MRI SIMULATOR
PST-101728
OPERATOR MANUAL

MRI Simulator Operator Manual
PST-100444
Rev 11

Copyright

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This manual describes the installation procedure for the MRI Simulator. Please review the manual completely and thoroughly before beginning the system installation. Proper performance of this system is guaranteed only while the simulator is used in accordance with the enclosed instructions and safety guidelines.

⚠️ **NOTICE:**
TRANSPORT AND STORE THIS PRODUCT UNDER THE FOLLOWING
AMBIENT TEMPERATURE OF -40°C to +60°C
RELATIVE HUMIDITY OF 10% TO 100% (Non-Condensing)
ATMOSPHERIC PRESSURE OF 765 hPa TO 1011 hPa

The MRI Simulator (PST-101728) is for research and educational purposes only.

Table of Contents

Chapter 1: **Safety**

1.1 Safety Symbol

The following symbol will be used throughout this manual and as a means to alert you to potential safety hazards on the accompanying equipment.

⚠️ **Attention! Consult Accompanying Documents**

Chapter 1: **Safety**

Please **read all WARNINGS carefully and completely before continuing** with the assembly and use of the MRI Simulator.

⚠ **DO NOT** power up the MRI Simulator until you are instructed to do so.

⚠ **NOTE:** *IN CASE OF EMERGENCY:* Push the Emergency Stop button near the Simulator power inlet. Twist the red knob clockwise (as indicated on the knob) to reset the button.

⚠ This unit is equipped with thermal protection. The motor may stop responding to controls after cycling several times in rapid order. **DO NOT** unplug the unit! Wait 10 minutes and try again.

⚠ Participants new to the MRI environment may become anxious or panic from the close confines of the enclosure in the Simulator. All efforts should be made by the researcher to quickly remove the participant, if such an event were to occur.

⚠ See instructions on use of Participant Table Emergency Release Handle for manual extraction of Participant Table.

⚠ To avoid injury, please use a solid step stool and exercise caution when participants are getting on/off of the Participant Table.

Chapter 1: **Safety**

Please **read all WARNINGS carefully and completely before continuing** with the assembly and use of the MRI Simulator.

⚠️ The unit is designed to support a maximum weight of 275 pounds.

⚠️ **DO NOT** remove or modify the lighting system.

⚠️ **DO NOT** remove or modify the fan system.

⚠️ **Service to be performed by a qualified personnel only.** Opening any panel may produce a shock or hazard. Opening the panel by non-qualified personnel may invalidate the warranty.

⚠️ **DO NOT** open or remove control panel enclosure. Opening this enclosure may produce a shock hazard. Service to be performed by a qualified technician.

⚠️ To avoid personal injury keep participant hands and hair away from the sides of the Participant Table.

⚠️ **DO NOT** leave the participant unattended when operating the table.

⚠️ **DO NOT** use alcohol on the surface of the Simulator, use only non-abrasive cleaners to clean the finished surfaces.

Chapter 2: **Unpacking Instructions**

Required Tools   7/16″ wrench or socket and ratchet to remove packing crate screws. *(Not included)*

⚠️ Unpacking the crate requires a minimum of two adults.

1) **Unscrew** lag screws securing the top, to the front and back of crate. **Remove** top and **set** aside.

2) **Unscrew** lag screws securing the front. **Remove** and **set** aside.

3) **Unscrew** lag screws securing the back right side. **Remove** and **set** aside.

Chapter 2: **Unpacking Instructions**

4) ***Remove* Front Facade** and place it aside in a manner that will ***prevent*** it from falling.

   Remove all boxes, including those inside the bore, and set aside. Refer to packing list for contents.

   Note: *Packing List, Operator Manual, and Assembly components are in an envelope marked Bag 1.*

   Remove the operator manual and read Task 1, (Page 12).
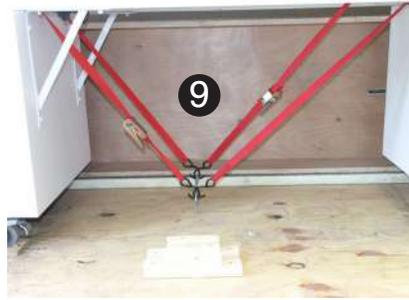
   Note: *For Steps 5-8, two individuals will be needed to unpack the remaining pieces.*

5) ***Remove* Simulator Bore**. ***Slide out*** carefully.

6) ***Untie*** the **yellow string** ***holding*** the **remaining pieces** in place.

7) ***Remove* Participant Table**. ***Slide out*** carefully.

8) ***Remove* Extension Panels**.
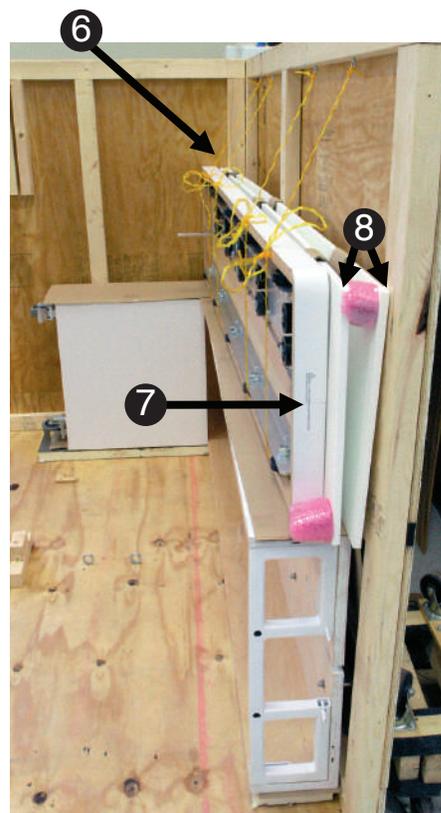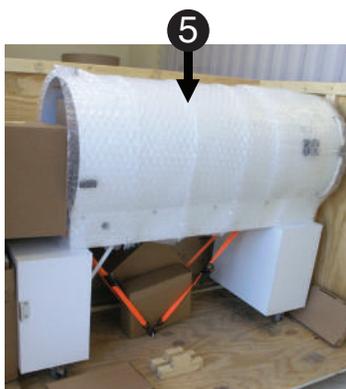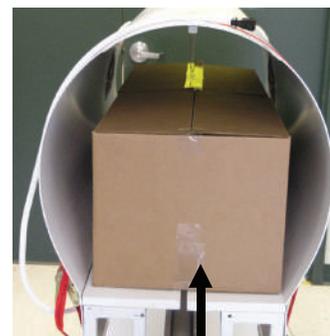
Chapter 2: **Unpacking Instructions**

9) *Loosen* and *remove* **ratchet tie downs** holding bore in place.

