Datex-Ohmeda Pressure Modules

S/5™ Pressure Temp Module, M-PT (Rev. 02)
S/5™ Pressure Module, M-P (Rev. 04)

Technical Reference Manual Slot

All specifications are subject to change without notice.

Document No. 800 1013-1

June 2001

TABLE OF CONTENTS

Pressure Module, M-P, Pressure Temp Module, M-PT

TABLE OF FIGURES

INTRODUCTION

This section provides information for the maintenance and service of the Pressure Module, M-P, and Pressure Temp Module, M-PT. The M-P and M-PT modules are single width plug-in modules designed for use with the S/5 monitors. Both modules provide invasive pressure measurement.

Additionally, the M-PT-module provides temperature measurement. The M-PT module also has a connector for direct ECG and pressure signal output.

NOTE: Do not use identical modules in the same monitoring system. The modules M-P and M-PT are considered as identical modules.

Figure 1   Datex-Ohmeda M-PT and M-P Module

1 SPECIFICATIONS

1.1 General specifications

Module size, W $\times$ D $\times$ H	37 $\times$ 180 $\times$ 112 mm / 1.5 $\times$ 7.1 $\times$ 4.4 in
Module weight	0.35 kg / 0.8 lbs
Power consumption	Approximately 3.5 W

1.2 Typical performance

1.2.1 InvBP

Measurement range	-40...+320 mmHg
Accuracy	$\pm$5 % or $\pm$2 mmHg, whichever is greater
Zero adjustment range	$\pm$150 mmHg
Calibration range	$\pm$20 %
Scales	Upper limit is adjustable between 10 and 300 mmHg in steps of 10. Lower limit is 10 % of selected upper limit below zero.
Sweep speed	12.5, 25, 50 mm/s

DIGITAL DISPLAY

Range	-40...+320 mmHg
Resolution	$\pm$1 mmHg

WAVEFORM DISPLAY

Range	-30...+300 mmHg

HEART RATE FROM ARTERIAL PRESSURE

Measurement range	30...250 bpm
Resolution	1 bpm
Accuracy	$\pm$5 bpm or $\pm$5 %, whichever is greater

1.2.2 Temperature

Measurement range	10...45 °C (50...113 °F)
Display resolution	0.1 °C (0.1 °F)
Temperature test	Automatic (every 10 min.)

YSI 400 probe compatible

1.2.3 Signal output

ECG out	1 V/mV
Pressure P3 out	1 V/100 mmHg, (0...300 mmHg)

1.3 Technical specifications

1.3.1 InvBP

Accuracy	±5 % or ±2 mmHg, whichever is greater
Transducer and input sensitivity	5 µV/V/mmHg, 5 VDC, 20 mA max current
Nonlinearity	<1 %, 0 to 200 mmHg
	<2 %, -40 to 0 and 200 to 320 mmHg
Filter	0...4 - 22 Hz adjustable
Zero set accuracy	±1 mmHg
Calibration resolution	±1 mmHg
Zero time	less than 15 sec
Protection against electrical shock	Type CF defibrillation proof

DIGITAL DISPLAY AVERAGING
Art and P1 digital displays are averaged over 5 seconds and updated at 5 seconds intervals. All other pressures have respiration artifact rejection.

NOTE: The accuracy of the measurement may be different from that specified, depending on the transducer/probe being used. Please check the transducer/probe specification.

1.3.2 Temperature

Measurement accuracy	±0.1 °C (25.0...45.0 °C)
	±0.2 °C (10.0...24.9 °C)
Protection against electrical shock	Type CF

NOTE: The accuracy of the measurement may be different from the specified, depending on transducer/probe used. Please check the transducer/probe specification.

1.3.3 Signal output

Max. delay:	ECG1	15 ms
	Pressure P3	25 ms (0...300 mmHg)
Pressure offset error	max. 10 mmHg	

2 FUNCTIONAL DESCRIPTION

2.1 Measurement principle

2.1.1 Invasive blood pressure

To measure invasive blood pressure, a catheter is inserted into an artery or vein. The invasive pressure setup, consisting of connecting tubing, 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.

2.1.2 Temperature

The temperature is measured by a probe whose resistance varies when the temperature changes, called Negative Temperature Coefficient (NTC) 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 to flow through the resistor and measuring the voltage that is generated across it.

In S/5 module the two methods are combined in a form of a voltage divider. The NTC-resistor is connected in series with a normal resistor and a constant voltage is applied across 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.

2.2 Main components

The M-PT module consists of the following main parts:

- PT board

- Two connectors for YSI 400 series temperature probes; temperature channels T3 and T4.

- Nicolay-type connector for an invasive blood pressure sensor; invasive blood pressure channel P3.

- Key for pressure zeroing.

- DIN-type connector for two direct ECG output signals and pressure 3.

NOTE: These output-signals are non-floating

The M-P module consists of the following main parts:

- PT board

- Nicolay-type connector for an invasive blood pressure sensor; invasive blood pressure channel P3.

- Key for pressure zeroing.

Communication between the module and the central unit is established through RS485 serial interface.

The power supply voltages to the module are generated in the power supply section of the monitor's Central Unit. All electrical connections between the module and the Central Unit are established via 25-pin D-type connector on the backside of the module.
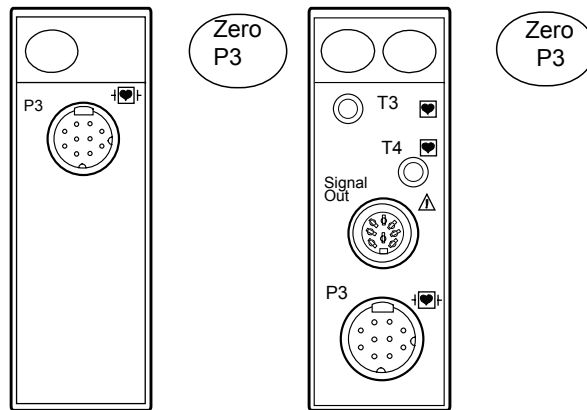
Figure 2   **Front panel of M-P and M-PT Module**

