

QFlow 8.1

User Manual

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Getting Started

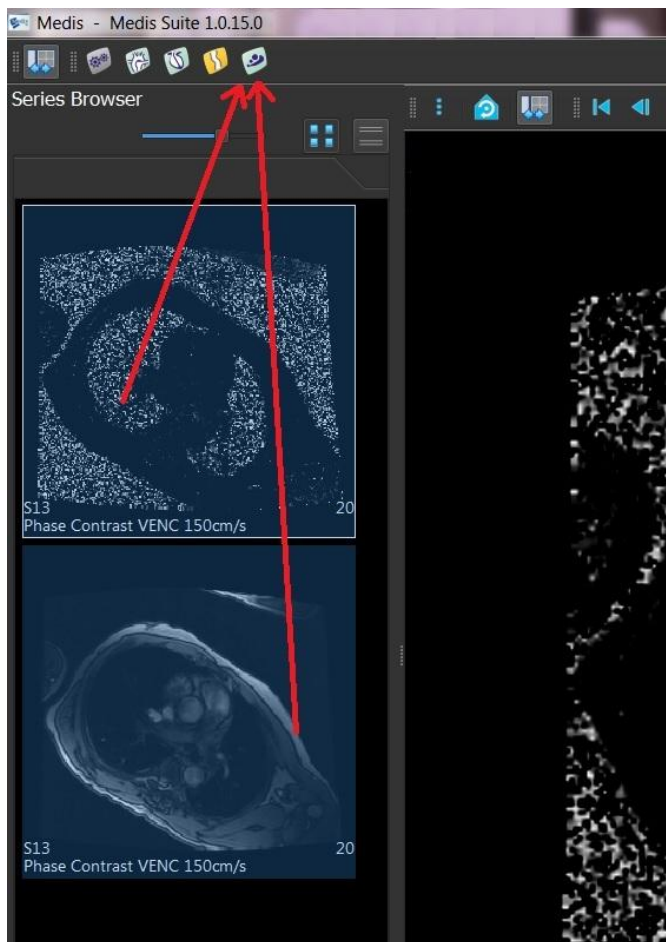
1 Starting QFlow

This chapter explains how:

- How QFlow is started and how data is loaded into QFlow

QFlow can be started from Medis Suite. Series that have been loaded in Medis Suite can be selected and dropped onto the QFlow icon using the left mouse button, which will start QFlow. Exactly 1 phase and 1 magnitude image series need to be selected and dragged onto the QFlow app. The selected series are then displayed in QFlow.

The following image shows how a phase and a magnitude image can be dropped simultaneously onto the QFlow icon.



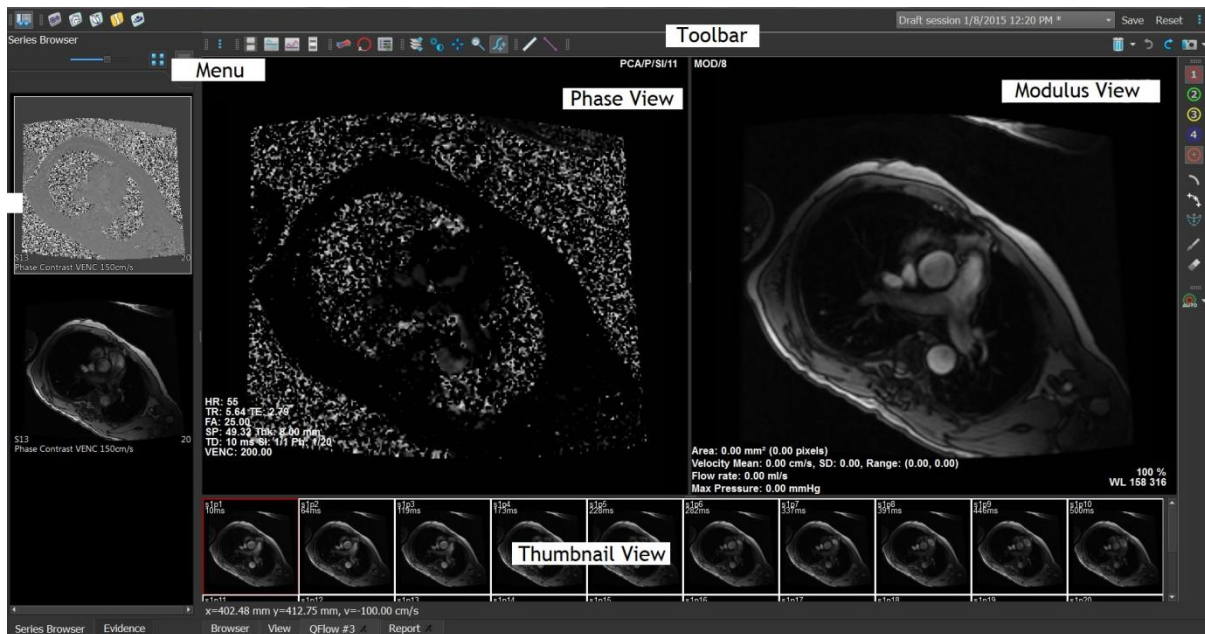
❗ QFlow requires both phase and modulus series. An error occurs if only one of these types is loaded.