10) *Unlock* **casters** and *remove* **bore**. **Chassis arm track** can be used as a handle.

Caster Locked   **Caster Unlocked**

11) *Remove* **Participant Table** and *turn* **upright**.

12) *Remove* **packing material from inside the crate.**

13) *Unscrew* **lag screws** securing the left side and back.
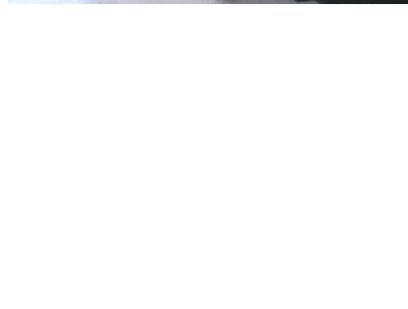

14) *Put* crate in storage.

Chapter 3: **Components and Technical Specifications**

3.1 Intended Use
The MRI Simulator introduces the participant to an authentic scanning environment, permitting them to gradually become accustomed to the scanning procedure and trained to minimize movements. For research purposes only.

3.2 Overview
MRI studies require long periods of scanning with minimal participant movement. The procedure can be an unsettling experience for many participants causing excessive movement resulting in unusable data and lost funds. Special populations such as children, the elderly, and psychiatric participants, are often prone to claustrophobia and anxiety in the bore of a magnet, and consequently have a much higher rate of terminating the scan session before its completion. Some centers that have dealt with these populations estimate a 50%-80% failure rate. With the use of the MRI Simulator (also known as a mock scanner) this failure rate can often be reduced below 5%, minimizing data loss.

The MRI Simulator provides a realistic approximation of an actual MRI scanner to allow habituation and training of participants in an environment less daunting than a real scanner. Allowing the participant to acclimate to the scanner before the actual session helps to prepare them and encourages a calmer and more focused participant, ultimately resulting in more productive scanning sessions.

The MRI Simulator includes: ~60cm bore with tapered entry and flat façade with integrated control panel (Light, Fan, In/Out), lights, fan, speakers & subwoofer, motorized patient table with drag sensing safety stop, manual table release.

The MRI Simulator is designed to fit easily within a 12 foot office space and can be assembled and ready for use within 30 minutes at most sites (no tools required for assembly).

Chapter 3: **Components and Technical Specifications**

The MRI Simulator is shipped in a custom crate. The five (5) main components of the Simulator are the Bore, the Facade, the Participant Table, the Participant Table Base and the Extension Panels. (A packet of small parts for assembly are included) See **Unpacking Instructions**, Step 4.

The Bore	
The Facade	
The Participant Table **The Participant Table Base**	
The Extension Panels	

Chapter 3: **Components and Technical Specifications**

Additional assembly components are packed in the crate. Be sure they are removed before continuing with assembly.

Contents Include:
- Bolts with Hinged Covers and Wing Nuts
- Male to Male Audio Cable
- Power Cable
- Table Locking Alignment Knobs

Optional Contents:
  (For additional information about purchasing these products, contact us at info@pstnet.com.)
- Button Response System
- Head Coil
- Headphones
- MoTrak
- SimFx
- Video Monitor

Chapter 4: **Hardware Setup**

The following section provides step by step instructions for the proper set up of the MRI Simulator.

4.1 Location Selection
Find a reliable and permanent location where the MRI Simulator will be put to use.

1) We strongly recommend leaving the MRI Simulator disassembled until you have moved the pieces to the location where it will be put to use.

   Although, the Simulator is on **locking casters** (shown at right), it is best to keep it in separate pieces when moving it around.

   The individual pieces will easily fit through a standard sized door.

2) When you are ready to begin assembly, move the **Bore** section to the desired location.

Locked   ❶

Unlocked   ❶

Bore

❷

Chapter 4: **Hardware Setup**

4.2 Facade and Bore Tube
Assembly of the Facade Tube onto the Bore Tube.

1) *Locate* the two (2) black plastic **Bore Entry Alignment Guides** on the undersides of the Bore Tube front.

2) *Fit* the **Facade** onto the **Bore** section so that the lip on the Facade Tube goes over the Bore Tube.

3) Start at the top and work your way down on both sides.
You may have to **gently pull on the Facade Tube** once you get towards the bottom.
Slide the Facade Tube into the **Bore Entry Alignment Guides** as shown to the right.

4) There are two (2) **Bolts with Hinged Covers and Wing Nuts** that help align and hold the Facade in place.
*Insert* the bolts from the front and hand tighten the Wing Nuts.