2.2.1 PT board
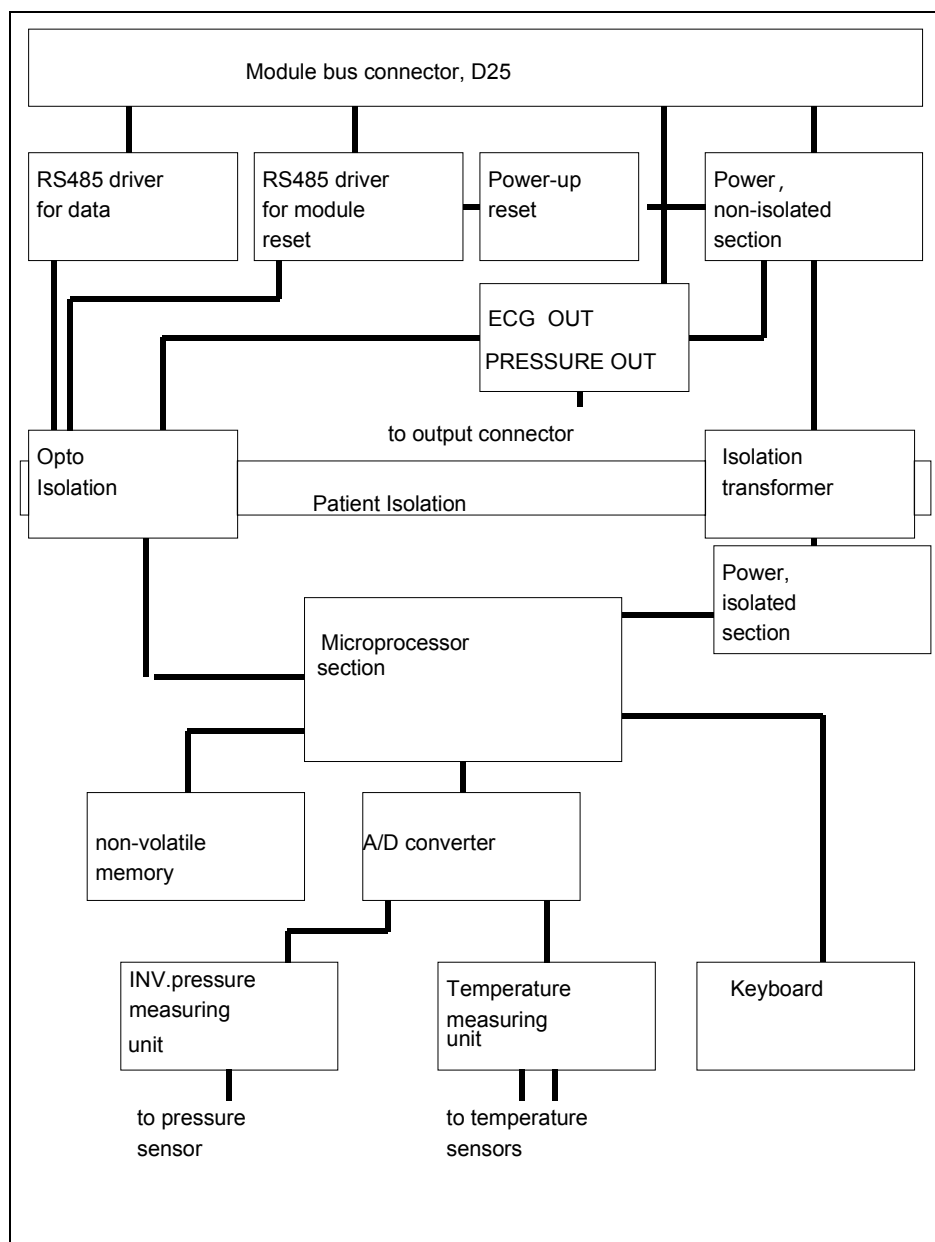
Figure 3   PT board block diagram

ECG and pressure signal prosessing

The PT-module has the Signal Out connector, for output of analog ECG and pressure signals.

The analog ECG-output signals are made by detecting the pulse-width modulated (PWM) ECG signal of the module bus. The module detects the presence of the pacemaker pulses by following the ECG module. Every time the pacer pulse has been detected, the microprocessor of the M-PT module generates a 2.5 ms pacer pulse which is added to the analog ECG signal.

The PRESSURE OUT signal is generated from the P3 invasive pressure signal of the M-PT module.

The P3 signal is transmitted as a pulse width modulated (PWM) signal over the patient isolation. The analog signal is generated by low-pass filtering the PWM signal.

Microprocessor unit

The microprocessor uses the Intel 80C196KC-16 which includes three A/D converters and a UART. There are external memories, an 8-bit data bus, a 16 MHz oscillator, an open collector reset, and a watchdog timer. The internal UART communicates and transfers data between the module and the CPU board in the monitor.

High speed I/O is used to obtain pulse control sequence necessary for pulse oximetry measurement. It receives its timing clock from the oscillator.

Invasive blood pressure measurement unit

An isolated +5 V supply is connected to the input of the pressure transducer bridge circuit. From the bridge circuit output a differential voltage, which depends on blood pressure and input supply voltage, is calculated using the following formula:

$Uout = Uin \times Pressure \times 5\ V$

where $Uin = 5\ V$

$Uout = 25\ V \times Pressure\ [mmHg]$

Pressure amplification is performed by the instrumentation amplifier. The gain of the amplifier is set so that the level of the signal transferred to the A/D converter stays within the measurement range even when there are circumstantial offsets or offsets caused by the pressure transducer. The input filter before the amplifier attenuates high frequency disturbances.
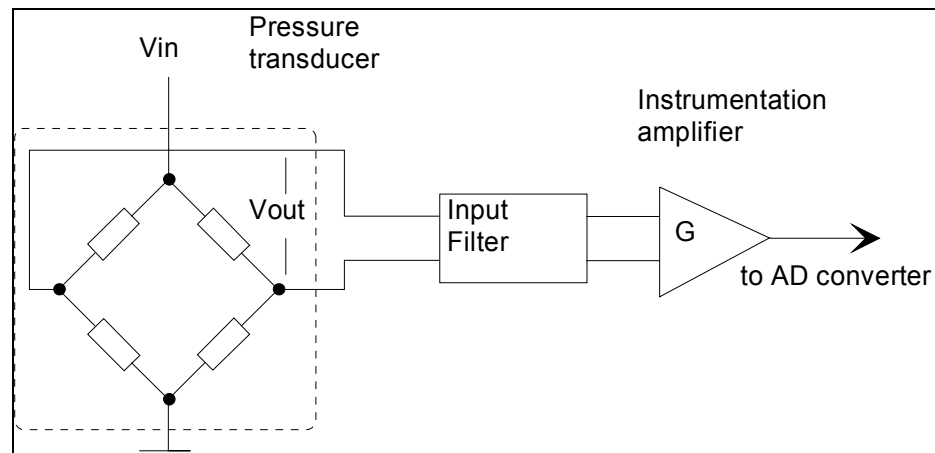
Figure 4   Pressure transducer principle of operation

