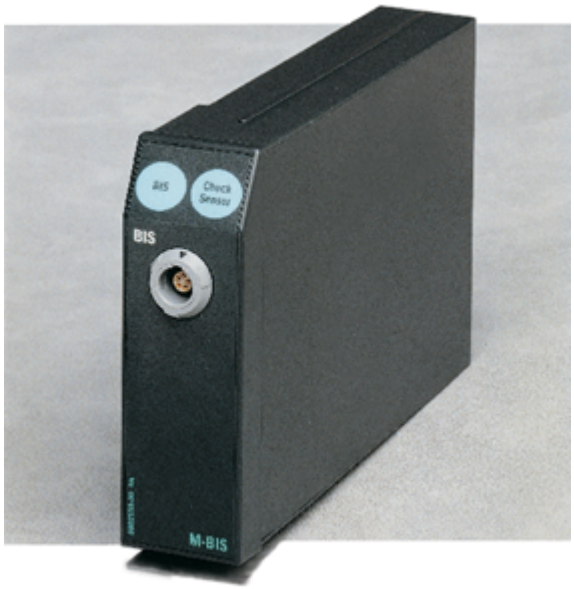
Datex-Ohmeda

S/5™ BIS Module

Technical Reference Manual Slot



All specifications are subject to change without notice.

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TABLE OF CONTENTS

BIS Module, M-BIS

TABLE OF FIGURES

TABLE OF TABLES

INTRODUCTION

This Technical Reference Manual Slot provides information for the maintenance and service of the Datex-Ohmeda S/5 BIS Module, M-BIS. The BIS module is a single width plug-in module designed for use with the S/5 monitors. Later in this manual modules can be called w/o system name Datex-Ohmeda S/5.

BIS, and the BIS logo are trademarks of Aspect Medical Systems Inc., and are registered in the USA, EU and other countries. Later in this manual Aspect Medical Systems Inc. will be called Aspect.

Please see also the *Technical Reference Manual* of the S/5 monitor for system specific information e.g. related documentation, conventions used, symbols on equipment, safety precautions, system description, system installation, interfacing, functional check and planned maintenance.

The BIS module is indicated for monitoring the state of the brain by data acquisition of EEG signals. BIS may be used as an aid in monitoring the effects of certain anesthetic agents. The raw EEG signals are processed to produce a single number, ranging from 100 for a patient being wide awake to 0 in the absence of brain activity.

Calculated parameters are:

- Bispectral Index, BIS
- Suppression Ratio, SR
- Electromyograph EMG
- Signal Quality Index, SQI

The calculated parameters can be selected on the display, and trended, (excluding SQI). Module has two user keys, BIS for BIS menu and Check Sensor for impedance check.

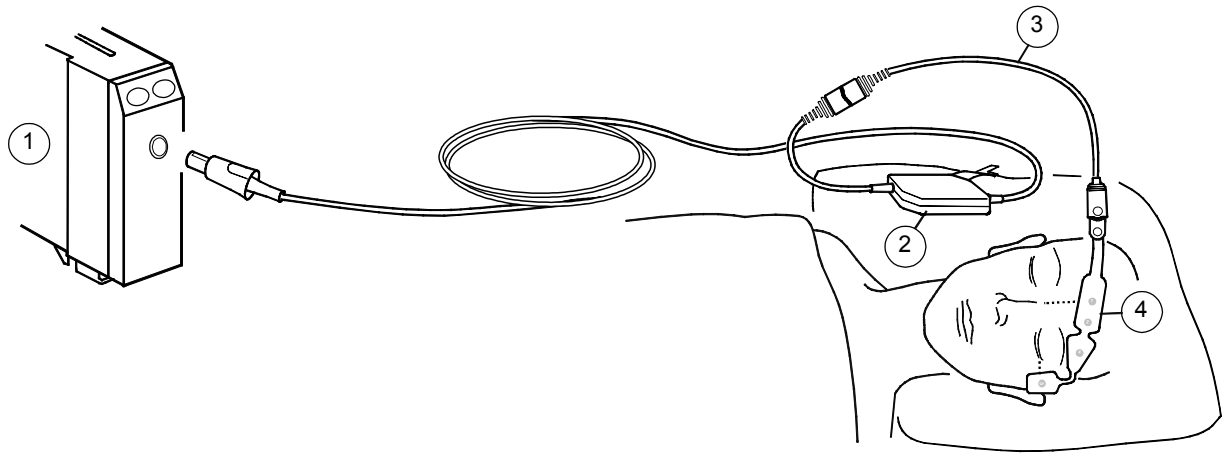


Figure 1 Measurement setup

(1) Module with BIS measurement capability, M-BIS

(2) Digital Signal Converter

(3) Patient Interface Cable

(4) BIS Sensor

NOTE: M-BIS module functions only with monitor software versions 02 or later.

Accessories

The BIS measurement is based on Aspect Medical Systems Inc. technology, and all accessories are developed and manufactured by Aspect.
NOTE: Only Aspect accessories can be used with the M-BIS module.

1 SPECIFICATIONS

1.1 General specifications

1.1.1 BIS Module

Module size, W × D × H	37 × 180 × 112 mm/1.5 × 7.1 × 4.4 in
Module weight	0.3 kg/0.7 lbs
Power consumption	2.2 W

1.1.2 Digital Signal Converter, DSC

DSC size, W × D × H	66 × 108 × 25 mm/2.6 × 4.3 × 1.0 in
DSC weight	0.134 kg/0.3 lbs
Integral DSC Cable length	3.6m / 12.5 ft
Patient Interface Cable (PIC Plus) length	1.2m / 4 ft

1.1.3 Environmental specifications

Operating temperature	+10 ... +40°C
storage temperature	-25 ... +70°C
relative humidity	10 ... 95%, non -condensing
atmospheric pressure	700 ... 1060 mbar
Protection against electrical shock	Type BF

1.2 Technical specifications

Parameter specifications

BIS EEG

Epoch duration	2 seconds
Artifact rejection	automatic
EEG scales	25 to 400 µV
EEG sweep speeds	12.5 / 25 / 50 mm /sec
Bispectral index (BIS)	0 to 100
Signal quality index (SQI)	0 to 100
EMG	30 to 80 db (70 to 110 Hz)
Suppression ratio (SR)	0 to 100 %
Update rate	1 second for BIS index
Filters	2 - 70 Hz bandpass (default) / 0.25Hz highpass
Smoothing rate	15 seconds, default in S/5 AM and CAM 30 seconds, default in S/5 CCM and CCCM

DSC

Analog to digital converter	noise-shaped sigma-delta
Sampling rate	16384 samples/second
Resolution	16 bits at 256 samples/second
Input impedance	>50 Mohms
Noise	< 0,3µV RMS (2.0µV peak-to-peak) 0.25 to 50 Hz
Common mode rejection	110 dB at 50/60 Hz to earth ground (Isolation mode)
Bandwith	0.16 to 450 Hz

2 FUNCTIONAL DESCRIPTION

2.1 Measurements principle

The BIS measurement is based on EEG signals, these are processed as BIS index. The BIS sensor is placed on the patient's forehead to acquire the high-resolution signals required. These EEG signals are transferred to digital signal converter DSC that amplifies and digitizes the EEG signal and sends it to the module. The module calculates BIS index and sends it to the monitor via MBUS.

