

Datex-Ohmeda

S/5™ Dual Pressure Module, M-PP (Rev. 01)

Technical Reference Manual



All specifications are subject to change without notice.

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Dual Pressure Module, M-PP

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INTRODUCTION

This section provides information for the maintenance and service of the Dual Pressure Module, M-PP. The M-PP module is a single width plug-in module designed for use with the S/5 monitors. The Dual Pressure module provides invasive blood pressure (InvBP) measurement.



Figure 1

Dual Pressure Module, M-PP

1 SPECIFICATIONS

1.1 General specifications

Module size, W × D × H	37 × 180 × 112 mm / 1.5 × 7.1 × 4.4 in
Module weight	0.35 kg / 0.8 lbs
Power consumption	approximately 3.5 W

1.2 Typical performance

Measurement range	-40...+320 mmHg
Accuracy	±5 % or ±2 mmHg, whichever is greater
Zero adjustment range	±150 mmHg
Calibration range	±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	±1 mmHg
WAVEFORM DISPLAY	
Range	-30...+300 mmHg
HEART RATE FROM ARTERIAL PRESSURE	
Measurement range	30...250 bpm
Resolution	1 bpm
Accuracy	±5 bpm or ±5 %, whichever is greater

1.3 Technical specifications

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...200 mmHg < 2 %, -40...0 and 200...320 mmHg
Filter	0...4 - 22 Hz adjustable
Zero set accuracy	±1 mmHg
Calibration resolution	±1 mmHg
Zero time	< 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 second 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.

2 FUNCTIONAL DESCRIPTION

2.1 Measurement principle

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.

2.2 Main components

The main components of the Dual Pressure Module, M-PP, are a PP circuit board, a front panel and a box. The front panel includes two Nicolay-type connectors, P5 and P6, and two direct function keys, Zero P5 and Zero P6 for pressure zeroing.

Communication between the Dual Pressure Module and the Central Unit is an RS485 serial interface.

The power supply voltages to the Dual Pressure Module are generated in the power supply section of the Central Unit. All electrical connections between the Dual Pressure Module and the Central Unit are via a 25-pin D-connector at the back of the module.

