

GE Healthcare

Respiratory Gating Option Installation Service Documentation



5321869-1EN

Rev 5

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To file a report:

- Call 1-800-548-3366 and use option 8.
- Fill out a report on <http://egems.med.ge.com/edq/home.jsp>
- Contact your local service coordinator for more information on this process.

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All electrical Installations that are preliminary to positioning of the equipment at the site prepared for the equipment shall be performed by licensed electrical contractors. In addition, electrical feeds into the Power Distribution Unit shall be performed by licensed electrical contractors. Other connections between pieces of electrical equipment, calibrations and testing shall be performed by qualified GE Medical personnel. The products involved (and the accompanying electrical installations) are highly sophisticated, and special engineering competence is required. In performing all electrical work on these products, GE will use its own specially trained field engineers. All of GE's electrical work on these products will comply with the requirements of the applicable electrical codes.

The purchaser of GE equipment shall only utilize qualified personnel (i.e., GE's field engineers, personnel of third-party service companies with equivalent training, or licensed electricians) to perform electrical servicing on the equipment.

IMPORTANT...X-RAY PROTECTION

X-ray equipment if not properly used may cause injury. Accordingly, the instructions herein contained should be thoroughly read and understood by everyone who will use the equipment before you attempt to place this equipment in operation. The General Electric Company, Medical Systems Group, will be glad to assist and cooperate in placing this equipment in use.

Although this apparatus incorporates a high degree of protection against x-radiation other than the useful beam, no practical design of equipment can provide complete protection. Nor can any practical design compel the operator to take adequate precautions to prevent the possibility of any persons carelessly exposing themselves or others to radiation.

It is important that anyone having anything to do with x-radiation be properly trained and fully acquainted with the recommendations of the National Council on Radiation Protection and Measurements as published in NCRP Reports available from NCRP Publications, 7910 Woodmont Avenue, Room 1016, Bethesda, Maryland 20814, and of the International Commission on Radiation Protection, and take adequate steps to protect against injury.

The equipment is sold with the understanding that the General Electric Company, Medical Systems Group, its agents, and representatives have no responsibility for injury or damage which may result from improper use of the equipment.

Various protective materials and devices are available. It is urged that such materials or devices be used.

LITHIUM BATTERY CAUTIONARY STATEMENTS



CAUTION
Risk of
Explosion

Danger of explosion if battery is incorrectly replaced. Replace only with the same or equivalent type recommended by the manufacturer. Discard used batteries according to the manufacturer's instructions.



ATTENTION
Danger
d'Explosion

Il y a danger d'explosion s'il y a remplacement incorrect de la batterie. Remplacer uniquement avec une batterie du même type ou d'un type recommandé par le constructeur. Mettre au rebut les batteries usagées conformément aux instructions du fabricant.

OMISSIONS & ERRORS

Customers, please contact your GE Sales or Service representatives.

GE personnel, please use the GEMS CQA Process to report all omissions, errors, and defects in this publication.

Revision History

Revision	Date	Reason for change
5	12/25/13	Only add MEP information, no contents change
4	07/14/11	Combine Add Advanced 4D content into this manual
3	11/30/09	Add Anzai Respiratory Gating Device connection on Section 4.0
2	07/06/09	Added Functional Test on Section 4.0
1	11/13/08	Initial release.

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Chapter 1

Respiratory Gating Installation

Section 1.0 Introduction

1.1 Overview

This document supports the CT Respiratory gated features, Advantage 4D option on CT Console/AW and Prospective Respiratory Gating (PRG) option. The respiratory monitoring hardware for these options is same.

There are two types of devices for selection, Varian RPM (Remote Patient Monitoring) system or Anzai system.

To precisely locate the tumor, the patient's respiratory cycle is recorded as a respiratory motion waveform via the respiratory monitoring device.

The **Advantage 4D** application is an optional post-processing and review software application. The application uses cine acquired CT image data with a simultaneously recorded respiratory waveform file to create a specified number of phases per respiratory cycle.

The **Prospective Respiratory Gating** option is to perform Axial and Helical images triggered by the respiratory trigger, called Axial-R and Helical-R, so images are got at a desired threshold in the patient's respiratory cycle.

This document gives an overall description of the respiratory gating options installation, including prerequisites.

This option kit only contains Respiratory Gating Cable (5199717), but this document gives an overall description of the PRG option installation, including prerequisites.

Section 2.0 Material List

Verify that the contents of this option kit are correct according to the Material List below.

