



M2™ Compact High-Performance MRI System

Operator Manual





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Operator Manual

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1 Introduction

Thank you for purchasing the M2™ Compact High-Performance MRI System. The M2 MRI is an innovative, medical-grade (1 Tesla), high-resolution Magnetic Resonance Imaging (MRI) system. The M2 addresses the needs of laboratories and pre-clinical research centers performing *in vivo* small animal imaging and *in vitro* studies that require the powerful imaging capabilities of MRI but without the cost, complexity, maintenance and expertise involved with traditional MRI systems.

Aspect Imaging's M2 MRI system is designed for specific applications and is optimized according to user requirements; workflow is made simple and streamlined.

This chapter contains the following sections:

- About the Operator Manual
- Operator Manual Conventions
- Navigating the Operator Manual

About the Operator Manual

This operator manual provides the information necessary to operate the M2 in a safe and efficient manner. Please read and thoroughly understand the operator manual before operating the system. If any part of this operator manual is not clear, contact Aspect Imaging Customer Support for clarifications.

The operator manual is intended to be enclosed with the M2 system. It is not intended to replace the user's training course.

This operator manual should always accompany the unit, and all personnel operating the unit must know its location.

Make sure you read the safety instructions carefully before operating the system for the first time.

Audience

This operator manual is written for operators who will be using the M2 MRI system. There are three main types of operators:

- **Operator:** a user who can acquire and measure images, and perform most of the system activities. Operators do not have access to the Design Mode, Design Panel, or the Playlist functionality.
- **Manager:** a user who has full access to the main modes and panels but cannot manage system users and cannot access proprietary company software.

- **Super User:** a user who has full access to the main modes and panels, can manage system users, but cannot access proprietary company software.

Operator Manual Conventions

The following conventions are used throughout the operator manual:

- The names of menus, screens, and dialog boxes are capitalized.
- The step-by-step instructions are numbered.
- Controls that have to be acted upon, are marked in bold, as in the following example:

Click **Next** to continue. A new screen is displayed.

Fill-in the data and click **OK**.

- Instructions to press keyboard keys are displayed as follows:

Press **<Ctrl>**.

- Cross-references are marked in dark blue italics. Example: *Acquiring Images*
- Important safety warnings appear in the text as follows:



Warning – indicates precautions and instructions, which, if not followed, may result in serious bodily injury or death.



Caution – indicates instructions, or cautionary notes, which, if not followed, may result in damage to the equipment or to the quality of measurements.

- Notes and tips appear in the text as follows:



Notes – contain helpful information and tips.

Using the Graphical User Interface (GUI)

This operator manual assumes that one knows how to use Windows-based applications. To prevent misunderstanding, however, the most important actions that are required for using the M2 software are described here.

Using Drag-and-Drop

Drag-and-drop is commonly used to move objects from one location on the screen to another location. In the M2 software, this functionality is used to measure distances or to define areas on an image. The basic sequence involved in drag-and-drop is:

- 1 Press, and hold down, the left button of the mouse at the point from which you want to start the dragging action.
Example: The start point of the measurement, or the first corner of a rectangle.
- 2 Move (or 'drag') the cursor to the desired location.
Example: The end point of the measurement, or the diagonal corner of the rectangle.
- 3 Finish the dragging movement (or 'drop') by releasing the button.

Closing Boxes Using the Windows Close Button

Some of the dialog boxes in the M2 software close automatically when an action is performed or a button is clicked. In some cases, however, you have to close the dialog box by clicking the Windows Close button.

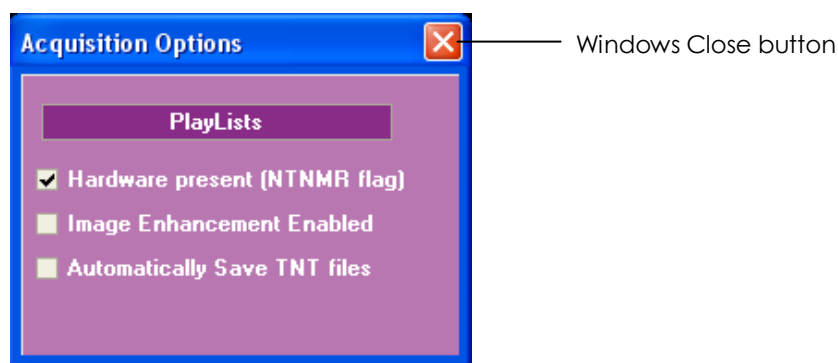


Figure 1: Windows Close button in dialog box

Whenever you are requested to "click the Windows Close button", locate the Close button of the current dialog box (always in the top right corner of the dialog box) and click.

Navigating the Operator Manual

The M2 MRI operator manual is comprised of the following chapters:

- **Chapter 1, Introduction**, describes the operator manual structure and conventions.
- **Chapter 2, Safety**, provides an overview of the hazards involved in improper use of the M2 MRI system, and the safety measures that will ensure safe operation. Read this chapter carefully before starting to use the M2 MRI system.
- **Chapter 3, System Overview**, describes the system components.
- **Chapter 4, Getting started**, explains how to turn the M2 MRI on and off, and describes the user interface and main operational modes and concepts of the NRG Console, the software application that you will use to operate the MRI.
- **Chapter 5, Acquiring Images**, walks you through the process of acquiring an MRI image. This chapter also describes the Control Panel tools, the Acquisition queue, and the Playlists functionality.
- **Chapter 6, Working with Images**, explains how to view, measure, edit and print acquired images.

- **Chapter 7, Managing Protocols**, explains how to create, edit, and delete protocols.
- **Chapter 8, Managing Archives**, describes the archiving options in the system and how to manage the various archives.
- **Chapter 9, System Set-up and Configuration**, provides information on managing users, using the various system logs, managing sequence protocols, and checking the system status.
- **Appendix A, Specifications**, details the M2 MRI specifications.
- **Appendix B, System Calibration**, details the M2 MRI system calibration procedures.
- **Appendix C, Troubleshooting**, describes common problems and how to overcome them.
- **Appendix D, Application Notes**, provides tips and work sequences for special application needs.
- **Appendix E, Glossary**, includes a glossary of MRI terms.

2 Safety

The M2 MRI was built to provide the highest safety requirements. Due to its vanishing external fringe-field, it can be safely installed in small spaces. The integrated RF shielding and silent gradients eliminate the need for a specially shielded room and other limiting operational procedures.

Improper operation of any electrical system, however, may be hazardous. Please read this chapter carefully before attempting to operate the system, to prevent harmful effects to you or your environment.

The information provided in this chapter is not intended to replace professional training on the safety and use of the M2 MRI system.



This system is intended exclusively for pre-clinical research.

This chapter contains the following sections:

- General Safety Guidelines
- General Hazards
- Potential Adverse Effects
- Noise
- Access Control

General Safety Guidelines

This product is designed and manufactured to ensure maximum safety of operation. It should be operated and maintained in strict compliance with the safety precautions, warnings, and operating instructions contained in official Aspect Imaging publications.

- This product should be installed, maintained, and serviced by Aspect Imaging qualified personnel.
- Do not modify the system in whole or in part in any way without prior written approval by Aspect Imaging.
- Do not connect any third-party equipment to the system without written approval from Aspect Imaging.
- Make sure that only properly trained and fully qualified personnel are authorized to operate this equipment. An authorized operator's list should be maintained.
- The SAR and dB/dt limits are below the "Normal Operating Mode" limit as defined by the IEC60601-2-33 standard, and the FDA Guidance for the Submission of Pre-Market Notification for Magnetic Resonance Diagnostic Devices.

- This operator manual should always accompany the unit, and all personnel operating the unit must know its location.
- Unauthorized personnel should not be allowed access to the system.
- The system is equipped with a main circuit breaker. Activate the breaker when there is any sign of danger.
- In the event of system malfunction or of improper response to safety controls, suspend all operation of the equipment, and notify Aspect Imaging's Customer Support Department immediately.
- System users should become familiar with product specifications, system accuracy, and stability limitations. These limitations must be considered before making any decision based on quantitative values. In case of doubt, consult the Aspect Imaging Customer Support Department.



Never place a metal or magnetically-susceptible object in or near the M2 magnet's opening or "bore". This could be dangerous and cause irreparable damage to the M2 system.



In some countries, legislation may exist covering occupational limits for exposure to static magnetic fields. Bear in mind, however, that no evidence exists to support cumulative effects with time for exposure to static magnetic fields.

General Hazards

Improper use of the system may expose you to various hazards of electrical or magnetic nature. Adhering to the following precautions is critical for your safety.

Electrical Shock

Internal circuits use high voltage that can cause fatal injury. Do not remove the system covers. There are no user serviceable components inside the magnet assembly or electronics cabinet. The electronics cabinet should be kept locked, and should be opened only for start-up, shutdown, and calibration.

Electrical Fire

- Liquids that contact active circuitry may cause an electrical fire. Therefore, never place any liquids near the system cabinet.
- Make sure that fire extinguishers at the site have been approved for use to extinguish electrical fires in an MRI environment.
- Fire precautions should be discussed with the local fire department, and emergency procedures established.

Explosion

Do not operate the system in the presence of flammable gases or liquids.

Magnetic Field

The magnetic field is 5 Gauss at a distance of approximately 70 centimeters from the magnet.

Note/Tip



We suggest that you mark a 5 Gauss line at a distance of 70 centimeters around the magnet. This will clearly delineate the safety zone.

- No metal objects are to be placed in close vicinity of the magnet.
- No objects are to be placed on top of magnet or attached to the side of the magnet.
- Anyone with surgical metal implants or embedded metal objects in their hands/wrists is not allowed to insert or remove objects from the magnet (the magnetic field inside the magnet is strong enough to potentially torque and twist metal implants.)

Potential Adverse Effects

Warning



Danger due to implanted electronic devices:

Persons with pacemakers or other implanted electronic devices should remain at a distance of at least 3 feet from the system.

Warning



Displacement and/or heating of ferromagnetic objects:

The magnetic force exerted by the MRI system on ferromagnetic objects within its field can cause implanted or embedded objects (such as surgical clips, aneurysm clips, or shrapnel) to become dislodged. In some cases, eddy currents induced by magnetic fields may cause heating of metallic implants.

Warning



Absorption of Radiofrequency energy:

Radiofrequency energy absorption may cause systemic thermal overload and local thermal injury. The use of auxiliary equipment that has not been specifically tested and approved for use in an MRI environment may result in burns or other injuries to the operator or to the test subject. Even instruments that are MRI compatible may cause injury if not used according to the manufacturer's instructions.

Noise

Acoustic noise may be generated by the pulses of electrical current energizing the gradient coils. The acoustic noise levels associated with the system are below the occupational limits recommended by the American Conference of Governmental Industrial Hygienists and IEC 60601-2-33, chapters 6 and 26. The operator is therefore not subjected to potentially dangerous levels of acoustic noise.

Note/Tip



Different legislation regarding exposure to noise may exist in other countries.

Access Control

Access to the site where the system is installed is restricted to authorized personnel.

3 System Overview

The M2 MRI system comprises hardware and software components. In this chapter, you will become familiar with the system components and the relationship between them.

This chapter contains the following sections:

- What is the M2 MRI System?
- Electronics Cabinet
- Magnet Sub-system
- Changing RF Coils
- Positioning the Sample
- Computer

What is the M2 MRI System?

The M2 MRI system is a compact, high-performance MRI system developed for pre-clinical research. The M2 MRI uses a permanent 1 Tesla magnet and a streamlined workflow to produce high-resolution images.



The M2 MRI system is not approved for use in humans.

Aspect Imaging's system is based on revolutionary permanent magnet technology. The magnet is highly efficient with no eddy currents from operation of the gradients. The system has high performance, silent gradients, highly sensitive RF coils, and powerful user-friendly application software providing high quality MR images.

Unlike most high field MRI systems the M2 MRI system can be placed anywhere in the laboratory, office, animal facility, etc. It is inherently shielded with virtually no magnetic fringe field. The M2 MRI requires only a small footprint and has no special requirements for operation, enabling every researcher maximum operational flexibility and simplicity. Due to its relatively lightweight and compact design, it is simple to relocate. Installation is simple and fast.

The system includes a PC, an electronics cabinet, and a magnet sub-system, as illustrated below:

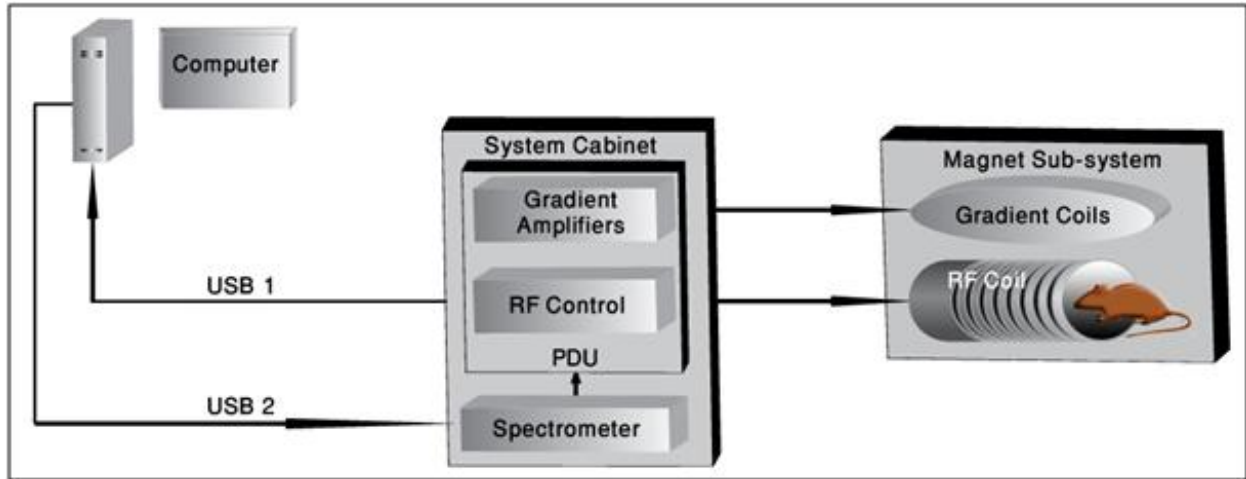


Figure 2: System Diagram

Electronics Cabinet

The electronics cabinet contains all the components required for controlling and operating the magnet sub-system.

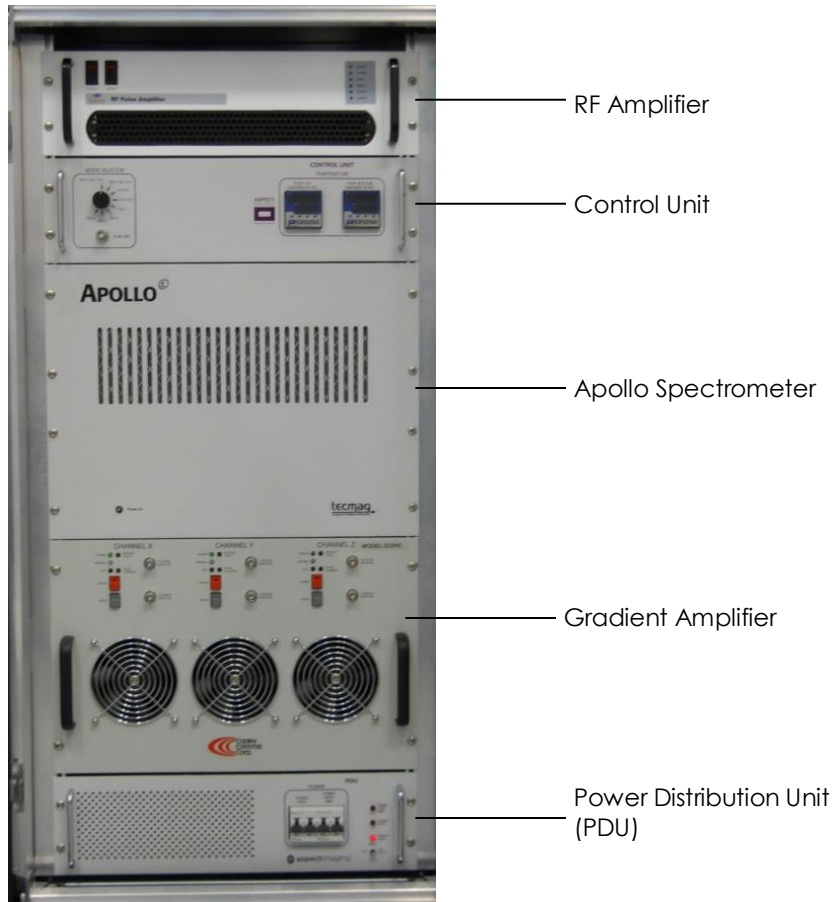


Figure 3: Electronics Cabinet

The electronics cabinet houses the following rack-mounted components:

- The RF Amplifier that amplifies the Radio Frequency signal delivered by the RF coils.
- The Control Unit that controls the Radio Frequency signal.
- The Apollo Spectrometer that generates the pulse signals and captures the scan data.
- The Gradient Amplifiers that amplify the gradient pulses.
- The PDU (Power Distribution Unit) that distributes power to the system.

Magnet Sub-system

The magnet assembly is a closed unit that is controlled by the Electronics Cabinet and the NRG Console software.

The magnet unit includes the following:

- Magnet assembly
- Wheeled cart



Figure 4: Magnet Sub-system

On the front of the magnet assembly, you will find the sample insertion opening or the M2 magnet's bore. When the M2 small animal handling unit is in place, you can see a plate with two black knobs.



Figure 5: Magnet Sub-system with M2 Small Animal Handling Unit in Place

- 4 To remove the Small Animal Handling unit, rotate both knobs counterclockwise.
- 5 Pull the mounting plate until the unit comes out.

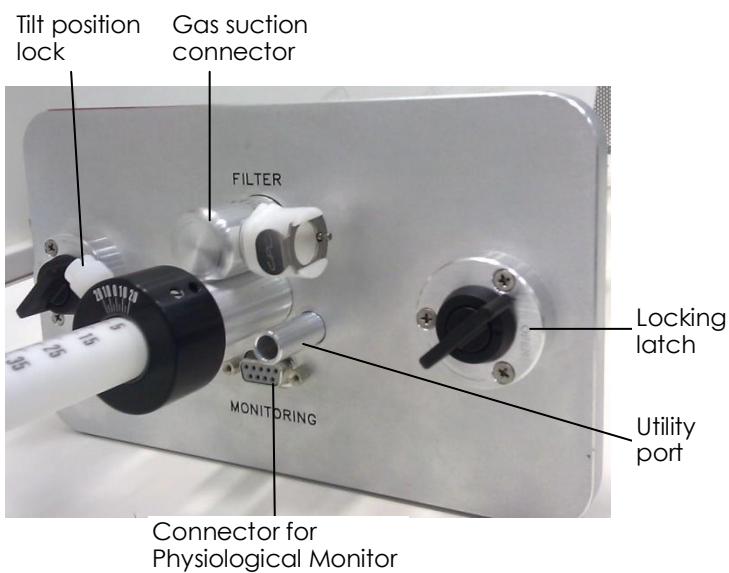


Figure 6: Face-plate of Small Animal Handling Unit

Radio Frequency (RF) Coils

The system can be ordered with multiple application-specific RF coils including the following two popular models: 35 mm, and 60 mm. The coils are calibrated to the required radio frequency for proton imaging and are used for RF transmission and reception.

One of the coils is mounted in the back of the M2 magnet assembly at all times.

For best quality of imaging, it is important to use the smallest coil that will provide the tightest fit to your sample.



Figure 7: 35 and 60 mm M2 RF Coils

Changing RF Coils

To switch coils

- 1 On the back of the magnet assembly, identify the coil assembly. The coil is attached to the magnet assembly body by two screws with black knob heads.

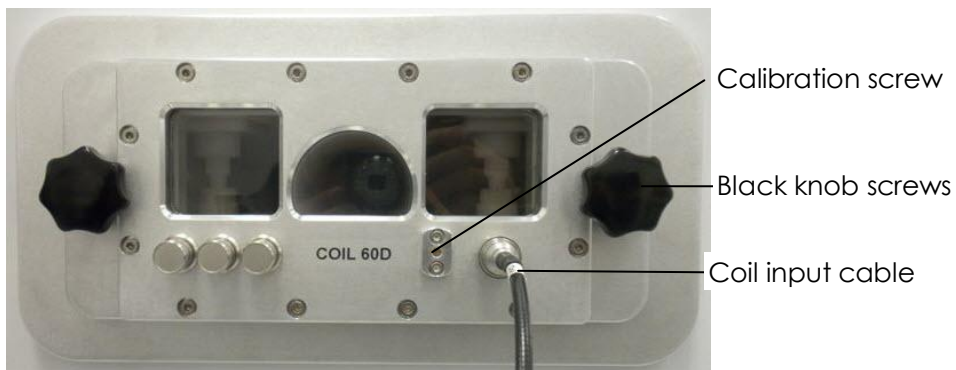


Figure 8: RF Coil Assembly

- 2 Remove the coil input cable by gently pulling the connector grip.
- 3 Rotate the knobs counterclockwise to loosen the bolt completely.
- 4 Gently pull the RF coil assembly out of the magnet unit.

- 5 Place the RF coil in the RF coil storage box.
- 6 Take the second RF coil and fit it into the slot. Make sure that the coil goes smoothly inside and fits around the Small Animal Handling unit. Push the coil assembly until it is fully inserted.
- 7 Make sure that the attachment screws fit into their slots, and fasten the two screws by turning the knobs clockwise.
- 8 Attach the coil input cable.



Always make sure to correctly indicate in the software which RF coil is installed. For additional information, refer to [Verify RF Coil](#) on page 31.

Positioning the Sample

Correct positioning of the sample is very important for obtaining high quality imaging results. Position the sample with the area of interest in the center of the RF coil and of the magnet. Make sure that the sample is positioned in the vertical center as well; if necessary, place it on top of a support as illustrated in the following image.

- 1 Rotate the sample mounting unit knobs counterclockwise and remove the Small Animal Handling unit from the magnet assembly.
- 2 Place the sample in the Small Animal Handling unit, making sure that the area to be imaged is centered on the center mark.