BIS measurement on the monitor screen

The waveform field shows the BIS EEG waveform. The following BIS related data appears in digit fields and graphical trends (except SQI):

BIS number indicates the patient's level of hypnosis, ranging from 100 for wide awake to 0 in the absence of brain activity.

Signal Quality Index (SQI) bar graph indicates the quality of the EEG signal in the range of 0 to 100.

Electromyograph (EMG) bar graph represents the absolute power in the 70 to 110 Hz frequency band and ranges from 30 to 55 dB. This frequency band contains power from muscle activity (electromyograph) as well as power from high frequency artifacts.

Suppression ratio (SR) number indicates the percentage of suppressed (flatline) EEG detected over the last 63 seconds. It ranges from 0 to 100%.

2.2 Sensor Check

Sensor check is performed automatically at the beginning of each case when the sensor is attached to the patient interface cable (monitor). An initial check-up message is shown at digit field together with an appropriate sensor picture. The information of the passed or failed sensor check is printed to this picture at each electrode's location. The BIS measurement can't continue if the first sensor check fails. In such case a message "Sensor check failed" is shown at the digit and waveform field.

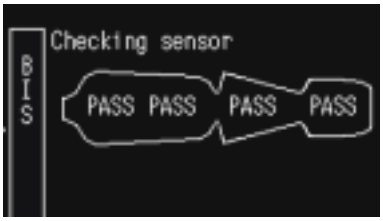


Figure 2 BIS sensor check

Continuous checking of the reference and signal electrodes and periodic checking of the ground electrode is performed by default. It can be switched off by selecting appropriate comand from menu – message "Automatic check off" will appear. Sensor check can be started manually by pushing a module key or selecting appropriate command from menu. Manual sensor check can be useful e.g. when AEP's are being monitored at the same time, as the continuous sensor check

might disturb the AEP measurement.

During periodic ground checks, the signal disappears momentarily and the message “Checking sensor” is printed in the digit and waveform fields. Also, all BIS calculation stops during this check, and no measurement values are shown.

CAUTION Continuous impedance check may need to be disabled if the 1 nA 128 Hz impedance check signal interferes with other equipment such as evoked potential.

WARNING **Make sure that the electrodes, sensor and connectors do not touch any electrically conductive material, including earth.**

2.3 Main components

BIS measurement chain is composed of Aspect BIS Sensor, Aspect digital signal converter, M-BIS module containing Aspect BIS Engine board and Datex-Ohmeda's interfacing board, and host monitor. Block diagram of the system below.

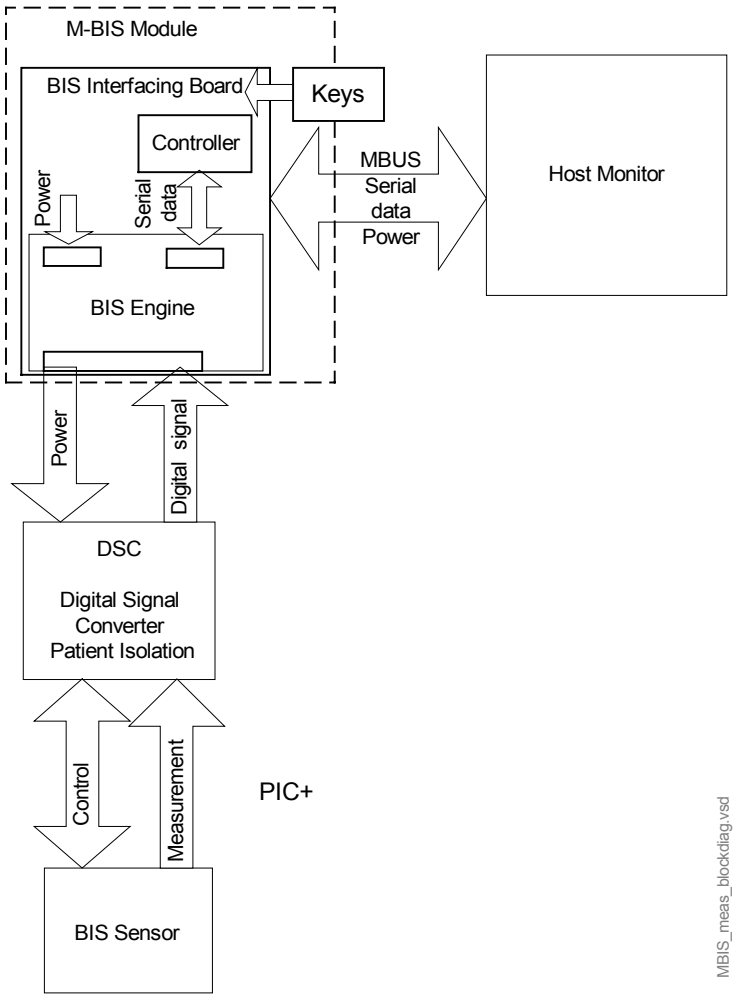


Figure 3 BIS measurement system block diagram

2.3.1 Digital Signal Converter, DSC

The digital signal converter, DSC, receives, amplifies and digitizes patient EEG signals. It is placed close to the patient's head where the EEG signal is less subject to interference from other medical equipment. The digital signal converter is connected to the module with a 3.6m long shielded cable and to the BIS sensor with 1.2m long patient interface cable, see Figure 1. For BIS Sensor related documentation refer to BIS documentation by Aspect, Inc.

CAUTION Do not autoclave the DSC. Do not open it for any reason.

WARNING **When using the electrosurgery unit, ensure proper contact of the ESU return electrode to the patient to avoid burns at monitor measurement sites. Also ensure that the ESU return electrode is near the operating area.**

WARNING **Radiated field strengths above 1V/m may cause erroneous measurements at various frequencies. Do not use electrical radiating equipment close to the DSC.**

2.3.2 BIS Module

Aspect BIS Engine

The BIS Module provides Bispectral index values to monitor. The BIS Engine processes the digital signal from DSC and outputs the BIS index and other supporting parameters through the asynchronous serial connection. The BIS Engine outputs the BIS Index, raw EEG, EMG, Signal Quality Index (SQI), Suppression Ratio (SR) and electrode impedance's. The BIS Engine software includes Aspects' proprietary algorithm for BIS calculation.