Bore Entry Alignment Guide

Facade Tube
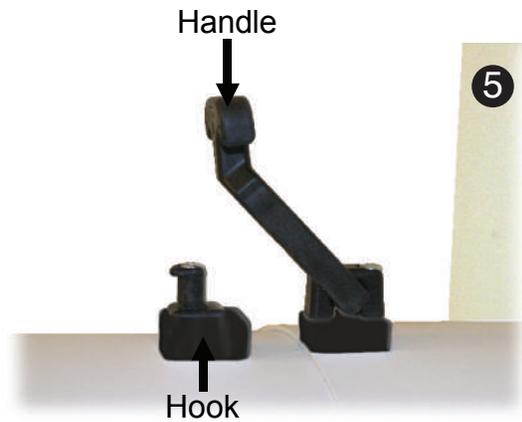
Bore Tube

Wing Nuts
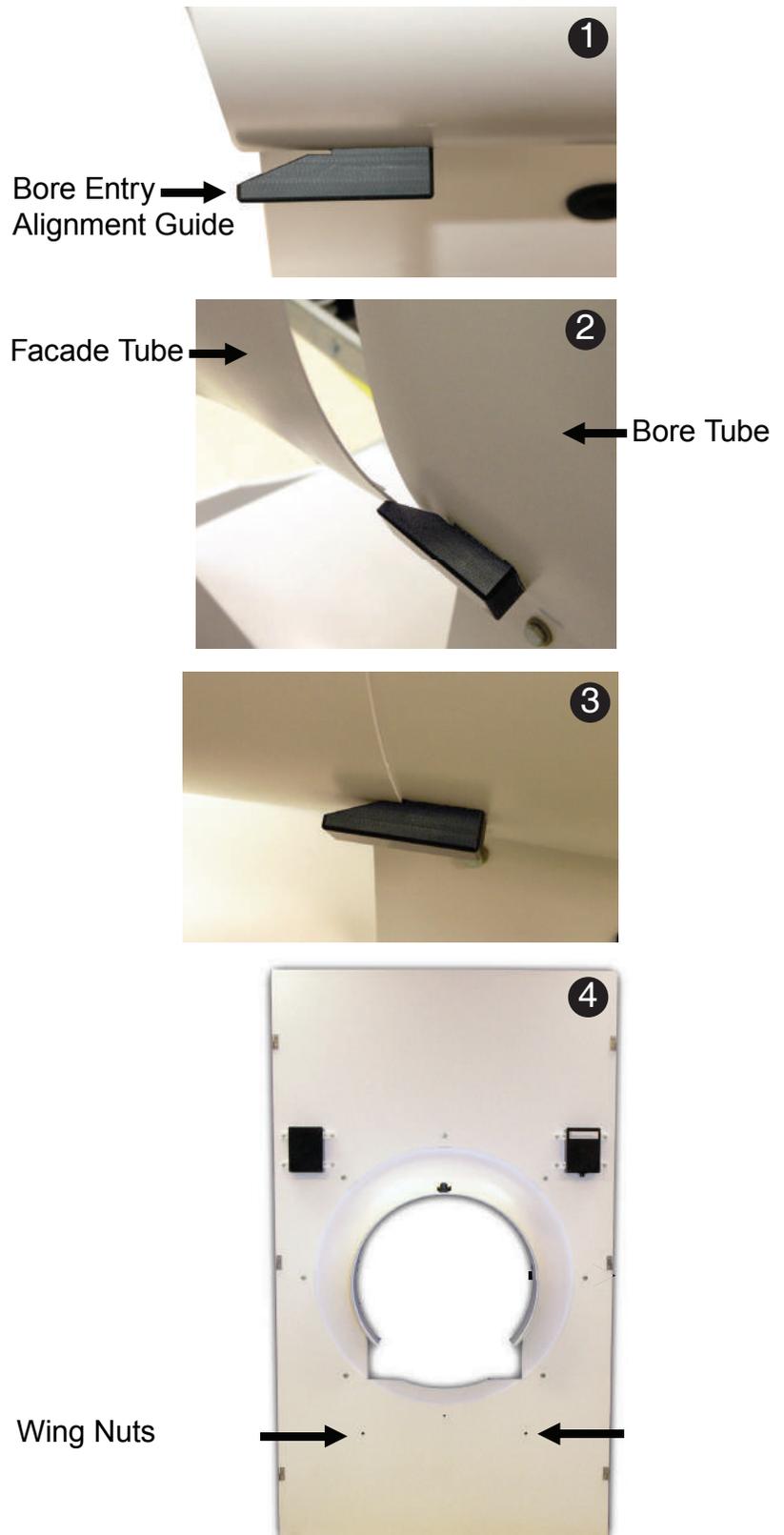
Chapter 4: **Hardware Setup**

4.2 Facade and Bore Tube Continued
Assembly of the Facade Tube onto the Bore Tube.

5) The top of the Facade has a **rounded t-shaped rubber handle** that must be *pulled outward* and *down* to properly latch onto the hook mounted on the Bore.
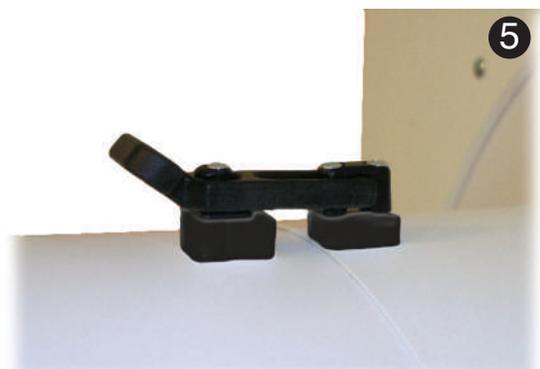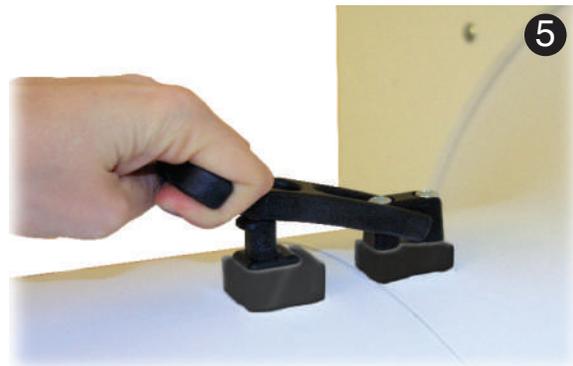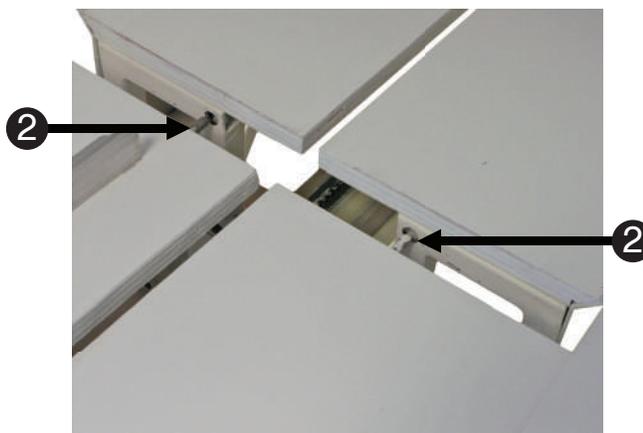
Chapter 4: **Hardware Setup**

4.3 Bore and Participant Table Base
Assembly of the Participant Table Base onto the Bore section.

1) Now fit the **Participant Table Base** through the Facade onto the **Bore section** as pictured to the right.

2) There are **guide pins** on the Participant Table Base that must be aligned with holes in the Bore section.

   In order to connect the **Participant Table Base** and **Bore sections**, *align* the guide pins and *push* the Participant Table Base from the other end.

   You will need to use a moderate amount of force to connect the two (2) pieces together.

Chapter 4: **Hardware Setup**

4.3 Bore and Participant Table Base Continued
Assembly of the Participant Table Base onto the Bore section.

1) *Slide* the **Participant Table Base** onto the **Bore section**\ until it fits snugly against the Bore.