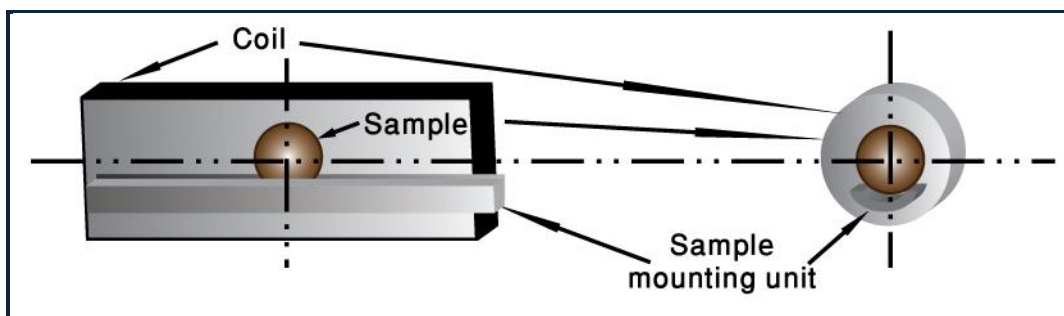


Figure 9: Sample Positioning in the Coil

Computer (PC)

The system is supplied with a desktop PC and a 24" LCD monitor. The system software is comprised of three independent modules:

- **NRG Console** is the main operation interface.
- **NTNMR** is the instrument control, data acquisition, and data processing software program for the Tecmag Apollo spectrometer. The NTNMR application window is displayed after login, when the logging-in user is of Manager user type.
For additional information about the NTNMR software, on the NTNMR Help menu click **Reference Manual**.
- The **Matlab** application constructs the MRI images from the raw data.



Caution

To prevent application conflict, it is recommended not to install any other applications on the M2 computer.

Data

The system scans the samples and generates raw data, which is reconstructed by the Matlab application into MRI images.

The raw data file and images file format is 16-bit signed integer, little endian (least significant byte first). If you require the raw data images for off-line processing, you can find the image data and text files with all the parameters in **C:/program files/NRGSYS/NRGConsole/IMAGE/** folder. The folder contains folders for each image series, with a Dat file and image files for the series and all of its slices.

4 Getting Started

In this chapter, you will become acquainted with the structure of the NRG Console user interface and its main operational concepts.

This chapter contains the following sections:

- Turning the System On
- Turning the System Off
- The NRG Console Main Screen
- Main Operational Concepts
- Operational Modes

Turning the System On

Turning the system on includes switching on the hardware and the software. Follow the start-up sequence described here:

- 1 Raise the main power switch (marked POWER RACK) on the front of the PDU (power distribution unit) in the Electronics Cabinet.



Figure 10: Power Switches

- 2 Power-on the PC.
- 3 On the Desktop, click the NRG program icon. The NRG Start window is displayed.



- 4 Click **Start**. The Login window is displayed.



- 5 Type your **Login** name and **Password**.
- 6 Click **Login** or press the **<Enter>** key to start the application. The system identifies the user type according to your login credentials, and displays the appropriate functionality.
- 7 Raise the gradients power switch (marked POWER GRAD. AMP.) on the front of the PDU (power distribution unit) in the Electronics Cabinet.

Turning the System Off

It is recommended to turn the Electronics Cabinet off at the end of the workday, and to close the NRG Console software. You may leave the PC powered on, if you prefer.

- 1 Lower the Gradient power switch (marked GRAD) on the front of the PDU.
- 2 Lower the Main power switch (marked MAIN) on the front of the PDU.
- 3 Click the Windows Close button on the NRG Console screen. A confirmation message is displayed.
- 4 Click **Yes**. The NRG Console and NTNMR windows close.

The NRG Console Main Screen

The user interface layout is divided into several sections. The layout is permanent, but the content of the sections changes according to the selected mode.

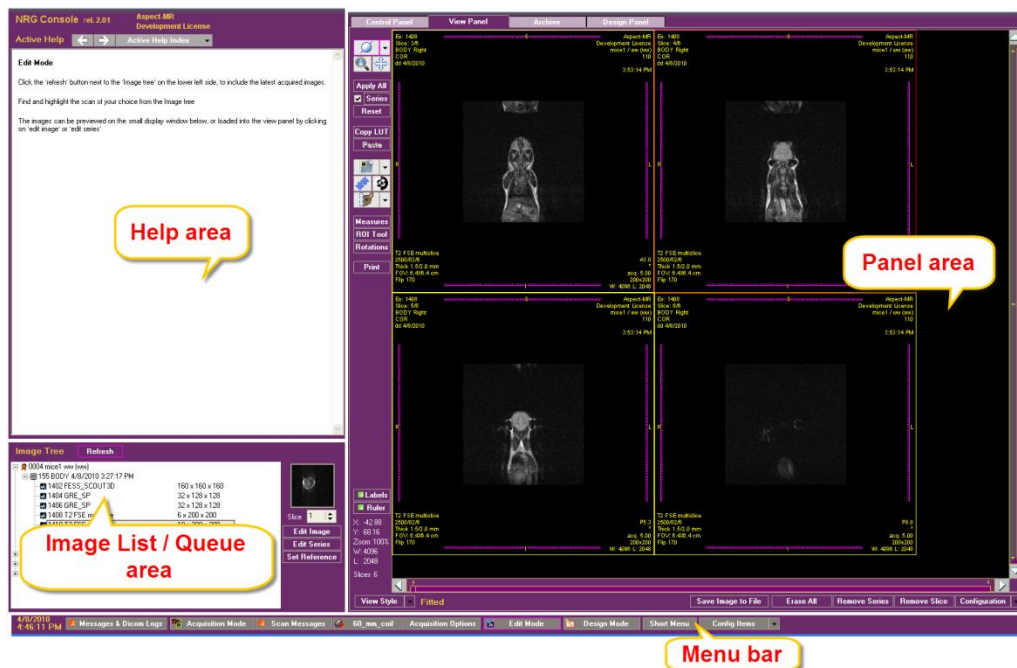


Figure 11: User Interface Layout

Help area	Contains help information specific to the current display.
Image List / Queue area	This area contains a list of previously acquired images, or the acquisition queue, according to the selected mode.
Menu bar	Provides quick access to information and tasks.
Panel area	Displays the Control, Edit, Archive and Design panels according to operational mode and user selection.

Main Operational Concepts

The NRG console is used for acquiring, managing, and measuring MRI images on the M2 MRI system.

The acquisition process involves several steps, which include performing an initial Scout scan, setting up scan parameters, and scanning.

The MRI calibration and scanning processes are performed using a queue mechanism, which is controlled from the NRG console.

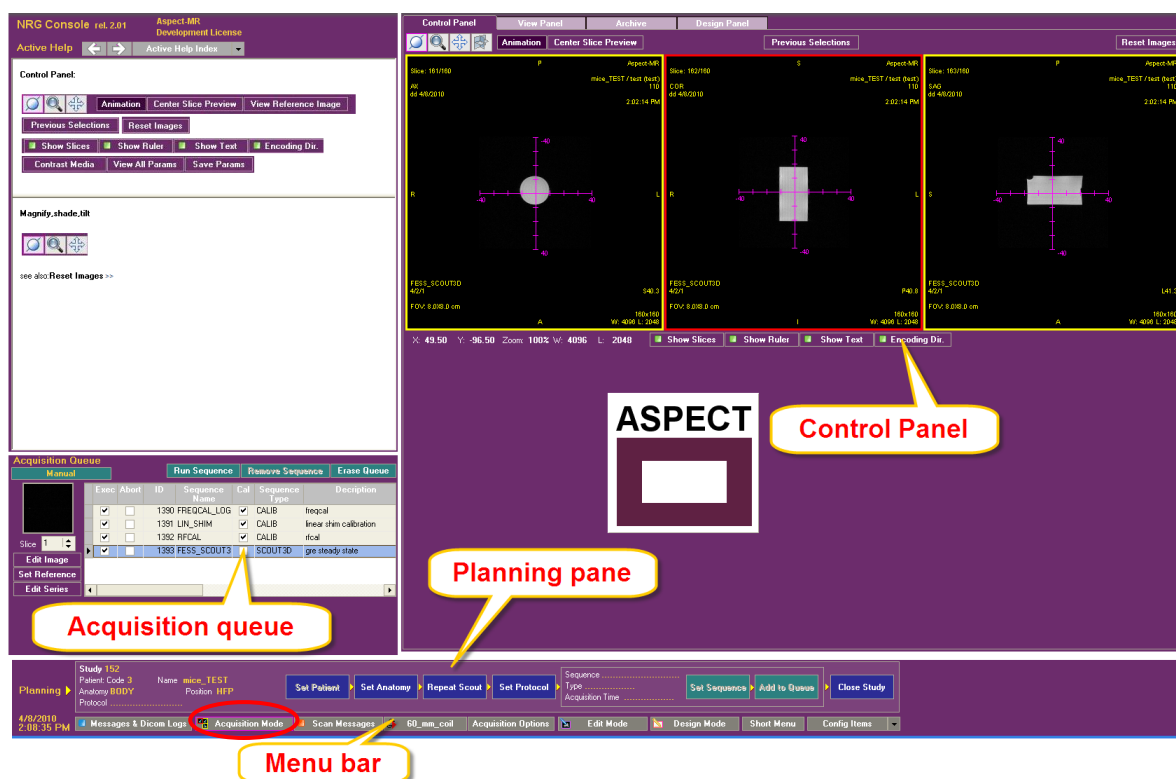
The software also contains a section for designing pulse sequences. This section is limited to users with high-level privileges, i.e., Managers and Super Users.

Operational Modes

The system includes three operational modes: Acquisition Mode, Edit Mode, and Design Mode. The display changes according to the selected mode.

Acquisition Mode

The Acquisition Mode is used for acquiring new images and is the most often used operating mode in routine operation. It is displayed by default when the logged-in user is of Operator type. In Acquisition Mode, the system displays the following screen:



Help area	Contains help information specific to the current display.
Acquisition Queue	Displays the sequences to be executed and their execution status.
Control Panel	Includes three display areas for the center scout image slices in each of the three planes, and a scan parameters area, which is filled with content after a pulse sequence is selected.
Planning pane	Guides you through the acquisition process.
Menu bar	Provides quick access to information and tasks.

Edit Mode

The Edit Mode is used for viewing and editing acquired images and series of images. When Edit Mode is selected, the system displays the following screen:



Help area

Contains help information specific to the current display.

Image tree

Shows all the acquired images on your disk. Includes a small preview of the selected image/series.

View panel

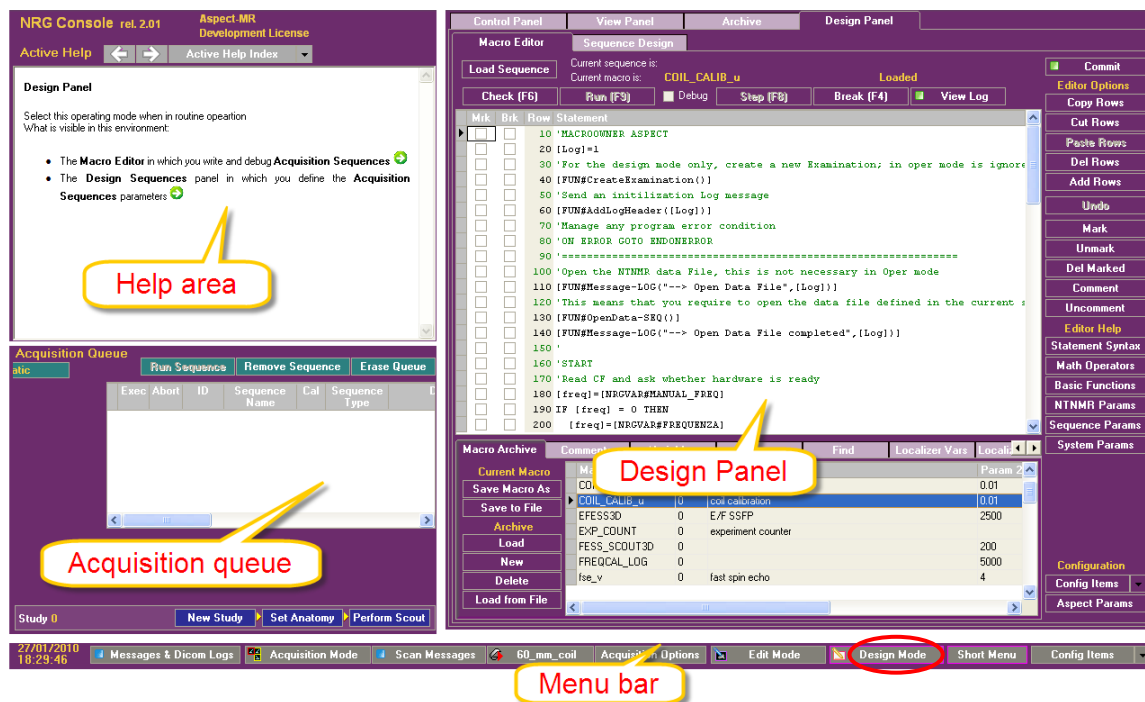
For display and management of acquired images.

Menu bar

Provides quick access to information and tasks.

Design Mode

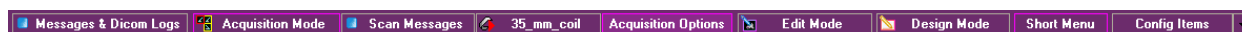
The Design Mode is used for designing and modifying sequences and macros. This mode is available only to Managers and Super Users. When the mode is selected, the system displays the following screen:



Help area	Contains help information specific to the current display
Acquisition Queue	Displays sequences to be executed and their execution status.
Design Panel	For editing macros and sequences.
Menu bar	Provides quick access to information and tasks.

Menu Bar

The menu bar is always present on the screen. It provides quick access to information and data.



Messages & DICOM Logs	Opens the history of all the system and DICOM messages displayed to the user.
Acquisition Mode	Opens the Acquisition Mode.

Scan Messages	Opens the history of scan related messages and the history of all the executed scan sequences.
35_mm_coil	Identifies the currently installed coil and opens the acquisition coils selection dialog box.
Acquisition Options	Opens a dialog box that provides access to the Playlist functionality and to several acquisition related options.
Edit Mode	Opens the Edit Mode.
Design Mode	Opens the Design Mode.
Short Menu	Changes the display of the Planning pane to display a long or short processing menu.
Config Items	Opens a menu of configuration and setup related options.

5 Acquiring Images

Now that you are acquainted with the components of the system and the user interface, you are ready to acquire images. This chapter guides you through the main flow of image acquisition. Cross-references are provided to other sections of the operator manual that contain detailed reference information, wherever appropriate.

This chapter contains the following sections:

- Prerequisites
- Acquisition Process
- Control Panel
- Using the Acquisition Queue
- Managing Playlists

Prerequisites

Before you proceed to acquire an image, make sure you have placed your sample in the Small Animal Handling unit and that you have the proper RF coil configured in the system.

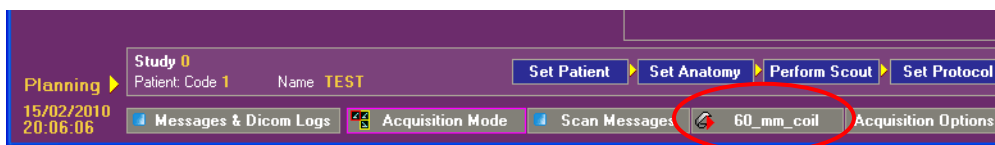
Sample

Make sure you have a properly positioned sample in the magnet. For additional information, refer to [Positioning the Sample](#) on page 20.

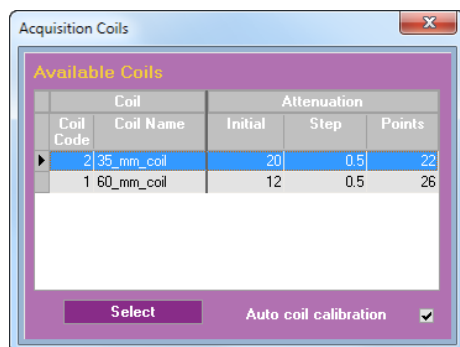
Verify RF Coil

For best image quality, use the smallest coil that will fit your sample snugly, and verify that you have entered the correct information to the system.

- 1 Make sure that the correct RF coil is identified by the system. The coil identification is displayed on a tab in the menu bar at the bottom of the screen.



- 2 If the coil identified is different from the one currently used, specify the correct coil:
 - a. Click the coil identification button. The Acquisition Coils dialog box is displayed.



- b. Choose the correct coil, mark the Auto coil calibration check box and click **Select**. The dialog box closes, the coil name is updated on the tab and the coil is automatically calibrated.

If you do not have coils that have been updated for automatic calibration, you must perform the calibration manually as described in Appendix B under the *Coil Calibration* section.

Acquisition Process

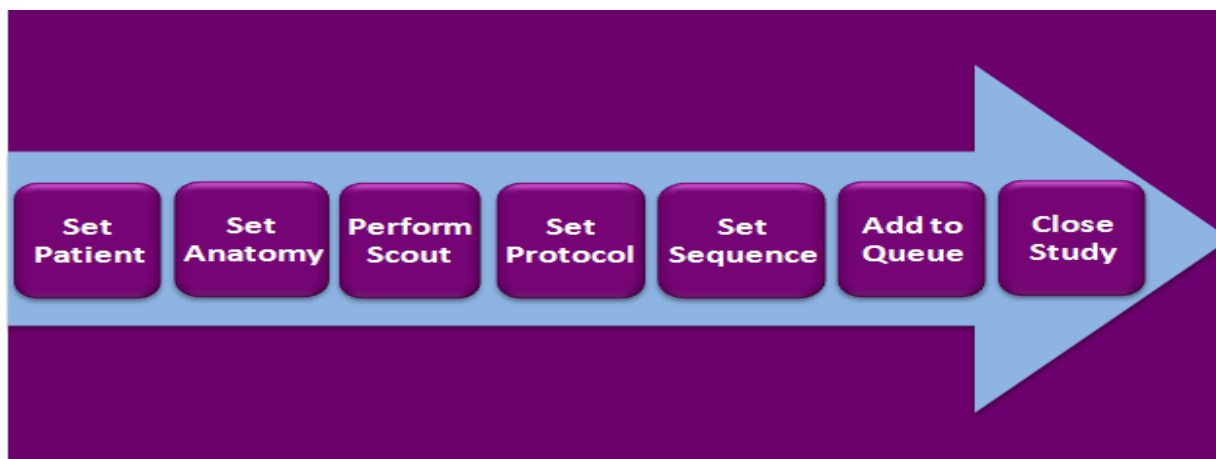
Image acquisition is the main purpose of the M2 MRI system. To guide you through the acquisition process, the software displays the image acquisition steps in the Planning pane at the bottom of the screen.

You acquire images in Acquisition Mode.

- 1 Select **Acquisition Mode**. The Acquisition Mode screen is displayed. The Planning pane is displayed at the bottom of the screen with partial information.
- 2 To expand the Planning pane:
 - a. Click **Short Menu** once to hide the Planning pane.
 - b. Click **Short Menu** another time to display an expanded Planning pane.



Workflow Sequence for New Image Acquisition



The following table describes each of the steps in the acquisition process:

Step	Description
Set Patient	Open a record for the subject
Set Anatomy	Define how the subject is positioned in the device
Perform Scout	Perform a preliminary scan
Set Protocol	Select the protocol containing the scan sequences you require
Set Sequence	Select the scan sequence and modify the scan parameters if needed
Add to Queue	Add the sequence with the final parameters to the queue and run the sequence
Close Study	To start a new session with a new subject, close the session for the existing subject

Set Patient

At this stage, you have to define the subject of the study. You can either add a new subject or record or open the record of a subject that has been imaged in the past.

- 1 Click **Set Patient**.

Last Name	First Name	Nome Animale	Race	Sex	ID1
TEST		Pet	Dog/Dog	*	
TEST_a		Pet	Dog/Dog	*	
peter		remote	Dog/Dog	*	
RFL_TEST	*			*	
RFL_TEST	*	tttt	tttt	*	
Ramat-Ishay_Low-Gain_Re	*			*	
Ramat-Ishay_Low-Gain_Re	*			*	
Ramat-Ishay_Low-Gain_Re	*	Ramat-Ishay_Low-Gai		*	
Netanya_Italy_Turin	*			*	
Novatech	3april09	3april09	3april09	*	
Novatech	4april09	QA_phantom	*	*	
Novatech	4april09	kiwi & limon	kiwi & limon	*	
Novatech	5_10_Phantom	5_10_Phantom	5_10_Phantom	*	
Novatech	5april09	5april09	5april09	*	
Novatech	7april09	7april09	7april09	*	
Novatech	egg_phantom	egg_phantom	egg_phantom	*	
Novatech	pingpong	pingpong	pingpong	*	
Ramat-Ishay	test	test	test	*	
Italy_Turin_Ramat-Ishay#2	test	test	test	*	
Italy_Turin_Ramat-Ishay#2	test	test	test	*	

- 2 Type the information of a new subject, or choose an existing subject from a list of previously examined subjects.
- 3 Set the patient information:
 - For a new subject, type the subject's name and details in the fields on the left side of the window. The **Confirm** button is disabled until at least the Last Name, Pet Name, and Race fields are filled.
 - To choose a previously examined subject from the list, highlight the subject and click **Select** or double-click the patient record. The subject's information is displayed in the left pane.
To simplify locating the subject, you can sort the table of previously examined subjects by every column in the table.

Note/Tip



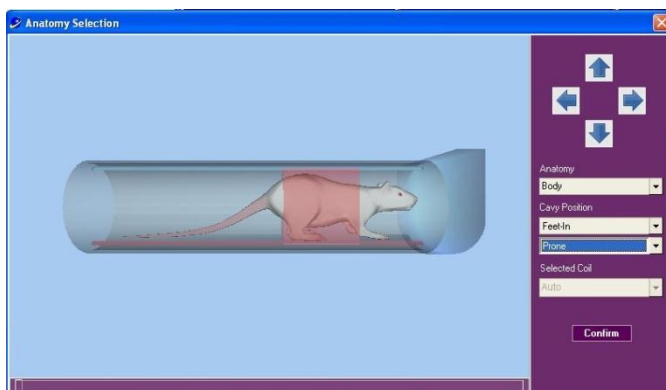
When you select an existing subject from the table, make sure that you click **Select**, and see the subject's details on the left.
Selecting the subject in the table and clicking **Confirm** is not enough!

- 4 Click **Confirm**. The window closes.

Set Anatomy

The Set Anatomy dialog box indicates to the system how the subject is positioned inside the coil. It is important to set this information correctly so that the labels on your images match the subject's position.

- 1 Click **Set Anatomy**.



The window display shows the sample-mounting unit, with the left hand side towards the center of the machine and the right hand side towards the outside.

