Express

Service manual

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Introduction

Disclaimer

Instrumentarium Dental endeavors to produce product documentation that is accurate and up to date. However, our policy of continual product development may result in changes to products that are not reflected in the product documentation. Therefore, this document should not be regarded as an infallible guide to current product specifications.
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Scope

This manual provides the information necessary to perform field servicing and maintaining of the Instrumentarium Dental Express Digital imaging plate system (hereafter referred as a "scanner unit").

> **NOTE: THIS MANUAL IS NOT A STAND-ALONE MANUAL AND MUST BE READ TOGETHER WITH THE USER'S MANUAL**

Only trained and approved service personnel of authorized distributors are allowed to service the unit.

Unit can be sent to manufacturer for repair if it can not be repaired by:
- Performing the calibrations instructed in this manual AND
- Replacing field serviceable parts

Instruction / command syntax used in the manual:

<text>   The text inside the brackets is typed in exactly as instructed + followed by enter

Example	**<reset>**	means typing: **reset** (and pressing **enter**)
Example	**<idle>**	Show the time unit waits before goes to standby
Example	**<idle XXX>**	Sets time (XXX seconds) unit waits before goes to standby

Acronyms used in this manual

ADC	Analog to Digital Converter
Cmd	Command
DSD driver	The device driver used together with an imaging application
EMC	Electromagnetic compatibility
EMI	Electromagnetic interference
FW	Firmware control the scanner unit operation
HV	High Voltage
I/O	Input/Output
IP	Imaging Plate
IP address	Internet Protocol Address, typically looks like 192.168.2.11
JXXXX	Connector number
Msg	Message
NIC	Network Interface Card
PMT	Photo Multiplier Tube (=Photo detector)
PSU	External Power Supply Unit

Operating Warnings and Precautions

CLASS 1 LASER EQUIPMENT

DANGER: Any failure to follow the recommendations and instructions in this manual may expose the user to laser radiation exceeding the class 1 specifications.

CAUTION:
- Do not move or knock the scanner when it is scanning.
- The use of control or adjustment or performance of procedures other than those specified herein may result in hazardous laser radiation exposure.
- This scanner must only be used to read image plates and must not be used for any other purpose. Only use the imaging plates and protective covers that are supplied by scanner unit manufacturer. NEVER use imaging plates or protective covers from other manufacturers with the scanner
- This scanner, or its accessories, must not be modified, altered or remanufactured in any way.
- Only the manufacturer's authorized service personnel are authorized to carry out annual maintenance and repair. There are no user serviceable parts inside.
- This device can interfere with other devices due to its EMC characteristics.
- Other devices can interfere with this device due to their EMC characteristics.
- This device complies with IEC 60601-1 standard. Accessory equipment connected to this device must be in compliance with the related nationally harmonized IEC standards.
- Equipment not suitable for use in the presence of flammable anesthetic mixture with air or with oxygen or nitrous oxide.
- Only use the power supply unit that is supplied with the scanner. Do not use any other power supply units with the scanner.

Servicing Precautions

Laser Radiation
There is a class 3B laser inside the scanner. The laser can be activated if the safety switch is defeated and the laser is switched on from the service terminal. Avoid direct exposure to the beam or its' reflections (for instance from shiny tools etc).

High Voltage
There is a high voltage circuit between the photo multiplier tube and amplifier card. High voltage can be set on when the safety switch is defeated.

Light Sensitivity of Photo Multiplier Tube
The tube is very sensitive to light when it is active. Tube is activated when the high voltage is turned on and safety switch defeated. The tube is used to measure extremely small amounts of light and normal room light and brighter light sources damage HV-activated tube.

Installing and Setting-up the s2terminal

Recommended hardware at installation

- Laptop-computer with:
    - Imaging application software installed
    - All s2terminal related files (including s2terminal.exe and s2.dll) copied to folder c:\s2terminal
    - s2terminal communication and settings tested with scanner unit
- RJ45 UTP network cable, known as working
- Switch 10M / 100M / 1Gb/s, known as working (optional)

Pre-installation requirements

- scanner unit only works with the compatible imaging application software**.**
- You also have to install the necessary drivers during the installation of the imaging application. Refer to the Application installation manual for more information.
- After successfully installing an imaging application you must get a **suitable, unique IP address for the scanner unit** so that you can attach it to the network. You can usually get one from your local network administrator. All that is basically required is that the address is unique inside the given network.
- If several workstations are required to share the scanner unit (Express Share), determine which workstations will be used with the scanner unit and the names that the users wish to allocate to the workstations.
- **You need administrator privileges to do both kinds of installations**
- Please allow plenty of time to do Express Share installations, as they are more complicated to do than normal installations.
- Make sure that the PC(s) and the scanner unit are connected correctly and then the scanner unit on. Wait until the self-test procedure has finished (this takes ~25-60 s.) and make sure that the unit indicates that the cables are connected correctly.
- It is recommended to use network cards (NIC) from the known manufacturer. Cheap, generic cards may cause problems. Here is a quick short list on recommended NIC-manufacturers:
    - Intel (card or integrated onto motherboard), 3Com, Linksys, D-Link, Netgear…

EMI –interference, vibration and operation with UPS

- scanner unit is tested as required by the medical device standards. However this testing does not guarantee that the device is totally immune to all possible interferences.
- The heavy levels of EMI will disturb the imaging chain and so the scanner may reject the calibration during the power-up or show as interference on the image.
- If the interference is temporarily happening during normal image readout, the 'Degraded Image Quality' -messages may appear.
- In addition to EMI also pure mechanical vibrations (even with small amplitudes) will cause the same effect if the vibration frequency is in the certain range.
- One practical example of vibration origin is if you have a computer reading CDROM (possibly a bit out of balance) next to scanner unit.

If you are operating scanner unit connected to the UPS (Uninterruptible Power System)
- Check any recommendations for the placement etc. The UPS may also generate mechanical vibrations at the frequency the scanner unit is sensitive to so try to locate the UPS on the floor for example

System Architecture

Block diagram
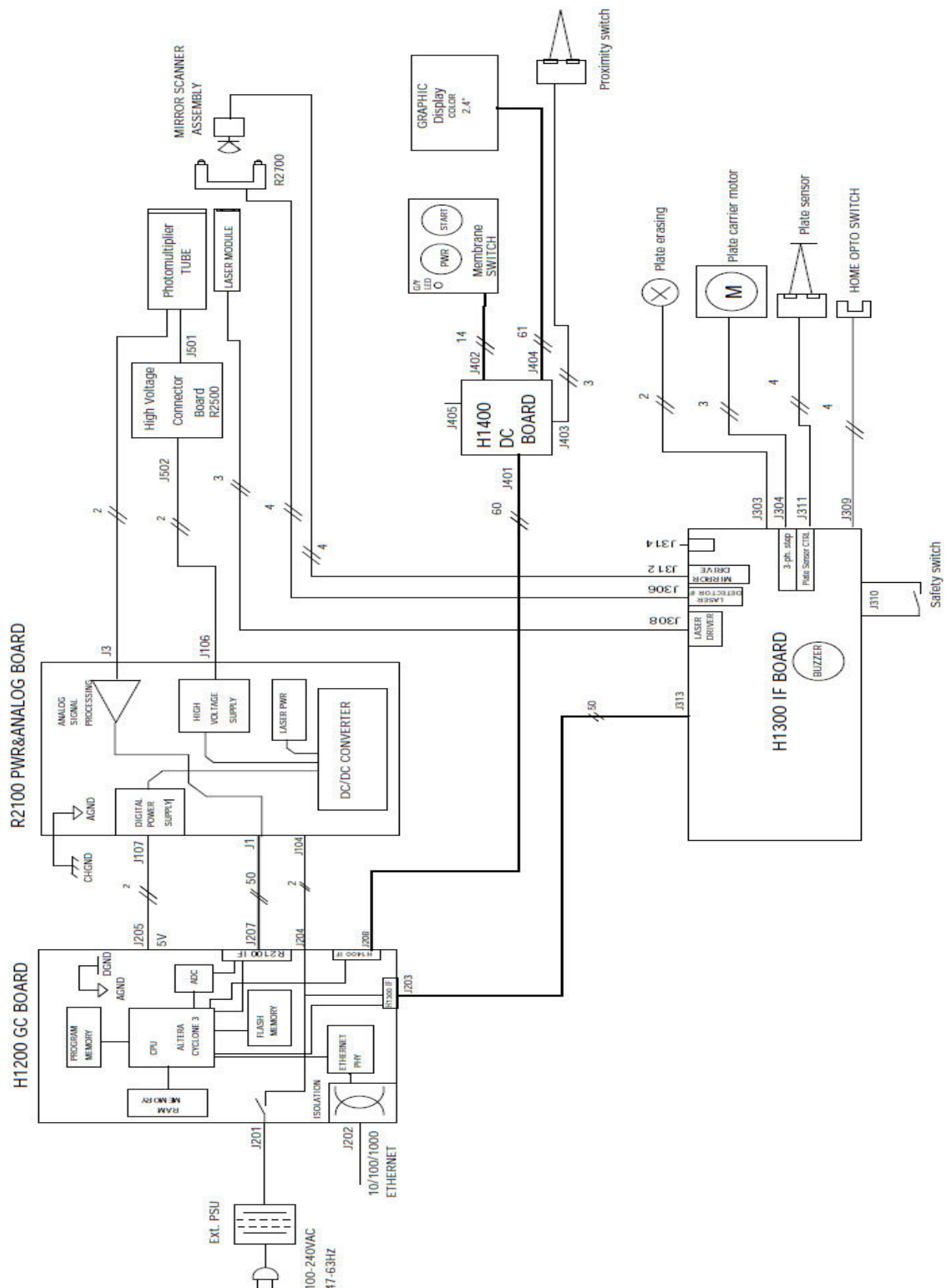
Scanner mechanics

External PSU is not shown here. See accessory catalog for details.

To open the unit covers you need 3mm hexagonal allen key.

Top cover

Front cover
Includes:
-Membrane switch
-Scanner display
-Proximity switch

Cover right and left

Rear cover

Scanner mechanisms

Electronics box

Bottom cover

Imaging plate collector

Light Protection Cover

Scanner module
Includes:
-R2500 HV Connector board
-R2700 Laser detector board
-PMT (Photo Multiplier Tube)
-Laser diode
-Light collector
-Mirror scanner assembly
aka. Resonant scanner

H1300 Interface board

Drive motor

Drive motor cable

Drive belt (and Drive Wheel)

Erasing lamp + socket

Safety switch

Safety switch holder

BNC Connector

Plate carrier belt (Conveyor belt)

H1200 General control Board (GC)

NOTE:
Proximity switch is fixed to the front cover of the unit!

Plate carrier (Imaging plate guide)
NOTE: Adjustable UP/DOWN

R2100 Power &Analog board (inside electronics box)

Home opto Switch

Plate/Reflective Sensor (+cable)

Electronics box lid

Electronics

Powering and grounding of the boards:
- INPUT voltage 24VDC from External Power Supply is connected to H1200 General Control board where supply voltage is split into two traces:
  - To H1300 Interface Board
  - R2100 Power and Analog Board
- Some of the boards are not powered directly = Their power is supplied and/or controlled by other board(s).
- For proper operation all boards must be attached to the unit chassis.

External Power Supply Unit
- Universal input, auto switching (100-240 VAC / 47-63Hz).
- Output 24VDC / 2.9A / 70W (Powerbox type EMX805121 include adapters for most commonly used power supply plugs) connected to the H1200 GC board.
- No serviceable parts inside. Do not open.

R2100 Power & Analog Board
- Analog signal processing circuitry
- Low voltage regulators for all boards & for laser
- High voltage power supply for PMT (J106 - thru R2500 connector brd)
- Analog signal from PMT J3
- Circuitry for checking the high voltage.
- Parallel data I/O between H1200 GC and this board
- 24Vdc input from H1200 (J201)
- +5Vdc digital supply to H1200 GC
- LED D2 is lit when high voltage is on

H1200 General Control Board
- System clock
- CPU inside FPGA (incl. Ethernet controller and other logic)
- System configuration flash-memory
- NAND flash memory
- General-purpose DDR2 memory
- Ethernet interface
- AD conversion
LEDs are used to indicate following voltages:
- D20 +5V
- D13 +1.2V
- D14 +1.8V
- D23 +3.3V

- If red led D19 is lit FPGA is in reset. This can mean that voltage +3.3V supplied to FPGA is too low.
- LEDs 13, 14, 20 and 23 turn on after pressing power button
- D9 (L10) indicates that Ethernet PHY has established link at 10 Mbps
- D10 (L100) indicates that Ethernet PHY has established link at 100 Mbps
- D11 (L1000) indicates that Ethernet PHY has established link at 1000 Mbps (1Gbps)

H1300 Interface Board

- Interface for multiple controls (motor, laser control, home opto switch and imaging plate detection), feedback and interface signals from and to H1200 -processor board.
- Controls erasing lamp on/off and generates a feedback of lamp current to CPU

H1400 Display & connector Board

- Interface between graphical display and H1200 GC Board
- Contains connector for proximity switch signals
- Connector for membrane switch panel push buttons and LED powering.
- Led D8 indicates if 5V is available at H1400 board.