   Then, go underneath the Bore section and *insert* the two (2) **Table Locking Alignment Knobs** (shown at the right) and *turn* them *clockwise* to secure the Participant Table Base to the Bore.

Table Locking
Alignment Knobs
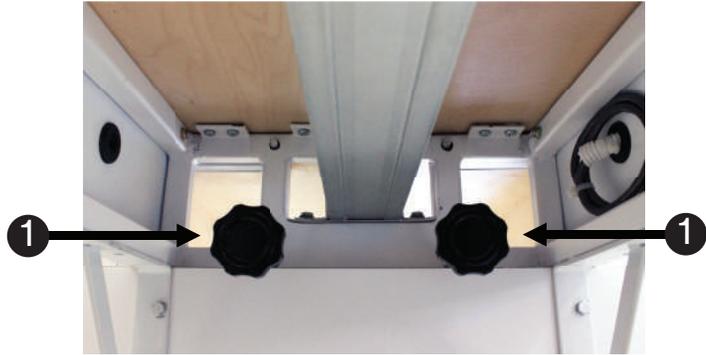
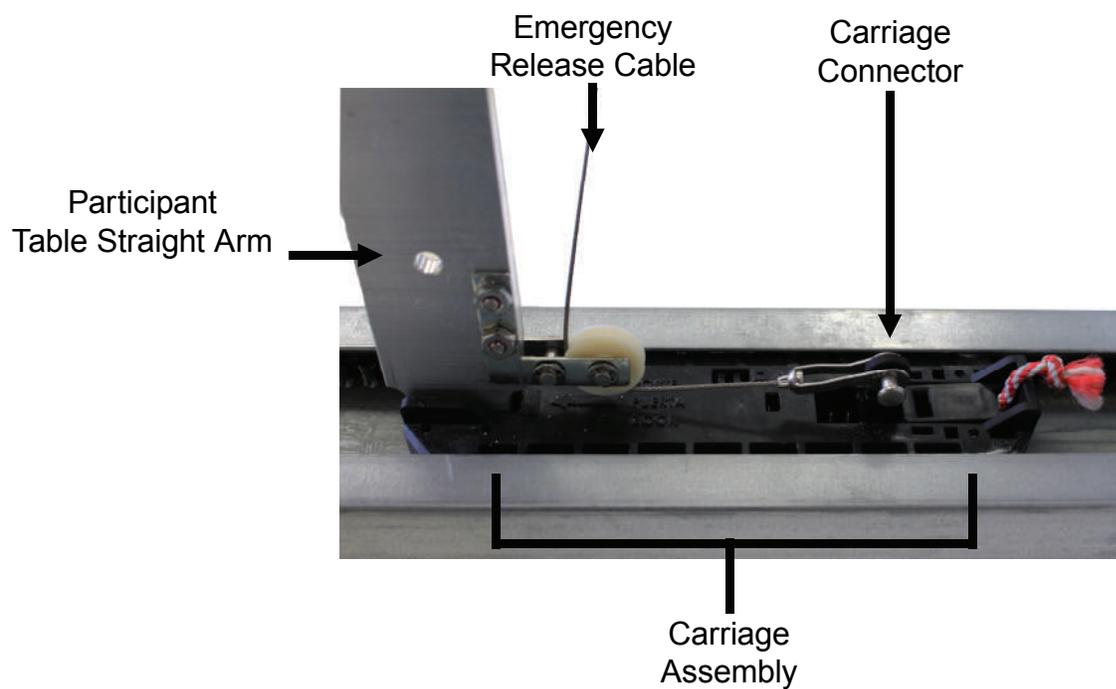# Chapter 4: **Hardware Setup**

4.4 Carriage Assembly
Assembly of the table motion linkage on the Carriage Assembly of the Bore.

1) Identify the necessary components of the table motion linkage on the **Carriage Assembly** of the Bore section.

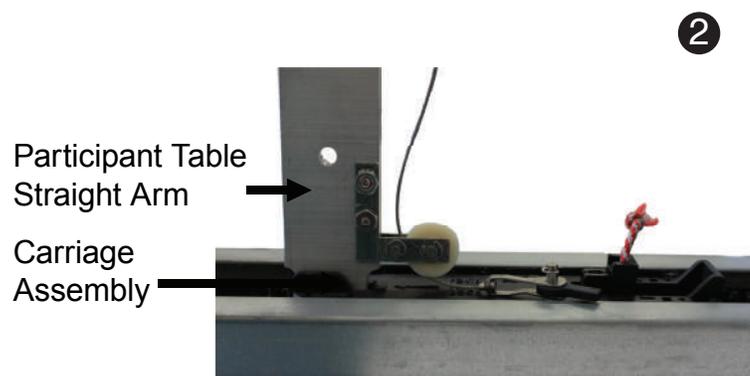# Chapter 4: **Hardware Setup**

4.4 Carriage Assembly Continued
Assembly of the table motion linkage on the Carriage Assembly of the Bore.

1) *Identify* the necessary components of the linkage on the underside of the **Participant Table**.

⚠️ **NOTE:** *In the event you have difficulty reaching the Emergency Release Cable, we suggest using needle nose pliers.*

2) *Move* the slot in the **Participant Table Straight Arm** into position *over* the pin in the **Carriage Assembly**.

The slot in the **Participant Table Straight Arm** should *slide* down over the pin inside the **Carriage Assembly**.
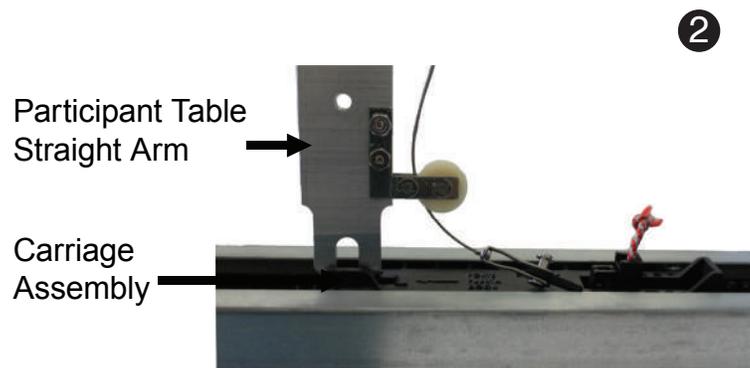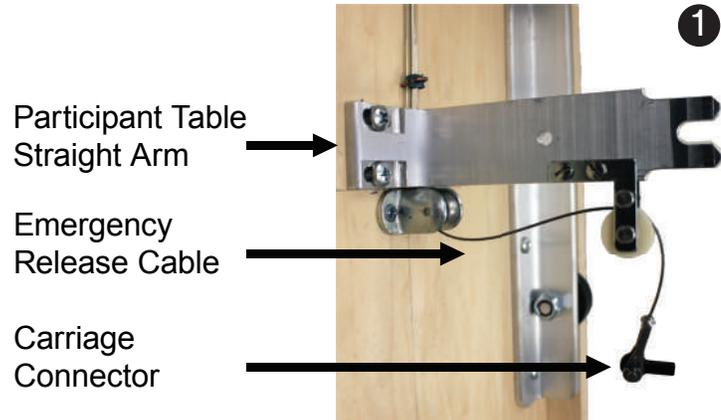
❶