- 2 Use the arrows and list options to define the subject's position.
 - Use the left/right arrows and the Head-In/Feet-In list to specify whether the subject is placed with the head or the feet pointing towards the center.
 - Use the up/down arrows and the Prone/Supine list to specify whether the subject is placed facing up or down.
 - Use the **Anatomy** list to specify which part of the subject's anatomy is being imaged. The settings of the system include Head and Body.
- 3 Click **Confirm**.

Perform Scout

Prior to running the scout, the system automatically calibrates the central frequency, optimizes the field homogeneity using linear shims, and calibrates the RF transmitter power. It then acquires a 3D image (128x128x128 pixels) with isotropic spatial resolution, using a fast steady-state gradient echo pulse sequence.

- 1 Click the **Perform Scout** button to initiate the Scout sequence. The Scout sequence and its calibrations are added to the Acquisition Queue.
- 2 The Scout sequence progress bar is displayed. Progress can be viewed in the lower left area of the window.

Three images appear in the viewing area showing the center slices through the scanned object, along the main orthogonal planes: the axial plane on the left, the coronal plane in the center, and the sagittal plane on the right. These images serve as reference for selecting slice positions and orientation of subsequent scans carried out in this study.

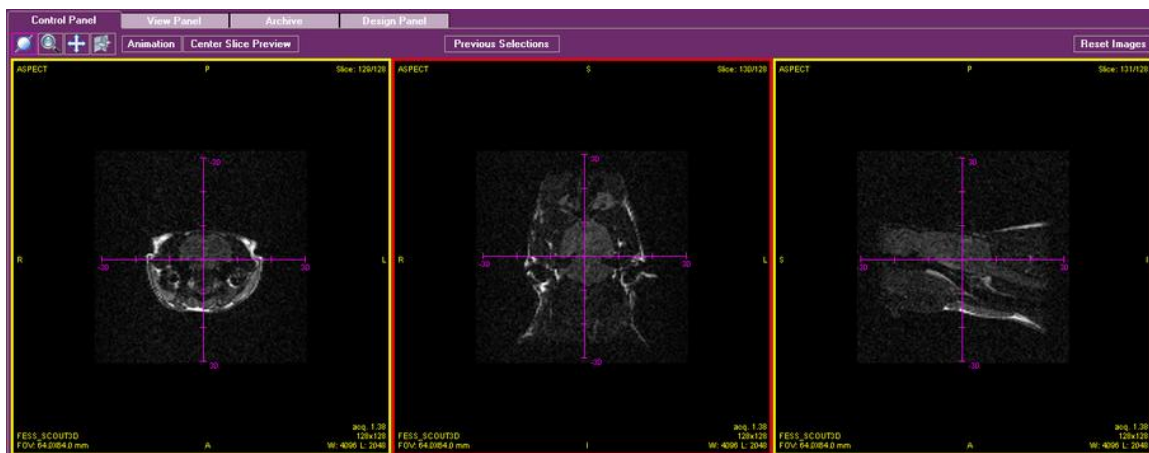


Figure 12: Scout image

A row of tools is displayed above the images, and another row immediately below. To learn more about these tools, see the [Control Panel](#) section.

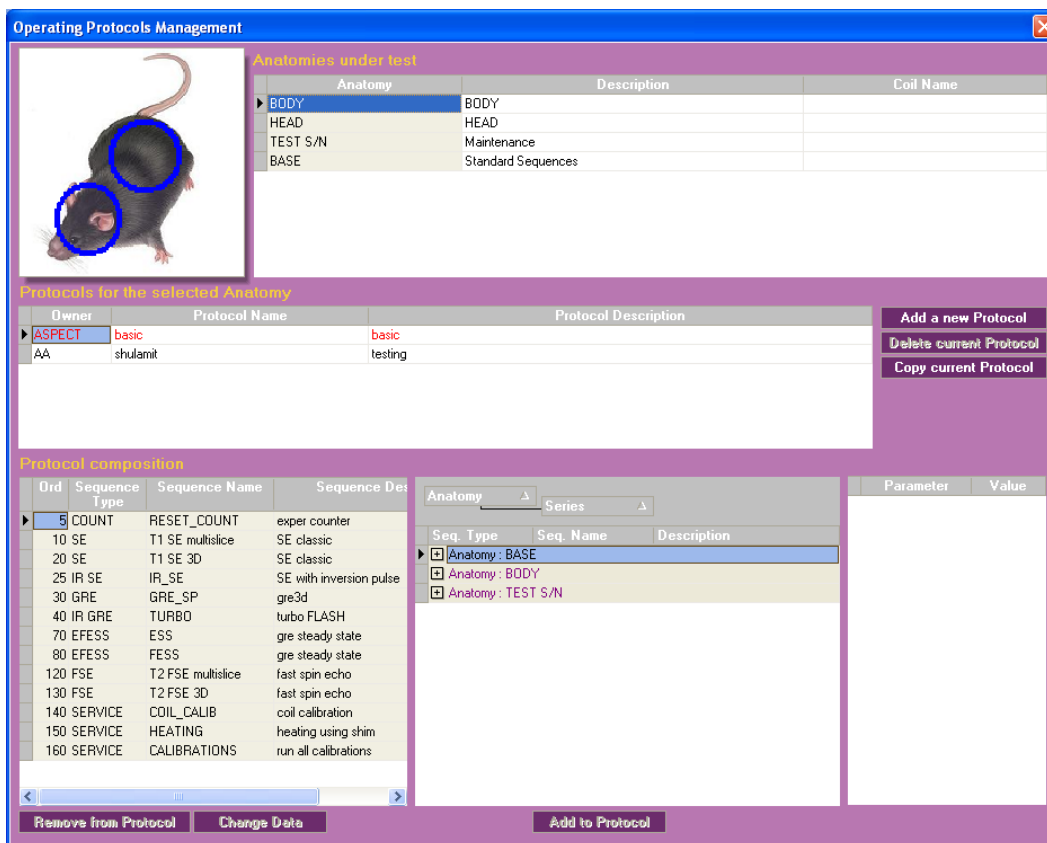
Set Protocol

Protocols are groups of imaging sequences. You create protocols to store sequences for different applications or to suit the preferences of different users. In the NRG Console, you connect the protocols to parts of the anatomy (i.e., running a certain protocol for neurological imaging). To choose a sequence for imaging you select the protocol containing the sequence. For additional information about managing protocols, see [Managing Protocols](#) on page 67.

- 1 Click **Set Protocol**. The Select Protocol window is displayed.



- 2 Select the protocol names to view the sequences they contain. If you identify the required protocol, skip to step 4.
- 3 If you do not see the required protocol in the list, click **Manage Protocols**. The Operating Protocols Management window is displayed.

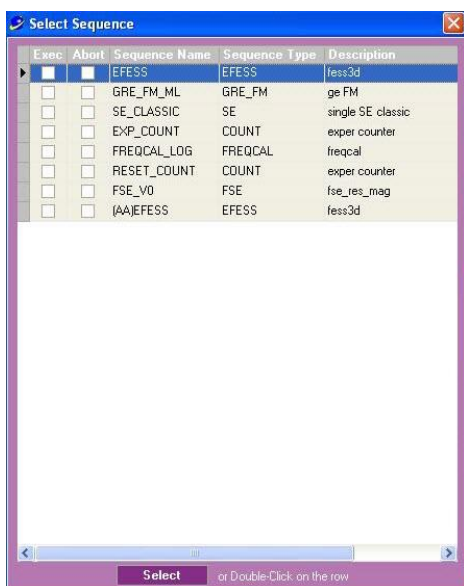


- a. Choose the anatomical target to which the required protocol is related.
 - b. Click the Windows **Close** button. The dialog box closes.
- 4 Choose the required protocol from the list at the top of the dialog box. The list of sequences contained in this protocol is displayed on the bottom half of the dialog box.
 - 5 Click **Select Protocol**. The protocol is selected and the dialog box closes.

Set Sequence

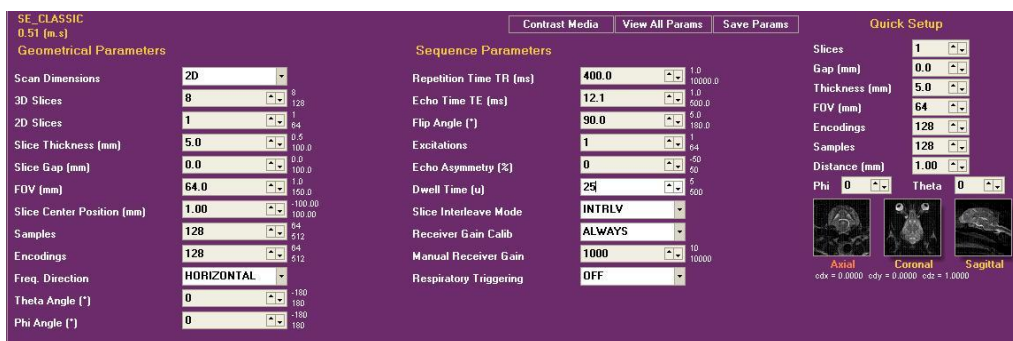
The sequence defines the pulse sequence and imaging parameters associated with this sequence the last time that they were saved. It is important to select the appropriate sequence according to the type of subject and required contrast.

- 1 Click **Set Sequence**. The Select Sequence dialog box is displayed.



- 2 Select a sequence and then click **Select**, or double-click the sequence. The sequence details are displayed in the Control Panel.

- 3 The selected sequence parameters are displayed in the control panel. You can adjust these parameters within the system constraints. Once you confirm the change by pressing **<Enter>**, the new parameters are saved. Click the Windows **Close** button. The dialog box closes.



- 4 Select the parameters that require adjustment and modify the value in one of the following ways:
 - By clicking the up/down arrows in the parameter box.
 - By typing a new value in the box and clicking Enter.
 - Using the up/down arrows of your keyboard.
 - Using the scroll wheel of your computer mouse.

Note/Tip



Other values may change automatically when you change the displayed parameters.

- 5 To save the parameters that you entered click **Save Params** and the next time the current sequence is selected under the current protocol, the new parameters will be implemented.



Note/Tip

Saving the parameters will permanently change this sequence in this protocol.

Add to Queue

- 1 Click **Add to Queue** to add the sequence to the acquisition queue. If you are in Automatic mode, the system will run the sequence and the calibration sequences preceding it automatically.
- 2 If you are in Manual mode, click **Run Sequence**. The sequence is processed and the resulting images are displayed in the small preview window next to the Acquisition Queue table.



Note/Tip

The sequence can run in the background while you perform other system tasks.

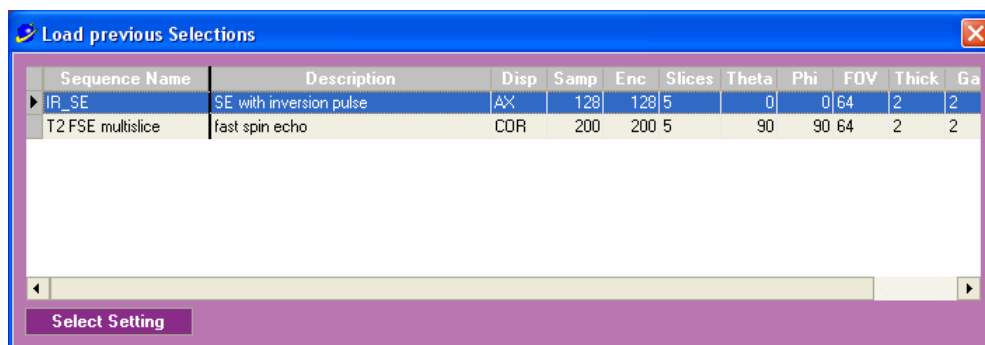
Perform Additional Scans

Additional scans in this study can be initiated by repeatedly clicking **Add to Queue**, either without any changes in the parameters, or after changing some of the parameters in the panel. It is also possible to repeat the Set Protocol and/or Set Sequence stages.

Repeat Previous Selections

In some cases, you may need to execute a scan using the same geometric parameters that you have used in a previous sequence, in the same study session.

- 1 Click **Previous Selections**. The Load Previous Selections window is displayed.



- 2 Select the scan from which you want to copy the geometric parameters and click **Select Setting**. The geometric parameters are loaded to the currently selected sequence in the Control Panel.

Close Study

When you have finished all the scans to be performed in this session on this subject, you can close the session.

- 1 Click **Close Study**, a confirmation message is displayed.
- 2 Click **Yes**. The study is closed and you can start a new study session with a new subject.

Control Panel

Once a sequence has been selected, the planned slices are superimposed on the scout images and the sequence parameters appear in the Control panel.

The sequence parameters are displayed in three columns: geometrical parameters, sequence parameters, and a column with a Quick Setup for the main settings. The displayed parameters and their default values change according to the selected sequence.

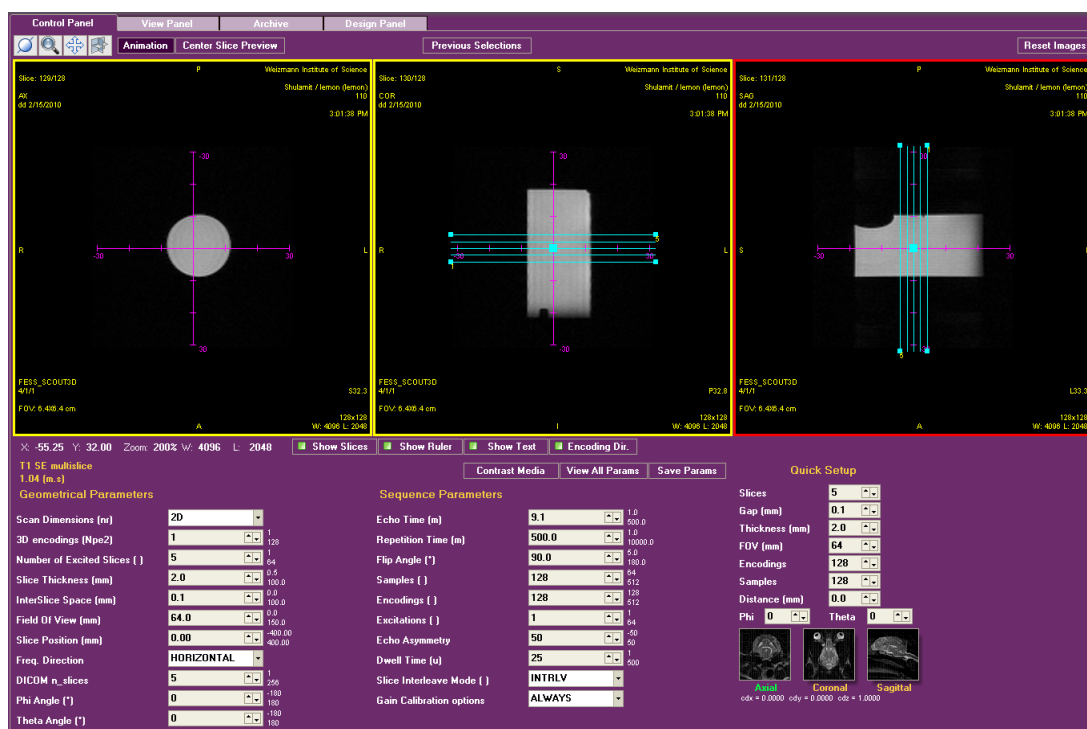


Figure 13: Control Panel with Animation tab selected

The Control Panel includes several tools organized at the top of the panel and immediately below the image area.



Use to increase or reduce image brightness and contrast. Click the icon to select it. Drag-and-drop to change the brightness – dragging to the right reduces brightness, dragging to the left increases brightness. Dragging up reduces contrast, dragging down increases contrast.



Use to increase or reduce image scaling. Click the icon to select it, and then drag-and-drop to change the scale – dragging to the right reduces scale, while dragging to the left – increases.



Use to move the image. Click the icon to select it, and then drag-and-drop the image to move it.



Use to navigate through the three axes of the scout image.

Animation

Click to show an animated sequence of the scout slices.

Center Slice Preview

Click to preview the approximated slices of the planned sequence. See [Checking Planned Slice Locations](#) on page 42.

View Reference Image

Displayed only if you have set a reference image in a previous scan. Click this button to display the reference image for planning slice locations. See [Checking Planned Slice Locations](#) on page 42.

Previous Selections

Click to load the geometric settings of a previously performed scan to the current sequence. This is especially useful when several different types of sequences are performed on the same sample and the results have to be compared slice by slice.

Reset Images

Click to reset the brightness, location and scale changes of the images.

X: -55.25 Y: 32.00

These parameters indicate the coordinates of the cursor on the image

Zoom: 200%

This parameter indicates the scaling of the image.

W: 4096 L: 2048

The Window and Level parameters indicate the brightness and contrast of the image.

Show Slices

Click to show or hide the slice location lines.

Show Ruler

Click to show or hide the ruler.

Show Text

Click to show or hide the text labels on the images.

Encoding Dir.

Click to show the frequency encoding direction as defined by the user's selection in the control panel.

Contrast Media

To define the contrast when a contrast agent has been injected. This parameter is mandatory for DICOM.

View All Params

Click to view all the system and global parameters used in this scan.

Save Params

Click to save the pulse sequence and imaging parameters for future use. Note that this will change the default parameters of the sequence.

SE_CLASSIC

Sequence name

1.04 (m.s)

Estimated run time in minutes and seconds

Checking Planned Slice Locations

Before you run a sequence, you may want to check whether the planned slices cut through the correct sample areas. There are two options to check the slice locations:

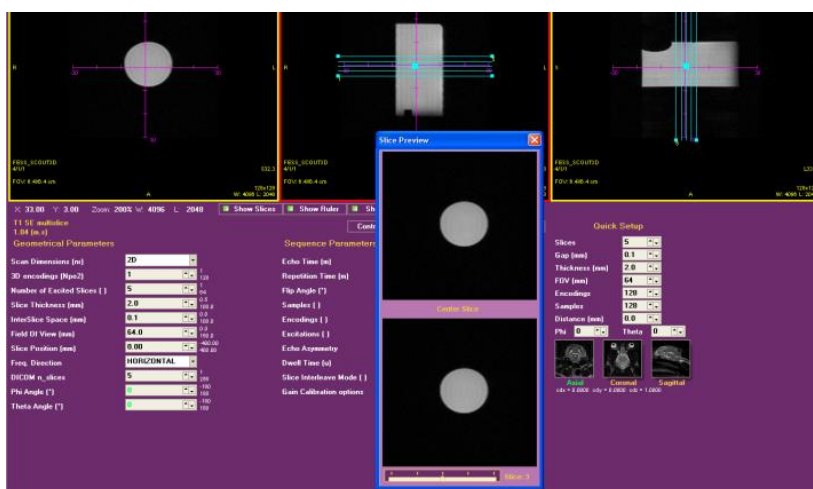
- **Center Slice Preview** – based on the scout image, it enables you to see an estimated view of each planned slice.
- **Set Reference** – displays a reference slice image –other than the scout– from a previous scan where you can preview the planned slice locations. Reference images can be defined either in the Edit Mode or in Acquisition Mode.

Center Slice Preview

When preparing for a scan with a new geometry, the Center Slice Preview option helps to estimate the slice images based on the scout.

To view and/or modify planned slices (based on a scout image)

- 1 Click the **Center Slice Preview** button. The following screen is displayed.



The screen includes a window with two images and a slider at the bottom. Both the top and bottom images display the estimated center slice. The bottom image can be changed to show any other slice.

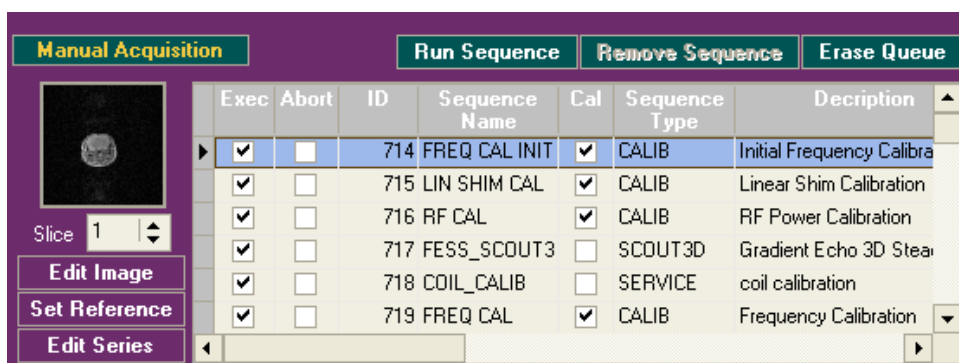
- 2 Drag the slider to the left or to the right to display a different slice. The selected slice is displayed at the bottom of the dialog box.
- 3 Check the slices and verify that the planned slices cover the desired areas.
- 4 If required, modify the slice locations/rotations by changing the geometrical prescription on the scout.
- 5 Click the Windows **Close** button to close the dialog box.

Set Reference

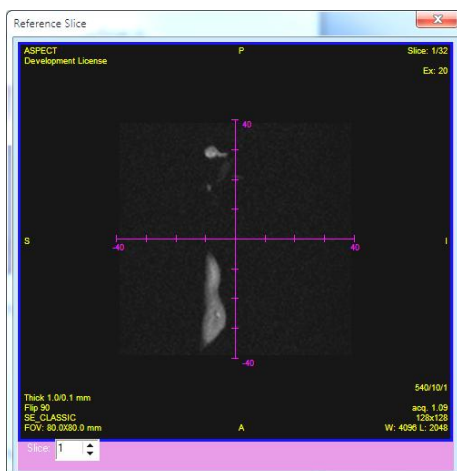
In order to enable viewing the planned geometry on a scan other than the scout, the Set Reference option displays the planned slice positions on a reference image selected by the user.

To view and/or modify planned slices (on a user-defined reference image)

- 1 Prepare a new scan to run in the control panel (by selecting a sequence).
- 2 Enter the required parameters.
- 3 On the queue, select the scan to be set as a reference and click **Set Reference**.



- 4 The Reference Slice window is displayed with the geometrical prescription overlaid on it.



- 5 Fine tune the geometrical prescription by moving or rotating the blue lines on the scout or by changing the parameter entries on the control panel.

Using the Acquisition Queue

All sequences to be processed are added to the Acquisition Queue.

