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RGSC 1.0

Calibration Manual

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Abstract

This document provides information about the Respiratory Gating for Scanners calibration procedure.

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Document History

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1. Introduction

1.1 Scope

This manual describes the calibration procedure for RGSC 1.0.

1.2 Conventions

This section presents the types of notes and precautionary notices used in the guide, along with their icons. The following notational conventions are used:

NOTE: A Note provides non-critical information, such as user requirements, computer messages, suggestions, and shortcuts, which can help the user to obtain optimum performance from the equipment and software.

CAUTION: Describes actions or conditions that could result in minor or moderate injury or damage to equipment or loss of data. All Caution notices must be obeyed.

WARNING: Describes actions or conditions that could result in serious injury or death. All Warning notices must be obeyed.

STOP: Notifier to indicate any condition that must be verified and/or satisfied before continuing.

Bold text	Commands are printed in **bold** text.
`Courier new`	Screen messages are printed in `Courier new`.
Italics	Menu and file navigations appear in *italic* type.
[References]	References to other documents are shown in square brackets, e.g. [1].

1.3 System Requirements

RGSC system with RGSC 1.0 software.

1.4 References

[1] Software Installation Manual, RGSC 1.0, SIM-GS-10

[2] Hardware Installation Manual, RGSC 1.0, HIM-GS-10

[3] Installation Product Acceptance RGSC 1.0, IPA-GS-10

1.5 Abbreviations

GS	Gating for Scanners
IR	Infra-Red
LED	Light Emitting Diode e.g. used as optical status indicator
RGSC	Respiratory Gating for Scanners
RT Node	Real-Time Node
UI	User Interface e.g. graphical interface on monitor
VCD	Visual Coaching Device
WAP	WLAN Access Point

2. System Components

The RGSC system consists of a RGSC cabinet, a single camera, a WAP and a VCD. However, a calibration is only needed for the single camera. This section describes the single camera hardware components used in this document.