Participant Table Straight Arm

Emergency Release Cable

Carriage Connector

❷

Participant Table Straight Arm

Carriage Assembly

❷

Participant Table Straight Arm

Carriage Assembly
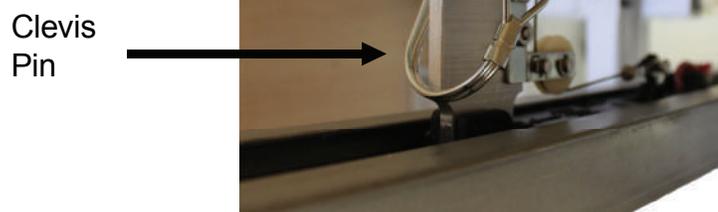
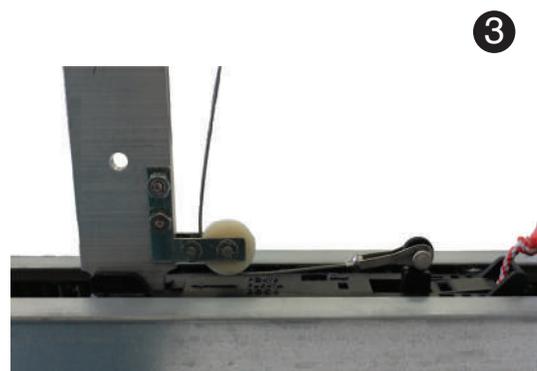# Chapter 4: **Hardware Setup**

4.4 Carriage Assembly Continued
Assembly of the table motion linkage on the Carriage Assembly of the Bore.

1) Once the **Participant Table Straight Arm** is properly seated in the **Carriage Assembly**, *pull up* on the rope to engage the **E-Release** stop.

2) With the **E-Release** stop engaged, *slide* the **Carriage Connector** *into* the **Carriage Assembly**, to secure it in place. Then *pull* the rope to the right to *disengage* the **E-Release** stop.

⚠️ **NOTE:** *To release the Emergency Release Cable from the Carriage Assembly, simply pull up on the rope to engage the E-Release stop. Then pull up on the Carriage Connector.*

3) The **Clevis Pin** safety strap is *unhooked* from the end of the pin. *Slide* the **Clevis Pin** *through* the **hole** in the **Participant Table Straight Arm**.

⚠️ **NOTE:** *The Clevis Pin is a safety device that keeps the Participant table from becoming detached from the Carriage Assembly during normal operation.*

1
Rope
Participant Table Straight Arm
Carriage Assembly

2
Carriage Connector

3

Clevis Pin
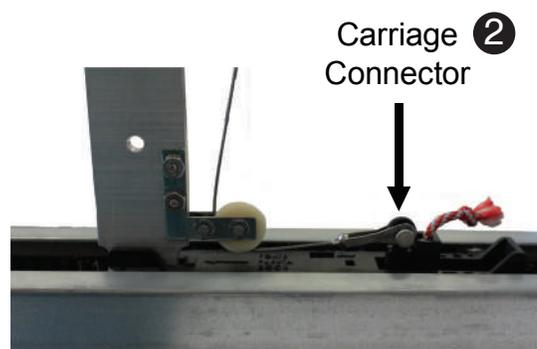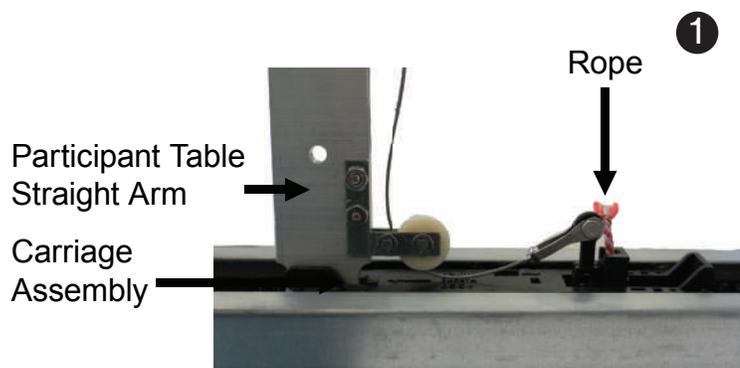
Chapter 4: **Hardware Setup**

4.5 Control Panel Assembly
Assembly of the control panel mounted on the Facade.

1) *Attach* the **Control Panel Power Cable** that runs along the side of the Bore to the rear of control panel that is mounted on the Facade.

2) When connected you may plug the Simulator into the power source for use.

Chapter 4: **Hardware Setup**

4.6 Extension Panels Assembly
Assembly of the Extension Panels to both sides of the Facade.

1) *Align* top, middle and bottom **hinges** on the **panel** to top, middle and bottom **hinges** on the **Facade**.

2) Once the hinges line up they will fall into place, as seen at the right.

    Repeat with other side.

3) When the panel is in place and adjusted to your preference, adjust the **floor stop** to keep panel in place.