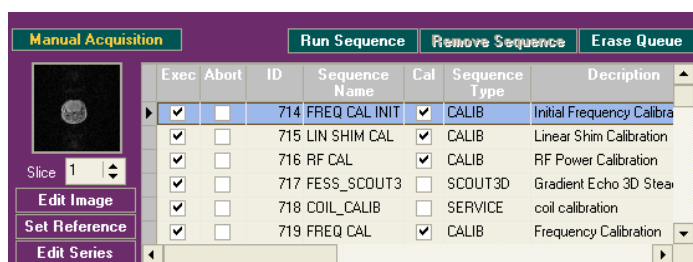


Figure 14: Acquisition Queue panel

The queue functions in a FIFO (first in, first out) mode. It is organized as a table, which includes execution information and sequence details. It is important to note the following columns:

- **Exec** – the Execution check box is marked when the sequence has been completed.
- **Abort** – the Abort check box is marked when the sequence has been aborted.
- **Cal** – this check box is marked for calibration type sequences.

The Acquisition Queue includes the following controls:

- **Manual/Automatic** – use this toggle button to switch from Automatic mode to Manual mode and back.
- **Run Sequence** – use this button to process the selected sequence.
- **Remove Sequence** – use this button to remove the selected sequence from the queue.
- **Erase Queue** – use this button to remove all the sequences from the queue.



Note/Tip

In some cases, several related sequences (calibration sequences) are added to the queue together. Removing one of these sequences from the queue will cause the other to be removed as well.

Manual Mode

When the queue is in Manual mode, sequences are processed only on request, by selecting the desired sequence and clicking **Run Sequence**.

Automatic Mode

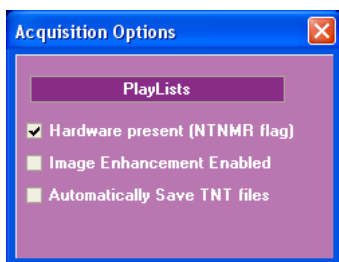
When the queue is in Automatic mode, the system automatically processes all the added sequences.

Acquisition Options

Acquisition Options enable you to define acquisition related settings, and to access the Playlist functionality.

To define acquisition settings

- 1 On the Menu bar at the bottom of the Main screen, click **Acquisition Options**. The Acquisition Options dialog box is displayed.



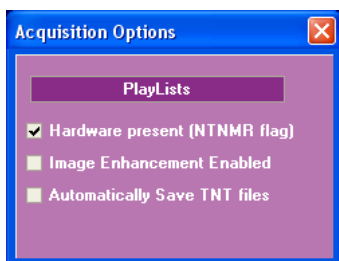
- 2 Clear the **Hardware present** check box if you are using the NRG Console software without the magnet unit. This option is useful for learning the system without operating the actual scan.
- 3 Select the **Image Enhancement Enabled** check box to improve image quality (not available with current version of software).
- 4 Select the **Automatically Save TNT files** check box to save the raw data of the scans on the hard disk.

Managing Playlists

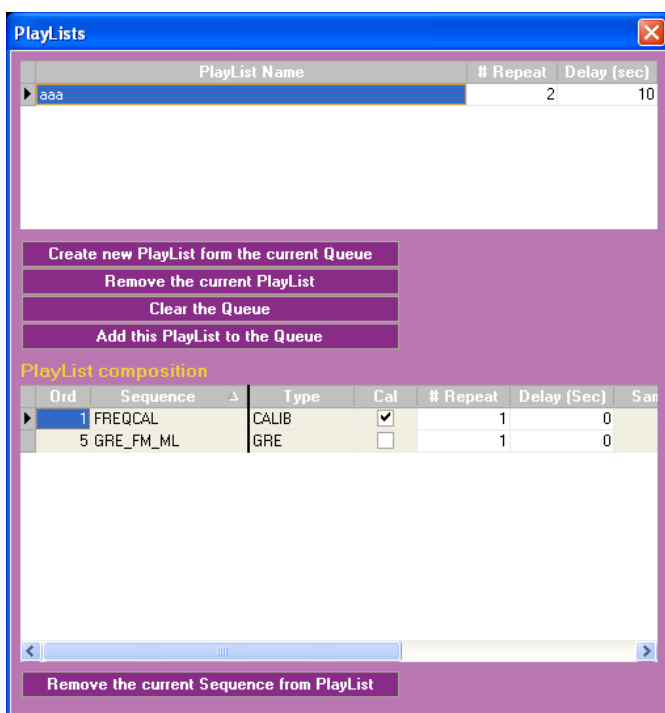
It is possible to save the queued sequences as playlists, which can be added to the queue and processed when necessary. Playlists are very useful when several sequences have to be repeated in the same order on several samples.

Playlists are available only to users with higher-level privileges – Managers and Super Users.

- 1 Click **Acquisition Options**. The Acquisition Options dialog box is displayed.



- 2 Click the **PlayLists** button. The PlayLists dialog box is displayed.

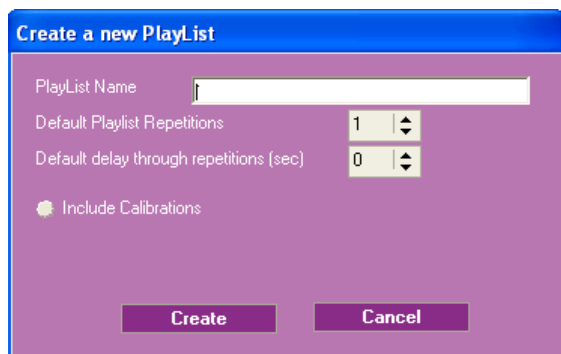


The dialog box displays a list of playlists at the top; below it – playlist management controls; and at the bottom half of the dialog box – a PlayList composition table.

Creating a New PlayList

A new playlist is created from the sequences that are currently in the queue.

- 1 Click **Create new PlayList from the current Queue**.



- 2 Type the name for the playlist.
- 3 Type the number of playlist repetitions, or change the number using the up/down arrows.
- 4 If the number of playlist repetitions is larger than one, change the delay between repetitions.
- 5 Select the **Include Calibrations** option, if you want to include calibration sequences.
- 6 Click **Create**. The dialog box closes and a new playlist is added to the list.

Removing a Sequence from a Playlist

You can remove sequences from a playlist, if necessary.

- 1 Select the playlist.
- 2 Select the sequence to be removed.
- 3 Click **Remove the current Sequence from Playlist**.

Deleting a Playlist

Once the playlist has been used and is not required anymore, it can be deleted.

- 1 Select a playlist in the list.
- 2 Click **Remove the current Playlist**. A confirmation message box opens.
- 3 Click **Yes**. The message box closes and the playlist is deleted.

Adding a Playlist to the Queue

Once a playlist is ready, you can add it to the queue and run the sequences.

- 1 Select a playlist in the list.
- 2 Click **Clear the Queue**, if required.

- 3 Click **Add this Playlist to the Queue**. All the sequences of the playlist are added to the queue.

Note/Tip



If the playlist contained repetitions, the sequences will be added to the queue several times according to the specified number of repetitions.

6 Working with Images

The NRG Console application includes a comprehensive set of tools for viewing, measuring and manipulating acquired images.

This chapter contains the following sections:

- Viewing Images
- View Panel
- Using the Image Tree

Viewing Images

During acquisition, images can be viewed in the lower left Preview and Sequence area. Acquired images are viewed in the View Panel, which can be accessed in Acquisition Mode or in Edit Mode.

Viewing Images from the Current Session

After acquisition, the acquired images can be viewed in the View Panel while you are in Acquisition Mode.

To access the View Panel, select **View Panel** at the top of the screen.

Viewing Images from Previous Sessions

To view and edit images acquired in previous sessions, access the Edit Mode.

To access Edit Mode and display the View Panel, click **Edit Mode** on the bottom menu. The Edit Mode screen displays, with the View Panel and the Image Tree.

Using the Image Tree

The Image Tree is displayed only in Edit Mode and contains all the previously acquired images. It is structured as a hierarchical tree. The top level includes the samples, for each sample a list of studies performed, and then the image series acquired.

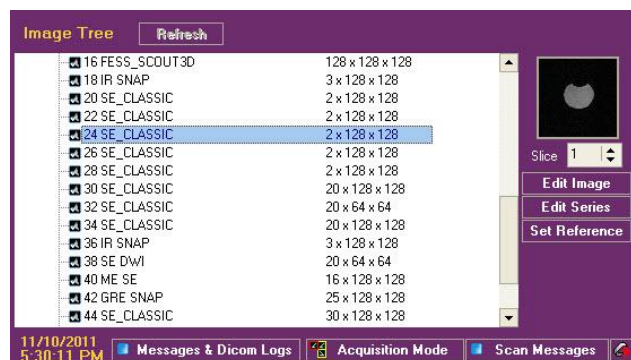
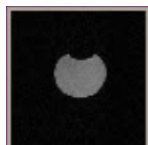


Figure 15: Image Tree panel



Click to display in the Image Tree the images acquired in the last session. The button is enabled, when new images have been acquired since the last refresh.



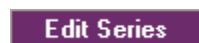
Displays the first slice of the selected series.



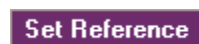
Use this spin box to display a different slice in the image preview.



Click to display the selected slice, of the selected series in the View Panel.



Click to display the selected series of images in the View Panel.



Select a slice and click this button to set this slice as reference. A reference preview window opens and the slice image is displayed in it. See [Checking Planned Slice Locations](#) on page 42 for additional information.

To navigate the image tree use the icons

- Click near the subject name to expand the tree node and display the studies performed on this subject.
- Click near the study name to expand the tree node and display the image series acquired for this study.
- Click to reduce the tree node and hide the studies/image series under it.

To display a previously acquired image

- 1 Select the series in the **Image Tree**.
- 2 Find the slice to display using the **Slice** spin box.

- 3 Click **Edit Image**. The selected slice is displayed in the View Panel.

To display a previously acquired series

- 1 Select the series in the **Image Tree**.
- 2 Click **Edit Series**. The series of slices is displayed in the View Panel.

View Panel

The View Panel is populated with images from the current acquisition or from the Image Tree.



You can modify the display, for example changing image brightness or size, perform measurements, and print the images.



Use to increase or reduce image brightness and contrast. Click the icon to select it, and then drag-and-drop. To change brightness, drag left-right; to change contrast, drag up-down.










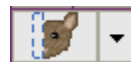
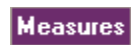





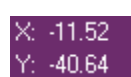
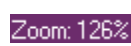
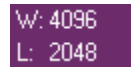
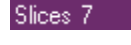
Use to increase or reduce image scaling. Click the icon to select it, and then drag-and-drop to change the scale – dragging to the right reduces scale, while dragging to the left – increases.



Use to move the image. Click the icon to select it, and then drag-and-drop the image to move it.

Apply All

Click to apply all of the changes performed on one slice to all the slices in the series.


	Mark the check box if you want to apply your changes to all the images in the series, while you are working.
	The Series check box does not affect all of the View Panel controls. When measuring distances or regions of interest, changes are applied to one slice only, even when the check box is selected.
	Click to reset the images to their original brightness, scale and position.
	Click to copy the brightness parameters, for applying it afterwards to another image or series.
	This button is enabled only after Copy LUT is clicked. Click to apply the brightness settings you copied before to another image or series.
	Click to change the sequence of slices. Click once to display the slices from last to first. Click again to display the slices from first to last.
	Click to change the images from positive to negative and from negative to positive.
	Use to mask a part of the image. See Masking an Image on page 53.
	Click to measure images. See Measuring the Images on page 54.
	Click to measure the region of interest. See Using ROI (Region of Interest) Tools on page 56.
	Click to rotate images. See Using Rotation Tools on page 57.
	Click to print images. See Printing on page 56.
	Click to show or hide the labels on the images.
	Click to show or hide the rulers on the images.
	These parameters indicate the coordinates of the cursor on the image
	This parameter indicates the scaling of the image.
	The Window and Level parameters indicate the brightness of the image.
	The number of slices, including the scout image, which is counted as a slice.

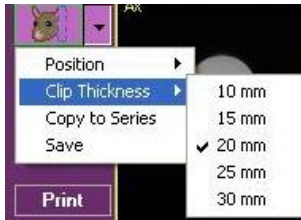
View Style ▾

Use this drop down list to control the viewing style. Options:

Option	Description
Standard specifying the column number	Default option. Allows you to specify the number of columns to display.
In two columns optimized on the screen height	Displays two columns optimizing the view based on the height of the screen.
One slice expanded and cine options	Displays one slice in expanded view and provides a button for selecting cine options.
Synchronized series in columns	Allows you to display a synchronized view of a number of series with each series being displayed in a different column.

Masking an Image

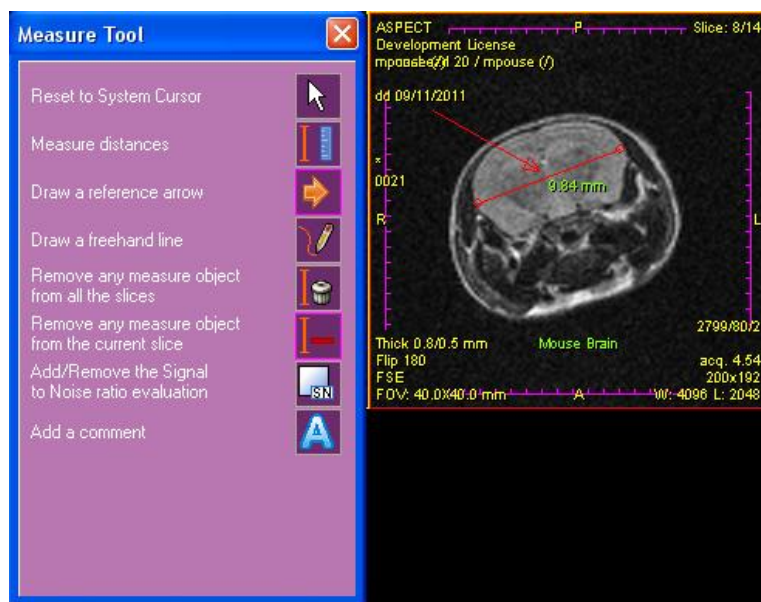
- 1 To mask a part of the image, click the  icon. The clipping functions menu opens.
- 2 Choose the **Position** option to define which side of the image to mask off.
- 3 Choose the **Clip Thickness** option to define how many millimeters to mask off.



- 4 Click **Save**.
- 5 If you want to apply the clip PERMANENTLY to all the images in the series, click **Copy to Series**.

Measuring the Images

To open the measuring toolbox, click **Measures**.




The tools can be used to measure distances on a single slice, mark points or areas of interest, or add comments.

Note/Tip



Measuring tools are applied to one slice image at a time, even when the Series check box is selected.

To measure a distance


- 1 Click the  icon.
- 2 Click the point you want to measure from, hold the mouse button.
- 3 Start moving the cursor in the required direction. A line with a measurement is displayed on the image.
- 4 Drag the line to the point you want to measure to, release the button. The measurement line and distance are drawn on the image.

Note/Tip



Once completed, a measurement cannot be changed. To change, you must delete the measurement and start again.

To draw a reference arrow


- 1 Click the  icon.
- 2 Click the point where you want the arrow to start, hold the mouse button.
- 3 Start moving the cursor in the required direction. An arrow is displayed on the image.
- 4 Drag to the point where you want the arrowhead to point, release the button. An arrow is drawn on the image.

Note/Tip



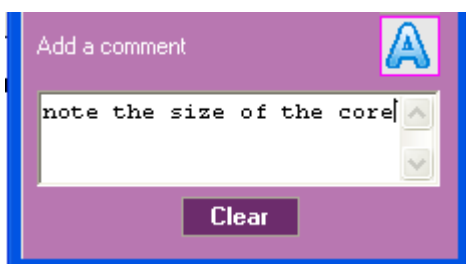
The location of the arrow cannot be adjusted. To change its location, you must delete the arrow and start again.

To draw a freehand line

- 1 Click the  icon.
- 2 Click the point where you want to start drawing, hold the mouse button.
- 3 Move the cursor slowly on the path of the required line, then release the button. A line is drawn on the image.


To add a comment

- 1 Click the  icon. A text box is displayed at the bottom of the Measure Tool dialog box.
- 2 Type the comment inside the box.





- 3 To clear the box, click **Clear**.
- 4 When the comment is to your satisfaction, click in the image area. The comment is added to the image.

To move the comment inside the image:

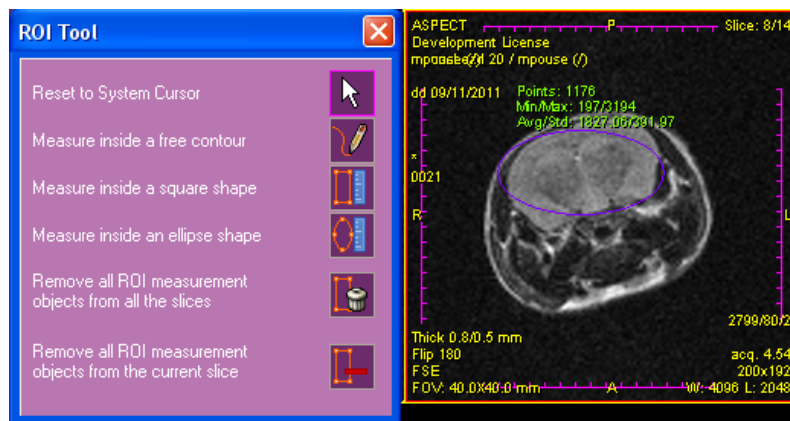
- 5 Click the  icon.
- 6 Click the comment as it appears in the image area, hold the mouse button. The text is replaced with a white rectangular frame.
- 7 Drag the frame to the required location and release the mouse button. The comment is now in the new location.

To remove measurement objects

- 1 Click the  icon to remove the region of interest objects from the current slice.
- 2 Click the  icon to remove the region of interest objects from all the slices.

Using ROI (Region of Interest) Tools

Click **ROI Tool**. The ROI Tool box opens.



The ROI tool can be used to measure inside a predefined area which can be free, rectangular, or elliptical in shape.

The measurements are defined as:


- Points: the number of pixels contained in the ROI.
- Min/Max: the minimum and maximum intensity value of the pixels in the ROI.
- Avg/Std: the average intensity value and the standard intensity value deviation.

Note/Tip



ROI tools are applied to one slice image at a time, even when the Series check box is selected.

To measure inside a free contour



- 1 Click the  icon.
- 2 Click the point where you want the contour to start, hold the mouse button.
- 3 Move the cursor slowly on the contour to be measured, release the button. The last point is automatically joined to the first point of the contour. A contour is drawn on the image and measurements are displayed.

Note/Tip



The location of the contour cannot be adjusted. To change its location, you must delete the contour and start again.

To measure inside a rectangular or elliptical shape



- 1 Click the  icon for a rectangle or the  icon for an ellipse.
- 2 Click one of the corners of the rectangle, or the rectangle enclosing the ellipse, hold the mouse button.
- 3 Move the cursor on the diagonal. The shape is displayed on the image and is enlarged or reduced according to the location of the cursor.
- 4 Release the button when the shape reaches the required size. A rectangle or ellipse is drawn on the image and measurements are displayed.

Note/Tip



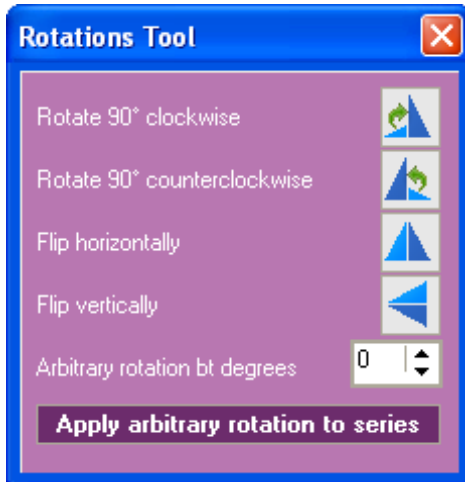
Once completed, the shape and measurement cannot be changed. To change, you must delete them and start again.

To remove measurement objects

- 1 Click the  icon to remove the measurement objects from the current slice.
- 2 Click the  icon to remove the measurement objects from all the slices.

Using Rotation Tools

Click **Rotations**. The Rotations Tool box opens.



The Rotations tool can be used to rotate and flip the slice images.



Click for a clockwise rotation.



Click for a counterclockwise rotation.



Click to flip horizontally.



Click to flip vertically.



Type an angle value in the spin box, or change the value with the up/down arrows. The image in the currently selected slice is rotated.

Apply arbitrary rotation to series

Click to apply an arbitrary rotation to all slices.

To rotate by an arbitrary angle

- 1 Type an angle value in the '**Arbitrary rotation**' spin box, or change the value with the up/down arrows. The image in the currently selected slice is rotated.



Note/Tip

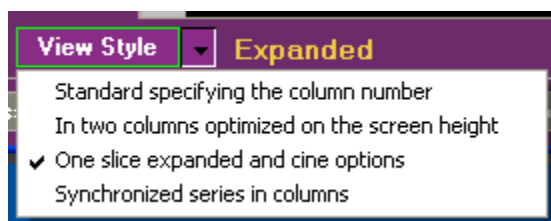
Arbitrary rotation is applied to one slice image at a time, even when the Series check box is selected.

If you want the rotation to be applied to the whole series:

- 1 Click '**Apply arbitrary rotation to series**'. A warning message is displayed.
- 2 Click **Yes**. All the images in the series are PERMANENTLY rotated.

Changing the Viewing Style

Click **View Style** to change the image layout in the View Panel. A pop-up menu is displayed.



Standard specifying the column number	Select to display the images in a regular grid, with a flexible number of columns
In two columns optimized on the screen height	Select to display the images in a two-by-two grid
One slice expanded and cine options	Select to display the image in Cine Mode
Synchronized series in columns	Select to display several series side by side

To adapt the standard viewing style

- 1 Type a number in the **Columns** spin box, or click the up/down arrows, to change the number of columns in the standard view.
- 2 Click **Apply**.

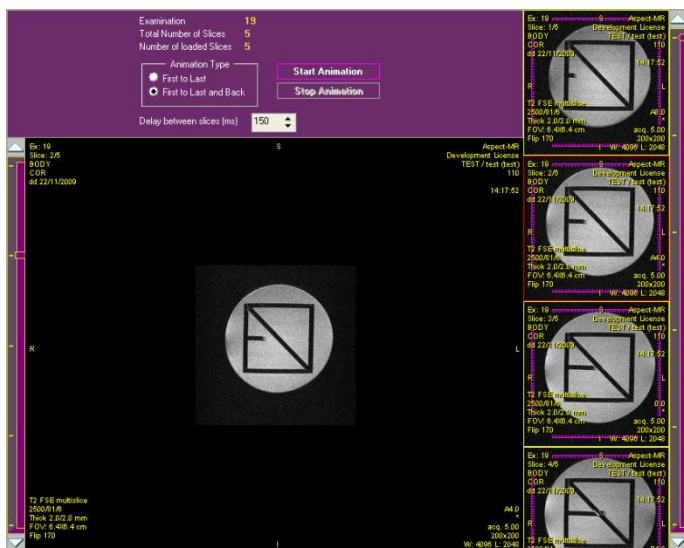
To view an animated sequence of the slices

Note/Tip



The “cine” mode enables viewing an animation of the series. A single slice is displayed in the main area of the screen and a column with all the slice frames to the right.