Temperature measurement unit

Value of NTC-resistor in the probe depends on patient's temperature. It is measured with the following principle.
The temperature signal(s) is produced by voltage dividers, part of which is the patient probe (YSI 400-series thermistor). The output is amplified by the calibrated amplifier(s) whose offset voltage makes its output spread on both sides of zero. Wider output range (measurement range) means better resolution.
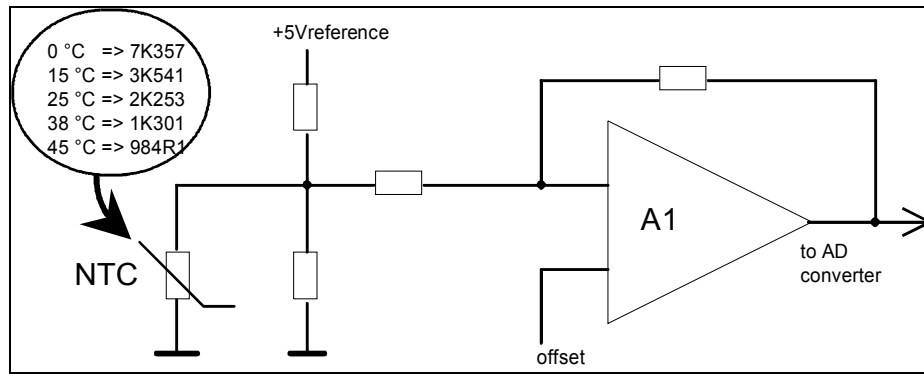
Figure 5   **Temperature measurement principle**

Serial communication

Serial communication between the module and the Central Unit is done by RS485 type bus whose buffers get their supply voltage (+5 VDC) from the Central Unit and in the isolation section get the supply voltage (+5 V) from the isolated power supply.

The communication drivers are controlled by a reset signal such that when the reset is active the drivers do not transfer data.

Reset is also RS485 type and additionally, there is an auxiliary logic power reset, which keeps the reset active for about 500 ms despite the state of reset in the module bus. A time constant determines the power-up reset time. There are components to prevent the module from sending data during reset. The data transmission rate is 500 kbps.
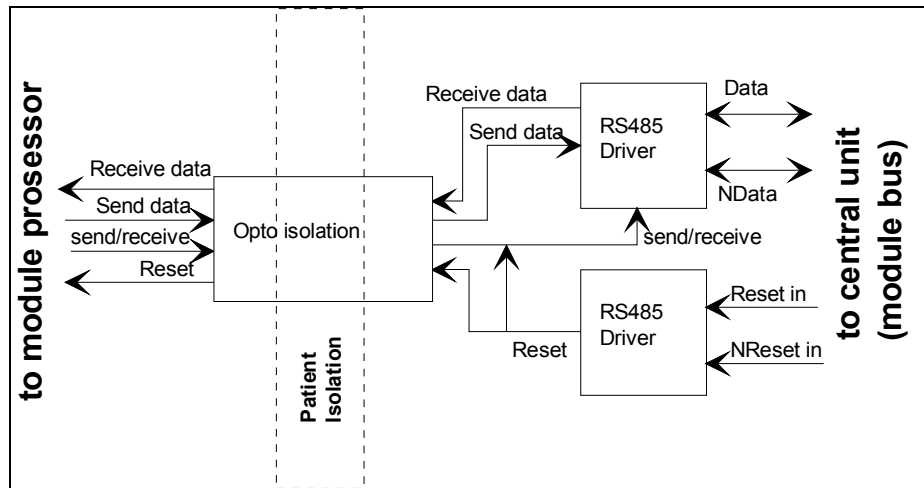
Figure 6   **Serial communication and opto isolation section**

Isolated section

There are two opto isolators, one for data and one for the reset signal. Signals are processed on logical high-low levels even though the output of the opto isolators in the isolation section are analog signals.

The reset line is an open collector type with a pull-up resistor so that the microprocessor is able to use its internal watchdog function.

Power supply section

Isolated supply voltage of the module is developed from +15 Vdirty voltage from the Central Unit. Power supply is a switched-mode circuit, where FET transistor switch is controlled by an oscillator using bipolar timer. The frequency of the oscillator is about 30 kHz and pulse ratio 50 %. Controlling of the FET switch is slowed to suppress spurious interference.

A special pulse transformer is used in the circuit. The transformer secondary circuit uses normal linear regulators except for +5 V which uses a low drop type linear regulator.

2.3 Connectors and signals

2.3.1 Module bus connector
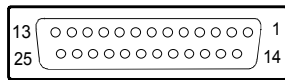
Figure 7   Module bus connector (X1)

Pin No	I/O	Signal
1	I	RESET_RS485*
2	I	-15 VDC*
3	I	+15 VDIRTY*
4	I	+15 Vin*
5	I/O	NDATA_RS485*
6	I/O	DATA_RS485*
7		Ground*
8	I	NRESET_RS485*
9	I	CTSB
10	O	RTSB
11	I	RXDB
12	O	TXDB
13		Ground*
14	I	+32 VDIRTY
15	I	GroundDIRTY*
16	I	CTSC
17	O	RTSC
18	I	RXDC
19	O	TXDC
20		ON/STANDBY
21	O	PWM_ECG*
22		RXDD_RS232
23		TXDD_RS232
24	I	+5 VDCin*
25	I	+5 VDC*

* Used in the M-PT module

2.3.2 Front panel connectors

Pressure connector (P3)
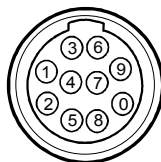
Pin No	Signal
1	Pressure 3 +
2	Pressure 3 -
3	Polarization - (ground)
4	Polarization +
5	Not connected
6	Not connected
7	Not connected
8	Not connected
9	Ground
10	Cable detection

Signal out connector (Sync. out)
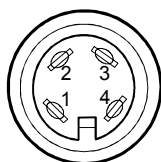
Pin No	Signal
1	ECG out, 1 V/ 1 mV
2	Pressure out, 1 V/ 100 mmHg
3	ECG out, 1 V/ 1 mV
4	Ground

NOTE: The ECG out signal is not available with modules M-ESTP rev. 01, M-EST rev. 00 and M-ETP rev. 00.