2.1 Front cover

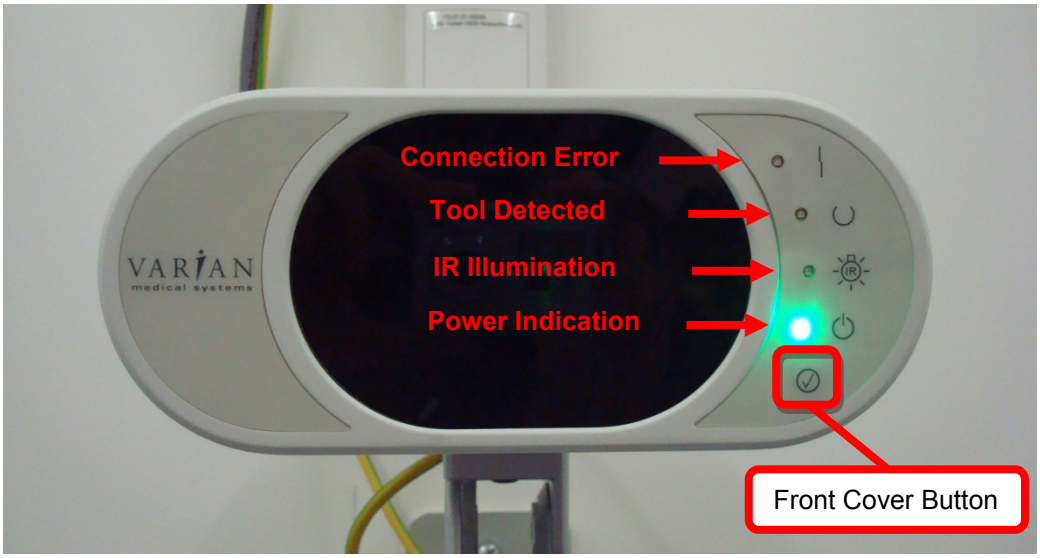


Figure 1: Camera front cover button

2.2 Internal

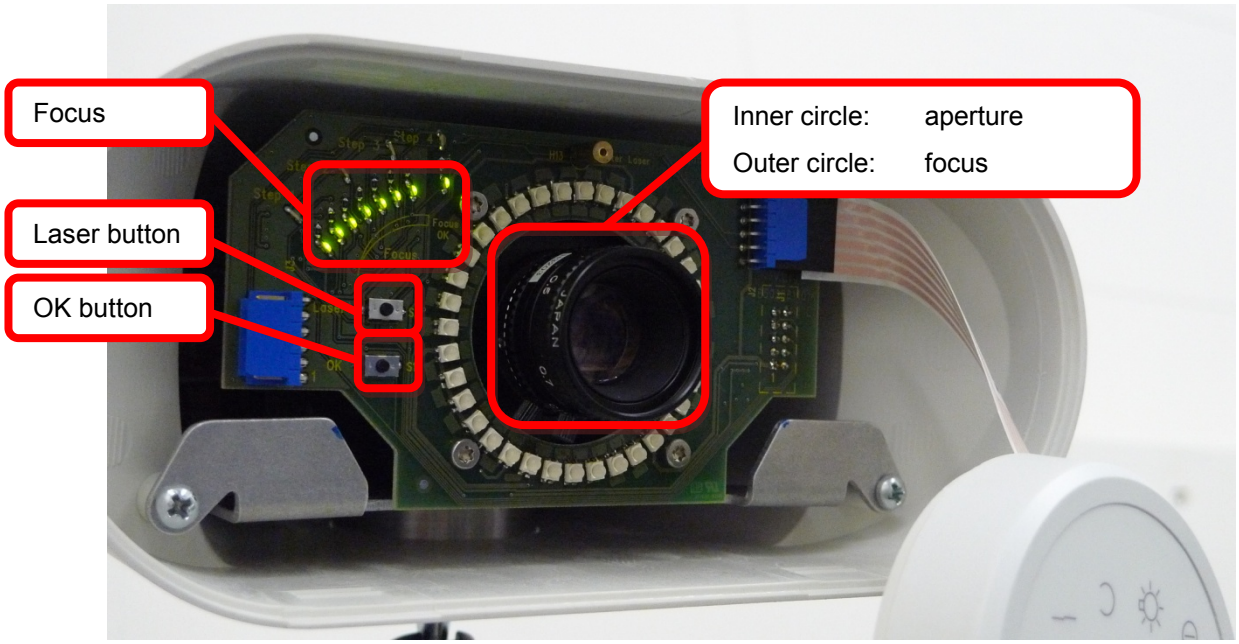


Figure 2: Camera buttons inside

3. Calibration sequence

The RGSC calibration sequence consists basically of 3 different procedures shown in Figure 3, while the *Camera Installation* procedure itself can be divided into an *Installation* subsequence and into an *Optics* subsequence.

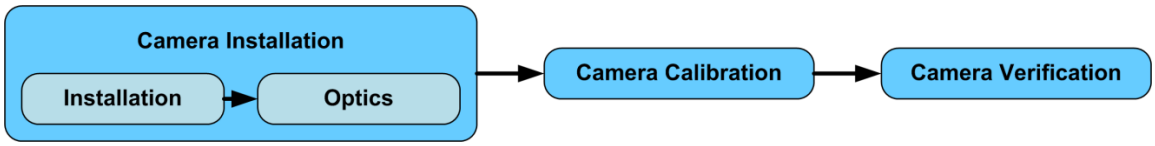


Figure 3: Calibration Sequence

The ***Camera Installation*** procedure aligns the single camera to isocenter, set the focus and aperture, calculates the exposure time and reflector block distance. The alignment of the single camera to isocenter, the focus and the aperture are established in the *Installation* subsequence, while the exposure time and reflector block distance are determined in the *Optics* subsequence. The *Optics* subsequence can be performed independently; however, it doesn't make sense if the Installation subsequence has not been performed before.

The ***Camera Calibration*** procedure is used to define the location of the couch surface in the scanner room. This calibration depends on the *Camera Installation* procedure.

The ***Camera Verification*** procedure is used to determine the camera calibration is still fine. This procedure depends obviously on the *Camera Calibration*.

In the following sections there is a detailed description of those three calibration procedures.

WARNING: Before calibrating verify that the lens installed on the camera (refer to *[2] Hardware Installation Manual, RGSC 1.0, HIM-GS-10* for the location) corresponds to the selected one in the RGSC configuration under *Configuration > Camera*. For RGSC 1.0 only the 25mm lens is supported.