BIS interfacing board

The BIS interfacing board supplies the data from BIS Engine to the monitor via module bus. As well the module accepts commands from the monitor via module bus. In addition, the module provides supply voltages and all the required control signals to the BIS Engine and DSC.

Controller H8 has on-chip RAM and FLASH ROM, external SRAM and EEPROM.

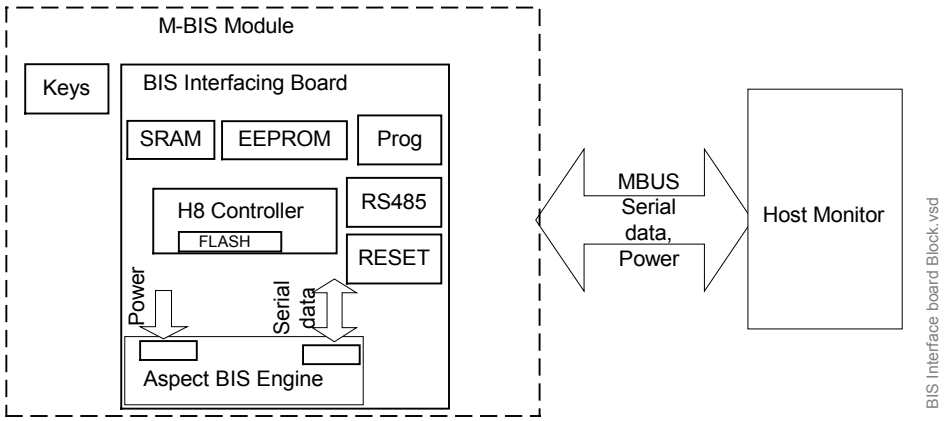


Figure 4 Block diagram of setup

2.4 Connectors and signals

2.4.1 Module bus connector

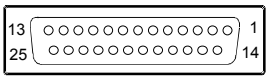


Table 1 Module bus connector (X1) pin description

PIN	Name	Description
1	Reset_ RS485	Module Bus Reset +
8	Nreset_ RS485	Module Bus Reset -
6	Data_ RS485	Module Bus Data +
5	Ndata_ RS485	Module Bus Data -
3	+15VD	+15V Supply voltage
7	GND	Ground
13	GND	Ground
15	GND	Ground
22	RS232_TXD	BIS-Engine SW update, data out, no monitor use
23	RS232_RXD	BIS-Engine SW update, data in, no monitor use
24	+5,1V	+5V Supply voltage
25	+5,1V	+5V Supply voltage
Other	NC	Not Connected

2.4.2 H8 programming connectors pin order

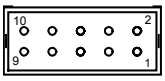


Table 2 Connector pinning for H8 programming connector

PIN	Name	Description
1	GND	Ground
2	PRG_FB	Program feedback
3	TxD	Data output to programmer
4	RxD	Data input from programmer
5	/RESET	RESET input from programmer
6	VDD	Power input from programmer
7	PRG_VCC	Programming voltage from programmer
8	MODE.2/BOOT	Control input from programmer
9	PCFB	Programmer Connector feedback / GND
10	CODE_RES	Coding resistor output to programmer

2.4.3 BIS Engine connectors pin order

Table 3 Connector pinning for DSC and BIS Engine connectors

PIN Redel	Name	PIN Samtec	Description
1	DSC_OUTA	2	Power out A
2	DSC_OUTB	4	Power out B
3	DSC_IN	6	Data input
4	DGND	7,8,9,10	Ground
5	Chassis Ground	1,3,5,	Ground

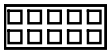


Table 4 Connector pinning BIS Engine power connector

PIN	Name	Description
1, 2	+12V	+12V Power output for BE
5,6,7,8	+5V	+5V Power output for BE
3,4,9,10	GND	Ground

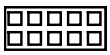
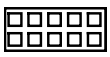


Table 5 Connector pinning for BIS Engine serial data connector

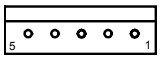
PIN	Name	Description
1	RS232_RXD	Data input to BE
2	TTL_RXD	Data input to BE
3	RS232_TXD	Data output from BE
4	TTL_TXD	Data output from BE
5	NC	Not Connected
6	NC	Not Connected
7	RS232_RESET	Reset input to BE
8	/TTL_RESET	/RESET input to BE
9	GND	Ground
10	/USE_TTL	TTL/RS232 selection input to BE



2.4.4 Keys

Table 6 Key connector pin assignments

PIN	Name	Description
1	GND	Ground /NC
2	Key 1	Key 1, right
3	Key 2	Key 2 left
4	GND	Ground
5	GND	Ground / Shield



3 SERVICE PROCEDURES

3.1 General service information

Field service of the M-BIS 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.

The Datex-Ohmeda BIS Simulator (order No. 900509) is recommended for functional checks.

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 should 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, *Service check form,* which should be filled in when performing the procedures.

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

The procedures are designed for monitors with S/5 monitor software of revision 02.

3.2.1 Recommended tools

Tool	Order No.	Notes
BIS Simulator or BIS Sensor simulator	900509 900508	
Screwdriver		

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

1. Check internal parts:
   - screws are tightened properly
   - cables are connected properly
   - there are no loose objects inside the module

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

   Reattach the module box

3. Check the external parts of the Digital Signal Converter
   - - the cover and the panel stickers are intact
   - - cables and their connections are intact

   Do not connect DSC to the module yet

Turn the monitor on and wait until the normal monitoring screen appears.

- Configure the monitor screen so that information regarding the BIS measurement is shown:

  Monitor Setup - ***Screen 1 Setup – Waveform Fields – Field1 – BIS EEG***

  Others – ***BIS – Scale - 100uV***
  Others – ***BIS – Smoothing Rate 15s***

4. Installation

   Plug in the module. Check that it goes in smoothly and engages properly

5. Recognition of module

   Check that the module is recognized, i.e. the BIS header with related information appears in the chosen waveform field and 'Cable off' message is shown on field.

6. Enter the service menu:

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

   Record the information regarding the module software of M-BIS by selecting SCROLL VERS and turning the ComWheel.

   Note! DSC related data will appear only when the DSC is connected for the first time after start-up.

7. Recognition of DSC

   Connect the PIC+ cable to the DSC.

   Connect the DSC to the module.

   - Check that the DSC is recognized (DSC related data appears to the page)

   - Check that 'No sensor' appears to the selected waveform field.