2.3.3 Other connectors

Keyboard connector (X3)

Pin No	Signal	Notes
1	N/C	Not connected
2	COSWITCH	Not used
3	PSWITCH	for zeroing of P3
4	fGND	Floating GND
5	fGND	Floating GND

X3

Pressure sensor connector (X4)

Pin No board	Pin No fr.panel	Signal	Notes
1	0	PCABEL	5V if cable not connected
2	4	PCURRENT	Pulsed supply to sensor
3	3,9	P3-	Signal from the sensor
4	1	P3+	Signal from the sensor
5	2	fGND	Floating GND

X4

1 ○ ○ ○ ○ ○ 5

When the board is used in the M-PT module, there are the following connectors connected on the board in addition to X1 and X4.

Signal out connector (X5)

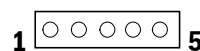| Pin No board	Pin No fr.panel	Signal	Notes
1	-	ECG OUT	ECG to (e.g.) IABP
2	-	N/C	Not connected
3	4	GND	+5VDCin GND
4	1	ECG OUT	ECG to (e.g.) defib.
5	-	N/C	Not connected
6	3	ECG OUT	ECG to (e.g.) IABP
7	2	P OUT	P3 to (e.g.) IABP
8	GND	GND	+5VDCin GND

X5

1 ○ ○ ○ ○ ○ ○ ○ ○ 8
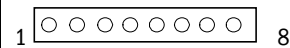
Connector for temperature probes (X8)

Pin No	Signal	Notes
1	T3	-
2	T4	-
3	fGND	Floating GND
4	CON	Low if PT
5	fGND	Floating GND
6	GND	Floating GND

X8

1 ○ ○ ○ ○ ○ ○ 6
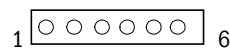
3   SERVICE PROCEDURES

3.1   General service information

Field service of the M-P and M-PT modules is limited to replacing faulty circuit boards or mechanical parts. The circuit boards should be returned to Datex-Ohmeda for repair.

Datex-Ohmeda is always available for service advice. Please provide the unit serial number, full type designation, and a detailed description of the fault.

CAUTION   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 recommended to be performed 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 should be filled in when performing the procedures.

The mark ✍ in the instructions means that the check list should be signed after performing the procedure.

The procedures are designed for monitors with S/5 monitor software of revision 01. However, most of the procedures also apply to monitors, which contain some other monitor software type/revision.

3.2.1   Recommended tools

Tool	Order No.	Notes
M-NE(12)STPR/M-ESTPR/M-ESTP		Not M-ESTP Rev. 01, M-EST Rev. 00 or M-ETP Rev. 00
Patient simulator		
Pressure manometer		
Temperature test set	884515	
InvBP transducer		
Oscilloscope		
Screwdriver		

All modules

- Detach the module box by removing the two screws from the back of the module. Be careful with the loose latch and spring locking pin.

1. Check internal parts:
    - screws are tightened properly
    - cables are connected properly
    - all socket mounted IC's are inserted properly
    - EMC covers are attached properly
    - there are no loose objects inside the module

    ✍

2. Check external parts:
    - the front cover and the front panel sticker are intact
    - all connectors are intact and are attached properly
    - the module box, latch and spring locking pin are intact

    ✍

- Reattach the module box 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*
  <div align="right">

  Field 2 - P1
  Field 3 - P3
  Field 4 - P5
  </div>

  Digit Fields

  <div align="right">*Field 4 - T3+T4*</div>

3. Plug in the module. Check that it goes in smoothly and locks up properly.

    ✍

- Preset InvBP measurement settings:

  Invasive Pressures - *P1 'Art' Setup - Label - Art*
  P3 Setup - Label – PA

4. Enter the service menu:

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

    Take down the information regarding module software by selecting SCROLL VERS and turning the ComWheel.

    ✍

5. Enter the P/PT service menu (according to the tested module):

    Parameters - P/PT

    Check that the "Timeouts", "Bad checksums" and "Bad c-s by mod" values are not increasing faster than by 50 per second. Check also that the module memories have passed the internal memory test, i.e. the "RAM", "ROM" and "EEPROM" show all OK.

    ✍

Invasive blood pressure measurement

6. Check the front panel membrane key.
    Press the key at least for one second. Check that the pressed key is identified, i.e. the text for "Button" changes from OFF to ON in the service menu.

    ✍

7. Check that the "Cable" and "Probe" show OFF.

    Plug a cable with an invasive blood pressure transducer into the front panel connector P3. Check that the "Cable" and "Probe" show ON and the pressure

8. waveform field appears onto the monitor screen..

    NOTE: Test both invasive blood pressure channels with M-PP.

    ✍

9. Calibrate the InvBP channel according to the instructions in the Technical Reference Manual.

    ✍

10. Check that the module configuration is correct with P and PT modules.
    The configuration in use is shown beside the text "Configuration" in the service menu and it can be either BP or PT.

    Change the configuration in the CALIBRATIONS -menu, if necessary.

    ✍

11. Check the InvBP channels with a patient simulator

The settings and checks with a Dynatech Nevada medSim 300 Patient Simulator are:

SENSITIVITY switch position: 5 µV/V/mmHg

ECG - BASE - BPM - 60

BP - 2 - WAVE -

ATM

connect a cable from the channel BP3 to the connector P3.

Ccheck that appropriate InvBP waveform is shown and the InvBP value is approximately 25/10 (±2 mmHg).

✍

Modules with temperature measurement

11. Check that the "Cable" and "Probe" show OFF for the channels T3 and T4 when no probes are connected.

    Connect a temperature test plug into the connector T3. Check that the "Cable" and "Probe" for T3 show ON and the corresponding temperature value appears onto the screen.

    Perform the same check also for the channel T4.

    ✍

12. Check the temperature calibrations using temperature test plugs.
    If the deviation on a temperature reading on the screen is more then 0.1 °C, calibrate the temperature channels according to the instructions in the Technical Reference Manual.

    ✍

13. 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 for T3+T4, check that no error messages appear and "Temp error" shows OFF for both channels in the menu.

    ✍

Modules with signal output connector

- Preset InvBP and ECG measurement settings:

Invasive Pressures *- P3 Setup - Label - Art*

ECG *- ECG1 LEAD -I*

Connect a patient simulator to the connector P3 and to the connector ECG on the used M-NE(12)STPR/M-ESTPR/M-ESTP.

