

1.2.1 NIBP

WARNING **Non-invasive blood pressure measurement is intended for patients weighing over 5 kg (11 lb.)**

Oscillometric measurement principle.

Measurement range	adult	25 to 260 mmHg
	child	25 to 195 mmHg
	infant	15 to 140 mmHg
Pulse rate range accepted	30 to 250 bpm	
Measurement interval	from 1 min. to 4h	
Typical measuring time	adult	23 s
	infant	20 s
Initial inflation pressure	adult	170 ±10 mmHg
	child	150 ±10 mmHg
	infant	120 ±10 mmHg
Venous stasis	adult	80 ±5 mmHg / 2 min.
	child	60 ±5 mmHg / 2 min.
	infant	40 ±5 mmHg / 1 min.
Cuff widths	see User's Guide	

Venous stasis pressure may be lower than the values above if the patient has low blood pressure. The venous stasis pressure adapts to the measured mean pressure being the same as mean pressure but always at least the following:

Infant 20 ± 5 mmHg
Child 30 ± 5 mmHg
Adult 40 ± 5 mmHg

Overall system accuracy: Meets or exceeds SP10-2002 AAMI standards[1]

1 (According to SP10-2002 AAMI 4.4.5.2.B, Intra-arterial method as the reference standard, mean difference of the test system and the comparison system shall be ± 5 mmHg or less with standard deviation of 8 mmHg or less).

1.2.2 ECG

Lead selection	I, II, III, aVR, aVL, aVF, V1, V2, V3, V4, V5, V6
Sweep speeds	12.5, 25, 50 mm/sec.

Display filter

Diagnostic	0.05 to 150 Hz
Monitoring	0.5 to 30 Hz (-3 dB, with 50 Hz reject filter) 0.5 to 40 Hz (-3 dB, with 60 Hz reject filter)
ST filter	0.05 to 30 Hz (-3 dB, with 50 Hz reject filter) 0.05 to 40 Hz (-3 dB, with 60 Hz reject filter)

Heart rate from ECG

Range	30 to 250 bpm
Accuracy	±5 bpm or ±5%, whichever is greater
Resolution	1 bpm
Update interval	5 s
Averaging time	5 s

ST levels (in main software)

ST level range	-9 to +9 mm (-0.9 to +0.9 mV)
Resolution	0.1 mm (0.01 mV)
Averaging	calculated from 8 QRS complexes

Pacemaker pulse detection

Detection level	2 to 700 mV
Pulse duration	0.5 to 2 ms

The monitor is specified for both of the methods A and B in ANSI/AAMI EC13 4.1.4.2.

Direct ECG and Synchronization

for specifications see section “Specifications” in the “Frame for FM Technical Reference Manual Slot”

1.2.3 Pulse oximetry

Measurement range	0 to 100%
Calibration range	70 to 100%
Accuracy[1]	100 to 70%, ±2 digits ±3 digits during clinical patient motion 69 to 0%, unspecified
Display resolution	1 digit = 1% of SpO_2
Display averaging time	Slow, Normal, beat-to-beat
Pulse beep pitch	varies with SpO_2 level

The monitor is calibrated against functional oxygen saturation SpO_2 func.

Pulse rate from Pleth

Measurement range	30 to 250 bpm
Accuracy	30 to 100, ±5 bpm, 100 to 250, ±5%
Resolution	1 bpm
Display averaging	10 s

Adjustable pulse beep volume.

Pleth waveform

Scales	2, 5, 10, 20, 50 mod%, Auto

Start up scale is 20 mod% if AUTO is not selected to be the default setting.

1 Accuracy is based on deep hypoxia studies with volunteered subjects during motion and non-motion conditions over a wide range of arterial blood oxygen saturation as compared to arterial blood CO-Oximetry. Accuracy may depend on the sensor used, please refer to the instructions for use in the accessory package.

1.2.4 Temperature

Measurement range	10 to 45 °C (50 to 113 °F)
Measurement accuracy	±0.1 °C (25 to 45.0 °C) ±0.2 °C (10 to 24.9 °C)
Display resolution	0.1 °C (0.1 °F)
Temperature test	automatic (every 10 min.)
Probe type	compatible with YSI 400 series
Single use sensors	±0.3 °C (25 to 45.0 °C) ±0.4 °C (10 to 24.9 °C)

1.2.5 Invasive blood pressure

Measurement range	-40 to 320 mmHg
Measurement accuracy	±5% or ±2 mmHg
Zero adjustment range	±150 mmHg
Calibration range	±25%
Scales	upper limit is adjustable between 10 and 300 mmHg in steps of 10 mmHg. Lower limit is 10% of selected upper limit below zero.
Sweep speed	12.5, 25, 50 mm/s

Digital display

Range	-40 to 320 mmHg
Resolution	±1 mmHg

Waveform display

Range	-30 to 300 mmHg

Pulse rate from arterial pressure

Measurement range	30 to 250 bpm
Resolution	1 bpm
Accuracy	±5 bpm or ±5% whichever is greater

1.2.6 Respiration

The EMC immunity of the respiration measurement has been tested with 1 Vrms and 1 V/m. This level has been used for optimizing the immunity of the respiration measurement to damp the operating frequency of the electrosurgery equipment.

WARNING **Impedance respiration measurement is intended for patients over three years old.**

Measurement range	4 to 120 breath/min
Accuracy	±5 breath/min or ±5%
Resolution	1 breath/min
Averaging time	30 s
Update interval	10 s

Respiration waveform

Sweep Speeds	6.25 mm/s and 0.625 mm/s

1.3 Technical specifications

1.3.1 NIBP

Deflation rate, PR dep.	3 to 8 mmHg/s	
Inflation time	20 to 185 mmHg, 1 to 5 s	
Automatic software control, max. inflation pressure		
	adult	280 ±10 mmHg
	child	200 ±10 mmHg
	infant	145 ±5 mmHg
Over pressure limit, stops measurement after 2 seconds		
	adult	320 mmHg
	child	220 mmHg
	infant	160 mmHg

The safety circuit limits the maximum cuff pressure to 320 mmHg in adult/child mode or to 160 mmHg in infant mode. Independent timing circuit limits the pressurizing (>15 mmHg) time to 3 minutes maximum in adult/child mode, and to 90 seconds at (>5mmHg) in infant mode.

Zeroing to ambient pressure is done automatically.

Inflation pressure is adjusted according to the previous systolic pressure, typically 40 mmHg above. If the systolic pressure is not found, the inflation pressure is increased typically 50 mmHg.

Max. measurement time	adult	120 s
	child	120 s
	infant	75 s

Pressure transducer accuracy is better than ±3 mmHg or ±2% whichever is greater.

Max. error	±4 mmHg.
Protection against electrical shock	Type BF defibrillator-proof

1.3.2 ECG

Defibrillation protection	5000 V, 360 J
Recovery time	5 s
Input impedance	>2.5 MΩ (10 Hz)
CMRR	>100 dB (ST)
System noise	<30 mV (p-p, RTI)
Allowable offset	±1VDC
Gain range	0.2 to 5.0 cm/mV
Pacemaker pulse detection	2 to 700 mV, 0.5 to 2 ms pulses
Protection against electrical shock	Type CF defibrillator-proof

1.3.3 Pulse oximetry

Protection against electrical shock	Type CF defibrillator-proof

1.3.4 Temperature

Measurement accuracy	±0.1 °C (25.0 to 45.0 °C)
	±0.2 °C (10.0 to 24.9 °C)
Protection against electrical shock	Type CF defibrillator-proof

NOTE: The accuracy of the measurement may be different from the specified, depending on the transducer/probe used. Please refer to the transducer/probe specification.

1.3.5 Invasive blood pressure

Digital display averaging

Digital displays Art and P1 are averaged over 5 seconds and updated at 5 seconds intervals. All other pressures have respiration artifact rejection.

Accuracy	±5% or ±2 mmHg, whichever is greater
Transducer and input sensitivity	5 μV/V/mmHg
Filter	0 to 4 - 22 Hz adjustable
Zero set accuracy	±1 mmHg
Calibration resolution	±1 mmHg
Zero time	less than 15 s
Protection against electrical shock	Type CF defibrillator-proof

NOTE: The accuracy of the measurement may be different from the specified, depending on the transducer/probe used. Please refer to the transducer/probe specification.

1.3.6 Respiration

Excitation frequency, 12-lead ECG	31.25 kHz
Breath detection	automatic, manually adjustable minimum detection: 0.2, 0.4, 0.6, 0.8, 1.0
Input dynamic range	0.2 to 20 Ω
Input impedance range	100 to 5000 Ω
Respiration Rate	min. 4 breath/min max. 120 breath/min
Lead off detection	>3 MΩ

2 Functional description

2.1 Measurement principle

2.1.1 NIBP

NIBP (Non-Invasive Blood Pressure) is an indirect method for measuring blood pressure.

The NIBP measurement is performed according to the oscillometric measuring principle. The cuff is inflated with a pressure slightly higher than the presumed systolic pressure, and deflated at a speed based on the patient's pulse, collecting data from the oscillations caused by the pulsating artery. Based on these oscillations, values for systolic, mean, and diastolic pressures are calculated.

The following parts are necessary for the NIBP measurement:

- E-PSMP/E-PSM module
- twin hose (adult or infant model)
- blood pressure cuffs (various sizes)

2.1.2 ECG

Electrocardiography analyzes the electrical activity of the heart by measuring the electrical potential produced with electrodes placed on the surface of the body.

ECG reflects:

- electrical activity of the heart
- normal/abnormal function of the heart
- effects of anesthesia on heart function
- effects of surgery on heart function

See the "User's Guide" or the "User's Reference Manual" for electrodes' positions and other information.

2.1.3 Pulse oximetry

A pulse oximeter measures the light absorption of blood at two wavelengths, one in the near infrared (about 940 nm) and the other in the red region (about 660 nm) of the light spectrum. These wavelengths are emitted by LEDs in the SpO_2 probe, the light is transmitted through peripheral tissue and is finally detected by a PIN-diode opposite the LEDs in the probe. The pulse oximeter derives the oxygen saturation (SpO_2) using an empirically determined relationship between the relative absorption at the two wavelengths and the arterial oxygen saturation SaO_2.

In order to measure the arterial saturation accurately, pulse oximeters use the component of light absorption giving variations synchronous with heart beat as primary information on the arterial saturation.

A general limitation of pulse oximetry is that due to the use of only two wavelengths, only two hemoglobin species can be discriminated by the measurement.

The modern pulse oximeters are empirically calibrated either against fractional saturation SaO_2frac;

$$SaO_2frac = \frac{HbO_2}{HbO_2 + Hb + Dyshemoglobin}$$

Formula 1

or against functional saturation SaO_2func;

$$SaO_2func = \frac{HbO_2}{HbO_2 + Hb}$$

Formula 2

Functional saturation is more insensitive to changes of carboxyhemoglobin and methemoglobin concentrations in blood.

The oxygen saturation percentage SpO_2 measured by the module is calibrated against functional saturation SaO_2func. The advantage of this method is that the accuracy of SpO_2 measurement relative to SaO_2func can be maintained even at rather high concentrations of carboxyhemoglobin in blood. Independent of the calibration method, pulse oximeters are not able to correctly measure oxygen content of the arterial blood at elevated carboxyhemoglobin or methemoglobin levels.

Plethysmographic pulse wave

The plethysmographic waveform is derived from the IR signal and reflects the blood pulsation at the measuring site. Thus the amplitude of the waveform represents the perfusion.

Pulse rate

The pulse rate calculation is done by peak detection of the plethysmographic pulse wave. The signals are filtered to reduce noise and checked to separate artifacts.

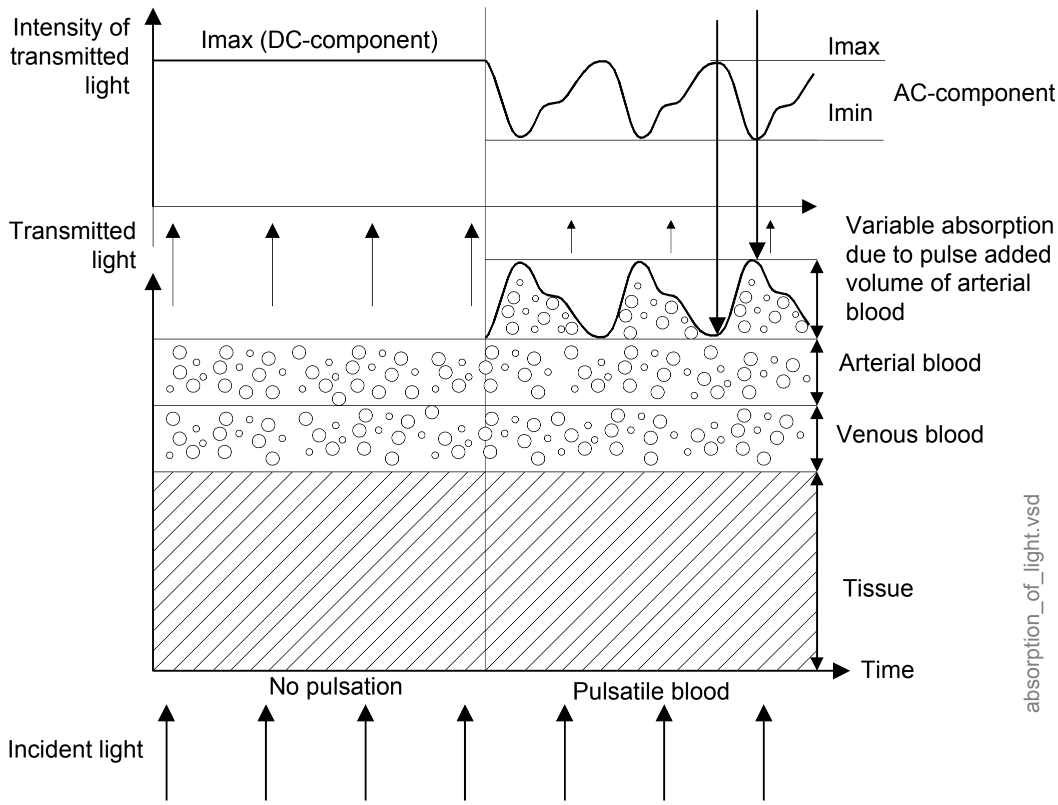


Figure 2 Absorption of infrared light in the finger

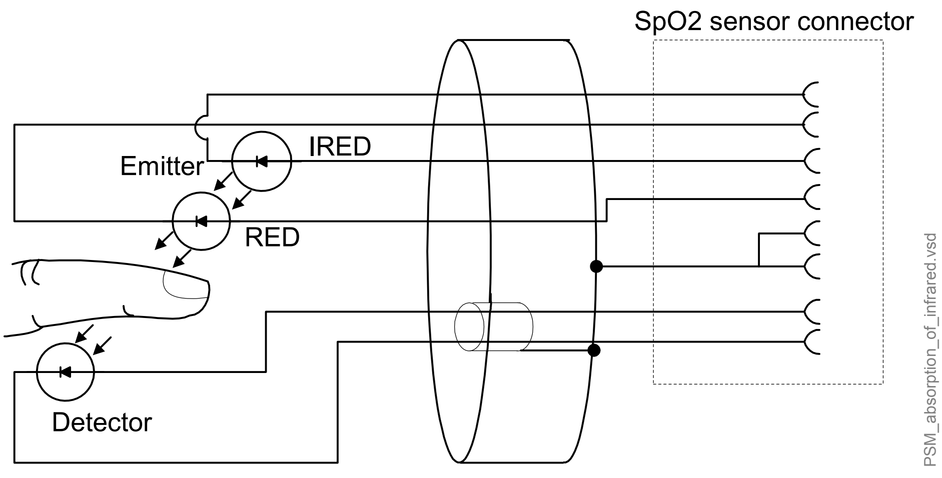


Figure 3 Pulse oximetry probe parts layout and schematic diagram

The standard probe is a finger clamp probe which contains the light source LEDs in one half and the photodiode detector in the other half. Different kinds of probes are available from GE Healthcare.

2.1.4 Temperature

The temperature is measured by a probe whose resistance varies when the temperature changes, called NTC (Negative Temperature Coefficient) resistor.

The resistance can be measured by two complementary methods:

- Applying a constant voltage across the resistor and measuring the current that flows through it.
- Applying a constant current through the resistor and measuring the voltage that is generated across it.

The E-PSM(P) module uses the constant current method. The NTC-resistor is connected in series with a normal resistor and a constant current is applied through them. The temperature dependent voltage can be detected at the junction of the resistors, thus producing the temperature signal from the patient. The signal is amplified by analog amplifiers and further processed by digital electronics.

2.1.5 Invasive blood pressure

To measure invasive blood pressure, a catheter is inserted into an artery or vein. The invasive pressure setup, consisting of a connecting tubing, a pressure transducer, an intravenous bag of normal saline, all connected together by stopcocks, is attached to the catheter. The transducer is placed at the same level with the heart, and is electrically zeroed.

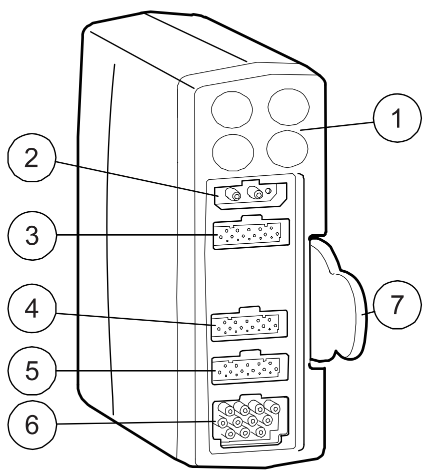
The transducer is a piezo-resistive device that converts the pressure signal to a voltage. The monitor interprets the voltage signal so that pressure data and pressure waveforms can be displayed.

2.1.6 Respiration

Impedance respiration is measured across the thorax between ECG electrodes. The respiration signal is made by supplying current between the electrodes and by measuring the differential current from the electrodes. The signal measured is the impedance change caused by breathing. The respiration rate is calculated from these impedance changes, and the respiration waveform is displayed on the screen.

2.2 Main components

2.2.1 E-PSMP/E-PSM



1. Module keys
2. NIBP connector
3. InvBP connector in E-PSMP only
4. Temperature connector
5. SpO_2 connector
6. ECG and impedance respiration connector
7. Tab for removing the module

Figure 4 Front panel of E-PSMP

The E-PSMP and E-PSM modules contain three main PC boards, the STP board, the ECG board, and the NIBP board. Each of these boards contain a processor and software in the processor flash memory. The boards produce their own supply voltages from the Vmod 13.8-16 V line that is available via the module bus connector. In addition to this, the NIBP board provides +5V for the ECG and STP board non-isolated side components. The NIBP board provides also the synchronization signal for the ECG and STP board power supplies.

There are two input boards; the STP input board and the ECG input board attached to the front panel of the module. The front panel has five connectors and four keys. There is one connector for two temperature measurements, one for two invasive blood pressure measurements, one for ECG, one for NIBP, and one for SpO_2 measurement. The NIBP connector includes two plungers for NIBP hose identification. The keys are for NIBP Auto On/Off, NIBP Start/Cancel, P1 zero, and P2 zero.

NOTE: The connectors and keys depend on the module variant, and some variants may not have all the mentioned connectors and keys.

2.2.2 NIBP board

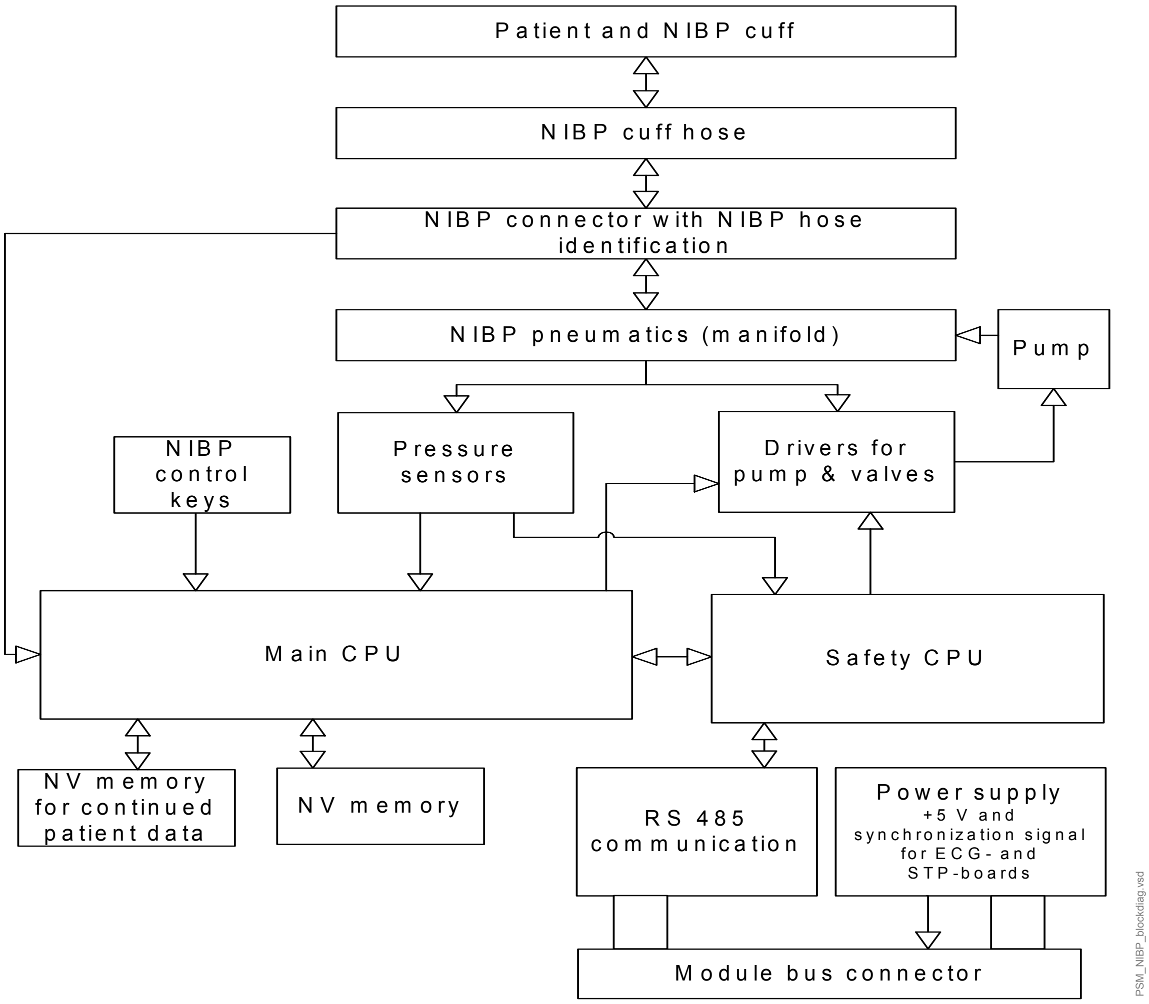


Figure 5 NIBP board functional block diagram

Signal processing

Two signals from the pressure transducers are amplified and sent to the A/D converter. After the converter, digitized signals are sent to the microprocessor for data processing.

The NIBP board is controlled with an H8/3052 microprocessor at 16 MHz oscillator frequency.

Memory

The NIBP program memory (processor flash memory) size is 512k x 8. The processor has 4 kBytes RAM and there is also an external RAM memory, the size of which is 128k x 8. Variable values of the NIBP measurement are stored into the external RAM. The EEPROM size is 512 x 8 and it is used to store the calibration values for the pressure transducers, the pulse valve constants gained during measurements, the PC board identification, and the module serial number.

Software control

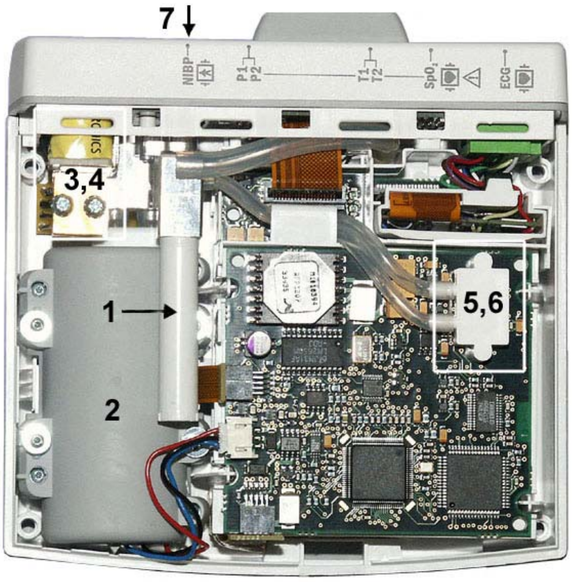
The software controls valves and a pump. In addition to the individual on/off signals for each component there is a common power switch for the valves and the pump that can be used at pump/valve failures.

In addition to external RS485 reset line, the microprocessor system is equipped with its own power-up reset. See the section in the ECG board's description: "RS485 communication."

Safety circuit

The NIBP board is equipped with an independent safety circuit to disconnect supply voltages from the pump and the valves if the cuff has been pressurized longer than the preset maximum measurement time, or if the pressure of the cuff is inflated over the specified pressure limit. The maximum measurement time values and pressure limits for different measurement modes have been specified in the technical specification section of this manual.

Pneumatics



The module has the following pneumatics parts:

1. **Intake air filter**; for preventing dust and other parts from entering the air pump and the valves.
2. **Air pump**; for pumping the measuring pressure of the cuff.
3. **(Pulse) Valve**; for producing a linear pressure fall (bleeding) in order to measure the blood pressure of the patient.
   Note that in the service menu also names **Valve** and **Set valve** have been used for this valve.
4. **Safety valve**; The safety valve is intended to be used for deflating the cuff in single fault case, i.e. to prevent too long a measurement time or too high an inflation pressure of the cuff.
   Note that also **Exh2 valve** has been used to designate the **Safety valve** in service menu.
5. **Main pressure sensor**; for measuring the pressure of the blood pressure cuff and the pressure fluctuations caused by arterial wall movement.
6. **Safety pressure sensor;** for detecting the cuff loose, cuff occlusion situations, etc. and for recognizing the pressure sensor fault.
7. **Cuff connector;** for connection and hose identification.

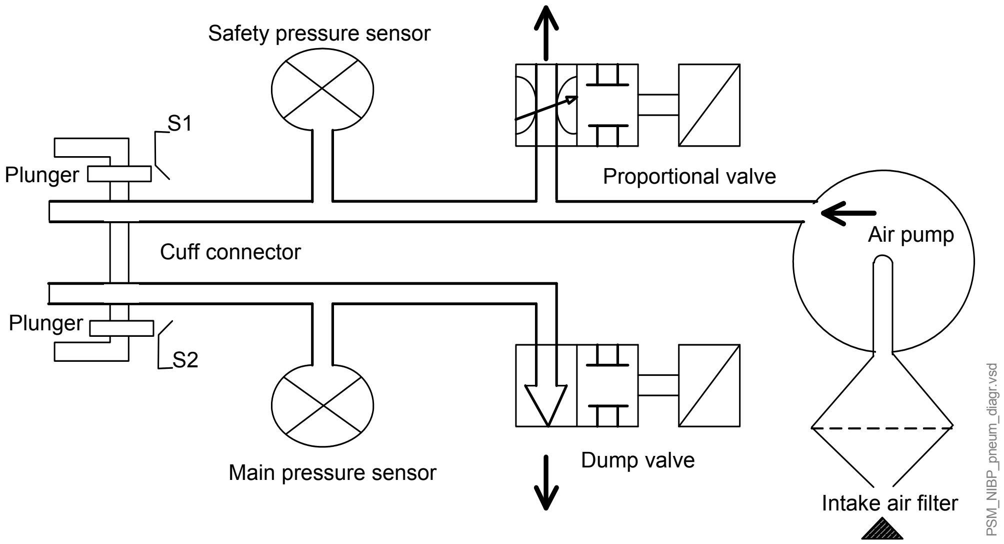


Figure 6 NIBP pneumatics diagram

Power supply section of the NIBP board

All connections are established via a 5-pin connector (female). The module needs a +15 V (dirty) power supply to operate. The supply voltage Vmod 13.8- 16 V is generated in the power supply section of the monitor. The other voltages needed for the operation of the NIBP measurement are made on the NIBP board.

The NIBP power supply synchronizes the ECG and STP isolation power and supplies non-isolated 5 V to the ECG and STP board.

2.2.3 ECG board in 12-lead measurement

The 12-lead ECG measurement consists of the functions shown in Figure 7 on page 15. All functions are located in the ECG board except the ECG input unit.

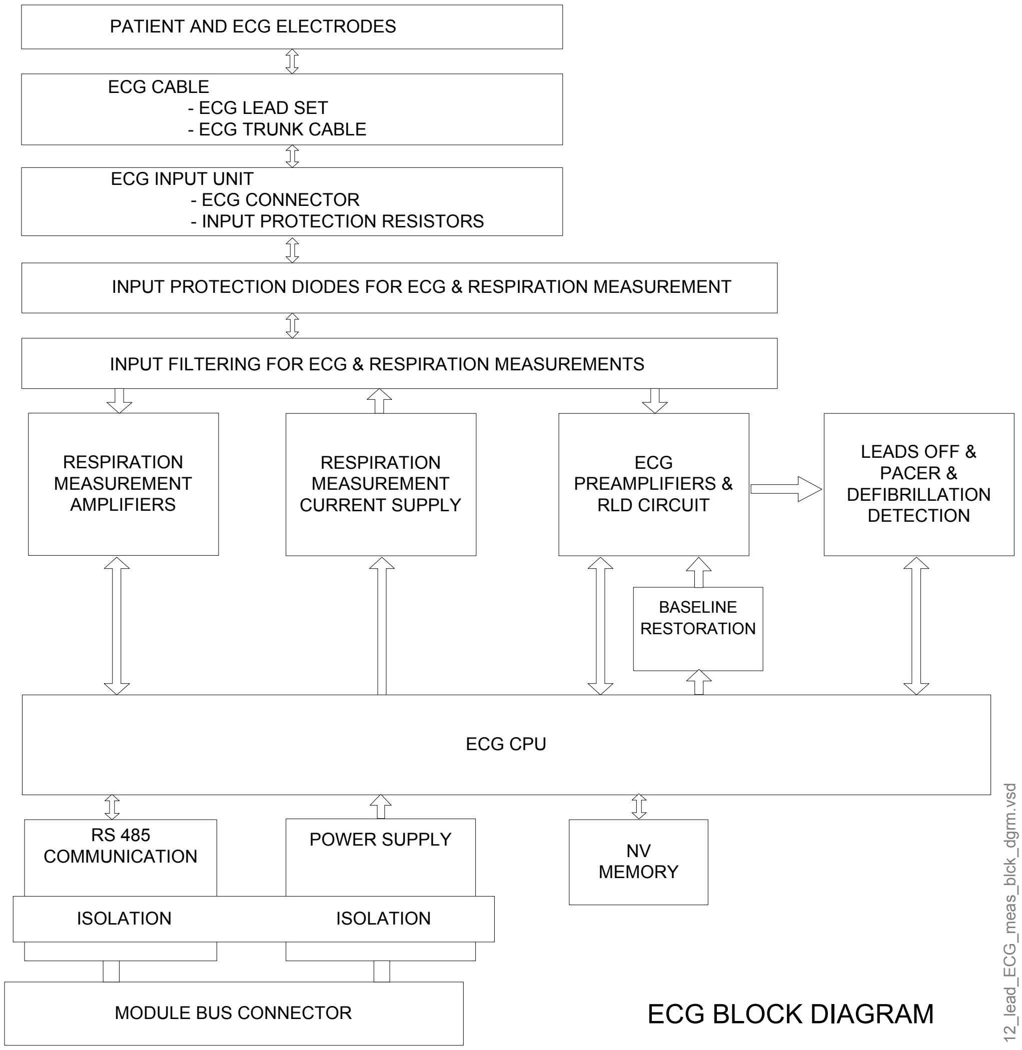


Figure 7 12-lead ECG measurement block diagram

ECG input unit

The ECG input unit consists of the front panel connector and the ECG input connector board with the high voltage protection resistors. The connector for the 12-lead ECG cable is a green 11-pin rectangle shaped connector.

Input protection and filtering

The input protection is implemented with high voltage protection resistors in the ECG input unit and with protection diodes in the ECG board. The input filtering for ECG measurement is done with passive RC filtering.

ECG preamplifiers

The buffer amplifiers are used for each lead. The "Leads off" detection is implemented by measuring the output level of the input buffer amplifiers with the A/D converter of the CPU. The ECG signals are measured using differential amplifiers.

ECG amplifiers and baseline restoration

The function of the ECG amplifiers and baseline restoration is to amplify the signal and to restore the baseline of the signal in the middle of the display after the change of the signal level, e.g. after the change of the DC offset voltage.

Pacer detection

Pacer detection has been made by using four slew rate detector circuits. The pacer detection amplifiers have been realized at the front of the slew rate detectors independently of the ECG measuring channels.

Respiration impedance supply

The 31.25 kHz sine wave generator is used as the respiration measurement signal supply. Analog switches are used for connecting the sine wave to the ECG leads to be measured.

Respiration impedance amplifiers

Buffer amplifiers are used in respiration measurement. Analog switches are used for selecting the measurement leads. There are also additional amplifiers for increasing the respiration signal gain. When ECG measurement is 5/12-lead, the respiration measurement is always done between R and F, independently on the ECG lead selection. When ECG measurement is 3-lead, then the respiration measurement happens at the same lead as the ECG measurement (I, II or III).

ECG CPU

The CPU is a 16 bit H8/3052 single-chip microcomputer. It contains 128 kbytes of flash memory and 4 kbytes of RAM. The clock frequency is 16 MHz.

RS485 communication

The communication to the CPU board of the monitor uses RS485 protocol. The RS485 driver circuits are optically isolated from the processor of the module.

Power supply

The ECG board has a driver-controlled half-bridge switching power supply with 5 kV isolation. The supply voltages have been regulated with linear regulators.