2 The QFlow Workspace

This chapter explains:

- The contents of the QFlow workspace

The QFlow main workspace consists of a set of toolbars, a phase view, a modulus view and a thumbnail view. The application menu is accessible through a menu icon in the toolbar.



Phase view

The phase view shows a velocity image of the selected series.

Modulus View

The modulus view shows a modulus image of the selected series.

Thumbnail View

The thumbnail view shows thumbnail images of the selected series. The thumbnail view shows either phase images or modulus images. This can be configured through the application menu. The thumbnail marked with the red border corresponds to the image displayed in either the phase view or the modulus view.

Toolbar

The toolbar area consists of a Medis Suite toolbar and several QFlow toolbars. The QFlow toolbars can be used to access the application menu, to start a movie, to show a graph, to access the main settings, and to perform some basic image manipulations like panning or zooming. The QFlow toolbars can also be used to undo and redo some actions, to create a snapshot, to detect or draw contours and to edit or delete them.

Menu

The application menu is accessible through the  button and can be used for example to reset the layout, to view graphs, to view reports, to view study parameters, to change settings, to detect and edit contours, to undo or redo actions and to cut, copy and paste elements.

3 Reviewing Studies

This chapter explains how to:

- Browse the images in the Modulus View and Phase View
- Select an image
- Switch between phase and modulus images in the Thumbnail View
- View the series in the Movie window
- Scroll through the images
- Zoom in or out
- Pan
- Adjust the window width and level
- Select the Edit mode

To browse the images

- Use the arrow keys on your keyboard to browse the images in the Modulus View and Phase View.

To select an image

- Click an image in the Thumbnail View to select it.

This displays the image in the Phase and Modulus Views.

To switch between phase and modulus images in the Thumbnail View

- Click  to open the application menu and Select **View > Modulus Images** or **View > Phase Images**.

To view the series in the Movie window

- Click  in the toolbar or press F5.

To scroll through the images

- In the toolbar, click . Pressing the left mouse button and moving the mouse from left to right allows you to scroll through the phases. Pressing the left mouse button and moving the mouse up and down allows you to scroll through the slices.

Or,

- Press the left and right mouse button simultaneously and move the mouse from left to right to scroll through the phases. Pressing the left and right mouse button and moving the mouse up and down allows you to scroll through the slices.

To zoom in or out

- In the toolbar, click . You can zoom in by pressing the left mouse button and moving the mouse down. You can zoom out by pressing the left mouse and moving the mouse up.

Or,

- Press + to zoom in or - to zoom out.

Or,

- Press the left and middle mouse buttons and move the mouse down to zoom in or move the mouse up to zoom out.

To pan

- In the toolbar, click . You can pan by pressing the left mouse button and dragging the mouse.

Or,

- Press the middle mouse button and drag the mouse.

 Panning only works when the images are zoomed in.

To adjust the window width and level

- In the toolbar, click . In the Phase View or Modulus View, hold down the left mouse button and drag.

Or,

- Press the right mouse button and drag the mouse.

To select the Edit mode

- In the toolbar, click . In the edit mode you are able to draw contours, distance measurements, profile lines etc.

4 Performing Vascular Flow Analyses

This chapter explains how to:

- Perform a vascular flow analysis
- Apply background correction
- View analysis results
- Perform a Qp/Qs analysis

Now that we have reviewed the series, we are going to perform a vascular flow analysis using the automatic contour detection.



If you want to perform a transvalvular flow analysis, you have to create contours manually. For detailed instructions, refer to the QFlow User Manual.



Automatic contour detection is performed based on the settings specified in the Contour Detection Settings window. You can access these settings by selecting **Settings > Contour Detection Settings...** from the application menu.