The settings and checks with a Dynatech Nevada medSim 300 Patient Simulator are:
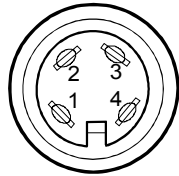
SENSITIVITY switch position: 5 µV/V/mmHg

BP - 1 - WAVE - ART

ECG - BASE - BPM - 160
        PACE - WAVE - NSR

Use the channel BP1 for the connector P3.

14. Connect an oscilloscope between the signal out connector pins 1 (ECG out) and 4 (Ground).

Check that an analog signal which corresponds with the ECG waveform on the screen comes out. The output signal's ratio to the actual ECG signal should be around 1V/1mV.

Check that a similar output signal is coming out also from the pin 3 (ECG out).

✍

15. Connect the oscilloscope between the signal out connector pins 2 (Pressure out) and 4 (Ground).

Check that an analog signal which corresponds with the InvBP waveform on the screen comes out. The output signal's ratio to the actual InvBP signal should be around 1V/100mmHg.

✍

All modules

16. Perform electrical safety check and leakage current test.

   ✍

17. Check that the module functions normally after the performed electrical safety check.

   ✍

18. Clean the module with suitable detergent.

   ✍

•   Fill in all necessary documents.

3.3 Disassembly and reassembly

Disassemble the M-P and M-PT modules in the following way. See the exploded view of the module.

1.   Remove the two screws from the back of the module.

2.   Pull the module box slowly backwards and detach it from main body. Be careful with loose latch and spring pin for locking.

3.   To detach the PT board. The board can be removed by detaching two screws on the folio side of the board near the front panel and disconnecting the two ribbon cables coming from the front panel.

To reassemble the module, reverse the order of the disassembly steps.

CAUTION   When reassembling the module, make sure that all cables are connected properly.

3.4 Adjustments and calibrations

3.4.1 Invasive pressure calibration

Perform pressure calibration whenever the pressure transducer (probe) is replaced with different type of transducer.

1.   Enter P/PT service menu: **Monitor Setup -** *Install/Service - Service - Parameters*

2.   Enter Calibrations menu.
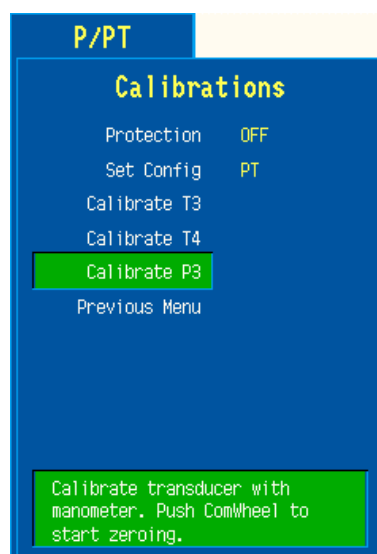
3.   Connect a pressure transducer with a pressure manometer to the P3 connector. Select Calibrate P3. Leave the transducer to room air pressure.

4.   Press the ComWheel to start zeroing.

5.   Supply a pressure of 100 mmHg...300 mmHg to the transducer. The recommended pressure is 200 mmHg.

6.   Set the pressure on the display to match the pressure reading on manometer and press the ComWheel. A tolerance of ±1 mmHg is allowed.

7.   The text 'calibrated' will appear on the display.

3.4.2 Temperature calibration

NOTE: For the temperature calibration, separate test plugs (25 °C and 45 °C) are necessary. A test set of two plugs is available from Datex-Ohmeda, order code 884515.

Performe temperature calibration whenever the measured values deviate more than ±0.1.

1.   Enter P/PT service menu (Monitor Setup, Install/Service, Service, Parameters).

2.   Enter Calibrations menu.

3.   Press the protect button at the bottom of the module and select OFF protect mode. Release the button.

4.   Select Calibrate T3/Calibrate T4.

5.   Insert calibration plug (25 °C) into T3/T4 connector.

6.   Press the ComWheel.

7.   Insert calibration plug (45 °C) into T3/T4 connector.

8.   Press the ComWheel.

9.   Press in the protect button at the bottom of the module and select ON protect mode. Release the button.

4   TROUBLESHOOTING

4.1   Troubleshooting chart

See also the *User's Reference Manual* for more troubleshooting procedures.

4.1.1 Invasive blood pressure

Trouble	Cause	Treatment
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 selected pressure waveforms by pressing Monitor Setup key and selecting modify waveforms. Check that pressure transducer open to patient.
Not zeroed-message	Measurement on, channel not zeroed.	Zero the channel.
Zeroing failed-message	Unsuccessful zeroing of P3 (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 calibrating of P3 (number field), possibly due to 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 measurement range.	Check transducer level. Zero the channel.
Out of range >320 mmHg	Measurement pressure is beyond measurement range.	Check 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 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 transducer and its level. Zero the channel.

4.1.2 Temperature

Trouble	Cause	Treatment
Message 'TEMPERATURE ERROR'	Faulty calibration.	Perform calibration. If it does not help, check that front panel connectors are properly connected to STP board.
No temperature displayed	Wrong type of probe.	Use correct probe.
	Temperature out of measurable range.	The range is between 10 and 45 °C.
	Temperature calibration not protected.	Set the Protection ON in the Service Menu.

