Dual Pressure Module, E-PP Pressure Temp Module, E-PT

Service Manual

Host software version 3
Module hardware version 00

Dual Pressure Module, E-PP Pressure Temp Module, E-PT
English
2nd edition
2098086–003

Due to continuing product innovation, specifications in this manual are subject to change without notice.

For technical documentation purposes, the abbreviation GE is used for the legal entity names, GE Medical Systems *Information Technologies*, Inc. and GE Healthcare Finland Oy.

Contents

1

About this manual

Intended use of this manual

The list below indicates the compatible products with which this manual is to be used:

- E-PT hardware version 00, serial numbers from 8210177
- E-PP hardware version 00, serial numbers from 8240790

This manual contains instructions for the planned and corrective maintenance of the acquisition module. This manual must be used together with the monitor's service manual for important safety and installation information.

Use the manual as a guide for maintenance procedures and repairs considered field repairable. Where necessary the manual identifies additional sources of relevant information and technical assistance.

See the monitor's service manual for an overview of the patient monitoring system, information needed for system installation and for planned and corrective maintenance of the monitor.

See the monitor's supplemental information manual for the technical specifications, default settings and compatibility information, including electromagnetic compatibility.

See the monitor's user manual for the instructions necessary to operate the device safely in accordance with its function and intended use.

Intended audience of this manual

This manual is intended for service representatives and technical personnel who maintain, troubleshoot, or repair this device.

Manual conventions

This manual uses the following styles to emphasize text or indicate an action. Also note the terminology conventions.

Item	Description
bold	Indicates hardware keys and connectors.
bold italic	Indicates menu options, software keys and messages.
italic	Indicates terms for emphasis.
>	Indicates menu options to select consecutively.

Item	Description
select	The word select means choosing and confirming.
NOTE	Note statements provide application tips or other useful information.

Illustrations and names

This manual uses illustrations as examples only. Illustrations in this manual may not necessarily reflect all system settings, features, configurations, or displayed data.

Names of persons, institutions, and places and related information are fictitious; any similarity to actual persons, entities, or places is purely coincidental.

Related documents

- CARESCAPE monitor's service manual
- CARESCAPE monitor's user manual
- CARESCAPE monitor's supplemental information manual

Product availability

NOTE Due to continual product innovation, design and specifications for these products are subject to change without notice.

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

Trademarks

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Third party trademarks

All third party product and company names are the property of their respective owners.

Manufacturer responsibility

GE is responsible for the effects on safety, reliability, and performance of the equipment only if:

- Assembly operations, extensions, readjustments, modifications, servicing, or repairs are carried out by authorized service personnel.
- The electrical installation of the relevant room complies with the requirements of the appropriate regulations.
- The equipment is used in accordance with the instructions for use.
- The equipment is installed, maintained and serviced in accordance with the instructions provided in the related service manuals.

WARNING SAFETY HAZARD. To avoid risks to personnel and patient, or damage to the equipment, only perform maintenance procedures described in this manual. Unauthorized modifications can lead to safety hazards.

2

Module introduction

Module introduction

This document provides information for the maintenance and service of the Dual Pressure Module, E-PP, and Pressure Temp Module, E-PT.

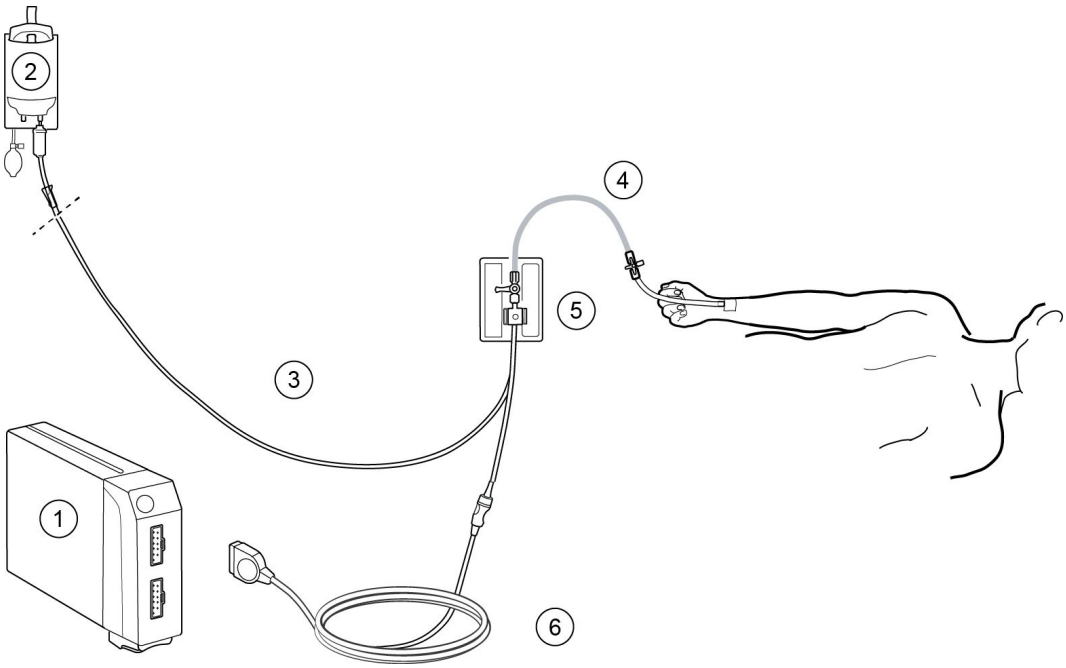
The E-PP and E-PT modules provide the following parameters:

Module	Invasive BP	Temp
E-PP	2	—
E-PT	1	2

Module compatibility

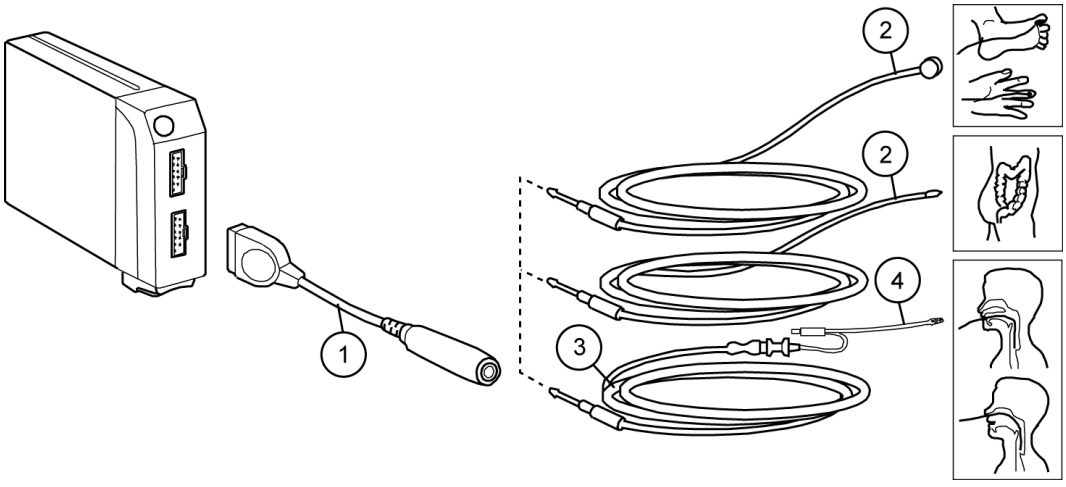
For detailed information regarding module, monitor, and accessory compatibility, see the supplemental information manual.