When you are using the analysis to obtain results on the average flow velocity, make sure that contours are present in every phase.



Automatically and manually created contours can lead to incorrect results. Make sure to review them and correct if necessary.

To perform a vascular flow analysis

1. Select the image that shows most contrast between the vessel and the background.
2. Click  in the toolbar.
3. Click  .
4. In the Phase or Modulus View, click to select the center point of the vessel you want to analyze.
5. Verify that the contour is correct.



The maximum velocity pixel within the contour in this phase is marked by an orange square, the minimum velocity pixel is marked by a blue square.

To create a new contour, you can place the center point again.

To draw or edit the contour, click  or  and trace the contour in the Modulus or



Phase View, or click  and drag the contour. To reshape the contour, right-click in the view, select **Contour Shape**, and select one of the reshaping options from the submenu.

6. If you want to analyze a second, third, or fourth vessel in the same series, click , in the toolbar, and repeat steps 3 through 5 for each vessel.



7. Click  or press CTRL+D to automatically detect contours in the other images of the series.



You can detect contours for all vessels you marked in one go. Click the arrow next to



this icon , and from the submenu, select **Detect Contours of All ROIs**. This detects contours for all vessels (regions of interest) you marked in the entire series.

8. Check if all contours have been detected correctly. Make sure to edit incorrect contours.



Click  or press CTRL+D again to automatically redetect the contours.

To view analysis results

1. Click , press F7, or select **View > Graph** from the application menu.

This displays the Volume diagram.



Click a point in the curve to display the corresponding image in the Phase View and Modulus View.

2. Select the diagram of your choice from the **Show** drop-down list.

To add or hide curves in flow diagrams

In the diagram window, click , , , or  to show or hide the corresponding curves in the diagram.

To apply background correction using the ROI4 area method

If needed, you can apply background correction. The ROI4 area method is one of four methods for background correction that are available.



Refer to the QFlow User Manual for instructions on performing background correction using one of the other methods.

1. Click  to open the application menu and Select **Settings > Main...** or click .
2. On the **Background subtraction** tab, from the **Subtract background flow** drop-down list, select **ROI 4 area** and close the settings dialog.
3. In the toolbar, select , and then select  or .
4. In the Phase or Modulus View, trace a contour in an area where you expect no flow. Make sure that you do so as close to the vessel as possible.
5. Press CTRL+C and then CTRL+SHIFT+V.
This copies the contour to the other images.
6. Check the area in all images to verify that it does **not** cover areas where flow is to be expected. Edit the contours if necessary.
 You can move a contour as follows. Select its ROI icon in the toolbar, then press CTRL and use the left mouse button to move the contour.
7. Any results that you now view are corrected for background flow.

To calculate the pulmonary-to-systemic flow ratio

1. Open a new instance of QFlow with series that show Pulmonary blood flow.
2. Click  in the toolbar to perform a regular vascular flow analysis and follow the steps above.
3. Click  in the toolbar to mark the analysis as a Pulmonary blood flow analysis.
4. Open a new instance of QFlow with series that show Systemic blood flow.
5. Click  in the toolbar to perform a regular vascular flow analysis and follow the steps above.
6. Click  in the toolbar to mark the analysis as a Systemic blood flow analysis.

The Qp/Qs results are automatically displayed in the report in Medis Suite.

5 Creating reports

This chapter explains:

- How to view a Medis Suite report.
- How to manually add a snapshot to the Medis Suite report.
- How to create a text or XML report.

Reports contain a summary of patient and study information and a number of analysis results. You can create plain text reports, XML reports or a Medis Suite report.

To view a Medis Suite report

Flow results and distance measurements are automatically added to a Medis Suite report. You can access a Medis Suite report by selecting the **Report** tab in Medis Suite.



Refer to the Medis Suite User Manual for instructions on how to customize a Medis Suite report.

To manually add a snapshot to the Medis Suite report

QFlow allows you to create a snapshot from an image or a graph and to add the snapshot to a Medis Suite report.

1. Press the right mouse button on an image or a graph and select the right mouse button menu.
2. Select **Add... To Results**.
3. The snapshot is added to the Medis Suite report.

To create a text or XML report

1. Click  to open the application menu and select **View > Report** or press F9.
2. To create a text or XML report, click Plain text or XML.

If you are creating a text report, you can select the results you are interested in by selecting the corresponding check boxes under Contents.

Accuracy of Measurements

In QFlow all measurements are derived from calculations performed on the loaded DICOM images.