2.2.4 ECG filtering

Datex-Ohmeda S/5 monitors have three ECG filtering modes:

MONITORING	0.5 to 30 Hz (with 50 Hz reject filter) 0.5 to 40 Hz (with 60 Hz reject filter)
DIAGNOSTIC 12-lead ECG	0.05 to 150 Hz
ST FILTER	0.05 to 30 Hz (with 50 Hz reject filter) 0.05 to 40 Hz (with 60 Hz reject filter)

The purpose of filtering is to reduce high frequency noise and low frequency (e.g. respiratory) movement artifacts.

The monitor filter is used in normal monitoring. The diagnostic filter is used if more accurate diagnostic information is needed. The ST filter gives more accurate information of ST segment, but reduces high frequency noise.

The high-pass filters 0.5 Hz and 0.05 Hz are done with software. The monitor sends a command to the hemodynamic module determining which of the corner frequencies 0.5 Hz or 0.05 Hz is to be used.

The 50 Hz and 60 Hz reject filters are both low-pass filters with zero at 50 Hz or 60 Hz correspondingly. They are software based filters used for the mains supply filtering. With these filters the 3 dB value for low-pass filter is 30 Hz or 40 Hz.

In diagnostic mode the upper frequency is 150 Hz and it is limited by software.

2.2.5 STP board

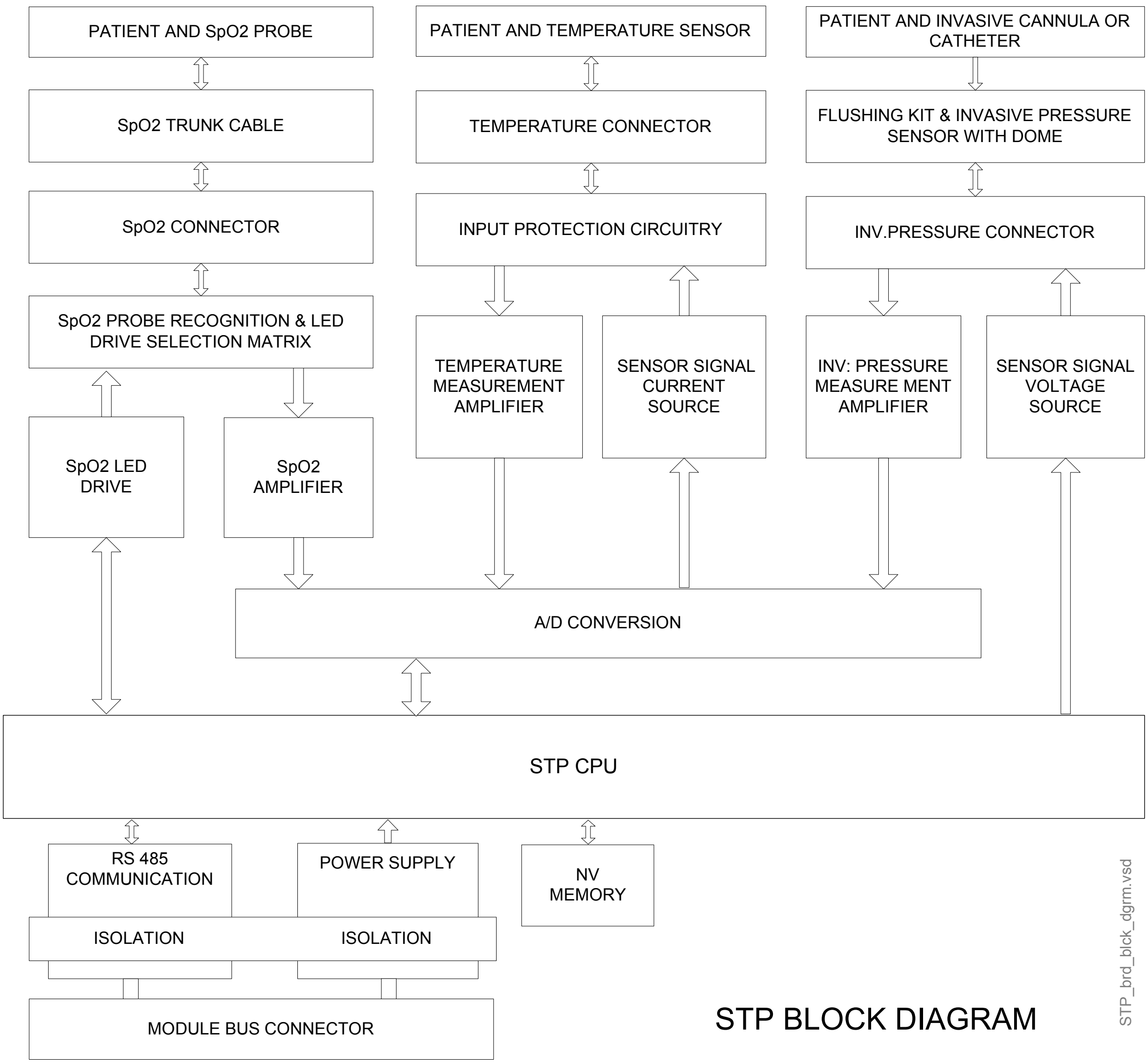


Figure 8 STP board block diagram

Microprocessor unit

The CPU is a 16 bit H8/3052 single-chip microcomputer. It contains 128 kbytes of flash memory and 4 kbytes of RAM. The clock frequency is 16 MHz.

High speed I/O is used to obtain a pulse control sequence necessary for pulse oximetry measurement. Timing for the clock is from the oscillator.

Temperature measurement unit

The NTC-resistor value in the probe depends on the patient's temperature. It is measured with the following principle described below.

The constant current source is supplied about 38 μA current through the temperature sensor (YSI 400-series NTC resistor). The constant current is caused a voltage over the temperature sensor (NTC resistor). The voltage over the temperature sensor is amplified in a differential amplifier stage. The amplified voltage is transferred to a controller of the STP board through an A/D converter.

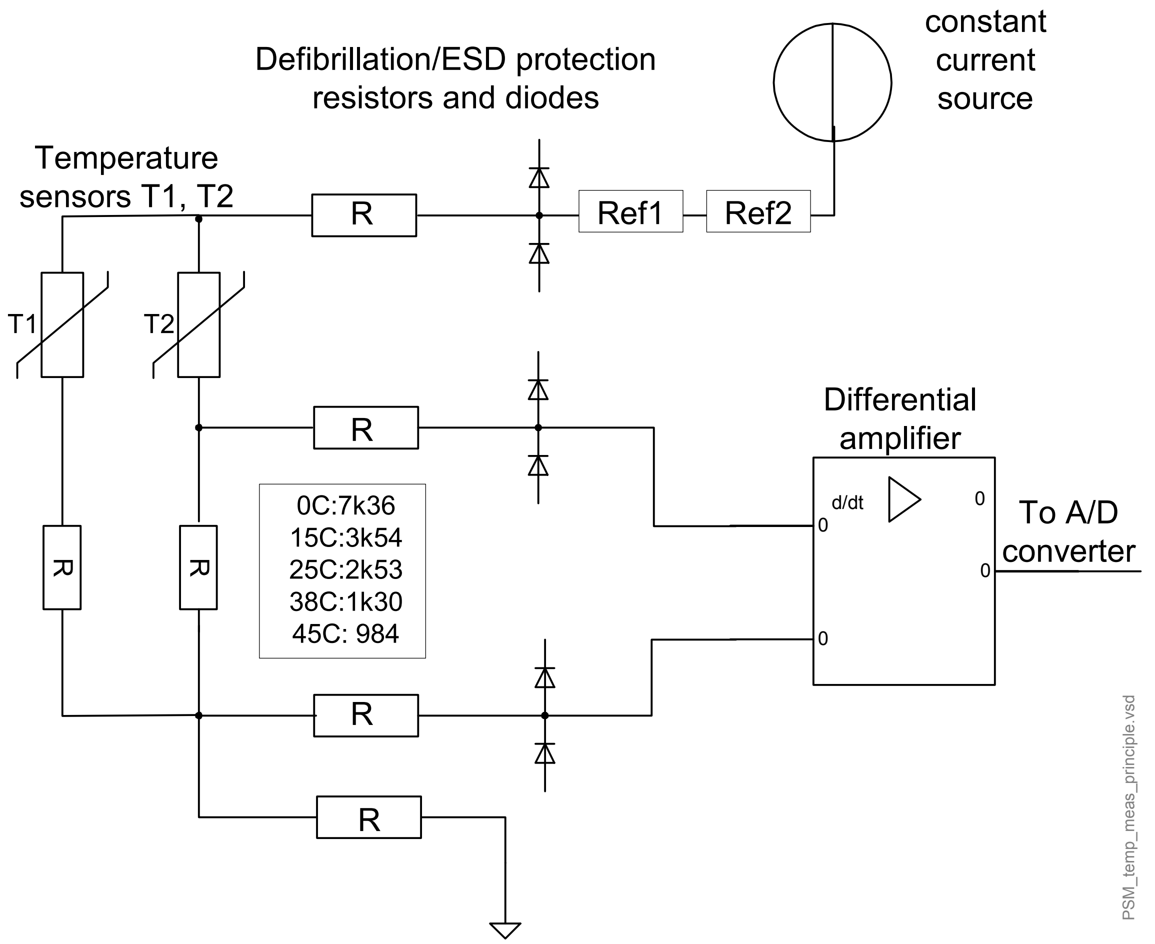


Figure 9 **Temperature measurement principle**

Invasive blood pressure measurement unit

An isolated +5 V voltage is supplied to the pressure transducer. The differential voltage, which depends on the pressure and the supplied voltage, is calculated from the bridge connection (see the formula below).

$U_{out} = U_{in} \times \text{pressure} \times 5\ \mu V$, where U_{in} is 5 V

$\Rightarrow U_{out} = 25\ \mu V \times \text{pressure}$ [mmHg]

Pressure amplification is realized in the instrumentation amplifier. The gain of the amplifier is set to keep the level of the signal transferred to the A/D converter within the measurement range even when there are circumstantial offsets or offsets caused by the transducer. There is a filter before the amplifier to attenuate high frequency disturbances.

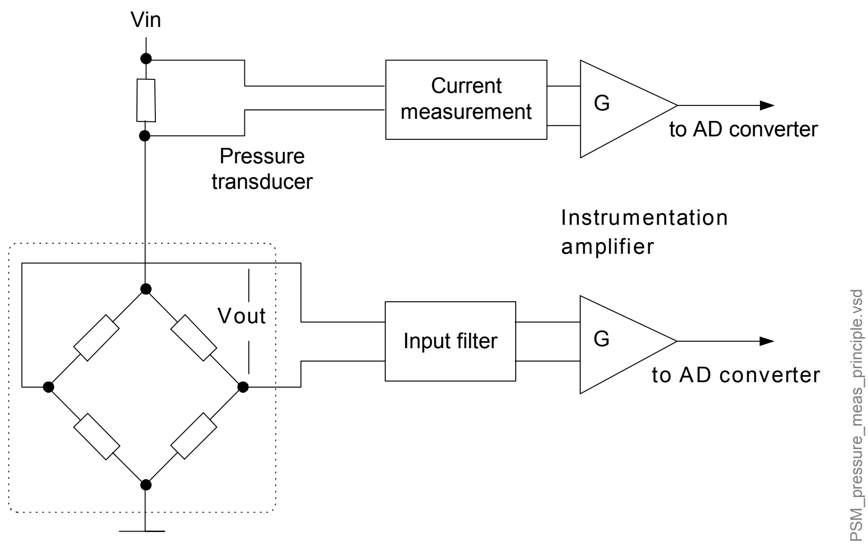


Figure 10 Pressure measurement principle

Pulse oximetry measurement section

LED control signals

The D/A converters of the microcontroller on the STP board set the LED intensity adjustment values for the infrared and red LEDs of the SpO_2 probe. The microcontroller on the STP board switches ON (to the adjusted intensity) and OFF the SpO_2 probe LEDs according to the predetermined sequence.

LED driving circuit

Differential amplifiers measure the LED currents (LED current indication) of the SpO_2 probe over the shunt resistors placed in the LED current paths. The LED driving voltages (LED voltage indication) are measured from the driver circuitry. The LED driving circuits also have MOSFET transistor matrix to enable the use of different probe configurations.

Measured signal preamplification

The preamplifier is a bipolar/single-ended current-to-voltage converter with adjustable gain. A higher gain is used for measuring thin tissue. The preamplification stage has also ambient light reduction and a second amplifier stage.

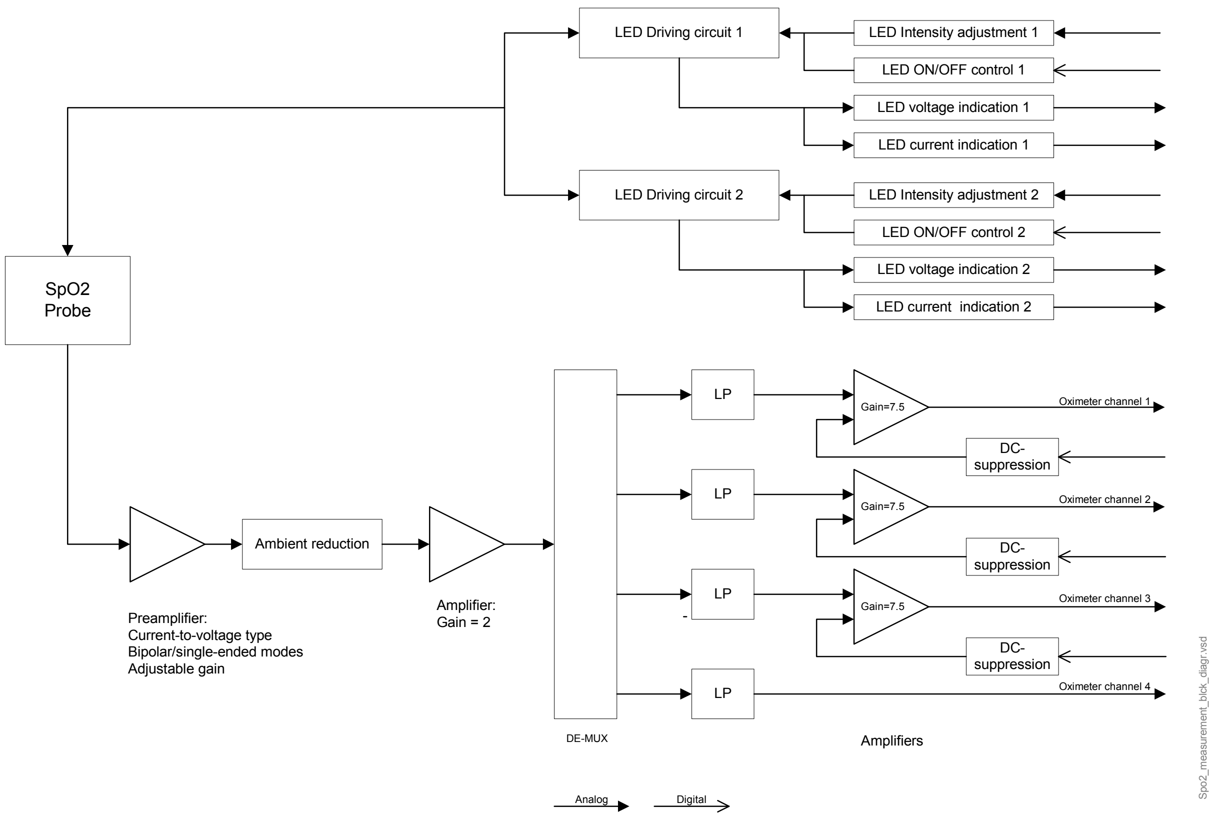


Figure 11 Pulse oximetry measurement block diagram

Red and infrared channel separation

It is possible to multiplex the detector signal to four different channels depending on the content of the signal. The detector signal must at least multiplex into infrared and red signals. Other channels are e.g. for diagnostic purposes.

Serial communication

An RS485 type bus driver makes the serial communication between the module and the frame. The data transmission rate is 500kbps.

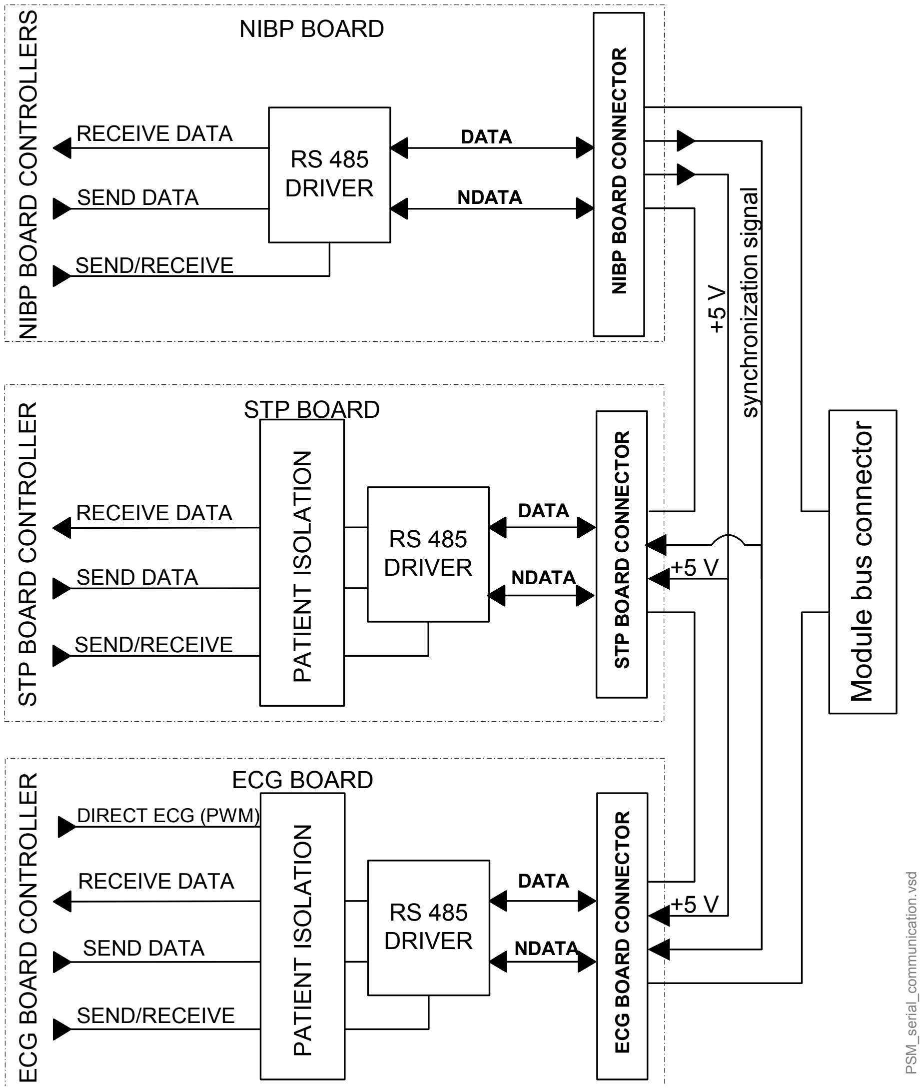


Figure 12 Serial communication of E-PSM(P) module

Signals and isolation barrier

The communication signals transfer over the isolation barrier by using high isolation voltage (6kV) opto isolators.

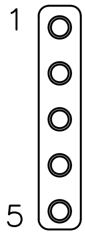
Power supply section

The power for the electronics on the floating part of the STP and the ECG boards is made on each board with the switching power supplies connected to a high voltage isolated transformer. The switching power supplies on the STP and ECG boards are synchronized to the frequency, about 340kHz of the switching power supply on the NIBP board. The NIBP board supplies non-isolated 5 V to the ECG and STP boards. The module uses only Vmod 13.8 - 16 V voltage of the frame. The other voltages of the measuring boards are made by the switching power supplies and regulators or the linear regulators. Each measuring board is protected against overloading with PTC type automatic fuses.

2.3 Connectors and signals

2.3.1 Module bus connector

Table 8 Module bus connector description

5 pin connector	Pin No.	Signal
	1 2 3 4 5	GND Vmod 13.8 - 16 V Data + Data - Shield

2.3.2 Front panel connectors

Table 9 ECG connector

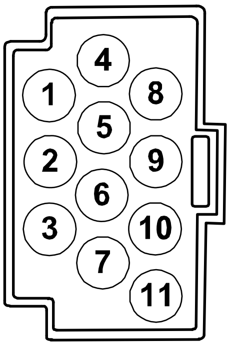
ECG Connector	Pin No.	Signal Name
	1 2 3 4 5 6 7 8 9 10 11	R/RA; Right arm electrode C2/V2; Chest electrode C3/V3; Chest electrode L/LA; Left arm electrode N/RL; Neutral/Right Leg Drive electrode C1/V1; Chest electrode C4/V4; Chest electrode F/LL; Left Leg electrode C6/V6; Chest electrode C5/V5; Chest electrode Cable Shield

Table 10 SpO_2 connector

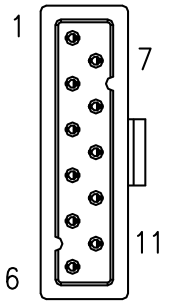
SpO_2 connector	Pin No.	Signal	Description
	1	DET_A	Photodiode anode
	2	DET_C	Photodiode cathode
	3	DATA-	
	4	Wire 1/3	LED connection
	5	IR_C	IR LED cathode
	6	OUTER SHIELD	
	7	DET_SHIELD	
	8	PRB_ID	Bin/ID Resistor+
	9	Wire 3/5	LED Connection
	10	RED_C	RED LED cathode
	11	DATA+	

Table 11 Invasive blood pressure connectors (P1, P2)

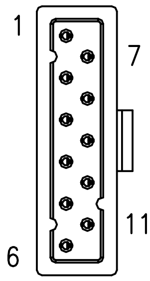
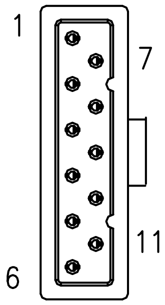
Invasive blood pressure connectors (Dual BP)	Pin No.	Signal	Description
	1	BP_+V_{REF}	BP transducer excitation voltage, channel 1
	2	BP SIG+	BP transducer signal positive (+), channel 1
	3	BP_+V_{REF}	BP transducer excitation voltage, channel 2
	4	AGND	Analog ground
	5	BP SIG+	BP transducer signal positive (+), channel 2
	6	SHIELD	BP cable shield
	7	AGND	Analog ground
	8	BP SIG1	BP transducer signal negative (-), channel 1
	9	BP SIG2	BP transducer signal negative (-), channel 2
	10	BP1_ID	BP1 probe identification
	11	NC	Not connected

Table 12 Temp connector (T1, T2)

Temp connector	Pin No	Signal
	1	Sensor drive current
	2	Input from temperature sensor, channel 1
	3	Not connected
	4	Not connected
	5	Thermistor ID (LOW= Temperature error, HIGH=YSI 400 series)
	6	Cable shield
	7	Analog ground
	8	Input from temperature sensor, channel 2
	9	Not connected
	10	Not connected
	11	Digital ground

3 Service procedures

3.1 General service information

The field service of the hemodynamic modules is limited to replacing faulty printed circuit boards or mechanical parts. The circuit boards should be returned to GE Healthcare for repair.

GE Healthcare is always available for service advice. Please provide the unit serial number, full type designation, and a detailed fault description.

WARNING **Only trained personnel with appropriate equipment should perform the tests and repairs outlined in this section. Unauthorized service may void warranty of the unit.**

3.2 Service check

These instructions include complete procedures for a service check. The service check is mandatory after any service repair. However, the service check procedures can also be used for determining possible failures.

The procedures should be performed in ascending order.

The instructions include a check form ("APPENDIX A:") which may be used when performing the procedures.

The symbol  in the instructions indicates that the check form contains space to record the results of the particular procedure.

3.2.1 Recommended tools

NOTE: Use only properly maintained, calibrated and traceable measurement equipment for the specified calibrations and adjustments to ensure accuracy.

Table 13 Recommended tools

Tool	Order No.	For product(s)
Hemodynamic patient simulator	M1010831	E-PSM(P)
Adapter cables for simulators		
- Dual temperature adapter cable	2016998-001	Hemodynamic patient simulator and Medsim
- Dual Inv.BP adapter cable	2005772-001	Hemodynamic patient simulator
- Temperature adapter cable	M1010832	Medsim
- Inv.BP adapter cable	M1010858	Medsim
- Temperature adapter cable	M1010846	Lionheart & MPS450
- Inv.BP adapter cable	M1010862	Lionheart & MPS450
Pressure manometer		E-PSMP
Accessories:		
Temperature test set	884515-HEL	E-PSM(P)

Tool	Order No.	For product(s)
Multi-Link ECG accessories, IEC:		
- Multi-link 3-leadwire set	412682-003	E-PSM(P)
- Multi-link 5-leadwire set	412681-003	E-PSM(P)
- Multi-link 5-leadwire set, C2-C6	416467-004	E-PSM(P)
- Multi-link 12-lead ECG trunk cable	416035-002	E-PSM(P)
Multi-Link ECG accessories, AHA:		
- Multi-link 3-leadwire set	412682-001	E-PSM(P)
- Multi-link 5-leadwire set	416681-001	E-PSM(P)
- Multi-link 5-leadwire set, V2-V6	416467-003	E-PSM(P)
- Multi-link 12-lead ECG trunk cable	416035-001	E-PSM(P)
SpO_2 finger probe	OXY-F-UN	E-PSM(P)
SpO_2 Interconnect Cable	OXY-ES3	E-PSM(P)
InvBP transducer	70077-001	E-PSMP
Adult NIBP cuff hose with cuff ID	2021285-001	E-PSM(P)
Adult NIBP cuff	2753E	E-PSM(P)
Infant cuff hose without cuff ID	414874-001	E-PSM(P)
Screwdriver		

3.2.2 Recommended parts

Table 14 Recommended parts

Part	Order No.	Notes
E-PSM(P), Air Filter, FRU	M1221481	Replace every 3 years

3.2.3 Visual inspection

Detach the module cover by removing the four screws from the bottom of the module.

Check:

1. Internal parts
   - screws are tightened properly
   - connectors are connected properly
   - NIBP tubing is attached properly
   - there are no loose objects inside the module

2. External parts
   - the front cover and the front panel sticker are intact

– all connectors are intact and attached properly

– the module box and latch are intact

3.2.4 Functional inspection

3. NIBP pump filter

   Replace the NIBP pump filter, if necessary.

   Reattach the module cover and check that the latch is moving properly.

   Switch the monitor on and wait until the monitoring screen appears. Configure the monitor screen so that all the needed parameters are shown, for example as follows:

   Monitor Setup ***- Screen 1 Setup - Waveform Fields - Field 1 - ECG1***
   Field 2 - ECG2
   Field 3 - P1
   Field 4 - P2
   Field 5 - Pleth
   Field 6 - Resp
   Digit Fields - Lower Field 2 - NIBP
   Lower Field 3 - T1+T2

4. Module installation

   Plug in the module. Check that it goes in smoothly and locks up properly.

5. Module recognition

   Check that the module is recognized, i.e. all the needed parameter information, except invasive blood pressure, starts to show on the screen.

   Preset ECG, Respiration, InvBP and SpO_2 measurement settings:

   ECG ***- ECG Setup - Hr Source - Auto***
   Pacemaker - Show

   Others ***- Resp Setup - Size - 1.0***
   Resp Rate Source - Auto
   Measurement - On
   Detection Limit - Auto

   Invasive Pressures ***- P1 'Art' Setup - Label - Art***
   P2 'Cvp' Setup - Label - Cvp

   PulseOximetry ***- Pleth Scale - Auto***

ECG measurement

6. Module software (serial numbers)

   Enter the service menu:

   Monitor Setup - ***Install/Service*** (password 16-4-34) -
   Service (password 26-23-8)

   Take down the information regarding the module software by selecting ***Scroll Vers*** and turning the ComWheel.

7. Communication and memories

   Enter the ***Parameters - ECG*** service menu.

   Check that the Time-outs, Bad checksums and Bad c-s by mod values are not increasing faster than by 5 per second. Check also that the ECG/RESP board memories have passed the internal memory test, i.e. the RAM, ROM and EEPROM state all OK.

8. Power frequency

   Check that the power frequency value is set according to the current mains power frequency. Change the setting by selecting ***Power Freq***, if necessary.

9. Cable recognition

   Connect a 12-lead ECG trunk cable without a lead set to the module. Check that the message 'Leads off' is displayed on the screen.

10. Lead detection

    Connect both 5-leadwire sets to the trunk cable. Connect all the leads together, for example to a suitable screwdriver. Check that all the electrodes show ON and the message 'Asystole' appears. Check that the Cable type shows 10 lead.

    Connect the 10-leadwire set to the simulator. Disconnect one of the leads and check that the corresponding electrode in the service menu shows OFF within 10 seconds of the disconnection, and then reconnect the lead. Check the rest of the leads using the same method. Disconnect the trunk cable.

    Connect a 3-leadwire set to a trunk cable and connect it to the module. Connect all the leads together, for example to a suitable screwdriver. Check that the cable type shows 3 lead.

    NOTE: When any of the limb leads is disconnected, the measurement will automatically change to 3 electrode ECG measurement.

    NOTE: The asystole and different leads off messages are shown using certain priority. Even though one of the leads is disconnected, the related leads off message may not appear on the screen.

    NOTE: When RA, LA, LL or RL electrode is disconnected, all six V electrodes show OFF.

11. Test with the patient simulator

    Connect the leads to a patient simulator.

    Perform the settings and checks with Dynatech Nevada MedSim 300 Patient Simulator:

    ECG - BASE - BPM - 160
        PACE - WAVE - NSR

    Check that a normal ECG waveform is shown, the HR value is 160 (±5) and the 'Pacer count' value is not increasing in the service menu.

    ECG - PACE - WAVE - ASNC

    Check that pacemaker spikes are shown on the ECG waveform, the HR value changes to 75 (±5) and the Pacer count value is increasing according to the shown pacemaker spikes.

    Set the pacemaker option off:

    ECG - PACE - WAVE - NSR

Respiration measurement

12. RESP measurement recognition

    Check that Resp Available and RESP Measurement both show ON in the ESTP: ECG service menu.

13. Test with patient simulator

    Check the respiration measurement with a patient simulator.

    The settings and checks with Dynatech Nevada MedSim 300 Patient Simulator:

    Simulator Cover:

    BASELINE IMPEDANCE -switch - 500
    LEAD SELECT-switch - II/RL-LL

    Simulator Menu:

    RESP - WAVE - NORM
    RATE - 20
    OHMS - 1.0
    RATIO - 1/1
    APNEA - OFF
    SHIFT - OFF

    Check that the RESP waveform is shown and the RR value is 20 (±5). Change the position of the BASELINE IMPEDANCE switch and check that appropriate RESP waveform and RR value are shown again within 30 seconds.

    RESP - APNEA - 32 S

    Check that the monitor activates the APNEA alarm.

    NOTE: Make sure that only the ECG leads are connected to the simulator during the apnea test. If other cables are connected at the same time, the respiration signal from the simulator may be disturbed, and therefore, the APNEA alarm may not be activated.

    NOTE: When you have the ECG service menu open, spikes will appear on the respiration waveform. These spikes represent the threshold level for detecting inspiration and expiration.

Temperature measurement

14. Communication and memories

    Enter the ESTP: STP service menu:

    Parameters - ESTP : STP

    Check that the Time-outs, Bad checksums and Bad c-s by mod values do not increase faster than by 5 per second. Check also that the STP board memories have passed the internal memory test, i.e. the RAM, ROM and EEPROM show all OK.

15. Temperature probe detection

    Check that the 'Cable' and 'Probe' show OFF for both channels, T1 and T2, when no probes are connected.

    Connect the temperature adapter cable to the module temperature connector and a temperature test plug to the adapter cable. Check that the Cable and Probe for T1 show ON and the corresponding temperature value appears on the monitor screen.

    Perform the same check also for the channel T2.

16. Calibration check

    Check the temperature calibrations using temperature test plugs.

    If the deviation on a temperature reading on the screen is more than 0.1°C, calibrate the temperature channels according to the instructions in chapter "Temperature calibration" on page 45."

17. Temp test

    Activate the temperature test by selecting ***Temp Test*** from the menu and pressing the ComWheel twice. When the message 'Performing temp test' disappears from the digit field, check that no error messages appear and Temp error shows OFF for both channels in the service menu.

18. Module configuration

    Check that the module configuration has been set correctly. The configuration in use is shown beside the text Configuration in the service menu and it can be either STP or ST. Change the configuration in the ***Calibrations - Set Config*** menu, if necessary. To activate the change, reset the module communication by removing and inserting the module.

Invasive blood pressure measurement

19. Membrane keys

    Check the front panel membrane keys that are related to the InvBP measurement.

    Press each of the keys for at least one second. Check that the pressed key is identified, i.e. one of the texts for Buttons changes from OFF to ON in the service menu.

    ✍

20. Cable and transducer detection

    Check that the Cable and Probe for P1 show OFF. Connect the InvBP adapter cable to the module, connect a cable with an invasive blood pressure transducer to the adapter cable and check that the Cable and Probe show ON and the corresponding pressure waveform appears on the screen.

    Perform the same check also for the InvBP channel P2.

    ✍

21. Calibration

    Calibrate the InvBP channels P1 and P2 according to the instructions in chapter “Invasive pressure calibration” on page 45.“

    ✍

22. Test with patient simulator

    Check the InvBP channels with a patient simulator.

    The settings and checks with Dynatech Nevada MedSim 300 Patient Simulator:

    SENSITIVITY - switch - 5 μV/V/mmHg

    ECG - BASE - BPM - 60 - BP - 1 - WAVE - ATM
2 - WAVE - ATM

    Restore the normal monitoring screen by pressing the key **Normal Screen**.

    Connect cables from the channels BP1 and BP2 to the module connectors. Zero the InvBP channels by pressing the keys ZERO P1 and ZERO P2 on the module front panel.

    BP - 1 - WAVE - ART
2 - WAVE - CVP

    Check that appropriate InvBP waveforms are shown and the InvBP values are approximately 120/80 (±3 mmHg) for the channel P1 and 15/10 (±2 mmHg) for the channel P2.

    Check that the HR value is calculated from P1, when ECG is not measured (ECG cable disconnected).