R2500 High Voltage Connector Board

- Connects high voltage from HV-supply to the Photomultiplier tube (=PMT).

Membrane switch panel

- Membrane keyboard, which has one led and control keys in it.
- See user's guide for more detailed description of keys and indicator light

NOTE! Membrane switch panel scan button and the proximity switch are parallel signals. You are able to wake up the unit from the power save mode either way. Please refer to the instructions of the **<wakeup>** command in service commands section for proper usage of the proximity sensor activation / de-activation.

R2700 Laser detector board

- Contains two pin diodes that are used to synchronize laser movement.

Firmware

Architecture

Workstation (PC)	Ethernet	The scanner unit
Driver (mandatory) All messages invisible to the user.	Image Data Request Msg → Image Data Msg ← Driver Cmd Msg → Driver Cmd Reply Msg ←	Normal mode / Service mode
Service Terminal (optional) All messages visible to user	User Cmd Msg → User Cmd Reply Msg ← Service Output Msg ←	Scanner Firmware, Core and display graphic files

(Imaging Application (optional) encloses the Driver and Service Terminal)

Imaging Application
- End user's interface to acquired images.
- Handles image archiving and displaying.

Driver
- Handles the connection/communication to the unit
- Transfers and manipulates images.
- Unit cannot operate without Driver

There are two alternatives to be used as a driver:
1. DSD driver. Run from Application (or other imaging application)
2. s2terminal program. Run from the command prompt of Windows.

Service Terminal
- Optional part of the driver.
- Execute user commands
- View the service output of the unit.

There are two alternatives to be used as a Service terminal:
1. DSD driver. Run from Service Assistant of Application (or other imaging application).
2. s2terminal program. Run from the command prompt of Windows.

Scanner Firmware and Core (=FW, Inside the connected unit)
- Takes care of the normal unit operations.
- Operates either in normal mode or service mode.
  - **Normal mode**: Unit is fully operational and images can be acquired.
  - **Service mode**: Unit does not react to any other inputs than those given by the user through service terminal. To be activated only from Service Terminal.

NOTE! Updating scanner FW may need updating of maximally 3 different binary files:
- Firmware
- Core
- Display graphics file

All updated files and related detailed instructions are described in the release letter of FW to be updated. Short description of the used commands is listed on the chapter Field service procedures.

Unit statuses and modes

Start-up sequence
1. Unit is powered on when power ON / OFF key is pressed
2. INITIALIZATION & SELF TEST SEQUENCE is indicated by animation ran while performing following checks:
    - Calculate the CRC
    - Drive the plate carrier home (to reset the location counter)
    - Drive the plate carrier back inside
    - Calibrate PMT-signal amplifier
    - Test high voltage (if safety switch is closed)
    - Test erasing lamp
    - Calibrate plate / reflective sensor DAC (if safety is closed)
    - Wait the mirror scanner stabilizing (uses laser; close the safety switch after lamp test to proceed without error if the cover is open)
    - Drive the plate carrier to loading position

> **NOTE**: if the light protection covers surrounding scanner module is removed (or safety switch defective / cable disconnected). Unit goes into error state after erase lamp test and self test sequence is halted (recovering from this needs restart of the unit)
>
> **However you are able to proceed with the start up sequence if safety switch is closed manually AFTER the erasing lamp has been ON shortly during the startup sequence**
>
> **NOTE! If the safety switch is pressed before the erasing lamp test –the PMT may be damaged!!!!!**

3. CHECK ANIMATIONS & ERROR CODE displayed if everything NOT OK
4. READY for operation (if connection to the application SW is OK)

Standby -mode
- Goes to standby –mode if not operated for a determined period of time:
    - Factory set default can be changed by commanding **<idle XXX>**
        - XXX=time in **seconds**
    - Unit wakes up from the standby mode by activation of the proximity sensor or by pressing the start key

Powering "OFF" the unit
- Ready state:
    - Power ON / OFF key pressed shortly >> BEEPS, but does not power off the unit
    - Power ON / OFF key pressed more than one second >> powers off the unit
- Standby mode:
    - Pressing of power ON / OFF key turn off the unit

Automatic shutdown
- Unit is powered off automatically if the unit stays in the standby mode for a longer period of time than set in the <off> parameter:.
    - Factory set default can be changed by commanding **<off XXX>**
        - XXX=time in **minutes**

Image read, but the connection lost during the read out of the imaging plate (application etc.)
- Scanner unit display shows "check application animation" indicating that there is image in the memory which is not transferred to the driver

- Drives the carrier in
- Will not shutdown automatically
- Does not allow switching off the power (continuously beep when pressed) until the image is transferred.

Service Terminal

Service terminal is not an end user interface and training to use it in advance is mandatory to prevent the changing of unit configuration (=resulting the unit to become inoperative) accidentally.

Be very careful not to use service commands without the necessary know-how. Gain knowledge by going through all useful commands and train their usage in practice with scanner unit.

All service terminal commands and functions are not explained in this manual. They are instructed in the scanner firmware help (which is accessible through service terminal). This arrangement is to keep the documentation up to date, since the service terminal instructions for commands are always up to date in the scanner firmware. Therefore this manual explains only the principles of the main commands.

More detailed instructions of Service Terminal commands can be found later in this document and in their help outputs **<h [command]>.**

Accessing Service Terminal

- Service terminal commands are controlled either from imaging applications Service Assistant or from s2terminal

  > **NOTE: Only have either imaging application (Service Assistant) OR s2terminal open at one time.**

- Service commands are executed by scanner unit

Access service terminal Using s2terminal Program
- **THIS IS THE RECOMMENDED WAY TO ACCESS SERVICE TERMINAL**
  - **Firmware and core upgrade can only be performed with s2terminal**
- s2terminal program is run from the command prompt of Windows.
- **Application must be closed when accessing service terminal from s2terminal** If Application is opened at the same time, you will have a "login fail (no connection)" error message on screen when trying to make the connection.

Note the difference of actual command prompt and the s2terminal program running in it:
- The input and output of the s2terminal and of the command prompt look similar.
- However, the functions and commands available in the command prompt are not available in the s2terminal and vice versa.
- If you get confused it is good idea to check the title bar of the command prompt window
  - it should read "s2terminal" when the s2terminal program is running.
  - it reads "cmd.exe" when only Command Prompt is running

- Running the s2terminal program needs the following files**:**
  - s2terminal.exe   (Must be version dated 22/05/2009 or later)
  - s2.dll   (Must be version dated 21/05/2009 or later)
  - W32N55.dll   (Must be version dated 23/10/2007 or later)
  - (s2terminal has to be version 3.2.127.0 or later)

1. Copy all these files to one same and dedicated service folder that you may need to create (in following example "c:\s2terminal" folder is used to store s2terminal files)
2. Select from Windows: **Start** / **Programs** / **Accessories** / **Command Prompt**
   Or
   Select from Windows: **Start** / **run**

3. Type into "Open" -field: **<cmd>**
4. Choose **OK**
   Command prompt examples :
   - **<cd\>** (Changes to the root directory =C:\)
   - **<cd s2terminal>** (changes to directory "s2terminal")
5. **CHECK THAT Application IS NOT OPENED**
6. Type **<s2terminal>** in the command prompt to see the instructions for the command syntax. Then execute the program using the unit's IP -address.
7. Type **<s2terminal 192.168.2.11>**:
   - Starts the Service Terminal for unit having ip 192.168.2.11
   Or
   Type **<s2terminal 192.168.2.11 –c>**:
   - Starts the service terminal and configures ip –address to scanner unit 192.168.2.11
   NOTE: Keep start button pressed when entering <s2terminal 192.168.2.11 –c>:
8. If the IP-address is correct and the s2terminal program is able to connect to the unit, it prints out terminal output of the login command, which displays "s2terminal, the unit's firmware version(s), serial number and some parameters". Otherwise it displays an error message(s).
   NOTE: It is normal that you may have few times "login fail (no connection)" –error also in normal functioning connection
9. Quit s2terminal program by **<xq>**

Access service terminal with Service assistant –utility from the imaging application
- THIS IS THE ALTERNATIVE WAY (backup) TO ACCESS SERVICE TERMINAL
  - Use when imaging application –connection available
  - **Firmware download CAN NOT be performed from Service Assistant**
- Application connected, press **CTRL+ALT+SHIFT+E** simultaneously
  >> Opens imaging software **Service Assistant**

NOTE: If operating in Express Share configuration, the unit must be reserved before accessing service assistant by pressing "**CTRL+ALT+SHIFT+E**" buttons

Normal and Service Mode of the Unit

Service terminal can be used having scanner unit in Normal mode or Service mode
- Normal mode = Normal operation, use Service terminal to monitor the scanner unit operation
- Service mode = scanner unit Executes only the commands given from Service terminal. For example, Service Assistant activated at start-up >> start-up procedure can be monitored (possible error messages Etc…)

Almost all of the service procedures described in this manual are done in the service mode.

Remember to quit the service mode before trying to use the unit normally.

<s> Activates the service mode – and "service>" prompt is shown in the service terminal. NOTE! If scanner unit is in standby mode, the first command only exits the unit from the standby mode
<quit> Quits the service mode (=resumes scanner into normal operation mode).
<reset> Resets scanner unit. **(ONLY SW RESET)** Use if you get strange behavior when trying to use the unit after exiting the service mode. After reset you exit also the service mode

Service Command principles

General Principles for Command Usage
- About half of the commands activate a function, for instance the movement of the plate carrier or enabling the laser.
- The other half view or set the configuration parameters of the scanner unit.

- To use commands first see their description by **<h [*command*]>.**
  >> Then read all of the description before actually using the command.
  NOTE: Do not execute the command if you are not sure about it's function. Improper use of some commands may result scanner unit to become inoperative!
- Some commands are used to view and/or set different parameters of the unit.
- When issuing the command without any value (for example **<eject>**) it will display the current value of the parameter.
- If the parameter is followed with a value (for example **<eject 12000>**) the parameter value is changed.

If the unit is in standby mode (=yellow power ON/OFF led and display off)
- Does not execute the command, exits the energy saving mode when the command is entered for the first time
  >> You have to enter the same command again to perform the required action.

Help Command
 • The scanner firmware has built-in help.
 • The help functionality is similar in both (Normal / Service) modes of the unit.

<h>   Prints list of available commands
<h command>   Typing h + any command followed by enter from the service terminal
                         shows the help for particular command

Example:
<h calpr >   Means that typing: h calpr (and pressing enter) shows the help for
                         using calpr –options

<xh>   s2terminal help menu

Configuration info
<conf>   Shows the configuration parameters of the scanner unit

Service Log

Service log is a very useful tool for troubleshooting, so please learn how to use it!
 • You can get list of the error messages, which helps on troubleshooting. (Every time an
   error is caught it is recorded into the service log).
 • You can see the performed service procedures

 • **Check service log before the service procedures**
   AND
 • **Sign the service log after servicing, so that it later displays what service has been
   done for the unit.**

**TIP: Copy the contents of the service log, paste it to Notepad, Word etc. and send to
manufacturer Technical Service by Email.**

That helps manufacturer staff to give troubleshooting support.

<h log>   Shows the help for Service Log usage
<log>   Shows the contents of Service Log after the latest service signature
<log all>   Shows the whole contents of Service Log
<logsign>   Signature =describe what kind of service you have performed.
Example: **<logsign plate was not erased. John Smith replaced the erasing lamp>**
                >> saves "plate was not erased. John Smith replaced the erasing lamp"
                to the service log

Configuration parameters

Showing / setting configuration parameters

- **<conf>**   shows all configuration parameters of scanner unit
  -factory settings are shown in parenthesis, like (60)
- **<parameter>**   Shows the active and factory setting of parameter
- **<parameter XX>** Sets parameter value to XX, factory setting remains.

Autostart <autoscan>

- **<autoscan 0>**   Configures scanner unit to start readout after START pressed
- **<autoscan 400>** Configures scanner unit to start readout AUTOMATICALLY 0,4s
  after plate cover is removed
  (**<autoscan XXX>**, **XXX =delay in milliseconds**)

Beeper

- **<beeper 0>**   disables extra beeps (when going to idle mode etc…), but leaves all
  error and warning beeps enabled
- **<beeper 1>**   Enables all beeps (including when going to idle mode etc…)

Energy save mode <idle>

- **<idle>**   Shows time (seconds) scanner unit waits before goes to energy-
  save (60)
- **<idle XXX>**   Sets time (**XXX seconds**) scanner unit waits before goes to energy-
  save

Proximity sensor

- **<wakeup 0>**   Disables (=0) proximity sensor. In case of failing proximity sensor
  type <wakeup 0> to disable the proximity sensor and to allow the
  user to operate scanner unit normally without proximity sensor by
  manually using of the scan button.
- **<wakeup 1>**   Enable proximity sensor.