Both during development and with each new release of the product, measurements and calculations are extensively validated. The accuracy of the measurements and calculations exceeds that of the displayed results, by at least one decimal point.

In practice, the image is the limiting factor of the accuracy of measurements. Limiting factors, such as, image resolution both spatial and time-based, image noise, inhomogeneity in the magnetic field and patient determine the accuracy of any given measurement.

The effective accuracy of measurements has been evaluated with multiple validation studies. The following table gives the expected accuracy for the different types of measurement.

Functional measurement	Accuracy
Automatic segmentation algorithm for the calculation of flow rates	Inter-observer variability areas [1]: Manual: 6.28 %. Automatic: 2.15 %.
Application of background correction, by means of stationary flow fit or phantom correction	Lankhaar method [2] has been implemented.
Calculation of flow curves for flow, velocity, peak values and regurgitation	Inter-observer variability volumes [1]: Manual: 0.85 %. Automatic: 1.2 %.
CSF flow analysis calculations	Error in absolute CSF flow [3]: In images from RPC: 1.15 %. In images from CPC: 8.91 %.

References used in table above:

1. van der Geest, Rob J, Niezen, Andre R, van der Wall, Ernst E, de Roos, Albert, Reiber, Johan HC, "Automated Measurement of Volume Flow in the Ascending Aorta Using MR Velocity Maps: Evaluation of Inter- and Intra-observer Variability in Healthy Volunteers", J Comput Assist Tomogr, vol. 22(6) (1998): 904-911.
2. Lankhaar JW et al, "Correction of Phase Offset Errors in Main Pulmonary Artery Flow Quantification", Journal of Magnetic Resonance Imaging 22 (2005):73-79.
3. Wentland, Andrew L., Oliver Wieben, Frank R. Korosec, and Victor M. Haughton. "Accuracy and reproducibility of phase-contrast MR imaging measurements for CSF flow." American Journal of Neuroradiology 31, no. 7 (2010): 1331-1336.

Troubleshooting

Multiple slices in one series

If there are multiple flow locations combined in one series and you are not able to separate them, the arrows up and down keys will then allow you to switch slices.

Function Keys

When you are working with QFlow, you can use the function keys on your keyboard to quickly perform the following tasks.

Press	To
F5	play the current study as a movie.
F6	display the study properties.
F7	show the graph window.
F8	view the flow profile.
F9	open the report window.

Shortcut Keys

Shortcut keys are combinations of keys that you can press on your keyboard to give a command.

Shortcut	Use to
Images	
CTRL+drag	move the active contour relative to the image in the Phase or Modulus View.
middle mouse button or mouse wheel and drag	pan the image.
left and right mouse button simultaneously and drag	scroll through the images. A horizontal movement lets you scroll through the phases. A vertical movement lets you scroll through the slices.
left and middle mouse button and drag	zoom the images. An upward movement zooms out, and a downward movement zooms in.
right mouse button and drag	adjust the window width and window level of the images. A horizontal movement adjusts the window width, and a vertical movement adjusts the window level.
+ or =	zoom in on the images.
-	zoom out.
→	scroll forward through the Thumbnail View.
←	scroll backward through the Thumbnail View.
1	reset window width and level.
2	optimize window width and level.
Elements	

CTRL+Z	undo the last action.
CTRL+Y	redo the action that was undone.
CTRL+X	cut the currently active element and place it onto the clipboard.
CTRL+C	copy all elements from the active image to the clipboard.
CTRL+V	paste the element to the selected image.
CTRL+F	paste the element or elements to all images from the selected image onward.
CTRL+B	paste the element or elements to all images from the selected image backward.
CTRL+SHIFT+V	paste the element to all images.
DEL	delete the currently active element from the active image.
SHIFT+DEL	delete all elements in the active image.
CTRL+SHIFT+DEL	delete all elements in the entire slice.
CTRL+D	automatically detect contours based on the active contour.
CTRL + →	move the profile line to the right.
CTRL + ←	move the profile line to the left.
SHIFT + S	smoothen the active contour.
SHIFT + C	make the active contour more convex.
SHIFT + D	make the active contour decurved.
Tool icons	
CTRL+1	make the tool icon of the first contour active in the toolbar.

CTRL+2	make the tool icon of the second contour active in the toolbar.
CTRL+3	make the tool icon of the third contour active in the toolbar.
CTRL+4	make the tool icon of the fourth contour active in the toolbar.
F	make the profile line icon active in the toolbar.
Spacebar	switches between ROIs.