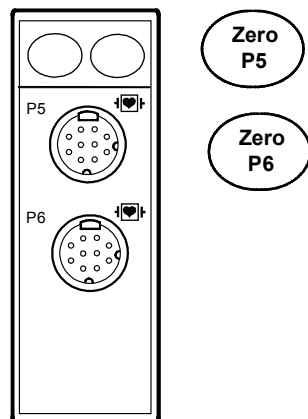


Figure 2 Dual Pressure Module, M-PP, front panel

2.2.1 PP board

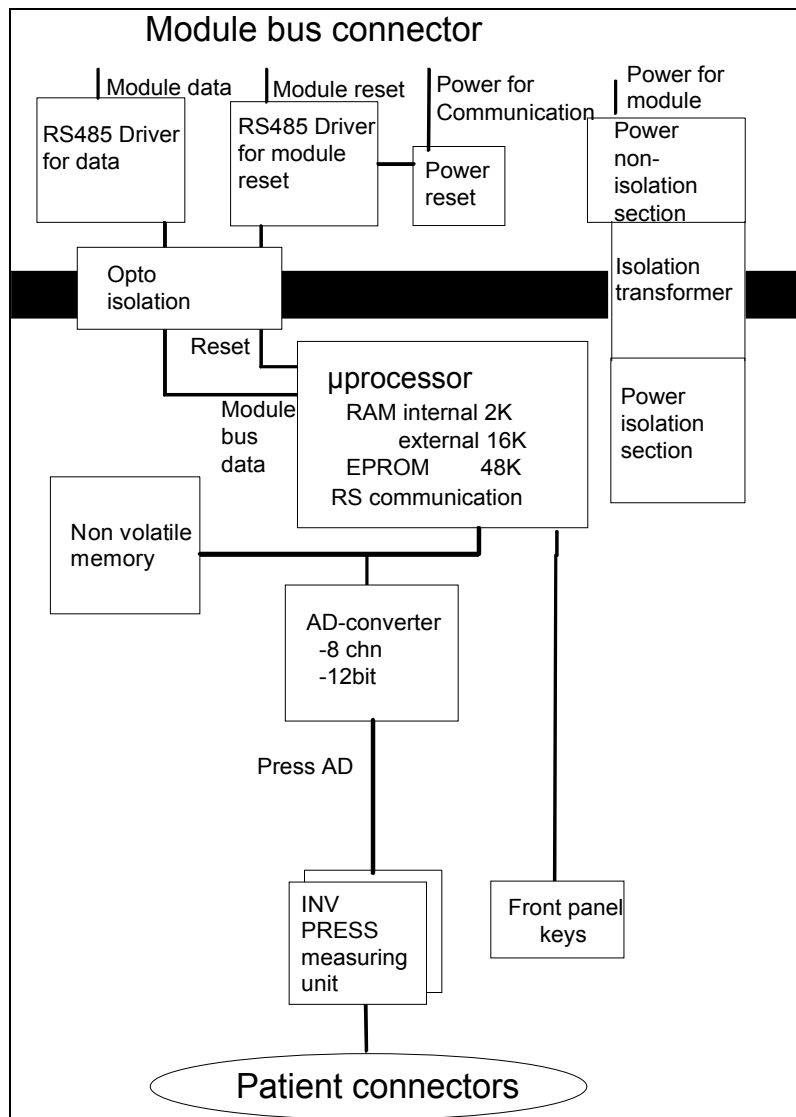


Figure 3 PP board block diagram

Microprocessor unit

The microprocessor uses the Intel 80C196KC-16 CPU which includes three A/D converters and a UART. The microprocessor uses external memories, an 8-bit data bus, a 16 MHz oscillator, an open collector reset, and a watchdog timer. The three A/D-converters within the CPU convert the analog input signals to digital. 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 the pulse control sequence necessary for pulse oximetry measurement. It receives its timing clock signal from the 16 MHz 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:

$$U_{out} = U_{in} \times \text{Pressure} \times 5 \text{ V}$$

where $U_{in} = 5 \text{ V}$

$$U_{out} = 25 \text{ V} \times \text{Pressure [mmHg]}$$

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.

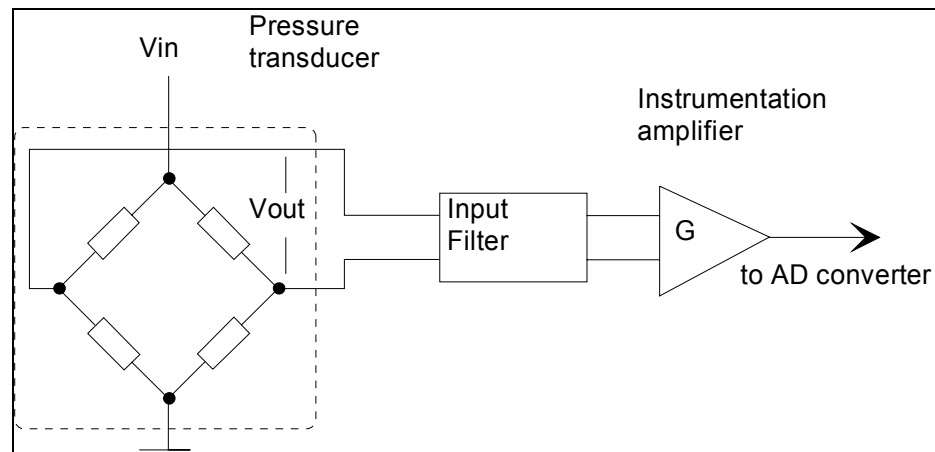


Figure 4 Pressure transducer principle of operation

Serial communication

Serial communication between the Dual Pressure Module and the Central Unit is via an RS485 type bus. The communication bus drivers are powered from the Central Unit Module Bus. The module isolation section (+5 V) is powered from the isolated power supply.