Automatic shutdown <off>

- **<off>**   Shows time before automatic shutdown (minutes, 240 DEFAULT)
- **<off XXX>**   Sets time (**XXX minutes**) before automatic shut-down

Restoring factory settings

- **<restore configuration>**   restores the factory settings for all <conf> -parameters

You can also restore individually each parameter to their factory settings by commanding
<parameter XXX>, where XXX is factory set value, which is shown after each parameter in
parenthesis (XXX).

Service commands on field service

Following are the recommended service commands to be used on field service:

- **\<h\>** Shows list of available commands (command **\<xh\>** in s2terminal)
- **\<autoscan 0\>** Configures scanner unit to start readout after START pressed
- **\<autoscan 400\>** Configures Unit to start readout AUTOMATICALLY 0,4 seconds after plate cover is removed (\<autoscan XXX\>, XXX =delay in milliseconds)
- **\<beeper 0\>** Disables extra beeps (when going to idle mode etc…), but leaves all error and warning beeps enabled
- **\<beeper 1\>** Enables all beeps (including when going to idle mode etc…)
- **\<calpr\>** Shows reflective sensor calibration values
- **\<calpr black\>** / **\<calpr none\>** / **\<calpr active\>** calibrates individual reflective sensor value
- **\<calpr all \>** Calibrates reflective sensor, follow on screen instructions
- **\<calpr position\>** NOTE! You must perform \<calpr position\> before any \<calpr\> commands to ensure that the scanner unit plate carrier is in the right position to perform reflective sensor adjustments. See chapter "Calibrating the reflective sensor"
- **\<clients\>** Shows the ip- or MAC-addresses of the client(s) connected to Unit
- **\<conf\>** Shows the configuration parameters of Unit -factory settings are shown in parenthesis, like (60)
- **\<cover\>** Shows the status of the safety switch
- **\<debug 9\>** Drives the plate carrier in, activates high voltage and starts to measure the ADC-input signal. This test is very useful when troubleshooting certain hardware (image signal) problems. Output value on the screen should be 0 (zero) when scanner door is closed (the PMT does not see any light and electronics after it is OK) / increases if you open the scanner door manually.\<debug 9\> test is stopped with command \<quit\> or pressing power on / off button.
- **\<diagnose\>** Performs self-diagnosis. This differs from the power-up diagnostics in the way that it requires user interaction. NOTE! Scanner unit asks you to press the control panel keys during self-diagnose. If not pressed, generates a timeout.
- **\<e\> & \<ec\>** Test the eject movement of the plate carrier
- **\<eject\>** Sets the carrier movement length for plate ejecting -increase the \<eject\> value if not properly ejected -decrease the \<eject\> value if plates are go outside plate collector
- **\<erase 1\>** / **\<erase 0\>** controls erasing lamp on/off
- **\<h\>** Shows list of available commands
- **\<h calpr\>** Shows help for calpr -command. **\<h xxx\>** = help for command xxx. With the same principle you get the help for each command. Syntax: \<h [*command*]\>.
- **\<home\>** shows the status of the home optoswitch
- **\<idle\>** Shows time (seconds) Unit waits before goes to energy-save (60)
- **\<idle XXX\>** Sets time (XXX seconds) Unit waits before goes to energy-save
- **\<laser 1\>** / **\<laser 0\>** Controls laser on/off
- **\<log\>** Shows the contents of service log after latest signature
- **\<log all\>** Shows the whole contents of service log
- **\<logsign\>** Stores a service signature into the service log
- **\<logsign sensor calibrated\>** Stores "sensor calibrated" to service log
- **\<off\>** Shows time before automatic shutdown (minutes, 240 DEFAULT)
- **\<off XXX\>** Sets time (XXX minutes) before automatic shut-down

- **<plate>**   Shows the reflective sensor detection status
- **<prevtime>**   Sets minimum preview image display duration in seconds. Preview image display can be disabled by setting value to 0.
- **<quit>**   Exits service mode
- **<reset>**   Resets Unit = Performs the normal initialisation sequence. Does not affect any parameter settings etc..
- **<restore configuration>** restores the factory settings for all <conf> -parameters
- **<xh>**   s2terminal help menu
- **<xq>**   Exits s2terminal –program (from command prompt of Windows)
- **<wakeup 0>** / **<wakeup 1>**   Disables / enables proximity sensor.
- **<wakeuptest>**   Displays the state of the proximity (wakeup) sensor (ON = sensing / active and OFF = inactive)

In service terminal normal mode you are able to perform following unit related functional tests:

- **<test XXXX YYY>** Performs endurance test with pause / as many times as commanded.
  -Endurance test = runs the normal readout/erase -cycle
  -Example: <test 5000 100> makes 100 tests with 5 seconds pause
  -Have top cover on OR command <togglehv> + keep the safety switch closed when issuing **<test XXXX YYY>**
  -NOTE: Disconnect Ethernet cable or close Application
      (=to avoid blank images appearing on the open patient card)
    - PRESSING STANDBY KEY ends the endurance test

- **<togglehv>**   toggles high voltage
  -Commanding **<togglehv>** the 1st time = DISABLES High Voltage
  -Commanding **<togglehv>** the 2nd time = ENABLES High Voltage
  -Commanding **<togglehv>** the 3rd time = DISABLES High Voltage etc...
  -Normally Unit uses high voltage (=hv) for self test @startup and during normal readout.
  -If the safety switch is open, Unit generates an error during startup and normal readout because laser and HV are disabled by the switch.
  -These precautions are necessary to protect the PMT.
  If you command **<togglehv>**, Unit does not use HV, and no HV error message is generated.
  -Then you can operate unit without top cover if you manually close the safety switch
  -This may be helpful on some troubleshooting.
  -Just remember to command **<togglehv>** again for normal operation.
  -If you operate service terminal from command prompt of Windows, you have indication on the screen telling that "hv is disabled".

Maintenance

Annual maintenance is not mandatory. However, it is recommended to check the following topics during site visit or other service activities:

ROUTINE CHECKS WITHOUT OPENING THE UNIT:
- Scan a test image using INTRA DIGI IEC TEST PHANTOM SP00267 and check the image quality
  - Refer to the instructions provided with the test phantom for image quality criteria

- Check image geometry (measure the length and and re calibrate <gear> if necessary)

- Check that reads and shows all 4 IP sizes properly

- Check all Imaging plates by exposing without a phantom
  - No scratches, spots etc.?
  - Need of cleaning?
  - Need for replacing?

ROUTINE CHECKS WHEN UNIT OPENED:
- Check the belt tension:
  - Rotate drive wheel manually slowly >> the motor drive shaft rotates along with
  - Rotate the motor shaft from the flywheel so that the eject-mechanism starts to utilize. The belt must not slip during the eject movement (=most resistance for the carrier movement when the eject spring is pressed)
  - Command <ec> + press start and observe the movement of the plate carrier
  - See chapter "Drive Belt: Cleaning, tension check, adjustment and replacement" in this manual.

- Clean drive belt , motor shaft and drive wheel + conveyor belt and it's drive wheels
  - Use lint-free cloth dampened with rubbing alcohol(ethanol)
  - See instructions "Plate carrier belt (conveyor belt): Tension check and adjustment" in this manual.

- Tighten the drive belt if got too loose (=the plate carrier not moving properly).
  - See instructions "Drive Belt: Tension check, adjust and replacement" in this manual.

- Tighten the plate carrier (conveyor) belt if gets too loose (=the plate carrier not moving properly).
  - See instructions "Plate carrier Belt (conveyor belt): Tension check and adjustment" in this manual

- Clean and Lubricate the plate carrier rails if dusty / dirty or lacking lubrication
  - Use lint-free cloth dampened with rubbing alcohol(ethanol) for cleaning
  - Use "Lithium MoS2" -grease (CRC "SUPER LONGTERM GREASE + MOS2", or equivalent). Apply thinly and move manually back and forth.
    NOTE: Using improper lubrication may cause problems!

- Check the movement of the eject mechanism
  - Use silicone or teflon based, fine lubrication if required
- Check that the ejecting mechanism is not making noise when moving.
  - Lubricate the spring rod with or teflon based, fine lubrication if required

- Check that the plate carrier is not hitting the plate guide (=aluminum block beside the erasing lamp reflector)
    - Between plate carrier and plate guide there must be gap which is less than the thickness of the imaging plate
    - Adjust the plate guide by loosening the two fastening screws from top, if necessary

- Check that the plate carrier is not hitting the light collector cylinder (reflecting aluminium)
    - Must be about 0,5mm clearance in between

- Check the bearings and shaft fastenings

- Check the sliding movement of door and movement of all mechanism joints
    - Use silicone or teflon based, fine lubrication

- Check that the flywheel on the motor shaft is not touching the frame or the belt

- Check that the plate carrier belt drive pulley (close to front plate) is properly fastened with set screw

Field Service Procedures

Service policy:

Scanner unit can be sent to factory for repair if it can not be repaired by:
- Performing the calibrations and configurations instructed in this manual **AND/OR**
- Replacing field serviceable parts

Please refer to spare parts manual for **FIELD REPLACEABLE PARTS**.

Other accessories include:
- Image Plate collector and
- External Power Supply

Both can be located from **ACCESSORY CATALOG**

Calibrating the Reflective Sensor

- Reflective sensor is used to detect when the protective cover is removed and that the plate is inserted correctly.
- Sensor has to be calibrated if scanner unit does not start readout when the plate is correctly inserted or if it starts the readout even without the plate. Also after sensor replacement.
- It is a good preventive action to check the sensor operation (and calibrate, if necessary) when performing any other service for scanner unit.
- Use command <plate> to check how detects active / black / none.
- See <h plate> and <h calpr> for instructions.
- Remember to close covers during calibration. Ambient light can interfere calibration.

> **Follow the <h command> online-instructions, they are updated if calibration routine is modified on future firmware.**

REFLECTIVE SENSOR CALIBRATION
- Have NO PLATE in plate carrier
- **<calpr position>**   Measures the optimum load position for the plate carrier
- **<calpr all>**   Calibrate reflective sensor. Follow on-screen instructions
- **<plate>**   Check the detection result when inserting:
    - -No plate inserted   >> NONE
    - -Plate in cover   >> ACTIVE
    - *Angle the plate+cover towards left from front edge to see that tolerates min. 1mm tilting before the output turns from "active" to black".
    - -Plate wrong way round   >> ACTIVE
    - -Plate right way round   >> BLACK
    - *Angle the plate towards left from front edge to see that tolerates 2mm tilting before the output turns from "black" to "none"

Calibrating Resonant Scanner Amplitude

- This may help in case that scanner unit generates some error related to laser sync (Degraded image quality, Error # 34 & 35 etc…)
- Necessary after H1300 interface board replacement
- Warm up the unit to the room temperature
  - Do not ignore the warm up procedure in previous step – scanner amplitude is naturally larger when cold with the same driver voltage than in the normal operation temperature
- Calibrate resonant scanner amplitude by **<calga>** + (safety switch must be closed)
- If <calga> is not completed successfully, check that:
  - Laser turns on
  - Mirror scanner oscillates (=makes the laser line)
  - Connectors (J306, J308, J311 & J312) from H1300 Interface board to the scanner module are OK.
- If <calga> is not completed successfully, you can also try the following:
  - Command **<ga>**, you get the output "object ga is at XXX (XXX)
  - Command **<ga YYY>** (YYY=XXX+10).
    Example: If you had "object ga is at 171, command **<ga 181>**
  - Command **<ga>**, to see that the output is "object ga is at YYY" as you wanted.
- Note! Verify image geometry after performing **<calga>**
  (calga changes the amplitude setting **<ga>** for resonant scanner amplitude).

Gear ratio calibration, Command: <gear>

- If the belt tightness changes, that changes also the gear ratio of scanner unit's plate carrier drive. This is because the drive belt from the motor shaft to the drive wheel has no teeth. Incorrect gear ratio causes error to horizontal (=slow scanning) dimension of images.
- Correct gear ratio has to be set by calibrating **<gear>** -parameter as instructed.
- When **<gear>** is calibrated correctly, the image measurements will be exact. In addition this improves the precision and functionality of automatic plate size detection (= prevents for example size 2 IP image to be shown in dental imaging application window as a size 3 image).
- If the belt tightness has been changed or adjusted, you have to perform **<gear>** parameter setting
- You need to take an X-ray image with some kind of phantom to be able to perform **<gear>** setting
- Instructions for **<gear>** -parameter setting can be found with command <h gear> from service mode

Gear ratio calibration instructions:
  <gear>, Syntax: **<gear [ratio]>**
  Slow scanning gear setting.
- Must be set directly after the belt tension has been adjusted.
- Default value is 54185.
- Typical values for different belt tightness and other variations range from 51000 to 57000.
- Greater difference from the default almost certainly means that the belt is slipping or the measurement for gear is made incorrectly.