Invasive pressure equipment to patient connection



1. Module with invasive blood pressure measurement capability
2. Heparinized fluid bag with pressure infusor
3. Flushing set
4. Disposable catheter
5. Transducer
6. Adapter cable for InvBP transducer

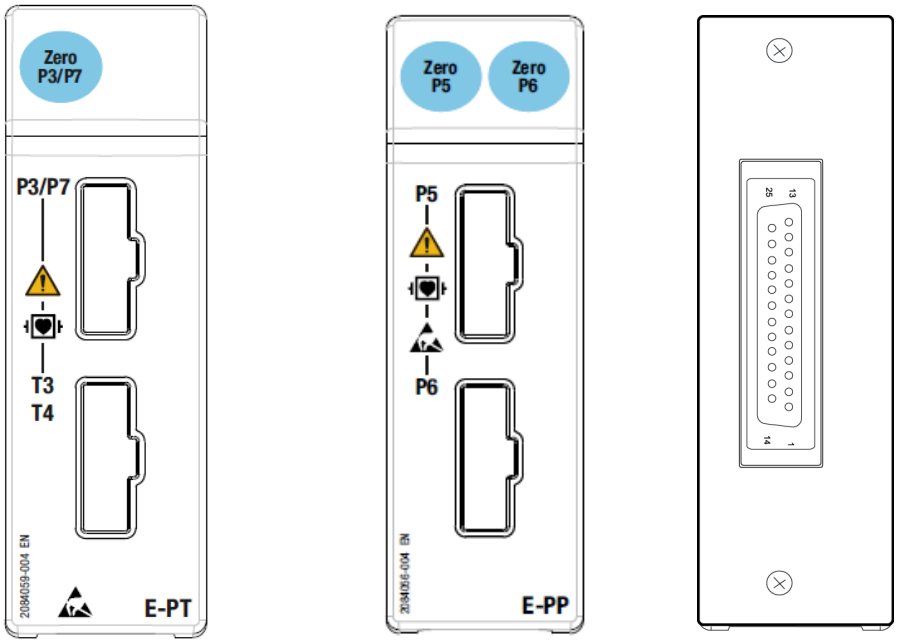
Temperature equipment to patient connection



1. Adapter cable for temperature probes
2. Reusable temperature probe
3. Adapter cable for disposable temperature probe
4. Disposable temperature probe

Controls and connectors of E-PP and E-PT

Front panels of E-PP and E-PT modules, and the back of the module:



Equipment safety symbol

This symbol on the module refers to defibrillator precautions. To ensure protection against the effects of cardiac defibrillator discharge, always use the recommended cables and leadwires only (see the supplemental information manual). Using other cables or leadwires may result in damage to the equipment and compromise patient and/or user safety.

Connector	Module	Description
P3/P7	E-PT	Invasive blood pressure
P5 and P6	E-PP	Invasive blood pressure
T3, T4	E-PT	Temp connector
D25 connector	E-PP, E-PT	Module bus connector

E-PP and E-PT module keys

NOTE The invasive pressure connector in the E-PT module is labelled as P3/P7. However, the monitor software always identifies this invasive pressure port as P7 channel.

Module keys	Module	Description
Zero P3/P7	E-PT	Zero P7
Zero P5	E-PP	Zero P5
Zero P6	E-PP	Zero P6

Measurement principles

Invasive blood pressure measurement principle

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.

Temperature measurement principle

The temperature is measured by a probe whose resistance varies when the temperature changes, called NTC (Negative Temperature Coefficient) resistor.

The module uses the constant current method to measure the resistance. The NTC resistor is connected in series with a normal resistor, and a constant current is applied through the resistors. 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.

Main components of E-PP and E-PT

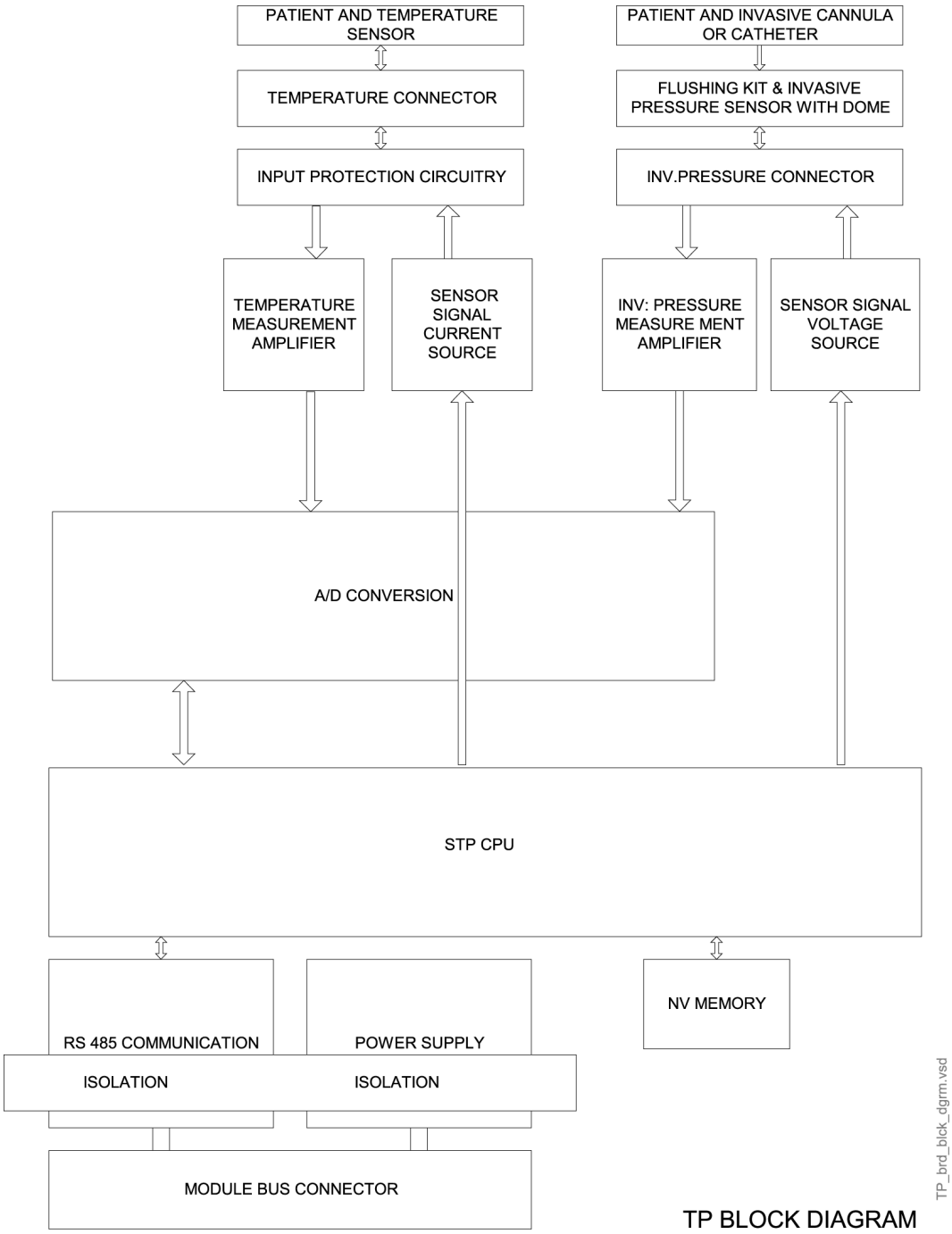
- The E-PP module consists of the following main parts:
  - STP board
  - Connectors for invasive blood pressure sensors; invasive blood pressure channels P5 and P6.
  - Keys for pressure zeroing
- The E-PT module consists of the following main parts:
  - STP board
  - Connector for temperature probes; temperature channels T3 and T4
  - Connector for an invasive blood pressure sensor; invasive blood pressure channel P3/P7
  - Key for pressure zeroing

Communication between the module and the monitor is established through an RS485 serial interface.

The power supply voltages to the module are generated in the power supply section of the monitor's CPU. All electrical connections between the module and the module bus are established via a 25-pin D-type connector at the back of the module.