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

In addition to the RS485 reset there is a logic power-up reset, which holds for approximately 500 ms regardless of the state of the RS485 reset. A time constant determines the power-up reset time. The power-up reset also prevents the module from sending data to the Module Bus. The data transmission rate is 500 kbps.

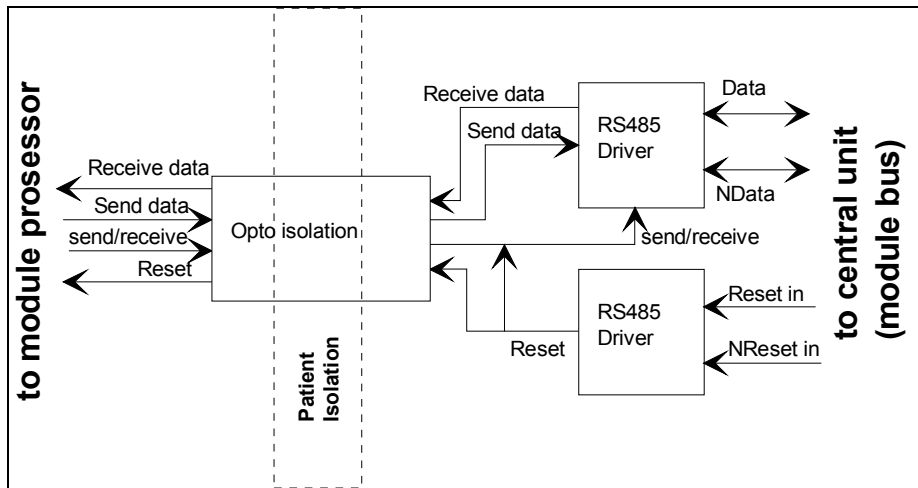


Figure 5 Serial communication and opto isolation sections

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 watch-dog function.

Power supply section

The module isolated supply voltage is developed from the +15 Vdirty (non-isolated) supply from the Central Unit power supply.

The isolated power supply is a switched-mode circuit, where an FET switch is controlled by an oscillator using a bipolar timer. The frequency of the oscillator is approximately 30 kHz with a pulse ratio 50 %; switching of the FET switch is slow to suppress spurious interference.

A special isolation 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

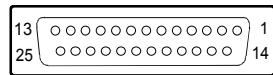
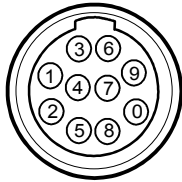


Figure 6 **Module bus connector (X1)**

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

2.3.2 Front panel connectors

Pressure connectors (P5, P6)

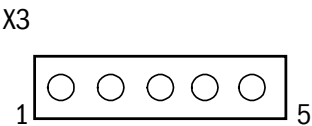


Pin no.	Signal
1	Pressure 5/6 +
2	Pressure 5/6 -
3	Polarization - (ground)
4	Polarization +
5	Not connected
6	Not connected
7	Not connected
8	Not connected
9	Ground
10	Cable detection

2.3.3 Other connectors

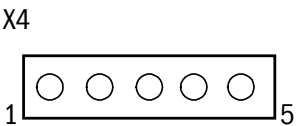
Keyboard connector (X3)

Pin no.	Signal	Notes
1	N/C	Not connected
2	PSWITCH	for zeroing of P5
3	PSWITCH	for zeroing of P6
4	fGND	Floating GND
5	fGND	Floating GND



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	P-	Signal from the sensor
4	1	P+	Signal from the sensor
5	2	fGND	Floating GND



3 SERVICE PROCEDURES

3.1 General service information

Field service of the Dual Pressure Module, M-PP, is limited to replacing faulty circuit boards or mechanical parts. Faulty 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** 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
Patient simulator		
Pressure manometer		
InvBP transducer		
Screwdriver		

- 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.