    Repeat with other side.
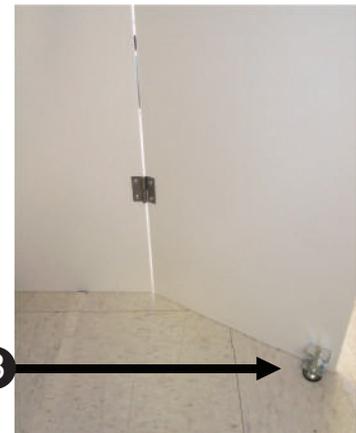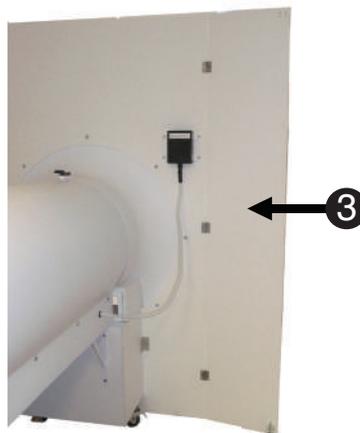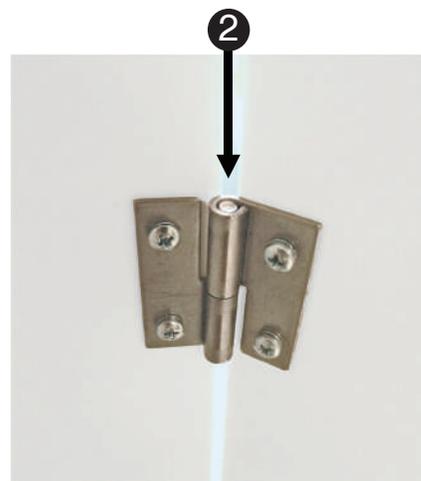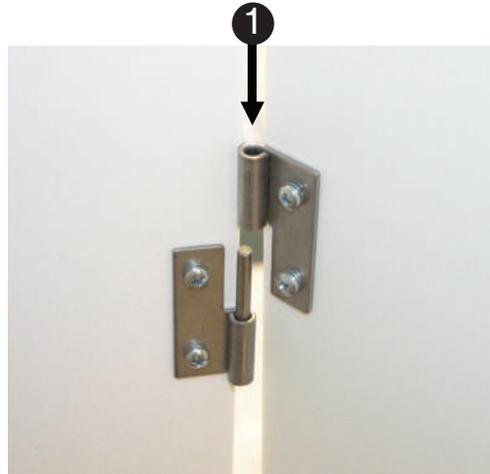
Chapter 5: **Operating Instructions**

5.1 Power Supply

The power supply for the Simulator is located towards the rear of the Bore section on the same side as the control panel. The power switch is a manual reset circuit breaker.

⚠ **NOTE:** Make sure the power switch is in the OFF position before attaching the Power Cable. (*See figure below*)

Plug the Power Cable into the outlet located below the power switch.

When instructed, move the power switch to the ON position.

Chapter 5: **Operating Instructions**

5.2 Control Panel Instructions

There are three (3) buttons on the Control Panel:

1) An *on/off switch* to control the Lights.
2) An *on/off switch* to control the Fans.
3) A *momentary button* to move the Participant Table in and out of the MRI Simulator Bore.

5.3 Emergency Stop Button

⚠️ **NOTE:** *IN CASE OF EMERGENCY:* Push the Emergency Stop button near the Simulator power inlet. Twist the red knob clockwise (as indicated on the knob) to reset the button. See image below:

Chapter 5: **Operating Instructions**

5.4 Fans   Two (2) fans are located on the Simulator Bore. They are operated by a lighted ON/OFF switch located on the control panel. When active, the light switch on the control panel will be illuminated.

5.5 Lights   Lights are located in the Simulator Bore. They are operated by a lighted ON/OFF switch located on the control panel. When active, the light switch on the control panel will be illuminated.

5.6 Participant Table Instructions

A single press of the Table button on the control panel moves the Participant Table into the Bore. Pressing the switch again stops the Participant Table and pressing it one more time will cause the Participant Table to move out of the Bore. The Participant Table will move slowly upon initiation and will slow again when coming to a stop. The Participant Table is equipped with a safety mechanism to reduce the likelihood of injury. It will automatically stop the Participant Table if it encounters too much resistance.

5.7 Participant Table Emergency Release Test

There is an emergency safety release at the foot of the Participant Table (see below) that will release the table from the mechanism, allowing it to be moved manually. Pulling the knob towards the foot of the table releases the table from the Carriage Assembly. To re-attach the table slide the Participant Table forward with a moderate amount of force until you hear the table lock back into the Carriage Assembly. Pull on the Participant Table to verify it has locked back in place.

Participant Table Emergency Release
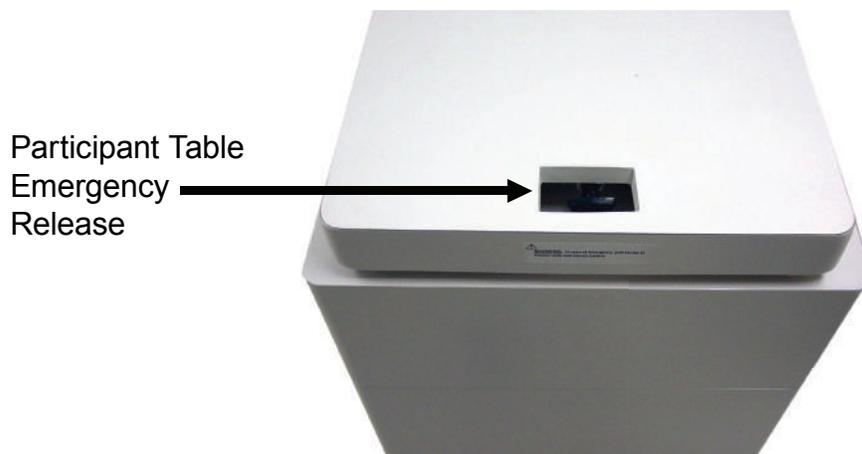
Chapter 5: **Operating Instructions**

5.8 Speakers

The Simulator speakers can be driven by your computer audio card or any compatible sound source.

The sound input is located on the side of the Simulator Bore behind the control panel.

Computers supplying scanner sounds can use SimFx software to play ambient magnet room sounds optionally mixed with realistic scanning sounds.

The Simulator audio system is for simulated scanner sounds only and is not to be used as a substitute for an audio stimulus presentation system for the participant.

For the optimum performance we strongly recommend the use of two (2) computers in the Simulator environment. One computer to supply the ambient scanner noise and one as your stimulus presentation computer.

5.9 Speaker Testing

With the Male to Male 1/8 inch Audio Cable (provided), attach a sound source (PC with Sound card, cd player, etc.) to the Simulator through the **Audio Input** jack located on the power panel at the rear of the Bore. The volume on the speaker system is set at the highest magnitude. You will need to do all of your fine volume adjustments from the sound source volume and sound controls.