    ✍

SpO_2 measurement

23. SpO_2 probe detection

    Check that the message ‘No probe’ is shown, when no SpO_2 sensor is connected to the module. Connect an SpO_2 finger probe to the module (with the interconnection cable, if needed). Check that the message ‘Probe off’ is shown when the probe is not connected to a finger.

    ✍

24. Test measurement

    Connect the SpO_2 probe onto your finger. Check that the reading of 95-99 and SpO_2 waveform appears. Check that the HR value is calculated from SpO_2 when ECG and InvBP (P1) are not measured.

Non Invasive Blood Pressure measurement

25. Communication and memories

    Enter the NIBP module service menu:

    Parameters - NIBP

    Check that the Time-outs, Bad checksums and Bad c-s by mod values are not increasing faster than by 5 per second. Check also that the NIBP board memories have passed the internal memory test, i.e. the RAM, ROM and EEPROM show all OK.

26. Membrane keys

    Check the front panel membrane keys.

    Select ***Buttons/Leds***.

    Press each of the two NIBP related membrane keys for at least one second. Check that the pressed key is identified, i.e. the corresponding text changes from OFF to ON in the menu, when the key is released back up again.

27. Pump and valves

    Check the pump and valves.

    Select ***Pneumatics*** from the NIBP menu. Connect a pressure manometer to the NIBP module cuff connector.

    Select ***Start Pump*** and press the ComWheel. Check that the pump turns on and the pressure inside the tubing system starts to increase. Stop the pump by pressing the ComWheel again when the pressure reaches 280 mmHg.

    Select ***Open Exh2***. Press the ComWheel and check that the pressure inside the tubing system starts to drop, then press the ComWheel again. If necessary, turn the pump on again for a moment to increase the pressure inside the tubing system.

    Select ***Set Valve***. Press the ComWheel and set the value under the text Pulse Valve to number 150 by turning the ComWheel. Press the ComWheel again and check that the pressure inside the tubing system starts to drop. Finish the test by selecting ***Previous Menu***.

28. Leak test

    Check the NIBP tubing system for leakages.

    Select ***Calibrations*** from the NIBP service menu.

    Connect the pressure manometer to the NIBP module cuff connector. Start the active leak test from the menu by pressing the ComWheel. The module pumps a pressure of about 290 mmHg and then the pump stops. The max pressure in Adult mode is about 290 mmHg, but in Infant mode only 140mmHg.

Wait for 15 seconds for the pressure to stabilize then check that the pressure does not drop more than 6 mmHg per one minute. Release the pressure by pressing the ComWheel once more.

29. Calibration check

    Recalibrate the NIBP measurement according to the instructions in section “NIBP calibrations” on page 44. Remember to set the calibration protection back on after the calibration.

    Disconnect the pressure manometer. Select ***Calibrations*** - ***Calibration Check***. Press the ComWheel and take down the zero offset values for both pressure transducers, B1 and B2. The values should be within ±20 mmHg.

    Connect the pressure manometer to the cuff connector and check the calibration with pressures 100 mmHg, 200 mmHg and 260 mmHg. The zero offset value must be added to the displayed pressure value in order to determine the real pressure.

30. Safety valve functions

    Select ***Safety Valve*** from the NIBP service menu.

    Disconnect the pressure manometer from the NIBP module cuff connector. Connect the NIBP hose and cuff to the NIBP module cuff connector. Perform the check with a standard adult cuff that is connected around some round object, for example a calibration gas bottle.

    Select ***Start Test***. Start the adult safety valve test by pressing the ComWheel. Wait until the pump stops and the pressure is deflated.

    Open cuff connector or disconnect and connect cuff connector from module

    Check the pressure values ‘Max press’ and ‘2 s after stop’ for both transducers. All the values should be within 270 - 330 mmHg.

    Select ***ADULT***. Press the ComWheel and check that the text changes now to ***INFANT***.

    Select ***Start Test*** and wait until the pump stops and the pressure values on the screen have been updated.

    Open cuff connector or disconnect and connect cuff connector from module

    Check that the values ‘Max press’ and ‘2 s after stop’ are all now within 135 to 165 mmHg.

    Return to the normal monitoring mode by pressing **Normal Screen**.

31. Cuff related messages

    Connect an adult NIBP cuff to the cuff connector and disconnect one of its hoses.

    Start NIBP measurement by pressing the key **Start/Cancel** on the module and check that the message ‘Cuff loose’ appears on the screen within 70 seconds.

    Reconnect the hose and then bend it with your fingers. Restart the measurement and check that the message ‘Cuff occlusion’ appears on the screen within 70 seconds.

32. Test measurement

    Check that the automatic inflation limits are in use:

    NIBP - ***NIBP Setup - Inflation Limits - Auto - Previous Menu***

    Connect the cuff onto your arm, select ***Start Ven.Stasis*** in the NIBP menu and press the ComWheel. Check that the module identifies the cuff, i.e. the text Adult appears in the NIBP digit field for a short moment.

    Keep the pressure inside the cuff for about half a minute in order to find out that the cuff is not leaking, then press the ComWheel again. Select **Normal Screen**.

    Disconnect the cuff hose.

33. NIBP hose detection

    Press the **Start/ Cancel** module or side panel key and check that the 'Cuff loose' message appears in the NIBP digit field.
    Attach a NIBP cuff hose without cuff identification and check that the module identifies the hose:

    – The message 'Select inflation limits' appears in the NIBP digit field.
    – When you try to start the measurement, the monitor automatically opens the selections ***NIBP Setup - Inflation Limits.***

All modules

34. Electrical safety check

    Perform an electrical safety check and a leakage current test.

35. Functioning after electrical safety check

    Check that the module functions normally after the performed electrical safety check.

36. Final cleaning

    Clean the module with suitable detergent.

    Fill in all necessary documents.

3.3 Disassembly and reassembly

3.3.1 Before disassembly

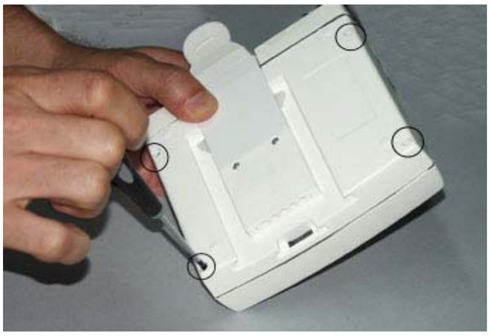
WARNING **Wear a grounded, antistatic wristband when handling PC boards. Electrostatic discharge may damage components on the board. Handle all PC boards by their edges.**

3.3.2 Tools needed

- torx screwdrivers; T6, T8
- flat blade screwdriver
- pincers
- antistatic wristband

CAUTION When reassembling the module, make sure to reconnect all cables properly.

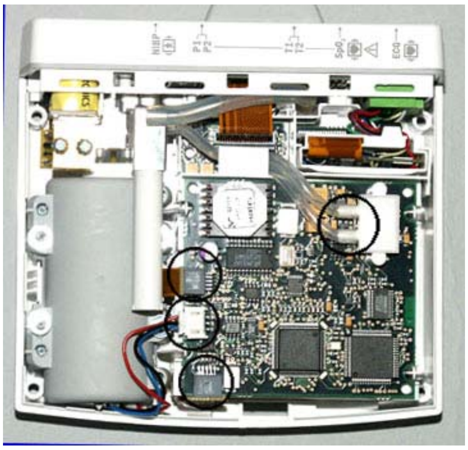
3.3.3 To disassemble the module



1. Remove the four screws (T8) holding the module cover to the frame from the bottom of the module.

2. Hold the cover from the back corners, lift it about 45° to unlock the snaps from the front unit and pull the cover out backwards.

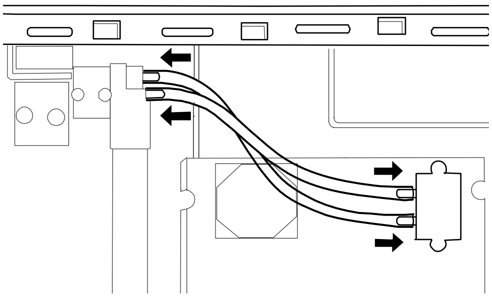
NOTE: Be careful not to damage the seal. When reassembling the seal may stick to the cover.



3. To remove the NIBP board:

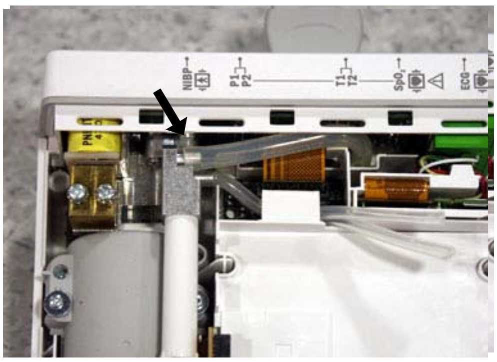
NOTE: You may remove the NIBP filter cover and the filter before disconnecting the flex cable.

- Disconnect the module bus connector, pump connector and NIBP flex connector.
- Disconnect the hoses (2 pcs) coming from the manifold.

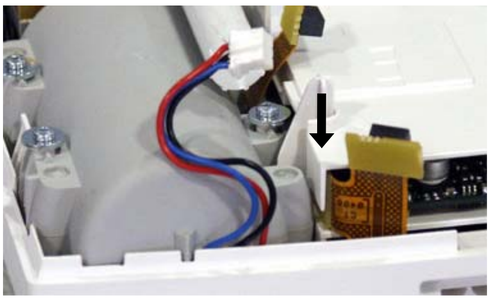


NOTE: Note the positions of the hoses; mark them if necessary to ensure they are replaced correctly.

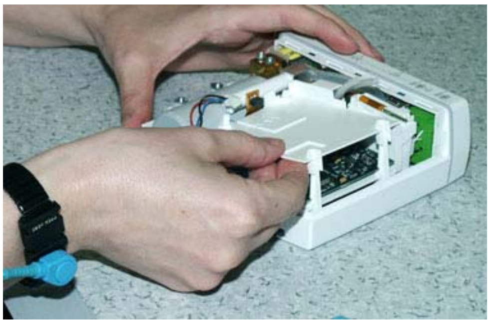
- Remove the NIBP board.



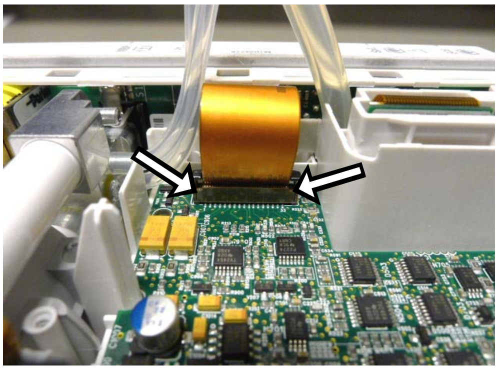
4. Disconnect the air intake hose from the NIBP manifold.



NOTE: The lips of the insulator plates secure the module bus connectors. While reassembling the insulator plates, ensure that the connector secure lips support the connectors correctly.



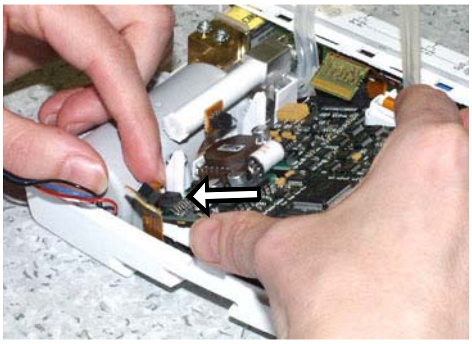
5. Lift the NIBP-STP insulator plate carefully up.



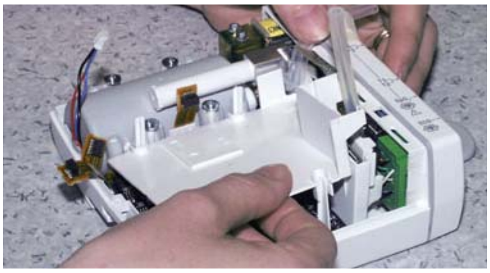
6. To remove the STP board

- Carefully open the connector lock and then disconnect the STP input flex cable from the STP board.

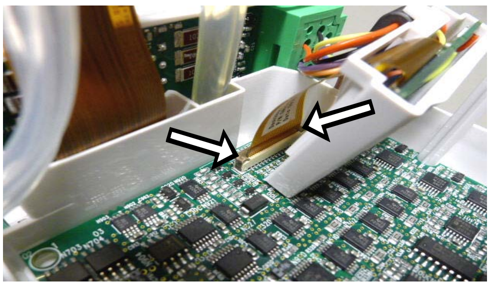
NOTE: When reassembling, ensure that the flex cable is aligned properly and the connector is locked.



- Lift the STP board a little to disconnect the module bus connector. Remove the STP board.

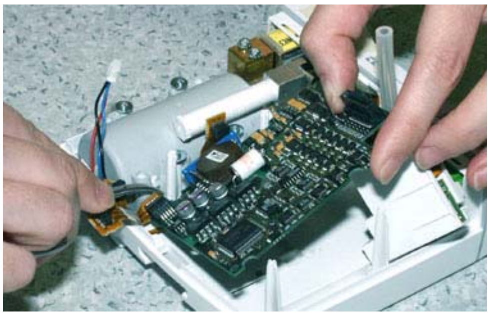


7. Remove the STP-ECG insulator plate. Be careful not to damage the NIBP hoses.



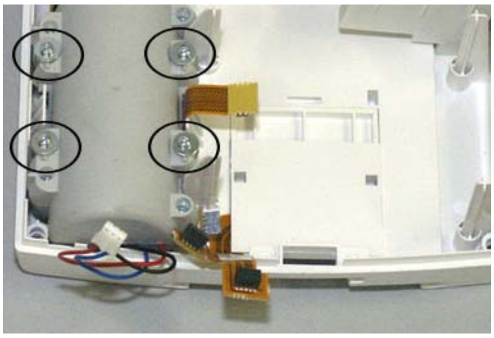
8. Hold down the ECG board. Carefully open the connector lock and then disconnect the ECG input flex cable from the ECG board.

NOTE: When reassembling, ensure that the flex cable is aligned properly and the connector is locked.



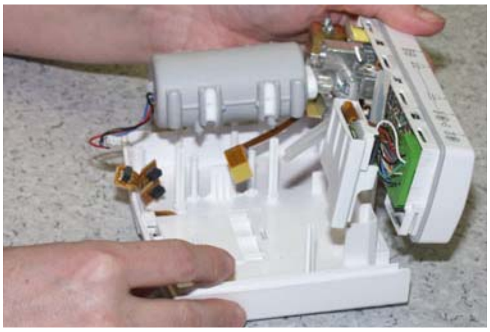
9. To remove the ECG board
- While holding the ECG input unit out of the way, lift the ECG board a little and disconnect the module bus connector.
- Remove the ECG board.

10. Remove the NIBP filter cover and the filter. (If not removed already.)



11. Remove the four screws (T6) with washers holding the NIBP pump to the frame.

12. Flip the module over and remove the two (T6) screws holding the lock unit to the frame. While pulling the tab push the lockers with a screwdriver to remove the lock unit.



13. Carefully lift up the front unit together with the NIBP pump.

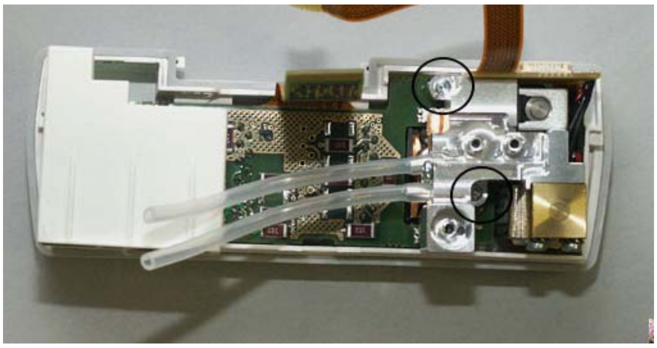
Reassemble the module in reverse order.

Always perform the "Service check" after reassembling the module.

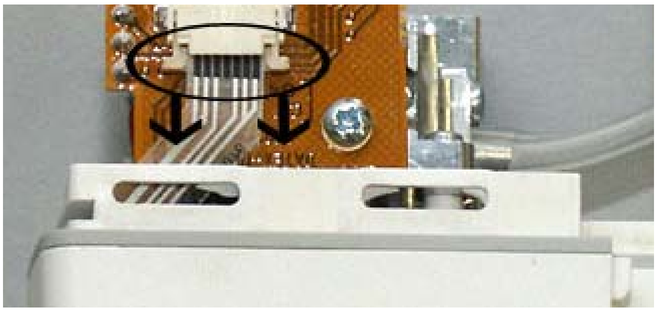
To remove the pump unit

14. Disconnect the hoses from the manifold. The hoses follow the pump.

3.3.4 To remove the manifold unit



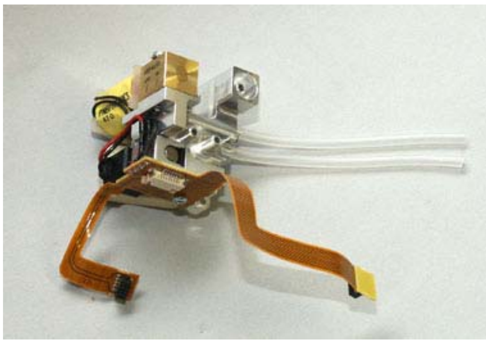
15. Disconnect the two (T6) screws holding the manifold to the front cover unit.



16. Open the connector lock from the NIBP flex board and disconnect the membrane keyboard flex.

17. Lift the manifold carefully aside. Be careful not to damage the NIBP flex board. Disconnect the NIBP flex board connector from the STP input board.

NOTE: When reassembling, make sure that the NIBP flex board connector is connected properly (all pins connected) to the STP input board.



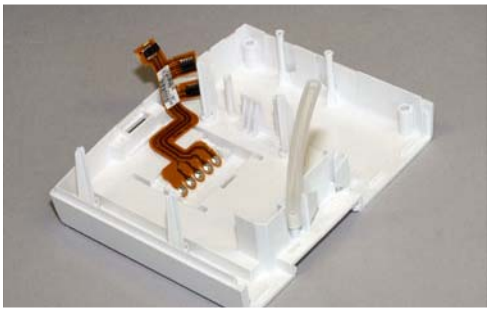
Reassemble the module in reverse order.

Always perform the "Service check" after reassembling the module.

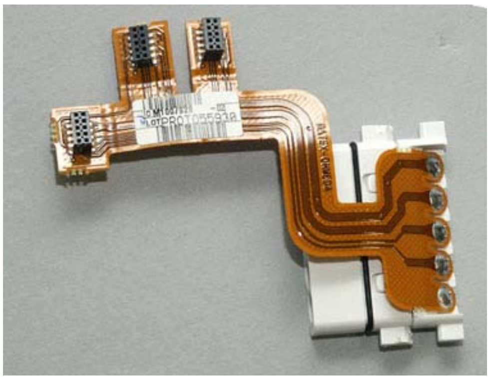
3.3.5 To remove the module bus connector

18. Use a flat blade screwdriver to unlock the module bus connector insulator cover.

    Put the screwdriver in the hole and move the blade backwards (away from the flex cable) until the insulator cover unlocks.



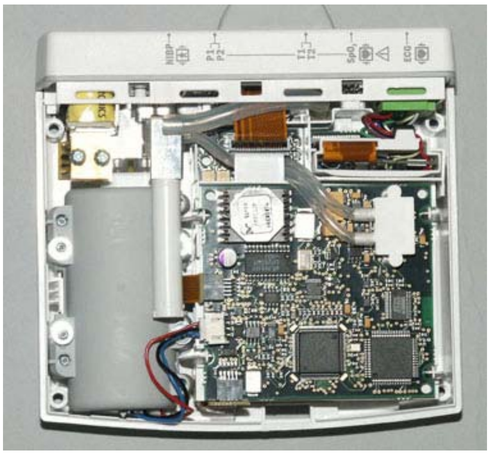
19. Pull the module bus connector carefully through the hole in the frame.



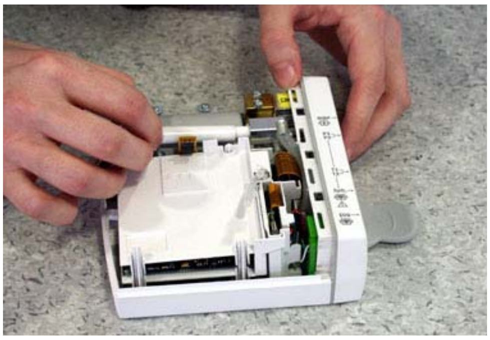
Reassemble the module in reverse order.

Always perform the "Service check" after reassembling the module.

3.3.6 To replace the NIBP filter



1. Follow the disassemble instruction steps 1 and 2.



2. Remove the NIBP filter cover and replace the filter.

Reassemble the module in reverse order.

Always perform the “Service check” after reassembling the module.

3.4 Adjustments and calibrations

NOTE: Use only properly maintained, calibrated and traceable measurement equipment for the specified calibrations and adjustments to ensure accuracy.

3.4.1 NIBP calibrations

The electronics of the NIBP pressure measurement is calibrated at the factory. The processor automatically maintains the zeroing pressure. If the zero point of the pressure transducer drifts more than specified, an error message is given and the NIBP board should be recalibrated or replaced.

Recalibrate the NIBP measurement once a year. The checking and recalibration can be done in the NIBP service menu.

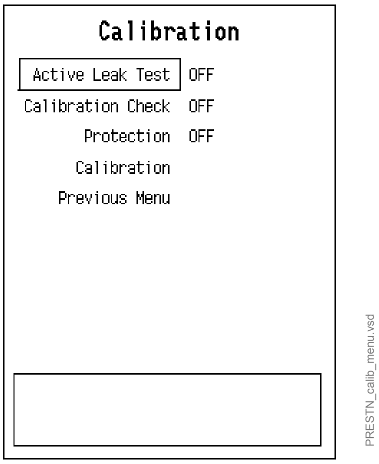
The calibration of the primary pressure channel can also be checked from the NIBP setup menu (***NIBP - NIBP Setup - Calibration Check***). In this case, the auto zeroing is performed at start - remove the hose before entering to ensure atmospheric pressure to the pressure transducers - the primary pressure is displayed. The zero-offset value should then be zero.

Check the intake air filter as part of the calibration check. Change the filter if it is visibly dirty.

Calibration check

1. Enter ***Calibration*** menu:

   Monitor Setup - ***Install/Service*** (password 16-4-34) -***Service*** (26-23-8) - ***Parameters - NIBP - Calibrations***



2. Select ***Calibration Check*** and push the ComWheel.
3. Connect an external precision manometer to the module.
4. Pump the following pressures to manometer and check the difference between the manometer and monitor pressure display (The zeroing offset is automatically subtracted from the pressure readings).

Table 3 NIBP calibration check pressures

Pressure	Max. error	Example
0 mmHg	±5 mmHg (=zero offset)	-1
100 mmHg	100 ±2 mmHg	100 ±2
200 mmHg	200 ±3 mmHg	200 ±3
260 mmHg	260 +/-3 mmHg	200 ±3

If the error of pressure channel B1 is larger than specified above, the module should be recalibrated. The error of B2 is allowed to be even twice as large because it has no effect on blood pressure measurement accuracy. However, we recommend recalibrating the module when the error of B2 is larger than specified above to ensure best possible operation.

Calibration

1. Enter ***Calibration*** menu.
2. Remove the hoses from the front panel connector to enable proper zeroing.
3. Select ***Calibration***. If it is not available, perform the steps a, b, and c.

NOTE: Do not pull out the hemodynamic module from the monitor frame. The module must be in the frame during the whole procedure.

a. Press the hemodynamic module buttons **Auto ON/OFF** and **Start Cancel** simultaneously for 3 seconds to enable the calibration. This enables menu selection ***Protection***. The message ‘Calibration switch ON!’ is displayed.

b. Select ***Protection OFF*** in the ***Calibration*** menu and push the ComWheel.

c. Press the buttons again for 3 seconds. Menu selection ***Calibration*** is now enabled, and ***Protection*** is disabled. When the calibration is enabled, a message ‘Calibration not protected’ is displayed.

- Start calibration by pushing the ComWheel. Messages ‘Zeroing’ and ‘Zeroed’ will be displayed in the NIBP message field. After this, a pressure bar and text ‘Calibrating’ will be displayed.
- Connect an external mercury manometer with a pump to the module through the both tubes of the hose - both transducers B1 and B2 must be calibrated simultaneously. Pump up to a pressure of about 200 mmHg according to the manometer. Calibration is possible in the range of 150 to 250 mmHg.
- Verify that both pressure values in the prompt field match the manometer reading. If not, adjust by turning the ComWheel. When the values of the pressure bar and the manometer are equal, push the ComWheel to confirm the calibration. The message ‘Calibrated’ will be displayed on the NIBP digit field after a few seconds, which means that the calibration succeeded, and the new calibration data is saved in EEPROM.

NOTE: When calibrating NIBP, always change the displayed pressure value slightly with the ComWheel, even in cases where the value would be correct. For example, change the value one step higher and then back one step lower. ‘Calibrated’ text should appear in the display. This ensures that the calibration procedure is correctly registered and stored by the module.

- To set the protection on:
  Press NIBP module buttons **Auto ON/OFF** and **Start Cancel** simultaneously for 3 seconds. Select ***Protection ON*** and push the ComWheel. Then press the buttons again for three seconds.

- Remove the module from the frame and plug it back again. Then perform "Calibration check" (see the preceding page) to verify the new calibration.

3.4.2 Temperature calibration

NOTE: For the temperature calibration, separate, accurate test plugs (25 °C and 45 °C) are needed. A test set of two plugs is available from GE Healthcare, order code 884515-HEL.

A Dual temperature adapter cable, order code 2016998-001 is also required for the temperature calibration.

Calibrate the temperature, when the measured test values differ for more than ±0.1 °C, and always after STP board replacement.

1. Enter the STP service menu.

   (**Monitor Setup** - ***Install/Service*** (password 16-4-34) - ***Service*** (password 26-23-8) - ***Parameters***).
2. Enter ***Calibrations*** menu.
3. Choose ***Protection OFF*** in protect mode.
4. Select ***Calibrate T1/Calibrate T2***.
5. Insert calibration plug (25 °C) into T1/T2 connector.
6. Push the ComWheel.
7. Insert calibration plug (45 °C) into T1/T2 connector.
8. Push the ComWheel.
9. Choose ***Protection ON*** in protect mode.

3.4.3 Invasive pressure calibration

NOTE: Before starting invasive pressure calibration, disconnect all patient cables and discharge the patient.

NOTE: For the Invasive pressure calibration a Dual InvBP adapter cable, order code 2005722-001, is needed.

Calibrate the invasive pressure when the pressure transducer (probe) is replaced with a different type of transducer, and when the STP board is replaced.

1. Enter the STP service menu.

   (**Monitor Setup** - ***Install/Service*** (password 16-4-34) - ***Service*** (password 26-23-8) - ***Parameters***).
2. Enter ***Calibrations*** menu.
3. Connect a pressure transducer with a pressure manometer to the P1/P2 connector. Choose ***Calibrate P1*** or ***Calibrate P2***. Leave the transducer to room air pressure.
4. Push the ComWheel to start zeroing.
5. Supply a pressure of 100 mmHg to 300 mmHg to the transducer. The recommended pressure is 200 mmHg.
6. Set the pressure on the display to match the pressure reading on the manometer and push the ComWheel. A tolerance of ±1 mmHg is allowed.
7. The message 'Calibrated' will be displayed on the display.

4 Troubleshooting

4.1 Troubleshooting charts

See also the “User’s Reference Manual” for more troubleshooting procedures.

4.1.1 NIBP

Problem	Cause	What to do
No NIBP value displayed	NIBP not selected on screen.	Check monitor setup.
NIBP menu fading	No E-PSM(P) module, module not properly connected.	Plug in the module.
‘Artifacts’ message	Unsuccessful measurement due to patient movement, shivering, external artifact or weak signal.	Check the patient status.
‘Weak pulsation’ message	Weak or unstable oscillation pulses due to: • artifacts • weak pulse pressure due to arrhythmias • improper cuff position or attachment • too few pulses detected • weak or unusual blood circulation • obese patient	Check patient condition and retry. Check any leaks and retry. Use proper size of cuff. Check attachment.
Call service ‘Error X’ message	NIBP hardware error. X = error number.	See the description of the error message code, the causes and the solutions listed in the “NIBP error code explanation” chapter.
‘Cuff loose’ message	1. Hose and/or cuff not connected.	1. Connect the hose and the cuff.
	2. Hose and cuff connected. Reasons:	
	- cuff loosely wrapped	- Tighten the cuff.
	- leakage inside the shield, in the Patient connector panel or tubings connecting to the module	- Check the tubings inside the shield and Patient connector panel, fix if necessary.
	- leakage in cuff or hose	- Replace cuff/hose.
	- leakage inside module	- Check internal tubing and fix if necessary.
	- pump does not work	- Check pump connector; if OK, replace the NIBP Pump Unit.

Problem	**Cause**	**What to do**
Cuff ID not working	1. Defective cuff ID holes in the NIBP cuff hose	- Replace NIBP cuff hose.
	2. NIBP flex board connector wrongly connected	- Check that the NIBP flex board connector is properly connected to the STP input board: all pins have to be connected.
	3. Cuff ID switches defective	- To check the switches, attach a NIBP cuff hose without the cuff ID and check that the message 'Select inflation limit' appears. If not, replace the Front Panel Unit.
	4. NIBP ID switch cable (between patient connector panel and the module) broken or poorly connected	- Check the cable, fix if necessary.
'Air leakage' message	1. Hose or cuff leaking. Reasons:	1. Replace cuff
	- cuff damaged	- Replace cuff.
	- cuff connector damaged	- Replace cuff connector (if the fault is in hose connector).
	- O-ring damaged or missing	- Replace O-ring.
	- hose double connector damaged	- Replace NIBP cuff hose.
	2. Hose and cuff OK. Reasons:	2. Connect or replace tube
	- leakage in the tubes connecting the patient connector panel and the module	- Check the tubes.
	- leakage inside the module	- Replace the whole tubing.
	- tube disconnected or damaged	- Fix connections.
	- manifold leaking	- Replace the manifold.
	- tubes or valve(s) damaged	- Replace tubes/valve(s).
'Unable to measure Sys' message	Systolic blood pressure probably higher than the inflation pressure or artifacts.	Automatic retrial with increased pressure.

Problem	Cause	What to do
'Cuff occlusion' message	1. Cuff and/or hose occluded. Reason:	
	- cuff tube kinked	- Straighten tube.
	- tubes inside the shield kinked	- Straighten tubes.
	- tubes inside module kinked	- Straighten tubes.
	- occlusion inside/outside module	- Remove occlusion.
	2. Cuff, hose, and tubes OK. Reason:	
	- fault in pressure transducer	- Replace the NIBP board.
	- fault in A/D converter	- Replace the NIBP board.
	- faulty calibration	- Check calibration.
'Calibration switch on' message	EEPROM protection has been handled by pressing module buttons **Auto ON/OFF** and **Start/Cancel** simultaneously for 3 seconds.	Enables setting the protection OFF in the ***Calibration*** menu. Press the buttons again if you are not going to calibrate.
'Calibration not protected' message.	Calibration protection is set to OFF.	Set the protection ON in the NIBP ***Calibration*** menu.

4.1.2 NIBP error code explanation

Code	Problem	What to do
0	RAM failure; memory failure	Change the NIBP board.
1	ROM checksum error; memory failure	Change the NIBP board.
2	Pump current failure	Check short circuits. Change the NIBP board.
3	Safety CPU internal test failure or pressure sensor reference voltage failure	Change the NIBP board.
4	EEPROM protection error	Press module buttons **Auto ON/OFF** and **Start/ Cancel** simultaneously for 3 seconds.
5	Calibration not protected	Protect calibration by selecting Protection ON in the NIBP calibration menu.
6	Pressure sensors give different readings	Try to remeasure. If the problem persists, recalibrate. If the problem still persists, change the NIPB board.
7	Calibration failure	Reset the module and recalibrate. If this does not help, change the NIBP board.
8	Exhaust Valve occlusion	Check and clean the tubing and air chamber. If this does not help, change the NIBP board.
9	Measurement related error	Automatic recovery.
10	EEPROM checksum error; memory failure	Change the NIBP board.
11	Auto zero range exceeded	Calibrate the NIBP.
12	Communication break; temporal break down of communication from monitor detected	Automatic recovery.
13	Illegal neonate cuff with identifying magnet connected	Remove the cuff.
14	Not in use	Not in use
15	Safety CPU pressure calibration error	Recalibrate. If this does not help, change the NIBP board.
16	Communication error between CPUs	Change the NIBP board.
17	Safety CPU has cut down power from pneumatics due to repeating safety limit violations	Reset the module. If the problem persists, change the NIBP board.