Figure 4: RGSC 1.0 only supports the 25mm lens

4. Camera Installation Procedure

The *Camera Installation* is a four step procedure which adjusts the single camera to the isocenter, sets the aperture and focus of the single camera, and calculates the exposure time and the distance between isocenter and single camera.

The procedure needs to be started on the RGSC workstation in *Major Mode* > *Configuration* > *Camera* (on the lower left corner) > *Camera Installation*.

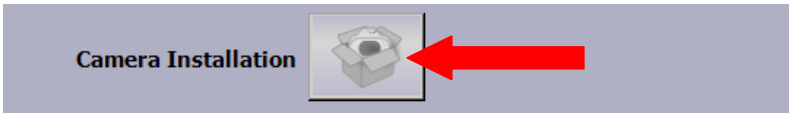


Figure 5: Start Installation Procedure with the button above

The procedure is roughly described on the screen by the camera installation wizard; however, this manual gives detailed instruction of the entire procedure.

NOTE: The single camera sends out an infrared signal which is reflected by the reflectors of the marker block. On some couch tops the reflectors are as well mirrored by the surface of the couch top which may impact the installation procedure. This can be avoided by placing a sheet of paper to the couch top at the front of the marker block

4.1 Installation Step 1 – Open Aperture

1. Place the reflector block into the isocenter of the scanner.

Figure 6: Align reflector block to the isocenter

2. Carefully remove the front cover of the single camera by loosening the two plastic screws at the back of the single camera – refer to Figure 7 on the left.

Figure 7: Remove Front Cover of the Single Camera

3. Let the front cover hang to the side as indicated by Figure 7 on the right.
4. Open the aperture to the maximum by unscrewing the inner knob on the lens and rotate the inner circle on the lens clockwise to the maximum – refer to Figure 8.

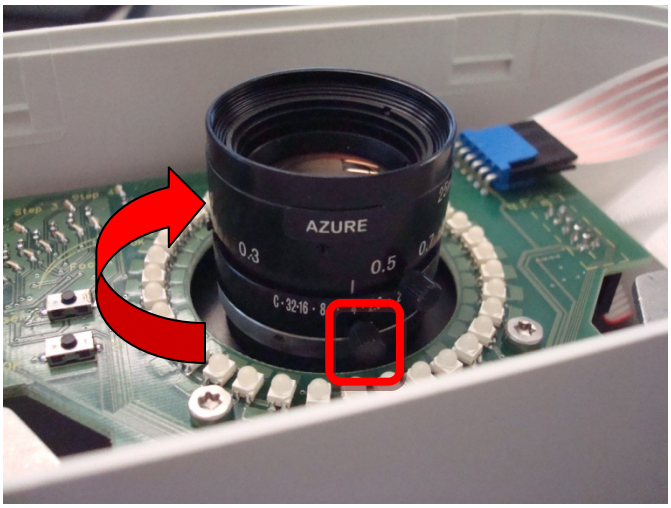


Figure 8: Open Aperture to the maximum

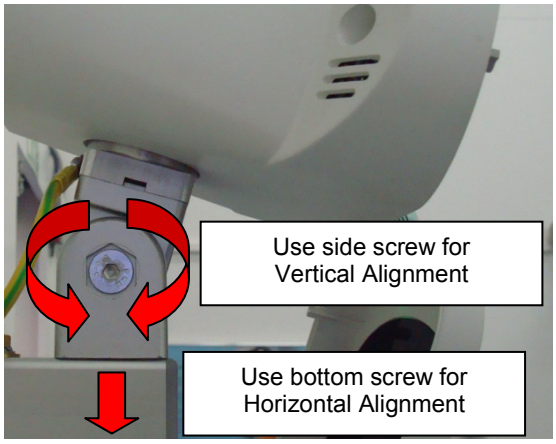
5. Press **OK** on the Camera Installation wizard to continue with the next calibration step of the wizard.

4.2 Installation Step 2 – Align Camera to Isocenter

1. Press the **Laser** button inside the single camera to see the view-direction of the single camera. Refer to Figure 2 for the location of the laser button.

CAUTION: Avoid looking into the beam of the laser pointer while it is turned on for camera alignment.

2. Align the single camera horizontal to the isocenter by rotating the camera mount at the bottom. Refer to Figure 9.
3. Align the single camera vertical to the isocenter by rotating the camera mount at the side. Refer to Figure 9.