- Turn the monitor on and wait until the monitoring screen appears. Configure the monitor screen so that all the required parameters are shown, for example:

**Monitor Setup - Screen 1 Setup - Waveform Fields - Field 4 - P5
Field 5 - P6**

3. Plug in the module, M-PP. Check that it goes in smoothly and locks up properly.



- Preset the InvBP measurement settings:

**Invasive Pressures - P5 Setup - Label - P5
P6 Setup - Label - P6**

4. Enter the service menu:

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

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



5. Enter the PP module service menu (according to the module being tested):

Modules - PP

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



6. Check the front panel membrane keys.
Press each of the keys for at least one second. Check that the key being pressed is identified, i.e. the text on the service menu for “Button” changes from OFF to ON.



7. Check that “Cable” and “Probe” show OFF.

Plug the cable from an invasive blood pressure transducer into front panel connector P5. Check that the corresponding “Cable” and “Probe” messages show ON and the correct pressure waveform field appears on the monitor screen.



8. Calibrate the InvBP channels according to the instructions in the Technical Reference Manual.



9. 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 $\mu\text{V/V/mmHg}$

ECG - BASE - BPM - 60

BP - 2 - WAVE - ATM

3 - WAVE - ATM

Connect channel BP2 to connector P5 and channel BP3 to connector P6.

Zero the InvBP channels by pressing the zeroing keys on the module front panel.

BP - 2 - WAVE - CVP

3 - WAVE - PA

Check that appropriate InvBP waveforms are shown and the InvBP values are approximately 15/10 mmHg (± 2 mmHg) for channel P5 and 25/10 (± 2 mmHg) for channel P6.



10. Perform an electrical safety check and a leakage current test.



11. Check that the module functions normally after performing the electrical safety check.



12. Clean the module with suitable detergent.



- Fill in all necessary documents.

3.3 Disassembly and reassembly

Disassemble the Dual Pressure Module, M-PP, 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 remove it from the main body. Be careful with the loose latch and spring locking pin.
3. To detach the PP board, remove the two screws, and disconnect the two ribbon cables from the front panel.

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

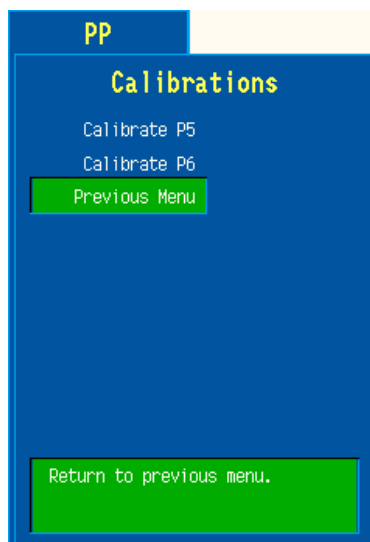
CAUTION When reassembling the module, make sure that all cables are connected properly.

3.4 Adjustments and calibrations

3.4.1 Invasive pressure calibration

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

1. Enter the PP service menu (**Monitor Setup - Install/Service - Service - Parameters**).
2. Enter the Calibrations menu.



3. Connect a pressure transducer with a pressure manometer to the P5/P6 connector. Select Calibrate P5 or Calibrate P6 from the menu. Leave the transducer at 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 the manometer and press the ComWheel. A tolerance of ± 1 mmHg is allowed.
7. The text 'calibrated' will appear on the display.

4 TROUBLESHOOTING

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

4.1 Troubleshooting chart

Trouble	Cause	Treatment
Abnormally low pressure	Transducer wrongly positioned.	Check mid-heart level and reposition transducer.
No pressure	Defective transducer.	Check the transducer.
	No pressure module plugged in.	Check the module.
	No selected waveform 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 P5 / P6 (number field), possibly due to pulsating pressure waveform. Offset is > 150 mmHg. Defective transducer.	Open the transducer to air and zero the channel. Open the transducer to air and zero the channel. Replace the transducer and zero the channel.
Calibration failed-message	Unsuccessful calibration of P5/P6 (number field), possibly due to pulsating waveform Gain is beyond the limits ($\pm 20\%$ of the default gain).	Turn the transducer to sphygmomanometer and try again (zeroing takes place first). Replace the transducer.
Out of range ≤ 40 mmHg	Pressure measurement is beyond measurement range.	Check the transducer level. Zero the channel.
Out of range > 320 mmHg	Pressure measurement is beyond measurement range.	Check the transducer level. Zero the channel. The patient may also have high blood pressure.
Zero adj. > 100 mmHg	Offset when zeroing is > 100 mmHg (but < 150 mmHg) from the absolute zero of the module (with default gain). The waveform may hit the top of the screen and the numeric display not shown.	Check the transducer.
Out of range	Measured pressure is beyond the internal measurement range of the module. The waveform may hit the top of the screen and the numeric display not shown.	Check the transducer and its level. Zero the channel.