STP board

The following illustrates the STP board and input connectors block diagram:

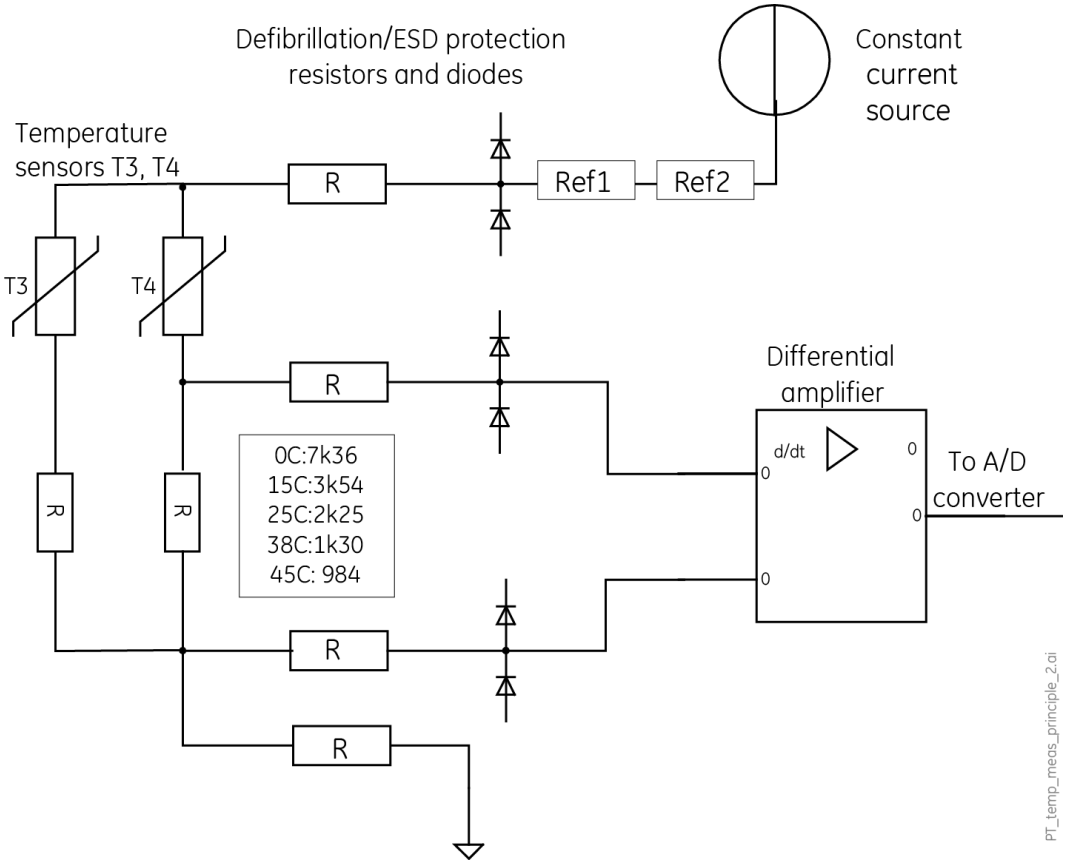


TP BLOCK DIAGRAM

- Microprocessor unit:
  - The CPU is a 16 bit H8/3052 single-chip microcomputer. It contains 512 kbytes of flash memory and 8 kbytes of RAM. The clock frequency is 16 MHz.
  - 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.
  - The constant current source supplies about 38 µA current through the temperature sensor (400 series NTC resistor). The constant current causes

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.

The following diagram illustrates the temperature measurement principle:



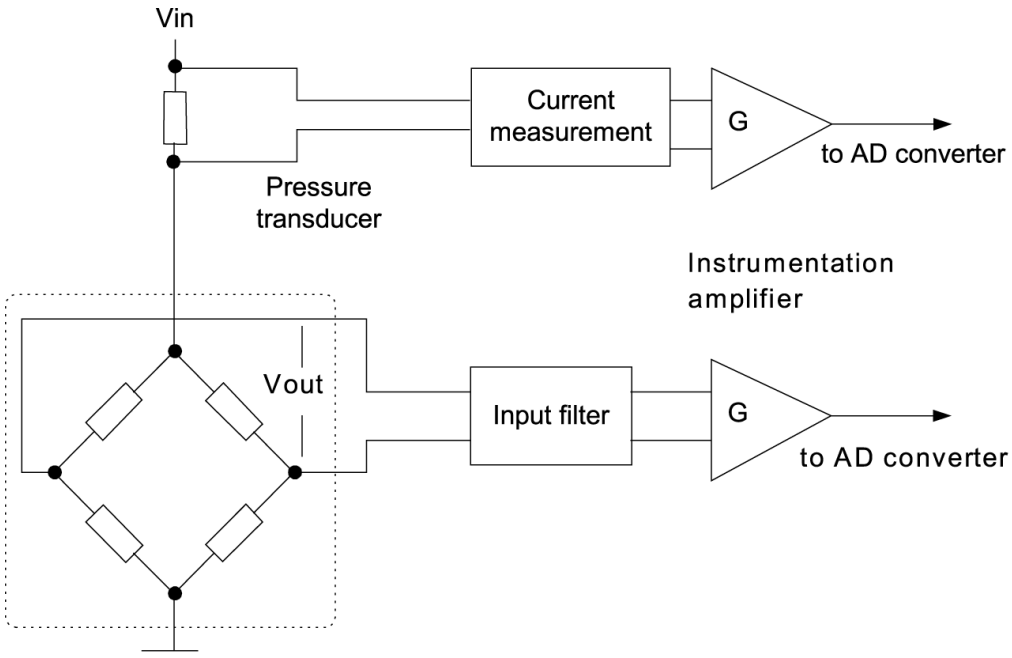
- Invasive blood pressure measurement unit
  - An isolated +5 V voltage is supplied to the pressure transducer. The differential voltage, which depends on the pressure and the supplied voltage, is calculated from the bridge connection (see the formula below).

  $U_{out} = U_{in} \times \text{pressure} \times 5\ \mu V$, where U_{in} is 5 V

  -> $U_{out} = 25\ \mu V \times \text{pressure [mmHg]}$

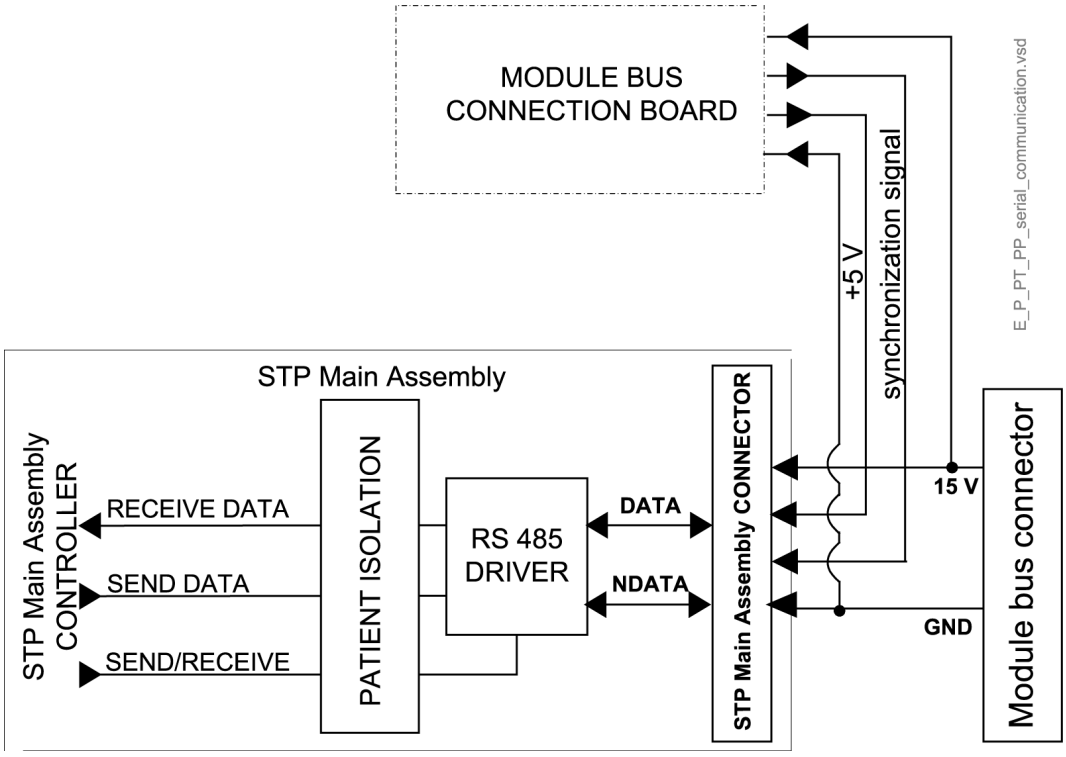
  - Pressure amplification is realized in the instrumentation amplifier. The gain of the amplifier is set to keep the level of the signal transferred to the A/D converter within the measurement range even when there are circumstantial offsets or offsets caused by the transducer. There is a filter before the amplifier to attenuate high frequency disturbances.