8. Enter the BIS module service menu:

   Parameters - More... - BIS

   Check that the 'Mod Mon Timeouts', ' Mon Mod Bad checksums' , ' Mod Mon Bad Checksums', ' Bad Checksums from BIS' values in the module view are not increasing faster than by 5 per second. Check that the memories of the module have passed the internal memory test, i.e. 'RAM', 'ROM' and 'EEPROM' all state OK.

9. Check the **BIS** and **Sensor Check** membrane keys of the module. Stay in the module view and press each key for at least one second and check that the key being pressed is identified, i.e. the corresponding PRESSED text appears in the service menu.

10. Check that ' Messages from BE ' are increasing steadily.

11. Go to the Sensor page.

    Check that

    - no sensor is identified

    - mains frequency is set correctly

    - check that ' BE powerup test', 'DSC selftest Ch1' and 'DSC selftest Ch2' all show PASs

    (if not, go to BIS Setup page, perform DSC Test and check the results again)

12. Sensor check

    Connect the BIS simulator to the PIC+ cable. See that 'Checking sensor' text and image appear. Wait for a while seconds and check that all sensors show PASS. Check that the 'Sensor type' shows Demo Sensor.

13. Check that the 'BIS', 'SQI' and 'SR' values are between 0..1000, and the 'EMG' value between 0..10000. Note! If Sensor simulator 900508 is used, the values can be out of the given range.

14. Go to the Module page

    Check that no BIS Engine errors appear.

15. Perform sensor check by pressing 'Check Sensor' and verify sensor passes.

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

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

18. Clean the module with suitable detergent.

- Fill in all necessary documents.

3.3 Disassembly and reassembly

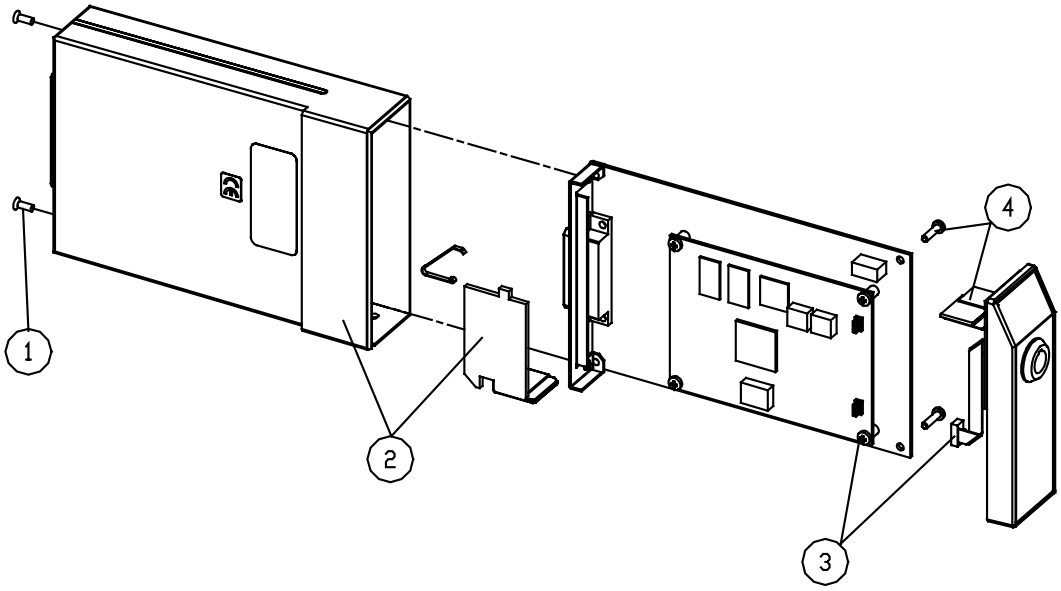


Figure 5 BIS module disassembly and reassembly

Disassemble the M-BIS in the following way.

1. Remove the two screws from the back of the module.
2. Pull the module box slowly rearward and detach it from main body. Be careful with the loose latch and spring locking pin.
3. Detach the BIS Engine board by removing the four screws located at the corners of the board and disconnecting the front panel connector cable.
4. Detach the interface board by removing the two screws located near the front panel frame, disconnect the cable and pull out the front panel frame.

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

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

4 TROUBLESHOOTING

4.1 Troubleshooting chart

Trouble	Cause	Treatment
No BIS waveforms on screen.	BIS waveforms not selected on screen.	Press Monitor Setup key and select BIS waveforms on the screen.
Sensor impedance check is not available on menus.	Sensor is not connected to the DSC or DSC is not connected to the module	Connect the sensor and the DSC
Sensor impedance check fails	Sensor poorly attached	Attach the sensor by following the sensor instructions

4.2 Messages

The messages below will appear in the BIS digit field (DF), BIS waveform field (WF) or at the message field (MF) at the upper section of the Datex-Ohmeda S/5 patient monitor display.

Message	Location	Cause	Treatment
Cable off BIS cable off	DF MF	DSC cable is not connected to the module.	Connect the DSC to the module
No Sensor No BIS Sensor	DF MF	Sensor is not connected to PIC+ cable or PIC+ cable is not connected to the DSC	Connect the Sensor to the PIC+ cable Connect the PIC+ cable to the DSC Replace sensor and then PIC+ cable.
Incompatible sensor	DF	Sensor is not recognized. Sensor is not a BIS sensor.	Connect correct type of sensor Make sure PIC connector is clean and dry
Incompatible DSC	DF	Current module hw/sw is incompatible with this DSC E.g. DSC-2	Connect correct type of DSC
Sensor check failed BIS sensor check failed	DF MF	Sensor check failed, one or more of the electrode impedances exceeds the threshold.	Reattach the sensor to the patient by following the sensor instructions Replace the sensor Check PIC+ cable and then DSC
Poor signal	DF	Artifacts, or the amount of EMG activity prevents calculating BIS, data excluded. SQI < 50	Check the sensor then the PIC cable. Reattach the sensor to the patient by following the sensor instructions
Checking sensor	DF	Sensor check in progress. Can be either the initial sensor check, manual check or the periodic check.	Wait until the check has been performed
Checking Sensor – message stays more than 2 min.	DF	Sensor check fails, the sensor is not attached to the patient while connected to the PIC+ cable	Attach the sensor to the patient and press the Check Sensor button on the module front panel
Automatic check off	DF	Continuous sensor checking has been turned off	Turn the check on from the BIS menu
Replace Sensor	DF	The sensor has passed its use by date The sensor has been used for 24h	Replace with a new sensor
High BIS impedance	DF	Sensor is not attached properly to the patient	Check the cable connections Reattach the sensor to the patient by following the sensor instructions
Artifact	DF	Non-EEG data such as EMG, eyeblinks or shivering present.	Wait for good data
Module error	DF	BIS Engine failure for more information see service page description	Replace the BIS Engine
DSC Error	DF MF	The DSC is not communicating or operating properly. This may occur during the use of electrocautery device. For more information see service page description	Replace the DSC If the message persists, the BIS Engine may require service.
Demo data	MF	BIS simulator is connected	Disconnect the BIS simulator