4.1.3 Pulse oximetry (SpO_2)

Problem	Cause	What to do
Message 'NO PROBE'	No sensor connected to the module SpO2 connector.	Check sensor connections.
	Sensor faulty.	Change the sensor.
	Flat cable connecting the SpO2 connector to the STP board loosen or broken.	Check the Flat cable, replace if necessary.
Message 'PROBE OFF' though sensor properly attached to the patient	Unsuitable site.	Try another site.
	Sensor faulty.	Try another sensor.
	Sensor connection cable not connected to sensor.	Connect the cable to sensor.
Finger sensor falls off	Sensor is slippery.	Wipe with 70% isopropyl alcohol and allow drying.
	Finger is too thin or thick.	Try other fingers, or other sensor types.
Weak signal artifacts	Poor perfusion.	Try another place.
	Movement artifacts.	
	Shivering.	
Message 'NO PULSE'	Pulse search > 20 sec. and low SpO_2 or low pulse rate.	Try other fingers.
Message 'ARTIFACT'	Pulse modulation exceeds the present scale.	Try another place or another sensor.
Message 'CHECK PROBE'	DC value not in balance.	Try another sensor.
Message 'POOR SIGNAL'	Poor perfusion. Modulation (Red or Ired) < 0.25%	Check that the sensor is positioned correctly to the patient.
Message 'FAULTY PROBE'	Sensor is faulty.	Change the sensor.
No SpO_2	No waveform selected on screen.	Check the selected SpO_2 waveforms by pressing **Monitor Setup** key and selecting ***Screen 1 Setup - Waveform Fields***.
	Wrong configuration setting.	Check the configuration settings from the STP/Calibrations menu (**Monitor Setup -** ***Install/Service - Service - Parameters***)

4.1.4 Invasive blood pressure

Problem	Cause	What to do
Abnormally low pressure	Transducer wrongly positioned.	Check mid-heart level and reposition transducer.
No pressure	Defective transducer.	Check transducer.
	No pressure module plugged in.	Check the module.
	No waveform selected on screen.	Check the selected pressure waveforms by pressing **Monitor Setup** key and selecting ***Screen 1 Setup - Waveform Fields***.
		Check that the pressure transducer is open to the patient.
	Wrong configuration setting	Check the configuration setting from the STP/Calibrations menu (**Monitor Setup** - ***Install/Service - Service - Parameters***).
	Flat cable connecting the patient connector panel to the module loosen or broken.	Check the Flat cable, replace if necessary.
'Not zeroed' message	Measurement on, channel not zeroed.	Zero the channel.
'Zeroing failed' message	Unsuccessful zeroing of P1 /P2 (number field).	Possibly due to pulsating pressure waveform. Open the transducer to air and zero the channel.
		Offset is > 150 mmHg. Open the transducer to air and zero the channel.
		Defective transducer. Replace it and zero the channel.
'Calibration failed' message	Unsuccessful calibration of P1/P2 (number field), possibly due to a pulsating waveform	Turn the transducer to sphygmomanometer and try again (zeroing takes place first).
		Gain is beyond the limits (± 20% of the default gain). Replace the transducer.
Out of range < 40 mmHg	Measurement pressure is beyond the measurement range.	Check the transducer level. Zero the channel.
Out of range > 320 mmHg	Measurement pressure is beyond the measurement range.	Check the transducer level. Zero the channel. The patient may also have high pressure.
Zero adj. > 100 mmHg	Offset when zeroing is > 100 mmHg (but < 150 mmHg) from the absolute zero of the module (with default gain).	Check the transducer. The waveform may hit the top and the numeric display not shown.
Out of range	Measured pressure is beyond the internal measurement range of the module.	The waveform hits the top and the numeric display not shown. Check the transducer and its level. Zero the channel.

4.2 Troubleshooting flowcharts

4.2.1 Troubleshooting for NIBP parameter

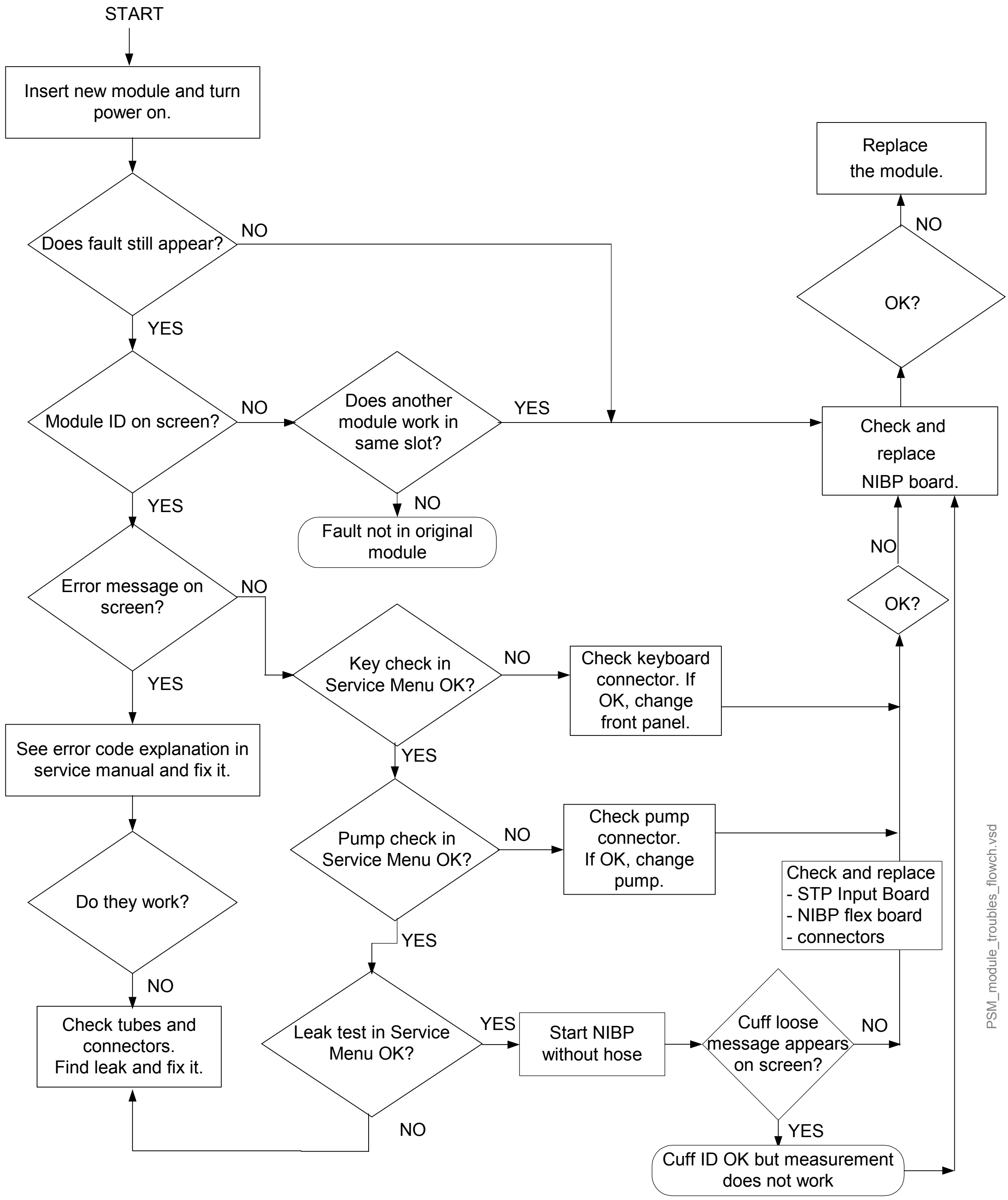


Figure 13 Troubleshooting flowchart for NIBP parameter

4.2.2 Troubleshooting for ESP parameters

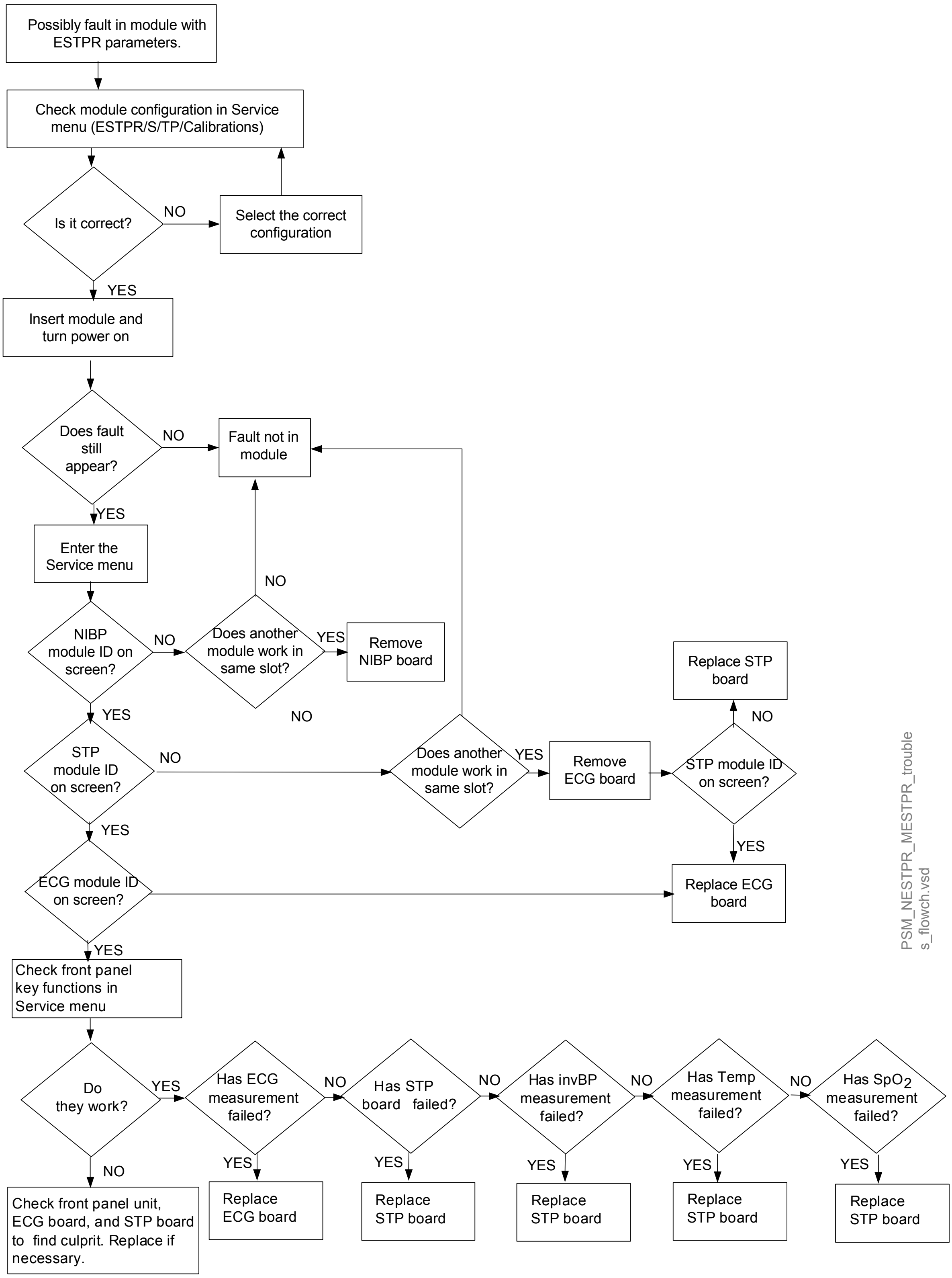


Figure 14 Troubleshooting flowchart for ESP Parameters

5 Earlier revisions

Patient Side Modules E-PSM, E-PSMP (Rev. 00)

APPENDIX A: Service check form, Patient Side Module, E-PSM, E-PSMP (Rev. 01)

Customer		
Service	Module type	S/N
Service engineer		Date

Measuring equipment / test gases used:				
Equipment / tool / gas:	Manufacturer:	Model/Type/Part Number:	Serial Number / ID:	Calibration Date:

Visual inspection	OK	N.A.	Fail		OK	N.A.	Fail
1. Internal parts	☐	☐	☐	2. External parts	☐	☐	☐
Notes							
Functional inspection							
3. NIBP pump filter	☐	☐	☐	4. Module installation	☐	☐	☐
5. Module recognition	☐	☐	☐				
Notes							

ECG measurement	S/N
6. Module software (serial numbers)	
ECG/RESP	
STP	
NIBP	

	OK	N.A.	Fail		OK	N.A.	Fail
7. Communication and memories	☐	☐	☐	8. Power frequency	☐	☐	☐
9. Cable recognition	☐	☐	☐	10. Lead detection	☐	☐	☐
11. Test with the patient simulator	☐	☐	☐				
Notes							

RESP measurement				S/N			
	OK	N.A.	Fail		OK	N.A.	Fail
12. RESP measurement recognition	☐	☐	☐	13. Test with patient simulator	☐	☐	☐
Notes							

TEMP measurement				S/N			
	OK	N.A.	Fail		OK	N.A.	Fail
14. Communication and memories	☐	☐	☐	15. Temperature probe detection	☐	☐	☐
16. Calibration check	☐	☐	☐	17. Temp test	☐	☐	☐
18. Module configuration	☐	☐	☐				
Notes							

InvBP measurement				S/N			
	OK	N.A.	Fail		OK	N.A.	Fail
19. Membrane keys	☐	☐	☐	20. Cable and transducer detection	☐	☐	☐
21. Calibration	☐	☐	☐	22. Test with patient simulator	☐	☐	☐
Notes							

SpO2 measurement							S/N
	OK	N.A.	Fail		OK	N.A.	Fail
23. SpO2 probe detection	☐	☐	☐	24. Test measurement	☐	☐	☐
Notes							

NIBP measurement							S/N
	OK	N.A.	Fail		OK	N.A.	Fail
25. Communication and memories	☐	☐	☐	26. Membrane keys	☐	☐	☐
27. Pump and valves	☐	☐	☐	28. Leak test	☐	☐	☐

29. Calibration check	Measured B1	Measured B2	Allowed range
0 mmHg			±9 mmHg
100 mmHg			100 ±2 mmHg
200 mmHg			200 ±3 mmHg
260 mmHg			260 ±4 mmHg
30. Safety valve functions	Measured B1	Measured B2	Allowed range
			270...330 mmHg
			270...330 mmHg
			130...165 mmHg
			130...165 mmHg

	OK	N.A.	Fail		OK	N.A.	Fail
31. Cuff related messages	☐	☐	☐	32. Test measurement	☐	☐	☐
33. NIBP hose detection	☐	☐	☐				
Notes							

All modules	OK	N.A.	Fail		OK	N.A.	Fail
34. Electrical safety check	☐	☐	☐	35. Functioning after electrical safety check	☐	☐	☐
36. Final cleaning	☐	☐	☐				
Notes							

Notes

Used spare parts			

Signature

Datex-Ohmeda

S/5 Extension Module for FM, N-FC, N-FCREC, N-FREC

Technical Reference Manual Slot

Conformity according to the Council Directive 93/42/EEC concerning Medical Devices amended by 2007/47/EC

CAUTION: U.S. Federal law restricts this device to sale by or on the order of a licensed medical practitioner. Outside the USA, check local laws for any restriction that may apply.

All specifications subject to change without notice.

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Introduction

This Technical Reference Manual Slot provides information for the maintenance and service of the Datex-Ohmeda S/5 Extension Module for FM, N-FC, N-FCREC and N-FREC. The Extension Modules for FM are designed for use with the S/5 FM Monitor and FM Light. Later in this manual the module can be called w/o the system name Datex-Ohmeda S/5.

Please also refer to the Part I sections of the manual for information regarding system specific information e.g. related documentation, conventions used, symbols on equipment, safety precautions, system description, system installation, interfacing, functional check and planned maintenance.

N-FREC and N-FCREC provide real time printing of waveform and numerical data, and trend data.

N-FCREC and N-FC provide CO_2 airway and respiratory measurements.

WARNING **The Extension Modules for FM provide airway and respiratory / CO_2 measurements intended for patients weighing over 5kg (11lb).**

NOTE: Printings on thermal paper may be destroyed when exposed to light, heat, alcohol etc. Take a photocopy for archive.

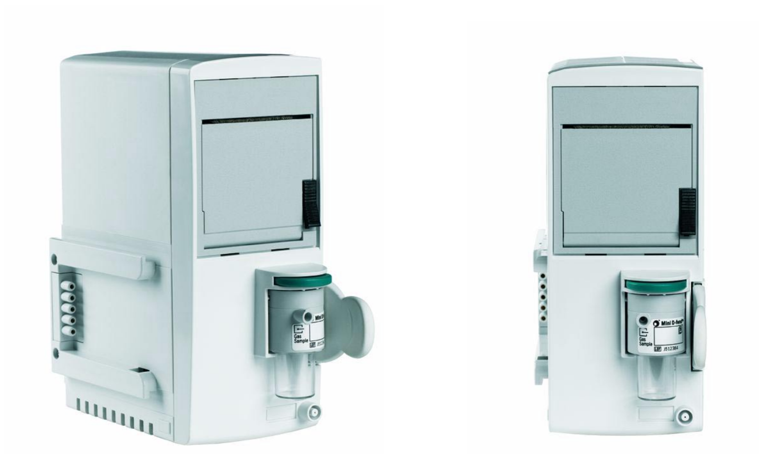


Figure 1 F-FCREC side and front views

Parameters

Module	CO_2	Recorder
N-FC	X	
N-FCREC	X	X
N-FREC		X

Compatibility

NOTE: The Extension Module for FM, N-FC is designed for use with L-FICU03(A) or later software.

NOTE: The Extension Modules for FM, N-FCREC and N-FREC are designed for use with L-FICU04(A) or later software.

NOTE: The Extension Modules for FM are compatible with S/5 FM and FM Light monitors only.

1 Specifications

1.1 General specifications

N-FCREC

Module size, W × D × H	90 × 169 × 191 mm, 3.54 × 6.65 × 7.51 in
Module weight	1.0 kg/2.2 lb.
Power consumption	2.7 W standby, 11.5 W printing

N-FREC

Module size, W × D × H	90 × 169 × 191 mm, 3.54 × 6.65 × 7.51 in
Module weight	0.8 kg/1.7 lb.
Power consumption	1.2 W standby, 10 W printing

N-FC

Module size, W × D × H	46 × 169 × 191 mm, 1.81 × 6.65 × 7.51 in
Module weight	0.5 kg/1.1 lb.
Power consumption	1.5 W typical

1.1.1 Environmental specifications

Operating temperature	+10...+40 °C (+50 to 104 °F)
Storage temperature	-20...+60 °C (-4 to +140 °F)
Atmospheric pressure	670...1060 hPa (500...800 mmHg) (670...1060 mbar)
Relative humidity	10...90% non-condensing
Protection against electrical shock	Type BF

1.1.2 Functional alarms

Funtional alarms for

– Blocked sample line
– D-Fend replacement
– D-Fend check

1.2 CO_2 measurement

1.2.1 Typical performance

$EtCO_2$	End-tidal CO_2 concentration
$FiCO_2$	Inspired CO_2 concentration
Measurement range	0 to 20 vol% (0 to 20 kPa, 0 to 150 mmHg)
Accuracy	
CO_2 concentration 0 to 15 vol%	±(0.2 vol% +2% of reading)
CO_2 concentration 15 to 20 vol%	±(0.7 vol% +2% of reading)
Measurement rise time	< 300 ms with nominal flow

Adjustable low and high limits for $EtCO_2$ and $FiCO_2$.

1.2.2 Technical specifications

Airway humidity	0...100%, condensing
Sampling rate	150 ±25ml/min (sampling line 2 to 3 m, normal conditions)
Sampling delay	2.1 seconds typical with a 3-m sampling line
Total system response time	2.4 seconds typical with a 3-m sampling line, including sampling delay and rise time (typically 3.7 seconds with a 6-m sampling line).

Automatic compensation for barometric pressure, CO_2-NO_2 and CO_2-O_2 collision broadening effect compensation selectable from menu.

Warm-up time	1 min for operation with CO_2, 30 min for full specification
Autozeroing interval	4, 15, 30 and 60 minutes after start-up, then every 60 minutes.

1.2.3 Normal conditions

Accuracy specifications apply in normal conditions (after 30 minutes warm-up period):

Ambient temperature	18...28 °C, within ±5°C of calibration
Ambient pressure	500...800mmHg, ±50mmHg of cal.
Ambient humidity	20...80% RH, ±20% RH of cal.

Automatic compensation for barometric pressure.

Non-disturbing gases are those with a maximum effect on the CO_2 reading <0.2 vol%. The effect is valid for specific concentrations shown in parentheses of the non-disturbing gas:

- Ethanol C_2H_5OH (<0.3%)
- Acetone (<0.1%)
- Methane CH_4 (0.2%)
- Nitrogen N_2
- Water vapor
- Dichlorofluromethane (<1%)
- Tetrafluoroethane (<1%)

Disturbing gases and their effect on the CO_2 reading at 5.0 vol% CO_2 are shown below. Errors listed reflect the effect of specific concentrations (shown in parentheses) of an individual disturbing gas and should be combined when estimating the effect of gas mixtures:

- Halotane (4%) increases < 0.3 vol%
- Isoflurane (5%) increases < 0.4 vol%
- Enflurane (5%) increases < 0.4 vol%
- Desflurane (24%) increases < 1.2 vol%
- Sevoflurane (6%) increases < 0.4 vol%
- Helium (50%) decreases < 0.3 vol%
- If O_2 compensation is not activated: O_2 (40 ... 95%) decreases < 0.3 vol%
- If O_2 compensation is activated: O_2 (40 ... 95%) error < 0.15 vol%
- If N_2O compensation is not activated: N_2O (40%) increases < 0.4 vol%, N_2O (40 to 80%) increases < 0.8 vol%
- If N_2O compensation is activated: N_2O (40 to 80%) error < 0.3 vol%

1.2.4 Conditions exceeding normal

Accuracy specifications under the following conditions ❶❷❸:

❶ Ambient temperature	10...40 °C, within ±5 °C of calibration
Ambient pressure	500...800 mmHg, ±50 mmHg of calibration
Ambient humidity	10...98% RH, ±20% RH of calibration

❷ During warm-up 1 to 10 minutes, under normal conditions

❸ During warm-up 10 to 30 minutes, under normal conditions

	Accuracy under different conditions (see above)	
	Conditions ❶ and ❸	Condition ❷
CO_2 (0 ... 15 vol%)	±(0.3 vol% + 4% of reading) (at 5 vol% error ±0.5 vol%)	±(0.4 vol% + 7% of reading) (at 5 vol% error ±0.75 vol%)
CO_2 (15 ... 20 vol%)	±(0.8 vol% + 4% of reading) (at 5 vol% error ±0.5 vol%)	±(0.9 vol% + 7% of reading) (at 5 vol% error ±0.75 vol%)

1.3 Respiration Rate (RR)

Measurement range	4 to 80 breaths /min
Breath detection	1% change in CO_2 level
Accuracy	±1/min in the range 4 to 20 l/min
	±5% in the range 20 to 80 l/min
Resolution	1/min

Adjustable low and high limits for respiration rate; alarm for apnea.

1.4 Recorder

1.4.1 Typical performance

Principle	Thermal array
Print resolution	
Vertical	8 dots/mm (200 dots/inch)
Horizontal	32 dots/mm (800 dots/inch) at a speed of 25 mm/s and slower
Paper width	50 mm, printing width 48 mm
Print speed	1, 6.25, 12.5, 25 mm/s
Waveform printout	selectable 1, 2, or 3 waveforms
Numerical printout	HR, NIPBP, P1, P2, T1, T2, Tblood, Et/FiCO_2, RR
Tabular Trend printout	HR, SpO_2, P1, NIBP, EtCO_2

2 Functional description

2.1 Measurement principle

2.1.1 CO_2 measurement

MiniC is a side stream gas analyzer, measuring real time concentrations of CO_2. It is a non dispersive infrared analyzer, measuring absorption of the gas sample using an optical narrow band filter.

The infrared radiation detector is thermopile.

Concentration of CO_2 is calculated from absorption measured at 4.2 to 4.3 μm.

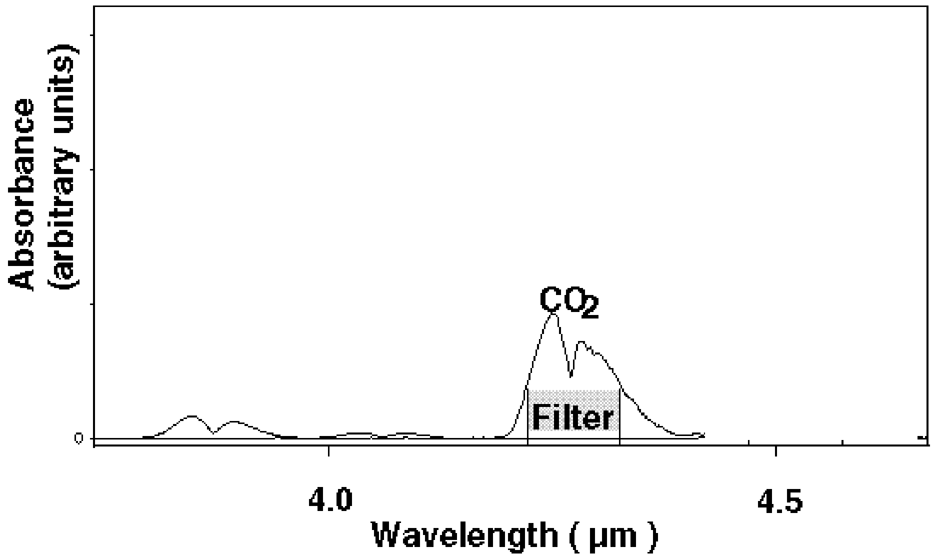


Figure 2 Absorbance of CO_2

2.2 Main components

The miniC unit in N-FC and N-FCREC modules consists of:

– Gas sampling system
– MiniC measuring unit
– CPU board

The recorder unit in N-FREC and N-FCREC consists of:

– Recorder board
– Thermal printer

2.2.1 Gas sampling system

The sampling system draws a gas sample to the analyzer at a fixed rate.

The gas sampling system samples the measured air to the module, and removes water and impurities from it. A sampling line is connected to the water trap. The pump draws gas through the sampling line to the gas measuring unit. After the measurement, the gas is exhausted from the sample gas out connector.

The sample flow is nominally 150 ml/min.

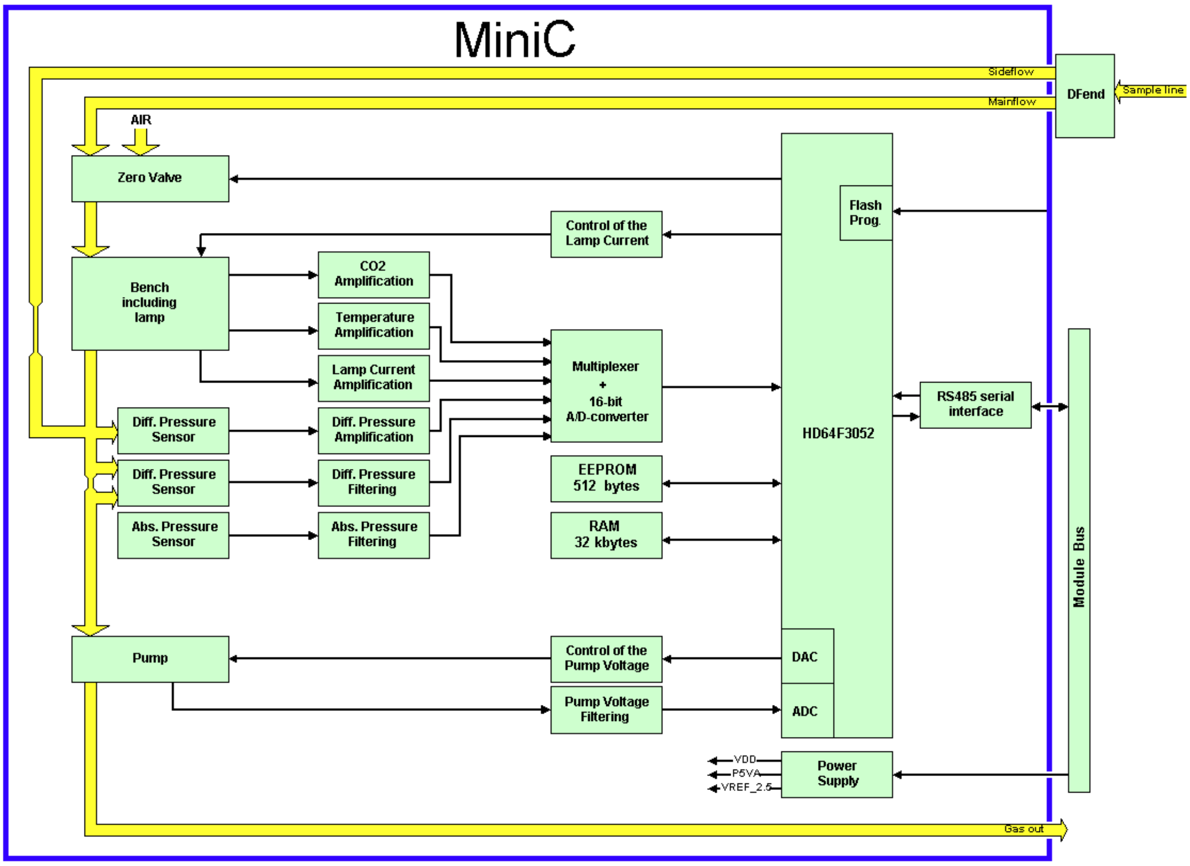


Figure 3 **MiniC block diagram**

Mini D-fend™

The sample is drawn through the sampling line. The gas then enters the module through the water trap, where it is divided into two flows, a main flow and a side flow. The main flow goes into the analyzer. This flow is separated from the patient side by a hydrophobic filter. The side flow creates a slight subatmospheric pressure within the Mini D-fend water trap which causes fluid removed by the hydrophobic filter to collect in the bottle.

Zero valve

The main flow passes through a magnetic valve before proceeding to the analyzer. This valve is activated to establish the zero point for the MiniC measuring unit. When the valve is activated, room air is drawn through a filter into the internal system and the gas sensor.

Nafion™ tube [1)]

A Nafion tube is used between the water trap and the zero valve to balance the sample gas humidity with that of ambient air. The tube prevents errors caused by the effect of water vapor on gas partial pressure when humid gases are measured after calibration with dry gases.

Gas analyzers

After the zero valve and Nafion tube, the gas passes through the miniC measuring unit.

Sample flow differential pressure transducer

The sample flow differential pressure transducer measures pressure drop across a restrictor and calculates the sample flow from the pressure difference.

Working pressure transducer

The working pressure transducer measures differential pressure between the tubing and ambient air near the miniC measuring unit.

Atmospheric pressure transducer

The atmospheric pressure transducer measures real-time atmospheric pressure. The following messages are based on the obtained pressure values: 'sample line blocked', 'check D-fend', 'replace D-fend' and 'check sample gas outlet'.

Sampling pump and damping chamber

The gas sampling pump is a membrane pump run by a DC-motor. Sample flow is measured with a differential pressure transducer across a known restriction. The motor is automatically controlled to maintain a constant flow even when the D-fend water trap ages and starts to get occluded. It also enables the use of sample tubes with varying lengths and diameters.

NOTE: In no occasion is the flow reversed towards the patient.

1 [1)] Nafion is a trademark of Perma Pure Inc.

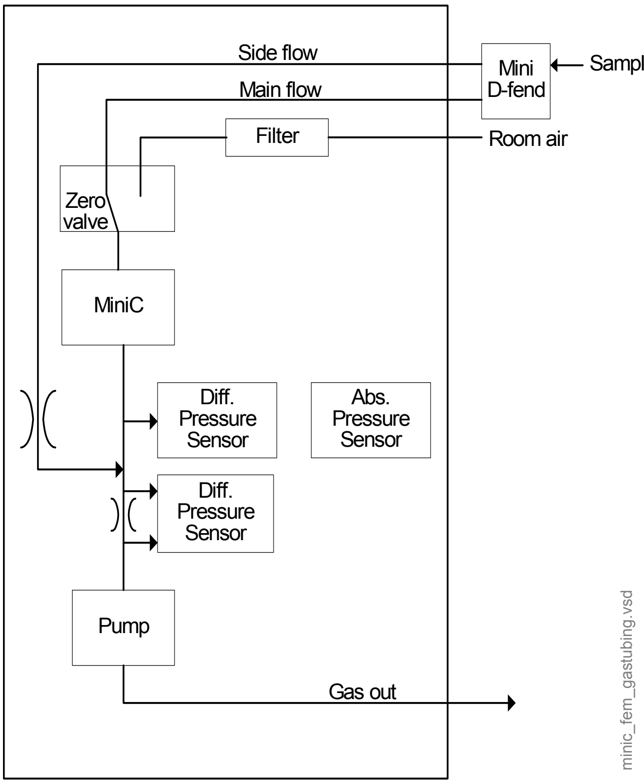


Figure 4 Gas tubing layout

2.2.2 MiniC measuring unit

The miniC measuring unit is a non-dispersive infrared analyzer measuring absorption of the gas sample at 4.2 to 4.3 μm infrared wavelength, which is selected using an optical narrow band filter. The IR lamp is a filament surrounded by thermal isolation. There is a hole in the isolation, passing the radiation to a conical measuring chamber with 3 mm length. From the sample chamber, the radiation goes into a thermopile detector with an optical filter in front of it.

The temperature sensor measures the miniC measuring unit's temperature and it is used for temperature compensation.

The miniC measuring unit includes a miniC flexible board, which connects the thermopile signal and the temperature sensor signal to the CPU board.

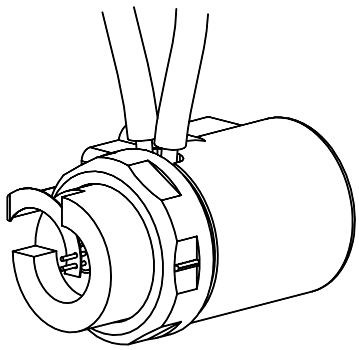


Figure 5 MiniC measuring unit

2.2.3 CPU board

The CPU board contains a processor, memories and all the analog signal processing needed. A MiniC measuring unit is attached to the board with a flexible PCB. Also supply voltage and an RS485 serial channel are connected to the CPU board using another flexible PCB.

Analog signals (CO_2, temperature, absolute and differential pressures and lamp current signals) are fed to the 16-bit A/D converter. The processor controls the A/D converter and calculates the CO_2 percentage and respiration rate from this data.

The processor controls sample flow by adjusting the pump voltage based on the differential pressure signal. The processor also controls the current of the IR source and keeps it constant.

Calibration data is stored on the EEPROM.

2.2.4 Recorder board

The function of the recorder board is to establish an interface between the recorder unit and main CPU board in the monitor. The recorder unit related side panel key is connected to the recorder unit via the recorder board. The recorder unit and the recorder board are connected together with a special connector. The REC board controls the recorder unit communication and power.

The REC board is grounded via the recorder unit. If the recorder unit is not installed, the REC board does not function.