Follow the procedure below to adjust the gear parameter:

1. Set resolution to super as follows:
   - Options >> Scanner Setup >> Image Scanning
     - Resolution: Super

It is IMPORTANT to have SUPER resolution selected! (HIGH -resolution setting results incorrect measurement values)

2. Start the adjustment with the value of 57000 for the gear (command <gear 57000>)
3. Measure the length of the size 2 IP to be used (**X0**, measured imaging plate, nominal 41mm) with accuracy of 0.1mm.
4. Exposure size 2 imaging plate fully using some dummy phantom.

It is IMPORTANT not to take an empty exposure (ANY PHANTOM!).

5. Read the image normally
6. Scan and MEASURE THE LENGTH OF EXPOSED AREA =X1
   - Measure only the exposed area (=leave the white area outside measurement)
   - Measure X1 as precisely as possible.
   - Use all digits of X1 for the following calculation
7. Set the new gear value to:

X1 (measured from image with Application) / **X0** (measured from the imaging plate) x 57000.

New **<gear>** -value must be between 51185…57185 (+/- 3000 from default 54185).

8. Read another exposed ip and measure the width of image with Application as described in 7.
9. Set the resolution back to high, if you wish

Example values for one scanner unit's <gear> calibration:

-Measured the exposed area of the image at Application (X1): 36,88 mm
-Measured the width of the imaging plate (X0):   41,0 mm

$$\frac{36,88 \ (X1)}{41,0 \ (X0)} \times 57000 = 51272$$

Adjusting the Plate Carrier (<calpr position>, <eject> and <start>).

Plate carrier parameters are used to control the plate handling positions.
Adjust these parameters only in case that there is some problem with plate insertion /-ejection, image centering or plate detection and/or reflective sensor calibration.

If adjusted, order is: 1) <calpr position> / 2) <eject> / 3) <start>

PLATE CARRIER POSITION FOR PLATE INSERTION AND PLATE DETECTION, COMMAND <calpr position>
- Perform **<calpr position>** as instructed in the reflective sensor calibration instructions

EJECT:
The main idea of **<eject>** -parameter adjustment is to set the parameter so that the ejecting mechanism is fully utilized
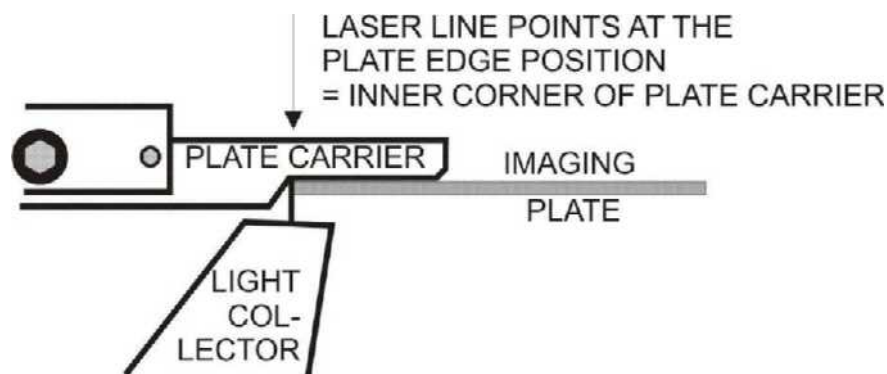**Eject force, command <eject XXXX>**
- **Bigger value** for **<eject XXXX>** =**Longer eject movement** (= "Stronger eject")
- **Smaller value** for **<eject XXXX>** =**Shorter eject movement** (= "Weaker eject")
- Plate carrier must not hit the front end at the end of eject movement

START (IMAGE HORIZONTAL POSITION):
Sets the plate carrier position in which the laser is turned on (=start of image readout)

COARSE CHECK/ ADJUSTMENT FOR IMAGE POSITION HORIZONTALLY LEFT-RIGHT (TOP COVER REMOVED):
1. **<laser 1>** + have safety switch closed
2. **<e>**
3. Check that the laser points to the start of the plate at the moment when stops shortly in front of the plate collector (see illustration below)

LASER LINE POINTS AT THE PLATE EDGE POSITION = INNER CORNER OF PLATE CARRIER

PLATE CARRIER   IMAGING
PLATE
LIGHT COL-LECTOR

FINE TUNING THE IMAGE POSITION HORIZONTALLY (LEFT - RIGHT), COMMAND <START XXXX>
- Expose and read image, check horizontal position from the image
- Adjust with **<start XXXX>**

BIGGER value for **<start XXXX>**   Moves the IMAGE LEFT in application window
SMALLER value for **<start XXXX>**   Moves the IMAGE RIGHT in application window

NOTES:
- Parameters can also be negative.
- You can always restore the original factory setting which is shown in (parenthesis).
- You can restore all factory set parameters with command <restore configuration>.

Eject adjustment:
1. **<eject 13000>** while in service mode
2. **<calpr position>**
3. Check that the plate carrier is 0,5…2mm out from the unit door
4. Insert size 0 plate (if available, it is the most critical size for eject performance)
5. Command **<e>** or **<ec>** and observe the plate eject performance
6. **<eject 13500>**, observe plate ejecting
7. Increase the value XXXX of **<eject XXXX>** by increments of 500, command **<e>** or **<ec>** until the plate ejects
8. Add 1500 to the value with which the plate was ejected and command **<eject YYYY>**
   YYYY = value XXXX when the plate was ejected + 1500
   (Example: If the plate was ejected with 14000, command **<eject 15500>**)
9. Command **<e>** or **<ec>** and observe the plate eject performance with all plate sizes

Centering the image vertically, FINE TUNING (UP – DOWN)
- Fine tuning for image vertical centering can be done by changing parameter **<ds>**
- Maximum allowed change for **<ds>** -value is +/-300 from the factory-set value.
- DECREASING **<ds XX>**   Moves the IMAGE UP in imaging software -window
- INCREASING **<ds XX>**   Moves the IMAGE DOWN in imaging software – window

Centering the image vertically, COARSE ADJUSTMENT
- If the image can not be vertically centered by changing **<ds XX>** as instructed above, it may be necessary to adjust the plate carrier mechanically up or down as follows.
- Vertical position adjustment of the plate carrier:
  1. Loosen two small screws and one bigger at the middle on top of the plate carrier
  2. Adjust equally with two screws on top (tightening moves the plate carrier down)
  3. Tighten the bigger middle screw on top
  4. Tighten the two smaller screws on the top
- Moving PLATE CARRIER UP   Moves the IMAGE UP in imaging software -window
- Moving PLATE CARRIER DOWN   Moves the IMAGE DOWN in imaging software - window

Firmware (=FW), core and display graphics upgrade

- You do not have systematically to upgrade newest version of firmware, core and display graphics to all Express units, unless Instrumentarium Dental technical service has instructed so. But it is recommended to upgrade latest FW, core and graphics in case you do any other service.
- **Instrumentarium Dental strongly recommends that the latest FW, core and display graphics are all updated at the same time.**
- **Using latest FW, core and display graphics versions provides the unit with all features and improvements**
- **Firmware, core and graphics upgrading is done using s2terminal -program**
  (This **CAN NOT** be done with Service Assistant –utility of the application!).

Upgrading requires the following files to be copied to same folder (for example **C:\s2terminal):**

Express **FW, core and graphics** upgrading:
- **OptPlus_FW.srec**   Firmware file
- **OptPlus_coreXXX.rbf** Core file, version XX
- **ImagesIJ.bin**   Display graphics file
- **s2terminal.exe**   Needed to run s2terminal   (Must be version dated 22/05/2009 or later)
- **s2.dll**   Needed to run s2terminal   (Must be version dated 21/05/2009 or later)
- **W32N55.dll**   Needed to run s2terminal   (Must be version dated 23/10/2007 or later)
  (S2Terminal has to be version 3.2.127.0 or later, shown when S2terminal runs)

Firmware (=FW) upgrade

Following commands are needed to upgrade FW.
- o Type **<xh>** in the command prompt to see the instructions for the command syntax.
- o Command **<xs>** Starts the firmware upgrade and restarts the scanner unit after upgrade is finished
- o After restart type **<h>** check the FW version
- o Switch scanner unit off and on to see that there are no errors during start up.

1. Copy the new firmware file (to be downloaded to the unit) to the same, dedicated folder (for example **c:\s2terminal**) with the s2terminal files = from which you will start the s2terminal.

2. CHECK THAT APPLICATION SW IS CLOSED!

3. Command <**xs**>   Starts the firmware upgrade
If the upgrading was succesfull, you should have the output similar to follows:
xs
Transferring firmware
Firmware data sent, waiting for flashing...........
Resetting...
Login fail (no connection).
Login fail (no connection).   **It is normal that this "Login fail…" –message appears several times**
Connected to Optime
Software (Firmware) version X.XX
Core version   XX
Serial number XXXXXXX
Etc… ending with Express vX.XX> (**vX.XX should now equal to the new firmware version)**

Core upgrade

- • You do not have systematically to upgrade newest core to all scanner units, unless technical service has instructed so, but it might be good thing to do in case you do any other service for scanner unit
- • Firmware upgrading is done using s2terminal -program (**can not** be done with Service Assistant on the Application software!).

1. Copy the core file to the same, dedicated folder with s2terminal files
          (for example **C:\s2terminal**).
2. CHECK THAT Application SW IS CLOSED!
3. Execute the s2terminal program using the unit's IP –address
4. Command **<xc XXX>** (**XXX** = version number in the core filename)
          >> Starts the core upgrade
5. Wait until s2terminal tells that upgrade is finished
6. Switch scanner unit off

Graphics file upgrading

1. Copy the graphics file to the same, dedicated folder with s2terminal files (for example **C:\s2terminal**).
2. CHECK THAT APPLICATION SW IS CLOSED!
3. Execute the s2terminal program using the unit's IP –address
4. Command **<xg>**
5. Wait until s2terminal tells that upgrade is finished("GUI update ready" is displayed on the s2terminal)
6. Switch scanner unit off

Changing hardware parts

Replacing External Power Supply

- Just plug in the new external power supply. No adjustments or calibrations required

Replacing R2100 Power & Analog Board

- Open the electronics box lid and replace R2100 with new board
NOTE: BNC-connector located on the solder side of R2100
- No calibrations or configurations required after replacement

Replacing H1200 General Control board (GC)

All factory calibrations and parameter settings are stored in the flash of H1200.
These settings must be stored from the original H1200 and configured to the new board.

- Open service assistant from Application (or enter service mode from s2terminal)
- Command **<s>**
- Command **<conf>**
- Copy all configuration parameters and paste to Notepad, Word etc.
- Save these settings for example with a filename xxyyyyyyy_conf, where xx are the letters of the main label serial number field and yyyyyy is the actual serial number of the scanner unit. (Alternatively record all parameters manually)
- Open the electronics box lid and replace R1200 with new board
- Connect all connectors to H1200 and fasten the electronics box lid
- Insert the scanner mechanism to the bottom cover
- Connect power and Ethernet -connectors
- Switch scanner unit on
- Start command prompt of windows, make connection and upgrade latest firmware (core and graphics) version(s) as described in this manual
- Command **<s>**
- Configure all parameters (except calpr active / black / none) as they were on the original board
- Calibrate reflective sensor as instructed in this manual
- Configure serial number to the new board, command **<serno xx yyyyyyy>,** where xx are two letters stated in the unit main label before serial number. NOTE! Letters are separated by one space in the command from the yyyyyyy which is the actual serial number of the scanner unit.
-
  NOTE! Serial number can be set only once on each board.

- If H1200 does not boot at all and you do not have the original configuration values available, you must get the original factory set configuration data from technical support of the scanner unit.

Replacing H1300 Interface Board

- Perform **\<calga\>** after replacement. Refer to calibrations instructions on how to do this.

Replacing Reflective Sensor

- Beware not to bend the infrared emitter (transparent LED).
- Do not touch pcb surface by bare finger (as may get dirty and affect on the functionality)
- Touching of the connector is permitted
- Calibrate as instructed

Replacing Home Opto Switch

1. Remove the top cover
2. Remove the Light Protection cover by opening the two screws on top of it.
3. After replacing the opto switch, check the plate insert / readout / ejecting –performance
   See instructions in this manual

Replacing Erasing Lamp

1. Remove the top cover
2. Remove the Light Protection cover by opening the two screws on top of it.
3. Remove the old erasing lamp by pulling it straight upwards.
   NOTE: Do not touch the new lamp with bare fingers when installing it!
4. Push the new lamp firmly into its' socket.
5. Test the lamp operation from service terminal: **\<erase 1\> \<erase 0\>**.