4.2 Troubleshooting flowchart

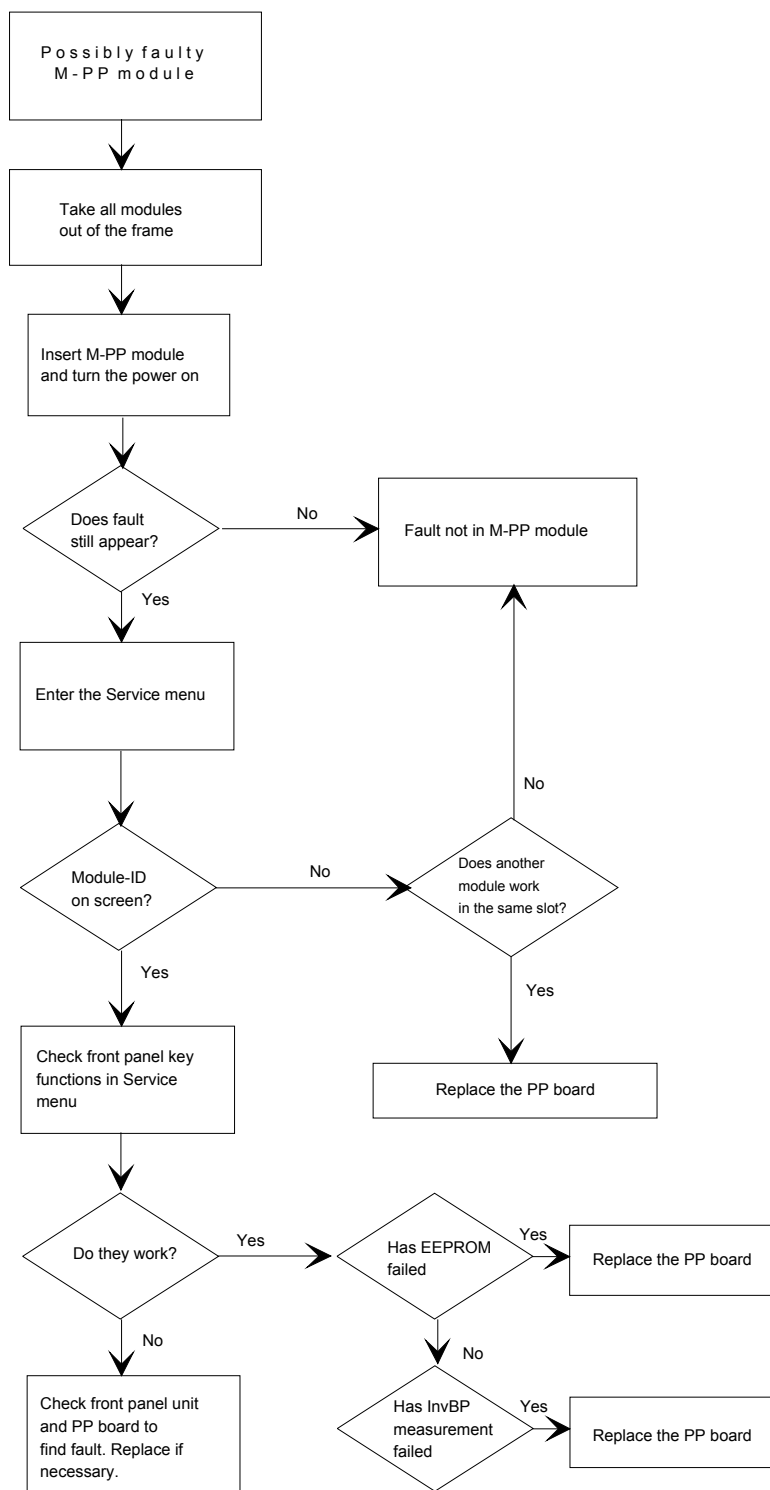
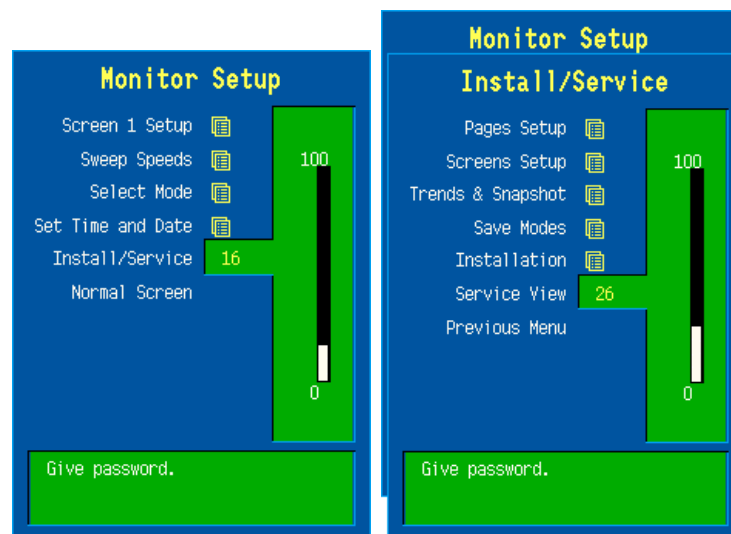


