Connecting to the VMS Workstation

Ensure Ultrasound system is up and running prior to starting VMS.

- Connect the video cable from the ultrasound machine to the VMS Integrated Station.
- If VMS is configured to use the ultrasound ECG trigger, connect the ECG cable from VMS to the ECG trigger.
- If VMS is configured to use the ECG splitter, Connect the ECG leads from the ultrasound machine to the ECG splitter leads on the VMS workstation.
- Mount the 3-D tracking sensor clip onto the ultrasound transducer that will be used during the scan.
- Mount the calibration baton directly beneath the scanning cutout using the attached Velcro tabs.
- Secure the ultrasound transducer cable to the tracking system cable, using the Velcro retention straps supplied with the system.
- Place the transmitter under the examination bed, on the designated shelf. Be sure to route the cable along the designated cable path.
- Connect the power cable (if necessary).
- Plug in the network cable (Ethernet).
- Press the Power button on the front of the VMS system cabinet. Wait for the Windows logon dialog box to appear.
- Log on using your local or domain user credentials.
- The VMS system is now connected and ready for use.
Patient Preparation

- Remove ferrous material, e.g., watches, jewelry, pocket change (patient and sonographer).
- Position Patient — The best position for each individual patient may be supine or left lateral decubitus, etc... The position must be constant during entire exam.
- Apply ECG Electrodes to proper anatomical location (requires a good R-wave).
- Transducer assembly — Ensure that the transducer sleeves are properly attached to the pre-calibrated transducers and that the receiver is firmly attached within the sleeve. Confirm that the sleeve is correctly aligned to transducer anatomical locator.
- Select VMS preset on ultrasound machine.
- Ensure patient’s comfort and stability on the bed. Use pillows and support bolsters as needed.
- Prior to image acquisition, confirm acoustic windows.
- Take time to explain to the patient the breathing technique to be used during imaging.

Note: Focus on coaching patient throughout entire exam. Any movement of patient during image acquisition may result in non-quality reconstruction.
Overview of Views

<table>
<thead>
<tr>
<th>PLAX</th>
<th>RV Inflow</th>
</tr>
</thead>
<tbody>
<tr>
<td>![PLAX Image]</td>
<td>![RV Inflow Image]</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>PLAX RV Outflow</th>
<th>SAX RVOT</th>
</tr>
</thead>
<tbody>
<tr>
<td>![PLAX RV Outflow Image]</td>
<td>![SAX RVOT Image]</td>
</tr>
</tbody>
</table>

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## Overview of Views

<table>
<thead>
<tr>
<th>SAX Proximal Papillary Level</th>
<th>SAX Apex</th>
</tr>
</thead>
<tbody>
<tr>
<td><img src="image1.png" alt="Diagram" /></td>
<td><img src="image2.png" alt="Diagram" /></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Apical 4CH</th>
<th>RV Oblique Apical</th>
</tr>
</thead>
<tbody>
<tr>
<td><img src="image3.png" alt="Diagram" /></td>
<td><img src="image4.png" alt="Diagram" /></td>
</tr>
</tbody>
</table>

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Overview of Views – Additional Views

<table>
<thead>
<tr>
<th>Apical 2CH</th>
<th>RVIOT</th>
</tr>
</thead>
</table>

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ED/ES Selection

- After you have finished scanning the patient, use the ED/ES screen to select the end diastolic (ED) and end systolic (ES) frames. For details in setting ED/ES, see the User Guide.

- When you are satisfied with the selected ED/ES frames, click Accept. The Reconstruction screen appears. You are now ready to identify anatomical structures on the selected scan images.

CAUTION: Be careful when selecting ED and ES. If your selections need to be corrected at a later date, any existing work (for example, anatomical structure marking) will be reset.
First Pass Point Placement Protocol

Colors of points correspond to VMS structure color

<table>
<thead>
<tr>
<th>Views</th>
<th>Initial points</th>
<th>Point placement</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>A4CH</td>
<td>Tricuspid Annulus (2)</td>
<td><img src="image1.png" alt="Diagram" /></td>
<td>This methodology is designed to optimize the initial 3D reconstruction. Following protocol in stepwise fashion will insure best possible results. *Annular Points are placed at level of leaflet-annular junction.</td>
</tr>
<tr>
<td>RV Inflow</td>
<td>Tricuspid Annulus (1)</td>
<td><img src="image2.png" alt="Diagram" /></td>
<td>To ensure anatomical point is placed on Posterior TV annular junction, confirm the selected image is void of LV Septum.</td>
</tr>
</tbody>
</table>

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<table>
<thead>
<tr>
<th>View</th>
<th>Points Description</th>
<th>Diagram</th>
</tr>
</thead>
<tbody>
<tr>
<td>RV Oblique Apical</td>
<td>Apex Point is placed at the crux of the free wall and septum. When placing points within the RV (Endo/Septal/Basal, etc.), place at location of Myocardial/Endocardial edge.</td>
<td><img src="image1" alt="Diagram" /></td>
</tr>
<tr>
<td>A4CH</td>
<td>Endocardial / Septal Points are to be placed equidistant and at opposing locations. *Basal Bulge is only used when appropriate and is placed at most extreme superior angle of “bulge”.</td>
<td><img src="image2" alt="Diagram" /></td>
</tr>
<tr>
<td>PLAX</td>
<td></td>
<td><img src="image3" alt="Diagram" /></td>
</tr>
</tbody>
</table>