- 1 Select **One Slice Expanded and Cine Options**. The Cine Mode view opens. The information panel at the top displays the image ID and the number of slices.



- 2 Click **Start Animation** to run the animation in a continuous loop.
- 3 Select '**First to Last**' option, to run the animation from first slice to last slice, and start again from the first.
- 4 Select '**First to Last and Back**' option, to run the animation from first slice to last slice, and then back from last to first.
- 5 Type a number in the **Delay between slices** spin box, or click the up/down arrows, to change the speed of the animation.
- 6 Click **Stop Animation** to stop.

Printing

You can print the images currently displayed on the screen to a DICOM printer or to your default Windows printer.

Click the **Print** button to open the Print tool dialog box.

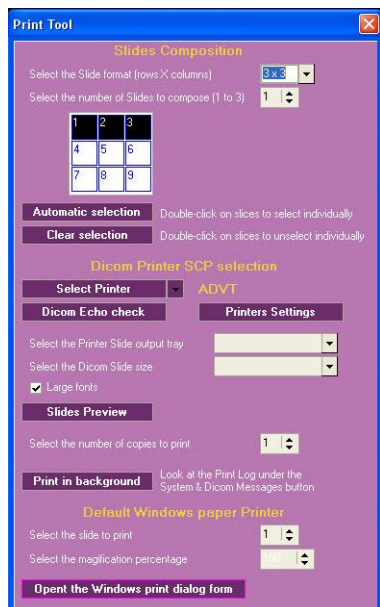


Figure 16: Print Tool dialog box

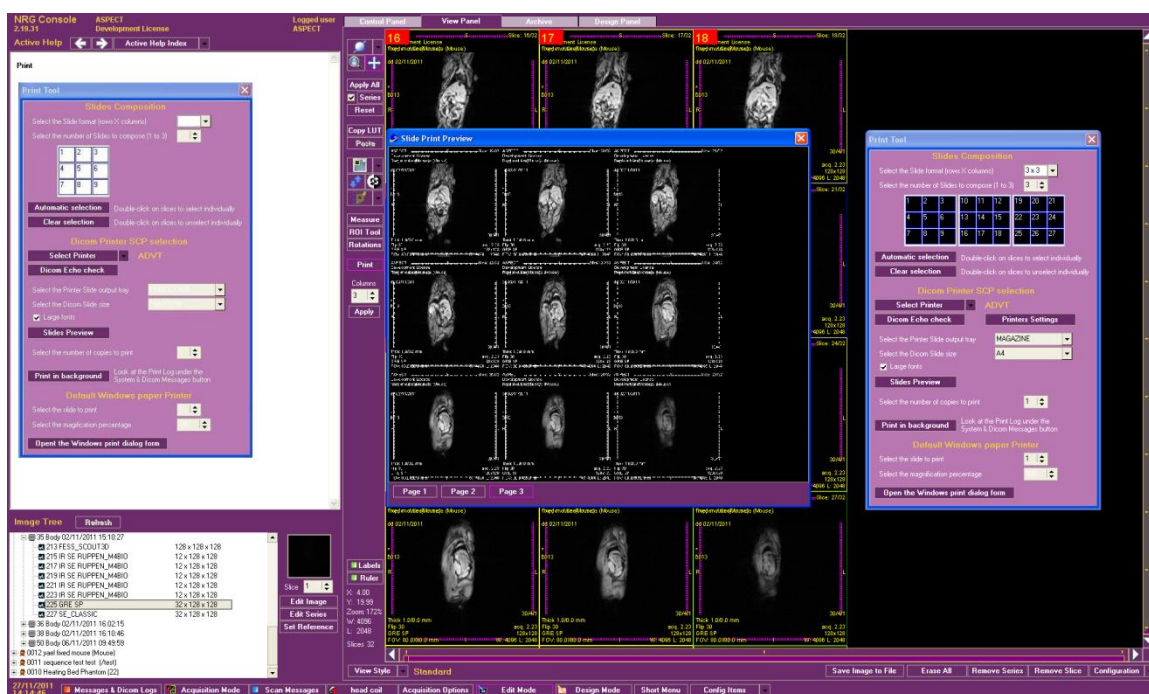
Selecting Images to Print

Images are printed as slides, with slice images arranged in rows and columns.

- 1 Select the number of rows and columns in each slide.
- 2 Select the number of slides to compose.
- 3 Select the slices to print.
 - a. Click **Automatic selection** to select all the slices. A number is displayed in the upper left corner of the slice, indicating that it was selected, and its location in the slide layout.
 - b. Double-click slices to clear the selection. The number disappears and the selected slices are renumbered.
 - c. Click **Clear selection** to deselect all slices. The numbers disappear.
 - d. Double-click a slice to select it. A number is displayed.

To preview slides

- 1 Click **Slides Preview**. The following screen is displayed.



- 2 Click the Windows **Close** button to close the preview.

To print to a DICOM printer

- 1 Select the printer.
- 2 Select the printer slide output tray.
- 3 Select the printer slide size.
- 4 Select the '**Large fonts**' check box, if required.
- 5 Select the number of copies to print.
- 6 Click **Print in background** to start printing to the DICOM printer.

To print to a Windows printer

- 1 Select the slide to print.
- 2 Select the magnification percentage.
- 3 Click **Open the Windows print dialog form**. The Windows Print dialog box is displayed.
- 4 Select the printer and the number of copies.

- 5 Change **Properties** if required.
- 6 Click **OK** to start printing to the Windows printer.

Managing Slice Settings

You can control the display and label settings of the slices.

Customize Slice Labels

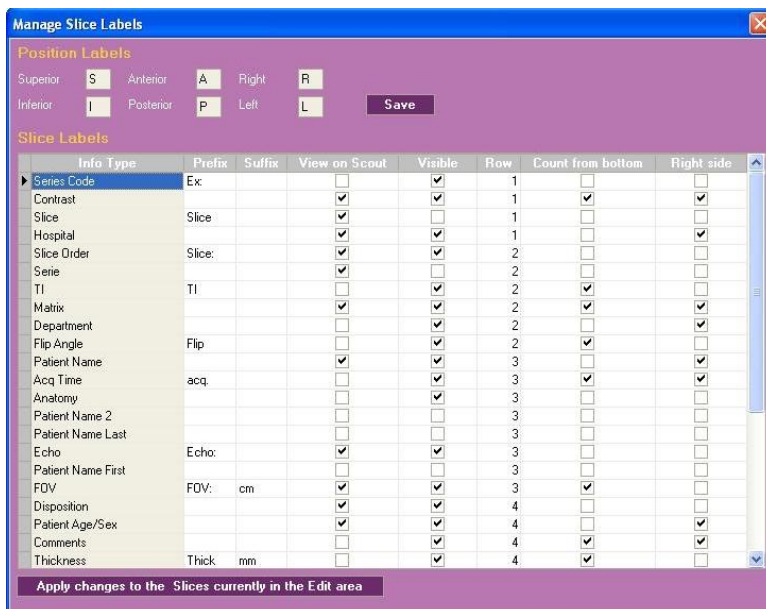
You can configure the subject position labels and the data displayed on each image. For each of the data items, you can configure:

- Whether to display it on the scout.
- Whether to display it in the View Panel.
- Its prefix and suffix.
- Its location on the image.

- 1 To manage the Slice Labels click **Configuration** in the lower right corner of the View Panel.



- 2 Choose **Manage Slice Labels** from the pop-up list. The Manage Slice Labels dialog box is displayed.



- 3 If required, modify the labels marking the sample position.
- 4 Click **Save** to save the changes to the labels.
- 5 If required, modify the various parameters: with which prefix and suffix they are displayed, whether they are displayed on the scout image, visible on the scan image, and their position on the display.
- 6 Press **<Enter>** to save the changes.
- 7 If you wish to apply the changes to the currently displayed images, click **Apply changes to the Slices currently in the Edit area**.
- 8 Close the dialog box.
- 9 Click the slice image to activate the change.

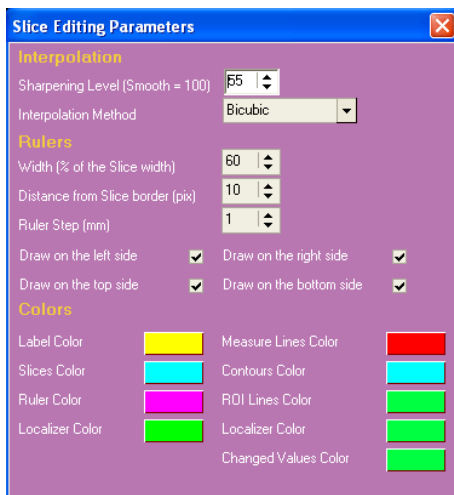
Customizing Slice Settings

You can customize the following aspects of slice display:

- The image quality
 - The appearance of rulers
 - The colors of rulers, labels, measure lines, etc.
- 1 To manage the slice settings click **Configuration** in the lower right corner of the View Panel.



- 2 Choose **Edit Slice Setting** from the pop-up list. The Slice Editing Parameters dialog box is displayed.



Sharpening Level	Increase the value to improve image smoothness
Interpolation Method	Choose Bicubic, Bilinear or Nearest (neighbor) options to define the pixel interpolation.
Width (of rulers)	Change the value to change the width of the rulers as a percentage of the slice width.
Distance from Slice Border	Increase to move the rules away from the slice border.
Ruler Step	Use to change the ruler divisions.
Draw on left/right/top/bottom side	The rulers by default appear on all sides of the image. If you would like to change that, clear the check boxes on the sides where the ruler is not required.

Changing Colors of Slice Objects

The basic color setting of labels, rulers, slice marking lines, etc. is defined to provide good readability and contrast. If, however, you find the basic settings not to your satisfaction, the system provides full flexibility in changing the colors.

To change the color of slice objects

- 1 Click the color box of any one of the color items. A Color dialog box opens.
- 2 Select a color or define a custom color.
- 3 Click **OK**. The Color dialog box closes and the color in the color box changes.
- 4 Click the Windows close button to close the Slice Editing Parameters dialog box.
- 5 Click **Erase All** in the View Panel.
- 6 Select the series in the Image Tree and click **Edit Image** or **Edit Series** to view the slices as required.

Note/Tip



In addition to working with images in NRG, the DICOM images generated on the M2 MRI system can be outputted to a variety of 3rd party software tools to measure and analyze the images. These images can be exported to different formats (JPEGs, TIFFs, movie loops, etc.). Specifically, Aspect Imaging offers **VivoQuant™ Image Analysis Software**, an extensive post-processing package to quantify 2D and 3D images generated from the M2 MRI system. In addition to an extensive suite of tools for image post processing, co-registration of M2 images with multi-modality images, and generation of video loops and multiple output formats, the software also includes an MR-specific workflow library to instruct M2 users on key post-processing techniques. Contact Aspect Imaging at info@aspectimaging.com for more information.

7 Managing Protocols

In this chapter, you will learn how to manage protocols.

The main purpose of protocols is to enable routine, repetitive imaging using a minimal amount of parameter entries and mouse clicks. A protocol contains a single or a group of sequences, in which the acquisition parameters are tailored and optimized for a specific application.

This chapter contains the following sections:

- Managing Protocols
- Image Acquisition Sequences

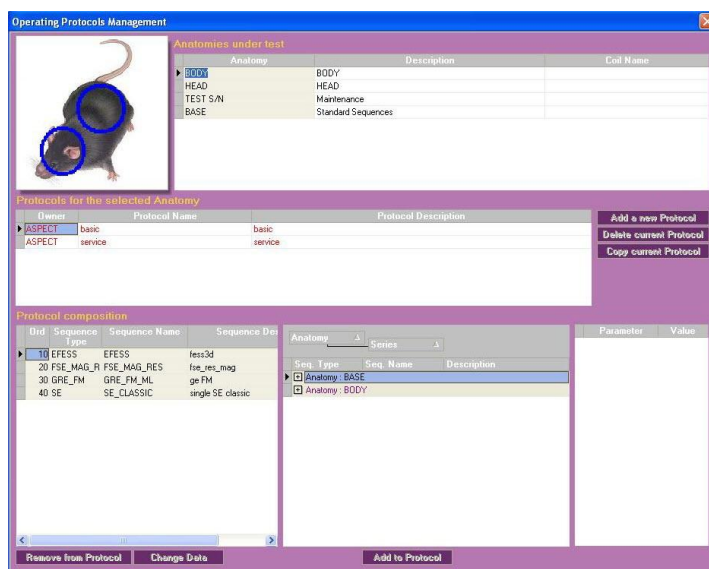
Managing Protocols

Protocols are groups of imaging sequences. You create protocols to store sequences for different applications or to suit the preferences of different users. In the NRG Console, you associate the protocols to anatomical targets. To choose a sequence for imaging you select the protocol containing the sequence.

The M2 MRI system is supplied with one protocol, named Basic, which includes a set of standard sequences for system calibration and image acquisition.

You can create new protocols, duplicate existing ones, delete protocols, and manage the sequences contained within protocols.

- 1 Click **Config Items** in the lower right-hand corner of the screen. The configuration pop-up list is displayed.
- 2 Select **Operating Protocols**. The Operating Protocols Management window is displayed.



The window is divided into four major sections:

- Anatomies
- Protocols for the selected anatomies
- Protocol composition
- Anatomy/protocol/sequence tree.

Creating a New Protocol

Creating a new protocol is useful when you want to create a set of several sequences for a specific need.

- 1 Select the anatomy under which you want to create the protocol.
- 2 Click **Add a new Protocol**. A row is added to the protocols table.
- 3 Select the **Owner** username.
- 4 Type the **Protocol Name** and **Protocol Description**.
- 5 Modify the protocol composition as described later in this chapter.

Copying a Protocol





Copying a protocol is useful when an existing protocol is close in characteristics to a protocol that you require for a specific need, and you do not want to modify the original. After copying the protocol, you will be able to add/remove sequences, or modify the sequence parameters for your purpose, without affecting the original settings.

- 1 Select the anatomy under which you want to create a duplicated protocol.
- 2 Select the protocol that you want to copy.
- 3 Click **Copy current Protocol**. The Copy Protocol dialog box opens.
- 4 Type a **Protocol Name** and **Description**.
- 5 Click **Copy**. The dialog box closes and a protocol with a new name is added to the list. The protocol composition is identical to the original protocol.
- 6 Modify the protocol composition as described later in this chapter.

Modifying the Protocol Composition

You can always modify the list of sequences in a protocol by removing or adding sequences.

- 1 Select the protocol to be modified.
- 2 Remove unnecessary sequences:

- a. Select a sequence to be removed from the protocol and click **Remove from Protocol**. A confirmation message is displayed.
 - b. Click **Yes**. The sequence is removed.
- 3** Add sequences:
- a. Using the   icons to navigate through the anatomies and protocols. Click  on the tree node to expand it, or click  to collapse the tree node.
 - b. Locate the required sequence.
 - c. Click **Add to Protocol**. The selected sequence is added to the end of the protocol composition list on the left.
- 4** Change sequence data:
- a. Select a sequence to be modified and click **Change Data**. The Change Values dialog box is displayed.
 - b. Modify **Sequence Name**, **Description**, or **Execution Order**.
 - c. Click **Confirm**. The dialog box is closed and the protocol composition updated. If the order was changed, the sequences are reorganized accordingly.

Deleting a Protocol

When a protocol is no longer useful, you can always delete it.

- 1** Select the protocol to be deleted.
- 2** Click **Delete current Protocol**. A confirmation message is displayed.
- 3** Click **Yes**.

Image Acquisition Sequences

A sequence defines the instructions to the hardware channels (gradients, transmitter, receiver), and the associated parameters.

There are several basic types of imaging sequences.

- **CALIBRATIONS** – Run all calibrations
- **COIL CALIB** – Coil calibration
- **FESS_SCOUT 3D** – Gradient Echo 3D Steady State FESS
- **FSE** – Fast Spin Echo
- **GRE EXT** – Gradient Echo 3D External Averaging
- **GRE SNAP** – Gradient Echo Snapshot 2D
- **GRE SP** – Gradient Echo Spoiled 3D

- **GRE SS** – Gradient Echo Steady State 3D (ESS/FESS)
- **IR GRE** – Inversion recovery gradient echo
- **IR SE** – Inversion Recovery Spin Echo 2D
- **IR SNAP** – Inversion Recovery Series Snapshot 2D
- **ITER LIN SHIM** – Iterative Linear Shim Calibration
- **ME SE** – Multi Echo Spin Echo 3D
- **QA PROCEDURE** – QA Daily Test Procedure
- **SCOUT3D** – Gradient echo steady state sequences that are used for generating the initial scout image
- **SE** – Spin echo. The default parameters of the SE sequences in M2 were defined mainly for T1 weighted imaging.
- **SE_CLASSIC** – SE Classic
- **SE DWI** – Spin Echo Diffusion Series 2D

8 Managing Archives

This chapter describes the archiving functionality of the M2 MRI. The system stores two types of archives: a hierarchical archive of patients, studies, and series, and a DICOM archive of images. Both archives are accessed through the Archive panel.

This chapter contains the following sections:

- Using the Native Format Archive
- Using the DICOM Creator
- Using the DICOM Archive

Using the Native Format Archive

The M2 MRI stores a native format archive of all the patients, studies and image series acquired by the application. It also includes functionality for archiving the information in DICOM format.

To access the native and DICOM archives, click **Archive** in the panels' area. The Archive panel is displayed, with the native format Patients/Images archive selected.

The screenshot shows the 'Archive' panel with three main sections: Patients Archive, Study Archive, and Series Archive. Each section has a 'Remove' button and a table of data.

Patients Archive (Remove Patient)

Code	Last Name	First Name	Animal Name	Race	Sex	Birth Date	Exp	Exp Srv	Referring
0001	TEST		test	test		30/12/1899	<input type="checkbox"/>	<input type="checkbox"/>	*

Study Archive (Remove Study)

Operator	Code	Study Date	Anatomy	Weight	Exp	Exp Srv	Head Position	Body Position	Laborat
1				0	<input type="checkbox"/>	<input type="checkbox"/>			
ASPECT	3	22/11/2009 12:52:58	BODY	0	<input type="checkbox"/>	<input type="checkbox"/>	Head Right	Supine	Aspect-MR
ASPECT	4	22/11/2009 13:36:09	BODY	0	<input type="checkbox"/>	<input type="checkbox"/>	Head Right	Supine	Aspect-MR

Series Archive (Remove Series)

Code	Series Date	Sequence Name	Acq Time	Exp	Exp Srv	Samples	Encodings	Strati	User Echos	To Ech
13	22/11/2009 13:40:37	FESS_ScOUT3D	1.18 (m.s)	<input type="checkbox"/>	<input type="checkbox"/>	128	128	128		
15	22/11/2009 13:49:03	T2 FSE 3D	5.00 (m.s)	<input type="checkbox"/>	<input type="checkbox"/>	128	128	12		
17	22/11/2009 14:05:24	T2 FSE 3D	6.00 (m.s)	<input type="checkbox"/>	<input type="checkbox"/>	128	128	12		
19	22/11/2009 14:17:52	T2 FSE multislice	5.00 (m.s)	<input type="checkbox"/>	<input type="checkbox"/>	200	200	5		

Additional controls: Slice 1, Edit Series, Edit Image.

The screen is divided into three sections:

- Patients Archive
- Study Archive
- Series Archive

Use the archive to locate specific image series according to patient and study information.

Locating and Displaying Images/Series

Sometimes you need to locate a series of images that you have acquired in the past. This may be complicated after the system has been in use for a while and a large number of images has been acquired.

To locate information hierarchically

- 1 Locate and select a patient in the Patients Archive. All the studies performed on this patient are displayed in the Study Archive.
- 2 Locate and select a study in the Study Archive. All the series performed in this study are displayed in the Series Archive.
- 3 Locate and select the required series in the Series Archive. The first slice of the series is displayed in the preview area.
- 4 Click **Edit Series** or **Edit Image**. The series/image is displayed in the View Panel.

Deleting a Patient

The option to delete a patient is reserved for operators with Super User privileges. This action is restricted because it irreversibly deletes the patient and all his related studies and images.

To delete a patient

- 1 Locate and select a patient in the Patient Archive.
- 2 Click **Remove Patient**. A confirmation message is displayed, warning that all the studies connected to this patient will be removed as well.
- 3 Click **Yes**. The patient and all its related studies and series are removed.

Deleting a Study

To reduce disk usage, you can delete studies that are no longer needed.

To delete a study

- 1 Locate and select a study in the Study Archive.

- 2 Click **Remove Study**. A confirmation message is displayed, warning that all the series connected to this study will be removed as well.
- 3 Click **Yes**. The study and all its related series are removed.

Deleting a Series

To reduce disk usage, you can delete image series that are no longer needed.

To delete a series

- 1 Locate and select a series in the Series Archive.
- 2 Click **Remove Series**. A confirmation message is displayed.
- 3 Click **Yes**. The series is removed.

Using the DICOM Creator

Images from the M2™ compact high-performance MRI system can be exported in a DICOM (Digital Imaging and Communications in Medicine) format; this format is often used to transfer images between software platforms, and may be used to load M2™ system images into various third party software tools for further analysis. The DICOM images as they are exported from the M2™ software must be processed through a converter to ensure that all facets of the M2™ images follow the strict conventions of the DICOM system. Aspect imaging provides an easy to use application (the DICOM Creator) to ensure the final product is in the official DICOM format.

This procedure describes how to export DICOM images from within the M2™ software and then convert them using the DICOM Creator. Once converted, the images can be loaded into any third party software for further analysis.

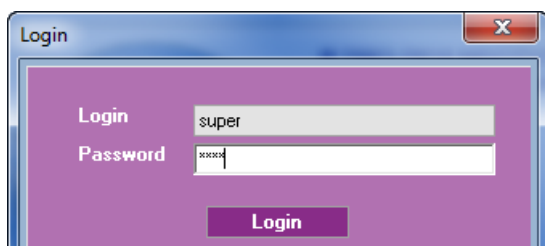
Note/Tip



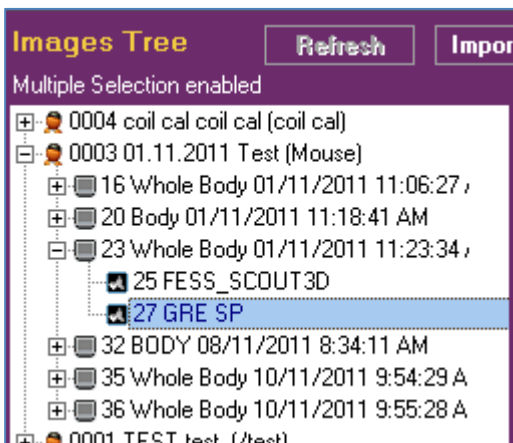
The DICOM Creator application must be previously installed in the M2 system computer.