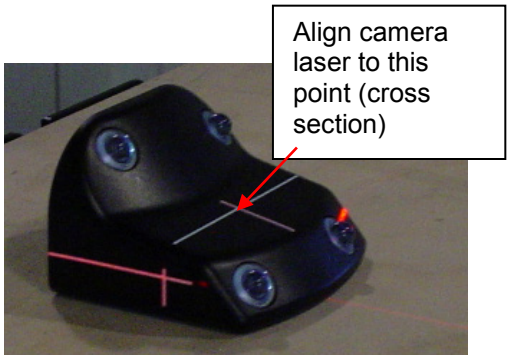


Figure 9: Align the single camera to isocenter

4. Fix the camera position to the proper alignment by tightening the two side screws and the bottom screw – refer to Figure 10.

Figure 10: Fix the single camera position

5. Press **OK** on the Camera Installation wizard to continue with the next calibration step of the wizard.

4.3 Installation Step 3 – Adjust Focus

1. Unscrew the outer knob on the lens and adjust the focus on the single camera for the sharpest view by rotating the outer circle on the lens.

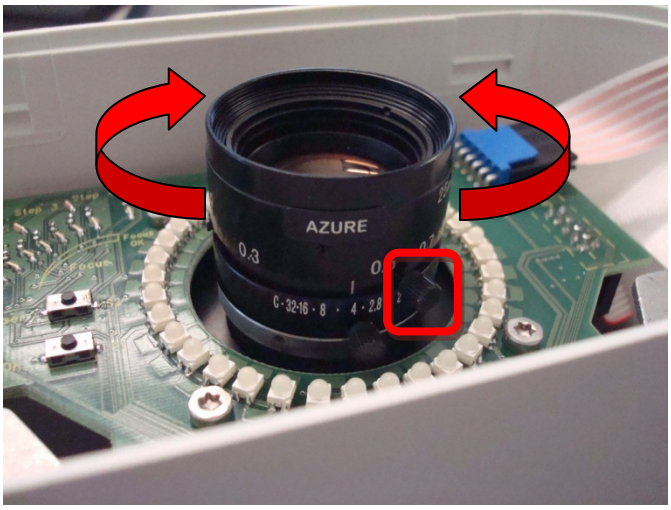


Figure 11: Adjust the focus to the sharpest view

The sharpest view is indicated by the focus LEDs inside the single camera. The sharpest view is reached when all Focus Level LEDs and the Focus OK LED are turned on – refer to the Figure 12 on the left. In the control room the sharpest view is indicated by the sharpness bar in the upper right corner of the RGSC application user interface – refer to the Figure 12 on the right.

NOTE: If an object gets close to the front of the lens during lens adjustment, e.g. your hand, the software will not be able to calculate the relative image focus correctly anymore. Press the front cover button on the camera front cover to reset the relative image focus calculation and proceed with the adjustment of the focus.

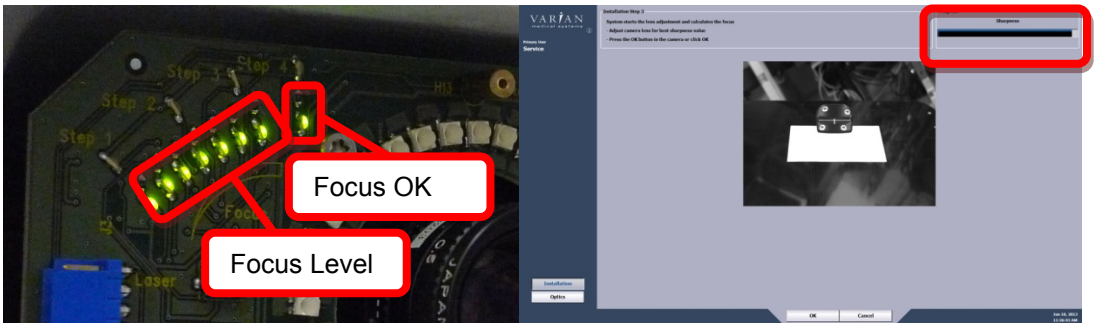


Figure 12: Focus feedback LEDs and focus indication in UI

2. When the focus is adjusted carefully fasten the outer knob on the circle of the lens.
3. Press **OK** on the Camera Installation wizard when the focus was adjusted.