Replacing Safety Switch

- Ensure that the newly replaced safety switch closes when the top cover is properly fit.
- When the switch is closed, output must be 1 after commanding **\<cover\>**.

Replacing membrane switch panel

- Membrane switch panel is integral part of the cover assembly into which it is fixed.
- Remove and replace the cover

Replacing the proximity sensor

- Remove front cover from the unit to have access on the proximity sensor fixing mechanics
- Replace the sensor and assemble back the cover in opposite order.
- Carefully place the wiring into the same place(s) to ensure flawless electrical operation after assembly
- Test operation with **\<wakeuptest\>** as instructed in this manual

Replacing the scanner module

- Refer to instructions provided with spare part –scanner module

Checking mechanical parts

Drive Belt: Tension check and adjust, if necessary

Tension check:
- Suitable tension of the belt = as little friction as possible while sustaining the movement.
- Rotate drive wheel manually slowly >> the motor drive shaft rotates along with it.
- Rotate the motor shaft from the flywheel so that the eject-mechanism starts to utilize. The belt must not slip during the eject movement (=most resistance for the carrier movement)
- Command **<ec>** + press start and observe the movement of the plate carrier

Adjusting the drive belt:
- Drive belt is removed according the image instructions
- After removing and replacing the motor and or drive belt adjusting of the tension is needed.
- Loosen the four motor fastening screws 1 to 2 turns equally.
- Adjust the belt tension with adjustment screw. Start adjustment with very low tension.
- Increase tension gradually while rotating the wheel from the flywheel of the motor shaft until the plate carrier moves all the way (including the whole ejecting mechanism movement) and does not (but barely) slip any more.
- Issue the **<e>** command from the service terminal. Plate carrier movement must not stop when the motor speed/current is changed to lower setting (this happens at the moment when the inwards movement of the carrier is slowed down).
- Tighten adjusting screw one additional full round
- Tighten the four motor fastening screws
- Loosen the adjustment screw 1/4 round
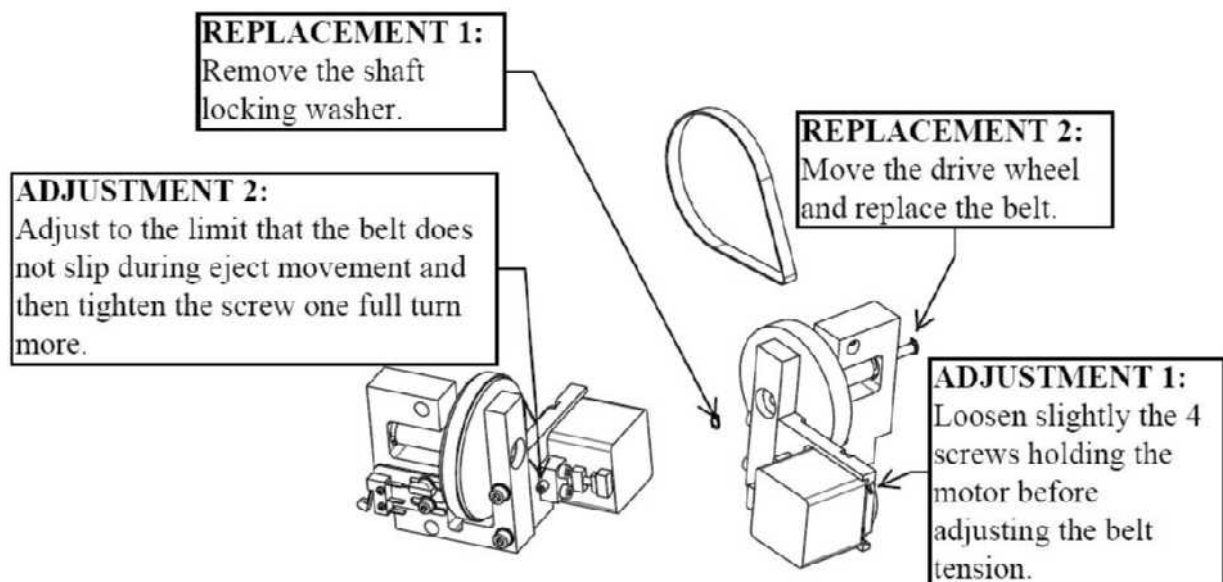- Perform **<gear>** ratio calibration as instructed earlier in this manual

REPLACEMENT 1:
Remove the shaft locking washer.

ADJUSTMENT 2:
Adjust to the limit that the belt does not slip during eject movement and then tighten the screw one full turn more.

REPLACEMENT 2:
Move the drive wheel and replace the belt.

ADJUSTMENT 1:
Loosen slightly the 4 screws holding the motor before adjusting the belt tension.

# Plate carrier belt (conveyor belt): Tension check and adjustment

Plate carrier tension check:

- Rotate the motor shaft from the flywheel or from drive wheel so that the eject-mechanism starts to utilize. The plate carrier belt (conveyor belt) must not slip during the eject movement (=most resistance for the carrier movement)
- Command **<ec>** + press start and observe the movement of the plate carrier

- Suitable tension of the belt is checked with the special tool SP00555(refer for the spare part catalog for detailed item information)

Adapter knob must be down as in the image.
Rotate clockwise to get it down if wrong.

- Move plate carrier as far back as it goes by manually rotating the drive wheel
- Insert the tool in the middle of the belt. Ends of the tool against the end pieces of the plate carrier rail mechanism
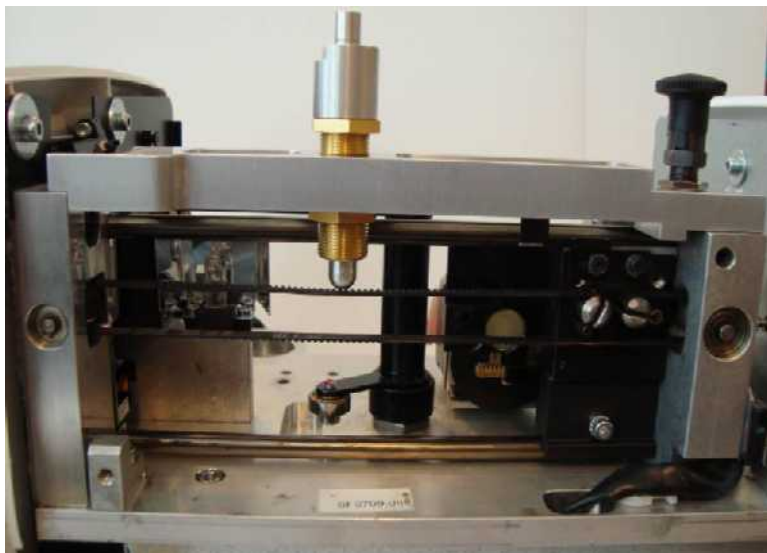
 Check / adjust between top and bottom lines.
(Optimal at middle line
= two rings shown).

Belt tension adjustment:
- Loosen the locking screw (A) (allen hex 2,5mm tool) at the front face of the plate carrier. Leave locking screw just a bit tight (so that the adjustment screw (B) can be turned but does not slip back by itself)
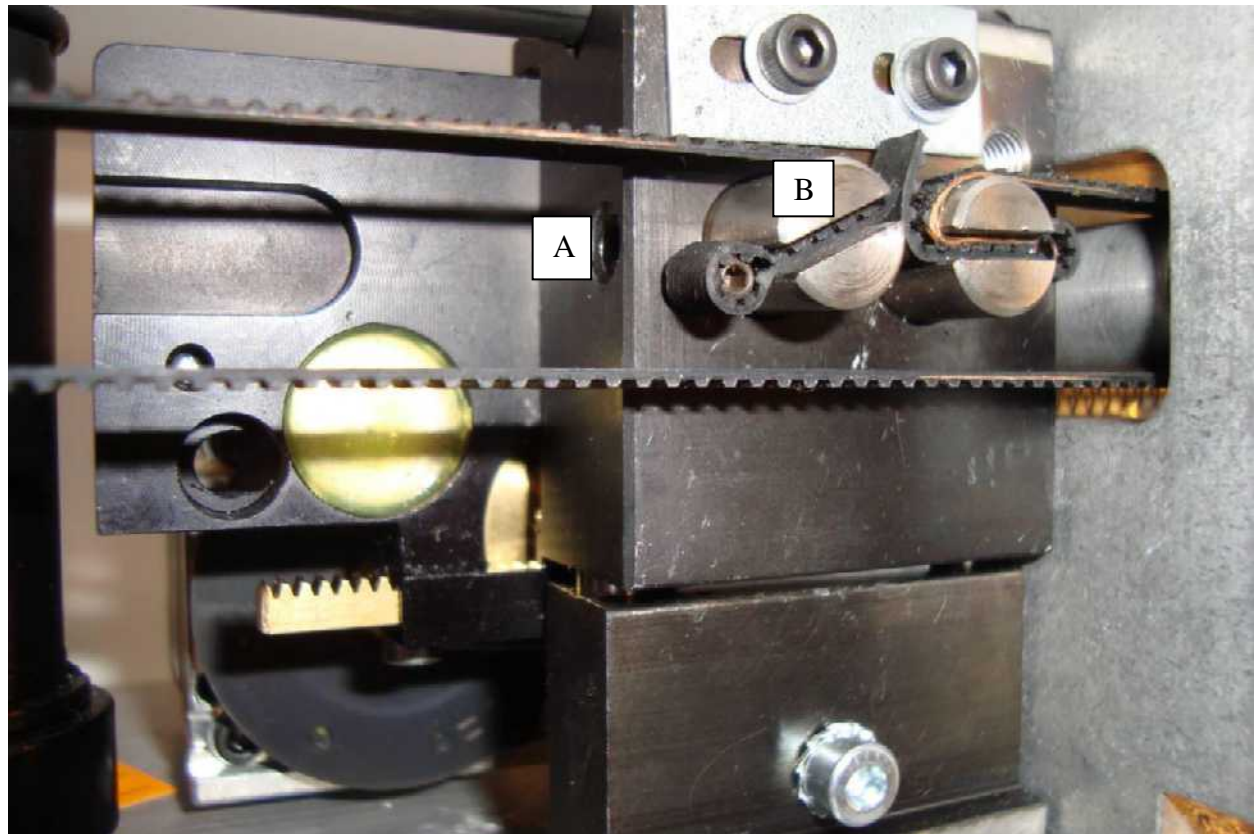
- Rotate adjustment screw (B) with flat screwdriver so that two rings is visible in the tool. This is optimal position. See following images.

| MAXIMUM LIMIT | **OPTIMAL** | MINIMUM LIMIT |
| Three rings shown | **Two rings shown** | One ring shown |

- Hold the adjustment screw in its position with flat screwdriver
- Tighten the locking screw (A)
- Check the tightness. Re-adjust if necessary.

Plate carrier drive mechanism: cleaning and lubricating

Clean drive belt , motor shaft and drive wheel + conveyor belt and it's drive wheels
For cleaning, use lint-free cloth dampened with rubbing alcohol

- Remove drive belt from the drive wheel and motor shaft (just push the belt off the drive wheel)
- Clean the inside surface of the plate carrier belt. Clean also the drive shaft of the plate carrier belt. Rotate from drive wheel back and worth to ease the cleaning.
- Clean the motor shaft
- Clean the drive wheel and drive belt
- Re-install the drive belt
  - See instructions "Drive Belt: Tension check, adjust and replacement" in this manual.
- Lubricating
  - See SP00202 INTRACR MECH MAINTENANCE KIT for further information

Troubleshooting with error codes

- Present error code is shown in the scanner unit display and in s2terminal (service software
- Dental imaging software has scanner setup tab / window where scanner setup related information is configured. From scanner setup page you are able to check active scanner unit error /status after scanner name / serial number
- Error codes are also stored in the service log inside the unit. Service log can be read by using s2terminal or Service assistant (for more info, see chapter service log)
- Correct service instructions can be found from the list below by using error code number as a reference

Error 032 Carrier home too early

Cause
- The plate carrier is not moving properly. This is recognized when the home optoswitch activates too early.
- The plate carrier is hitting the plate guide (aluminum piece inside the scanner)
- The plate carrier is hitting the light collector
- Belt(s) slipping
- Home opto-switch is broken.

Check
- Movement of the plate carrier, the gear belts and belt wheels **<e>**
- Belt tightness check and cleaning
- Adjustment of the plate guide and light collector (must be about 1mm gap).
- Operation of the home optic switch **<home>**

Solutions
- Adjust the plate guide by loosening the two fastening screws from top and re-tighten
- Adjust / bend slightly the light collector cylinder
- Clean the belts and drive wheels & shafts (and tighten the belt, if necessary), as instructed in service manual
- Clean and lubricate the gliding parts

Error 033 Timeout while homing carrier

Cause
- The plate carrier is not returning to home position quickly enough. This is recognized by the home optoswitch not activated when supposed to.