Audio Input to
Speaker System

Chapter 5: **Operating Instructions**

5.10 Proper Placement of the Participant into the Simulator

The following section is intended to help the researchers get optimal results from the use of their MRI Simulator. This is by no means an exhaustive list of proper or common simulator practices and procedures. It is intended to provide insight and suggestions to improve the simulator environment.

The operator should go through all of the steps that an MR technician would normally go through in a normal scanner session. They should include all items such as ear plugs and headphones, performing a standard screening just as they would in a normal scanning environment.

Be sure to explain the expected experience and all aspects of the test for the participant before conducting any testing. They should be allowed to handle the stimulus response devices, view the stimulus presentation system and any other critical aspects of the scanner environment.

Upon completion of the experiment and withdrawal of the participant from the Simulator, give an exit interview to the participant. Exit interviews provide valuable information that might highlight potential problems that may occur in the actual MR runs (feelings of panic, discomfort, etc.) and can be used as feedback to improve the simulator environment.

Explain any differences between the simulator and actual scanner experience. Some examples might be; room temperature, separation of the scanner and control rooms, and the presence of additional staff.

Chapter 6: **FAQs and Diagnostics**

6.1 Frequently Asked Questions

Q: How much space do I need for the MRI Simulator?
A: The MRI Simulator is designed to fit in standard sized office spaces. The specific sitting requirements will vary slightly by model and options, but the Standard model fits easily within a 12 foot office space. An optional compact participant table is also available which allows the unit to fit in a minimum 10 foot space (participant inserted/extracted with knees bent).

Q: Will I have to assemble the MRI Simulator myself?
A: The MRI Simulator is typically shipped as three independent sections (table, façade, bore) which will arrive on locking castors. The sections can be moved into position quickly and bolted together easily using the included illustrated assembly instructions (no tools are required for assembly). At most sites the entire unit may be assembled and ready for use within 30 minutes.

6.2 Diagnostics

The Simulator does not appear to be working.
1) Make sure the power cable is attached properly, plugged into a power source and that the power switch is in the ON position.
2) Ensure the emergency stop button is not pushed in.

The table doesn't move, but the motor is running.
Check to see that the table is connected to the Carriage Assembly and that the Emergency Release Handle is pushed in.

The table is going in and stops.
Check to see that there isn't an obstruction around the table, causing it to stop.

The table is coming out and reverses direction.
Check to see that there isn't an obstruction around the table, causing it to reverse.

Chapter 7: **Accessories**

7.1 Mock Head Coil

The MRI Simulator Mock Head Coil (below) is a two (2) piece unit designed to allow easy participant placement and simulation of "birdcage" style head coils used in actual MRI scanners.
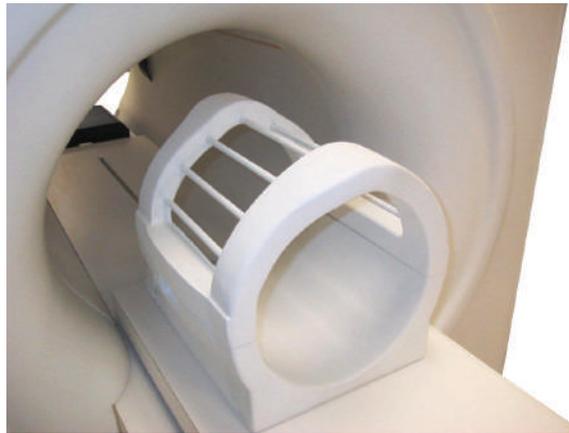
The top piece of the Mock Head Coil is easily removed for participant placement.

Chapter 7: **Accessories**
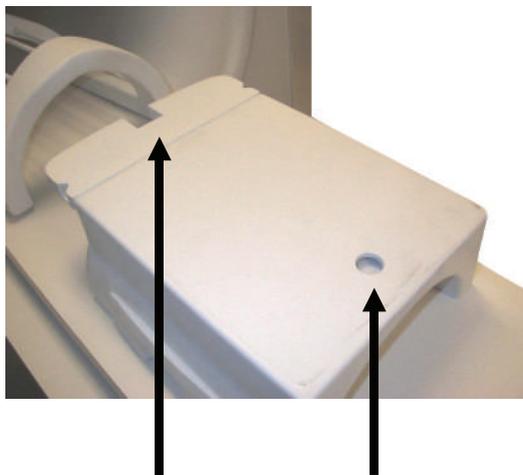
When placing the head coil on the participant table, align the notches on the underside of head coil with the two (2) corresponding tabs mounted on the participant table pictured below.
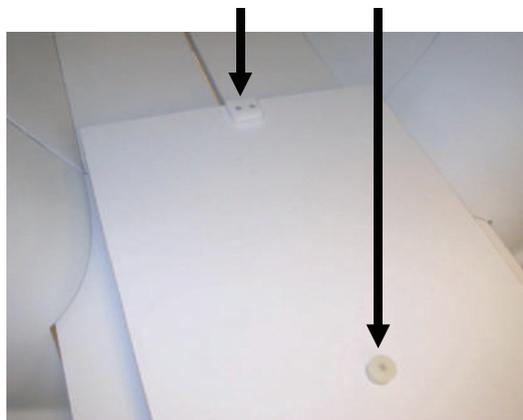
Chapter 7: **Accessories**

7.2 MoTrak Installation

Chapter 7: **Accessories**

Equipment supplied for the MoTrak Head Motion Tracking System

Shelf Mounted Console

MoTrak Console Power Supply

Transmitter

Sensor

Headbands

Chapter 7: **Accessories**

6 Foot USB Cable

16 Foot Extension, USB Active Extender

10 Foot Serial Cable

20 Foot Cable Assembly, HD15
male to male

Supplemental Hardware Manual and Drivers

Manual, CD and Hardware Key

Tools needed for the MoTrak Head Motion Tracking System

• A screwdriver to mount the shelf on the Bore.

Chapter 7: **Accessories**

1) The Simulator must be assembled prior to setting-up the MoTrak System.