To export and convert images to full DICOM format

- 1 Open the M2 software using any available login. The NRG software Main screen is displayed.



- 2 Click **Archive** and **Dicom Archive**. The *Images Tree* and *Dicom Archive* panels are displayed. Click **Refresh** to refresh the panel display.



- 3 Within the *Images Tree* section of the screen, expand the desired section and identify the study or scan to be exported.

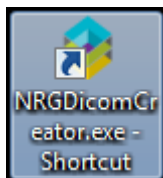
To export more than one study, multiple selections can be made by holding down the **<Ctrl>** key and clicking on each study.

- 4 In the *Dicom Archive* panel of the screen, the location to which the files will be exported is identified. It is recommended to leave this as the default (C:\Program Files\NRGSYS\NRGConsole\Archive).

- 5 Click the **Convert Dicom** button.

A window is displayed confirming the export, click **Yes**. This may take several minutes. To verify that the export is complete click the **Convert Dicom** button again. If a window is displayed explaining the export session is still active, then the export is not complete.

- 6 On the system desktop, select and double-click the **NRGDicomCreator.exe** icon to open the application.



- 7 Identify the **Sequence Type** to be converted.
- 8 Click **Browse** under the *DICOM Source folder* and navigate to the Archive folder.
- 9 Click **Browse** under the *DICOM Destination folder* and navigate to the desired location for the converted DICOM files.



Note/Tip

Important: The destination folder for the converted files needs to be created before starting the DICOM Creator.

10 Click **Create DICOM**.

11 Repeat Steps 8 through 10 for all scans to be converted. The DICOM files can now be loaded from the *Destination Folder* to third party software for further analysis.

List of DICOM tags modified by the application in the DICOM header

The following is a list of DICOM tags modified by the DICOM Creator application. The tags are listed by sequences.

Diffusion Weighted Imaging (SE_DWI)

Slice Location - corrected

MR Diffusion Sequence - corrected

Diffusion b-value – corrected, ensure that the appropriate values are saved in the b-value table (C:\NTNMR)

Rescale Slope (Image scale factor) – set to 0, as to not affect images when loaded into third party software. The correct value can be found in the .dat file associated with the image (C:\Program Files (x86)\NRGSYS\NRGConsole\IMAGE)

Multi Echo Spin Echo (ME_SE)

Slice Location - corrected

Echo Time - corrected

Echo Numbers - corrected

Rescale Slope (Image scale factor) – set to 0, as to not affect images when loaded into third party software. The correct value can be found in the .dat file associated with the image (C:\Program Files (x86)\NRGSYS\NRGConsole\IMAGE)

Inversion Recovery SNAP (IR SNAP)

Slice Location - corrected

MR Modifier Sequence – corrected

Inversion Recovery – set to YES

Inversion Times – corrected, ensure that the appropriate values are saved in the TI table (C:\NTNMR)

Scanning Sequence - corrected

Rescale Slope (Image scale factor) – set to 0, as to not affect images when loaded into third party software. The correct value can be found in the .dat file associated with the image (C:\Program Files (x86)\NRGSYS\NRGConsole\IMAGE)

Gradient Echo SNAP (GRE SNAP)

Slice Location - corrected

Temporal Resolution – corrected

Temporal Position Identifier - corrected

Number of Temporal Positions - corrected

Repetition Time - corrected

Rescale Slope (Image scale factor) – set to 0, as to not affect images when loaded into third party software. The correct value can be found in the .data file associated with the image (C:\Program Files (x86)\NRGSYS\NRGConsole\IMAGE)

All Other Sequences

Rescale Slope (Image scale factor) – set to 0, as to not affect images when loaded into third party software. The correct value can be found in the .dat file associated with the image (C:\Program Files (x86)\NRGSYS\NRGConsole\IMAGE)

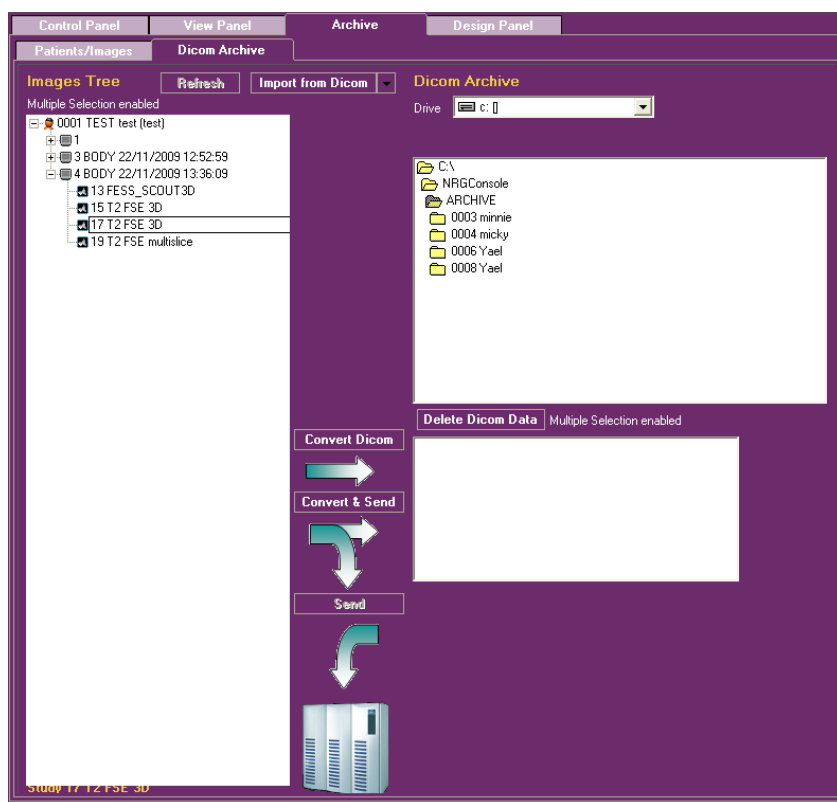
Using the DICOM Archive

Digital Imaging and Communications in Medicine (DICOM) is a standard for handling, storing, printing, and transmitting information in medical imaging.

With the M2 MRI, you can:

- Import data (patients, studies, and series) from DICOM to the native archive.
- Convert acquired images to DICOM.
- Send DICOM format files to a DICOM server.
- Print to a DICOM printer.

Click **Dicom Archive**, to access the Dicom archive.



To import DICOM images from other systems

- 1 Define the DICOM server if it has not been defined.
- 2 Choose the Series/Study/Patient of interest from the tree on the left side of the panel.

- 3 Choose **Import this Series/Study/Patient**

To convert to DICOM format

- 1 Select the **Archive** tab.
- 2 Open the Dicom Archive.
- 3 Refresh the list.
- 4 Choose one study/series and click **Convert to DICOM**. The study/series is displayed in the preview area. The DICOM files are stored in the C:\NRGConsole\Archive folder.

9 System Set-up and Configuration

This chapter describes routine administrative tasks such as how to manage users, check system status, and use the log files.

This chapter contains the following sections:

- Procedure for Switching between User Interfaces
- Managing Users
- Viewing System Status
- Checking the Location of Database and Folders
- Setting-Up DICOM Services
- Using Log Files

Procedure for Switching between User Interfaces

The M2 MRI system works with two distinct software interfaces: NRG and Certainti™ (Optional). The NRG interface is designed for use by advanced users with imaging and MR know-how. Certainti™ is an optional software module that simplifies MR imaging for life scientists with no imaging expertise. It allows them to access the power of MRI and quickly generate quantitative imaging results. The Certainti™ module provides a simple, step-by-step, push-button interface to set up your study, select the anatomical target of interest and imaging mode, preview a “scout” image and then run the image session. The images are easily retrieved, viewed, compared and exported for further analysis.

To switch between interfaces

Note/Tip



Make sure all instances of M2 software are closed before proceeding.

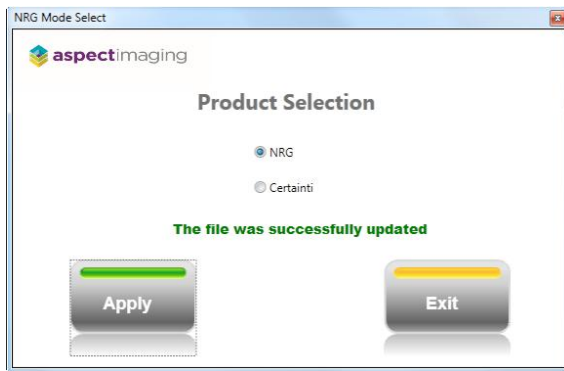
- 1 On the Desktop, select and double-click the **NRGMode** icon. The Product Selection login window is displayed.



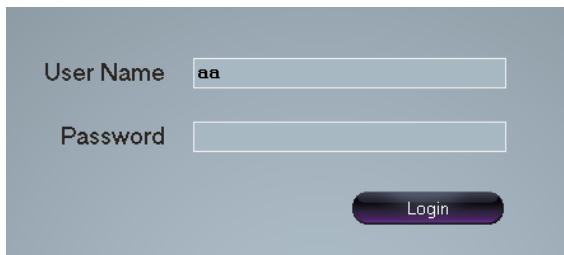
- 2 Enter the password **Aspect0974** and click **Login**. The NRG Mode Select window is displayed.



- 3 Select the interface you want to activate and click **Apply**. The following image is displayed.



- 4 Click **Exit**.
- 5 On the Desktop, select and double-click the **NRGConsole** icon. The selected software interface Login window is displayed.



- 6 Enter your User Name and Password.
- 7 Click **Login**. The selected interface's Main screen is displayed.

Note/Tip



To switch to the alternative interface you must exit the application and repeat steps 1 through 7.

Managing Users

There are three types of users assigned for customer use:

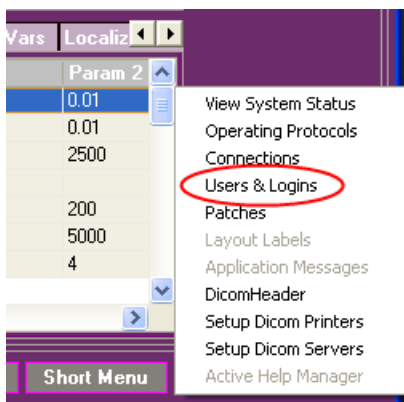
- Super User – full usage rights, including management of users
- Manager – updating and running sequences
- Operator – running sequences

The following table summarizes the major differences between the user types:

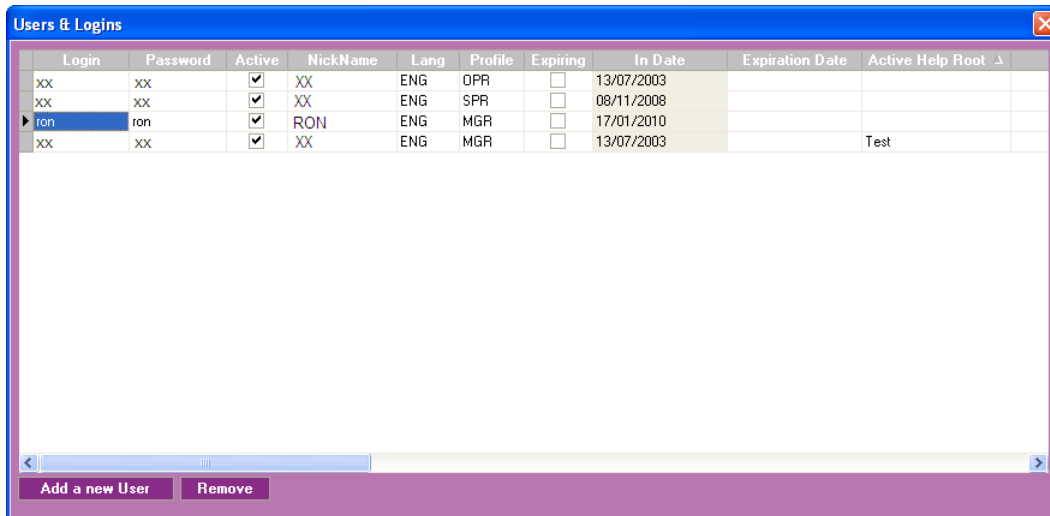
	Super User	Manager	Operator
Opening screen	Acquisition mode		
Preemphasys	+	+	+
Aspect Parameters	+	+	+
User management	+	-	-
Design Panel	+	+	-
View Panel > Configuration/Manage Slice Labels and Edit Slice Settings	+	+	-
Acquisition Coils	+	+	-
Automatically save TNT files	+	+	-
Config Items > Connections	+	+	-
Config Items > Users & Logins	+	-	-
Config Items > Patches	+	+	-
Config Items > Setup Dicom Printers and Servers	+	+	-

To access User management

- 1 Log into the system as a super user.
- 2 Click the **down arrow** near the **Config Items** button.



- 3 Select **Users & Logins**. The Users & Logins dialog box is displayed.



- 4 Add or remove users, as described below.
- 5 Close the window using the Windows Close button.

Adding Users

To add a user

- 1 Access the Users & Logins window.
- 2 Click **Add a new User**. The Add a new user dialog box is displayed.

Add a new User

Login:

Password:

Nickname:

Language: ENG ▾

Mode: CE ▾

Profile: OPR ▾

Expiring:

Expiration Date: / /

Buttons: Create, Cancel

- 3 Type a unique **Login**.
- 4 Type a **Password**.
- 5 Type the user's **Nickname**.
- 6 Select the user interface language from the **Language** list.
- 7 Select the user's **Profile**. The options are OPR (operator) and MGR (manager).

- Operators cannot access the Design mode or Design panel of the applications.
 - Managers have full access to the main modes and panels, but cannot manage system users and cannot access proprietary company software.
- 8 Click **Create**. The dialog box closes and the user is created and added to the list.
 - 9 Exit the NRG application.

Removing Users

When personnel leave or for some reason access to the system has to be prevented, users have to be removed from the system.

To remove a user

- 1 Access the Users & Logins window.
- 2 Select a user.
- 3 Click **Remove**. A confirmation message is displayed.
- 4 Click **Yes**. The user is removed from the list.
- 5 Close the Users & Logins window.

Viewing System Status

The information included in this window is important for service and support.

To view system information

- 1 Click **Config Items** on the lower right-hand corner of the screen. The Config list is displayed.
- 2 Select **View System Status**. The System Information screen is displayed.



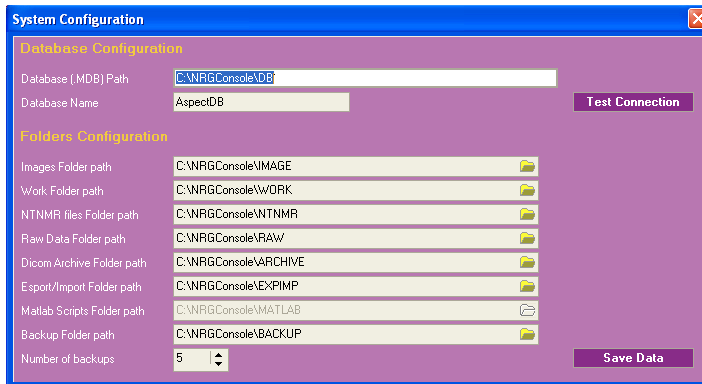
- 3 Close the dialog box using the Windows Close button.

Checking the Location of Database and Folders

Use this dialog box to check the location of the system database and the folders for storing system-generated data.

To check the location of the system database and folders

- 1 Click **Config Items** on the lower right-hand corner of the screen. The Config list is displayed.
- 2 Select **Connections**. The System Configuration dialog box is displayed.



A careless or erroneous change of database path or name may prevent proper software performance.

- 3 Close the window using the Windows Close button.

Setting-Up DICOM Services

Digital Imaging and Communications in Medicine (DICOM) is a standard for handling, storing, printing, and transmitting information in medical imaging.

For the M2 MRI to generate DICOM information correctly, you have to setup DICOM printers and servers.

To setup DICOM servers

- 1 Click **Config Items** on the lower right-hand corner of the screen. The Config list is displayed.
- 2 Click **Setup Dicom Servers**. The Dicom Servers dialog box is displayed.



To add a new server

- 1 Click **Add a new Server**. A line is added to the table and the Server AE Title is selected.

- 2 Type the server name.
- 3 Type the client AE Title.
- 4 Type the server IP.
- 5 Type the server port.

To remove a server

- 1 Select a server in the list.
- 2 Click **Remove**. A confirmation message is displayed.
- 3 Click **Yes**. The server is removed.

To set a default server

- 1 Select a server in the list.
- 2 Click **Select as default**.

Setting-Up DICOM Printers

To setup DICOM printers

- 1 Click **Config Items** on the lower right-hand corner of the screen. The Config list is displayed.
- 2 Select **Setup Dicom Printers**. The Dicom Printers dialog box is displayed.



To add a new printer

- 1 Click **Add a new Printer**. A line is added to the table and the Server AE Title is selected.
- 2 Type the server name.
- 3 Type the client AE Title.
- 4 Type the server IP.
- 5 Type the server port.

- 6 Fill-in the rest of the parameters.

To remove a printer

- 1 Select a printer in the list.
- 2 Click **Remove**. A confirmation message is displayed
- 3 Click **Yes**. The printer is removed.

To set the default printer

- 1 Select a printer in the list.
- 2 Click **Select as default**.

Using Log Files

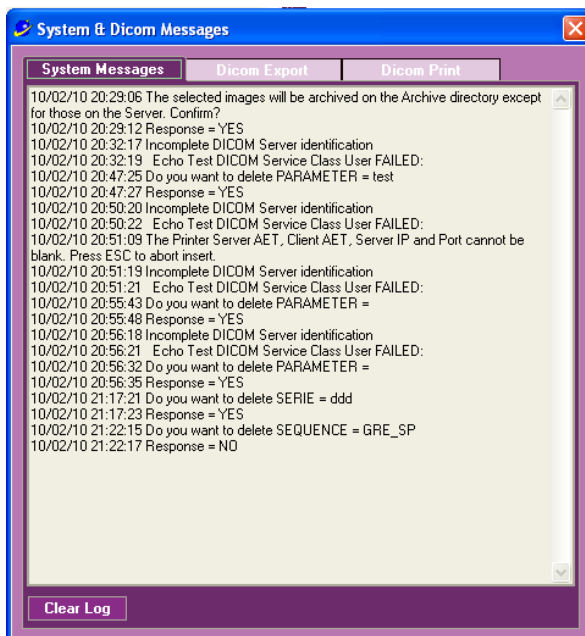
The system collects information about user activity and system messages. This information can be useful for troubleshooting and reporting problems.

System Messages

The System & Dicom Messages log file collects every system message that is displayed to the user and the user's response.

To view system and Dicom messages

- 1 On the bottom menu, click **Messages & Dicom Logs**. The System & Dicom Messages screen is displayed.



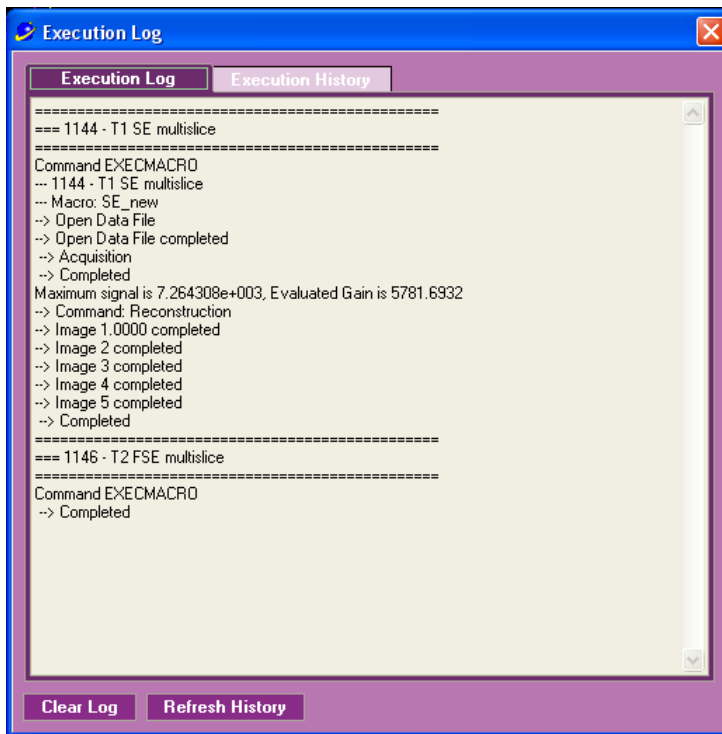
- 2 Click **Clear Log**, if required.

Execution Log

The Execution Log stores all the system activity for the last session. The information is very detailed and includes every executed command.

To view the execution log

- 1 On the bottom menu, click **Scan Messages**. The Execution Log screen is displayed.
- 2 Click **Execution Log**.



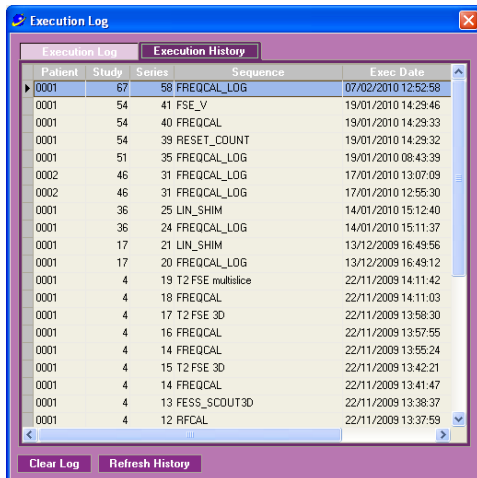
- 3 Click the Windows **Close** button to close the window.

Execution History

The Execution History file collects the information of executed sequences from the system's first activation.

To view the execution history

- 1 On the bottom menu, click **Scan Messages**. The Execution Log screen is displayed.