ITEM	PART NO.	DESCRIPTION	QTY.
1	5199717	Respiratory Gating Cable	1
2	5321869-1EN	Respiratory Gating Option installation Instruction	1

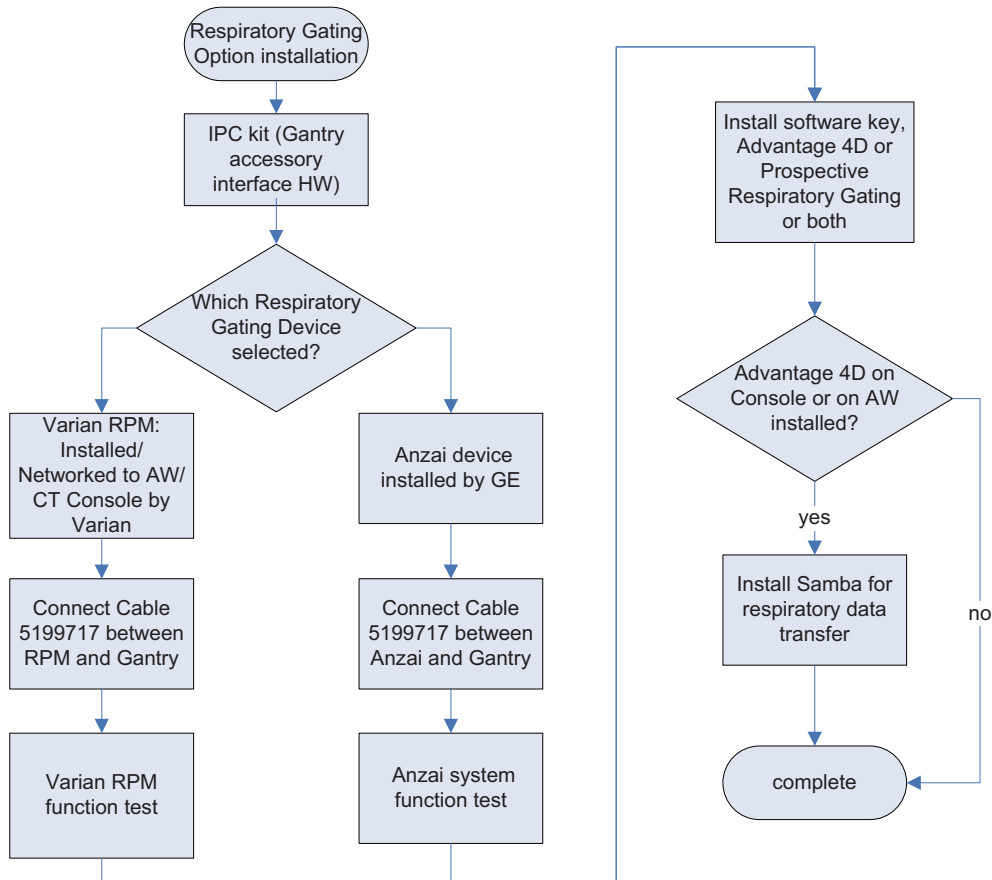
Section 3.0 Prerequisite

The following hardware must be installed prior to this option kit installation. Refer to the relevant option installation manual.

- 1.) Gantry Accessory I/F Hardware with IPC (Integrated Peripheral Control) board. This is sold separately, and is NOT part of this option kit.
- 2.) Accessory AC Outlet in console must be installed. This is NOT part of this option kit.
- 3.) The respiratory gating device (Varian RPM or Anzai respiratory gating system) must be installed and functional. The respiratory gating device is sold separately, and is NOT part of this option kit.