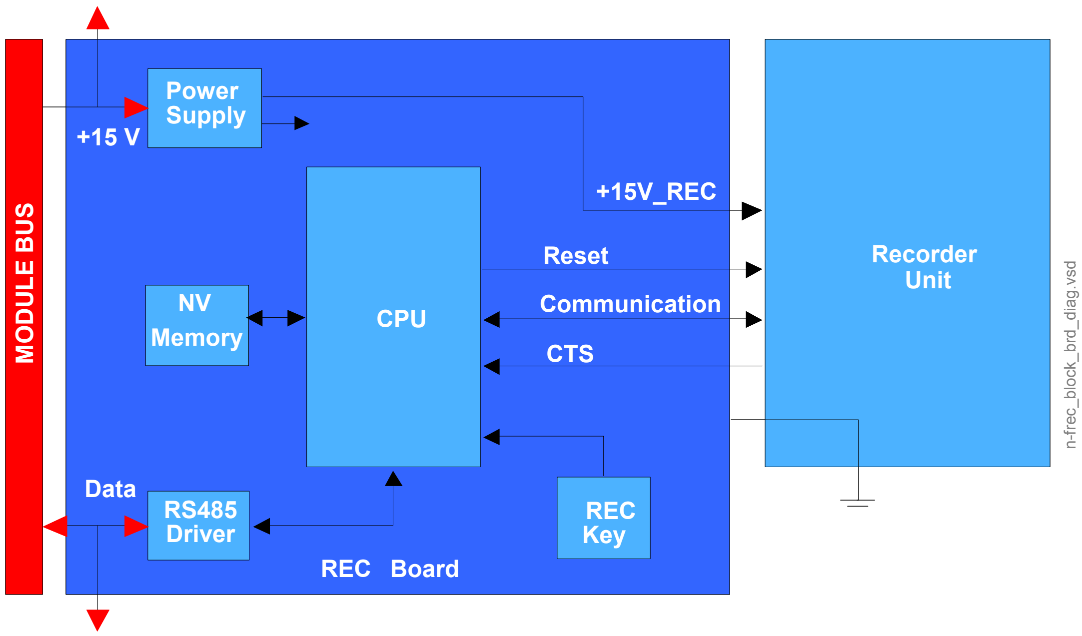


Figure 6 Recorder board block diagram

External Communication

Communication with the main CPU board is established via RS485.

Supply voltage The recorder unit supply voltage, +15V_REC, is provided by the recorder board.

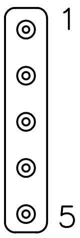
Module Bus Flex board

Module Bus Flex board connects the CPU board of the miniC unit and the recorder board to the module bus.

Figure 7 Module bus flex board

2.3 Connectors and signals

2.3.1 Module bus connector

5 pin female connector	**Pin No.**	**Signal**
	1	GND
	2	Vmod 13.8 - 16 V
	3	Data +
	4	Data -
	5	Shield

3 Service procedures

3.1 General service information

The field service of the Extension Modules for FM is limited to replacing faulty circuit boards or mechanical parts. The circuit boards should be returned to GE Healthcare for repair.

GE Healthcare is always available for service advice. Please provide the unit serial number, full type designation and a detailed fault description.

WARNING **Only trained personnel with appropriate equipment should perform the tests and repairs outlined in this section. Unauthorized service may void warranty of the unit.**

CAUTION The module electronics can only be repaired and calibrated at the factory.

3.1.1 MiniC measuring unit

WARNING **The miniC measuring unit can only be repaired and calibrated at the factory. Attempts to repair/calibrate the unit elsewhere will adversely affect operation of the unit. In case of failure, the complete miniC unit should be sent to GE Healthcare for factory exchange.**

WARNING **Handle the water trap and its contents as you would any body fluid. Infectious hazard may be present.**

Serviceable parts

- Mini D-fend
- Mini D-fend O-rings
- Nafion tube
- Air filter
- Pump

NOTE: After any component replacement, see chapter "Adjustments and calibrations".

Calibration interval six months. Preventive maintenance once a year including the change of Nafion tube and the O-rings of water separator, pump check and calibration, leak test and absolute pressure sensor check.

3.1.2 Recorder unit

Serviceable or exchangeable parts

- Recorder board
- Thermal plotter

3.2 Service check

These instructions include complete procedures for a service check. The service should be performed after any service repair. Additionally, the service check procedures can also be used for determining possible failures.

The procedures should be performed in ascending order.

The instructions include a check form ("APPENDIX A:") which should be filled in when performing the procedures.

The symbol ✍ in the instructions means that the check form should be signed after performing the procedure.

3.2.1 Recommended tools

Tool	Order No.	Notes
Screwdriver		Pozi-drive, Torx T10
Ambient pressure manometer		Amb. Press. can be checked from local meteorological station
Flowmeter		TSI model 4140 recommended
Flow cassette 50/1.1	873812-HEL	
Calibration gas	755580* (gas)	Contains 5 CO_2 and air
Regulator	755534-HEL	
E-PSM / E-PSMP		
Patient simulator		

3.2.2 Recommended parts

Recorder paper	74205-HEL	

Detach the module box cover by removing the five screws from the locking side of the module. Be careful with the flex cable, when opening the cover. Remove the grey plastic shield over the miniC unit.

3.2.3 Inspection

General

1. Check internal parts
   - all screws are tightened properly
   - all cables are connected properly
   - tubes are not pinched and there are no sharp bends on them
   - all tubes are connected properly
   - EMC covers are attached properly
   - there are no loose objects inside the module

N-F(C)REC:

Open the paper compartment hatch and take out the paper roll, if installed.

Remove any paper chaff from the paper compartment.

Clean the thermal printhead and the small glass window in front of the static brush with a cotton swab dipped in isopropyl alcohol. Avoid contact with the rubber paper roller.

NOTE: Be careful to limit the application of alcohol to the thermal printhead and the window.

Leave the paper compartment empty and close the hatch.

2. Check external parts
   - all connectors are intact and attached properly
   - the module box and the locking system are intact

   Reattach the module and check that the locking system moves properly.

CO_2 measurement

3. Check Mini D-Fend

   Detach the Mini D-fend. Check the condition of the rubber O-rings on the metal Mini D-fend connectors, located in the module front cover.

   If necessary, detach the connectors by first disconnecting the tubes, then removing the locking rings from the back of the front cover.

   Replace the Mini D-fend and sampling line with new ones.

NOTE: Use only Datex-Ohmeda sampling lines in order to ensure proper functioning.

Connect the Extension Module, N-FC or N-FCREC to the monitor.

Turn on the monitor.

Configure the monitor screen so that the CO_2 curve is shown, for example as follows:

Monitor Setup - ***Screen 1 Setup - Waveform fields -***

Field 6 - CO2

Digit Fields

Lower Field 1 - Gases

4. Module software

   Wait until the message ‘Calibrating gas sensor’ disappears from the screen, then enter the service menu.

   Monitor Setup - ***Install/Service*** (password 16-4-34) ***- Service*** (password 26-23-8).

   Write down the information regarding the ExtensionModule software.

5. Module bus communication

   Enter the service menu ***General: Parameters - Gas Unit - General***

   Check that the Timeouts, Bad checksums and Bad c-s by mod values are not increasing faster than by 5 per second.

If one of the values is increasing faster, it indicates a failure in module bus communication.

✍

6. Flow measurement offset

   Enter the service menu ***Gases***:

   Gas Unit - Gases

   Check that the flow measurement offset, i.e. the shown sample Zero value is within ±10 ml/min.

   ✍

7. Ambient pressure

   Check that the shown Ambient value corresponds with the current ambient pressure (±20 mmHg).

   ✍

8. Zero valve check

   Feed calibration gas and check that the gas readings in the service menu correspond with the values on the gas bottle sticker. Keep feeding gas, then activate the zero valve from the menu. The CO_2 reading should drop back to near 0%. Set back the Zero valve to state MEAS.

   ✍

9. Nafion tube

   Replace the Nafion tube, if necessary.

NOTE: The Nafion tube should be replaced annually.

✍

10. Leak test

    Perform the sampling system leak test.

    Connect a flow cassette with high flow resistance value (50/1.1) to the end of the sampling line and start following the Amb-Work value in the service menu. When the value exceeds 130 mmHg, connect the other port of the flow cassette to the sample gas out connector and switch off the pump.

    Wait until the pressure inside the sampling system is stabilized, then observe the shown Amb-Work value. The value, i.e. the pressure inside the sampling system should not drop more than 6 mmHg in 20 seconds.

    If the pressure drops more, first check the connections and repeat the test.

    ✍

11. Check the flow rates

    Wait until the Sample Flow value returns close to 150 ml/min.

    Connect a flow meter to the 3 meter sampling line and check that the flow (the flow meter reading) is within the following range:

    Sampling flow (ml/min) 135...165

    If necessary, readjust the sampling flow:

    Select ***Sample gain adj*** from the menu.

    To increase the sampling flow, turn the ComWheel counterclockwise. To decrease the flow, turn the ComWheel clockwise.

    A change of 0.050 in the Gain value changes the flow approximately 7.5 ml/min.

    After you have changed the gain, wait until the Sample Flow value on the screen returns near to the original, then check the flow meter reading again.

12. Working pressure

    Check that the Amb-Work value in the service menu is within the following range:

    Amb-Work (mmHg) 20...50

13. Gas calibration

    Airway Gas - ***Gas Calibration***

NOTE: The calibration should not be performed before 30 minutes warm-up time.
Use calibration gas 755580 (5% CO_2, about 20% O_2) for calibrating the module with CO_2 measurement.

14. Occlusion detection

    Block the tip of the sampling line with your finger and check that the message 'Sample line blocked' appears on the monitor screen within 60 seconds.

15. Check D-fend

    Detach the mini D-fend and check that the message 'Check D-fend' appears on the monitor screen within 30 seconds.

16. Apnea detection

    Reattach the mini D-fend. Simulate at least 5 breaths by feeding calibration gas into the sampling line. Check that the shown gas information is correct.

Check that the monitor shows the message ‘Apnea’ within 30 seconds after you have stopped feeding the gas.

Recorder

17. Paper compartment cleaning

    Open the paper compartment hatch and take out the paper roll, if installed.

    Remove any paper chaff from the compartment.

    Clean the thermal printhead and the small glass window in front of the static brush with a cotton swab dipped in isopropyl alcohol. Avoid contact with the rubber paper roller.

NOTE: Be careful to limit the application of alcohol to the thermal printhead and the window.

Leave the paper compartment empty and close the hatch.

Configure the monitor screen so that all required parameters are shown, for example:

Monitor Setup - ***Screen 1 Setup - Waveform Fields -Field 1 - ECG1***
Field 2 - ECG2
Field 3 - P1
Field 4 - P2
Field 5 - PLETH
Field 6 - OFF

Plug in the Hemodynamic Module. Connect a patient simulator to the module and check that all connected parameters are shown on the screen.

Preset recording settings:

Record/Print - ***Record Waveforms*** - ***Waveform 1 - ECG1***
Waveform 2 - P1
Waveform 3 - P2
Delay - Off
Paper Speed - 6.25 Mm/S
Length --> 30 S
Record Trends - Graphic Trend 1 - Hr
Graphic Trend 2 - P1

Monitor Setup - ***Install/Service*** (password 16-4-34) ***- Trends & Snapshot - Default Trend - Graph.***

Pt.Data&Trends ***- Trends - Time Scale - 2 h***

18. Cover state recognition

    Open the paper compartment cover. Check that the message ‘Recorder: Cover open’ appears on the screen.

19. Paper recognition

    Close the paper compartment cover. Check that the previous message changes to 'Recorder: Out of paper’.

Install a paper roll and close the cover. Check that the message 'Recorder: Cover open' disappears from the screen.

20. Quality of recording

    Press the **Start/ Stop** key again and check that the quality of the recordings is acceptable.

21. Recording speed

    Press the **RECORD WAVE** key again and this time wait until the recording stops. Check that the length of the recorded waveform scale is 18.7 cm (±1.5 cm).

    Change the paper speed setting to 1 mm/s:

    Record/Print - *Record Waveforms - Paper Speed - 1 mm/s*

    Press the **RECORD WAVE** key and wait until the recording stops. Check that the length of the scale is now 3.0 cm (±0.5 cm).

General

22. Electrical safety check

    Perform an electrical safety check and a leakage current test.

23. Functioning after electrical safety check

    Check that the module functions normally after performing the electrical safety check.

24. Final cleaning

    Turn off the monitor, disconnect and clean the module.

- Fill in all necessary documents.

3.3 S/5 N-FCREC disassembly and reassembly

CAUTION When reassembling the module, make sure that the tubes and cables are not pinched between the boards and the cover.

To reassemble the module, reverse the order of the disassembly steps.

3.3.1 Instructions after replacing MiniC unit

After replacing the MiniC unit:

- perform the sampling system leak test
- perform the occlusion test
- perform the gas calibration

3.3.2 Before disassembly

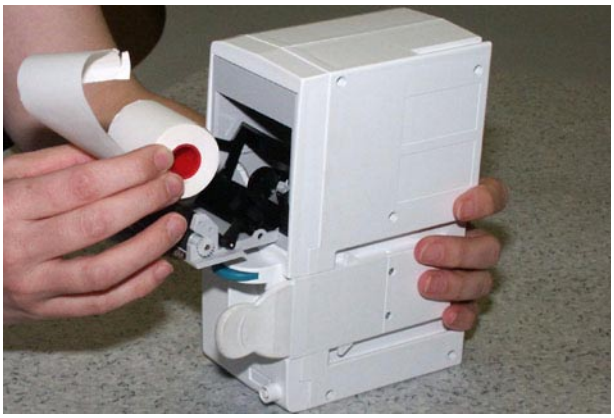
WARNING **Wear a grounded, antistatic wristband when handling PC boards. Electrostatic discharge may damage components on the board.**

Disconnect the Extension Module from the monitor.

Tools needed

- screwdrivers, TORX; T8, T10, T15
- crosshead screwdriver; M15
- flat blade screwdriver
- pinchers
- antistatic wristband

Disassemble the Extension Module

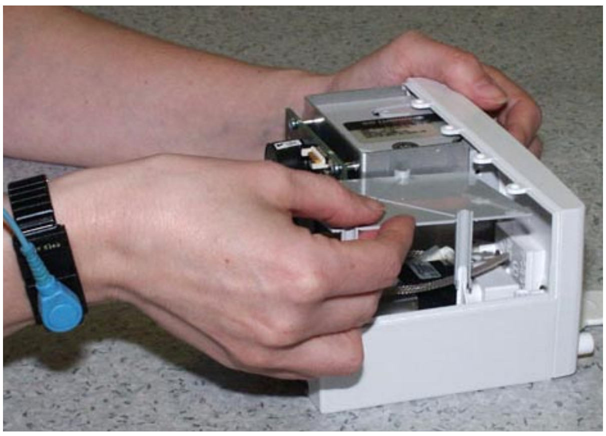


1. Remove the Mini D-fend.
2. Open the recorder unit paper cover and remove the paper roll, if installed.

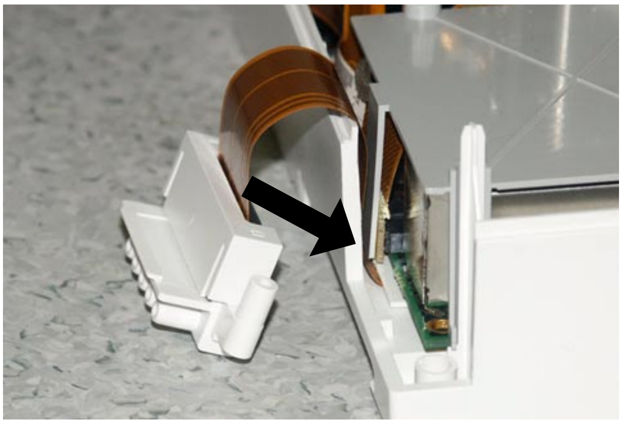
3. Unscrew the two pozidrive screws inside the recorder unit completely (the screws cannot be removed) and remove the recorder unit.

4. Remove the five screws (T8) on the side where the device plate is located.

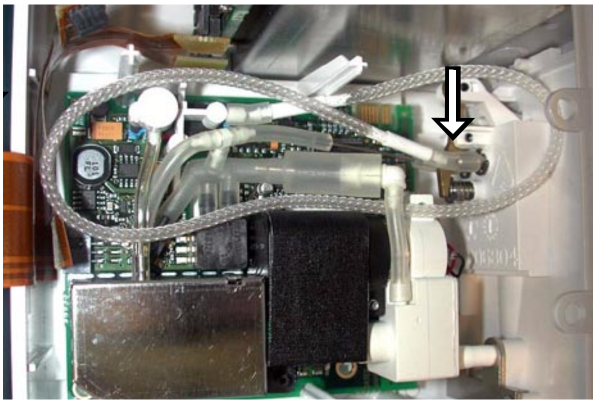
5. Place the N-F(C)(REC) on a table the device plate side down.
6. Remove the two screws (T8) near the module bus connector.



7. Remove the module cover carefully.
8. Remove the EMC-cover and CO_2 unit insulator plate.



NOTE: The finger of the insulator plate secures the interconnection flex connector. While reassembling the insulator plate ensure that the finger supports the connector correctly.

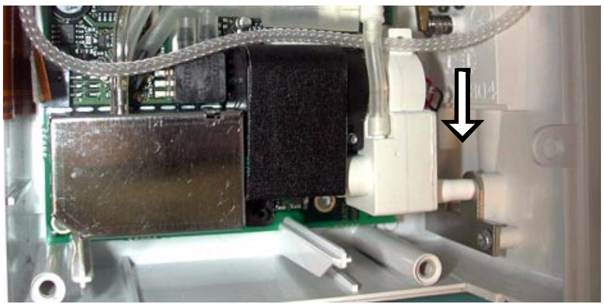


9. Disconnect the Nafion and silicon tubes from the mini D-fend connectors.

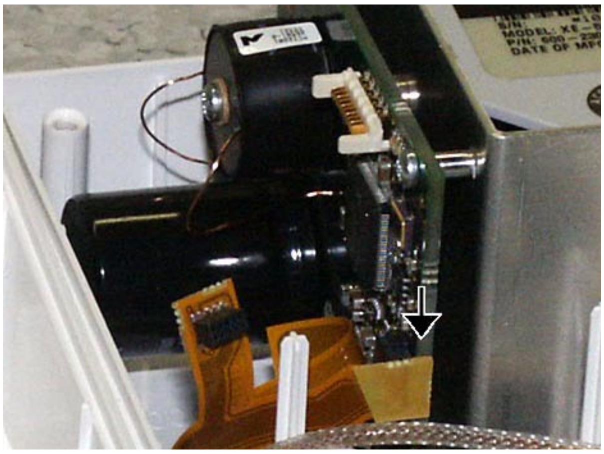
NOTE: While reassembling the nafion tube ensure the correct routing for both modules. If the nafion tube is not correctly routed it may get bent or jammed when reassembling the cover. Bent or pinched tube can get permanently blocked. The block may appear later when the tube warms up.

Correct nafion tube routing in **N-FCREC** module, arrow pointing at the mini D-fend connectors.

Correct nafion tube routing in **N-FC** module, arrow pointing at the mini D-fend connectors.

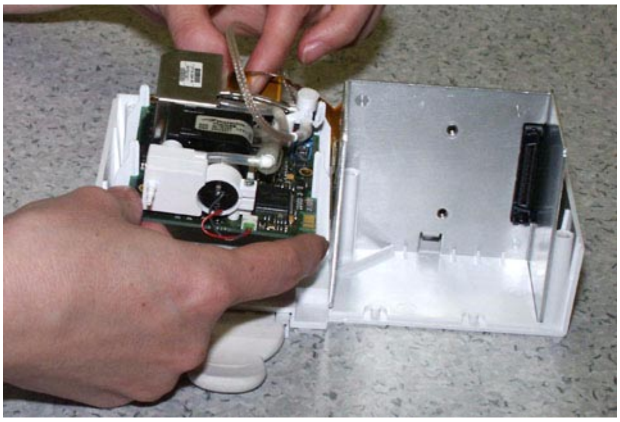


10. Disconnect the gas out tube from the pump unit and remove the front panel unit.

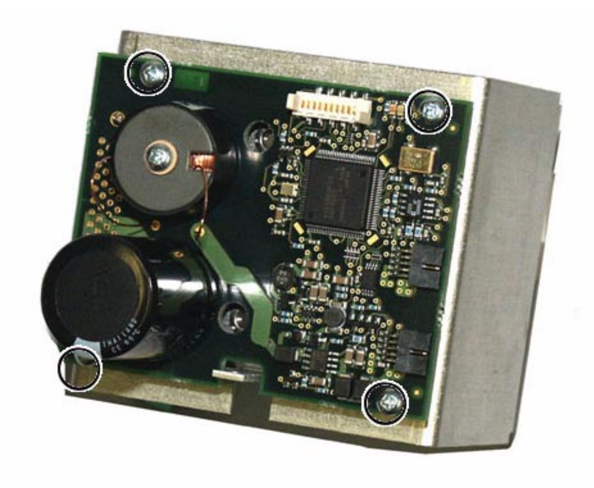


11. Remove the CO2 unit module bus flex cable from the REC board.

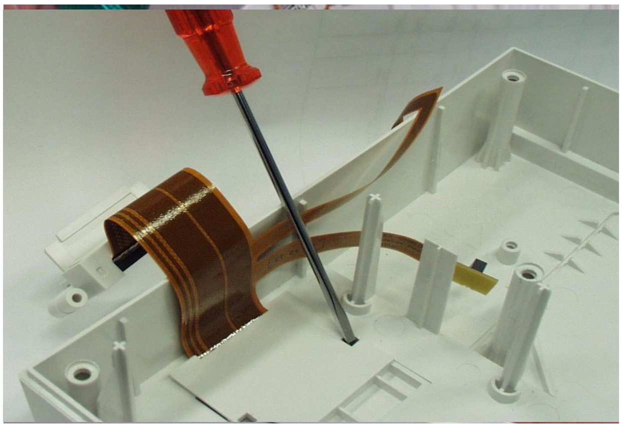
NOTE: Be careful with the insulation plate covering the cable connector on the REC board.



12. Lift the CO2 unit carefully up and remove the unit from the module cover.

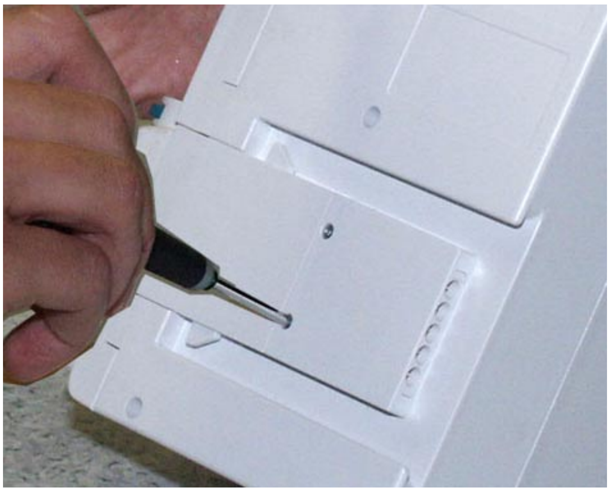


13. Remove the screw (T8) holding the module bus flex cable to recorder unit metal plate and module cover.
14. Lift the REC board carefully up and disconnect the two module bus flex cables from the REC board. Remove the REC board with the recorder unit metal plate from the module cover.
15. Remove the four pozidrive screws holding the REC board to the recorder unit metal plate.



16. Use a flat blade screwdriver to unlock the module bus connector insulator cover. Put the screwdriver in the hole and move the blade backwards (away from the module bus flex cable) until the insulator cover unlocks.

17. By assisting with a screwdriver pull the module bus connector through the hole in the module cover.



18. Flip the module cover over and remove the two (T6) screws holding the lock unit to the frame. While pulling the tab push the lockers with a screwdriver to remove the lock unit.

3.4 Adjustments and calibrations

3.4.1 Calibrating

The airway module should be calibrated once every six months or whenever there are indications of errors in the gas readings.

Calibrate the gas measurement with the Datex-Ohmeda calibration gas. Do not use any other calibration gases.

– Use the regulator 755534-HEL.
– Use gas 755580 only and set the FiO2 level in the CO2 setup menu to 21-40% ***Airway Gas - CO2 setup.***.O_2 concentration to 20%.

Use only recommended calibration gases to guarantee a successful calibration.

During gas calibration, % units are always used for CO_2 regardless of selected measuring units.

NOTE: Ensure that the calibration gas and regulator are functioning properly before calibration. Perform the annual maintenance on the regulator as required.

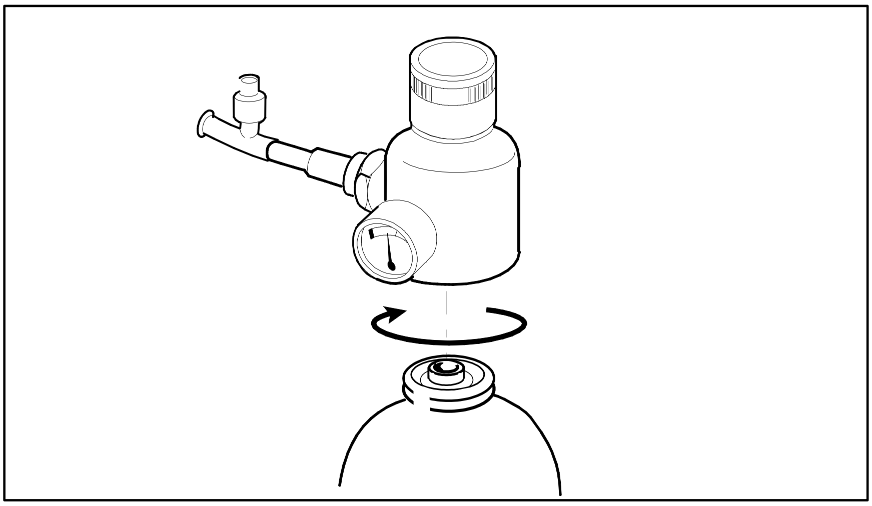


Figure 8 Attaching regulator to the calibration can

1. Attach the regulator to the gas container.
2. Attach a new sampling line to the water trap. Connect the loose end of the sampling line to the regulator on the gas container.

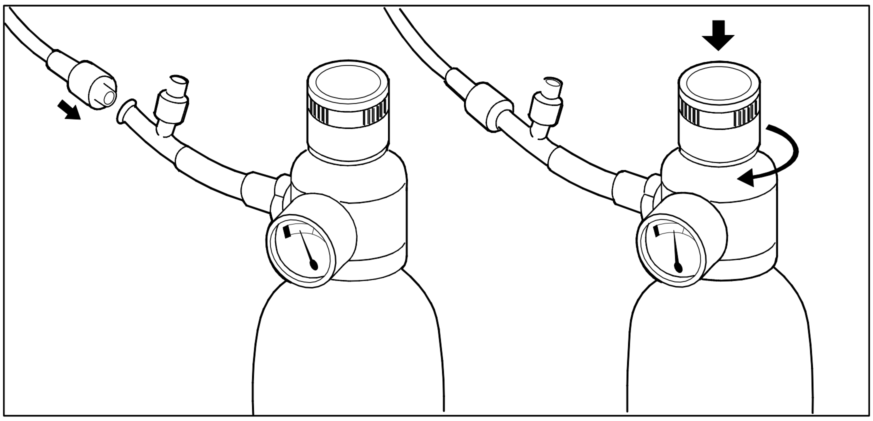
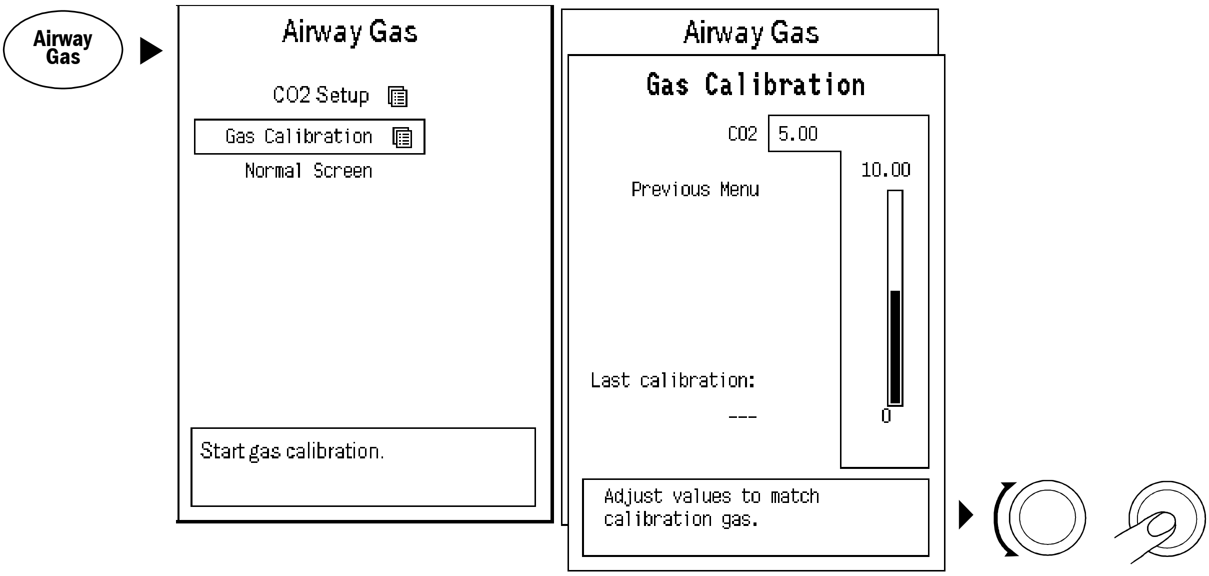


Figure 9 Connecting sampling line to the gas valve and feeding gas

3. For maximum accuracy, let the monitor warm up for 30 minutes. The menu item ***Gas calibration*** remains gray as long as the message 'Calibrating gas sensor' is displayed.
4. Press the **Airway Gas** key and select ***Gas calibration***.



5. Wait until the 'Zero ok' and then the 'Feed gas' messages appear after each gas on the screen.
6. Open the regulator and feed calibration gas until the message 'Adjust' appears, then close the valve.
7. Check that the displayed gas value matches the value on the calibration gas container.

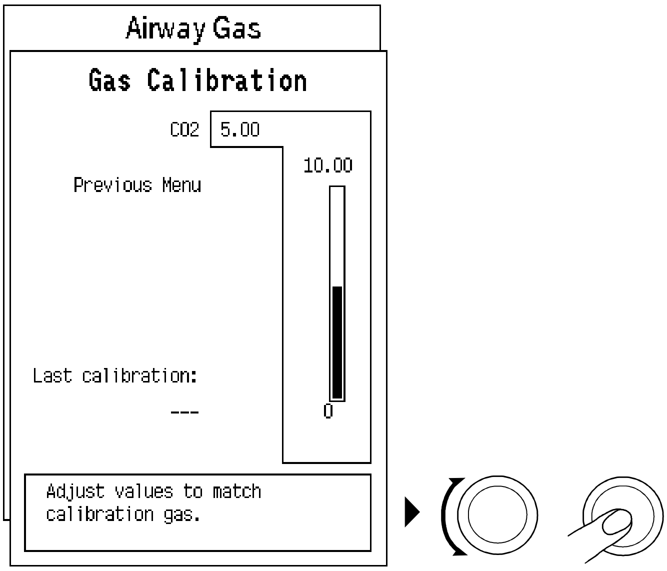
NOTE: Adjust the O_2 percentage according to the calibration gas (for 755580 the right O2 value is 20%).

NOTE: If an error occurs during calibration or if no gas is fed, the text 'Calibr. error' appears. Push the ComWheel to perform a new calibration.

If adjustments are required:

- Turn the ComWheel to highlight the first gas to be adjusted and then push the ComWheel.

- Turn the ComWheel until the displayed value matches the desired value in the gas bottle and push it again.



If the message 'Zero error' is displayed, press the **Normal Screen** key and repeat the calibration procedure.

The time of the last calibration is shown at the bottom of the menu page.

3.4.2 Gas sampling system adjustment

For flow rate measurements, a flow meter with a low flow resistance and the capability to measure low flow rates is required. A sampling line of normal length has to be connected to the monitor as it has a considerable effect on the flow.

3.4.3 Flow rate measurement

If any flow rates are not correct, first replace the Mini D-Fend water trap, then recheck the flows.

The sampling flow rate is measured by a flow meter at the sampling line. The flow rate should be between 135 and 165 ml/min. The flow rate is adjusted in the ***Gases*** service menu with ***Sample gain adj***.

3.4.4 Flow rate adjustment

NOTE: Before adjusting the sampling flow, make sure there is no leakage in the sampling system.

Refer to chapter *3.2 Service check,* step 13. Gas calibration.

Wait until the Sample Flow value is back to near 150 ml/min.

Connect a flow meter to the 3 meter sampling line and check that the flow (the flow meter reading) is within the following range:

Sampling flow (ml/min)   135...165

If necessary, readjust the sampling flow:

Select ***Sample gain adj*** from the menu.

To increase the sampling flow, turn the ComWheel counterclockwise.

To decrease the flow, turn the ComWheel clockwise.

A change of 0.050 in the Gain value changes the flow approximately 7.5 ml/min.

After you have changed the gain, wait until the Sample Flow value on the screen returns near to the original, then check the flow meter reading again.

3.4.5 Gas calibration

Gas calibration is performed in the ***Airway Gas*** menu.

Calibration gas regulator flow check

Interval: every 12 months

Regulator flow specification:

REF 755583-HEL & 755534-HEL: 260 – 410 ml/min at 1-10 bar cylinder pressure
REF 755530-HEL: 260 – 410ml/min at 5-7psi cylinder pressure

Tools needed: calibration gas can, regulator, piece of silicon hose and flow meter. GE Healthcare recommends use of TSI 4140 Flow Meter.

Insert the calibration gas regulator on the gas cylinder. Connect a silicon hose between the regulator and the flow meter. Block the regulator overflow port and open the regulator. Check the flow rate from the flow meter and verify that the flow is within the specification.