4.4 Installation Step 4 – Close Aperture

1. On the single camera close the aperture to position 4 by rotating the inner circle on the lens anti clock wise. Position 4 is reached when the number four on the outer circle is pointing to the white mark indicated in Figure 13.

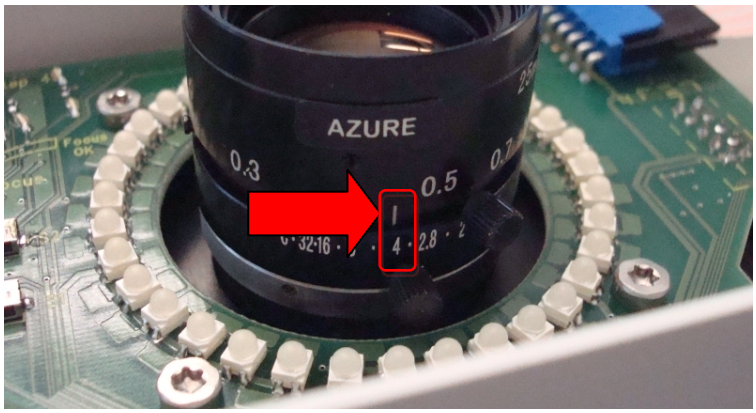


Figure 13: Close aperture to position 4

2. When the aperture is closed to position 4 carefully fasten the outer knob on the circle of the lens.
3. Carefully install the front cover back to the single camera.
4. Press **OK** on the Camera Installation wizard.

4.5 Optical Adjustment Step 1

1. Verify the marker block is still at isocenter.
2. Press **OK** on the Camera Installation wizard.

4.6 Optical Adjustment Step 2

1. The system automatically adjusts the illumination level and the exposure time – refer to Figure 14.

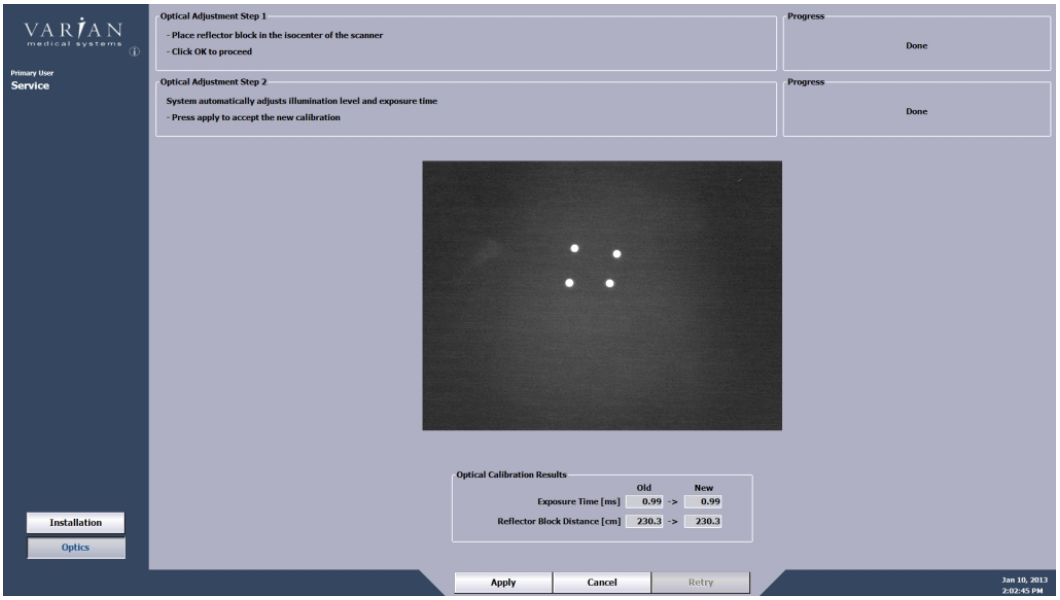


Figure 14: Adjustment of illumination level and exposure time

NOTE: The following warning is expected and normal during first time camera calibration:
The new reflector block distance deviates from the old value by more than 20%. Verify the focal length of the installed and the configured lens.

2. Press the **Apply** button to accept the new exposure time and the new calculated reflector block distance.

5. Camera Calibration Procedure

The Camera Calibration is used to define the location of the couch surface in the scanner room.