Section 4.0 Installation Procedure

4.1 Overview



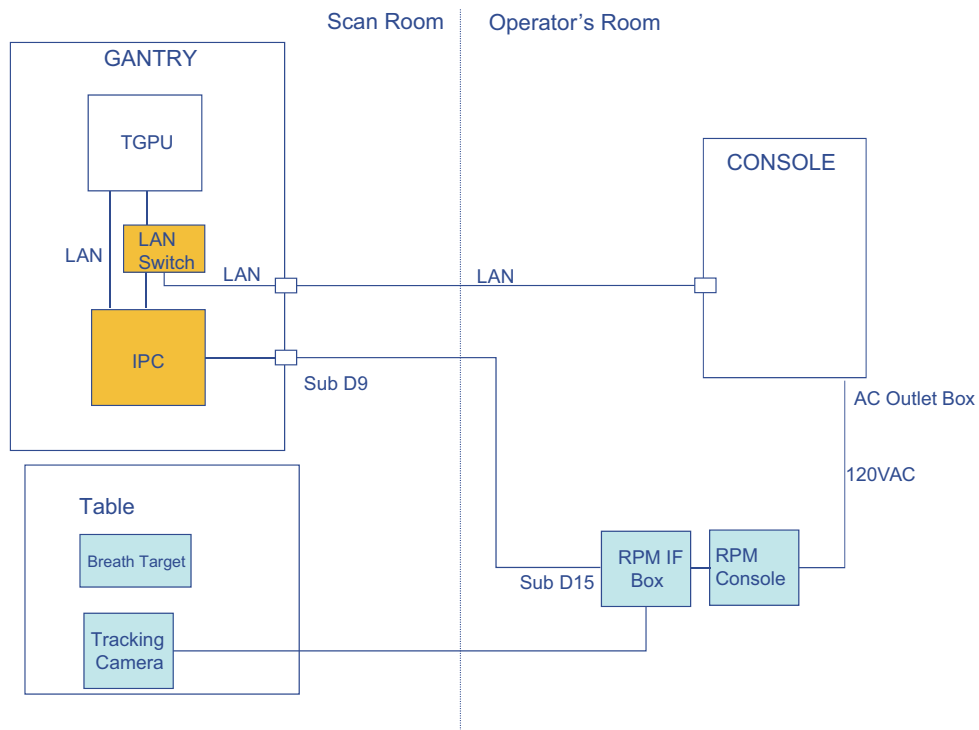
4.2 Procedure

Complete the following installation procedures. Refer to the relevant option installation manuals or sections in this manual.

- 1.) Mount Configurations pre-requisites.
 - Flat Top Table Option must be installed by a GE Field Engineer. Refer to the installation instructions included with that option.
 - If the customer selects a Varian RPM, all other mount configurations must be coordinated with the Customer and Varian on a case-by-case basis. These may include wall mounts, ceiling mounts etc.
 - For a successful installation, clarify the mounting configuration before proceeding with this installation.
- 2.) Gantry Accessory Interface Hardware (IPC kit) must be installed.
 - Refer to *Service Methods -> Installation -> Option -> Accessory Interface Hardware Installation (5321858-1EN)*
 - Do not install the gantry covers back in this step, if you will continue with the respiratory gating device installation.
- 3.) [For GOC console only] Accessory AC Outlet in console must be installed.
 - Skip to next step if the console is not a GOC type.
- 4.) The respiratory gating device must be installed and functional. There are two types of devices for selection, Varian RPM (Remote Patient Monitoring) system or Anzai system.
 - a.) For Varian RPM:
 - Varian RPM system MUST be installed, configured, and tested by a Varian representative. To proceed, continue with [Section 4.3 RPM Hardware Installation](#).
 - b.) For Anzai system:
 - Anzai respiratory gating system should be installed by GE service personnel.
 - To proceed with hardware installation and functional test, refer to *Service Methods -> Installation -> Option -> Anzai Respiratory Gating System Installation*
- 5.) After the hardware installation, continue with [Section 5.0 Software Installation](#)
- 6.) Finalization: [Section 6.0 Finalization](#)

4.3 RPM Hardware Installation

Hardware Interconnect



4.3.1 Responsibilities

1.) Responsibility of the GE Field Service

- The network mapping (Getting the IP address required) for the RPM System.
- Removal of any covers.
- Connect Respiratory option cables to scanner.
- Finalization Tests

2.) Responsibility of the Varian Service

- Initial installation of the RPM Workstation and associated equipment.
- Install RPM Camera as defined by the site configuration.
- Verify the current software version is loaded on the RPM workstation computer.
- Verify Respiratory gating is functional and set gating OPTIONS for 4D or Prospective Gating
- Verify the RPM system is physically networked to any other RPM systems or the AW or the Console.
- Confirm that the trigger output and "X-ray On" channels work using Varian supplied manual and functional test/self test at the Varian Interface (I/F) Box.
- Confirm on RPM function with X-ray ON (System Scanning) and when X-Rays are off.
- Export a file to the AW or the Console.

4.3.2 Preparing the scanner for installation of the Respiratory Gating Option

- 1.) If necessary, remove the right side cover from Gantry.
- 2.) Turn OFF the three switches, (Axial Drive, HVDC, 120VAC) at the Service Switch Panel.
- 3.) Follow all lockout/Tagout as required by your LOTO training
- 4.) If necessary remove the right Gantry rear base covers.
- 5.) Connect the RPM to Gantry Cable (5199717) from IPC bracket to RPM IF box. Please refer to Figure 1-1.