Figure 7 M-PP troubleshooting flowchart

5 SERVICE MENU



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 **PP module**.

5.1 PP menu

PP		Service Data	
Calibrations		P5	P6
Record Data		Gain	0
Previous Menu		Zero	0
		Cable	OFF
		Probe	OFF
		Value	---
		Button	OFF
		Timeouts	0
		Bad checksums	0
		Bad c-s by mod	0
		RAM	OK
		ROM	OK
		EEPROM	OK

Calibrations See section 5.2 “PP Calibrations Menu.”

Record Data **Record Data** prints out the service data and circuit board information (id., serial number, and software id.) on the Recorder Module, M-REC.

Service Data **Gain** is a coefficient to compensate for gain error. Usually the values for P5 and P6 are between 17000 and 25000.

Zero indicates the offset compensation value for each parameter in the A/D converter. Typically the values for P5 and P6 are within ± 1000 . Calibrate if the 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.

Value displays the measured numeric values simultaneously. Pressure value is a real time value and shown in mmHg.

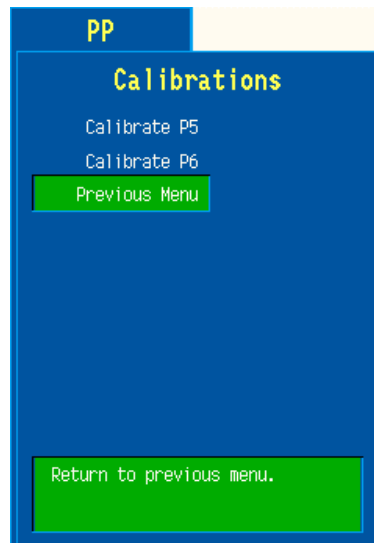
Button; the front panel key function can be confirmed by pressing the key and checking that OFF turns to ON.

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 failed. **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 normal operation indicates either a serial communication failure or the module is not in place.

RAM indicates the state of the RAM memory. **ROM** indicates whether the checksum in the EPROM is in accordance with the software calculated value. **EEPROM** indicates whether 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 PP calibrations menu



Calibrate P5 and Calibrate P6

These functions are for calibrating invasive blood pressure channels P5 and P6. The calibrations require a pressure transducer (with an appropriate cable) and a pressure manometer.