Patient	Study	Series	Sequence	Exec Date
0001	67	58	FREQCAL_LOG	07/02/2010 12:52:58
0001	54	41	FSE_V	19/01/2010 14:29:46
0001	54	40	FREQCAL	19/01/2010 14:29:33
0001	54	39	RESET_COUNT	19/01/2010 14:29:32
0001	51	35	FREQCAL_LOG	19/01/2010 08:43:39
0002	46	31	FREQCAL_LOG	17/01/2010 13:07:09
0002	46	31	FREQCAL_LOG	17/01/2010 12:55:30
0001	36	25	LIN_SHIM	14/01/2010 15:12:40
0001	36	24	FREQCAL_LOG	14/01/2010 15:11:37
0001	17	21	LIN_SHIM	13/12/2009 16:49:56
0001	17	20	FREQCAL_LOG	13/12/2009 16:49:12
0001	4	19	T2 FSE multise	22/11/2009 14:11:42
0001	4	18	FREQCAL	22/11/2009 14:11:03
0001	4	17	T2 FSE 3D	22/11/2009 13:58:30
0001	4	16	FREQCAL	22/11/2009 13:57:55
0001	4	14	FREQCAL	22/11/2009 13:55:24
0001	4	15	T2 FSE 3D	22/11/2009 13:42:21
0001	4	14	FREQCAL	22/11/2009 13:41:47
0001	4	13	FESS_SCOU3D	22/11/2009 13:38:37
0001	4	12	RFICAL	22/11/2009 13:37:59

- 2 Select the **Execution History** tab.
- 3 Click **Refresh History**, to update the last scans.
- 4 Click the Windows **Close** button to close the window.

Appendix A Specifications

Dimensions

Magnet

Height	114 cm (including the cart)
Width	75 cm
Length	75 cm
Weight	950 kg (approximately)

Electrical Cabinet

Height	130 cm
Width	60 cm
Length	80 cm
Weight	205 kg (approximately)

Display Configuration

The minimum NRG Console screen resolution is 1280 pixels by 768 pixels. The optimal resolution is 1920 pixels by 1200 pixels.

Power Requirements

Line voltage:

- Dual phase (N America), One phase all others
- 208-220 VAC 15A max
- 47-63 HZ.
- Dedicated grounding connection

Ambient Operating Conditions

Temperature	23° – 30° C
Relative Humidity	20% - 80%
Operating Voltage	US - 2 phase, 208 Volt x 6 Amps EU - 1 phase, 220/240 Volt x 6 AMP
Frequency	50 - 60 Hz
Power	2.5 kW (Max)

Atmospheric Pressure

Operating Range: 70 - 106 kPa

Shock & Vibration Limitations

Shock:	5 g, 6 msec, 100 shocks in the X, Y, Z axis
Vibration:	10 – 60 Hz, 0.035 mm; 60 – 500 Hz, 0.5 g in the X, Y, Z axis

Grounding Requirements

A flexible copper cable of type #6 AWG must be used to connect **System Rack** to the site's main ground connection.

Magnetic Field Requirement

Magnetic field mass be less than 0.2m Gauss at 50/60 Hz

Storage Conditions

Temperature	5° - 45° C
Humidity	10% - 90%

Transportation Conditions

The magnet center of gravity is very high and special precautions and tools are needed for transportation.

Do not transport the system without first consulting with Aspect Imaging.

Appendix B System Calibration

The M2 MRI system is configured to include several calibration sequences that are identified as 'service' type sequences.

This appendix covers the following topics:

- Frequency Calibration
- Linear Shim Calibration
- RF Calibration
- Coil Calibration

Frequency Calibration

System frequency is affected by several factors, among them temperature fluctuations. Therefore, to ensure good quality images, frequency calibration has to be performed periodically. It is performed automatically before every scout sequence.

Most scanning sequences that you add to the acquisition queue are automatically complemented with a frequency calibration sequence preceding them. If you operate in Automatic mode, frequency calibration is performed before every sequence. If, however, you operate in Manual mode, you may choose to run only the imaging sequence, skipping the preceding calibrations. In this case, every 10 to 15 minutes, select the Frequency Calibration sequence in the queue and click **Run Sequence**.

Linear Shim Calibration

The Linear Shim calibration deals with the magnet field homogeneity. It is performed automatically before every scout sequence so you do not need to initiate it manually.

RF Calibration

The RF calibration procedure calibrates the RF pulses.

RF calibration has to be performed every time you replace the coil or the sample. It is performed automatically before every scout sequence so you do not need to initiate it manually.

Coil Calibration

In its endeavor to provide improved and more sophisticated product solutions, Aspect Imaging has been constantly upgrading its hardware and software. Based upon these changes, and depending upon the system implemented at each customer installation, there are currently six different procedures for performing coil calibration. Which procedure applies to your particular installation depends upon your system configuration. The following are the possible scenarios. Click on the scenario number that applies to your installation to go to the coil calibration instructions that are applicable for your system configuration.

Calibration Method	System Installed		Software Interface Scenario number to apply	
	Electronics Cabinet	Coil	NRG	Certainiti
Manual	Original	Original	1	2
Semiautomatic	New	Original	3	4
Automatic	New	New	5	6

If you have any questions please contact Aspect Imaging Support at support@aspectimaging.com

Scenario 1 – Original Electronics Cabinet, Original Coil, NRG interface

Performing Manual Coil Calibration using the M2™ Software

Purpose

Coil calibration is an important part to acquiring high-quality images with the M2™ compact high-performance MRI system. The frequency of the coil must match the frequency of the system to ensure the highest image quality. Since the frequency of the system depends on ambient temperature, it is not fixed and can slightly deviate. As a result, the coil should be calibrated from time to time in order to maintain the highest quality images.

This protocol describes how to perform the steps necessary for manual coil calibration, assuming that the system hardware has not been updated and an original coil is being employed.

It is recommended that coil calibration be completed several times throughout the imaging day to ensure proper calibration and to ensure the highest quality images are acquired.

Requirements

- M2 compact high-performance MRI System
- Original system hardware, no hardware upgrade for automatic coil calibration
- Original coil design
- Any user login
- Working knowledge of the M2 system and software

Procedure

1. Prepare the M2 system for imaging by placing the sample in the magnet with the desired coil installed.
2. Open the **NRG software** and log in using any username and password.
3. Proceed through the image acquisition set up until the *scout image* has been acquired.
4. Click **Set Protocol**. The Select Protocol dialog box is displayed.
5. Select the **Basic** protocol.
6. Click **Set Sequence**. The Select Sequence dialog box is displayed.
7. Select **COIL_CALIB** sequence from the list and click **Select**.

Exec	Abort	Sequence Name	Sequence Type	Description
<input type="checkbox"/>	<input type="checkbox"/>	RESET_COUNT	COUNT	exper counter
<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	COIL_CALIB	SERVICE	coil calibration
<input type="checkbox"/>	<input type="checkbox"/>	HEATING	SERVICE	heating using sh
<input type="checkbox"/>	<input type="checkbox"/>	CALIBRATIONS	SERVICE	run all calibrator
<input type="checkbox"/>	<input type="checkbox"/>	GRE EXT	GRE	Gradient Echo 3

Select

8. In the Coil Calib Options combo box, select **Direct**.

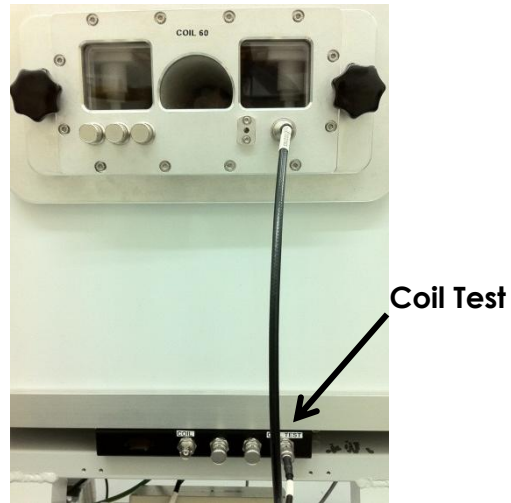


9. Select **Add to Queue**

10. Add the sequence to the queue and click **Run Sequence**.

Note: Before the coil calibration procedure is run, you need to change a cable connection on the magnet assembly and to change the mode selection in the system cabinet.

11. On the M2 system, change the location of the cable connecting the coil faceplate to the manifold, from Coil to **Coil Test**.



12. In the electronics cabinet, change the Mode Selector dial to **Coil Test**.

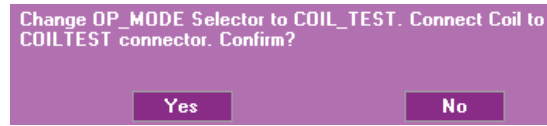
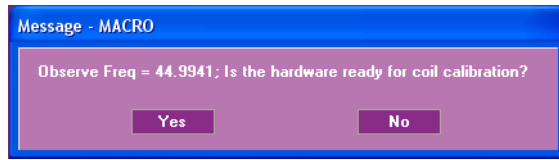


13. If the sequence does not begin immediately the queue is set to Manual Acquisition, press this button to initiate the sequence. A dialog box is displayed confirming the observed frequency.



14. Click **Yes** in the dialog box. The calibration is performed and a result is displayed.

A subsequent window is displayed confirming the user has changed the location of the cable connecting the coil faceplate to the manifold and the location of the Mode Selector dial in the electronics cabinet. Choose **Yes**.

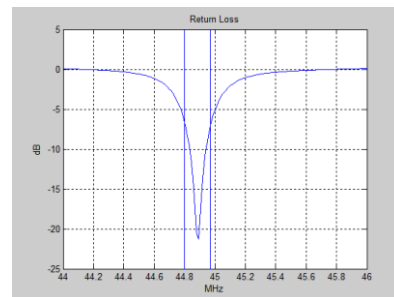


15. A frequency plot is displayed along with a window displaying the coil and observed frequencies.

The Frequency delta is the difference between these frequencies, and should approach 0 when possible. A tolerance of ± 0.01 is acceptable.

Note: If the delta is negative, as in this example, the coil calibration screw should be adjusted counter clockwise. However, if it is positive, the screw should be adjusted clockwise.

One full turn will adjust the frequency delta by approximately 0.04, therefore every $\frac{1}{4}$ turn adjusts the delta by 0.01.



Coil frequency = 44.89
 Observe Freq = 45

Frequency delta = -0.11

(-7 dB) Q = 264
 Coil BW = 0.17
 max RL = 21.2428 dB
 accept coil-calibration or continue calibration?



16. Adjust the **Coil Calibration**

Screw according to the detected frequency delta.

Once the screw has been appropriately adjusted click **Continue** on the pop up window.

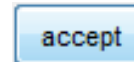


17. The COIL_CALIB sequence must be repeated until the Frequency delta is ± 0.01 or better. Highlight the COIL_CALIB sequence already listed in the queue. Click **Run Sequence**.

Exec	Abort	ID	Sequence Name	Cal	Sequence Type	Description
<input checked="" type="checkbox"/>	<input type="checkbox"/>	354	FREQ CAL INIT	<input checked="" type="checkbox"/>	CALIB	Initial Frequency Calibration
<input checked="" type="checkbox"/>	<input type="checkbox"/>	355	LIN SHIM CAL	<input checked="" type="checkbox"/>	CALIB	Linear Shim Calibration
<input checked="" type="checkbox"/>	<input type="checkbox"/>	356	RF CAL	<input checked="" type="checkbox"/>	CALIB	RF Power Calibration
<input checked="" type="checkbox"/>	<input type="checkbox"/>	357	FESS_SCOUT3	<input type="checkbox"/>	SCOUT3D	Gradient Echo 3D Steady S
<input checked="" type="checkbox"/>	<input type="checkbox"/>	358	COIL_CALIB	<input type="checkbox"/>	SERVICE	coil calibration

Run Sequence

18. Repeat steps 6 through 9 until the Frequency delta is ± 0.01 . Instead of clicking Continue, click **Accept** to accept the coil calibration.



Scenario 2 – Original Electronics Cabinet, Original coil, Certainti interface

Performing Manual Coil Calibration using the Certainti™ Software

Purpose

Coil calibration plays an important role in acquiring high-quality images with the M2™ compact high-performance MRI system. The frequency of the coil must match the frequency of the system to ensure the highest image quality. Since the frequency of the system depends on ambient temperature, it is not fixed and can deviate slightly. As a result, the coil should be calibrated from time to time in order to maintain the highest quality images.

This protocol describes how to perform the steps necessary for manual coil calibration, assuming the system hardware has not been updated and an original coil is being employed.

It is recommended that coil calibration be completed several times throughout the imaging day to ensure proper calibration and to ensure the highest quality images are acquired.

Requirements

- M2 compact high-performance MRI System
- Original system hardware, no hardware upgrade for automatic coil calibration
- Original coil design
- Any user login
- Working knowledge of the M2 system and software

Procedure

1. Prepare the M2 system for imaging by placing the sample in the magnet with the desired coil installed.

2. Automatic coil calibration cannot be performed using the original coil design. To calibrate such coils a manual technique is required.

If the **Certainti software** is already opened this software should be closed since the **NRG** software must be used to perform the coil calibration in this system configuration.

Open the **NRG software** and log in using the same username and password used for the Certainti software.

3. Click the **Set Patient** button and enter information for the *Last Name of the Owner, Pet Name, and Race*. Click **Confirm**.



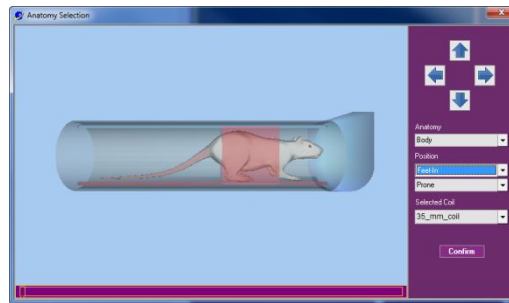
Note: This information will not be saved or used in the Certainti software for image acquisition so entries may be as simple as coil cal for example.

4. Click the **Set Anatomy** button.



Set the position of the animal accordingly.

Click **Confirm**.



5. Click the **Perform Scout** button.

The system automatically acquires the scout image; this is required because the system detects the frequency of the magnet at this point.

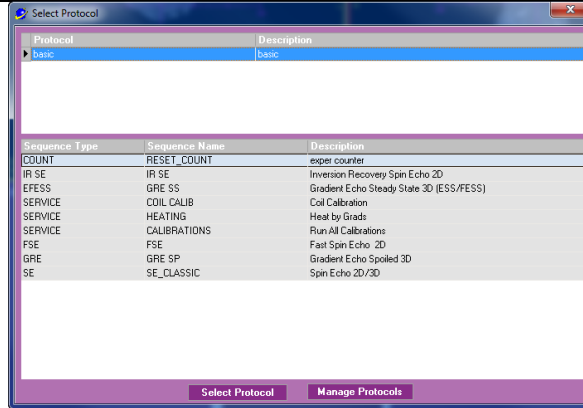


6. Click the **Set Protocol** button.

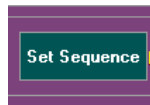


A window is displayed listing all the available protocols.

Highlight **Basic** and then click **Select Protocol**.



7. Click the **Set Sequence** button.



Highlight the **COIL_CALIB** sequence from the list, and click **Select**.

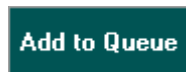
Exec	Abort	Sequence Name	Sequence Type	Description
<input type="checkbox"/>	<input type="checkbox"/>	RESET_COUNT	COUNT	exper counter
<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	COIL_CALIB	SERVICE	coil calibration
<input type="checkbox"/>	<input type="checkbox"/>	HEATING	SERVICE	heating using sh
<input type="checkbox"/>	<input type="checkbox"/>	CALIBRATIONS	SERVICE	run all calibrator
<input type="checkbox"/>	<input type="checkbox"/>	GRE EXT	GRE	Gradient Echo 3



8. In the Coil Calib Options combo box, select **Direct**.



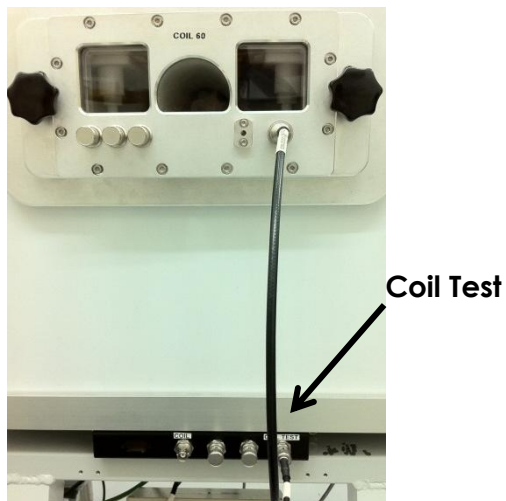
9. Click **Add to Queue**.



10. Add the sequence to the queue and click **Run Sequence**.

Note: Before the coil calibration procedure is run, you need to change a cable connection on the magnet assembly and to change the mode selection in the system cabinet.

11. On the M2 system, change the location of the cable connecting the coil faceplate to the manifold from Coil to **Coil Test**.



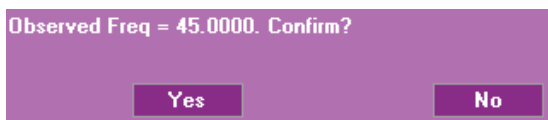
12. In the electronics cabinet, change the location of the Mode Selector dial from Body Coil 1 CH or any other location currently used to **Coil Test**.



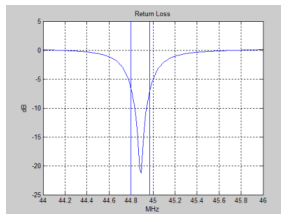
13. If the sequence does not begin immediately, the queue is set to **Manual Acquisition**, click to initiate the sequence.



14. A window is displayed confirming the observed frequency of the system. Click **Yes**.
A subsequent window is displayed confirming the user has changed the location of the cable connecting the coil faceplate to the manifold and the location of the Mode Selector dial in the electronics cabinet. Click **Yes**.



15. A frequency plot is displayed along with a window displaying the coil frequency and observed frequencies.



Coil frequency = 44.89
 Observe Freq = 45
 Frequency delta = -0.11
 (-7 dB) Q = 264
 Coil BW = 0.17
 max RL = 21.2428 dB
 accept coil-calibration or continue calibration?

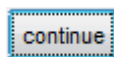
Note: If the delta is negative, as in this example, the coil calibration screw should be adjusted counter clockwise. However, if it is positive, the screw should be adjusted clockwise.



One full turn adjusts the frequency delta by approximately 0.04, thus every 1/4 turn adjusts the delta by 0.01.



16. Adjust the **Coil Calibration Screw** according to the detected frequency delta.



Once the screw has been appropriately adjusted click **Continue** on the pop up window.

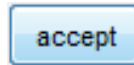
17. The COIL_CALIB sequence must be repeated until the Frequency delta is ± 0.01 or better.

Exec	Abort	ID	Sequence Name	Cal	Sequence Type	Description
<input checked="" type="checkbox"/>	<input type="checkbox"/>	354	FREQ CAL INIT	<input checked="" type="checkbox"/>	CALIB	Initial Frequency Calibration
<input checked="" type="checkbox"/>	<input type="checkbox"/>	355	LIN SHIM CAL	<input checked="" type="checkbox"/>	CALIB	Linear Shim Calibration
<input checked="" type="checkbox"/>	<input type="checkbox"/>	356	RF CAL	<input checked="" type="checkbox"/>	CALIB	RF Power Calibration
<input checked="" type="checkbox"/>	<input type="checkbox"/>	357	FESS_SCOU3	<input type="checkbox"/>	SCOUT3D	Gradient Echo 3D Steady S
<input checked="" type="checkbox"/>	<input type="checkbox"/>	358	COIL_CALIB	<input type="checkbox"/>	SERVICE	coil calibration

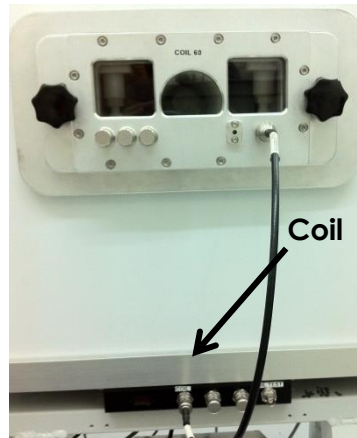
Highlight the **COIL_CALIB** sequence already listed in the queue. Click **Run Sequence**.



18. Repeat steps 6 to 9 until the *Frequency delta* is ± 0.01 . Instead of clicking Continue, click **Accept** the coil calibration.



19. The coil calibration has been completed. On the M2 system, change the location of the cable connecting the coil faceplate to the manifold from Coil Test to **Coil**. In the electronics cabinet, change the location of the Mode Selector dial from Coil Test to **Body Coil 1 CH**, or appropriate setting.



20. Close the M2 software, launch the Certainti software and proceed with image acquisition.

Scenario 3 – New Electronics Cabinet, Original Coil, NRG interface

Performing Semi-Automatic Coil Calibration using the M2™ Software

Purpose

Coil calibration plays an important role in acquiring high-quality images with the M2™ compact high-performance MRI system. The frequency of the coil must match the frequency of the system to ensure the highest image quality. Since the frequency of the system depends on ambient temperature, it is not fixed and can slightly deviate. Recently Aspect Imaging has developed the hardware necessary to perform automatic coil calibration. If the hardware of the system has been updated, but the coil being used requires manual adjustment the procedure can still be completed.

This protocol describes how to perform the steps necessary for semi-automatic coil calibration, assuming that the system hardware has been updated and an original coil is being employed.

It is recommended that coil calibration be completed several times throughout the imaging day to ensure proper calibration and to ensure the highest quality images are acquired.

Requirements

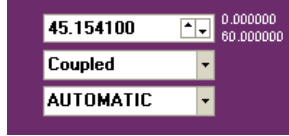



- M2 compact high-performance MRI System
- Updated system hardware for automatic coil calibration
- Original coil design
- Any user login
- Working knowledge of the M2 system and software

Procedure

1. Prepare the M2 system for imaging by placing the sample in the magnet with the desired coil installed.

2. Proceed through the image acquisition set up until the scout image has been acquired, the protocol selected, and the *Set Sequence* window has been opened.