Check & Solutions
- First check instruction below, if this does not apply, see error 032 for more instructions.

If the Home Opto Switch is defected, this problem occurs. The condition of the Home Opto Switch can be checked by using s2terminal or service assistant in the service mode.
- Turn on the unit
- Open the unit upper cover
- Run s2terminal or enter the service assistant by pressing **<Ctrl+Alt+Shift+E>** keys simultaneously
- Enter the service mode - type **<s>** and hit enter
- Type **<home>** and hit enter

- Move the plate carrier manually (by turning the big belt wheel) so that the Home Opto Switch will turn on and off.
    * When the plate carrier is home (closing the Opto Switch connector) the text in the service assistant should be "Home Opto Switch Close".
    * When the carrier is moved away from the switch the status should be "Home Opto Switch Open".
- If the switch is defected, please change the switch.

Error 034 Timeout while trying to get laser sync

Cause
- The mirror scanner amplitude is incorrect
- Laser, laser detector board or mirror scanner is not working properly.
        * This can happen if the environment temperature is very high or low.

Check
- Laser operation and length of the sweeping laser line (**<laser 1>** + defeat safety switch).
        * Laser must turn on and the length of the line must reach both sensors on the R2700 Laser Detector Board, but not exceed too much above or below.
- Cover switch operation (**<cover>**)(In case FW is 5.04 or older)
- See APPENDIX 1 for further information

Solutions
- Recalibrate amplitude (**<calga>** + defeat safety switch).
        Note! Verify image geometry if you need to change factory preset for amplitude.
- Make sure the using conditions of the Unit are within specified values.
- If these do not help, scanner module may need to be replaced. See APPENDIX 1 for more info

Error 035 Timeout when waiting the stabilizing of the laser sync

NOTE: same instructions apply in case of error 041 & 042

Cause
- Safety switch open or defective(In case FW is 5.04 or older)
- The mirror scanner amplitude is incorrect or the scanning module is not working properly.
- External shocks, vibrations and/or heavy electromagnetic interference may also cause this error.

Check
- Cover switch operation (**<cover>**)(In case FW is 5.04 or older)
- Laser operation and length of the sweeping laser line (**<laser 1>** + defeat safety switch).
        * Laser must turn on and the Length of the line must reach both sensors on the R2700 Laser Detector Board, but not exceed too much above or below.
- Locate possible Electro Magnetic Interference sources near to unit (monitors, amplifiers, transformers, phones, etc.).
- Locate sources of vibration and put the scanner into the sturdy surface.
        * Even small vibrations can cause interference if they are at the certain frequency range (about 50 Hz upwards).
- See APPENDIX 1 for further information

Solutions
- Relocate scanner to avoid EMI interference and vibrations.

- In the Unit error log, if there more than 5 error messages from the groups: 34, 35, 41 or 42, and if the above mentioned steps did not fix the problem, scanner module may need to be replaced. For more info about scanner module replacement, see APPENDIX 1.

Error 036 Configuration data invalid

Cause
-The flash configuration memory on H1200 General Control Board is corrupted.
   *Proper configuration data is lost.

Solutions
-Re-configure the processor board
-Replace H1200 General Control Board processor board

Error 037 CRC invalid

Cause
-The flash memory on H1200 General Control Board has been corrupted.

Solutions
-Upgrade the firmware
-Replace H1200 General Control Board

Error 038 High voltage not ok

NOTE: same instructions apply in case of error 039

Cause
High voltage check failed before the scan or during initialization.

Check
- Check that the safety switch is working properly (**<cover>**)(In case FW is 5.04 or older)
- Check Photo Multiplier Tube PMT cabling
- Check the R2100 Power and analog board
- Check the H1300 Interface board
- Check as instructed in APPENDIX 2

Solutions
Check if the cover safety switch is working properly(In case FW is 5.04 or older)
   - Enter service mode from s2terminal by command **<s>**
   - Command **<cover>** shows the status of safety switch.
    * When the cover is in place, system should reply "Object cover is at 1".
    * When cover is not in place, system should reply "Object cover is at 0".
   - If the command <cover> shows wrong status, first replace the safety switch.
   - If this does not help, then replace the H1300 Interface board.

Check photo multiplier tube (PMT) cabling and grounding
   - Follow the HV and signal cabling from PMT to the R2100 power&analog board.
   Perform visual check.
   - Follow instructions of APPENDIX 2 for BNC ground connection checking

Replace R2100 power&analog board
- No calibrations needed after replacement.

Replace Scanner Module
- If the above mentioned steps did not solve the problem and the problem root cause is located in the scanner module, it may need to be replaced. For more info about scanner module replacement, see APPENDIX 1.

Error 039 Log amp calibration failure

Cause
- Self check of the internal analog signal amplifier fails.

Check
- Are the R2100 (Power and analog) and H1200 General Control Board firmly grounded?
- "Logamp test curve" values during the Unit initialization
- PMT and R2100 as instructed in APPENDIX 2.
- Instructions for Error 038

Solutions
- See APPENDIX 2 for detailed instructions
- Solutions for Error 038
- Replace R2100

Error 040 Carrier unable to leave home position

Cause
- Plate carrier is stuck at home position.
- HOME-optoswitch or it's cabling is defective
- H1300 Interface board is defective (either the motor drive or HOME-optoswitch circuitry)

Check & Solution
- See error 032 for instructions

Error 041 Timeout while trying to get laser sync averages

Cause
- Problem with laser synchronization
- Laser sync check failed before the scan or during initialization.

Check & Solution
- See errors 034, 035 and APPENDIX 1 for instructions

Error 042 Timeout while trying to get laser sync during scan

Cause
- Problem with laser synchronization
- Laser sync failed during the scan

Check & Solution
- See errors 034, 035 and APPENDIX 1 for instructions

Error 043 Erasing lamp blown

Cause
- Erasing lamp or cabling defective
- Improper lamp condition monitoring feedback (the lamp itself might be OK)

Check
- Erasing lamp (try **<erase 1>** from the service terminal).

Solutions
- Check the cabling or replace the lamp
- Replace H1300 Interface board

Error 044 Plate / reflective sensor broken (detected during start up)

Cause
- Plate sensor is not working during start up. Functioning of the sensor can be checked with **<plate>** command
- Check that PMT grounding is not defective. FW check HV voltage every time when unit is powered. Check routine fails and error is displayed (in this case misleadingly for reflective sensor)

Check
1. Check wiring of the plate sensor
2. Check PMT functioning according following instructions:
   - enter service mode (command <s> in s2terminal)
   - enter <debug 33>, wait until unit has driven the image plate holder inside the unit and that unit door is closed properly
   - Press start button to stop the movement
   - enter <hvtest>
   - if PMT is OK results are:
     ```
     Service>hvtest
     HV feedback with dac values 0, 50 and configurated HV:
     0 = 0
     50 = 8199
     HV (161) = 16383
     Service>
     ```
     NOTE! Value for HV setting 50 is not necessary 8199, value is different for each tube.

   - If PMT is defected results are following:
     ```
     Service>hvtest
     HV feedback with dac values 0, 50 and configurated HV:
     0 = 16383
     50 = 16383
     HV (161) = 16383
     Service>
     Bolded values are not ok, PMT ground signal is broken.
     ```

Solutions
1. Change wiring or replace plate / reflective sensor
After replacement perform **\<calpr all\>** and check functioning
2. Change scanner module (PMT) and perform all necessary calibrations as instructed in APPENDIX 1.

Error 045 Plate / reflective sensor broken (calibration failure)

Cause
- Plate sensor cannot be calibrated. Functioning of the sensor can be checked with **\<plate\>** command

Check
- Check wiring of the plate sensor

Solutions
- Change wiring
- Replace plate / reflective sensor
After replacement perform **\<calpr all\>** and check functioning

Error 046 Incompatible driver version (FW ver5.04 and newer)

Cause
- DSD version installed to the computer does not support the pixel size of the scanner

Check
- Check DSD version used in the imaging system. DSD version 3.39 and newer support correct pixel size.

Solutions
- Update DSD

Error 047 Safety switch open (FW ver5.05 and newer)

Cause
- Safety switch was open during boot or scanning sequence.

Check
- Use **\<cover\>** command in service mode to check safety switch operation
- Check wiring and operation of the safety switch
- Check that cover closes safety switch properly

Solutions
- change the safety switch
- adjust safety switch so that cover closes it properly

Troubleshooting without actual error code available

Error: Degraded image quality

Symptom, cause, check and solution
- See APPENDIX 3

Error: Shows completely blank image

Symptom, cause, check and solution
- See APPENDIX 3

Error: Door mechanism related errors

Symptom
- Abnormal door mechanism operation
- Abnormal noise while door operates
- Stripes in images
- Imaging plate size shows wrong in computer screen

Check and solution
- See APPENDIX 4 for instructions

Error: Not ejecting properly / Eject force varies / Changing <eject XXXX> does not solve the problem

Cause
- Belts are slipping
- Plate carrier, eject or door opening mechanism not moving properly

Check
- Command **<e>** or **<ec>** and observe the movements of:
  * Plate carrier
  * Door and eject mechanism
- See APPENDIX 4 for instructions

Solutions
- Clean the belts and drive wheels & shafts (and tighten the belt, if necessary), as instructed in service manual
- See APPENDIX 4
- Fix the plate carrier, door and eject mechanism.

Error: Not starting image readout when the plate is inserted properly or Starts readout without the plate or Starts readout plate wrong way round

Cause
- Reflective sensor not detecting the imaging plate properly

Check
- Insert plate, check the **<plate>** output
> * Should be "BLACK" when plate is inserted
> * Should be "ACTIVE" when plate + cover is inserted
> * Should be "ACTIVE" when plate is wrong way round.
-Insert plate properly and see that there is tolerance enough
> * **<plate>** output should remain "BLACK" even when deflecting/tilting plate 3mm to left
-Is there anything reflective in front of the sensor (for example bite cover?)

Solutions
-Check the cabling
-Remove if there is anything "extra" in front of the sensor
-Eliminate the possible bright light disturbing the detection
-Calibrate sensor as instructed in calibration instructions in this manual, **<h calpr>**, **<calpr>**.
-Replace the sensor and re-calibrate.

Error: No response while a key is pressed

Cause
- Switch of the control panel is not closing when a key pressed

Check
- Operation of the keys with command **<diagnose>** in service mode. Diagnose –command asks you to press the keys at the end of the test.

Solutions
- Check the cabling
- Replace the control panel

Error: Membrane switch panel LED dim, lit constantly or not lit at all

Cause
- Membrane switch panel or its cabling defective

Solutions
- Check the cabling
- Replace the control panel or the connector panel board

Error: Unit starts up by itself after plugging in the power cord

Cause
- Control panel or its cabling defective (STANDBY-key is closed by itself)

Check
- Operation of the keys, for example checking the Service Assistant -output when pressing the key

Solutions
- Check the cabling
- Replace the control panel

Error: Unit goes to standby-mode by itself during or after startup

Cause
- Control panel or its cabling defective (START- or STANDBY -key is closed by itself)

Check
- Operation of the keys, for example by using the service terminal

Solutions
- Check the cabling
- Replace the control panel

Troubleshooting based on image errors

Improper use of the hygiene accessories

Shows a "ghost image" having possibly shapes of the edge of the protective cover
Plate not properly shielded from light (with protective cover and hygiene bag) between exposure and readout
>>part of the image erased by ambient light
- Protective cover misused or not used at all
- Hygiene bags not sealed properly
- Improper, non-genuine hygiene accessories used

Improper X-ray settings used

Too dark image
Some areas showing uniform "black"
>> decreased diagnostic value
- Too long exposure time

Too light Image
Noisy image
Showing only part of the image
Showing wrong size of the image (Image smaller than actual IP)
- Too short exposure time

Ghost images, shadows

IP has been exposed twice without readout in between
- More than one image exposed to the same plate

IP has not been erased properly after readout
- Optime erasing lamp is monitored during normal operation. If lamp is blown, application SW shows warning

Improper aiming of the X-ray

Cone cut (= X-ray beam has exposed only part of the IP surface)

Image may show on different (smaller) size than the IP used

- Check exposure procedure
- Use of proper holder avoids this

Unsharp / blurred images

Motion artefact
- Patient or X-ray cone has moved during the exposure (maybe because too long exposure time has been used)
  - Check exposure procedure
  - Use proper holder
  - Use shorter exposure time (increase kV if necessary after shortening exposure time)