4.2   Troubleshooting flowchart
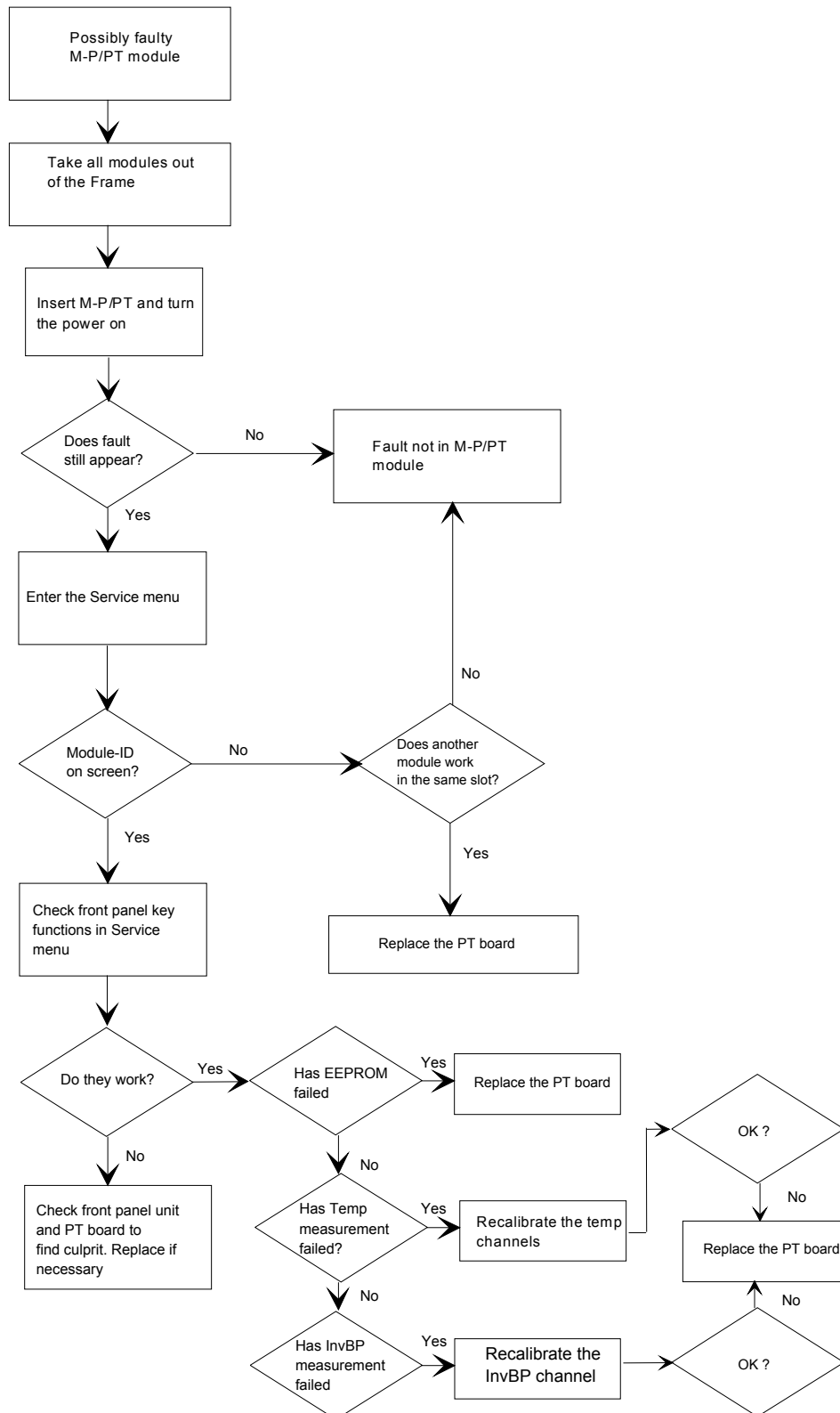
Figure 8   Troubleshooting flowchart

5 SERVICE MENU

```
              Monitor Setup
  Monitor Setup       Install/Service

Screen 1 Setup  ▤        Pages Setup  ▤
Sweep Speeds  ▤    100   Screens Setup  ▤    100
Select Mode  ▤          Trends & Snapshot  ▤
Set Time and Date  ▤       Save Modes  ▤
Install/Service  16      Installation  ▤
Normal Screen              Service  26
                        Previous Menu

                  0                    0

Give password.          Give password.
```
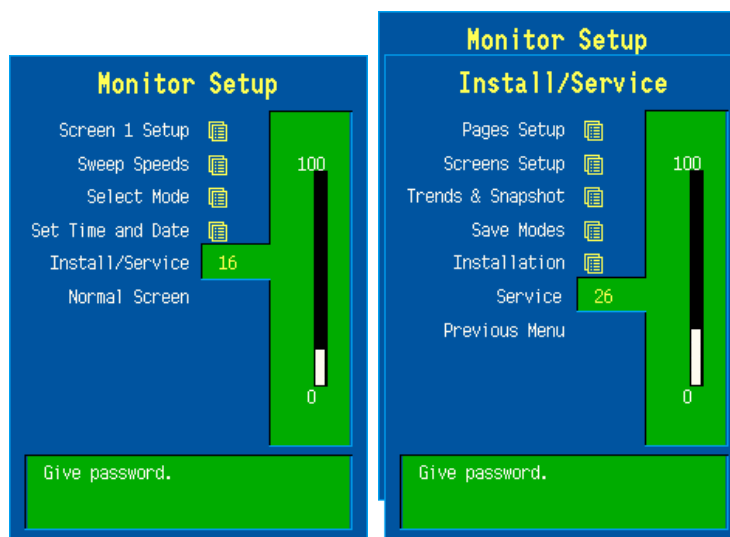
1.   Press the **Monitor Setup** key.

2.   Select *Install/Service* (password 16-4-34).

3.   Select *Service* (password 26-23-8).

4.   Select *Parameters*.

5.   Select *P/PT module*.

5.1 P/PT menu

Calibrations   See section 5.2 "*Calibrations menu*."

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

Service Data   **Gain** is a coefficient to compensate gain error. Usually the value for P3 is between 17000 and 25000 and for T3 and T4 between 13000 and 14300. **Zero** indicates offset compensation value of each parameter in A/D converter. Typically the values for P3 is within ±1000 and for T3 and T4 between -150 and +300. Calibrate if zero and/or gain value is outside the ranges.

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

Under **Value** the measured numeric values are displayed simultaneously. Pressure value is a real time value and shown in mmHg.

Button; the front panel key function can be confirmed by pressing the key and checking that OFF turns to ON.

Temp error shows whether the calibration of the temperature was successful or not.

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: BP or PT.

Timeouts is a cumulative number that indicates how many times the module has not responded to the monitor's inquiry.
Bad checksums is also a cumulative number that indicates how many times communication from the module to monitor broke 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 50 per second) during the normal operation indicates either serial communication failure or module not in place.

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).

5.2 P/PT calibration menu
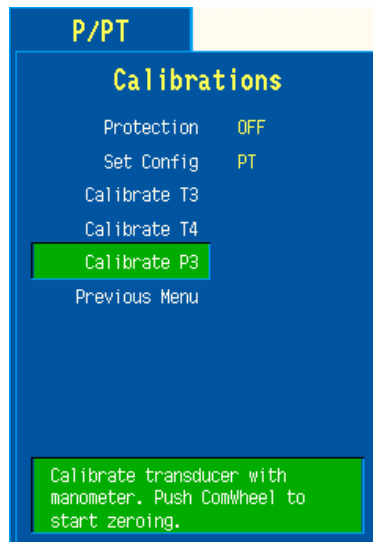
Protection   Protection for the configuration and temperature calibrations can be set ON and OFF only when protect button at the bottom of the module is pressed.