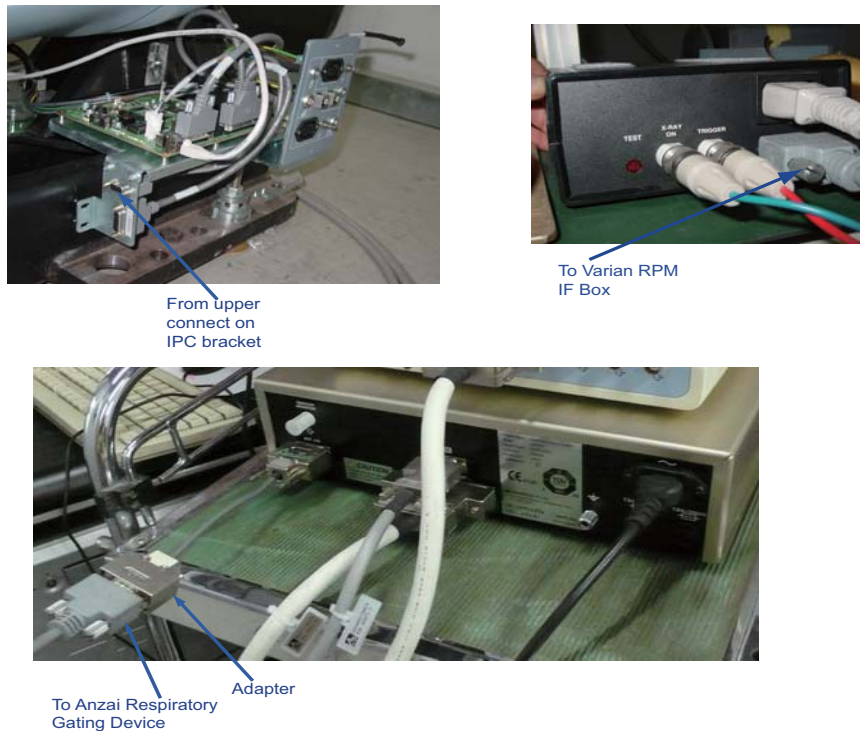


Figure 1-1 Respiratory Gating Cable (5199717) Connection

4.3.3 RPM Respiratory Gating Hardware Function Check

Note: Refer to the attached appendices for general references that may help in the final setup and testing of the unit.

This section uses the RPM system to generate a simulated Respiratory Trigger

4.3.3.1 Basic Varian RPM Hardware Check

- 1.) Make sure the Varian camera support equipment is connected, powered up and Varian RPM Computer is powered up with Microsoft Windows running. (RPM software does not need to be running).
- 2.) Turn Varian camera power ON
- 3.) Turn on the Varian I/F Box
- 4.) Remove, or DO NOT connect the gating cable 5199717 to the Varian I/F Box. (Make sure this is disconnected from the CT or PET system).

- 5.) On the Varian I/F Box verify the following:
 - a.) The green power indicator is ON.
 - b.) The red "X-Ray ON" indicator is ON.
 - c.) The "Test" indicator is OFF.
 - d.) The Trigger Indicator is OFF.
 - If one or more of these conditions are not met the problem is with the Varian RPM equipment.
 - Troubleshoot the issue or contact Varian to resolve the problem.

4.3.3.2 Setup the Breathing Phantom and Varian Camera

Note: An alternate Breathing Phantom setup is defined in Appendix B Section B-1, which will accomplish the same result without physically mounting the camera

- 1.) Mount the camera so it is facing through the patient opening of the gantry, Refer to Figure 1-2
 - a.) Attach it to the Flat Table Top cradle (If present)
 - b.) Use one of the optional Camera mounts at the rear of table, (End that is furthest away from the gantry).
 - c.) Mount as defined by the customer, (Walk rack, boom etc....).

Note: Ambient light can disrupt the camera tracking. Reduce the lighting to correct this.



Figure 1-2 TYPICAL CAMERA MOUNTED ON FLAT TABLE TOP

- 2.) Verify camera power is ON and the RPM cable and equipment is connected and Varian RPM computer is powered up with Microsoft Windows running.
- 3.) Tape the Marker block to the plastic tab on the Breathing Phantom. (Refer to Figure 1-3)
- 4.) The Marker Block should be taped so the 6 "Dots" will face the Varian Camera at the other end of the table and the rotation of the wheel is free to move the plastic tab and Marker Block up and down during its rotation. (The camera must "See" these 6 dots moving up and down).
- 5.) If not already installed, install two "D Cell" batteries in the Breathing Phantom.
- 6.) Refer to Figure 1-4. Place the RPM Breathing Phantom on the table near the table head holder end of the gantry.
- 7.) Turn the unit on. The Marker Block will slowly move up and down.



Figure 1-3 BREATHING PHANTOM AND MARKER BLOCK SETUP

- 8.) Refer to Figure 1-4 and Figure 1-5. Adjust camera head and Breathing Phantom so the dots from the marker block appear in the camera's LCD display window.
- 9.) Verify that the dots appear in the center of the Camera LCD and do not move outside of the LCD FOV. Adjust the Breathing Phantom or camera if required.