4.3 Troubleshooting flowchart

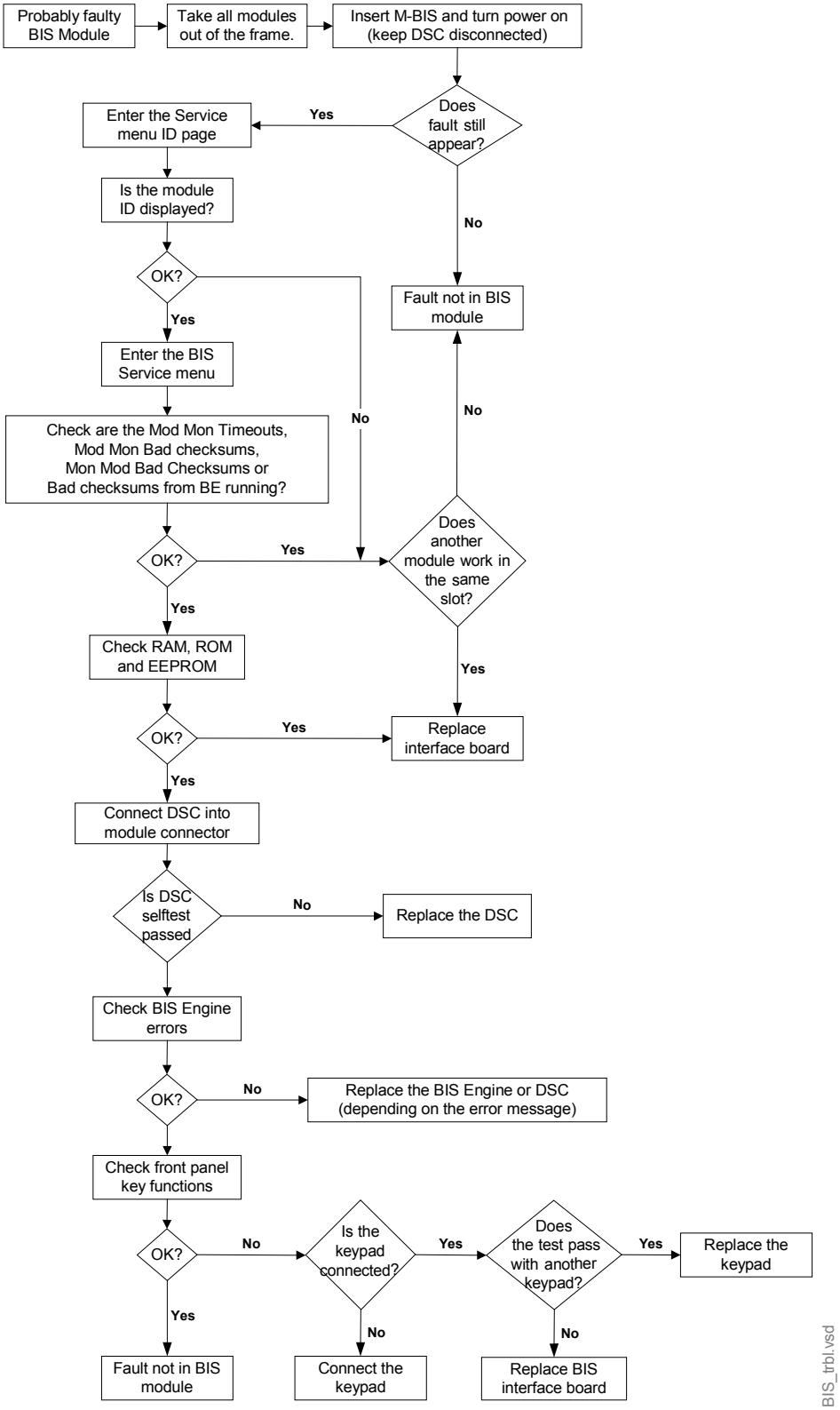
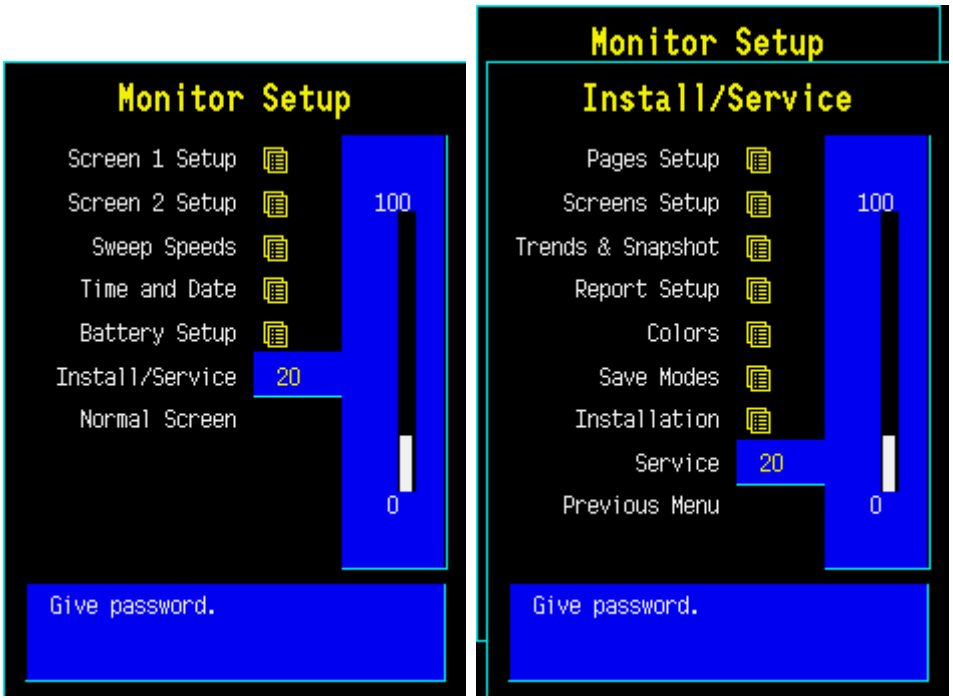