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 BP or PT.

The configuration setting should be checked if the PT board is replaced.

Calibrate T3 and Calibrate T4

The functions are for calibrating the temperature channels T3 and T4. 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.

Calibration:

1.   Select Calibrate T3 / Calibrate T4

2.   Insert the test plug 25 °C into the T3 / T4 connector

3.   Press the ComWheel

4.   Insert the test plug 45 °C into the T3 / T4 connector

5.   Press the ComWheel

Calibrate P3   The function is for calibrating the invasive blood pressure channel P3.

The calibration requires a pressure transducer (with an appropriate cable) and a pressure manometer.

Calibration:

1. Connect the pressure transducer with the pressure manometer to the P3 connector. Select Calibrate P3. 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.

6 SPARE PARTS

6.1 Spare parts list

NOTE: Only changed part numbers are listed under later revisions. To find the desired part: check first the list of the revision that corresponds your device. If the part is not listed there, check the previous revision, etc. until you find the right number.

NOTE: Accessories are listed in the *Patient Monitor Supplies and Accessories*.

6.1.1 Pressure Module, M-P, Rev. 00
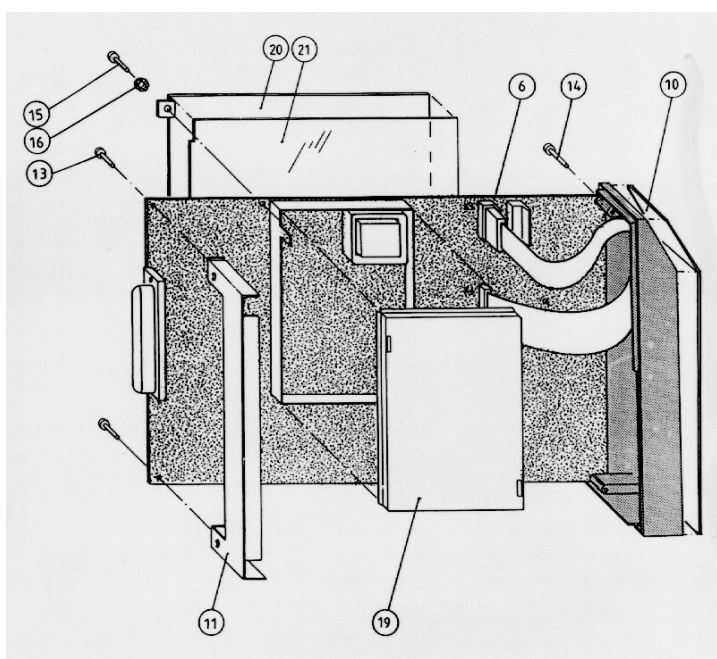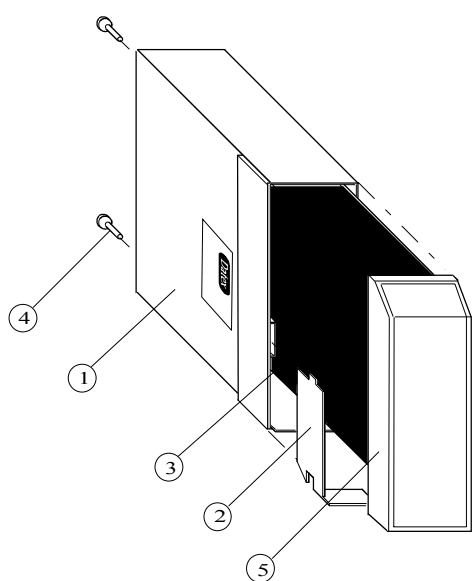
Item	Description	Order No.
-	Membrane keypad	880101
1	Module box (single width)	886167
2	Spring pin for module box	879182
3	Latch for module box	879181
4	Cross recess screw M3x8 black	616215
5	Front panel unit, M-P	880044
6	STP board, M-ESTP (Rev. 01), M-P (Rev. 00-01)	*(880339) Use 885697
11	Metal frame	879184
13	Cross cylinder head screw M3x6	61721
14	Cross cylinder head screw M3x12	628700
15	Cross cylinder head screw M3x6	628710
16	Shakeproof washer	63611

6.1.2 Pressure Module, M-P, Rev. 01

No new spare parts.

6.1.3 Pressure Module, M-P, Rev. 02

Item	Description	Order No.
6	STP board, M-ESTP (Rev. 03-04), M-P (Rev. 02)	*(882627) Use 885697