  The following diagram illustrates the pressure measurement principle:



- Serial communication
  - An RS485 type bus driver enables the serial communication between the module and the monitor. The data transmission rate is 500 kbps.

  The following diagram illustrates the serial communication of the E-PP and E-PT modules:



- Signals and isolation barrier

  - The communication signals transfer over the isolation barrier by using high voltage opto isolators (5kV).

- Power supply section
  - The module receives only Vmod 14 to 16 V voltage from the module bus. The module bus connection board generates a linearily regulated, non-isolated 5 V voltage and supplies it to the STP board. Vmod voltage is also connected to the STP board through the module bus interface board. The switching power supply on the STP board is synchronized to the frequency of about 340 kHz, which is generated by an oscillator on the module bus connection board.
  - The floating part of the STP board receives power from the switching power supply through a high voltage isolated transformer. The linear regulators on the floating part provide the other voltages for the STP board. PTC-type automatic fuses on the module bus connection board and on the STP board protect the module against overloading.

3

Planned and corrective maintenance

About the maintenance check procedures

This chapter describes the planned and corrective maintenance check procedures for the product. To help ensure the equipment remains in proper operational and functional order and maintains its essential performance and basic safety, follow the corrective and planned maintenance recommendations. The tests that are related to the essential performance and basic safety are marked with the *.

The cleaning precautions, cleaning requirements, cleaning procedures, and recommended cleaning solutions are described in the monitor's user manual.

For details about cleaning, disinfecting and sterilizing the accessories, see the instructions for use in the accessory package.

Record the results of the planned and the corrective maintenance check procedures to the eCheckforms delivered in the electronic manual media.

WARNING SAFETY HAZARD. To avoid risks to personnel and patient, or damage to the equipment, only perform maintenance procedures described in this manual. Unauthorized modifications can lead to safety hazards.

Planned maintenance

WARNING Planned maintenance should be carried out at recommended interval. Failure to implement the recommended maintenance schedule may cause equipment failure and possible health hazards.

Perform the planned maintenance procedure completely every 2 years after installation. Perform the procedure in the following order:

1. Visual inspection
2. Electrical safety tests *
3. Functional check

Corrective maintenance

Perform the following check procedure after any corrective maintenance, before taking the product back into clinical use:

Performed service activity	Required checkout procedure		
	Visual inspection	Electrical safety test	Functional check
Product casing opened either for troubleshooting purpose or for replacing any of the internal parts.	All steps	All steps	All steps
Front cover, or an other external part, replaced.	All steps	Not applicable	Not applicable

Performing visual inspection

1. Remove the module and check that:
   a. The front cover is intact.
   b. All connectors are intact, clean and attached properly.
   c. The module casing and the latch are clean and intact.
   d. The patient cables are clean and intact.

Performing electrical safety tests *

Perform the electrical safety tests described in the monitor's service manual, Checkout procedures chapter. Perform the following tests:

1. Patient (source) leakage current test
2. Patient (sink) leakage current test

Performing functional check

Required tools for E-PP and E-PT functional check

For a list of compatible accessories, see the supplemental information manual.

- A multiparameter patient simulator with adapter cables to temperature and GE invasive blood pressure connectors.
- Dual temperature adapter cable.

Making connections for the functional check

1. Turn on or restart the monitor and wait until the normal screen appears.
2. Ensure that the module is connected to the monitor.

3. Connect the multiparameter patient simulator with its invasive blood pressure adapter cable to the red invasive pressure connector in the module.

   With E-PP module, connect and test P5 and P6 invasive blood pressure channels one at a time.

   The invasive blood pressure connector in the E-PT module is labelled as a P3/P7. The monitor software always identifies this invasive blood pressure port as a P7 channel.

4. Connect the temperature cables:

   a. Connect the dual temperature adapter cable to the brown temperature connector in the module and check that it is configured for 400 series probes.

   b. Connect the multiparameter patient simulator with its temperature adapter cables to the dual temperature adapter cable.

Module	Invasive pressure channel	Temperature channel
E-PT	P3 / P7	T3 and T4
E-PP	P5 and P6	-

Configuring monitor for E-PP and E-PT modules functional check

1. Configure the invasive pressure measurement:

   a. Select the tested invasive pressure channels to the waveform fields with adequate priority.

   b. In the ***Invasive Pressures*** menu select the tested IP channel tab and configure:

   - ***Label***: Px
   - ***Scale mmHg***: 0-250 mmHg
   - ***Display Format***: Sys/Dia (Mean)

   The 'x' in the Px refers to the invasive pressure channels being tested.

2. Configure the temperature measurement:

   a. Select T3 and T4 parameters to the screen with adequate priority.

   b. In the ***Temperatures*** menu select the ***T3, T4*** tab and configure:

   - ***T3 measurement***: On
   - ***T4 measurement***: On

Configuring simulator for the functional check of E-PP and E-PT modules

For instructions on how to use and configure the simulators, refer to the simulators' documentation.

1. Configure the invasive pressure channels as follows:

   - ***Sensitivity***: 5 µV/V/mmHg
   - ***InvBP output***: 0 mmHg static pressure or atmosphere

2. Configure the temperature channels as follows:
   - ***Temperature***: 37°C

Testing invasive pressure measurement *

Check the functionality of the measurement with a patient simulator.

Perform the following steps to all invasive pressure channels in the module.

1. Zero the tested pressure channel:
   a. Ensure that the simulator's invasive pressure output channel is configured to 0 mmHg static.
   b. Zero the tested invasive pressure channel by pressing the related Zero key on the module.
   c. Check that a ***Zeroing*** message followed by a ***Zeroed*** message is shown in the related parameter window.
2. Test a static pressure:
   a. Configure the simulator's invasive pressure output channel to 200 mmHg static pressure.
   b. Check that a flat pressure line appears on the related waveform field.
   c. Check that the reading in the parameter window is 200 ± 10 mmHg.
   - If the measured value is not within the specification limits, recalibrate the measurement.
3. Check the pressure waveform:
   a. Configure the simulator's invasive pressure output channel to Arterial 120/80.
   b. Check that the pressure waveform for the tested invasive pressure channel appears in the waveform window.
   c. Check that the Sys/Dia (Mean) pressure values are shown in the related parameter window.

Testing temperature measurement *

Check the functionality of the measurement with a patient simulator.

Perform the following steps to both the temperature channels in the module.

NOTE The 'x' in the Tx refers to the temperature channel being tested.

1. Check that:
   a. Tx temperature matches the configured simulator value chosen earlier ± 0.1 °C/ ± 0.2 °F.
   b. There are no error messages on the screen.

Completing the functional check

1. Select ***Discharge Patient*** or ***Reset Case*** to discard any changes made to the monitor configuration during the functional check.
2. Disconnect the test setup.

4

Configuration and calibration

Configuration

P/PT/PP settings

The E-PP and E-PT modules include the STP board and software. The PT/PP setting defines the parameter set the module is capable of measuring. This setting is stored into the permanent memory of the module.

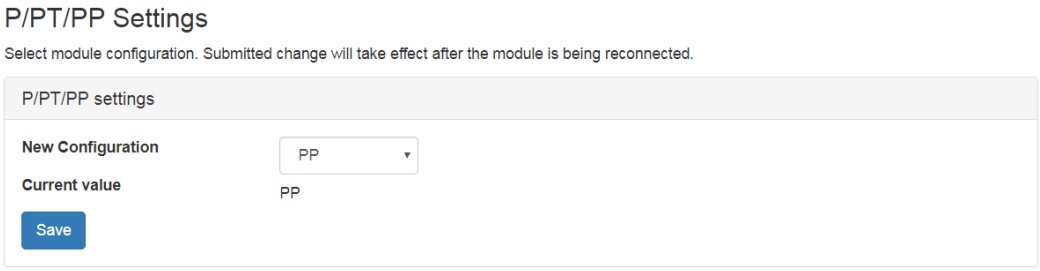
The PT/PP setting should be always checked and, if necessary, reconfigured after the STP board has been replaced.