2) The first step is to mount the MoTrak console on the rear of the Bore. The shelf and the Bore are pre-drilled (Refer to **Figures 1** and **2** below).
Align the pre-drilled holes with each other and insert the provided screws and tighten. Do not over tighten.
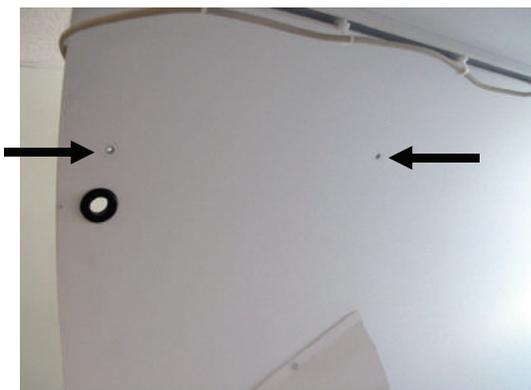
⚠️**NOTE:** This shelf may come pre-installed.

Figure 1
Left Side of Bore
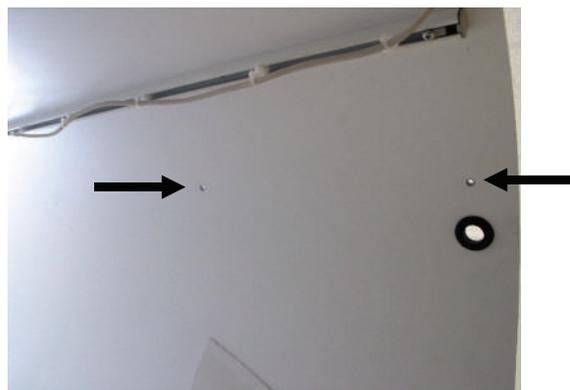
Figure 2
Right Side of Bore

Figure 3
Completed Installation — shelf mounted with MoTrak

Chapter 7: **Accessories**

3) The transmitter mounts on two (2) pins located inside the rear of the Bore. (Refer to **Figures 4** and **5** below).

Figure 4

Figure 5

4) The sensor is pre-mounted on a sliding track and no other modifications are necessary except to uncoil the cable.

5) Connection to the MoTrak:
   Refer to **Figure 6** for the following steps:
   A. Plug the Transmitter into the port marked Transmitter on the front of the MoTrak console.
   B. Plug the Sensor into Sensor Port 1 on the front of the MoTrak console.

Figure 6

Chapter 7: **Accessories**

Refer to **Figure 7** for the following steps:

    C. Plug the Power Supply into the port on the right rear of the MoTrak console.

    D. Plug the 6 foot USB Cable into the port marked USB on the center rear of the console.

⚠ **NOTE:** If the USB cable is not long enough to reach the PC, plug the USB cable into the USB Active Extender.

Figure 7

6) When the sensor cable is not in use it is designed to mount on the front of the Simulator so that it will not become damaged by the Participant Table being moved in or out of the Bore (Refer to **Figure 8** below).

Figure 8

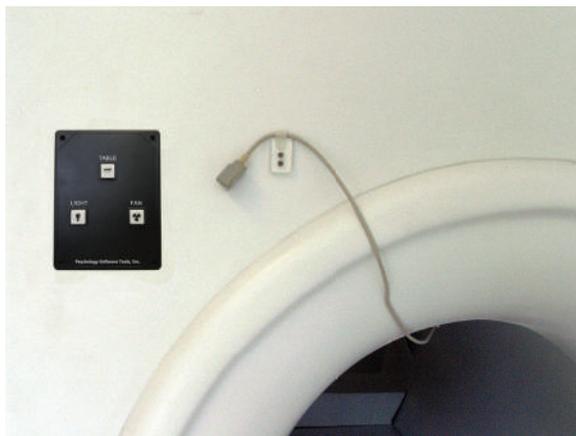# Chapter 7: **Accessories**

7) When the sensor is in use and connected to a participant it is designed to mount on the rear of the head coil. (Refer to **Figure 9** below).

Figure 9

8) **Figure 10** shows the headband connected to the sensor. It is recommended that the sensor be placed on the participant's forehead with the headband around the circumference of the head.

Figure 10

Chapter 7: **Accessories**

7.3 SimFx

⚠️**NOTE:** *SimFx is compatible with Microsoft Windows XP, Vista, Windows 7 and 8. The table below shows the default paths to your personal documents folder. Note that the path on your particular machine may have been modified by your administrator:*

Operating System	Path to your personal documents folder("My Documents" or "Documents")
XP	<drive>\Documents and Settings\<user name>\My Documents\
Vista	<drive>\Users\<user name>\Documents\
Windows 7	<drive>\Users\<user name>\My Documents
Windows 8	<drive>\Users\<user name>\Documents

When the documentation directs you to your personal documents folder it does not include the full path to the folder. Instead, the documentation refers to "...", where the "…" indicates the full path up to your personal documents folder. When you see this notation in the documentation, replace the "…" with the path to your personal documents folder.

SimFx software simulates the ambient scanner sound and the active scanning noise. The player allows two sound files to be played at once. It also has the capability to accept input from an experimental paradigm which can be used to simulate how the scanner synchronization pulse triggers an experiment.

Supported file formats
.wav, .mpa, .mp2, .mp3, .au, .aif, .snd, .wma

Included files
AmbientNoise.wav, GEScannerSound1.wav, GEScannerSound2.wav, GEScannerSound3.wav

File locations
...Program Files (x86)\PST\SimFx2\Sounds
Windows 8.1: ...Program Files\PST\SimFx2\Sounds

Serial Communications
The serial communication settings can be used to configure your serial port to listen for outside input. They can be accessed via the File menu under Configuration… Below is a list of serial communication settings and a brief description of how they function.

⚠️ **NOTE:** *It is unlikely that you will need to change your default configuration settings.*

COM Port: This option designates which port you want the program to use to communicate.
Baud Rate: This option controls the number of data bits per second that are transferred via the selected port.
Data Bit: This option will change the number of data bits you want to use for each character that is transmitted and received.
Parity: This controls the type of error checking the device performs. Please be advised that the computer or device you are communicating with must have the same setting as what you chose here.
Stop bit: Changes the time between each character being transmitted.

For more information about what specific configuration settings do, please consult the help provided by your OS.

The address of your port can be found by selecting "System" from the Windows Control Panel, clicking on the Hardware tab, clicking on the Device Manager button, and navigating to Ports. Select the serial (COM1, COM2, etc.) port to which your device is connected, click the Properties button, and select the Port Settings tab.

Here the current settings of the port will be shown. The SimFx configuration settings should match the port setting in order for your serial port to be enabled. Otherwise, the program will prompt you that the serial communications are disabled.

Chapter 8: **Contact Information**

For additional information or support

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