Figure 6 BIS module troubleshooting flowchart

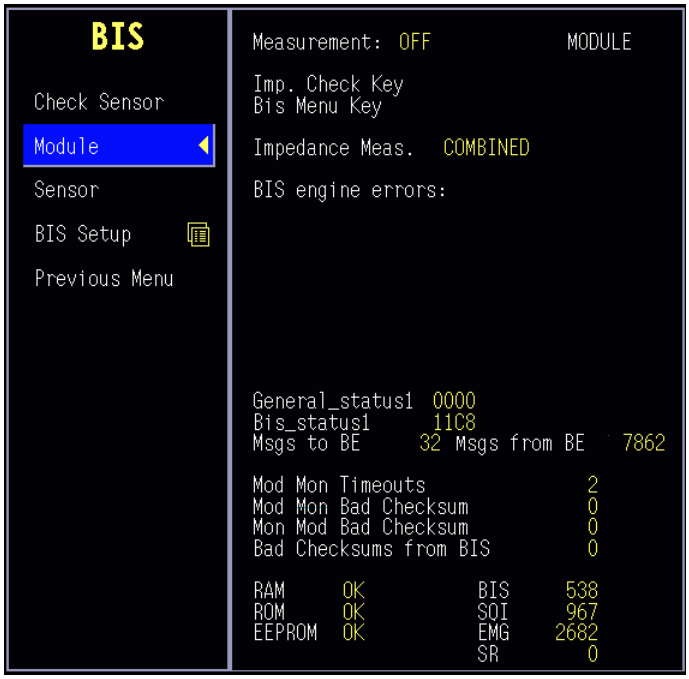
5 SERVICE MENU



Press the **Monitor Setup** key - select ***Install/Service*** (password: 16-4-34) - select ***Service*** (password: 26-23-8) - select ***Parameters - More... - BIS***.

5.1 BIS service menu

5.1.1 Module service page



Check Sensor activates the sensor impedance check.

Module

Measurement indicates if BIS Engine is on: ON/OFF
Imp.Check Key indicates that the key in the module front panel works properly.
Bis Menu Key indicates that the key in the module front panel works properly.
Impedance Meas indicates the impedance measurement mode. The modes are CYCLIC/COMBINED/GROUND/OFF
BIS Engine errors: error messages created by DSC or BIS Engine. See "*Table 9*" below for detailed description of the error message
Statuses (HEX): See appendix B; How to read HEX numbers.
General Status1 indicates the general status of the module. See "*Table 7*" to see the detailed description of the message
Bis_status1 indicates the BIS Engine status. See "*Table 8*" to see the detailed description of the message
Msgs to BE number of data packages sent from interface board to BIS Engine
Msgs from BE number of data packages sent from BIS Engine to interface board
Mod Mon Timeouts is a cumulative number that indicates how many times the module (interface board) has not responded to monitor's inquiry.
Mod Mon Bad Checksum is a cumulative number that indicates how many times there has been an error in the message from module (interface board) to monitor.
Mon Mod Bad Checksum is a cumulative number that indicates how many times there has been an error in the message from monitor to module (interface board).
Bad Checksums from BIS is a cumulative number that indicates how many times there has been an error in the message from the BIS Engine to module interface board.

RAM indicates the state of the RAM memory.
ROM indicates whether the checksum at the EPROM is accordance with the one the software has calculated.
EEPROM indicates if the values stored in permanent memory are valid.
The states in memory checks are **OK, Fail** or **?** (module not in place or a communication error).
Measured parameters indicated:
BIS indicates BIS index ; range 0..1000 (corresponds 0..100)
SQI indicates signal quality index; range 0..1000 (corresponds 0..100)
EMG indicates EMG activity level; range 0..10000 (corresponds 0..100dB NOTE! On the display EMG will be shown between 30..55dB on the bar graph or 30..80dB on the trend)
SR indicates supression ratio; range 0...100 (corresponds 0..100%)

General_Status1 **Module general status.**

Table 7 Module general status

bit 0-5	Not used
bit 6	State error
bit 7	Communication failure
bit 8	Power failure
bit 9	Clock failure
bit 10	EEPROM checksum failure
bit 11	EEPROM writing failure
bit 12	ROM failure
bit 13	RAM failure
bit 14	Test mode
bit 15	Init mode

BIS_Status1 **BIS Engine status**

Table 8 BIS Engine status

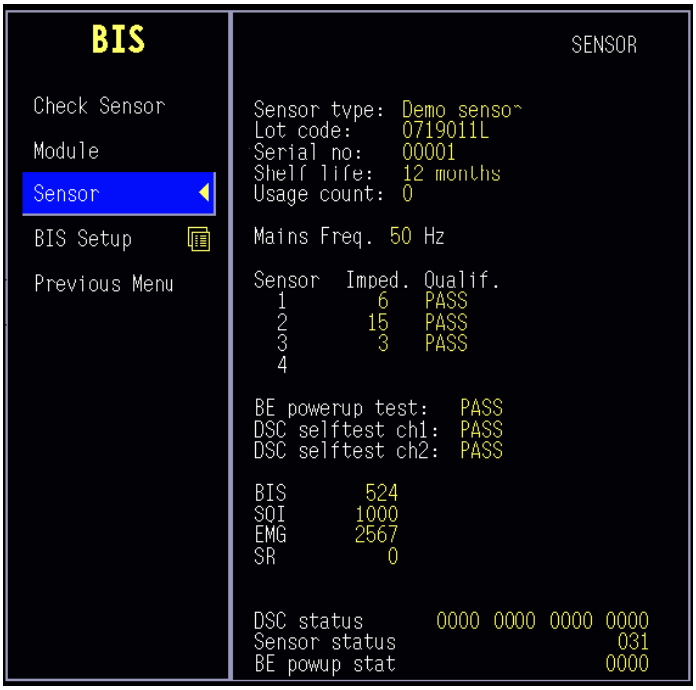
bit 0	Check Sensor key pressed
bit 1	BIS key pressed
bit 2	Inpedance check mode cyclic
bit 3	Impedance check mode combined
bit 4	Impedance check mode ground
bit 5	Impedance check off
bit 6	Measurement on
bit 7	EEG measurement on
bit 8	Impedance check on DSC channel 1 passed
bit 9	Impedance check on DSC channel 2 passed
bit 10	BIS Engine powerup failure
bit 11	DSC selftest failure
bit 12	DSC quick test failure
bit 13	DSC selftest on
bit 14	No data from BIS Engine
bit 15	Not used