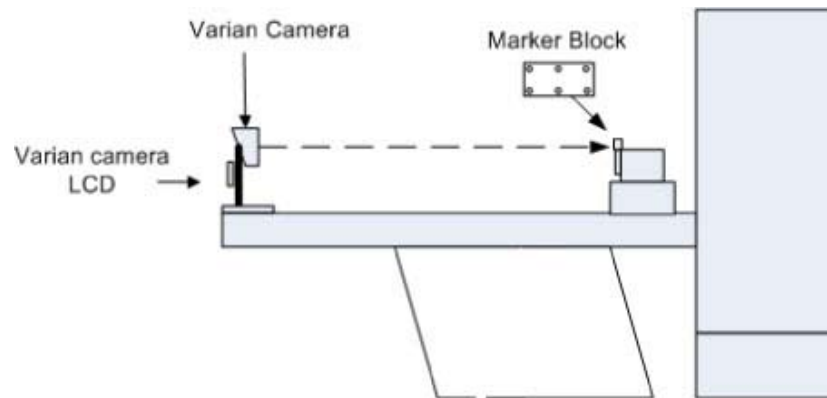


Figure 1-4 CAMERA AND PHANTOM SETUP

Note: The camera is very sensitive. The marker block should face the camera and not tilted at an angle that exceeds 25 degrees, with relationship to the camera face. Minor adjustments should be made to ensure the 6 dots clearly show up in the Varian Camera LCD display window.



Figure 1-5 CAMERA DOTS IN LCD FOV

- 10.) Turn off the Breathing Phantom. (It will be turned on again later).

4.3.3.3 Respiratory Gating Signal Function Check

- 1.) Connect the RPM to Gantry Cable (5199717) to the Varian I/F box Sub-D-J4. Verify that the "X-Ray On" indicator on the Varian I/F box is OFF.
- 2.) Launch the application (RPM Respiratory Gating System) on the RPM Computer (Windows XP or Windows 2000).
- 3.) Enter Username: (This varies site to site. Consult with site personnel).
- 4.) Username: "**VARIAN**" (ALL CAPITAL LETTERS) (Default)
- 5.) Enter the password for Windows. (This varies site to site. Consult with site personnel).
- 6.) Password: "**VARIAN**" (ALL CAPITAL LETTERS) (Default)
- 7.) Select the RPM Gating System Icon to launch the program. The RPM Respiratory System Gating Main Window will appear.
- 8.) The Daily calibration check window will open. Select: **Yes**
- 9.) The Breathing Phantom (Marker Block) and its 6 dots will appear in the center of the display.

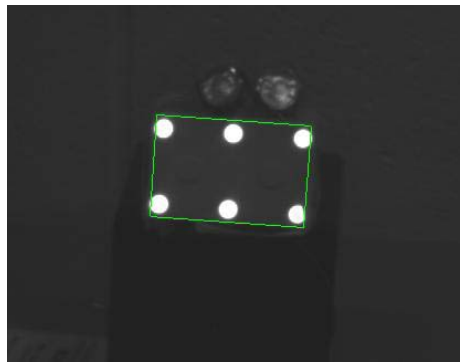


Figure 1-6 Marker Block in Center of Display ON Varian PC

- 10.) On the RPM Gating Calibration Wizard window, select: **Continue**.



Figure 1-7 PROGRESS BAR

- 11.) To proceed:
 - a.) If the Tracking Camera does not required calibration continue at step 12.
 - b.) If the Tracking camera requires calibration, a message will appear:
 - 1.) Start Calibration Now? Select: **Yes**
 - 2.) The Single Step camera Calibration wizard window will appear. Enter the amount of distance you raised/lowered the phantom to place it at ISO. (Approximate height in centimeters).
 - 3.) Select: **start** to calibrate the camera.
 - 4.) Select: **Finish**

12.) On the Patient List Window select: New Patient (Refer to Figure 1-8)

- a.) Enter: [**GE Service 1**] Patient ID
- b.) Enter: [**GE**] Last name
- c.) Enter: [**GE Service**] First Name
- d.) Enter: [**Check**] Middle Name
- e.) Select: **OK**

Note: ID must be unique. Name field information may be defined as desired. The values shown are suggested defaults.