Configuring E-PP and E-PT settings

1. Disconnect any other E-PP, E-PT or E-P module from the monitor, except the one you are configuring.

   NOTE The P/PT/PP setting can be configured only for one module at a time. Presence of several modules may cause the configuration to fail.

2. Log in to the service interface.
3. Select the ***Configuration*** tab.
4. Select ***Modules*** and scroll down to the ***P/PT/PP Settings***.



5. Check the current configuration for the PP/PT modules. If the current configuration is incorrect, proceed to the next step and reconfigure it. Otherwise, leave the P/PT/PP Settings menu without changes.

6. Select the correct ***New Configuration*** from the drop-down menu according to the following table.

Module	New Configuration
E-PP	PP
E-PT	PT

7. Select ***Save***.

   The change will take effect when the module is reconnected.

Calibration and adjustments

Invasive pressure calibration

Invasive pressure calibration shall be performed:

- whenever the pressure transducer in use is replaced with a new type of transducer
- if the invasive pressure calibration check failed
- if the measured value is not within the specification limits.

Required tools

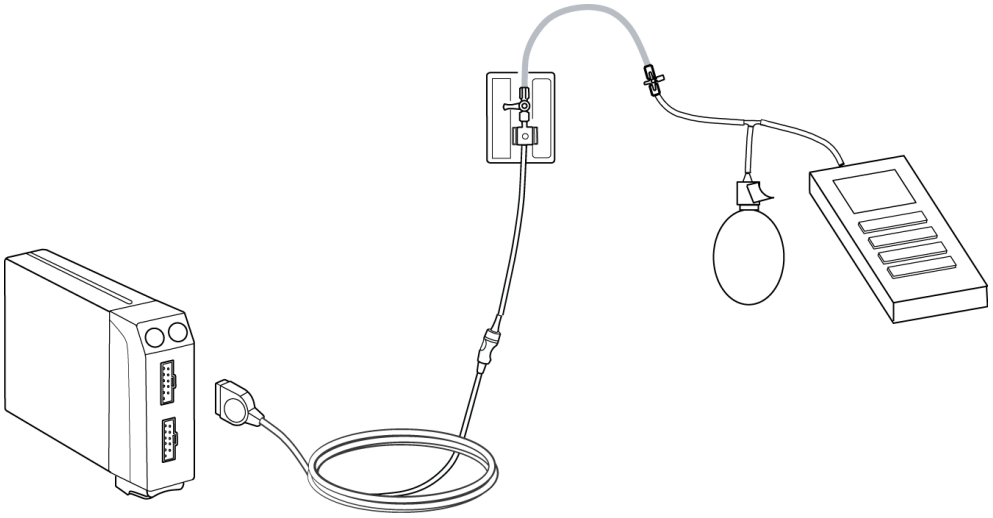
- Pressure manometer with a pressure pump
- Transducer adapter cable
- Invasive pressure transducer

NOTE See the supplemental information manual for compatible accessories.

NOTE The pressure transducer is a key component in the measurement setup. If possible, perform the invasive pressure calibration with the same type of pressure transducer that is used in daily clinical use.

NOTE Use only accurate, properly maintained, calibrated, and traceable calibration tools for the parameter calibration to ensure measurement accuracy.

Making connections



1. Ensure that the module is connected to the monitor.
2. Connect the transducer adapter cable to the red Inv BP connector in the module.
3. Connect the invasive pressure transducer to the transducer adapter cable.
4. Connect the pressure manometer with a pressure pump to the transducer's pressure line with a piece of tubing.

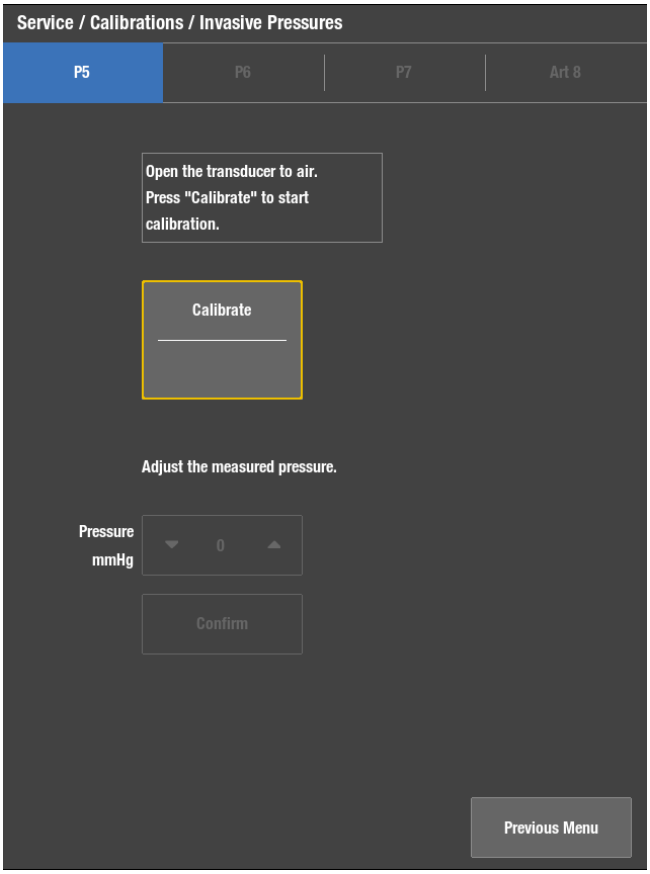
Calibrating invasive pressure

1. Select ***Monitor Setup*** > ***Defaults & Service*** > ***Service Calibrations***.
2. Enter the User Name and the Password and press ***Enter*** to get into the Calibrations menu.
3. Select ***Invasive Pressures***.

4. Select the tab of the invasive pressure channel you want to calibrate.

Module	Inv BP channel
E-PP	P5 or P6
E-PT	P3 / P7

NOTE The invasive pressure connector in the E-PT module is labelled as P3/P7. However, the monitor software always identifies this invasive pressure port as P7 channel.



5. Prepare the transducer for the zeroing by opening the dome stopcock to room air.
6. Select ***Calibrate***.
7. The monitor will start automatic zeroing of the invasive pressure channel. Wait until the message ***Zeroing*** is replaced by the message ***Zero Ok***.
8. Pump a 200 mmHg ± 100 mmHg static pressure with the pressure pump when the message ***Create 200 mmHg pressure*** is shown. The pressure measured by the module is updated in real-time to the calibration menu.
9. When the pressure is stabilized, check the pressure reading from the manometer.
10. Use the up-down spinner control in the calibration menu to adjust the reading measured by the module to match with the manometer reading. Select ***Confirm*** to complete the calibration when the two readings match each other.
11. Wait until the message ***Calibrated*** is shown.

Repeat the above procedure, steps 4 through 11, for the other invasive pressure channel in the module.

NOTE The ***Zero Failure*** message is shown if the zeroing fails.

NOTE The ***Calibration Error*** message is shown, if you do not start inflating the pressure within 45 seconds after the automatic zeroing is completed, or if the calibration fails.

Temperature calibration

Temperature calibration shall be performed:

- if the temperature calibration check failed.
- if the measured value is not within the specification limits.

Required tools

- P/N 884515-HEL Temperature calibration plugs
- Dual temperature adapter cable

NOTE Use only accurate, properly maintained, calibrated and traceable calibration tools for the parameter calibration to ensure measurement accuracy.

NOTE See the CARESCAPE monitor supplemental information manual for compatible accessories.