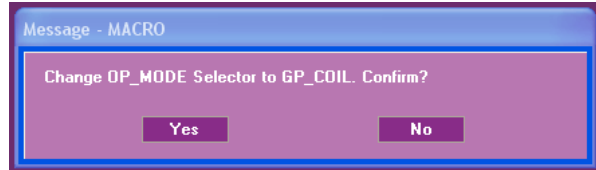


<p>3. Highlight the <i>COIL_CALIB</i> sequence from the list, and click Select.</p>	<table border="1"> <thead> <tr> <th>Exec</th> <th>Abort</th> <th>Sequence Name</th> <th>Sequence Type</th> <th>Description</th> </tr> </thead> <tbody> <tr> <td><input type="checkbox"/></td> <td><input type="checkbox"/></td> <td>RESET_COUNT</td> <td>COUNT</td> <td>exper counter</td> </tr> <tr> <td><input checked="" type="checkbox"/></td> <td><input checked="" type="checkbox"/></td> <td>COIL_CALIB</td> <td>SERVICE</td> <td>coil calibration</td> </tr> <tr> <td><input type="checkbox"/></td> <td><input type="checkbox"/></td> <td>HEATING</td> <td>SERVICE</td> <td>heating using sh</td> </tr> <tr> <td><input type="checkbox"/></td> <td><input type="checkbox"/></td> <td>CALIBRATIONS</td> <td>SERVICE</td> <td>run all calibrator</td> </tr> <tr> <td><input type="checkbox"/></td> <td><input type="checkbox"/></td> <td>GRE EXT</td> <td>GRE</td> <td>Gradient Echo 3</td> </tr> </tbody> </table>	Exec	Abort	Sequence Name	Sequence Type	Description	<input type="checkbox"/>	<input type="checkbox"/>	RESET_COUNT	COUNT	exper counter	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	COIL_CALIB	SERVICE	coil calibration	<input type="checkbox"/>	<input type="checkbox"/>	HEATING	SERVICE	heating using sh	<input type="checkbox"/>	<input type="checkbox"/>	CALIBRATIONS	SERVICE	run all calibrator	<input type="checkbox"/>	<input type="checkbox"/>	GRE EXT	GRE	Gradient Echo 3
Exec	Abort	Sequence Name	Sequence Type	Description																											
<input type="checkbox"/>	<input type="checkbox"/>	RESET_COUNT	COUNT	exper counter																											
<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	COIL_CALIB	SERVICE	coil calibration																											
<input type="checkbox"/>	<input type="checkbox"/>	HEATING	SERVICE	heating using sh																											
<input type="checkbox"/>	<input type="checkbox"/>	CALIBRATIONS	SERVICE	run all calibrator																											
<input type="checkbox"/>	<input type="checkbox"/>	GRE EXT	GRE	Gradient Echo 3																											
<p>4. In the displayed combo box, select the Coupled mode.</p>																															
<p>5. In the electronics cabinet, change the location of the Mode Selector dial from Body Coil 1 CH or any other location currently used to GP COIL.</p>																															
<p>6. Click Add to Queue button</p>																															
<p>7. If the sequence does not begin immediately, the queue is set to Manual Acquisition. Click this button to initiate the sequence.</p>																															

8. A window is displayed confirming the observed frequency of the system. Click **Yes**.

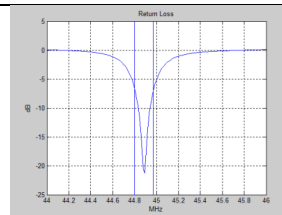


A subsequent window is displayed confirming that the user has changed the position of the Mode Selector dial in the electronics cabinet. Click **Yes**.



Note: this window is important only if the hardware has not been updated on the M2 system, without the update various manual changes to the hardware are required.

9. A frequency plot is displayed along with a window displaying the coil and observed frequencies. The *Frequency delta* is the difference between these frequencies, and should approach 0 when possible. A tolerance of ± 0.01 is acceptable.



Coil frequency = 44.89
 Observe Freq = 45
 Frequency delta = -0.11
 (-7 dB) Q = 264
 Coil BW = 0.17
 max RL = 21.2428 dB
 accept coil-calibration or continue calibration?

Note: If the delta is negative, as in this example, the coil calibration screw should be adjusted counter clockwise, if it is positive the screw should be adjusted clockwise.



One full turn adjusts the frequency delta by approximately 0.04, therefore every $\frac{1}{4}$ turn adjusts the delta by 0.01.



10. Adjust the **Coil Calibration Screw** according to the detected frequency delta.

Once the screw has been appropriately adjusted click **Continue** on the pop up window.



11. The COIL_CALIB sequence must be repeated until the Frequency delta is ± 0.01 or lower.

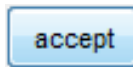
Highlight the COIL_CALIB sequence already listed in the queue. Click **Run Sequence**.

Exec	Abort	ID	Sequence Name	Cal	Sequence Type	Description
<input checked="" type="checkbox"/>	<input type="checkbox"/>	354	FREQ CAL INIT	<input checked="" type="checkbox"/>	CALIB	Initial Frequency Calibration
<input checked="" type="checkbox"/>	<input type="checkbox"/>	355	LIN SHIM CAL	<input checked="" type="checkbox"/>	CALIB	Linear Shim Calibration
<input checked="" type="checkbox"/>	<input type="checkbox"/>	356	RF CAL	<input checked="" type="checkbox"/>	CALIB	RF Power Calibration
<input checked="" type="checkbox"/>	<input type="checkbox"/>	357	FESS_SCOUT3	<input type="checkbox"/>	SCOUT3D	Gradient Echo 3D Steady S
<input checked="" type="checkbox"/>	<input type="checkbox"/>	358	COIL_CALIB	<input type="checkbox"/>	SERVICE	coil calibration

Run Sequence

12. Repeat steps 6 to 9 until the *Frequency delta* is ± 0.01 .

Instead of clicking Continue, click **Accept**.



13. In the electronics cabinet, change the location of the Mode Selector dial from Coil Test to **Body Coil 1 CH**, or to another appropriate setting.



The imaging session can now begin.

Scenario 4 – New Electronics Cabinet, Original Coil, Certainti interface

Performing Semi-Automatic Coil Calibration using the Certainti™ Software

Purpose

Coil calibration plays an important role in acquiring high-quality images with the M2™ compact high-performance MRI system. The frequency of the coil must match the frequency of the system to ensure the highest image quality. Since the frequency of the system depends on ambient temperature, it is not fixed and can slightly deviate. Recently, Aspect Imaging developed the hardware necessary to perform automatic coil calibration. If the hardware of the system has been updated, but the coil being used requires manual adjustment, the procedure can still be completed.

This protocol describes how to perform the steps necessary for semi-automatic coil calibration, assuming that the system hardware and software have been updated and an original coil is being employed.

It is recommended that coil calibration be completed several times throughout the imaging day to ensure proper calibration and to ensure the highest quality images are acquired.

Requirements

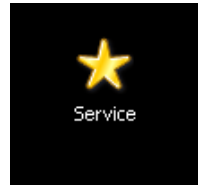
- M2 compact high-performance MRI System
- Certainti software
- Updated M2 system hardware for automatic coil calibration
- Original coil design
- Working knowledge of the M2 system and software

Procedure

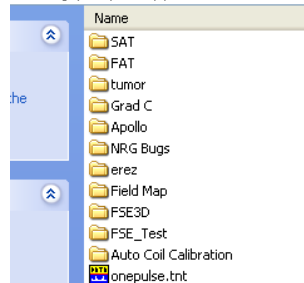
1. Prepare the M2 system for imaging by placing the sample in the magnet with the desired coil installed.

- The automatic coil calibration cannot be performed using the original coil design. In order to calibrate such coils a manual technique is required.

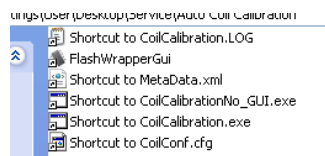
Open the **Service folder** located on the desktop of the M2 system.



Locate the **Auto Coil Calibration** folder and *Open* it.

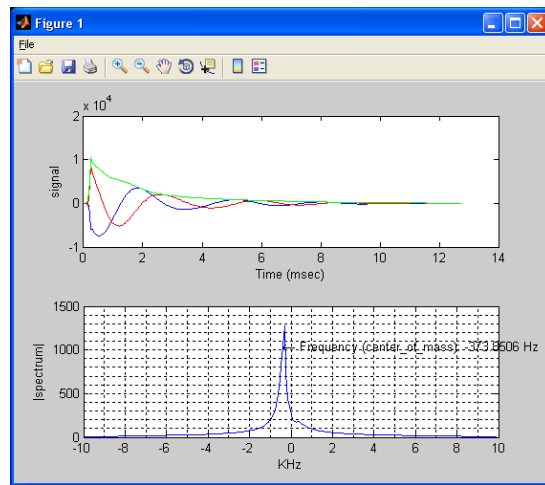
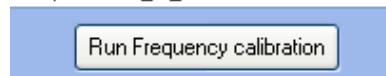


Locate the **Shortcut to CoilCalibration.exe** file and *Open* it.

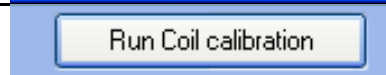


- Click **Run Frequency Calibration**.

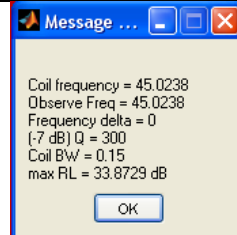
This automatically detects the frequency of the magnet. This value is used to compare with the coil frequency. If different, the coil frequency is adjusted manually.



- Click **Run Coil calibration**.



5. Once completed a window is displayed showing the difference in frequency between the magnet and the coil. Manually adjust the *coil calibration* screw on the faceplate of the coil as indicated in the image displayed here.



Note: Here the *Frequency delta* is shown to be 0, however if any difference in frequencies is detected it is displayed in this line. If the delta is negative, the coil calibration screw should be adjusted counter clockwise. However, if it is positive, the screw should be adjusted clockwise. One full turn will adjust the frequency delta by approximately 0.04, therefore every $\frac{1}{4}$ turn will adjust the delta by 0.01.



6. Once the **coil calibration screw** has been appropriately adjusted click **Ok** on the pop up window.
7. Repeat steps 4 to 6 until the coil frequency is within ± 0.01 of the magnet.
8. The coil calibration is now complete. The imaging session can begin.

Scenario 5 – New Electronics Cabinet, New Coil, NRG interface

Performing Automatic Coil Calibration using the M2™ Software

Purpose

Coil calibration plays an important role in acquiring high-quality images with the M2™ compact high-performance MRI system. The frequency of the coil must match the frequency of the system to ensure the highest image quality. Since the frequency of the system depends on ambient temperature, it is not fixed and can slightly deviate. Recently, Aspect Imaging developed the hardware necessary to perform automatic coil calibration. This requires an update to the hardware and software of the system, as well as a specific coil which has been equipped with additional automatic coil calibration hardware.

This protocol describes how to perform the steps necessary for automatic coil calibration, assuming that both the system hardware and software have been updated and the new coil design is available.

It is recommended that coil calibration be completed several times throughout the imaging day to ensure proper calibration and to ensure the highest quality images are acquired.

Requirements

- M2 compact high-performance MRI System
- Updated system hardware for automatic coil calibration
- New coil designed for automatic coil calibration
- Any user login
- Working knowledge of the M2 system and software

Procedure

1. Prepare the M2 system for imaging by placing the sample in the magnet with the desired coil installed.

2. Open the **NRG** software. Locate the **Coil Selection** button and click it.

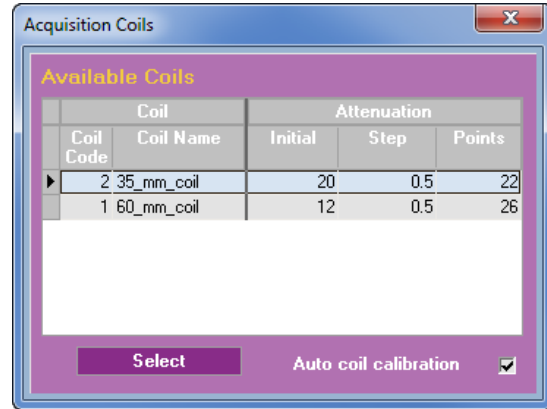
Note: Here the 35mm coil was previously set, if another coil was previously used the button will display that coil's name.



3. Make sure the coil installed on the system is selected.

Mark the **Auto Coil Calibration** box.

Click **Select**. The window will close.

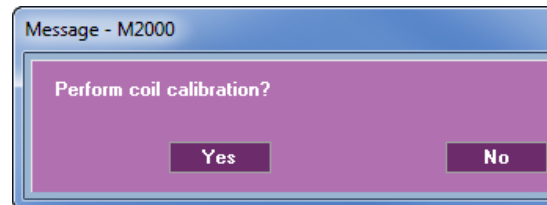


4. Click the **Coil Selection** button again.



5. A window is displayed asking if you wish to perform the coil calibration. Choose **Yes**.

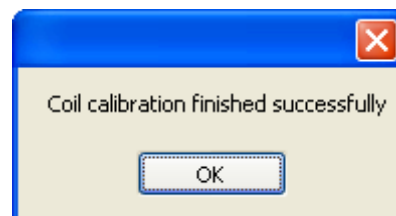
Note: if an incorrect coil is selected, or the coil has been changed and the user needs to return to the *Available Coils* screen simply choose **No** and you will be returned to the appropriate window.



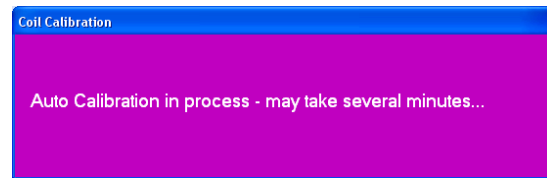
There is an indicator light on the cover plate of the coil, when this light is green the motor is not working to adjust the coil calibration, when orange the motor is active. Do not disconnect or adjust the coil at any time during the automatic coil calibration process.



6. Once the coil calibration process is completed a dialogue box is displayed. Click **OK**.



Note: Automatic coil calibration may take upwards of 1 minute to perform. Do not close any window or perform any other tasks with the software or the computer.



Scenario 6 – New Electronics Cabinet, New Coil, Certainti interface

Performing Automatic Coil Calibration using the Certainti™ Software

Purpose

Coil calibration plays an important role in acquiring high-quality images with the M2™ compact high-performance MRI system. The frequency of the coil must match the frequency of the system to ensure the highest image quality. Since the frequency of the system depends on ambient temperature, it is not fixed and can slightly deviate. Recently, Aspect Imaging developed the hardware necessary to perform automatic coil calibration. This requires an update to the hardware and software of the system, as well as a specific coil which has been equipped with additional automatic coil calibration hardware.

This protocol describes how to perform the steps necessary for automatic coil calibration, assuming that both the M2 system hardware and software have been updated and the new coil design is available.

It is recommended that coil calibration be completed several times throughout the imaging day to ensure proper calibration and to ensure the highest quality images are acquired.

Requirements

- M2 compact high-performance MRI System
- Certainti software
- Updated M2 system hardware for automatic coil calibration
- New coil designed for automatic coil calibration
- Working knowledge of the M2 system and software

Procedure

1. Prepare the M2 system for imaging by placing the sample in the magnet with the desired coil installed.
2. Open the Certainti software. Locate and click the **Calibration** button.



- Automatic coil calibration begins, a window is displayed to this effect; the process may take several minutes.

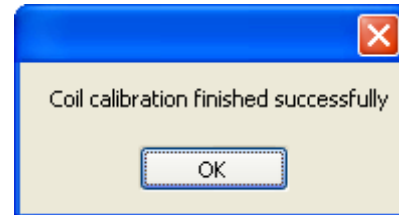
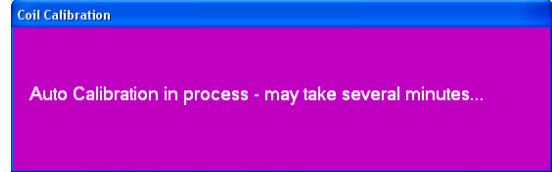
Once completed, a dialog box is displayed indicating the calibration finished successfully, Click **OK**.

Note: The calibration process is iterative; typically the calibration requires 2 to 3 iterations (approx. 1 to 2 min.)

Do not close any window or perform any other tasks on the computer while the automatic coil calibration is being completed.

Note: There is an indicator light on the cover plate of the coil. When this light is green, the motor is not moving and it is safe to remove the coil.

Alternately, when the light is orange, auto calibration is in process and the motor is active. Do not disconnect or adjust the coil at any time during the automatic coil calibration process.



- When the coil calibration is complete, the imaging session can begin.

Appendix C Troubleshooting

General

Problem	Possible Cause	Solution
White noise is displayed instead of an image	Frequency is not calibrated	Run Freq Calibration .
	Sample is not inserted	Insert sample
	Sample is not centered	Reposition sample
	Observation frequency is not correct	Select the Macro Editor tab in the Design Panel . Select Config Items in the bottom-right corner and select Acquisition&Preemphasis . Click Save in the pop-up, then close the window and run Freq Calibration in the queue. It will update the SW with the correct central frequency as defined during installation.
The image contains a single high-intensity line	The gradients stopped working due to overheating.	Cool the room check the gradients temperature is below 35°C and try again.
A "Signal too low" error is displayed.	The coil input cable is not connected.	Connect the coil.
	The mode selector in the electronic cabinet is not set properly.	Turn the mode selector to Body1CH/2CH/GP coil.
	Cable is not connected to the 'coil test' connector	Connect the cable to the 'coil test' connector and turn mode selector to 'Coil Test'.
	The coil is not calibrated.	Perform Coil Calibration.
	There is no phantom or sample in the magnet	Place phantom or sample in the magnet.
A 'frequency not calibrated' message is displayed when trying to run a scout or scan	The software frequency, main coil frequency, and magnet resonance do not match	Perform Coil Calibration. Verify that RF Pulse Amp. is turned on.
A 'gradients not	The gradient Amp. is	Verify that the Power Grad

Problem	Possible Cause	Solution
responding' message is displayed during Scout or Linear Shim calibration	switched OFF.	Amp breaker is switched on.
	The Inhibit button was pressed.	Check whether the Inhibit light on the Gradient Amp. is on. If yes, press the Inhibit button to reset it.
	There is no phantom or sample in the magnet	Place phantom or sample in the magnet.
	The scanned object does not generate a strong enough signal	Place a standard Aspect Imaging phantom and check again.
A 'frequency too low' message is displayed	The central frequency of the spectrometer has changed	Select the Macro Editor tab in the Design Panel . Select Config Items in the bottom-right corner and select Acquisition&Preemphasis . Click Save in the Acquisition Setting window, then close the window and run Freq Calibration from the queue. It will update the SW with the correct central frequency as defined during installation.
An 'att_cal not calibrated' message is displayed	The mounted RF coil does not match the coil indicated in the software.	Change the coil setting in the software.
	The coil frequency is not calibrated	Perform Coil Calibration.
The NRG Console application does not start	The h/w dongle is not connected or broken	Verify that the dongle is in the USB slot.
		Take it out and insert again.
		Try moving to a different USB slot.
		Restart the PC.
		If none of the above help, contact Support.
A 'Demo license missing or incorrect' message is displayed when trying to	The H/W dongle is not connected or broken	Verify that the dongle is in the USB slot.

Problem	Possible Cause	Solution
start the NRG Console application		Take it out and insert again. Try moving to a different USB slot. Restart the PC. If none of the above help, contact Support.
A 'server execution failed' message is displayed when trying to start the NRG Console application	The network cable between the main cabinet to the PC is not connected	Verify that the USB extender is connected. Take it out and insert again. Try moving to a different USB slot. Restart the PC. If none of the above help, contact Support.
The NTNMR does not start	The spectrometer is switched OFF.	Verify that the spectrometer is switched ON.

Image Quality

Problem	Cause	Solution
The image is very grainy	The mounted RF coil does not match the coil indicated in the software.	Change the coil setting in the software.
	The 60 mm coil was used for a small object	Replace the coil to the 35 mm.
	The SNR (signal to noise ratio) is very low	Change scanning parameters to increase SNR. For example, thicker slice, larger FOV, smaller matrix.
There is a fold-over of the image edges	The sample is longer than the field of view	Change the frequency encoding direction to Vertical.
		Increase the FOV (Field of View)

Appendix D Application Notes

Acquiring Images with the Same Receiver gain

When you are repeating the same spin echo sequence several times for the same study, you may want to retain the same value for the Receiver gain. To achieve this, calibrate the receiver gain in the first sequence and omit the receiver gain calibration in subsequent sequences.

- 1 Select a spin echo sequence.
- 2 For the first sequence, select **Always** in the Gain Calibration list.
- 3 Add the sequence to queue.
- 4 For the next sequence, select **Retain** in the Gain Calibration list.
- 5 Add sequence to queue.
- 6 Repeat steps 4 and 5.

Using the Scaling Factor to Normalize Scan Values

Although you have scanned the images with the same receiver gain, the scaling factor of the image intensity can differ from scan to scan. For quantitative image evaluation purposes, this scaling factor must be normalized.

The scans are located in the C:\NRGConsole\IMAGE folder. Each scan is represented by a single folder identified by a serial number. Each scan folder contains a DAT file and image files.

- 1 Open the DAT file of every scan.
- 2 In the DAT file, find the scaling factor.
- 3 Write down the value.
- 4 Use this value to normalize your measurements.

Appendix E Glossary

Acquisition Mode	The mode used for acquiring images
Axial	An imaging plane bisecting the body into top and bottom parts
Coronal	An imaging plane bisecting the body into ventral (front) and dorsal (back) parts
Design Mode	The mode used for designing new pulse sequences
DICOM	Digital Imaging and Communications in Medicine, a standard for handling, storing, printing, and transmitting information in medical imaging.
Editing Mode	The mode used for viewing and measuring acquired images
FOV	Field of View – the extent of space included in the image
Gradient coils	The gradients are used to vary the magnetic field linearly across the imaging volume.
LUT	Look Up Table
Matlab	A software application that generates MRI images out of raw data
NRG Console	The main software operating the M2
NTNMR	A software application operating the spectrometer
Playlist	Several sequences stored in a predefined order, with repetitions and time delays that can be added as a single entity to the acquisition queue.
Prone	Face down
Protocol	A hierarchical entity containing several sequences and related to a part of a subject's anatomy.
RF coils	Radio frequency coils, are used to transmit the pulses to the sample and

	to receive the MR signal.
ROI	Region of Interest
Sagittal	An imaging plane bisecting the body into left and right parts
Scout	A preliminary scan that generates a 3D image of the sample and assists in identifying areas of interest for the scan sequence
Sequence	A sequence defines the instructions to the hardware channels (gradients, transmitter, and receiver), and the associated parameters.
Series	Several images acquired during a single scan sequence.
Shims	Coils that are used to correct the MRI field homogeneity
SNR	Signal to Noise Ratio
Study	One or more sequences performed in a single session.
Supine	Face up

Support and Contact Information

Contact **Aspect Imaging** at:

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Shoham, 60850

Israel

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Fax: +972-3-7165606

Technical Support: support@aspectimaging.com