13.) From the Patient List Window scroll to the patient ID just created: [**GEService1**]

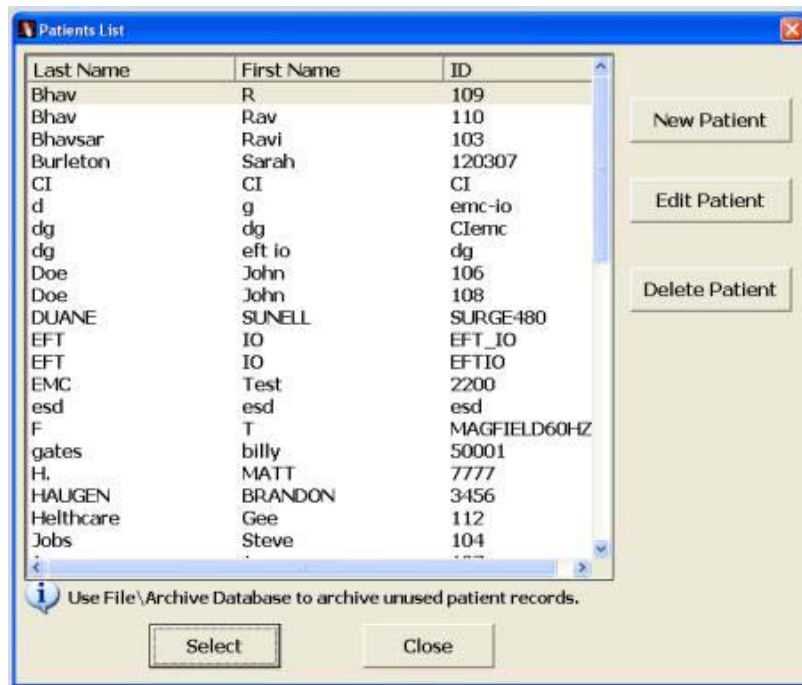


Figure 1-8 PATIENT LIST WINDOW

14.) Select: **Select** button.

- 15.) A “New Treatment Field Window” will appear:
 - a.) Select an existing treatment field from the list. [**Breast Medial**] (Default)
 - b.) Select: **OK**
 - c.) A Reference Session Window will appear:
 - * **Select: Yes** (Create Reference Session). The Main RPM Window will now appear.
- 16.) Select: **Auto Scale** On the main window. (If not checked)
- 17.) Select: **Session Options**
- 18.) Verify Options setting on Gating Tab:
 - a.) Select: **Session Options** and verify “Normal Breathing Predictive Filter Threshold parameter is set to **20**
- 19.) Verify Audio settings on the Audio Tab:
 - a.) Under “Automatic Audio Instructions Window:
 - * Set “Automatic Audio instructions” to **Enable**
 - * Set Inhale and Exhale Periods to: **(Automatically) tied to sensed intervals**. (No change to Inhale and Exhale periods. They remain at a value of 0.0)
- 20.) Select: **OK** to accept the values.
- 21.) Turn on the Breathing Phantom. (Start the Marker Block (Dots) moving up and down in the camera FOV).
- 22.) From the Navigation bar, select: Record (The display will start mapping the motion)
- 23.) The Enable gating Button becomes active. Select: **Enable Gating** Button from the navigation bar to start simulated triggers.
- 24.) Verify that the Green “Trigger” Indicator on Varian I/F Box flashes slowly.
- 25.) At the Gating Options board, verify that the Green “Resp” indicator on the Gating Options board is flashing slowly.
- 26.) Select: **Stop**
- 27.) Select: **Cancel** (Do not save session data)
- 28.) Select: **File**
- 29.) Select: **Exit**
- 30.) Select: **NO** (Do not save motion data)
- 31.) Turn off the Breathing Phantom.
- 32.) Proceed to [4.3.3.4 X-Ray-On Signal Functional Test](#)

4.3.3.4 X-Ray-On Signal Functional Test

- 1.) With the CT or PET system software (Applications) up and running, verify that the yellow “Pwr” LED is on at the Gating Options Board in the scanner.
- 2.) Make sure that cable 5199717 is connected to the Varian I/F Box (9-pin Sub-D-J4).
- 3.) Make sure the other end of cable 5199717 is connected to the Respiratory Gating port at the scanner.
- 4.) Enter Patient ID: [**Service1**]
- 5.) Enter Patient Name: **RPM Check**
 - a.) Select: (**GE**) (Anatomical Selector) prescribe/select a Scout Scan [**PTCT_ET_2D**] or equivalent to initiate a scan (“X-Ray on”).
 - b.) Establish Landmark (For Pet systems use CT Base Position)
 - c.) Place the Headholder on the cradle
 - d.) Place a phantom on the Headholder.