The procedure needs to be started on the RGSC workstation in *Major Mode* > *Verification / Calibration* > *Calibration* (on the lower left corner).

Figure 15: Start Camera Calibration Procedure

5.1 Calibration Step 1

1. Place the *Camera Calibration Board* on the couch and align it to isocenter – refer to Figure 16 on the right.
2. Place the reflector block into the isocenter and align the couch vertical to isocenter – an accuracy of 2mm for all position is enough, but make sure the marker block is looking towards the single camera and the surface where the marker block is placed is flat.
3. Press **OK** on the Camera Installation wizard.

5.2 Calibration Step 2 - 9

1. Place the reflector block on the *Camera Calibration Board* to position 2 as indicated by the instructions on the screen. The positions on the screen, as shown in Figure 16 on the left, match the positions on the *Camera Calibration Board* indicated in Figure 16 on the right.

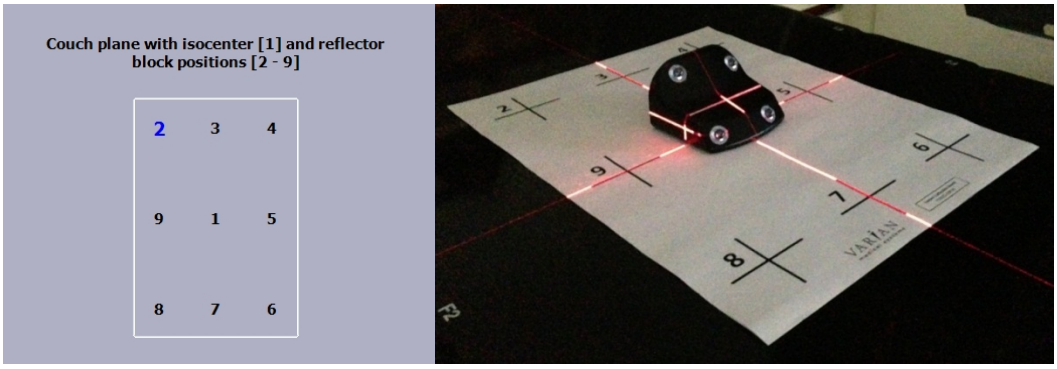


Figure 16: Place reflector block to position 2

NOTE: The *Tool Detected* LED on the front of the single camera can be used to verify that the marker block doesn't get out of the camera view – refer to Figure 17. When the *Tool Detected* LED turns off, the marker block cannot be detected any more successfully by the Single Camera.

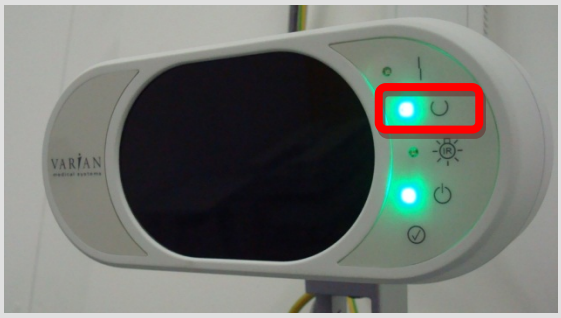


Figure 17: Tool Detected LED

Press **OK** on the *Camera Installation* wizard or press the front cover button on the single camera when the block is at position 2.

2. Place the reflector block on the surface of the couch to position 3.

   Press **OK** on the *Camera Installation* wizard or press the front cover button on the single camera.

3. Repeat the steps above till all nine positions have been calibrated.

5.3 Calibration Step 10

1. The system automatically defines the location of the couch surface based on the previous steps (measurements) and confirms this with "*Calibration passed*" as indicated in Figure 18.