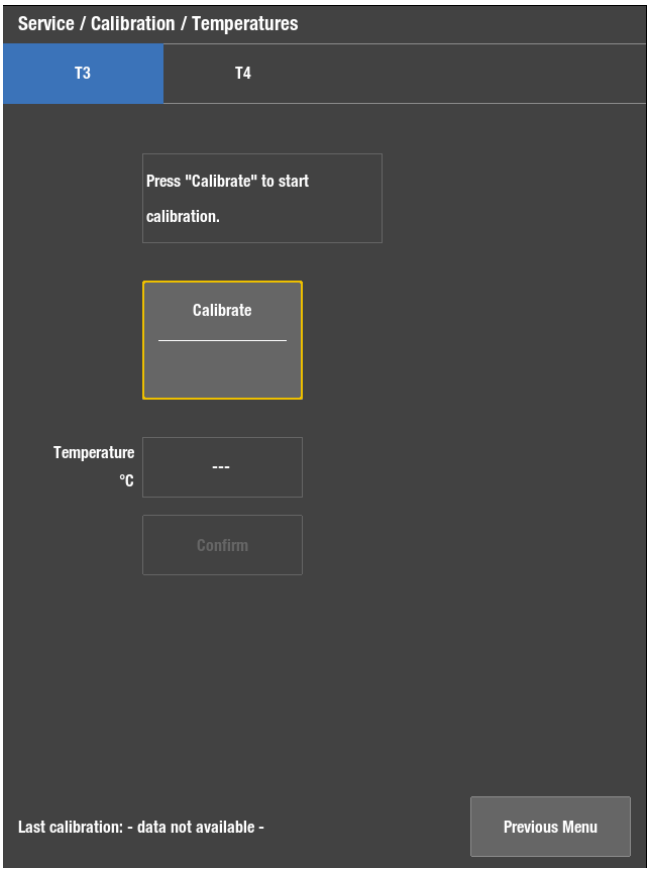
Making connections

1. Ensure that the module is connected to the monitor.
2. Connect the dual temperature adapter cable to the brown temperature connector in the module.
3. Check that the dual temperature adapter cable is configured for 400 series probes.

Calibrating temperature

1. Select ***Monitor Setup*** > ***Defaults & Service*** > ***Service Calibrations***.
2. Enter the User Name and the Password and press ***Enter*** to get into the Calibrations menu.
3. Select ***Temperatures***.

4. Select the tab for the temperature channel, ***T3*** or ***T4***, you want to calibrate.



5. Select ***Calibrate*** to start the calibration procedure.
6. Wait until the message ***Plug in 25 °C*** is shown. Plug in the temperature calibration plug labelled with TEMP 25°C/77°F to the dual temperature adapter cable connector T1 (=temperature channel T3) or T2 (=temperature channel T4).
7. Wait until the value is shown in the ***Temperature °C*** field and select ***Confirm***.
8. Wait until the message ***Now plug in 45 °C*** is shown. Plug in the temperature calibration plug labelled with TEMP 45°C/113°F to the dual temperature adapter cable connector T1 (=temperature channel T3) or T2 (=temperature channel T4).
9. Wait until the value is shown in the ***Temperature °C*** field and select ***Confirm***.
10. Wait until the message ***Calibrated*** is shown.

Repeat the above procedure, steps 3 through 10, for the other temperature channel in the module.

NOTE If calibration is not proceeding within 30 seconds, the calibration is stopped automatically.

5

Troubleshooting

Troubleshooting guidelines

This chapter focuses on troubleshooting technical problems. Refer to the user manual for troubleshooting monitoring problems and clinical configuration issues.

If a problem remains, contact technical support for service. To ensure accurate problem solving, please be prepared to provide the following information:

- Product name and serial number or UDI
- Hardware and software versions
- Detailed problem description
- Error messages, if any
- Configuration information (or settings file)
- Service Logs
- The troubleshooting you have done so far

Perform the specified corrective maintenance check after any corrective maintenance to the product.

Performing visual inspection

Before any detailed troubleshooting, complete a thorough visual inspection for the module.

1. Remove the module and check that:
   a. The front cover is intact.
   b. All the connectors are intact, clean, and attached properly.
   c. The module casing and the latch are clean and intact.
   d. The patient cables are clean and intact.
2. If you suspect that there are loose parts or cable connections inside the module, remove the two screws from the back of the module to detach the module box, and check that:
   a. All the screws are tightened properly.
   b. All the cables are connected properly.
   c. There are no loose objects inside the module.

Troubleshooting module functionality

Follow these instructions to identify the unit causing the functional problem.

Before you begin, ensure that the monitor is turned on, and all the modules are connected.

1. Check if there are any error messages shown in the message field.

   For a list of possible causes and solutions, see Messages related to the measurement.

2. Check the compatibility of each system component.

   For a list of the compatible monitors, modules, and accessories, see the supplemental information manual.

3. Check that there are no identical modules connected to the monitor.

   For a list of identical modules, see the supplemental information manual.

4. Visually check the accessories in use. Replace them, if necessary.

   For a list of compatible accessories, see the supplemental information manual.

5. Connect the accessories with a simulator to the module. Check that the parameters measured by the module are configured to the display with adequate priority.

6. Press one of the module keys.

7. Check that the correct menu opens or the activity starts. If nothing happens, check if there is a loose keypad cable or other problem in the module.

Viewing device information

To view the hardware, software and configuration information of the monitor, modules and/or connected devices:

1. Ensure that the module is connected to the monitor.
2. Log in to the service interface.
3. Select ***Information***.
4. Select an item on the side navigation menu or scroll down the page to view the information.

Service log files

The monitor collects information about different system events, errors and alarms to log files to help troubleshoot equipment problems. The following service logs may contain related useful information:

- ***System Logs*** records different system events, messages, clinical alarms, user interactions and internal communication events.
- ***EMBC Logs*** records module communication events and errors for E-series acquisition modules.

Viewing log files

1. Log in to the service interface.

2. Select ***Diagnostics*** > ***View Logs***.
3. Select the log you want to view. The contents of the selected log file are shown on the screen.

Downloading log files

For security reasons, the contents of the log file(s) will be encrypted with a user-selectable password before the download. Provide the password in a secure way only for the authorized receiver of the log file. Use 7-Zip open-source file archiver (http://7-zip.org/) and the password to decrypt the downloaded log file.

1. Log in to the service interface.
2. Select ***Diagnostics*** > ***Download Logs***.
3. Select the log(s) you want to download.
4. Provide a password to encrypt the contents of the log file. This password is user-selectable.
5. Depending on your access to the service interface:
   a. If you are using a service PC, you can save the log file to any storage device connected to the service PC.
      i. Select ***Download***.
      ii. Save the log file according to the instructions provided by the web browser.

      The steps to download the log file to a service PC depend on the web browser used. The web browser may also notify you about security issues. Refer to the web browser documentation for details.
   b. If you are using the local, integrated service interface, you can save the log file to a USB flash drive that is connected to one of the monitor's USB ports:
      i. Select ***Save to USB storage*** to save the log file to the USB flash drive.

      The log file is saved always to the root directory of the USB flash drive.

      NOTE Do not disconnect the USB flash drive until downloading is complete.
6. Send the log file and the password in a secure way to GE Service for further investigation.

Messages related to invasive pressures measurement

For information regarding alarm priorities and escalation times, see the supplemental information provided.

Make sure you are familiar with the generic layout of the screen. This will help you identify where on screen the following messages appear. The message location is indicated with the following abbreviations:

- al. area = alarm area
- param. = parameter window
- wavef. = waveform area

Message	Location	Possible causes	Suggested actions
• ***> 320 mmHg*** or ***> 43 kPa*** • ***P5 over range*** to ***P8 over range***	• param.	Measurement is over range, or the sensor or cable is faulty. If you pre-zero a line with the stopcock closed, it creates a high fluid bag pressure and triggers this message. In this case, you can acknowledge the alarm with the pause audio key. Transducer is not zeroed correctly.	• Check the cable and connections. • Rezero the transducer. • Replace the sensor. • Replace the transducer. • Replace the module. • Zero the invasive pressure channel.
• ***< -40 mmHg*** or ***< -5 kPa*** • ***P5under range*** to ***P8under range***	• param.	Measurement is under range, or the sensor or cable is faulty. Transducer is not zeroed correctly.	• Check the cable and connections. • Rezero the transducer. • Replace the sensor. • Replace the transducer. • Replace the module. • Zero the invasive pressure channel.
• ***Art*** 1 ***disconnect*** to ***Art*** 8 ***disconnect*** • ***Disconnected***	• al. area • param.	No arterial invasive pressure is detected.	• Check connections. • If pressure drops because of zeroing, perform the zeroing process.
• ***Calibrated***	• param.	Channel calibrated successfully.	• Wait until the message disappears (after 10 seconds) before starting a measurement. • No action required.
• ***Calibrating***	• param.	Calibration of a channel is in progress.	• No action required.
• ***Calibration error***	• param.	Pressure calibration failure due to time-out. Pulsating waveform detected during calibration. Gain is beyond the limits (± 20% of the default gain).	• Re-calibrate. Start inflating the pressure within 45 seconds after the automatic zeroing is completed. • Check the manometer reading to ensure that a static 100-300 mmHg pressure is present for calibration. • Replace the transducer and re-calibrate.
• ***Fem*** 1 ***disconnect*** to ***Fem*** 8 ***disconnect*** • ***Disconnected***	• al. area • param.	No arterial invasive pressure is detected.	• Check connections. • If pressure drops because of zeroing, perform the zeroing process.
• ***Identical PP modules***	• al. area	There are two or more E-PP modules in the system.	• Remove all but one E-PP module.