Table 9 BIS Engine and DSC error messages

Message	Errors of type 1
DSC buffer overrun	
Out of dynamic memory	
Execution time exceeded in main	
Error in algorithm processing	
Invalid state in UART receive state machine	UART related errors
UART initalization error	
Transmit queue full	
Illegal number of data bytes for packet to be transmitted to the Host	
Illegal number of channels for EEG data	Misc. errors
Illegal EEG data type	
Illegal EEG data rate	
Illegal EEG filter coefficients	
No updates from Host	Communication related errors
Bad CRC - TI_SELFTEST_CODE	EEPROM CRC checks
Bad CRC - TI_RUN_CODE	
Bad CRC - FPGA_CONFIG	
Bad CRC - REV_INFO	
Illegal serial number	Serial number check
DSC failed to power up	DSC related errors
Serious DSC overcurrent error	
DSC receiver data overrun	
DSC failed repeatedly in responding to commands	
DSC update failed	
Serious DSC power regulation fault	
General DSC failure	
Sensor Negative Ground Fault	Smart sensor errors
Serious Sensor Positive Ground Fault	
Serious Sensor Overcurrent Fault	

Message	**Errors of type 2**
Illegal message ID	Errors for layer 3 packets
Illegal command parameter	
Illegal length for layer 2 data	
Disabled interrupt received - UART transmitter empty interrupt	UART related errors
Disabled interrupt received - UART modem interrupt	
No status nibble received	DSC related errors
DSC not connected	
DSC disconnected after test failure	
Illegal DSC ID	
DSC power regulation fault	
DSC interface fault	
DSC did not respond to command	
Illegal PIC ID	
DSC overcurrent	
DSC overrun	
EEPROM Bad packet length	Software update related errors
EEPROM Bad checksum	
EEPROM Bad code length	
EEPROM Illegal packet subtype	
EEPROM physical write error	
EEPROM NOT_DATA_TIMEOUT	

5.1.2 Sensor



Sensor type: indicates the type of the sensor connected
Lot code: indicates the manufacturing lot code of the sensor. The lot code contains the manufacturing date and shift
Serial no: indicates the serial number of the sensor.
Shelf life: indicates max storage duration
Usage count: indicates how many times the sensor has been attached/detached. Not Active!!
Mains Freq.: indicates the set mains frequency; 50Hz/60 Hz
Sensor Impedances: indicates the last measured impedances
Imped. indicates the measured impedance value in Kohms.
Qualif. indicates the quality of the measured impedance; PASS/FAIL
BE powerup test: indicates the status of BIS Engine power up test: PASS/FAIL
DSC selftest ch1: indicates the DSC selftest status for channel 1: PASS/FAIL
DSC selftest ch2: indicates the DSC selftest status for channel 2: PASS/FAIL

Measured parameters indicated:
BIS indicates BIS index ; range 0..1000 (corresponds 0..100)
SQI indicates signal quality index; range 0..1000 (corresponds 0..100)
EMG indicates EMG activity level; range 0..10000 (corresponds 0..100dB
(NOTE! On the trend display EMG will be shown between 30..80dB)
SR indicates supression ratio; range 0...100 (corresponds 0..100%)

Statuses (HEX): See "*APPENDIX B*" How to read HEX numbers.
DSC status: indicates the DSC status for the four channels. See "*Table 10*" to see the detailed description of the message.
Sensor status: indicates the Sensor status. See "*Table 11*" to see the detailed description of the message.
BE powup stat: indicates the BE power up status. See "*Table 12*" to see the detailed description of the message.

Table 10 DSC status

bit 0	Noise test
bit 1	BIS key pressed
bit 2	Blocked droop test
bit 3	Unblocked gain test
bit 4	Impedance wait time out test
bit 5	Noise timeout test
bit 6	Blocked timeout test
bit 7	Unblocked timeout test
bit 8	DSC not connected test
bit 9	Not used test
bit 10	Not used test
bits 11 - 15	Not used

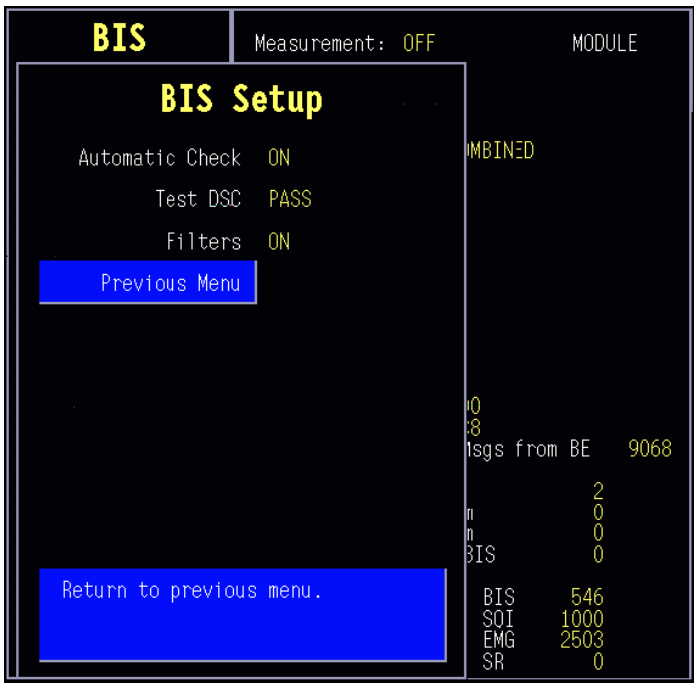
Table 11 Sensor status

bit 0	Quick selftest pass
bit 1	Quick selftest gain
bit 2	Quick selftest noise
bit 3	Quick selftest fail
bit 4	Quick selftest valid
bit 5	Sensor valid
bit 6	Sensor invalid
bit 7	Sensor too many uses
bit 8	Sensor expired
bit 9	Sensor validity unknown
bits 10 -15	Not used

Table 12 BE powup stat

bit 0	XRAM test
bit 1	Dma test
bit 2	Timer test
bit 3	Fpga test
bits 4 -15	Not used

5.1.3 Setup



Automatic Check: A selection to define whether automatic sensor check is used ON/OFF

Test DSC indicates the status of the DSC self test; PASS/FAIL

Filters: A selection to define if filters are used
ON; disturbances are filtered from the raw EEG signal
OFF; raw EEG signal is shown