Calibration:

1. Connect the pressure transducer with the pressure manometer to the P5 / P6 connector. Select Calibrate P5 / Calibrate P6. Leave the transducer at room air pressure.
2. Push 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 push the ComWheel.

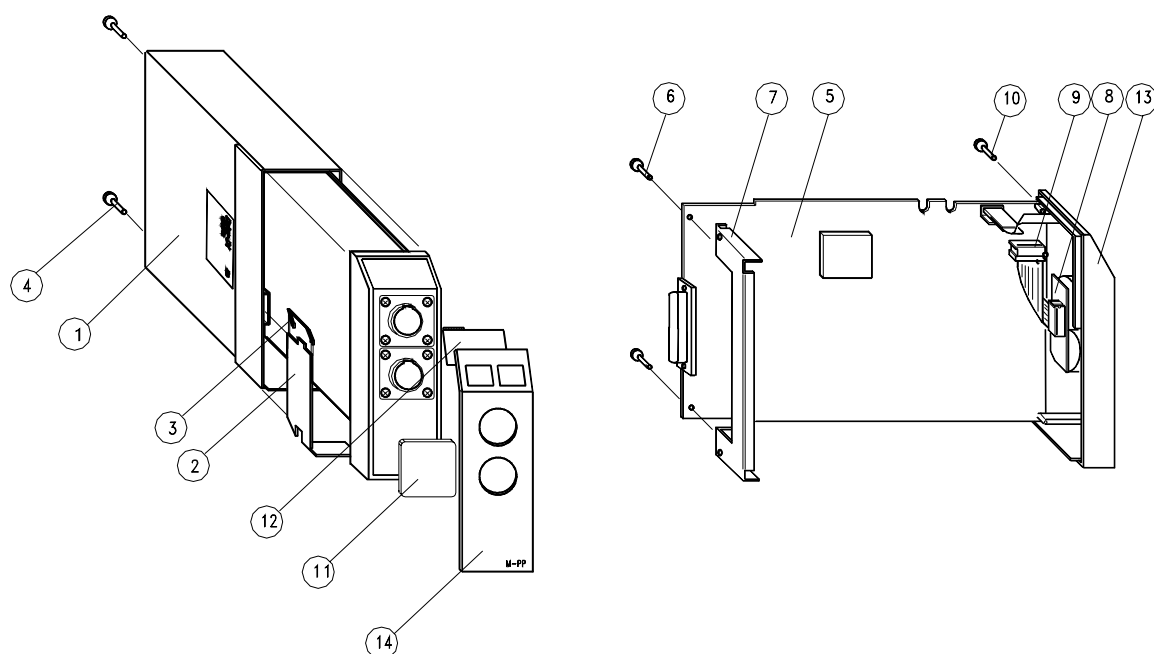
6 SPARE PARTS

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 Dual Pressure Module, M-PP, Rev. 00



Item	Description	Order No.	Item	Description	Order No.
1	Module box (single width)	886167	8	PP input board, M-PP	891308
2	Latch	879181	9	Flat cable	891573
3	Spring pin	879182	10	Cross cylinder-head screw M3×12	628700
4	Cross recess screw M3×8 black	616215	11	Fitting plate	879510
5	PP board, M-PP (Rev. 00)	*8000998	12	Membrane keypad	880101
6	Cross cylinder-head screw M3×6	61721	13	Front panel frame	879094
7	Metal frame	891034	14	Front panel sticker	see 6.1.2

* this part is recommended for stock

6.1.2 Dual Pressure Module, M-PP, Rev. 01

Item	Description	Order No.
5	PP board, M-PP (Rev.-01)	8000998

6.1.3 Front panel stickers for AS/3 modules (square 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

Item no. 14

Adaptation	M-PP (Rev. 00), Order No.
DA	892212
DE	891293
EN	889463
ES	891298
FI	891297
FR	891294
IT	891299
JA	--
NL	891295
NO	893570
PT	895238
SV	891296