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<table>
<thead>
<tr>
<th>SAX RVOT</th>
<th>RV Endocardium (1), Pulmonic Annulus*(2), Sub Pulmonic (1)</th>
<th>*If only one Pulmonary Valve annular junction can be identified, do not place second point unless location is confirmed. Sub Pulmonic point is placed at Conal Septum</th>
</tr>
</thead>
<tbody>
<tr>
<td>SAX Proximal Papillary Level</td>
<td>RV Septal Edge (2), RV Septum (1), RV Endocardium</td>
<td>Prior to placing Septal Edge Point at lateral edge, confirm that partial Right Atrium is not included.</td>
</tr>
<tr>
<td>SAX Apex</td>
<td>RV Septal Edge (2), RV Septum (1), RV Endocardium (2)</td>
<td></td>
</tr>
</tbody>
</table>

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<table>
<thead>
<tr>
<th><strong>Optional:</strong> PLAX RV Outflow</th>
<th></th>
<th><strong>Pulmonic Annulus (1)</strong></th>
</tr>
</thead>
</table>
| | | If unable to determine Pulmonary Annulus from SAX, use this acquired view in place of it, NOT in addition to adequate SAX. Must be able to identify actual Valve Annular insertion.

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Apical 4 Chamber (A4CH)

- Tricuspid Annulus (1)
- RV Septum (2)
- RV Endocardium (2)

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RV Inflow

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Oblique RV Apical – Depicting True RV Apex

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Parasternal Long Axis (PLAX)

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SAX RVOT

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Apex

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tional Use of PLAX  RV Outflow

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Quality Assurance – Borders Feature

- After a 3D reconstruction is created, the borders feature can be turned on (found under 3D View, Show).
- The yellow lines on the image show where the fit intersects the plane of the scan. This will be the most useful tool in ensuring that an accurate reconstruction was created.

- When the true borders of the heart and the borders of the reconstruction do not line up, it means that the reconstruction is not accurately depicting the heart’s anatomy in that region.
- This can be corrected by adding more points to increase coverage in underrepresented areas or reassessing point placement.

The 3D reconstruction is outside the RV endocardium in this area. More points can be added to bring the border further in.
Quality Assurance – Borders Feature

- The borders feature can be useful in distinguishing scans that are misaligned with others. When 3D reconstructed borders seem to be shifted from the true borders, a scan is likely to be misaligned.
Quality Assurance – Intersection Feature

- After a 3D reconstruction is created, the intersection feature can be turned on (found under 3D View, Show). The intersections of the 3D reconstruction with the scan planes will appear on the 3D reconstruction. If an intersection is clicked, the corresponding scan will appear in the 2D view.
- This tool can be helpful when trying to choose a particular scan for coverage or inspection.
Quality Assurance – Combined View Feature

- After a 3D reconstruction is created for both ED and ES, the combined view feature can be turned on (found under 3D View, Show). This feature shows both the ED and ES meshes.
- This feature is helpful when assessing the shapes of the meshes by comparing relative ED and ES sizes.
Disconnecting the VMS Workstation

Note: The following procedure is required only when the ultrasound machine that is connected to the VMS workstation needs to be moved.

- Log off from VMS.
- Turn off the system by using the Windows Shut Down button. Wait until the system has completely turned off (the power light on the monitor turns off).
- Unplug the main power cable.
- Unplug the network cable.
- Remove the transmitter from under the examination bed, and place it on the VMS table.
- Disconnect the Calibration Baton and place it in the storage bin.
- Remove the Velcro retention straps holding the tracking system cable to the ultrasound transducer cable (place the straps in the storage bin above the cart).
- Remove the transducer sleeve from the transducer, and place it in the storage bin (ensure that the transducer cable is not entangled with the tracking system cable).
- If using the ECG splitter, disconnect the ultrasound ECG leads from the ECG splitter, wrap up the cable and place it in the storage bin.
- If using the ECG trigger, disconnect the ECG trigger cable from the ultrasound, wrap up the cable and place it in the storage bin.
- Disconnect the video cable from the ultrasound machine, wrap up the cable and store it using the cable management strap on the back of the VMS cabinet.
- The VMS workstation is now disconnected, and the ultrasound machine can be moved to another location.

CAUTION: All VMS cables must be handled with utmost care to prevent damage.

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List of abbreviations used in this document and their associated definitions:

ED: End Diastole
ES: End Systole
TTE: Trans-Thoracic Echocardiography
RV: Right Ventricle
MV: Mitral Valve
AoV: Aortic Valve
TV: Tricuspid Valve
PV: Pulmonary Valve
RVOT: Right Ventricular Outflow Tract
RVE: Right Ventricular Endocardium
RVS: Right Ventricular Septum
Lat: Lateral
Ant: Anterior
Inf: Inferior
Prox: Proximal
PSAL: Parasternal long Axis
SAX: Short Axis
RVIOT: Right Ventricular Inflow Outflow Tract
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