- e.) Press: **Alignment Light button** (Turn On the laser Alignment Lights)
- f.) Move the phantom into the Laser alignment lights. (Actual alignment light location on the phantom is not critical).
- g.) Press: **Landmark button** (Enable Landmark).
- h.) Press: **Alignment Light button** (Turn OFF the laser Alignment Lights)
- i.) At the Scanner Display, enter a scan Length for Scout and Acquisition.
* Start: **S0.00** End: **I900.00**
- j.) Verify "Gating Off" Button is **OFF**. (This is a scan setup parameter on scanner display and is not used with the Respiratory hardware Function Check).
- 6.) Verify at the Varian I/F box that the green Power indicator is ON).
- 7.) At the scanner Display select: **Confirm**
- 8.) Select: **Move to scan.**
- 9.) WHILE LOOKING AT THE VARIAN I/F BOX "X-Ray On" indicator, PRESS: **Start Scan**
- 10.) Verify red "X-Ray-On" indicator came on for the duration of the scan.
- 11.) Select: **End Exam**
- 12.) To proceed:
 - a.) If the "X-Ray-On" light did NOT light up during scan. Troubleshoot the problem.
 - b.) If the "X-Ray-On" Light was seen proceed to step 13.
- 13.) At the Gantry, move the cradle out to a neutral position.
- 14.) Remove the Phantom.
- 15.) Remove the Headholder
- 16.) Turn the Breathing Phantom OFF.
- 17.) Turn the Varian I/F box OFF.
- 18.) Turn the Camera OFF
- 19.) Shut down the RPM Software
- 20.) Select: **File**
- 21.) Select **Exit**
- 22.) Shutdown Windows
- 23.) Select: **Start**
- 24.) Select: **Shutdown**
- 25.) Turn the monitor **OFF**
- 26.) Turn off RPM Computer power.
- 27.) (If necessary) disconnect any cables.
- 28.) This completes the Respiratory Gating Hardware Function Test.
- 29.) Restore any system covers removed.

Note: Further testing of the applications associated with the Advantage (4D) Respiratory Option may proceed at this time by qualified Applications personnel.

4.3.4 Restore Power to the Gantry

- 1.) Remove any Lockout/tagout devices.
- 2.) Turn ON the 3 switches, (Axial Drive, HVDC, 120VAC) at the Service Switch Panel.
- 3.) If necessary, boot the system up to Applications Level.

Section 5.0 Software Installation

- 1.) Install the respiratory gating option software key.
- 2.) (ONLY required for 4D) Install Samba software on Console or AW for respiratory motion file transfer, refer to *Service Methods -> Installation -> Samba Installation for CT Console, or AW service manual*.
- 3.) Further testing of the applications associated with the Respiratory Options may proceed at this time by qualified Applications personnel. Refer to the operator manual (Learning and Reference Guide), Respiratory Triggering chapter for details.

Section 6.0 Finalization

Attach the rating plates on the chassis of the OC. Process the product locator card according to the instruction in your country.

Appendix A

Advantage 4D General Reference

The GE Healthcare Field Engineer should not install or configure the RPM Acquisition Software the first time it is installed. This is the responsibility of the Varian Representative. This section is for “General reference only”. Refer to the Varian Installation Manual for details and exact procedures for the operation of this unit. To proceed with the Varian RPM system checkout a Varian representative must complete the RPM unit and camera installation in accordance with the Varian installation manuals supplied by Varian.

The RPM acquisition software procedures can be found in the VARIAN Respiratory Gating System Version 1.7 (and forward) Installation Reference Guide. This document should accompany the RPM system. If you cannot find this manual contact Varian Support. (See Contacts).

Contacts

If you have failures or concerns with the outcomes from previous instructions that you cannot resolve with normal analysis and troubleshooting refer to the Operators manual and the VARIAN Respiratory Gating System Version 1.7 (and forward) Installation Reference Guide, or call Varian Support:

- Varian: 1-888-VARIAN5

Appendix B

Alternate Breathing Phantom and Varian Camera Setup

Section 1.0

Alternate Breathing Phantom and Varian Camera Setup

If the Flat table Top Mount or other Mount kits are not available, this setup can be used to complete the functional test of the respiratory gating hardware.

- 1.) Setup the Varian Camera so it can be pointed directly at the Breathing Phantom and Marker Block (with dots).