6 SPARE PARTS

6.1 Spare part list

6.1.1 M-BIS

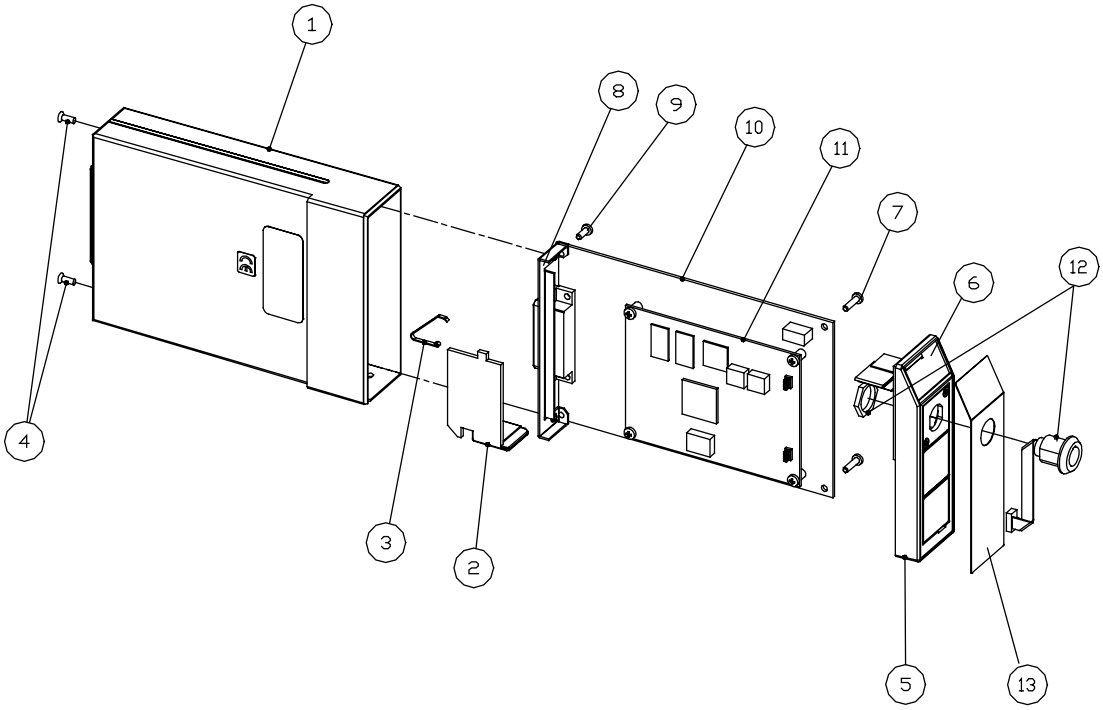


Figure 7 Exploded view of module box and BIS module

Item	Description	Order code
1	Module box (single width)	886167
2	Latch	879181
3	Spring pin	879182
4	Cross recess screw, M3×8 black	616215
5	Front panel unit	8002476
6	Membrane keypad	880101
7	Cross cylinder head screw, M3×12	628700
8	Metal frame	879184
9	Cross cylinder head screw, M3×6	61721
10	BIS interface board	8002285
11	Aspect BIS engine board	900505
12	BIS connector unit, M-BIS	8002480

Item	Description	Order code
13	Front panel sticker, M-BIS, DA	8002855
13	Front panel sticker, M-BIS, DE	8002848
13	Front panel sticker, M-BIS, EN	8002555
13	Front panel sticker, M-BIS, ES	8002853
13	Front panel sticker, M-BIS, FI	8002847
13	Front panel sticker, M-BIS, FR	8002852
13	Front panel sticker, M-BIS, IT	8002850
13	Front panel sticker, M-BIS, JA	8003001
13	Front panel sticker, M-BIS, NO	8002849
13	Front panel sticker, M-BIS, NL	8002856
13	Front panel sticker, M-BIS, PT	8002854
13	Front panel sticker, M-BIS, SV	8002851

7 EARLIER REVISIONS

Revision	Manual slot/main manual	Note

No previous revisions

APPENDICES A, B

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SERVICE CHECK FORM

BIS Module, M-BIS

Customer					
Service		Module type		S/N	
Service engineer				Date	

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

Service check

	OK	N.A.	Fail		OK	N.A.	Fail
1. Check internal parts:	☐	☐	☐	2. Check external parts of the module:	☐	☐	☐
3. Check the external parts of DSC	☐	☐	☐	4. Installation	☐	☐	☐
5. Recognition of module	☐	☐	☐				
6. module software	M-BIS						
7. Recognition of DSC	☐	☐	☐	8. Communication and memories of module	☐	☐	☐
9. membrane keys	☐	☐	☐	10. Messages from BE	☐	☐	☐
11. Sensor IDSensor	☐	☐	☐	12. Sensor check	☐	☐	☐

13. Checks with simulator		Allowed range
BIS		0...1000
SQI		0...1000
SR		0...100
EMG		0...10000

14. BIS Engine errors	☐	☐	☐	15. check	☐	☐	☐

	OK	N.A.	Fail		OK	N.A.	Fail
16. Electrical safety check	☐	☐	☐	17. Functioning after electrical safety check	☐	☐	☐
18. Final cleaning	☐	☐	☐				

Notes _____

_____

_____

_____

_____

Used Spare Parts _____ _____ _____

_____ _____ _____

Signature _____

APPENDIX B, HOW TO READ HEX NUMBERS

Some statuses on BIS Module service pages are given as HEX (hexadecimal) numbers. To understand them, please read the following:

A HEX number has a base of 16 instead of 10. This means that every character in a number can have a value between 0 and 15. Numbers from 0 to 9 are displayed as if they were normal 10-based numbers. Numbers from 10 to 15 are displayed with letters from a to f or A to F respectively.

Every character of a HEX number expands into a binary code of four 0:s (zeroes) and 1:s (ones) as given in table 13. Four successive characters thus expand into four times four binary numbers. Here's an example:

We have a HEX number F3A1. We expand the number into binary code so that we first take the four binary digits that correspond to F, which are 1111. Then we write the four binaries that correspond to 3 (0011) after the first four. We now have 11110011. And so on.

Eventually, we have a string of 16 binary numbers, so called bits. HEX number F3A1 corresponds to a binary code of 1111 0011 1010 0001. Spaces are added here for legibility and to visualize the fact that every group of four bits corresponds to one HEX character.

The bits in a binary number are numbered from right to left always starting from 0 as follows:

bit 15	bit 14	bit 13	bit 12	bit 11	bit 10	bit 9	bit 8	bit 7	bit 6	bit 5	bit 4	bit 3	bit 2	bit 1	bit 0
1	1	1	1	0	0	1	1	1	0	1	0	0	0	0	1

With this information and a table of status fields from section 5 "*Service Menu*" we can translate a HEX status code into actual status messages. If a bit is 1 this means that the corresponding status/error condition is valid, whereas a 0 means that it is not.

Table 13 HEX to binary conversion

HEX	binary	HEX	binary
0	0000	8	1000
1	0001	9	1001
2	0010	A	1010
3	0011	B	1011
4	0100	C	1100
5	0101	D	1101
6	0110	E	1110
7	0111	F	1111