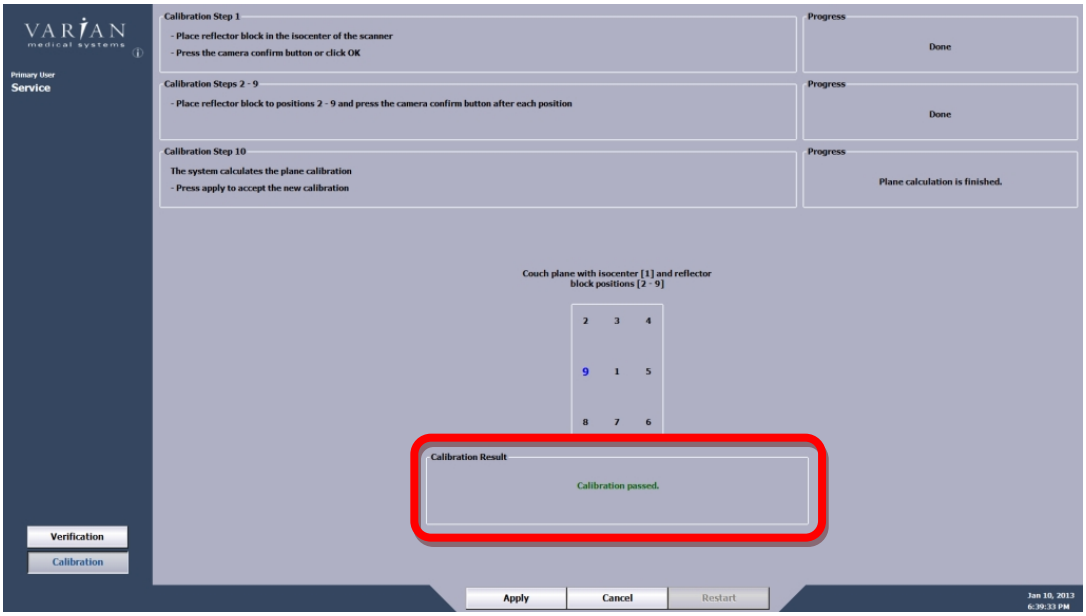


Figure 18: Camera calibration passed

2. Press **Apply** to accept the new calibration.

6. Camera Verification Procedure

The Camera Verification is used to determine if the Camera Calibration is accurate.

The procedure needs to be started on the RGSC workstation in *Major Mode* > *Verification / Calibration* > *Verification* (on the lower left corner).

Figure 19: Start Camera Verification Procedure

6.1 Verification Step 1

1. Place the reflector block into the isocenter.
2. Press **OK** on the Camera Installation wizard.

6.2 Verification Step 2

1. The system is acquiring automatically the reflector block position and on the screen the message "*Verification passed. All axes are within the tolerance of 0.5cm*" appears.