4 Troubleshooting

4.1 Troubleshooting chart for recorder unit

Problem	Cause	What to do
Module not responding to front panel key, but operates through Recorder menu.	Membrane switch cable loose or broken.	Check the cable. Replace the front panel if necessary.
Recorder will not start. No error messages shown.	Recorder: Module not properly inserted.	Re-insert the module properly.
	Recorder: Flex-strip cable broken.	Check the cable. Replace if necessary.
	Recorder board faulty.	Replace the recorder board.
	Recorder unit faulty.	Replace the recorder unit.
Recorder works but nothing appears on the paper.	Active side of the paper downwards.	Turn the paper roll over. To test which side is active: Place the paper on a hard surface and draw a line with a fingernail - a dark line will appear on the active (thermal) side.
	Recorder unit faulty.	Replace the recorder unit.

4.2 Troubleshooting chart for CO_2 measurement

Problem	Cause/What to do
No response to breathing	Sampling line or water trap blocked or loose, or improperly attached. Water trap container full. See the gas sampling system troubleshooting.
'SENSOR INOP.' message	The temperature is too low or high, check the temperature in the service menu. Supply voltage is too low or high, IR source current or voltage is too low or high, check current in the service menu. Pump is not working properly, check sample flow and pump voltage in the service menu. Ambient pressure too low or high, check the ambient pressure in the service menu. Zero valve not working properly, check the functionality by switching zero valve on and off in the service menu.
'ZEROING ERROR' message	Gas zeroing failed. Condensation or residual gases are affecting the zero measurement. Allow the module to run drawing room air for half an hour and calibrate again.
'CHECK D-FEND' message	Amb – Work pressure difference too small. Probably water trap or the sampling line is not attached properly. Gas zero valve failure. Pump failure or gas outlet blockage.

Problem	Cause/What to do
'REPLACE D-FEND' message	Amb – Work pressure difference too big. Indicates residue build-up on the water trap membrane. This decreases air flow. Replace the D-fend.
'SAMPLE LINE BLOCKED' message	Amb – Work pressure difference too big. Sampling line or water trap is occluded. Water trap container is full. If occlusion persists, check internal tubing for blockages.
No response to any gas	Check Sample Gas Out. Amb - Work pressure low, flow too small and pump voltage too high. Sampling line, water trap, or internal tubing is blocked or loose, or improperly attached. Gas out connector or tubing is blocked. Zero valve malfunction. Pump failure or pump is worn. Supply voltage missing. Serial communication error.
Sudden increase in gas display	Water trap malfunction. Check all internal tubing and the interior of the water trap for occlusions or leaks. Replace water trap. Check flow rates.
Abnormally high (or abnormally low response to CO_2 or sudden occlusion warning	Pressure transducer failure. Check the Ambient and Amb – Work pressures in ***Gases*** service menu.
Strong drift in all gases	Leak in sampling line or internal tubing (especially in conjunction with too low readings).

4.2.1 CO_2 measurement

Problem	Cause	What to do
Action too low $ETCO_2$ value	• sudden decrease in circulation • pulmonary embolism • hyperventilation • very large dead-space • large shunting • leak in sampling system • calibration error • high by-pass flow from ventilator	• check all connections • check calibration
too high $ETCO_2$	• hypoventilation • increased metabolism • D-fend contaminated • calibration error	• change D-fend • check calibration
waveform clipped	• incorrect scaling	• change scale

Problem	Cause	What to do
no response to breathing	• apnea • (disconnection) • sampling line or water trap loose or blocked (air leak)	• check all connections
	• sample gas outlet blocked	• check that outlet is open
$ETCO_2$ over scale >20% Shown until 32%, specified range 0...20%	• abnormally high $ETCO_2$ (permissive hypercapnia) • CO_2 sensor contaminated • D-fend malfunction	• let the module run without a sampling line until the CO_2 sensor has dried out • change D-fend
$ETCO_2$>$PaCO_2$	• unit is mmHg or kPa and $ETCO_2$ is close to arterial PCO_2 • "dry gas" as default	• change to "wet gas" by using install/service menu

4.3 Gas sampling system troubleshooting

The faults which can occur in the sampling system are: leaks or blockages in the tubing, failure of the sampling pump or the magnetic valves, or diminishing of the flow rates because of dirt accumulating in the internal tubing.

The following checks should help in localizing the fault. Whenever suspecting the sampling system and always after having done any work on the sampling system, check and if necessary adjust the flow rate.

CAUTION The special internal sample tube is mechanically fragile. Sharp bends will cause leaks.

NOTE: D-fend water trap should be replaced, when the 'REPLACE D-FEND' message appears during the monitor startup.

NOTE: If any liquid has entered the miniC measuring unit due to water trap filter failure, leave the module running without a sampling line for several hours and check the functions after it has dried out.

4.3.1 Sampling system leak test

1. Connect a flow cassette with a high flow resistance value (50/1.1) to the end of the sampling line and start following the 'Amb-Work' value in the service menu. When the value exceeds 130 mmHg, connect the other port of the flow cassette to the sample gas out connector and switch off the pump.
2. Wait until the pressure inside the sampling system is stabilized, then observe the shown Amb-Work value. The value, i.e. the pressure inside the sampling system, should not drop more than 6 mmHg in 20 seconds.
3. If the pressure drops more, first ensure the connections you have made and repeat the test.

4.4 MiniC unit troubleshooting

WARNING **The miniC measuring unit can only be repaired and calibrated at the factory. Attempts to repair/calibrate the unit elsewhere will adversely affect operation of the unit. In case of failure, the complete miniC unit should be sent to GE Healthcare for factory exchange.**

4.5 Error messages

Message	Explanation
Occlusion or Sample Line Blocked	The sample tube inside or outside the monitor is blocked or water trap is occluded. If occlusion persists, measured gas values disappear.
Continuous occlusion. Check sample line and D-fend.	Occlusion over 40 seconds.
Check D-fend	- The water trap is not connected - There is a leak in the sampling line inside the module. If air leak persists, measured gas values disappear. Check sample gas out.
(Air leak detected.) Check water trap and sample gas out-flow. Press normal screen to continue.	Air leak over 40 seconds.
Replace D-fend (replace water trap)	Indicates residue build-up on the water trap membrane. This decreases air flow.
Gas calibration is not available during first 5 minutes/during occlusion/during air leak	Entering calibration is not allowed during 5 minutes after power up and during occlusion or air leak.
Gas out blocked	- Gas out connector on the front panel, or the exhaust line connected to it, is blocked. - If the sample gas is returned to the patient circuit, the filter in the return kit may be occluded. - Make sure the sample gas outlet is connected to an open scavenging system only where gas is removed in room pressure.
Recalibration	Time out, fluctuating gases, gain adjusted “over”.
Zero error	Unsuccessful zeroing.
Unstable, Calibr error	Unsuccessful calibration.
Menu messages during calibration:	
Zero error	Unsuccessful zeroing.
Adjust	Calibration gas accepted and monitor is ready for adjusting the gas values to match the calibration gas concentration.
Unstable	Unsuccessful calibration.

5 Earlier revisions

There are no earlier revisions of the S/5™ Extension Module for FM, N-FC, N-FCREC, N-FREC.

For your notes:

APPENDIX A: Service check form, S/5 Extension Module for FM, N-FC, N-FCREC, N-FREC

Customer		
Service	Module type	S/N
Service engineer		Date

Measuring equipment / test gases used:				
Equipment / tool / gas:	Manufacturer:	Model/Type/Part Number:	Serial Number / ID:	Calibration Date:

OK = Test OK **N.A. = Test not applicable** **Fail = Test failed**

General	OK	N.A.	Fail		OK	N.A.	Fail
1. Check internal parts	☐	☐	☐	2. Check external parts	☐	☐	☐

CO_2 measurement	OK	N.A.	Fail		OK	N.A.	Fail
3. Check Mini D-Fend	☐	☐	☐				
4. Module software	GAS						
5. Module bus communication	☐	☐	☐				
6. Flow measurement offset					±10 ml/min		
7. Ambient pressure	☐	☐	☐	8. Zero valve check	☐	☐	☐
9. Nafion tube	☐	☐	☐				
10. Leak test					≤6 mmHg/20 sec		

General	OK	N.A.	Fail		OK	N.A.	Fail
11. Check the flow rates							
Sampling flow					135...165 ml/min		
12. Working pressure							
Amb-Work					20...50 mmHg		
13. Gas calibration	☐	☐	☐				
14. Occlusion detection	☐	☐	☐	15. Check D-fend	☐	☐	☐
16. Apnea detection	☐	☐	☐				

Recorder	OK	N.A.	Fail		OK	N.A.	Fail
17. Paper compartment cleaning	☐	☐	☐	18. Cover state recognition	☐	☐	☐
19. Paper recognition	☐	☐	☐	20. Quality of recording	☐	☐	☐
21. Recording speed	☐	☐	☐				

General	OK	N.A.	Fail		OK	N.A.	Fail
22. Electrical safety check	☐	☐	☐	23. Functioning after electrical safety check	☐	☐	☐
24. Final cleaning	☐	☐	☐				

Notes

Used Spare Parts			

Signature

Datex-Ohmeda

Remote Controller

S/5™ Remote Controller, K-REMCO (Rev. 01)
S/5™ Remote Controller, K-CREMCO (Rev. 00)

Technical Reference Manual Slot

Conformity according to the Council Directive 93/42/EEC concerning Medical Devices amended by 2007/47/EC

CAUTION: U.S. Federal law restricts this device to sale by or on the order of a licensed medical practitioner. Outside the USA, check local laws for any restriction that may apply.

All specifications subject to change without notice.

Document number M1187342-004

February 3, 2010

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Table of contents

Introduction

This Technical Reference Manual slot provides information for the maintenance and service of the Datex-Ohmeda S/5 Remote Controllers, K-REMCO and K-CREMCO. The Remote Controllers are designed for use with the Datex-Ohmeda modular monitors. Later in this manual the remote controllers may be referred to without S/5 for simplicity.

The service menu is described in a separate “Service Menu“ slot and the spare part lists in the “Spare Parts” slot .

The Remote Controller, K-REMCO/K-CREMCO, brings the Command Bar/ monitor keyboard functions near to the user and allows access to the same menus as the Command Bar/ monitor keyboard.

- Remote Controller, K-REMCO for Anesthesia Monitor and Critical Care Monitor
- Remote Controller, K-CREMCO for Compact Monitors, S/5 FM and FM Light.

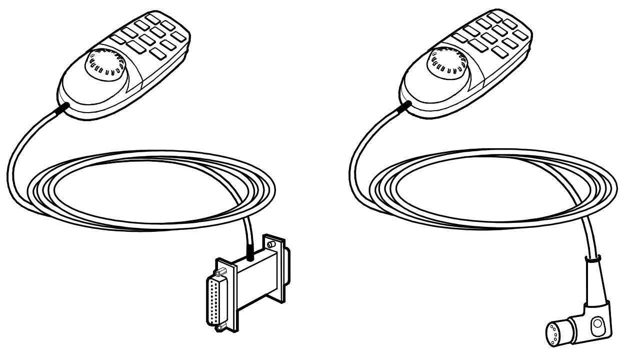


Figure 1 K-REMCO and K-CREMCO

Monitor software compatibility

K-REMCO and K-CREMCO require monitor software version 97 or later.

1 Specifications

1.1 Remote Controller, K-REMCO, K-CREMCO

Dimensions (without cable)	150 × 60 × 50 mm
Weight (incl. cable)	0.5 kg
Cable length	6 m
Input voltage	5 V
Power consumption	180 mW
Communication protocol	RS-232

NOTE: Power supply from the monitor only.

2 Functional description

2.1 Remote Controller, K-REMCO/ K-CREMCO

The Remote Controller consists of 12 direct function keys and the ComWheel.

2.1.1 K-REMCO/ K-CREMCO PCBs

The K-REMCO/ K-CREMCO has two PCBs located inside the Remote Controller. One board has only the push button switches of the keys. The other board reads the status of the keys and the ComWheel and forwards the information to the CPU board.

2.1.2 External communication

K-REMCO Rev. 00-01

Two signals, TXD and RXD in RS232 format are in use. No handshaking is used. Serial communication speed is 19.2 kbps. The 26-pin subminiature D-connector of the Remote Controller is connected to the Display Controller Board, B-DISP.

K-REMCO Rev. 00 with optional Remote Controller - Compact Monitor cable or K-CREMCO Rev. 00

Two signals, TXD and RXD in RS232 format are in use. No handshaking is used. Serial communication speed is 19.2 kbps.

In Compact Monitors, the DIN 5 connector is connected to the keyboard connector X9.

In S/5 FM and FM Light, the DIN 5 connector is connected to Multi IO adapter X7.

2.1.3 ComWheel

The ComWheel is used for menu selection.

3 Service procedures

3.1 General service information

The field service of the remote controllers is limited to replacing faulty circuit boards or mechanical parts. The circuit boards should be returned to GE Healthcare for repair.

GE Healthcare is always available for service advice. Please provide the unit serial number, full type designation, and a detailed fault description.

WARNING **Only trained personnel with appropriate equipment should perform the tests and repairs outlined in this section. Unauthorized service may void the warranty of the unit.**

3.2 Service check

These instructions include complete procedures for a service check. The service check is mandatory after any service repair. However, the service check procedures can also be used for determining possible failures.

The procedures should be performed in ascending order.

The instructions include a check form ("APPENDIX A:") which may be used when performing the procedures.

The symbol in the instructions indicates that the check form contains space to record the results of the particular procedure.

3.2.1 Recommended tools

Tool	Order No.	Notes
Screwdriver		

3.2.2 Visual inspection

Turn the monitor to STBY.

Disconnect the remote controller cable from the monitor.

Detach the remote controller upper cover and the keypad cover by removing the screws (7 pcs) from the bottom.

1. Internal parts

   Check that:

   - cables are connected properly
   - the remote controller cable is fastened to the bottom cover with screws
   - the keypad switches are intact
   - the software EPROM under the keypad is attached properly

2. External parts

   Check that:

   - the upper and bottom covers are intact
   - the keypad cover is intact
   - the ComWheel cover is intact and attached properly

   ✍

   Reassemble the remote controller.

3. Cable

   Check the remote controller cable:

   - the cable is intact
   - the cable connector is intact
   - the connector pins are clean, straight and at about the same height
   - the locking screws inside the connector case are intact

   ✍

3.2.3 Functional inspection

Reconnect the cable to the monitor and turn the monitor ON.

4. Command board software

   Enter the service menu:

   Menu (on the remote controller keypad) **– Monitor Setup *- Install/Service*** (password 16-4-34) ***- Service*** (password 26-23-8)

   Take down the information regarding the remote controller software.

   ✍

   Select the menu ***KEYBOARD***:

   Service - Keyboard

5. Remote controller keys

   Press the keys one by one. Check that each key generates a sound from the loudspeaker.

   ✍

6. ComWheel

   Turn the ComWheel clockwise and counterclockwise and check that each step generates a sound and the corresponding values at the bottom of the menu increase.

   Select DUMMY PRESS. Push the ComWheel and check that the push generates a sound and the corresponding value in the menu increases.

   ✍

7. Electrical safety check
   Perform an electrical safety check and a leakage current test.

   ✍

8. Functioning after electrical safety check
   Check that the remote controller functions normally after the electrical safety check.

   ✍

9. Final cleaning
   Clean the remote controller and the cable.

   ✍

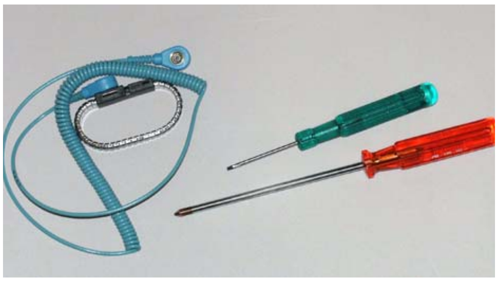
- Fill in all necessary documents.

3.3 Disassembly and reassembly

3.3.1 Before disassembly

WARNING **Wear a grounded, antistatic wristband when handling PC boards. Electrostatic discharge may damage components on the board. Handle all PC boards by their edges.**

3.3.2 Tools needed



- screwdriver
- flat blade screwdriver
- antistatic wristband

3.3.3 To disassemble Remote Controller K-REMCO / K-CREMCO

To disassemble the Remote Controller (see Figure 2):

1. Disconnect the K-REMCO/ K-CREMCO cable from the monitor.
2. Pull out the knob of the ComWheel.
3. Open the nut on the shaft of the ComWheel.
4. Open the three cross head screws on the bottom of the K-REMCO/ K-CREMCO.
5. Remove the top cover.
6. Open the four screws on the bottom of the K-REMCO/ K-CREMCO.
7. Remove the keyboard cover.
8. Disconnect the K-REMCO/ K-CREMCO cable and the wire set from the Comwheel.
9. Remove the PCBs.

For more information on the spare parts, see the "Spare parts" slot.

In reassembly, remember to put the reinforcing cord of the cable around the screw on the metal bridge before tightening the screw.

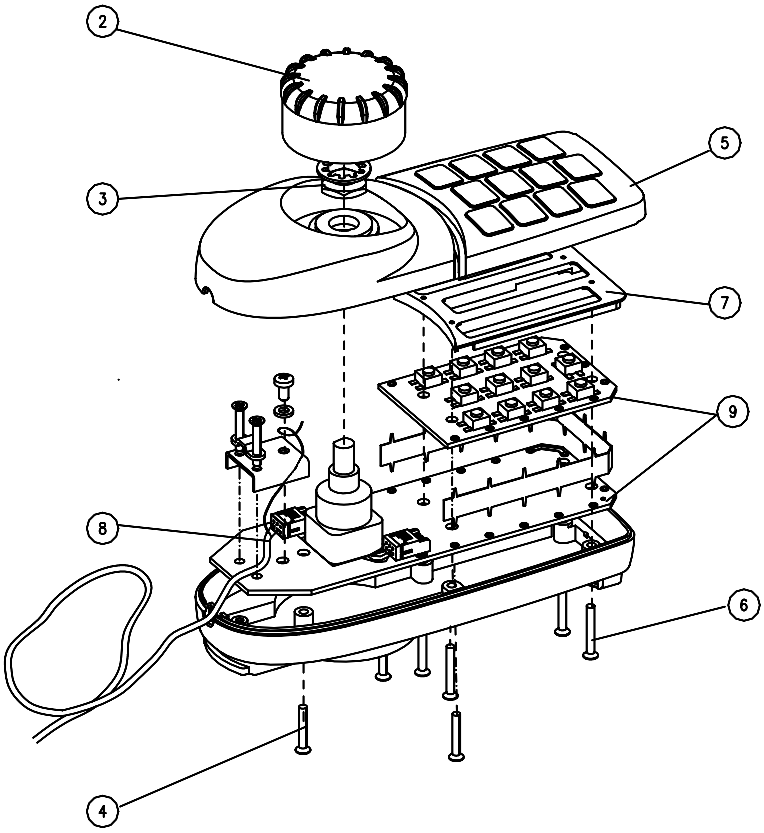


Figure 2 **K-REMCO, K-CREMCO disassembly and reassembly**

To reassemble the module, reverse the order of the disassembly steps.

In reassembly, remember to put the reinforcing cord of the cable around the screw on the metal bridge before tightening the screw.

CAUTION When reassembling the remote controller make sure that the cables are reconnected properly.

Always perform the “Service check” after reassembling the remote controller.

4 Troubleshooting

4.1 K-REMCO, K-CREMCO

See Keyboard Service Menu in the “Service Menu“ slot and perform tests available. If any of the tests fail, see explanation below.

Problem	Cause	What to do
ComWheel not working	ComWheel leads broken or connector loose. ComWheel faulty.	Check the items. Replace the ComWheel if necessary.
Membrane key not working	Switch cable loose or broken. Keyboard cable loose or broken. Cable connector pin failure. RS232 communication failure on CPU board.	Check the items. Replace them if necessary.

For your notes:

APPENDIX A: Service check form, Remote Controllers K-REMCO (Rev. 01) and K-CREMCO (Rev. 00)

Customer		
Service	Keyboard type	S/N
Service engineer		Date

OK = Test OK　　N.A. = Test not applicable　　Fail = Test failed

Visual inspection	OK	N.A.	Fail		OK	N.A.	Fail
1. Internal parts	☐	☐	☐	2. External parts	☐	☐	☐
3. Cable	☐	☐	☐				
Notes							

Functional inspection							
4. Command board software	KB						
5. Remote controller keys	☐	☐	☐	6. ComWheel	☐	☐	☐
7. Electrical safety check	☐	☐	☐	8. Functioning after electrical safety check	☐	☐	☐
9. Final cleaning	☐	☐	☐				

Notes

Used spare parts			

Signature

For your notes:

Datex-Ohmeda

Device Interfacing Solution

Technical Reference Manual Slot

Conformity according to the Council Directive 93/42/EEC concerning Medical Devices amended by 2007/47/EC

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3 February, 2010

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Introduction

This “Technical Reference Manual” slot provides information for the maintenance and service of the Datex-Ohmeda S/5 Device Interfacing Solution, N-DISxxx. Later in this manual modules may be referred to without S/5 for simplicity.

Please also refer to the “Installation Guide” accompanying each module.

The service menu is described in a separate “Service Menu“ slot and the spare part lists in the “Spare Parts” slot.

The purpose of the Device Interfacing Solution is to produce a data connection between an external bedside device and a Datex-Ohmeda modular monitor.

Up to 4 devices can be connected simultaneously via device specific N-DISxxx modules. No Device Interfacing Solution is called N-DISxxx, but the xxx are replaced with a device specific ending such as N-DISQVUE and N-DISOPT.

NOTE: Only revision 01 or later is compatible with the S/5 FM.

NOTE: Not compatible with L-FICU05L.

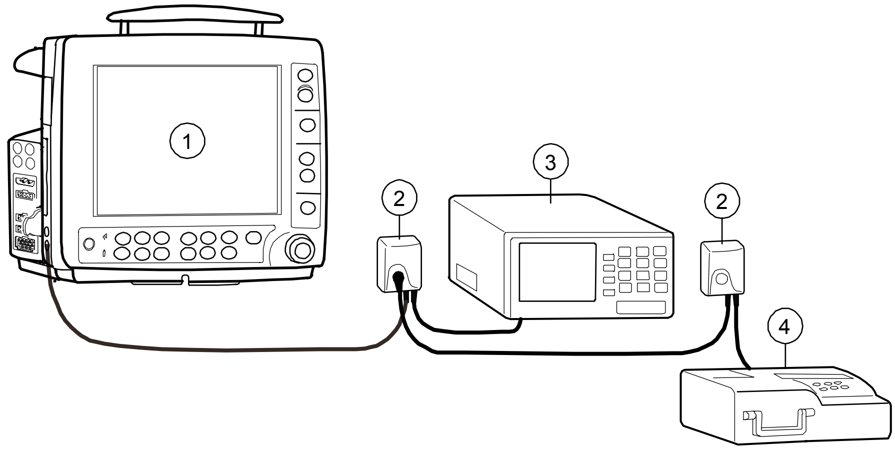


Figure 1 An example of interfacing external devices with Device Interfacing Solution

(1) Datex-Ohmeda S/5 FM (with **s**oftware L-FICU04(A) or later)

(2) DIS module (max. 4pcs)

(3) Baxter Vigilance monitor

(4) Opti CCA blood gas analyzer

1 Specifications

1.1 Environmental specification

Operating temperature	+10 to +40°C (50 to 104°F)
Storage and transport temperature	-20 to +60°C (-4 to 140°F)
Relative humidity	10...90% non condensing (in airway 0 to 100% condensing)
Atmospheric pressure	670...1060 hPa (670...1060 mbar/500...800 mmHg)

1.1.1 Protection against ingress of liquids

According to IEC/EN 60592 class IPX 1.

The DIS module must always be used in vertical position to prevent water from entering the module.

1.2 Technical specifications

1.2.1 General

Max 4 DIS modules.

NOTE: Only revision 01 or later is compatible with the S/5 FM.

Module

Size (W × D × H)	60 × 27 × 85 mm/2.4 × 1.1 × 3.4 in
Weight	0.1 kg/0.2 lb.

Bus cables

8-pin Hirose HR12/HR212 connector

Material	black PVC
Length/Weight	1 m/47 g (39 in/3.3 ft./0.104 lb.) 2 m/85 g (79 in/6.6 ft./0.187 lb.) 6 m/220 g (236 in/19.7 ft./0.485 lb.)

Device cables

Depends on device.

Material	elastollan
Length	0.5...1 m (19...39 in/1.6...3.3 ft.)
Weight	40...70 g (0.088...0.154 lbs.)

1.3 Electrical specification

There is no isolation in the DIS module. The interfaced device, DIS module and the monitor must be situated in the same patient environment (as defined in IEC 60601-1-1).

WARNING **Connecting electrical equipment together or using the same extension cord for more than one device may cause their leakage currents to exceed the limits specified in relevant safety standards. Always make sure that the entire combination complies with the international safety standard IEC 60601-1-1 for medical electrical systems and with the requirements of local authorities.**

1.4 Maximum power consumption

450 mW (30 mA @ 15 V) 900mW peak.

1.5 Module communication

Bus communication speed is 500 kbps. RS422 implementation.

Device communication speed depends on the interfaced external device. RS232 implementation.

2 Functional description

The S/5™ Device Interfacing Solution provides a seamless link between external patient care devices and the Datex-Ohmeda S/5 Monitoring system. You can interface simultaneously up to four external devices: monitors, blood gas analyzers, etc.

The Device Interfacing Solution is designed for use with the S/5 FM Monitors with software L-FICU04(A) or later.

WARNING **The manufacturer guarantees a reliable functioning of the devices with tested software versions only. Always refer to the Installation guide accompanying the DIS module and verify the compatibility before use.**

2.1 Main components

The implementation of Device Interfacing Solution can be divided into five parts:

- Device specific software
- Device specific module
- Device specific cable
- Bus cables
- Software in Datex-Ohmeda Monitor

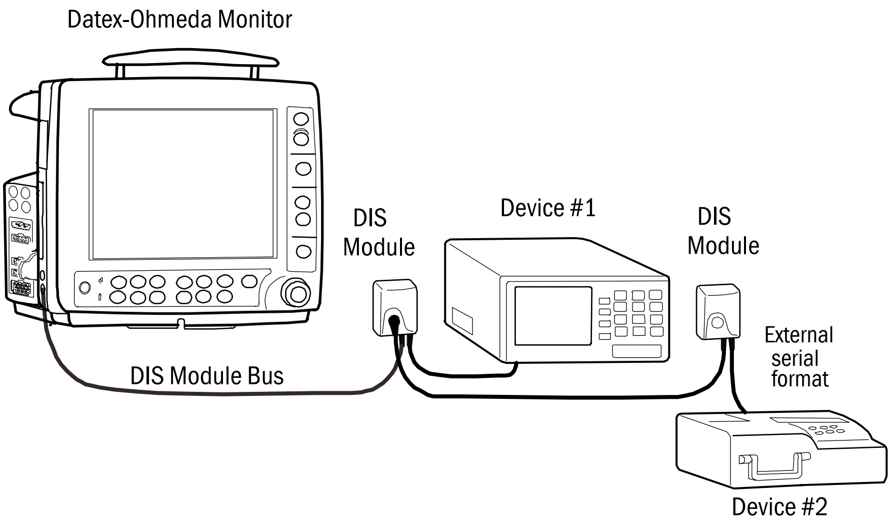


Figure 2 Implementation of Device Interfacing Solution

2.2 DIS module

A DIS module receives data from an external device, converts the data to a suitable format for the monitor and then sends the data to the monitor. The main board contains the power supply with a current limiter, microcontroller, reset circuits, memory and serial communication buffers. The board communicates with the Datex-Ohmeda Monitor through the DIS bus.

A DIS module consists of:

- Power supply with current limiter and reset circuit parts
- Microcontroller H8, internal and external RAM, non volatile memory, etc.

- Programming connection
- Device communication connection and RS232 driver
- Bus communication connection and RS422 driver
- LEDs that indicate the status of the communication
- Device specific software

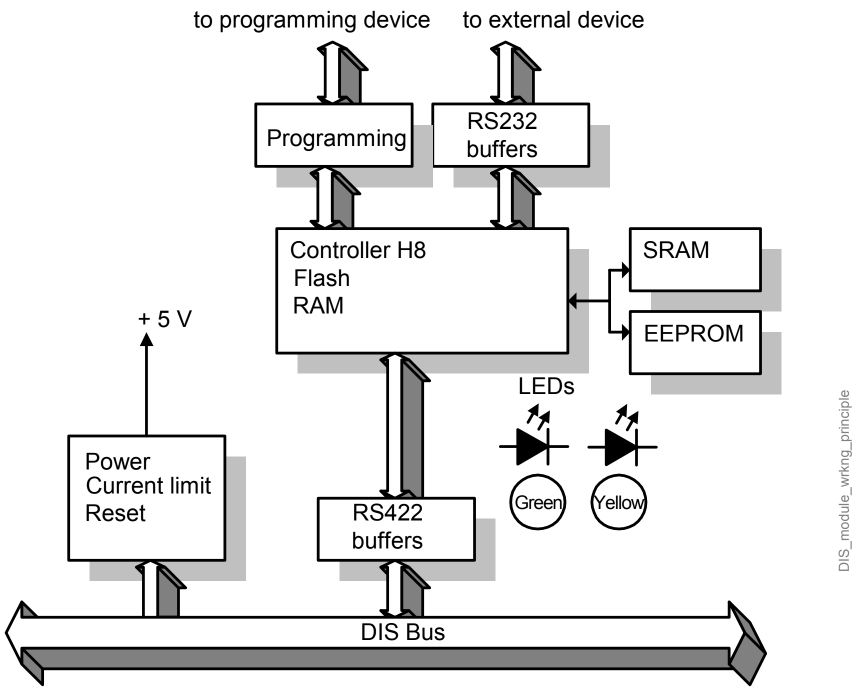
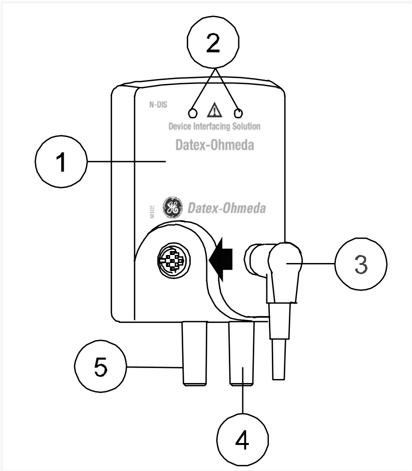


Figure 3 DIS module working principle diagram

2.3 Connections

Connect the device specific cable to the external device and the bus cable to the Datex-Ohmeda Monitor's DIS connector or to another DIS module.



(1) label specifying the external device

(2) LED indicators

(3) black bus cable from another interfacing module, if needed

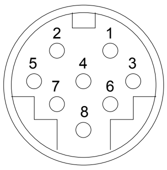
(4) grey device specific cable to the communication port of the external device

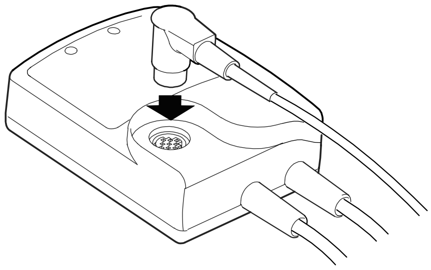
(5) black bus cable to the monitor's DIS connector (or to another interfacing module)

Figure 4 Connection cables and LED indicators

2.4 Connectors and signals

2.4.1 Male bus cable connector





Pin No.	Signal	Color
1	Data from UPI +	brown
2	Data from UPI -	red
3	VDD 9 V to 18 V (max 1 A)	orange
4	GND	yellow
5	VCC 7 V to 8 V (max 1 A)	blue
6	GND	grey
7	Data to UPI +	white
8	Data to UPI -	black

2.5 Interfaced devices

See the following table of DIS modules and devices that you can interface with the Device Interfacing Solution.

For specific information on parameters transferred from the interfaced device to the Datex-Ohmeda Monitor and the applicable software versions of the device, refer to the Installation guide accompanying.

	Device Monitors
N-DISOXIM3	Oximetrix 3[a]
N-DISQVUE	QVue /Q2[a]
N-DISVIGIL	Baxter-Vigilance[b]

a Trademark of Hospira Inc. (previously trademark of Abbott Laboratories)
b Trademark of Edwards Lifesciences Corporation

	Device Blood gas analyzers
N-DISOPT	Opti CCA[a]

a Trademark of Osmetech plc

3 Service procedures

3.1 General service information

The field service of the Device Interfacing Solution is limited to replacing faulty cables or mechanical parts. The circuit boards should be returned to GE Healthcare for repair.

GE Healthcare is always available for service advice. Please provide the unit serial number, full type designation, and a detailed fault description.

WARNING **Only trained personnel with appropriate equipment should perform the tests and repairs outlined in this section. Unauthorized service may void the warranty of the unit.**

3.2 Service check

These instructions include complete procedures for a service check. The service check is mandatory after any service repair. However, the service check procedures can also be used for determining possible failures.

The procedures should be performed in ascending order.

The instructions include a check form (“APPENDIX A:”) which may be used when performing the procedures.

The symbol in the instructions indicates that the check form contains space to record the results of the particular procedure.

3.2.1 Recommended tools

Tool	Order No.	Notes
Screwdrivers		

3.2.2 Recommended parts

No recommended parts.

3.2.3 Visual inspection

Disconnect the DIS module from the DIS bus and from the interfaced external device.

1. Internal check
   - Disassemble the DIS module.
   - Make sure that there are no loose parts inside the DIS module.
   - Check that the screws holding the PC board are tightened properly.
   - Check that the cables are attached properly and the connectors are intact.

2. External check
   - Check that the DIS module case and label are clean and intact.
   - Reassemble the DIS module.
   - Check that the screws for the DIS module case are secured properly.
   - Check that the bus cable connector is intact.
   - Check that the DIS bus and device specific cables are intact.

3.2.4 Functional inspection

3. DIS module interface status

   Connect the DIS module to the DIS bus and to the external device that is specified in the DIS module label. Turn on the interfaced external device.

   Check that no error messages are displayed on the monitor screen.

   Check via the ***Interfacing*** menu that the connected DIS module status is correct:

   Monitor Setup - *Interfacing - Status Page*

   Check that the waveforms and numeric data are transferred to the monitor according to the configuration.