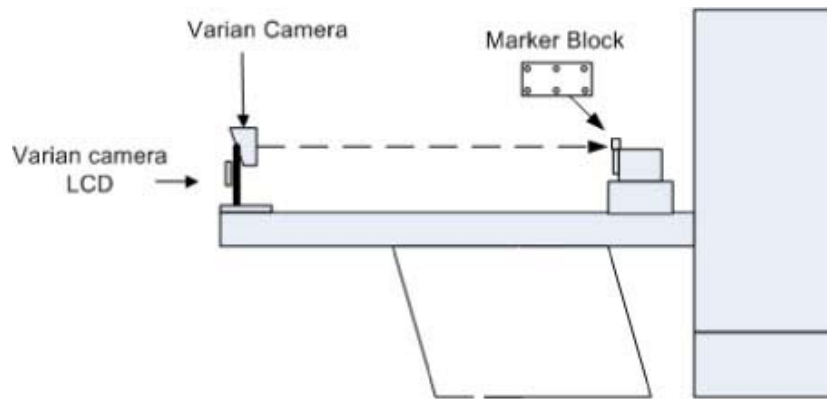


Figure B-1 Alternate Camera/Breathing Phantom setup

- 2.) Verify camera power is ON and the RPM cable and equipment is connected and Varian RPM Computer is powered up with Microsoft Windows running.
- 3.) Tape the Marker block to the plastic tab on the Breathing Phantom. (Refer to [Figure B-1](#)). The Marker Block should be taped so the 6 "Dots" can be setup to face the Varian Camera and the rotation of the wheel on the Phantom is free to turn, which will move the plastic tab and Marker Block during its rotation. (The camera must "See" these 6 dots moving up and down).
- 4.) If necessary, install two "D" Cell batteries into the Breathing Phantom.



Figure B-2 BREATHING PHANTOM AND MARKER BLOCK SETUP

- 5.) Place the Breathing Phantom and Marker Block (Dots) directly in front of the Varian camera approximately 5 feet (1.5m) and adjust its position to align the Marker Block (dots) so they appear in the center of the Camera LCD Field Of View (FOV). (Refer to [Figure B-3](#)).
- 6.) Turn the unit it on. It will move the Marker Block with the dots up and down.
- 7.) Verify that the dots appear in the center of the Camera LCD and do not move outside of the LCD FOV. Adjust the Breathing Phantom or camera if required.

Note: The camera is very sensitive. The marker block should face the camera and not tilted at an angle that exceeds 25 degrees, with relationship to the camera face. Minor adjustments should be made to ensure the 6 dots clearly show up in the Varian Camera LCD display window.

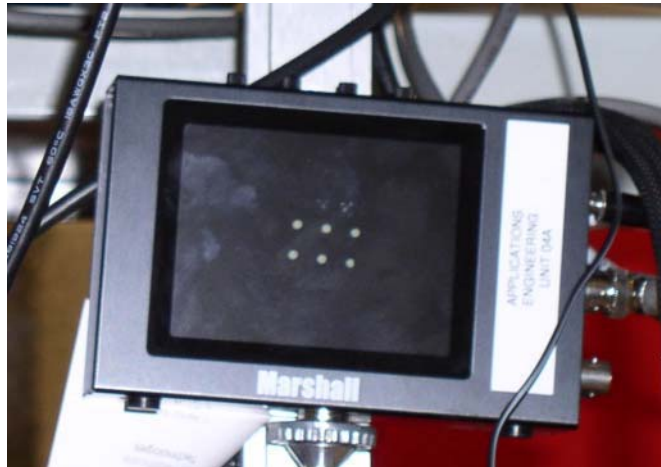


Figure B-3 CAMERA DOTS IN LCD FOV

- 8.) Turn off the Breathing Phantom. (It will be turned on again later).
- 9.) Return to Section [4.3.3.3 - Respiratory Gating Signal Function Check](#).

Section 2.0 Troubleshooting

- 1.) If using cable 2371402 make sure the Orange end is plugged into the Cardiac port and the Blue end is plugged into the Respiratory port. If connected in reverse you will not get Respiratory triggers.
- 2.) To proceed:
 - a.) If Varian RPM Hardware fails the problem is with the Varian RPM hardware. Troubleshoot the Varian Hardware only. Troubleshoot the Varian hardware problem or contact Varian.
 - b.) If Breathing Phantom and Varian Camera fails the problem is with the Varian RPM hardware OR Software. Troubleshoot the Varian Hardware or Software or contact Varian
 - c.) If Respiratory Gating Signal fails the problem is with the GE hardware (cabling or GOB board) or software on the scanner. Refer to the Functional Block Diagrams & Schematic manual for detailed troubleshooting information.
- 3.) TroubleShooting Information

Please refer below listed the Troubleshooting information during the Funtional Test.

Error Code	Error Message	Possible reason
260100179	Respiratory Monitoring Device was NOT ready.	RPM system connection error.
260100180	Scan Aborted. A Timeout Occurred Waiting for a Respiratory Trigger Signal. Check Respiratory Monitoring Device/Patient Connection."	RPM system connection error. Patient breath wave is not good.
260100182	The time from respiratory triggering to x-ray enabled was too long. The expected time should be less than %d msec. The actual time was: %d msec."	CT system issue

Table 1-1 Troubleshooting Information

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Imagination at work