6.1.4 Pressure Module, M-P, Rev. 03

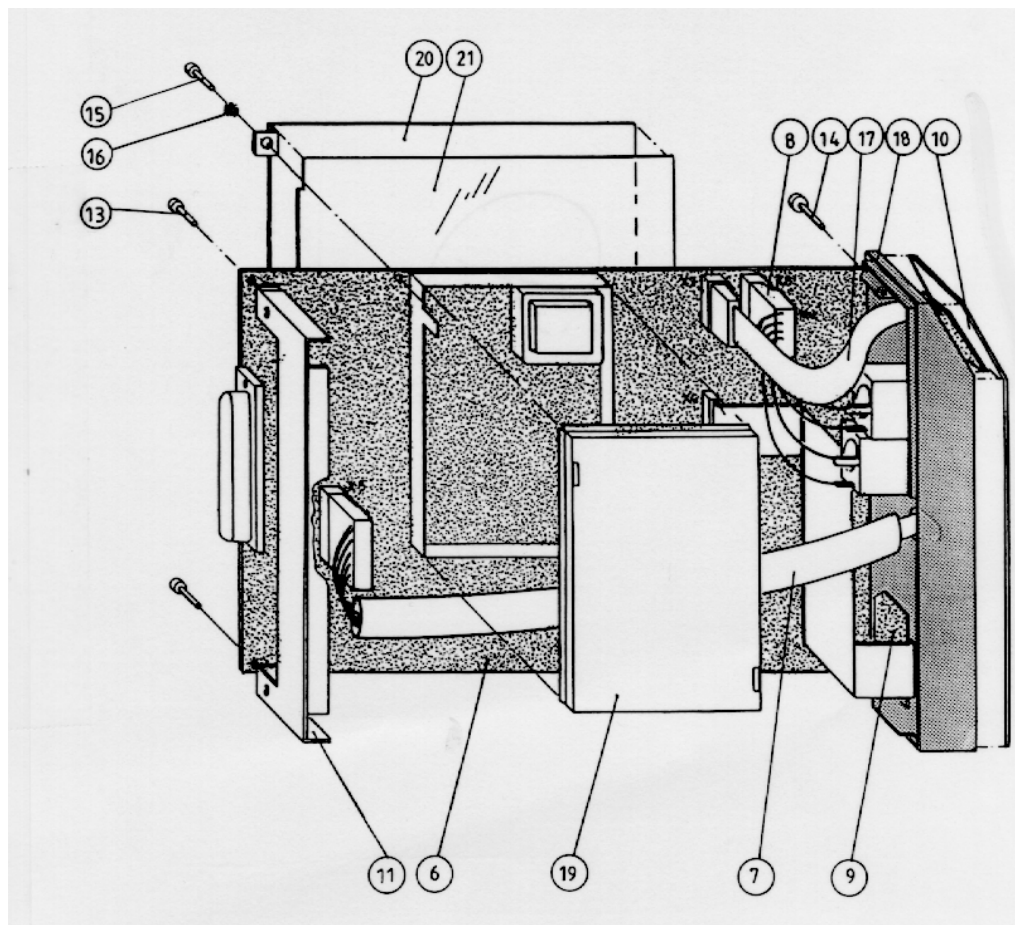| Item	Description	Order No.
6	PT board, M-PT (Rev. 01), M-P (Rev. 03)	*895047
19	EMC cover	884099
20	Protection plate	883946
21	Insulation plate for 883946	884121

The front panel unit includes all the connectors and input boards.
* the part is recommended for stock

6.1.5 Pressure Module, M-P, Rev. 04

No new spare parts.

6.1.6 Pressure Temp Module, M-PT, Rev. 00

Item	Description	Order No.
1	Module box (single width)	886167
2	Spring pin for module box	879182
3	Latch for module box	879181
5	Cross recess screw M3x8 black	616215
6	PT board, M-PT (Rev. 00)	*885697
7	Signal out connector, M-PT	884316
8	T-Input connectors	*884315
9	P-Input connector	884314
11	Metal frame	879184
13	Cross cylinder head screw M3x6	61721
14	Cross cylinder head screw M3x12	628700
15	Cross cylinder head screw M3x6	628710
16	Shakebroof washer	63611
17	Membrane keypad	880101
18	Front panel frame, M-PT	883801
19	EMC cover	884099
20	Protection plate	883946
21	Insulation plate for 883946	884121

6.1.7 Pressure Temp Module, M-PT, Rev. 01

Item	Description	Order no.
6	PT board, M-PT (Rev. 01), M-P (Rev.03)	*895047

* the part is recommended for stock

6.1.8 Pressure Temp Module, M-PT, Rev. 02

No new spare parts.

6.1.9 Front panel stickers for AS/3 modules (square buttons)

Item No. 10

Front panel stickers that are related to the Compact Module type and adaptation:

Adaptation codes: DA=Danish, DE=German, EN=English, ES=Spanish, FI=Finnish, FR=French, IT=Italian, JA=Japanese, NL=Dutch, NO=Norwegian, PT=Portuguese, SV=Swedish

Adaptation	M-P (Rev. 00-03) Order No.	M-PT (Rev. 01) Order No.
DA	892211	892210
DE	880488	885035
EN	880139	884004
ES	884201	886193
FI	888863	888864
FR	880130	885033
IT	886756	886758
JA	888308	888307
NL	886063	886330
NO	893569	893571
PT	--	895237
SV	885847	885845

6.1.10 Front panel stickers for S/5 modules (round buttons)

Front panel stickers that are related to the Compact Module type and adaptation:

Adaptation codes: DA=Danish, DE=German, EN=English, ES=Spanish, FI=Finnish, FR=French, IT=Italian, JA=Japanese, NL=Dutch, NO=Norwegian, PT=Portuguese, SV=Swedish

Adaptation	M-P (Rev. 04) Order No.	M-PT (Rev. 02) Order No.
DA	898768	898768
DE	898735	898759
EN	898734	898758
ES	898738	898762
FI	898741	898765
FR	898736	898760
IT	898739	898763
JA	898745	898769
NL	898737	898761
NO	898743	898767
PT	898734	898764
SV	898742	898766

7 EARLIER REVISIONS

This manual also supports M-P revisions 02 and 03.

For service information on the earlier revisions, please refer to:
P Module revision 00   Service Manual p/n 880850
P Module revision 01   Service Manual p/n 882580

APPENDIX A

APPENDIX A, Service Check Form, M-P and M-PT

SERVICE CHECK FORM

Pressure Modules, M-P, M-PT

Customer			
Service		Module type	S/N
Service engineer			Date

☐ OK = Test OK   ☐ N.A. = Test not applicable   ☐ Fail = Test Failed

All modules

		OK	N.A.	Fail			OK	N.A.	Fail
1.	Internal parts	☐	☐	☐	2.	External parts	☐	☐	☐
3.	Installation	☐	☐	☐					

Notes

4.	Module software	P	
		PT	
5.	Communication and memories	☐ ☐ ☐	

Notes

InvBP measurement

6.	Membrane keys	☐ ☐ ☐	7.	Cable and transducer detection	☐ ☐ ☐
8.	Calibration	☐ ☐ ☐	9.	Configuration BP/PT	☐ ☐ ☐
10.	Test with patient simulator				

Notes

A-1(2)

Document No. 8001013-1

☐
OK = Test OK

☐
N.A. = Test not applicable

☐
Fail = Test Failed

TEMP measurement

11. Temperature probe detection ☐ ☐ ☐

12. Calibration check ☐ ☐ ☐

13. Temp test -function ☐ ☐ ☐

Notes _____

Signal output

14. ECG output ☐ ☐ ☐

15. InvBP output ☐ ☐ ☐

Notes _____

All modules

16. Electrical safety check ☐ ☐ ☐

17. Functioning after electrical safety check ☐ ☐ ☐

18. Final cleaning ☐ ☐ ☐

Notes _____

Notes _____

Used Spare Parts _____ _____ _____

_____ _____ _____

Signature _____