4. Recognition of interface

   Disconnect the DIS bus cable and check that the '[device name] module removed' message appears on the monitor screen. Reconnect the cable.

   Turn off the external device (if possible) and check that the '[device name] disconnected from module' message appears on the screen. Turn the external device back on again.

5. DIS module service menu

   Enter the service menu:

   Monitor Setup – *Install/Service* (password 16-4-34) **–**
   Service (password 26-23-8) **–**
   Parameters – DIS Interfacing

   Check that the menu displays submenus for all connected DIS modules.

   Enter the corresponding DIS module service menu and check that the displayed information corresponds to the information on the DIS module labels.

   Check that the DIS bus voltage is between 13.80...16.00 V.

   Check that the DIS module time-out and checksum error values do not increase more than by 5 per second.

   Check that the status of each DIS module memory indicates OK.

6. Electrical safety check
   Perform the electrical safety test and leakage current test.

7. Functioning after electrical safety check
   Check that the DIS module functions normally after the tests.

8. Final cleaning
   Clean the DIS module, bus cable and device specific cable with a suitable detergent.

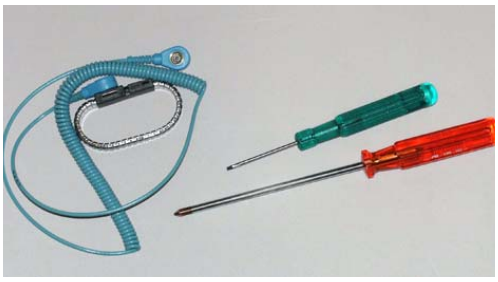
- Fill up all the necessary documents.

3.3 Disassembly and reassembly

3.3.1 Before disassembly

WARNING **Wear a grounded, antistatic wristband when handling PC boards. Electrostatic discharge may damage components on the board. Handle all PC boards by their edges.**

3.3.2 Tools needed



- screwdriver
- flat blade screwdriver
- antistatic wristband

3.4 To disassemble the module

To disassemble the N-DISxxx module (see the exploded view of the module in the "S/5 FM Spare parts" slot):

1. Remove the two screws from the back of the module.
2. Loosen the two strain-relief threads and after that disconnect the cables from the connectors.

To remove the Module Front Cover from the module, release the snaps that hold the front cover to the front chassis.

To reassemble the module, reverse the order of the disassembly steps.

CAUTION When reassembling the module, make sure to reconnect all cables properly.

Always perform the "Service check" after reassembling the module.

4 Troubleshooting

4.1 LED indicators

Figure 5 LED indicators

4.1.1 Green LED

The green LED indicates that the communication between the monitor and DIS module and the communication between the DIS module and external device is working properly. When all cables are connected and the connected devices are on, the green LED should be lit continuously.

4.1.2 Yellow LED

The yellow LED alerts the user. The yellow LED is lit when any of the following conditions becomes true:

1. The DIS module is connected to the DIS bus, but the external device is not connected.
2. The external device is in power off state.
3. The external device is not selected from the interfacing menu as an active source of data.

NOTE: The meaning of the yellow LED varies with some external devices. See the “Installation Guide” delivered with the DIS module.

4.2 Quick functional check

You have two ways for checking the function of the Device Interfacing Solution:

- Press the **Monitor Setup** key, select ***Interfacing*** and open the ***Status Page*** menu. The status page shows you the current communication status of the interfacing modules connected to the bus (1...4 pcs).

NOTE: The status message 'Connected' appears on the monitor screen after you have connected the external device to the DIS module and turned it on, if the monitor and DIS module have already been initialized.

- Check the LED indicators on the DIS module (the green LED indicates the physical connections, the yellow LED software selections):

GREEN	YELLOW	INDICATION
lit ●	dark ○	Physical connections between the monitor, DIS module and external device are in order and the device has been selected in the menu.
dark ○	lit ●	There is something wrong with the physical connections between the monitor, interfacing module and external device. The external device has not been selected in the menu.
lit ●	lit ●	Physical connections between the monitor, DIS module and external device are in order, but the external device has not been selected in the menu (see the "User's Reference Manual" of the monitor).
dark ○	dark ○	The DIS module is not connected to the monitor.

5 Earlier revisions

This manual supports the previous version of N-DISxx.

APPENDIX A: Service check form, Device Interfacing Solution, N-DISxxx (Rev. 01)

Customer		
Service	Module type	S/N
Service engineer		Date

OK = Test OK   N.A. = Test not applicable   Fail = Test failed

Visual inspection	OK	N.A.	Fail		OK	N.A.	Fail
1. Internal check	☐	☐	☐	2. External check	☐	☐	☐
Notes							
Functional inspection							
3. DIS module interface status	☐	☐	☐	4. Recognition of interface	☐	☐	☐
5. DIS module service menu	☐	☐	☐	6. Electrical safety check	☐	☐	☐
7. Functioning after electrical safety check	☐	☐	☐	8. Final cleaning	☐	☐	☐

Notes

Used spare parts			

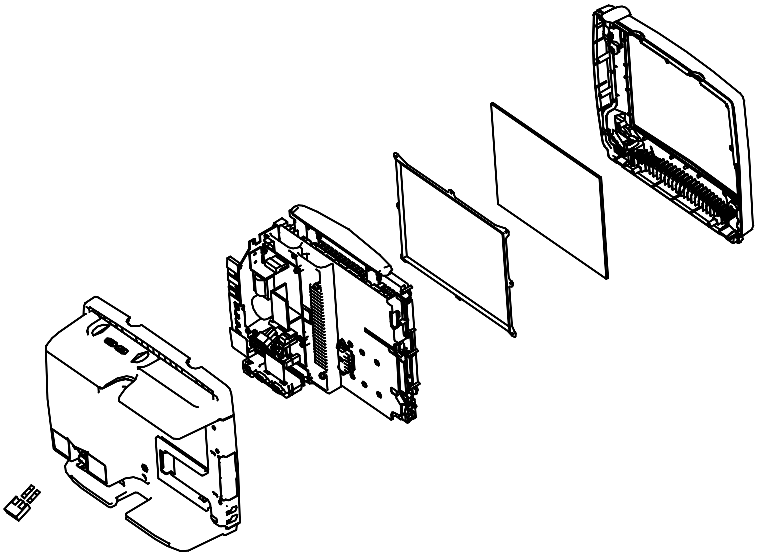
Signature

For your notes:

Datex-Ohmeda

S/5 FM

Spare Parts



Conformity according to the Council Directive 93/42/EEC concerning Medical Devices amended by 2007/47/EC

CAUTION: U.S. Federal law restricts this device to sale by or on the order of a licensed medical practitioner. Outside the USA, check local laws for any restriction that may apply.

All specifications subject to change without notice.

Document number M1187346-007

30 January, 2012

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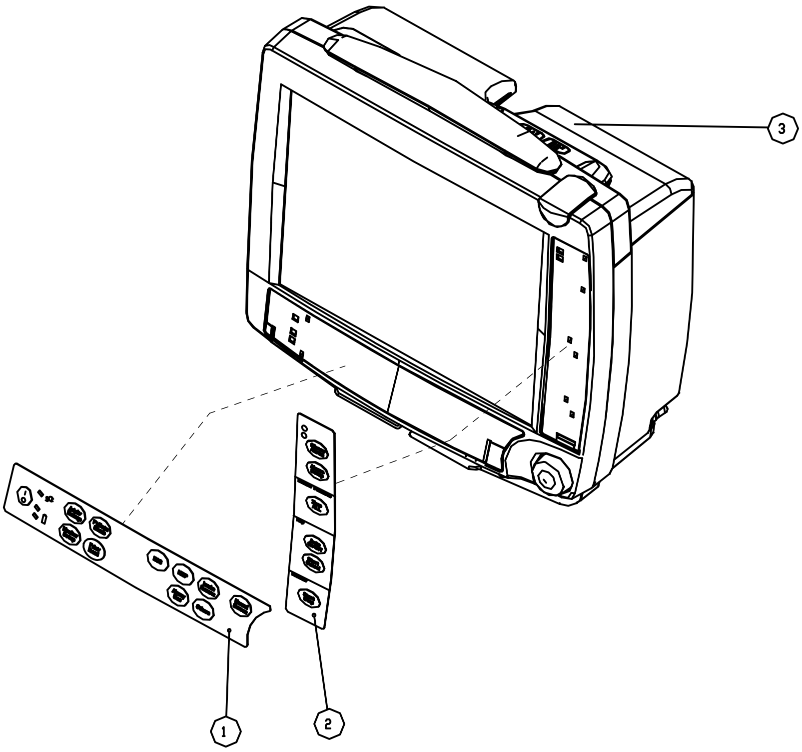
Table of contents

1 S/5 FM, monitor

The following S/5 FM parts will be available as field replaceable spare parts.

1.1 Front panel labeling



Front panel labeling, S/5 FM, monitor

Item	Description	Order Code	Replaced by
1	Horizontal Panel Sticker, F-FM-CS	M1064524	
1	Horizontal Panel Sticker, F-FM-DA	M1022586	
1	Horizontal Panel Sticker, F-FM-DE	M1022575	
1	Horizontal Panel Sticker, F-FM-EN	M1002328	
1	Horizontal Panel Sticker, F-FM-ES	M1022578	
1	Horizontal Panel Sticker, F-FM-FI	M1002582	
1	Horizontal Panel Sticker, F-FM-FR	M1002576	
1	Horizontal Panel Sticker, F-FM-HU	M1042462	
1	Horizontal Panel Sticker, F-FM-IT	M1022580	
1	Horizontal Panel Sticker, F-FM-NL	M1022577	
1	Horizontal Panel Sticker, F-FM-NO	M1022584	

Item	Description	Order Code	Replaced by
1	Horizontal Panel Sticker, F-FM-PL	M1022589	
1	Horizontal Panel Sticker, F-FM-PT	M1022581	
1	Horizontal Panel Sticker, F-FM-SV	M1022583	
2	Vertical Panel Sticker, F-FM - CS	M1064527	
2	Vertical Panel Sticker, F-FM - DA	M1023027	
2	Vertical Panel Sticker, F-FM - DE	M1022991	
2	Vertical Panel Sticker, F-FM - EN	M1002324	
2	Vertical Panel Sticker, F-FM - ES	M1023004	
2	Vertical Panel Sticker, F-FM - FI	M1023015	
2	Vertical Panel Sticker, F-FM - FR	M1022997	
2	Vertical Panel Sticker, F-FM - HU	M1042466	
2	Vertical Panel Sticker, F-FM - IT	M1023008	
2	Vertical Panel Sticker, F-FM - NL	M1023001	
2	Vertical Panel Sticker, F-FM - NO	M1023024	
2	Vertical Panel Sticker, F-FM - PL	M1023033	
2	Vertical Panel Sticker, F-FM - PT	M1023011	
2	Vertical Panel Sticker, F-FM - SV	M1023019	
3	Battery Caution Sticker, F-FM	M1140504	
3	Battery Caution Sticker, F-FM - CS	M1065250	M1140504
3	Battery Caution Sticker, F-FM - DA	M1029195	M1140504
3	Battery Caution Sticker, F-FM - DE	M1029196	M1140504
3	Battery Caution Sticker, F-FM - EN	M1029197	M1140504
3	Battery Caution Sticker, F-FM - ES	M1029198	M1140504
3	Battery Caution Sticker, F-FM - FI	M1029200	M1140504
3	Battery Caution Sticker, F-FM - FR	M1029201	M1140504
3	Battery Caution Sticker, F-FM - HU	M1042369	M1140504
3	Battery Caution Sticker, F-FM - IT	M1029202	M1140504
3	Battery Caution Sticker, F-FM - NL	M1029203	M1140504
3	Battery Caution Sticker, F-FM - NO	M1029205	M1140504
3	Battery Caution Sticker, F-FM - PL	M1029206	M1140504
3	Battery Caution Sticker, F-FM - PT	M1029207	M1140504
3	Battery Caution Sticker, F-FM - SV	M1029208	M1140504
3	Battery Caution Sticker, F-FM - ZH	M1065259	M1140504

1.2 S/5 FM, service software

F-FM(W)-00

Item	Description	Order Code
	Critical Care Software License for S/5 FM, L-FICU04S	L-FICU04S
	Critical Care Software License for S/5 FM w/ Extended Arrhythmia Analysis, L-FICU04AS	L-FICU04AS

F-FM-01

NOTE: L-FICU06(A)S Service software can be used only together with FM CPU board M1186848. When ordering the service software, the FM CPU board is delivered at the same time. The service software will be loaded on the board at factory.

NOTE: This CPU and Service Software package is for monitors without Wireless Network Option.

Description	Order Code	Note
Critical Care Service Software License for S/5 FM, L-FICU06S and CPU board		
S/5 FM Service SW, L-FICU06S, Group A + CPU	M1184250	SW pre-loaded on the CPU board
Languages in Group A: Danish, Dutch, English, Finnish, French, German, Italian, Norwegian, Portuguese, Spanish, Swedish		
S/5 FM Service SW, L-FICU06S, Group B + CPU	M1184264	SW pre-loaded on the CPU board
Languages in Group B: Czech, English, Polish, Hungarian		
Critical Care Service Software License w/ Extended Arrhythmia Analysis for S/5 FM, L-FICU06AS and CPU board		
S/5 FM Service SW w/EAA, L-FICU06AS, Group A + CPU	M1184268	SW pre-loaded on the CPU board
Languages in Group A: Danish, Dutch, English, Finnish, French, German, Italian, Norwegian, Portuguese, Spanish, Swedish		
S/5 FM Service SW w/EAA, L-FICU06AS, Group B + CPU	M1184285	SW pre-loaded on the CPU board
Languages in Group B: Czech, English, Polish, Hungarian		

F-FMW-01

NOTE: L-FICU06(A)S Service software can be used only together with FM CPU board M1186848. When ordering the service software, the FM CPU board is delivered at the same time. The service software will be loaded on the board at factory.

NOTE: This CPU and Service Software package is for monitors with Wireless Network Option installed. (WLAN card and antennas are not included)

NOTE: WLAN Option and Virtual ID will be loaded on the board at factory.

Description	Order Code	Note
Critical Care Service Software License for S/5 FM, L-FICU06S and CPU board with WLAN Option		
S/5 FM Service Software, L-FICU06S, Group A + CPU + WLAN	M1184279	SW pre-loaded on the CPU board
Languages in Group A: Danish, Dutch, English, Finnish, French, German, Italian, Norwegian, Portuguese, Spanish, Swedish		
SS/5 FM Service Software, L-FICU06S, Group B + CPU + WLAN	M1184280	SW pre-loaded on the CPU board
Languages in Group B: Czech, English, Polish, Hungarian		
Critical Care Service Software License w/ Extended Arrhythmia Analysis for S/5 FM, L-FICU06AS and CPU board with WLAN Option		
S/5 FM Service Software w/EAA, L-FICU06AS, Group A + CPU + WLAN	M1184281	SW pre-loaded on the CPU board
Languages in Group A: Danish, Dutch, English, Finnish, French, German, Italian, Norwegian, Portuguese, Spanish, Swedish		
S/5 FM Service Software w/EAA, L-FICU06AS, Group B + CPU + WLAN	M1184282	SW pre-loaded on the CPU board
Languages in Group B: Czech, English, Polish, Hungarian		

1.3 S/5 FM, service option

NOTE: For F-FM-00 only.

Item	Description	Order Code
	Wireless Network Service Option for S/5 FM	N-FMWS

1.4 Upgrades

For F-FM-00

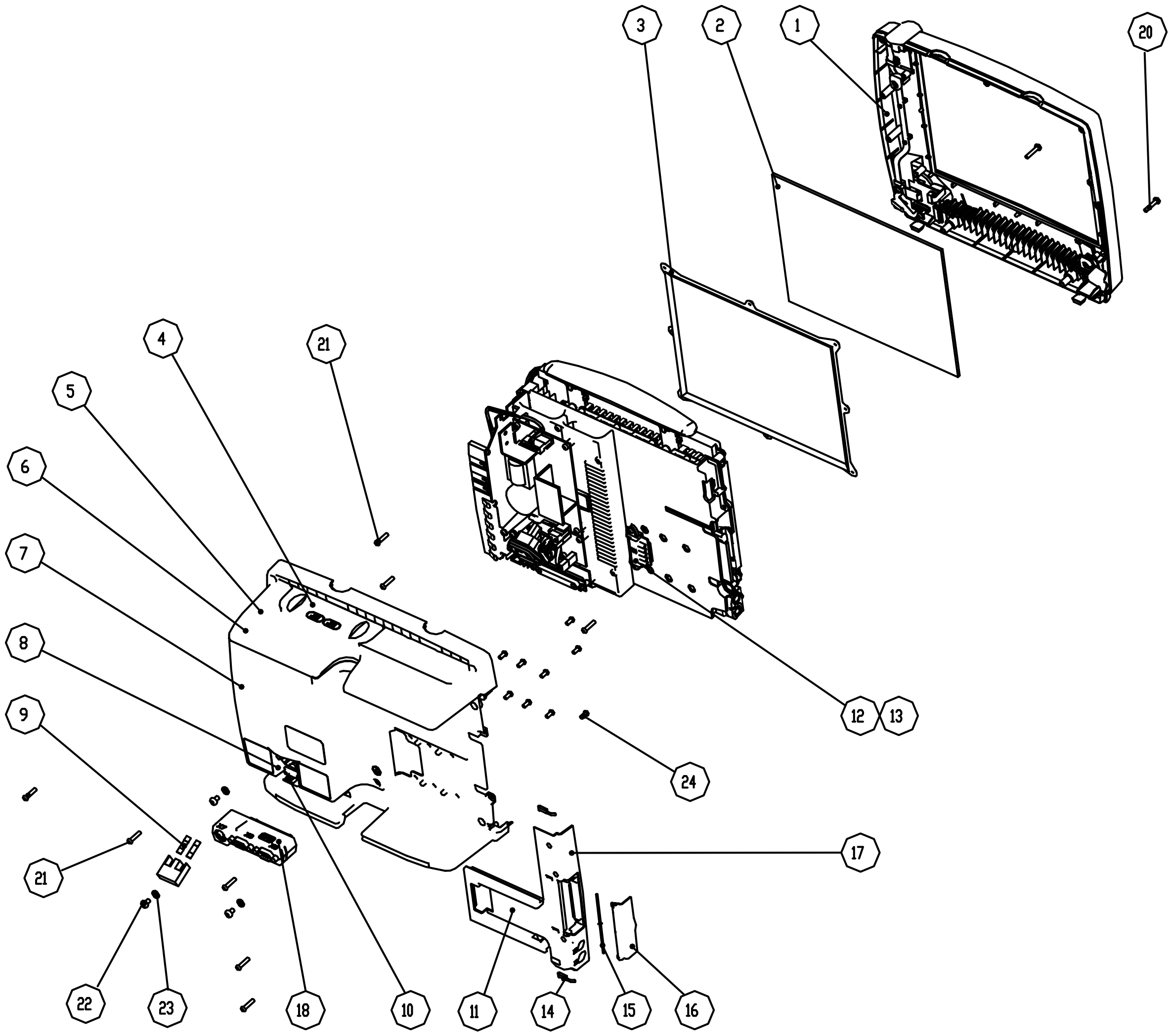
Item	Description	Order Code
	Wireless Network Upgrade for S/5 FM	U-FMW
	S/5 ICU Upgrade SW License for S/5 FM, L-FICU04S	U-FICU04S
	S/5 ICU Upgrade SW License for S/5 FM, w/Arr, L-FICU04AS	U-FICU04AS

For F-FM-01

NOTE: SWDL Tool is needed when installing U-FMW-01

Item	Description	Order Code
	Wireless Network Upgrade for FM-01, U-FMW-01	M1186854

1.5 S/5 FM, back cover unit

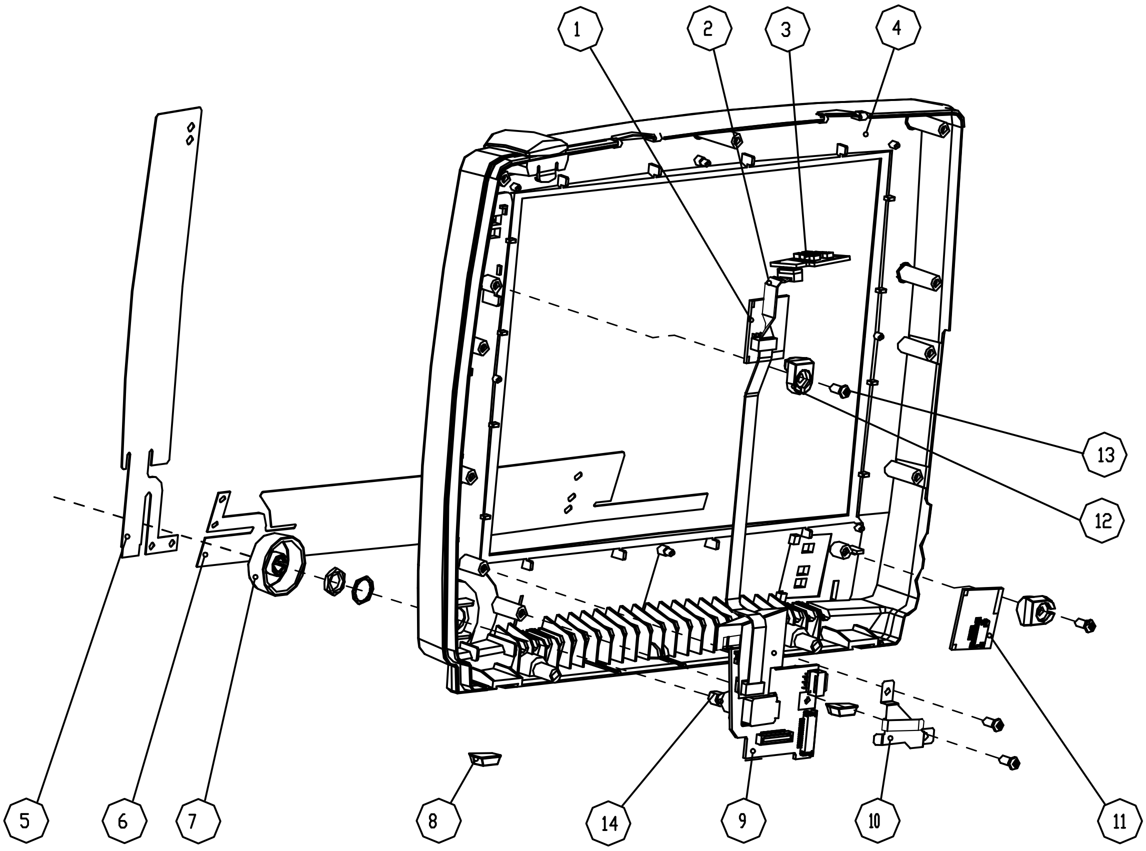


Back cover unit

Item	Description	Order Code
1	Front Cover, F-FM	M1007245
2	Display Filter, F-FM	M1009577
3	Dust Seal, F-FM	M1009506
4	Battery Cover, F-FM	M1008598
5	Top Cover Unit, F-FM	M1017874
6	Top Cover, F-FM	M1007250
7	Back Cover, F-FM	M1005721
8	Equipment Potential Plug, F-FM	M1009625
9	Fuse T2A, 250V, 5X20mm, F-FM	511393

Item	Description	Order Code
10	Multi-IO Adapter Lock, F-FM	M1020477
11	Module Guide, F-FM	M1007251
12	Module Connector Shell, F-FM	M1008905
13	Module Connector Rear, F-FM	M1008907
14	MemCard Door Spring, F-FM	M1009892
15	MemCard Door Axle, F-FM	M1009894
16	MemCard Door, F-FM	M1007252
17	Module Guide Unit, F-FM	M1011791
18	Multi-IO adapter	M1020847
20	Screw PTDG 3.5x18, TORX	M1013392
21	Screw PT 3.5x16, TORX	M1013390
22	Screw PTDG 4x6, TORX	M1013393
23	Washer	63615
24	Screw PT 3.5x7.5, TORX/T8	M1013389

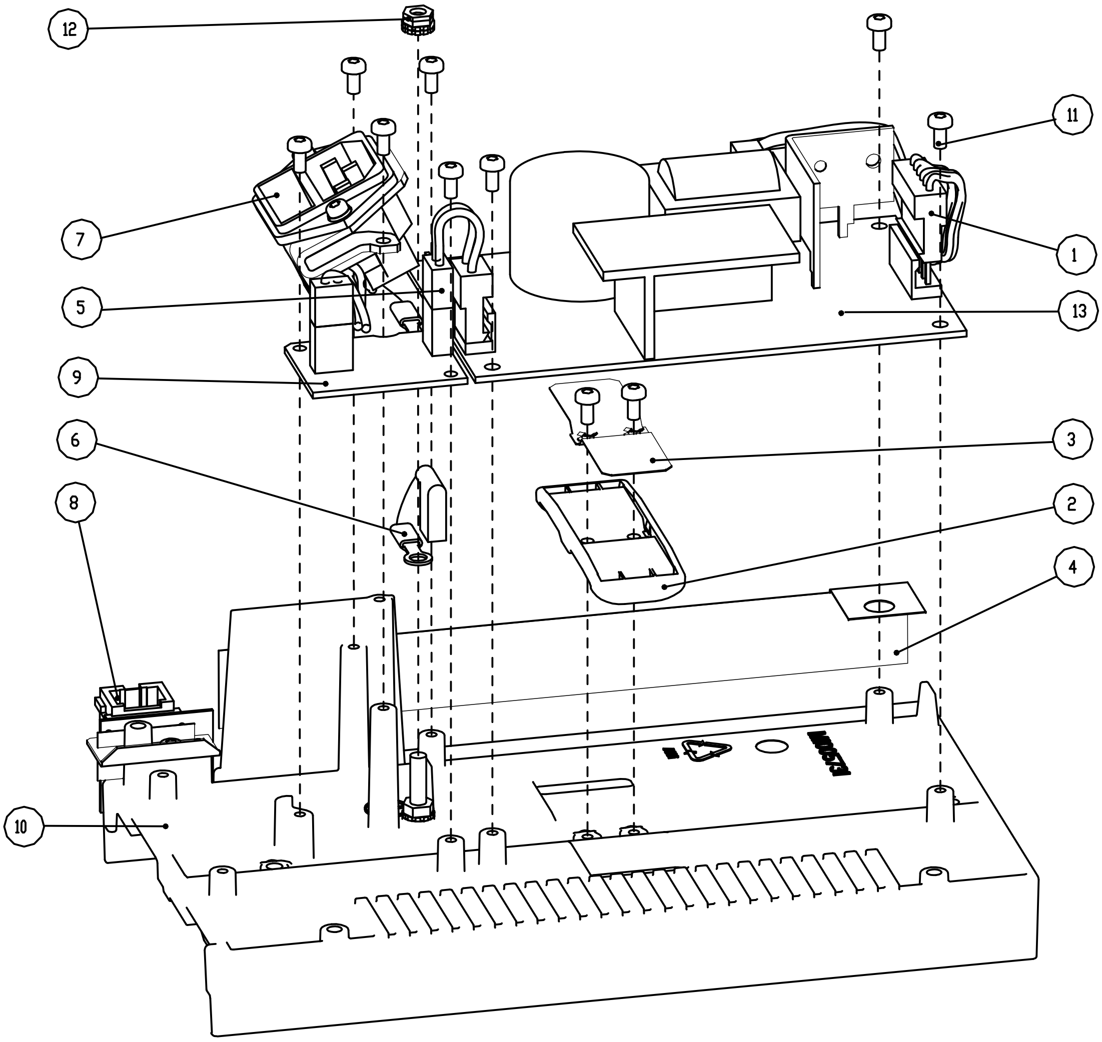
1.6 S/5 FM, front cover unit



Front cover unit

Item	Description	Order Code
1	Alarm Indicator Board, F-FM	M1011439
2	Indicator Ribbon Cable, F-FM	M1010843
3	Alarm Light Board, F-FM	M1011418
4	Front Cover, F-FM	M1011320
5	Vertical Membrane Key pad, F-FM	M1002474
6	Horizontal Membrane Key pad, F-FM	M1002473
7	ComWheel	898794
8	Foot Pad, F-FM	M1009556
9	User Interface Board, F-FM	M1011413
10	ComWheel EMC Spring, F-FM	M1009883
11	Power Indicator Board, F-FM	M1011462
12	PCB Fastening Part, F-FM	M1008663
13	Screw PT 3.5x7.5, TORX/T8	M1013389
14	Opto-encoder, rotary switch, push button, 3-inch flat cable	M1007539

1.7 S/5 FM, AC/DC unit

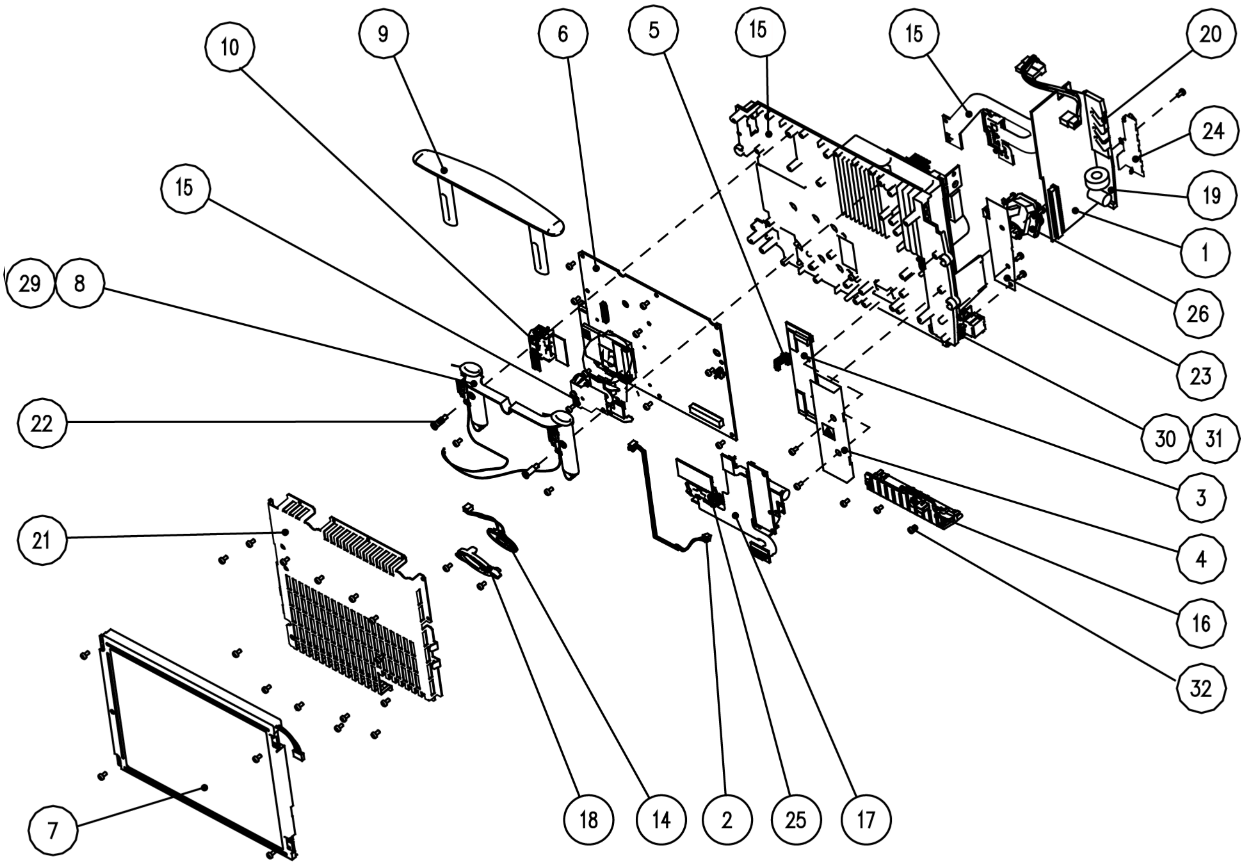


AC/DC unit

Item	Description	Order Code
1	AC/DC Output Cable, F-FM	M1009794
2+3	Battery Brake Unit, F-FM	M1011346
2	Battery Brake Spring, F-FM	M1009880
3	Battery Brake, F-FM	M1008898
4	Power Supply Frame Insulator, F-FM	M1013451
5	AC/DC Input Cable, F-FM	M1009793
6	AC/DC Protective Earth Cable, F-FM	M1009792
7	Power Inlet Board, F-FM	M1011344
8	Network Connector Board Unit, F-FM	M1011329

Item	Description	Order Code
9	Filter Board, F-FM	M1011361
10	Power Supply Frame, F-FM	M1005731
11	Screw PTDG 3x6, TORX11	M1013391
12	Nut M4	M1018448
13	AC/DC unit, F-FM	M1009074

1.8 Frame for S/5 FM



Frame for S/5 FM

Item	Description	Order Code
1	DC/DC Board, F-FM	M1007651
2	Network Cable, F-FM	M1009788
3	DISPL-ACC, Dual Lamp CCFL Inverter, F-FM-00	M1007567
3	LCD backlight inverter for FM, F-FM-01	M1181212-S
4	Inverter Insulator Plate, F-FM	M1009889
5	Inverter Cable, F-FM	M1009787
6	CPU Board, F-FM-00	M1008748**
6	CPU Board, F-FM-01	M1186848*
	Battery for SRAM/Timekeeper	197230-HEL-S
7	DISPL-LCD, Color 262144, F-FM-00	M1007543***
	Backlight for LCD-display M1007543	M1034568
7	10.4 inch LCD display for FM, F-FM-01	M1181228-S
8	Handle Guide Unit, F-FM	M1017686

Item	Description	Order Code
9	Handle, F-FM	M1007253
10	Display Connection Board, F-FM	M1010659
14	Loudspeaker Unit, F-FM	M1010921
15	Inner Frame and Module Bus Cable Unit, FRU - Inner Frame - Module Bus Connector Cable Unit - Sync Connector Unit	M1230405
16	Flex PCB Support, F-FM	M1008903
17	Interconnection Board, F-FM	M1009286
18	Loudspeaker Support, F-FM	M1008896
19	Heatsink, F-FM	8004369
20	Spring, F-FM	8004370
21	EMC Shield, F-FM	M1013800
22	Screw for Handle Guide, F-FM	M1013724
23	Power Supply Insulator Plate, F-FM	M1009887
24	DC/DC EMC Spring, F-FM	M1009604
25	Ferrite Support, F-FM	M1008900
26	Power Inlet Bracket, F-FM	M1009602
29	Handle Guide, F-FM	M1007254
30	Net Connector Bracket, F-FM	M1009622
31	Net Connector Insulator, F-FM	M1009885
32	Screw, PTDG 3x6, TORX	M1013391

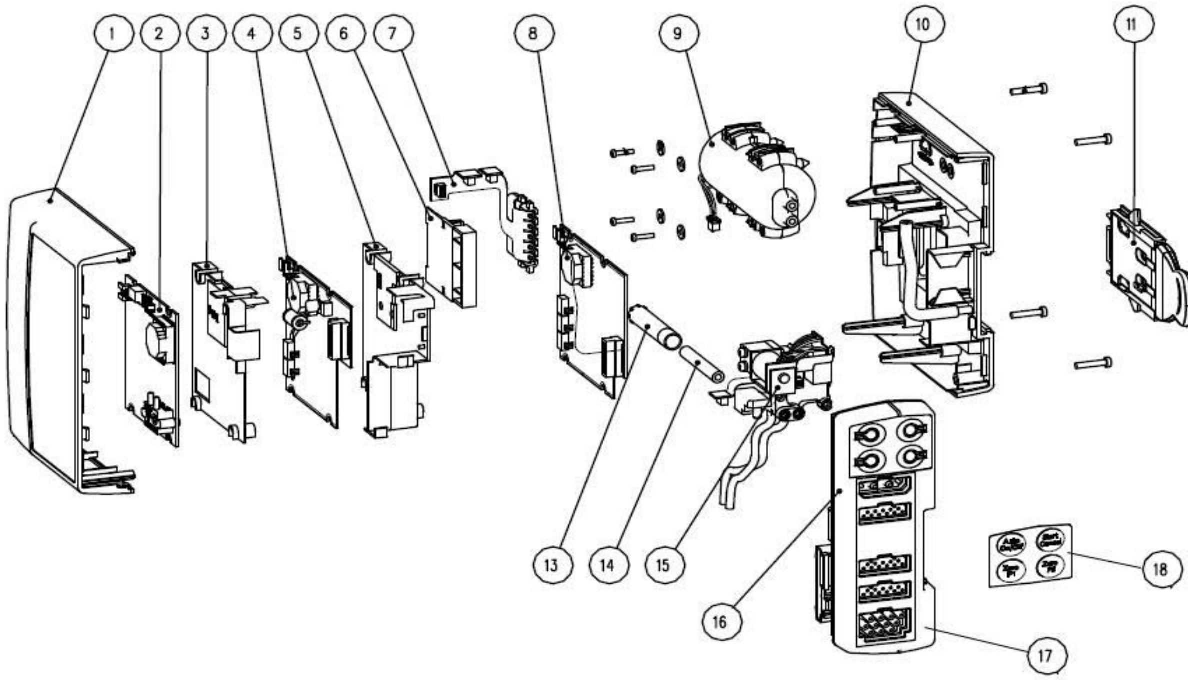
*NOTE: Note that the CPU spare part can be ordered with or without software pre-loaded. In case the CPU is needed with software pre-loaded, order only the correct service software license. See chapter 1.2. S/5 FM, service software.