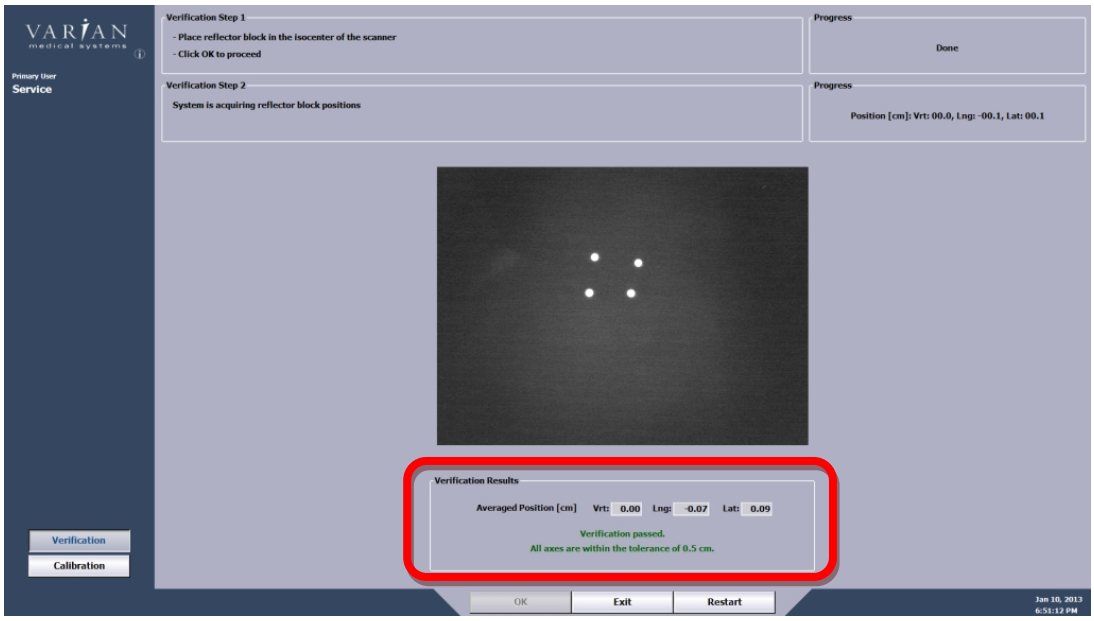


Figure 20: Camera verification passed

2. Press **Exit** to leave the verification procedure.

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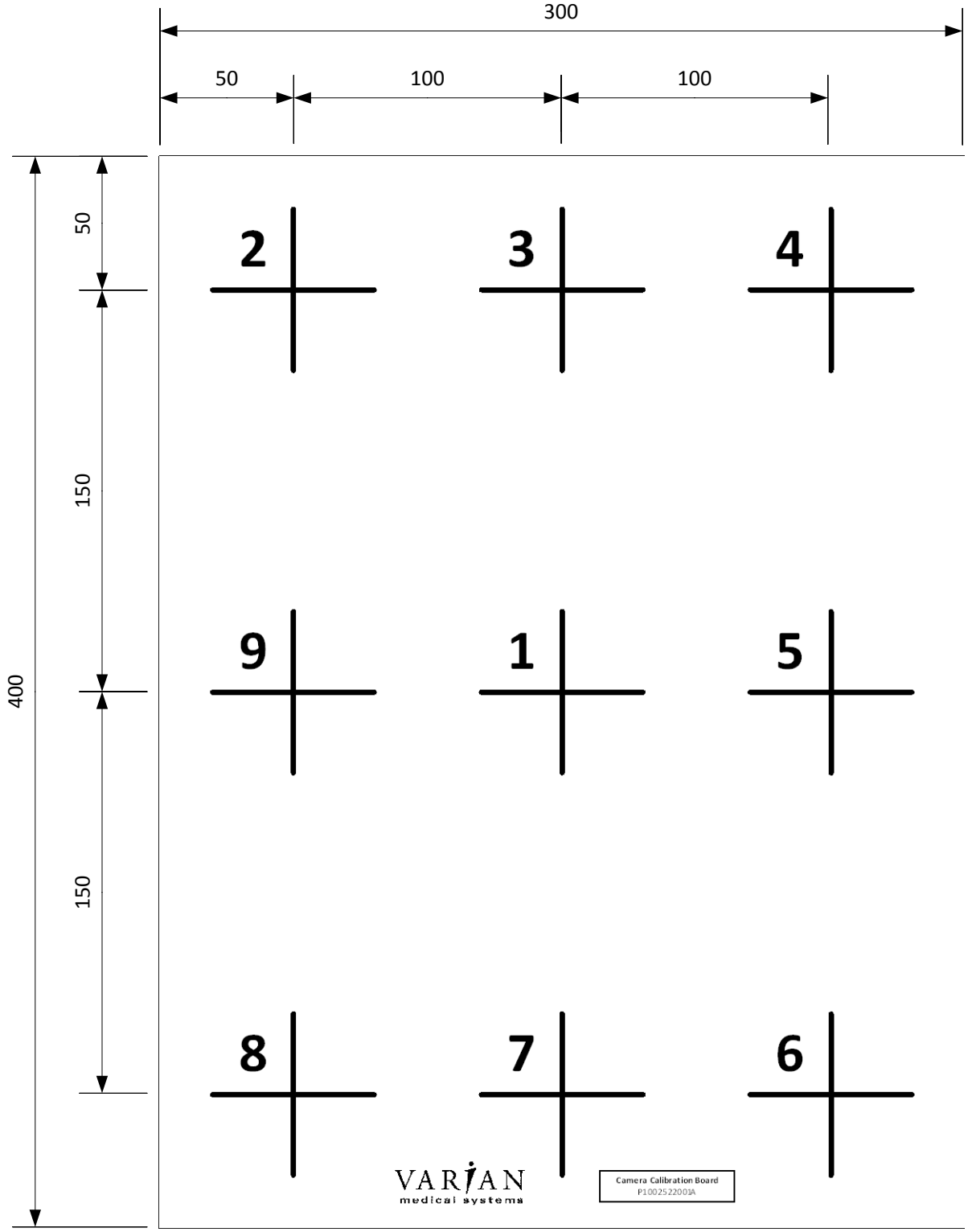
Appendix A Camera Calibration Board



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