Message	Location	Possible causes	Suggested actions
• ***Identical PT modules***	• al. area	There are two or more E-PT modules in the system.	• Remove all but one E-PT module.
• ***IP's not zeroed*** • ***P***X ***not zeroed***, where X = invasive pressure channel number 1 to 8.	• al. area • param.	There is at least one invasive pressure channel that has not been zeroed.	• Perform zeroing for all channels.
• ***P5 over range*** to ***P8 over range*** • ***> 320 mmHg*** or ***> 43 kPa*** • ***P5 under range*** to ***P8 under range*** • ***< -40 mmHg*** or ***< -5 kPa***	• al. area	The measurement value is over or under range, or the sensor is faulty. Transducer is not zeroed correctly.	• Check the cables. • Rezero the transducer. • Replace the sensor. • Replace the transducer. • Replace the module. • Zero the invasive pressure channel.
• ***P1 standby*** to ***P8 standby***	• param.	The IP channel has been set to standby.	• Reactivate the channel by selecting ***Activate P1*** to ***Activate P8***.
• ***P1 zeroing failed*** to • ***P8 zeroing failed***	• param.	Defective transducer. Offset is >150 mmHg.	• Open the transducer to room air and zero the channel. • Replace the transducer, open it to room air, and zero the channel.
• ***Pressure measurement removed***	• al. area	The acquisition device has been removed.	• Reconnect if necessary.
• ***Pressure Sensed***	• param.	Pressure pulsation has been sensed during zeroing.	• Open the venting stopcock to air. • Re-zero.
• ***Sensor*** • [Invasive pressure channel label] X ***sensor disconnected***, where [Invasive pressure channel label] = ***Art***, ***CPP***, ***CVP***, ***Fem***, ***FemV***, ***ICP***, ***LAP***, ***P***, ***RAP***, ***RVP***, ***UAC***, or ***UVC***, and X = invasive pressure channel number 1 to 8.	• param. • al. area	• The transducer detected a disconnection or the cable is disconnected from the module.	• Check connections. • Acknowledge the alarm if you are intentionally disconnecting the invasive pressure line.
• ***UAC*** 1 ***disconnect*** to ***UAC*** 4 ***disconnect*** • ***Disconnected***	• al. area • param.	Invasive pressure line is disconnected.	• Check connections. • If pressure drops because of zeroing, perform the zeroing process.

Message	Location	Possible causes	Suggested actions
• ***Zero adj >100 mmHg***	• param.	Offset during zeroing has exceeded 100 mmHg.	• Repeat the transducer zeroing. • Replace the sensor. • Replace the transducer. • Replace the module. • Check transducer. Re-zero the pressure channel.
• ***Zeroed***	• param.	Zeroing was successful.	• No action required. Message is automatically removed after 10 seconds.
• ***Zeroing***	• param.	IP channel is currently being zeroed.	• No action required. Message is automatically removed and replaced with the zeroing results after completion.
• ***Zero ICP separately***	• al. area	The ICP channel must be zeroed separately from all other invasive pressures.	• Zero the channel using the ***Zero*** option found under the ICP channel setup menu.

Messages related to temperature measurement

For information regarding alarm priorities and escalation times, see the supplemental information provided.

Make sure you are familiar with the generic layout of the screen. This will help you identify where on screen the following messages appear. The message location is indicated with the following abbreviations:

- al. area = alarm area
- param. = parameter window
- wavef. = waveform area

Message	Location	Possible causes	Suggested actions
• ***Performing temp test***	• param.	Module is calibrating.	• Wait until the self-check is completed. • Check that no error messages appear.
• ***T3 temperature error*** / ***T4 temperature error*** / ***Temperature error***	• al. area, param.	Calibration error. Hardware failure.	• Perform calibration. • Check that the front panel connectors are properly connected to the STP board. • Replace the STP board.
• ***Temp measurement removed***	• al. area	Acquisition module or temperature cable has been removed. Active temperature channel becomes inactive.	• Check all connections and reconnect as required.

Troubleshooting invasive pressure measurement

Problem	Possible causes	Recommended actions
Abnormally low pressure.	Transducer wrongly positioned.	Check mid-heart level and reposition transducer.
No pressure.	Defective transducer.	Check or replace transducer.
	Module not connected.	Connect module.
	Transducer adapter cable not connected to the module.	Connect the transducer adapter cable with the transducer to the module.
	Invasive pressure channel not configured to the screen (with adequate priority).	Configure the invasive pressure channel to the screen with adequate priority and check that it is active.
	Invasive pressure channel not zeroed.	Zero the invasive pressure channel.

Troubleshooting temperature measurement

Problem	Possible causes	Recommended actions
No temperature displayed.	Temperature channel not configured to the screen (with adequate priority).	Configure the temperature channel to the screen with adequate priority and check that it is active.
	Incompatible temperature probe.	Use correct probe (400 series).
	The STP setting incorrect.	Check the STP setting and configure it, if needed.
	Faulty temperature probe.	Replace temperature probe.
	Temperature out of measurable range.	The measurement range is between 10 to 45°C (50 to 113°F).

6

Disassembly and reassembly

Disassembly guidelines

Field repair of the device is limited to replacing field replaceable units (FRUs).

NOTE Only qualified service personnel should perform field replacement procedures.

NOTE Perform the specified corrective maintenance check after any corrective maintenance to the product.

ESD precautions

All external connectors of the device are designed with protection from ESD damage. However, if the device requires service, exposed components and assemblies inside are susceptible to ESD damage. This includes human hands, non-ESD protected work stations or improperly grounded test equipment. The following guidelines may not guarantee a 100% static-free workstation, but can greatly reduce the potential for failure of any electronic assemblies being serviced:

- Discharge any static charge you may have built up before handling semiconductors or assemblies containing semiconductors.
- Wear a grounded, antistatic wristband or heel strap at all times while handling or repairing assemblies containing semiconductors.
- Use properly grounded test equipment.
- Use a static-free work surface while handling or working on assemblies containing semiconductors.
- Do not remove semiconductors or assemblies containing semiconductors from antistatic containers until absolutely necessary.
- Do not slide semiconductors or electrical/electronic assemblies across any surface.
- Do not touch semiconductor leads unless absolutely necessary.
- Store the semiconductors and electronic assemblies only in antistatic bags or boxes.
- Handle all PCB assemblies by their edges.
- Do not flex or twist a circuit board.

Before disassembly

- Note the positions of any wires or cables. Mark them if necessary to ensure that they are re-assembled correctly.
- Save and set aside all hardware for reassembly.

Required tools

- Torx screwdriver, T10
- Flat blade screwdriver
- Antistatic wristband

Disassembly procedures

For reference, see the exploded view in Service parts chapter.

Detaching the front cover

1. Detach the front cover of the module by releasing the snaps that hold the front cover to the front chassis unit by using a small flat blade screwdriver. There are 2 snaps on both sides of the module and 1 snap on the top.