**NOTE: CPU Board, F-FM-01 is also compatible with F-FM-00 version. However, CPU Board, F-FM-01 is only compatible with FICU06(A) software.

***NOTE: 10.4 inch LCD display for FM, F-FM-01 (M1181228-S) is also compatible with F-FM-00 version. However, if M1181228-S is ordered for F-FM-00 also LCD backlight inverter (M1181212-S) and Inner Frame (M1005729) need to be ordered to ensure compatibility.

2 Patient Side Modules

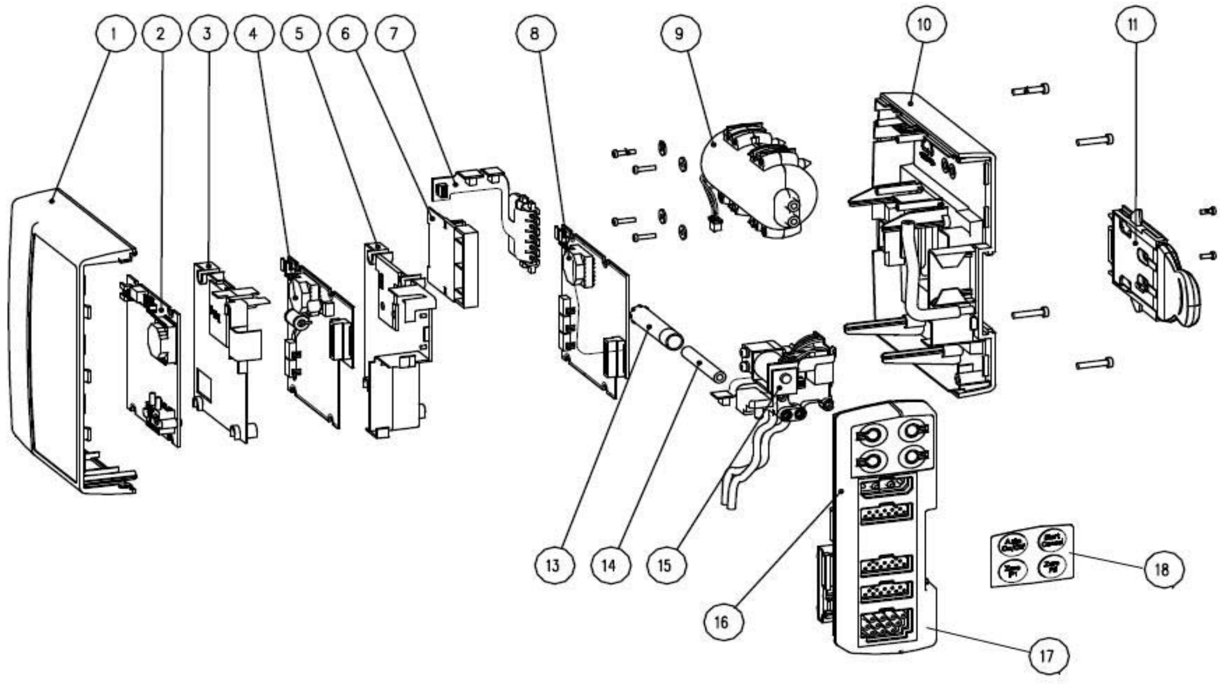
2.1 Patient Side Modules, E-PSM, E-PSMP (Rev. 01)



FRU Description	Parts Included	Order No.
E-PSM(P)-01, NIBP Board, FRU	2) NIPB Board	M1221544
E-PSM(P)-01, STP Board, FRU	4) STP Board	M1221543
E-PSM(P)-01, Module Bus Connector Board, FRU	7) Module Bus Connector 6) Module Bus Insulator	M1221542
E-PSM(P)-01, ECG Board, FRU	8) ECG Board	M1221541
E-PSM(P), NIPB Pump, FRU	9) NIPB Pump, screws and washers	M1221540
E-PSM(P)-01, NIPB Manifold Unit, FRU	15) NIPB Manifold Unit 14) Filter 13) Filter Cover	M1221539
E-PSM(P), Plastic Parts, FRU	1) Cover 3) STP NIPB Insulator 5) ECG STP Insulator 6) Module Bus Insulator	M1221538
E-PSM(P), Frame, FRU	10) Frame	M1221537
E-PSM(P), Screws and Washers, FRU	All screws and washers	M1221482

FRU Description	Parts Included	Order No.
E-PSM(P), Air Filter, FRU	14) Filter 13) Filter Cover	M1221481
E-PSM(P), Lock Unit, FRU	11) Lock Unit and screws	M1221394
E-PSM-01, Front Panel Unit - DE, FRU	16) Front Panel Unit 17) Front Mask - DE 18) Front Panel Stickers: DE	M1213585
E-PSM-01, Front Panel Unit - EN, NL, IT, FRU	16) Front Panel Unit 17) Front Mask - EN, NL, IT 18) Front Panel Stickers: EN, NL, IT	M1213586
E-PSM-01, Front Panel Unit - ES, FRU	16) Front Panel Unit 17) Front Mask - ES 18) Front Panel Stickers: ES	M1213587
E-PSM-01, Front Panel Unit - CS, DA, FI, NO, PL, SV, FRU	16) Front Panel Unit 17) Front Mask - CS, DA, FI, NO, PL, SV 18) Front Panel Stickers: CS, DA, FI, NO, PL, SV	M1213588
E-PSM-01, Front Panel Unit - FR, PT, FRU	16) Front Panel Unit 17) Front Mask - FR, PT 18) Front Panel Stickers: FR, PT	M1213589
E-PSM-01, Front Panel Unit - HU, FRU	16) Front Panel Unit 17) Front Mask - HU 18) Front Panel Stickers: HU	M1213590
E-PSMP-01, Front Panel Unit - DE, FRU	16) Front Panel Unit 17) Front Mask - DE 18) Front Panel Stickers: DE	M1213591
E-PSMP-01, Front Panel Unit - EN, NL, IT, FRU	16) Front Panel Unit 17) Front Mask - EN, NL, IT 18) Front Panel Stickers: EN, NL, IT	M1213592
E-PSMP-01, Front Panel Unit - ES, FRU	16) Front Panel Unit 17) Front Mask - ES 18) Front Panel Stickers: ES	M1213593
E-PSMP-01, Front Panel Unit - CS, DA, FI, NO, PL, FRU	16) Front Panel Unit 17) Front Mask - CS, DA, FI, NO, PL 18) Front Panel Stickers: CS, DA, FI, NO, PL	M1213594
E-PSMP-01, Front Panel Unit - FR, PT, FRU	16) Front Panel Unit 17) Front Mask - FR, PT 18) Front Panel Stickers: FR, PT	M1213595
E-PSMP-01, Front Panel Unit - HU, FRU	16) Front Panel Unit 17) Front Mask - HU 18) Front Panel Stickers: HU	M1213596
E-PSMP-01, Front Panel Unit - SV, FRU	16) Front Panel Unit 17) Front Mask - SV 18) Front Panel Stickers: SV	M1213597

2.2 Patient Side Modules, E-PSM, E-PSMP (Rev. 00)



FRU / Item Description	Parts Included	Order No.
NIBP Board, E-PSM(P)	2) NIPB Board	M1007747
STP-CO Board, E-PSM(P)	4) STP Board	M1018406
Module Flex Board Unit, E-PSM(P)	7) Module Bus Connector	M1012191
ECG Board, E-PSM(P)	8) ECG Board	M1007722
E-PSM(P), NIPB Pump, FRU	9) NIPB Pump, screws and washers	M1221540
NIBP Manifold Unit, E-PSM(P)	15) NIPB Manifold Unit	M1020158
E-PSM(P), Plastic Parts, FRU	1) Cover 3) STP NIPB Insulator 5) ECG STP Insulator 6) Module Bus Insulator	M1221538
E-PSM(P), Frame, FRU	10) Frame	M1221537
E-PSM(P), Screws and Washers, FRU	All screws and washers	M1221482
E-PSM(P), Air Filter, FRU	14) Filter 13) Filter Cover	M1221481
E-PSM(P), Lock Unit, FRU	11) Lock Unit and screws	M1221394
Front Panel Unit, E-PSM - DE	16) Front Panel Unit 17) Front Mask - DE	M1027533

FRU / Item Description	Parts Included	Order No.
Front Panel Unit, E-PSM - EN, NL, IT	16) Front Panel Unit 17) Front Mask - EN, NL, IT	M1027530
Front Panel Unit, E-PSM - ES	16) Front Panel Unit 17) Front Mask - ES	M1027534
Front Panel Unit, E-PSM - FI, DA, NO, PL, SV, CS	16) Front Panel Unit 17) Front Mask - CS, DA, FI, NO, PL, SV	M1027531
Front Panel Unit, E-PSM - FR, PT	16) Front Panel Unit 17) Front Mask - FR, PT	M1027532
Front Panel Unit, E-PSM - HU	16) Front Panel Unit 17) Front Mask - HU	M1050791
Front Panel Unit, E-PSMP - DE	16) Front Panel Unit 17) Front Mask - DE	M1027524
Front Panel Unit, E-PSMP - EN, NL, IT	16) Front Panel Unit 17) Front Mask - EN, NL, IT	M1027528
Front Panel Unit, E-PSMP - ES	16) Front Panel Unit 17) Front Mask - ES	M1027529
Front Panel Unit, E-PSMP - FI, DA, NO, PL, CS	16) Front Panel Unit 17) Front Mask - CS, DA, FI, NO, PL	M1027523
Front Panel Unit, E-PSMP - FR, PT	16) Front Panel Unit 17) Front Mask - FR, PT	M1027525
Front Panel Unit, E-PSMP - HU	16) Front Panel Unit 17) Front Mask - HU	M1050790
Front Panel Unit, E-PSMP - SV	16) Front Panel Unit 17) Front Mask - SV	M1027526

2.2.1 Front panel labeling, E-PSM(P) (Rev. 00 and 01)

Item	Description	Order No.
	Front Panel Sticker, E-PSM - CS	M1063619
	Front Panel Sticker, E-PSM - DA	M1023749
	Front Panel Sticker, E-PSM - DE	M1023740
	Front Panel Sticker, E-PSM - EN	M1023739
	Front Panel Sticker, E-PSM - ES	M1023743
	Front Panel Sticker, E-PSM - FI	M1023746
	Front Panel Sticker, E-PSM - FR	M1023741
	Front Panel Sticker, E-PSM - HU	M1042359
	Front Panel Sticker, E-PSM - IT	M1023744
	Front Panel Sticker, E-PSM - NL	M1023742
	Front Panel Sticker, E-PSM - NO	M1023748

Item	Description	Order No.
	Front Panel Sticker, E-PSM - PL	M1023750
	Front Panel Sticker, E-PSM - PT	M1023745
	Front Panel Sticker, E-PSM - SV	M1023747
	Front Panel Sticker, E-PSMP - CS	M1063611
	Front Panel Sticker, E-PSMP - DA	M1021379
	Front Panel Sticker, E-PSMP - DE	M1021348
	Front Panel Sticker, E-PSMP - EN	M1020271
	Front Panel Sticker, E-PSMP - ES	M1021358
	Front Panel Sticker, E-PSMP - FI	M1021369
	Front Panel Sticker, E-PSMP - FR	M1021352
	Front Panel Sticker, E-PSMP - HU	M1042356
	Front Panel Sticker, E-PSMP - IT	M1021362
	Front Panel Sticker, E-PSMP - NL	M1021355
	Front Panel Sticker, E-PSMP - NO	M1021375
	Front Panel Sticker, E-PSMP - PL	M1021386
	Front Panel Sticker, E-PSMP - PT	M1021366
	Front Panel Sticker, E-PSMP - SV	M1021372

2.2.2 Spare parts for PSM mounts

Item	Description	Order No.
	Pole Mount for PSM, long	M1051023-S
	Frame Mount for PSM	M1051021-S
	Pole Mount for PSM, short	M1049197-S

3 Extension Modules for FM

3.1 Extension Modules for FM, N-FCREC, N-FREC

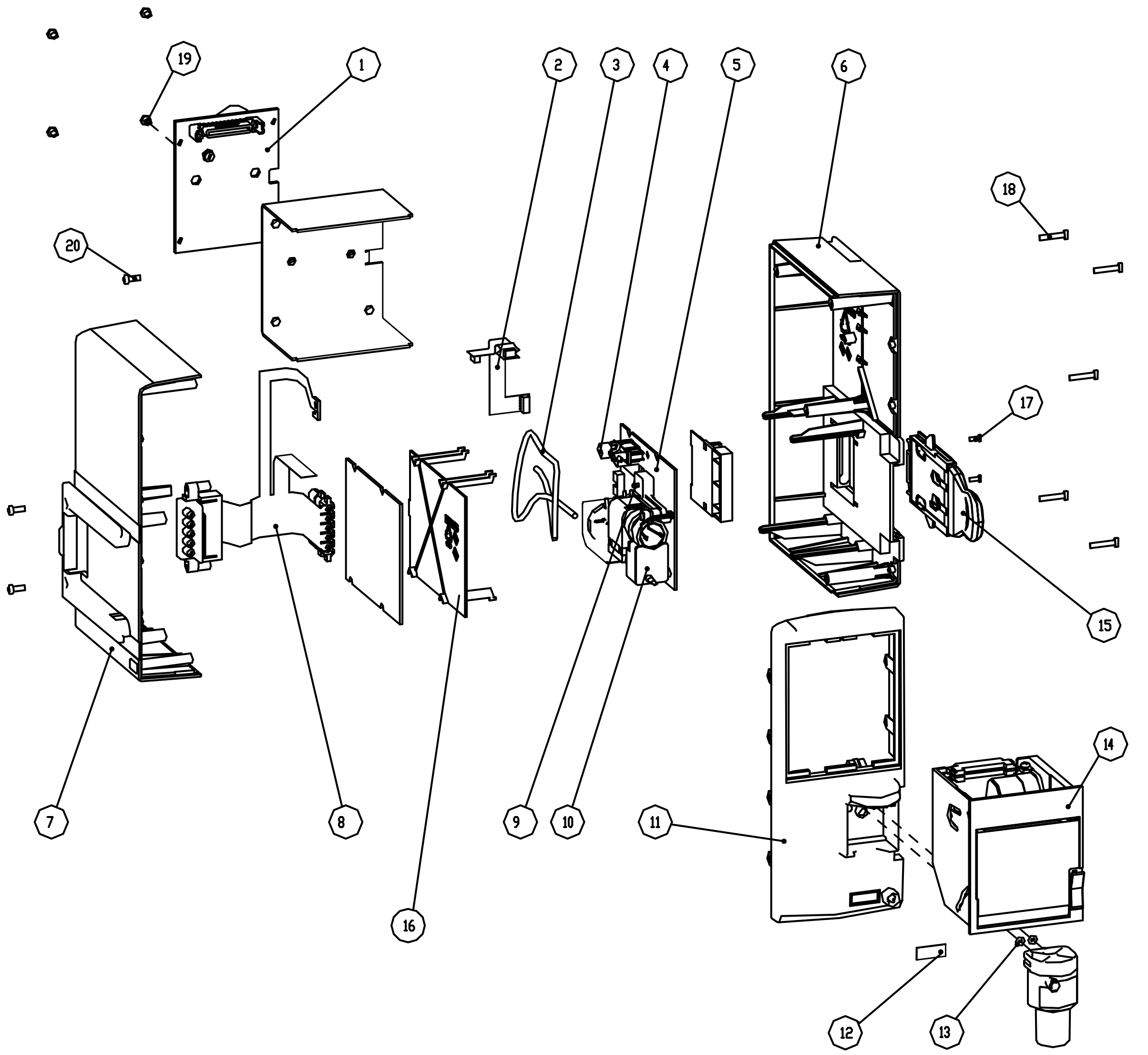


Figure 1 Exploded view of N-FCREC module

Extension Module for FM, N-FCREC, N-FREC

The following N-F(C)(REC) parts will be available as field replaceable spare parts:

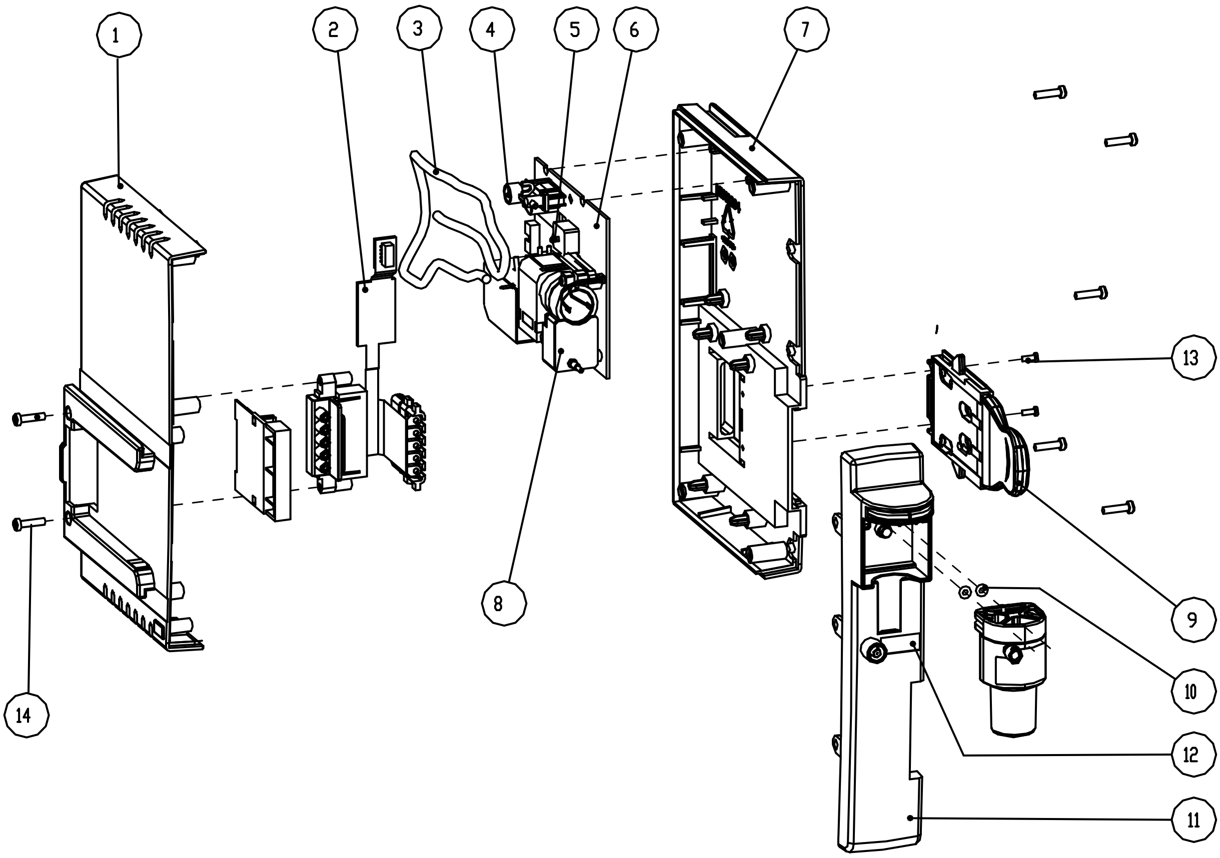
Item	Description	Order Code
1	REC Board, N-F(C)REC	M1009960
2	Interconnection flex	M1009962
3	Nafion Tubing	733382

Item	Description	Order Code
4	Air Filter, N-FC(REC)	M1011471
5	MiniC Unit, N-FC(REC)	M1013204
6	Module cover, right, N-F(C)REC	M1006806
7	Module cover, left, N-F(C)REC	M1006808
8	Module Bus Flex Board Unit, N-F(C)(REC)	M1015109
9	Tubing Unit for miniC, N-FC(REC)	M1013717
10	Pump Unit for miniC, N-FC(REC)	M1013716
11	Front Panel Unit, N-FREC	M1007843
11	Front Panel Unit, N-FCREC	M1015148
13	Mini D-fend O-ring	656565
14	Recorder Unit, N-F(C)REC	M1007853
15	Lock Unit, N-F(C)(REC)	M1011862
16	Insulation plate	M1006816
	Screws	
17	PT2.2x6, TORX	M1010189
18	PT3x16, TORX	M1000523
19	M3x6, POZIDRIVE	61721
20	PT3x8, TORX	628727
	Screw for plastic, PT3.5x7.5mm, pan head, torx /T8	M1013389

3.2 Front panel labeling, N-FC, N-FCREC

Item	Description	Order Code
12	Gas Exhaust Sticker, N-FC(REC)	M1013819
12	Gas Exhaust Sticker, N-FC(REC) - US	M1025438

3.3 Extension Module for FM, N-FC



N-FC

Item	Description	Order Code
1	Module cover, left, N-FC	M1010206
2	Module Bus Flex Board Unit, N-FC	M1027713
3	Nafion Tubing	733382
4	Air Filter, N-FC(REC)	M1011471
5	Tubing Unit for miniC, N-FC(REC)	M1013717
6	miniC Unit, N-FC(REC)	M1013204
7	Module cover, right, N-FC	M1010204
8	Pump Unit for miniC, N-FC(REC)	M1013716
9	Lock Unit, N-F(C)(REC)	M1011862
10	Mini D-fend O-ring	656565
11	Front Panel Unit, N-FC	M1026296
12	Screw PT2.2x6, TORX	M1010189
13	Screw PT3x12, TORX	628729
14	Screw for plastic, PT3.5x7.5mm, pan head, torx /T8	M1013389

4 Remote controller, K-CREMCO, rev. 00, 01

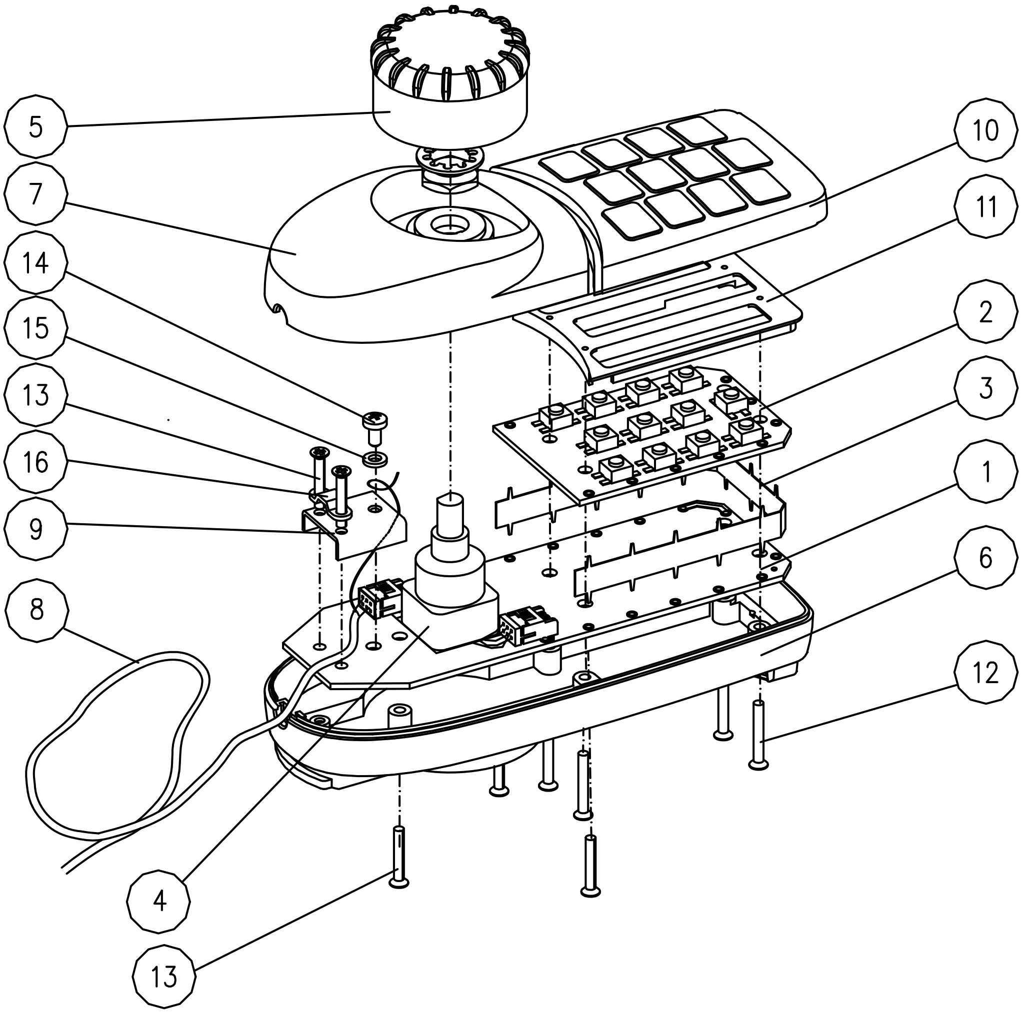


Figure 2 Exploded view of the Remote Controller

Item	Description	Order No.	Replaced by
1	CPU board, K-REMCO	890368	
2	Keyboard PCB, K-REMCO	890371	
3	Connecting plate	891427	
4	Rotary wheel	891036	
5	ComWheel (green); K-REMCO; S/5	898940	
6	Bottom (Munsell N9); K-REMCO; S/5	898938	
7	Cover (Munsell N9); K-REMCO; S/5	898939	
8	K-REMCO - CM cable	891965	
9	Bridge for cable	893235	

Item	Description	Order No.	Replaced by
10	Printing of the keyboard, CS; K-REMCO	M1063588	
10	Front Panel sticker, DA; K-REMCO (rev.00), (rev.01; S/5)	892203	
10	Front Panel sticker, DE; K-REMCO (rev.00), (rev.01; S/5)	892312	
10	Front Panel sticker, EN; K-REMCO (rev.00), (rev.01; S/5)	891425	
10	Front Panel sticker, ES; K-REMCO	892315	
10	Front Panel sticker, FI; K-REMCO (rev.00), (rev.01; S/5)	892317	
10	Front Panel sticker, FR; K-REMCO (rev.00), (rev.01; S/5)	892313	
10	Front Panel sticker, IT; K-REMCO (rev.00), (rev.01; S/5)	892316	
10	Front Panel sticker, NL; K-REMCO (rev.00), (rev.01; S/5)	892314	
10	Front Panel sticker, NO; K-REMCO (rev.00), (rev.01; S/5)	893553	
10	Front Panel sticker, PT; K-REMCO (rev.01); S/5	895233	
10	Front Panel sticker; SV; K-REMCO (rev.00), (rev.01; S/5)	892318	
10	PANEL, Printing of the keyboard, K-REMCO, HU	M1060080	
11	Front panel framework	891426	
12	Slotted recess screw M2.5x22	61218	
13	Cross recess PT-screw M2.5x16	628719	
14	Cross cylinder-head screw M3x6	61721	
15	Shake proof washer m3.2	63611	
16	Cable binder	546454	

5 Device Interfacing Solution, N-DISxxx (rev.01)

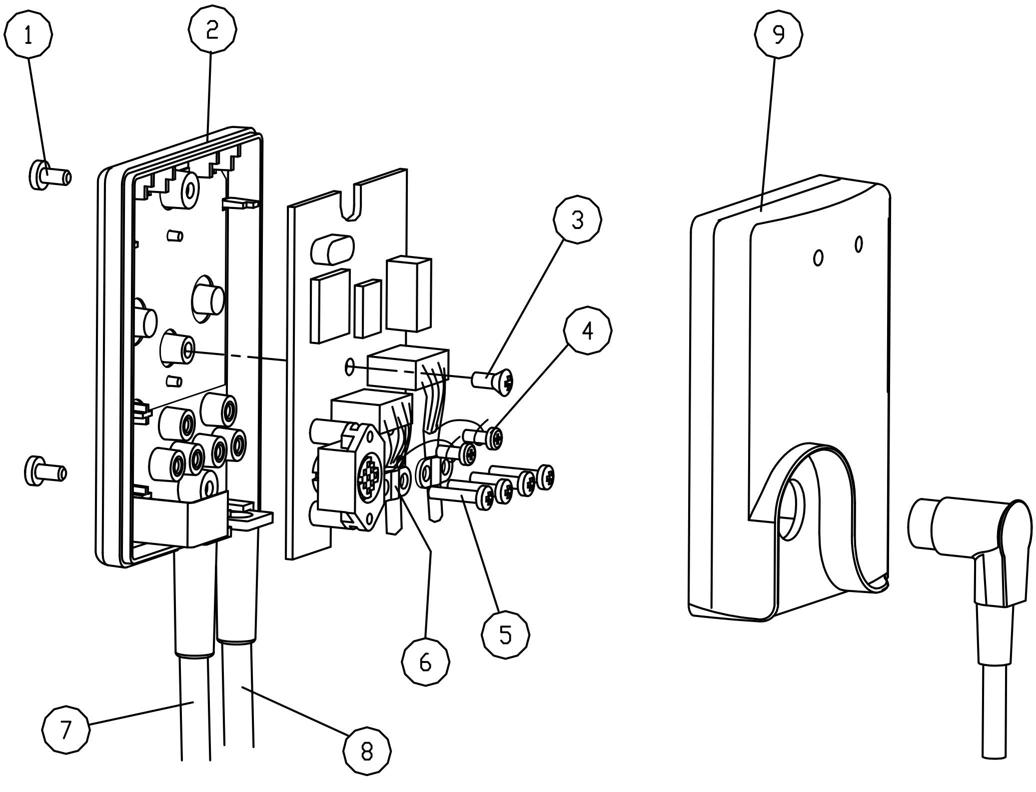


Figure 3 Exploded view of the Device Interfacing module

Item	Description		Order No.
1	Screw for the DIS module case		617210
2	DIS module case, rear		896930
3	Screw for the PC board, MFX M2.5X5 STZN		61209
4	Screw, STZN M3x6 TUFFLOCK		617120
5	SCREW, machine screw, M2.5x10mm, DIN7985, ISO7045, Pozidrive, pan head, steel, zinc coated		61715
6	Strain relief, N-DIS		897443
7	Bus cable, 1 m		900501
7	Bus cable, 2 m		900502
7	Bus cable, 6 m		900503
	Device specific cables:		
8	Cable for Abbot Oximetrix 3	N-DISOXIM3	M1034676
8	Cable for Abbot Q-Vue/Q2	N-DISQVUE	897230

Item	**Description**		**Order No.**
8	Cable for AVL Opticca	N-DISOPT	M1034675
8	Cable for Baxter Vigilance	N-DISVIGIL	8002841
	DIS module case with labeling:		
9	Front cover for Abbot Oximetrix 3	N-DISOXIM3	M1057869
9	Front cover for Abbot Q-Vue/Q2	N-DISQVUE	M1057870
9	Front cover for AVL Opticca	N-DISOPT	M1057867
9	Front cover for Baxter Vigilance	N-DISVIGIL	M1057872