6.1.4 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-PP (Rev. 01), Order No.
DA	898756
DE	898747
EN	898746
ES	898750
FI	898753
FR	898748
IT	898751
JA	898757
NL	898749
NO	898755
PT	898746
SV	898754

7 EARLIER REVISIONS

This manual also supports the earlier revisions of the Dual Pressure Module, M-PP

APPENDIX A

SERVICE CHECK FORM

Dual Pressure Module, M-PP

Customer			
Service		Module type	
S/N			
Service engineer		Date	



OK = Test OK



N.A. = Test not applicable



Fail = Test Failed

	OK	N.A.	Fail		OK	N.A.	Fail
1. Internal parts	<input style="width: 30px; height: 20px; border: 1px solid green;" type="checkbox"/>	<input style="width: 30px; height: 20px; border: 1px solid red;" type="checkbox"/>	<input style="width: 30px; height: 20px; border: 1px solid red;" type="checkbox"/>	2. External parts	<input style="width: 30px; height: 20px; border: 1px solid green;" type="checkbox"/>	<input style="width: 30px; height: 20px; border: 1px solid red;" type="checkbox"/>	<input style="width: 30px; height: 20px; border: 1px solid red;" type="checkbox"/>
3. Installation	<input style="width: 30px; height: 20px; border: 1px solid green;" type="checkbox"/>	<input style="width: 30px; height: 20px; border: 1px solid red;" type="checkbox"/>	<input style="width: 30px; height: 20px; border: 1px solid red;" type="checkbox"/>				

4. Module software	pp	
5. Communication and memories	<input style="width: 30px; height: 20px; border: 1px solid green;" type="checkbox"/> <input style="width: 30px; height: 20px; border: 1px solid red;" type="checkbox"/> <input style="width: 30px; height: 20px; border: 1px solid red;" type="checkbox"/>	

6. Membrane keys	<input style="width: 30px; height: 20px; border: 1px solid green;" type="checkbox"/> <input style="width: 30px; height: 20px; border: 1px solid red;" type="checkbox"/> <input style="width: 30px; height: 20px; border: 1px solid red;" type="checkbox"/>	7. Cable and transducer detection	<input style="width: 30px; height: 20px; border: 1px solid green;" type="checkbox"/> <input style="width: 30px; height: 20px; border: 1px solid red;" type="checkbox"/> <input style="width: 30px; height: 20px; border: 1px solid red;" type="checkbox"/>
8. Calibration	<input style="width: 30px; height: 20px; border: 1px solid green;" type="checkbox"/> <input style="width: 30px; height: 20px; border: 1px solid red;" type="checkbox"/> <input style="width: 30px; height: 20px; border: 1px solid red;" type="checkbox"/>	9. Test with patient simulator	<input style="width: 30px; height: 20px; border: 1px solid green;" type="checkbox"/> <input style="width: 30px; height: 20px; border: 1px solid red;" type="checkbox"/> <input style="width: 30px; height: 20px; border: 1px solid red;" type="checkbox"/>

10. Electrical safety check	<input style="width: 30px; height: 20px; border: 1px solid green;" type="checkbox"/> <input style="width: 30px; height: 20px; border: 1px solid red;" type="checkbox"/> <input style="width: 30px; height: 20px; border: 1px solid red;" type="checkbox"/>	11. Functioning after electrical safety check	<input style="width: 30px; height: 20px; border: 1px solid green;" type="checkbox"/> <input style="width: 30px; height: 20px; border: 1px solid red;" type="checkbox"/> <input style="width: 30px; height: 20px; border: 1px solid red;" type="checkbox"/>
12. Final cleaning	<input style="width: 30px; height: 20px; border: 1px solid green;" type="checkbox"/> <input style="width: 30px; height: 20px; border: 1px solid red;" type="checkbox"/> <input style="width: 30px; height: 20px; border: 1px solid red;" type="checkbox"/>		

Notes	
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Used Spare Parts	
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Signature	
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