Detaching the STP board

1. Remove the two screws (T10) from the back of the module.
2. While pressing the release latch, pull the module casing slowly backwards and remove it from the main body.
3. Detach the 4 nylon screws with washers that secure the STP board to the body plate.
4. Disconnect the front panel connector cable and the module bus connector from the STP board.
5. Detach the STP board.

Detaching the module bus connector board

Detach the STP board before completing the following steps.

1. Detach the four screws (T10) that secure the module bus connection board to the body plate.
2. Disconnect the module bus connection board from the STP board.
3. Detach the module bus connection board.

Reassembling the module

1. Reassemble in reverse order. Make sure that you:
   a. Tighten all the screws properly.
   b. Connect all the cables properly.
   c. Check that the front panel connector flex cable is properly installed, see the figure for details. Plug the end marked with STP to the STP board, and the end marked with INPUT to the front panel, text side up.

   d. Check that there are no loose objects inside the module.

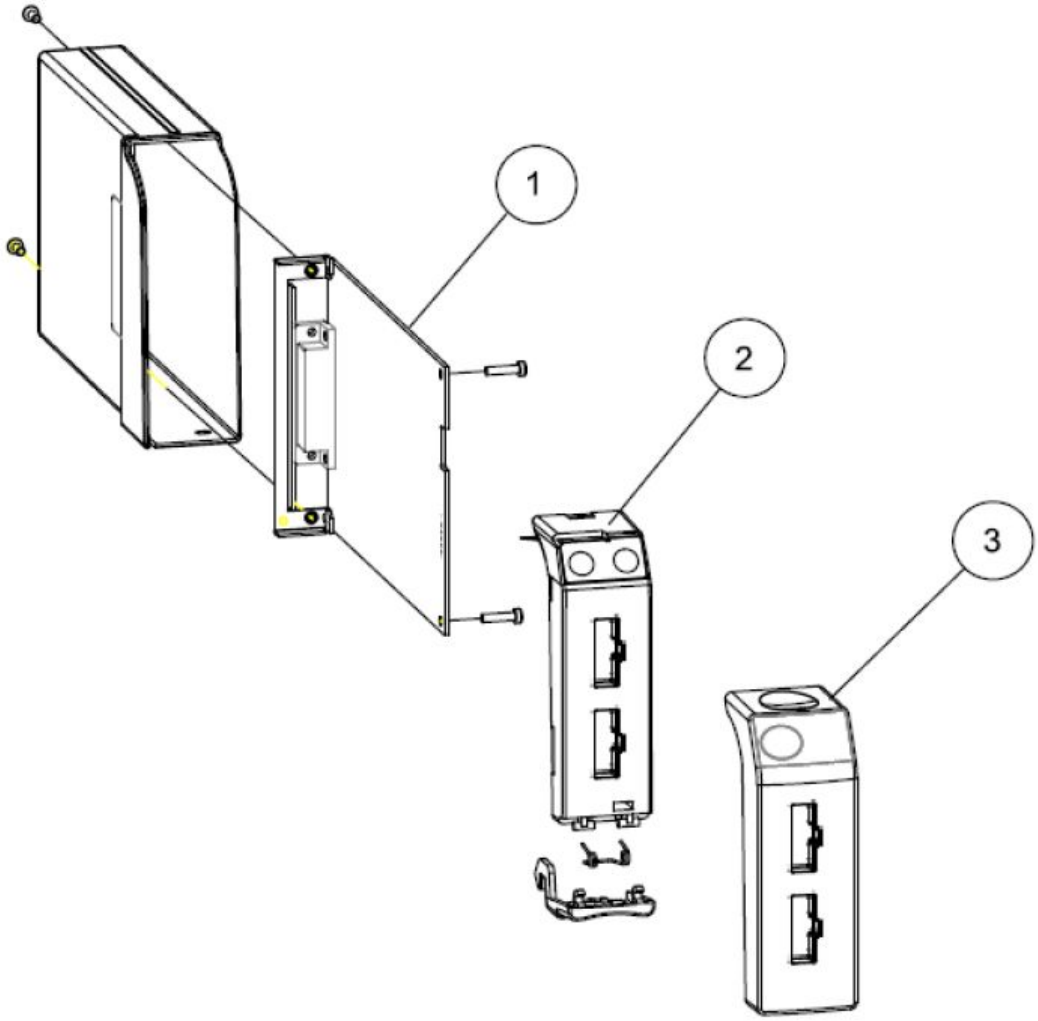
7

Service parts

Ordering parts

To order parts, contact your local GE representative. Contact information is available at www.gehealthcare.com. Make sure you have all necessary information at hand.

Exploded view of Pressure and Pressure Temperature Modules E-PP and E-PT



List of FRUs for E-PP and E-PT

Item	Part Description	Order No.
1	FRU, STP MAIN BOARD FOR E-PP • Measurement Board • Input Flex cable • Metal Frame • 2 mounting screws	2094253–001
1	FRU, STP MAIN BOARD FOR E-PT • Measurement Board • Input Flex cable • Metal Frame • 2 mounting screws	2093794–001
2	FRU, FRONT CHASSIS UNIT, E-PP • Membrane Keyboard • Connector Unit • Latch • Torsion Spring	2094254–001
2	FRU, FRONT CHASSIS UNIT, E-PT • Input Flex cable • Membrane Keyboard • Connector Unit • Latch • Torsion Spring	2093795–001
	E-Modules, Hardware Kit, FRU • 2 mounting screws for Metal Frame • 2 mounting screws for Interface Board • 2 mounting screws for Module Casing • Latch • Torsion Spring • Membrane Keyboard	M1206392

List of front covers for E-PP, E-PT

Item	Part Description	Order No.
3	FRU, FRONT COVER, DANISH, E-PP	2085617-001
3	FRU, FRONT COVER, GERMAN, E-PP	2085617-002
3	FRU, FRONT COVER, ENGLISH, E-PP	2085617-003

Item	Part Description	Order No.
3	FRU, FRONT COVER, SPANISH, E-PP	2085617-004
3	FRU, FRONT COVER, FINNISH, E-PP	2085617-005
3	FRU, FRONT COVER, FRENCH, E-PP	2085617-006
3	FRU, FRONT COVER, ITALIAN, E-PP	2085617-007
3	FRU, FRONT COVER, JAPANESE, E-PP	2085617-008
3	FRU, FRONT COVER, DUTCH, E-PP	2085617-009
3	FRU, FRONT COVER, NORWEGIAN, E-PP	2085617-010
3	FRU, FRONT COVER, POLISH, E-PP	2085617-011
3	FRU, FRONT COVER, PORTUGUESE, E-PP	2085617-012
3	FRU, FRONT COVER, SWEDISH, E-PP	2085617-013
3	FRU, FRONT COVER, HUNGARY, E-PP	2085617-014
3	FRU, FRONT COVER, CZECH, E-PP	2085617-015
3	FRU, FRONT COVER, CHINESE, E-PP	2085617-016
3	FRU, FRONT COVER, DANISH, E-PT	2086271-001
3	FRU, FRONT COVER, GERMAN, E-PT	2086271-002
3	FRU, FRONT COVER, ENGLISH, E-PT	2086271-003
3	FRU, FRONT COVER, SPANISH, E-PT	2086271-004
3	FRU, FRONT COVER, FINNISH, E-PT	2086271-005
3	FRU, FRONT COVER, FRENCH, E-PT	2086271-006
3	FRU, FRONT COVER, ITALIAN, E-PT	2086271-007
3	FRU, FRONT COVER, JAPANESE, E-PT	2086271-008
3	FRU, FRONT COVER, DUTCH, E-PT	2086271-009
3	FRU, FRONT COVER, NORWEGIAN, E-PT	2086271-010
3	FRU, FRONT COVER, POLISH, E-PT	2086271-011
3	FRU, FRONT COVER, PORTUGUESE, E-PT	2086271-012
3	FRU, FRONT COVER, SWEDISH, E-PT	2086271-013
3	FRU, FRONT COVER, HUNGARY, E-PT	2086271-014
3	FRU, FRONT COVER, CZECH, E-PT	2086271-015
3	FRU, FRONT COVER, CHINESE, E-PT	2086271-016

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