Geometry distortion
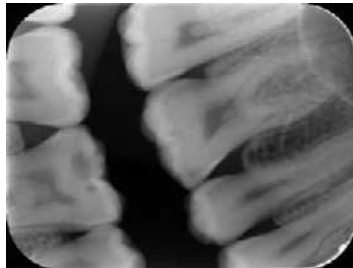
Improper patient positioning
- Use proper holders to avoid this

Decreased contrast, shadows/shading, ghost images…

Improper storing of the imaging plates
- IP has collected background radiation because:
  - IP has been stored near X-ray unit
  - IP has been stored in the bag or in dark too long
- Use dedicated IP storage box to avoid these
- Alternatively, perform initial erasing for the plate(s)

White or grey dots/spots/stains in images
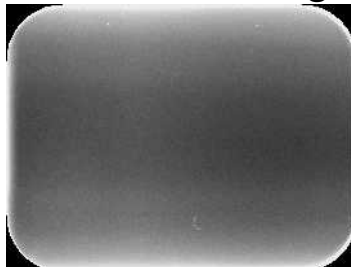
Dust or stains on the imaging plates
Any extra particle on top of the IP is visible on the image
- Clean the plate(s), replace if cleaning does not help
- Pay attention on IP handling, storing and maintenance

Wearing of the imaging plates
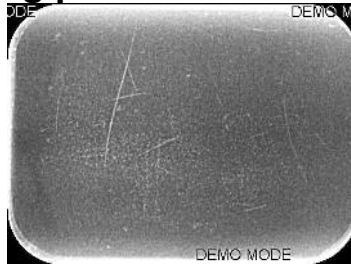
- Scratches
- Clean the plate(s), replace if cleaning does not help
- Pay attention on IP handling, storing and maintenance

- Spots, dots (white or gray)
Spots are most propably caused by wearing of the IP
- Clean the plate(s), replace if cleaning does not help
- Pay attention on handling, storing and maintenance of the imaging plates

Image shows different size than the IP used
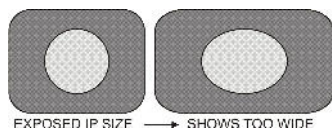
Shows too big (too wide) image compared to the IP used
Objects stretched horizontally
- Belt slipping / plate carrier movement too slow
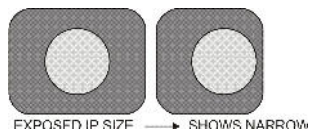
Shows too small (too narrow) image compared to the IP used:
- Too short exposure time used
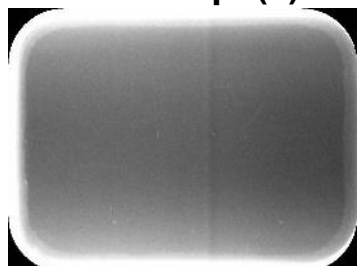- X-ray cone cut (caused by improper aiming of the X-ray)

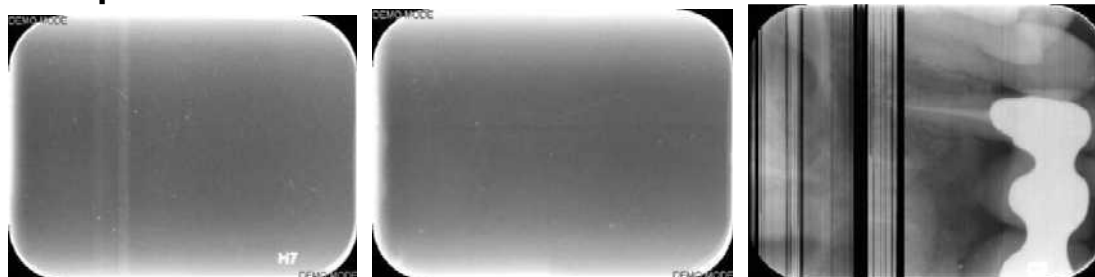## Circle on image
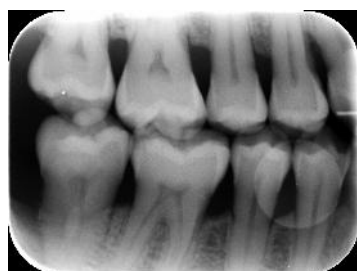
Shows circular shadow
- Exposure from the wrong side of imaging plate

Vertical stripe(s)

- Problem with plate carrier movement (belt?)

PMT problems

Shows vertical or horizontal stripe(s), random or repeated, sharp or smooth
- PMT malfunction, may need scanner module replacement

Incorrect dimensions
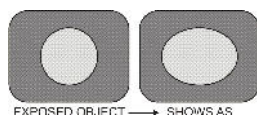
Stretched (too wide) image
- Clean the drive belts + drive wheels, adjust the drive belt and perform gear –calibration as instructed

Compressed (too narrow) image
- Clean the drive belts + drive wheels, adjust the drive belt and perform gear –calibration

Triangular artifact in the left bottom corner of the image
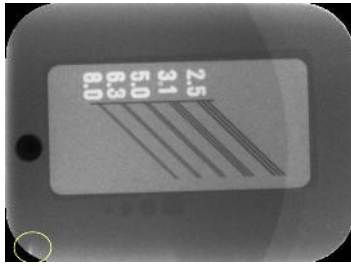
Image plate holder focus laser light reflection into one specific region causing partial information attenuation from that area

- IP holder corner and IP bottom support part must be sanded lightly to disperse reflective laser light evenly to surrounding space. See image below to locate right place and amount of sanding / grinding needed.

APPENDIX 1: Troubleshooting errors 034, 035, 041 and 042

INSTRUCTIONS FOR SCANNER MODULE REPLACEMENT AND CALIBRATION.

Perform the following service actions in given order.

1. Check if the cover safety switch is working properly(Applies only if FW is 5.04 or older)
- Enter service mode from s2terminal by command **<s>**
- Command **<cover>** shows the status of safety switch. When the cover is in place, system should reply "Object cover is at 1". When cover is not in place, system should reply "Object cover is at 0".
- If the command **<cover>** shows wrong status, first replace the safety switch. If this does not help, then replace the H1300 Interface board.

2. Check if the laser is functioning properly
- Enter service mode from s2terminal by command **<s>**
- Open the unit cover
- Close the enclosure safety switch
- Type command **<laser 1>**. This switches the laser on.
- See if the laser beam is sweeping normally. Amplitude must be large enough for the sweeping laser beam to reach the both of the sensors on the R2700 Laser Detector Board.
- If the laser beam is not sweeping normally, first replace H1300 Interface board. If this does not solve the problem, then replace the scanner module.

3. Check if there are several errors 35, 41 or 42 in the error log
In the Unit error log, if there more than 5 error messages from the groups 35, 41 or 42, and if the above mentioned steps did not fix the problem, scanner module may need to be replaced.

- First replace the scanner module (see image)
- Then calibrate the scanner module as instructed below

Instructions on how to calibrate the scanner module
- Enter service mode from s2terminal by command **<s>**
- Type command: **<autoscan 0>**
- Type command: **<dx0 0>**
- Type command: **<dx1 0>**
- Type command: **<ds 0>**
- Exit from the service mode by command **<quit>**
- Take a reference exposure by using recently erased size2 imaging plate and a calibration tool (see image below).
  - Use 500µGy dose (tolerance ±25µGy), with an uniform x-ray field.
  - Distance between the X-ray source and an imaging plate is 1meter.
  - Imaging plate protective cover and hygienic bag shall always be used when the imaging plate is transported after the calibration exposure.
  - Calibration must be done within 5 minutes from the exposure.

IMPORTANT: In order to perform this task successfully, fixed test set-up is highly recommended.
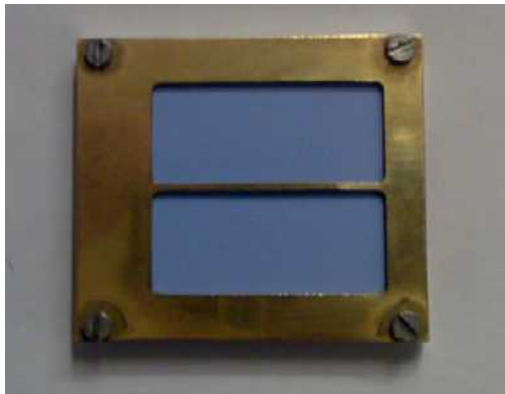
Image: Calibration tool with plate inserted

- Type command **calibrate**, but don't press enter
- Insert size2 imaging plate, which has exposure with reference setup.
- Press Enter-button immediately after placing the imaging plate on the carrier.
- Type command **<xi>**. Calibration results are now visible on the computer screen.
- Enter service mode from s2terminal by command **<s>**
- Enter the calibration results manually by typing **<dx0 XXXXX>**, where XXXXX is the number seen on the computer screen earlier (see image below).
- Type command **<dx1 XXXXX>**, where XXXXX is the number seen on the computer screen earlier
- Type command **<ds XX>**, where XX is the number seen on the computer screen earlier.
- Type **<autoscan 400>** if you want to enable automatic readout
- Take an empty exposure with size2 imaging plate and 500µGy dose. Use the imaging plate protective cover and hygienic bag.
- Scan the exposed imaging plate normally
- Fine tune the image area position, as instructed below.

Image: Calibration results

Fine tuning the image area position: Horizontal adjustment
- By typing command <start> the parameter value of current horizontal image area position can be read.
- The position can be adjusted by typing command **<start XXXX>**, where XXXX is adjustable;
    - o   Increasing the value moves the image to the left
    - o   Decreasing moves image to the right.

Fine tuning the image area position: Vertical adjustment
- By typing **<ds>** the parameter value of current image area vertical position can be read.
- The position can be adjusted by typing command **<ds XXX>**, where XXX is adjustable;
    - o   Increasing the value moves the image down
    - o   Decreasing moves image up.

NOTE: Maximum allowed change for **<ds>** -value is +/-300 from the factory-set value.
NOTE: Both ds and start parameters can also be negative.
NOTE: You can restore all factory set parameters with command **<restore configuration>**.

Criteria for image area adjustment:
- The whole imaging plate area has to be visible.
- Judgment is done by visual inspection.
- In order to see the imaging plate edges the best possible way, brightness and contrast adjustment sliders may and shall be used freely.

APPENDIX 2: Solution for Error 039 Log amp calibration failure

1. Check the connection and grounding of boards R2100 and H1200
- Open the board connection screws and check the screw length
  - Should be M4*6mm.
  - If the screws are longer, they are not grounding the boards properly
  - Replace with m4*6mm. Use Thread Locker (Loctite 243).

2. Check "Logamp test curve" values during the Unit initialization
- Open service assistant
- Switch on the Unit
- Read the initialization values
  - 2 lowest "Logamp test curve" parameters must be within the values stated in brackets (see below, parameters in bold red font).
  - If parameters are out from the bracketed range, the R2100 power & analog board must be replaced. No calibrations needed after replacement.

```
Connected to Unit
Software version 5.02
Core version      109
Serial number     IJ0900001
LogAmp input offset (dac2b):122
LogAmp output offset (dac1a):129
Output amp offset (dac1b):229
Logamp test curve:
0:      [0, 1500]
13871:  [13000, 15000]
16383:  [16383]
___
```

Example of OK values:
Calibration result 13871 is within the range [13000...15000]

Calibration result 16383 equals with the range [16383]

3. Trouble-shoot PMT and R2100 power&analog card
- If the above mentioned steps did not solve the problem, the root cause is located either in PMT or in R2100 board.

How to determine which component must be change:
- Detach the BNC connector from R2100.
- Close Unit covers (with BNC connector not connected)
- Switch on the Unit
- If the unit <u>DOES NOT</u> go into Error39 state, the root cause is PMT. Scanner module must be changed.
- If the unit still goes to Error39 state, the root cause is in R2100 power&analog board. It is recommended to replace R2100. No calibrations needed after replacement

NOTE! If PMT cable BNC connector is not contacting chassis Error38 may occur during BNC cable not connected. This normal situation and Error38 disappear when connecting BNC cable again.

APPENDIX 3: Solution for the Blank image and "degraded image quality".

DESCRIPTION OF SYMPTOMS

- Unit shows white or blank image
> * Image is white or blank, even if there was an exposed image on the read plate

- "WARNING: Degraded image quality"
> * Warning message appears together with the Image
> * The image may be without any distortion or artifacts

HOW TO FIX THE PROBLEM

Calibrate the amplitude of the resonant scanner by performing <calga> calibration from s2terminal or service assistant
NOTE: Unit must be in normal operation room temperature when performing <calga>

If the problem still appears, scanner module may need to be replaced. For more info about scanner module replacement, see APPENDIX 1.

APPENDIX 4: Door and plate carrier mechanism movement related problems

General explanation:
- Left side of the image is dark or completely black
- There is difference in the darkness
- Image has stripes and may have distorted image size detection. See sample image below.

- Problems with door mechanism movements may also disturb the plate carrier movement and thus result error state

Cause:
- The door not closing properly after the image is inserted
- Door mechanism not working properly

Following reasons may cause the problem.
-The pulleys, the conveyor and the drive belts may not be clean.
> *Clean them carefully as instructed in service manual.

- The conveyor belt (longer) may be loose.
> * Loose belt may cause inaccuracy to the linear movement speed and positioning.
> * Tighten as instructed in service manual

-Lever mechanism jams.
> * Check the free movement of joint. Possible cause might be thread locker from the screw & nut. See picture below.

- Door mechanism bearing does not rotate freely
> * Make sure the bearing rotates freely. Adjust if needed. See picture below

- Lever mechanism not moving properly
> * Check that the fixing nut of the lever mechanism is fastened properly.
> * Use thread locker to secure. See the picture below
> NOTE: Too tight fixing nut could cause lock up of the lever mechanism and the door would not open properly

- The motor flywheel is able to touch the belt. See picture below
> * Incorrectly adjusted flywheel may cause abnormal noise or disturb movement and may cause stripes in the picture
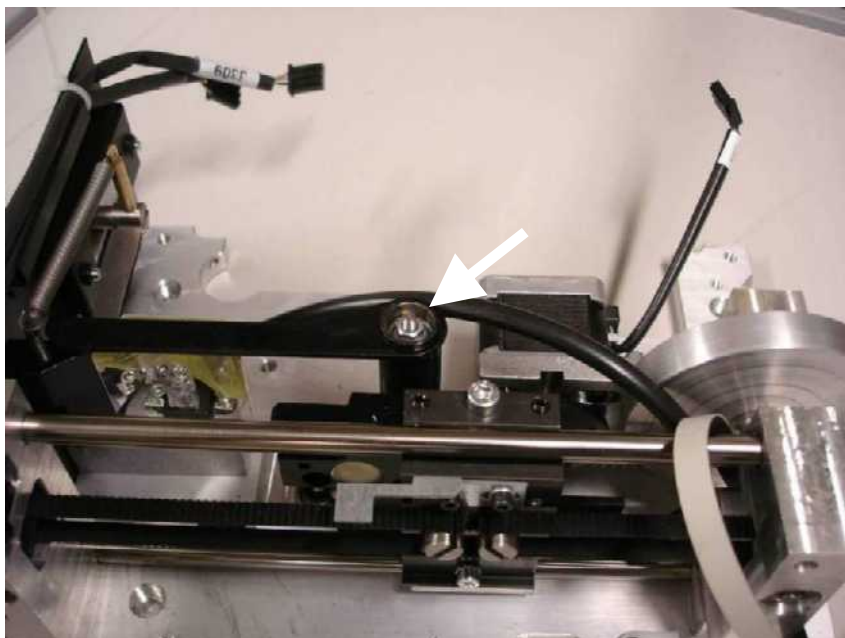
Lever mechanism jams
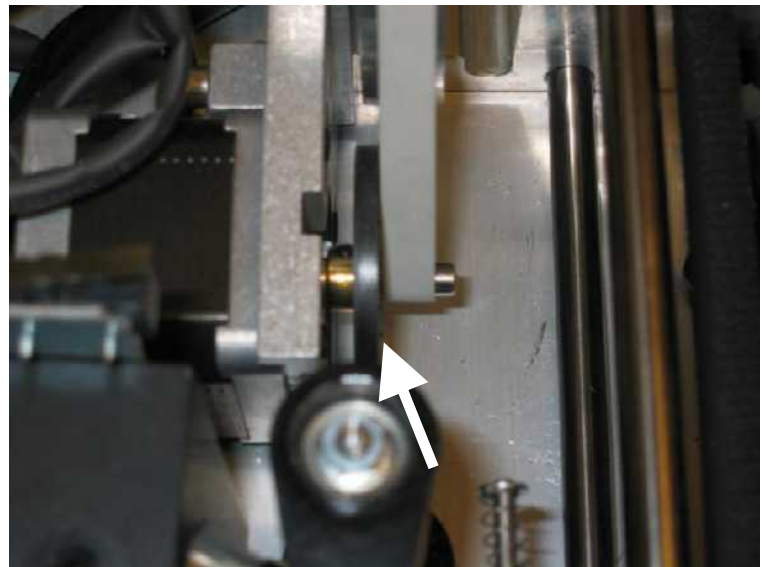
Step motor flywheel is able to touch the belt. Clearance is too small.
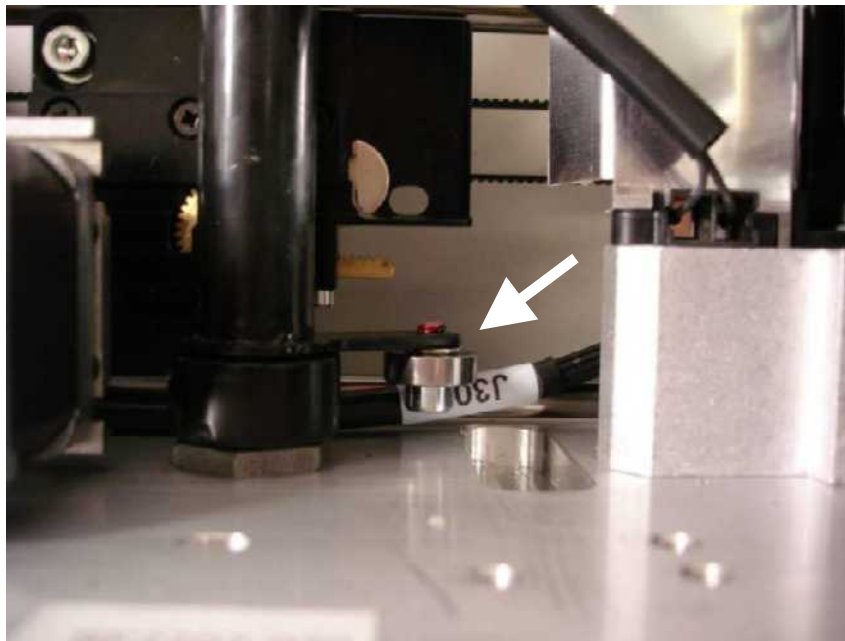
Bearing must rotate freely

Lever mechanism's fixing nut.

APPENDIX 5: Test after repair

After the repair is completed, the following tests shall be done:
- Image quality test with INTRA DIGI IEC TEST PHANTOM SP00267. See documentation of the test phantom for detailed using / approval instructions.
- 500 scan endurance test

Perform endurance test
- Enter s2terminal
- Type command <test 5000 500>. NOTE: Do not use any other numerical parameters after test-command! Changing the numbers may damage the unit.
- Remove Ethernet cable from Unit

Check for possible errors after endurance test
- After endurance test is performed, check the display for the unit status

Check the service log
- Connect Ethernet cable again
- Enter service mode from s2terminal by command **<s>**
- Type command **<log>** and double-check if there are any NEW error codes, which have appeared during the endurance test.

Sign the service log

- Store performed service tasks into Unit service log by typing command **<logsign xxxxxx>**, where xxxxxx.is free text inserted by service technician to be stored into log.
    - As an example **<logsign John Smith: Replaced new scanner module, calibrated and endurance test performed. OK.>**

APPENDIX 6: PMT filter light leak check/repair/replacement

- Scanner unit image readout (scanning) is based on measuring very low intensity of blue light with Photomultiplier tube (PMT). Blue light is emitted from the imaging plate when it is stimulated (scanned) with red laser.
- Light measurement is performed in total darkness inside the scanner unit covers
- Principle requires PMT-filter which passes through the blue light but blocks the red light.
- Therefore light proof fastening of the blue filter is essential for proper images.
- Loosened fastening or insufficient light-proofness of the filter may allow the red laser light to pass to the PMT. In this case the image shows various random shades or show size 2 image in a size 3 length of window. May also show shade of the imaging plate and/or some random patterns (caused by laser reflections from internal parts) on screen, even if reading a non-exposed IP. See sample images below.

Various random shades or patterns

Shows size 2 image in a size 3 length window

Shows shade of the IP and/or random patterns even with non-exposed IP

Shows shade of the size 2 IP and/or random patterns in a size 3 length window even with non-exposed IP

The light leak can be caused by two alternative reasons:

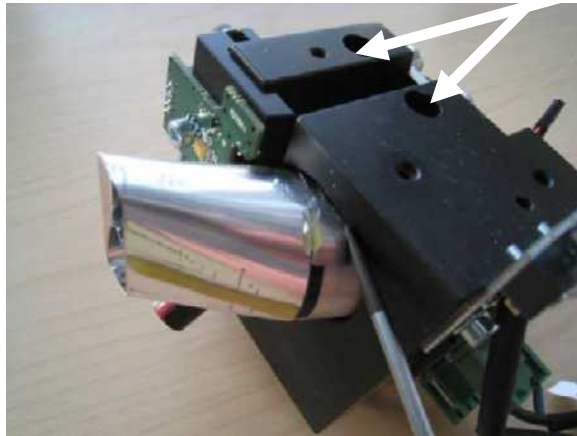a). Filter support ring is loose or not fastened light-proof

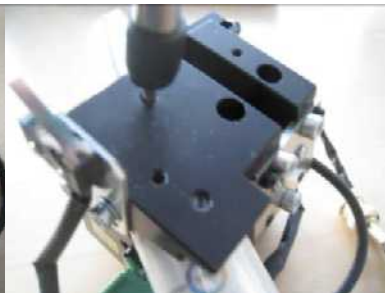b). Filter is loose from the support ring or not fastened light proof

NOTE! Performing check / repair actions for the PMT following **PMT MODULE REMOVAL AND CHECK INSTRUCTION** must be followed with great care.

PMT MODULE REMOVAL AND CHECK:
1) Remove the scanner module by loosening the two screws on top

2) Mark the light collector position all around with some sharp tool

3) Loosen the two screws on top and one at the bottom to release the PMT module

4) Disconnect the green connector   5) Pull out the PMT module

6) Check visually if there is doubt for light leak.
   Check by pulling/bending if the filter support ring or the filter is loose.

After finding out the possible cause for light leak, either:
* Light seal the problem point with Loctite 480, black silicone etc. (the light leak may be either between filter and support ring or between support ring and metal cylinder)
   or
* Follow the instructions below to re-attach

PMT FILTER SUPPORT RING ATTACHMENT REPAIR:

1) Remove any silicone adhesive residue from the outer surface of the support ring
2) Use sandpaper to clean and roughen the outer surface of the ring

3) Clean the outer surface using tissue/cloth dampened with rubbing alcohol
4) Apply LOCTITE 480 adhesive (black) thinly on the outer surface of the ring
5) Push ring firmly in it's place on the PMT module

PMT FILTER ATTACHMENT REPAIR:

1) Remove any silicone adhesive residue from the surface and edge of the support ring
2) Use sandpaper to clean and roughen the inner surface of the support ring

3) Clean the filter surfaces and edges using tissue/cloth dampened with rubbing alcohol

4) Clean the inner surface using tissue/cloth dampened with rubbing alcohol
5) Apply LOCTITE 480 adhesive (black) thinly on the inner surface of the ring
6) Push filter firmly in it's place on the ring
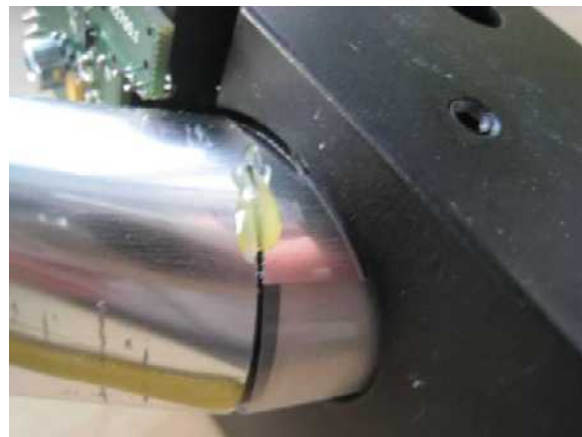
PMT MODULE RE-INSTALLATION:

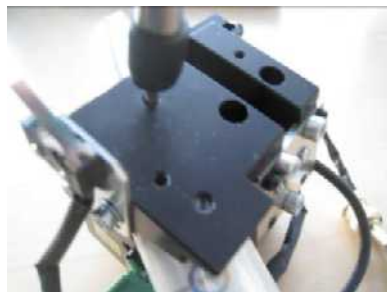1) Clean the filter front surface properly

2) Check that the insulator foil edge stay half way to the support ring

3) Check that the PMT module is as far inside the light collector as it goes and that the insulator foil is going half way over the support ring
4) Check that the light collector is in marked position

5) Fasten the two screws on top and one at the bottom to release the PMT module.
Check after fastening that PMT module, insulator foil and light collector are properly aligned.
Loosen the screws and re-adjust the position of PMT module, insulator foil and light collector, if necessary, and fasten the three screws again.

6) Connect the green connector